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# FlashStack Data Center with Oracle RAC 12cR2 Database

Deployment Guide for Oracle RAC Database 12cR2 on Cisco Unified Computing System and Pure Storage FlashArray//X Series

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## **Executive Summary**

The Cisco Unified Computing System<sup>™</sup> (Cisco UCS®) is a next-generation data center platform that unites computing, network, storage access, and virtualization into a single cohesive system. Cisco UCS is an ideal platform for the architecture of mission critical database workloads. The combination of Cisco UCS platform, Pure Storage® and Oracle Real Application Cluster (RAC) architecture can accelerate your IT transformation by enabling faster deployments, greater flexibility of choice, efficiency, high availability and lower risk.

Cisco® Validated Designs include systems and solutions that are designed, tested, and documented to facilitate and improve customer deployments. These designs incorporate a wide range of technologies and products into a portfolio of solutions that have been developed to address the business needs of customers.

This Cisco Validated Design (CVD) describes a FlashStack reference architecture for deploying a highly available Oracle RAC Databases environment on Pure Storage FlashArray//X using Cisco UCS Compute Servers, Cisco Fabric Interconnect Switches, Cisco MDS Switches, Cisco Nexus Switches and Oracle Linux. Cisco and Pure Storage have validated the reference architecture with OLTP (On-line Transaction Processing) and Data Warehouse workload in Cisco's lab. This document presents the hardware and software configuration of the components involved, results of various tests and offers implementation and best practices guidance.

FlashStack is a converged infrastructure solution that brings the benefits of an all-flash storage platform to your converged infrastructure deployments. Built on best of breed components from Cisco UCS Systems and Pure Storage, FlashStack provides a converged infrastructure solution that is simple, flexible, efficient, and costs less than legacy converged infrastructure solutions based on traditional disk.

FlashStack embraces the latest technology and efficiently simplifies data center workloads that redefine the way IT delivers value:

- Guarantee customer success with prebuilt, pre-tested drivers and Oracle database software
- A cohesive, integrated system that is managed, serviced and tested as a whole
- Faster Time to Deployment Leverage a pre-validated platform to minimize business disruption, improve IT agility, and reduce deployment time from months to weeks.
- Reduces Operational Risk Highly available architecture with no single point of failure, non-disruptive operations, and no downtime.

## Solution Overview

## Introduction

Database administrators and their IT departments face many challenges that demand a simplified Oracle deployment and operation model providing high performance, availability and lower TCO. The current industry trend in data center design is towards shared infrastructures featuring multitenant workload deployments. Cisco® and Pure Storage have partnered to deliver FlashStack, which uses best-in-class storage, server, and network components to serve as the foundation for a variety of workloads, enabling efficient architectural designs that can be quickly and confidently deployed.

FlashStack solution provides the advantage of having the compute, storage, and network stack integrated with the programmability of the Cisco Unified Computing System (Cisco UCS). This Cisco Validated Design (CVD) describes how Cisco UCS System can be used in conjunction with Pure Storage FlashArray//X System to implement an Oracle Real Application Clusters (RAC) 12c R2 Database solution.

#### Audience

The target audience for this document includes but is not limited to storage administrators, data center architects, database administrators, field consultants, IT managers, Oracle solution architects and customers who want to implement Oracle RAC database solutions with Linux on a FlashStack Converged Infrastructure solution. A working knowledge of Oracle RAC Database, Linux, Storage technology, and Network is assumed but is not a prerequisite to read this document.

## Purpose of this Document

Oracle RAC databases deployments are extremely complicated in nature and customers face enormous challenges in maintaining these landscapes in terms of time, efforts and cost. Oracle RAC databases often manage the mission critical components of a customer's IT department, ensuring availability while also lowering the IT TCO is always their top priority.

The goal of this CVD is to highlight the performance, scalability, manageability, and simplicity of the FlashStack Converged Infrastructure solution for deploying mission critical applications such as Oracle RAC databases.

The following are the objectives of this reference architecture document:

- 1. Provide reference architecture design guidelines for the FlashStack based Oracle RAC Databases.
- 2. Build, validate, and predict performance of Server, Network, and Storage platform on a per workload basis.
- 3. Seamless scalability of performance and capacity to meet growth needs of Oracle Database.
- 4. High availability of DB instances without performance compromise through software and hardware upgrades.

We will demonstrate the scalability and performance of this solution by running SwingBench and SLOB (Silly Little Oracle Benchmark) on OLTP (On-line Transaction Processing) and DSS (Decision Support System), such as benchmarking with varying users, nodes and read/write workload characteristics.

## FlashStack System Overview

The FlashStack platform, developed by Cisco and Pure Storage, is a flexible, integrated infrastructure solution that delivers pre-validated storage, networking, and server technologies. Cisco and Pure Storage have carefully validated and verified the FlashStack solution architecture and its many use cases while creating a portfolio of detailed documentation, information, and references to assist customers in transforming their data centers to this shared infrastructure model.

This portfolio includes, but is not limited to, the following items:

- Best practice architectural design
- Implementation and deployment instructions and provides application sizing based on results

Figure 1 FlashStack System Components



As shown in Figure 1, these components are connected and configured according to best practices of both Cisco and Pure Storage and provide the ideal platform for running a variety of enterprise database workloads with confidence. FlashStack can scale up for greater performance and capacity (adding compute, network, or storage resources individually as needed), or it can scale out for environments that require multiple consistent deployments.

The reference architecture covered in this document leverages the Pure Storage FlashArray//X70 Controller with NVMe based DirectFlash modules for Storage, Cisco UCS B200 M5 Blade Server for Compute, Cisco Nexus 9000 and Cisco MDS 9100 series for the switching element and Cisco Fabric Interconnects 6300 series for System Management. As shown in Figure 1, FlashStack Architecture can maintain consistency at scale. Each of the component families shown in (Cisco UCS, Cisco Nexus, Cisco MDS, Cisco FI and Pure Storage) offers platform and resource options to scale the infrastructure up or down, while supporting the same features and functionality that are required under the configuration and connectivity best practices of FlashStack.

## FlashStack Solution Benefits

FlashStack provides a jointly supported solution by Cisco and Pure Storage. Bringing a carefully validated architecture built on superior compute, world-class networking, and the leading innovations in all flash storage. The portfolio of validated offerings from FlashStack includes but is not limited to the following:

- Consistent Performance and Scalability
  - Consistent sub-millisecond latency with 100 percent NVMe enterprise flash storage
  - Consolidate hundreds of enterprise-class applications in a single rack
  - Scalability through a design for hundreds of discrete servers and thousands of virtual machines, and the capability to scale I/O bandwidth to match demand without disruption
  - Repeatable growth through multiple FlashStack CI deployments.
- Operational Simplicity
  - Fully tested, validated, and documented for rapid deployment
  - Reduced management complexity
  - No storage tuning or tiers necessary
  - 3x better data reduction without any performance impact
- Lowest TCO
  - Dramatic savings in power, cooling and space with Cisco UCS and 100 percent Flash
  - Industry leading data reduction
  - Free FlashArray controller upgrades every three years with Forever Flash™
- Mission Critical and Enterprise Grade Resiliency
  - Highly available architecture with no single point of failure
  - Non-disruptive operations with no downtime
  - Upgrade and expand without downtime or performance loss
  - Native data protection: snapshots and replication

Cisco and Pure Storage have also built a robust and experienced support team focused on FlashStack solutions, from customer account and technical sales representatives to professional services and technical support engineers. The support alliance between Pure Storage and Cisco gives customers and channel services partners direct access to technical experts who collaborate with cross vendors and have access to shared lab resources to resolve potential issues.

## What's New in this FlashStack Release

This version of the FlashStack CVD introduces new hardware with the Pure Storage FlashArray//X, that is 100 percent NVMe enterprise class all-flash array along with Cisco UCS B200 M5 Blade Servers featuring the Intel Xeon Scalable Family of CPUs. This is the second Oracle RAC Database deployment Cisco Validated Design with Pure Storage. It incorporates the following features:

• Pure Storage FlashArray//X

- Cisco UCS B200 M5 Blade Servers
- Oracle RAC Database 12c Release 2

## **Solution Components**

This section provides a list of all the components used in this solution.

## Cisco UCS 6332-16UP Fabric Interconnect

The 6332-16UP Fabric Interconnect is the management and communication backbone for Cisco UCS B-Series Blade Servers, C-Series Rack Servers, and 5100 Series Blade Server Chassis. It implements 20x40 Gigabit Ethernet and Fibre Channel over Ethernet ports, with additional support for 16 unified ports that can be configured to 1 or 10 Gbps Ethernet, or 4/8/16 Gbps Fibre Channel.



The Fabric Interconnect provides high-speed upstream connectivity to the network, or converged traffic to servers through its 40 Gbps ports, but also allows for Fibre Channel connectivity to SAN switches like the MDS, or alternately directly attached Fibre Channel to storage arrays like the Pure Storage FlashArray through its unified ports.

## Cisco UCS MDS 9148S Fabric Switch

The Cisco<sup>®</sup> MDS 9148S 16G Multilayer Fabric Switch is the next generation of highly reliable, flexible and low-cost Cisco MDS 9100 Series Switches. It provides up to 48 auto-sensing Fibre Channel ports, which are capable of speeds of 2, 4, 8, and 16 Gbps, with 16 Gbps of dedicated bandwidth for each port.



In all, the Cisco MDS 9148S is a powerful and flexible switch that delivers high performance and comprehensive Enterprise-class features at an affordable price.

## Cisco Nexus 9372PX-E Switch

The Cisco Nexus 9372PX-E Switches are 1RU switches that support 1.44 Tbps of bandwidth and over 1150 mpps across 48 fixed 10-Gbps SFP+ ports and 6 fixed 40-Gbps QSFP+ ports.



## Cisco UCS B200 M5 Blade Servers

The Cisco UCS B200 M5 Blade Server delivers performance, flexibility, and optimization for deployments in data centers, in the cloud, and at remote sites. This enterprise-class server offers market-leading performance, versatility, and density without compromise for workloads including Virtual Desktop Infrastructure (VDI), web infrastructure, distributed databases, converged infrastructure, and enterprise applications such as Oracle and SAP HANA.



The Cisco UCS B200 M5 server can quickly deploy stateless physical and virtual workloads through programmable, easy-to-use Cisco UCS Manager Software and simplified server access through Cisco Single-Connect technology.

## Cisco UCS 5108 Blade Server Chassis

Cisco UCS 5108 Blade Server Chassis, is six rack units (6RU) high, can mount in an industry-standard 19-inch rack, and uses standard front-to-back cooling. A chassis can accommodate up to eight half-width or four full-width Cisco UCS B-Series Blade Servers form factors within the same chassis.



By incorporating unified fabric and fabric-extender technology, the Cisco Unified Computing System eliminates the need for dedicated chassis management and blade switches, reduces cabling, and allowing scalability to 20 chassis without adding complexity. The Cisco UCS 5108 Blade Server Chassis is a critical component in delivering the simplicity and IT responsiveness for the data center as part of the Cisco Unified Computing System.

## Cisco UCS 2304 Fabric Extender

Cisco UCS 2304 Fabric Extender brings the unified fabric into the blade server enclosure, providing multiple 40 Gigabit Ethernet connections between blade servers and the fabric interconnect, simplifying diagnostics, cabling, and management.



The Cisco UCS 2304 connects the I/O fabric between the Cisco UCS 6300 Series Fabric Interconnects and the Cisco UCS 5100 Series Blade Server Chassis, enabling a lossless and deterministic Fibre Channel over Ethernet (FCoE) fabric to connect all blades and chassis together.

## Cisco UCS Virtual Interface Card (VIC) 1340

The Cisco UCS Virtual Interface Card (VIC) 1340 is a 2-port, 40 Gigabit Ethernet, Fibre Channel over Ethernet (FCoE)-capable modular LAN on motherboard (mLOM) mezzanine adapter.



Cisco UCS 1340 VIC delivers 80 Gbps throughput to the Server and helps reduce TCO by consolidating the overall number of NICs, HBAs, cables, and switches; LAN and SAN traffic runs over the same mezzanine card and fabric.

## Pure Storage FlashArray //X70

The Pure Storage FlashArray family delivers purpose-built, software-defined all-flash power and reliability for businesses of every size. FlashArray is all-flash enterprise storage that is up to 10X faster, more space and power efficient, more reliable, and far simpler than other available solutions. Critically, FlashArray also costs less, with a TCO that's typically 50% lower than traditional performance disk arrays.

At the top of the FlashArray line is FlashArray//X – the first mainstream, 100 percent NVMe, enterprise-class allflash array. //X represents a higher performance tier for mission-critical databases, top-of-rack flash deployments, and Tier 1 application consolidation. It is optimized for the lowest-latency workloads and delivers an unprecedented level of performance density that makes possible previously unattainable levels of consolidation.

FlashArray//X provides microsecond latency, 1PB in 3U, and GBs of bandwidth, with rich data services, proven 99.9999 percent availability (inclusive of maintenance and generational upgrades), 2X better data reduction versus alternative all-flash solutions, and DirectFlash<sup>™</sup> global flash management. Further, //X is self-managing and plug-

n-play, thanks to unrivalled Pure1® Support and the cloud-based, machine-learning predictive analytics of Pure1 Meta. Finally, FlashArray//X, like the rest of the FlashArray line, has revolutionized the 3-5 year storage refresh cycle by eliminating it: Pure's Evergreen<sup>™</sup> Storage model provides a subscription to hardware and software innovation that enables organizations to expand and enhance their storage for 10 years or more.

Figure 2 Pure Storage FlashArray //X70



At the heart of FlashArray//X is the Purity Operating Environment software. Purity enables organizations to enjoy Tier 1 data services for all workloads, completely non-disruptive operations, and the power and efficiency of DirectFlash. Moreover, Purity includes enterprise-grade data security, comprehensive data protection options, and complete business continuity via ActiveCluster multi-site stretch cluster – all included with every array.



Pure Storage FlashArray sets the benchmark for all-flash enterprise storage arrays. It delivers the following:

- Consistent Performance FlashArray delivers consistent <1ms average latency. Performance is optimized for the real-world applications workloads that are dominated by I/O sizes of 32K or larger vs. 4K/8K hero performance benchmarks. Full performance is maintained even under failures/updates.
- Less Cost than Disk Inline de-duplication and compression deliver 5 10x space savings across a broad set of I/O workloads including Databases, Virtual Machines and Virtual Desktop Infrastructure. With VDI workloads data reduction is typically > 10:1
- Disaster Recovery Built-In FlashArray offers native, fully-integrated, data reduction-optimized backup and disaster recovery at no additional cost. Setup disaster recovery with policy-based automation within minutes. In addition, recover instantly from local, space-efficient snapshots or remote replicas.
- Mission-Critical Resiliency FlashArray delivers >99.999 percent proven availability, as measured across the Pure Storage installed base and does so with non-disruptive everything without performance impact.

## Solution Architecture

The FlashStack architecture brings together the proven data center strengths of the Cisco UCS and Cisco Nexus network switches with the Fibre Channel delivered storage of the leading visionary in all flash arrays. This collaboration creates a simple, yet powerful and resilient data center footprint for the modern enterprise. The FlashStack Data Center with Oracle RAC database on Oracle Linux solution provides an end-to-end architecture with Cisco, Oracle, and Pure Storage technologies and demonstrates the FlashStack configuration benefits for running highly available Oracle RAC Database 12c R2 with Cisco VICs (Virtual Interface Cards).

## Design Topology

This section describes the design considerations for the Oracle RAC Database 12c Release 2 on FlashStack deployment. In this solution design, we used two Cisco UCS Blade Server Chassis with 8 identical Intel Xeon CPU based Cisco UCS B-Series B200 M5 Blade Servers for hosting the 8-Node Oracle RAC Databases. The Cisco UCS B200 M5 Server has Virtual Interface Card (VIC) 1340 with port expander and they were connected four ports from each Cisco Fabric extender of the Cisco UCS Chassis to the Cisco Fabric Interconnects, which were in turn connected to the Cisco MDS Switches for upstream connectivity to access the Pure Storage FlashArray//X70.

The following table list the inventory of the components used in the FlashStack solution.

Vendor	Name	Model	Description	Qty	
Cisco	Cisco Nexus 9372PX-E	N9K-C9372PX-E	Cisco Nexus 9300 Series Switches	2	
	Switch				
Cisco	Cisco MDS 9148S 16G Fab-	DS-C9148S-12PK9	Cisco MDS 9100 Series Multilayer	2	
	ric Switch		Fabric Switches		
Cisco	Cisco UCS 6332-16UP Fab-	UCS-FI-6332-16UP	Cisco 6300 Series Fabric Intercon-	2	
	ric Interconnect		nects		
Cisco	Cisco UCS Fabric Extender	UCS-IOM-2304	Cisco UCS 2304XP I/O Module (4	4	
			External, 8 Internal 40Gb Ports)		
Cisco	Cisco UCS 5108 Blade	UCSB-5108-AC2	Cisco UCS 5100 Series Blade Server	2	
	Server Chassis		AC2 Chassis		
Cisco	Cisco UCS B200 M5 Blade	UCSB-B200-M5	Cisco UCS B-Series Blade Servers	8	
	Servers				
Cisco	Cisco UCS VIC 1340	UCSB-MLOM-40G-03	Cisco UCS Virtual Interface Card	8	
			1340		
Cisco	Cisco UCS Port Expander	UCSB-MLOM-PT-01	Port Expander Card for Cisco UCS	8	
	Card		MLOM		
Pure	Pure FlashArray //X70 Con-	Purity 4.10.6	Pure Storage FlashArray (FA //X70)	1	
Storage	troller	-			

 Table 1
 Inventory and Bill of Material

The following table list the server configuration used in the FlashStack solution.

#### Table 2 Cisco UCS B200 M5 Blade Server Configuration

Server Configuration			
Processor	2 x Intel® Xeon® Gold 6152 Processor (2.10 GHz, 140W, 22C, 30.25MB		
	Cache, DDR4 2666MHz 768GB)		
Memory	16 x 32GB DDR4-2666-MHz RDIMM/dual rank/x4/1.2v		
Cisco UCS VIC 1340	Cisco UCS VIC 1340 Blade MLOM		
Cisco UCS Port Expander	Port Expander Card for Cisco UCS MLOM		
Card			

For this FlashStack solution design, we configured two VLANs and two VSANs as described in the table below.

Name	ID	Description	
VLANs			
Default VLAN	1	Native VLAN	
Public VLAN	134	VLAN for Public Network Traffic	
Private VLAN	10	VLAN for Private Network Traffic	
VSANs			
• VSAN – A	201	SAN Communication through for Fabric Interconnect A	
<ul> <li>VSAN – B</li> </ul>	202	SAN Communication through for Fabric Interconnect B	

Table 3	VLAN and VSAN Configuration	

The FlashStack design comprises of Pure Storage FlashArray //X70 with NVMe enterprise class all-flash for increased scalability and throughput. The table below lists the components of the array.

 Table 4
 Pure Storage FlashArray Configuration

Storage Components	Description
FlashArray	// X70
Capacity	23 TB
Connectivity	8 x 16 Gb/s redundant Fibre Channel
-	1 Gb/s redundant Ethernet (Management port)
Physical	3U

For this FlashStack solution design, we used the following Software and Firmware.

Table 5	Software and	Firmware	Configuration
---------	--------------	----------	---------------

Software and Firmware	Version
Oracle Linux Server 7.4 (64 bit) Operating System	Linux 4.1.12-94.3.9.el7uek.x86_64
Oracle 12c Release 2 GRID	12.2.0.1.0
Oracle 12c Release 2 Database Enterprise Edition	12.2.0.1.0
Cisco Nexus 9372PX-E NXOS Version	6.1(2) I2 (2a)
Cisco MDS 9148S System Version	6.2 (9)
Cisco UCS Manager System	3.2 (2c)
Cisco UCS Adapter VIC 1340	4.2 (2b)
Cisco eNIC (modinfo enic)	2.3.0.31
Cisco fNIC (modinfo fnic)	1.6.0.24
Pure Storage Purity Version	4.10.6
Oracle Swingbench	2.5.971
Oracle DBMS_RESOURCE_MANAGER_CALIBRATE_IO	
SLOB	2.4.2

## Physical Topology

FlashStack consists of a combined stack of hardware (storage, network and compute) and software (Cisco UCS Manager, Oracle Database, Pure Storage GUI, Purity, and Oracle Linux).

- Network: Cisco Nexus 9372PX-E, Cisco MDS 9148S and Cisco UCS Fabric Interconnect 6332-16UP for external and internal connectivity of IP and FC network.
- **Storage**: Pure Storage FlashArray//X70 with 16Gb Fibre Channel connectivity
- Compute: Cisco UCS B200 M5 Blade Server

Figure 4 illustrates the FlashStack solution physical infrastructure.

Solution Architecture



Figure 4 is a typical network configuration that can be deployed in a customer's environment. The best practices and setup recommendations are described later in this document.

As shown in Figure 4, a pair of Cisco UCS 6332-16UP fabric interconnects carries both storage and network traffic from the server blades with the help of Cisco Nexus 9372PX-E and Cisco MDS 9148S switches. Both the fabric interconnect and the Cisco Nexus switch are clustered with the peer link between them to provide high availability. Two virtual Port-Channels (vPCs) are configured to provide public network and private network paths for the server blades to northbound switches. Each vPC has VLANs created for application network data and management data paths.

As illustrated in Figure 4, eight (4 x 40G link per chassis) links go to Fabric Interconnect "A". Similarly, eight links go to Fabric Interconnect B. Fabric Interconnect-A links are used for Oracle Public network traffic shown as green lines. Fabric Interconnect-B links are used for Oracle private interconnect traffic shown as red lines. FC Storage access from Fabric Interconnect-A and Fabric Interconnect-B show as an orange line.

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For Oracle RAC configuration on Cisco Unified Computing System, we recommend to keep all private interconnects local on a single Fabric interconnect. In this case, the private traffic stays local to that fabric interconnect and will not be routed via northbound network switch. All inter-server blade (or RAC node private) communication will be resolved locally at the fabric interconnect and this significantly reduces latency for Oracle Cache Fusion traffic.

## Solution Configuration

## Cisco UCS Configuration Overview

This section details the Cisco UCS configuration that was done as part of the infrastructure build out. The racking, power, and installation of the chassis are described in the install guide, see <u>www.cisco.com/c/en/us/support/servers-unified-computing/ucs-manager/products-installation-guides-list.html</u>). It is beyond the scope of this document to cover detailed information about UCS infrastructure setup and connectivity. The documentation guides and examples are available at <a href="http://www.cisco.com/en/US/products/ps10281/products\_installation\_and\_configuration\_guides\_list.html">http://www.cisco.com/en/US/products/ps10281/products\_installation\_guides\_list.html</a>



#### Cisco UCS Manager Software Version 3.2 (2c)

This document assumes the use of Cisco UCS Manager Software version 3.2(2c). To upgrade the Cisco UCS Manager software and the Cisco UCS 6332-16UP Fabric Interconnect software to a higher version of the firmware, refer to <u>Cisco UCS Manager Install and Upgrade Guides</u>.

#### Configure Base Cisco Unified Computing System

The following are the high-level steps involved for a Cisco UCS configuration:

- 1. Configure Fabric Interconnects for a Cluster Setup.
- 2. Set Fabric Interconnects to Fibre Channel End Host Mode.
- 3. Synchronize Cisco UCS to NTP.
- 4. Configure Fabric Interconnects for Chassis and Blade Discovery:
  - a. Configure Global Policies
  - b. Configure Server Ports
- 5. Configure LAN and SAN on Cisco UCS Manager:
  - a. Configure Ethernet LAN Uplink Ports
  - b. Create Uplink Port Channels to Cisco Nexus Switches
  - c. Configure FC SAN Uplink Ports
  - d. Configure VLAN
  - e. Configure VSAN
- 6. Configure IP, UUID, Server, MAC, WWNN and WWPN Pools:
  - a. IP Pool Creation
  - b. UUID Suffix Pool Creation
  - c. Server Pool Creation
  - d. MAC Pool Creation
  - e. WWNN and WWPN Pool Creation

- 7. Set Jumbo Frames in both the Cisco Fabric Interconnect.
- 8. Configure Server BIOS Policy.
- 9. Create Adapter Policy.
- 10. Configure Update Default Maintenance Policy.
- 11. Configure vNIC and vHBA Template:
  - a. Create Public vNIC Template
  - b. Create Private vNIC Template
  - c. Create Storage vHBA Template
- 12. Create Server Boot Policy for SAN Boot

Details for each step are discussed in the following sections.

#### Configure Fabric Interconnects for a Cluster Setup

To configure the Cisco UCS Fabric Interconnects, complete the following steps:

- 1. Verify the following physical connections on the fabric interconnect:
  - a. The management Ethernet port (mgmt0) is connected to an external hub, switch, or router
  - b. The L1 ports on both fabric interconnects are directly connected to each other
  - c. The L2 ports on both fabric interconnects are directly connected to each other

For more information, refer to the Cisco UCS Hardware Installation Guide for your fabric interconnect.

2. Connect to the console port on the first Fabric Interconnect.

Putty
Enter the configuration method. (console/gui) ? console
Enter the setup mode; setup newly or restore from backup. (setup/restore) ? setup
You have chosen to setup a new Fabric interconnect. Continue? $(y/n): y$
Enforce strong password? (y/n) [y]: n
Enter the password for "admin": Confirm the password for "admin":
Is this Fabric interconnect part of a cluster(select 'no' for standalone)? (yes/no) [n]: yes
Enter the switch fabric (A/B) []: A
Enter the system name: ORARAC-X-FI
Physical Switch Mgmt0 IP address : 10.29.134.101
Physical Switch Mgmt0 IPv4 netmask : 255.255.255.0
IPv4 address of the default gateway : 10.29.134.1
Cluster IPv4 address : 10.29.134.100
Configure the DNS Server IP address? (yes/no) [n]:
Configure the default domain name? (yes/no) [n]:
Join centralized management environment (UCS Central)? (yes/no) [n]:
Following configurations will be applied:
Switch Fabric=A System Name=ORARAC-X-FI Enforced Strong Password=no Physical Switch Mgmt0 IP Address=10.29.134.101 Physical Switch Mgmt0 IP Netmask=255.255.255.0 Default Gateway=10.29.134.1 Ipv6 value=0
Cluster Enabled=yes Cluster IP Address=10.29.134.100 NOTE: Cluster IP will be configured only after both Fabric Interconnects are initialized
UCSM will be functional only after peer FI is configured in clustering mode.
Apply and save the configuration (select 'no' if you want to re-enter)? (yes/no): yes

- 3. Review the settings on the console. Answer yes to Apply and Save the configuration.
- 4. Wait for the login prompt to make sure the configuration has been saved to Fabric Interconnect A.
- 5. Connect the console port on the second Fabric Interconnect and do as follows:

COM3 - PuTTY
Enter the configuration method. (console/gui) ? console
Installer has detected the presence of a peer Fabric interconnect. This Fabric interconnect will be added to the cluster. Continue (y/n) ? yes
Enter the admin password of the peer Fabric interconnect: Connecting to peer Fabric interconnect done Retrieving config from peer Fabric interconnect done Peer Fabric interconnect Mgmt0 IPv4 Address: 10.29.134.101 Peer Fabric interconnect Mgmt0 IPv4 Netmask: 255.255.255.0 Cluster IPv4 address : 10.29.134.100
Peer FI is IPv4 Cluster enabled. Please Provide Local Fabric Interconnect Mgmt0 IPv4 Address Physical Switch Mgmt0 IP address : 10.29.134.102
Apply and save the configuration (select 'no' if you want to re-enter)? (yes/no): yes Applying configuration. Please wait.
Fri Nov 3 22:14:46 UTC 2017 Configuration file - Ok
Cisco UCS 6300 Series Fabric Interconnect ORARAC-X-FI-B login:

- 6. Review the settings on the console. Answer yes to Apply and Save the configuration.
- 7. Wait for the login prompt to make sure the configuration has been saved to Fabric Interconnect B.

To log into the Cisco Unified Computing System (Cisco UCS) environment, complete the following steps:

- 1. Open a web browser and navigate to the Cisco UCS Fabric Interconnect cluster address configured above.
- 2. Click the Launch UCS Manager link to download the Cisco UCS Manager software.
- 3. If prompted, accept the security certificates.



- 4. When prompted, enter the user name and password enter the password.
- 5. Click "Log In" to login to Cisco UCS Manager.

A 0	DRARAC-X-FI - Unified Com X +				-	٥	×
(+) (	€ https://10.29.134.100/app/3_2_2b/index	ihtml C Q Search	☆	Ê	+ 1		≡
cisco	UCS Manager		0	?	0	۲	e
æ	All	Equipment					
8	▼ .Equipment	Main Topology View Fabric Interconnects Servers Thermal Decommissioned Firmware Management Policies Faults Diagnostics					
윪	Chassis Rack-Mounts					(* <sup>^</sup>	<b>`</b>
Ŧ	FEX Servers					+	
Q	<ul> <li>Fabric Interconnect A (primary)</li> <li>Fabric Interconnect B (subordinate)</li> </ul>					ļ	
=	<ul> <li>Policies</li> <li>Port Auto-Discovery Policy</li> </ul>					1	
						16 M	
1 <sub>0</sub>		Fabric Interconnect A (primary) Fabric Interconnect B (subordinate)					

#### Set Fabric Interconnects to Fibre Channel End Host Mode

To set the Fabric Interconnects to the Fibre Channel End Host Mode, complete the following steps:

- 1. On the Equipment tab, expand the Fabric Interconnects node and click Fabric Interconnect A.
- 2. On the General tab in the Actions pane, click Set FC End Host mode.
- 3. Follow the dialogs to complete the change.

Both Fabric Interconnects automatically reboot sequentially when you confirm you want to operate in this mode.

#### Synchronize Cisco UCS to NTP

To synchronize the Cisco UCS environment to the NTP server, complete the following steps:

- 1. In Cisco UCS Manager, in the navigation pane, click the Admin tab.
- 2. Select All > Time zone Management.
- 3. In the Properties pane, select the appropriate time zone in the Time zone menu.
- 4. Click Save Changes and then click OK.
- 5. Click Add NTP Server.
- 6. Enter the NTP server IP address and click OK.
- 7. Click OK to finish.

#### Configure Fabric Interconnects for Chassis and Blade Discovery

Cisco UCS 6332-16UP Fabric Interconnects are configured for redundancy. It provides resiliency in case of failures. The first step is to establish connectivity between blades and Fabric Interconnects.

#### **Configure Global Policies**

The chassis discovery policy determines how the system reacts when you add a new chassis. We recommend using the platform max value as shown. Using platform max helps ensure that Cisco UCS Manager uses the maximum number of IOM uplinks available.

To configure global policies, complete the following steps:

- Go to Equipment > Policies (right pane) > Global Policies > Chassis/FEX Discovery Policies. As shown in the screenshot below, select Action as "Platform Max" from the drop-down list and set Link Grouping to Port Channel.
- 2. Click Save Changes.
- 3. Click OK.

cisco	UCS Manager	Ø ♥ 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Æ	All	Equipment
	Equipment Chassis Rack-Mounts Fabric Interconnect A (subordinate) Fabric Interconnect B (primary) Policies Port Auto-Discovery Policy	Main Topology View Fabric Interconnects Servers Thermal Decommissioned Firmware Management Policies Faults Diagnostics     Global Policies Autoconfig Policies Server Inheritance Policies Server Discovery Policies SEL Policy Power Groups Port Auto-Discovery Policy     Chassis/FEX Discovery Policy   Action : Platform Max   Unik Grouping Preference : None
		Power Policy       Redundancy : Non Redundant N+1 Grid   MAC Address Table Aging
		Aging Time:       Never          Mode Default         other         Global Power Allocation Policy       Info Policy Driven Chassis Group Cap         Allocation Method:       Manual Blade Level Cap         Policy Driven Chassis Group Cap         Firmware Auto Sync Server Policy       Info Policy         Sync State:       Info Policy         Global Power Profiling Policy       Info Policy         Profile Power:       Action:         Olisabled       Enabled

Figure 5 illustrates the advantage of having Discrete mode versus Port Channel mode.

### Figure 5 Fabric Ports: Discrete vs. Port Channel Mode



#### **Configure Server Ports**

Configure Server Ports to initiate Chassis and Blade discovery. To configure server ports, complete the following steps:

- 1. Go to Equipment > Fabric Interconnects > Fabric Interconnect A > Fixed Module > Ethernet Ports.
- Select the ports (for this solution ports are 17-24) which are connected to the Cisco IO Modules of the two B-Series 5108 Chassis.
- 3. Right-click and select "Configure as Server Port".
- 4. Click Yes to confirm and click OK.

.1 1.1 1. c1sco	UCS Manager			Q	3 👽 🙆 📀 0 0 6				
乕	All	Equipment / Fabric	Interconnects / Fabric Interconnect	t A (subordinate) / Fixed Mo	dule / Ethernet Ports				
8	▼ Equipment	Ethernet Ports							
	<ul> <li>Chassis</li> </ul>	T∉ Advanced Filter	All Vunc	configured Vetwork Ser	ver VFCoE Uplink Unified Uplink	Appliance Storage V FCoE S	torage Vinified Storage V	Monitor	
뮮	<ul> <li>Rack-Mounts</li> </ul>	Slot	Aggr. Port ID	Port ID	MAC	If Role	If Type	Overall Status	Admin State
	Fabric Interconnects	1	0	15	8C:60:4F:8D:64:9A	Unconfigured	Physical	V Sfp Not Present	Disabled
=	<ul> <li>Fabric Interconnect A (subordinate)</li> </ul>	1	0	16	8C:60:4F:BD:64:9B	Unconfigured	Physical	V Sfp Not Present	Disabled
	<ul> <li>Fans</li> <li>Eixed Module</li> </ul>	1	0	17	8C:60:4F:8D:64:9C	Server	Physical	🕈 Up	Enabled
<u> </u>	Ethernet Ports	1	0	18	8C:60:4F:BD:64:A0	Server	Physical	1 Up	1 Enabled
=	<ul> <li>FC Ports</li> </ul>	1	0	19	8C:60:4F:BD:64:A4	Server	Physical	1 Up	1 Enabled
	<ul> <li>PSUs</li> </ul>	1	0	20	8C:60:4F:BD:64:A8	Server	Physical	t Up	1 Enabled
	<ul> <li>Fabric Interconnect B (primary)</li> </ul>	1	0	21	8C:60:4F:8D:64:AC	Server	Physical	🕈 Up	1 Enabled
	✓ Policies	1	0	22	8C:60:4F:BD:64:B0	Server	Physical	1 Up	1 Enabled
40	Port Auto-Discovery Policy	1	0	23	8C:60:4F:BD:64:B4	Server	Physical	t Up	1 Enabled
		1	0	24	8C:60:4F:BD:64:B8	Server	Physical	🕈 Up	1 Enabled
		1	0	25	8C:60:4F:BD:64:BC	Unconfigured	Physical	V Sfp Not Present	Disabled
		1	0	26	8C:60:4F:BD:64:C0	Unconfigured	Physical	V Sfp Not Present	Disabled
		1	0	27	8C:60:4F:BD:64:C4	Unconfigured	Physical	V Sfp Not Present	Disabled
		1	0	28	8C:60:4F:8D:64:C8	Unconfigured	Physical	V Sfp Not Present	Disabled
		1	0	29	8C:60:4F:BD:64:CC	Unconfigured	Physical	V Sfp Not Present	Disabled

- 5. Repeat the steps above for Fabric Interconnect B.
- 6. After configuring Server Ports, acknowledge both the Chassis. Go to Equipment >Chassis > Chassis 1 > General > Actions > select "Acknowledge Chassis". Similarly, acknowledge the chassis 2.
- After acknowledging both the chassis, re-acknowledge all the servers placed in the chassis. Go to Equipment

   Chassis 1 > Servers > Server 1 > General > Actions > select Server Maintenance > select option "Reacknowledge" and click OK. Repeat this process to re-acknowledge all eight Servers.
- 8. When the acknowledgement of the Servers is completed, verify the Port-channel of Internal LAN. Go to the LAN tab > Internal LAN > Internal Fabric A > Port Channels as shown in the screenshot below.

Network Type Lan
Network Type Lan
Network Type
Network Type
Lan
Lan

9. Repeat these steps for Internal Fabric B.

#### Configure LAN and SAN on Cisco UCS Manager

Configure Ethernet Uplink Ports and Fibre Channel (FC) Storage ports as explained in the following section.

#### Configure Ethernet LAN Uplink Ports

To configure network ports used to uplink the Fabric Interconnects to the Cisco Nexus switches, complete the following steps:

- 1. In Cisco UCS Manager, in the navigation pane, click the Equipment tab.
- 2. Select Equipment > Fabric Interconnects > Fabric Interconnect A > Fixed Module.
- 3. Expand Ethernet Ports.
- 4. Select ports (for this solution ports are 11-14) that are connected to the Nexus switches, right-click them, and select Configure as Network Port.
- 5. Click Yes to confirm ports and click OK.
- 6. Verify the Ports connected to Cisco Nexus upstream switches are now configured as network ports.
- 7. Repeat the above steps for Fabric Interconnect B. The screenshot below shows the network uplink ports for Fabric A.

cisco	UCS Manager			8 👽 ( 0 0	<ul> <li>▲</li> <li>●</li> <li>●</li></ul>			٩	
æ	All	Equipment / Fabric Interconn	nects / Fabric Interconnect A (sub	oordinate) / Fixed Module / Ethe	ernet Ports				
■	▼ Equipment	Ethernet Ports							
-	▼ Chassis	▼ Advanced Filter ↑ Export	Print VII Unconfigure	d Vetwork Server VFC	oE Uplink 🗸 Unified Uplink 🖌 Ap	pliance Storage FCoE Storage	Unified Storage Monitor		
몲	<ul> <li>Chassis 1</li> </ul>	Slot	Aggr. Port ID	Port ID	MAC	If Role	If Type	Overall Status	Admin State
	<ul> <li>Chassis 2</li> </ul>	1	0	7	8C:60:4F:BD:64:92	Unconfigured	Physical	V Sfp Not Present	Disabled
1	<ul> <li>Rack-Mounts</li> </ul>	1	0	8	8C:60:4F:BD:64:93	Unconfigured	Physical	V Sfp Not Present	Disabled
	Fabric Interconnects	1	0	9	8C:60:4F:BD:64:94	Unconfigured	Physical	V Sfp Not Present	Disabled
	Fabric Interconnect A (subordinate)     Eane	1	0	10	8C:60:4F:BD:64:95	Unconfigured	Physical	V Sfp Not Present	Disabled
-	<ul> <li>Fixed Module</li> </ul>	1	0	11	8C:60:4F:BD:64:96	Network	Physical	1 Up	1 Enabled
	Ethernet Ports	1	0	12	8C:60:4F:BD:64:97	Network	Physical	t Up	Enabled
	<ul> <li>FC Ports</li> </ul>	1	0	13	8C:60:4F:BD:64:98	Network	Physical	t Up	1 Enabled
	<ul> <li>PSUs</li> </ul>	1	0	14	8C:60:4F:BD:64:99	Network	Physical	1 Up	Enabled
40	<ul> <li>Fabric Interconnect B (primary)</li> <li>Policies</li> </ul>	1	0	15	8C:60:4F:BD:64:9A	Unconfigured	Physical	V Sfp Not Present	Disabled
	Port Auto-Discovery Policy	1	0	16	8C:60:4F:BD:64:9B	Unconfigured	Physical	V Sfp Not Present	Disabled
		1	0	17	8C:60:4F:BD:64:9C	Server	Physical	t Up	Enabled
		1	0	18	8C:60:4F:BD:64:A0	Server	Physical	t Up	1 Enabled
		1	0	19	8C:60:4F:BD:64:A4	Server	Physical	t Up	1 Enabled
		1	0	20	8C:60:4F:BD:64:A8	Server	Physical	t Up	1 Enabled
		1	0	21	8C:60:4F:BD:64:AC	Server	Physical	t Up	t Enabled
		1	0	22	8C:60:4F:BD:64:B0	Server	Physical	t Up	1 Enabled
		1	0	23	8C:60:4F:BD:64:B4	Server	Physical	t Up	1 Enabled
		1	0	24	8C:60:4F:BD:64:B8	Server	Physical	↑ Up	1 Enabled

You have now created four uplink ports on each Fabric Interconnect as shown above. These ports will be used to create Virtual Port Channel in the next section.

#### Create Uplink Port Channels to Cisco Nexus Switches

In this procedure, two port channels were created; one from Fabric A to both Cisco Nexus 9372PX-E switches and one from Fabric B to both Cisco Nexus 9372PX-E switches. To configure the necessary port channels in the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Under LAN > LAN Cloud, expand node Fabric A tree:
  - a. Right-click Port Channels.
  - b. Select Create Port Channel.
  - c. Enter 21 as the unique ID of the port channel.

		Create Port Channel
1	Set Port Channel Name	ID : 21
2	Add Ports	Name : Oracle-Public

- d. Enter Oracle-Public as the name of the port channel.
- e. Click Next.
- f. Select Ethernet ports 11-14 for the port channel.
- 3. Click Finish.

.ili.ili. cisco	UCS Manager			⊗ 👽 🛆 📀 0 0 0 6		
æ	All	LAN / LAN Cloud				
-	▼ LAN	LAN Uplinks VLANs Server Links	MAC Identity Assignment	IP Identity Assignment QoS Global Policies Faul	lts Ever	nts FSM
-	LAN Cloud	Port Channels and Uplinks				Pin Groups
뮮	✓ Fabric A	+ - Ty Advanced Filter 🕈 Export	Print		\$	+ - 🌾 Advanced Filter
	Port Channels	Name	Fabric ID	Admin State		Name
	Port-Channel 21 Oracle-Public     Eth Interface 1/11	▼ Port Channels				
	Eth Interface 1/12	▼ Fabric A				
	Eth Interface 1/13	➡ Port-Channel 21 Oracle-Public	А	1 Enabled		
	Eth Interface 1/14	Eth Interface 1/11	А	t Enabled		
	<ul> <li>Uplink Eth Interfaces</li> </ul>	Eth Interface 1/12	A	1 Enabled		
	<ul> <li>VLANs</li> <li>VD Optimization Sets</li> </ul>	Eth Interface 1/13	А	t Enabled		
20	<ul> <li>Fabric B</li> </ul>	Eth Interface 1/14	A	Enabled		
	▼ Port Channels	▼ Fabric B				
	Port-Channel 22 Oracle-Private		В	* Enabled		
	Eth Interface 1/11	Eth Interface 1/11	В	Enabled		
	Eth Interface 1/12	Eth Interface 1/12	В	Enabled		
	Eth Interface 1/13	Eth Interface 1/13	В	Enabled		* *
	<ul> <li>Uplink Eth Interfaces</li> </ul>	Eth Interface 1/14	В	Enabled		
	<ul> <li>VLANs.</li> <li>VP Optimization Sets</li> <li>QoS System Class</li> </ul>	▶ Uplink Eth Interfaces				

4. Repeat steps 1-3 for Fabric Interconnect B, substituting 22 for the port channel number and Oracle-Private for the name. Your resulting configuration should look like the screenshot above.

#### Configure FC SAN Uplink Ports

To configure Fibre Channel Uplink ports, complete the following steps:

1. Go to Equipment > Fabric Interconnects > Fabric Interconnect A > General tab > Actions pane, click Configure Unified ports.

- 2. Click Yes to confirm in the pop-up window.
- 3. Move the slider to the right.

configure (	Jnified Ports		? ×
		A DA VA VA DA VA VA DA VA	
	elider determines the type of the p	=+	
All the ports to the	left of the slider are Fibre Channel	ports (Purple), while the ports to the right are Ethernel	t ports (Blue).
All the ports to the Port Dest 1	Transport	If Role or Port Channel Membership	Desired <b>If Role</b>
Port Port 1 Part 2	Transport ether	If Role or Port Channel Membership Unconfigured	t ports (Blue). Desired <b>If Role</b> FC Uplink
Port 1 Port 2 Port 2	Inder determines the type of the p left of the slider are Fibre Channel Transport ether ether other	If Role or Port Channel Membership Unconfigured Unconfigured Unconfigured	t ports (Blue). Desired <b>If Role</b> FC Uplink FC Uplink FC Uplink
Port Port 3	Transport ether ether ether ether	If Role or Port Channel Membership Unconfigured Unconfigured Unconfigured Unconfigured	t ports (Blue).  Desired If Role  FC Uplink  FC Uplink  FC Uplink  FC Uplink  FC Uplink
Port 1 Port 2 Port 3 Port 4 Port 5	Transport ether ether ether ether ether	If Role or Port Channel Membership Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured	t ports (Blue).  Desired If Role  FC Uplink
Port 1 Port 2 Port 3 Port 5 Port 6	Transport ether ether ether ether ether ether ether	If Role or Port Channel Membership Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured	t ports (Blue).  Desired <b>If Role</b> FC Uplink  FC Uplink
Port 1 Port 2 Port 3 Port 5 Port 6 Port 7	Transport ether ether ether ether ether ether ether ether ether ether ether	If Role or Port Channel Membership Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured	t ports (Blue).  Desired If Role  FC Uplink
Port 1 Port 2 Port 3 Port 4 Port 5 Port 6 Port 7	Transport ether ether ether ether ether ether ether ether ether ether ether ether	If Role or Port Channel Membership Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured	t ports (Blue).  Desired If Role  FC Uplink
Port 1 Port 2 Port 3 Port 4 Port 5 Port 6 Port 7 Port 8	Inder determines the type of the p left of the slider are Fibre Channel ether ether ether ether ether ether ether ether ether ether ether ether ether ether ether ether	If Role or Port Channel Membership Unconfigured	t ports (Blue).  Desired <b>If Role</b> FC Uplink



Ports to the right of the slider will become FC ports. For our study, we configured the first six ports on the FI as FC Uplink ports.

- 4. Click OK.
- 5. Click Yes to apply the changes.

Applying this configuration will cause the immediate reboot of Fabric Interconnect and/or Expansion Module(s)

6. After the FI reboot, your FC Ports configuration should look like the screenshot below:

cisco	UCS Manager			8 👽 🙆 🔮 0 0 0 6				
Æ	All 👻	Equipment / Fabric	Interconnects / Fabric Interconnect A (s	subordinate) / Fixed Module / FC Ports				
	<ul> <li>✓ Equipment</li> <li>✓ Chassis</li> </ul>	FC Ports	+ Export - Print All Vinconfig	ured Vetwork Storage Monitor				
무	<ul> <li>Chassis 1</li> </ul>	Slot	Port ID	WWPN	If Role	If Type	Overall Status	Admin State
	<ul> <li>Chassis 2</li> </ul>	1	1	20:01:8C:60:4F:8D:64:80	Network	Physical	1 Up	t Enabled
1	<ul> <li>Rack-Mounts</li> </ul>	1	2	20:02:8C:60:4F:BD:64:80	Network	Physical	t Up	1 Enabled
	<ul> <li>Fabric Interconnects</li> <li>Eshric Interconnect A (subordinate)</li> </ul>	1	3	20:03:8C:60:4F:8D:64:80	Network	Physical	t Up	1 Enabled
9	<ul> <li>Fans</li> </ul>	1	4	20:04:8C:60:4F:BD:64:80	Network	Physical	1 Up	Enabled
=	▼ Fixed Module	1	5	20:05:8C:60:4F:BD:64:80	Network	Physical	V Sfp Not Present	1 Enabled
	<ul> <li>Ethernet Ports</li> </ul>	1	6	20:06:8C:60:4F:BD:64:80	Network	Physical	V Sfp Not Present	1 Enabled
	FC Ports							
	<ul> <li>PSUs</li> </ul>							

#### Configure VLAN

To configure the necessary virtual local area networks (VLANs) for the Cisco UCS environment, complete the following steps:

1. In Cisco UCS Manager, click the LAN tab in the navigation pane.

In this solution, we created two VLANs: one for private network (VLAN 10) traffic and one for public network (VLAN 134) traffic. These two VLANs will be used in the vNIC templates that are discussed later.

It is very important to create both VLANs as global across both fabric interconnects. This way, VLAN identity is maintained across the fabric interconnects in case of NIC failover.

- 2. Select LAN > LAN Cloud.
- 3. Right-click VLANs.
- 4. Select Create VLANs.

cisco.	UCS Manager	🐼 👽 🙆 🚸 1 8 1 6	۲
Æ	All	LAN / LAN Cloud / VLANs	
	✓ LAN ▲ ✓ LAN Cloud	VLANS VLANS Create VLANS ? ×	
品	Fabric A     Fabric B     QoS System Class     LAN Dis Common	Name       VLAN Name/Prefix       :       Public_Traffic         VLA       Multicast Policy Name : <not set="">       Create Multicast Policy          <ul> <li>Common/Global</li> <li>Fabric A</li> <li>Fabric B</li> <li>Both Fabrics Configured Differently</li> </ul></not>	Primary VLAN
<u> </u>	CAN Pril Gloups     Threshold Policies     VLAN Groups     VLANs	You are creating global VLANs that map to the same VLAN IDs in all available fabrics.         Enter the range of VLAN IDs.(e.g. * 2009-2019", * 29,35,40-45", * 23", * 23,34-45")         VLAN IDs :       134         Sharing Type :       None        Primary        Isolated        Community	
	Appliances     Fabric A     Fabric B     VLANs     Internal LAN     Internal Fabric A	Detail Ger Faul	
	<ul> <li>Internal Fabric B</li> <li>Threshold Policies</li> <li>Policies</li> <li>Appliances</li> <li>LAN Cloud</li> <li>root</li> <li>Default vNIC Behavior</li> </ul>	Acti Check Overlap OK Cancel	al tual
	Flow Control Policies     Dynamic vNIC Connection Policie:     S		

- 5. Enter Public\_Traffic as the name of the VLAN to be used for Public Network Traffic.
- 6. Keep the Common/Global option selected for the scope of the VLAN.
- 7. Enter 134 as the ID of the VLAN ID.
- 8. Keep the Sharing Type as None.

9. Click OK and then click OK again.

111 11 15CO.	UCS Manager					🙁 🔽 ( 1 8	⚠ <ul><li>▲</li><li>▲</li><li>1</li><li>6</li></ul>				
æ	All	, LAN / LAN Clos	ud / VLAN:	5							
=	▼ LAN	^									
-	✓ LAN Cloud	Te Advanced I	Filter 🔶 E	xport 📥 🖡	Print						
<b>ठॅठ</b>	Fabric R	Name			ID		Туре	Transpor	t Native		VLAN Sha
_	OoS System Class	VLAN defa	ault (1)		1		Lan	Ether	Yes		None
-	LAN Pin Groups	VLAN Priv	ate_Traffic	(10)	10		Lan	Ether	No		None
	Threshold Policies	VLAN Pub	lic_Traffic (	134)	134		Lan	Ether	No		None
<u> </u>	<ul> <li>VLAN Groups</li> </ul>										
=	✓ VLANs										
	VLAN default (1)										
	VLAN Private_Traffic (10)							$\oplus$ Add	🗊 Delete 🚯 Info		
	VLAN Public_Traffic (134)	Details									
¢	<ul> <li>Appliances</li> </ul>										
	<ul> <li>Fabric A</li> </ul>	General	Org Per	missions	VLAN Group	Membership	Faults E	vents			
	Fabric B	Fault Sum	mary			Properties					
	► VLANS		inci y			Topordoa					
	<ul> <li>Internal LAN</li> <li>Internal Entric A</li> </ul>	$\otimes$	V		•	Name		default		VLAN ID	: 1
	<ul> <li>Internal Fabric A</li> <li>Internal Fabric B</li> </ul>	0	0	0	0	Native VLA	N	Yes		Fabric ID	: Dua
	<ul> <li>Threshold Policies</li> </ul>					Network Ty	/pe	: Lan		If Type	: Virt
	<ul> <li>Policies</li> </ul>	Actions						<b>-</b> · ·		-	
	<ul> <li>Appliances</li> </ul>										
	LAN Cloud										

These two VLANs will be used in the vNIC templates that are discussed later.

#### **Configure VSAN**

To configure the necessary virtual storage area networks (VSANs) for the Cisco UCS environment, complete the following steps:

1. In Cisco UCS Manager, click the SAN tab in the navigation pane.

In this solution, we have created two VSANs. VSAN-A 101 and VSAN-B 102 for SAN Boot and Storage Access.

- Select SAN > SAN Cloud. 2.
- Under VSANs, right-click VSANs. 3.
- Select Create VSANs. 4.
- Enter VSAN 201 as the name of the VSAN. 5.



- 6. Select Fabric A for the scope of the VSAN.
- 7. Enter 20 as the ID of the VSAN.
- 8. Click OK and then click OK again.
- 9. Repeat the above steps to create the VSANs necessary for this solution. VSAN 201 and 202 are configured as shown below:

alialia cisco	UCS Manager		1	3 👽 📤 🚯 1 8 1 6				•
Æ	All	SAN / SAN Cloud / VSANs						
	- 641	VSANs						
	SAN Cloud	+ - 🏹 Advanced Filter 🔺 Expor	t 🖷 Print					
	<ul> <li>Fabric A</li> </ul>	Name	ID	Fabric ID	If Type	If Role	Transport	FCoE VLAN ID
66	Fabric B	▼ Fabric A						
	SAN Pin Groups	VSANs						
	<ul> <li>Threshold Policies</li> </ul>	- Eabric B						
	✓ VSANs	VEAN						
	VSAN default (1)	VSAINS						
	VSAN ORA-VSAN-A (201)	▼ VSANs						
	VSAN ORA-VSAN-B (202)	VSAN default (1)	1	Dual	Virtual	Network	Fc	4048
	✓ Storage Cloud	VSAN ORA-VSAN-A (201)	201	Dual	Virtual	Network	Fc	201
•	Fabric A	VSAN ORA-VSAN-B (202)	202	Dual	Virtual	Network	Fc	202
-0	Fabric B							
	<ul> <li>VSANs</li> </ul>							
	▼ Policies							
	<ul> <li>SAN Cloud</li> </ul>							
	▼ root							
	Default vHBA Behavior							
	<ul> <li>Fibre Channel Adapter Policies</li> </ul>							
	<ul> <li>LACP Policies</li> </ul>				🕀 Add 📋 De			
	<ul> <li>SAN Connectivity Policies</li> </ul>				0.111			
	<ul> <li>Storage Connection Policies</li> </ul>							
	<ul> <li>Threshold Policies</li> </ul>							
	<ul> <li>vHBA Templates</li> </ul>							
A 1								

#### Configure IP, UUID, Server, MAC, WWNN, and WWPN Pools

#### **IP Pool Creation**

An IP address pool on the out of band management network must be created to facilitate KVM access to each compute node in the Cisco UCS domain. To create a block of IP addresses for server KVM access in the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, in the navigation pane, click the LAN tab.
- 2. Select Pools > root > IP Pools > click Create IP Pool.



- 3. Select option Sequential to assign IP in sequential order then click Next.
- 4. Click Add IPv4 Block.
- 5. Enter the starting IP address of the block and the number of IP addresses required, and the subnet and gateway information as shown in the screenshot.



6. Click Next and then click Finish to create the IP block.

#### **UUID Suffix Pool Creation**

To configure the necessary universally unique identifier (UUID) suffix pool for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Select Pools > root.
- 3. Right-click UUID Suffix Pools and then select Create UUID Suffix Pool.



- 4. Enter ORA-UUID-Pool as the name of the UUID name.
- 5. Optional: Enter a description for the UUID pool.
- 6. Keep the prefix at the derived option and select Sequential in as Assignment Order then click Next.
- 7. Click Add to add a block of UUIDs.
- 8. Create a starting point UUID as per your environment.

Crea	te a Block of U	UID Suffixes	? ×
From :	0005-00000000001	Size : 256 🌲	
		ОК	Cancel

9. Specify a size for the UUID block that is sufficient to support the available blade or server resources.
## Server Pool Creation

To configure the necessary server pool for the Cisco UCS environment, complete the following steps:



Consider creating unique server pools to achieve the granularity that is required in your environment.

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Select Pools > root > right-click Server Pools > Select Create Server Pool.
- 3. Enter ORA-Pool as the name of the server pool.
- 4. Optional: Enter a description for the server pool then click Next
- 5. Select all the eight servers to be used for the Oracle RAC management and click > to add them to the server pool.
- 6. Click Finish and then click OK.

# **MAC Pool Creation**

To configure the necessary MAC address pools for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Select Pools > root > right-click MAC Pools under the root organization.
- 3. Select Create MAC Pool to create the MAC address pool.
- 4. Enter ORA-MAC-A as the name for MAC pool.



- 5. Enter the seed MAC address and provide the number of MAC addresses to be provisioned.
- 6. Click OK and then click Finish.
- 7. In the confirmation message, click OK.
- 8. Create MAC Pool B and assign unique MAC Addresses as shown below.
  - We created Oracle-MAC-A and Oracle-MAC-B as shown below for all the vNIC MAC Addresses.

uluulu cisco	UCS Manager		🛞 👽 📤 📀 1 8 1 6		
Æ	All	, LAN / Pools / root / MAC Pools			
	- 1 41	MAC Pools			
	▼ LAN Cloud	+ - 🏹 Advanced Filter 🛧 Export 🖶 Print			
무	<ul> <li>Fabric A</li> </ul>	Name	Size		Assigned
66	Fabric B	MAC Pool default	0		0
1	<ul> <li>QoS System Class</li> </ul>	MAC Pool ORA-MAC-A	256		0
	<ul> <li>LAN Pin Groups</li> </ul>	[00:25:B5:CC:00:00 - 00:25:B5:CC:00:FF]			
Ū	Threshold Policies	MAC Pool ORA-MAC-B	256		0
-	VLAN Groups	[00:25:B5:DD:00:00 - 00:25:B5:DD:00:FF]			
	<ul> <li>Appliances</li> </ul>				
	<ul> <li>Internal LAN</li> </ul>				
_	<ul> <li>Policies</li> </ul>				
20	<ul> <li>Appliances</li> </ul>				
	LAN Cloud				
	► root				
	▼ Pools				
	▼ root				
	IP Pools				
	<ul> <li>MAC Pools</li> </ul>				
	<ul> <li>MAC Pool default</li> </ul>				
	MAC Pool ORA-MAC-A			(+) Add in Delete (1) Info	
	MAC Pool ORA-MAC-B				
	<ul> <li>Sub-Organizations</li> </ul>				

# WWNN and WWPN Pool Creation

To configure the necessary WWNN pools for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the SAN tab in the navigation pane.
- 2. Select Pools > Root > WWNN Pools > right-click WWNN Pools > select Create WWNN Pool.
- 3. Assign name and Assignment Order as sequential, as shown below.

alialia cisco	UCS Manager	😢 🤯 🙆 🚸 1 8 1 6	
E E	All Fabric A	SAN / Pools / root / WWNN Pools  WWNN Pools  A Structure of Elter A Event Brief	
器	<ul> <li>Fabric B</li> <li>FC Zone Profiles</li> <li>VSANs</li> </ul>	Name Create WWNN Pool ? >	< ssign
<u>.</u>	▼ Policies	Define Name and Description Name : ORA-WWNN-Pool	
	<ul> <li>SAN Cloud</li> <li>root         <ul> <li>Default vHBA Behavior</li> <li>Fibre Channel Adapter Policies</li> <li>LACP Policies</li> <li>SAN Connectivity Policies</li> <li>Storage Connection Policies</li> </ul> </li> </ul>	Add WWN Blocks       Description :         Assignment Order :       Opefault • Sequential	
*0	<ul> <li>Threshold Policies</li> <li>vHBA Templates</li> <li>Sub-Organizations</li> <li>Pools</li> <li>root</li> <li>IQN Pools</li> <li>WWNN Pools</li> <li>WWNN Pool node-default</li> <li>WWPN Pools</li> <li>WWPN Pools</li> <li>WWXN Pools</li> </ul>	< Prov Next > Finish Cancel Add ur Delete for Info	

- 4. Click Next and then click Add to add block of Ports.
- 5. Enter Block for WWN and size of WWNN Pool as shown below.

Nama	From
Create WWN Block	? ×
From : 20:00:00:25:B5:50:00:00	Size : 256 🜲
To ensure uniqueness of WWNs in the S the following WWN prefix:	AN fabric, you are strongly encouraged to use
20:00:00:25:b5:xx:xx:xx	
	OK Cancel

6. Click OK and then click Finish.

To configure the necessary WWPN pools for the Cisco UCS environment, complete the following steps:

We created two WWPN as ORA-WWPN-A Pool and ORA-WWPN-B as World Wide Port Name as shown below. These WWNN and WWPN entries will be used to access storage through SAN configuration.

- 1. In Cisco UCS Manager, click the SAN tab in the navigation pane.
- 2. Select Pools > Root > WWPN Pools > right-click WWPN Pools > select Create WWPN Pool.
- 3. Assign name as ORA-WWPN-A and Assignment Order as sequential.

Create WWN Block	? ×
From : 20:00:00:25:B5:6A:00:00	Size : 256 🜲
To ensure uniqueness of WWNs in the S the following WWN prefix:	AN fabric, you are strongly encouraged to use
20:00:00:25:b5:xx:xx:xx	
	OK Cancel

- 4. Click Next and then click Add to add block of Ports.
- 5. Enter Block for WWN and size.
- 6. Click OK and then click Finish.
- 7. Configure ORA-WWPN-Bs Pool as well and assign the unique block IDs as shown below.

Crea	te WWN Block	? ×
From :	20:00:00:25:B5:6B:00:00	Size : 256 🜲
To ensur the follow	e uniqueness of WWNs in the S wing WWN prefix:	AN fabric, you are strongly encouraged to use
20:00:00	):25:b5:xx:xx	
		OK Cancel

## Set Jumbo Frames in both the Cisco Fabric Interconnect

To configure jumbo frames and enable quality of service in the Cisco UCS fabric, complete the following steps:

1. In Cisco UCS Manager, click the LAN tab in the navigation pane.

- 2. Select LAN > LAN Cloud > QoS System Class.
- 3. In the right pane, click the General tab.
- 4. On the Best Effort row, enter 9216 in the box under the MTU column.

uluulu cisco.	UCS Manager				8 👽 💪 0 2 0	<b>0</b> 7			
Æ	All	LAN / LAN Cloud	/ QoS Syste	em Class					
-	▼ LAN	General	ents FSN	Λ.					
모	► Fabric A	Actions			Properties				
66	<ul> <li>Fabric B</li> </ul>				Owner : Local				
重	QoS System Class								
	► LAN Pin Groups	Priority	Enabled	CoS	Packet Drop	Weight	Weight (%)	мти	Multicast Optimized
Y	<ul> <li>Threshold Policies</li> </ul>	Platinum		5		10	N/A	normal	
=	<ul> <li>VLAN Groups</li> </ul>			3		10		nombi	
	<ul> <li>VLANs</li> </ul>	Gold		4		9 🔻	N/A	normal 🔻	
	<ul> <li>Appliances</li> </ul>	Silver		2		8	N/A	normal 🔻	
	<ul> <li>Fabric A</li> </ul>	Bronze			2		N/A		
40	<ul> <li>Fabric B</li> </ul>	DIGINE		1	٢	7		normal	
	▶ VLANs	Best Effort	×.	Апу	×.	5	50	9216 🔻	
	✓ Internal LAN	Fibre	Ø	3		5	50	fc	N/A
	<ul> <li>Internal Fabric A</li> </ul>	Channel		3		-			
	<ul> <li>Internal Fabric B</li> </ul>								
	<ul> <li>Threshold Policies</li> </ul>								
	<ul> <li>Policies</li> </ul>								

- 5. Click Save Changes.
- 6. Click OK.

# **Create Adapter Policy**

To create an Adapter Policy for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Select Policies > root > right-click Adapter Policies.
- 3. Select Create Ethernet Adapter Policy.
- 4. Provide a name for the Ethernet adapter policy. Change the following fields and click Save Changes when you are finished:
  - Resources
    - Transmit Queues: 8
    - o Ring Size: 4096
    - o Receive Queues: 8
    - o Ring Size: 4096
    - Completion Queues: 16
    - o Interrupts: 32
  - Options
    - Receive Side Scaling (RSS): Enabled

5. Configure adapter policy as shown below:

iliiilii cisco	UCS Manager		🔇 👽 스 📀 0 0 0 6	
æ	All	Servers / Policies / root / Adapter Policies / Eth Ada	pter Policy ORA_Linux_Tuning	
	▼ Servers	General Events		
-	<ul> <li>Service Profiles</li> </ul>	Delete	Name : ORA_Linux_Tuning	
몲	Service Profile Templates	Show Policy Usage	Description :	
	✓ Policies		Owner : Local	
=	▼ root 🕐			
	<ul> <li>Adapter Policies</li> </ul>			
	Eth Adapter Policy default	Resources		
	Eth Adapter Policy Linux			
=	Eth Adapter Policy ORA_Linux_	Transmit Queues : 8 [1-1000]		
	Eth Adapter Policy SMBClient	Ring Size : 4096 [64-4096]		
	Eth Adapter Policy SMBServer		<mark>-</mark>	
	Eth Adapter Policy Solaris	Receive Queues : 8 [1-1000]		
20	Eth Adapter Policy SRIOV	Ring Size : 4096 [64-4096]		
	Eth Adapter Policy usNIC			
	Eth Adapter Policy usNICOracle	Completion Queues : 16 [1-2000]		
	Eth Adapter Policy VMWare	Interrupts : 32 [1-1024]		
	Eth Adapter Policy VMWarePas			
	Eth Adapter Policy Windows			
	FC Adapter Policy default	Options		
	FC Adapter Policy fc_tushar	Transmit Checksum Offload	: Oisabled () Enabled	
	FC Adapter Policy Linux	Receive Checksum Offload	: Oisabled () Enabled	
	FC Adapter Policy Solaris	TOD Secondarias Official	O Disabled O Fachlad	
	FC Adapter Policy VMWare	TCP Segmentation Omoad	: Disabled (•) Enabled	
	FC Adapter Policy Windows	TCP Large Receive Offload	: ODisabled () Enabled	
	FC Adapter Policy WindowsBoc	Receive Side Scaling (RSS)	: O Disabled () Enabled	
	ISCSI Adapter Policy default	Accelerated Receive Flow Steering	: ( Disabled ) Enabled	
	BIOS Defaults	Network Virtualization using Constite Routing Encapsulation		
	Bios Policies	Network Virtualization using denenc Routing Encapsulation		
	Diagnostics Policies	Virtual Extensible LAN	: Olisabled Enabled	
	Craphics Card Deliaion	Failback Timeout (Seconds)	: 5	[0-600]
	Host Firmware Dackages	Interrupt Mode	: OMSLX OMSLOIN TX	
	IPMI Access Profiles	Interrupt Coalescing Type		
	<ul> <li>KVM Management Policies</li> </ul>			
	Local Disk Config Policies	Interrupt Timer (us)	125	[0-65535]
	<ul> <li>Maintenance Policies</li> </ul>	RoCE	: <ul> <li>Disabled  </li></ul>	
	<			

RSS distributes network receive processing across multiple CPUs in multiprocessor systems. This can be one of the following:

- Disabled—Network receive processing is always handled by a single processor even if additional processors are available.
- Enabled—Network receive processing is shared across processors whenever possible.
- 6. Click OK to finish.

# Configure Update Default Maintenance Policy

To update the default Maintenance Policy, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Select Policies > root > Maintenance Policies > Default.

6

- 3. Change the Reboot Policy to User Ack.
- 4. Click Save Changes.
- 5. Click OK to accept the changes.

# Configure vNIC and vHBA Template

We created two vNIC template for Public Network and Private Network Traffic. We will use these vNIC Templates during the creation of the Service Profile later in this section.

# Create Public vNIC Template

To create vNIC (virtual network interface card) template for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Select Policies > root > vNIC Templates > right-click to vNIC Template and Select "Create vNIC Template"
- 3. Enter ORA-vNIC-A as the vNIC template name and keep Fabric A selected.
- 4. Select the Enable Failover checkbox for high availability of the vNIC.
- 5. Select Template Type as Updating Template.
- 6. Under VLANs, select the checkboxes default and Public\_Traffic and set Native-VLAN as the Public\_Traffic.
- 7. Keep MTU value 1500 for Public Network Traffic.
- 8. In the MAC Pool list, select ORA-MAC-A.
- 9. Click OK to create the vNIC template as shown below:

cisco.	UCS Manager		
æ	All	LAN / Policies / root / vNIC Templates / vNIC Template ORA-vi	NIC-A
8	▼ LAN ^	General VLANs Faults Events VLAN Groups	
	LAN Cloud	Antione	Droportion
몲	<ul> <li>Appliances</li> </ul>	Acuons	Properties
	<ul> <li>Internal LAN</li> </ul>	Modify VLANs	Name : ORA-vNIC-A
1	<ul> <li>Policies</li> </ul>	Modify VLAN Groups	Description :
	<ul> <li>Appliances</li> </ul>	Delete	Owner : Local
	LAN Cloud	Show Policy Usage	Fabric ID :
	▼ root ()	Use Global	Redundancy
	Default vNIC Behavior		
	Flow Control Policies		Redundancy Type : No Redundancy O Primary Template O Secondary Template
	Dynamic vNIC Connection Policie:		Target
	LACP Policies		Adapter
40	Link Dretected Delice		VM
	Multicast Dalision		
	Network Control Policies		
	OoS Policies		
	Threshold Policies		
	<ul> <li>VMO Connection Policies</li> </ul>		
	<ul> <li>usNIC Connection Policies</li> </ul>		
	✓ vNIC Templates		
	vNIC Template ORA-vNIC-A		
	vNIC Template ORA-vNIC-B		Template Type
	<ul> <li>Sub-Organizations</li> </ul>		
	▼ Pools		CDN Source : VNIC Name User Defined
	▼ root 🕚		MTU : 1500
	<ul> <li>IP Pools</li> </ul>		Policies
	<ul> <li>MAC Pools</li> </ul>		MAC Pool : ORA-MAC-A(246/256) V
	<ul> <li>Sub-Organizations</li> </ul>		
	<ul> <li>Traffic Monitoring Sessions</li> </ul>		QoS Policy : <pre>cnot set&gt; *</pre>
	<ul> <li>Fabric A</li> </ul>		Network Control Policy : <not set=""> •</not>
	<ul> <li>Fabric B</li> </ul>		
	<ul> <li>Netflow Monitoring</li> </ul>		Pin Group : <not set=""></not>
	<ul> <li>Flow Record Definitions</li> </ul>		Stats Threshold Policy : default •
	Flow Exporters		Connection Policies
	<ul> <li>Flow Monitors</li> </ul>		

- 10. Click OK to finish.
- 11. Create another vNIC template for Private Network Traffic.
- 12. Enter ORA-vNIC-B as the vNIC template name for Private Network Traffic.
- 13. Select the Fabric B and Enable Failover for Fabric ID options.
- 14. Select Template Type as Updating Template.
- 15. Under VLANs, select the checkboxes default and Private\_Traffic and set Native-VLAN as the Private\_Traffic.
- 16. Set MTU value to 9000 and MAC Pool as ORA-MAC-B.
- 17. Click OK to create the vNIC template as shown below:

cisco.	UCS Manager	
æ	All	LAN / Policies / root / vNIC Templates / vNIC Template ORA-vNIC-B
8	- LAN	Generali VLANS FAUITS EVENTS VLAN GROUPS
	LAN Cloud	Actions Properties
몲	<ul> <li>Appliances</li> </ul>	
	<ul> <li>Internal LAN</li> </ul>	Modify VLANs Name : ORA-vNIC-B
	▼ Policies	Modify VLAN Groups Description :
	<ul> <li>Appliances</li> </ul>	Delete Owner : Local
	<ul> <li>LAN Cloud</li> </ul>	Show Policy Usage Eabric ID · C Fabric A  Fabric B  Fabric B  Fabric B
	🔻 root 🕚	Use Global Redundancy
=	Default vNIC Behavior	
	<ul> <li>Flow Control Policies</li> </ul>	Redundancy Type :      No Redundancy Oprimary Template Secondary Template
	<ul> <li>Dynamic vNIC Connection Policie:</li> </ul>	Terrot
	<ul> <li>LACP Policies</li> </ul>	a get Adapter
20	<ul> <li>LAN Connectivity Policies</li> </ul>	VM
	<ul> <li>Link Protocol Policy</li> </ul>	
	<ul> <li>Multicast Policies</li> </ul>	
	<ul> <li>Network Control Policies</li> </ul>	
	<ul> <li>QoS Policies</li> </ul>	
	<ul> <li>Threshold Policies</li> </ul>	
	<ul> <li>VMQ Connection Policies</li> </ul>	
	<ul> <li>usNIC Connection Policies</li> </ul>	
	<ul> <li>vNIC Templates</li> </ul>	
	vNIC Template ORA-vNIC-A	
	vNIC Template ORA-vNIC-B	Temolate Type : O Initial Temolate O Updating Temolate
	<ul> <li>Sub-Organizations</li> </ul>	
	▼ Pools	CDN Source : • VNIC Name User Denned
	• root 🕚	MTU : 9000
	<ul> <li>IP Pools</li> </ul>	Policies
	<ul> <li>MAC Pools</li> </ul>	MAC Pool :: ORA-MAC-B(246/256) V
	<ul> <li>Sub-Organizations</li> </ul>	
	Traffic Monitoring Sessions	QoS Policy : <pre><not set=""> •</not></pre>
	Fabric A	Network Control Policy
	<ul> <li>Fabric B</li> </ul>	Herman Control Folicy - <not set=""> Y</not>
	<ul> <li>Netflow Monitoring</li> </ul>	Pin Group : <a href="https://www.endline.com">received and the second se</a>
	Flow Record Definitions	Stats Threshold Policy : default +
	<ul> <li>Flow Exporters</li> </ul>	unaut Public View
	<ul> <li>Flow Monitors</li> </ul>	connection Policies

## Create Storage vHBA Template

To create multiple virtual host bus adapter (vHBA) templates for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the SAN tab in the navigation pane.
- 2. Select Policies > root > right-click vHBA Templates > Select "Create vHBA Template" to create vHBAs.
- 3. Enter name as ORA-HBA-A and keep Fabric A selected.
- 4. Select VSAN as ORA-VSAN-A and template type to Updating Template.
- 5. Select WWPN Pool as Oracle-WWPN-A from the drop-down list as shown below.

Name :	ORA-HBA-A	
Description :		
Fabric ID :	● A ○ B	
Redundancy		
Redundancy Type	: No Redundancy O Primary Template O Secondary Template	
Select VSAN :	ORA-VSAN-A 💌 Create VSAN	
Template Type :	Initial Template  Updating Template	
Max Data Field Size :	2048	
WWPN Pool :	ORA-WWPN-A(256/256) 🔻	
QoS Policy :	<not set=""> V</not>	
Pin Group :	<not set=""></not>	
Stats Threshold Policy :	default 🔻	
	ОК Саг	icel

6. Enter name as ORA-HBA-B and select Fabric B. Select WWPN Pool for Oracle-HBA-B as "Oracle-WWPN-B" as shown below:

For this solution, we created two vHBA as Oracle-HBA-A and Oracle-HBA-B.

root / uUDA Tomplaton		(
Create vHBA	Template	? ×
Name :	ORA-HBA-B	
Description :		
Fabric ID :	⊖ A ⊛ B	
Redundancy		
Redundancy Type	: No Redundancy O Primary Template O Secondary Template	
Select VSAN :	ORA-VSAN-B Create VSAN	
Template Type :	O Initial Template  Updating Template	
Max Data Field Size :	2048	
WWPN Pool :	ORA-WWPN-B(256/256) ▼	
QoS Policy :	<not set=""> V</not>	
Pin Group :	<not set=""></not>	
Stats Threshold Policy :	default 🔻	
	ОК	Cancel

# Create Server Boot Policy for SAN Boot

All Oracle nodes were set to boot from SAN for this Cisco Validated Design as part of the Service Profile template. The benefits of booting from SAN are numerous; disaster recovery, lower cooling and power requirements for each server since a local drive is not required, and better performance, to name just a few.

We strongly recommend to use "Boot from SAN" to realize the full benefits of Cisco UCS stateless computing feature, such as service profile mobility.

This process applies to a Cisco UCS environment in which the storage SAN ports are configured in the following section.

A Local disk configuration for the Cisco UCS is necessary if the servers in the environments have a local disk.

To configure Local disk policy, complete the following steps:

- 1. Go to tab Servers > Policies > root > right-click Local Disk Configuration Policy > Enter "SAN-Boot" as the local disk configuration policy name and change the mode to "No Local Storage."
- 2. Click OK to create the policy as shown in the screenshot below:

Create Local Disk	Configuration Policy	? ×
Name :	SAN-Boot	
Description :		
Mode :	No Local Storage	
FlexFlash		
FlexFlash State :	Disable      Enable	
If FlexFlash State is disabled, SD Please ensure SD cards are not in	cards will become unavailable immediately. use before disabling the FlexFlash State.	
FlexFlash RAID Reporting State :	Disable      Enable	
	ОК С	ancel

As shown in the screenshot below, the Pure Storage FlashArray have eight active FC connections that go to the Cisco MDS switches. Four FC ports are connected to Cisco MDS-A and the other four FC ports are connected to Cisco MDS-B Switches. All FC ports are 16 Gb/s. The SAN Ports CT0.FC0, CT0.FC6, of Pure Storage FlashArray Controller 0 are connected to Cisco MDS Switch A and CT0.FC1, CT0.FC7 are connected to Cisco MDS Switch B. Similarly, the SAN Ports CT1.FC0, CT1.FC6, of Pure Storage FlashArray Controller 1 are connected to Cisco MDS Switch A and CT1.FC1, CT1.FC7 are connected to Cisco MDS Switch B.

# Figure 6 Pure Storage FC Ports

	Help   Terms   Log ( PURESTORAGE Welcome pureuser logged in as array_admin to flashstac								
DASHBOARD	STORAGE PROT	TECTION ANALYSIS SYSTEM	MESSAGES					Search Hosts	and Volumes Q
System Health	Target Po	rts							
Configuration	PORT	NAME	SPEED	FAILOVER	PORT	NAME		SPEED	FAILOVER
Connected Arrays	CT0.FC0	52:4A:93:7B:25:8B:4D:00	16 Gb/s		CT1.FC0	w 52:4A:93:7B:25:8B:4D:10		16 Gb/s	
connected Arrays	CT0.FC1	52:4A:93:7B:25:8B:4D:01	16 Gb/s		CT1.FC1	w 52:4A:93:7B:25:8B:4D:11		16 Gb/s	
Connections	CT0.FC2	52:4A:93:7B:25:8B:4D:02	0 b/s		CT1.FC2	52:4A:93:7B:25:8B:4D:12		0 b/s	
Host Connections	CT0.FC3	52:4A:93:7B:25:8B:4D:03	0 b/s		CT1.FC3	52:4A:93:7B:25:8B:4D:13		0 b/s	
Target Ports	CT0.FC6	52:4A:93:7B:25:8B:4D:06	16 Gb/s		CT1.FC6	w 52:4A:93:7B:25:8B:4D:16		16 Gb/s	
Users	CT0.FC7	52:4A:93:7B:25:8B:4D:07	16 Gb/s		CT1.FC7	52:4A:93:7B:25:8B:4D:17		16 Gb/s	
Plugins									
Apps									

#### Create SAN Policy A

The SAN-A boot policy configures the SAN Primary's primary-target to be port CT0.FC0 on the Pure Storage cluster and SAN Primary's secondary-target to be port CT1.FC0 on the Pure Storage cluster. Similarly, the SAN Secondary's primary-target should be port CT1.FC1 on the Pure Storage cluster and SAN Secondary's secondary's secondary target should be port CT0.FC1 on the Pure Storage cluster.

Log into the storage controller and verify all the port information is correct. This information can be found in the Pure Storage GUI under System > Connections > Target Ports.

You have to create SAN Primary (hba0) and SAN Secondary (hba1) in SAN-A Boot Policy by entering WWPN of Pure Storage FC Ports as detailed in the following section.

To create Boot Policies for the Cisco UCS environments, complete the following steps:

- 1. Go to Cisco UCS Manager and then go to Servers > Policies > root > Boot Policies.
- 2. Right-click and select Create Boot Policy. Enter SAN-A as the name of the boot policy as shown below:

Create Boot Policy		? ×
Name : SAN-7	Α	
Description :		
Reboot on Boot Order Change :		
Enforce vNIC/vHBA/iSCSI Name :		
Boot Mode : 💽 Leg	acy 🔿 Uefi	
WARNINGS: The type (primary/secondary) does not indic The effective order of boot devices within the If Enforce vNIC/vHBA/iSCSI Name is select If it is not selected, the vNICs/vHBAs are selected.	ate a boot order presence. e same device class (LAN/Storage/iSCSI) is determined by PCIe bus scan order. ed and the vNIC/vHBA/iSCSI does not exist, a config error will be reported. ected if they exist, otherwise the vNIC/vHBA with the lowest PCIe bus scan order is used.	
<ul> <li>Local Devices</li> </ul>	Boot Order	
	+ - 🏷 Advanced Filter 🔺 Export 🚔 Print	¢ ^
(+) VNICS	Name Order • vNIC/vH Type WWN LUN Na Slot Nu Boot Na Boot Path	Descript
⊕ vHBAs	No data available	
⊕ CIMC Mounted vMedia		
(+) EFI Shell		
	🕇 Move Up 🦊 Move Down 💼 Delete	~
	ОК	Cancel

3. Expand the Local Devices drop-down menu and Choose Add CD/DVD. Expand the vHBAs drop-down list and Choose Add SAN Boot.

The SAN boot paths and targets will include primary and secondary options in order to maximize resiliency and number of paths.

4. In the Add SAN Boot dialog box, select Type as "Primary" and name vHBA as "hba0". Click OK to add SAN Boot.

Add SAN Boot	? ×
vHBA : hba0	
Type : Primary O Secondary O Any	
OK Can	el

5. Select add SAN Boot Target to enter WWPN address of storage port. Keep 1 as the value for Boot Target LUN. Enter the WWPN for FC port CT0.FC0 of Pure Storage and add SAN Boot Primary Target.

Add SAN Bo	? ×	
Boot Target LUN :	1	
Boot Target WWPN :	52:4A:93:7B:25:8B:4D:00	
Type :	Primary      Secondary	
	ОК	Cancel

6. Add secondary SAN Boot target into same hba0, enter the boot target LUN as 1 and WWPN for FC port CT1.FC0 of Pure Storage, and add SAN Boot Secondary Target.

Add SAN Bo	? ×	
Boot Target LUN :	1	
Boot Target WWPN :	52:4A:93:7B:25:8B:4D:10	
Type :	Primary  Secondary	
		-
	ок	Cancel

7. From the vHBA drop-down menu and choose Add SAN Boot. In the Add SAN Boot dialog box, enter "hba1" in the vHBA field. Click OK to SAN Boot, then choose Add SAN Boot Target.

Add SAN Boot	? ×
vHBA : hba1	
Type : Primary  Secondary  Any	
ОК Саг	ncel

8. Keep 1 as the value for the Boot Target LUN. Enter the WWPN for FC port CT1.FC1 of Pure Storage and add SAN Boot Primary Target.

Add SAN Bo	? ×	
Boot Target LUN :	1	
Boot Target WWPN :	52:4A:93:7B:25:8B:4D:11	
Type :	Primary      Secondary	
	ок	Cancel

9. Add a secondary SAN Boot target into same hba1 and enter the boot target LUN as 1 and WWPN for FC port CT0.FC1 of Pure Storage and add SAN Boot Secondary Target.

Add SAN Boot	Target ? ×
Boot Target LUN : 1	
Boot Target WWPN : 52	4A:93:7B:25:8B:4D:01
Type : F	Primary   Secondary
	OK Cancel

10. After creating the FC boot policies, you can view the boot order in the Cisco UCS Manager GUI. To view the boot order, navigate to Servers > Policies > Boot Policies. Click Boot Policy SAN-Boot-A to view the boot order in the right pane of the Cisco UCS Manager as shown below:

Create Boot Policy						? >
Name : SAN	-A					
Description :						
Reboot on Boot Order Change :						
Enforce vNIC/vHBA/iSCSI Name :						
Boot Mode : O Le	egacy 🔿 Uefi					
The type (primary/secondary) does not inn The effective order of boot devices within If Enforce vNIC/vHBA/iSCSI Name is sele If it is not selected, the vNICs/vHBAs are s	licate a boot order presence. the same device class (LAN/Storage/iSCSI) is cted and the vNIC/vHBA/iSCSI does not exist, elected if they exist, otherwise the vNIC/vHBA	determined by a config error with the lowes	PCIe bus scan o will be reported. It PCIe bus scan o	rder. order is used.		
+ Local Devices	Boot Order					<u>ہ</u> بہ
⊕ vNICs	+ - Madvanced Pilter + Export	vNIC/vH	Туре	WWN	1	÷.
⊖ vHBAs	SAN Primary	nbau	Primary			^
	SAN Target Primary		Primary	52:4A:93:7B:25:8B:4D:00	1	
Add SAN Boot	SAN Target Secondary		Secondary	52:4A:93:7B:25:8B:4D:10		
Add SAN Boot Target	▼ SAN Secondary	hba1	Secondary			
	SAN Target Primary		Primary	52:4A:93:7B:25:8B:4D:11		
⊕ iSCSI vNICs	SAN Target Secondary		Secondary	52:4A:93:7B:25:8B:4D:01	÷	~
$\oplus$ CIMC Mounted vMedia		Move Up	Move Down	Delete		~
+ EFI Shell						
				ок	C	ancel

# Create SAN Policy B

The SAN-B boot policy configures the SAN Primary's primary-target to be port CT0.FC6 on the Pure Storage cluster and SAN Primary's secondary-target to be port CT1.FC6 on the Pure Storage cluster. Similarly, the SAN Secondary's primary-target should be port CT1.FC7 on the Pure Storage cluster and SAN Secondary's secondary target should be port CT0.FC7 on the Pure Storage cluster.

Log into the storage controller and verify all the port information is correct. This information can be found in the Pure Storage GUI under System > Connections > Target Ports.

You have to create SAN Primary (hba0) and SAN Secondary (hba1) in SAN-B Boot Policy by entering WWPN of Pure Storage FC Ports as explained in the following section.

To create boot policies for the Cisco UCS environments, complete the following steps:

- 1. Go to UCS Manager and then go to tab Servers > Policies > root > Boot Policies.
- 2. Right-click and select Create Boot Policy. Enter SAN-B as the name of the boot policy as shown in the figure below:

么

Create Boot Policy		? ×
Name :	SAN-B	^
Description :		
Reboot on Boot Order Change :		
Enforce vNIC/vHBA/iSCSI Name :		
Boot Mode :	● Legacy ◯ Uefi	
WARNINGS: The type (primary/secondary) does i The effective order of boot devices i If Enforce vNIC/vHBA/iSCSI Name If it is not selected, the vNICs/vHBAs	not indicate a boot order presence. within the same device class (LAN/Storage/iSCSI) is determined by PCIe bus scan order. is selected and the vNIC/vHBA/iSCSI does not exist, a config error will be reported. are selected if they exist, otherwise the vNIC/vHBA with the lowest PCIe bus scan order is used.	
Local Devices	Boot Order	
⊕ vNICs	+ - Ty Advanced Filter ↑ Export  Print Name Ord ↑ vNIC/v Type WWN LUN N Slot N Boot N Boot P Desc	<b>☆</b> ^
⊖ vHBAs	CD/DVD 1	
Add SAN Boot Add SAN Boot Target		
⊕ iSCSI vNICs		
① CIMC Mounted vMedia	↑ Move Up ↓ Move Down  Delete	~
EFI Shell		~
	ОК С	ancel

3. Expand the Local Devices drop-down list and Choose Add CD/DVD. Expand the vHBAs drop-down list and choose Add SAN Boot.

The SAN boot paths and targets will include primary and secondary options in order to maximize resiliency and number of paths.

4. In the Add SAN Boot dialog box, select Type as "Primary" and name vHBA as "hba0". Click OK to add SAN Boot.

Add SAN Boot	? ×
vHBA : hba0	
Type : OPrimary OSecondary OAny	
ОК	Cancel

5. Select add SAN Boot Target to enter WWPN address of storage port. Keep 1 as the value for Boot Target LUN. Enter the WWPN for FC port CT0.FC6 of Pure Storage and add SAN Boot Primary Target.

Add SAN Bo	ot Target	? ×
Boot Target LUN :	1	
Boot Target WWPN :	52:4A:93:7B:25:8B:4D:06	
Type :	Primary O Secondary	
	ок	Cancel

6. Add the secondary SAN Boot target into the same hba0; enter boot target LUN as 1 and WWPN for FC port CT1.FC6 of Pure Storage, and add SAN Boot Secondary Target.

Add SAN Bo	? ×	
Boot Target LUN :	1	
Boot Target WWPN :	52:4A:93:7B:25:8B:4D:16	
Type :	Primary  Secondary	
	ОК	Cancel

7. From the vHBA drop-down list, choose Add SAN Boot. In the Add SAN Boot dialog box, enter "hba1" in the vHBA field. Click OK to SAN Boot, then choose Add SAN Boot Target.

Add SAN Boot	? ×
vHBA : hba1	
Type : Primary  Secondary  Any	
ОК Са	ncel

8. Keep 1 as the value for Boot Target LUN. Enter the WWPN for FC port CT1.FC7 of Pure Storage and Add SAN Boot Primary Target.

Add SAN Boot Target	? ×
Boot Target LUN : 1	
Boot Target WWPN : 52:4A:93:7B:25:8B:4D:17	
Type : OPrimary OSecondary	
ОКС	ancel

9. Add secondary SAN Boot target into same hba1 and enter boot target LUN as 1 and WWPN for FC port CT0.FC7 of Pure Storage and add SAN Boot Secondary Target.

10. After creating the FC boot policies, you can view the boot order in the Cisco UCS Manager GUI. To view the boot order, navigate to Servers > Policies > Boot Policies. Click Boot Policy SAN-Boot-A to view the boot order in the right pane of the Cisco UCS Manager as shown below:

Create Boot Policy							?	$\times$
Name : SAN-	В							^
Description :								
Reboot on Boot Order Change :								
Enforce vNIC/vHBA/iSCSI Name :								
Boot Mode : O Leg	acy 🔾 Uefi							
WARNINGS: The type (primary/secondary) does not india The effective order of boot devices within th If Enforce vNIC/vHBA/iSCSI Name is select If it is not selected, the vNICs/vHBAs are set (+) Local Devices	cate a boot order presence. le same device class (LAN/Storage/iSCSI) in ted and the vNIC/vHBA/iSCSI does not exis lected if they exist, otherwise the vNIC/vHB, Boot Order	s determine t, a config e A with the I	ed by PCIe bus error will be rep owest PCIe bu	scan order. ported. s scan order is used.				
	+ - 🏹 Advanced Filter 🔺 Export	📥 Print				¢	F ^	
⊕ vNICs	Name	vNIC/v	Туре	WWN	LL SI BC	Bc De		
() vHBAs	SAN Primary	noau	Primary				^	
	SAN Target Primary		Primary	52:4A:93:7B:25:8B:4D:06	1			
Add SAN Boot	SAN Target Secondary		Secondary	52:4A:93:7B:25:8B:4D:16	1			
Add SAN Boot Target	SAN Secondary	hba1	Secondary					
	SAN Target Primary		Primary	52:4A:93:7B:25:8B:4D:17	1			
⊕ iSCSI vNICs	SAN Target Secondary		Secondary	52:4A:93:7B:25:8B:4D:07	1		•	
① CIMC Mounted vMedia		1 Move U	Jp 👎 Move 🛛	Down 🛍 Delete			~	
⊕ EFI Shell								>
					ОК	Ca	ncel	)

For this solution, we created two Boot Policy as "SAN-A" and "SAN-B". For 8 Oracle RAC Nodes, you will assign first 4 Service Profiles with SAN-A to first 4 RAC nodes (oraracx1, oraracx2, oraracx3 and oraracx4) and remaining 4 Service Profiles with SAN-B to remaining 4 Oracle RAC nodes (oraracx5, oraracx6, oraracx7 and oraracx8) as explained in the following section.

# Configure and Create a Service Profile Template

Service profile templates enable policy based server management that helps ensure consistent server resource provisioning suitable to meet predefined workload needs.

You will create two Service Profile Template. First Service profile template "ORAX-1" using boot policy as "SAN-A" and second Service profile template "ORAX-2" using boot policy as "SAN-B" to utilize all the FC ports from Pure Storage for high-availability in case of any FC links go down.

You will create the first ORAX-1 as explained in the following section.

#### Create Service Profile Template

To create a service profile template, complete the following steps:

- 1. In the Cisco UCS Manager, go to Servers > Service Profile Templates > root and right-click to "Create Service Profile Template" as shown below.
- 2. Enter the Service Profile Template name, select the UUID Pool that was created earlier, and click Next.

		Create Service Profile Template			
0	Identify Service Profile Template	You must enter a name for the service profile template and specify the template type. You can also specify how a UUID will be assigned to this template and enter a description.			
2	Storage Provisioning	Name : ORAX-1			
3	Networking	The template will be created in the following organization. Its name must be unique within this organization. Where : <b>org-root</b>			
4	SAN Connectivity	The template will be created in the following organization. Its name must be unique within this organization. Type : Initial Template  Updating Template			
5	Zoning	Specify how the UUID will be assigned to the server associated with the service generated by this template.			
6	vNIC/vHBA Placement				
0	vMedia Policy	The UUID will be assigned from the selected pool. The available/total UUIDs are displayed after the pool name.			
8	Server Boot Order				
9	Maintenance Policy	Optionally enter a description for the profile. The description can contain information about when and where the service profile should be used.			
10	Server Assignment				
1	Operational Policies				
F					
		< Prev Next > Finish Cancel			

3. Select Local Disk Configuration Policy to SAN-Boot as No Local Storage.

		Create Service Profile Template	? ×		
0	Identify Service Profile	Optionally specify or create a Storage Profile, and select a local disk configuration policy.			
	Template	Specific Storage Profile Storage Profile Policy Local Disk Configuration Policy			
2	Storage Provisioning				
3	Networking	Note Notes Office Office			
4	SAN Connectivity	Create Local Disk Configuration Policy Mode Protect Configuration Policy Protect Configuration : Yes			
5	Zoning	If <b>Protect Configuration</b> is set, the local disk configuration is preserved if the service profile is disassociated with the server. In that case, a configuration error will be raised when a new service profile is associated with			
6	vNIC/vHBA Placement	that server if the local disk configuration in that profile is different.			
9	vMedia Policy	FlexFlash State : Disable			
8	Server Boot Order	In Frex read is blacked, so cards will become unavailable immediately. Please ensure SD cards are not in use before disabling the FlexFlash State.			
9	Maintenance Policy	FlexFlash RAID Reporting State : Disable			
10	Server Assignment				
U	Operational Policies				
F					
		< Prev Next > Finish Can	icel		

- 4. In the networking window, select "Expert" and click "Add" to create vNICs. Add one or more vNICs that the server should use to connect to the LAN.
- 5. Now there are two vNIC in the create vNIC menu. You have given name to first vNIC as "eth0" and second vNIC as "eth1."
- 6. As shown below, select vNIC Template as Oracle-vNIC-A and Adapter Policy as ORA\_Linux\_Tuning which was created earlier for vNIC "eth0".

		Create vNIC		? ×	? ×
1	Identify Templat	Name : eth0 Use vNIC Template :			
2	Storage	Redundancy Pair :	Peer Name :		
3	Network	vNIC Template : ORA-vNIC-A V Adapter Performance Profile	Create VNIC Template	ý -	
4	SAN Co	Adapter Policy : ORA_Linux_Tuning V	Create Ethernet Adapter Policy		
5	Zoning				^
6	vNIC/vH				
7	vMedia				
8	Server E				
9	Mainten				~
10	Server A				
U	Operatio				
				OK Cancel	Cancel

7. Similarly, as shown below, select vNIC Template as Oracle-vNIC-B and Adapter Policy as ORA\_Linux\_Tuning for vNIC "eth1".

			24.2	
				Templat
		Peer Name :	Redundancy Pair :	Storage
	Ç	Create vNIC Template	vNIC Template : ORA-vNIC-B ▼	Network
	0	Create Ethernet Adapter Policy	Adapter Policy : ORA_Linux_Tuning	SAN Co
				Zoning
				VNIC/vH
				vMedia
				Server E
				Mainten
				Server A
				Operatio
Cance	OK Cancel			

As shown above, eth0 and eth1 vNICs are created so that Servers can connect to the LAN.

		Create Service F	Profile Template			? ×
0	Identify Service Profile	Optionally specify LAN confi	guration information.			
2	Template Storage Provisioning	Dynamic vNIC Connection Pol	icy: Select a Policy to use (no D	tynamic vNIC Policy by default) 🔻		
3	Networking		Create Dynamic vNIC Connecti	on Policy		
4	SAN Connectivity	How would you like to configu	re LAN connectivity? NICs () Use Connectivity Policy			
5	Zoning	Click Add to specify one or m	ore vNICs that the server should MAC Address	use to connect to the LAN.	Native VI AN	^
6	vNIC/vHBA Placement	vNIC eth1	Derived	derived		
0	vMedia Policy	vNIC eth0	Derived	derived		
8	Server Boot Order					
9	Maintenance Policy					
10	Server Assignment	⊕ iSCSI vNICs	<u></u>	Delete 🕀 Add 🕕 Modify		¥
1	Operational Policies					
				< Prev	Next > Finish	Cancel

- 8. Once vNICs are created, you need to create vHBAs. Click Next.
- 9. In the SAN Connectivity menu, select "Expert" to configure as SAN connectivity. Select WWNN (World Wide Node Name) pool, which we created earlier. Click on "Add" to add vHBAs as shown below. The following four HBA were created:
  - Hba0 using vHBA Template Oracle-HBA-A
  - Hba1 using vHBA Template Oracle-HBA-B
  - Hba2 using vHBA Template Oracle-HBA-A
  - Hba3 using vHBA Template Oracle-HBA-B

Figure	7	VHBA0
เหน่าธ		

Create vHBA	<u>^</u>	? ×
Name : hba0		
Use vHBA Template :		
Redundancy Pair :	Peer Name :	
vHBA Template : ORA-HBA-A 🔻	Create vHBA Template	
Adapter Performance Profile		
Adapter Policy : Linux 🔻	Create Fibre Channel Adapter Policy	
,		
	ОК С	ancel

# Figure 8 vHBA1

Create vHBA		• ×
Name : hba1		
Use vHBA Template : 🗹		
Redundancy Pair :	Peer Name :	
vHBA Template : ORA-HBA-B 🔻	Create vHBA Template	
Adapter Performance Profile		
Adapter Policy : Linux 🔻	Create Fibre Channel Adapter Policy	
2		
2		
c		
3		
	ОК	Cancel

		Create Service Prof	ile Template	?
1	Identify Service Profile Template	Optionally specify disk policies and	I SAN configuration information.	
2	Storage Provisioning			
3	Networking	WWNN Assignment:	ORA-WWNN-Pool(256/256)	
4	SAN Connectivity	The WWNN will be assigned The available/total WWNNs a	from the selected pool. re displayed after the pool name.	
5	Zoning	۲	>	
6	vNIC/vHBA Placement			
7	vMedia Policy			
8	Server Boot Order	Name	WWPN	
9	Maintenance Policy	▶ vHBA hba3	Derived	
10	Server Assignment	▶ vHBA hba2	Derived Derived	
	Operational Policies	<ul><li>vHBA hba1</li><li>vHBA hba0</li></ul>	Derived	
	operational Policies	,		
			🗓 Delete 🕂 Add 🕕 Modify	
			< Prev Next > Finish C	Cance

# Skip zoning; for this Oracle RAC Configuration, the Cisco MDS 9148S is used for zoning.

10. Select default option as Let System Perform Placement in the Placement Selection menu.

11. For the Server Boot Policy, select "SAN-A" as Boot Policy which you created earlier.

		Create Service Profile	e Template			? ×
	Identify Service Profile	Optionally specify the boot policy for t	this service profile terr	plate.		
	Template	Select a boot policy.				^
2	Storage Provisioning	Boot Policy: SAN-A 🔻		Create Boot Policy	^	
3	Networking	Name : S. Description :	AN-A		~	
4	SAN Connectivity	Reboot on Boot Order Change : N Enforce vNIC/vHBA/iSCSI Name : Y	lo 'es			
5	Zoning	Boot Mode : Lo WARNINGS:	egacy			
6	vNIC/vHBA Placement	The type (primary/secondary) does no The effective order of boot devices wi If Enforce vNIC/vHBA/iSCSI Name is	ot indicate a boot orde ithin the same device selected and the vNI	r presence. class (LAN/Storage/iSCSI) is determine C/vHBA/iSCSI does not exist, a config e	d by PCIe bus scan order. error will be reported.	
0	vMedia Policy	If it is not selected, the vNICs/vHBAs a Boot Order	are selected if they ex	st, otherwise the vNIC/vHBA with the lo	west PCIe bus scan order is used	d.
8	Server Boot Order	+ - Ty Advanced Filter ↑ Exp	ort 🖶 Print	WWN	I Slo Bor Br	C Det
9	Maintenance Policy	CD/DVD	1			*
10	Server Assignment	<del>▼</del> San	2			
		SAN Primary	hba Primar			
11	Operational Policies	SAN Target Primary	Primar	52:4A:93:7B:25:8B:	4D:00 1	
		SAN Target Secondary	Secon	52:4A:93:7B:25:8B:	40:10	<b>,</b>
		Create ISCSI vNIC Set ISC	bba Secon CSI Boot Parameters	Set Uefi Boot Parameters		~
				< Prev	Next > Finish	Cancel

- 12. The remaining maintenance and assignment policies were left as default in the configuration. However, they may vary from site-to-site depending on workloads, best practices, and policies.
- 13. Click Next and then click Finish to create service profile template as "ORAX-1." This service profile template is be used to create first 4 service profiles for oracle RAC node 1 to 4.
- 14. Create another service profile template as "ORAX-2". This ORAX-2 service profile template will be used to create remaining 4 service profiles for oracle RAC node 5 to 8.

You can achieve this quickly by cloning the template. For this solution, we have cloned service profile template ORAX-1 to ORAX-2.

Create Clone From ORAX-1		$\times$
Clone Name	: ORAX-2	
Org	: root	
	OK Cancel Help	)

15. In this service profile template ORAX-2, you have modified Boot Policy as "SAN-B" to use all the remaining FC paths of storage for high availability.

oot Policy:		SAN-B			•					
	C	reate Boo	t Policy							
ime	: SAN-B									
scription	:									
boot on Boot Order Change	: No									
force vNIC/vHBA/iSCSI Name	: Yes									
ot Mode	: Legacy									
RNINGS: type (primary/secondary) dou effective order of boot device tforce vNIC/vHBA/iSCSI Nan is not selected, the vNICs/vHB t Order	es not indicat s within the le is selecter As are select	ate a boot same development and the cted if the	order presen vice class (L4 vNIC/vHBA/i v exist, other	ce. N/Storage/iS/ SCSI does no wise the vNIC	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus	scan order. ported. s scan order is us	sed.			
RNINGS: type (primary/secondary) doe effective order of boot device iforce vNIC/vHBA/iSCSI Nan is not selected, the vNICs/vHB it Order Advanced Filter me	es not indicat s within the is selected As are select Export	e a boot same dev ed and the cted if the Print	order presen vice class (L4 vNIC/vHBA/i ey exist, other	ce. N/Storage/iSi SCSI does no wise the vNIC	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus	scan order. ported. s scan order is us	Slot Num	Root Name	Root Dath	Description
RNINGS: type (primary/secondary) doi effective order of boot device force vNIC/vHBA/iSCSI Nan is not selected, the vNICs/vHB t Order Advanced Filter	es not indicat s within the e is selecter As are select Export	te a boot of a same deved and the cted if the cted if the Print	order presen vice class (L4 vNIC/vHBA/i ey exist, other vNIC/vH	ce. IN/Storage/iSi SCSI does no wise the vNIC	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus	scan order. ported. s scan order is us LUN Name	sed. Slot Num	Boot Name	Boot Path	Description
RNINGS: type (primary/secondary) doi effective order of boot device inforce vNIC/vHBA/iSCSI Nan is not selected, the vNICs/vHB to Order — Ty Advanced Filter me y SAN Primary SAN Target Primary	s not indicat s within the is selected As are select Export	ete a boot i e same dev ed and the cted if the Print der •	order presen vice class (L4 vNIC/vHBA/i y exist, other vNIC/vH hba0	ce. IN/Storage/iSI SCSI does no wise the vNIC	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus WWN	scan order. ported. s scan order is us LUN Name	sed. Slot Num	Boot Name	Boot Path	Cescription
RNINGS: type (primary/secondary) doe effective order of boot device force vNIC/vHBA/iSCSI Nam is not selected, the vNICs/vHB et Order — Te Advanced Filter me SAN Primary SAN Target Primary	s not indical s within the is selecter (As are selecter (As are selecter) (Ord	ete a boot i same dev ed and the ccted if the Print der	order presen vice class (L/ vNIC/vHBA/i ey exist, other vNIC/vH hba0	ce. N/Storage/iSI SCSI does no wise the vNIC Type Primary Primary	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus /vWN 52:4A:93:7B:25:8B:4D:06	scan order. ported. s scan order is us LUN Name	sed. Slot Num	Boot Name	Boot Path	Description
RNINGS: type (primary/secondary) doi effective order of boot devict force vNIC/vHBA/iSCSI Nam is not selected, the vNICs/vHB t Order — ▼ Advanced Filter ↑ me ▼ SAN Primary SAN Target Primary SAN Target Secondary	s not indicat s within the le is selecte: As are select Export	te a boot i same dev ed and the cted if the Print der	order presen vice class (L/ vNIC/vHBA/i ey exist, other vNIC/vH hba0	ce. N/Storage/iSi SCSI does no wise the vNIC Type Primary Primary Secondary	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus www 52:4A:93:7B:25:8B:4D:06 52:4A:93:7B:25:8B:4D:16	scan order. ported. s scan order is us LUN Name	Slot Num	Boot Name	Boot Path	Description
RNINGS: type (primary/secondary) doi effective order of boot device force vNIC/vHBA/iSCSI Nam is not selected, the vNICs/vHB et Order Advanced Filter SAN Primary SAN Target Primary SAN Target Secondary SAN Secondary	s not indical s within the le is selecter As are select Export	te a boot i same dev d and the cted if the Print der	vNIC/vH hba0	ce. N/Storage/iSi SCSI does no wise the vNIC Type Primary Primary Secondary Secondary	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus www 52:4A:93:7B:25:8B:4D:06 52:4A:93:7B:25:8B:4D:16	scan order. ported. s scan order is us LUN Name	Slot Num	Boot Name	Boot Path	Description
RNINGS: type (primary/secondary) doi effective order of boot device force vNIC/vHBA/iSCSI Nan is not selected, the vNICs/vHB to Order	s not indicat s within the le is selecter As are select Export	te a boot 4 same devid and the cted if the	order presen vice class (L/ vNIC/vHBA/i ey exist, other vNIC/vH hba0 hba1	ce. N/Storage/iSi SCSI does no wise the vNIC Type Primary Primary Secondary Secondary Primary	CSI) is determined by PCle bus t exist, a config error will be rep /vHBA with the lowest PCle bus www 52:4A:93:7B:25:8B:4D:06 52:4A:93:7B:25:8B:4D:16 52:4A:93:7B:25:8B:4D:17	scan order. ported. s scan order is us LUN Name 1 1 1	Slot Num	Boot Name	Boot Path	Description
RNINGS: type (primary/secondary) doi effective order of boot device force vNIC/vHBA/iSCSI Nan is not selected, the vNICs/vHf t Order — Y Advanced Filter SAN Target Primary SAN Target Primary SAN Secondary SAN Target Primary SAN Target Primary SAN Target Primary SAN Target Secondary	s not indicat s within the le is selecter As are select Export	te a boot i same deve ed and the cted if the Print der	vNIC/vH vNIC/vHBA/i vNIC/vHBA/i vNIC/vH hba0 hba1	ce. N/Storage/iSi SCSI does no wise the vNIC Type Primary Primary Secondary Secondary Primary Secondary Secondary	CSI) is determined by PCIe bus t exist, a config error will be rep /vHBA with the lowest PCIe bus /vWN 52:4A:93:7B:25:8B:4D:06 52:4A:93:7B:25:8B:4D:16 52:4A:93:7B:25:8B:4D:17 52:4A:93:7B:25:8B:4D:07	scan order. ported. s scan order is us LUN Name 1 1 1 1	Slot Num	Boot Name	Boot Path	Description

You have now created Service profile template as "ORAX-1" and "ORAX-2" with each having four vHBAs and two vNICs.

# Create Service Profiles from Template and Associate to Servers

## Create Service Profiles from Template

You will create eight Service profiles for eight Oracle RAC nodes as explained in the following sections.

For the first four Oracle RAC Nodes (oraracx1, oraracx2, oraracx3 and oraracx4), you will create four Service Profiles from Template "ORAX-1." The remaining four Oracle RAC Nodes (oraracx5, oraracx6, oraracx7 and oraracx8), will require creating another four Service Profiles from Template "ORAX-2".

To create first four Service Profiles from Template, complete the following steps:

- 1. Go to tab Servers > Service Profiles > root > and right-click "Create Service Profiles from Template."
- 2. Select the Service profile template as "ORAX-1" which you created earlier and name the service profile as "ORARACX."
- 3. To create four service profiles, enter "Number of Instances" as 4 as shown below. This process will create service profiles as "ORARACX1", "ORARACX2", "ORARACX3" and "ORARACX4."

Naming Prefix :	ORARACX	
Name Suffix Starting Number :	1	
Number of Instances :	4	
Service Profile Template :	ORAX-1	

4. Create remaining four Service Profiles "ORARACX5", "ORARACX6", "ORARACX7" and "ORARACX8" from Template "ORAX-2."

When the service profiles are created, associate them to the servers as described in the following section.

#### Associate Service Profiles to the Servers

To associate service profiles to the servers, complete the following steps.

- 1. Under the servers tab, select the desired service profile, and select Change Service Profile Association.
- 2. Right-click the name of service profile you want to associate with the server and select the option "Change Service Profile Association."
- 3. In the Change Service Profile Association page, from the Server Assignment drop-down list, select existing server that you would like to assign and click OK.



- 4. You will assign service profiles ORARAXC1 to ORARACX4 to Chassis 1 Servers and ORARACX5 to ORARACX8 to Chassis 2 Servers.
- 5. Repeat the same steps to associate remaining seven service profiles for the blade servers.

You have assigned "ORARACX1" to Chassis 1 Server 1, Service Profile "ORARACX2" to Chassis 1 Server 2, Service Profile "ORARACX3" to Chassis 1 Server 3 and, Service Profile "ORARACX4" to Chassis 1 Server 4.

You have assigned Service Profile "ORARACX5" to Chassis 2 Server 1, Service Profile "ORARACX6" to Chassis 2 Server 2, Service Profile "ORARACX7" to Chassis 2 Server 3 and Service Profile "ORARACX8" to Chassis 2 Server 4.

6. Make sure all the service profiles are associated as shown below:

uluilu cisco	UCS Manager					0 0	<mark>○</mark>								0	
Æ	All	Equipment /	Chassis													
8	▼ Equipment	Servers	Service Pr	rofiles Thermal	PSUs Fans CPUs In	stalled Firmware	Decommissioned	f Fault	s Event	ts						
뮮	Chassis     Chassis 1     Chassis 1	Ty Advanced	Filter 🛧 E	xport 🚔 Print PID	Model		User L Cores	Cores	Memory	Adapt	NICs	HBAs Ove	al Operability	Po 🔺	Assoc State	Profile
Ŧ	Chassis 2     Rack-Mounts     FEX	Server 1 Server 2	1	UCSB-B200-M5 UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Cisco UCS B200 M5 2 Socket	Blade Server Blade Server	44 44	44 44	524288 524288	1	2	1 † c 1 † c	K Operable	t On	Associated     Associated	org-root/ls-ORARACX1 org-root/ls-ORARACX2
Q	Servers     Eabric Interconnects	Server 3	1	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket	Blade Server	44	44	524288	1	2	• • •	K † Operable	t On	Associated	org-root/ls-ORARACX3
=	Fabric Interconnect A (subordinate)     Estric Interconnect B (oriman)	Server 4 Server 1	2	UCSB-B200-M5 UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Cisco UCS B200 M5 2 Socket	Blade Server Blade Server	44	44	524288 524288	1	2		K T Operable K T Operable	T On T On	Associated     Associated	org-root/ls-ORARACX4
	Policies     Port Auto-Discovery Policy	Server 2 Server 3	2	UCSB-B200-M5 UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Cisco UCS B200 M5 2 Socket	Blade Server Blade Server	44	44 44	524288 524288	1	2	1 1 C	K Dperable	On     On	Associated     Associated	org-root/ls-ORARACX6
J <sub>o</sub>	POLYAGO-DISCOVERY POILOY	Server 4	2	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket	Blade Server	44	44	524288	1	2	1 <b>†</b> (	K T Operable	🕈 On	Associated	org-root/ls-ORARACX8

7. As shown above, make sure all the server nodes has no major or critical fault and all are in operable state.

This completes the configuration required for Cisco UCS Manager Setup.

# Configure Cisco Nexus 9372PX-E Switches

The following sections detail the steps for the Nexus 9372PX-E switch configuration. The details of "show run" output is listed in the Appendix.

# Configure Global Settings for Cisco Nexus A and Cisco Nexus B

To set global configuration, complete the following steps on both the Nexus switches

1. Login as admin user into the Nexus Switch A and run the following commands to set global configurations and jumbo frames in QoS:

conf terminal

spanning-tree port type network default

spanning-tree port type edge bpduguard default

port-channel load-balance ethernet source-dest-port

policy-map type network-qos jumbo

class type network-qos class-default

mtu 9216

exit

class type network-qos class-fcoe

pause no-drop

mtu 2158

exit

exit

system qos

service-policy type network-qos jumbo

exit

copy run start

2. Login as admin user into the Nexus Switch B and run the same above commands to set global configurations and jumbo frames in QoS.

# Configure VLANs for Cisco Nexus A and Cisco Nexus B Switches

To create the necessary virtual local area networks (VLANs), complete the following steps on both Nexus switches.

- 1. Login as admin user into the Nexus Switch A.
- 2. Create VLAN 134 for Public Network Traffic:

PURESTG-NEXUS-A# config terminal

PURESTG-NEXUS-A(config)# VLAN 134

PURESTG-NEXUS-A(config-VLAN)# name Oracle\_Public\_Traffic

PURESTG-NEXUS-A(config-VLAN)# no shutdown

PURESTG-NEXUS-A(config-VLAN)# exit

PURESTG-NEXUS-A(config)# copy running-config startup-config

PURESTG-NEXUS-A(config)# exit

3. Create VLAN 10 for Private Network Traffic:

PURESTG-NEXUS-A# config terminal

PURESTG-NEXUS-A(config)# VLAN 10

PURESTG-NEXUS-A(config-VLAN)# name Oracle\_Private\_Traffic

PURESTG-NEXUS-A(config-VLAN)# no shutdown

PURESTG-NEXUS-A(config-VLAN)# exit

PURESTG-NEXUS-A(config)# copy running-config startup-config

PURESTG-NEXUS-A(config)# exit

4. Login as admin user into the Nexus Switch B and create VLAN 134 for Public Network Traffic and VLAN 10 for Private Network Traffic.

# Virtual Port Channel (vPC) Summary for Data and Storage Network

In the Cisco Nexus 9372PX-E switch topology, a single vPC feature is enabled to provide HA, faster convergence in the event of a failure, and greater throughput. Cisco Nexus 9372PX-E vPC configurations with the vPC domains and corresponding vPC names and IDs for Oracle Database Servers is shown below:

vPC Domain	vPC Name	vPC ID
1	Peer-Link	1
1	vPC Public	21
1	vPC Private	22

# Table 6 vPC Summary

As listed in the table above, a single vPC domain with Domain ID 1 is created across two Cisco Nexus 9372PX-E member switches to define vPC members to carry specific VLAN network traffic. In this topology, we defined a total number of 3 vPCs.

vPC ID 1 is defined as Peer link communication between two Nexus switches in Fabric A and B.

vPC IDs 21 and 22 are defined for public and private network traffic from Cisco UCS fabric interconnects.

## Create vPC Peer-Link Between the Two Nexus Switches

To create the vPC Peer-Link, complete the following steps:

## Figure 10 Nexus Switch Peer-Link

PC Domain 1	vPC Peer Link 1	
N9K-C9372PX	N9K-C9372PX	-
- 1. Login as "admin" user into the Nexus Switch A.
- For vPC 1 as Peer-link, we used interfaces 1-2 for Peer-Link. You may choose the appropriate number of ports for your needs.

To create the necessary port channels between devices, complete the following on both the Nexus Switches:

PURESTG-NEXUS-A# config terminal

PURESTG-NEXUS-A(config)#feature vpc

PURESTG-NEXUS-A(config)#feature lacp

PURESTG-NEXUS-A(config)#vpc domain 1

PURESTG-NEXUS-A(config-vpc-domain)# peer-keepalive destination 10.29.134.154 source 10.29.134.153

PURESTG-NEXUS-A(config-vpc-domain)# exit

PURESTG-NEXUS-A(config)# interface port-channel 1 PURESTG-NEXUS-A(config-if)# description VPC peer-link PURESTG-NEXUS-A(config-if)# switchport mode trunk PURESTG-NEXUS-A(config-if)# switchport trunk allowed VLAN 1,10,134 PURESTG-NEXUS-A(config-if)# spanning-tree port type network PURESTG-NEXUS-A(config-if)# vpc peer-link PURESTG-NEXUS-A(config-if)# exit

PURESTG-NEXUS-A(config)# interface Ethernet1/1 PURESTG-NEXUS-A(config-if)# description Nexus5k-B-Cluster-Interconnect PURESTG-NEXUS-A(config-if)# switchport mode trunk PURESTG-NEXUS-A(config-if)# switchport trunk allowed VLAN 1,10,134 PURESTG-NEXUS-A(config-if)# channel-group 1 mode active PURESTG-NEXUS-A(config-if)# no shutdown PURESTG-NEXUS-A(config-if)# exit

PURESTG-NEXUS-A(config)# interface Ethernet1/2 PURESTG-NEXUS-A(config-if)# description Nexus5k-B-Cluster-Interconnect PURESTG-NEXUS-A(config-if)# switchport mode trunk PURESTG-NEXUS-A(config-if)# switchport trunk allowed VLAN 1,10,134 PURESTG-NEXUS-A(config-if)# channel-group 1 mode active PURESTG-NEXUS-A(config-if)# no shutdown

PURESTG-NEXUS-A(config-if)# exit

PURESTG-NEXUS-A(config)# interface Ethernet1/15

PURESTG-NEXUS-A(config-if)# description connect to uplink switch

PURESTG-NEXUS-A(config-if)# switchport access vlan 134

PURESTG-NEXUS-A(config-if)# speed 1000

PURESTG-NEXUS-A(config-if)# no shutdown

PURESTG-NEXUS-A(config-if)# exit

PURESTG-NEXUS-A(config)# copy running-config startup-config

 Login as admin user into the Nexus Switch B and repeat the above steps to configure second nexus switch. (Note: Make sure to change peer-keepalive destination and source IP address appropriately for Nexus Switch B)

Create vPC Configuration Between Nexus 9372PX-E and Fabric Interconnects

Create and configure vPC 21 and 22 for Data network between Nexus switches and Fabric Interconnects.



### Figure 11 vPC Configuration Between Nexus Switches and Fabric Interconnects

The table below lists the vPC IDs, allowed VLAN IDs, and Ethernet uplink ports.

vPC Description	vPC ID	Fabric Interconnects Ports	Nexus Ports	Allowed VLANs
Port Channel FI-	21	FI-A Port 1/11	N9K-A Port 11	134 10
A	2.	FI-A Port 1/12	N9K-A Port 12	Note: V/I AN 10 need-
		FI-A Port 1/13	N9K-B Port 11	ed for failover
		FI-A Port 1/14	N9K-B Port 12	
Port-Channel FI-	22	FI-B Port 1/11	N9K-A Port 13	10.134
В		FI-B Port 1/12	N9K-A Port 14	Note: V/I AN 134
		FI-B Port 1/13	N9K-B Port 13	needed for failover
		FI-B Port 1/14	N9K-B Port 14	

### Table 7 vPC IDs & VLAN IDs

To create the necessary port channels between devices, complete the following steps on both Nexus Switches:

1. Login as admin user into Nexus Switch A and perform the following:

PURESTG-NEXUS-A# config Terminal

PURESTG-NEXUS-A(config)# interface port-channel21

PURESTG-NEXUS-A(config-if)# description connect to Fabric Interconnect A

PURESTG-NEXUS-A(config-if)# switchport mode trunk

PURESTG-NEXUS-A(config-if)# switchport trunk allowed VLAN 1,10,134

PURESTG-NEXUS-A(config-if)# spanning-tree port type edge trunk

PURESTG-NEXUS-A(config-if)# vpc 21

PURESTG-NEXUS-A(config-if)# no shutdown PURESTG-NEXUS-A(config)# exit PURESTG-NEXUS-A(config)# interface port-channel22 PURESTG-NEXUS-A(config-if)# description connect to Fabric Interconnect B PURESTG-NEXUS-A(config-if)# switchport mode trunk PURESTG-NEXUS-A(config-if)# switchport trunk allowed VLAN 1,10,134 PURESTG-NEXUS-A(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-A(config-if)# vpc 22 PURESTG-NEXUS-A(config-if)# no shutdown PURESTG-NEXUS-A(config-if)# exit

PURESTG-NEXUS-A(config)# interface Ethernet1/11 PURESTG-NEXUS-A(config-if)# description Fabric-Interconnect-A:1/11 PURESTG-NEXUS-A(config-if)# switch mode trunk PURESTG-NEXUS-A(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-A(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-A(config-if)# mtu 9216 PURESTG-NEXUS-A(config-if)# channel-group 21 mode active PURESTG-NEXUS-A(config-if)# no shutdown PURESTG-NEXUS-A(config-if)# exit PURESTG-NEXUS-A(config)# interface Ethernet1/12 PURESTG-NEXUS-A(config-if)# description Fabric-Interconnect-A:1/12 PURESTG-NEXUS-A(config-if)# switch mode trunk PURESTG-NEXUS-A(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-A(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-A(config-if)# mtu 9216 PURESTG-NEXUS-A(config-if)# channel-group 21 mode active PURESTG-NEXUS-A(config-if)# no shutdown PURESTG-NEXUS-A(config-if)# exit PURESTG-NEXUS-A(config)# interface Ethernet1/13 PURESTG-NEXUS-A(config-if)# description Fabric-Interconnect-B:1/11 PURESTG-NEXUS-A(config-if)# switch mode trunk

PURESTG-NEXUS-A(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-A(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-A(config-if)# mtu 9216 PURESTG-NEXUS-A(config-if)# channel-group 22 mode active PURESTG-NEXUS-A(config-if)# no shutdown PURESTG-NEXUS-A(config-if)# exit PURESTG-NEXUS-A(config)# interface Ethernet1/14 PURESTG-NEXUS-A(config-if)# description Fabric-Interconnect-B:1/12 PURESTG-NEXUS-A(config-if)# switch mode trunk PURESTG-NEXUS-A(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-A(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-A(config-if)# mtu 9216 PURESTG-NEXUS-A(config-if)# channel-group 22 mode active PURESTG-NEXUS-A(config-if)# no shutdown PURESTG-NEXUS-A(config-if)# exit PURESTG-NEXUS-A(config)# copy running-config startup-config 2. Login as admin user into the Nexus Switch B and complete the following for the second switch configuration: PURESTG-NEXUS-B# config Terminal PURESTG-NEXUS-B(config)# interface port-channel21 PURESTG-NEXUS-B(config-if)# description connect to Fabric Interconnect A PURESTG-NEXUS-B(config-if)# switchport mode trunk PURESTG-NEXUS-B(config-if)# switchport trunk allowed VLAN 1,10,134 PURESTG-NEXUS-B(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-B(config-if)# vpc 21 PURESTG-NEXUS-B(config-if)# no shutdown PURESTG-NEXUS-B(config-if)# exit PURESTG-NEXUS-B(config)# interface port-channel22 PURESTG-NEXUS-B(config-if)# description connect to Fabric Interconnect B PURESTG-NEXUS-B(config-if)# switchport mode trunk PURESTG-NEXUS-B(config-if)# switchport trunk allowed VLAN 1,10,134 PURESTG-NEXUS-B(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-B(config-if)# vpc 22

PURESTG-NEXUS-B(config-if)# no shutdown PURESTG-NEXUS-B(config-if)# exit PURESTG-NEXUS-B(config)# interface Ethernet1/11 PURESTG-NEXUS-B(config-if)# description Fabric-Interconnect-A:1/13 PURESTG-NEXUS-B(config-if)# switch mode trunk PURESTG-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-B(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-B(config-if)# mtu 9216 PURESTG-NEXUS-B(config-if)# channel-group 21 mode active PURESTG-NEXUS-B(config-if)# no shutdown PURESTG-NEXUS-B(config-if)# exit PURESTG-NEXUS-B(config)# interface Ethernet1/12 PURESTG-NEXUS-B(config-if)# description Fabric-Interconnect-A:1/14 PURESTG-NEXUS-B(config-if)# switch mode trunk PURESTG-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-B(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-B(config-if)# mtu 9216 PURESTG-NEXUS-B(config-if)# channel-group 21 mode active PURESTG-NEXUS-B(config-if)# no shutdown PURESTG-NEXUS-B(config-if)# exit PURESTG-NEXUS-B(config)# interface Ethernet1/13 PURESTG-NEXUS-B(config-if)# description Fabric-Interconnect-B:1/13 PURESTG-NEXUS-B(config-if)# switch mode trunk PURESTG-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-B(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-B(config-if)# mtu 9216 PURESTG-NEXUS-B(config-if)# channel-group 22 mode active PURESTG-NEXUS-B(config-if)# no shutdown PURESTG-NEXUS-B(config-if)# exit PURESTG-NEXUS-B(config)# interface Ethernet1/14 PURESTG-NEXUS-B(config-if)# description Fabric-Interconnect-B:1/14 PURESTG-NEXUS-B(config-if)# switch mode trunk PURESTG-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,134 PURESTG-NEXUS-B(config-if)# spanning-tree port type edge trunk PURESTG-NEXUS-B(config-if)# mtu 9216 PURESTG-NEXUS-B(config-if)# channel-group 22 mode active PURESTG-NEXUS-B(config-if)# no shutdown PURESTG-NEXUS-B(config-if)# exit

PURESTG-NEXUS-B(config)# copy running-config startup-config

Verify All vPC Status Is Up on Both Cisco Nexus Switches

Figure	-igure 12 Cisco Nexus Switch A Port-Channel Summary						
PURESTG-NEXUS-A# PURESTG-NEXUS-A# show port-channel summary Flags: D - Down P - Up in port-channel (members) I - Individual H - Hot-standby (LACP only) s - Suspended r - Module-removed S - Switched R - Routed U - Up (port-channel) M - Not in use. Min-links not met							
Group	Port- Channel	Туре	Protocol	Member Ports			
1 19 20 21 22 PURES	Po1(SU) Po19(SU) Po20(SU) Po21(SU) Po22(SU) TG-NEXUS-A#	Eth Eth Eth Eth Eth Eth	LACP LACP LACP LACP LACP LACP	Eth1/1(P) Eth1/17(P) Eth1/19(P) Eth1/11(P) Eth1/13(P)	Eth1/2(P) Eth1/18(P) Eth1/20(P) Eth1/12(P) Eth1/14(P)		

Figure 13 Cisco Nexus Switch B Port-Channel Summary

PURES	PURESTG-NEXUS-B#						
PUREST	TG-NEXUS-B#	show port	-channel s	ummary			
Flags	: D - Down I - Indiv s - Suspe S - Switc U - Up (p M - Not i	P idual H nded r hed R ort-channo n use. Min	- Up in po - Hot-stan - Module-ro - Routed el) n-links no	rt-channel (me dby (LACP only emoved t met	embers) y)		
Group	Port- Channel	Туре	Protocol	Member Ports			
1	Pol(SU)	Eth	LACP	Eth1/1(P)	Eth1/2(P)		
19	Po19(SU)	Eth	LACP	Eth1/17(P)	Eth1/18(P)		
20	Po20(SU)	Eth	LACP	Eth1/19(P)	Eth1/20(P)		
21	Po21(SU)	Eth	LACP	Eth1/11(P)	Eth1/12(P)		
22	Po22(SU)	Eth	LACP	Eth1/13(P)	Eth1/14(P)		
PURES	PURESTG-NEXUS-B#						

Figure 14 VFC Description for Cisco Nexus Switch A						
PURES PURES Leger	PURESTG-NEXUS-A# PURESTG-NEXUS-A# <mark>show</mark> vpc brief Legend:					
		(*)	) - local vP(	C is down, forwarding via vf	°C peer-link	
<pre>vPC domain id : 1 Peer status : peer adjacency f vPC keep-alive status : peer is alive Configuration consistency status : success Per-vlan consistency reason : Consistency Check vPC role : primary Number of vPCs configured : 4 Peer Gateway : Disabled Dual-active excluded VLANs : - Graceful Consistency Check : Enabled Auto-recovery status : Enabled (timeour)</pre>				<pre>: 1 : peer adjacency formed : peer is alive us : success : success : Consistency Check Not : primary : 4 : Disabled : - : Enabled : Enabled (timeout = 240)</pre>	ok Performed 9 seconds)	
vPC F	Peer-lin	ık statı	IS			
id	Port	Status	Active vlans	3		
1	Pol	up	1,10,134			
vPC s	status					
id	Port	Status	Consistency	Reason	Active vlans	
19	Po19	up	success	success	1,10,134	
20	Po20	up	success	success	1,10,134	
21	P021	up	success	success	1,10,134	
22	Po22	up	success	success	1,10,134	
PURESTG-NEXUS-A#						

### Figure 14 vPC Description for Cisco Nexus Switch A

Figur	Figure 15 vPC Description for Cisco Nexus Switch B					
PURES	PURESTG-NEXUS-B#					
PURES	STG-NEX	JS-B# si	now vpc brief	Ī		
Leger	10:	(*)	- local vP(	is down forwarding via v	C neer-link	
		<b>(</b> )	, tocat with	15 down, forwarding via vi	e peer cink	
vPC (	domain i	id		: 1	-1.	
Peer	status	ivo etat	tue	: peer adjacency formed	ок	
Conf	iduratio	on consi	istency stati	is i success		
Per-	/lan cor	nsistend	y status	: success		
Туре	-2 incor	nsistena	y reason	: Consistency Check Not	Performed	
VPC I Numba	role ar of v		Figured	: secondary		
Peer	Gateway	V	rigureu	: Jisabled		
Dual	active	exclude	ed VLANs	: -		
Grace	eful Cor	nsistend	cy Check	: Enabled	)d-)	
AUTO	-recover	ry stati	IS	: Enabled (timeout = 240	(seconds)	
VPC F	Peer-lin	nk statu	IS			
id	Port	Status	Active vlans	j		
1	Pol	up	1,10,134			
vPC s	status					
id	Port	Status	Consistency	Reason	Active vlans	
19	Po19	up	success	success	1,10,134	
20	Po20	IID	SUCCASS	51100955	1 10 134	
20	1020	up	3400033	3400033	1,10,134	
21	P021	ир	success	success	1,10,134	
22	Po22	up	success	success	1,10,134	
PURES	STG-NEX	JS-B#				

## Configure Cisco MDS 9148S Switches

Connect MDS Switches to Fabric Interconnects and Pure Storage System as shown in the figure below:





For this solution, we have connected four ports (ports 33 to 36) of MDS Switch A to Fabric Interconnect A (ports 1-4). Similarly, we have connected four ports (ports 33 to 36) of MDS Switch B to Fabric Interconnect B (ports 1-4) as shown in the table below. All ports carry 16 Gb/s FC Traffic.

MDS Switch	MDS Switch Port	FI Ports	Fabric Interconnects
	FC Port 1/33	FI-A Port 1/1	
MDS Switch A	FC Port 1/34	FI-A Port 1/2	Fabric Interconnect A (FI-A)
	FC Port 1/35	FI-A Port 1/3	
	FC Port 1/36	FI-A Port 1/4	
	FC Port 1/33	FI-B Port 1/1	
MDS Switch B	FC Port 1/34	FI-B Port 1/2	Fabric Interconnect B (FI-B)
	FC Port 1/35	FI-B Port 1/3	
	FC Port 1/36	FI-B Port 1/4	

### Table 8 MDS 9148S Port Connection to Fabric Interconnects

For this solution, we connected four ports (ports 25 to 28) of MDS Switch A to Pure Storage System. Similarly, we connected four ports (ports 25 to 28) of MDS Switch B to Pure Storage System as shown in the table below. All ports carry 16 Gb/s FC Traffic.

### Table 9 MDS 9148S Port Connection to Pure Storage System

MDS Switch	MDS Switch Port	Pure Storage	Storage Port
	FC Port 1/25	Storage Controller-0	CT0-FC0
MDS Switch A	FC Port 1/26	Storage Controller-0	CT0-FC6
	FC Port 1/27	Storage Controller-1	CT1-FC0
	FC Port 1/28	Storage Controller-1	CT1-FC6
	FC Port 1/25	Storage Controller-0	CT0-FC1
MDS Switch B	FC Port 1/26	Storage Controller-0	CT0-FC7
	FC Port 1/27	Storage Controller-1	CT1-FC1
	FC Port 1/28	Storage Controller-1	CT1-FC7

### Configure Feature for MDS Switch A and MDS Switch B

To set feature on MDS Switches, complete the following steps on both MDS switches:

1. Login as admin user into MDS Switch A.

PURESTG-MDS-A# config terminal

PURESTG-MDS-A(config)# feature npiv

PURESTG-MDS-A(config)# feature telnet

PURESTG-MDS-A(config)# switchname PURESTG-MDS-A

PURESTG-MDS-A(config)# copy running-config startup-config

(1) Login as admin user into MDS Switch B.

PURESTG-MDS-B# config terminal

PURESTG-MDS-B(config)# feature npiv

PURESTG-MDS-B(config)# feature telnet

PURESTG-MDS-B(config)# switchname PURESTG-MDS-B

PURESTG-MDS-B(config)# copy running-config startup-config

### Configure VSANs for MDS Switch A and MDS Switch B

To create VSANs, complete the following steps on both MDS switches:

- 1. Login as admin user into MDS Switch A.
- 2. Create VSAN 201 for Storage Traffic:

PURESTG-MDS-A # config terminal

PURESTG-MDS-A(config)# VSAN database

PURESTG-MDS-A(config-vsan-db)# vsan 201

PURESTG-MDS-A(config-vsan-db)# vsan 201 interface fc 1/25-36

PURESTG-MDS-A(config-vsan-db)# exit

PURESTG-MDS-A(config)# interface fc 1/25-36

PURESTG-MDS-A(config-if)# switchport trunk allowed vsan 201

PURESTG-MDS-A(config-if)# switchport trunk mode off

PURESTG-MDS-A(config-if)# port-license acquire

PURESTG-MDS-A(config-if)# no shutdown

PURESTG-MDS-A(config-if)# exit

PURESTG-MDS-A(config)# copy running-config startup-config

3. Login as admin user into MDS Switch B.

4. Create VSAN 202 for Storage Traffic:

PURESTG-MDS-B # config terminal

PURESTG-MDS-B(config)# VSAN database

PURESTG-MDS-B(config-vsan-db)# vsan 202

PURESTG-MDS-B(config-vsan-db)# vsan 202 interface fc 1/25-36

PURESTG-MDS-B(config-vsan-db)# exit

PURESTG-MDS-B(config)# interface fc 1/25-36

PURESTG-MDS-B(config-if)# switchport trunk allowed vsan 202

PURESTG-MDS-B(config-if)# switchport trunk mode off

PURESTG-MDS-B(config-if)# port-license acquire

PURESTG-MDS-B(config-if)# no shutdown

PURESTG-MDS-B(config-if)# exit

PURESTG-MDS-B(config)# copy running-config startup-config

### Create and Configure Fiber Channel Zoning

This procedure sets up the Fibre Channel connections between the Cisco MDS 9148S switches, the Cisco UCS Fabric Interconnects, and the Pure Storage FlashArray systems.

Before you configure the zoning details, decide how many paths are needed for each LUN and extract the WWPN numbers for each of the HBAs from each server. We used 4 HBAs for each Server. Two HBAs (HBA0 and HBA2) are connected to MDS Switch-A and other two HBAs (HBA1 and HBA3) are connected to MDS Switch-B.

To create and configure the fiber channel zoning, complete the following steps:

 Log in to the Cisco UCS Manager > Equipment > Chassis > Servers and select the desired server. On the right hand menu, click the Inventory tab and HBA's sub-tab to get the WWPN of HBA's as shown in the screenshot below:

ı. cısco	UCS Manager			8 👽 🙆 ٩					•
Æ		Servers / Service Pr Storage FSM	ofiles / root / Service Profile	ORARACX1 / vHBAs					
뮮	Service Profiles     v root	Reset WWNN Addr	ess	WWNN Pool Instance	: org-root/wwn-	pool-ORA-WWNN-P	lool		
	VINANALAN     ISCSI VNICS     VHBAs			Local Disk Policy Local Disk Policy Insta	: SAN-Boot	-disk-config-SAN-B	oot		
	<ul> <li>VNICS</li> <li>VRARACX2</li> <li>ISCSI WIICS</li> </ul>			SAN Connectivity Pol	cy : <not< th=""><th>set&gt; *</th><th></th><th></th><th></th></not<>	set> *			
	VHBAs VNICs ORARACX3			SAN Connectivity Poli Create SAN Connectiv	cy Instance : ity Policy				
20	<ul> <li>ORARACX4</li> <li>ORARACX5</li> <li>ORARACX6</li> </ul>	vHBAs	🕆 Export 🚔 Print			10 17 1 19 1 - 5 17			
	<ul> <li>ORARACX7</li> </ul>	Name	WWPN	Desired Order	Actual Order	Fabric ID	Desired Placement	Actual Placement	Admin Hos
	► ORARACX8	vHBA hba0	20:00:00:25:B5:6A:00:00	3	2	A	Any	1	ANY
	<ul> <li>Test-ORA1</li> </ul>	vHBA hba1	20:00:00:25:85:6B:00:00	4	3	В	Any	1	ANY
	<ul> <li>Test-ORA2</li> </ul>	vHBA hba2	20:00:00:25:B5:6A:00:01	5	5	A	Any	1	ANY
	Sub-Organizations     Service Profile Templates	vHBA hba3	20:00:00:25:85:68:00:01	6	6	В	Any	1	ANY

Connect to the Pure Storage System and extract the WWPN of FC Ports connected to the Cisco MDS Switches. We have connected 8 FC ports from Pure Storage System to Cisco MDS Switches. FC ports CT0.FC0, CT1.FC0, CT0.FC6, CT1.FC6 are connected to MDS Switch-A and similarly FC ports CT0.FC1, CT1.FC1, CT0.FC7, CT1.FC7 are connected to MDS Switch-B.

	AGE					Help Welcome pureuser logged in as array_a
DASHBOARD ST	ORAGE PROT	TECTION ANALYSIS SYSTEM	MESSAGES			Search Hosts and
System Health	Target Por	rts				
Configuration	PORT	NAME	SPEED FAILOVER	PORT	NAME	SPEED
Connected Arrays	CT0.FC0	52:4A:93:7B:25:8B:4D:00	16 Gb/s	CT1.FC0	🕎 52:4A:93:7B:25:8B:4D:10	16 Gb/s
Connected Arrays	CT0.FC1	m 52:4A:93:7B:25:8B:4D:01	16 Gb/s	CT1.FC1	👿 52:4A:93:7B:25:8B:4D:11	16 Gb/s
Connections	CT0.FC2	www.52:4A:93:7B:25:8B:4D:02	0 b/s	CT1.FC2	👜 52:4A:93:7B:25:8B:4D:12	0 b/s
Host Connections	CT0.FC3	52:4A:93:7B:25:8B:4D:03	0 b/s	CT1.FC3	52:4A:93:7B:25:8B:4D:13	0 b/s
Target Ports	CT0.FC6	w 52:4A:93:7B:25:8B:4D:06	16 Gb/s	CT1.FC6	🚃 52:4A:93:7B:25:8B:4D:16	16 Gb/s
Users	CT0.FC7	12:4A:93:7B:25:8B:4D:07	16 Gb/s	CT1.FC7	52:4A:93:7B:25:8B:4D:17	16 Gb/s
Plugins						

### Create Device Aliases for Fiber Channel Zoning

#### Cisco MDS Switch A

To configure device aliases and zones for the SAN boot paths as well as datapaths of MDS switch A, complete the following steps:

1. Login as admin user and run the following commands:

conf t

device-alias database

device-alias name oraracx1-hba0 pwwn 20:00:00:25:b5:6a:00:00

device-alias name oraracx1-hba2 pwwn 20:00:00:25:b5:6a:00:01

device-alias name oraracx2-hba0 pwwn 20:00:00:25:b5:6a:00:02 device-alias name oraracx2-hba2 pwwn 20:00:00:25:b5:6a:00:03 device-alias name oraracx3-hba0 pwwn 20:00:00:25:b5:6a:00:04 device-alias name oraracx3-hba2 pwwn 20:00:00:25:b5:6a:00:05 device-alias name oraracx4-hba0 pwwn 20:00:00:25:b5:6a:00:06 device-alias name oraracx4-hba2 pwwn 20:00:00:25:b5:6a:00:07 device-alias name oraracx5-hba0 pwwn 20:00:00:25:b5:6a:00:08 device-alias name oraracx5-hba2 pwwn 20:00:00:25:b5:6a:00:09 device-alias name oraracx6-hba0 pwwn 20:00:00:25:b5:6a:00:0a device-alias name oraracx6-hba2 pwwn 20:00:00:25:b5:6a:00:0b device-alias name oraracx7-hba0 pwwn 20:00:00:25:b5:6a:00:0c device-alias name oraracx7-hba2 pwwn 20:00:00:25:b5:6a:00:0d device-alias name oraracx8-hba0 pwwn 20:00:00:25:b5:6a:00:0e device-alias name oraracx8-hba2 pwwn 20:00:00:25:b5:6a:00:0f device-alias name FLASHSTACK-X-CT0-FC0 pwwn 52:4a:93:7b:25:8b:4d:00 device-alias name FLASHSTACK-X-CT0-FC6 pwwn 52:4a:93:7b:25:8b:4d:06 device-alias name FLASHSTACK-X-CT1-FC0 pwwn 52:4a:93:7b:25:8b:4d:10 device-alias name FLASHSTACK-X-CT1-FC6 pwwn 52:4a:93:7b:25:8b:4d:16 device-alias commit

#### Cisco MDS Switch B

To configure device aliases and zones for the SAN boot paths as well as datapaths of MDS switch B, complete the following steps:

1. Login as admin user and run the following commands:

#### conf t

#### device-alias database

device-alias name oraracx1-hba1 pwwn 20:00:00:25:b5:6b:00:00 device-alias name oraracx1-hba3 pwwn 20:00:00:25:b5:6b:00:01 device-alias name oraracx2-hba1 pwwn 20:00:00:25:b5:6b:00:02 device-alias name oraracx2-hba3 pwwn 20:00:00:25:b5:6b:00:03 device-alias name oraracx3-hba1 pwwn 20:00:00:25:b5:6b:00:04 device-alias name oraracx3-hba3 pwwn 20:00:00:25:b5:6b:00:05 device-alias name oraracx4-hba3 pwwn 20:00:00:25:b5:6b:00:06 device-alias name oraracx4-hba3 pwwn 20:00:00:25:b5:6b:00:07 device-alias name oraracx5-hba1 pwwn 20:00:00:25:b5:6b:00:08 device-alias name oraracx5-hba3 pwwn 20:00:00:25:b5:6b:00:09 device-alias name oraracx6-hba1 pwwn 20:00:00:25:b5:6b:00:0b device-alias name oraracx6-hba3 pwwn 20:00:00:25:b5:6b:00:0c device-alias name oraracx7-hba1 pwwn 20:00:00:25:b5:6b:00:0c device-alias name oraracx7-hba3 pwwn 20:00:00:25:b5:6b:00:0d device-alias name oraracx8-hba1 pwwn 20:00:00:25:b5:6b:00:0e device-alias name oraracx8-hba3 pwwn 20:00:00:25:b5:6b:00:0f device-alias name FLASHSTACK-X-CT0-FC1 pwwn 52:4a:93:7b:25:8b:4d:01 device-alias name FLASHSTACK-X-CT0-FC7 pwwn 52:4a:93:7b:25:8b:4d:07 device-alias name FLASHSTACK-X-CT1-FC1 pwwn 52:4a:93:7b:25:8b:4d:11 device-alias name FLASHSTACK-X-CT1-FC1 pwwn 52:4a:93:7b:25:8b:4d:11

### Create Zoning

### Cisco MDS Switch A

To configure zones for the MDS switch A, complete the following steps:

- 1. Create a zone for each service profile.
- 2. Login as admin user and create the zone as shown below:

#### conf t

zone name oraracx1 vsan 201

member pwwn 52:4a:93:7b:25:8b:4d:00

member pwwn 52:4a:93:7b:25:8b:4d:06

member pwwn 52:4a:93:7b:25:8b:4d:10

member pwwn 52:4a:93:7b:25:8b:4d:16

member pwwn 20:00:00:25:b5:6a:00:00

member pwwn 20:00:00:25:b5:6a:00:01

zone name oraracx2 vsan 201

member pwwn 52:4a:93:7b:25:8b:4d:00 member pwwn 52:4a:93:7b:25:8b:4d:06 member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:16 member pwwn 20:00:00:25:b5:6a:00:02 member pwwn 20:00:00:25:b5:6a:00:03 zone name oraracx3 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00 member pwwn 52:4a:93:7b:25:8b:4d:06 member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:16 member pwwn 20:00:00:25:b5:6a:00:04 member pwwn 20:00:00:25:b5:6a:00:05

zone name oraracx4 vsan 201

member pwwn 52:4a:93:7b:25:8b:4d:00 member pwwn 52:4a:93:7b:25:8b:4d:06 member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:16 member pwwn 20:00:00:25:b5:6a:00:06 member pwwn 20:00:00:25:b5:6a:00:07 zone name oraracx5 vsan 201

member pwwn 52:4a:93:7b:25:8b:4d:00 member pwwn 52:4a:93:7b:25:8b:4d:06 member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:16 member pwwn 20:00:00:25:b5:6a:00:08 member pwwn 20:00:00:25:b5:6a:00:09

zone name oraracx6 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00 member pwwn 52:4a:93:7b:25:8b:4d:06 member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:16

member pwwn 20:00:00:25:b5:6a:00:0a member pwwn 20:00:00:25:b5:6a:00:0b zone name oraracx7 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00

member pwwn 52:4a:93:7b:25:8b:4d:06

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member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:16 member pwwn 20:00:00:25:b5:6a:00:0c member pwwn 20:00:00:25:b5:6a:00:0d zone name oraracx8 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00 member pwwn 52:4a:93:7b:25:8b:4d:06 member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:10 member pwwn 52:4a:93:7b:25:8b:4d:16 member pwwn 20:00:00:25:b5:6a:00:0e member pwwn 20:00:00:25:b5:6a:00:0f exit

 After the zone for the Cisco UCS service profile has been created, create the zone set and add the necessary members.

conf t

zoneset name oraracx vsan 201

member oraracx1

member oraracx2

member oraracx3

member oraracx4

member oraracx5

member oraracx6

member oraracx7

member oraracx8

exit

4. Activate the zone set by running following commands.

zoneset activate name oraracx vsan 201

exit

#### copy run start

#### Cisco MDS Switch B

To configure zones for the MDS switch B, complete the following steps:

- 1. Create a zone for each service profile.
- 2. Login as admin user and run the following commands:

#### conf t

zone name oraracx1 vsan 202 member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17 member pwwn 20:00:00:25:b5:6b:00:00 member pwwn 20:00:00:25:b5:6b:00:01 zone name oraracx2 vsan 202

member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17 member pwwn 20:00:00:25:b5:6b:00:02 member pwwn 20:00:00:25:b5:6b:00:03

zone name oraracx3 vsan 202

member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17 member pwwn 20:00:00:25:b5:6b:00:04 member pwwn 20:00:00:25:b5:6b:00:05

zone name oraracx4 vsan 202

member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17

91

member pwwn 20:00:00:25:b5:6b:00:06 member pwwn 20:00:00:25:b5:6b:00:07 zone name oraracx5 vsan 202

member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17 member pwwn 20:00:00:25:b5:6b:00:08 member pwwn 20:00:00:25:b5:6b:00:09

zone name oraracx6 vsan 202

zone name oraracx7 vsan 202

member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17 member pwwn 20:00:00:25:b5:6b:00:0a member pwwn 20:00:00:25:b5:6b:00:0b

member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17 member pwwn 20:00:00:25:b5:6b:00:0c member pwwn 20:00:00:25:b5:6b:00:0d zone name oraracx8 vsan 202

member pwwn 52:4a:93:7b:25:8b:4d:01 member pwwn 52:4a:93:7b:25:8b:4d:07 member pwwn 52:4a:93:7b:25:8b:4d:11 member pwwn 52:4a:93:7b:25:8b:4d:17 member pwwn 20:00:00:25:b5:6b:00:0e member pwwn 20:00:00:25:b5:6b:00:0f exit

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 After the zone for the Cisco UCS service profile has been created, create the zone set and add the necessary members:

conf t

zoneset name oraracx vsan 202

member oraracx1

member oraracx2

member oraracx3

member oraracx4

member oraracx5

member oraracx6

member oraracx7

member oraracx8

exit

4. Activate the zone set by running following commands:

zoneset activate name oraracx vsan 202

exit

copy run start

### **Configure Pure Storage**

The design goal of the reference architecture was to best represent a real-world environment as closely as possible. The approach included features of Cisco UCS to rapidly deploy stateless servers and use Pure Storage FlashArray's boot LUNs to provision the O.S on top it. Zoning was performed on the Cisco MDS 9148S switches to enable the initiators discover the targets during boot process.

A Service Profile was created within Cisco UCS Manager to deploy the 8 servers quickly with a standard configuration. SAN boot volumes for these servers were hosted on the same Pure Storage FlashArray //X70. Once the stateless servers were provisioned, following process was performed to enable Rapid deployment of 8 RAC nodes.

Each Server node has dedicated single LUN to install operating system and all the eight server node was booted off SAN. For this solution, we have installed Oracle Linux 7.4 on this LUNs and performed all the pre-requisite packages for Oracle Database 12cR2 to create eight node Oracle RAC database solution.

Using logical servers that are disassociated from the physical hardware removes many limiting constraints around how servers are provisioned. Cisco UCS Service Profiles contain values for a server's property settings, including virtual network interface cards (vNICs), MAC addresses, boot policies, firmware policies, fabric connectivity, external management, and HA information. The service profiles represent all the attributes of a logical server in Cisco UCS model. By abstracting these settings from the physical server into a Cisco UCS domain. Furthermore, Profile can then be deployed to any physical compute hardware within the Cisco UCS domain. Furthermore, Service Profiles can, at any time, be migrated from one physical server to another. Furthermore, Cisco is the only hardware provider to offer a truly unified management platform, with Cisco UCS Service Profiles and hardware abstraction capabilities extending to both blade and rack servers.

In addition to the service profiles, the use of Pure Storage's FlashArray's with SAN boot policy provides the following benefits:

- Scalability Rapid deployment of new servers to the environment in a very few steps
- Manageability Enables seamless hardware maintenance and upgrades without any restrictions. This is a huge benefit in comparison to other appliance model like Exadata
- Flexibility Easy to repurpose physical servers for different applications and services as needed
- Availability Hardware failures are not impactful and critical. In rare case of a server failure, it is easier to associate the logical service profile to another healthy physical server to reduce the impact

#### **Configure Host**

Before using a volume (LUN) on a host, the host has to be defined on Pure FlashArray. To set up a host complete the following steps:

- 1. Log into Pure Storage dashboard.
- 2. In the PURE GUI, go to Storage tab.
- 3. Under Hosts option in the left frame, click the + sign to create a host.
- 4. Enter the name of the host and click Create. This will create a Host entry under the Hosts category.

Create Host					
Name:	ORARACX-1				
Creat	e Multiple	Cancel	Create		

5. To update the host with the connectivity information by providing the Fibre Channel WWNs or iSCSI IQNs, click the Host that was created.

PURESTORAGE	Welcome pureuse	Help   Terms   Log Ou r logged in as array_admin to flashstack-
DASHBOARD STORAGE	PROTECTION ANALYSIS SYSTEM MESSAGES	Search Hosts and Volumes Q
- Hosts 🛛 🛨	ORARACX-1   Provisioned Total Reduction	Data Reduction
s= ORARACX-1	Volumes         Snapshots           Onnected Volumes (0)         Host Ports (0)         Details (0)	Used
	No host ports have been configured.	Configure Fibre Channel WWNS Configure ISCSI IQNS Remove Ports
+ Volumes +		

6. In the host context, click the Host Ports tab and click the settings button and select "Configure Fibre Channel WWNs" which will display a window with the available WWNs in the left side.

Configure Fibre Channel WWNs for H	ost 🖙 ORARACX-	1 ×
Existing WWNs	Enter WWNs Manually	Selected WWNs
		None selected
🔲 📼 20:00:00:25:B5:6A:00:00		
20:00:00:25:B5:6B:00:00		
		Cancel

WWNs will appear only if the appropriate FC connections were made and the zones were setup on the underlying FC switch.

7. Select the list of WWNs that belongs to the host in the next window and click "Confirm."

PUREST	ORAGE		Help   Terms   Log 0 Welcome pureuser logged in as array_admin to flashstack
DASHBOARD	STORAGE	PROTECTION ANALYSIS SYSTEM MESSAGES	Search Hosts and Volumes
- Hosts	+	ORARACX-1 Provisioned Total Reduction     O	Data Reduction
OPARACY 4			Used
URAHACA-1		Volumes Snapshots 0 0	
		Connected Volumes (0) Host Ports (2) Protection (0) Details (0)	
			1-2 of 2 🗮
		PORT	
		20:00:00:25:B5:6A:00:00	110
		20.00.00.25.85.6B.00.00	
- Volumes	+		
Los .			

Make sure the zoning has been setup to include the WWNs details of the initiators along with the target, without which the SAN boot will not work.

### **Configure Volume**

To configure a volume, complete the following steps:

1. Go to tab Storage > Volumes > and click on + sign to "Create Volume."

	PROTECTION	ANALYSIS	SYSTEM	MESSAGES
→ Hosts +	▼ Hosts 8.4	visioned Total Redu 2 TB 6.7 to 1	ction	
Volumes     +	2			
	Volumes 1.23 TB	Snapshots SI 0 GB 23	ared Space Sy 3.29 GB 0	GB Empty Space 4.33 TB
	Hosts (5) Hos	st Groups (1)		

2. Provide the name of the volume, size, choose the size type (KB, MB, GB, TB, PB) and click Create to create the volume.

Create Volume *						
Name:	ORARACX1-OS					
Provisioned Size:	200	G 🗸				
Create Multiple Cancel						

3. Attach the volume to a host by going to the "Connected Hosts and Host Groups" tab under the volume context menu.

PURES	TORAGE	Welcome pureuser logged in as an	Help   Terms   rray_admin to flas	Log Out shstack-x
DASHBOARD	STORAGE	PROTECTION ANALYSIS SYSTEM MESSAGES	ts and Volumes	Q
✓ Hosts	+	ORARACX1-OS     Provisioned Total Reduction     200.00 G	Data Reduction	=
CRARACX-1		Volumes Snapshots		Used O
		Connected Hosts (0) Connected Host Groups (0) Snapshots (0) Protection (0) Details		
			0 of 0	
		No hosts have been connected.	Connect Host Disconnect H	ts losts
- Volumes	+			
S ORARACX1-OS				

4. Click the Settings icon and select "Connect Hosts." Select the host where the volume should be attached and click Confirm.

Connect Hosts to Volume 🔒 ORARAC	(1-OS		×
Existing Hosts	Create New Host	Selected Hosts	
	< 1-1 of 1 >	1 selected	Clear All
🗹 📼 ORARACX-1		DE ORARACX-1	8
		LUN: automatic	Cancel Confirm

This completes the connectivity of Storage LUN to the Server Node. You created one boot LUN (ORARACX1-OS) of 200GB and assigned this LUN to the first oracle RAC node "ORARACX-1". You will install OS and perform all prerequisites for Oracle RAC Database to this LUN. Similarly, repeat the steps to create 7 more Hosts and LUNs to get ready 8 nodes for OS installation in the next steps.

## OS and Database Deployment

### **Operating System Configuration**

Step-by-step OS installation details are not detailed in this document, but the following section describes the key steps for OS install.

- 1. Download Oracle Linux 7.4 OS image from https://edelivery.oracle.com/linux.
- Launch KVM console on desired server by going to tab Equipment > Chassis > Chassis 1 > Servers > Server 1 > from right side windows General > and select KVM Console to open KVM.

cisco	UCS Manager		⊗ <b>⊽</b> ( 0 0	<ul> <li>▲</li> <li>Φ</li> <li>0</li> <li>7</li> </ul>			• • (
æ	All	Equipment / Chassis / Chassis 1 / Servers / Se	erver 1				
-	<ul> <li>✓ Equipment</li> <li>✓ Chassis</li> </ul>	General Inventory Virtual Machines	Installed Firmwa	re CIMC Sessions Physical Display	SEL Logs VIF Paths Faults	Events FSM Health	Diagnostics S
品	Chassis 1 Fans IO Modules PSI is		<b>⊘</b> 0				
Q	Servers     Server 1	Status					
	Server 2     Server 3     Server 4	Overall Status :					
20	<ul> <li>Chassis 2</li> <li>▼ Rack-Mounts</li> </ul>	Actions					
	FEX   Servers  Fabric Interconnects	Create Service Profile Associate Service Profile Set Desired Power State		shida 6120			
	<ul> <li>Fabric Interconnect A (subordinate)</li> <li>Fabric Interconnect B (primary)</li> </ul>	Boot Server Shutdown Server		Properties			
	<ul> <li>Policies</li> <li>Port Auto-Discovery Policy</li> </ul>	Reset Recover Server		Slot ID Product Name	: 1 : Cisco UCS B200 M5 2 Socket Blac	Chassis ID de Server	: 1
		Reset All Memory Errors Server Maintenance		Vendor Revision	: Cisco Systems Inc : 0	PID Serial	: UCSB-B200-M5 : FCH21437KVH
		KVM Console >>		Manufacturing Date	2017-10-30		

3. Click Accept security and open KVM. Enable virtual media, map the Oracle Linux ISO image and reset the server.

disco UCS KVM	E	E C C X D	? G
KVM Console Server		Activate Virtual Devices	
	No Signal		

4. When the Server starts booting, it will detect the Pure Storage active FC paths as shown below. If you see the following message in the KVM console while the server is rebooting along with the target WWPNs, it confirms the setup is done correctly and boot from SAN will be successful.

dialo UCS KVM	Ŧ	0	6	*	0	? G
KVM Console Server						
Cisco VIC FC, Boot Driver Version 4.2(2b) (C) 2016 Cisco Systems, Inc. PURE 524a937b258b4d00:001 PURE 524a937b258b4d10:001 Option ROM installed successfully Cisco VIC FC, Boot Driver Version 4.2(2b) (C) 2016 Cisco Systems, Inc. PURE 524a937b258b4d11:001 PURE 524a937b258b4d11:001 Option ROM installed successfully						

5. During server boot order, it will detect the virtual media connected as Oracle Linux cd. It should launch the Oracle Linux installer. Select language and assign the Installation destination as Pure Storage FlashArray LUN. Apply hostname and click "Configure Network" to configure all network interfaces. Alternatively, you can only configure "Public Network" in this step. You can configure additional interfaces as part of post install steps.

A ORARAC-X-FI / (Chassis - 1 Server - 1) - KVM Console(Launched By: admin)	- 0	×
File View Macros Tools Virtual Media Help		
🚙 Boot Server 🔩 Shutdown Server 🥥 Reset		
KVM Console Server		
INSTALLATION DESTINATION	ORACLE LINUX 7.4 INSTALL	LATION Help!
Device Selection		
Select the device(s) you'd like to install to. They will be left untouched until you click Local Standard Disks	on the main menu's "Begin Installation" button.	
	Disks left unselected here will not be	touched.
Specialized & Network Disks		
200 GiB		
Add a disk		
<b>36:24:a900:11:05:2</b> 3624a93701c0d5dfa58fa45d800011052 / 200 GiB free		
	Disks left unselected here will not be	touched.
Other Storage Options		
Partitioning		
I would like to make additional space available.		
Focountion		
Encrypt my data. You'll set a passphrase next.		
R.		
Full disk summary and boot loader	1 disk selected; 200 GiB capacity; 200 GiB free	Refresh

- 6. As a part of additional RPM package, we recommend to select "Customize Now" and configure "UEK kernel Repo."
- After the OS install, reboot the server, complete appropriate registration steps. You can choose to synchronize
  the time with ntp server. Alternatively, you can choose to use Oracle RAC cluster synchronization daemon
  (OCSSD). Both ntp and OCSSD are mutually exclusive and OCSSD will be setup during GRID install if ntp is
  not configured.

### Operating System Prerequisites for Oracle Software Installation

### **Configure BIOS**

This section describes how to optimize the BIOS settings to meet requirements for the best performance and energy efficiency for the Cisco UCS M5 generation of blade and rack servers.

### Configure BIOS for OLTP Workloads

OLTP systems are often decentralized to avoid single points of failure. Spreading the work over multiple servers can also support greater transaction processing volume and reduce response time. Make sure to disable Intel IDLE driver in the OS configuration section. When Intel idle driver is disabled, the OS uses acpi\_idle driver to control the c-states.

For latency sensitive workloads, it is recommended to always disable c-states in both OS and BIOS to ensure c-states are disabled.

The following are the recommended options for optimizing OLTP workloads on Cisco UCS M5 platforms managed by Cisco UCS Manager.

# Figure 17 BIOS Options for OLTP Workloads Main Advanced Boot Options Server Management Events

Advanced filter 1 Expert i Tint	
OS Setting	Value
Altitude	Platform Default
CPU Hardware Power Management	Platform Default
Boot Performance Mode	Platform Default
CPU Performance	Platform Default
Core Multi Processing	Platform Default
DRAM Clock Throttling	Platform Default
Direct Cache Access	Platform Default
Energy Performance Tuning	Platform Default
Enhanced Intel SpeedStep Tech	Platform Default
Execute Disable Bit	Platform Default
Frequency Floor Override	Platform Default
Intel HyperThreading Tech	Platform Default
Intel Turbo Boost Tech	Platform Default
Intel Virtualization Technology	Platform Default
Channel Interleaving	Platform Default
IMC Inteleave	Platform Default
Memory Interleaving	Platform Default
Rank Interleaving	Platform Default
Sub NUMA Clustering	Platform Default
Local X2 Apic	Platform Default
Max Variable MTRR Setting	Platform Default
P STATE Coordination	Platform Default
Package C State Limit	C0 C1 State
Processor C State	Disabled
Processor C1E	Disabled
Processor C3 Report	Disabled
Processor C6 Report	Disabled
Processor C7 Report	Disabled
Processor CMCI	Platform Default
Power Technology	Custom
Energy Performance	Platform Default
Adjacent Cache Line Prefetcher	Platform Default
DCU IP Prefetcher	Platform Default
DCU Streamer Prefetch	Platform Default
Hardware Prefetcher	Platform Default
UPI Prefetch	Platform Default
LLC Prefetch	Platform Default
XPT Prefetch	Platform Default
Demand Scrub	Platform Default
Patrol Scrub	

For more information about BIOS settings, refer to: <u>https://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/whitepaper\_c11-740098.pdf</u>

If the CPU gets into a deeper C-state and not able to get out to deliver full performance quickly. The result is unwanted latency spikes for workloads. To address this, it is recommended to disable C states in the BIOS and in addition, Oracle recommends disabling it from OS level as well by modifying grub entries. For this solution, we have configured BIOS options by modifying in /etc/default/grub file as shown below:

[root@oraracx1 ~]# cat /etc/default/grub

GRUB\_TIMEOUT=5

GRUB\_DISTRIBUTOR="\$(sed 's, release .\*\$,,g' /etc/system-release)"

GRUB\_DEFAULT=saved

GRUB\_DISABLE\_SUBMENU=true

GRUB\_TERMINAL\_OUTPUT="console"

GRUB\_CMDLINE\_LINUX="crashkernel=auto rd.lvm.lv=ol/root rd.lvm.lv=ol/swap rhgb quiet numa=off transparent\_hugepage=never intel\_idle.max\_cstate=0 processor.max\_cstate=0"

GRUB\_DISABLE\_RECOVERY="true"

### Prerequisites Automatic Installation

After installing Oracle Linux 7.4 on all the server nodes (oraracx1, oraracx2, oraracx3, oraracx4, oraracx5, oraracx6, oraracx7 and oraracx8), you have to configure operating system pre-requisites on all the eight nodes to successfully install Oracle RAC Database 12cR2.

To configure operating system pre-requisite for Oracle 12cR2 software on all eight nodes, complete the following steps:

Follow the steps according to your environment and requirements. Refer to the Install and Upgrade Guide for Linux for Oracle Database 12c R2: <u>https://docs.oracle.com/en/database/oracle/oracle-</u> <u>database/12.2/cwlin/configuring-operating-systems-for-oracle-grid-infrastructure-on-linux.html#GUID-</u> <u>B8649E42-4918-49EA-A608-446F864EB7A0.</u>

To configure the prerequisites on all the eight nodes, complete the following steps:

You can perform either the Automatic Setup or the Manual Setup to complete the basic prerequisites. The Additional Setup is required for all installations.

For this solution, we configured the prerequisites automatically by installing the "oracle-database-server-12cR2-preinstall" rpm package. You can also download the required packages from <u>http://public-yum.oracle.com/oracle-linux-7.html</u>. If you plan to use the "oracle-database-server-12cR2-preinstall" rpm package to perform all your prerequisite setup automatically, then login as root user and issue the following command.

[root@oraracx1 ~]# yum install oracle-database-server-12cR2-preinstall

If you have not used the "oracle-database-server-12cR2-preinstall" package, then you will have to manually perform the prerequisites tasks on all the eight nodes.

### Additional Prerequisites Setup

After configuring automatic or manual prerequisites steps, you have to configure a few additional steps to complete the prerequisites for the Oracle Software installations on all the eight nodes as described below.

#### **Disable SELinux**

As most of the Organizations might already be running hardware-based firewalls to protect their corporate networks, we disabled Security Enhanced Linux (SELinux) and the firewalls at the server level for this reference architecture.

You can set secure linux to permissive by editing the "/etc/selinux/config" file, making sure the SELINUX flag is set as follows.

SELINUX= permissive

#### **Disable Firewall**

Check the status of the firewall by running following commands. (The status displays as active (running) or inactive (dead)). If the firewall is active / running, enter the following command to stop it:

systemctl status firewalld.service

systemctl stop firewalld.service

Also, to completely disable the firewalld service, so it does not reload when you restart the host machine, run the following command:

systemctl disable firewalld.service

#### Set the User Passwords

Run the following commands to change the password for Oracle and Grid Users:

passwd oracle

passwd grid

### **Configure Multipath Setup**

Follow the steps below on all the eight oracle RAC nodes.

Configure multipaths to access the LUNs presented from Pure Storage to the nodes. Device Mapper Multipath provides the ability to aggregate multiple IO paths to a newly created device mapper mapping to achieve high availability, I/O load balancing and persistent naming. We made sure the multipathing packages were installed and enabled for automatic restart across reboots.

Add or modify "/etc/multipath.conf" file accordingly to give the alias name of each LUN id presented from Pure Storage as given below into all eight nodes:

Run "multipath -II" command to view all the LUN id.

[root@oraracx1 ~]# cat /etc/multipath.conf

defaults {

polling\_interval 10

}

```
devices {
     device {
         vendor
                           "PURE"
         path_grouping_policy multibus
         path_checker
                              tur
         path_selector
                             "queue-length 0"
         fast_io_fail_tmo
                              10
         dev_loss_tmo
                              60
                             0
         no_path_retry
    }
}
multipaths {
     multipath {
                    3624a93701c0d5dfa58fa45d800011066
         wwid
         alias
                   orarax1_os
    }
}
```

Make sure the LUNs wwid address reflects the correct value for all eight nodes in /etc/multipath.conf

Configure /etc/multipath.conf (Appendix) as per Pure Storage's recommended multipath config for Oracle Linux as documented in the Pure Support Page:

https://support.purestorage.com/Solutions/Operating\_Systems/Linux/Linux\_Recommended\_Settings

### Configure UDEV rules

Follow the steps below on all the eight oracle RAC nodes.

As per Pure Storage FlashArray's best practice, setup the queue settings with udev rules. Refer to the updated Linux best practices for Pure Storage FlashArray on Pure's support site.

Create file named /etc/udev/rules.d/99-pure-storage.rules with the following entries:

# Recommended settings for PURE Storage FlashArray

# Use noop scheduler for high-performance solid-state storage

ACTION=="add|change", SUBSYSTEM=="block", ENV{ID\_VENDOR}=="PURE", ATTR{queue/scheduler}="noop"

# Reduce CPU overhead due to entropy collection

ACTION=="add|change", SUBSYSTEM=="block", ENV{ID\_VENDOR}=="PURE", ATTR{queue/add\_random}="0"

# Schedule I/O on the core that initiated the process

ACTION=="add|change", SUBSYSTEM=="block", ENV{ID\_VENDOR}=="PURE", ATTR{queue/rq\_affinity}="2"

These steps complete the prerequisite for Oracle Database 12cR2 Installation at OS level on Oracle RAC Node 1 (ORARACX1). For this FlashStack Solution, we used 8 identical Cisco UCS B-series B200 M5 blade servers for hosting the 8-node Oracle RAC database. All of the steps above were also performed on all eight nodes to create 8 node Oracle RAC solution.

This process will complete all 8 Oracle RAC Nodes with OS and all prerequisites to install Oracle Database Software 12cR2.

### Configure Host Groups

After completion of all Oracle Nodes OS Boot LUN, create and configure Host Group. You will assign all the Oracle Nodes to the Host Group into Pure FlashArray.

To configure the Host Group, complete the following steps:

- 1. Log into Pure Storage dashboard.
- 2. In the PURE GUI, go to tab Storage > Hosts > click the + sign to "Create Host Group" as shown below:

Crea	te Host Group	×
Name:	ORAXRAC	
Creat	e Multiple	ncel Create

3. Select from Host Group "ORARACX" > Hosts > click Settings and "Add Hosts."

		Help   Terms   Log Out Welcome pureuser logged in as array_admin to flashstack-x
DASHBOARD STORAGE	PROTECTION ANALYSIS SYSTEM MESSAGES	Search Hosts and Volumes Q
+ Hosts	CRAXRAC Provisioned Total Reduction	Data Reduction
CRARACX-1	Volumes Snapshots 0 Connected Volumes (0) Protection (0)	0 0
DEARACX-3 DEARACX-4 DEARACX-5 DEARACX-6 DEARACX-7 DEARACX-7 DEARACX-7	No hosts have been added.	0 of 0 Add Hosts Remove Hosts

4. Add all nodes from "Existing Hosts" to "Selected Hosts" and click Confirm.

Add Hosts to Host Group 🧱 ORAXRAC			×
Existing Hosts	Create New Host	Selected Hosts	
	< 1-8 of 8 >	8 selected	Clear All
🕑 📼 ORARACX-1		De ORARACX-1	0
🗹 📼 ORARACX-2		De ORARACX-2	0
🗹 📼 ORARACX-3		De ORARACX-3	8
🗹 📼 ORARACX-4		DE ORARACX-4	8
🗹 📼 ORARACX-5		DE ORARACX-5	8
🗹 📼 ORARACX-6		De ORARACX-6	8
🗹 📼 ORARACX-7		De ORARACX-7	8
🗹 📼 ORARACX-8		De ORARACX-8	8
			Cancel Confirm

5. Verify that all nodes are added into Host Group as shown below:

PURESTORAGE						
DASHBOARD	STORAGE	PROTECTION ANALYSIS SYSTEM MESSAGES			Sea	rch Hosts and Volumes
- Hosts	+	ORAXRAC   Provisioned Total Reduction     0				Data Reduction
CRAXRAC		Volumes Snapshots				0
CRARACX-3		Hosts (8) Connected Volumes (0) Protection (0)				
CRARACX-4						1-8 of 8
CRARACX-6		NAME	INTERFACE	PROVISIONED	VOLUMES	REDUCTION
DE ORARACX-7		r ORARACX-1	FC	200.00 G	160.28 M	20.3 to 1
DRARACX-8		JE ORARACX-2	FC	200.00 G	138.74 M	21.9 to 1
		DRARACX-3	FC	200.00 G	182.89 M	19.1 to 1
		DE ORARACX-4	FC	200.00 G	190.65 M	18.7 to 1
		DE ORARACX-5	FC	200.00 G	204.69 M	18.0 to 1
		DRARACX-6	FC	200.00 G	151.09 M	21.0 to 1
		CRARACX-7	FC	200.00 G	150.36 M	21.1 to 1
		∞ ORARACX-8	FC	200.00 G	243.14 M	16.2 to 1

### Configure CRS, Data and Redo log Volumes

You will create and assign CRS, Data and Redo Log Volumes to Host Group, which was created earlier. By doing this, all the nodes into Host Group can able to read/write data from/to the Volume.

For this FlashStack solution, we created two OLTP Database (OLTPDB1 and SOEDB1) and one DSS Database (DSSDB1). The following table shows the LUNs are created and the description of the LUNs.

Table 10 L	UN Description		
Database	Volume Name	Size	Purpose
	dg_orarac_crs	200 GB	Store OCR and Voting Disk information for All Database
OLTPDB1	dg_oradata_oltp1	5 TB	Store Datafiles for OLTPDB1 Database
	dg_redolog_oltp1	500 GB	Store Redolog Files for OLTPDB1 Database
SOEDB1	dg_oradata_soe1	10 TB	Store Datafiles for SOEDB1 Database

	dg_redolog_soe1	500 GB	Store Redolog Files for SOEDB1 Database
DSSDB1	dg_oradata_dss1	13 TB	Store Datafiles for DSSDB1 Database
	dg_redolog_dss1	500 GB	Store Redolog Files for DSSDB1 Database
SLOBDB	dg_oradata_slob01	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob02	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob03	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob04	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob05	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob06	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob07	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob08	600 GB	Store Datafiles for SLOBDB Database
	dg_oradata_slob09	600 GB	Store Datafiles for SLOBDB Database
	dg_oraredo_slob	100 GB	Store Redolog Files for SLOBDB Database

- 1. Create CRS Volume of 200 GB for storing OCR and Voting Disk files for all the database.
- 2. Create Data Volumes for each database to store database files.
- 3. Create Redo Volumes for each database to store redo log files.
- 4. After you create all appropriate volumes, assign these volumes to Host Group. Attach all the volumes to a host group by going to the "Connected Hosts and Host Groups" tab under the volume context menu, click the Settings icon and select "Connect Host Group." Select the host group where the volume should be attached and click Confirm.
- 5. Verify that all the volumes are visible into Host Group as shown below:

PURESTO	RAGE				Welcom	e pureuser logged in a	Help   Terms   Log C is array_admin to flashstack
DASHBOARD	STORAGE	PROTECTION ANALYSIS SYSTEM MESSAGES				Search H	losts and Volumes Q
- Hosts	+	ORAXRAC Provisioned Total Reduction     36.20 T 5.1 to 1					Data Reduction 4.0 to 1 ≡
							Used
CRAXRAC CRARACX-1		Volumes Snapshots 6.99 T 1.70 T					
DE ORARACX-2 DE ORARACX-3 DE ORARACX-4		Hosts (8) Connected Volumes (17) Protection (0)					
CRARACX-5							1-17 of 17
DE ORARACX-6		NAME	PROVISIONED	VOLUMES	SNAPSHOTS	REDUCTION	LUN
ORARACX-7		g dg_oradata_dss1	13 T	3.28 T	73.90 G	3.1 to 1	250
		e dg_oradata_oltp1	5 T	1.34 T	657.24 G	3.6 to 1	253
		g dg_oradata_slob01	600 G	36.00 G	0.00	16.2 to 1	247
		g_oradata_slob02	600 G	36.03 G	0.00	16.2 to 1	246
		g_oradata_slob03	600 G	36.01 G	0.00	16.2 to 1	245 ***
		g_oradata_slob04	600 G	35.99 G	0.00	16.2 to 1	244 ***
		😝 dg_oradata_slob05	600 G	31.41 G	0.00	16.9 to 1	242 ***
- Volumos		😝 dg_oradata_slob06	600 G	31.46 G	0.00	16.9 to 1	241
volumes	+	😝 dg_oradata_slob07	600 G	31.47 G	0.00	16.9 to 1	240
		g_oradata_slob08	600 G	31.42 G	0.00	16.9 to 1	239
g_dg_oradata_dss1	Î	😝 dg_oradata_sicb09	600 G	30.88 G	0.00	17.2 to 1	238
g_oradata_oltp1		😝 dg_oradata_soe1	10 T	2.01 T	981.74 G	3.8 to 1	251
g_ dg_oradata_slob02		e dg_orarac_crs	200 G	9.13 G	498.13 M	5.0 to 1	254
g_oradata_slob03	e dg_redolog_dss1	500 G	8.56 G	221.44 M	5.4 to 1	248	
dg_oradata_slob04		g_redolog_oltp1	500 G	19.96 G	16.54 G	2.4 to 1	252
g_dg_oradata_slob06		g dg_redolog_slob	100 G	10.23 G	0.00	6.1 to 1	243
Garadata_slob07	e dg_redolog_soe1	500 G	19.79 G	13.09 G	2.4 to 1	249	

### **Configure UDEV rules**

After creating all volumes into Pure Storage, you need to configure UDEV to assign permission in all Oracle RAC Nodes. This includes the device details along with required permissions to enable grid user to have read/write privileges on these devices. Configure UDEV rules on all Oracle Nodes as shown below:
IMPORTANT: The /etc/multipath.conf for the Oracle ASM devices and udev rules for these devices should be copied on to all the RAC nodes and verified to make sure the devices are visible and permissions are enabled for grid user on all the nodes

Create a new file named /etc/udev/rules.d/99-oracleasm.rules with the following entries:

#All volumes which starts with dg\_orarac\_\* #

ENV{DM\_NAME}=="dg\_orarac\_crs", OWNER:="grid", GROUP:="oinstall", MODE:="660"

#All volumes which starts with dg\_oradata\_\* #

ENV{DM\_NAME}=="dg\_oradata\_\*", OWNER:="grid", GROUP:="oinstall", MODE:="660"

#All volumes which starts with dg\_oraredo\_\* #

ENV{DM\_NAME}=="dg\_oraredo\_\*", OWNER:="grid", GROUP:="oinstall", MODE:="660"

#### Configure Public and Private NICs on Each RAC Node

If you have not configured network settings during OS installation, then configure it now. Each node must have at least two network interface cards (NIC), or network adapters. One adapter is for the public network interface and the other adapter is for the private network interface (the interconnect).

Login as a root user into each node and go to "/etc/sysconfig/network-scripts" and configure Public network and Private network IP Address. Configure the private and public NICs with the appropriate IP addresses across all the Oracle RAC nodes.

#### Configure "/etc/hosts" on Each RAC Node

Login as a root user into node and edit "/etc/hosts" file. Provide details for Public IP Address, Private IP Address, SCAN IP Address and Virtual IP Address for all nodes. Configure these settings in each Oracle RAC Nodes as shown below:

cat /etc/hosts

127.0.0.1 localhost localhost.localdomain

**#Public IP** 

- 10.29.134.121 oraracx1 oraracx1.cisco.com
- 10.29.134.122 oraracx2 oraracx2.cisco.com
- 10.29.134.123 oraracx3 oraracx3.cisco.com
- 10.29.134.124 oraracx4 oraracx4.cisco.com
- 10.29.134.125 oraracx5 oraracx5.cisco.com
- 10.29.134.126 oraracx6 oraracx6.cisco.com
- 10.29.134.127 oraracx7 oraracx7.cisco.com

10.29.134.128 oraracx8 oraracx8.cisco.com

#### #Virtual IP

10.29.134.129	oraracx1-vip	oraracx1-vip.cisco.com
10.29.134.130	oraracx2-vip	oraracx2-vip.cisco.com
10.29.134.131	oraracx3-vip	oraracx3-vip.cisco.com
10.29.134.132	oraracx4-vip	oraracx4-vip.cisco.com
10.29.134.133	oraracx5-vip	oraracx5-vip.cisco.com
10.29.134.134	oraracx6-vip	oraracx6-vip.cisco.com
10.29.134.135	oraracx7-vip	oraracx7-vip.cisco.com
10.29.134.136	oraracx8-vip	oraracx8-vip.cisco.com

#### **#Private IP**

192.168.10.121 oraracx1-priv	oraracx1-priv.cisco.com
192.168.10.122 oraracx2-priv	oraracx2-priv.cisco.com
192.168.10.123 oraracx3-priv	oraracx3-priv.cisco.com
192.168.10.124 oraracx4-priv	oraracx4-priv.cisco.com
192.168.10.125 oraracx5-priv	oraracx5-priv.cisco.com
192.168.10.126 oraracx6-priv	oraracx6-priv.cisco.com
192.168.10.127 oraracx7-priv	oraracx7-priv.cisco.com
192.168.10.128 oraracx8-priv	oraracx8-priv.cisco.com

#### **#SCAN IP**

10.29.134.137oraracx-cluster-scanoraracx-cluster-scan.cisco.com10.29.134.138oraracx-cluster-scanoraracx-cluster-scan.cisco.com10.29.134.139oraracx-cluster-scanoraracx-cluster-scan.cisco.com

## **#Oracle Client**

10.29.134.196linuxclient1linuxclient1.cisco.com10.29.134.197linuxclient2linuxclient2.cisco.com

## You must configure the following addresses manually in your corporate setup.

- A Public IP Address for each node
- A Virtual IP address for each node
- Three single client access name (SCAN) address for the oracle cluster

When all the LUNs are created and O.S level prerequisites are completed, you are ready to install Oracle Grid Infrastructure as grid user. Download Oracle Database 12c Release 2 (12.2.0.1.0) for Linux x86-64 and Oracle Database 12c Release 2 Grid Infrastructure (12.2.0.1.0) for Linux x86-64 software from Oracle Software site. Copy these software binaries to Oracle RAC Node 1 and Unzip all files into appropriate directories.

## Oracle Database 12c GRID Infrastructure Deployment

For this FlashStack Solution, you will install Oracle Grid and Database software on all eight nodes (oraracx1, oraracx2, oraracx3, oraracx4, oraracx5, oraracx6, oraracx7 and oraracx8). The installation guides you through gathering all node information and configuring ASM devices and all the prerequisite validations for GI.

It is not within the scope of this document to include the specifics of an Oracle RAC installation; you should refer to the Oracle installation documentation for specific installation instructions for your environment. We will provide a partial summary of details that might be relevant.

This section describes the high-level steps for Oracle Database 12c R2 RAC install. Prior to GRID and database install, verify all the prerequisites are completed. As an alternate, you can install Oracle validated RPM that will make sure all prerequisites are meet before Oracle grid install.

Use the following link for Oracle Database 12c Release 2 Install and Upgrade guide: https://docs.oracle.com/en/database/oracle/oracle-database/12.2/install-and-upgrade.html

### Run Cluster Verification Utility

This step will verify that all prerequisites are meet to install Oracle Grid Infrastructure Software. Oracle Grid Infrastructure ships with the Cluster Verification Utility (CVU) that can run to validate pre and post installation configurations. To run this utility, login as Grid User in Oracle RAC Node 1 and go to the directory where oracle grid software binaries are located. Run script named as "runcluvfy.sh" as follows:

./runcluvfy.sh stage -pre crsinst -n oraracx1,oraracx2,oraracx3,oraracx4,oraracx5,oraracx6,oraracx7,oraracx8 – verbose

#### Configure HugePages

HugePages is a method to have larger page size that is useful for working with a very large memory. For Oracle Databases, using HugePages reduces the operating system maintenance of page states, and increases Translation Lookaside Buffer (TLB) hit ratio.

Advantages of HugePages:

- HugePages are not swappable so there is no page-in/page-out mechanism overhead.
- HugePages uses fewer pages to cover the physical address space, so the size of "book keeping" (mapping from the virtual to the physical address) decreases, so it requiring fewer entries in the TLB and so TLB hit ratio improves.
- HugePages reduces page table overhead. Also, HugePages eliminated page table lookup overhead: Since the pages are not subject to replacement, page table lookups are not required.

• Faster overall memory performance: On virtual memory systems each memory operation is actually two abstract memory operations. Since there are fewer pages to work on, the possible bottleneck on page table access is clearly avoided.



For our configuration, we used HugePages for all the OLTP and DSS workloads.

Please refer to the Oracle support for HugePages configuration details: <u>https://docs.oracle.com/en/database/oracle/oracle-database/12.2/unxar/administering-oracle-database-on-linux.html#GUID-CC72CEDC-58AA-4065-AC7D-FD4735E14416</u>

#### Create Directory Structure

The directory structure should be create on all the RAC nodes but unzipping grid software happens on the first node only.

As the grid user, download the Oracle Grid Infrastructure image files and extract the files into the Grid home.

You must extract the zip image software into the directory where you want your Grid home to be located. Also, Download and copy the Oracle Grid Infrastructure image files to the local node only. During installation, the software is copied and installed on all other nodes in the cluster.

mkdir -p /u01/app/12.2.0/grid

chown grid:oinstall /u01/app/12.2.0/grid

cd /u01/app/12.2.0/grid

unzip -q download\_location/linuxx64\_12201\_grid\_home

mkdir -p /u01/app/oracle/product/12.2.0/dbhome\_1

chown -R oracle:oinstall /u01/app/oracle

Configure Oracle ASM Driver and Shared Disks

This step has to be done only on the first node.

1. Log in as the root user and set the environment variable ORACLE\_HOME to the location of the Grid home:

export ORACLE\_HOME=/u01/app/12.2.0/grid

2. Use Oracle ASM command line tool (ASMCMD) to provision the disk devices for use with Oracle ASM Filter Driver:

/u01/app/12.2.0/grid/bin/asmcmd afd\_label OCRVOTE /dev/mapper/dg\_orarac\_crs -init

3. Verify the device has been marked for use with Oracle ASMFD:

/u01/app/12.2.0/grid/bin/asmcmd afd\_lslbl /dev/mapper/dg\_orarac\_crs

\_\_\_\_\_

Label Duplicate Path

\_\_\_\_\_

OCRVOTE /dev/mapper/dg\_orarac\_crs

After configuring the Oracle ASM disk group, you will install Oracle Grid Infrastructure and Oracle Database 12c R2 standalone software. For this solution, we installed Oracle binaries on the boot LUN of the nodes. The OCR, Data, and redo log files reside in the Oracle ASM disk group created from CRS, Data and Redolog volume.

Log in as the grid user, and start the Oracle Grid Infrastructure installer as detailed in the next step.

## Install and Configure Oracle Database Grid Infrastructure Software



It is not within the scope of this document to include the specifics of an Oracle RAC installation. However, we will provide partial summary of details that might be relevant. Please refer to the Oracle installation documentation for specific installation instructions for your environment.

To install Oracle Database Grid Infrastructure Software, complete the following steps:

- 1. Go to grid home where the Oracle 12c R2 Grid Infrastructure software binaries are located and launch the installer as the "grid" user.
- 2. Start the Oracle Grid Infrastructure installer by running the following command:

./gridSetup.sh

3. Select option "Configure Oracle Grid Infrastructure for a New Cluster" as shown below, then click Next:

🛃 Oracle Grid Infrastructure 12c Re	ease 2 Installer - Step 1 of 9@oraracx1 -	$\times$
Select Configuration Opt	ion ORACLE GRID INFRASTRUCTURE	C
Configuration Ontion	Select an option to configure the software. The wizard will register the home in the central	
Cluster Configuration	inventory and then perform the selected configuration.	
Operating System Groups	Onfigure Oracle Grid Infrastructure for a New <u>Cluster</u>	
Installation Location	Configure Oracle Grid Infrastructure for a Standalone Server (Oracle <u>Restart</u> )	
Root script execution Prerequisite Checks	O Upgrade Oracle Grid Infrastructure	
Summary Install Product Finish	○ Set Up Software <u>O</u> nly	
Help	< <u>B</u> ack <u>N</u> ext > Install Cance	el

- 4. Select cluster configuration options "Configure an Oracle Standalone Cluster", then click Next.
- 5. In next window, enter the Cluster Name and SCAN Name fields.

Enter the names for your cluster and cluster scan that are unique throughout your entire enterprise network. You can select Configure GNS if you have configured your domain name server (DNS) to send to the GNS virtual IP address name resolution requests

6. In next Cluster node information window, click the "Add" button to add all eight nodes Public Hostname and Virtual Hostname as shown below:

<b>4</b>	Oracle Grid Infrastructure 12c Rel	ease 2 Installer - Step 4 of 16@orara	acx1	– 🗆 X
Clu	uster Node Information			
1	Configuration Option	Provide the list of nodes to be and Virtual Hostname.	managed by Oracle Grid Infrastruc	ture with their Public Hostname
L.T.	Grid Plug and Play	Public Hostname	Role	Virtual Hostname
Ť		oraracx1	HUB	oraracx1-vip
•	Cluster Node Information	oraracx2	HUB	oraracx2-vip
6	Network Interface Usage	oraracx3	HUB	
	Stanson Onting	oraracy5	НИВ	oraracx5-vip
ĬĬ	Storage Option	oraracx6	НИВ	
Ý	Grid Infrastructure Managem	oraracx7	HUB	oraracx7-vip
6	Create ASM Disk Group	oraracx8	HUB	oraracx8-vip
	Operating System Groups Installation Location Root script execution	SSH <u>c</u> onnectivity	Use Cluster Configuration F	ile <u>A</u> dd <u>E</u> dit <u>R</u> emove
	Prerequisite Checks	<u>O</u> S Username: grid	OS Pass <u>w</u> ord:	••••••
J	Install Product	User home is shared by th	he selected nodes	
5	Finish			<u>T</u> est Setup
•	▶ • •		< <u>B</u> ack	lext > Install Cancel

- 7. As shown above, you will see all nodes listed in the table of cluster nodes. Make sure the Role column is set to HUB for all eight nodes. Click the SSH Connectivity button at the bottom of the window. Enter the operating system user name and password for the Oracle software owner (grid). Click Setup.
- 8. A message window appears, indicating that it might take several minutes to configure SSH connectivity between the nodes. After sometime, another message window appears indicating that password-less SSH connectivity has been established between the cluster nodes. Click OK to continue.

🛓 Oracle Grid Infrastructure 12c Release 2 Installer - Step 4 of 16@oraracx1

Cluster Node Information				
Configuration Option	Provide the list of nodes to be r and Virtual Hostname.	managed by Oracle Grid Infra	structure with thei	ir Public Hostname
	Public Hostname	Role	Virtu	ual Hostname
Grid Plug and Play	oraracxl	НИВ	🔷 oraracx1-vip	D
💩 Cluster Node Information	oraracx2	HUB	▼ oraracx2-vip	0
Natural Interferent Linear	oraracx3	HUB	▼ oraracx3-vip	)
	oraracx4	HUB	oraracx4-vip	<b>)</b>
🔆 Storage Option	oraracx5	HUB	▼ oraracx5-vip	)
Grid Infrastructure	Grid Infrastructure 12c Release 2 Inst	taller@oraracx1	× P	)
			IP	
Create ASM Disk Gr	Successfully established na	sewordlase SSH connectivity	hetween	)
🔶 ASM Password 🛛 🚺	the selected nodes.		between	
Operating System				
<ul> <li>Installation Location</li> </ul>				
Root script executic			<u></u>	
🍦 Prerequisite Checke	<u>o o o o o o o o o o o o o o o o o o o </u>			
Summary	User home is shared by the	e selected nodes		
🖕 Install Product				
O. Finish	Reuse private and public <u>k</u> e	ys existing in the user home		
O Finish				Test Satur
				Test Seruh
Help		< <u>B</u> ack	<u>N</u> ext >	Install Cancel

\_

 $\times$ 

9. In Network Interface Usage screen, select the usage type for each network interface displayed as shown below:

🔬 Oracle Grid Infrastructure 12c Release 2 Installer - Step 5 of 16@oraracx1

Specify Network Interface Usage

			GRID INFRASTRUCTURE
Configuration Option	Private interfaces are used I	by Oracle Grid Infrastructure fo	or internode traffic.
Cluster Configuration			
Grid Plug and Play	Interface Name	Subnet	Use for
Cluster Node Information	enos	10.29.134.0	Public  ASM 6. Private
Network Interface Usage	virbr0	192.168.122.0	Do Not Use
network interface usage			·
<u>Storage Option</u>			
Grid Infrastructure Managem			
Create ASM Disk Group			
ASM Password			
Operating System Groups			
Installation Location			
Root script execution			
Prerequisite Checks			
Summary			
Install Product			
Finish			
11-1-		. Baak	

ORACL

×

- 10. Select the Oracle ASM storage configuration option as "Configure ASM using block devices." Choose whether you want to store the Grid Infrastructure Management Repository in a separate Oracle ASM disk group as "No", and then click Next.
- 11. In the Create ASM Disk Group window, enter the name of disk group and select appropriate redundancy options as show below. We selected Oracle ASM Filter Driver (Oracle ASMFD) to manage Oracle ASM disk devices, so select the option Configure Oracle ASM Filter Driver. Select the OCRVOTE LUN assigned from Pure Storage to store OCR and Voting disk files.



2

🛓 Oracle Grid Infrastructure 12c Rel	ease 2 Installer - Step 8 of 16@oraracx1	– 🗆 X
Create ASM Disk Group	GRI	
Configuration Option Cluster Configuration Grid Plug and Play Cluster Node Information Network Interface Usage Storage Option	OCR and Voting disk data will be stored in the following ASM Disk grocharacteristics of this Disk group.         Disk group name       OCRVOTE         Redundancy       Flex       High       Normal       External         Allocation Unit Size       4       MB       Select Disks       Show	oup. Select disks and Candidate/Provisioned Disks 💌
Grid Infrastructure Managem     Create ASM Disk Group     ASM Password     Operating System Groups     Installation Location     Root script execution	Disk Path	Size (in MB) Status 204800 Provisioned
<ul> <li>Prerequisite Checks</li> <li>Summary</li> <li>Install Product</li> <li>Finish</li> </ul>	Configure Oracle ASM Filter Driver Select this option to configure ASM Filter Driver(AFD) to simplify conf disk devices by Oracle ASM.	Change Discovery <u>Path</u>
Help	< <u>B</u> ack <u>N</u> ex	t > Install Cancel

- 12. Choose the same password for the Oracle ASM SYS and ASMSNMP account, or specify different passwords for each account, then click Next.
- 13. Select the option "Do not use Intelligent Platform Management Interface (IPMI)", then click Next.

You can choose to set it up according to your requirements.

- 14. Select the appropriate operating system group names for Oracle ASM according to your environments.
- 15. Specify the directory to use for the Oracle base for the Oracle Grid Infrastructure installation and then click Next. The Oracle base directory must be different from the Oracle home directory.

If you copied the Oracle Grid Infrastructure installation files into the Oracle Grid home directory as directed
above, then the default location for the Oracle base directory should display as /u01/app/grid.

16. Click Automatically run configuration scripts to run scripts automatically and enter the relevant root user credentials. Click Next. 17. Wait while the prerequisite checks complete. If you have any issues, use the "Fix & Check Again" button.

If any of the checks have a status of Failed and are not fixable, then you must manually correct these issues. After you have fixed the issue, you can click the Check Again button to have the installer recheck the requirement and update the status. Repeat as needed until all the checks have a status of Succeeded. Click Next.

 Review the contents of the Summary window and then click Install. The installer displays a progress indicator enabling you to monitor the installation process.

🤹 Oracle G	rid Infrastructure 12c Release 2 Installer - Step 18 of 19@oraracx1	- 0 X
Install Product		ETURE 12 <sup>C</sup>
Configuration Option Cluster Configuration Grid Plug and Play Cluster Node Information	Progress 74% Copying database files	
<ul> <li>Network Interface Usage</li> <li>Storage Option</li> <li>Grid Infrastructure Managem</li> <li>Create ASM Disk Group</li> <li>ASM Password</li> <li>Failure Isolation</li> <li>Management Options</li> <li>Operating System Groups</li> <li>Installation Location</li> </ul>	Status         Configure Local Node         Prepare         Link binaries         Setup         Copy Files to Remote Nodes         Configure Remote Nodes         Configure Remote Nodes         Prepare         Setup         Setup         Setup         Setup         Configure Remote Nodes         Prepare         Setup         Setup	Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded Succeeded
Create Inventory Root script execution Prerequisite Checks Summary Install Product Finish	Oracle Net Configuration Assistant     Automatic Storage Management Configuration Assistant     Creating Container Database for Oracle Grid Infrastructure Managemen     Details     Details     ORACLE     T2C     Flexibility, Agility, Availabilit     Scale-out with Flex ASM and Flex C     <	Retry Skip

- 19. Wait for the grid installer configuration assistants to complete.
- 20. When the configuration complete successfully, click "Close" button to finish and exit the grid installer.
- 21. When GRID install is successful, login to each of the nodes and perform minimum health checks to make sure that Cluster state is healthy. After your Oracle Grid Infrastructure installation is complete, you can install Oracle Database on a cluster node for high availability, or install Oracle RAC.

## Install Oracle Database Software

After successful GRID install, we recommend to install Oracle Database 12c software only. You can create databases using DBCA or database creation scripts at later stage.

It is not within the scope of this document to include the specifics of an Oracle RAC database installation. However, we will provide partial summary of details that might be relevant. Please refer to the Oracle database installation documentation for specific installation instructions for your environment.

To install Oracle Database Software, complete the following steps:

- 1. Start the runInstaller command from the Oracle Database 12c Release 2 (12.2) installation media where Oracle database software is located.
- 2. Select option "Install database software only" into Select Installation Option.

S C	Dracle Database 12c Release 2 Installer - Step 2 of 9@oraracx1 🛛 📃 🗖 🗙
Select Installation Option	
<u>Configure Security Updates</u> Installation Option     Database Installation Options	Select any of the following install options.
Install Type Typical Installation Prerequisite Checks Summary Install Product	♥ ♥ unstall gatabase software only
Finish	
<mark>↓</mark> <u>H</u> elp	< Back Next > Install Cancel

3. Select option "Oracle Real Application Clusters database installation" and click Next.

<u>چ</u>	racle Database 12c Release 2 Installer - Step 3 of 9@oraracx1
Select Database Installat	ion Option ORACLE 12 <sup>C</sup>
<u>Configure Security Updates</u>	Select the type of database installation you want to perform.
Installation Option	Single instance database installation
Database Installation Opt	$rac{W}{\odot}$ Oracle Real Application Clusters database installation
A Install Type	○ Oracle RAC On <u>e</u> Node database installation
Typical Installation	
Prerequisite Checks	
9 Summary	
Install Product	
Ó Finish	
Help	< <u>Back</u> Next > Install Cancel

4. Select nodes in the cluster where installer should install Oracle RAC. For this setup, you will install software on all nodes as shown below.

S Ora	acle Database 12c Release 2 Installer - Step 4 of 10@oraracx1
Select List of Nodes	
Configure Security Updates Installation Option Database Installation Options Nodes Selection Install Type Typical Installation Prerequisite Checks Summary Install Product Finish	Select nodes (in addition to the local node) in the cluster where the installer should install Oracle RAC or Oracle RAC One.          Node name         2       oraracx3         2       oraracx3         3       oraracx3         4       oraracx6         7       oraracx7         8       oraracx4         SSH connectivity       Select all         QS Username:       oracle         OS Username:       oracle         OS Password:       oracle         Image:       Image:         Image:       oracle         Image:       Image:         Image:       oraracx6         Image:       Image:         Image:       Image:
Help	< <u>B</u> ack <u>N</u> ext > Install Cancel

- 5. Click the "SSH Connectivity..." button and enter the password for the "oracle" user. Click the "Setup" button to configure passwordless SSH connectivity, and the "Test" button to test it once it is complete. When the test is complete, click Next.
- 6. Select Database Edition Options according to your environments and then click Next.
- 7. Enter Oracle Base as "/u01/app/oracle" and "/u01/app/oracle/product/12.2.0/dbhome\_1" as the software location, then click Next.
- 8. Select the desired operating system groups and then click Next.
- 9. Wait for the prerequisite check to complete. If there are, any problems either click the "Fix & Check Again" button, or try to fix those by checking and manually installing required packages. Click Next.
- 10. Verify the Oracle Database summary information, click Install.
- 11. When prompted, run the configuration script on each node. When the scripts run successfully on each node, click OK.

🛓 Ora	acle Database 12c Release 2 Installer - Step 11 of 11@orarac	x1 ×
Finish		
Configure Security Updates Installation Option Database Installation Options Nodes Selection Database Edition Installation Location Operating System Groups Prerequisite Checks Summary	The installation of Oracle Database was successful.	
Finish	- Back Mex	

12. Click Close to exit the installer.

## **Configure Database LUNs**

Use the Oracle ASM command line tool (ASMCMD) or ASM Configuration Assistance GUI to provision devices for use with Oracle ASM Filter Driver. You can label the disks by running asmcmd command line utility as shown below:

/u01/app/12.2.0/grid/bin/asmcmd afd\_label DATAOLTP1 /dev/mapper/dg\_oradata\_oltp1 --init

/u01/app/12.2.0/grid/bin/asmcmd afd\_label REDOOLTP1 /dev/mapper/dg\_oraredo\_oltp1 -init

/u01/app/12.2.0/grid/bin/asmcmd afd\_label DATASOE1 /dev/mapper/dg\_oradata\_soe1 --init

/u01/app/12.2.0/grid/bin/asmcmd afd\_label REDOSOE1 /dev/mapper/dg\_oraredo\_soe1 -init

/u01/app/12.2.0/grid/bin/asmcmd afd\_label DATADSS1 /dev/mapper/dg\_oradata\_dss1 -init

/u01/app/12.2.0/grid/bin/asmcmd afd\_label REDODSS1 /dev/mapper/dg\_oraredo\_dss1 -init

/u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB1 /dev/mapper/dg\_oradata\_slob01 --init

/u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB2 /dev/mapper/dg\_oradata\_slob02 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB3 /dev/mapper/dg\_oradata\_slob03 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB4 /dev/mapper/dg\_oradata\_slob04 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB5 /dev/mapper/dg\_oradata\_slob05 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB6 /dev/mapper/dg\_oradata\_slob06 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB7 /dev/mapper/dg\_oradata\_slob07 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB8 /dev/mapper/dg\_oradata\_slob08 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB8 /dev/mapper/dg\_oradata\_slob08 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB8 /dev/mapper/dg\_oradata\_slob08 –init /u01/app/12.2.0/grid/bin/asmcmd afd\_label DSLOB9 /dev/mapper/dg\_oradata\_slob09 –init

Verify the device has been marked for use with Oracle ASMFD:

Figure 18 ASM Disk Groups	
<pre>[root@oraracx1 ~]# export ORACLE_HOW [root@oraracx1 ~]# cd \$ORACLE_HOME [root@oraracx1 grid]# cd bin/ [root@oraracx1 bin]# [root@oraracx1 bin]# ./asmcmd afd_ls</pre>	4E=/u01/app/12.2.0/grid
Label Duplicate	Path
DATADSS1 DATAOLTP1 DATASOE1 DSLOB1 DSLOB2 DSLOB3 DSLOB4 DSLOB5 DSLOB6 DSLOB6 DSLOB7 DSLOB8 DSLOB9 OCRVOTE RED0DSS1 RED0DLTP1 RED0SLOB RED0S0E1 [root@oraracx1 bin]#	/dev/mapper/dg_oradata_dss1 /dev/mapper/dg_oradata_oltp1 /dev/mapper/dg_oradata_soe1 /dev/mapper/dg_oradata_slob01 /dev/mapper/dg_oradata_slob03 /dev/mapper/dg_oradata_slob04 /dev/mapper/dg_oradata_slob05 /dev/mapper/dg_oradata_slob06 /dev/mapper/dg_oradata_slob07 /dev/mapper/dg_oradata_slob08 /dev/mapper/dg_oradata_slob09 /dev/mapper/dg_orarac_crs /dev/mapper/dg_oraredo_dss1 /dev/mapper/dg_oraredo_oltp1 /dev/mapper/dg_oraredo_slob /dev/mapper/dg_oraredo_soe1

The figure below displays all the Disk Groups created to configure databases for this solution environment.

KASM Configuration Assi	stant: Disk Groups@oraracx1					– 🗆 X
					144	
Disk Groups				\$4 \$		
0 ACM	I				A AT	
ASM Instances	Disk Group Name	Size (GB)	Free (GB)	Usable (GB)	Redundancy	State
	DATADSS1	13312.00	2667 21	2667.21	EXTERN	MOUNTED(3 of 8)
G oranacx1	DATAOLTP1	5120.00	22 75	22 75	EXTERN	MOUNTED(3 of 8)
oraracx2	DATASLOB	5400.00	483.03	483.03	EXTERN	MOUNTED(3 of 8)
i oraracx3	DATASOEI	10240.00	1622.06	1622.06	EVTEDN	MOUNTED(3 of 9)
oraracx4	OCRVOTE	200.00	15214	15214	EXTERN	MOUNTED(3 of 8)
@ oraracx5	REDODSS1	500.00	451 55	152.14	EXTERN	MOUNTED(3 of 8)
	REDODITR1	500.00	451.50	451.50	EVTEDNI	MOUNTED(3 of 9)
	REDOCIOR	100.00	67.40	67.40	EVTEDNI	MOUNTED(3 of 9)
oraracx8	REDOSCOB	500.00	451 55	451 55	EVTEDNI	MOUNTED(3 of 8)
REDOSLOB     REDOSLOB     O DATADSS1     O DATASOE1     O OCRVOTE     O DATASLOB     REDOOLTP1     O DA						
∰ Volumes }-∰ ACFS File Systems ∦ Settings	Note: Use right click to see	more options. ismount All	h			
Help	1					Exit

As shown above, we created the disk-group as DATADSS1 and REDODSS1 for DSS Database (DSSDB1) workload. Similarly, we have created disk-groups for OLTPDB1, SOEDB1 and SLOBDB1 for OLTP Databases workloads as explained in the following section.

# Scalability Test and Results

Before configuring a database for workload tests, it is extremely important to validate that this is indeed a balanced configuration that is capable of delivering expected performance. In this FlashStack solution, we will test and validate node and user scalability on an 8 node Oracle RAC Databases with various database benchmarking tools. We used widely adopted database performance test tools to test and validate throughput, IOPS, and latency for various test scenarios on FlashArray //X70 system as follows:

- SLOB (Silly Little Oracle Benchmark)
- CalibrateIO
- Swingbench

## Database Creation with DBCA

We used Oracle Database Configuration Assistant (DBCA) to create three OLTP (SLOBDB, OLTPDB1 and SOEDB1) and one DSS (DSSDB1) databases for SLOB and Swingbench calibration. Alternatively, you can use Database creation scripts to create the databases as well. Make sure to place the data files, redolog files and control files in appropriate directory paths discussed in the storage layout section.

# SLOB Performance on FlashArray //X70

The Silly Little Oracle Benchmark (SLOB) is a toolkit for generating and testing I/O through an Oracle database. SLOB is very effective in testing the I/O subsystem with genuine Oracle SGA-buffered physical I/O. SLOB supports testing physical random single-block reads (db file sequential read) and random single block writes (DBWR flushing capability).

SLOB issues single block reads for the read workload that are generally 8K (as the database block size was 8K). For testing the SLOB workload, we created one OLTP database (SLOBDB) of 4 TB in Size. We created two diskgroup to store the data and redolog files for the SLOBDB database. First disk-group "Data-SLOB" was created with 9 LUNs (600 GB each) while second disk-group "Redo-SLOB" was created with one LUN (100 GB). We loaded SLOB schema on "Data-SLOB" disk-group of up to 4 TB in size. The following tests were performed and various metrics like IOPS and latency were captured along with Oracle AWR reports for each test scenario.

## User Scalability Performance on FlashArray //X70

SLOB was configured to run against all the 8 RAC nodes and the concurrent users were equally spread across all the nodes. For Pure Storage FlashArray //X70, we scale users from 32 to 256 for Oracle RAC 8 nodes and identify the maximum IOPS and latency as explained.

- User Scalability test with 32, 64, 128, 192 and 256 users on 8 Oracle RAC nodes
- Varying workloads
  - 100% read (0% update)
  - 90% read (10% update)
  - 70% read (30% update)
  - 50% read (50% update)

The following table illustrate user scalability for the total number of IOPS (both read and write) when run with 32, 64, 128, 192 and 256 Users. For all user scale, we recorded the following number of IOPS as shown in the table below:

Users	Read/Write % (100/0)	Read/Write % (90/10)	Read/Write % (70/30)	Read/Write % (50/50)		
32	74,363	87,205	106,367	105,738		
64	<b>64</b> 154,943 169,370		198,618	204,928		
128	302,211	316,118	329,088	322,619		
192	414,616	397,346	367,135	327,229		
256	496,892	412,491	364,626	342,852		

#### Table 11 User Scalability

The following graphs illustrate user scalability in terms of total IOPS while running SLOB workload for 32, 64, 128, 192 and 256 concurrent users for each test scenario.





The graph illustrates the linear scalability with increased users and similar IOPS from 32 users to 256 users with 100% read, 90% read, 70% read and 50% read. The below snapshot was captured from a 100% Read (0% update) Test scenario while running SLOB test. The snapshot shows a section from 3-hour window of AWR report from the run that highlights Physical Reads/Sec and Physical Writes/Sec for each instance. This section highlights that IO load is distributed across all the cluster nodes performing workload operations. Due to variations in workload randomness, we conducted multiple runs to ensure consistency in behavior and test results.

#### Figure 21 SLOB – IOPS AWR Snapshot

System	Statistics - Pe	r Second	DB,	/Inst: SLOB/sl	obl Snaps: 46	6-47				
I#	Logical Reads/s	Physical Reads/s	Physical Writes/s	Redo Size (k)/s	Block Changes/s	User Calls/s	Execs/s	Parses/s	Logons/s	Txns/s
1	67,666.78	61,597.7	1.2	2.8	8.8	0.5	1,029.7	2.3	0.12	0.0
2	68,027.41	61,921.7	1.1	2.9	8.8	0.5	1,035.5	2.3	0.12	0.0
3	68,204.55	62,089.6	1.0	2.7	8.5	0.7	1,037.9	2.4	0.12	0.0
4	72,683.00	62,249.4	1.1	2.9	8.8	0.5	1,040.4	2.4	0.12	0.0
5	68,223.68	62,098.3	1.1	2.8	8.9	0.5	1,039.1	2.4	0.12	0.0
6	68,461.38	62,338.5	1.1	2.7	8.3	0.5	1,041.7	2.3	0.11	0.1
7	68,004.02	61,936.0	1.1	2.8	8.5	0.5	1,035.1	2.4	0.12	0.0
8	72,693.44	62,651.9	1.2	2.6	36.6	0.5	1,045.1	2.8	0.11	0.0
Sum	553,964.26	496,883.0	8.9	22.1	97.1	4.3	8,304.4	19.2	0.93	0.3
Avg	69,245.53	62,110.4	1.1	2.8	12.1	0.5	1,038.0	2.4	0.12	0.0
Std	2,136.91	314.9	0.0	0.1	9.9	0.1	4.7	0.2	0.00	0.0

Even though the FlashArray //X70 can scale up to 9 GBps of reads, we were limited by the total number of IOPS and not on the bandwidth. The maximum bandwidth is validated with the DSS query as shown in next section.

The following graph illustrates the latency exhibited by the //X70 FlashArray across different workloads. All the workloads experienced less than 1 millisecond latency and it varies based on the workload. As expected, the 50% read (50% update) test exhibited higher latencies as the user counts increases. However, these are exceptional performance characteristics keeping the nature of the IO load.





The following screenshot was captured from 50% Read (50% Update) Test scenario while running SLOB test. The snapshot shows a section from 3-hour window of AWR report from the run that highlights top timed Background Events.



Top Ti	med Backgro	und Events DB/Inst: SLOB	/slob1 Snaps: 150-	151								
-> % 0	T bg time:	s of background elapsed time										
-> 1ns	tance *	<ul> <li>cluster wide summary</li> </ul>										
->	.*.	Waits, %Timeouts, Wait Time Total(s)	: Cluster-wide t	otal for t	he wait event							
->	'*'	'Wait Time Avg' :	Cluster-wide averag	e computed	as (Wait Time	Total / E	vent Waits	)				
->	*	Summary 'Avg Wait Time' :	Per-instance 'Wait	Time Avg'	used to compute	e the foll	owing stat	istics				
->	'*'	[Avg/Min/Max/Std Dev]	: average/minimu	m/maximum/	standard devia	tion of pe	r-instance	'Wait Time	Avg '			
->	'*' Cnt : count of instances with wait times for the event											
		Wait	Event		Wa:	it Time			Summary	Avg Wait Tir	ne	
T#	Class Event		Waite &	Waits %Timeouts		Total(s) Ava Wait %DB time			Ava Min Max Std			Cnt
1#	Class	Lvent	Naits -	Nuites allineoutes		Totat(s) Avg Wart 400 time		Avy	IIIIII	FIGA	Stu Dev	CITC
*		background cpu time	N/A	N/A	14,519.13		63.01					8
	System I/O	db file parallel write	13,242,015	0.0	6,555,66	495.07us	28.45	495.02us	490.23us	499.82us	3.46us	8
	System I/O	log file parallel write	3,123,071	0.0	4.747.55	1.52ms	20.60	1.52ms	1.50ms	1.55ms	20.96us	8
	Other	RMA: IPCO completion sync	15.139	0.0	293.53	19.39ms	1.27	19.39ms	19.35ms	19.42ms	25.12us	8
	Cluster	service monitor: inst recovery complet	io 0	N/A	212.55		0.92					8
	System T/O	control file sequential read	101,438	Θ.Θ	78.96	778,41us	0.34	778.85us	763.67us	815.00us	17.31us	8
	Other	latch free	51,699	0.0	44.68	864.2405	0.19	885.27us	350,6305	1.86ms	672.41us	8
	Annlicatio	eng: TX - row lock contention	17	0 0	40 10	2358 68m	0.17	2391 43ms	2022 23ms	2814 90ms	279 92ms	8
	Other	Sync ASM rebalance	3 504	0.0	32 06	Q 15mc	0 14	Q A9mc	14 6805	24 3/ms	12 //ms	8
	System T/O	log file sequential read	12 156	0.0	25.89	1 07mc	0 11	1 07mg	1 01mc	2 0.2ms	36 83116	g
	oysean 170	tog fite sequentiat feau	15,150	0.0	25.65	1.57115	0.11	1.57115	119103	2:0203	3010303	

The following screenshot was captured from 90% Read (10% Update) Test scenario while running SLOB test. The snapshot shows a section from 3-hour window of AWR report from the run that highlights top timed Events.

#### Figure 24 SLOB User Scalability – Top Timed Events Timed Ev Instance - cluster wide summary Waits, %Timeouts, Wait Time Total(s) 'Wait Time Avg Summary 'Avg Wait Time ' [Avg/Min/Max/Std Dev] : Cluster-wide total for the wait event : Cluster-wide average computed as (Wait Time Total / Event Waits) : Per-instance 'Wait Time Avg ' used to compute the following statistics : average/minimum/maximum/standard deviation of per-instance 'Wait Time Avg' : count of instances with wait times for the event Wait Event Wait Time Summary Avg Wait Time Waits %Timeouts Class T# Event Total(s) Avg Wait %DB time Avg Min Max Std Dev Cnt file sequential read 670,680,974 User I/O db 416,854,63 621,54us 621.54us 620.33us db file sequentiat read DB CPU gc cr grant 2-way gc current grant 2-way db file parallel write log file parallel write gcs dnm freeze in enter server mode RMA: IPCO completion sync db file scattered read 622.49us 660.67ns N/A N/A 43 762 04 822.33 Cluster System I/O System I/O Other 371.6lus 777.99us 371.630 1,121,20 771.77us 280.98ms 588.33 291.25ms 291.27ms I/0 attered read fault extent map

# SwingBench Performance on FlashArray //X70

## Database Workload Configuration

We used Swingbench and Calibrate IO for workload testing. Swingbench is a simple to use, free, Java-based tool to generate database workload and perform stress testing using different benchmarks in Oracle database environments. Swingbench can be used to demonstrate and test technologies such as Real Application Clusters, Online table rebuilds, Standby databases, online backup and recovery, etc.

Swingbench provides four separate benchmarks, namely, Order Entry, Sales History, Calling Circle, and Stress Test. For the tests described in this solution, Swingbench Order Entry benchmark was used for OLTP workload testing and the Sales History benchmark was used for the DSS workload testing.

The Order Entry benchmark is based on SOE schema and is TPC-C like by types of transactions. The workload uses a very balanced read/write ratio around 60/40 and can be designed to run continuously and test the performance of a typical Order Entry workload against a small set of tables, producing contention for database resources.

The Sales History benchmark is based on the SH schema and is TPC-H like. The workload is query (read) centric and is designed to test the performance of queries against large tables.

Typically encountered in the real-world deployments, we tested a combination of scalability and stress related scenarios that ran on all the 8-node Oracle RAC cluster configuration.

OLTP database user scalability and OLTP database node scalability representing small and random transactions

- DSS database workload representing larger transactions
- Mixed workload featuring OLTP and DSS database workloads running simultaneously for 24 hours

For Swingbench workload, we created two OLTP (Order Entry) and one DSS (Sales History) database to demonstrate database consolidation, multi-tenancy capability, performance and sustainability. We created approximately 4 TB of OLTPDB1, 5 TB of SOEDB1 and 9 TB of DSSDB1 database to perform swingbench testing.

After creating all the databases, we have to run the Calibrate IO tool to check the performance of the storage system as described below.

## Oracle Calibrate IO Performance on FlashArray //X70

The I/O calibration feature of Oracle Database enables you to assess the performance of the storage subsystem, and determine whether I/O performance problems are caused by the database or the storage subsystem. Unlike other external I/O calibration tools that issue I/Os sequentially, the I/O calibration feature of Oracle Database issues I/Os randomly using Oracle datafiles to access the storage media, producing results that more closely match the actual performance of the database.

The I/O calibration feature of Oracle Database is accessed using the

DBMS\_RESOURCE\_MANAGER.CALIBRATE\_IO procedure. This procedure issues an I/O intensive read-only workload (made up of one megabytes of random of I/Os) to the database files to determine the maximum IOPS (I/O requests per second) and MBPS (megabytes of I/O per second) that can be sustained by the storage subsystem. Due to the overhead from running the I/O workload, I/O calibration should only be performed when the database is idle, or during off-peak hours, to minimize the impact of the I/O workload on the normal database workload.

To run I/O calibration and assess the I/O capability of the storage subsystem used by Oracle Database, use the DBMS\_RESOURCE\_MANAGER.CALIBRATE\_IO procedure:

#### SET SERVEROUTPUT ON

DECLARE

lat INTEGER;

iops INTEGER;

mbps INTEGER;

BEGIN

DBMS\_RESOURCE\_MANAGER.CALIBRATE\_IO (2, 10, iops, mbps, lat);

DBMS\_OUTPUT.PUT\_LINE ('max\_iops = ' || iops);

DBMS\_OUTPUT.PUT\_LINE ('latency = ' || lat);

dbms\_output.put\_line('max\_mbps = ' || mbps);

end;

/

Å

For Oracle Real Application Clusters (RAC) configurations, make sure that all instances are opened to calibrate the storage subsystem across nodes.

#### Calibrate IO Test Run on One Database At-a-Time

In this test scenario, we ran the calibrate IO on each OLTP and DSS database one at a time to get the result. We observed the following number of IOPS, throughput and latency.

- For OLTPDB1 Database
  - max\_iops = 450827
  - latency = 1
  - max\_mbps = 8648
- For SOEDB1 Database
  - max\_iops = 445286
  - latency = 2
  - max\_mbps = 8662
- For DSSDB1 Database
  - max\_iops = 384166
  - latency = 3
  - max\_mbps = 8184

As these tests were ran one at a time, each database was able to get the maximum IOPS and bandwidth at lower latency.

#### Calibrate IO Test Run on All Databases at Once

In this test scenario, we ran the calibrate IO on all three database (2 OLTP and one DSS) at the same time to get the result. We observed the following number of IOPS, throughput and latency:

- For OLTPDB1 Database
  - max\_iops = 249580
  - latency = 13
  - max\_mbps = 7786
- For SOEDB1 Database
  - max\_iops = 150149
  - latency = 35
  - max\_mbps = 4329
- For DSSDB1 Database
  - max\_iops = 135476
  - latency = 33
  - max\_mbps = 8524

As expected, when calibrate IO was simultaneously across all three databases, all of them ended in getting a portion of the IOPS that was possible. Similarly, all three received the maximum possible bandwidth but with higher latency due to higher queues of IO requests pushing the array to its limit. In comparison to the standalone calibrate IO tests, the bandwidth results from the above test stands out as couple of databases were able to achieve 7.7 and 8.5 GBps simultaneously. The latency is the end-to-end latency seen by Oracle and not necessarily reflect just the storage latency.

## Scalability Performance on FlashArray //X70

The first step after the databases creation is calibration; about the number of concurrent users, nodes, OS and database optimization. For Pure Storage FlashArray //X70, we will scale the system from a 1 to 8 Oracle RAC Nodes. Also, for this FlashStack solution, we tested system performance with different databases running at a time and capture the results as explained in the following sections.

#### One (OLTP) Database Performance

For OLTP database workload featuring Order Entry schema, we used one SOEDB1 database. For the SOEDB1 database (5 TB), we used 64GB size of System Global Area (SGA). We also ensured that HugePages were in use. The OLTP Database scalability test was run for at least 12 hours and made sure that results are consistent for the duration of the full run.

We ran the SwingBench scripts on each node to start SOEDB1 database and generate AWR reports for each scenario as shown below:

User Scalability

Total number of Reads and Write IOPS, TPM for various users are as shown below with system utilization under 25% all the time.

Users	Read IOPS	Write IOPS	Total IOPS	ТРМ	System Utilization (%)
100 (8 Nodes)	39,084	23,886	62,969	455,855	5.2
200 (8 Nodes)	69,046	39,662	108,708	763,248	10.3
300 (8 Nodes)	93,765	56,734	150,499	1,064,874	14.0
400 (8 Nodes)	130,635	73,493	204,128	1,552,266	19.0
600 (8 Nodes)	160,107	86,035	246,142	1,967,604	23.4
800 (8 Nodes)	161,166	96,800	257,966	2,094,720	25.4

The graph below illustrates the TPM for SOEDB1 database user scale on 8 node:

#### Figure 25 User Scalability – TPM & System Utilization (%)



The graph illustrates steady scalability till 600 users. Beyond 600 users, the additional users yield higher TPM but not at the same TPM/user rate. The below graph illustrates the total number of IOPS for SOEDB1 database user scale on all 8 nodes.



Figure 26 User Scalability – IOPS

The screenshot below was captured from Pure Storage GUI for the 800 Users Scale Test scenario while running Swingbench workload on one database.



Figure 27 User Scalability – System Statistics Per Second

The screenshot shown below was captured from the 800 Users Scale Test scenario while running Swingbench workload on one database. The snapshot shows a section from 3-hour window of AWR Global report from the run that highlights Physical Reads/Sec and Physical Writes/Sec for each instance. Notice that IO load is distributed across all the cluster nodes performing workload operations. Even though the FlashArray //X is capable of

achieving higher IOPS, the application was benefiting from the SGA and global cache and not all requests for data was sent to the storage array.

System	Statistics - Pe	r Second	DB/Ins	t: SOEDB1/soed	lbll Snaps: 2	27-31				
I#	Logical Reads/s	Physical Reads/s	Physical Writes/s	Redo Size (k)/s	Block Changes/s	User Calls/s	Execs/s	Parses/s	Logons/s	Txns/s
1	442,198.97	19,141.8	11,323.2	14,318.4	90,139.8	12,339.4	42,715.3	4,888.5	0.12	4,104.6
2	460,705.17	20,033.0	11,883.2	15,085.5	94,919.9	12,984.9	44,946.9	5,141.3	0.12	4,319.4
3	473,471.17	20,365.5	12,223.5	15,316.6	96,443.1	13,204.8	45,707.9	5,235.4	0.12	4,392.5
4	457,944.66	19,843.7	11,853.4	14,986.3	94,274.5	12,902.6	44,669.0	5,115.3	0.12	4,292.1
5	455,656.07	19,738.2	11,913.0	14,923.6	93,906.2	12,852.1	44,483.1	5,093.2	0.12	4,275.2
6	460,117.57	19,897.2	12,017.6	15,057.4	94,785.3	12,974.7	44,918.0	5,128.3	0.12	4,315.9
7	456,932.35	19,808.4	11,816.9	14,943.7	94,098.7	12,886.8	44,610.8	5,108.3	0.12	4,286.6
8	524,797.71	22,337.9	13,769.2	17,111.4	108,079.1	14,806.1	51,257.3	5,871.4	0.12	4,925.7
Sum	3,731,823.67	161,165.7	96,800.1	121,743.0	766,646.6	104,951.4	363,308.4	41,581.7	0.97	34,912.0
Avg	466,477.96	20,145.7	12,100.0	15,217.9	95,830.8	13,118.9	45,413.5	5,197.7	0.12	4,364.0
Std	25,055.36	949.2	720.6	816.2	5,262.2	724.3	2,508.4	289.0	0.00	241.1

Figure 28	User Scalabilit	y – System	Statistics	Per Second
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The AWR screenshot shown below shows latency for the same 800 Users Scale Test while swingbench test was running.

Figure 29	User Scalabilit	y – Top Timed	Events
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Top T -> In -> -> -> ->	imed Events stance '*' '*' '*' '*' '*'	DB/Inst: SOEC - cluster wide summary Waits, %Timeouts, Wait Time Total(s) 'Wait Time Avg' Summary 'Avg Wait Time ' [Avg/Min/Max/Std Dev] Cnt	Bl/soedbll Snaps: 27-31 : Cluster-wide total for t : Cluster-wide average computer : Per-instance 'Wait Time Avg : average/minimum/maximum : count of instances with	the wait event d as (Wait Time Total / Event Waits ' used to compute the following st 'Standard deviation of per-instance wait times for the event	s) tatistics e 'Wait Time Avg'	
		Wait	Event	Wait Time	Summary Avg Wait Time	
I#	Class	Event	Waits %Timeouts	Total(s) Avg Wait %DB time	Avg Min Max Std Dev Cnt	
*	User I/O Commit Cluster Cluster Cluster Cluster Cluster Cluster Cluster Cluster	db file sequential read DB CPU log file sync gc cr block 3-way gc current block busy gc current block 3-way gc current block 3-way gc current block congested gc cr grant 2-way gc current grant busy	1.679115E+09         0.0           N/A         N/A           373,925,161         0.0           506,608,241         0.0           639,480,825         0.0           479,055,766         0.0           955,533,922         0.0           53,410,383         0.0           706,498,677         0.0           112,218,694         0.0	2,018,414.54 1.20ms 34.76 1,263,753.80 21.76 791,233.31 2.12ms 13.62 274,258.24 541.36us 4.72 265,645.86 415.41us 4.57 247,249.70 516.12us 4.26 214,135.72 250.29us 3.69 177,337.22 3.32ms 3.05 147,518.65 208.80us 2.54 130,489.24 1.16ms 2.25	1.20ms         1.18ms         1.21ms         10.77us         8           2.12ms         2.03ms         2.16ms         41.98us         8           540.10us         329.62us         606.27us         86.39us         8           417.46us         308.85us         443.99us         84.99us         8           514.93us         324.09us         564.54us         77.89us         8           250.26us         242.92us         264.62us         7.06us         8           3.27ms         2.92ms         3.33ms         142.48us         8           209.02us         197.59us         1.39us         8         1.16ms         1.19ms         12.51us	

The AWR screenshot shown below shows the Interconnect device statistics for the same 800 Users Scale Test while swingbench test running. This confirms the caching phenomenon that reduced the amount of IO to the storage.

#### Figure 30 Interconnect Device Statistics

Interconnect Device Statistics (per Second)DB/Inst: SOEDB1/soedb11 Snaps: 27--> Data is retrieved from underlying Operating system and may overflow on some 32-bit OSs

		Interface					Received								
I#	NAME	IP Address	IP Mask	MBytes	Packets	Errors	Packets Dropped	Buffer Ovrrun	Carrier Lost	MBytes	Packets	Errors	Packets Dropped	Buffer Ovrrun	Fram Error
1	eno5	10.29.134.121	255.255.255.0	11.4	61,192	Θ	0	0	0	7.7	63,226	0	0	e	
	eno5:2	10.29.134.139	255.255.255.0	0.0	0	Θ	Θ	0	0	0.0	Θ	Θ	Θ	e	
	eno5:5	10.29.134.129	255.255.255.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	Θ	Θ	Θ	e	
	eno6	192.168.10.121	255.255.255.0	261.2	270,725	Θ	Θ	Θ	0	258.8	266,108	0	Θ	e	
	eno6:1	169.254.161.134	255.255.0.0	Θ.Θ	Θ	Θ	Θ	Θ	Θ	0.0	0	Θ	0	G	
	lo	127.0.0.1	255.0.0.0	2.6	23,815	0	Θ	0	0	2.6	23,815	0	0	G	
	VIFDFO	192.168.122.1	255.255.255.0	0.0	0	Θ	Θ	Θ	0	0.0	0 000	0	0	e	
2	eno5	10.29.134.122	255.255.255.0	1.1	8,905	Θ	Θ	Θ	0	1./	8,609	0	9	6	
	eno5:1	10.29.134.130	255.255.255.0	0.0	Ð	0	Ð	Ð	U	0.0	Ū	0	0	6	
	eno5:2	10.29.134.137	255.255.255.0	0.0	200 151	0	Ū	0	U	0.0	200 257	0	0	6	
	enuo	192.108.10.122	255.255.255.0	281.4	298,151	U	Ð	U	U	2/4.5	288,257	0	0	0	
	enoo:1	109.254.189.224	255.255.0.0	0.0	0 536	0	Ð	U	0	0.0	0 536	0	0	0	
	virbr0	102 160 122 1	255.0.0.0	0.4	0,520	0	0	0	0	0.4	0,320	0	0	0	
2	0005	192.100.122.1	255,255,255,0	0.0	0 070	0	0	0	0	0.0	0 756	0	0	0	
5	eno5.1	10.29.134.123	255.255.255.0	1.1	9,070	0	0	0	0	1./	6,750	0	0	6	
	eno5.2	10.20.124.131	255,255,255,0	0.0	0	0	0	0	0	0.0	0	0	0	0	
	eno6	192 168 10 123	255 255 255 0	269.4	268 530	0	0	0	0	265.7	266 269	0	6	6	
	eno6.1	169 254 194 220	255 255 0 0	0.0	200,000	e e	0	0	0	0.0	200,200	e e	0	6	
	10	127.0.0.1	255.0.0.0	0.4	7,782	ē.	ē.	0	0	0.4	7.782	0	6	G	
	virbro	192,168,122,1	255,255,255,0	0.0	0	Ð	ē.	0	0	0.0	0	0	0	G	
4	eno.5	10.29.134.124	255.255.255.0	1.1	8,865	0	Ø	Ø	0	1.6	8.555	0	0	G	
	eno.5:1	10.29.134.132	255.255.255.0	0.0	Θ	Θ	Θ	Θ	0	0.0	Θ	Θ	0	G	
	eno6	192.168.10.124	255.255.255.0	242.8	233,291	Θ	Ō	Ō	Ō	246.7	230,423	Θ	e	6	
	eno6:1	169.254.213.255	255.255.0.0	0.0	Θ	Θ	Θ	Θ	0	0.0	0	0	0	G	
	lo	127.0.0.1	255.0.0.0	0.5	10,242	0	Θ	0	0	0.5	10,242	0	0	6	
	virbr0	192.168.122.1	255.255.255.0	0.0	Θ	0	Θ	Θ	Θ	0.0	0	0	0	e	
5	eno5	10.29.134.125	255.255.255.0	1.1	8,848	Θ	Θ	Θ	Θ	1.6	8,530	Θ	0	e	
	eno5:1	10.29.134.133	255.255.255.0	0.0	Θ	Θ	Θ	Θ		0.0	Θ	0	Θ	e	
	eno6	192.168.10.125	255.255.255.0	234.9	222,354	0	Θ	Θ	Θ	241.2	220,774	Θ	0	e	
	eno6:1	169.254.200.249	255.255.0.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	Θ	Θ	Θ	e	
	lo	127.0.0.1	255.0.0.0	0.6	11,218	Θ	Θ	Θ	Θ	0.6	11,218	Θ	0	e	
	virbr0	192.168.122.1	255.255.255.0	Θ.Θ	Θ	Θ	Θ	Θ	Θ	0.0	Θ	Θ	Θ	e	
6	eno5	10.29.134.126	255.255.255.0	1.1	8,911	Θ	Θ	Θ	Θ	1.7	8,609	Θ	e	e	
	eno5:1	10.29.134.134	255.255.255.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	Θ	Θ	Ø	e	
	eno6	192.168.10.126	255.255.255.0	234.8	221,053	Θ	Θ	Θ	Θ	242.4	220,333	Θ	G	e	
	eno6:1	169.254.207.209	255.255.0.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	0	0	G	e	
	lo	127.0.0.1	255.0.0.0	0.6	11,089	0	Θ	0	0	0.6	11,089	0	0	G	
1.122	virbr0	192.168.122.1	255.255.255.0	0.0	0	0	Θ	0	0	0.0	Θ	0	0	e	
1	eno5	10.29.134.12/	255.255.255.0	1.1	8,858	Θ	Θ	0	Θ	1.6	8,551	0	G	6	
	eno5:1	10.29.134.135	255.255.255.0	0.0	0	Θ	Θ	Θ	Θ	0.0	0	0	0	6	
	enob	192.168.10.12/	255.255.255.0	234.7	220,743	Θ	0	0	0	240.7	219,631	0	G	6	
	enoo:1	109.254.40.154	255.255.0.0	0.0	9 001	U	U	U	U	0.0	0 001	0	0	C C	
	L0	127.0.0.1	255.0.0.0	0.4	8,901	U	U	0	0	0.4	8,901	0	0	6	
0	VIIDIO	192.108.122.1	200.200.200.0	0.0	0 000	0	0	0	0	0.0	0 001	0	0	6	
8	eno5.1	10.29.134.128	200.200.200.0	1.2	9,999	0	0	0	0	1.9	9,821	0	0	6	
	enosit	10.29.134.130	200.200.200.0	207.6	201 210	0	0	0	0	204.4	204 269	0	0	0	
	enoo .1	192.108.10.128	255,255,255,0	307.0	281,318	0	0	0	0	304.4	304,308	0	0	0	
	100:1	109.254.101.143	255.255.0.0	0.0	4 217	U	U	U	U	0.0	1 217	0	0	6	
	virbr0	192.168.122.1	255.255.255.0	0.0	4,217	0	0	0	0	0.0	4,217	0	0	6	
~~~				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~	~~~~~~	~~~~~~	~~~~~~			~~~~~~	~~~~~~	~~~~~~	
Sum				2,091.5	2,226,662	0	0	0	0	2,099.6	2,226,671	0	0	e	
Avg				41.0	43,660	0	0	0	0	41.2	43,660	0	0	G	
Std				95.2	91,994	Θ	Θ	Θ	0	95.4	92,145	0	0	e	

#### Two (OLTP) Database Performance

For two OLTP database workload featuring Order Entry schema, we used SOEDB1 and OLTPDB1databases. For both the databases, we used 64GB of System Global Area (SGA). We also made sure that HugePages were in use all the time while databases were running. The SOEDB1 + OLTPDB1 Database scalability test were run for at least 12 hours and ensured that results are consistent for the duration of the full run.

We ran the SwingBench scripts on each node to start SOEDB1 and OLTPDB1 database and generate AWR reports for each scenario as shown below:

User Scalability

The table below illustrates the TPM for SOEDB1 + OLTPDB1 database user scale on all 8 node:

Users	TPM for SOEDB1	TPM for OLTPDB1	Total TPM	System Utilization (%)
100	231,174	231,840	463,014	5.7
200	455,244	453,300	908,544	11.5
300	654,330	659,574	1,313,904	17.9
400	737,880	850,128	1,588,008	21.7
600	931,932	977,994	1,909,926	29.7
800	1,095,000	1,108,542	2,203,542	31.6

The graph below illustrates the Total Transactions Per Minute (TPM) for SOEDB1 + OLTPDB1 database user scale on 8 nodes.



Figure 31 User Scalability – TPM & System Utilization

The table below illustrates the TPM for SOEDB1 + OLTPDB1 database user scale on all 8 node.

Users	IOPS for SOEDB1	IOPS for OLTPDB1	Total IOPS
100	31,732	32,701	64,433
200	58,774	60,936	119,710
300	81,514	82,965	164,479
400	92,883	100,591	193,474
600	119,714	120,655	240,369
800	133,672	125,647	259,319

The results were in line with prior assessments where the user scalability was almost linear till 600 users and beyond 600 users the rate of IOPS increase slowed down.

The graph below illustrates the total IOPS for SOEDB1 + OLTPDB1 database user scale on all the 8 Oracle RAC nodes.



## Figure 32 User Scalability – IOPS

The screenshot shown below was captured from the 800 Users Scale Test scenario while running Swingbench workload on two database at the same time. The snapshot shows a section from 3-hour window of AWR Global report from the run that highlights Physical Reads/Sec, Physical Writes/Sec and Transactions per Seconds for each instance. Notice that IO load is distributed across all the cluster nodes performing workload operations.

#### Figure 33 User Scalability – System Statistics Per Second for SOEDB1 Database

System Statistics - Per Second DB/Inst: SOEDB1/soedb11 Snaps: 28-31

I#	Logical Reads/s	Physical Reads/s	Physical Writes/s	Redo Size (k)/s	Block Changes/s	User Calls/s	Execs/s	Parses/s	Logons/s	Txns/s
1	278,474.06	10,465.6	6,725.8	8,358.7	51,999.8	7,033.7	24,341.0	2,781.8	0.11	2,336.0
2	267,489.80	10,110.9	6,507.7	8,132.6	50,307.0	6,808.0	23,556.2	2,691.9	0.11	2,260.4
3	302,679.63	10,215.9	6,526.7	8,283.7	51,260.3	6,923.4	23,957.6	2,737.6	0.11	2,298.8
4	245,484.21	10,269.7	6,513.4	8,253.3	51,122.6	6,915.4	23,927.5	2,730.8	0.11	2,296.1
5	242,581.88	10,110.1	6,536.9	8,174.8	50,656.6	6,834.6	23,647.3	2,701.8	0.11	2,269.1
6	239,147.35	10,001.8	6,415.4	8,055.1	49,895.8	6,738.8	23,313.7	2,623.2	0.11	2,237.3
7	242,043.86	10,151.6	6,445.0	8,138.6	50,469.3	6,821.6	23,599.7	2,656.8	0.11	2,264.8
8	244,713.72	10,158.7	6,516.4	8,215.0	51,003.8	6,889.4	23,837.8	2,723.8	0.11	2,287.4
Sum	2,062,614.51	81,484.3	52,187.2	65,611.8	406,715.4	54,965.0	190,180.7	21,647.8	0.90	18,250.0
Avg	257,826.81	10,185.5	6,523.4	8,201.5	50,839.4	6,870.6	23,772.6	2,706.0	0.11	2,281.2
Std	22,947.71	138.0	92.1	96.5	651.9	90.0	313.6	49.5	0.00	30.1

#### Figure 34 User Scalability – System Statistics Per Second for OLTPDB1 Database

System	Statistics - Pe	r Second	DB/Inst:	OLTPDB1/oltpd	lbll Snaps: 5	4-57				
I#	Logical Reads/s	Physical Reads/s	Physical Writes/s	Redo Size (k)/s	Block Changes/s	User Calls/s	Execs/s	Parses/s	Logons/s	Txns/s
1	249,921.91	8,747.9	5,328.4	7,519.9	46,136.8	6,275.9	21,747.2	2,456.4	0.54	2,084.2
2	369,488.14	14,079.4	9,400.9	12,011.3	74,996.7	10,217.9	35,407.6	4,040.9	0.54	3,393.1
4	227,211.38	8,851.9	5,448.1	7,653.7	47,030.9	6,386.4	22,132.0	2,527.1	0.53	2,120.9
5	354,581.24	13,552.0	9,026.7	11,746.4	73,438.5	9,973.4	34,565.5	3,944.7	0.54	3,312.1
6	405,374.79	13,274.0	8,758.6	11,493.3	71,727.3	9,765.9	33,844.9	3,836.7	0.54	3,243.2
7	228,700.07	8,350.0	5,118.8	7,217.9	44,179.9	5,999.9	20,792.3	2,373.6	0.53	1,992.3
8	249,443.24	9,675.1	6,035.1	8,361.5	51,613.9	7,016.2	24,313.7	2,770.8	0.53	2,330.0
~~~ ~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			~~~~~~
Sum	2,084,720.77	76,530.2	49,116.7	66,004.0	409,124.0	55,635.5	192,803.1	21,950.3	3.76	18,475.7
Avg	297,817.25	10,932.9	7,016.7	9,429.1	58,446.3	7,947.9	27,543.3	3,135.8	0.54	2,639.4
Std	75,634.95	2,569.0	1,942.3	2,203.2	14,184.0	1,934.7	6,705.1	765.0	0.00	642.5

The screenshot shown below shows latency for the same 800 Users Scale Test while swingbench test running for SOEDB1 Database.

#### Figure 35 User Scalability – Top Timed Events

Тор	Timed Events	DB/Inst: OLTF	DB1/oltpdb11 Snaps: 54-57								
-> I	instance '*'	<ul> <li>cluster wide summary</li> </ul>									
->		'*' Waits, %Timeouts, Wait Time Total(s) : Cluster-wide total for the wait event									
->		<pre>'*' 'Wait Time Avg' : Cluster-wide average computed as (Wait Time Total / Event Waits)</pre>									
->		ummary 'Avg Wait Time ' : Per-instance 'Wait Time Avg ' used to compute the following statistics									
->		[Avg/Min/Max/Std Dev]	: average/minimum/maximu	m/standard deviat	tion of pe	r-instance	'Wait Time /	Avg'			
->		Cnt	: count of instances wit	th wait times for	the event						
		Wait	Event	Wa:	it Time			Summary /	Avg Wait Tim	e	
I#	Class	Event	Waits %Timeouts	s Total(s)	Avg Wait	%DB time	Avg	Min	Max	Std Dev	Cnt
*	User I/O	db file sequential read	790,081,754 0.0	814,811.13	1.03ms	34.14	1.03ms	1.00ms	1.05ms	24.80us	7
		DB CPU	N/A N/A	705,952.76		29.58					.7
	Commit	log file sync	198,547,682 0.0	423,686.87	2.13ms	17.75	2.13ms	2.08ms	2.18ms	43.90us	7
	System I/0	) db file parallel write	169,203,787 0.0	113,805.85	672.60us	4.77	654.50us	509.13us	748.76us	98.10us	7
	Cluster	gc current block busy	376,940,110 0.0	82,767.25	219.58us	3.47	220.18us	201.00us	230.43us	9.61us	7
	Cluster	gc cr block 3-way	279,239,117 0.0	67,188.15	240.61us	2.82	239.95us	214.99us	253.33us	12.16us	7
	System I/0	) log file parallel write	71,300,378 0.0	66,160.82	927.92us	2.77	927.77us	905.83us	.95ms	15.01us	7
	Cluster	gc current block 3-way	276,311,342 0.0	64,362.42	232.93us	2.70	232.63us	212.02us	245.22us	10.66us	7
	Cluster	gc current block congested	7,373,716 0.0	54,955.53	7.45ms	2.30	7.94ms	6.54ms	11.70ms	1.69ms	7
	Cluster	gc current grant 2-way	422,930,654 0.0	54,240.83	128.25us	2.27	129.45us	120.70us	148.95us	11.52us	7

The screenshot shown below shows the Interconnect device statistics for the same 800 Users Scale Test while swingbench test running on both OLTP databases.

#### Figure 36 Interconnect Device Statistics

Interconnect Device Statistics (per Second)DB/Inst: OLTPOB1/oltpdb11 Snaps: 5 > Data is retrieved from underlying Operating system and may overflow on some 32-bit OSs

	Interface					Sent				Received					
I#	NAME	IP Address	IP Mask	MBytes	Packets	Errors [	Packets Dropped	Buffer Ovrrun	Carrier Lost	MBytes	Packets	Errors	Packets Dropped	Buffer Ovrrun	Frame Errors
1	eno5	10.29.134.121	255.255.255.0	12.2	65,270		Θ	0		8.1	66,728		Θ	Θ	Θ
	eno5:2	10.29.134.139	255.255.255.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	Θ	Θ	Θ	Θ	0
	eno5:3	10.29.134.129	255.255.255.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	0	0	Θ	Θ	0
	eno6	192.168.10.121	255.255.255.0	302.1	323,186	Θ	Θ	0	Θ	299.0	324,715	Θ	Θ	Θ	Θ
	eno6:1	169.254.161.134	255.255.0.0	0.0		Θ	Θ	Θ	Θ	0.0	0	0	Θ	0	0
	lo	127.0.0.1	255.0.0.0	3.0	29,445		Θ	0	0	3.0	29,445	0	Θ	Θ	0
	virbr0	192.168.122.1	255.255.255.0	0.0		Θ	Θ		Θ	0.0	0		Θ	Θ	0
2	eno5	10.29.134.122	255.255.255.0	1.4	11,566	Θ	Θ	0	Θ	2.2	11,335	Θ	Θ	Θ	Θ
	eno5:1	10.29.134.130	255.255.255.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	Θ	0	Θ	Θ	0
	eno5:2	10.29.134.137	255.255.255.0	0.0	Θ	Θ	Θ	0	Θ	0.0	Θ	Θ	Θ	Θ	Θ
	eno6	192.168.10.122	255.255.255.0	372.0	404,889	Θ	Θ	Θ	Θ	365.0	405,186	Θ	Θ	Θ	0
	eno6:1	169.254.189.224	255.255.0.0	0.0	0	Θ	Θ	0	0	0.0	0	0	Θ	Θ	0
	10	127.0.0.1	255.0.0.0	0.5	10,903	Θ	Θ	Θ	Θ	0.5	10,903	0	Θ	Θ	0
	virbr0	192.168.122.1	255.255.255.0	0.0	Θ	Θ	Θ	Θ	Θ	0.0	Θ	Θ	Θ	Θ	Θ
4	eno5	10.29.134.124	255.255.255.0	1.1	9,047	Θ	Θ	Θ	Θ	1.7	8,861	Θ	Θ	Θ	Θ
	eno5:1	10.29.134.132	255.255.255.0	0.0	0	Θ	Θ	0	Θ	0.0	0	Θ	Θ	Θ	Θ
	eno5:2	10.29.134.138	255.255.255.0	0.0	Θ	Θ	Θ	0	Θ	0.0	0	0	0	0	0
	eno6	192.168.10.124	255.255.255.0	281.3	284,873	Θ	Θ	0	0	280.9	285,419	0	Θ	O	0
	eno6:1	169.254.213.255	255.255.0.0	0.0	Θ	Θ	Θ	0	Θ	0.0	0	0	Θ	Θ	0
	10	127.0.0.1	255.0.0.0	0.7	13,338	Θ	Θ	0	Θ	0.7	13.338	Θ	Θ	Ø	0
	virbr0	192.168.122.1	255.255.255.0	0.0	0	Θ	Θ	Ð	Θ	0.0	0	0	Θ	O	0
5	eno5	10,29,134,125	255,255,255,0	1.4	11,420	Θ	Ø	Θ	Θ	2.2	11,194	Ø	Θ	ē	0
	eno5:1	10.29.134.133	255.255.255.0	0.0	Θ	Θ	Θ	Ø	Θ	0.0	0	0	Θ	õ	0
	eno6	192,168,10,125	255.255.255.0	304.3	293,360	Θ	0	0	Θ	314.9	300,806	Ø	Θ	ē.	0
	eno6:1	169.254.200.249	255.255.0.0	0.0	0	Θ	Θ	0	Θ	0.0	0	0	0	0	0
	10	127.0.0.1	255.0.0.0	0.8	15,797	Ð	Θ	0	Θ	0.8	15.797	õ	ē	Ð	0
	virbr0	192, 168, 122, 1	255,255,255,0	0.0	Θ	Θ	Θ	Θ	e	0.0	Θ	0	Θ	Ð	0
6	eno5	10,29,134,126	255.255.255.0	1.3	11,232	Θ	Θ	õ	Θ	2.1	10.994	õ	Θ.	õ	0
	eno5:1	10.29.134.134	255.255.255.0	0.0	0	Θ	Θ	Θ	Θ	0.0	0	õ	Θ	õ	0
	eno6	192,168,10,126	255.255.255.0	302.6	291,215	Θ	0	ō	Θ	312.8	297,880	o	Θ	ē	0
	eno6:1	169.254.207.209	255.255.0.0	0.0	0	Θ	Θ	Ø	Θ	0.0	0	0	Θ	0	0
	10	127.0.0.1	255.0.0.0	0.7	14,975	Θ	0	0	0	0.7	14,975	0	Θ	Ø	Ø
	virbr0	192.168.122.1	255.255.255.0	0.0	0	Ð	Ð	ē.	Ð	0.0	0	õ	ē.	0	0
7	eno5	10,29,134,127	255.255.255.0	1.1	8.749	Θ	Θ	õ	Θ	1.6	8.549	õ	ē	ē	0
	eno5:1	10.29.134.135	255.255.255.0	0.0	Θ.	ē	Θ	ē	Θ	0.0	0	õ	Θ	õ	0
	eno6	192, 168, 10, 127	255.255.255.0	266.9	268,312	Θ	0	0	Θ	269.3	268,628	ē	Θ	ē	0
	eno6:1	169 254 40 154	255 255 0.0	0.0	0	Ð	Ð	õ	Ø	0.0	200,020	0	0	0	0
	10	127.0.0.1	255.0.0.0	0.7	13,572	õ	0	0	0	0.7	13,572	õ	Ð	0	0
	virhrA	192 168 122 1	255 255 255 0	0.0	0	0	A	ē.	A	0.0	0	ñ	ē.	ē.	0
8	eno5	10 29 134 128	255 255 255 A	1 1	9 466	0	0	õ	e e	1.8	9 266	ē.	A	e e	0
0	eno5.1	10.20.134.120	255 255 255 A	0.0	0,400	ē	Ð	ē.	0	0.0	0,200	0	6	ē.	0
	eno6	102 168 10 128	255 255 255 A	316.7	340 742	õ	6	õ	A	310.6	336 073	õ	e e	ē	0
	eno6.1	160 254 161 143	255 255 0 0	0.0	040,742	0	0	0	0	0.0	0,0,0,0	0	0	0	0
	100.1	105.254.101.145	255.0.0.0	0.0	12 715	0	0	0	0	0.0	12 715	0	0	0	6
	virbr0	192.168.122.1	255.255.255.0	0.0	0	0	0	0	0	0.0	0	0	0	0	0
~~~ Sum				2.172.7	2.444.072	 0	 Θ	 0		2,179.2	2.457.278			Θ	
Ava				48.3	54,313	0	Ð	0	0	48.4	54,606	0	0	0	0
Std				112.8	115 073	0	Ð	0	0	113.0	115 687	0	0	0	0
Stu				112.0	115,0/5	0	0			115.0	113,007	0	0	0	0

#### **DSSDB1** Database Performance

DSS database workloads are generally sequential in nature, read intensive and exercise large IO size. DSS database workload runs a small number of users that typically exercise extremely complex queries that run for hours. We configured 9 TB of DSS database by loading Swingbench sh schema into Datafile Tablespace. DSS Database activity is captured for four Oracle RAC Instances using Oracle Enterprise Manager for 24 hours workload test.

PUREST	TORAGE									Welcom	e pureuser logg	H ed in as array	elp   Terms   Log Ou /_admin to flashstack->
DASHBOARD	STORAGE	PROTECTION	ANALYSIS	SYSTEM	MESSAGES						Se	arch Hosts a	nd Volumes Q
Alerts		- Capacity	Provisioned Total 39.22 T 3.9 to	Reduction 1							Da <b>3</b> .	ta Reduction 2 to 1	45% full
ARRAY STATUS		Volumes 9.75 T	Snapshots S 221.33 G 3	hared Space	System Empty Sp 0 12.66 T	pace							Used Total 10.35 T / 23.00 T
													21.73 ms
RECENT ALERTS	lerts.	800 ms	15:46	15:48 15	:50 15:52	15:54	15:56	15:58	16:00	16:02	16:04	16:06	16:08
		- IOPS											<b>12.9</b> 9 к
		20.00 K 15:44	15:46	15:48 15	:50 15:52	15:54	15:56	15:58	16:00	16:02	16:04	16:06	16:08
			h										8.83 GB/s
		10.00 GB/s	15:46	15:48 15	:50 15:52	15:54	15:56	15:58	16:00 Â(	ctiva6102 VVi	nd 98.646	16:06	16:08

#### Figure 37 DSS Performance – Bandwidth

For 24 hours DSS workload test, we observed the total sustained IO bandwidth was up to 8.7 GB/sec after the initial ramp up workload. As indicated on the charts, the IO was consistent throughout the run and we did not observe any significant dips in performance for complete period of time.

The screenshot shown below shows latency while swingbench test running for DSSDB1 Database.





The screenshot shown below shows system utilization of each instance while swingbench test running for DSSDB1 Database.

## Figure 39 DSS Performance – All Nodes System Utilization

ACLE Enter	rprise Man	ager Database	Express 12c						Help 🔹 👥 SYS Log Ou
SSDB1 (12.2.0.1.0 F	RAC) 🏓 Cor	nfiguration 🔻 🀐	Storage 🔻 🦺 Se	curity 🔻 🔜 Performance 🔻					🗐 o
formance Hub: R	Real Time -	Last Hour	Select Time Period	Hide Time Picker		PerfHub Report	AWR Report Page Refr	reshed 8:01:20 AM GMT-0800	Auto Refresh 1 Minute 🛛 🔻
240									
160 -									
80 -									
0									
	07:05AM	07:10AM	07:15	4M 07:20AM	07:25AM 07:30AM	07:35AM 07:4	40AM 07:45AM	07:50AM	07155AM 06100AM
8 - E - E - E	thread does at	Maniferrard COI	ADDM Clabel C	and an and an and a second					
		Monitored SUL	ADDM GIODAI C	acre Instances					
omary Activity	workload		- COMPOSE IN - COMPANY						
Top Instances	workload								
Top Instances	workload	💣 Instance Home	🔗 Memory					Instance Name	
Top Instances Op 100 By CPU Instance Name	Workload	Instance Home	@ Memory Host Name	Instance Up Time	Host CPU	Active Sessions	Memory	Instance Name	IO Throughput
Top Instances op 100 By CPU Instance Name dssdb 18	Workload	Instance Home Instance ID 8	Host Name	Instance Up Time 11 hours, 45 minutes, 40 seconds	Host CPU 2.95%	Active Sessions	Memory 56GB	Instance Name IO Requests 1,349.22	IO Throughput
Top Instances Top 100 By CPU Instance Name dssdb 18 dssdb 11	Workload	Instance Home Instance ID 8 1	Memory Host Name oraracx8 oraracx1	Instance Up Time 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 42 seconds	Host CPU	Active Sessions	Memory 5668	V Instance Name IO Requests 1,349.22 1,507.18	IO Throughput 1.3GB 1.38GE
Top Instances Top 100 By CPU Instance Name dosdb 18 dosdb 11 dosdb 16	workload	Instance Home Instance ID 8 1 6	Memory     Host Name     oraracx8     oraracx1     oraracx6	Instance Up Time 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 42 seconds 11 hours, 45 minutes, 41 seconds	Host CPU	Active Sessions 20.15	Memory 56GB	V Instance Name IO Requests 1,349.22 1,507.18 1,352.39	IO Throughput 1.3G8 1.3G8 1.31G8
Top Instances Top 100 By CPU Instance Name dssdb 11 dssdb 16 dssdb 15	Vorkood	Instance Home Instance ID 8 1 6 5	Memory Host Name oraracx8 oraracx1 oraracx6 oraracx5	Instance Up Time 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 42 seconds 11 hours, 45 minutes, 41 seconds 11 hours, 45 minutes, 40 seconds	Host CPU 2.95% 2.95% 2.65% 2.43% 2.43%	Active Sessions 20.15 20.22.24 19.87 13.97	Memory 5668	Instance Name     Io Requests     1,349.22     1,507.18     1,352.99     1,350.71	10 Throughput 1.308 1.3868 1.3168 1.3168 1.3168
Top Instances Top 100 By CPU Instance Name dssdb 18 dssdb 16 dssdb 15 dssdb 15 dssdb 17	Vorkood	Instance Home Instance ID 8 1 6 5 7 7	Memory Host Name orarack8 orarack1 orarack6 orarack5 orarack7	Instance Up Time 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 42 seconds 11 hours, 45 minutes, 41 seconds 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 40 seconds	Host CPU 2.95% 2.95% 2.66% 2.43% 2.07%	Active Sessions 20.15 22.24 19.67 13.97 19.7	Memory 6368 5368 5368 5368 5368	✓ Instance Name 10 Requests 1,349.22 1,597.18 1,352.39 1,350.71 1,122.28	10 Throughput 1.308 1.3168 1.3168 1.308 941.5498
Top Instances iop 100 By CPU Instance Name desdb 18 desdb 11 desdb 16 desdb 15 desdb 17 desdb 14	VVorkioad	Instance Home Instance ID 8 1 6 5 7 4	Memory Host Name orarack8 orarack1 orarack5 orarack7 orarack7	Instance Up Time 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 42 seconds 11 hours, 45 minutes, 41 seconds 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 40 seconds	Host CPU 2.95% 2.95% 2.65% 2.43% 2.07% 1.76%	Active Sessions 20.15 22.24 19.87 13.97 19.7 15.78	Memory 5668 5668 5668 5668 568 568	▼ Instance Name 10 Requests 1,349.22 1,507.18 1,352.39 1,352.71 1,129.28 1,005.85	10 Throughput 1.368 1.366 1.366 1.368 1.368 941.5498 933.5398
Top Instances iop 100 By CPU Instance Name dosdo 18 dosdo 11 dosdo 15 dosdo 15 dosdo 15 dosdo 15 dosdo 14 dosdo 13	VVorkioad	Instance Home Instance ID 8 1 6 5 7 7 4 3 3	Memory Host Name orarack8 orarack1 orarack6 orarack7 orarack7 orarack4 orarack3	Instance Up Time 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 41 seconds 11 hours, 45 minutes, 41 seconds 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 40 seconds 11 hours, 45 minutes, 41 seconds	Host CPU 2.95% 2.95% 2.25% 2.23% 2.43% 2.43% 2.75% 1.76% 1.49%	Active Sessions 20.15 2.24 13.97 19.77 19.77 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.78 19.77 19.78 19.77 19.77 19.78 19.78 19.77 19.77 19.78 19.78 19.78 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.77 19.	Memory 5008	Instance Name 10 Requests 1,349.22 1,352.39 1,352.39 1,252.39 1,252.35 1,252.35 1,252.35 1,252.35 1,252.35 1,006.85 652.1	10 Throughput 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.4GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.3GB 1.

#### Mixed Workload

The next test is to run both OLTP and DSS database workloads simultaneously. This test will make sure that configuration in this test is able to sustain small random queries presented via OLTP database along with large and sequential transactions submitted via DSS database workload.

The screenshot shown below shows IOPS, Latency and Throughput of the FlashArray //X70 system while all three databases (2 OLTP and 1 DSS) running swingbench workload.



#### Figure 40 All three Database Performance

DSSDB1 Database activity was captured for all eight node Oracle RAC Instances using Oracle Enterprise Manager for 24 hours mixed workload test. The screenshot below shows Throughput GB/s for DSSDB1 database.



#### Figure 41 DSS Performance – Bandwidth

SOEDB1 Database activity was captured for all eight node Oracle RAC Instances using Oracle Enterprise Manager for 24 hours mixed workload test. The screenshot below shows Physical I/Os per second for SOEDB1 database.



### Figure 42 SOEDB1 Performance – IOPS

OLTPDB1 Database activity was captured for all eight node Oracle RAC Instances using Oracle Enterprise Manager for 24 hours mixed workload test. The screenshot below shows Physical I/Os per second for OLTPDB1 database.



Figure 43 OLTPDB1 Performance – IOPS

The Mixed workload results were in line with the simultaneous calibrate IO tests that were performed earlier and clearly showcases the level of performance that can be achieved with this FlashStack solution.

# **Resiliency and Failure Tests**

The goal of these tests is to ensure that reference architecture withstands commonly occurring failures due to either unexpected crashes, hardware failures or human errors. We conduct many hardware (disconnect power), software (process kills) and OS specific failures that simulate real world scenarios under stress condition. In the destructive testing, we also demonstrate unique failover capabilities of Cisco UCS components. We have highlighted some of those test cases below.

Scenario	Test	Status
Test 1 – UCS FI – A	Run the system on Full Database work Load.	Fabric Interconnect Failover did not
Failure	Power Off Fabric Interconnect – A and check	cause any disruption to Private, Pub-
	network traffic on Fabric Interconnect – B.	lic and Storage Traffic
Test 2 – UCS FI – B	Run the system on Full Database work Load.	Fabric Interconnect Failover did not
Failure	Power Off Fabric Interconnect – B and check	cause any disruption to Private, Pub-
	network traffic on Fabric Interconnect – A	lic and Storage Traffic
Test 3 – UCS Nexus	Run the system on Full Database work Load.	Nexus Switch Failover did not cause
Switch – A Failure	Power Off Nexus Switch – A and check net-	any disruption to Private and Public
	work traffic on Nexus Switch – B.	network Traffic
Test 4 – UCS Nexus	Run the system on Full Database work Load.	Nexus Switch Failover did not cause
Switch – B Failure	Power Off Nexus Switch – B and check net-	any disruption to Private and Public
	work traffic on Nexus Switch – A.	network Traffic
Test 5 – UCS MDS	Run the system on Full Database work Load.	MDS Switch Failover did not cause
Switch – A Failure	Power Off MDS Switch – A and check storage	any disruption to Storage network
	traffic on MDS Switch – B	Traffic
Test 6 – UCS MDS	Run the system on Full Database work Load.	MDS Switch Failover did not cause
Switch – B Failure	Power Off MDS Switch – B and check storage	any disruption to Storage network
	traffic on MDS Switch – A	Traffic
Test 7 – UCS Chassis	Run the system on full Database work Load.	No disruption in network traffic.
1 and Chassis 2 IOM	Disconnect two links from each Chassis 1	
Links Failure	IOM and Chassis 2 IOM by pulling it out and	
	reconnect it after 5 minutes.	

Table 12 Hardware Failover Tests




0 illustrates the FlashStack solution infrastructure diagram under normal operating conditions. Cisco UCS 6332-16UP Fabric Interconnects carries both storage and network traffic from the blades with the help of Cisco Nexus 9372PX-E and Cisco MDS 9148S switches. Two virtual Port-Channels (vPCs) are configured to provide public network and private network paths for the blades to northbound switches. Eight (four per chassis) links go to Fabric Interconnect – A. Similarly, eight links go to Fabric Interconnect – B. Fabric Interconnect – A links are used for Oracle Public network traffic shown as green lines. Fabric Interconnect – B links are used for Oracle Private Interconnect traffic shown as red lines. FC Storage access from Fabric Interconnect – A and Fabric Interconnect – B shown as an orange line.

The figure below shows a complete infrastructure details of MAC address, VLAN information and Server connections for Cisco UCS Fabric Interconnect – A switch before failover test.

Log into Cisco Fabric Interconnect – A and "connect nxos a" then type "show mac address-table" to see all VLAN connection on Fabric Interconnect – A as shown below:

# Figure 45 Fabric Interconnect – A Network Traffic

00	RARAC -	X-FI-A(nxos)# X-FI-A(nxos)# <mark>show</mark> m	ac address	-table			
	egend: VLAN	* - primary entry, age - seconds since MAC Address	G - Gatewa last seen Type	y MAC, ,+ - pr age	(R) - Rout imary entr Secure	ed I y u NTF	MAC, O - Overlay MAC sing vPC Peer-Link Y Ports/SWID.SSID.LID
*	134	0025.b5cc.0000	++ static	0	++ F	F	-+ Veth1029
*	134	0025.b5cc.0001	static	Θ	F	F	Veth1037
*	134	0025.b5cc.0002	static	Θ	F	F	Veth1133
*	134	0025.b5cc.0003	static	Θ	F	F	Veth1053
*	134	0025.b5cc.0004	static	Θ	F	F	Veth1061
ж	134	0025.b5cc.0005	static	Θ	F	F	Veth1069
*	134	0025.b5cc.0006	static	Θ	F	F	Veth1077
*	134	0025.b5cc.0007	static	Θ	F	F	Veth1085
*	4044	025d.7358.c8b3	dynamic	Θ	E	F	Eth2/1/33

As shown in the above screenshot, Fabric Interconnect – A carry Oracle Public Network traffic on VLAN 134 under normal operating conditions before failover test.

Log in to Cisco Fabric Interconnect – B and "connect nxos b" then type "show mac address-table" to see all VLAN connection on Fabric – B as shown in the screenshot below:

## Figure 46 Fabric Interconnect – B Network Traffic

ORARAC-X-	FI-B(nxos)#									
<pre>DRARAC-X-FI-B(nxos)# show mac address-table</pre>										
Legend:										
* 	<ul> <li>primary entry,</li> <li>ge - seconds since</li> <li>MAC Address</li> </ul>	G - Gatewa last seen	y MAC, ,+ - pr:	(R) - Rout imary entr Socuro	ed y u	MAC, 0 - Overlay MAC sing vPC Peer-Link V Ports (SWID SSID LID				
VLAN	MAC AUUTESS	Type	aye	Secure	NIF	FOILS/SWID.SSID.LID				
* 10	0025.b5dd.0000	static	0	F	F	Veth1031				
* 10	0025.b5dd.0001	static	0	F	F	Veth1039				
* 10	0025.b5dd.0002	static	0	F	F	Veth1135				
* 10	0025.b5dd.0003	static	Θ	F	F	Veth1055				
* 10	0025.b5dd.0004	static	Θ	E	F	Veth1063				
* 10	0025.b5dd.0005	static	Θ	F	F	Veth1071				
* 10	0025.b5dd.0006	static	Θ	F	F	Veth1079				
* 10	0025.b5dd.0007	static	Θ	F	F	Veth1087				
* 4044	025d.7358.c8b2	dynamic	Θ	F	F	Eth2/1/33				

As shown in the above screenshot, Fabric Interconnect – B carry Oracle Private Network traffic on VLAN 10 under normal operating conditions before failover test.

### Test 1 – Cisco UCS 6332-16UP Fabric Interconnect – A Failure Test

We conducted a hardware failure test on Fabric Interconnect – A by disconnecting power cable to the switch as explained below.

The figure below illustrates how during Fabric Interconnect – A switch failure, the respective blades (ORARACX1, ORARACX2, ORARACX3 and ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 and ORARACX8) on chassis 2 will fail over the public network interface MAC addresses and its VLAN network traffic to fabric interconnect – B.





Unplug power cable from Fabric Interconnect – A and check the MAC address and VLAN information on Cisco UCS Fabric Interconnect – B.

### Figure 48 Fabric Interconnect – B Network Traffic

0	RARAC-X	-FI-B(nxos)# -FI-B(nxos)# show m	ac address	-table				
Le	egend:							
		<ul> <li>* - primary entry, age - seconds since</li> </ul>	G - Gatewa last seen	y MAC, ,+ - pr	<pre>(R) - Rout imary entr</pre>	ed y u	MAC, O - Overlay MAC sing vPC Peer-Link	
	VLAN	MAC Address	Туре	age	Secure	NTF	Y Ports/SWID.SSID.LID	
*	134	0025.b5cc.0000	static	0	++ F	F	Veth1030	
ж	134	0025.b5cc.0001	static	Θ	F	F	Veth1038	
ж	134	0025.b5cc.0002	static	Θ	F	F	Veth1134	
ж	134	0025.b5cc.0003	static	Θ	F	F	Veth1054	
ж	134	0025.b5cc.0004	static	Θ	F	F	Veth1062	
ж	134	0025.b5cc.0005	static	Θ	F	F	Veth1070	
ж	134	0025.b5cc.0006	static	Θ	F	F	Veth1078	
ж	134	0025.b5cc.0007	static	Θ	F	F	Veth1086	
ж	10	0025.b5dd.0000	static	0	F	F	Veth1031	
ж	10	0025.b5dd.0001	static	Θ	F	F	Veth1039	
ж	10	0025.b5dd.0002	static	Θ	F	F	Veth1135	
ж	10	0025.b5dd.0003	static	Θ	F	F	Veth1055	
ж	10	0025.b5dd.0004	static	Θ	F	F	Veth1063	
ж	10	0025.b5dd.0005	static	Θ	F	F	Veth1071	
ж	10	0025.b5dd.0006	static	Θ	F	F	Veth1079	
ж	10	0025.b5dd.0007	static	Θ	F	F	Veth1087	
ж	4044	025d.7358.c8b2	dynamic	0	F	F	Eth2/1/33	

We noticed in the figure above, when the Fabric Interconnect – A failed, it would route all the Public Network traffic of VLAN 134 to Fabric Interconnect – B. So Fabric Interconnect – A Failover did not cause any disruption to Private, Public and Storage Network Traffic.

After plug back power cable to Fabric Interconnect – A Switch, the respective blades (ORARACX1, ORARACX2, ORARACX3 & ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 & ORARACX8) on chassis 2 will route back the MAC addresses and its VLAN traffic to Fabric Interconnect – A.

The figure below shows details of MAC address, VLAN information and Server connections for Cisco UCS Fabric Interconnect – A switch under normal operating condition.

### Figure 49 Fabric Interconnect – A Network Traffic

0	RARAC->	(-FI-A(nxos)#									
0	<pre>DRARAC-X-FI-A(nxos)# show mac address-table</pre>										
L	egend:										
		* - primary entry,	G - Gatewa	y MAC,	(R) - Rout	ed	MAC, 0 - Overlay MAC				
		age - seconds since	last seen	,+ - pr:	imary entr	y u	sing vPC Peer-Link				
	VLAN	MAC Address	Туре	age	Secure	NTF	Y Ports/SWID.SSID.LID				
-		-+	++		++		-+				
ж	134	0025.b5cc.0000	static	Θ	F	F	Veth1029				
ж	134	0025.b5cc.0001	static	Θ	F	F	Veth1037				
ж	134	0025.b5cc.0002	static	Θ	F	F	Veth1133				
*	134	0025.b5cc.0003	static	Θ	F	F	Veth1053				
*	134	0025.b5cc.0004	static	Θ	F	F	Veth1061				
ж	134	0025.b5cc.0005	static	Θ	F	F	Veth1069				
ж	134	0025.b5cc.0006	static	Θ	F	F	Veth1077				
ж	134	0025.b5cc.0007	static	Θ	F	F	Veth1085				
*	4044	025d.7358.c8b3	dynamic	0	F	F	Eth2/1/33				

The figure below shows details of MAC address, VLAN information and Server connections for Cisco UCS Fabric Interconnect – B switch under normal operating condition.

## Figure 50 Fabric Interconnect – B Network Traffic

0R	ORARAC-X-FI-B(nxos)#									
0R	ORARAC-X-FI-B(nxos)# show mac address-table									
Le	gend:									
	VLAN	<ul> <li>* - primary entry, entry, end</li> <li>age - seconds since</li> <li>MAC Address</li> </ul>	G - Gatewa last seen Type	y MAC, ,+ - pr age	(R) - Routed MAC, 0 - Overlay MAC imary entry using vPC Peer-Link Secure NTEY Ports/SWID.SSID.LID					
		+	++		+++					
ж	10	0025.b5dd.0000	static	0	F F Veth1031					
ж	10	0025.b5dd.0001	static	Θ	F F Veth1039					
ж	10	0025.b5dd.0002	static	Θ	F F Veth1135					
ж	10	0025.b5dd.0003	static	Θ	F F Veth1055					
ж	10	0025.b5dd.0004	static	Θ	F F Veth1063					
*	10	0025.b5dd.0005	static	Θ	F F Veth1071					
ж	10	0025.b5dd.0006	static	0	F F Veth1079					
*	10	0025.b5dd.0007	static	Θ	F F Veth1087					
ж	4044	025d.7358.c8b2	dynamic	Θ	F F Eth2/1/33					

# Test 2 – Cisco UCS 6332-16UP Fabric Interconnect – B Failure Test

The below figure illustrates how during Fabric Interconnect – B switch failure, the respective blades (ORARACX1, ORARACX2, ORARACX3 and ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 and ORARACX8) on chassis 2 will fail over the public network interface MAC addresses and its VLAN network traffic to fabric interconnect – A.





Unplug power cable from Fabric Interconnect – B and check the MAC address and VLAN information on Cisco UCS Fabric Interconnect – A.

Figure 52	Fabric Interconnect -	- A Network	Traffic
-----------	-----------------------	-------------	---------

0	ORARAC-X-FI-A(nxos)#									
0	ORARAC-X-FI-A(nxos)# show mac address-table									
L	Legend:									
		<ul> <li>* - primary entry, age - seconds since</li> </ul>	G - Gateway last seen	y MAC, ,+ - pr	<pre>(R) - Rout imary entit</pre>	ted ry u	MAC, O - Overlay MAC sing vPC Peer-Link			
	VLAN	MAC Address	Туре	age	Secure	NTF	Y Ports/SWID.SSID.L	ID		
*	134	0025.b5cc.0000	++ static	0	+ F	F	Veth1029			
ж	134	0025.b5cc.0001	static	Θ	F	F	Veth1037			
ж	134	0025.b5cc.0002	static	0	F	F	Veth1133			
ж	134	0025.b5cc.0003	static	0	F	F	Veth1053			
*	134	0025.b5cc.0004	static	Θ	F	F	Veth1061			
ж	134	0025.b5cc.0005	static	Θ	E	F	Veth1069			
*	134	0025.b5cc.0006	static	Θ	F	F	Veth1077			
ж	134	0025.b5cc.0007	static	0	F	F	Veth1085			
*	10	0025.b5dd.0000	static	Θ	F	F	Veth1032			
*	10	0025.b5dd.0001	static	Θ	F	F	Veth1040			
ж	10	0025.b5dd.0002	static	Θ	F	F	Veth1136			
ж	10	0025.b5dd.0003	static	Θ	F	F	Veth1056			
ж	10	0025.b5dd.0004	static	Θ	F	F	Veth1064			
ж	10	0025.b5dd.0005	static	0	F	F	Veth1072			
ж	10	0025.b5dd.0006	static	Θ	F	F	Veth1080			
ж	10	0025.b5dd.0007	static	0	F	F	Veth1088			
ж	4044	025d.7358.c8b3	dynamic	0	F	F	Eth2/1/33			

As seen in the screenshot above, When the Fabric Interconnect – B failed, it will route all the Private Network traffic of VLAN 10 to Fabric Interconnect – A. So Fabric Interconnect – B Failover did not cause any disruption to Private, Public and Storage Network Traffic.

After plug back power cable to Fabric Interconnect – B Switch, the respective blades (ORARACX1, ORARACX2, ORARACX3 & ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 & ORARACX8) on chassis 2 will route back the MAC addresses and its VLAN traffic to Fabric Interconnect – B.

The figure below shows details of MAC address, VLAN information and Server connections for Cisco UCS Fabric Interconnect – A switch under normal operating condition.

#### Figure 53 Fabric Interconnect – A Network Traffic

```
ORARAC-X-FI-A(nxos)#
ORARAC-X-FI-A(nxos)# show mac address-table
Legend:
          - primary entry, G - Gateway MAC, (R) - Routed MAC, O - Overlay MAC
        age - seconds since last seen, + - primary entry using vPC Peer-Link
                                                                Ports/SWID.SSID.LID
   VLAN
            MAC Address
                                                 Secure NTFY
                              Type
                                         age
 134
           0025.b5cc.0000
                                         0
                                                          F
                              static
                                                     F
                                                             Veth1029
  134
           0025.b5cc.0001
                                         0
                                                     F
                                                          F
                                                             Veth1037
                              static
                                                             Veth1133
  134
           0025.b5cc.0002
                              static
                                         0
                                                     F
                                                          F
  134
           0025.b5cc.0003
                                         Θ
                                                     F
                                                          F
                                                             Veth1053
                              static
  134
                                                     F
           0025.b5cc.0004
                              static
                                         0
                                                          F
                                                             Veth1061
  134
                                                     F
                                                          F
           0025.b5cc.0005
                              static
                                         0
                                                             Veth1069
  134
                                                     F
                                                          F
           0025.b5cc.0006
                              static
                                         0
                                                             Veth1077
  134
           0025.b5cc.0007
                              static
                                         0
                                                     F
                                                          F
                                                             Veth1085
                              dynamic
                                                     F
                                                          F
  4044
           025d.7358.c8b3
                                         0
                                                             Eth2/1/33
```

The figure below shows details of MAC address, VLAN information and Server connections for Cisco UCS Fabric Interconnect – B switch.

### Figure 54 Fabric Interconnect – B Network Traffic

OF	ORARAC-X-FI-B(nxos)#										
0F	ORARAC-X-FI-B(nxos)# show mac address-table										
Le	Legend:										
	* - primary entry, G - Gateway MAC, (R) - Routed MAC, O - Overlay MAC age - seconds since last seen, + - primary entry using vPC Peer-Link										
	VLAN	MAC Address	туре	age	Secure NIFY Ports/SWID.SSID.LID						
		+	++		+						
*	10	0025.b5dd.0000	static	Θ	F F Veth1031						
×	10	0025.b5dd.0001	static	Θ	F F Veth1039						
ж	10	0025.b5dd.0002	static	Θ	F F Veth1135						
ж	10	0025.b5dd.0003	static	Θ	F F Veth1055						
ж	10	0025.b5dd.0004	static	Θ	F F Veth1063						
*	10	0025.b5dd.0005	static	Θ	F F Veth1071						
ж	10	0025.b5dd.0006	static	Θ	F F Veth1079						
*	10	0025.b5dd.0007	static	Θ	F F Veth1087						
ж	4044	025d.7358.c8b2	dynamic	Θ	F F Eth2/1/33						

# Test 3 – Cisco Nexus 9372PX-E Switch – A Failure Test

We conducted a hardware failure test on Nexus Switch – A by disconnecting power cable to the switch as explained below.

The figure below illustrates how during Nexus Switch – A failure, the respective blades (ORARACX1, ORARACX2, ORARACX3 and ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 and ORARACX8) on chassis 2 will fail over the MAC addresses and its VLAN network traffic to Nexus Switch – B.





Unplug the power cable from Nexus Switch – A, and check the MAC address and VLAN information on Cisco UCS Nexus Switch – B. We noticed when the Nexus Switch – A failed, it would route all the Private Network and Public Network Traffic of VLAN 10 and VLAN 134 to Nexus Switch – B. So, Nexus Switch – A Failover did not cause any disruption to Private, Public and Storage Network Traffic.

After plug back power cable to Nexus Switch – A Switch, the respective blades on chassis 1 and chassis 2 will route back the MAC addresses and its VLAN traffic to Nexus Switch – A.

#### Test 4 - Cisco Nexus 9372PX-E Switch - B Failure Test

We conducted a hardware failure test on Nexus Switch – B by disconnecting power cable to the switch as explained below.

The figure below illustrates how during Nexus Switch – B failure, the respective blades (ORARACX1, ORARACX2, ORARACX3 and ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 and ORARACX8) on chassis 2 will fail over the MAC addresses and its VLAN network traffic to Nexus Switch – A.

# Figure 56 Cisco Nexus Switch – B Failure



Unplug the power cable from Nexus Switch – B, and check the MAC address and VLAN information on Cisco UCS Nexus Switch – A. We noticed when the Nexus Switch – B failed, it will route all the Private Network and Public Network Traffic of VLAN 10 and VLAN 134 to Nexus Switch – A. So Nexus Switch – B Failover did not cause any disruption to Private, Public and Storage Network Traffic.

After plug back power cable to Nexus Switch – B Switch, the respective blades on chassis 1 and chassis 2 will route back the MAC addresses and its VLAN traffic to Nexus Switch – B.

# Test 5 - MDS 9148S Switch - A Failure Test

We conducted hardware failure test on MDS Switch – A by disconnecting power cable to the Switch as explained below.

The figure below illustrates how during MDS Switch – A failure, the respective blades (ORARACX1, ORARACX2, ORARACX3, & ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 & ORARACX8) on chassis 2 will failover the MAC addresses and its storage traffic to MDS Switch B same way as Fabric Switch failure.

# Figure 57 MDS Switch A Failure



# Test 6 - MDS 9148S Switch - B Failure Test

We conducted a hardware failure test on MDS Switch – B by disconnecting power cable to the Switch as explained below.

The figure below illustrates how during MDS Switch – B failure, the respective blades (ORARACX1, ORARACX2, ORARACX3, & ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 & ORARACX8) on chassis 2 will failover the MAC addresses and its storage traffic to MDS Switch B same way as Fabric Switch failure.





# Test 7 - Cisco UCS Chassis 1 and 2 IOM Links Failure

We conducted a Cisco UCS Chassis 1 and Chassis 2 IOM Link Failure test by disconnecting two of the server port link cables from the Chassis as explained below.

The figure below illustrates how during UCS Chassis 1 and Chassis 2 IOM Links failure, the respective blades (ORARACX1, ORARACX2, ORARACX3 and ORARACX4) on chassis 1 and (ORARACX5, ORARACX6, ORARACX7 and ORARACX8) on chassis 2 will fail over the MAC addresses and its VLAN network traffic to fabric interconnect – B.





Unplug two server port cables from Chassis 1 and Chassis 2 and check the MAC address and VLAN traffic information on both UCS Fabric Interconnects. The screenshot below shows network traffic on Fabric Interconnect A when two links from Chassis 1 and two links from Chassis 2 IOM Failed.

## Figure 60 Fabric Interconnect – A Network Traffic

ORARAC-	X-FI-A(nxos)#					
ORARAC-	X-FI-A(nxos)# show m	ac address	-table			
Legend:						
	* - primary entry,	G - Gatewa	y MAC,	(R) - Rout	ed	MAC, 0 - Overlay MAC
	age - seconds since	last seen	,+ - pr:	imary entr	y u	sing vPC Peer-Link
VLAN	MAC Address	Туре	age	Secure	NTF	Y Ports/SWID.SSID.LID
	+	++		++		-+
* 134	0025.b5cc.0000	static	Θ	F	F	Veth1029
* 134	0025.b5cc.0001	static	Θ	F	F	Veth1037
* 134	0025.b5cc.0002	static	Θ	F	F	Veth1133
* 134	0025.b5cc.0003	static	Θ	F	F	Veth1053
* 134	0025.b5cc.0004	static	Θ	F	F	Veth1061
* 134	0025.b5cc.0005	static	Θ	F	F	Veth1069
* 134	0025.b5cc.0006	static	Θ	F	F	Veth1077
* 134	0025.b5cc.0007	static	Θ	F	F	Veth1085
* 4044	025d.7358.c8b3	dynamic	0	F	F	Eth2/1/33

The screenshot below shows network traffic on Fabric Interconnect B when two links from Chassis 1 and two links from Chassis 2 IOM Failed.

Figure 61 Fabric Interconnect – B Network Traffic

OF	RARAC-X	-FI-B(nxos)#									
OF	ORARAC-X-FI-B(nxos)# show mac address-table										
L	Legend :										
		<ul> <li>* - primary entry,</li> </ul>	G - Gatewa	y MAC,	(R) - Routed MAC, 0 - Overlay	MAC					
		age - seconds since	last seen	,+ - pr:	mary entry using vPC Peer-Li	nk					
	VLAN	MAC Address	Туре	age	Secure NTFY Ports/SWID.S	SID.LID					
-		-+	++		+++						
ж	10	0025.b5dd.0000	static	Θ	F F Veth1031						
ж	10	0025.b5dd.0001	static	Θ	F F Veth1039						
ж	10	0025.b5dd.0002	static	Θ	F F Veth1135						
ж	10	0025.b5dd.0003	static	Θ	F F Veth1055						
*	10	0025.b5dd.0004	static	Θ	F F Veth1063						
*	10	0025.b5dd.0005	static	Θ	F F Veth1071						
ж	10	0025.b5dd.0006	static	0	F F Veth1079						
*	10	0025.b5dd.0007	static	Θ	F F Veth1087						
ж	4044	025d.7358.c8b2	dynamic	Θ	F F Eth2/1/33						

We noticed no disruption in public and private network traffic even after two failed traffic links from both the Chassis because of the port-channel feature.

We completed additional failure scenario and validated that there are no single point of failure in this reference design.

# Summary

Cisco and Pure Storage have partnered to deliver the FlashStack solution, that uses best-in-class storage, server, and network components to serve as the foundation for a variety of workloads, enabling efficient architectural designs that can be quickly and confidently deployed. FlashStack Datacenter is predesigned to provide agility to large enterprise data centers with high availability and storage scalability. With a FlashStack solution, customers can leverage a secure, integrated, and optimized stack that includes compute, network, and storage resources that are sized, configured, and deployed as a fully tested unit running industry standard applications such as Oracle RAC Database 12c R2

The following factors make the combination of Cisco UCS with Pure Storage so powerful for Oracle environments:

- Cisco UCS stateless computing architecture provided by the Service Profile capability of Cisco UCS allows fast, non-disruptive workload changes to be executed simply and seamlessly across the integrated UCS infrastructure and Cisco x86 servers.
- Cisco UCS, combined with Pure Storage's highly scalable FlashArray storage system provides the ideal combination for Oracle's unique, scalable, and highly available FAS technology.
- Hardware level redundancy for all major components using Cisco UCS and Pure Storage availability features.

FlashStack is a flexible infrastructure platform composed of pre-sized storage, networking, and server components. It is designed to ease your IT transformation and operational challenges with maximum efficiency and minimal risk.

FlashStack differs from other solutions by providing:

- Integrated, validated technologies from industry leaders and top-tier software partners.
- A single platform built from unified compute, fabric, and storage technologies, allowing you to scale to largescale data centers without architectural changes.
- Centralized, simplified management of infrastructure resources, including end-to-end automation.
- A flexible Cooperative Support Model that resolves issues rapidly and spans across new and legacy products.

# Appendix

```
Cisco Nexus 9372PX-E Running Configuration
PURESTG-NEXUS-A# show running-config
!Command: show running-config
!Time: Wed Jan 10 19:59:21 2018
version 6.1(2)I2(2a)
hostname PURESTG-NEXUS-A
policy-map type network-qos jumbo
  class type network-qos class-default
    mtu 9216
vdc PURESTG-NEXUS-A id 1
  allocate interface Ethernet1/1-48
  allocate interface Ethernet2/1-12
  limit-resource vlan minimum 16 maximum 4094
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 768
  limit-resource u4route-mem minimum 248 maximum 248
  limit-resource u6route-mem minimum 96 maximum 96
  limit-resource m4route-mem minimum 58 maximum 58
  limit-resource m6route-mem minimum 8 maximum 8
cfs eth distribute
feature lacp
feature vpc
system qos
  service-policy type network-qos jumbo
vlan 1,10,134
vlan 10
  name Oracle Private Traffic
vlan 134
  name Oracle Public Traffic
spanning-tree port type edge bpduguard default
spanning-tree port type network default
vrf context management
  ip route 0.0.0.0/0 10.29.134.1
port-channel load-balance src-dst l4port
vpc domain 1
  role priority 10
  peer-keepalive destination 10.29.134.154 source 10.29.134.153
  auto-recovery
interface port-channel1
  description VPC peer-link
  switchport mode trunk
  switchport trunk allowed vlan 1,10,134
  spanning-tree port type network
  vpc peer-link
interface port-channel21
```

description connect to Fabric Interconnect A switchport mode trunk switchport trunk allowed vlan 1,10,134 spanning-tree port type edge trunk vpc 21 interface port-channel22 description connect to Fabric Interconnect B switchport mode trunk switchport trunk allowed vlan 1,10,134 spanning-tree port type edge trunk vpc 22 interface Ethernet1/1 description Nexus5k-B-Cluster-Interconnect switchport mode trunk switchport trunk allowed vlan 1,10,134 channel-group 1 mode active interface Ethernet1/2 description Nexus5k-B-Cluster-Interconnect switchport mode trunk switchport trunk allowed vlan 1,10,134 channel-group 1 mode active interface Ethernet1/3 . . interface Ethernet1/11 description Fabric-Interconnect-A:11 switchport mode trunk switchport trunk allowed vlan 1,10,134 spanning-tree port type edge trunk channel-group 21 mode active interface Ethernet1/12 description Fabric-Interconnect-A:12 switchport mode trunk switchport trunk allowed vlan 1,10,134 spanning-tree port type edge trunk channel-group 21 mode active interface Ethernet1/13 description Fabric-Interconnect-B:11 switchport mode trunk switchport trunk allowed vlan 1,10,134 spanning-tree port type edge trunk channel-group 22 mode active interface Ethernet1/14 description Fabric-Interconnect-B:12 switchport mode trunk switchport trunk allowed vlan 1,10,134 spanning-tree port type edge trunk channel-group 22 mode active interface Ethernet1/15 description connect to uplink switch

```
switchport access vlan 134
  speed 1000
interface Ethernet1/16
interface Ethernet1/17
interface Ethernet1/18
interface Ethernet1/19
interface Ethernet1/20
interface Ethernet1/21
interface Ethernet1/22
interface Ethernet1/23
interface Ethernet1/24
interface Ethernet1/25
interface Ethernet1/26
interface Ethernet1/27
interface Ethernet1/28
interface Ethernet1/29
interface Ethernet1/30
interface Ethernet1/31
interface Ethernet1/32
interface Ethernet1/33
interface Ethernet1/34
interface Ethernet1/35
interface Ethernet1/36
interface Ethernet1/37
interface Ethernet1/38
interface Ethernet1/39
interface Ethernet1/40
interface Ethernet1/41
interface Ethernet1/42
interface Ethernet1/43
```

- interface Ethernet1/44
- interface Ethernet1/45
- interface Ethernet1/46
- interface Ethernet1/47
- interface Ethernet1/48
- interface Ethernet2/1
- interface Ethernet2/2
- interface Ethernet2/3
- interface Ethernet2/4
- interface Ethernet2/5
- interface Ethernet2/6
- interface Ethernet2/7
- interface Ethernet2/8
- interface Ethernet2/9
- interface Ethernet2/10
- interface Ethernet2/11
- interface Ethernet2/12

interface mgmt0
 vrf member management
 ip address 10.29.134.153/24
line console
line vty
boot nxos bootflash:/n9000-dk9.6.1.2.I2.2a.bin

#### MDS 9148S FC Switch Running Configuration

PURESTG-MDS-A# show running-config

!Command: show running-config
!Time: Mon Jan 8 22:36:38 2018

version 6.2(9)
power redundancy-mode redundant
feature npiv
feature telnet
no feature http-server
ip domain-lookup
ip host PURESTG-MDS-A 10.29.134.155
vsan database

```
vsan 101
 vsan 201
device-alias database
 device-alias name oraracx1-hba0 pwwn 20:00:00:25:b5:6a:00:00
 device-alias name oraracx1-hba2 pwwn 20:00:00:25:b5:6a:00:01
 device-alias name oraracx2-hba0 pwwn 20:00:00:25:b5:6a:00:02
 device-alias name oraracx2-hba2 pwwn 20:00:00:25:b5:6a:00:03
 device-alias name oraracx3-hba0 pwwn 20:00:00:25:b5:6a:00:04
 device-alias name oraracx3-hba2 pwwn 20:00:00:25:b5:6a:00:05
 device-alias name oraracx4-hba0 pwwn 20:00:00:25:b5:6a:00:06
 device-alias name oraracx4-hba2 pwwn 20:00:00:25:b5:6a:00:07
 device-alias name oraracx5-hba0 pwwn 20:00:00:25:b5:6a:00:08
 device-alias name oraracx5-hba2 pwwn 20:00:00:25:b5:6a:00:09
 device-alias name oraracx6-hba0 pwwn 20:00:00:25:b5:6a:00:0a
 device-alias name oraracx6-hba2 pwwn 20:00:00:25:b5:6a:00:0b
 device-alias name oraracx7-hba0 pwwn 20:00:00:25:b5:6a:00:0c
 device-alias name oraracx7-hba2 pwwn 20:00:00:25:b5:6a:00:0d
 device-alias name oraracx8-hba0 pwwn 20:00:00:25:b5:6a:00:0e
 device-alias name oraracx8-hba2 pwwn 20:00:00:25:b5:6a:00:0f
 device-alias name FLASHSTACK-X-CT0-FC0 pwwn 52:4a:93:7b:25:8b:4d:00
 device-alias name FLASHSTACK-X-CT0-FC6 pwwn 52:4a:93:7b:25:8b:4d:06
 device-alias name FLASHSTACK-X-CT1-FC0 pwwn 52:4a:93:7b:25:8b:4d:10
 device-alias name FLASHSTACK-X-CT1-FC6 pwwn 52:4a:93:7b:25:8b:4d:16
```

device-alias commit

```
fcdomain fcid database
 vsan 1 wwn 52:4a:93:7a:b3:18:ce:02 fcid 0x3a0000 dynamic
            [Pure-STG-CT0-FC2]
1
 vsan 1 wwn 52:4a:93:7a:b3:18:ce:12 fcid 0x3a0100 dynamic
I.
             [Pure-STG-CT1-FC2]
 vsan 1 wwn 20:01:8c:60:4f:bd:31:80 fcid 0x3a0200 dynamic
 vsan 1 wwn 20:02:8c:60:4f:bd:31:80 fcid 0x3a0300 dynamic
 vsan 1 wwn 20:01:8c:60:4f:bd:64:80 fcid 0x3a0400 dynamic
 vsan 1 wwn 52:4a:93:7b:25:8b:4d:00 fcid 0x3a0500 dynamic
T
            [FLASHSTACK-X-CT0-FC0]
 vsan 201 wwn 20:04:8c:60:4f:bd:64:80 fcid 0x570000 dynamic
 vsan 201 wwn 20:01:8c:60:4f:bd:64:80 fcid 0x570100 dynamic
 vsan 201 wwn 20:03:8c:60:4f:bd:64:80 fcid 0x570200 dynamic
 vsan 201 wwn 52:4a:93:7b:25:8b:4d:16 fcid 0x570300 dynamic
              [FLASHSTACK-X-CT1-FC6]
I.
 vsan 201 wwn 52:4a:93:7b:25:8b:4d:06 fcid 0x570400 dynamic
              [FLASHSTACK-X-CT0-FC6]
T
 vsan 201 wwn 52:4a:93:7b:25:8b:4d:10 fcid 0x570500 dynamic
T
              [FLASHSTACK-X-CT1-FC0]
 vsan 201 wwn 20:02:8c:60:4f:bd:64:80 fcid 0x570600 dynamic
 vsan 201 wwn 52:4a:93:7b:25:8b:4d:00 fcid 0x570700 dynamic
               [FLASHSTACK-X-CT0-FC0]
I.
 vsan 201 wwn 20:00:00:25:b5:aa:00:00 fcid 0x570102 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:06 fcid 0x570605 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:02 fcid 0x570206 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:04 fcid 0x570003 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:08 fcid 0x570107 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:0a fcid 0x570608 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:0c fcid 0x570202 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:0e fcid 0x570002 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:01 fcid 0x570601 dynamic
 vsan 201 wwn 20:00:00:25:b5:aa:00:10 fcid 0x570208 dynamic
```

	vsan	201	wwn	20:00:00:25:b5:aa:00:03	fcid	0x570103	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:05	fcid	0x570203	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:07	fcid	0x570006	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:09	fcid	0x570205	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:0b	fcid	0x570005	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:0d	fcid	0x570602	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:0f	fcid	0x570606	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:12	fcid	0x570603	dynamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:13	fcid	0x57010a	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:11	fcid	0x570109	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:14	fcid	0x570207	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:15	fcid	0x570105	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:16	fcid	0x570108	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:17	fcid	0x570001	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:18	fcid	0x570101	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:19	fcid	0x570607	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:1a	fcid	0x570604	dvnamic
	vsan	201	wwn	20:00:00:25:b5:aa:00:1b	fcid	$0 \times 570201$	dynamic
	vsan	201	សសា	20.00.00.25.b5.6a.00.00	fcid	$0 \times 570110$	dynamic
ī	vouii	201	** ** 11	[oraracx1-hba0]	ICIU	02010110	aynamic
•	wsan	201	547547 M	20.00.00.25.b5.6a.00.02	fcid	0x570609	dynamic
ī	vouii	201	** ** 11	[oraracy2-bba0]	ICIU	02010000	aynamic
·	TRAN	201	1.71.70	20.00.00.25.62.00.04	faid	0~570204	dynamic
1	vsaii	201	VV VV II	[oraracy3-bba0]	ICIU	02010201	aynamic
÷	TRAN	201	1.71.70	20.00.00.25.62.00.06	faid	0~570007	dynamic
	vsall	201	W W I I	20.00.00.23.03.00.00	ICIU	023/000/	uynamic
÷	trean	201	T.TT.TD	20.00.00.25.b5.62.00.08	faid	0.2570009	dunamia
	vsall	201	W W I I	20.00.00.23.03.00.00	ICIU	02370009	uynamite
:	traan	201	1.11.12		faid	0.2570106	dunamia
	vsall	201	WWII	20.00.00.23.05.0a.00.0a	ICIU	0x370100	uynamite
÷		201			faid	0	dunamia
	vsan	ZUI	WWII	20:00:00:25:05:0a:00:0C	ICIA	0x570200	aynamirc
÷		201			د ما ما	0	den em é e
	vsan	ZUI	WW11	20:00:00:25:65:6a:00:0e	ICIA	0x57060d	aynamic
!		201			لحصنا	0	den em é e
	vsan	ZUI	WW11	20:00:00:25:65:64:00:10	ICIA	0x57060a	aynamic
!		201			لحصنا	0	den em é e
	vsan	ZUI	WW11	20:00:00:25:65:6a:00:12	ICIA	0x5/0104	aynamic
ł		0.01			6	0	
	vsan	201	wwn	20:00:00:25:65:6a:00:01	ICIA	0x57020a	aynamic
!		0.01		[oraracx1-nba2]	c ' 1	0 570105	, ,
	vsan	201	wwn	20:00:00:25:65:6a:00:03	ICIA	0x5/0101	dynamic
!		0.01		[oraracx2-hba2]	с I 1	0 5 7 0 1 0 1	, ,
	vsan	201	wwn	20:00:00:25:b5:6a:00:05	fcid	0x57010d	dynamıc
!		0.01		[oraracx3-hba2]	~ · · ·		
	vsan	201	wwn	20:00:00:25:b5:6a:00:0f	fcid	0x57060f	dynamic
!				[oraracx8-hba2]			
	vsan	201	wwn	20:00:00:25:b5:6a:00:11	fcid	0x57010c	dynamic
!				[test-oral-hba2]			
	vsan	201	wwn	20:00:00:25:b5:6a:00:13	fcid	0x570209	dynamic
!				[test-ora2-hba2]			
	vsan	201	wwn	20:00:00:25:b5:6a:00:07	fcid	0x57000a	dynamic
!				[oraracx4-hba2]			
	vsan	201	wwn	20:00:00:25:b5:6a:00:0b	fcid	0x57060e	dynamic
!				[oraracx6-hba2]			
	vsan	201	wwn	20:00:00:25:b5:6a:00:09	fcid	0x570004	dynamic
!				[oraracx5-hba2]			
	vsan	201	wwn	20:00:00:25:b5:6a:00:0d	fcid	0x57020a	dynamic
!				[oraracx7-hba2]			

```
vsan database
  vsan 201 interface fc1/25
  vsan 201 interface fc1/26
  vsan 201 interface fc1/27
  vsan 201 interface fc1/28
  vsan 201 interface fc1/33
  vsan 201 interface fc1/34
  vsan 201 interface fc1/35
  vsan 201 interface fc1/36
switchname PURESTG-MDS-A
line console
line vty
boot kickstart bootflash:/m9100-s5ek9-kickstart-mz.6.2.9.bin
boot system bootflash:/m9100-s5ek9-mz.6.2.9.bin
interface fc1/1
interface fc1/2
interface fc1/3
interface fc1/4
interface fc1/5
interface fc1/6
interface fc1/7
interface fc1/8
interface fc1/9
interface fc1/10
interface fc1/11
interface fc1/12
interface fc1/13
interface fc1/14
interface fc1/15
interface fc1/16
interface fc1/17
interface fc1/18
interface fc1/19
interface fc1/20
interface fc1/21
interface fc1/22
interface fc1/23
interface fc1/24
interface fc1/25
interface fc1/26
interface fc1/27
interface fc1/28
interface fc1/29
interface fc1/30
interface fc1/31
interface fc1/32
interface fc1/33
interface fc1/34
interface fc1/35
interface fc1/36
interface fc1/37
interface fc1/38
interface fc1/39
interface fc1/40
interface fc1/41
interface fc1/42
interface fc1/43
```

interface fc1/44 interface fc1/45 interface fc1/46 interface fc1/47 interface fc1/48 !Active Zone Database Section for vsan 201 zone name oraracx1 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00 [FLASHSTACK-X-CT0-FC0] ! member pwwn 52:4a:93:7b:25:8b:4d:06 [FLASHSTACK-X-CT0-FC6] ! member pwwn 52:4a:93:7b:25:8b:4d:10 ! [FLASHSTACK-X-CT1-FC0] member pwwn 52:4a:93:7b:25:8b:4d:16 ! [FLASHSTACK-X-CT1-FC6] member pwwn 20:00:00:25:b5:6a:00:00 T [oraracx1-hba0] member pwwn 20:00:00:25:b5:6a:00:01 ! [oraracx1-hba2] zone name oraracx2 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00 I [FLASHSTACK-X-CT0-FC0] member pwwn 52:4a:93:7b:25:8b:4d:06 ! [FLASHSTACK-X-CT0-FC6] member pwwn 52:4a:93:7b:25:8b:4d:10 ! [FLASHSTACK-X-CT1-FC0] member pwwn 52:4a:93:7b:25:8b:4d:16 ! [FLASHSTACK-X-CT1-FC6] member pwwn 20:00:00:25:b5:6a:00:02 I. [oraracx2-hba0] member pwwn 20:00:00:25:b5:6a:00:03 ! [oraracx2-hba2] zone name oraracx3 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00 Ţ [FLASHSTACK-X-CT0-FC0] member pwwn 52:4a:93:7b:25:8b:4d:06 ! [FLASHSTACK-X-CT0-FC6] member pwwn 52:4a:93:7b:25:8b:4d:10 ! [FLASHSTACK-X-CT1-FC0] member pwwn 52:4a:93:7b:25:8b:4d:16 ! [FLASHSTACK-X-CT1-FC6] member pwwn 20:00:00:25:b5:6a:00:04 ! [oraracx3-hba0] member pwwn 20:00:00:25:b5:6a:00:05 ! [oraracx3-hba2] zone name oraracx4 vsan 201 member pwwn 52:4a:93:7b:25:8b:4d:00 I [FLASHSTACK-X-CT0-FC0] member pwwn 52:4a:93:7b:25:8b:4d:06 ! [FLASHSTACK-X-CT0-FC6] member pwwn 52:4a:93:7b:25:8b:4d:10 [FLASHSTACK-X-CT1-FC0] ! member pwwn 52:4a:93:7b:25:8b:4d:16 ! [FLASHSTACK-X-CT1-FC6]

```
member pwwn 20:00:00:25:b5:6a:00:06
!
                [oraracx4-hba0]
   member pwwn 20:00:00:25:b5:6a:00:07
                [oraracx4-hba2]
T
zone name oraracx5 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
!
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
                [FLASHSTACK-X-CT0-FC6]
I
   member pwwn 52:4a:93:7b:25:8b:4d:10
                [FLASHSTACK-X-CT1-FC0]
!
   member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
    member pwwn 20:00:00:25:b5:6a:00:08
!
                [oraracx5-hba0]
    member pwwn 20:00:00:25:b5:6a:00:09
T
                [oraracx5-hba2]
zone name oraracx6 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
                [FLASHSTACK-X-CT0-FC0]
I.
    member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
    member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
   member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
    member pwwn 20:00:00:25:b5:6a:00:0a
!
                [oraracx6-hba0]
    member pwwn 20:00:00:25:b5:6a:00:0b
I.
                [oraracx6-hba2]
zone name oraracx7 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
!
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
Ţ
                [FLASHSTACK-X-CT0-FC6]
    member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
   member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
    member pwwn 20:00:00:25:b5:6a:00:0c
!
                [oraracx7-hba0]
    member pwwn 20:00:00:25:b5:6a:00:0d
                [oraracx7-hba2]
!
zone name oraracx8 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
!
                [FLASHSTACK-X-CT0-FC0]
   member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
   member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
   member pwwn 52:4a:93:7b:25:8b:4d:16
                [FLASHSTACK-X-CT1-FC6]
!
   member pwwn 20:00:00:25:b5:6a:00:0e
!
                [oraracx8-hba0]
```

```
member pwwn 20:00:00:25:b5:6a:00:0f
!
              [oraracx8-hba2]
zoneset name oraracx vsan 201
   member oraracx1
    member oraracx2
    member oraracx3
   member oraracx4
   member oraracx5
   member oraracx6
   member oraracx7
   member oraracx8
zoneset activate name oraracx vsan 201
do clear zone database vsan 201
!Full Zone Database Section for vsan 201
zone name oraracx1 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
I.
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
    member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
    member pwwn 20:00:00:25:b5:6a:00:00
!
                [oraracx1-hba0]
    member pwwn 20:00:00:25:b5:6a:00:01
!
               [oraracx1-hba2]
zone name oraracx2 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
!
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
    member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
   member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
   member pwwn 20:00:00:25:b5:6a:00:02
!
                [oraracx2-hba0]
    member pwwn 20:00:00:25:b5:6a:00:03
!
                [oraracx2-hba2]
zone name oraracx3 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
!
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
    member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
    member pwwn 20:00:00:25:b5:6a:00:04
!
                [oraracx3-hba0]
    member pwwn 20:00:00:25:b5:6a:00:05
!
                [oraracx3-hba2]
```

```
zone name oraracx4 vsan 201
   member pwwn 52:4a:93:7b:25:8b:4d:00
!
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
                [FLASHSTACK-X-CT0-FC6]
!
   member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
   member pwwn 20:00:00:25:b5:6a:00:06
I
                [oraracx4-hba0]
    member pwwn 20:00:00:25:b5:6a:00:07
!
                [oraracx4-hba2]
zone name oraracx5 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
I
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
I.
                [FLASHSTACK-X-CT0-FC6]
   member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
   member pwwn 20:00:00:25:b5:6a:00:08
!
                [oraracx5-hba0]
    member pwwn 20:00:00:25:b5:6a:00:09
!
                [oraracx5-hba2]
zone name oraracx6 vsan 201
   member pwwn 52:4a:93:7b:25:8b:4d:00
I
                [FLASHSTACK-X-CT0-FC0]
   member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
   member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
   member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
   member pwwn 20:00:00:25:b5:6a:00:0a
I
                [oraracx6-hba0]
   member pwwn 20:00:00:25:b5:6a:00:0b
                [oraracx6-hba2]
I
zone name oraracx7 vsan 201
    member pwwn 52:4a:93:7b:25:8b:4d:00
I
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
   member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
   member pwwn 20:00:00:25:b5:6a:00:0c
!
                [oraracx7-hba0]
    member pwwn 20:00:00:25:b5:6a:00:0d
I
                [oraracx7-hba2]
```

zone name oraracx8 vsan 201
 member pwwn 52:4a:93:7b:25:8b:4d:00

```
!
                [FLASHSTACK-X-CT0-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:06
!
                [FLASHSTACK-X-CT0-FC6]
    member pwwn 52:4a:93:7b:25:8b:4d:10
!
                [FLASHSTACK-X-CT1-FC0]
    member pwwn 52:4a:93:7b:25:8b:4d:16
!
                [FLASHSTACK-X-CT1-FC6]
    member pwwn 20:00:00:25:b5:6a:00:0e
!
                [oraracx8-hba0]
    member pwwn 20:00:00:25:b5:6a:00:0f
!
                [oraracx8-hba2]
zoneset name oraracx vsan 201
    member oraracx1
    member oraracx2
    member oraracx3
    member oraracx4
   member oraracx5
   member oraracx6
    member oraracx7
    member oraracx8
interface fc1/1
interface fc1/2
interface fc1/3
interface fc1/4
interface fc1/5
interface fc1/6
interface fc1/7
interface fc1/8
interface fc1/9
interface fc1/10
interface fc1/11
interface fc1/12
interface fc1/13
interface fc1/14
interface fc1/15
interface fc1/16
interface fc1/17
interface fc1/18
interface fc1/19
interface fc1/20
interface fc1/21
interface fc1/22
interface fc1/23
interface fc1/24
interface fc1/25
  switchport trunk allowed vsan 201
  switchport trunk mode off
 port-license acquire
 no shutdown
interface fc1/26
  switchport trunk allowed vsan 201
  switchport trunk mode off
 port-license acquire
 no shutdown
```

interface fc1/27 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/28 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/29 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/30 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/31 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/32 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/33 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/34 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/35 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire no shutdown interface fc1/36 switchport trunk allowed vsan 201 switchport trunk mode off port-license acquire

no shutdown interface fc1/37 interface fc1/38 interface fc1/39 interface fc1/40 interface fc1/41 interface fc1/42 interface fc1/43 interface fc1/44 interface fc1/45 interface fc1/46 interface fc1/47 interface fc1/48 interface mgmt0 ip address 10.29.134.155 255.255.255.0 no system default switchport shutdown ip default-gateway 10.29.134.1

#### Multipath Configuration "/etc/multipath.conf"

```
[root@oraracx1 ~]# cat /etc/multipath.conf
blacklist {
       devnode "^(ram|zram|raw|loop|fd|md|sr|scd|st)[0-9]*"
}
defaults {
        find multipaths yes
        polling interval 1
}
devices {
        device {
                vendor
                                         "PURE"
                path grouping policy
                                         multibus
                path checker
                                         tur
                path_selector
                                         "queue-length 0"
                fast_io_fail_tmo
                                        10
                dev loss tmo
                                         30
                no path retry
                                         0
        }
}
multipaths {
        multipath {
                                         3624a93701c0d5dfa58fa45d800011066
                wwid
                alias
                                         orarax1 os
        }
        multipath {
                                         3624a93701c0d5dfa58fa45d800011084
                wwid
                alias
                                         dg orarac crs
        }
        multipath {
                wwid
                                         3624a93701c0d5dfa58fa45d80001107f
                alias
                                         dg_oradata_oltp1
        }
        multipath {
                                         3624a93701c0d5dfa58fa45d800011080
                wwid
                alias
                                         dg oraredo oltp1
        }
        multipath {
```

}

wwid alias } multipath { wwid alias }

3624a93701c0d5dfa58fa45d800011091 dg oradata dss1 3624a93701c0d5dfa58fa45d800011093 dg oraredo dss1 3624a93701c0d5dfa58fa45d800011096 dg oradata soel 3624a93701c0d5dfa58fa45d800011097 dg oraredo soel 3624a93701c0d5dfa58fa45d800011125 dg\_oradata\_slob01 3624a93701c0d5dfa58fa45d800011126 dg oradata slob02 3624a93701c0d5dfa58fa45d800011127 dg oradata slob03 3624a93701c0d5dfa58fa45d800011128 dg oradata slob04 3624a93701c0d5dfa58fa45d800011129 dg oraredo slob 3624a93701c0d5dfa58fa45d800011130 dg oradata slob05 3624a93701c0d5dfa58fa45d800011131 dg oradata slob06 3624a93701c0d5dfa58fa45d800011132 dg oradata slob07 3624a93701c0d5dfa58fa45d800011133 dg oradata slob08 3624a93701c0d5dfa58fa45d800011134 dg oradata slob09

Configuration of "/etc/sysctl.conf" ### File located "/etc/sysctl.conf" directory [root@oraracx1 ~]# cat /etc/sysctl.conf # oracle-database-server-12cR2-preinstall setting for fs.file-max is 6815744 fs.file-max = 6815744# oracle-database-server-12cR2-preinstall setting for kernel.sem is '250 32000 100 128' kernel.sem = 250 32000 100 128 # oracle-database-server-12cR2-preinstall setting for kernel.shmmni is 4096 kernel.shmmni = 4096 # oracle-database-server-12cR2-preinstall setting for kernel.shmall is 1073741824 on x86 64 kernel.shmall = 1073741824 # oracle-database-server-12cR2-preinstall setting for kernel.shmmax is 4398046511104 on x86 64 kernel.shmmax = 4398046511104# oracle-database-server-12cR2-preinstall setting for kernel.panic on oops is 1 per Orabug 19212317 kernel.panic on oops = 1 # oracle-database-server-12cR2-preinstall setting for net.core.rmem default is 262144 net.core.rmem default = 262144 # oracle-database-server-12cR2-preinstall setting for net.core.rmem max is 4194304 net.core.rmem max = 4194304# oracle-database-server-12cR2-preinstall setting for net.core.wmem default is 262144 net.core.wmem default = 262144 # oracle-database-server-12cR2-preinstall setting for net.core.wmem max is 1048576 net.core.wmem max = 1048576# oracle-database-server-12cR2-preinstall setting for net.ipv4.conf.all.rp filter is 2 net.ipv4.conf.all.rp filter = 2 # oracle-database-server-12cR2-preinstall setting for net.ipv4.conf.default.rp filter is 2 net.ipv4.conf.default.rp filter = 2 # oracle-database-server-12cR2-preinstall setting for fs.aio-max-nr is 1048576 fs.aio-max-nr = 1048576# oracle-database-server-12cR2-preinstall setting for net.ipv4.ip local port range is 9000 65500 net.ipv4.ip local port range = 9000 65500 # Huge Page Setting for Oracle vm.nr hugepages=125000

Configuration of "oracle-database-server-12cR2-preinstall.conf"
### File located "/etc/security/limits.d/oracle-database-server-12cR2-preinstall.conf"
directory

[root@oraracx1 ~]# cat /etc/security/limits.d/oracle-database-server-12cR2preinstall.conf # oracle-database-server-12cR2-preinstall setting for nofile soft limit is 1024 oracle soft nofile 1024 # oracle-database-server-12cR2-preinstall setting for nofile hard limit is 65536 oracle hard nofile 65536 # oracle-database-server-12cR2-preinstall setting for nproc soft limit is 16384 # refer orabug15971421 for more info. soft nproc 16384 oracle # oracle-database-server-12cR2-preinstall setting for nproc hard limit is 16384 oracle hard nproc 16384 # oracle-database-server-12cR2-preinstall setting for stack soft limit is 10240KB oracle soft stack 10240 # oracle-database-server-12cR2-preinstall setting for stack hard limit is 32768KB 32768 oracle hard stack # oracle-database-server-12cR2-preinstall setting for memlock hard limit is maximum of 128GB on x86 64 or 3GB on x86 OR 90 % of RAM oracle hard memlock 237114345 # oracle-database-server-12cR2-preinstall setting for memlock soft limit is maximum of 128GB on x86 64 or 3GB on x86 OR 90% of RAM oracle soft memlock 237114345 grid soft nofile 1024 grid hard nofile 65536

grid soft nproc 16384 grid hard nproc 16384 grid soft stack 10240 grid hard stack 32768 grid soft memlock 237114345 grid hard memlock 237114345

Configuration of "/etc/udev/rules.d/99-oracle-asmdevices.rules"

### File located "/etc/udev/rules.d/" directory

[root@oraracx1 ~]# cat /etc/udev/rules.d/99-oracle-asmdevices.rules
#All volumes which starts with dg\_orarac\_\* #
ENV{DM NAME}=="dg orarac crs", OWNER:="grid", GROUP:="oinstall", MODE:="660"

```
#All volumes which starts with dg_oradata_* #
ENV{DM_NAME}=="dg_oradata_*", OWNER:="grid", GROUP:="oinstall", MODE:="660"
```

#All volumes which starts with dg\_oraredo\_\* #
ENV{DM NAME}=="dg oraredo \*", OWNER:="grid", GROUP:="oinstall", MODE:="660"

#All volumes which starts with dg\_oraarchive\_\* #
ENV{DM\_NAME}=="dg\_oraarchive\_\*", OWNER:="grid", GROUP:="oinstall", MODE:="660"

Configuration of "/etc/udev/rules.d/99-pure-storage.rules"

### File located ``/etc/udev/rules.d/" directory

[root@oraracx1 ~]# cat /etc/udev/rules.d/99-pure-storage.rules
# Recommended settings for Pure Storage FlashArray.

# Use noop scheduler for high-performance solid-state storage ACTION=="add|change", KERNEL=="sd\*[!0-9]", SUBSYSTEM=="block", ENV{ID\_VENDOR}=="PURE", ATTR{queue/scheduler}="noop"

# Reduce CPU overhead due to entropy collection
ACTION=="add|change", KERNEL=="sd\*[!0-9]", SUBSYSTEM=="block", ENV{ID\_VENDOR}=="PURE",
ATTR{queue/add random}="0"

# Spread CPU load by redirecting completions to originating CPU
ACTION=="add|change", KERNEL=="sd\*[!0-9]", SUBSYSTEM=="block", ENV{ID\_VENDOR}=="PURE",
ATTR{queue/rq\_affinity}="2"

# Set the HBA timeout to 60 seconds
ACTION=="add", SUBSYSTEMS=="scsi", ATTRS{model}=="FlashArray ", RUN+="/bin/sh -c
'echo 60 > /sys/\$DEVPATH/device/timeout'"

# About the Authors

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Tushar Patel is a Principal Engineer in Cisco Systems CSPG UCS Product Management and Data Center Solutions Engineering Group and a specialist in Flash Storage technologies and Oracle RAC RDBMS. Tushar has over 23 years of experience in Flash Storage architecture, Database architecture, design and performance. Tushar also has strong background in Intel X86 architecture, hyper converged systems, Storage technologies and Virtualization. He has worked with large number of enterprise customers, evaluate and deploy mission critical database solutions. Tushar has presented to both internal and external audiences at various conferences and customer events.

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Hardikkumar Vyas is a Solution Engineer in Cisco Systems CSPG UCS Product Management and Data Center Solutions Engineering Group for developing and validating infrastructure best practices for Oracle RAC and Standalone databases on Cisco UCS Servers, Cisco Nexus Products and Storage Technologies. Hardikkumar Vyas holds a Master's degree in Electrical Engineering and has over 5 years of experience in Oracle Database and applications. Hardikkumar Vyas's focus is developing Oracle Database solutions on Cisco UCS Platform.

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Somu Rajarathinam is the Oracle Solutions Architect at Pure Storage responsible for defining database solution based on the company's products, performing benchmarks, preparing reference architecture and technical papers for Oracle databases on Pure. Somu has over 20 years of Oracle database experience, including as a member of Oracle Corporation's Systems Performance and Oracle Applications Performance Groups. His career also included assignments with Logitech, Inspirage, and Autodesk, ranging from providing database and performance solutions to managing infrastructure, to delivering database and application support, both in-house and in the cloud.

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