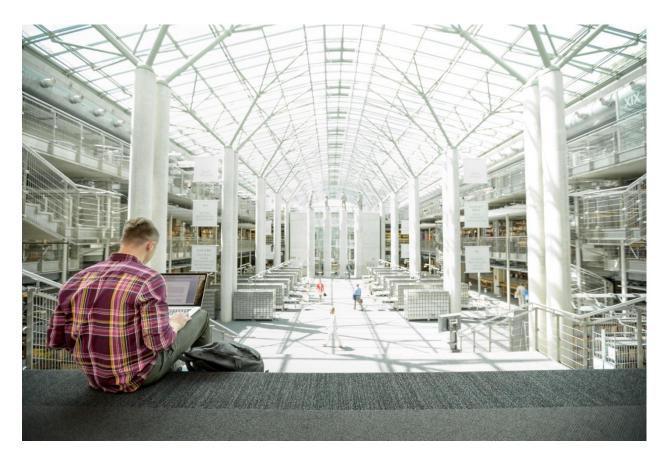
cisco.



FlashStack[™] Data Center with Oracle RAC 12cR2 Database on Pure Storage FlashBlade

Deployment Guide for Oracle Data Warehouse Solution on Cisco Unified Computing System and Pure Storage Flash-Blade™

Last Updated: July 23, 2018



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Executive Summary

The Cisco Unified Computing System[™] (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.

Cisco and Pure Storage deliver FlashStack[™], a modern converged infrastructure (CI) solution that is smarter, simpler, smaller, and more efficient than ever before. FlashStack is virtual machine-aware and hybrid cloud-ready, while retaining the predictability and efficiency advantages of dedicated compute and storage tiers. With FlashStack, customers can modernize their operational model, stay ahead of business demands, and protect and secure their applications and data, regardless of the deployment model on premises, at the edge, or in the cloud.

The FlashStack Advantage:

- Simple no trade-off architecture eliminates disparate hardware silos
- Proven, validated interoperability and for confident application deployment
- Infrastructure for both traditional and converged operating models so you can consolidate operations at your pace
- Converged infrastructure for multi-hypervisor, bare metal or container deployments
- Built for the cloud, including full integration with cloud platforms from Cisco, VMware, OpenStack and others

Architect Once and Adopt New Technology without Disruption

Infrastructure sprawl hinders the agility needed to adapt to changing business dynamics and the ability to scale on demand. As a result, new technology is slow to deploy, requiring regular and time-consuming changes to data center architectures. FlashStack's fully modular and non-disruptive architecture abstracts hardware into software for non-disruptive changes which allow customers to seamlessly deploy new technology without having to re-architect their data center solutions

This Cisco Validated Design (CVD) describes a FlashStack reference architecture for deploying a highly available Oracle RAC Databases environment on Pure Storage[®] FlashBlade[™] using Cisco UCS Compute Servers, Cisco Fabric Interconnect Switches, Cisco Nexus Switches and Oracle Linux. Cisco and Pure Storage have validated the reference architecture with a **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.

Solution Overview

Introduction

Database administrators and their IT departments face many challenges that demand a simplified Oracle RAC Database 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 describes how Cisco UCS System can be used in conjunction with Pure Storage FlashBlade 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 Oracle 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

The goal of this CVD is to highlight the performance, scalability, manageability, and simplicity of the FlashStack Converged Infrastructure solution for deploying for deploying a modern data warehouse with Oracle 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. Demonstrate the seamless scalability of performance and capacity to meet growth needs of Oracle Database.
- 4. Confirm the high availability of Database instances, without performance compromise through software and hardware upgrades.

In this solution, we will demonstrate scalability and performance by executing business-related queries with a high degree of complexity that represent typical data warehouse operations. For hardware calibration we used Linux FIO tool to generate IO patterns simulating data warehouse workload. This is followed by Swingbench test runs on "Sales History" schema that facilitates load tests for sustained 24 hour runs with varying users and node scale tests.

This solution is validated for Oracle RAC single domain cluster only. For Oracle RAC, a Flex Cluster is created and tested with HUB nodes only. A Flex Cluster with leaf nodes is not tested and not supported.

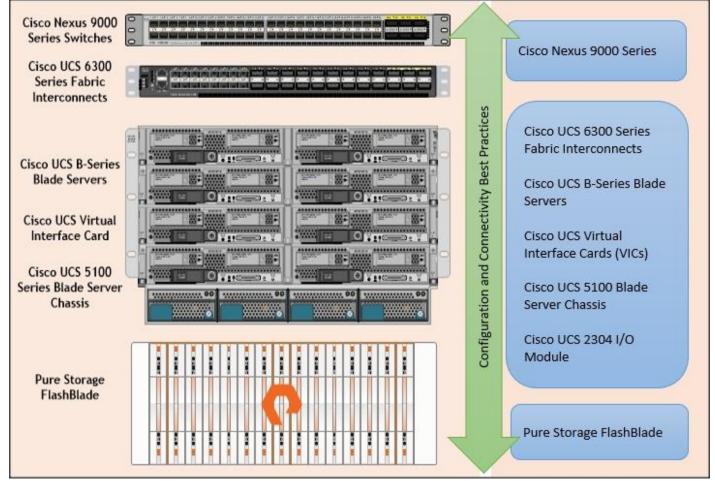
FlashStack System Overview

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





As shown in Figure 1, FlashStack Architecture can maintain consistency at scale. Each of the component families shown in (Cisco UCS, Cisco Nexus, Cisco Fl 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:

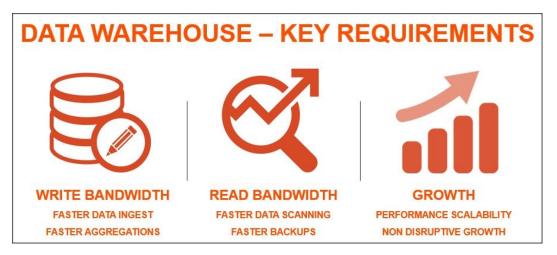
- Consistent Performance and Scalability
 - Consistent performance including bandwidth and latencies with all flash storage
 - Consolidate hundreds of enterprise-class applications in a single rack
 - Scalability design with capability to scale I/O bandwidth to match demand without disruption
 - Repeatable 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
- Lowest TCO
 - Dramatic savings in power, cooling and space with Cisco UCS and 100 percent 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 including snapshots

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.

Solution Summary

Oracle data warehouse deployments are extremely complicated in nature and customers face enormous challenges in maintaining these landscapes in terms of data scale, 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. A storage platform based on Oracle data warehouse and analytics solutions supported by an all-flash storage solution, such as Pure Storage FlashBlade, can help you solve the challenges of data warehousing, management, and analysis – no matter where your data is stored.



A data warehouse is a relational or multidimensional database that is designed for query and analysis. Data warehouses usually consolidate historical and analytic data derived from multiple sources in one single place. This data is used for creating analytical reports for workers throughout the enterprise. The data in a data warehouse is typically loaded through an extraction, transformation, and loading (ETL) process from one or more data sources such as OLTP applications, mainframe applications, or external data providers.

Users of the data warehouse perform data analyses that are often time-related. Data warehouses are typically used to optimize business operations. Typical operations on a data warehouse include trend analysis and data mining, which use existing data to forecast trends or predict futures. The data warehouse typically provides the foundation for a business intelligence environment.

Storage configurations for a data warehouse should be chosen based on the I/O bandwidth that they can provide, and not necessarily on their overall storage capacity.

To implement successful data warehouse solution, there are three metric considerations:

- Write Bandwidth: Ability to quickly create and populate data warehouse or loading additional data for various data sources can challenge IO subsystem with sustained writes
- Read Bandwidth: Complex queries and analysis will require a huge amount of data reads.
- Growth: Growth of a data warehouse is inevitable, so a solution must be able to scale, and scale predictably, with that growth.

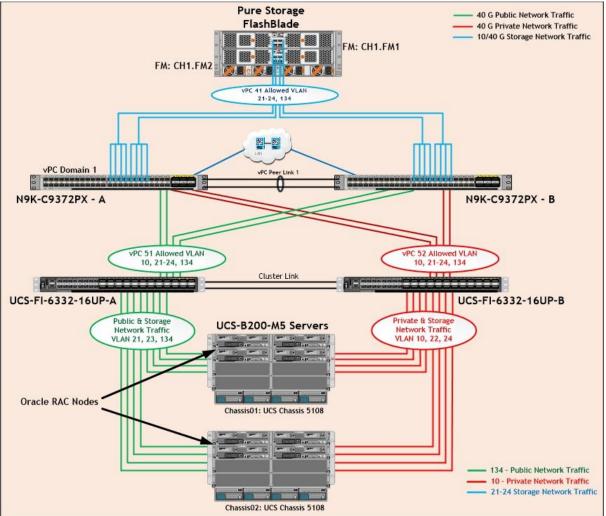
Considering such characteristics, we heavily emphasized on write and read bandwidth by running FIO and Swingbench performance test on this configured solution.

We will also demonstrate that this solution can scale with near-linear performance and provides a flexible platform for growth as needed on-demand.

The reference architecture covered in this document leverages the Pure Storage FlashBlade for Storage, Cisco UCS B200 M5 Blade Server for Compute, Cisco Nexus 9000 series for the switching element and Cisco Fabric Interconnects 6300 series for System Management. This solution is architected to modernize Oracle data warehouse by delivering performance you need to keep up with the data growth.

As shown in Figure 2, 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.

What's New in this FlashStack Release?

This version of the FlashStack CVD introduces new hardware with the Pure Storage FlashBlade which is industry's most advanced file and object storage platform ever along with Cisco UCS B200 M5 Blade Servers featuring the Intel Xeon Scalable Family of CPUs. This is the third Oracle RAC Database deployment Cisco Validated Design with Pure Storage. It incorporates the following features:

- Pure Storage FlashBlade
- Cisco UCS B200 M5 Blade Servers
- Oracle RAC Database 12c Release 2
- Oracle Direct NFS

Solution Components

The IT industry has been transforming rapidly to converged infrastructure, which enables faster provisioning, scalability, lower data center costs, simpler management infrastructure, and future-proofing with technology advancement. The FlashStack solution provides best of breed technology to reap the benefits that converged infrastructure bring to the table. This section details the various infrastructure components that make up FlashStack.

Cisco UCS 6332-16UP Fabric Interconnect

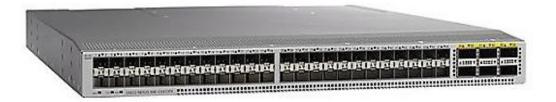
The 6332-16UP Fabric Interconnect is the management and communication backbone for Cisco UCS B-Series Blade Servers, C-Series Rack Servers, and 5100 Series Blade Server Chassis. It implements 20x40 Gigabit Ethernet and Fibre Channel over Ethernet ports, with additional support for 16 unified ports that 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 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 and databases including Oracle.



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 19inch 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.



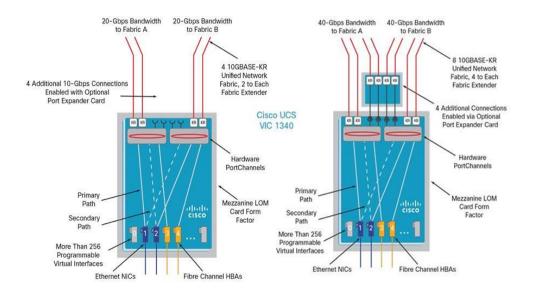
The Cisco UCS 2304 connects the I/O fabric between the Cisco UCS 6300 Series Fabric Interconnects and the Cisco UCS 5100 Series Blade Server Chassis, enabling a lossless and deterministic Fibre Channel over Ethernet (FCoE) fabric to connect all blades and chassis together.

Cisco UCS Virtual Interface Card (VIC) 1340

The Cisco UCS Virtual Interface Card (VIC) 1340 is a 2-port 40-Gbps Ethernet or dual 4 x 10-Gbps Ethernet, Fibre Channel over Ethernet (FCoE)-capable modular LAN on motherboard (mLOM) designed for the Cisco UCS B-Series Blade Servers. When used in combination with an optional port expander, the Cisco UCS VIC 1340 capabilities is enabled for two ports of 40-Gbps Ethernet.



The Cisco UCS VIC 1340 enables a policy-based, stateless, agile server infrastructure that can present over 256 PCIe standards-compliant interfaces to the host that can be dynamically configured as either network interface cards (NICs) or host bus adapters (HBAs).



Pure Storage FlashBlade

FlashBlade[™] is a new scale-out storage platform designed to accelerate data-intensive applications, like modern analytics, data warehouse, and AI, while providing best of breed performance in all dimensions of concurrency – including IOPS, throughput, latency, and capacity. FlashBlade is as simple as it is powerful, offering elastic scale-out storage services at every layer alongside DirectFlash technology for global flash management.

FlashBlade is the industry's first to deliver modern file and object on a single platform, delivering unprecedented performance for all data-intensive applications. Its massively distributed architecture enables consistent performance for all analytics applications using NFS, S3/Object, SMB, and HTTP protocols.

FlashBlade delivers industry-leading throughput, IOPS, latency, and capacity – in 20x less space and 10x less power and cooling. FlashBlade is built on the scale-out metadata architecture of Purity for FlashBlade, capable of handling ten's of billions of files and objects while delivering maximum performance, effortless scale, and global flash management. The distributed transaction database built into the core of Purity means storage services at every layer are elastic: simply adding blades grows system capacity and performance, instantly. It also offers a wave of new enterprise features, like snapshots, SMB, LDAP, network lock management (NLM), and IPv6, to extend FlashBlade into new use cases.

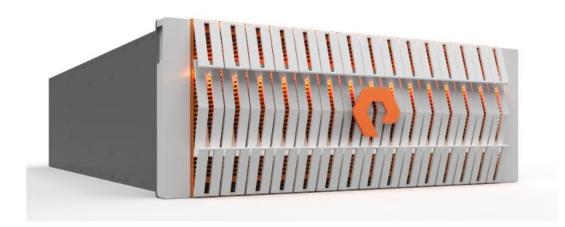


Figure 3 Pure Storage FlashBlade

Pure1[®], our cloud-based management, analytics, and support platform, expands the self-managing, plug-nplay design of our products with the machine learning predictive analytics and continuous scanning of Pure1 Meta[™] to enable an effortless, worry-free storage experience.

For the first time in the industry, Pure1 Analyze delivers true performance forecasting – giving customers complete visibility into the performance and capacity needs of their arrays – now and in the future. Performance forecasting enables intelligent consolidation and unprecedented workload optimization.

Figure 4 FlashBlade Specification

PECIFICATIONS	17 TB BLADE	52 TB BLADE
7 BLADES	190 TBs Usable	591 TBs Usable
15 BLADES	525 TBs Usable	1607 TBs Usable

PERFORMANCE	CONNECTIVITY	PHYSICAL
 17 GB/s bandwidth 	 8x 40Gb/s or 	• 40
with 15 blades	32x 10Gb/s Ethernet	 1,800 Watts (nominal
Up to 1.5M NFS IOPS	ports / chassis	at full configuration)

The Evergreen[™] Storage ownership model operates like SaaS and the cloud. Deploy storage once and benefit from a subscription to continuous innovation as you expand and improve performance, capacity, density, and/or features for 10 years or more - all without downtime, performance impact, or data migrations. Evergreen Storage provides expandability and upgradability for generations via its modular, stateless architecture, while FlashBlade's blade-based design delivers the linear scale of DirectFlash technology and compute simply by adding blades.

Oracle Linux 7.4

Oracle Linux, formerly known as Oracle Enterprise Linux, is a Linux distribution based on Red Hat Enterprise Linux (RHEL), repackaged and freely distributed by Oracle, available under GNU General Public License (GPL) since late 2006. Oracle Linux can be downloaded through Oracle's E-Delivery service or from a variety of mirror sites, and can be deployed and distributed freely. Commercial technical support is available through Oracle's Oracle Linux Support program, which supports Oracle Linux, and existing RHEL or CentOS installation.

Oracle Corporation distributes Oracle Linux with two alternative kernels:

- Red Hat Compatible Kernel (RHCK) identical to the kernel shipped in Red Hat Enterprise Linux
- Unbreakable Enterprise Kernel (UEK) based on newer mainline Linux kernel versions, with Oracle's • own enhancements for OLTP, Infiniband, and SSD disk access, NUMA-optimizations, Reliable Datagram Sockets (RDS), async I/O, OCFS2, and networking.

Oracle Linux Support Program provides support for KVM components as part of the Oracle Linux 5, Oracle Linux 6, Oracle Linux 7, RHEL5, RHEL6, and RHEL7. This does not include Oracle Product support on KVM offerings.

Oracle 12cR2 Database

Oracle revolutionized the field of enterprise database management systems with the most extensive selfmanagement capabilities in the industry, ranging from zero-overhead instrumentation to integrated selfhealing and business-**driven management.** Oracle Database 12c, the next generation of the world's most popular database, makes DBA lives easier by providing various features like change and configuration management, patching, provisioning, testing, performance management, and automatic tuning. Oracle Database high-availability (HA) technologies, collectively referred to as Oracle Maximum Availability Architecture (MAA), provide complete resiliency against all types of outages – from component failures to natural disasters. Industry-leading Oracle HA technology such as Oracle Real Application Clusters (Oracle RAC) provides the highest levels of server HA while Oracle Active Data Guard protects data and applications against site-wide outages.

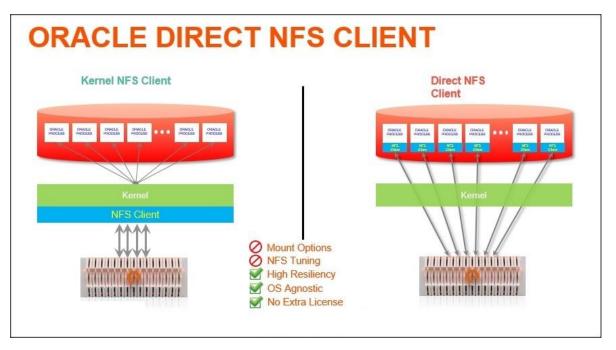
The FlashStack solution for Oracle includes the following Oracle 12c components and/or features:

- Oracle Database 12c Release 2 (12.2.0.1) Enterprise Edition
- Oracle Grid Infrastructure 12c (12.2.0.1)
- Oracle Flex ASM & ASM Cluster File System (ACFS)
- Oracle Direct NFS Client

Oracle dNFS (direct Network File System)

Oracle dNFS (direct Network File System) is the NFS client functionality directly integrated in the Oracle RDBMS server. dNFS makes the task of configuring Oracle database on NAS storage much simpler compared to Standard NFS (aka Kernel NFS). Direct NFS Client on Oracle 11g, 12c, or higher supports NFSv3, NFSv4, and NFSv4.1 protocols to access the NFS server.

The key benefits of Direct NFS Client include simplicity, ease of administration, load balancing, high availability and cost effectiveness. Oracle has optimized the I/O code path by avoiding kernel overhead and, as such, it can improve I/O performance.



Direct NFS Client is capable of performing concurrent direct I/O by bypassing Operating System level caches. It also performs asynchronous I/O, which allows processing to continue while the I/O request is submitted and processed. These two key performance and scalability features provide unparalleled performance when compared to native kernel NFS clients. Another key feature of Direct NFS Client is high availability. Direct NFS Client delivers optimized performance by automatically load balancing requests across all specified paths (up to 4 parallel network paths). If one network path fails, then Direct NFS Client will reissue I/O commands over any remaining paths, ensuring fault tolerance and high availability.

One of the primary challenges of kernel NFS administration is inconsistency with configurations across different platforms. Direct NFS Client eliminates this problem by providing a standard NFS client implementation across all platforms supported by Oracle Database. This also makes NFS a viable option on platforms like Windows, which **doesn't natively support NFS**. As NFS is a shared file system, it supports Real Application Cluster (RAC) databases as well as single-instance databases. Oracle Direct NFS Client recognizes when an instance is part of an RAC and automatically optimizes the mount points for RAC, relieving the administrator of manually configuring the NFS parameters.

Solution Architecture

The FlashStack architecture brings together the proven data center strengths of the Cisco UCS and Cisco Nexus network switches with the NFS 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).

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 and Cisco UCS Fabric Interconnect 6332-16UP for external and internal connectivity of IP network.
- Storage: Pure Storage FlashBlade with 40Gb Ethernet connectivity
- Compute: Cisco UCS B200 M5 Blade Server

Figure 5 illustrates the FlashStack solution physical infrastructure.



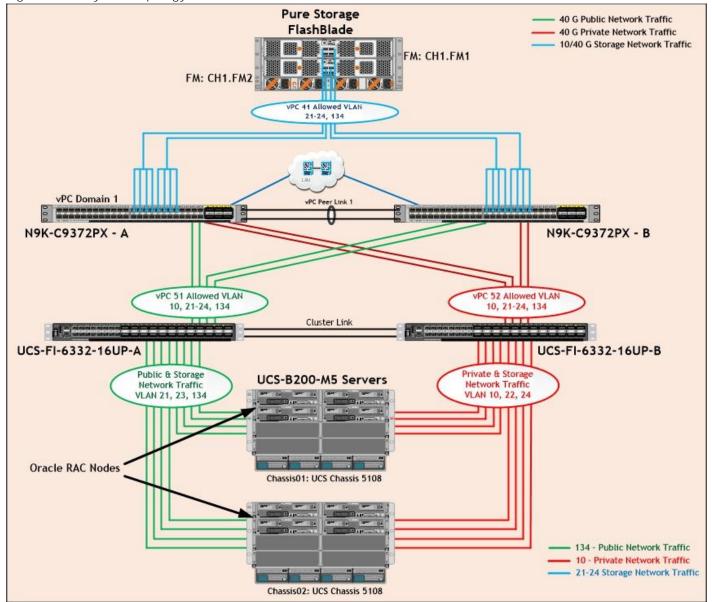


Figure 5 is a typical network configuration that can be deployed in a customer's environment. The best practices and setup recommendations are described later in this document.

As shown in Figure 5, 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 switches. Both the Fabric Interconnect and the Cisco Nexus switch are clustered with the peer link between them to provide high availability. Three virtual Port-Channels (vPCs) are configured to provide public network, private network and storage network paths for the server blades to northbound switches and storage. Each vPC has VLANs created for application network data, storage data and management data paths.

As illustrated in in Figure 5, 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 (VLAN-134) and Storage Network Traffic (VLAN-21 & 23) shown as green lines. Fabric Interconnect –

B links are used for Oracle Private Interconnect Traffic (VLAN 10) and Storage Network Traffic (VLAN-22 & 24) shown as red lines. NFS Storage access from Nexus Switch – A and Nexus Switch –B show as blue lines.

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 interconnects 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.

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 12cR2 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 Nexus Switches for upstream connectivity to access the Pure Storage FlashBlade.

Table 1 lists the inventory of the components used in the FlashStack solution.

Vendor	Name	Model	Description	Qty
Cisco	Cisco Nexus 9372PX-E Switch	N9K-C9372PX-E	Cisco Nexus 9300 Series Switches	2
Cisco	Cisco UCS 6332-16UP Fabric Interconnect	UCS-FI-6332-16UP	Cisco 6300 Series Fabric Interconnects	2
Cisco	Cisco UCS Fabric Extender	UCS-IOM-2304	Cisco UCS 2304XP I/O Module (4 External, 8 Internal 40Gb Ports)	4
Cisco	Cisco UCS 5108 Blade Server Chassis	UCSB-5108-AC2	Cisco UCS 5100 Series Blade Server AC2 Chassis	2
Cisco	Cisco UCS B200 M5 Blade Servers	UCSB-B200-M5	Cisco UCS B-Series Blade Servers	8
Cisco	Cisco UCS VIC 1340	UCSB-MLOM-40G- 03	Cisco UCS Virtual Interface Card 1340	8
Cisco	Cisco UCS Port Expander Card	UCSB-MLOM-PT-01	Port Expander Card for Cisco UCS MLOM	8
Pure Storage	Pure FlashBlade	Purity //FB 2.1.8	Pure Storage FlashBlade	1

Table 1	Inventory and	d Bill of Materials

Table 2 lists the server configuration used in the FlashStack solution.

	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 Card	Port Expander Card for Cisco UCS MLOM
NIC1 (eth0)	Management and Public Network Traffic Interface for Oracle RAC. MTU=1500
NIC2 (eth1)	Private Server-to-Server Network (Cache Fusion) Traffic Interface for Oracle RAC. MTU=9000
NIC3 (eth2)	Database IO Traffic to Pure Storage FlashBlade. Controller VLAN 21. MTU=9000
NIC4 (eth3)	Database IO Traffic to Pure Storage FlashBlade. Controller VLAN 22. MTU=9000
NIC5 (eth4)	Database IO Traffic to Pure Storage FlashBlade. Controller VLAN 23. MTU=9000
NIC6 (eth5)	Database IO Traffic to Pure Storage FlashBlade. Controller VLAN 24. MTU=9000

Table 2	Cisco UCS B200 M5 Blade Server Configuration	

For this FlashStack solution design, we configured six VLANs as described in Table 3.

Table 3 VLAN and VSAN Configuration

VLANs			
Name	ID	Description	
Default VLAN	1	Native VLAN	
Public VLAN	134	VLAN for Public Network Traffic	
Private VLAN	10	VLAN for Private Network Traffic (RAC Interconnect)	
Storage VLAN - 21	21	NFS VLAN for Storage Network Traffic A Side	
Storage VLAN - 22	22	NFS VLAN for Storage Network Traffic B Side	
Storage VLAN - 23	23	NFS VLAN for Storage Network Traffic A Side	
Storage VLAN - 24	24	NFS VLAN for Storage Network Traffic B Side	

The FlashStack design comprises of Pure Storage FlashBlade enterprise class all-flash for increased scalability and throughput. Table 4 lists the components of the array.

Storage Components	Description	
FlashBlade	Pure Storage FlashBlade	
Capacity	162.46 TB	
Connectivity	8 x 40 Gb/s redundant Ethernet port	
Physical	4U	

Table 4 Pure Storage FlashBlade Configuration

For this FlashStack solution design, we used the Software and Firmware listed in Table 5 .

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 UCS Manager System	3.2 (2c)
Cisco UCS Adapter VIC 1340	4.2 (2b)
Cisco eNIC (modinfo enic)	2.3.0.31
Pure Storage FB Purity Version	2.1.8
Oracle Swingbench	2.5.971
ТРС-Н	
FIO	fio-2.1.10-1.el7.rf.x86_64

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 installation guide www.cisco.com/c/en/us/support/servers-unified-computing/ucs-manager/products-installation-guides-list.html.

It is beyond the scope of this document to cover detailed information about Cisco UCS infrastructure setup and connectivity. The documentation guides and examples are available at http://www.cisco.com/en/US/products/ps10281/products_installation_and_configuration_guides_list.html.

All of the tasks to configure Cisco UCS are detailed in this document, but only some of the screenshots are included.

Cisco UCS Manager Software Version 3.2 (2c)

This document assumes you are using 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 on Cisco UCS Manager:
 - a. Configure Ethernet LAN Uplink Ports
 - b. Create Uplink Port Channels to Cisco Nexus Switches
 - c. Configure VLAN

- 6. Configure IP, UUID, Server and MAC Pools:
 - a. IP Pool Creation
 - b. UUID Suffix Pool Creation
 - c. Server Pool Creation
 - d. MAC 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 Template:
 - a. Create Public vNIC Template
 - b. Create Private vNIC Template
 - c. Create Storage vNIC Template
- 12. Create Server Boot Policy for Local 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:

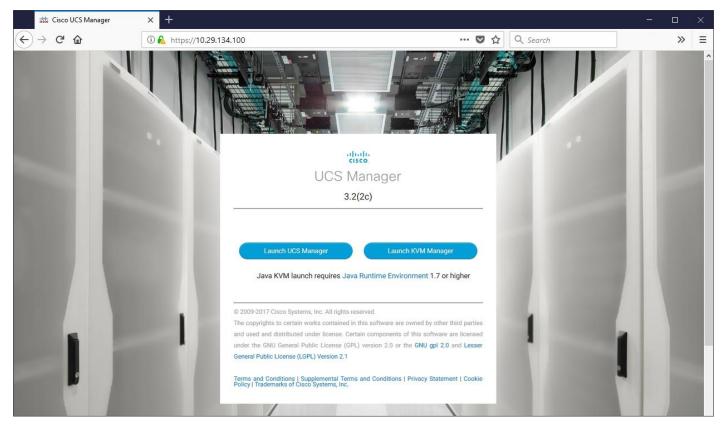


6. Review the settings on the console. Answer yes to Apply and Save the configuration.

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 log into Cisco UCS Manager.

A 0	RARAC-X-FI - Unified Com X		- 0 >
(https://10.29.134.100/app/3_2_2b/inde	intmi C Q Search L	1 🖬 🖡 🕈 🛡 🗄
uluilu cisco	UCS Manager		9 9 9 8 6
ѫ	All	Equipment	
	 Equipment Chassis 	Main Topology View Fabric Interconnects Servers Thermal Decommissioned Firmware Management Policies Faults Diagnostics	
윪	 ▼ Rack-Mounts FEX 		्रे
Ŧ	Servers Fabric Interconnects		+
Q	 Fabric Interconnect A (primary) Fabric Interconnect B (subordinate) 		4
=	 Policies Port Auto-Discovery Policy 		
			K 71 K 72
J _o		Between the bolis of the bolis	

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.

illiilii cisco	UCS Manager	Ø ♥ △ ◆ 0 0 6
Æ	All	Equipment
8	 Equipment Chassis 	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 Security
쁆	 Rack-Mounts Fabric Interconnects 	Chassis/FEX Discovery Policy
₽	 Fabric Interconnect A (subordinate) Fabric Interconnect B (primary) Policies 	Action : Platform Max Y Link Grouping Preference : O None O Port Channel
=	Port Auto-Discovery Policy	Backplane Speed Preference : 0 40G 4x10G
		Rack Server Discovery Policy Action : Immediate User Acknowledged
J 0		Scrub Policy: <not set=""></not>
		Rack Management Connection Policy Action : Auto Acknowledged
		Power Policy
		Redundancy : Non Redundant Grid
		Aging Time : Never Mode Default other
		Global Power Allocation Policy
		Allocation Method : O Manual Blade Level Cap Policy Driven Chassis Group Cap
		Firmware Auto Sync Server Policy Sync State : No Actions User Acknowledge
		Global Power Profiling Policy Info Policy
		Profile Power : D Action : O Disabled C Enabled

0 illustrates the advantage of having Discrete mode versus Port Channel mode.

Solution Configuration

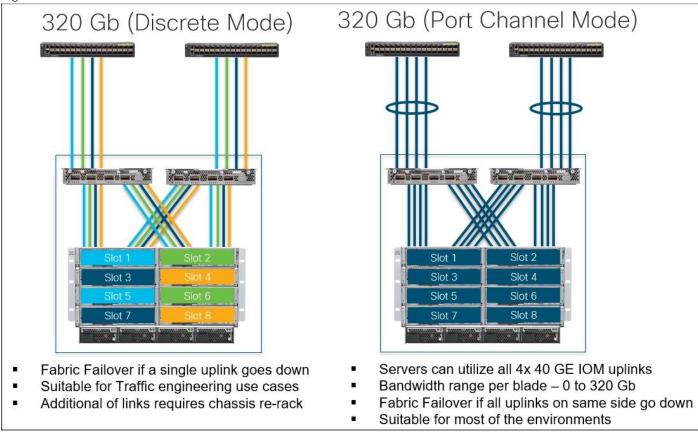


Figure 6 Fabric Ports: Discrete vs. Port Channel Mode

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.
- 2. 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.

UCS Manager			0) 👽 스 📀 0 0 6				0 🛛 0	
All		nterconnects / Fabric Interconnect	t A (subordinate) / Fixed Mod	ule / Ethernet Ports					
▼ Equipment		Ethernet Ports							
 Chassis 	-								
 Rack-Mounts 	Slot	Aggr. Port ID	Port ID	MAC	If Role	If Type	Overall Status	Admin State	
 Fabric Interconnects 	1	0	15	8C:60:4F:BD:64:9A	Unconfigured	Physical	V Sfp Not Present	Disabled	
 Fabric Interconnect A (subordinate) 	1	0	16	8C:60:4F:BD:64:9B	Unconfigured	Physical	V Sfp Not Present	Disabled	
 Fans Fixed Module 	1	0	17	8C:60:4F:8D:64:9C	Server	Physical	t Up	1 Enabled	
Fixed Module Ethernet Ports	1	0	18	8C:60:4F:BD:64:A0	Server	Physical	t Up	1 Enabled	
 FC Ports 	1	0	19	8C:60:4F:BD:64:A4	Server	Physical	t Up	t Enabled	
 PSUs 	1	0	20	8C:60:4F:BD:64:A8	Server	Physical	🕈 Up	1 Enabled	
 Fabric Interconnect B (primary) 	1	0	21	8C:60:4F:BD:64:AC	Server	Physical	t Up	1 Enabled	
 Policies 	1	0	22	8C:60:4F:BD:64:B0	Server	Physical	t Up	1 Enabled	
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.
- 7. 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 "Re-acknowledge" 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.

. 0	UCS Manager			😢 👽 🙆 🚯 0 0 0 6							
R.	All 👻	LAN / Internal LAN / Internal Fabric A	/ Port Channels								
	▼ LAN	Port Channels									
-	LAN Cloud	🏹 Advanced Filter 🔺 Export 👘 Print									
몲	 Appliances 	Name	Port	Fabric ID	Port Type	Network Type					
-	 Internal LAN 	Port-Channel 1025 (Fabric A)	1025	А	Aggregation	Lan					
	 Internal Fabric A 	Port-Channel 1026 (Fabric A)	1026	А	Aggregation	Lan					
	 Interfaces 										
	Port Channels										
	 Port-Channel 1025 (Fabric A) 										
	Eth Interface 1/17										
	Eth Interface 1/18										
	Eth Interface 1/19										
	Eth Interface 1/20										
1 ₀	 Port-Channel 1026 (Fabric A) 										
	Eth Interface 1/21										
	Eth Interface 1/22										
	Eth Interface 1/23										
	Eth Interface 1/24										
	 Internal Fabric B 										
	 Threshold Policies 										
	 Policies 										

9. Repeat these steps for Internal Fabric B.

Configure LAN on Cisco UCS Manager

Configure Ethernet Uplink 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.

	UCS Manager			0 2 0 8						
	All Equipment / Fabric Interconnects / Fabric Interconnect A (subor / Fixed Module / Ethernet Ports									
	▼ Equipment	Ethernet Ports	Ethernet Ports							
	▼ Chassis	T _e Advanced Filter	🔶 Export 🛛 👘 Print	All Unconfigured Network	Server FCoE Uplink	Unified Uplink	Appliance Storage	FCoE Storage Unified Storage	 Monitor 	
5	Chassis 1	Slot	Aggr. Port ID	Port ID		If Role	If Type	Overall Status	Admin State	
,	Chassis 2	10	U	26	8016014F18D164100	Unconfigured	Physical	V Sfp Not Present	 Disabled 	
	▼ Rack-Mounts	1	0	27	8C:60:4F:BD:64:C4	Unconfigured	Physical	💔 Sfp Not Present	Disabled	
-	FEX	1	0	28	8C:60:4F:BD:64:C8	Unconfigured	Physical	V Sfp Not Present	Disabled	
<u>D</u>	 Servers 	1	0	29	8C:60:4F:BD:64:CC	Unconfigured	Physical	V Sfp Not Present	Disabled	
	▼ Fabric Interconnects	1	0	30	8C:60:4F:8D:64:D0	Unconfigured	Physical	V Sfp Not Present	Disabled	
	▼ Fabric Interconnect A (subordinate)	1	0	31	8C:60:4F:BD:64:D4	Network	Physical	🕈 Up	Enabled	
	▶ Fans	1	0	32	8C:60:4F:BD:64:D8	Network	Physical	t Up	1 Enabled	
	 Fixed Module 	1	0	33	8C:60:4F:BD:64:DC	Network	Physical	t Up	1 Enabled	
5	Ethemet Ports	1	0	34	8C:60:4F:BD:64:E0	Network	Physical	🕈 Up	1 Enabled	
	 FC Ports 	1	0	35	8C:60:4F:BD:64:E4	Unconfigured	Physical	V Sfp Not Present	Disabled	
	 PSUs 	1	0	36	8C:60:4F:BD:64:E5	Unconfigured	Physical	V Sfp Not Present	Disabled	
	 Fabric Interconnect B (primary) 	1	0	37	8C:60:4F:BD:64:E6	Unconfigured	Physical	👽 Sfp Not Present	Disabled	
	 Policies 	1	0	38	8C:60:4F:8D:64:E7	Unconfigured	Physical	V Sfp Not Present	Disabled	
	Port Auto-Discovery Policy	1	0	39	8C:60:4F:BD:64:E8	Unconfigured	Physical	V Sfp Not Present	Disabled	
		1	0	40	8C:60:4F:BD:64:E9	Unconfigured	Physical	V Sfp Not Present	Disabled	

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 51 as the unique ID of the port channel.

		Create Port Channel
0	Set Port Channel Name	ID : 51
2	Add Ports	Name : FI-A

- d. Enter FI-A as the name of the port channel.
- e. Click Next.
- f. Select Ethernet ports 31-34 for the port channel.
- 3. Click Finish.

cisco.	UCS Manager			
æ	All	LAN / LAN Cloud / Fabric A / Port Channels	s / Port-Channel 51 FI-A	
2	 ► LAN ► LAN Cloud 	General Ports Faults Events	Statistics	
뮮	✓ Fabric A	Status	Properties	
	 Port Channels 	Overall Status : 🛉 Up	ID : 51	
=	 Port-Channel 21 Oracle-Public 	Additional Info :	Fabric ID : A	
	Port-Channel 51 FI-A	Actions	Port Type : Aggregation	
			- Transport Type : Ether	
	Eth Interface 1/31		Name : FI-A	
=	Eth Interface 1/32	Disable Port Channel	Description :	
	Eth Interface 1/33	Add Ports	Flow Control Policy : default	
	Eth Interface 1/34			
	 Uplink Eth Interfaces 		LACP Policy : default T	
20	▶ VLANs		Note: Changing LACP policy may flap the port-channel if the suspend-individual value changes!	
	 VP Optimization Sets 		Admin Speed : 1 Gbps 10 Gbps • 40 Gbps	
			Operational Speed(Gbps): 160	
	▼ Fabric B			
	 Port Channels 			
	 Port-Channel 22 Oracle-Private 			
	▼ Port-Channel 52 FI-B			
	Eth Interface 1/31			
	Eth Interface 1/32			
	Eth Interface 1/33			
	Eth Interface 1/34			

4. Repeat steps 1-3 for Fabric Interconnect B, substituting 52 for the port channel number and FI-B for the name. Your resulting configuration should look like the screenshot above.

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 six VLANs: one for private network (VLAN 10) traffic, one for public network (VLAN 134) traffic and four storage network (VLAN 21, 22, 23 and 24) traffic. These six VLANs will be used in the vNIC templates that are discussed later.

It is very important to create all six 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.

alialia cisco	UCS Manager	S ♥ ▲ ◆ 1 8 1 6	۲
Æ	All	LAN / LAN Cloud / VLANs	
	✓ LAN ^ ^	VLANS V_Advi	
品	 Fabric A Fabric B 	Name VLAN Name/Prefix : Public_Traffic VLA Multicast Policy Name : <not set=""> Create Multicast Policy</not>	Primary VLA
IF.	QoS System Class LAN Pin Groups Threshold Policies	Common/Global Fabric A Fabric B Both Fabrics Configured Differently 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 Groups VLANs VLAN default (1)	VLAN IDs: 134 Sharing Type : Image: None Optimary	
	Appliances Fabric A	Detail	
4 0	 Fabric B VLANs ✓ Internal LAN 	Ger	
	 Internal Fabric A Internal Fabric B 	Faul	
	Threshold Policies Policies Appliances		ual
	 ► LAN Cloud ▼ root 	Acti Check Overlap OK Cancel	
	Default vNIC Behavior Flow Control Policies Dvnamic vNIC Connection Policie:		

- 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.
- 10. Similarly, we have created the second VLAN: for private network (VLAN 10) traffic and remaining four storage VLANs for storage network (VALN 21, 22, 23 & 24) traffic as shown below:

AII .	LAN / LAN Cloud / VLANs VLANs						
▼ LAN	Ty Advanced Filter ↑ Export ♣ P	rint					
Fabric A	Name	ID	Туре	Transport	Native	VLAN Sharing	Prima
Fabric B	VLAN default (1)	1	Lan	Ether	Yes	None	
 QoS System Class 	VLAN Private_Traffic (10)	10	Lan	Ether	No	None	
LAN Pin Groups Threshold Policies	VLAN Public_Traffic (134)	134	Lan	Ether	No	None	
Construction of the second sec	VLAN Storage_VLAN21 (21)	21	Lan	Ether	No	None	
VLAN Groups VLANs	VLAN Storage_VLAN22 (22)	22	Lan	Ether	No	None	
	VLAN Storage_VLAN23 (23)	23	Lan	Ether	No	None	
VLAN default (1) VLAN Private_Traffic (10)	VLAN Storage_VLAN24 (24)	24	Lan	Ether	No	None	
VLAN Public_Traffic (134)							
VLAN Storage_VLAN21 (21)							
VLAN Storage_VLAN22 (22)							
VLAN Storage_VLAN23 (23)				🕀 Add 🍈 Del	ete 🚯 Info		
VLAN Storage_VLAN24 (24)							

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

Configure IP, UUID, Server and MAC 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.



We named the IP Pool as ORA-IP-Pool for this solution.

- 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.

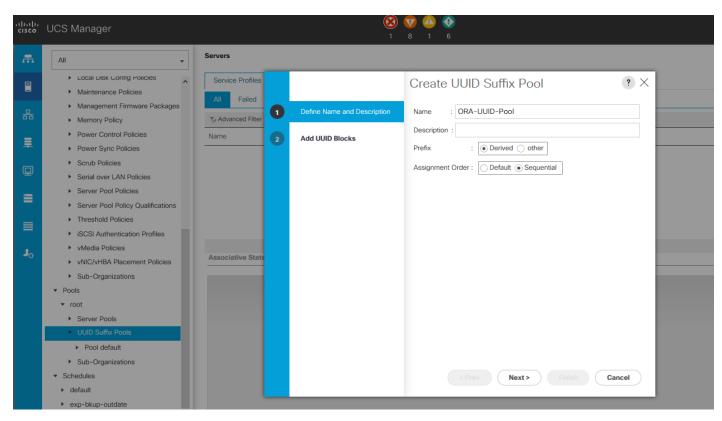
alialia cisco	UCS Manager	 (3) (3) (4) (5) (5) (6) 	
æ	All	LAN / Pools / root / IP Pools IP Pools	
日本	 ► LAN ► LAN Cloud ▶ Fabric A 	Create IP Pool	
	 Fabric B QoS System Class 	Define Name and Description + − Ty Advanced Filter ↑ Export ♣ Print Create Block of IPv4 Addresses	? X hary DNS
Q	LAN Pin Groups Threshold Policies VLAN Groups	Add IPv4 Blocks From : 10.29.134.110 Size : 10 \$	0.0
=	 VLANs Appliances 	Subnet Mask : 255.255.255.0 Default Gateway : 10.29.134.1 Primary DNS : 0.0.0.0 Secondary DNS : 0.0.0	
	 Internal LAN Policies 		
1 0	AppliancesLAN Cloud		
	 root Pools root 		
	IP Pools IP Pool ext-mgmt	OK C4 ⊕ Add ⊡ Delete	ancel
	 IP Pool iscsi-initiator-r MAC Pools 	< Prev	Next > Finish
	Sub-Organizations Traffic Monitoring Sessions		

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

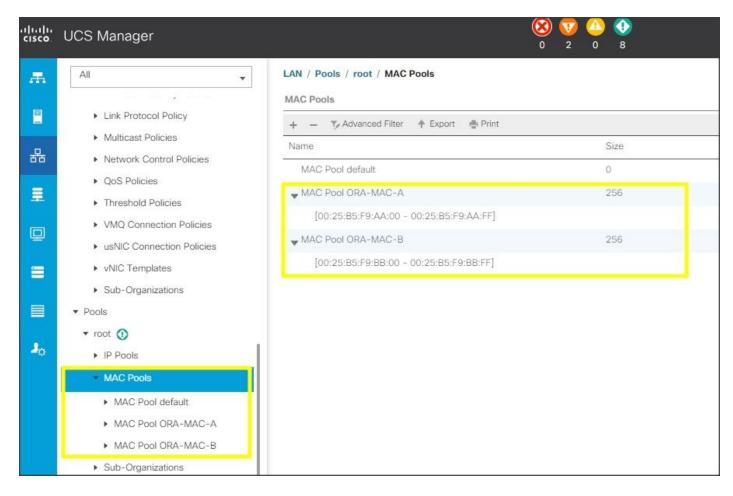
To configure the necessary MAC address pools for the Cisco UCS environment, complete the following steps:

- 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.

Create a Blo	ck of MAC Ac	ldresses	? >	<
First MAC Address :	00:25:B5:F9:AA:00	Size : 256	*	
To ensure uniqueness prefix: 00:25:B5:xx:xx:xx	of MACs in the LAN fabri	c, you are strongly (encouraged to use the following MAC	~ A

- 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.



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.

cisco.	UCS Manager				8 V	O 7					
Æ	All	LAN / LAN Cloud	d / QoS Sys	stem Class							
8	▼ LAN	General	vents F	SM							
	LAN Cloud Fabric A	Actions			Properties						
윪	▶ Fabric B				Owner : Local						
重	QoS System Class										
Q	 LAN Pin Groups 	Priority	Enable	d CoS	Packet Drop	Weight		Weight (%)	мти		Multicast Optimized
<u></u>	 Threshold Policies 	Platinum		5		10	•	N/A	normal	v	
=	 VLAN Groups 										
	► VLANs	Gold		4	۲	9	Υ.	N/A	normal	•	
	 Appliances 	Silver		2		8	v	N/A	normal	v	
20	 Fabric A Fabric B 	Bronze		1	Ø	7	v	N/A	normal	¥	
	► VLANs	Best Effort	Ø.	Апу	Ø	5		50	9216	Ţ	
	 Internal LAN Internal Fabric A 	Fibre Channel	Y	3		5	٧	50	fc		N/A
	 Internal Fabric B 										
	 Threshold Policies 										
	▼ Policies										

- 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
 - Ring Size: 4096
 - Receive Queues: 8
 - Ring Size: 4096
 - Completion Queues: 16
 - Interrupts: 32
 - Options
 - Receive Side Scaling (RSS): Enabled
- 5. Configure adapter policy as shown below:

iliiilii cisco	UCS Manager		
æ	All	Servers / Policies / root / Adapter Policies / Eth Adapter Poli	cy ORA_Linux_Tuning
-	✓ Servers ^	General Events	
	 Service Profiles 	Delete	Name : ORA_Linux_Tuning
쁆	Service Profile Templates	Show Policy Usage	Description :
	✓ Policies		Owner : Local
	▼ root ()		
	 Adapter Policies 		1
	Eth Adapter Policy default		
	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		- <mark>-</mark> -
	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		
	FC Adapter Policy Linux	Transmit Checksum Offload :	isabled) Enabled
	FC Adapter Policy Solaris	Receive Checksum Offload : O	isabled () Enabled
	FC Adapter Policy VMWare	TCP Segmentation Offload : O	isabled Enabled
	FC Adapter Policy Windows	TCP Large Receive Offload :	isabled () Enabled
	FC Adapter Policy WindowsBor		
	iSCSI Adapter Policy default	Receive Side Scaling (RSS) : C	isabled Enabled
	 BIOS Defaults 	Accelerated Receive Flow Steering :	isabled C Enabled
	 BIOS Policies 	Network Virtualization using Generic Routing Encapsulation :	isabled C Enabled
	Boot Policies	Virtual Extensible LAN :	isabled () Enabled
	 Diagnostics Policies 		
	 Graphics Card Policies 	Failback Timeout (Seconds) : 5	[0-600]
	 Host Firmware Packages 	Interrupt Mode : OM	ISI X _ MSI _ IN Tx
	IPMI Access Profiles	Interrupt Coalescing Type :	tin 🔿 Idle
	 KVM Management Policies 	Interrupt Timer (us) : 125	[0-65535]
	 Local Disk Config Policies 		
	Maintenance Policies	RoCE : O	isabled 🔿 Enabled
	<		

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:

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

1. Select Policies > root > Maintenance Policies > Default.

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

Configure vNIC Template

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

Create Public, Private and Storage 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:

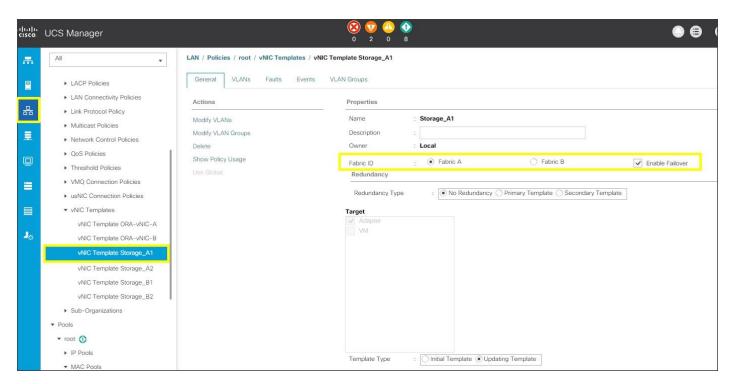
uluili. cisco	UCS Manager	
Æ	All	LAN / Policies / root / vNIC Templates / vNIC Template ORA-vNIC-A
8	▼ LAN ^	General VLANs Faults Events VLAN Groups
	LAN Cloud	
몲	 Appliances 	Actions Properties
	 Internal LAN 	Modify VLANs Name : ORA-vNIC-A
E	 Policies 	Modify VLAN Groups Description :
	 Appliances 	Delete Owner : Local
	 LAN Cloud 	Show Policy Usage
	▼ root 🕐	Chick House Global Fabric ID : Fabric A Fabric B Image: Chick House Blobe Enable Failover Use Global Redundancy Red
=	Default vNIC Behavior	Redundancy
	 Flow Control Policies 	Redundancy Type :
	 Dynamic vNIC Connection Policie: 	
	 LACP Policies 	Target
20	 LAN Connectivity Policies 	VM VM
	 Link Protocol Policy 	
	 Multicast Policies 	
	 Network Control Policies 	
	 QoS Policies 	
	 Threshold Policies 	
	 VMQ Connection Policies 	
	 usNIC Connection Policies 	
	 vNIC Templates 	
	vNIC Template ORA-vNIC-A	
	vNIC Template ORA-vNIC-B	Template Type : O Initial Template O Updating Template
	 Sub-Organizations 	CDN Source : ● vNIC Name ◯ User Defined
	▼ Pools	
	🔹 root 🕚	MTU : 1500
	 IP Pools 	Policies
	 MAC Pools 	MAC Pool : ORA-MAC-A(246/256) ¥
	 Sub-Organizations 	QoS Policy : <not set=""> V</not>
	 Traffic Monitoring Sessions 	Qos Policy : <pre><rpre></rpre></pre>
	 Fabric A 	Network Control Palicy : <not set=""> •</not>
	 Fabric B 	
	 Netflow Monitoring 	Pin Group : rot set> Y
	 Flow Record Definitions 	Stats Threshold Policy: default •
	Flow Exporters	Connection Policies
	 Flow Monitors 	

10. Click OK to finish.

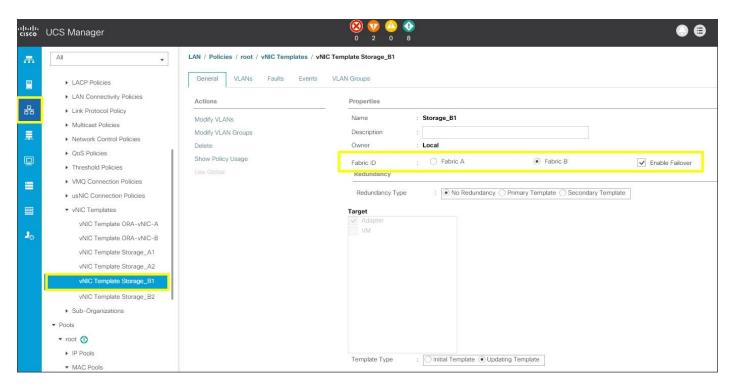
- 11. Create second vNIC template for Private Network Traffic.
- 12. Enter ORA-vNIC-B as the vNIC template name for Private Network Traffic.
- 13. Select the Fabric B and Enable Failover for Fabric ID options.
- 14. Select Template Type as Updating Template.
- 15. Under VLANs, select the checkbox Private_Traffic 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-v	NIC-B
	✓ LAN ^	General VLANs Faults Events VLAN Groups	
-	LAN Cloud	Actions	Properties
뮮	Appliances Internal LAN	Made M ANA	Name : ORA-vNIC-B
_	 Policies 	Modify VLANs Modify VLAN Groups	
-	Appliances	Delete	Description :
	LAN Cloud	Show Policy Usage	Owner : Local
<u> </u>	▼ root ①	Use Global	Fabric ID : : Fabric A Image: Fabric B Image: Fabric B
=	Default vNIC Behavior		Redundancy
	 Flow Control Policies 		Redundancy Type : • No Redundancy O Primary Template O Secondary Template
	 Dynamic vNIC Connection Policies 		
	LACP Policies		Target
10	LAN Connectivity Policies		VM
	 Link Protocol Policy 		
	 Multicast Policies 		
	 Network Control Policies 		
	 QoS Policies 		
	 Threshold Policies 		
	 VMQ Connection Policies 		
	 usNIC Connection Policies 		
	 vNIC Templates 		
	vNIC Template ORA-vNIC-A		
	vNIC Template ORA-vNIC-B		Template Type : Initial Template Updating Template
	 Sub-Organizations 		CDN Source : O vNIC Name User Defined
	▼ Pools		
	🔻 root 🕚		MTU : 9000
	IP Pools		Policies
	 MAC Pools 		MAC Pool : ORA-MAC-B(246/256) V
	 Sub-Organizations 		QoS Policy : <not set=""> V</not>
	 Traffic Monitoring Sessions 		chot sets V
	 Fabric A 		Network Control Policy : <not set=""></not>
	 Fabric B 		Pin Group :

- 18. Create third vNIC template for Storage Network Traffic through Fabric Interconnect A.
- 19. Enter Storage_A1 as the vNIC template name for Storage Network Traffic.
- 20. Select the Fabric A and Enable Failover for Fabric ID options.
- 21. Select Template Type as Updating Template.
- 22. Under VLANs, select the checkbox Storage_VLAN21 and set Native-VLAN as the Storage_VLAN21.
- 23. Set MTU value to 9000 and MAC Pool as ORA-MAC-A.
- 24. Click OK to create the vNIC template as shown below:



- 25. Similarly, create fourth vNIC template as Storage_A2 and set Native-VLAN as the Storage_VLAN23 and Click OK to create vNIC template.
- 26. Now, create fifth vNIC template for Storage Network Traffic through Fabric Interconnect B.
- 27. Enter Storage_B1 as the vNIC template name for Storage Network Traffic.
- 28. Select the Fabric B and Enable Failover for Fabric ID options.
- 29. Select Template Type as Updating Template.
- 30. Under VLANs, select the checkbox Storage_VLAN22 and set Native-VLAN as the Storage_VLAN22.
- 31. Set MTU value to 9000 and MAC Pool as ORA-MAC-B.
- 32. Click OK to create the vNIC template as shown below:



- 33. Similarly, create last sixth vNIC template as Storage_B2 and set Native-VLAN as the Storage_VLAN24. Click OK to create vNIC template.
- 34. All the vNIC templates are as shown below.

sco.	UCS Manager			
æ.	All	LAN / Policies / root / vNIC Templates		
e	LACP Policies	vNIC Templates		
-	LAN Connectivity Policies	+ - Ty Advanced Filter 🛧 Export 🖷	Print	
器	Link Protocol Policy	Name	VLAN	Native VLAN
	Multicast Policies	▼ vNIC Template ORA-vNIC-A		
=	 Network Control Policies 	Network Public_Traffic	Public_Traffic	۲
	QoS Policies	▼ vNIC Template ORA-vNIC-B		
₽	Threshold Policies	Network Private_Traffic	Private_Traffic	۲
=	 VMQ Connection Policies 	▼ vNIC Template Storage_A1		
_	 usNIC Connection Policies 	Network Storage_VLAN21	Storage_VLAN21	۲
	 vNIC Templates 	▼ vNIC Template Storage_A2		
	vNIC Template ORA-vNIC-A	Network Storage_VLAN23	Storage_VLAN23	۲
1 0	vNIC Template ORA-vNIC-B	vNIC Template Storage_B1		
	vNIC Template Storage_A1	Network Storage_VLAN22	Storage_VLAN22	۲
	vNIC Template Storage_A2	vNIC Template Storage_B2		
	vNIC Template Storage_B1	Network Storage_VLAN24	Storage_VLAN24	۲
	vNIC Template Storage_B2			
	 Sub-Organizations 			

Create Server Boot Policy for Local Boot

All Oracle nodes were set to boot from Local Disk for this Cisco Validated Design as part of the Service Profile template. A Local disk configuration for the Cisco UCS is necessary if the servers in the environments have a local disk. 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 Local_Disk as the name of the boot policy as shown below:
- 3. Expand the Local Devices drop-down list and Choose Add CD/DVD and then Local Disk for the Boot Order as shown below.

ahaha cisco.	UCS Manager					0	9 🚯 😂
_		Create Boot Policy		? ×	_		_
- A	All			^			
	▼ Servers	Name : Local_	Disk				
	 Service Profiles 	Description :					
뮮	► root 🕚	Reboot on Boot Order Change :			Boot Pa	th	Description
	 Service Profile Templates 	Enforce vNIC/vHBA/iSCSI Name :				-	
三	► root ①	Boot Mode : Eg	acy 🔿 Uefi				
	▼ Policies	WARNINGS: The type (primary/secondary) does not indic					
	▼ root 🕐	The effective order of boot devices within th	e same device class (LAN/Storage/ISCSI) is determined by PCIe bus scan order.				
	 Adapter Policies 		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.				
	 BIOS Defaults 		cuted in any exist, otherwise are willow they wan are towest Pole bus sean order is used.				
	 BIOS Policies 	 Local Devices 	Boot Order				
	 Boot Policies 	Add Local Disk	+ - Ty Advanced Filter 🛧 Export 🚔 Print	¢ ^			
	Boot Policy default	Add Local LUN	Name Order 🔺 vNIC/ Type WWN LUN Slot Boot Boot D	esc			
30	Boot Policy diag	Add Local JBOD	CD/DVD 1				
	Boot Policy SAN-A Boot Policy SAN-B	Add SD Card	Local Disk 2	- 11			
	Boot Policy sAN-B	Add Internal USB	LUCAI DISK 2				
	Diagnostics Policies	Add External USB					
	Graphics Card Policies	Add Embedded Local LUN					
	 Host Firmware Packages 	Add Embedded Local Disk					
	IPMI Access Profiles	Add CD/DVD	↑ Move Up	- 11			
	KVM Management Policies	Add Local CD/DVD		*			
	Local Disk Config Policies	Add Remote CD/DVD					
	Maintenance Policies	Add Floppy		~			
	 Management Firmware Packages 		ОК	Cancel			
	< · · · · · · · · · · · · · · · · · · ·				Save C		

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 one Service Profile Template name as "ORA_FlashBlade" as explained below:

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.

alialia cisco	UCS Manager			8 👽 🙆 🐠 💮	0 9	0
æ				Create Service Profile Template		
	→ Servers	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.		
	▼ Service Profiles	2	Storage Provisioning	Name : ORA FlashBlade		
몲	root () Service Profile Templates	3	Networking	The template will be created in the following organization. Its name must be unique within this organization. Where : org-root		
Ŧ	 root () Policies 	4	SAN Connectivity	The template will be created in the following organization. Its name must be unique within this organization. Type : Onlial Template Oupdating Template		
Q	 root () Adapter Policies 	5	Zoning	Specify how the UUID will be assigned to the server associated with the service generated by this template. UUID		
≡	 BIOS Defaults BIOS Policies 	6	vNIC/vHBA Placement			
	 Boot Policies Diagnostics Policies 	0	vMedia Policy	UUID Assignment: ORA-UUID-Pool(248/256) The UUID will be assigned from the selected pool.		
J _o	 Graphics Card Policies 		Server Boot Order	The available/total UUIDs are displayed after the pool name.		
	 Host Firmware Package: IPMI Access Profiles 	0	Maintenance Policy	Optionally enter a description for the profile. The description can contain information about when and where the service profile should be used.		
	 KVM Management Polici Local Disk Config Policie 		Server Assignment			
	Maintenance PoliciesManagement Firmware I		Operational Policies			
	Memory Policy Power Control Policies	W	operational Policies			
	Power Sync Policies Scrub Policies					
	Scrub Policies Serial over LAN Policies			< Prov Next> Finish Cancel		
🔒 Logge	<pre>d in as admin@10.29.134.100</pre>				System Ti	ime: 2018-

3. Select Local Disk Configuration Policy to default as Any configuration mode.

alialia cisco	UCS Manager			(3)	V 📣 🚯				0
æ				Create Service Pro	ofile Template	e		? ×	
m	All		Identify Service Profile	Optionally specify or create a Ste	orage Profile, and selec	ct a local disk configuration policy.			
	▼ Servers		Template				1		
_	Service Profiles		Oleana Duratelarian	Specific Storage Profile St	torage Profile Policy	Local Disk Configuration Policy			
윰	root root Service Profile Templates	2	Storage Provisioning	Local Storage: default 🔻					
Ŧ	 service Profile Templates root () 	3	Networking	delaur.					
	✓ Policies			Create Local Disk Configuration	on Policy	Mode	: Any Configuration		
	▼ root 🕦	4	SAN Connectivity			Protect Configuration	Yes		
_	 Adapter Policies 					preserved if the service profile	et, the local disk configuration is e is disassociated		
=	 BIOS Defaults 	5	Zoning			with the server. In that case, a raised when a new service pr			
	 BIOS Policies 	6	vNIC/vHBA Placement			that server if the local disk co			
	 Boot Policies 					different. FlexFlash			
20	 Diagnostics Policies 	7	vMedia Policy			FlexFlash State	Disable		
-	 Graphics Card Policies Host Firmware Packages 					If FlexFlash State is disabled, unavailable immediately.	, SD cards will become		
	 IPMI Access Profiles 	8	Server Boot Order			Please ensure SD cards are n FlexFlash State.	not in use before disabling the		
	 KVM Management Polici 	9	Maintenance Policy			FlexFlash RAID Reporting State.	ate : Disable		
	 Local Disk Config Policie 		Maintenance Foncy						
	Maintenance Policies	10	Server Assignment						
	 Management Firmware F 								
	 Memory Policy 	1	Operational Policies						
	 Power Control Policies 								
	Power Sync Policies								
	 Scrub Policies Serial over LAN Policies 								
	Senal over LAN Policies					< Pr	rev Next > Finish	Cancel	
	<	_							
Logg	ed in as admin@10.29.134.100								System Tir

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 six vNIC in the create vNIC menu. You have given name to first vNIC as "eth0" and second vNIC as "eth1." Similarly, you have given name to third vNIC as "eth2", fourth vNIC as "eth3.", fifth vNIC as "eth4" and sixth vNIC as "eth5".
- 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		? ×	? ×
0	ldentify Templat	Name : eth0 Use vNIC Template :			
2	Storage	Redundancy Pair :	Peer Name :	^	
3	Network	vNIC Template : ORA-vNIC-A 🔻	Create vNIC Template	^	
4	SAN Co	Adapter Performance Profile Adapter Policy : ORA_Linux_Tuning	Create Ethernet Adapter Policy		
5	Zoning				^
6	vNIC/vH				
7	vMedia				
8	Server E				
9	Mainten				
10	Server #				~
•	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".

		Create vNIC		? ×	? ×
0	Identify Templat	Name : eth1 Use vNIC Template : 🗹			
2	Storage	Redundancy Pair :	Peer Name :	^	
3	Network	vNIC Template : ORA-vNIC-B V	Create vNIC Template	Ŷ	
4	SAN Co	Adapter Performance Profile Adapter Policy : ORA_Linux_Tuning	Create Ethernet Adapter Policy		
5	Zoning	Con_Linux_tuning			^
6	vNIC/vH				
0	vMedia				
8	Server I				
9	Mainten				
10	Server /				×
0	Operatio				
				OK Cancel	Cancel

8. For vNIC "eth2", select vNIC Template as Storage_A1 and Adapter Policy as ORA_Linux_Tuning as shown below.

Create vNIC		? ×
Name : eth2		
Use vNIC Template : 🗹		
Redundancy Pair ;	Peer Name :	
vNIC Template : Storage_A1 v	Create vNIC Template	
Adapter Performance Profile		
Adapter Policy : ORA_Linux_Tuning 🔻	Create Ethernet Adapter Policy	
		OK Cancel

9. For vNIC "eth3", select vNIC Template as Storage_B1 and Adapter Policy as ORA_Linux_Tuning as shown below.

Create vNIC		? ×
Name: eth3		
Use vNIC Template : 🗹		
Redundancy Pair :	Peer Name :	
vNIC Template : Storage_B1 v	Create vNIC Template	ĺ.
Adapter Performance Profile		
Adapter Policy : ORA_Linux_Tuning v	Create Ethernet Adapter Policy	-
		OK Cancel

10. For vNIC "eth4", select vNIC Template as Storage_A2 and Adapter Policy as ORA_Linux_Tuning as shown below.

Create vNIC		? ×
Name : eth4		
Use vNIC Template : 🗹		
Redundancy Pair : 🔲	Peer Name :	
vNIC Template : Storage_A2 🔻	Create vNIC Template	I
Adapter Performance Profile		
Adapter Policy : ORA_Linux_Tuning	Create Ethernet Adapter Policy	42
		OK Cancel

11. For vNIC "eth5", select vNIC Template as Storage_B2 and Adapter Policy as ORA_Linux_Tuning as shown below.

Create vNIC		? ×
Name : eth5		
Use vNIC Template : 🗹		
Redundancy Pair :	Peer Name :	
vNIC Template : Storage_B2 V	Create vNIC Template	1
Adapter Performance Profile		
Adapter Policy : ORA_Linux_Tuning V	Create Ethernet Adapter Policy	
		OK Cancel

As shown above, eth0, eth1, eth2, eth3, eth4 and eth5 vNICs are created so that Servers can connect to the LAN and NFS Storage.

		Create Service	Profile Template		? ×
1	Identify Service Profile	Optionally specify LAN co	nfiguration information.		
	Template	Dynamic vNIC Connection I	Policy: Select a Policy to use (no Dy	namic vNIC Policy by default) 🔻	
2	Storage Provisioning		Create Dynamic vNIC Connectio	n Policy	
3	Networking				
0	SAN Connectivity		igure LAN connectivity? o vNICs () Use Connectivity Policy more vNICs that the server should u	se to connect to the LAN	
5	Zoning	Name	MAC Address	Fabric ID	Native VLAN
6	vNIC/vHBA Placement	vNIC eth5	Derived	derived	
		vNIC eth4	Derived	derived	
7	vMedia Policy	vNIC eth3	Derived	derived	
8	Server Boot Order	vNIC eth2	Derived	derived	
•		vNIC eth1	Derived	derived	
9	Maintenance Policy	vNIC eth0	Derived	derived Delete (Add (Modify	
10	Server Assignment	⊕ iSCSI vNICs			
1	Operational Policies				
				< Prev	Next > Finish Cancel

- 12. When the vNICs are created, click Next.
- 13. In the SAN Connectivity menu, select "No vHBAs". Click Next.

Skip zoning; for this Oracle RAC Configuration, we did not use any zoning for SAN.

14. In the vNIC/vHBA Placement Menu, select option "Specify Manually". Click vCon1 from Name option and eth0 from vNICs, and then select assign button to send "eth0" under vCon1 option. Similarly, click "eth2", "eth4", and select assign button to send them under vCon1 options as shown below.

		Create Service Pr	ofile Templa	nte			? ×
	Identify Service Profile Template	Specify how vNICs and vHBAs	are placed on physica	al network adapters			
2	Storage Provisioning	vNIC/vHBA Placement specifies in a server hardware configuration Select Placement: Specify		s are placed on physical ne		anine)	
	Networking	vNICs vHBAs		Specific Virtual Network		cell to edit) Selection Admin Hos	-
4	SAN Connectivity	Name	1	vCon 1	olda L	All	1
5	Zoning	No data available	>> assign >>	vNIC eth0	1	ANY	
			<< remove <<	vNIC eth2	2	ANY	I.
0	vNIC/vHBA Placement			vNIC eth4	3	ANY	
	vMedia Policy			vCon 2 vNIC eth1	1	All	
8	Server Boot Order			VNIC BUT	↑ Move Up		
9	Maintenance Policy						
10	Server Assignment						
11	Operational Policies						
					< Prev	Next > Finish	Cancel

- 15. Similarly, click vCon2 from Name option and eth1 from vNICs, and then select assign button to send "eth1" under vCon2 option. Similarly, click "eth3", "eth5", and select assign button to send them under vCon2 options as shown above.
- 16. Keep default value in the vMedia Policy menu then click Next.
- 17. For the Server Boot Policy, select "Local Disk" as Boot Policy you created earlier.

8 9 10 11	Maintenance Policy Server Assignment Operational Policies	Local 2
9	-	
	Maintenance Policy	
8		CD/DVD 1
	Server Boot Order	Name Order 🔺 vNIC/vHB Type WWN LUN Name Slot Num Boot Name Boot Path Description
7	vMedia Policy	If it is not selected, the vNICs/vHBAs are selected if they exist, otherwise the vNIC/vHBA with the lowest PCIe bus scan order is used. Boot Order + - T_Advanced Filter + Export + Print T_Advanced Filter + Export + Print
6	vNIC/vHBA Placement	The type (primary/secondary) does not indicate a boot order presence. The effective order of boot devices within the same device class (LAN/Storage/iSCSI) is determined by PCIe bus scan order. If Enforce vNIC/vHBA/iSCSI Name is selected and the vNIC/vHBA/iSCSI does not exist, a config error will be reported.
5	Zoning	Boot Mode : Legacy WARNINGS:
4	SAN Connectivity	Reboot on Boot Order Change : No Enforce vNIC/vHBA/iSCSI Name : Yes
3	Networking	Description :
2	Storage Provisioning	Boot Policy: Local_Disk Create Boot Policy Name : Local_Disk
		Select a boot policy.
	Identify Service Profile Template	
1		Optionally specify the boot policy for this service profile template.

ever, they may vary from site-to-site depending on workloads, best practices, and policies.

18. Click Next and Select BIOS Policy as "OLTP_BIOS" in the BIOS Configuration.

		Create Service Profile Template	? ×
1	Identify Service Profile Template	Optionally specify information that affects how the system operates.	
2	Storage Provisioning	BIOS Configuration If you want to override the default BIOS settings, select a BIOS policy that will be associated with this service profile	
3	Networking	BIOS Policy : OLTP_BIOS V	
4	SAN Connectivity	<	>
5	Zoning	External IPMI Management Configuration	
6	vNIC/vHBA Placement	Management IP Address	
7	vMedia Policy	⊕ Monitoring Configuration (Thresholds)	
8	Server Boot Order	Power Control Policy Configuration	
9	Maintenance Policy	⊕ Scrub Policy	
10	Server Assignment	⊕ KVM Management Policy	
11	Operational Policies	Graphics Card Policy	
		< Prev Next > Finish Ca	ancel

19. Click Finish to create service profile template as "ORA_FlashBlade". This service profile template is used to create all eight service profiles for oracle RAC node 1 to 8.

You have now created Service profile template as "ORA_FlashBlade" with each having six vNICs as shown below.

iliiilii cisco	UCS Manager			8 V 0 2	△ ③ 0 8				0 6	
æ	All	Servers / Service Pr	ofile Templates /	root / Service Template C	RA_FlashBlade					
	Servers ^	General Storag	e Network	iSCSI vNICs Boot Orc	ler Policies	Events FSM vMe	dia Policy			
品	► root 🕐				4			All		
=	Service Profile Templates root									
	Service Template ORA_FlashBlade Service Template ORACLE_TEAM									
	 Service Template ORAX-1 				LAN Connectivit					
=	Service Template ORAX-2 Sub-Organizations				LAN Connectivit	Policy : <pre></pre>	set> 🔻			
	▼ Policies				Create LAN Conr					
	▼ root 🕐	vNICs								
20	Adapter Policies BIOS Defaults									
	BIOS Defaults BIOS Policies	¥∉ Advanced Filter	Transferration (Transfer	it						
	Boot Policies	Name	MAC Address	Desired Order	Actual Order	Fabric ID	Desired Placement	Actual Placement	Admin Host Port	Actual Host Por
	 Diagnostics Policies 	vNIC eth0	Derived	1	unspecified	AB	1	Any	ANY	NONE
	 Graphics Card Policies 	vNIC eth1	Derived	1	unspecified	BA	2	Any	ANY	NONE
	 Host Firmware Packages 	vNIC eth2	Derived	2	unspecified	AB	1	Any	ANY	NONE
	 IPMI Access Profiles 	vNIC eth3	Derived	2	unspecified	BA	2	Any	ANY	NONE
	 KVM Management Policies 	vNIC eth4	Derived	3	unspecified	AB	1	Any	ANY	NONE
	 Local Disk Config Policies 	VAIC ath5	Darivart	3	unenarifiad	RA	2	Anu	ANIV	NONE
	 Maintenance Policies 					Doloso 🕀 Add 🔮	A Annality			
	 Management Firmware Packages 									

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.

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 "ORA_FlashBlade" which you created earlier and name the service profile as "ORA."
- 3. To create eight service profiles, enter "Number of Instances" as 8 as shown below. This process will create service profiles as "ORA1", "ORA2", "ORA3", "ORA4", "ORA5", "ORA6", "ORA7" and "ORA8."

Naming Prefix	ORA		
Name Suffix Starting Number	1		
Number of Instances	8		
Service Profile Template	ORA_FlashBla	de	
	1		

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.

- 4. Under the Servers tab, select the desired service profile, and select Change Service Profile Association.
- 5. Right-click the name of service profile you want to associate with the server and select the option "Change Service Profile Association."
- 6. 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.
- 7. You will assign service profiles ORA1 to ORA4 to Chassis 1 Servers and ORA5 to ORA8 to Chassis 2 Servers.
- 8. Repeat the same steps to associate remaining seven service profiles for the blade servers.

You have assigned "ORA1" to Chassis 1 Server 1, Service Profile "ORA2" to Chassis 1 Server 2, Service Profile "ORA3" to Chassis 1 Server 3 and, Service Profile "ORA4" to Chassis 1 Server 4.

You have assigned Service Profile "ORA5" to Chassis 2 Server 1, Service Profile "ORA6" to Chassis 2 Server 2, Service Profile "ORA7" to Chassis 2 Server 3 and Service Profile "ORA8" to Chassis 2 Server 4.

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

i.ili. isco	UCS Manager				8 V (0 2	≙ ⊙ 0 8										• •	• • • •	0 🕲 🏟
æ	All	Equipment																
•	Equipment	Main Topolog	gy View Fa	abric Interconnects	Servers Thermal Decommissioned	Firmware Ma	nagemei	nt Polic	ies Fau	lts Diag	postics							
-		Blade Server	Rack-M	ount Servers														
몲	▼ Chassis 1	T∉ Advanced Fi	ilter 🛧 Expor	r 🚓 Print														¢
	 Fans 	Name	Chassis ID	2	Model	User La C	ores	Cores	Memory	Adapters	NICs	HBAs	Overall	Operability	Pow A	Assoc State	Profile	Fault S.
	 IO Modules 	Server 1	1	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Blade Server		4	44	524288	1	6	0	t OK	Operable	1 On	Associated	org-root/ls-ORA1	N/A
ล	 PSUs 	Server 2	1	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Blade Server		4	44	524288	1	6	0	* OK	Operable	t On	Associated Associated	org-root/ls-ORA2	N/A
2	▼ Servers	Server 3	1	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Blade Server		4	44	524288		6	0	* OK		t On	Associated Associated	org-root/ls-ORA3	N/A
	 Server 1 	Server 4	1	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Blade Server		4	44	524288	1	6	0	* OK	Operable Operable	• On • On	Associated Associated	org-root/ls-ORA4	N/A
	 Server 2 	Server 1	2	UCSB-B200-M5	Cisco UCS B200 MS 2 Socket Blade Server		4	44	524288		6	0					org-root/ls-ORA5	N/A
	 Server 3 		-		Cisco UCS B200 MS 2 Socket Blade Server								† ок	Operable	1 On	Associated	org-root/ls-ORA6	
	 Server 4 	Server 2	2	UCSB-B200-M5			14	44	524288	1	6	0	t OK	Operable	1 On	Associated	org-root/ls-ORA7	N/A
•	▼ Chassis 2	Server 3	2	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Blade Server		4	44	524288	1	6	0	* ок	Operable	1 On	Associated	org-root/is-ORA8	N/A
	 Fans 	Server 4	2	UCSB-B200-M5	Cisco UCS B200 M5 2 Socket Blade Server	4	14	44	524288	1	6	0	↑ ОК	Operable	1 On	Associated	019-100015-0706	N/A
	 IO Modules PSUs 																	
	Servers																	
	 Server 1 																	
	 Server 2 																	
	 Server 3 																	
	 Server 4 																	
	Rack-Mounts																	
	Fabric Interconnects																	
	 Fabric Interconnect A (subordinate) 																	
	 Fabric Interconnect B (primary) 																	
	Policies																	

10. 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 details 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. Log in as admin user into the Nexus Switch A and run the following commands to set global configurations and jumbo frames in QoS:
 - conf terminal
 feature lacp
 feature hsrp
 feature vpc
 feature interface-vlan
 spanning-tree port type network default
 spanning-tree port type edge bpduguard default
 policy-map type network-qos jumbo
 class type network-qos class-default
 mtu 9216

exit system qos service-policy type network-qos jumbo exit copy run start

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

ORA134-NEXUS-A# config terminal ORA134-NEXUS-A(config)# VLAN 134 ORA134-NEXUS-A(config-VLAN)# name Oracle_RAC_Public_Traffic ORA134-NEXUS-A(config-VLAN)# no shutdown ORA134-NEXUS-A(config-VLAN)# exit ORA134-NEXUS-A(config)# copy running-config startup-config ORA134-NEXUS-A(config)# exit

3. Create VLAN 10 for Private Network Traffic:

ORA134-NEXUS-A# config terminal ORA134-NEXUS-A(config)# VLAN 10 ORA134-NEXUS-A(config-VLAN)# name Oracle_RAC_Private_Traffic ORA134-NEXUS-A(config-VLAN)# no shutdown ORA134-NEXUS-A(config-VLAN)# exit ORA134-NEXUS-A(config)# copy running-config startup-config ORA134-NEXUS-A(config)# exit

4. Create VLAN 21 for Storage Network Traffic:

ORA134-NEXUS-A# config terminal ORA134-NEXUS-A(config)# VLAN 21 ORA134-NEXUS-A(config-VLAN)# name Storage Traffic A1 ORA134-NEXUS-A(config-VLAN) # no shutdown ORA134-NEXUS-A(config-VLAN) # exit ORA134-NEXUS-A(config) # copy running-config startup-config ORA134-NEXUS-A(config) # exit

5. Create VLAN 22 for Storage Network Traffic:

ORA134-NEXUS-A# config terminal ORA134-NEXUS-A(config)# VLAN 22 ORA134-NEXUS-A(config-VLAN)# name Storage_Traffic_B1 ORA134-NEXUS-A(config-VLAN)# no shutdown ORA134-NEXUS-A(config-VLAN)# exit ORA134-NEXUS-A(config)# copy running-config startup-config ORA134-NEXUS-A(config)# exit

6. Create VLAN 23 for Storage Network Traffic:

ORA134-NEXUS-A# config terminal ORA134-NEXUS-A(config)# VLAN 23 ORA134-NEXUS-A(config-VLAN)# name Storage_Traffic_A2 ORA134-NEXUS-A(config-VLAN)# no shutdown ORA134-NEXUS-A(config)# copy running-config startup-config ORA134-NEXUS-A(config)# exit

7. Create VLAN 24 for Storage Network Traffic:

ORA134-NEXUS-A# config terminal ORA134-NEXUS-A(config) # VLAN 24 ORA134-NEXUS-A(config-VLAN) # name Storage_Traffic_B2 ORA134-NEXUS-A(config-VLAN) # no shutdown ORA134-NEXUS-A(config-VLAN) # exit ORA134-NEXUS-A(config) # copy running-config startup-config ORA134-NEXUS-A(config) # exit

8. Log in as admin user into the Nexus Switch B and create VLAN 134 for Public Network Traffic, VLAN 10 for Private Network Traffic and VLAN 21 to 24 for Storage 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 listed in Table 6

Table 6 vPC Summary		
vPC Domain	vPC Name	vPC ID
1	Peer-Link	1
1	vPC Public	51
1	vPC Private	52

As listed in Table 6 , 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 51 and 52 are defined for public, private and storage 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 7 Nexus Switch Peer-Link

vPC Domain 1	vPC Peer Link 1
N9K-C9372PX	N9K-C9372PX

1. Log in 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.

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

ORA134-NEXUS-A# config terminal ORA134-NEXUS-A(config)#feature interface-vlan ORA134-NEXUS-A(config)#feature vpc ORA134-NEXUS-A(config)#feature lacp

```
ORA134-NEXUS-A(config)#vpc domain 1
ORA134-NEXUS-A(config-vpc-domain)# peer-keepalive destination 10.29.134.6 source
10.29.134.5
ORA134-NEXUS-A(config-vpc-domain)# exit
ORA134-NEXUS-A(config)# interface port-channel 1
ORA134-NEXUS-A(config-if)# description VPC peer-link
ORA134-NEXUS-A(config-if)# switchport mode trunk
ORA134-NEXUS-A(config-if)# switchport trunk allowed VLAN 1,10,21-24,134
ORA134-NEXUS-A(config-if)# spanning-tree port type network
ORA134-NEXUS-A(config-if)# vpc peer-link
ORA134-NEXUS-A(config-if)# no shutdown
ORA134-NEXUS-A(config-if)# no shutdown
ORA134-NEXUS-A(config-if)# exit
```

```
ORA134-NEXUS-A(config)# interface Ethernet1/1
ORA134-NEXUS-A(config-if)# description Peer link connected to N9KB-Eth1/1
ORA134-NEXUS-A(config-if)# switchport mode trunk
ORA134-NEXUS-A(config-if)# switchport trunk allowed VLAN 1,10,21-24,134
ORA134-NEXUS-A(config-if)# channel-group 1 mode active
ORA134-NEXUS-A(config-if)# no shutdown
ORA134-NEXUS-A(config-if)# exit
```

```
ORA134-NEXUS-A(config) # interface Ethernet1/2
ORA134-NEXUS-A(config-if) # description Peer link connected to N9KB-Eth1/2
ORA134-NEXUS-A(config-if) # switchport mode trunk
ORA134-NEXUS-A(config-if) # switchport trunk allowed VLAN 1,10,21-24,134
ORA134-NEXUS-A(config-if) # channel-group 1 mode active
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # exit
```

```
ORA134-NEXUS-A(config) # interface Ethernet1/3
ORA134-NEXUS-A(config-if) # description Peer link connected to N9KB-Eth1/3
```

```
Solution Configuration
```

```
ORA134-NEXUS-A(config-if) # switchport mode trunk
ORA134-NEXUS-A(config-if) # switchport trunk allowed VLAN 1,10,21-24,134
ORA134-NEXUS-A(config-if) # channel-group 1 mode active
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # exit
ORA134-NEXUS-A(config) # interface Ethernet1/4
ORA134-NEXUS-A(config-if) # description Peer link connected to N9KB-Eth1/4
ORA134-NEXUS-A(config-if) # switchport mode trunk
ORA134-NEXUS-A(config-if) # switchport trunk allowed VLAN 1,10,21-24,134
ORA134-NEXUS-A(config-if) # channel-group 1 mode active
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # exit
ORA134-NEXUS-A(config) # interface Ethernet1/15
ORA134-NEXUS-A(config-if) # description connect to uplink switch
ORA134-NEXUS-A(config-if) # switchport access vlan 134
ORA134-NEXUS-A(config-if) # speed 1000
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # exit
```

ORA134-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

To create and configure vPC 51 and 52 for Data network between Nexus switches and Fabric Interconnects, complete the following steps:

Figure 8 vPC Configuration Between Nexus Switches and Fabric Interconnects

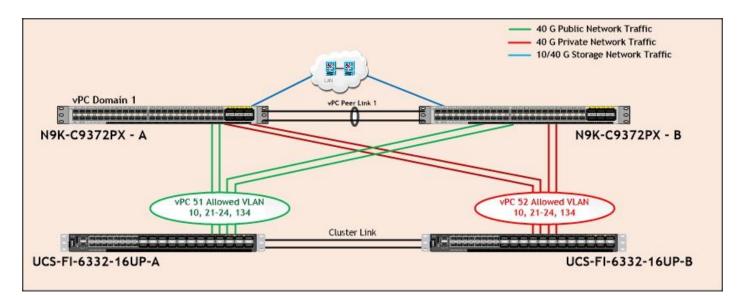


Table 7 lists the vPC IDs, allowed VLAN IDs, and Ethernet uplink ports.

vPC Description	vPC ID	Fabric Interconnects Ports	Nexus Ports	Allowed VLANs
		FI-A Port 1/31	N9K-A Port 2/1	
Port Channel FI-A	51	FI-A Port 1/32	N9K-A Port 2/2	134,10, 21 - 24
		FI-A Port 1/33	N9K-B Port 2/1	
		FI-A Port 1/34	N9K-B Port 2/2	Note: VLAN 10, 22, 24 needed for failover
		FI-B Port 1/31	N9K-A Port 2/3	
Port-Channel FI-B	52	FI-B Port 1/32	N9K-A Port 2/4	10,134
		FI-B Port 1/33	N9K-B Port 2/3	
		FI-B Port 1/34	N9K-B Port 2/4	Note: VLAN 134,10, 21-24 needed for failover

Table 7	vPC IDs and VLAN IDs	
	VEC IDS AND VEAN IDS	

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

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

```
ORA134-NEXUS-A# config Terminal
```

```
ORA134-NEXUS-A(config) # interface port-channel51
```

ORA134-NEXUS-A(config-if) # description connect to Fabric Interconnect A ORA134-NEXUS-A(config-if)# switchport mode trunk ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 1,10,21-24,134 ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk ORA134-NEXUS-A(config-if) # mtu 9216 ORA134-NEXUS-A(config-if) # vpc 51 ORA134-NEXUS-A(config-if) # no shutdown ORA134-NEXUS-A(config-if) # exit ORA134-NEXUS-A(config) # interface port-channel52 ORA134-NEXUS-A(config-if) # description connect to Fabric Interconnect B ORA134-NEXUS-A(config-if) # switchport mode trunk ORA134-NEXUS-A(config-if)# switchport trunk allowed vlan 1,10,21-24,134 ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk ORA134-NEXUS-A(config-if) # mtu 9216 ORA134-NEXUS-A(config-if) # vpc 52 ORA134-NEXUS-A(config-if) # no shutdown ORA134-NEXUS-A(config-if) # exit ORA134-NEXUS-A(config) # interface Ethernet2/1 ORA134-NEXUS-A(config-if)# description Fabric-Interconnect-A-31 ORA134-NEXUS-A(config-if) # switch mode trunk ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 1,10,21-24,134 ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk

ORA134-NEXUS-A(config-if) # mtu 9216

ORA134-NEXUS-A(config-if) # channel-group 51 mode active

- ORA134-NEXUS-A(config-if) # no shutdown
- ORA134-NEXUS-A(config-if) # exit

ORA134-NEXUS-A(config) # interface Ethernet2/2

ORA134-NEXUS-A(config-if)# description Fabric-Interconnect-A-32

- ORA134-NEXUS-A(config-if) # switch mode trunk
- ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 1,10,21-24,134

ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk

Solution Configuration

ORA134-NEXUS-A(config-if) # mtu 9216 ORA134-NEXUS-A(config-if) # channel-group 51 mode active ORA134-NEXUS-A(config-if) # no shutdown ORA134-NEXUS-A(config-if) # exit ORA134-NEXUS-A(config) # interface Ethernet2/3 ORA134-NEXUS-A(config-if) # description Fabric-Interconnect-B-31 ORA134-NEXUS-A(config-if) # switch mode trunk ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 1,10,21-24,134 ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk ORA134-NEXUS-A(config-if) # mtu 9216 ORA134-NEXUS-A(config-if) # channel-group 52 mode active ORA134-NEXUS-A(config-if) # no shutdown ORA134-NEXUS-A(config-if) # exit ORA134-NEXUS-A(config) # interface Ethernet2/4 ORA134-NEXUS-A(config-if)# description Fabric-Interconnect-B-32 ORA134-NEXUS-A(config-if) # switch mode trunk ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 1,10,21-24,134 ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk ORA134-NEXUS-A(config-if) # mtu 9216 ORA134-NEXUS-A(config-if) # channel-group 52 mode active ORA134-NEXUS-A(config-if) # no shutdown ORA134-NEXUS-A(config-if) # exit ORA134-NEXUS-A(config) # copy running-config startup-config 2. Log in as admin user into the Nexus Switch B and complete the following for the second switch configuration: ORA134-NEXUS-B# config Terminal ORA134-NEXUS-B(config) # interface port-channel51 ORA134-NEXUS-B(config-if) # description connect to Fabric Interconnect A ORA134-NEXUS-B(config-if) # switchport mode trunk ORA134-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,21-24,134

ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk

ORA134-NEXUS-B(config-if) # mtu 9216

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```
ORA134-NEXUS-B(config-if) # vpc 51
ORA134-NEXUS-B(config-if) # no shutdown
ORA134-NEXUS-B(config-if) # exit
ORA134-NEXUS-B(config) # interface port-channel52
ORA134-NEXUS-B(config-if) # description connect to Fabric Interconnect B
ORA134-NEXUS-B(config-if) # switchport mode trunk
ORA134-NEXUS-B(config-if) # switchport trunk allowed vlan 1,10,21-24,134
ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-B(config-if) # mtu 9216
ORA134-NEXUS-B(config-if) # mtu 9216
ORA134-NEXUS-B(config-if) # no shutdown
ORA134-NEXUS-B(config-if) # no shutdown
ORA134-NEXUS-B(config-if) # exit
```

```
ORA134-NEXUS-B(config-if)# description Fabric-Interconnect-A-33
ORA134-NEXUS-B(config-if) # switch mode trunk
ORA134-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,21-24,134
ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-B(config-if) # mtu 9216
ORA134-NEXUS-B(config-if) # channel-group 51 mode active
ORA134-NEXUS-B(config-if) # no shutdown
ORA134-NEXUS-B(config-if) # exit
ORA134-NEXUS-B(config) # interface Ethernet2/2
ORA134-NEXUS-B(config-if)# description Fabric-Interconnect-A-34
ORA134-NEXUS-B(config-if) # switch mode trunk
ORA134-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,21-24,134
ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-B(config-if) # mtu 9216
ORA134-NEXUS-B(config-if) # channel-group 51 mode active
ORA134-NEXUS-B(config-if) # no shutdown
ORA134-NEXUS-B(config-if) # exit
```

ORA134-NEXUS-B(config)# interface Ethernet2/3

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ORA134-NEXUS-B(config-if)# description Fabric-Interconnect-B-33 ORA134-NEXUS-B(config-if) # switch mode trunk ORA134-NEXUS-B(config-if) # switchport trunk allowed vlan 1,10,21-24,134 ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk ORA134-NEXUS-B(config-if) # mtu 9216 ORA134-NEXUS-B(config-if) # channel-group 52 mode active ORA134-NEXUS-B(config-if) # no shutdown ORA134-NEXUS-B(config-if) # exit ORA134-NEXUS-B(config) # interface Ethernet2/4 ORA134-NEXUS-B(config-if)# description Fabric-Interconnect-B-34 ORA134-NEXUS-B(config-if) # switch mode trunk ORA134-NEXUS-B(config-if)# switchport trunk allowed vlan 1,10,21-24,134 ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk ORA134-NEXUS-B(config-if) # mtu 9216 ORA134-NEXUS-B(config-if) # channel-group 52 mode active ORA134-NEXUS-B(config-if) # no shutdown ORA134-NEXUS-B(config-if) # exit ORA134-NEXUS-B(config) # copy running-config startup-config

Create vPC Configuration between Nexus 9372PX-E and Pure Storage FlashBlade

To create and configure one vPC 41 for Storage network between both Nexus switches and FlashBlade, complete the following steps:

Figure 9 vPC Configuration Between Nexus Switches and FlashBlade

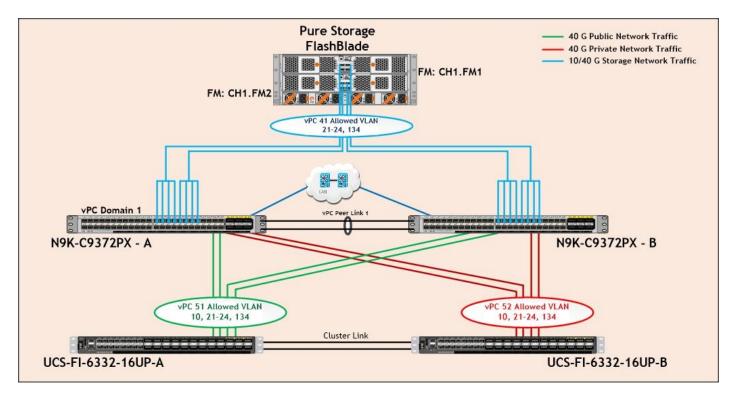


Table 8 lists the vPC IDs, allowed VLAN IDs, and Ethernet uplink ports for Nexus Switch A.

Table 8	vPC.	IDs	and	VLAN IDs
		IDS	anu	

VPC ID	Nexus Ports	FlashBlade	Allowed VLANs
		Ports	
	N9K-A Port 1/33	CH1.FM1.ETH1	
41	N9K-A Port 1/34	_	VLAN 134, 21 - 24
	N9K-A Port 1/35		
	N9K-A Port 1/36		
	N9K-A Port 1/37	CH1.FM2.ETH1	
	N9K-A Port 1/38		
	N9K-A Port 1/39	_	
	N9K-A Port 1/40		
	vPC ID 41	41 N9K-A Port 1/33 41 N9K-A Port 1/34 N9K-A Port 1/35 N9K-A Port 1/35 N9K-A Port 1/36 N9K-A Port 1/36 N9K-A Port 1/37 N9K-A Port 1/38 N9K-A Port 1/39 N9K-A Port 1/39	Ports 41 N9K-A Port 1/33 CH1.FM1.ETH1 41 N9K-A Port 1/34 CH1.FM1.ETH1 N9K-A Port 1/35 N9K-A Port 1/35 CH1.FM2.ETH1 N9K-A Port 1/36 N9K-A Port 1/37 CH1.FM2.ETH1 N9K-A Port 1/38 N9K-A Port 1/39 CH1.FM2.ETH1

Table 9 lists the vPC IDs, allowed VLAN IDs, and Ethernet uplink ports for Nexus Switch B.

vPC Description	vPC ID	Nexus Ports	FlashBlade	Allowed VLANs
			Ports	
		N9K-B Port 1/33	CH1.FM1.ETH3	

Port Channel Nexus - B	41	N9K-B Port 1/34		VLAN 134, 21 - 24
		N9K-B Port 1/35		
		N9K-B Port 1/36		
		N9K-B Port 1/37	CH1.FM2.ETH3	
		N9K-B Port 1/38		
		N9K-B Port 1/39		
		N9K-B Port 1/40		

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

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

```
ORA134-NEXUS-A# config Terminal
ORA134-NEXUS-A(config) # interface port-channel41
ORA134-NEXUS-A(config-if) # description Port-Channel to Storage
ORA134-NEXUS-A(config-if) # switchport mode trunk
ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 21-24,134
ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-A(config-if) # mtu 9216
ORA134-NEXUS-A(config-if) # vpc 41
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # exit
ORA134-NEXUS-A(config) # interface Ethernet1/33-36
ORA134-NEXUS-A(config-if) # description Connected to FlashBlade Controller-0
ORA134-NEXUS-A(config-if) # switch mode trunk
ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 21-24,134
ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-A(config-if) # mtu 9216
ORA134-NEXUS-A(config-if) # channel-group 41 mode active
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # exit
```

```
ORA134-NEXUS-A(config) # interface Ethernet1/37-40
ORA134-NEXUS-A(config-if) # description Connected to FlashBlade Controller-1
ORA134-NEXUS-A(config-if) # switch mode trunk
ORA134-NEXUS-A(config-if) # switchport trunk allowed vlan 21-24,134
ORA134-NEXUS-A(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-A(config-if) # mtu 9216
ORA134-NEXUS-A(config-if) # mtu 9216
ORA134-NEXUS-A(config-if) # channel-group 41 mode active
ORA134-NEXUS-A(config-if) # no shutdown
ORA134-NEXUS-A(config-if) # no shutdown
```

ORA134-NEXUS-A(config) # copy running-config startup-config

2. Log in as admin user into the Nexus Switch B and complete the following for the second switch configuration:

```
ORA134-NEXUS-B# config Terminal
ORA134-NEXUS-B(config) # interface port-channel41
ORA134-NEXUS-B(config-if) # description Port-Channel to Storage
ORA134-NEXUS-B(config-if) # switchport mode trunk
ORA134-NEXUS-B(config-if) # switchport trunk allowed vlan 21-24,134
ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-B(config-if) # mtu 9216
ORA134-NEXUS-B(config-if) # vpc 41
ORA134-NEXUS-B(config-if) # no shutdown
ORA134-NEXUS-B(config-if) # exit
ORA134-NEXUS-B(config) # interface Ethernet1/33-36
ORA134-NEXUS-B(config-if) # description Connected to FlashBlade Controller-0
ORA134-NEXUS-B(config-if) # switch mode trunk
ORA134-NEXUS-B(config-if) # switchport trunk allowed vlan 21-24,134
ORA134-NEXUS-B(config-if) # spanning-tree port type edge trunk
ORA134-NEXUS-B(config-if) # mtu 9216
ORA134-NEXUS-B(config-if) # channel-group 41 mode active
```

```
Solution Configuration
```

```
ORA134-NEXUS-B(config-if)# no shutdown
ORA134-NEXUS-B(config-if)# exit
ORA134-NEXUS-B(config)# interface Ethernet1/37-40
ORA134-NEXUS-B(config-if)# description Connected to FlashBlade Controller-1
ORA134-NEXUS-B(config-if)# switch mode trunk
ORA134-NEXUS-B(config-if)# switchport trunk allowed vlan 21-24,134
ORA134-NEXUS-B(config-if)# spanning-tree port type edge trunk
ORA134-NEXUS-B(config-if)# mtu 9216
ORA134-NEXUS-B(config-if)# channel-group 41 mode active
ORA134-NEXUS-B(config-if)# no shutdown
ORA134-NEXUS-B(config-if)# no shutdown
ORA134-NEXUS-B(config-if)# exit
```

ORA134-NEXUS-B(config) # copy running-config startup-config

Verify all vPC Status Is Up on Both Cisco Nexus Switches

Figure 10 Cisco Nexus Switch A Port-Channel Summary

ORA13	ORA134-NEXUS-A# ORA134-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 Port	S				
1 41	Pol(SU) Po41(SU)	Eth Eth	LACP LACP	Eth1/1(P) Eth1/33(P) Eth1/36(P) Eth1/39(P)	Eth1/2(P) Eth1/34(P) Eth1/37(P) Eth1/40(P)	Eth1/35(P) Eth1/38(P)			
51 52	Po51(SU) Po52(SU)	Eth Eth	LACP LACP	Eth2/1(P) Eth2/2(P)	L (11) 40(1)				

Figure	ETT CISCO	ivexus Swi	ICH B POIL-C	nannei Summa	i y	
ORA13	I - Indi s - Susp S - Swit U - Up (F vidual H ended r ched F port-chan	P - Up in po H - Hot-stan - Module-r R - Routed	ort-channel (n ndby (LACP on removed		
Group	Port- Channel	Туре	Protocol	Member Port	S	
1 41	Pol(SU) Po41(SU)	Eth Eth	LACP LACP	Eth1/1(P) Eth1/33(P) Eth1/36(P) Eth1/39(P)	Eth1/2(P) Eth1/34(P) Eth1/37(P) Eth1/40(P)	Eth1/35(P) Eth1/38(P)
51 52	Po51(SU) Po52(SU)	Eth Eth	LACP LACP	Eth2/1(P) Eth2/2(P)		

Figure 11 Cisco Nexus Switch B Port-Channel Summary



ORA134-NEXUS-A# ORA134-NEXUS-A# show vpc brief Legend: (*) - local vPC is down, forwarding via vPC peer-link vPC domain id : 1 Peer status : peer adjacency formed ok vPC keep-alive status : peer is alive Configuration consistency status : success Per-vlan consistency status : success Type-2 consistency status vPC role : success : secondary Number of vPCs configured : 3 Peer Gateway : Disabled Dual-active excluded VLANs Graceful Consistency Check : Enabled Auto-recovery status : Disabled Delay-restore status : Timer is off.(timeout = 30s) Delay-restore SVI status : Timer is off.(timeout = 10s) vPC Peer-link status id Port Status Active vlans -- - - -P01 up 1,10,21-24,134 1 vPC status id Status Consistency Reason Active vlans Port 41 Po41 21-24,134 up success success 51 Po51 up success success 1,10,21-24, 134 52 Po52 1,10,21-24, up success success 134

0			ription for Cise	co Nexus Switch B	
ORA	134-NEXU 134-NEXU end:	JS-B# sho	ow vpc brief) - local vPC	C is down, forwarding via v	PC peer-link
Pee vPC Con Per Type vPC Num Pee Dua Grad Auto Dela Dela	figurati -vlan co e-2 cons role ber of v r Gatewa l-active ceful Co o-recove ay-resto ay-resto	ive stat ion cons: onsistency sistency vPCs con ay e exclude onsistence ery stat	istency statu cy status figured ed VLANs cy Check us us status	: Disabled	= 30s) = 10s)
id	Port	Status	Active vlans		
1 vPC	Pol status	up	1,10,21-24,1		
id	Port	Status	Consistency	Reason	Active vlans
41	Po41	up	success	success	21-24,134
51 52	Po51 Po52	up up	success success	success	1,10,21-24, 134 1,10,21-24, 134

Figure 13 vPC Description for Cisco Nexus Switch B

Configure Pure Storage

The design goal of the reference architecture was to best represent a real-world environment as closely as possible. The FlashStack design includes FlashBlade for increased bandwidth and throughput. There are no performance knobs to tune on FlashBlade. The hosts are redundantly connected to the controllers through 4 x 40Gb connections (2 x 40Gb per controller module) from the redundant Cisco Nexus 9K switches. FlashBlade was loaded with Purity//FB version 2.1.8, which includes a NLM (Network Lock Manager) feature for the NFS protocol to provide advisory file locking semantics.

The FlashBlade network settings were configured with five subnets across five VLANs. The NFS file systems were mounted on these four subnets on to the target host. To configure network settings into Pure Storage FlashBlade, complete the following steps:

- 1. Open a web browser and navigate to the Pure Storage FlashBlade Cluster address.
- 2. Enter the Username and Password for the storage.
- 3. From the Pure Storage Dashboard, go to Settings > Network. Click the "+" sign to Create Subnets.

4. Enter name, Prefix, VLAN, Gateway and MTU as shown below and click "Create" to create subnet.

Create Subnet	×
Name	VLAN21
Prefix	192.168.21.0/24
VLAN	21
Gateway	192.168.21.1
МТО	9000
	Cancel
	Cancel Create

5. Click the "+" sign into the subnet VLAN21 to add Interface as shown below then click "Create" to create network interface on subnet.

Create Network In	terface ×
Name	NFS21
Address	192.168.21.201
Services	data
Subnet	VLAN21
	Cancel Create

6. Add Subnets VLAN22, VLAN23 and VLAN24 and appropriate interfaces as shown below.

		-	-											
Storage	Subnets	;										+	DNS Settings	G
Analysis		Name	Enabled	Prefix	VLAN	Gateway	MTU	LAG	Interfaces	Addresses	Services		Domain No domain configured	
Performance		fb-mgmt	~	10.29.134.0/24	134	10.29.134.1	1500	uplink	NFS134	10.29.134.201	data	2		
Capacity									fm1.admin0	10.29.134.103	support		DNS Server(s) 171.70.168.183	
Health									fm2.admin0	10.29.134.104	support			
									vir0	10.29.134.105	management			
Settings									+ Add interface					
	2	VLAN21	~	192.168.21.0/24	21	192.168.21.1	9000	uplink	NFS21	192.168.21.201	data	2 0		
5									+ Add interface					
ut	3	VLAN22	~	192.168.22.0/24	22	192.168.22.1	9000	uplink	NFS22	192.168.22.201	data			
									+ Add interface					
		VLAN23	~	192.168.23.0/24	23	192.168.23.1	9000	uplink	NFS23	192.168.23.201	data	2 1		
									+ Add interface					
	2 0	VLAN24	~	192.168.24.0/24	24	192.168.24.1	9000	uplink	NFS24	192.168.24.201	data	2 0		
			v					- april - a				<u>س</u>		
γ tack-fb									+ Add interface					

For this FlashStack solution, we have configured VLAN 134 for management network traffic and four VLAN (21, 22, 23 and 24) for data network traffic. We will use these interface addresses and configure mount point on Oracle RAC nodes as discussed later in the sections.

OS and Database Deployment

Operating System Configuration

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

- 1. Download Oracle Linux 7.4 OS image from https://edelivery.oracle.com/linux.
- 2. 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.

			⊗ ⊽ △ ○ ○ ○		UCS Manager	uluulu cisco
			ssis 1 / Servers / Server 1	Equipment / Chassis / Cha	All	Æ
Diagnostics S	s Events FSM H	C Sessions SEL Logs VIF Paths Faults E	Virtual Machines Installed Firmware	General Inventory	▼ Equipment ▼ Chassis	-
					 Chassis 1 Fans IO Modules 	品
			0 0	Status	PSUs Servers Server 1	ē
	0			Overall Status : † OK (+) Status Details	Server 2 Server 3	
				Actions	Server 4 Chassis 2 Rack-Mounts	
				Create Service Profile Associate Service Profile	FEX Servers	-0
		1	Pro	Set Desired Power State Boot Server	Fabric Interconnects Fabric Interconnect A (subordinate) Eabric Interconnect B (oriman)	
: 1	Chassis ID Blade Server	: 1 lame : Cisco UCS B200 M5 2 Socket Blade S	SI	Reset Recover Server	 Policies Port Auto-Discovery Policy 	
: UCSB-B200-M5 : FCH21437KVH	PID Serial	: Cisco Systems Inc : 0	Ve Re	Reset All Memory Errors Server Maintenance		
	Blade Server PID	ame Cisco UCS B200 M5 2 Socket Blade S Cisco Systems Inc	SI Pr Vē Re	Boot Server Shutdown Server Reset Recover Server Reset All Memory Errors	 Fabric Interconnect A (subordinate) Fabric Interconnect B (primary) Policies 	

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

Cisco UCS KVM				E C C % □ ? O Create Image					
KVM Console S	lerver				Activate V	irtual Devic	es		
			No Signal						

- 4. When the Server starts booting, it will detect the Local Disk and the virtual media connected as Oracle Linux cd.
- It should launch the Oracle Linux installer. Select language and assign the Installation destination as local disk volume. 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.

Please verify the Device MAC Address and desired MTU settings as you configure the interfaces.

- 6. As a part of additional RPM package, we recommend to select "Customize Now" and configure "UEK kernel Repo."
- 7. After the OS install, reboot the server, complete appropriate registration steps. You can choose to synchronize the time with the 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 Oracle Database Workloads

Oracle Database 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 disable c-states in both OS and BIOS to ensure cstates are disabled.

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

Intel Directed IO RAS Memory Serial Port US	B PCI QPI LOM and PCIe Slots Trusted Platform Graph	ics Configuration
Advanced Filter 🔶 Export 🌰 Print		
OS Setting	Value	
Altitude	Platform Default	7
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	Υ.
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	7
Memory Interleaving	Platform Default	Υ.
Rank Interleaving	Platform Default	*
Sub NUMA Clustering	Platform Default	7
Local X2 Apic	Platform Default	Ψ.
Max Variable MTRR Setting	Platform Default	×.
P STATE Coordination	Platform Default	Y
Package C State Limit	C0 C1 State	
Processor C State	Disabled	7
Processor C1E	Disabled	•
Processor C3 Report	Disabled	۲
Processor C6 Report	Disabled	Ŧ
Processor C7 Report	Disabled	
Processor CMCI	Platform Default	
Power Technology	Performance	*

Figure 14 BIOS Options for Oracle Database Workloads
--

For more information about BIOS settings, refer to:

https://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/whitepaper_c11-740098.pdf.

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 configured the BIOS options by modifying in /etc/default/grub file as shown below:

```
[root@oral ~]# 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 (ora1, ora2, ora3, ora4, ora5, ora6, ora7 and ora8), you have to configure operating system pre-requisites on all the eight nodes to successfully install Oracle RAC Database 12cR2.

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>

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

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

For this solution, we configured the prerequisites automatically by installing the **"oracle**-database-server-12cR2-preinstall" rpm package. The oracle-rdbms-server-12cR2-preinstall RPM packages are accessible through the Oracle Unbreakable Linux Network (ULN, which requires a support contract), from the Oracle Linux distribution media, or from the Oracle public yum repository. You can download the required packages from http://public-yum.oracle.com/oracle-linux-7.html. 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@oral ~]# 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

Create the GRID User

Run the following commands to create the grid user

useradd -u 54322 -g oinstall -G dba grid

Set the User Passwords

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

passwd oracle passwd grid

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

Configure Public, Private and Storage NICs

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

Log in as a root user and go to "/etc/sysconfig/network-scripts". Configure Public, Private and Storage NICs with the appropriate IP addresses across all the Oracle RAC nodes.

Configure "/etc/hosts"

Log in 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:

###Public IP			
10.29.134.221	oral	oral	.cisco.com
10.29.134.222	ora2	ora2	.cisco.com
10.29.134.223	ora3	ora3	.cisco.com
10.29.134.224	ora4	ora4	.cisco.com
10.29.134.225	ora5	ora5	.cisco.com
10.29.134.226	ora6	ora6	.cisco.com
10.29.134.227	ora7	ora7	.cisco.com
10.29.134.228	ora8	ora8	.cisco.com
###Virtual IP			
10.29.134.229	oral-vi	р	oral-vip.cisco.com

```
10.29.134.230 ora2-vip
                          ora2-vip.cisco.com
10.29.134.231
                          ora3-vip.cisco.com
              ora3-vip
10.29.134.232 ora4-vip
                          ora4-vip.cisco.com
10.29.134.233 ora5-vip
                          ora5-vip.cisco.com
10.29.134.234 ora6-vip
                         ora6-vip.cisco.com
10.29.134.235 ora7-vip
                        ora7-vip.cisco.com
10.29.134.236 ora8-vip
                         ora8-vip.cisco.com
###Private IP
                         oral-priv.cisco.com
192.168.10.221 oral-priv
                        ora2-priv.cisco.com
192.168.10.222 ora2-priv
192.168.10.223 ora3-priv
                          ora3-priv.cisco.com
192.168.10.224 ora4-priv ora4-priv.cisco.com
192.168.10.225 ora5-priv ora5-priv.cisco.com
192.168.10.226 ora6-priv ora6-priv.cisco.com
192.168.10.227 ora7-priv ora7-priv.cisco.com
192.168.10.228 ora8-priv ora8-priv.cisco.com
###SCAN IP
10.29.134.237
              ora-scan
                             ora-scan.cisco.com
10.29.134.238
              ora-scan
                             ora-scan.cisco.com
10.29.134.239
              ora-scan
                             ora-scan.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

This completes all the required prerequisites to install Oracle Grid Infrastructure and Database 12cR2 Software. Reboot all the nodes to apply all the changes.

Configure the NFS File System on FlashBlade

To configure NFS File System on FlashBlade, complete the following steps:

- 1. Open a web browser and navigate to the Pure Storage FlashBlade Cluster address.
- 2. Enter the Username and Password for the storage.
- 3. From the Pure Storage Dashboard, go to Storage > File Systems. Click the **"+" sign to Create File Sys**tem.
- 4. Enter Name, Prefix, Size, Protocols NFS Enabled, Export Rules as shown below and click "Create" to create file system.

Edit File System			×
Name	ocr		
Provisioned Size	200	G	•
Special Directories			
Fast Remove	Snapshot		
Protocols			
NFS SMB	НТТР		
Enabled			
Export Rules	*(rw,no_root_squash)		
	Cancel	Sav	е

- 5. You will use the above created OCR File System on FlashBlade to store OCR (Oracle Cluster Registry) files, Voting Disk files, and other Clusterware files.
- 6. Create file systems **"oradata01"**, **"oradata02"**, **"oradata03"** and **"oradata04"** to store data files and control files as well as file system "oraredo" to store log files for the database as shown below.

Dashboard	File Systems Object Store								
Storage	() > File Systems								
Analysis	File Systems								1-7 of 7 🔇 💙
	Name 🔺	Size	Used	% Used	Data Reduction	Physical	Snapshots	Protocols	
	C ocr	200 G	36.90 G	18%	6.9 to 1	5.36 G	0.00	NFS	
	C oradata01	10 T	5.38 T	54%	2.1 to 1	2.53 T	0.00	NFS	
	C oradata02	10 T	5.38 T	54%	2.1 to 1	2.57 T	0.00	NFS	
	— oradata03	10 T	5.40 T	54%	2.1 to 1	2.62 T	0.00	NFS	2
	C oradata04	10 T	5.09 T	51%	2.1 to 1	2.42 T	0.00	NFS	
	C oradata05	10 T	0.00	0%	2	0.00	0.00	NFS	12
	D oraredo	200 G	64.00 G	32%	2.2 to 1	28.47 G	0.00	NFS	
	Destroyed File Systems			0-0 of 0 < >	Destroyed Snapshots				0-0 of 0
	Name 🔺		Ti	me Remaining	Name 🔺				Time Remaining

1h

More information about the File Systems for Database is explained below in the document.

Create NFS Mount Point in /etc/fstab

You have created the following local directories on each Oracle RAC nodes to mount NFS file systems:

```
/nfsocr → OCR, Voting disk, Clusterware Files
/nfsdb/oradata01 → Data files for Database
/nfsdb/oradata02 → Data files for Database
/nfsdb/oradata03 → Data files for Database
/nfsdb/oradata04 → Data files for Database
/nfsdb/oraredo → Log Files for Database
/fiol → FIO Performance Test
/fio2 → FIO Performance Test
/fio3 → FIO Performance Test
/fio4 → FIO Performance Test
```

1. Edit /etc/fstab file in each Oracle RAC node and enter the following entry to configure mount option for all the file systems.

10.29.134.201:/ocr	/nfsocr	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.21.201:/oradata01	/nfsdb/oradata01	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.22.201:/oradata02	/nfsdb/oradata02	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.23.201:/oradata03	/nfsdb/oradata03	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.24.201:/oradata04	/nfsdb/oradata04	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.21.201:/oraredo	/nfsdb/oraredo	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.21.201:/fio1	/fiol	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.22.201:/fio2	/fio2	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.23.201:/fio3	/fio3	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>
192.168.24.201:/fio4	/fio4	nfs	<pre>rw,bg,nointr,hard,tcp,vers=3,actimeo=0</pre>

The Oracle Direct NFS (dNFS) configuration is completed at a later stage.

2. When you complete /etc/fstab edit, mount those **file system using "mount -a" command.** The following is a sample output from mount command on Node 1 (ora1)

[root@oral ~]# mount

. . . 192.168.21.201:/oradata01 on /nfsdb/oradata01 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp,timeo=600,retrans=2,sec=sys,mountaddr=192.168.21.201,mountvers=3,mountport=2049,mountproto=tcp ,local_lock=none,addr=192.168.21.201) 192.168.21.201:/fio1 on /fio1 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp,timeo=600,retrans=2,sec=sys,mountaddr=192.168.21.201,mountvers=3,mountport=2049,mountproto=tcp ,local_lock=none,addr=192.168.21.201) 10.29.134.201:/ocr on /nfsocr type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp, timeo=600, retrans=2, sec=sys, mountaddr=10.29.134.201, mountvers=3, mountport=2049, mountproto=tcp, local_lock=none,addr=10.29.134.201) 192.168.22.201:/oradata02 on /nfsdb/oradata02 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp, timeo=600, retrans=2, sec=sys, mountaddr=192.168.22.201, mountvers=3, mountport=2049, mountproto=tcp ,local_lock=none,addr=192.168.22.201) 192.168.24.201:/oradata04 on /nfsdb/oradata04 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp,timeo=600,retrans=2,sec=sys,mountaddr=192.168.24.201,mountvers=3,mountport=2049,mountproto=tcp ,local_lock=none,addr=192.168.24.201) 192.168.21.201:/oraredo on /nfsdb/oraredo type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp, timeo=600, retrans=2, sec=sys, mountaddr=192.168.21.201, mountvers=3, mountport=2049, mountproto=tcp ,local_lock=none,addr=192.168.21.201) 192.168.23.201:/fio3 on /fio3 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp, timeo=600, retrans=2, sec=sys, mountaddr=192.168.23.201, mountvers=3, mountport=2049, mountproto=tcp ,local_lock=none,addr=192.168.23.201) 192.168.22.201:/fio2 on /fio2 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard ,proto=tcp,timeo=600,retrans=2,sec=sys,mountaddr=192.168.22.201,mountvers=3,mountport=2049,mountproto=tcp ,local_lock=none,addr=192.168.22.201) 192.168.23.201:/oradata03 on /nfsdb/oradata03 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp, timeo=600, retrans=2, sec=sys, mountaddr=192.168.23.201, mountvers=3, mountport=2049, mountproto=tcp ,local_lock=none,addr=192.168.23.201) 192.168.24.201:/fio4 on /fio4 type nfs (rw,relatime,vers=3,rsize=524288,wsize=524288,namlen=255,acregmin=0,acregmax=0,acdirmin=0,acdirmax=0,hard , proto=tcp, timeo=600, retrans=2, sec=sys, mountaddr=192.168.24.201, mountvers=3, mountport=2049, mountproto=tcp ,local_lock=none,addr=192.168.24.201) tmpfs on /run/user/42 type tmpfs (rw,nosuid,nodev,relatime,size=52648888k,mode=700,uid=42,gid=42) tmpfs on /run/user/0 type tmpfs (rw,nosuid,nodev,relatime,size=52648888k,mode=700)

3. Change Permission of the Mount points to Oracle User as shown below

```
[root@oral ~]# chown -R grid:oinstall /nfsocr
[root@oral ~]# chown -R oracle:oinstall /nfsdb/*
```

These NFS file systems were mounted on all 8 nodes with similar mount names on the storage VLANs (21 – 24). Verify that all the file system volumes are mounted as shown below:

[root@oral ~]# df -h /nfsdb/* Filesystem Size Used Avail Use% Mounted on 192.168.21.201:/oradata01 10T 0 10T 0% /nfsdb/oradata01 10T 192.168.22.201:/oradata02 0 10T 0% /nfsdb/oradata02 192.168.23.201:/oradata03 10T 0 10T 0% /nfsdb/oradata03 192.168.24.201:/oradata04 0 10T 0% /nfsdb/oradata04 10T 192.168.21.201:/oraredo 200G 0 200G 0% /nfsdb/oraredo

[root@oral ~]# df -h /nfs*
Filesystem Size Used Avail Use% Mounted on
10.29.134.201:/ocr 200G 38G 163G 19% /nfsocr

By doing this, all the oracle RAC nodes are able to read/write data from/to the file system.

When all the OS level prerequisites and file systems are configured, 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 the Oracle Grid Infrastructure and Database software binaries on all eight nodes (ora1, ora2, ora3, ora4, ora5, ora6, ora7 and ora8) on their respective local disk. Oracle 12c Release 2 Grid Infrastructure (GI) was installed on the first node as grid user. The installation also configured and added the remaining 7 nodes as part of the GI setup. ASM was configured with NFS in the Flex ASM mode.

4

For this solution, we have placed Oracle Clusterware Binaries into local file system. Alternatively, for Oracle 12cR2, you can also use Network File System (NFS) on a certified network-attached storage (NAS) filer. Please check Oracle documentation for supported storage options for Oracle Grid Infrastructure according to your environments. <u>https://docs.oracle.com/en/database/oracle/oracle-database/12.2/cwlin/supported-storage-options-for-oracle-grid-infrastructure.html#GUID-1022FFAD-7441-44BB-807D-C87B2DBCD015</u>.



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.

For detailed information, review the Oracle Database 12c Release 2 Install and Upgrade Guide.

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 have used HugePages for the DSS workloads.

Please refer to the Oracle Support for HugePages Configuration Details.

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/grid
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
```

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.

1. Run script named as "runcluvfy.sh" as follows:

./runcluvfy.sh stage -pre crsinst -n ora1,ora2,ora3,ora4,ora5,ora6,ora7,ora8 -verbose

After configuring this, you are ready to install Oracle Grid Infrastructure and Oracle Database 12c R2 standalone software. For this solution, we installed Oracle binaries on the local disk of the nodes. The OCR, Data, and redo log files reside in the file system configured on FlashBlade.

2. 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 doc-umentation 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@ora1	– 🗆 X
Select Configuration Opt	ion	
	Select an option to configure the software. The wizard will rea	dister the home in the central
Q Configuration Option	inventory and then perform the selected configuration.	
Cluster Configuration	Coofigure Occele Crid Infractructure for a New Cluster	
Operating System Groups	 Configure Oracle Grid Infrastructure for a New <u>Cluster</u> 	
 Installation Location 	○ Configure Oracle Grid Infrastructure for a Standalone Serv	ver (Oracle <u>R</u> estart)
Root script execution	○ <u>U</u> pgrade Oracle Grid Infrastructure	
Prerequisite Checks		
Summary		
↓ ♀ Install Product	○ Set Up Software <u>O</u> nly	
O Finish		
<u>H</u> elp	< <u>B</u> ack	Next > Install Cancel

- 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:

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🛓 Oracle Grid Infrastructure 12c Release 2 Installer - Step 4 of 16@ora1

Cluster Node Information			
Configuration Option Cluster Configuration Grid Plug and Play	and Virtual Hostname. Public Hostname	managed by Oracle Grid Infrastrue Role	Virtual Hostname
Cluster Node Information	oral ora2 ora3	НИВ	oral-vip ora2-vip ora3-vip
 Network Interface Usage Storage Option Grid Infrastructure Managem Create ASM Disk Group ASM Password Operating System Groups 	ora4 ora5 ora6 ora7 ora8	HUB HUB HUB	ora4-vip ora5-vip ora6-vip ora7-vip ora8-vip
 Installation Location Root script execution Prerequisite Checks Summary Install Product Finish 	SSH <u>c</u> onnectivity <u>O</u> S Username: grid User home is shared by th Reuse private and public <u>k</u>	Use Cluster Configuration F OS Password: ne selected nodes eys existing in the user home	
Help		< Back	Test Setup

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.

<u>S</u> .	Oracle Grid Infrastructure 12c Rel	ease 2 Installer - Step 4 of 16@ora1			—	\Box \times
Cli	uster Node Informatior	1				12°
Ť	Configuration Option	Provide the list of nodes to be and Virtual Hostname.	managed by Oracle Grid Infrastru	cture with th	neir Public H	ostname
T	·	Public Hostname	Role	Vi	rtual Hostna	me
Ý	Grid Plug and Play	oral	HUB	oral-vip		
	Cluster Node Information	ora2	НИВ	ora2-vip		
Ť		ora3	HUB	🕶 ora3-vip		
Ŷ	Network Interface Usage	ora4	HUB	🕶 ora4-vip		
ģ	Storage Option	ora5		▼ ora5-vip	-	
4	Grid Infrastructure	e Grid Infrastructure 12c Release 2 Ins	staller@ora1	×		
	Create ASM Disk Gr ASM Password Operating System (Successfully established pathe selected nodes.	asswordless SSH connectivity betv	veen		
	Installation Location Root script executic Prerequisite Checke	<u>vo ocernania.</u> gra		<u></u> K	<u>E</u> dit	Remove
ģ	Summary	User home is shared by th	ne selected nodes			
ģ	Install Product		eys existing in the user home			
5	Finish				Test	: Setu <u>p</u>
•						
	<u>H</u> elp		< <u>B</u> ack _ !	<u>V</u> ext ≻	Install	Cancel

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

<u>Configuration Option</u> Private interfaces are <u>Cluster Configuration</u>	used by Oracle Grid Infrastructure	for internode traffic.	
Grid Plug and Play Interface Nam	e Subnet	Use for	
eno5	10.29.134.0	Public	
Cluster Node Information eno6	192.168.21.0	Do Not Use	
Network Interface Usage eno7	192.168.23. 0	Do Not Use	
eno8	192.168.10.0	ASM & Private	-
Storage Option eno9	192.168.22. 0	Do Not Use	
Grid Infrastructure Managem enol0	192.168.24. 0	Do Not Use	
Create ASM Disk Group	192.168.122. 0	Do Not Use	-
Root script execution Prerequisite Checks Summary Install Product			
Finish			

10. Select the Oracle ASM storage configuration option as "Configure ASM on NFS" as shown below then click "Next."

🛓 Oracle Grid Infrastructure 12c Release 2 Installer - Step 6 of 16@ora1

Storage Option Informati	on GRID INFRASTRUCTURE 12 ^c
Configuration Option Cluster Configuration Grid Plug and Play Cluster Node Information Network Interface Usage Storage Option	Oracle Cluster Registry (OCR) files, voting disk files and other clusterware data will be configured with Oracle ASM. You can choose to configure Oracle ASM on block devices or on a NFS location. O Configure <u>A</u> SM using block devices O <u>Configure ASM on NFS</u>
 Grid Infrastructure Managem Create ASM Disk Group ASM Password Operating System Groups Installation Location Root script execution Prerequisite Checks Summary Install Product Finish 	
 <u>H</u>elp 	< <u>B</u> ack <u>N</u> ext > _install Cancel

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11. In the Specify the NFS Location for ASM disk groups configuration option, select the NFS mount point which we have configured earlier to store OCR and Voting disk files as shown below.

	Oracle Grid Infrastructure 12c Re	lease 2 Installer - Step 7 of 15@ora1 -	\Box \times
Specify NFS locations for ASI		r ASM disk groups	
		GRID INFRASTRUCT	
	Configuration Option	Specify the NFS location where the ASM disks have to be setup.	
点	Cluster Configuration	For <u>O</u> CR: /nfsocr	Brow <u>s</u> e
4	Grid Plug and Play		
4	Cluster Node Information	Do you want to provide a different NFS location for disks to configure GIMR disk go 	roup
4	Network Interface Usage	For <u>G</u> IMR:	Brow <u>s</u> e
4	Storage Option		
•	ASM on NFS		
-	ASM Password		
4	Operating System Groups		
¢	Installation Location		
l Å	Root script execution		
•	Prerequisite Checks		
•	Summary		
¢	Install Product		
6	Finish		
	Help	< <u>B</u> ack <u>N</u> ext > <u>I</u> nstall	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.

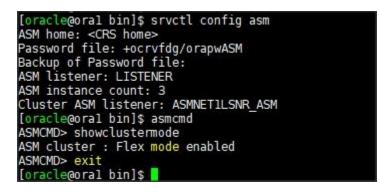
- 16. Click "Automatically run configuration scripts" to run scripts automatically during grid installation and enter the relevant root user credentials. Click Next.
- 17. Wait while the prerequisite checks complete. If you have any issues, use the "Fix & Check Again" button.

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.

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

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	Неір	< Back Next > Instal	Cancel

- 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.



As shown in the screenshot above, ASM was installed in Flex ASM mode with an ASM instance count of 3 out of the 8-node RAC. After your Oracle Grid Infrastructure installation is complete, you can install Oracle Database on a cluster node for high availability.

Install Oracle Database Software

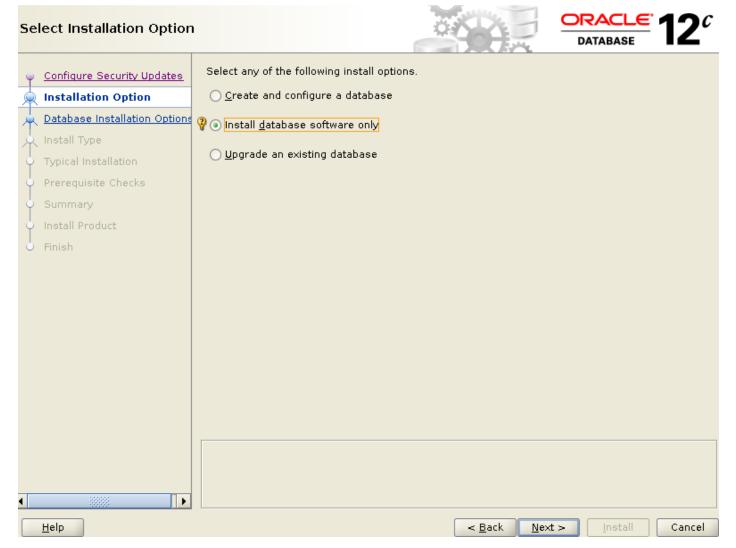
After successful GRID install, we recommend to install Oracle Database 12c software only. You can create databases using DBCA or database creation scripts at later stage.

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 as "oracle" user:

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

🛓 Oracle Database 12c Release 2 Installer - Step 2 of 9@ora1



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

🔬 Oracle Database 12c Release 2 Installer - Step 3 of 9@ora1

Select Database Installat	tion Option ORACLE 12 ^C
<u>Configure Security Updates</u>	Select the type of database installation you want to perform.
A Installation Option	○ <u>S</u> ingle instance database installation
🔎 Database Installation Opt	${f Q}$ ${f \odot}$ Oracle Real Application Clusters database installation
🔶 Install Type	○ Oracle RAC On <u>e</u> Node database installation
 Typical Installation 	
• Prerequisite Checks	
ý Summary	
Install Product	
Ó Finish	
◀	
Help	< <u>B</u> ack <u>N</u> ext > <u>Install</u> Cancel

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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.

<u>H</u>elp

🛓 Oracle Database 12c Release 2 Inst	aller - Step 4 of 10@ora1	– 🗆 X
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 RAC or Oracle RAC One. Node name 1 1 2 0 3 0 4 0 5 0 6 0 7 0 8 0 SSH connectivity	installer should install Oracle

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.

< Back Next > Install Cancel

- 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 and then click Install.

11. When prompted, run the configuration script on each node as root user. When the scripts run successfully on each node, click OK.

👙 Oracle Database 12c Release 2 Ins	taller - Step 11 of 11@ora1	– 🗆 X
Finish		
 Configure Security Updates Installation Option Database Installation Options Nodes Selection Database Edition Installation Location Operating System Groups Prerequisite Checks Summary Install Product 	The installation of Oracle Database was successful.	
♥ Finish	< Back Nex	t > <u>I</u> nstall <u>C</u> lose

12. Click Close to exit the installer.

Now you are ready to run synthetic IO tests against this infrastructure setup. We used fio as primary tools for IO tests.

You will configure Direct NFS as you get into the actual database testing with Swingbench later in this section.

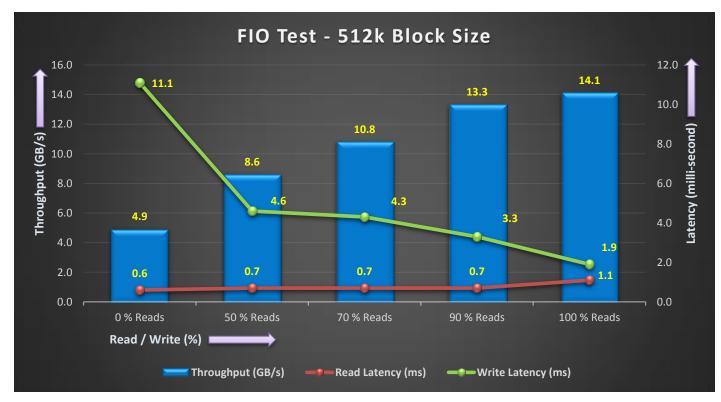
Scalability Test and Results

Before configuring any database for workload tests, it is extremely important to validate that it is indeed a balanced configuration capable of delivering the expected performance. FlashBlade can handle high volumes of data, leveraging massively parallel architecture, and delivers a powerful data warehouse system that is fast, big, and simple. In this FlashStack solution, we will test the scalability and high throughput performance of the FlashBlade for the Oracle Data Warehouse use cases as explained below.

Hardware Calibration Using FIO

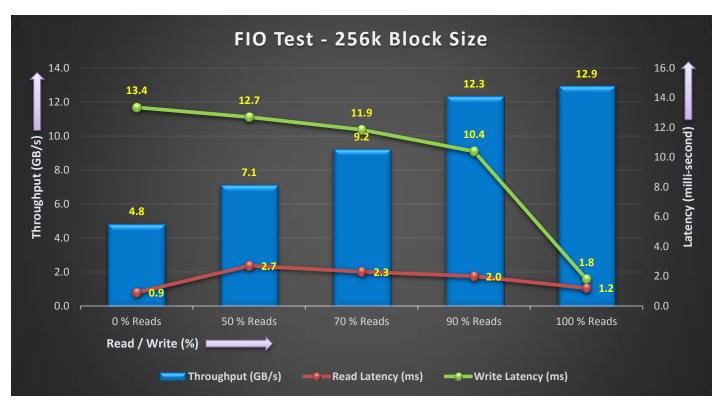
Flexible IO (FIO), a versatile IO workload generator. FIO is a tool that will spawn a number of threads or processes doing a particular type of I/O action as specified by the user. For this solution, we used FIO to measure the performance of a storage device. We run FIO tests by changing Read/Write ratio and recorded the results over a given period.

We ran various Read/Write percentage (100/0, 90/10, 70/30, 50/50 & 0/100) combination and observed the below throughput.



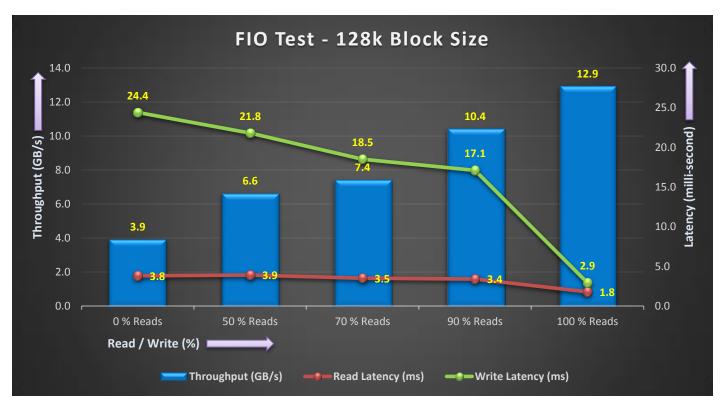
The bandwidth tests are carried out with 512K IO size and represent Data Warehouse workloads. As shown above, the bandwidth scaled linearly as we scale from 0% Read/Write to 100% Read/Write on 8 nodes. With all eight nodes, we could generate about 14.1 GB/sec of sustained bandwidth over 3 hours run period. We did not see any performance dips or degradation over the period of runtime.

Similarly, we scale 256K block size performance test from 0% Read/Write to 100% Read/Write and observed the below results.



As shown above for 256K block size test, the bandwidth scaled linearly as we scale from 0% Read/Write to 100% Read/Write on 8 nodes. With all the eight nodes, we could generate about 12.9 GB/sec of sustained bandwidth over 3 hours run period. We did not see any performance dips or degradation over the period of runtime. The write latency was improving as we go from 100% write to 0% write.

Similarly, we scale 128K block size performance test from 0% Read/Write to 100% Read/Write and observed the below results.



As shown above for 128K block size test, the bandwidth scaled linearly as we scale from 0% Read/Write to 100% Read/Write on 8 nodes. With all the eight nodes, we could generate about 12.9 GB/sec of sustained bandwidth over 3 hours run period. We did not see any performance dips or degradation over the period of runtime. The write latency was improving as we go from 100% write to 0% write.

It is also important to note that this is not a benchmarking exercise and the numbers presented are not the peak numbers where there is hardware resource saturation. At this time, we are ready to create DSS database and continue with database performance tests.

Database Creation with DBCA

We used Oracle Database Configuration Assistant (DBCA) to create One DSS (Decision Support System) database to demonstrate the high-bandwidth, high throughput data warehouse type workload laid out in this solution.

The database related files (data files, redo logs, control files) were placed on FlashBlade NFS volumes as listed below. These NFS file systems were mounted on all 8 nodes with similar mount names on the storage VLANs (21 – 24) as previously explained.

Database	NFS Volume Name	Size	Description
DSSDB	oradata01	10 TB	Data and Control files for DSS Database
	oradata02	10 TB	Data and Control files for DSS Database
	oradata03	10 TB	Data and Control files for DSS Database

Table 10	NFS Description
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Database	NFS Volume Name	Size	Description
	oradata04	10 TB	Data and Control files for DSS Database
	oraredo	200 GB	Redo Log Files for DSS Database
	ocr	200 GB	Oracle Cluster Registry (OCR) Files, Voting Disk Files and Other Clusterware Files

Oracle dNFS Configuration

We recommend configuring Oracle Database to access NFS V3 servers directly using an Oracle internal Direct NFS client instead of using the operating system kernel NFS client.

To enable Oracle Database to use Direct NFS Client, the NFS file systems must be mounted and available over regular NFS mounts before you start installation. Direct NFS Client manages settings after installation. If Oracle Database cannot open an NFS server using Direct NFS Client, then Oracle Database uses the platform operating system kernel NFS client. You should still set the kernel mount options as a backup, but for normal operation, Direct NFS Client uses its own NFS client.

Direct NFS Client supports up to four network paths to the NFS server. Direct NFS Client performs load balancing across all specified paths. If a specified path fails, then Direct NFS Client reissues I/O commands over any remaining paths.

About the oranfstab File and Direct NFS Client

If you use Direct NFS Client, then you can use a new file specific for Oracle data file management, oranfstab, to specify additional options specific for Oracle Database to Direct NFS Client. For example, you can use oranfstab to specify additional paths for a mount point. You can add the oranfstab file either to /etc or to \$ORACLE_HOME/dbs.

With shared Oracle homes, when the oranfstab file is placed in \$ORACLE_HOME/dbs, the entries in the file are specific to a single database. In this case, all nodes running an Oracle RAC database use the same \$ORACLE_HOME/dbs/oranfstab file. In non-shared Oracle RAC installs, oranfstab must be replicated on all nodes. The oranfstab configuration in \$ORACLE_HOME/dbs is local to the database under \$ORACLE_HOME, whereas the oranfstab in /etc/oranfstab applies to all Oracle databases on that server.

When the oranfstab file is placed in /etc, then it is globally available to all Oracle databases, and can contain mount points used by all Oracle databases running on nodes in the cluster, including standalone databases. However, on Oracle RAC systems, if the oranfstab file is placed in /etc, then you must replicate the file /etc/oranfstab file on all nodes, and keep each /etc/oranfstab file synchronized on all nodes, just as you must with the /etc/fstab file.



In all cases, mount points must be mounted by the kernel NFS system, even when they are being served using Direct NFS Client. Refer to your vendor documentation to complete operating system NFS configuration and mounting. Please refer Oracle document for more information: <u>https://docs.oracle.com/database/121/CWLIN/storage.htm#CWLIN270</u>

Direct NFS Client searches for mount entries in the following order.

- 1. \$ORACLE_HOME/dbs/oranfstab
- 2. /etc/oranfstab
- 3. /etc/mtab

If a volume is not listed in oranfstab, Oracle will look through the OS mount tab (/etc/mtab) to find a match. If that fails, control is handed back to the database and file access is made through Kernel NFS.

Typical syntax for the oranfstab is:

```
server: MyDataServer1
local: 192.0.2.0
path: 192.0.2.1
local: 192.0.100.0
path: 192.0.100.1
export: /vol/oradata1 mount: /mnt/oradata1
```

Oracle dNFS was enabled at the RDBMS level on all the database nodes, and the oranfstab was updated to reflect the same across all nodes.

The following is a sample oranfstab configuration from Oracle RAC Node 1:

[oracle@oral ~]\$ cat \$ORACLE_HOME/dbs/oranfstab

```
Server: FlashBlade

path: 192.168.21.201

path: 192.168.22.201

path: 192.168.23.201

path: 192.168.24.201

nfs_version: nfsv3

export: /oradata01 mount: /nfsdb/oradata01

export: /oradata02 mount: /nfsdb/oradata02

export: /oradata03 mount: /nfsdb/oradata03

export: /oradata04 mount: /nfsdb/oradata04

export: /oraredo mount: /nfsdb/oraredo
```

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When oranfstab file is created on all nodes, you need to enable the direct NFS client ODM library on all nodes. Please shutdown the databases before this step. You can perform this as shown below:

```
[oracle@oral dbs]$ cd $ORACLE_HOME/rdbms/lib
```

```
[oracle@oral lib]$ make -f ins_rdbms.mk dnfs_on
rm -f /u01/app/oracle/product/12.2.0/dbhome_1/rdbms/lib/odm/libnfsodm12.so; \
    cp /u01/app/oracle/product/12.2.0/dbhome_1/lib/libnfsodm12.so
/u01/app/oracle/product/12.2.0/dbhome_1/rdbms/lib/odm/libnfsodm12.so
```

This completes dNFS setup.

Oracle dNFS is by default enabled on Oracle 12c. To disable dNFS, the RDBMS should be rebuilt with the dnfs_off option. Please check the Best Practices section for enabling/disabling Oracle dNFS.

Verify if Oracle dNFS is enabled at the database level and working as expected. Run a SQL query against v\$dnfs_servers that should show the details of the dNFS mounts as shown below

SVRNAME	DIRNAME	MNTPORT	NESPORT	WTMAX	RTMAX NESVERSION
192.168.21.201	/oradata01	2049	2049	524288	524288 NFSv3.0
192.168.21.201	/oraredo	2049	2049	524288	524288 NFSv3.0
192.168.22.201	/oradata02	2049	2049	524288	524288 NFSv3.0
192.168.23.201	/oradata03	2049	2049	524288	524288 NFSv3.0
192.168.24.201	/oradata04	2049	2049	524288	524288 NFSv3.0

SwingBench Performance on FlashBlade

The first step after creating the databases is calibrating the concurrent users, nodes, OS and database optimization. We have used Swingbench tool to validate the data-warehouse type workload on an eight node Oracle RAC as explained below.

Database Workload Configuration

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 Sales History benchmark was used for the DSS workload testing.

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. The benchmark illustrates decision support systems that examine large volumes of data and execute queries with a high degree of complexity.

Swingbench SH wizard was used for the database schema creation and to load into the database data files. We have configured nearly around 8 TB of DSS database by loading Swingbench SH schema into Data Files of the Tablespace as shown below.

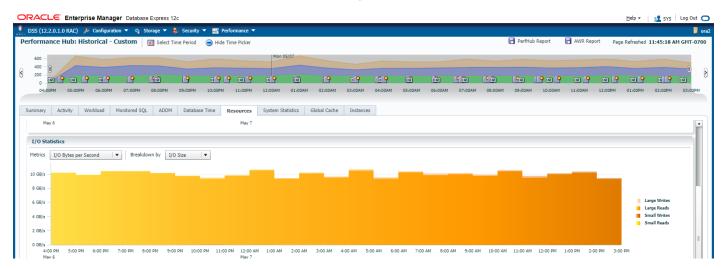
Table Name	Rows	Blocks	Size	Compressed?	Partitioned?
SALES	94,264,057,600	735,127,727	5.0TB		Yes
CUSTOMERS	10,406,809,600	269,056,124	2.0TB	i i	Yes
SUPPLEMENTARY DEMOGRAPHICS	9,556,377,600	100,592,502	767.6GB		Yes
TIMES	7,305	66	576KB	Disabled	No
PROMOTIONS	503	13	128KB	Disabled	No
COUNTRIES	23	5	64KB	Disabled	No
CHANNELS	5	5	64KB	Disabled	No
PRODUCTS	72	5	64KB	Disabled	No

Database Performance

The data warehouse 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. 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 for 24 hours run to validate sustained configuration.

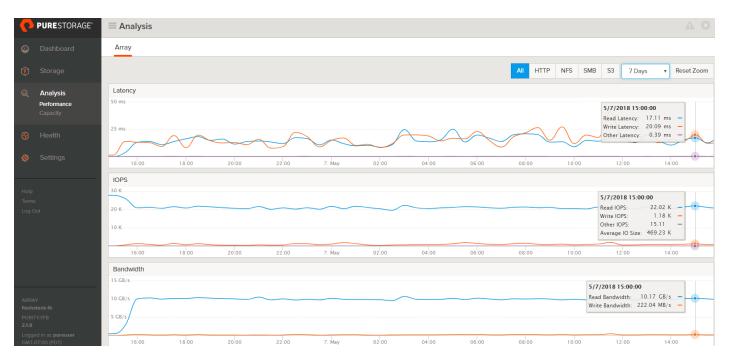
We have captured DSS Database activity for all the eight Oracle RAC Instances using Oracle Enterprise Manager as well as Pure Storage GUI.

For this test, we ran Swingbench Sales history workload with 64 users. The charts below show DSS workload results captured from Oracle Enterprise Manager for the 24-hour workload test.

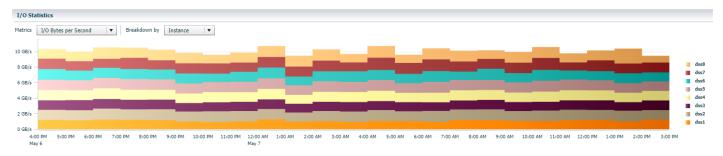


As shown above, for 24 hours DSS workload test, we observed the total IO bandwidth ranging between 10.2 GB/s to 10.8 GB/s.

The below screenshot shows Pure Storage FlashBlade GUI for the same 24 hour DSS workload Test. We also observed Read and Write Latency was under 20 milliseconds throughout the test run.



As indicated on the chart below, the I/O was evenly distributed across all the eight Oracle RAC nodes and we did not observe any significant dips in performance and IO bandwidth for a sustained period.



The screenshot shown below shows the CPU Utilization, Active Sessions and IO Throughput for each Oracle RAC Instance while Swingbench test was running. The servers CPU utilization averaged around 35% for the 24-hour run and we did not observe any queueing or bandwidth saturation for the Network interfaces also.

Top Instances									
Top 100 By CPU V Instance Home & Memory Instance Name									
Instance Name	Instance ID	Host Name	Instance Up Time	Host CPU 🔻	Active Sessions	Memory	IO Requests	IO Throughput	
dss6	6	ora6	1 day, 22 hours, 37 minutes, 5 seconds	36.04%	50.85	66GB	1,450.48	1.27GB	
dss2	2	ora2	1 day, 22 hours, 37 minutes, 4 seconds	33.13%	54.75	66GB	1,483.59	1.33GB	
dss3	3	ora3	1 day, 22 hours, 37 minutes, 3 seconds	31.92%	52.29	66GB	1,333.87	1.19GB	
dss5	5	ora5	1 day, 22 hours, 37 minutes, 4 seconds	32.3%	52.69	66GB	1,495.61	1.32GB	
dss4	4	ora4	1 day, 22 hours, 37 minutes, 14 seconds	31.29%	57.03	66GB	1,458.59	1.28GB	
dss1	1	oral	1 day, 22 hours, 37 minutes, 3 seconds	29.45%	45.18	66GB	1,304.22	1.11GB	
dss8	8	ora8	1 day, 22 hours, 37 minutes, 4 seconds	32.24%	50.5	66GB	1,711.35	1.32GB	
dss7	7	ora7	1 day, 22 hours, 37 minutes, 3 seconds	30.43%	46.35	66GB	1,512.77	1.32GB	

The screenshot shown below shows the System Statistics of Physical IO Bytes Per Second throughout 24-hour test run.

System	Statistics	
Statistic	Physical I/O Bytes May 7 5:00 AM	
12 G/s -	physical read total bytes: 11.12 G/s	
10 G/s -		
8 G/s -		
6 G/s -		physical write to physical read to
4 G/s —		physical write b physical read by
2 G/s		
0 G/s -		
May	DPM 5:00 PM 6:00 PM 5:00 PM 5:00 PM 5:00 PM 10:00 PM 10:00 PM 10:00 AM 2:00 AM 2:00 AM 3:00 AM 4:00 AM 5:00 AM 5:00 AM 5:00 AM 5:00 AM 5:00 AM 10:00 AM 10:00 AM 11:00 AM 12:00 PM 10:00 PM 2:00 PM 3:00 PM	

Node Scalability

This test shows the scalability aspect of this FlashStack solution and the scale-out functionality that makes it very simple to add and gain performance as needed for each physical server node.

For these tests, we ran the Swingbench workload on one, two, four, six, and eight Oracle RAC Nodes.

The screenshot shown below shows Latency and Throughput of the DSS Database during Swingbench workload test running on two Oracle RAC Nodes. We recorded average 2.92 GB/s Bandwidth during the test with read and write latency always under three milliseconds.



The screenshot shown below shows Latency and Throughput of the DSS Database during Swingbench workload test running on four Oracle RAC Nodes. We recorded average 6.24 GB/s Bandwidth during the test.



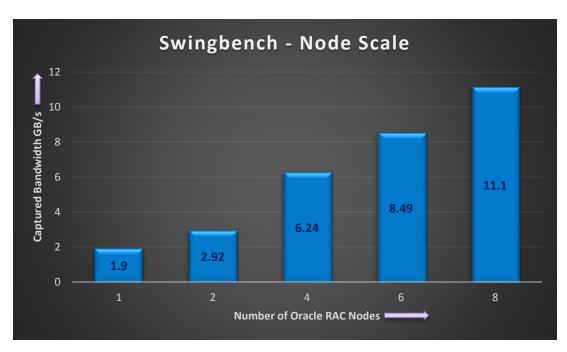
The screenshot shown below shows Latency and Throughput of the DSS Database during Swingbench workload test running on six Oracle RAC Nodes. We recorded average 8.49 GB/s Bandwidth during the test.



The screenshot shown below shows Latency and Throughput of the DSS Database during Swingbench workload test running on eight Oracle RAC Nodes. We recorded average 11.1 GB/s Bandwidth during the test.



We recorded the below throughput for 1 node to 8 node Oracle RAC node Scale test.



The results show a close-to-perfect linear scalability from one Oracle RAC node to eight Oracle RAC nodes. As the response time includes Oracle's end-to-end time, the throughput numbers don't reflect the maximum achievable throughput on FlashBlade.

Oracle also equally distributed the parallel queries across the 8 RAC nodes, which helped in extracting high performance across all the infrastructure components through which I/O passes between hosts and storage (I/O modules, Fabric Interconnects, 9K switches).

This test also validates FlashBlade's simplicity approach to scale out and gain performance.

Data Reduction on FlashBlade

The screenshot below shows the data reduction rate we achieved for this entire performance test.

	≡ Storage								
Dashboard	File Systems Object Store								
Storage	File Systems								
Analysis	File Systems								1-10 of 10
	Name 🛦	Size	Used	% Used	Data Reduction	Physical	Snapshots	Protocols	
	D fiot	5 T	98.03 G	2%	2.7 to 1	36.13 G	0.00	NFS	
	D fio2	5 T	97.66 G	2%	2.7 to 1	36.12 G	0.00	NFS	
	D fio3	5 T	4.86 G	0%	>100 to 1	4.21 M	0.00	NFS	
	D fio4	5 T	97.66 G	2%	2.7 to 1	36.11 G	0.00	NFS	
	D ocr	200 G	37.78 G	19%	6.0 to 1	6.35 G	0.00	NFS	
	C oradata01	10 T	5.38 T	54%	2.1 to 1	2.53 T	0.00	NFS	
	C oradata02	10 T	5.38 T	54%	2.1 to 1	2.57 T	0.00	NFS	
	C oradata03	10 T	5.40 T	54%	2.1 to 1	2.62 T	0.00	NFS	
	oradata04	10 T	5.09 T	51%	2.1 to 1	2.42 T	0.00	NFS	
	D oraredo	200 G	64.00 G	32%	3.4 to 1	18.81 G	0.00	NFS	
2.1.8 Logged in as pureuser	Destroyed File Systems			0-0 of 0 < >	Destroyed Snapshots				0-0
	Name 🔺		ті	me Remaining	Name 🛦				Time Rem

For this solution, we achieved an average 2:1 data reduction rate throughout all the time.

Actual data reduction may vary based on use case.

Best Practice for Oracle Database on FlashBlade

NFS File System for Oracle

Networked file systems provide the flexibility to mount the same file system across multiple hosts, which meets the shared storage requirement for Oracle RAC. NFS file systems can certainly be used for single instances as well. Make sure the NFS protocol is selected when creating the file system on FlashBlade.

Use dNFS over Kernel NFS

To scale up bandwidth on FlashBlade, enable numerous connections from the client rather than a single **connection.** Oracle's Direct NFS creates a separate connection to the storage system for every server process, as opposed to a single connection per mount point via Kernel NFS.

Enable Parallelism

To increase read and write bandwidth on FlashBlade, use client level parallelization techniques like parallel queries and multiple RMAN channels based on the CPU availability of your host in conjunction with dNFS. This increases the number of connections to FlashBlade, especially with dNFS.

Use Multiple Network Interface

To enhance network bandwidth, be sure to have multiple network interfaces on the client. These multiple interfaces can be configure on a single subnet or on multiple subnets.

Multiple Subnets

Direct NFS client best practices recommend always using multipath in separate subnets. Below is the screenshot for one of the node routing table.

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
0.0.0.0	10.29.134.1	0.0.0	UG	100	Θ	Θ	eno5
10.29.134.0	0.0.0.0	255.255.255.0	U	Θ	Θ	Θ	eno5
10.29.134.0	0.0.0.0	255.255.255.0	U	100	Θ	Θ	eno5
69.254.0.0	0.0.0.0	255.255.0.0	U	0	Θ	Θ	eno8
192.168.10.0	0.0.0.0	255.255.255.0	U	100	Θ	Θ	eno8
192.168.21.0	0.0.0.0	255.255.255.0	U	100	Θ	Θ	eno6
192.168.22.0	0.0.0.0	255.255.255.0	U	100	Θ	Θ	eno9
192.168.23.0	0.0.0.0	255.255.255.0	U	100	Θ	Θ	eno7
92.168.24.0	0.0.0.0	255.255.255.0	U	100	Θ	Θ	eno10
192.168.122.0	0.0.0.0	255.255.255.0	U	Θ	Θ	Θ	virbre

In this case, these are four storage dynamic routes and, based on the traffic, the route is selected automatically. As such, if you decide to use multiple subnets, they should be configured on both the client and the FlashBlade sides. Multiple subnets can be configured in the FlashBlade GUI under Network Settings as explained earlier in the storage configuration section.



Oracle recommends using a separate subnet for each, and it supports up to four subnets. With multiple subnets, there is no need to bond the network interfaces to aggregate bandwidth across the available interfaces. The routing will be automatic in the case of multiple subnets.



Be sure to update the oranfstab with the subnets and the mount point details. In an RAC environment, all RAC nodes should have the appropriate oranfstab file configured.

NFS Volumes and Mount Point Requirements

It is not required to have as many NFS filesystems/volumes as subnets for dNFS to be effective. Also, it is not required to mount a single volume on to all subnets for dNFS to be effective either. Oracle dNFS reads the oranfstab and, based on the storage paths and mount details, it will create multiple paths when the database files are accessed. For example, with two subnets and two mounts, dNFS would create four paths to the storage system for every server process.

Linux Mount Options

For mounting the NFS filesystem on Linux, use the following mount options. Do not specify the rsize, wsize options as the system can get the default offered by FlashBlade, which is 524288.

rw, bg, nointr, hard, tcp, vers=3, noac, actimeo=0

Enabling and Disabling Direct NFS Client

To enable the Direct NFS Client, the standard Oracle Disk Manager (ODM) library that supports Direct NFS Client should be used. It can be enabled as follows (beginning with Oracle 11.2).

cd \$ORACLE _ HOME/rdbms/lib

```
make -f ins _ rdbms.mk dnfs _ on
```

To disable the Direct NFS Client, perform the following:

cd \$ORACLE _ HOME/rdbms/lib
make -f ins _ rdbms.mk dnfs _ off

Verifying the Use of Direct NFS Client

If dNFS is enabled, the alert.log will show the following entry when the database is started:

Oracle instance running with ODM: Oracle Direct NFS ODM Library Version 4.0

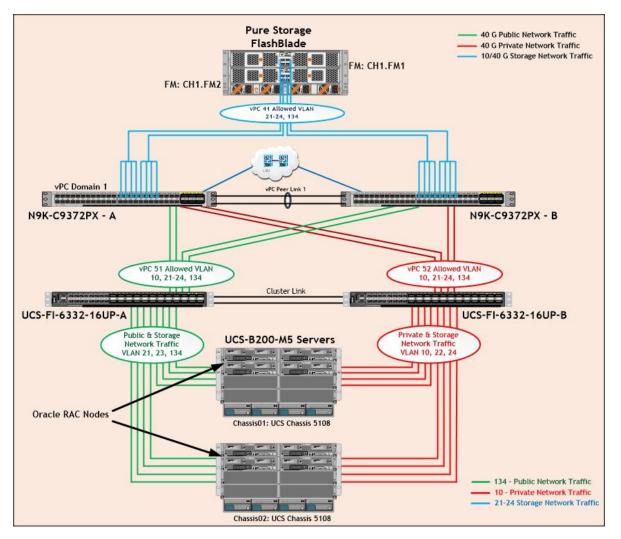
Check the dNFS server information from v\$dnfs_servers view.

SVRNAME	DIRNAME	MNTPORT	NFSPORT	WTMAX	RTMAX	NFSVERSION
192.168.21.201	/oradata01	2049	2049	524288	524288	NFSv3.0
192.168.21.201	/oraredo	2049	2049	524288	524288	NFSv3.0
192.168.22.201	/oradata02	2049	2049	524288	524288	NFSv3.0
192.168.23.201	/oradata03	2049	2049	524288	524288	NFSv3.0
192.168.24.201	/oradata04	2049	2049	524288	524288	NFSv3.0

Resiliency and Failure Tests

The goal of these tests is to help ensure that the reference architecture withstands commonly occurring failures due to either unexpected crashes, hardware failures, or human errors. We conducted 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 demonstrated unique failover capabilities of Cisco UCS components.

Below is the architecture diagram for this FlashStack solution 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 switches. Two virtual Port-Channels (vPCs) are configured to provide public network, private network and storage 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 (VLAN 134) and Storage Network (VLAN 21 & 23) traffic shown as green lines.
- Fabric Interconnect B links are used for Oracle Private Interconnect Network (VLAN 10) and Storage Network (VLAN 22 & 24) traffic shown as red lines. Storage Network Traffic from both the Nexus Switch to FlashBlade is shown as blue lines.

The screenshots below show the complete infrastructure details of VLAN and MAC address details for Cisco UCS Fabric Interconnect – A and Fabric Interconnect – B switches under normal working condition.

1. 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.

ORARAC-)	<-FI-A(nxos)# <-FI-A(nxos)# <mark>show</mark> ma	ac address	-table	9
Legend:	* primary optry	Gotowo	MAC	(P) Pouted MAC 0 Overlay MAC
				(R) - Routed MAC, O - Overlay MAC rimary entry using vPC Peer-Link
VLAN	MAC Address	Туре	age	Secure NTFY Ports/SWID.SSID.LID
	-+	++		+++
* 134	000c.29c4.dfa9	dynamic	Θ	F F Veth2813
* 134	000c.29el.d592	dýnamic	Θ	F F Veth2813
* 134	0025.b5f9.aa00	static	Θ	F F Veth2789
* 134	0025.b5f9.aa03	static	Θ	F F Veth2777
* 134	0025.b5f9.aa06	static	Θ	F F Veth2801
* 134	0025.b5f9.aa09	static	Θ	F F Veth2727
* 134	0025.b5f9.aa0c	static	Θ	F F Veth2739
* 134	0025.b5f9.aa0f	static	Θ	F F Veth2715
* 134	0025.b5f9.aa12	static	Θ	F F Veth2751
* 134	0025.b5f9.aa15	static	Θ	F F Veth2763
* 134	0025.b5f9.aa18	static	Θ	F F Veth2813
* 23	0025.b5f9.aa02	static	Θ	F F Veth2793
* 23	0025.b5f9.aa05	static	Θ	F F Veth2781
* 23	0025.b5f9.aa08	static	Θ	F F Veth2805
* 23	0025.b5f9.aa0b	static	Θ	F F Veth2731
* 23	0025.b5f9.aa0e	static	Θ	F F Veth2743
* 23	0025.b5f9.aa11	static	Θ	F F Veth2719
* 23	0025.b5f9.aa14	static	Θ	F F Veth2755
* 23	0025.b5f9.aa17	static	Θ	F F Veth2767
* 21	0025.b5f9.aa01	static	Θ	F F Veth2791
* 21	0025.b5f9.aa04	static	Θ	F F Veth2779
* 21	0025.b5f9.aa07	static	Θ	F F Veth2803
* 21	0025.b5f9.aa0a	static	Θ	F F Veth2729
* 21	0025.b5f9.aa0d	static	Θ	F F Veth2741
* 21	0025.b5f9.aa10	static	Θ	F F Veth2717
* 21	0025.b5f9.aa13	static	Θ	F F Veth2753
* 21	0025.b5f9.aa16	static	Θ	F F Veth2765

As shown in the above screenshot, Fabric Interconnect – A carry Oracle Public Network Traffic on VLAN 134 and Storage Network Traffic on VLAN 21 & 23 under normal operating conditions before failover test.

2. Log into Cisco Fabric Interconnect – B and "connect nxos b" then type "show mac address-table" to see all VLAN connection on Fabric Interconnect – B.

	K-FI-B(nxos)# K-FI-B(nxos)# <mark>show</mark> ma	ac address	-table	
Legenu.	* - primary entry,	G - Gatewa	y MAC,	(R) - Routed MAC, 0 - Overlay MAC
10 41				rimary entry using vPC Peer-Link
VLAN	MAC Address	Туре	age	Secure NTFY Ports/SWID.SSID.LID
* 24	0025.b5f9.bb02	static	Θ	F F Veth2799
* 24	0025.b5f9.bb05	static	Θ	F F Veth2787
* 24	0025.b5f9.bb08	static	Θ	F F Veth2811
* 24	0025.b5f9.bb0b	static	Θ	F F Veth2737
* 24	0025.b5f9.bb0e	static	Θ	F F Veth2749
* 24	0025.b5f9.bb11	static	Θ	F F Veth2725
* 24	0025.b5f9.bb14	static	Θ	F F Veth2761
* 24	0025.b5f9.bb17	static	Θ	F F Veth2773
* 22	0025.b5f9.bb01	static	Θ	F F Veth2797
* 22	0025.b5f9.bb04	static	Θ	F F Veth2785
* 22	0025.b5f9.bb07	static	Θ	F F Veth2809
* 22	0025.b5f9.bb0a	static	Θ	F F Veth2735
* 22	0025.b5f9.bb0d	static	Θ	F F Veth2747
* 22	0025.b5f9.bb10	static	Θ	F F Veth2723
* 22	0025.b5f9.bb13	static	Θ	F F Veth2759
* 22	0025.b5f9.bb16	static	Θ	F F Veth2771
* 10	0025.b5f9.bb00	static	Θ	F F Veth2795
* 10	0025.b5f9.bb03	static	Θ	F F Veth2783
* 10	0025.b5f9.bb06	static	Θ	F F Veth2807
* 10	0025.b5f9.bb09	static	Θ	F F Veth2733
* 10	0025.b5f9.bb0c	static	Θ	F F Veth2745
* 10	0025.b5f9.bb0f	static	Θ	F F Veth2721
* 10	0025.b5f9.bb12	static	Θ	F F Veth2757
* 10	0025.b5f9.bb15	static	Θ	F F Veth2769
* 10	0025.b5f9.bb18	static	Θ	F F Veth2815

As shown in the above screenshot, Fabric Interconnect – B carry Oracle Private Network Traffic on VLAN 10 and Storage Network Traffic on VLAN 22 & 24 under normal operating conditions before failover test.

We have highlighted some of the common failure scenario in the architecture diagram as shown below. We will describe only a few test scenario performed and observe the results as explained below.

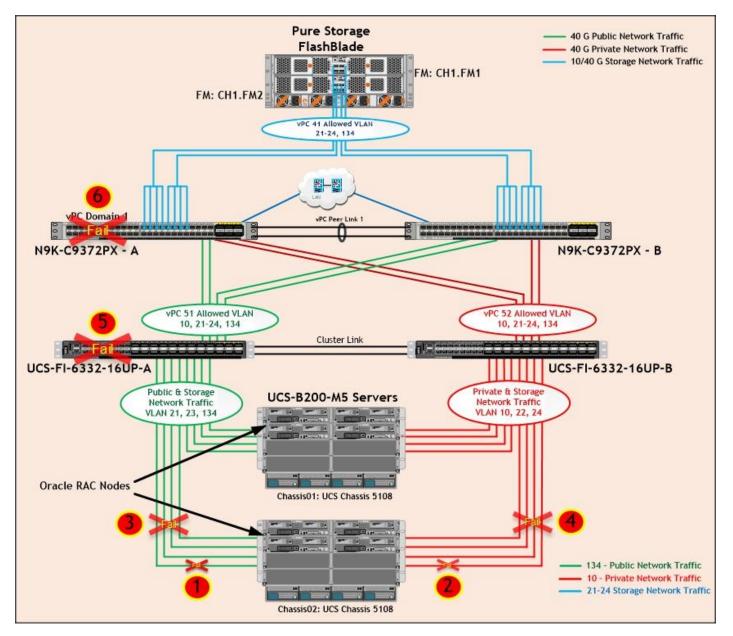


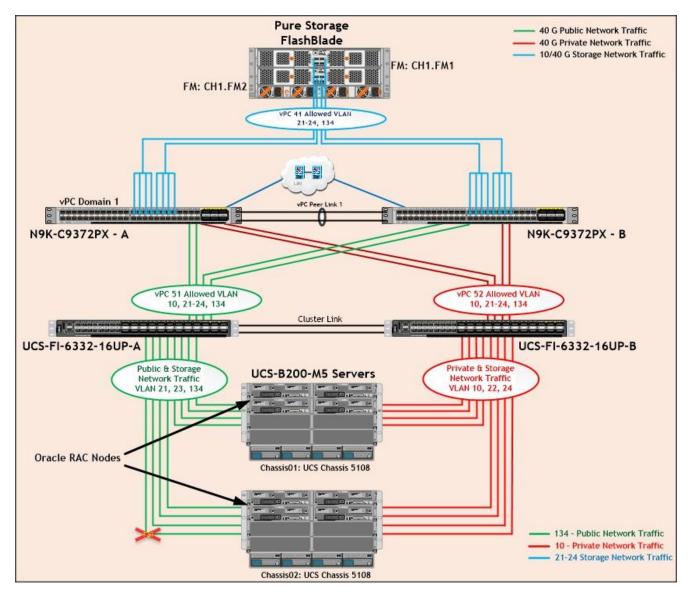
Table 11	Hardware	Failover	Tests
101010 11	i i di l'i di l'i di l'		

Test	Scenario	Description	Verified Result
1	Single Link Failure (Public or Storage Interface on FI-A Side)	Disconnect any one links going to FI-A from Chassis 2 IOM by pulling it out.	No disruption in Public or Storage Interface traffic because of Port- Channel benefit.
2	Single Link Failure (Private or Storage Interface on FI-B Side)	Disconnect any one links going to FI-B from Chassis 2 IOM by pulling it out.	No disruption in Public or Storage Interface traffic because of Port- Channel benefit.
3	All Links Failure (Public or Storage Interface on	Disconnect all the links going to FI-A from Chassis 2 IOM by pulling it out.	No disruption in network traffic. All nodes should continue work via

Test	Scenario	Description	Verified Result
	FI-A Side)		failover path through another FI Switch.
4	All Links Failure (Private or Storage Interface on FI-B Side)	Disconnect all the links going to FI-B from Chassis 2 IOM by pulling it out.	
5	Any one Fabric Interconnect Failure	Power Off Fabric Interconnect – A and check the network traffic on Fabric Interconnect – B.	
6	Any one Nexus Switch Failure	Power Off Nexus Switch – A and check the network traffic on Nexus Switch – B.	No disruption in Network Interface Traffic. All nodes should continue work (vPC)

Test Scenario 1 – Chassis IOM Single Link Failure (Public or Storage Interface on FI-A Side)

We conducted a Chassis IOM single Link Failure test by disconnecting anyone of the server port cable going to FI-A from the Chassis as shown below.

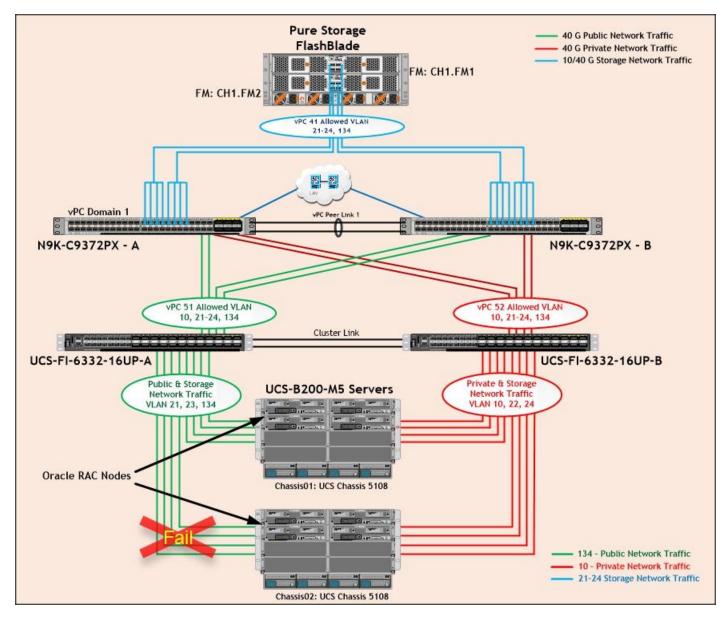


Unplug anyone of the server port cables from chassis 2 going to FI-A, then check the MAC address and VLAN traffic information on both UCS Fabric Interconnects. We noticed no disruption in public, private and storage network traffic after one chassis link failed because of the port-channel feature.

We conducted Test Scenario 2 (Chassis IOM Single Link Failure on FI-B Side) and observed expected results.

Test Scenario 3 - Chassis IOM All Links Failure (Public or Storage Interface on FI-A Side)

We conducted a Chassis IOM all links failure test by disconnecting all of the server port cable going to FI-A from the Chassis as shown below.



As shown above, unplug all the server port cables from chassis 2 going to FI-A, then check the MAC address and VLAN traffic information on both UCS Fabric Interconnects.

The screenshot below shows MAC Address information from FI-A.

	 primary entry, age - seconds since 	G - Gatewa last seen	y MAC,	(R) - Rou imary ent	ted rv u	MAC, O - Overlay MAC
VLAN	MAC Address	Туре	age	Secure	NTF	Y Ports/SWID.SSID.LID
134	-+ 000c.29c4.dfa9	++ dynamic	0	+ F	+ F	-+ Veth2813
134	0025.b5f9.aa00	static	õ	F	F	Veth2789
134	0025.b5f9.aa03	static	Θ	F	F	Veth2777
134	0025.b5f9.aa06	static	Θ	F	F	Veth2801
134	0025.b5f9.aa09	static	Θ	F	F	Veth2727
134	0025.b5f9.aa18	static	Θ	F	F	Veth2813
23	0025.b5f9.aa02	static	Θ	F	F	Veth2793
23	0025.b5f9.aa05	static	Θ	F	F	Veth2781
23	0025.b5f9.aa08	static	Θ	F	F	Veth2805
23	0025.b5f9.aa0b	static	Θ	F	F	Veth2731
21	0025.b5f9.aa01	static	Θ	F	F	Veth2791
21	0025.b5f9.aa04	static	Θ	F	F	Veth2779
21	0025.b5f9.aa07	static	Θ	F	F	Veth2803
21	0025.b5f9.aa0a	static	Θ	F	F	Veth2729

The screenshot below shows MAC Address information from FI-B.

VLAN	MAC Address	Type	age	Secure	NIE	Y Ports/
104	-+	++		-+	+	-+
134 134	0025.b5f9.aa0c 0025.b5f9.aa0f	static	0 0	F	F	Veth2740
		static		F	F	Veth2716
134 134	0025.b5f9.aa12	static	Θ	F	F	Veth2752
	0025.b5f9.aa15	static	0	F	F	Veth2764
24	0025.b5f9.bb02	static	0	F	F	Veth2799
24	0025.b5f9.bb05	static	0	E.		Veth2787
24	0025.b5f9.bb08	static	Θ	E	F	Veth2811
24	0025.b5f9.bb0b	static	Θ	F	F	Veth2737
24	0025.b5f9.bb0e	static	0	F	F	Veth2749
24	0025.b5f9.bb11	static	0	F	F	Veth2725
24	0025.b5f9.bb14	static	0	F	F	Veth2761
24	0025.b5f9.bb17	static	0	F	F	Veth2773
23	0025.b5f9.aa0e	static	Θ	Ę	F	Veth2744
23	0025.b5f9.aa11	static	0	E	F	Veth2720
23	0025.b5f9.aa14	static	Θ	F	F	Veth2756
23	0025.b5f9.aa17	static	0	F	F	Veth2768
22	0025.b5f9.bb01	static	Θ	F	F	Veth2797
22	0025.b5f9.bb04	static	Θ	F	F	Veth2785
22	0025.b5f9.bb07	static	Θ	F	F	Veth2809
22	0025.b5f9.bb0a	static	Θ	F	F	Veth2735
22	0025.b5f9.bb0d	static	Θ	F	F	Veth2747
22	0025.b5f9.bb10	static	Θ	F	F	Veth2723
22	0025.b5f9.bb13	static	Θ	F	F	Veth2759
22	0025.b5f9.bb16	static	0	F	F	Veth2771
21	0025.b5f9.aa0d	static	Θ	F	F	Veth2742
21	0025.b5f9.aa10	static	0	E	F	Veth2718
21	0025.b5f9.aa13	static	Θ	E	F	Veth2754
21	0025.b5f9.aa16	static	0	F	F	Veth2766
10	0025.b5f9.bb00	static	Θ	F	F	Veth2795
10	0025.b5f9.bb03	static	Θ	F	F	Veth2783
10	0025.b5f9.bb06	static	Θ	F	F	Veth2807
10	0025.b5f9.bb09	static	Θ	F	F	Veth2733
10	0025.b5f9.bb0c	static	Θ	F	F	Veth2745
10	0025.b5f9.bb0f	static	Θ	F	F	Veth2721
10	0025.b5f9.bb12	static	Θ	F	F	Veth2757
10	0025.b5f9.bb15	static	Θ	F	F	Veth2769
10	0025.b5f9.bb18	static	Θ	F	F	Veth2815

As indicated in the screenshot above, we noticed that, appropriate VLAN and MAC addresses of those chassis 2 servers (ora5, ora6, ora7 and ora8) route the network traffic to Fabric Interconnect – B. So Chassis all links failure did not cause any disruption to Public, Private and Storage Network Traffic.

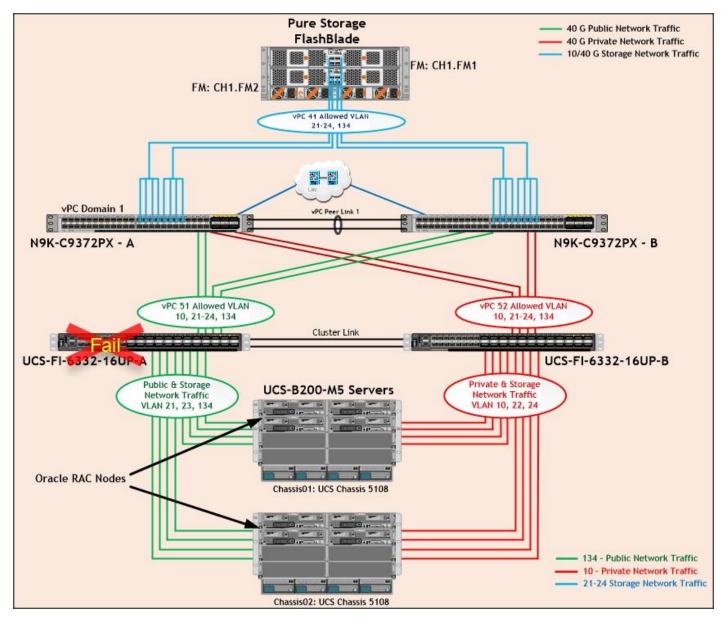
After plugging in all the links of chassis, the respective servers (ora5, ora6, ora7 and ora8) on chassis 2 will route back the MAC addresses and its VLAN traffic to Fabric Interconnect – A.

We conducted Test Scenario 4 (Chassis IOM All Links Failure on FI-B Side) and observed expected results.

Test Scenario 5 - Cisco UCS anyone Fabric Interconnect Failure

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 (ORA1, ORA2, ORA3 and ORA4) on chassis 1 and (ORA5, ORA6, ORA7 and ORA8) on chassis 2 will fail over the public and storage interface MAC addresses and its VLAN network traffic to fabric interconnect – B.



We unplugged the power cable from Fabric Interconnect – A then checked the MAC address and VLAN information on Cisco UCS Fabric Interconnect – B.

ORARAC-X	(-FI-B(nxos)# show ma	ac address	-table)			
Legend:							
	 * - primary entry, (
	age - seconds since					sing vPC Peer-L	_ink
VLAN	MAC Address	Туре	age	Secure	NTF	Y Ports/SWID.	.SSID.
	+	++-		++		+	
* 134	000c.29c4.dfa9	dynamic	Θ	F	F	Veth2814	
* 134	000c.29e1.d592	dynamic	Θ	F	F	Veth2814	
134	0025.b5f9.aa00	static	θ	F	F	Veth2790	
134	0025.b5f9.aa03	static	0	F	F	Veth2778	
134 134	0025.b5f9.aa06 0025.b5f9.aa09	static	0 0	F	F	Veth2802	
134	0025.b5f9.aa0c	static static	0	F	F	Veth2728 Veth2740	
134	0025.b5f9.aa0f	static	0	F	F	Veth2716	
134	0025.b5f9.aa12	static	Θ	F	F	Veth2752	
134	0025.b5f9.aa15	static	ē	F	F	Veth2764	
134	0025.b5f9.aa18	static	ē	F	F	Veth2814	
* 24	0025.b5f9.bb02	static	Ö	F	F	Veth2799	
* 24	0025.b5f9.bb05	static	ē	F	F	Veth2787	
* 24	0025.b5f9.bb08	static	ē	F	F	Veth2811	
* 24	0025.b5f9.bb0b	static	e	F	F	Veth2737	
* 24	0025.b5f9.bb0e	static	Θ	F	F	Veth2749	
* 24	0025.b5f9.bb11	static	Θ	F	F	Veth2725	
* 24	0025.b5f9.bb14	static	Θ	F	F	Veth2761	
* 24	0025.b5f9.bb17	static	Θ	F	F	Veth2773	
× 23	0025.b5f9.aa02	static	Θ	F	F	Veth2794	
23	0025.b5f9.aa05	static	Θ	F	F	Veth2782	
23	0025.b5f9.aa08	static	Θ	F	F	Veth2806	
* 23	0025.b5f9.aa0b	static	Θ	F	F	Veth2732	
* 23	0025.b5f9.aa0e	static	Θ	F	F	Veth2744	
23	0025.b5f9.aa11	static	Θ	F	F	Veth2720	
23	0025.b5f9.aa14	static	Θ	F	F	Veth2756	
23	0025.b5f9.aa17	static	Θ	F	F	Veth2768	
* 22	0025.b5f9.bb01	static	Θ	F	F	Veth2797	
* 22	0025.b5f9.bb04	static	0	F	F	Veth2785	
* 22 * 22	0025.b5f9.bb07 0025.b5f9.bb0a	static	0 0	F	F	Veth2809	
* 22	0025.b5f9.bb0d	static	0	F	F	Veth2735 Veth2747	
* 22	0025.b5f9.bb10	static static	0	F	F	Veth2723	
* 22	0025.b5f9.bb13	static	0	F	F	Veth2759	
* 22	0025.b5f9.bb16	static	0	F	F	Veth2771	
* 21	0025.b5f9.aa01	static	0	F	F	Veth2792	
* 21	0025.b5f9.aa04	static	ē	F	F	Veth2780	
* 21	0025.b5f9.aa07	static	0	F	F	Veth2804	
21	0025.b5f9.aa0a	static	Ð	F	F	Veth2730	
21	0025.b5f9.aa0d	static	Θ	F	F	Veth2742	
21	0025.b5f9.aa10	static	Θ	F	F	Veth2718	
* 21	0025.b5f9.aa13	static	Θ	F	F	Veth2754	
× 21	0025.b5f9.aa16	static	Θ	F	F	Veth2766	
* 10	0025.b5f9.bb00	static	Θ	F	F	Veth2795	
* 10	0025.b5f9.bb03	static	Θ	F	F	Veth2783	
* 10	0025.b5f9.bb06	static	Θ	F	F	Veth2807	
* 10	0025.b5f9.bb09	static	Θ	F	F	Veth2733	
* 10	0025.b5f9.bb0c	static	Θ	F	F	Veth2745	
* 10	0025.b5f9.bb0f	static	Θ	F	F	Veth2721	
* 10	0025.b5f9.bb12	static	Θ	F	F	Veth2757	
* 10	0025.b5f9.bb15	static	Θ	F	F	Veth2769	
* 10	0025.b5f9.bb18	static	Θ	F	F	Veth2815	

We noticed in the figure above, when the Fabric Interconnect – A failed, it would route all the Public and Storage Network traffic of VLAN 134, 21 & 23 to Fabric Interconnect – B. So Fabric Interconnect – A Failover did not cause any disruption to Private, Public and Storage Network Traffic.

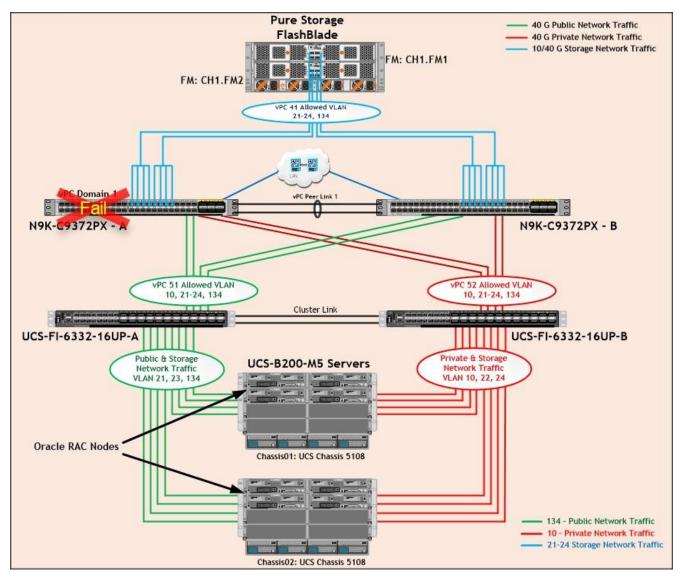
After plugging in the power cable to Fabric Interconnect – A Switch, the respective blades (ORA1, ORA2, ORA3 & ORA4) on chassis 1 and (ORA5, ORA6, ORA7 & ORA8) on chassis 2 will route back the MAC addresses and its VLAN traffic to Fabric Interconnect – A.

We conducted a hardware failure test on Fabric Interconnect – B by disconnecting power cable to the switch and observed the expected results. Therefore Fabric Interconnect – B Failover did not cause any disruption to Private, Public and Storage Network Traffic.

Test Scenario 6 - Cisco UCS anyone Nexus Switch Failure

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 (ORA1, ORA2, ORA3 and ORA4) on chassis 1 and (ORA5, ORA6, ORA7 and ORA8) on chassis 2 will fail over the MAC addresses and its VLAN network traffic to Nexus Switch – B.



We unplugged the power cable from Nexus Switch – A, and checked 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 Public, Private and Storage Network Traffic of VLAN 10, VLAN 134, VLAN 21 to 24 to Nexus Switch – B. Therefore, Nexus Switch – A Failover did not cause any disruption to Private, Public and Storage Network Traffic.

After plugging in the 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.

Similarly, we unplugged the power cable from Nexus Switch – B, and observed expected results. Thus, Nexus Switch – B Failover did not cause any disruption to Private, Public and Storage Network Traffic.

The screenshot shown below shows the above tests performed while database was running the workload.



As expected during Fabric Interconnect – A failure, it would route all the appropriate traffic of VLAN Fabric Interconnect – B and database performance was persistent. Similarly, during Fabric Interconnect – B failure, it would route all the appropriate traffic of VLAN Fabric Interconnect – A and database performance was not affected. Likewise, we observed Nexus Switch failure did not cause any degradation on database performance.

From the above test, we can conclude that there are no single point of failure in this reference design. All of these failure tests were performed while database workload was running. We did not observe any significant dips in performance and IO bandwidth during the failure scenarios.

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 FlashBlade Storage system provides the ideal combination for Oracle's unique, scalable, and highly available NFS technology.
- Hardware level redundancy for all major components using Cisco UCS and Pure Storage availability features.

Oracle data warehouse deployments are not easy. Ensuring performance, availability, and low TCO are always top priorities for IT managers and DBAs. In this Cisco Validated Design, we have demonstrated how to address those challenges using the right tools from Oracle running on the right infrastructure from Cisco UCS and Pure Storage. This solution enables your user community to perform ad-hoc analysis across all of the data in your Oracle data warehouse quickly, cost-effectively, and with a solution that scales out virtually on the fly.

- Excellent throughput performance, achieved across data warehouse workloads through high-end data ingest and business-related queries
- The scalability of Oracle RAC Nodes, in which throughput went from 1.5 GB/s with 1 node to 11.23 GB/s with 8 nodes.

Overall, the test results prove that a data warehouse solution on Oracle RAC is an ideal use case for FlashStack Converged Infrastructure with FlashBlade. Excellent bandwidth, high throughput, and scalability were achieved – showcasing the versatility of FlashBlade within the FlashStack CI solution. Finally, factors like service profiles via UCS, Oracle dNFS, ease of storage management, and lower costs for power, cooling, and rack space make the TCO for large scale deployments even more attractive.

References

The following references were used in preparing this document.

Cisco Unified Computing System

https://www.cisco.com/c/en/us/products/servers-unified-computing/index.html

Cisco UCS B200 M5 Blade Servers

https://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-b-series-bladeservers/datasheet-c78-739296.html

Oracle Database 12c Release 2

https://docs.oracle.com/en/database/oracle/oracle-database/12.2/index.html

Pure Storage FlashBlade

https://www.purestorage.com/products/flashblade.html

Pure Storage Support Pages

https://support.purestorage.com/

Cisco UCS Manager

https://www.cisco.com/c/en/us/products/servers-unified-computing/ucs-manager/index.html

Cisco UCS Solutions for Data Center Applications

https://www.cisco.com/c/en/us/solutions/data-center-virtualization/data-center-applications/index.html

Appendix

```
Cisco Nexus 9372PX-E Running Configuration
ORA134-NEXUS-A# show running-config
!Command: show running-config
!Time: Sat Jun 2 01:21:04 2018
version 7.0(3)I4(8)
switchname ORA134-NEXUS-A
policy-map type network-qos jumbo
  class type network-gos class-default
   mtu 9216
vdc ORA134-NEXUS-A id 1
  limit-resource vlan minimum 16 maximum 4094
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 511
  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 interface-vlan
feature hsrp
feature lacp
feature vpc
no password strength-check
username admin password 5 $5$RVD7EXgX$j8C3VaP4dox9.ncFILksvy/Ypiivvm4.X1WVg/JZNYA role
network-admin
ip domain-lookup
system qos
  service-policy type network-qos jumbo
copp profile strict
snmp-server user admin network-admin auth md5 0x245a78523ec9113d79755d724da371c1 priv
0x245a78523ec9113d79755d724da371c1 localizedkey
rmon event 1 log trap public description FATAL(1) owner PMON@FATAL
rmon event 2 log trap public description CRITICAL(2) owner PMON@CRITICAL
rmon event 3 log trap public description ERROR(3) owner PMON@ERROR
rmon event 4 log trap public description WARNING(4) owner PMON@WARNING
rmon event 5 log trap public description INFORMATION(5) owner PMON@INFO
vlan 1,10,21-24,134
vlan 10
  name Oracle RAC Private Traffic
vlan 21
 name Storage_Traffic A1
vlan 22
  name Storage Traffic B1
vlan 23
 name Storage Traffic A2
vlan 24
```

```
name Storage_Traffic_B2
vlan 134
  name Oracle RAC 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
vpc domain 1
  peer-keepalive destination 10.29.134.6 source 10.29.134.5
interface Vlan1
interface Vlan21
  description Storage-VLAN21
  no shutdown
  no ip redirects
  ip address 192.168.21.250/24
  hsrp version 2
  hsrp 21
    priority 140 forwarding-threshold lower 1 upper 140
    ip 192.168.21.1
interface Vlan22
  description Storage-VLAN22
  no shutdown
  no ip redirects
  ip address 192.168.22.250/24
  hsrp version 2
  hsrp 22
    priority 140 forwarding-threshold lower 1 upper 140
    ip 192.168.22.1
interface Vlan23
  description Storage-VLAN23
  no shutdown
  no ip redirects
  ip address 192.168.23.250/24
  hsrp version 2
  hsrp 23
    priority 140 forwarding-threshold lower 1 upper 140
    ip 192.168.23.1
interface Vlan24
  description Storage-VLAN24
  no shutdown
  no ip redirects
  ip address 192.168.24.250/24
  hsrp version 2
  hsrp 24
    priority 140 forwarding-threshold lower 1 upper 140
    ip 192.168.24.1
interface port-channel1
  description vPC peer-link
  switchport mode trunk
```

```
switchport trunk allowed vlan 1,10,21-24,134
  spanning-tree port type network
  vpc peer-link
interface port-channel41
  description Port-Channel to Storage
  switchport mode trunk
  switchport trunk allowed vlan 21-24,134
  spanning-tree port type edge trunk
 mtu 9216
 vpc 41
interface port-channel51
  description connect to Fabric Interconnect A
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  spanning-tree port type edge trunk
 mtu 9216
 vpc 51
interface port-channel52
  description connect to Fabric Interconnect B
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  spanning-tree port type edge trunk
 mtu 9216
 vpc 52
interface Ethernet1/1
  description Peer link connected to N9KB-Eth1/1
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  channel-group 1 mode active
interface Ethernet1/2
  description Peer link connected to N9KB-Eth1/2
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  channel-group 1 mode active
interface Ethernet1/3
  description Peer link connected to N9KB-Eth1/3
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  channel-group 1 mode active
interface Ethernet1/4
  description Peer link connected to N9KB-Eth1/4
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  channel-group 1 mode active
interface Ethernet1/5
```

.....

interface Ethernet1/14

interface Ethernet1/15 description connect to uplink switch switchport access vlan 134 speed 1000 interface Ethernet1/16 interface Ethernet1/32 interface Ethernet1/33 description Connected to FlashBlade Controller-0 switchport mode trunk switchport trunk allowed vlan 21-24,134 spanning-tree port type edge trunk mtu 9216 channel-group 41 mode active interface Ethernet1/34 description Connected to FlashBlade Controller-0 switchport mode trunk switchport trunk allowed vlan 21-24,134 spanning-tree port type edge trunk mtu 9216 channel-group 41 mode active interface Ethernet1/35 description Connected to FlashBlade Controller-0 switchport mode trunk switchport trunk allowed vlan 21-24,134 spanning-tree port type edge trunk mtu 9216 channel-group 41 mode active interface Ethernet1/36 description Connected to FlashBlade Controller-0 switchport mode trunk switchport trunk allowed vlan 21-24,134 spanning-tree port type edge trunk mtu 9216 channel-group 41 mode active interface Ethernet1/37 description Connected to FlashBlade Controller-1 switchport mode trunk switchport trunk allowed vlan 21-24,134 spanning-tree port type edge trunk mtu 9216 channel-group 41 mode active interface Ethernet1/38 description Connected to FlashBlade Controller-1 switchport mode trunk switchport trunk allowed vlan 21-24,134 spanning-tree port type edge trunk

```
mtu 9216
 channel-group 41 mode active
interface Ethernet1/39
  description Connected to FlashBlade Controller-1
  switchport mode trunk
  switchport trunk allowed vlan 21-24,134
  spanning-tree port type edge trunk
 mtu 9216
  channel-group 41 mode active
interface Ethernet1/40
  description Connected to FlashBlade Controller-1
  switchport mode trunk
  switchport trunk allowed vlan 21-24,134
  spanning-tree port type edge trunk
 mtu 9216
  channel-group 41 mode active
interface Ethernet1/41
.....
interface Ethernet1/48
interface Ethernet2/1
 description Fabric-Interconnect-A-31
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  spanning-tree port type edge trunk
 mtu 9216
 channel-group 51 mode active
interface Ethernet2/2
  description Fabric-Interconnect-A-32
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  spanning-tree port type edge trunk
 mtu 9216
  channel-group 51 mode active
interface Ethernet2/3
  description Fabric-Interconnect-B-31
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  spanning-tree port type edge trunk
 mtu 9216
 channel-group 52 mode active
interface Ethernet2/4
  description Fabric-Interconnect-B-32
  switchport mode trunk
  switchport trunk allowed vlan 1,10,21-24,134
  spanning-tree port type edge trunk
 mtu 9216
  channel-group 52 mode active
```

```
interface Ethernet2/5
.....
interface Ethernet2/12
interface mgmt0
  vrf member management
  ip address 10.29.134.5/24
line console
line vty
boot nxos bootflash:/nxos.7.0.3.I4.8.bin
Configuration of "/etc/sysctl.conf"
### File located "/etc/sysctl.conf" directory
[root@ora1 ~]# cat /etc/sysctl.conf
# sysctl settings are defined through files in
# /usr/lib/sysctl.d/, /run/sysctl.d/, and /etc/sysctl.d/.
# Vendors settings live in /usr/lib/sysctl.d/.
# To override a whole file, create a new file with the same in
# /etc/sysctl.d/ and put new settings there. To override
# only specific settings, add a file with a lexically later
# name in /etc/sysctl.d/ and put new settings there.
# For more information, see sysctl.conf(5) and sysctl.d(5).
# 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
```

```
Appendix
```

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 Pages
vm.nr hugepages=40000

Configuration of "oracle-database-server-12cR2-preinstall.conf"

```
### File located "/etc/security/limits.d/oracle-database-server-12cR2-preinstall.conf"
directory
[root@ora1 ~]# cat /etc/security/limits.d/oracle-database-server-12cR2-preinstall.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.
oracle
        soft
             nproc
                        16384
# 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
oracle
        hard stack
                        32768
# 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
                          473839754
# 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 473839754

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	473839754
grid	hard	memlock	473839754

Configuration of "/etc/fstab"

/etc/fstab # Created by anaconda on Tue Apr 17 17:41:23 2018 # Accessible filesystems, by reference, are maintained under '/dev/disk' # See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info 10.29.134.201:/ocr /nfsocr nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.21.201:/oradata01 /nfsdb/oradata01 nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.22.201:/oradata02 /nfsdb/oradata02 nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.23.201:/oradata03 /nfsdb/oradata03 nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.24.201:/oradata04 /nfsdb/oradata04 nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.21.201:/oraredo /nfsdb/oraredo nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.21.201:/fio1 /fiol nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.22.201:/fio2 /fio2 nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.23.201:/fio3 /fio3 nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0 192.168.24.201:/fio4 /fio4 nfs rw,bg,nointr,hard,tcp,vers=3,actimeo=0

Configuration of "oranfstab"

[oracle@ora1 ~]\$ cat \$ORACLE_HOME/dbs/oranfstab

Server: FlashBlade
path: 192.168.21.201
path: 192.168.22.201
path: 192.168.23.201
path: 192.168.24.201
nfs_version: nfsv3
export: /oradata01 mount: /nfsdb/oradata01
export: /oradata02 mount: /nfsdb/oradata02
export: /oradata03 mount: /nfsdb/oradata03
export: /oradata04 mount: /nfsdb/oradata04
export: /oradata05 mount: /nfsdb/oradata05
export: /oraredo mount: /nfsdb/oraredo

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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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