Validated Reference Architecture for Oracle Database with Oracle VM

A Dell Reference Architecture with Oracle Validated Configuration Certification
A pre-tested and validated reference architecture using four socket Dell
PowerEdge M820 blade Server, Dell Compellent SC8000 SAN Storage, Oracle VM
Server 3.2.4, Oracle Database 11g Release 2 and Oracle Database 12c Release 1

Revisions

Date	Description
September 2013	Initial Release
October 2013	Dell	Oracle Logo Update

Table of contents

Executive Summary

Dell and Oracle have partnered to deliver end-to-end solutions that integrate data and processes across organizations of various sizes. This new x86 reference architecture continues a long history of joint support and cooperative engineering that has resulted in a stable and pervasive portfolio of database implementation guidance, automation, and optimization making both Dell and Oracle a forerunner in x86 database solutions.

Dell has expanded its portfolio to offer validations and solutions around Oracle VM server virtualization. This white paper focuses on a new reference architecture that is targeted for those end-users who are:

- Looking to deploy Oracle VM on top of Dell's latest 12th generation x86 blade servers, and
- Looking to deploy Oracle Linux with Unbreakable Enterprise Kernel paravirtualized guest VMs (PVMs) running instances of Oracle Database 11g Release 2 or Oracle Database 12c Release 1.

The reference architecture that is covered in this white paper is validated using the Oracle Validated Configurations (OVC) program - a partner vendor program from Oracle. The solution combines Dell's best-in-class hardware with Oracle's industry-leading software, enabling organizations to deploy and manage applications faster than ever before with increased performance, flexibility, and value.

This white paper describes the following:

- Architectural design of the offered reference architecture
- Overview of the Oracle Linux Test (OLT) test suite used to stress and validate the reference architecture
- Best practices and recommendations for implementing the reference architecture
- Details of the hardware, software, test suite configuration, and tuning details that are relevant to this study

1   Introduction

The Active Infrastructure for Oracle is a new solution offering from Dell that is built on the longtime relationship with Oracle. This solution now offers a bundle that includes:

- **Validated Hardware and Software Stack:**
    - Certified Dell x86 hardware infrastructure with Oracle Linux with the Unbreakable Enterprise Kernel and Oracle VM operating systems
    - Pre-tested, validated reference architectures on Oracle Linux and Oracle VM along with best practices and recommendations for Oracle Databases
- **Sales Enablement**: One stop-shop sales enablement to streamline the ordering of the certified and validated hardware and software stack
- **Joint Support**: Joint support from Dell and Oracle on the certified and validated hardware and software stack

This white paper describes a reference architecture that is built for end-users looking to deploy a database on Dell's end-to-end hardware stack that includes blade servers, storage, and network components along with Oracle's software stack that includes Oracle VM and Oracle Linux with the Unbreakable Enterprise Kernel paravirtualized guest VMs running instances of Oracle Database 11g Release 2 or Oracle Database 12c Release 1

The key objectives of this reference architecture are to:

- Simplify deployment for end-users with a pre-tested and validated configuration.
- Verify that the system is installed and configured correctly as per the Dell and Oracle's best practices.
- Verify the solution robustness against various hardware failures by performing fault injection testing to validate the availability, performance and integrity at each and every layer of the hardware and software stack.
- Simulate a data load on the database and verify failover and live migration of VMs.

This reference architecture is validated using the Oracle Validated Configuration (OVC) program. The following sub-section introduces the OVC program. Succeeding sections describe the overview of the products used in the reference architecture and the test methodology, including the test cases. This is followed by the results and recommendations. It ends with a conclusion.

1.1   Oracle Validated Configurations (OVC)

Oracle Validated Configurations is a partner program offered by Oracle to provide pre-tested, validated reference architectures that include software, hardware, storage, and network components along with documented best practices for running Oracle Databases. In order to validate the reference architectures Oracle provides an Oracle Linux Test (OLT) tool kit that simulates different workloads, performs stress tests, regression tests, system verification tests, migration tests and destructive tests.

Dell engineers collaborated and worked closely with Oracle engineers to design the reference architecture covered in this white paper and to test it using the OLT tool kit. The OLT tool kit provides an automated mechanism to define, execute and analyze the tests results. It verifies the Linux kernel functionality and stability essential for the Oracle Database. The OLT kit is used for running tests on Oracle Linux with the Unbreakable Enterprise Kernel and Oracle VM.

For more details on the OVC program, visit http://www.oracle.com/technetwork/topics/linux/validated-configurations-085828.html

2 Audience

The target audiences who will benefit from this white paper are:

- Oracle database administrators
- Oracle solution architects
- Storage administrators
- System administrators
- Oracle database deployment services
- Sales representatives
- Technical support

3 Reference Architecture Components Overview

The following are the critical components that were used to build and test the solution:

- Dell PowerEdge M820 server
- Dell Compellent SC8000 storage controller
- Networking switches:
    - Dell Networking MXL 10/40GbE Blade Switch
    - Brocade M6505 Fibre Channel Blade Switch
- Oracle VM

3.1 Dell PowerEdge M820 Server

The Dell PowerEdge M820 uses Intel Xeon E5-4600 series processors and Intel chipset architecture in a full height blade form factor. The M820 is a powerful general purpose platform with highly expandable memory and I/O capabilities. Its extensive scalability and balanced design allows it to handle very demanding workloads. The server features four CPU sockets and 12 memory slots supporting 2, 4, 8, 16, or 32 GB DIMMs to meet the memory demands of a virtualized infrastructure. The M820 provides four PCIe 3.0 mezzanine connectors for add-in cards and supports multiple adapter vendors for 1Gb/10Gb NICs, Fiber Channel and InfiniBand.

> **Note**: For more details on the M820 full height blade server refer to the following technical guide:
> Technical Guide for M820

PowerEdge M820 is certified on Oracle Linux with the Unbreakable Enterprise Kernel and Oracle VM.

> **Note:** For more details refer to the following website:
> http://linux.oracle.com/pls/apex/f?p=117:1:1202773984821014:::::

3.2 Dell Compellent SC8000 Storage Array

The Dell Compellent SC8000 is a 2U rack form factor storage controller with dual six-core, 2.5GHz (with Turbo) Intel Xeon E5-2640 processors. It can support full high availability and failover capabilities with a dual controller system and provides enhanced diagnostics capability with the Integrated Dell Remote Access Controller (iDRAC),

A Storage Center Storage Area Network (SAN) built with the SC8000 scales up to 960 SAS drives per dual controller system and scales-out to multiple systems across multiple sites, monitored by a single console. It supports simultaneous iSCSI, Fibre Channel (FC) and Fibre Channel over Ethernet (FCoE) front-end interconnects to provide flexibility in your datacenter.

The SC8000 offers exceptional power efficiency with dual redundant 80 Plus® Platinum rated hot-swappable, low wattage power supplies and has six redundant hot-plug fans. Using Fresh Air™ technology, the SC8000 can operate at higher temperatures or even chiller-free environments to help reduce datacenter costs.

Providing up to 99.999% availability, Storage Center keeps critical customer data at the ready. With resilient hardware and software combined with world-class Copilot Support continuous data availability is ensured.

> **Note**: For more information on the Compellent SC8000 system, see the Compellent SC8000 Spec Sheet.

The Dell Compellent SC8000 storage array is certified on Oracle VM.

> **Note:** For more details refer to the following website:
> http://linux.oracle.com/pls/apex/f?p=117:3:2644180376456244::NO:RP::

3.3 Networking Switches

This section gives a brief introduction of the networking switches used to build this reference architecture.

3.3.1 Dell Networking MXL 10/40GbE Blade Switch

The Dell Networking MXL 10/40GbE Blade Switch is a layer 2/3 blade switch with two fixed 40GbE ports on the base module and support for two optional plug-in modules. The switches operate in a PowerEdge M1000e enclosure, which can support up to 32 servers and six MXL 10/40GbE switches. The MXL 10/40GbE switch runs Force10 Operating System (FTOS), providing switching, bridging and routing functionality for transmitting data, storage. The switch supports data center bridging (DCB) features and optimizes connectivity between servers and storage devices over Fiber Channel over Ethernet (FCoE) and iSCSI links.

> **Note**: For more information on the Dell Networking MXL 10/40GbE blade switch visit the following website: http://www.dell.com/us/business/p/force10-mxl-blade/pd

3.3.2 Brocade M6505 Fibre Channel Blade Switch

The Brocade M6505 Blade Switch is part of the Brocade Gen 5 family of Fibre Channel switches that operates in a PowerEdge M1000e enclosure. It is designed to enable maximum flexibility and reliability and supports 2, 4, 8 or 16 Gbps speeds in an efficiently designed 1U package.

> **Note**: For more information on Brocade M6505 Blade Switch, refer to the following M6505 data sheet: M6505 data sheet

3.4   Oracle VM

Offering benefits beyond simple server consolidation, Oracle VM's application-driven virtualization design enables rapid enterprise application deployment and simplifies lifecycle management in a cloud environment. Oracle VM is designed to support business critical workloads for both Oracle and non-Oracle applications with a highly scalable architecture. With over 100 pre-built, pre-tested Oracle VM Templates for Oracle applications, companies can accelerate business service delivery and realize quicker time to value.

4 Reference Architecture Configuration

The reference architecture discussed in this whitepaper is configured using Dell PowerEdge servers, Dell Compellent Storage, Brocade FC switches and Oracle VM. This section provides the architectural diagram and provides an overview of the hardware and software configuration of the reference architecture.

Figure 1 below shows the architectural diagram of the validated reference architecture covered in this paper.

Figure 1. Architectural Diagram
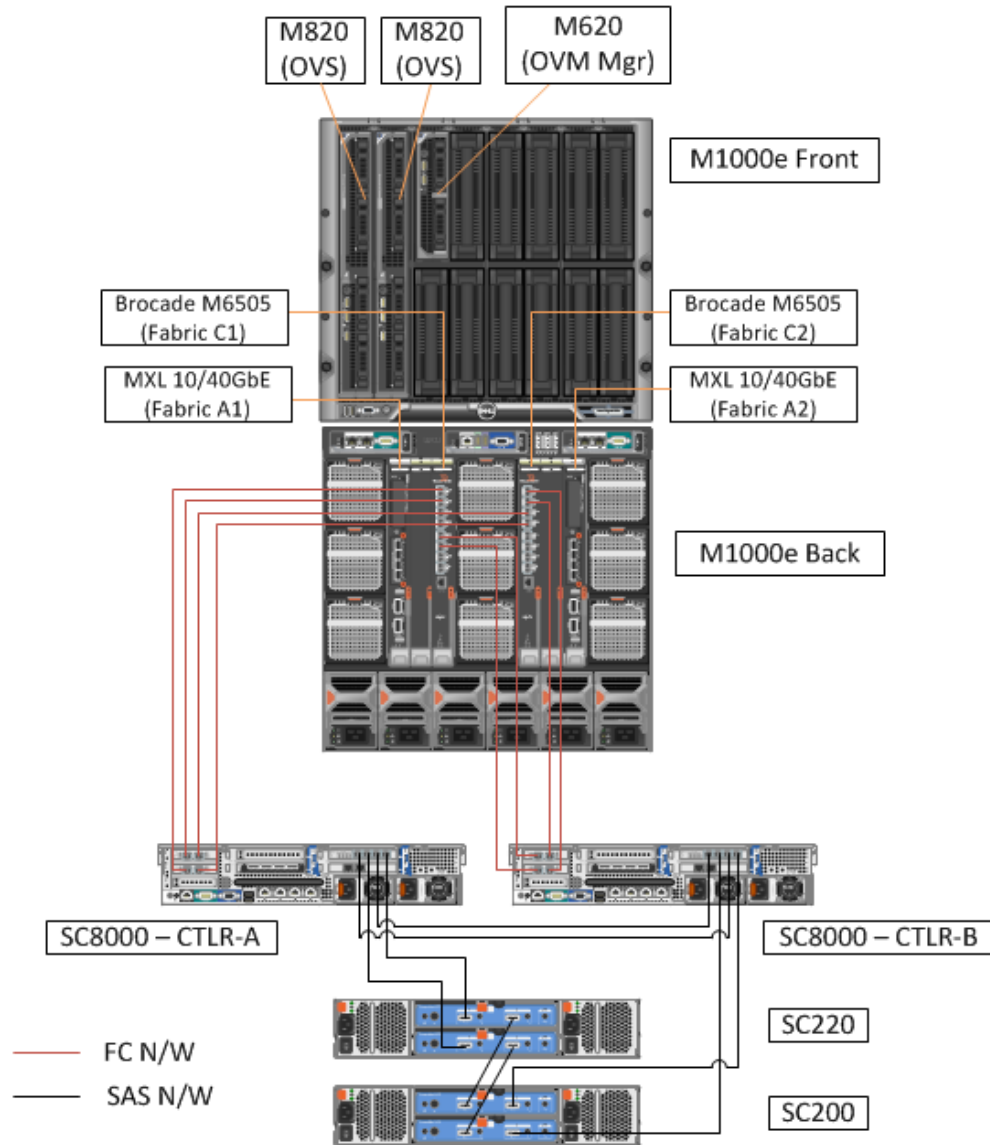
4.1   Hardware Configuration Overview

As seen in Figure 1, the architecture was designed in such a way that there is no single point of failure and redundancy is incorporated into every mission critical component of the solution that includes blade servers, storage controllers, and networking components. The design also includes high availability at the sub-component level.

The reference architecture was designed with Dell PowerEdge M820s as the Oracle VM Servers connected to two Dell Compellent SC8000 storage controllers in a SAN configuration. The storage controllers are connected to two Compellent expansion enclosures. Dell PowerEdge M620 is setup as an Oracle VM Manager and is used to configure and maintain the Oracle VM Servers running on the Dell PowerEdge M820s. One of the M820 Oracle VM Server is setup with the OLT tool kit to test the Oracle Database 12c Release 1 and Oracle Database 11g Release 2 single instances that are running in the paravirtualized guest VMs. The second M820 Oracle VM Server is setup to test the live migration of VMs.

Figure 2.   Architecture Diagram of internal IO mapping within M1000e blade chassis
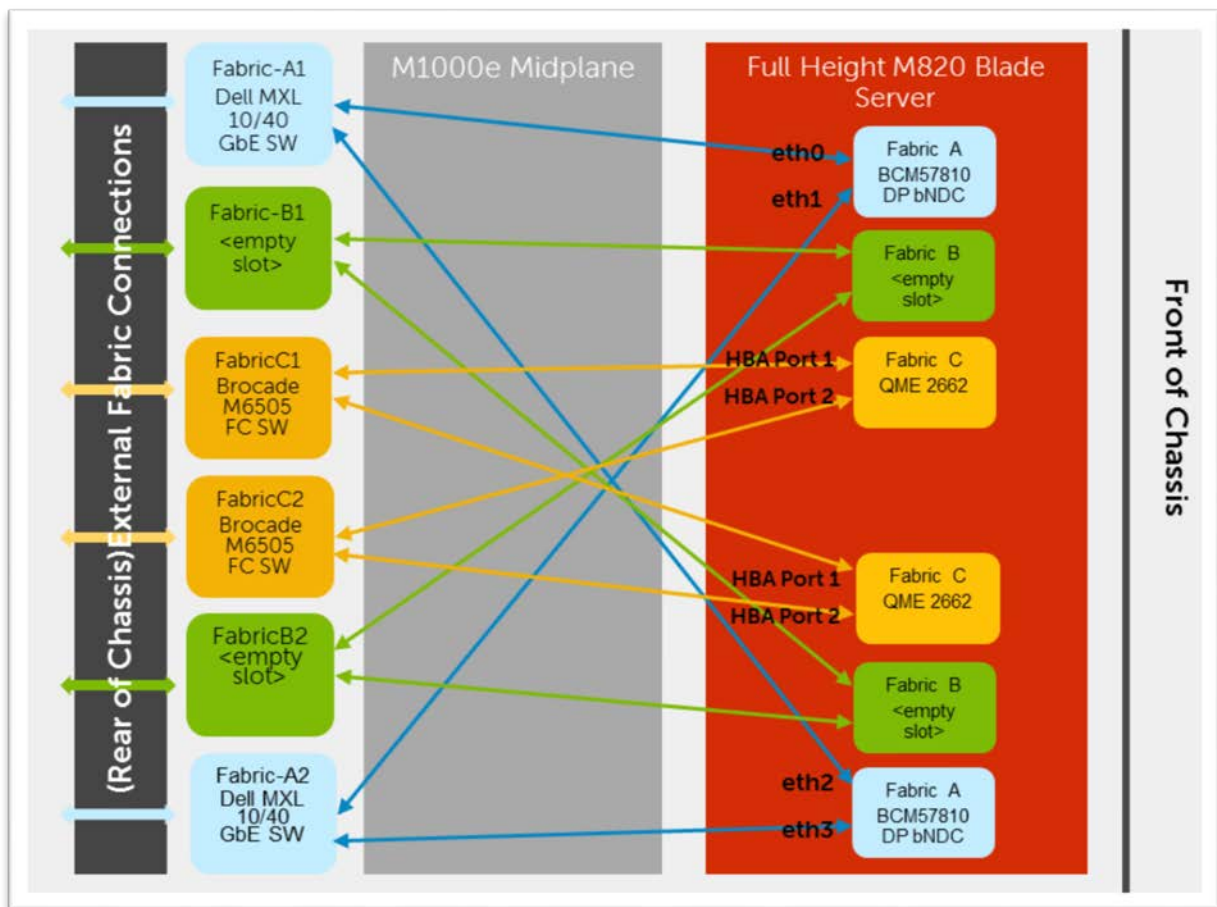
As seen in Figure 2, the blade infrastructure is setup for maximum network high availability with redundant switches in the rear of the blade chassis and redundant mezzanine cards within the blade servers. Using the full-height M820 as an example, Figure 2 also shows the internal IO fabric mappings between the mezzanine cards and the blade switch modules that are setup as part of this reference architecture.

A full height M820 blade server has two Fabric A slots, two Fabric B slots and two Fabric C slots, while a half height M620 blade server has only one Fabric A slot, one Fabric B slot and one Fabric C slot. As seen in Figure 2, each fabric slot inside a blade server is internally connected to two separate switches in the back of the chassis for redundancy. E.g. the dual port Broadcom BCM57810 10GbE blade Network Daughter Card (bNDC) populated in Fabric A of the M820 is internally connected to two Dell MXL 10/40 GbE blade switches populated in Fabric A1 and A2 slots in the rear of the chassis.

For public network high availability, eth0 and eth3 that belong to two different Fabric A mezzanine cards are bonded together. Two Qlogic QME 2662 mezzanine cards are connected to two separate Brocade M6505 FC switches in Fabric C for maximum bandwidth and to maintain high availability in case of a switch failure or a mezzanine card failure. Though Fabric B is not used as part of this reference architecture, it can be used to setup a private network for an Oracle Real Application Cluster (RAC) database.

As a best practice, the front end ports on the Compellent SC8000 controllers are setup as virtual ports. The virtual port feature within Compellent enables high availability at the controller and the controller port level. To enable the virtual port feature, it is necessary to create fault domains by grouping physical ports. If a physical port in the Compellent controller goes down, other physical ports belonging to the same domain takes over for the failed port. Backend cabling for Compellent is performed to obtain the redundancy in paths for failover of virtual ports between the two controllers.

For additional Compellent best practice guides, refer to the *References* section.

Note: For other hardware configuration details, refer to appendix section *Visit Dell Compellent's Knowledge Center* at http://kc.compellent.com to access the following documents:

- o CT-SC040 & SC8000 Connectivity Guide
- o Dell Compellent - Oracle Best Practices Guide
- o Dell Compellent Oracle VM Best Practices Guide
- Dell Server Hardware Certification List (HCL) certified with Oracle Linux and Oracle VM: http://linux.oracle.com/pls/apex/f?p=117:1:2526069251147525::NO:RP::
- Dell Storage Hardware Certification List (HCL) certified with Oracle VM: http://linux.oracle.com/pls/apex/f?p=117:3:46019236825768::NO:RP::
- Dell best practices, deployment and how-to guides, deployment automation tools and white papers for Oracle Databases: www.delltechcenter.com/oracle

Hardware Configuration .

4.2   Software Configuration Overview

The features of the software configuration are:

- **Operating System**: The Dell PowerEdge M820 blade servers are installed with Oracle VM version 3.2.4.
- **Testing Software**: The OLT tool kit is used to stress test and validate the reference architecture covered in this paper. The pre-installation steps that includes configuring OVM Server, network configuration, storage requirements, and setting up VM templates that are necessary for setting up and running OLT tests are conducted using the [OLT user's guide for OVM](#).
- **Oracle VM Templates**: This reference architecture is tested with the following Oracle VM templates:
  - **Dom0 tests**: The Dom0 testing was conducted using the following Oracle VM templates:
    - Oracle Linux 4 update 8 64-bit PVM Template,
    - Oracle Linux 5 update 7 64-bit PVM Template
    - Oracle 11g database 64-bit PVM template
  - **DomU tests**: The DomU testing was conducted using the following VM templates for Oracle databases:
    - Oracle VM templates for Oracle Database - Single Instance and RAC 12cR1 (12.1.0.1.0) - Oracle Linux 6 Update 4 64-bit
    - Oracle VM templates for Oracle Database - Single Instance and RAC 11gR2 (11.2.0.3.0) - Oracle Linux 5 Update 9 64 bit

Note: For more information and to download these templates, refer to https://edelivery.oracle.com

- **Storage Configuration**: Compellent's Storage Center 6.3 operating system is used to configure the storage array. The necessary volumes needed by the OLT tests are created as thin provisioned volumes on the storage array. The Storage Center is configured with default policy settings with no data progression enabled.

Note: For other software configuration details, refer to appendix section *Software Configuration* .

5 Test Methodology

This section provides the high level steps for installing the Oracle Linux Test tool Kit and some of the high level test cases performed using this tool kit.

5.1 Oracle Linux Test - Steps

The following steps were followed to setup the OLT tool kit and to execute the tests:

1. Verification of hardware requirements for OLT testing
2. OLT pre-installation
   a. Operating system configuration
   b. Storage configuration
3. OLT installation and configuration
4. OLT test execution - OVM tests

Note: For more details on the above individual steps, refer to OLT user's guide for OVM and to OLT supplemental guide for OVM.

5.2 Oracle Linux Test - Test Cases

The OLT toolkit provides a comprehensive suite of test cases to validate a reference architecture on Oracle VM. Some of the high level test cases are as follows:

1. **Dom0 tests:** Dom0 test verifies if Oracle VM Server supports installation of guest VMs from Oracle VM templates.
2. **DomU tests:** DomU tests verify if the guest VMs and the database instances running inside them are functioning as expected. It also verifies the functionality of Oracle VM Manager that is used to configure the Oracle VM Server and the guest VMs. Some of the high level test cases that is included in the DomU tests are as follows:
   a. **Creating VMs by importing templates in repository:** This test verifies if the guest VM is created successfully from the VM template for the Oracle Database.
   b. **Creating single Instance 11gR2 and 12cR1 databases:** Once the VM templates for the Oracle databases are imported as guest VMs, this DomU test verifies if the single instance database was successfully started after the guest VMs are up and running.
   c. **Performing stress tests on single Instance 11gR2 and 12cR1 database:** Once the single instance database is up and running, stress tests are performed by running different tests scripts that are included as part of the OLT tool kit. As part of these stress tests, ft-aio (function test for testing async IO), ft-dio (direct IO), and ft-aio-dio (async-direct IO) tests are run.
3. **Dom0-DomU tests:** Dom0-domU tests verify the functionalities of guest VMs in combination with Oracle VM servers by running different tests scenarios as mentioned below:
   a. **Suspend and resume VMs:** While the stress test (ft-aio, ft-dio, ft-aio-dio) is running on the guest VM, suspend and resume the VM from the OVM shell for this test to verify if the

stress test continues from where it was suspended or if it starts all over again. Expected result is for the stress test to continue from where it was suspended once the guest VM is resumed.

    b. **VM Migration while stress tests not running:** This test case verifies if the guest VM migrates successfully between two Oracle VM Servers while no stress test is running.

    c. **VM Migration while stress tests running:** While the stress test is running on the Guest VM, this test verifies if the guest VM migrates successfully between Oracle VM servers and if the stress tests continue without interruption.

> **NOTE:** For more details on the different test cases, refer to the OLT test coverage guide below:
> https://oss.oracle.com/projects/olt/dist/documentation/OLT_TestCoverage.pdf

5.3   Storage (Compellent) Controller Tests

Storage controller fault injection tests verify if the Compellent controller sustain any faulty HBA ports attached in the controllers and other scenarios like failures in the backend cabling and failure of the controller.

- **Front end virtual port failover test:** Compellent supports virtual ports i.e. grouping of physical front end HBA ports into one fault domain. In this test case, a fibre cable connected to one of the front end ports of the controller is unplugged to simulate a port failure. This test verifies the virtual port functionality of the Compellent controller and tests the fail over of the virtual WWN of the failed port on to another physical port within the same fault domain.

- **Controller failover test:** In this test case, one of the controllers is rebooted to simulate controller failure. This test verifies the high availability of the Compellent controller and tests if the virtual port WWNs failover to the other controller. It also tests if the volumes are still accessible from the other controller using the alternative backend SAS cabling.

6 Results, Analysis and Recommendations

During the stress testing one issue was discovered. The details of the issue along with the recommended workaround are listed below:

Summary	IO Performance degradation due to transparent hugepages (THP) enabled, when the system is under memory pressure.
Affects	2.6.39-100 and upwards
Symptom	With THP enabled by default, RAC nodes may reboot due to slow I/O, when the system is under moderate memory pressure
Solution/ Workaround	Disable hugepages by the command `echo never > /sys/kernel/mm/transparent_hugepage/enabled`, and `echo never > /sys/kernel/mm/transparent_hugepage/defrag`

The above issue and the recommended workaround applies to both Oracle Database 11g Release 2 and Oracle Database 12c Release 1 running inside their respective paravirtualized VMs tested in this study.

Results from all the testing, including the one above after the workaround was applied, were successful. During the tests the single instance Oracle Database performed as expected.

7   Conclusion

With this reference architecture successfully completing and passing the comprehensive suite of OLT test cases, we have established the proper functionality of a single instance Oracle Database 12c Release 1 or a single instance Oracle Database 11g Release 2 running inside an Oracle Linux with the Unbreakable Enterprise Kernel paravirtualized guest VMs. This reference architecture is validated and approved by Oracle as an Oracle Validated Configuration. This validated reference architecture can be found at the following link:

http://linux.oracle.com/pls/apex/f?p=102:2:2760906105028609::NO::P2_VC_ID:628

All the best practices and recommendations provided in this white paper serve as a proof-point of a robust Oracle database hardware and software solution that is specifically integrated and optimized for running on Dell's enterprise blade infrastructure and on Oracle VM.

With this pre-tested and validated reference architecture jointly supported by Dell and Oracle, customers can now purchase with confidence and help reduce risks and save on cost for running their mission critical database applications in the datacenters.

With the new worldwide alliance between Dell and Oracle, you can expect more innovations on the horizon, as Dell and Oracle will be continuing to combine forces to drive systems management integration and innovation and further improving the manageability and enterprise class performance of the overall solution.

8   References

- Visit Dell Compellent's Knowledge Center at http://kc.compellent.com to access the following documents:
    - CT-SC040 & SC8000 Connectivity Guide
    - Dell Compellent - Oracle Best Practices Guide
    - Dell Compellent Oracle VM Best Practices Guide
- Dell Server Hardware Certification List (HCL) certified with Oracle Linux and Oracle VM: http://linux.oracle.com/pls/apex/f?p=117:1:2526069251147525::NO:RP::
- Dell Storage Hardware Certification List (HCL) certified with Oracle VM: http://linux.oracle.com/pls/apex/f?p=117:3:46019236825768::NO:RP::
- Dell best practices, deployment and how-to guides, deployment automation tools and white papers for Oracle Databases: www.delltechcenter.com/oracle

# A	Hardware Configuration Details

## A.1	Server Configuration (Oracle VM Server)

Server Configuration	
Server	PowerEdge M820
BIOS	v1.5.1
iDRAC7 ESM FW	V1.35.35
LC2	v1.1.1.18
CPU	4xIntel(R) Xeon(R) CPU E5-4617 0 @ 2.90GHz
Memory	128GB (8x16GB); 1600MHz; A1-A4, B1-B4, C1-C4, D1-D4
PERC H310 Mini	FW: 21.12.0-0004 Driver: 00.00.05.40-rc1
Broadcom Corporation NetXtreme II BCM57810S 10 Gigabit Ethernet	Driver name: bnx2x Driver version: 1.72.50-0 Firmware : 7.2.51.0
Team Interfaces	Bond0

## A.2	Server Configuration (Oracle VM Manager)

Server Configuration	
Server	PowerEdge M620
BIOS	v1.2.6
iDRAC7 ESM FW	V1.20.20
LC2	v1.0.8.42
CPU	2x Intel(R) Xeon(R) CPU E5-2680 0 @ 2.70GHz
Memory	64GB
PERC H710 Mini	FW: 21.0.2-0001 Driver: 06.505.02.00
Broadcom Corporation NetXtreme II BCM57810 10 Gigabit Ethernet	Driver name: bnx2x Driver version: 1.76.54 Firmware : 7.2.20

## A.3	Storage Configuration

Storage Configuration	
Storage	Compellent SC8000
Firmware	SC 6.3
Controllers	2
Enclosures	2

Disks	SAS 15k 300GB
Tiering	Tier 1

B Software Configuration Details

B.1.1 Oracle VM Manager

Software Configuration	
OS	Oracle Linux 6 Update 4
Kernel	2.6.39-400.109.4.el6uek.x86_64
Oracle VM Manager	3.2.4

B.1.2 Oracle VM Server

Software Configuration	
Oracle VM Server	3.2.4
Kernel	2.6.39-300.32.1.el5uek

B.1.3 Guest VM OS Configuration (Template-1: Oracle Database 12cR1)

Software Configuration	
OS	Oracle Linux 6 Update 4 PVM
Kernel	2.6.39-400.109.1.el6uek.x86_64
Oracle DB version	Oracle Database 12c Release 1 Single Instance

B.1.4 Kernel Parameter Settings (Template-1: Oracle Database 12cR1)

Parameter Name	Value
net.ipv4.ip_forward	0
net.ipv4.conf.default.rp_filter	1
net.ipv4.conf.default.accept_source_route	0
kernel.sysrq	0
kernel.core_uses_pid	1
net.ipv4.tcp_syncookies	1
kernel.msgmnb	65536
kernel.msgmax	65536
Fs.file-max	6815744
kernel.sem	250 32000 100 128
kernel.shmmni	4096
kernel.shmall	1073741824
kernel.shmmax	4398046511104
net.core.rmem_default	262144
net.core.rmem_max	4194304
net.core.wmem_default	262144
net.core.wmem_max	1048576
fs.aio-max-nr	3145728

B.1.5   Limits.conf Settings (Template-1: Oracle Database 12cR1)

Parameter Name	Value
oracle soft nofile	1024
oracle hard nofile	65536
oracle soft nproc	2047
oracle hard nproc	16384
oracle soft stack	10240
oracle hard stack	32768
oracle soft core	unlimited
oracle hard core	unlimited
oracle soft memlock	50000000
oracle hard memlock	50000000

B.1.6   Guest VM OS Configuration (Template-2: Oracle Database 11gR2)

Software Configuration	
OS	Oracle Linux 5 Update 9
Kernel	2.6.39-400.109.1.el5uek
Oracle DB version	Oracle Database 11g Release 2 Single Instance

B.1.7   Kernel Parameter Settings (Template-2: Oracle Database 11gR2)

Parameter Name	Value
net.ipv4.ip_forward	0
net.ipv4.conf.default.rp_filter	2
net.ipv4.conf.default.accept_source_route	0
kernel.sysrq	1
kernel.core_uses_pid	1
net.ipv4.tcp_syncookies	1
kernel.msgmnb	65536
kernel.msgmax	8192
Fs.file-max	6815744
kernel.sem	250 32000 100 142
kernel.shmmni	4096
kernel.shmall	1073741824
kernel.shmmax	4398046511104
net.core.rmem_default	262144
net.core.rmem_max	4194304
net.core.wmem_default	262144
net.core.wmem_max	1048576
fs.aio-max-nr	3145728

B.1.8   Limits.conf Settings (Template-2: Oracle Database 11gR2)

Parameter Name	Value
oracle soft nofile	131072
oracle hard nofile	131072
oracle soft nproc	131072
oracle hard nproc	131072
oracle soft stack	10240
oracle hard stack	32768
oracle soft core	unlimited
oracle hard core	unlimited
oracle soft memlock	50000000
oracle hard memlock	50000000

C   Sales and Support

Customers interested in purchasing this pre-tested and validated reference architecture featuring Oracle Database 12c Release 1 or Oracle Database 11g Release 2 single instances running in an Oracle VM environment, call the Dell sales representative and enquire about Dell Active Infrastructure for Oracle.

The entire Dell Active Infrastructure for Oracle hardware and software stack is jointly supported by Dell and Oracle.

For more information, see **dell.com/contactdell**