Oracle Database 11g Release 2 with Oracle Real Application Clusters on IBM Flex System™ p460 Compute Nodes with IBM Storwize™ V7000 Unified

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Table of contents

Abstract ........................................................................................................................................... 2
Introduction .................................................................................................................................... 2
Prerequisites .................................................................................................................................. 3

About IBM Flex System p460 Compute Nodes and Flex System Manager .................................. 3
  IBM Flex System Enterprise Chassis .......................................................................................... 3
  IBM Flex System Manager (FSM) .............................................................................................. 4
  IBM Flex System p460 Compute Node ....................................................................................... 4

About IBM Storwize V7000 Unified .............................................................................................. 5

Oracle Database 11g Release 2 Real Application Clusters (RAC) .......................................... 6

Test environment ......................................................................................................................... 7
  Oracle RAC setup with IBM Flex System p460 Compute Nodes ............................................. 7
  IBM Storwize V7000 Unified configuration for Oracle RAC .................................................... 8
  Oracle Database 11g Release 2 with RAC software installation and database creation .......... 9
  Oracle workload generator tool “Swingbench” ........................................................................ 10

Test scenarios ................................................................................................................................ 10

Summary ..................................................................................................................................... 11

Acknowledgement ......................................................................................................................... 12

About the author ............................................................................................................................. 12

Resources .................................................................................................................................... 13

Appendix A - Configuring LUNs in the IBM Storwize V7000 Unified .......................................... 14

Appendix A - Configuring LUNs in the IBM Storwize V7000 Unified .......................................... 14
  IBM Storwize V7000 Unified with Easy Tier configuration ....................................................... 15
  Creating a Storage Pool .............................................................................................................. 15
  MDisk configuration .................................................................................................................. 17
  Adding SSD to the Storwize V7000 Unified storage pool ......................................................... 22
  Volume configuration ............................................................................................................... 25
  Mapping volumes to the host ...................................................................................................... 26

Trademarks and special notices .................................................................................................. 28
Abstract

This white paper is written to confirm that the Oracle Database 11g Release 2 (11.2.0.3) with Oracle Real Application Clusters (RAC) works on the newly introduced IBM Flex System™ p460 Compute Nodes with AIX® 6.1 along with the IBM Storwize® V7000 Unified. The information provided in this document is based on the experiences gained in a test environment in the IBM Oracle International Competency Center test labs.

IBM AIX 7.1 is also supported for implementing Oracle Database 11g Release 2 (11.2.0.3) with RAC on IBM Flex System p460 Compute Nodes.

This document provides a high level description of how to configure IBM Flex System p460 Compute Nodes for use with Oracle 11g Release 2 RAC environments. As phase one, the entire IBM Flex System p460 Compute Node was used as a RAC node without PowerVM features implemented. The phase2 of the tests used IBM PowerVM™ features running on the Compute Nodes using IBM Flex System Manager (FSM). A new white paper will be written for the phase 2 of the test to document our findings.

This document can be helpful for the Power Systems™ AIX system administrators for provisioning IBM Flex System p460 Compute Nodes for an Oracle RAC database environment. It also can be helpful for Oracle Database administrators to deploy Oracle Database in a single instance or RAC configuration confidently on IBM Flex System p460 Compute Nodes.

The set of test cases and scenarios executed on the IBM Flex System p460 Compute Nodes with Oracle Database and Oracle RAC confirms their interoperability and stability.

Introduction

In fast growing customer application computing environments, either cloud-based or conventional, data centers need an optimized hardware environment with virtualization capabilities and integrated, easy to use management software to manage the hardware and software components, optimized power management and redundant hardware components for high availability and scalability. On April 11, 2012 IBM introduced a new modular computing paradigm consisting of hardware and management software, the IBM PureFlex System to address these needs.

IBM Flex System p460 Compute Node is a versatile and fully optimized hardware environment which provides the infrastructure for deploying entry to enterprise-level applications. IBM Flex System p460 Compute Node combines POWER® processors, integrated Ethernet switches (1 GigE and 10GigE) and Fiber Channel switches, and disk storage in a single chassis. The single chassis houses all essential end-to-end hardware components to host any type of applications, from the database to the applications tier.

The purpose of deploying Oracle Database 11g Release 2 with RAC on the newly introduced IBM Flex System p460 Compute Nodes is to confirm the interoperability of the IBM Flex System p460 Compute Nodes with the Oracle Database. The deployment of Oracle Database 11g Release 2 with RAC on IBM Flex System p460 Compute Nodes is a comprehensive solution which provides a highly flexible and highly available environment for the database. This solution test demonstrates and proves that Oracle Database 11g Release 2 with RAC works well with IBM Flex System p460 Compute Nodes.

IBM Flex System p460 Compute Nodes offer customers a dynamic, versatile, virtualized Oracle Database computing environment designed to enable easy deployment the necessary hardware and software stack.
IBM Flex System p460 Power Compute Nodes and the IBM Flex System Enterprise Chassis are managed by the IBM Flex System Manager (FSM). The FSM has many advanced features which reduce the deployment time and management of hardware and software components transparently without affecting the current hardware and software stack in the chassis.

Prerequisites

The author assumes that the readers of this white paper have basic knowledge in the following areas.

- Oracle Database and Oracle Real Application Clusters concepts
- IBM AIX 6.1 and IBM Storwize V7000 Unified
- IBM Power Systems servers
- IBM PureFlex System Compute Nodes and Chassis

About IBM Flex System p460 Compute Nodes and Flex System Manager

IBM PureFlex System is an expert integrated system and new cross-brand hardware and software platform optimized for performance, scalability, high availability, and ease of management and automation. The basic components of IBM Flex System p460 are the Enterprise Chassis, the Compute Nodes and the I/O modules. All of these components are managed by the FSM as single point of control.

IBM Flex System p460 Compute Nodes in the IBM Flex System Enterprise Chassis are managed by the FSM with advanced features through a graphical user interface (GUI) and a command line interface (CLI).

IBM Flex System Enterprise Chassis

The IBM Flex System Enterprise Chassis houses collective hardware components such as Compute Nodes, networking, storage capabilities and FSM node. A single IBM Flex System Enterprise Chassis can hold up to 14 mixed POWER and x86 Compute Nodes. The rear of the chassis accommodates four high speed networking switches. These switches interconnect the Compute Nodes, networking, and SAN storage through a high performance and scalable mid-plane.
IBM Flex System Manager (FSM)

The FSM is management software preloaded in a dedicated IBM Flex System x240 Compute Node which is capable of managing more than one IBM Flex System Enterprise Chassis and their components, such as Compute Nodes, x86 nodes, and storage servers. This is used for provisioning the hardware environment with PowerVM virtualization features for AIX, IBM i, and Linux® logical partitions. The FSM is also used to apply firmware updates to the various system components, perform user management, manage security, control remote access of system elements, provide service-related support management, perform network element management, control energy management and it provides additional system management applications for both IBM and non-IBM appliances. The FSM is a single point of control for management of IBM Flex System p460 components.

IBM Flex System p460 Compute Node

Compute Nodes are designed to balance system performance with improved I/O capacity and reliability availability and serviceability (RAS). Up to over 35% of improvement in per core performance compared to previous generation of POWER blades was seen during internal IBM laboratory tests. The Compute Nodes come with either two sockets or four sockets each supporting up to eight POWER7® cores per socket. Each two or four socket Compute Node can have up to 512GB of memory.

Figure 1. IBM Flex System Enterprise Chassis

For more detailed information on IBM Flex System p460 Compute Nodes hardware components and supported network and I/O fabric components refer to the following link:

http://www.ibm.com/ibm/puresystems

Figure 2. IBM Flex System Manager Appliance

More information about the FSM can be found at the following link:

http://www.ibm.com/ibm/puresystems
For more information on various configurations of IBM Flex System p460 Compute Nodes, refer the following link:
http://www.ibm.com/ibm/puresystems

**About IBM Storwize V7000 Unified**

The IBM Storwize V7000 Unified is a dynamic, clustered, scalable, modular, flexible, high performance and cost effective midrange disk system. The IBM Storwize V7000 Unified provides advanced features such as Easy Tier®, Space Efficient FlashCopy®, thin provisioning, online data migration and much more. It supports high speed high-performing SSDs, SAS drives and Nearline SAS drives.

Easy Tier can enhance performance and reduce operating expenses by automating data movement by moving frequently accessed or updated data into high speed disks and less frequently accessed or updated data into high capacity slower disks. The Easy Tier function can be turned on or off as needed.

IBM Storwize V7000 Unified storage capacity and functionality can be added as needed over time with less disruption than with traditional midrange disk systems. It brings enterprise level technology to entry or midrange storage. IBM Storwize V7000 Unified provides a modular storage system that includes the capacity to virtualize external SAN-attached storage and its own internal storage. It is built on IBM SAN Volume Controller (SVC) technology as a base and uses technologies from the IBM System Storage DS8000® product family.

IBM Storwize V7000 Unified protects the data using data replication services such as FlashCopy, Metro Mirror (Synchronous) and Global Mirror (Asynchronous).

A simple and easy to use GUI is included with IBM Storwize V7000 Unified to allow storage to deploy quickly and efficiently. There is no need for a separate console. The management GUI contains a set of pre-established configuration options (presets) that use commonly used settings to quickly configure storage objects on the system. IBM Storwize V7000 Unified can also be managed through the IBM Systems Storage Productivity Center.
Oracle Database 11g Release 2 Real Application Clusters (RAC)

Oracle RAC is an option to cluster the Oracle Database on more than one Compute Node. Each Oracle Database instance running on a node can access a single database using a “shared everything” data architecture. This means that all data storage needs to be globally available to all cluster nodes. Oracle RAC is a clustered database with a shared cache architecture that allows data in the cache on the nodes to be made immediately available to client application requests, instead of accessing the data from the disks. The data moving between the nodes is travelling through a low latency, high speed, and dedicated private network interconnectivity between the nodes. Instances running on the cluster nodes communicate via cluster interconnect using Cache Fusion technology.

Oracle RAC provides high availability (HA) for data and flexible scalability to systems by allowing you to dynamically add more Compute Nodes or resources to the cluster as required. In addition, it also provides load balancing of the users’ requests across the nodes.

Client application user session connections to the database are equally distributed across the available Oracle RAC database instances. Many users’ queries are executed in parallel on the cluster nodes using local CPU and memory resources. A single large query can be executed on more than one RAC node using the Oracle Parallel query option.

Oracle provides its own proprietary cluster software for clustering Oracle Database nodes. Oracle Automatic Storage Management (ASM) provides volume and cluster file system management where the I/O subsystem’s LUNs are directly handled by the Oracle kernel.

Starting with Oracle Database 11g Release 2, Oracle Clusterware files can be stored in Oracle ASM. Oracle Clusterware and Oracle ASM, which together constitute the Oracle Grid Infrastructure, are installed into a single home directory called Grid Home.

Oracle Database binaries are installed in a separate directory called Oracle Home. Grid Home and Oracle Home can be placed either on a cluster file system to maintain a single copy of the software or can be placed on every node with their local storage. In our test environment, each cluster node has its own copy of the Grid Home and Oracle Home.

Oracle provides a cluster verification tool “cluvfy” that can be used to verify the Oracle RAC environment before, during and after the Oracle software stack (Grid Infrastructure and Oracle Database) installation. This tool shows any issues with Oracle RAC infrastructure components such as network, shared storage devices, IP addresses and OS software and hardware prerequisites.

Oracle provides a web based graphical management tool, the “Oracle Enterprise Manager”, for managing single instance Oracle Database or Oracle RAC deployments. This simplifies database and cluster administration via a central administration interface and also provides live performance advisories and performance monitoring capabilities.

For more information about Oracle RAC and for other related documents, refer to the following Oracle Database document library for Oracle 11g Release 2 in the following link:

http://www.oracle.com/pls/db112/portal.portal_db?selected=11
Test environment

For the testing done with Oracle Database 11g Release 2 with Oracle RAC a four socket Compute Node (model p460) was used with the following configuration.

- 4 sockets, 8 cores per socket with 3.55 GHz POWER7 processors
- 256 KB L2 cache per core
- 4 MB eDRAM L3 Cache per core
- 2 x 4 ports 10 GigE PCIe2 Mezzanine adapters
- 2 x dual port 8Gb FC Mezzanine adapters
- 128 GB RAM
- 2 x 10GigE Blade Network Technology (BNT) switches in chassis
- 2 x 8Gb FC switches in chassis
- RAID-capable SAS controller

The following storage configuration was used for the test environment:

- IBM System Storage Storwize V7000 Unified external storage
- Shared LUNs for the Oracle Database with Oracle RAC
- AIX 6.1 OS boot from SAN
- 5 x 1GB LUNs for Oracle RAC cluster
- 6 x 50GB LUNs for Oracle Database

The following software was used for the test environment:

- AIX 6.1 TL07 SP03
- SDDPCM Multipath software for IBM System Storage Storwize V7000 Unified
- Oracle 11g Release 2 with RAC version 11.2.0.3
- Oracle Patch set update 11.2.0.3.1 (13348650)
- “Swingbench” workload generator tool

Note: AIX7.1 TL01 SP03 also supported

Oracle RAC setup with IBM Flex System p460 Compute Nodes

During phase one of the laboratory tests, a two node Oracle Database 11g Release 2 with RAC implementation test was done using the entire Compute Node for each Oracle RAC instance.

The following diagram shows the setup of hardware, network, and SAN infrastructure for the tests.
In the above configuration, the Oracle RAC node private interconnectivity uses two interfaces per node. Starting with Oracle Database 11g Release 2 version 11.2.0.2, Oracle has introduced the Redundant Interconnect Usage feature for using more than one interconnect (up to four) between RAC nodes. The Redundant Interconnect Usage feature is operating based on a multiple-listening-endpoint architecture, in which Oracle Clusterware assigns highly available virtual IP (HAIP) address to each private network interface.

Oracle RAC uses all of the private interconnectivity interfaces and provides load balancing, high availability and failover protection.

There are two fiber channel adapter ports used per node. Each alternative port was connected to two fiber channel switches in the IBM Flex System Enterprise Chassis.

The AIX operating system was installed on a storage LUN from the IBM System Storage Storwize V7000 Unified. Shared LUNs were presented to the nodes from IBM Storwize V7000 Unified as well for Oracle Cluster Registry (OCR) files, voting files and Oracle RAC database files.

IBM Storwize V7000 Unified configuration for Oracle RAC

IBM Storwize V7000 Unified has easy to use GUI-based storage management software for managing disk drives local to the Storwize V7000 Unified and LUNs from other external storage devices such as IBM disk storage servers and non-IBM disk storage servers from other vendors and advanced copy services.

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Refer to Appendix A in this document for the detailed description of how the IBM Storwize V7000 Unified storage devices were configured for this testing.

**Oracle Database 11g Release 2 with RAC software installation and database creation**

Before installing the Oracle RAC software stack, the nodes were prepared based on the Oracle Database installation documentation and pre-requisite checks were made on the nodes. AIX default network parameter values were modified, “oinstall” and “dba” groups, “grid” and “oracle” OS users were created. Proper access permissions were set to the $GRID_HOME and Oracle Database home. Shared storage LUNs were filled with zeros using the “dd” command and set with “grid:oinstall” access permission.

For more detailed pre-installation requirement and setup, refer to the link given in the “References” section of this document.

Oracle Database 11g Release 2 version 11.2.0.3 Grid Infrastructure and the same version of Oracle Database binaries were installed on the local file systems (JFS2) in the nodes. At end of the Grid Infrastructure installation, a script “root.sh” was executed on the nodes as “root” user. Generally, if “root.sh” is successfully completed, the installation is successful. If not, you need to diagnose the problem by looking at the log files located at $GRID_HOME/log directory, especially $GRID_HOME/log/<nodename>/alert<hostname>.log and $GRID_HOME/log/<hostname>/agent/crsd/oraagent directory. After fixing any problems either re-execute the “root.sh” as instructed in the My Oracle Support note 942166.1 “How to proceed from failed 11gR2 Grid Infrastructure (CRS) Installation” or deinstall the Grid Infrastructure software using the “deinstall” scripts that came along with the Oracle software packages which can be found in the $GRID_HOME/deinstall directory.

In our setup, “root.sh” was successfully completed and brought up the CRS services, ASM instances and Oracle listener successfully.

Two Oracle ASM disk groups were created. The “OCRVOTE” disk group was created with “normal” redundancy for Oracle OCR and voting disks and the “DATA” disk group was created with “external” redundancy for the RAC database. Creating the “OCRVOTE” disk group was done when running “root.sh” and the disk group “DATA” was created manually using oracle “asmca” tool.

After the Grid Infrastructure and database binaries were installed successfully, patch “p13348650” was installed for both Grid Infrastructure and database binaries on both nodes.

Oracle RAC Database was created using Database Configuration Assistant (DBCA) tool with custom configuration method. About 64GB of memory (System Global Area and Program Global Area) assigned to each Oracle Database instance. The file sizes of UNDO tablespaces and TEMP tablespaces were increased. The Oracle Database redo log files sizes were increased to 2GB. The Oracle Database system parameter “processes” modified to 3000 and “filesystemio_options” set to “SETALL”. The database was created successfully and added to the Oracle CRS stack automatically.

We then created a database service to implement Oracle Transparent Application Failover (TAF) for keeping the database queries and sessions running on the database while the database instance is going down as part of the tests.
For more information on Oracle RAC software installation, refer to the Oracle Database documentation libraries for 11g Release 2 (11.2) for AIX operating system at:

http://www.oracle.com/pls/db112/portal.portal_db?selected=11&frame=

### Oracle workload generator tool “Swingbench”

Oracle Database 11g with RAC on IBM Flex System p460 Compute Nodes was tested using the Java™-based free Oracle workload generator tool “Swingbench” version 2.4. Swingbench version 2.4 in AIX 6.1 requires IBM Java version 6 (64-bit version). This tool is designed to stress test Oracle Database versions 10g and 11g. This tool creates various sample schemas such as SalesOrderEntry, SalesHistory and CallingCircle. For testing Oracle RAC on the IBM Flex System p460 Compute Nodes environment, SalesOrderEntry schema was created and loaded with about 200GB of data.

After the database was populated with data in the SalesOrderEntry schema, the workload was started with 1000 concurrent users doing about 70% reads and 30% writes, we then increased the number of users to 1500 dynamically.

The Swingbench tool has GUI based driver to start and monitor the workload on the RAC nodes. It shows performance numbers for the workload such as number of transactions per second, average response time and different characteristics of the workload. It has other components “coordinator” and “clusteroverview” for sophisticated workload monitoring for the Oracle RAC nodes.

For our testing, the Swingbench tool was setup on a separate AIX 6.1 logical partition (LPAR) with Oracle Database 11g Release 2 client version 11.2.0.3.

### Test scenarios

The interoperability of Oracle Database 11g Release 2 with RAC on IBM Flex System p460 Compute Nodes was tested with various test scenarios. Some of the test cases we used in our testing were:

1. Stress testing the database instances by connecting more than 1000 concurrent users doing online transaction processing concurrently with fewer users doing full table scans for more than 24 hours
2. Planned instance and node outages
3. Unplanned instance and node outages
4. Simulating Oracle RAC instance failures
5. Oracle CRS process failures, node eviction and node re-joining with the cluster
6. Hardware destructive testing covered the public network down, master RAC node failure, Oracle private interconnect network failure, Fiber channel disk and adapter port failure, network interconnect switch failure, Fiber channel redundant switch failure, whole site failure
7. Software destructive tests and human errors were also introduced in the scenarios

All of the above tests were successfully completed and showed the expected behaviors and results.
Summary

The interoperability test of Oracle Database 11g Release 2 with RAC on IBM Flex System p460 Compute Nodes proves that the Oracle Database with RAC works as expected on this platform and demonstrates the readiness of IBM Flex System p460 Compute Nodes for deploying the Oracle Database in a single instance or with RAC. The IBM Flex System p460 components in the Enterprise Chassis, processor, I/O and network components in the Compute Nodes and their capabilities provide a highly available, scalable, high speed and optimized computing environment for running the Oracle Database and associated applications.
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- Jenny Li
- Kathryn Arrell
- Wayne T. Martin

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Resources

The following websites provide useful references to supplement the information contained in this paper.

- IBM PureFlex System
- IBM PowerVM virtualization Introduction and configuration
- Implementing IBM Storwize V7000
- Oracle database Document Libraries for 11g Release 2(11.2)
Appendix A - Configuring LUNs in the IBM Storwize V7000 Unified

An IBM Storwize V7000 Unified was used for providing storage for installing AIX 6.1 (SAN Boot) on the hosts and shared storage for the Oracle Database 11g Release 2 with RAC cluster (OCR and voting disks) and database files. The following procedures explain the way the Storage LUNs were configured for the test environment documented in this paper.

To configure IBM Storwize V7000 Unified you must first login to the storage manager software.

Figure 5. Storage manager login page
IBM Storwize V7000 Unified with Easy Tier configuration

Start from the “Getting Started” page on the GUI, as shown in the following figure.

**Figure 6. Getting started with the storage configuration**

Creating a Storage Pool

A new Storage Pool dedicated for internal storage has been created.

Clicking on the New Pool button brings up the “Create Storage Pool” pop-up window. For our test we have created a Storage Pool called POOL_NGP1, by entering the name of Storage Pool and clicking the “Next” button.

**Figure 7. Storage pool creation**

The “Next” button takes us to the following screen, there are no MDisks (Managed Disks) that are currently available to be added to the Storage Pool. MDisk is a logical unit of a physical storage. MDisks
are either RAID arrays from internal storage of IBM Storwize V7000 Unified or volumes from external storage systems), click on the “Finish” button.

**Figure 8. Warning message**

This brings up a warning message asking if we want to create an empty pool. Click on the OK button to continue.

The figure below shows the command that gets executed to create the Storage Pool in the background.

**Figure 9. Create Storage Pool command**
The figure below shows the Storage Pool “POOL_NGP1” has been created.

![Storage Pool Creation](image.png)

**Figure 10. Storage pool creation confirmed**

**MDisk configuration**

In the IBM Storwize V7000 Unified, the initial setup wizard prompts the user to use the fully-automated RAID setup. The users also can do a customized RAID setup by selecting “a different configuration”. In general, fully-automated RAID setup is recommended for novice users. In this setup example, “a different configuration” has been used. In this step, first select the drive class. The GUI then provides a preset list based on the drive class. You can decide whether to configure spares automatically, and optimize the array for performance or capacity. You can also indicate the number of drives to be provisioned. The configuration summary at the bottom of the page displays information on what the system will attempt to do, or indicate that it cannot meet the RAID creation requirement.

Click on the “Configure Storage” button as shown in the figure below,

![Configuration Storage](image.png)

**Figure 11. Configure Storage process screen**

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Next, you will see the “Configure Internal Storage” pop-up window. Click the “Select a different configuration” radio button and then click the “Next” button. Then click “Select a preset...” from the drop down menu as shown in the figure, and then click the “Next” button.

![Configure Internal Storage window](image)

**Figure 12. Configure Internal Storage window**

With the Optimize for Performance option selected, all arrays in a pool will have the same performance characteristics, and potentially leave unused drives in the system. The Optimize for Capacity option uses all drives in the system, which means that some of the arrays might not meet the array width goals. It will do this by reducing the number of drives in one or more arrays to be created by an equal amount, and you will get an optimal performance layout (all arrays have the same width, or the width with one drive more or one drive less, but the width will not be the same as the width goal).
Figure 13. Configuration Summary

Note: If the perfect number of drives exists, the Optimize for Capacity option creates the same layout as the Optimize for Performance option. Both algorithms are explained in the IBM Redbook, “Implementing the IBM Storwize V7000” at: www.ibm.com/redbooks/redpieces/abstracts/sg247938.html?Open.
The following figure shows choices for expanding the existing pool or creating new pool(s). “Expanding existing pool” was selected in our setup for adding space for “POOL_NGP1”.

![Configuration Internal Storage](image)

**Figure 14. Expanding the existing pool**

Click the “Finish” button, which completes creating the RAID array as shown in the following figure.

![Create RAID Arrays](image)

**Figure 15. Create RAID Array process**
The same MDisk creation (RAID array) procedures are repeated to create two more MDisks for the POOL_NGP1 pool. The following figure shows the MDisks for POOL_NGP1 and their status.

Figure 16. MDisks and status

The figure below shows the internal drives with an “Online” status after the MDisks were configured.

Figure 17. Verifying drive status

So far, managing the internal HDDs and SDDS are completed. Next, the internal SSDs will be managed.
Adding SSD to the Storwize V7000 Unified storage pool

Click on the “Configure Storage” button to create the SSD MDisk. The Configure Internal Storage window will pop-up as shown in the figure below.

Figure 18. Configure Internal Storage window

Click on the “Select a different configuration” radio button to select a preset configuration as shown below.

Figure 19. Select a different configuration
Select “SSD Easy Tier” from the Preset drop down menu as shown. We used 2 x SSD drives with RAID10 for the new MDisk, and then clicked the “Next” button.

Figure 20. Creating the SSD MDisk
Next select “Expand existing pool” to add this new MDisk to pool “POOL_NGP1”.

Figure 21. Add new MDisk to IBM Flex System p4601 pool

The figure below shows the newly created SSD MDisk mdisk3.

Figure 22. Verify new MDisk creation
The following figure shows the storage pool “POOL_NGP1” with the SSD MDisk, and with Easy Tier active.

![Storage Pool Figure](image)

Figure 23. New mdisk3 verified online

Move the mouse pointer over a MDisk name, for example: mdisk0. Then right-click and click “Properties”. This shows the details of the volume in the three tabs: Overview, Dependent Volumes, and Member Drives.

### Volume configuration

A volume is a logical disk that is presented to a host system by the IBM Storwize V7000 Unified. The IBM Storwize V7000 Unified storage system translates this volume into a number of extents which are allocated across MDisks present in the storage pool.

On the left pane, click “Volumes by Pool” on the pop-up menu and then click “New Volume” to launch the New Volume wizard. Then select the storage pool from which you want to create volumes. The following figure shows the volumes which were created for the Oracle Database 11g Release 2 with RAC testing.
Figure 24. Volume creation

Enter the volume name and the size of the volume that you need to create. Then click the “+” sign to create additional volumes.

**Mapping volumes to the host**

A host system is connected to the Storwize V7000 Unified system through either a Fiber Channel connection or an iSCSI connection. For the Oracle RAC testing documented in this paper, Fiber Channel connectivity from the host to the IBM Storwize V7000 Unified system is used. Hosts are defined to IBM Storwize V7000 Unified by identifying their WWPNs for Fiber Channel hosts.

After viewing the details, when you click “Continue”, the Modify Mappings dialog box is displayed. In this example, the volumes are mapped to the Oracle RAC nodes, which are selected from the list.

Click “Next” to navigate to the “Modify Mappings” screen. Once you click “OK”, you can see that the volumes are mapped to the host.

In the figure below you can see that volume RAC1_db1 has been mapped to hosts “VIO1-A75A” and “VIO2-A75A”.

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At this stage, the volumes that are mapped to the hosts in the IBM Storwize V7000 Unified are visible in the hosts.

Figure 25. Volume mapping
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