Rapid Deployment and Scale Out for Oracle E-Business Suite Enabled by EMC RecoverPoint, EMC Replication Manager, and VMware vSphere

A Detailed Review

Abstract

This white paper describes a process for rapid provisioning of Oracle E-Business Suite test and development environments. The solution extends an existing disaster recovery infrastructure. EMC® RecoverPoint is used to replicate a physical production environment to a virtualized VMware vSphere environment, across heterogeneous storage platforms (EMC Symmetrix® VMAX™ and EMC CLARiiON® CX4-960). EMC Replication Manager, EMC SnapView™, and VMware templates are used to create new test environments on demand.
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Executive summary

Business case
Complex business applications like Oracle E-Business Suite (EBS) undergo repeated cycles of development, testing, and maintenance over their lifetime. Administrators and development teams are increasingly under pressure to deploy new test and development (test/dev) environments—quickly and reliably, without impacting the production environment.

Provisioning of Oracle EBS test/dev environments involves creating copies of the production environment and reconfiguring these to function independently. The lengthy preparation process for provisioning new test/dev environments impacts the time to deployment of new applications and releases, and can lead to increased administrative and project-related costs.

Reducing the time and costs associated with provisioning multiple test/dev environments is critical for organizations that rely on Oracle EBS for their business applications.

This white paper demonstrates an automated, repeatable, and scalable solution for rapid, on-demand provisioning of multiple, virtualized Oracle EBS test/dev environments.

Solution overview
The solution infrastructure can be purpose built for test/dev provisioning or can extend a pre-existing disaster recovery (DR) infrastructure. This solution extends an existing DR infrastructure that uses EMC® RecoverPoint to replicate a two-node Oracle RAC EBS physical production environment to a VMware vSphere ESX 4.0 cluster at the DR site. An EMC Symmetrix® VMAX™ array provides the storage at the production site; an EMC CLARiiON® CX4-960 provides the storage at the remote DR site.

The solution integrates EMC Replication Manager within the EMC RecoverPoint infrastructure. This enables automated cloning of the Oracle EBS environment and automated provisioning of multiple, independent copies of the environment for test/dev purposes. Replication Manager uses EMC SnapView™ technology, in conjunction with Oracle Rapid Clone scripts, to create application-consistent clones and snapshots of the replicated environment. VMware templates are used to provision virtual machines for hosting these copies, enabling rapid and repeatable scale out.

Solution benefits
The key benefits of the solution include:

- **Agility:** The solution replicates Oracle EBS environments across heterogeneous storage arrays using EMC RecoverPoint. This allows organizations flexibility in their selection of target DR and test/dev environments where these platforms do not need to meet the performance characteristics of the production environment.

- **Automation:** By using Replication Manager’s sophisticated automation capabilities, together with virtualized environments created using VMware templates, the entire process of replicating, provisioning, and deploying test Oracle EBS environments requires minimal user interaction.
The processes are automated and repeatable, allowing for rapid, on-demand, and scheduled provisioning of new environments. This can improve support response times to production issues and reduce build and maintenance costs, helping an organization to maintain its SLAs.

- **Flexibility**: Multiple, independent copies can be rapidly provisioned for various test purposes, with minimal impact to the production environment. These virtualized environments enable administrators to isolate individual operating systems (OSs) for patching and upgrading, and to isolate entire application stacks for performance tuning and testing.

- **Security**: Integrated data cleansing ensures that test/dev environments comply with regulatory requirements by not revealing sensitive information to unauthorized personnel.

- **Consolidation**: Server sprawl is contained by deploying the test/dev environments on virtual machines. This optimizes the use of resources and provides significant cost savings on hardware and energy consumption.
Introduction

Purpose
This white paper presents a solution for on-demand provisioning of test/dev environments using EMC RecoverPoint, EMC Replication Manager, EMC SnapView, and VMware templates.

Scope
The scope of this paper is to:
- Document details of the DR infrastructure on which the solution is based
- Describe the processes involved in configuring automated provisioning of test/dev environments using RecoverPoint, Replication Manager, and VMware templates
- Document the procedures for on-demand creation and refreshing of test/dev environments
- Present the business benefits of the solution

Audience
This white paper is intended for EMC employees, partners, and customers, including Oracle, storage, and virtualization administrators, who want to understand how to build or extend a RecoverPoint DR infrastructure for rapid, on-demand provisioning of test environments on virtual machines.

It is assumed that the reader is familiar with the following EMC, VMware, and Oracle products:
- EMC RecoverPoint and EMC Replication Manager
- VMware vSphere and VMware templates
- EMC Symmetrix VMAX and EMC CLARiiON storage
- Oracle Database 11g R1 Enterprise Edition, Oracle RAC, Oracle ASM, and Oracle E-Business Suite Release 12
**Terminology**

This white paper includes the following terminology and acronyms.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASM</td>
<td>Oracle Automatic Storage Management</td>
</tr>
<tr>
<td>CDP</td>
<td>Continuous data protection</td>
</tr>
<tr>
<td>CLR</td>
<td>Concurrent local and remote replication</td>
</tr>
<tr>
<td>CRR</td>
<td>Continuous remote replication</td>
</tr>
<tr>
<td>DR</td>
<td>Disaster recovery</td>
</tr>
<tr>
<td>EBS</td>
<td>Oracle E-Business Suite</td>
</tr>
<tr>
<td>NFS</td>
<td>Network File System</td>
</tr>
<tr>
<td>PP/VE</td>
<td>EMC PowerPath®/Virtual Edition</td>
</tr>
<tr>
<td>RAC</td>
<td>Oracle Real Application Clusters</td>
</tr>
<tr>
<td>RDM</td>
<td>Raw Device Mapping</td>
</tr>
<tr>
<td>RPA</td>
<td>RecoverPoint appliance</td>
</tr>
<tr>
<td>RPO</td>
<td>Recovery point objective – the maximum acceptable time period between the last available consistent image and a disaster or failure</td>
</tr>
<tr>
<td>RTO</td>
<td>Recovery time objective – the maximum acceptable time to bring a system or application back to operational state after a failure or disaster</td>
</tr>
<tr>
<td>ST</td>
<td>System testing – testing conducted on a complete, integrated system to evaluate the system’s compliance with its specified requirements</td>
</tr>
<tr>
<td>UT</td>
<td>Unit testing – a software verification and validation method in which a programmer tests if individual units of source code are fit for use</td>
</tr>
<tr>
<td>VMFS</td>
<td>Virtual Machine File System</td>
</tr>
<tr>
<td>VSI</td>
<td>EMC Virtual Storage Integrator</td>
</tr>
</tbody>
</table>
Key technology components

Overview

The solution uses the following EMC information infrastructure hardware and software components:

- EMC Symmetrix VMAX
- EMC CLARiiON CX4-960
- EMC RecoverPoint
- EMC Replication Manager
- EMC Solutions Enabler
- EMC Navisphere®
- EMC SnapView
- EMC PowerPath/Virtual Edition (PP/VE)
- EMC Virtual Storage Integrator (VSI)

The solution uses the following Oracle and VMware technologies:

- VMware vSphere, VMware vCenter, and VMware templates
- Oracle Database 11g R1 Enterprise Edition, Oracle RAC, and Oracle ASM
- Oracle E-Business Suite Release 12

EMC Symmetrix VMAX

The EMC Symmetrix VMAX is a high-end, enterprise storage array comprising a system bay and separate storage bays. The system scales from a single high-availability (HA) node configuration to eight-node configurations with up to 10 bays. Each VMAX Engine contains two Symmetrix VMAX directors with extensive CPU processing power, physical memory, front-end ports, and back-end ports.

Symmetrix VMAX systems deliver scalable performance that meets the most demanding access, protection, and distribution requirements. They provide three-tier storage within a single array. Enterprise Flash Drives (EFDs), Fibre Channel (FC) drives, and Serial Advanced Technology Attachment (SATA) are all supported, as well as an extensive range of RAID types.

EMC CLARiiON CX4-960

EMC CLARiiON model CX4-960 provides a powerful networked storage system that scales seamlessly (up to 1,899 TB of capacity) so more applications can be consolidated. The CLARiiON CX4-960 combines CLARiiON’s proven five 9s (99.999 percent) availability with innovative, future-ready technologies such as Fully Automated Storage Tiering, Flash drives, CLARiiON Virtual Provisioning™, UltraFlex™ technology, a 64-bit operating system, and multi-core processors.

EMC CLARiiON CX4 arrays also support RecoverPoint replication through an integrated splitter. This simplifies CLARiiON CX4 deployments and enables local and remote replication for any-point-in-time recovery without requiring intelligent fabric splitting.
EMC RecoverPoint

EMC RecoverPoint is an enterprise-class data protection, replication, and disaster recovery solution designed to protect application data on heterogeneous SAN-attached servers and storage arrays. It supports local continuous data protection (CDP), continuous remote replication (CRR), and concurrent local and remote (CLR) data protection enabling local and/or remote application recovery to any point in time.

RecoverPoint is appliance-based, which enables it to better support large amounts of information stored across heterogeneous environments. It uses lightweight splitting technology, on the application server, in the fabric, or in a CLARiiON array, to mirror application writes to a RecoverPoint appliance (RPA) that resides outside of the primary data path. This out-of-band approach enables RecoverPoint to deliver continuous replication without impacting an application’s I/O operations.

For remote replication, RecoverPoint uses powerful bandwidth reduction and compression technologies to minimize the use of bandwidth and dramatically reduce the time lag between writing data to storage at the source and target sites – for local replication and synchronous remote replication, the lag is zero.

RecoverPoint records all data changes in a journal, with each image in the journal bookmarked and time-stamped for instant, point-in-time recovery.

The consistency and write-order fidelity of point-in-time images are assured by RecoverPoint’s use of replication sets and consistency groups. A replication set defines an association between a production source volume and its replica. A consistency group logically groups replication sets that must be consistent across one another.

RecoverPoint replication is policy-driven. A replication policy, based on a particular business need, can be uniquely specified for each consistency group. This governs the replication method for that consistency group – for example, setting the data compression and bandwidth reduction options.

EMC Replication Manager

EMC Replication Manager provides a common user interface for managing EMC point-in-time replication technologies such as RecoverPoint and SnapView. It coordinates the entire data replication process, from discovery and configuration to management of multiple, application-consistent, disk-based replicas.

With Replication Manager, it is possible to discover a replication environment and enable streamlined management of replica creation, mounting, and expiry. Replicas can be created on demand or based on schedules and policies that the customer defines.

Replication Manager consists of the following software components:

- **Replication Manager Server**
  The component that manages replicas. It stores metadata about users, hosts, replicas, and ongoing operations, and sends commands to Replication Manager agents to perform operations relating to application replication.

- **Replication Manager Agent**
  Replication Manager communicates with hosts, arrays, and applications through the use of agents. Replication Manager Oracle Agent 5.2.4 components are installed on each host participating in the replication process.
- **Replication Manager Console**
  The GUI that enables the user to control the server and agent software locally or remotely. This component also includes a command line interface.

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**EMC Solutions Enabler**

EMC Solutions Enabler SYMCLI is a specialized library consisting of commands that can be invoked from the command line, or within scripts. These commands can be used to monitor device configuration and status, and perform control operations on devices and data objects within a managed storage complex.

Solutions Enabler 7.7.1.017 is a prerequisite for installing the Replication Manager Oracle Agent and must be available on the source and target database servers before installing the agent.

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**EMC Navisphere**

The EMC Navisphere Management Suite of integrated software tools allows you to manage, discover, monitor, and configure EMC CLARiiON systems as well as control all platform replication applications from an easy-to-use, secure, web-based management console.

Navisphere Secure Command Line Interface (naviseccli) provides a comprehensive CLI solution for storage-system management, including storage provisioning, status and configuration information retrieval, and control. You can use the CLI to automate management functions through shell scripts and batch files.

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**EMC SnapView**

EMC SnapView software provides powerful replication capabilities for creating local point-in-time snapshots and complete data clones on CLARiiON storage. Replication Manager provides the user-friendly, point-and-click interface for automating creation, management, and usage of these snapshots and clones.

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**EMC PowerPath/Virtual Edition**

EMC PowerPath/Virtual Edition (PP/VE) delivers EMC PowerPath multipathing functionality to virtual environments. PP/VE works with the storage system to intelligently manage I/O paths, and supports multiple paths to a logical device.

For customers standardizing on VMware, PP/VE provides access to flexible and automatic I/O load balancing to manage the complexity of virtual machines and I/O-intensive applications in hyper-consolidated environments.

- PP/VE intelligently distributes I/O requests to a logical device across all available paths. This improves I/O performance and reduces management time and downtime by eliminating the need to configure paths statically across logical devices.
- In the event of a hardware failure, PP/VE automatically detects path failure and redirects I/O to alternate path.

In the solution, PP/VE provides load balancing on the virtualized DR site.
VMware vSphere can transform your IT infrastructure into a private cloud, then bridge on-demand to public clouds, delivering IT infrastructure as an easily accessible service. It delivers uncompromised control over all IT resources with the highest efficiency and choice in the industry.

With VMware vSphere, businesses can dramatically reduce capital and operational expenses, while minimizing any potential lost revenue associated with downtime, outages, and failures. It reduces capital and operational expenses per application by more than 50 percent through virtualization of server, storage, and networking resources.

This solution uses the following VMware products:

- **VMware vSphere 4**
  The industry’s most widely deployed virtualization platform, vSphere abstracts applications and information from the complexity of underlying infrastructure, through comprehensive virtualization of server, storage, and networking hardware.

- **VMware vCenter**
  A scalable and extensible platform for centralized management of VMware vSphere environments, providing control and visibility at every level of the virtual infrastructure.

- **VMware virtual machine templates**
  In VMware, a template is a master copy of a virtual machine that can be used to quickly create and provision virtual machines.
By using a template, a guest OS can be installed and patched to a virtual machine, and application users and software configured ready for use, with minimal user intervention. This minimizes deployment time and avoids repetitive installation and configuration tasks for each virtual machine that is required.

Customization Specifications, held in vCenter, further simplify rollout of virtual machines. A deployment wizard uses these to automatically precreate or request server settings (such as server name, time zone, and network configuration) prior to building the new virtual machine.

**EMC Virtual Storage Integrator (VSI) v.3.0 for vSphere Client**

This provides Storage Viewer (SV) and Storage Pool Management (SPM) functionality. SV functionality extends the vSphere Client to facilitate the discovery and identification of EMC Symmetrix, EMC CLARiiON, and EMC Celerra® storage devices that are allocated to VMware ESX/ESXi hosts and virtual machines. VSI for vSphere Client presents the underlying storage details to the virtual data center administrator, merging the data of several different storage mapping tools into a few seamless vSphere Client views. VSI enables you to resolve the underlying storage of Virtual Machine File System (VMFS) and Network File System (NFS) datastores and virtual disks, as well as raw device mappings (RDM).

**Oracle**

This solution uses the following Oracle products:

- **Oracle Database 11g R1 Enterprise Edition**
  Oracle Database 11g Enterprise Edition delivers industry-leading performance, scalability, security, and reliability on a choice of clustered or single servers running Windows, Linux, and UNIX. Oracle Database 11g Enterprise Edition comes with a wide range of options to help grow your business and meet users' performance, security, and availability service level expectations.

- **Oracle RAC**
  Oracle Real Application Clusters (RAC) is an optional feature of Oracle Database 11g Enterprise Edition. Oracle RAC supports the transparent deployment of a single database across a cluster of servers, providing fault tolerance from hardware failures or planned outages. If a node in the cluster fails, Oracle continues running on the remaining nodes—if more processing power is needed, new nodes can be added to the cluster.

- **Oracle ASM**
  Oracle Automatic Storage Management (ASM) is an integrated database file system and disk manager. It can reduce the complexity of managing storage for the database. The ASM file system and volume management capabilities are built into the Oracle database kernel.

  In addition to providing performance and reliability benefits, ASM can also increase database availability as disks can be added or removed without shutting down the database. ASM automatically rebalances the database files across an ASM diskgroup after disks have been added or removed.
• **Oracle ASMLib**
  Oracle ASMLib is a support library for the Oracle ASM. It is an add-on module that simplifies the management and discovery of ASM disks. The ASMLib provides an alternative to the standard operating system interface used by ASM to identify and access block devices.

  ASMLib is composed of the actual ASMLib library, which is loaded by Oracle at Oracle startup, and a kernel driver that is loaded into the OS kernel at system boot. The kernel driver is specific to the OS kernel.

• **Oracle E-Business Suite Release 12**
  Oracle E-Business Suite (EBS) is a comprehensive suite of integrated business applications based on Oracle's core database management system technology. It provides a complete and integrated system for managing and optimizing enterprise-wide processes. Oracle EBS Release 12 has numerous configuration options that can be chosen to suit particular business scenarios, uptime requirements, hardware capability, and availability requirements.
Solution environment

Architecture

The solution presented in the paper extends a pre-existing DR infrastructure for Oracle E-Business Suite applications. The following diagram depicts the solution architecture.

The production system is a physical Oracle EBS R12 Vision environment consisting of a two-node shared APPL_TOP application tier and a two-node Oracle RAC database tier. The physical servers are connected by FC SAN to EMC Symmetrix VMAX storage.

The DR system consists of a VMware vSphere ESX 4.0 cluster running on two physical hosts. The physical servers are connected by FC SAN to CLARiiON CX4-960 storage.
### Profile

The following table shows the solution profile.

<table>
<thead>
<tr>
<th>Details</th>
<th>Quantity/Type/Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database size</td>
<td>300 GB (standard Vision instance size)</td>
</tr>
<tr>
<td>Database profile</td>
<td>OLTP</td>
</tr>
<tr>
<td>Network connectivity</td>
<td>GbE</td>
</tr>
<tr>
<td>SAN protocol</td>
<td>4 Gb FC</td>
</tr>
</tbody>
</table>

### Hardware environment

The following table shows the hardware environment for the solution.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production site storage</td>
<td>Symmetrix VMAX, with:</td>
</tr>
<tr>
<td></td>
<td>• Enginuity™ 5874.230.183</td>
</tr>
<tr>
<td></td>
<td>• 2 x VMAX 64 GB engines</td>
</tr>
<tr>
<td>DR site storage</td>
<td>CLARiiON CX4-960, with</td>
</tr>
<tr>
<td></td>
<td>• FLARE® 29 (4.29.000.5.003)</td>
</tr>
<tr>
<td>Oracle EBS application tier (production site)</td>
<td>2 x Quad CPU, 96 GB RAM</td>
</tr>
<tr>
<td>VMware vSphere ESX cluster (DR site)</td>
<td>2 x Quad CPU, 96 GB RAM</td>
</tr>
<tr>
<td>FC switches</td>
<td>4 Gb FC switches, 2 per site</td>
</tr>
<tr>
<td>Ethernet switches</td>
<td>Gigabit Ethernet switches, 2 per site</td>
</tr>
<tr>
<td>Splitters</td>
<td>• Intelligent fabric splitter (production site)</td>
</tr>
<tr>
<td></td>
<td>• CLARiiON CX-based splitter (DR site)</td>
</tr>
<tr>
<td>RecoverPoint appliances, GEN 4</td>
<td>2-node cluster per site</td>
</tr>
</tbody>
</table>

### Software environment

The following table shows the software used for the solution.

<table>
<thead>
<tr>
<th>Software</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle Database 11g Release 1</td>
<td>• 2-node RAC at physical, production site</td>
</tr>
<tr>
<td></td>
<td>• Single instance at virtualized DR site</td>
</tr>
<tr>
<td>Oracle E-Business Suite Release 12.1</td>
<td>Pre-configured Vision instance (300 GB initial size)</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 5.3</td>
<td>Server version for x86_64 – installed on all physical and virtual servers</td>
</tr>
<tr>
<td>Microsoft Windows Server 2003</td>
<td>Deployed on the virtual machine running management applications such as Replication Manager Server and Console and vSphere vCenter</td>
</tr>
</tbody>
</table>
VMware vSphere 4  |  • ESX 4.0 server  
|  • vCenter Server 4.0

EMC Navisphere 6.29.5.0.66-1 | Deployed on the hosts connected to the CLARiiON

EMC RecoverPoint 3.3 Patch 2 | Installed on each of the 4 RPAs

Replication Manager 5.2.4 | Installed on a vSphere 4 virtual Microsoft Windows 2003 machine

EMC Replication Manager client 5.2.4 (agent software) | Installed on the 4 physical servers on the production site and on all virtual machines on the DR site

EMC SnapView Enabler 29.0.6.34 | Installed on the CLARiiON array

PowerPath/VE 5.4.SP1 | Deployed on ESX servers on DR site

PowerPath Remote CLI 5.4.1 | Installed on management host for monitoring and configuration of PowerPath on ESX hosts

Solutions Enabler 7.1.017 | Installed on production and DR site database servers

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**Storage requirements**

The following table details the database and application storage volumes provisioned for CRR of Oracle EBS by RecoverPoint.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Symmetrix capacity (GB)</th>
<th>CLARiiON device capacity (GB)</th>
<th>Additional copies on CLARiiON array</th>
<th>RecoverPoint consistency group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>500</td>
<td>500</td>
<td>1</td>
<td>db_tier</td>
</tr>
<tr>
<td>FRA</td>
<td>100</td>
<td>100</td>
<td>1</td>
<td>db_tier</td>
</tr>
<tr>
<td>Oracle binaries</td>
<td>20</td>
<td>20</td>
<td>1</td>
<td>oracle_bin</td>
</tr>
<tr>
<td>APPL_TOP</td>
<td>450</td>
<td>450</td>
<td>1</td>
<td>appl_top</td>
</tr>
</tbody>
</table>

---

**Oracle E-Business Suite logical configuration**

The production Oracle EBS environment is configured with a shared APPL_TOP, two application servers, and a separate database tier. The Infrastructure Server provides a shared APPL_TOP file system (over NFS) to each of the other Oracle E-Business Suite servers. It also performs the function of a software-based network load balancer.

Two application servers are deployed, running the following Oracle EBS services: Web, Form, and Parallel Concurrent Processing. The database tier is provided by an Oracle Database configured on two-node Oracle RAC 11g R1. No Oracle EBS application tier services were configured to run on these nodes.

The replication process is designed to create virtualized Oracle EBS test environments, each configured with a single Application Server with its own APPL_TOP and a separate database tier with a single-instance Oracle 11g database.
The following diagrams show the logical configuration of Oracle EBS for both the production environment and the virtualized test environment.

The RecoverPoint replication flow is as follows:

- Replication of the production environment to the virtualized DR environment is performed by RecoverPoint, with a two-node RPA cluster deployed on both sites.
- Each write from the production application is intercepted by an intelligent fabric splitter, which sends one copy to the Symmetrix VMAX array and a second copy to the local RPA. The RPA applies data bandwidth reduction and data compression and transmits the data to the remote site. The RPA at the remote site verifies the checksums and the data is then uncompressed and written to the remote RecoverPoint journal. Once the data is safely in the journal, it is distributed to the target replica volumes on the CLARiiON CX4-960 array.
Building and cloning multiple Oracle EBS environments is an essential part of Oracle EBS application lifecycle management.

The standard Oracle methods for deploying new environments are largely manual (see the References section of this white paper for further information). Therefore they are labor-intensive and can be prone to error. Oracle EBS environments can be provisioned in minutes as opposed to hours with the method used for this solution.

- The virtual machines required by the solution were deployed on the DR infrastructure using VMware virtual machine templates, creating multiple copies of the Oracle EBS environment for DR and test purposes (see VMware virtual machine deployment).

The APPL_TOP and DB tiers for each environment were mounted on separate virtual machines, with a total of 10 virtual machines required for the solution.

- Creation and management of the Oracle EBS copies were controlled and automated by Replication Manager. The overall process has three phases, as follows:

  - **Phase 1: RecoverPoint bookmark**
    Create RecoverPoint point-in-time bookmark images (BKM) of the replicated database and application tiers.

  - **Phase 2: SnapView clone (cleansed)**
    Create a SnapView Clone copy (CLN) of each bookmark, and cleanse the cloned database of any sensitive information.

  - **Phase 3: SnapView snapshots**
    Use the CLN clones as the source for multiple test environments created using SnapView Snap. For the solution, three snapshot copies were created: one for quality assurance (QA), one for system testing (ST), and one for unit testing (UT). Others can be created on demand using the same procedures.
The following image shows the application sets, jobs, and virtual machines involved in the replication process and its three phases.

**Phase 1: Create RecoverPoint bookmark images**

1. Run RM Job blmoutside_bln
2. Run RM Job blm_db tiers
3. Run RM Job blm_appl_tap

**Phase 2: Create SnapView clones (cleansed)**

4. Run RM Job cln_oracle_bln
5. Run RM Job cln_db tiers
6. Run RM Job cln_appl_tap

**Phase 3: Create SnapView snapshots (test/dev)**

7. Run RM Job qa_oracle_bln
8. Run RM Job qa_db tiers
9. Run RM Job qa_appl_tap

Repeat Jobs 7, 8, and 9 for ST and UT environments
RecoverPoint has been configured as follows for the solution:

- CRR is the replication method being used by RecoverPoint.
- Consistency groups are defined as follows:

<table>
<thead>
<tr>
<th>Consistency group</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>oracle_bin</td>
<td>Encompasses all the replication sets for the Oracle binary files</td>
</tr>
<tr>
<td>appl_top</td>
<td>Encompasses all the replication sets for the Oracle EBS application tier</td>
</tr>
<tr>
<td>db_tier</td>
<td>Encompasses all the replication sets for the Oracle EBS database tier</td>
</tr>
</tbody>
</table>

- Two journals have been set up – that is, one each for the production and DR sites.
- The type of splitter has been defined – for the solution, a fabric-based splitter is used on the production site and a CLARiiON CX4-based splitter on the DR site.
- Appropriate replication policies are in place for compression, bandwidth limits, maximum lag, and so on.

For further details, consult the *EMC RecoverPoint Release 3.3 Administrator’s Guide*.

Replication Manager has been set up as follows:

- The Replication Manager Server and Replication Manager Console components are installed and patched to version 5.2.4 on a vSphere 4 virtual machine running a Windows Server 2003 guest operating system.
- Replication Manager Oracle Agent 5.2.4 components are installed on each host that is participating in the replication process.
- Solutions Enabler 7.1.017 is a prerequisite for installing the Replication Manager Oracle Agent and must be available on the source and target database servers before installing the agent.

The main Replication Manager configuration steps for RecoverPoint are as follows:

- Register each host participating in the replication process with Replication Manager.
- Add the RecoverPoint appliances and the storage arrays to the Storage Services lists in Replication Manager.
- Add the target devices to Replication Manager.
• Create an application set for each RecoverPoint consistency group. For the solution, the application sets have the same names as the associated consistency groups, as follows:

<table>
<thead>
<tr>
<th>Consistency groups</th>
<th>Application sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>oracle_bin db_tier appl_top</td>
<td>oracle_bin db_tier appl_top</td>
</tr>
</tbody>
</table>

• Create Replication Manager storage pools for the target devices for each CLN mount host and its associated storage.

• Configure the required Replication Manager application sets and jobs (see the Replication and cloning processes section later in this paper).

• Create the required application callout scripts. These are maintained in a central repository and distributed to the /opt/emc/rm/client/bin/ directory on all hosts and virtual machines participating in the replication process.

For further details of Replication Manager installation and configuration consult the EMC Replication Manager Version 5.2 Product Guide and EMC Replication Manager Version 5.2 Administrator’s Guide.

**Replication Manager application callout scripts**

Application callout scripts allow users to add customized actions to Replication Manager at many points during replication, mount, failover, restore, and unmount operations. Scripts must be named according to the following naming convention in order to ensure that they run exactly at the required stage in the replication process and on the required host:

```
IR_CALLOUT_<application_set_name>_<job_name>_<n>
```

where:

• `<application_set_name>` is the name of the application set that contains the job that will run the script

• `<job_name>` is the name of the job that will run the script

• and `<n>` is a numeric identifier that defines when and where the script runs

The following table summarizes the options available for `<n>`:

<table>
<thead>
<tr>
<th>ID range</th>
<th>For ...</th>
<th>Run on ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 60</td>
<td>Scripts called as part of replication operations</td>
<td>Production server</td>
</tr>
<tr>
<td>100 to 600</td>
<td>Scripts called as part of mount, failover, and restore operations</td>
<td>Production server (for restore operations)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mount host (for mount operations)</td>
</tr>
<tr>
<td>1100 to 1500</td>
<td>Scripts called as part of unmount operations</td>
<td>Mount host</td>
</tr>
</tbody>
</table>
All the callout scripts created for the solution have one or other of the following numeric identifiers:

- 10  Script is run at the beginning of replication
- 60  Script is run after the application is returned to normal processing
- 600 Script is run after application recovery is complete

For example, IR_CALLOUT_appl_top_bkm_appl_top_10 specifies appl_top as the application set and bkm_appl_top as the job, and the numeric identifier 10 specifies that the script is run prior to replication.
VMware virtual machine deployment

For the solution, VMware virtual machine templates are used to enable rapid deployment of new virtual machines to the test environment. Two separate templates were created:

- AppsTier_Template01 – template for deploying virtual machines for the Oracle EBS application tier
- DBTier_Template01 – template for deploying virtual machines for the Oracle database tier

The templates were configured (in vSphere Client) with the requirements and prerequisites for the Oracle and EMC software, including:

- Operating system and rpm packages
- Kernel configuration
- OS users
- Supporting software

Application tier template

The specification for the AppsTier_Template01 template is as follows:

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>2 vCPUs</td>
</tr>
<tr>
<td>Memory</td>
<td>4096 MB</td>
</tr>
<tr>
<td>Operating system</td>
<td>Red Hat Enterprise Linux 5 (64-bit) release 5.3</td>
</tr>
<tr>
<td>Kernel</td>
<td>2.6.18-128.el5 #1 SMP</td>
</tr>
</tbody>
</table>
| OS users (users created and passwords set)| Username: oracle UserID:1101  
Username: applmgr UserID:1100                                                    |
| OS groups                                 | Group: dba GroupID:1200  
Group: oper GroupID:1201  
Group: asmdba GroupID:1300  
Group: asmoper GroupID:1301:                                                   |
| Software pre-installed                    | EMC Replication Manager Agent for Oracle 5.2.4  
Symmetrix Command Line Interface (SYMCLI) Version 7.1.0.17 (Edit Level: 1009)  
Naviseccli v.29  
AdmSnap v.29                                                                        |
| rpm packages installed                    | See the relevant Oracle installation guide                                  |
| (as Oracle prerequisites)                 |                                                                             |
| Disk configuration                        | Root 12 GB virtual disk                                                     |
| System configuration                      | See the relevant Oracle installation guide                                  |
| (as Oracle prerequisites)                 |                                                                             |
Database tier template

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>4 vCPUs</td>
</tr>
<tr>
<td>Memory</td>
<td>8192 MB</td>
</tr>
<tr>
<td>Operating system</td>
<td>Red Hat Enterprise Linux 5 (64-bit) release 5.3</td>
</tr>
<tr>
<td>Kernel</td>
<td>2.6.18-128.el5 #1 SMP</td>
</tr>
<tr>
<td>OS users (users created and passwords set)</td>
<td>Username: oracle  UserID:1101  Username: applmgr  UserID:1100</td>
</tr>
<tr>
<td>Software pre-installed</td>
<td>EMC Replication Manager Agent for Oracle 5.2.4  Symmetrix Command Line Interface (SYMCLI) Version 7.1.0.17 (Edit Level: 1009)  Naviseccli v.29  AdmSnap v.29</td>
</tr>
<tr>
<td>rpm packages installed</td>
<td>See the relevant Oracle installation guide</td>
</tr>
<tr>
<td>Disk configuration</td>
<td>Root 12 GB virtual disk</td>
</tr>
<tr>
<td>System configuration</td>
<td>See the relevant Oracle installation guide</td>
</tr>
</tbody>
</table>

Deploying new virtual machines

For the solution, 10 virtual machines were deployed from the template images held in vSphere vCenter. The Deploy Virtual Machine from this Template option in vSphere Client was used to do this. This option runs the Deploy Template wizard, where the name and location for the new virtual machine are specified, as well as the customization option for the guest operating system.

For the solution a pre-created Custom Specification (held in vCenter) defines the network configuration for new virtual machines, as illustrated by the following image.
Using the pre-created template images and Custom Specification with the vSphere Client Deploy Template wizard, all 10 virtual machines required for the solution were deployed in less than 10 minutes.

The following image shows the virtual machines deployed, with summary details for one of the machines:

Note
An alternative to manually building the VMware template images would be to use VMware vCenter Converter, an add-on plug-in for vCenter Server. VMware vCenter Converter clones the physical source to create a target virtual machine and does a system reconfiguration to enable the guest operating system to function on virtual hardware. A template could then be created from the captured virtual machine.
Replication Manager jobs

Jobs overview

The solution requires a number of application sets and jobs to be created within Replication Manager. Each application set defines a set of data to be replicated. Each job performs the actions necessary for creating a copy of a given application set.

For the solution, the following jobs were created:

<table>
<thead>
<tr>
<th>Job No.</th>
<th>Name</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: RecoverPoint bookmark (BKM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1, 2, 3</td>
<td>bkm_oracle_bin bkm_db_tier bkm_appl_top</td>
<td>Create and mount RecoverPoint bookmark images of the production binary files, and Oracle EBS database and APPL_TOP tiers.</td>
</tr>
<tr>
<td>Phase 2: SnapView clone (cleansed) (CLN)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4, 5, 6</td>
<td>cln_oracle_bin cln_db_tier cln_appl_top</td>
<td>Create, cleanse, and mount SnapView clones of the BKM binary files, database tier, and application tier.</td>
</tr>
<tr>
<td>Phase 3: SnapView snapshots (QA, ST, UT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7, 8, 9</td>
<td>qa_oracle_bin qa_db_tier qa_appl_top</td>
<td>Create and mount SnapView snapshots of the cloned copies of the binary files, database tier, and application tier, for QA test purposes.</td>
</tr>
<tr>
<td>10, 11, 12</td>
<td>st_oracle_bin st_db_tier st_appl_top</td>
<td>Create and mount SnapView snapshots of the cloned copies of the binary files, database tier, and application tier, for ST test purposes.</td>
</tr>
<tr>
<td>13, 14, 15</td>
<td>ut_oracle_bin ut_db_tier ut_appl_top</td>
<td>Create and mount SnapView snapshots of the cloned copies of the binary files, database tier, and application tier, for UT test purposes.</td>
</tr>
</tbody>
</table>

Within each phase, the second job is configured to run automatically when the first job has finished, and the third is configured to run automatically when the second has finished. This ensures that a complete copy of the Oracle EBS environment is provisioned as a single task.

Notes

In this configuration each job calls one or more application callout scripts.

Before taking a replica image, the database tier is placed into hot or cold backup mode.
The following image illustrates a test/dev copy being created in Replication Manager.

### Phase 1: RecoverPoint bookmark images

The three jobs associated with this phase are used to create and mount RecoverPoint bookmark images of the production binary files, Oracle EBS database tier, and Oracle EBS APPL_TOP tier.

**Job 1: bkm_oracle_bin**

This job creates and mounts a RecoverPoint bookmark image of the production Oracle binary files, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>oracle_bin</td>
<td>The application set for the job. This specifies the consistency group being replicated.</td>
</tr>
<tr>
<td>Replication source</td>
<td>RecoverPointCRR</td>
<td>The CLARiiON devices defined in the RecoverPoint consistency group.</td>
</tr>
</tbody>
</table>

---

Rapid Deployment and Scale Out for Oracle E-Business Suite Enabled by EMC RecoverPoint, EMC Replication Manager, and VMware vSphere—A Detailed Review
Replication technology | RecoverPoint Bookmark | The replication technology used to create the bookmark image.
---|---|---
Mount options | vm-BKM-oebs-vtp-db01 | The host virtual machine for the image.
Application callout scripts | IR_CALLOUT_oracle_bin_bkm_oracle_bin_10 | Resides on the production database nodes and is executed prior to taking the bookmark image of the oracle_bin consistency group.
| IR_CALLOUT_oracle_bin_bkm_oracle_bin_600 | Resides on the target virtual machine and is executed after the image has been mounted.

This job performs the following tasks:

1. Executes the IR_CALLOUT_oracle_bin_bkm_oracle_bin_10 callout script. This runs the Oracle Rapid Clone script for the database tier.

2. Uses RecoverPoint to take a bookmark image of the oracle_bin consistency group, which contains all of the volumes necessary to create a new copy of the file system for the Oracle binary files.

3. Enables image access.

4. Automatically mounts the image to the host vm-BKM-oebs-vtp-db01.

5. Executes the IR_CALLOUT_oracle_bin_bkm_oracle_bin_600 callout script. This relinks the Oracle Database binaries to turn RAC off and registers the Oracle Home on the target host. It also runs a local reconfiguration reset to start essential Oracle background services.

**Job 2: bkm_db_tier**

This job creates and mounts a RecoverPoint bookmark image of the production database tier, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>db_tier</td>
<td>The application set for the job. This specifies the consistency group being replicated.</td>
</tr>
<tr>
<td>Replication source</td>
<td>RecoverPointCRR</td>
<td>The CLARiiON devices defined in the RecoverPoint consistency group.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>RecoverPoint Bookmark</td>
<td>The replication technology used to create the bookmark image.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-BKM-oebs-vtp-db01</td>
<td>The host virtual machine for the image.</td>
</tr>
<tr>
<td>Job start options</td>
<td>Start the job after another job completes: bkm_oracle_bin</td>
<td>The job runs automatically when Job 1 has completed.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_db_tier_bkm_db_tier_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted.</td>
</tr>
</tbody>
</table>
This job performs the following tasks:

1. Places the source database into hot backup mode.
2. Uses RecoverPoint to take a bookmark image of the db_tier consistency group, which contains all of the volumes necessary to create a new copy of the Oracle EBS database tier.
3. Enables image access.
4. Automatically mounts the image to the host vm-BKM-oeb-vtp-db01.
5. Executes the IR_CALLOUT_db_tier_bkm_db_tier_600 callout script. This performs the recovery and reconfiguration tasks necessary for running the Oracle EBS database tier on the target machine.

Job 3: bkm_appl_top
This job creates and mounts a RecoverPoint bookmark image of the production APPL_TOP LUN, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>appl_top</td>
<td>The application set for the job. This specifies the consistency group being replicated.</td>
</tr>
<tr>
<td>Replication source</td>
<td>RecoverPointCRR</td>
<td>The CLARiiON devices defined in the RecoverPoint consistency group.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>RecoverPoint Bookmark</td>
<td>The replication technology used to create the bookmark image.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-BKM-oeb-vtp-ap01</td>
<td>The host virtual machine for the image.</td>
</tr>
<tr>
<td>Job start options</td>
<td>Start the job after another job completes: bkm_db_tier</td>
<td>The job runs automatically when Job 2 has completed.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_appl_top_bkm_appl_top_10</td>
<td>Resides on the production APPL_TOP host and is executed prior to taking the bookmark image of the appl_top consistency group.</td>
</tr>
<tr>
<td></td>
<td>IR_CALLOUT_appl_top_bkm_appl_top_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted.</td>
</tr>
</tbody>
</table>

This job performs the following tasks:

1. Executes the IR_CALLOUT_appl_top_bkm_appl_top_10 callout script, which runs the Oracle Rapid Clone script for the APPL_TOP tier.
2. Uses RecoverPoint to take a bookmark image of the appl_top consistency group, which contains all of the volumes necessary to create a new copy of the Oracle EBS application tier.
3. Enables image access.
4. Mounts the image to the host vm-BKM-oeb-vtp-ap01.
5. Executes the IR_CALLOUT_appl_top_bkm_appl_top_600 callout script. This runs the Rapid Clone post-clone reconfiguration on the mount host and starts the application services.

When Jobs 1, 2, and 3 have finished, a fully-functional, application-consistent copy of the production Oracle EBS environment is available in the virtualized DR environment.

**Phase 2: SnapView clones (cleansed)**

The three jobs associated with this phase are used to create, cleanse, and mount SnapView clones of the BKM binary files, database tier, and application tier.

**Job 4: cln_oracle_bin**

This job creates and mounts a SnapView clone of the RecoverPoint bkm_db_tier bookmark image, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>cln_oracle_bin</td>
<td>The application set for the job. This specifies the bookmark image being cloned.</td>
</tr>
<tr>
<td>Replication source</td>
<td>Primary Storage</td>
<td>The volumes mounted to the host by Job 1.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>SnapView Clone</td>
<td>The replication technology used to create the clone.</td>
</tr>
<tr>
<td>Storage pool</td>
<td>vm-CLN-oeb-s-vtp-db01</td>
<td>The target volumes assigned as physical RDM to the virtual machine for mounting the cloned image.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-CLN-oeb-s-vtp-db01</td>
<td>The host virtual machine for the clone.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_cln_oracle_bin_cln_oracle_bin_10</td>
<td>Resides on the BKM database node and is executed prior to taking the clone image.</td>
</tr>
<tr>
<td></td>
<td>IR_CALLOUT_cln_oracle_bin_cln_oracle_bin_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted.</td>
</tr>
</tbody>
</table>
This job performs the following tasks:

1. Executes the IR_CALLOUT_cln_oracle_bin_cln_oracle_bin_10 callout script. This runs the Oracle Rapid Clone script for the database tier.

2. Uses SnapView to take a clone of the bkm_oracle_bin bookmark image.

3. Automatically mounts the clone to the host vm-CLN-oeb-vtp-db01.

4. Executes the IR_CALLOUT_cln_oracle_bin_cln_oracle_bin_600 callout script. This registers the Oracle Home on the target host and runs a local reconfiguration reset to start essential Oracle background services.

**Job 5: cln_db_tier**

This job creates, cleanses (masks), and mounts a SnapView clone of the bkm_db_tier bookmark image, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>cln_db_tier</td>
<td>The application set for the job. This specifies the bookmark image being cloned.</td>
</tr>
<tr>
<td>Replication source</td>
<td>Primary Storage</td>
<td>The volumes mounted to the host by Job 2.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>SnapView Clone</td>
<td>The replication technology used to create the clone.</td>
</tr>
<tr>
<td>Storage pool</td>
<td>vm-CLN-oeb-vtp-db01</td>
<td>The target volumes assigned as physical RDM to the virtual machine for mounting the cloned image.</td>
</tr>
<tr>
<td>Job start options</td>
<td>Start the job after another job completes: cln_oracle_bin</td>
<td>The job runs automatically when Job 4 has completed.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-CLN-oeb-vtp-db01</td>
<td>The host virtual machine for the clone.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_cln_db_tier_cln_db_tier_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted.</td>
</tr>
</tbody>
</table>

This job performs the following tasks:

1. Shuts down the bookmark database on vm-oeb-vtp-BKM-db01.

2. Uses SnapView to take a clone of the bmk_db_tier bookmark image.

3. Automatically mounts the clone to the host vm-CLN-oeb-vtp-db01.

4. Executes the IR_CALLOUT_cln_db_tier_cln_db_tier_600 callout script. This performs:
   - the reconfiguration tasks necessary for running the Oracle EBS database tier on the target machine
   - database cleansing
**Job 6: cln_appl_top**

This job creates and mounts a SnapView clone of the APPL_TOP bookmark image, using the following Replication Manager settings.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>cln_appl_top</td>
<td>The application set for the job. This specifies the bookmark image being replicated.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>SnapView Clone</td>
<td>The replication technology used to create the clone.</td>
</tr>
<tr>
<td>Storage pool</td>
<td>vm-CLN-oebs-vtp-ap01</td>
<td>The target volumes assigned as physical RDM to the virtual machine for mounting the cloned image.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-CLN-oebs-vtp-ap01</td>
<td>The host virtual machine for the clone.</td>
</tr>
<tr>
<td>Job start options</td>
<td>Start the job after another job completes: cln_db_tier</td>
<td>The job runs automatically when Job 5 has completed.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_cln_appl _top_cln_appl_top_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted.</td>
</tr>
</tbody>
</table>

This job performs the following tasks:

1. Uses SnapView to take a clone of the bkm_appl_top bookmark image.
2. Automatically mounts the clone to the host vm-CLN-oebs-vtp-ap01.
3. Executes the IR_CALLOUT_cln_appl_top_cln_appl_top_600 callout script. This runs the Rapid Clone post-clone reconfiguration on the mount host and starts the application services.

When Jobs 4, 5, and 6 have finished, a complete copy of the production Oracle EBS environment is available in the DR environment, with sensitive information masked so that it cannot be accessed by unauthorized personnel. This clone can now be copied on demand to provide multiple test environments.
**Phase 3: SnapView snapshots (test/dev)**

The three jobs associated with this phase are used to create and mount SnapView snapshots of the cloned copies of the binary files, database tier, and application tier, for QA test purposes (see the following image).

![SnapView snapshots diagram](image)

**Job 7: qa_oracle_bin**

This job creates and mounts a SnapView snapshot of the cln_oracle_bin clone image, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>cln_oracle_bin</td>
<td>The application set for the job. This specifies the clone being replicated.</td>
</tr>
<tr>
<td>Replication source</td>
<td>Primary Storage</td>
<td>The volumes mounted to the host by Job 4.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>SnapView Snap</td>
<td>The replication technology used to create the snapshot.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-QA-oebbs-vtp-db01</td>
<td>The host virtual machine for the snapshot.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_cln_oracle_bin_qa_oracle_bin_10</td>
<td>Resides on the bookmark database host and is executed prior to taking the snapshot image.</td>
</tr>
<tr>
<td></td>
<td>IR_CALLOUT_cln_oracle_bin_qa_oracle_bin_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted</td>
</tr>
</tbody>
</table>

This job performs the following tasks:

1. Executes the IR_CALLOUT_cln_oracle_bin_qa_oracle_bin_10 callout script. This runs the Rapid Clone script for the database tier.
2. Uses SnapView to take a snapshot of the cln_oracle_bin clone image.
3. Automatically mounts the snapshot to the host vm-QA-oebbs-vtp-db01.
4. Executes the IR_CALLOUT_cln_oracle_bin_qa_oracle_bin_600 callout script. This registers the Oracle Home on the target host and runs a local reconfiguration reset to start essential Oracle background services.
Job 8: qa_db_tier

This job creates and mounts a SnapView snapshot of the cleansed cln_db_tier clone image, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>cln_db_tier</td>
<td>The application set for the job. This specifies the clone being replicated.</td>
</tr>
<tr>
<td>Replication source</td>
<td>Primary Storage</td>
<td>The volumes mounted to the host by Job 5.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>SnapView Snap</td>
<td>The replication technology used to create the clone.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-QA-oeb-vtp-db01</td>
<td>The host virtual machine for the snapshot.</td>
</tr>
<tr>
<td>Job start options</td>
<td>Start the job after another job completes: qa_oracle_bin</td>
<td>The job runs automatically when Job 7 has completed.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_cln_db_tier_qa_db_tier_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted.</td>
</tr>
</tbody>
</table>

This job performs the following tasks:

1. Shut down the cloned database on vm-CLN-oeb-vtp-db01.
2. Uses SnapView to take a snapshot of the cln_db_tier clone image.
3. Automatically mounts the snapshot to the host vm-QA-oeb-vtp-db01.
4. Executes the IR_CALLOUT_cln_db_tier_qa_db_tier_600 callout script. This performs the reconfiguration tasks necessary for running the Oracle EBS database tier on the target machine.

Job 9: qa_appl_top

This job creates and mounts a SnapView snapshot of the cln_appl_top clone image, using the following Replication Manager settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application set</td>
<td>cln_appl_top</td>
<td>The application set for the job. This specifies the clone being replicated.</td>
</tr>
<tr>
<td>Replication source</td>
<td>Primary Storage</td>
<td>The volumes mounted to the host by Job 6.</td>
</tr>
<tr>
<td>Replication technology</td>
<td>SnapView Snap</td>
<td>The replication technology used to create the clone.</td>
</tr>
<tr>
<td>Mount options</td>
<td>vm-QA-oeb-vtp-ap01</td>
<td>The host virtual machine for the clone.</td>
</tr>
<tr>
<td>Job start options</td>
<td>Start the job after another job completes: qa_db_tier</td>
<td>The job runs automatically when Job 8 has completed.</td>
</tr>
<tr>
<td>Application callout scripts</td>
<td>IR_CALLOUT_cln_appl_top_qa_appl_top_600</td>
<td>Resides on the target virtual machine and is executed after the image has been mounted.</td>
</tr>
</tbody>
</table>

This job performs the following tasks:

1. Uses SnapView to take a snapshot of the cln_appl_top clone image.
2. Mounts the snapshot to the host vm-QA-oebs-vtp-ap01.
3. Executes the IR_CALLOUT_cln_appl_top_qa_appl_top_600 callout script. This runs the Rapid Clone post-clone reconfiguration on the mount host and starts the application services.

Once Jobs 7, 8, and 9 have finished, a fully-functional, application-consistent, cleansed snapshot of the Oracle EBS environment is available in the DR environment for QA testing.

**Jobs 10 to 15**

Jobs 10 to 12 and Jobs 13 to 15 create test environments for ST and UT, respectively. These jobs are modified versions of Jobs 7, 8, and 9.

**Unmounting the RecoverPoint replicas**

Once the CLN clone has been created, the RecoverPoint replicas (bkm_oracle_bin, bkm_db_tier, and bkm_appl_top) can be unmounted in Replication Manager. This disables image access and returns the RecoverPoint portion of the environment to its original state.
Data privacy and protection

Overview

In recent years there has been increased corporate governance surrounding the security and use of sensitive data to meet legislative requirements and industry standards. Legislation such as Sarbanes-Oxley has had a worldwide impact on data security and audit, as have industry standards such as the Payment Card Industry (PCI) Data Security Standard (DSS) and national and state data privacy laws.

To comply with these statutory and regulatory requirements, organizations need to implement strong business and personal data protection policies to secure employee, customer, company, and vendor information, such as Social Security numbers (SSNs), bank account details, credit card numbers, and credit ratings.

Due to their less critical nature, non-production systems tend to have less restrictive access controls than production systems, potentially enabling unauthorized personnel to access sensitive information. As a result, any process that replicates data from production to test environments requires a mechanism to cleanse or mask sensitive data before making it available for wider use.

Note
Sensitive data should be identified and agreed with business customers.

Solution implementation

As an example for the solution, SSN was identified as sensitive data and a simple custom Oracle PLSQL function was used to mask the data in the SSN column in all tables.

<table>
<thead>
<tr>
<th>Function name</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>f_scramble_SSN</td>
<td>create or replace function f_scramble_SSN ( V_SSN_IN varchar2)</td>
</tr>
<tr>
<td></td>
<td>return varchar2 is</td>
</tr>
<tr>
<td></td>
<td>v_ssn_out varchar2(30);</td>
</tr>
<tr>
<td></td>
<td>BEGIN</td>
</tr>
<tr>
<td></td>
<td>v_ssn_out:=translate(V_SSN_IN,'ABCDEFGHIJKLMNOPQRSTUVWXYZ',</td>
</tr>
<tr>
<td></td>
<td>'0123456789', dbms_random.string('U',10)</td>
</tr>
<tr>
<td></td>
<td>'ABCDEFGHIJKLMNOPQRSTUVWXYZ', '0123456789', 01234567890123456789012345');</td>
</tr>
<tr>
<td></td>
<td>return v_ssn_out;</td>
</tr>
<tr>
<td></td>
<td>end f_scramble_SSN;</td>
</tr>
</tbody>
</table>

The function was wrapped in an application callout script that is run by Replication Manager when creating the clone from which all the test snapshots are taken. This ensures that the clone and the copies taken from it do not contain data identified as sensitive and can be freely used in test environments without breaching security.

Customized data cleansing code can similarly be wrapped in Replication Manager callout scripts to meet individual business requirements. Alternatively a third-party data masking/cleansing tool could be used.
Provisioning and refreshing test/dev environments

Deploying new test/dev environments on demand
Provisioning a new test/dev environment involves the following steps:

- Using the Navisphere Snapshot Configuration Wizard, create a set of snapshot volumes on the CLARiiON array for the new EBS environment and assign the LUNs to the ESX and Replication Manager storage groups.
- Use the pre-defined VMware templates and Custom Specifications to create virtual machines for the database and application tiers of the new environment.
- Assign storage volumes as RDMs with physical compatibility mode. This is a Replication Manager and RecoverPoint requirement for replicating between physical and virtual environments. It also provides performance gains over virtual access on RDM and supports VMware vMotion. See the *EMC Virtual Infrastructure for Oracle Enabled by EMC Symmetrix VMAX and VMware vSphere 4 - Proven Solution Guide*.
- Add the newly-provisioned storage to Replication Manager.
- Create three jobs in Replication Manager to create SnapView snapshot copies of the cln_oracle_bin, cln_db_tier, and cln_appl_top clones. These jobs are modified versions of Jobs 7, 8, and 9 (described previously in this white paper), configured to use the new mount hosts.
- Run the jobs in Replication Manager.

By using the Navisphere Snapshot Configuration Wizard, the SnapView snapshots for an entirely new environment can be provisioned and assigned to ESX hosts in seconds. By using VSI on the vCenter host, the SnapView LUNs can be quickly identified and provisioned to virtual machines as RDM for use.

Refreshing test/dev environments
Periodically it will be necessary to refresh the test/dev environments. The environments can either be refreshed to the point-in-time image encapsulated by the clone environments or the entire environment can be completely refreshed with the latest information from the source production volumes:

- To refresh one of the test/dev environments to the point-in-time image on the clone, simply unmount the snapshots used in the environment and then rerun the jobs for creating the snapshots.
- To refresh the entire environment the administrator needs to unmount all the Replication Manager replicas (RecoverPoint images, clones, and test/dev snapshots) and then rerun the jobs for creating the replicas (in the order indicated in the *Replication and cloning process* section of this white paper).
Conclusion

Summary

Reducing the time and costs associated with provisioning test/dev environments is critical for organizations that rely on Oracle EBS for their business applications.

This solution extends an EMC RecoverPoint DR infrastructure for Oracle EBS applications, which replicates a physical, two-node Oracle RAC production environment to a virtualized, single-instance DR environment.

The solution integrates Replication Manager within the RecoverPoint DR infrastructure. This enables automated creation of multiple, independent copies of the production environment for test/dev purposes. VMware templates are used to provision virtual machines for hosting these copies, enabling rapid and repeatable scale out.

Key points

This white paper demonstrates the following benefits of the solution:

- Extends a RecoverPoint DR infrastructure:
  - Optimization of an organization’s resources
  - Replication across heterogeneous storage platforms
  - Application-consistent replicas for DR and test purposes

- Virtualization of test/dev environments with VMware:
  - Significantly reduces the time required to provision new test/dev environments—using VMware templates, all 10 virtual machines deployed for the solution were provisioned in under 10 minutes—using Navisphere and VSI, storage for new Oracle EBS environments was rapidly provisioned
  - Reduces server sprawl, providing significant cost savings on hardware and energy consumption—the solution shows the deployment of multiple, virtual EBS R12 environments on two physical ESX servers
  - Allows administrators to isolate operating systems during patching and upgrading and to isolate entire application stacks during performance tuning and testing

- Automated replication with Replication Manager:
  - Rapid, automated provisioning of test/dev environments
  - Minimal user interaction required to provision new copies and refresh existing copies, and replication has minimal impact on the production environment
  - Repeatable processes, enabling multiple, independent copies to be provisioned on demand, in a few well-defined steps
  - Reduced build and maintenance costs and improved support response times to production issues
  - Application customization through Replication Manager callout scripts—for example, data cleansing of test/dev environments to comply with regulatory and statutory requirements
References

White papers
For additional information, see the white papers listed below.
- EMC Replication Manager and EMC RecoverPoint – Applied Technology
- EMC Virtual Infrastructure for Oracle Enabled by EMC Symmetrix VMAX and VMware vSphere 4 - Proven Solution Guide
- EMC RecoverPoint Replicating VMware Technical Notes (P/N 300-004-302 Rev A08)
- EMC RecoverPoint Replicating Oracle with RecoverPoint Technical Notes (P/N 300-007-595 Rev A04)

Product documentation
For additional information, see the product documents listed below.
- EMC RecoverPoint Release 3.3 Administrator’s Guide
- EMC Replication Manager Version 5.2 Product Guide
- EMC Replication Manager Version 5.2 Administrator’s Guide

Other documentation
For additional information, see the documents listed below.

VMware manuals
- vSphere Basic System Administration vCenter Server 4.0/ESX 4.0
  Chapter 14 - Working with Templates and Clones
  Chapter 15 - Customizing Guest Operating Systems

Oracle manuals
- Oracle Applications Installation Guide: Using Rapid Install Release 12.1 (12.1.1)
- Oracle Applications System Administrator's Guide – Configuration Release 12.1
- Oracle Applications System Administrator's Guide – Maintenance Release 12.1
- Oracle Applications Installation Guide: Using Rapid Install Release 12.1 (12.1.1)
- Oracle Real Application Clusters Installation Guide 11g Release 1 (11.1) for Linux and UNIX
- Oracle Clusterware Installation Guide 11g Release 1 (11.1) for Linux

Oracle support documents
- Using Electronic Delivery With Rapid Install in Oracle E-Business Suite Release 12 [ID 406138.1]
- Using Oracle 11g Release 1 (11.1.0.7) Real Application Clusters and Automatic Storage Management with Oracle E-Business Suite Release 12 [ID:466649.1]
- Using AutoConfig to Manage System Configurations in Oracle E-Business Suite Release 12 [ID 387859.1]
- Cloning Oracle Applications Release 12 with Rapid Clone [ID 406982.1]
• Cloning Oracle Applications Release 12 with Rapid Clone on RAC Systems [559518.1]

• Oracle Metalink Note 604683.1 – Supported Backup, Restore and Recovery Operations using Third Party Snapshot Technologies
Appendix A

Application callout scripts

The following are examples of the Replication Manager application callout scripts used for the solution.

```
IR_CALLOUT_oracle_bin_bkm_oracle_bin_10
su - oracle -c "echo apps | /u01/oracle/VIS/db/tech_st/11.1.0/appsuutil/scripts/${ORACLE_SID}_${HOSTNAME}/adpreclone.pl dbTier"

IR_CALLOUT_oracle_bin_bkm_oracle_bin_600
su - oracle -c "/home/oracle/working_copy/update_env.sh"
su - oracle -c "rm -f /u01/oracle/VIS/db/tech_st/11.1.0/dbs/init*ora
/u01/oracle/VIS/db/tech_st/11.1.0/dbs/sp*ora /u01/oracle/VIS/db/tech_st/11.1.0/dbs/*_dsk"
su - oracle -c "cp /home/oracle/working_copy/init*ora
/u01/oracle/VIS/db/tech_st/11.1.0/dbs/"
su - oracle -c "/home/oracle/working_copy/clone_oracle_home.sh"
/u01/oracle/VIS/db/tech_st/11.1.0/root.sh
/u01/oracle/VIS/db/tech_st/11.1.0/bin/localconfig reset

IR_CALLOUT_db_tier_bkm_db_tier_600
/etc/init.d/oracleasm scandisks
/etc/init.d/oracleasm listdisks
su - oracle -c "/home/oracle/working_copy/asm_db_RC_pc.sh"
su - oracle -c "/home/oracle/working_copy/change_tns_ifile.sh"

IR_CALLOUT_appl_top_bkm_appl_top_10
su - applmgr -c "echo apps | ${INST_TOP}/admin/scripts/adpreclone.pl appsTier"

IR_CALLOUT_appl_top_bkm_appl_top_600
su - applmgr -c "/home/applmgr/working_copy/update_apps.sh"
su - applmgr -c "/home/applmgr/working_copy/run_RCclone.sh"

IR_CALLOUT_cln_db_tier_cln_db_tier_600
/etc/init.d/oracleasm scandisks
/etc/init.d/oracleasm listdisks
su - oracle -c "/home/oracle/working_copy/asm_db_RC_pc.sh"
su - oracle -c "/home/oracle/working_copy/change_tns_ifile.sh"
su - oracle -c "/home/oracle/working_copy/db_datacleanse.sh"
```