White Paper

# ENHANCING ORACLE DATABASE PROTECTION WITH EMC RECOVERPOINT

## Applied Technology

### Abstract

Oracle database administrators face many challenges to managing the application and storage resources necessary for Oracle operations.  This white paper outlines how EMC® RecoverPoint provides cost-effective local and remote replication of their Oracle database environments.

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## Executive summary

This paper explains the benefits of using EMC® RecoverPoint local and remote replication to provide operation and disaster recovery for Oracle environments. RecoverPoint provides crash-consistent and application-consistent recovery points that can be utilized in response to a number of possible scenarios, enhancing the native availability within an Oracle environment. Oracle supports third-party enterprise replication technologies to protect Oracle environments. EMC RecoverPoint provides full support for data replication and disaster recovery when working with Oracle databases. RecoverPoint supports Oracle whether the Oracle databases are stored as raw disks or on a file system.

## Introduction

Backup and recovery are some of the most important aspects of database administration. If a database crashed and there was no way to recover it, the devastating results to a business could include lost data, lost revenue, and customer dissatisfaction. Whether companies operate a single database or multiple databases storing hundreds of gigabytes or even terabytes of data, they share one common factor — the need to back up important data and protect themselves from disaster by developing a backup and recovery plan. Because of the long recovery gaps, tape-based backup and recovery are no longer an option for real-time data protection. Even disk-to-disk backup and traditional snapshot techniques fall short to address the critical nature of mission-critical applications.



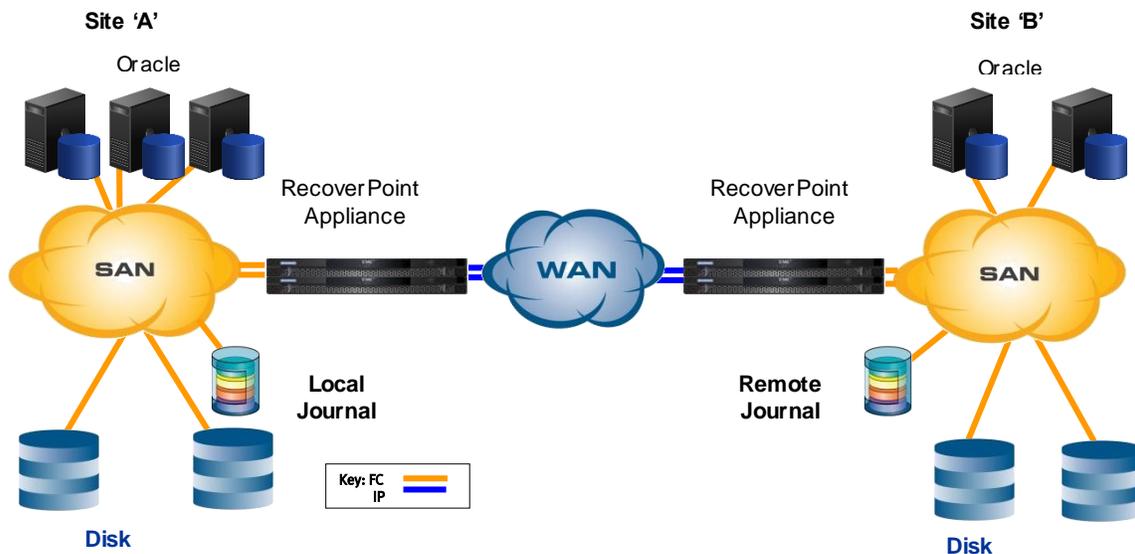**Figure 1. EMC RecoverPoint supporting a high-availability Oracle environment**

EMC RecoverPoint is proven technology for high-availability Oracle environments with both local and remote protection across SAN storage with complete protection against many possible disaster scenarios. RecoverPoint provides resiliency against failures within the data center infrastructure and helps improve recovery from a

regional disaster, all with the added benefit of immediate and instantaneous application recovery. The Oracle database is protected from data corruption using time stamped history volumes that records each write locally and groups of writes remotely.   By mapping customer service level agreements for database and application restartability into RecoverPoint's RPO and RTO policies, the administrator can achieve improvements in the operational and disaster recovery procedures for their Oracle environment.

The innovative technology of RecoverPoint enables local and remote recovery with policy-based protection and no distance limitations or performance degradation. With its unique architecture, powerful data recovery features, and business-driven approach, RecoverPoint offers advanced levels of data protection to organizations with Oracle applications.

## Audience

This white paper is targeted to corporate management and technical decision-makers, including storage and server administrators, IT managers, and application engineers, as well as storage integrators, consultants, and distributors.


# Oracle protection concepts

## Oracle tools for replication

### Requirements for data replication and disaster recovery

To provide reliable disaster recovery (DR), a data replication solution must provide protection from the hard failure of critical system components as well as protection from corruption of the data.

- **Hard failure**

  In the event of a hard failure of system components, it becomes impossible to carry on normal operation of the host application. A data replication solution must support the orderly failover of operations to the secondary site or system.  When possible, this should be done with no data loss and should provide the means for minimizing downtime (or, "RTO" — recovery time objective).

- **Soft failure**

  A soft failure, in the form of data corruption, can occur in any database system for a variety of reasons. To support recovery from data corruption, a data replication solution must enable rollback to a point-in-time copy of the database that precedes the advent of the corruption. By facilitating rollback to the latest uncorrupted data, data loss (or, "RPO" — recovery point objective) due to the corruption is minimized.

### Oracle tools for replication

Oracle provides the following capabilities for backup, recovery, and replication:

- Reliable, largely automatic procedures for recovering its database files following a hardware crash, instance crash, or process crash.

- Range of options for database backup from individual tablespaces to the entire database. Additionally, the database can be backed up when it is active ("hot") or inactive ("cold").

- Recovery Manager (RMAN), for effective central management of enterprise-wide backup and recovery procedures.

- Data Guard, which provides management, monitoring, and automation software to create and maintain one or more standby databases to protect Oracle data from failures, disasters, human error, and data corruption.

## Oracle crash recovery

Oracle has developed reliable, largely automatic procedures for recovering its database files following a hardware crash, instance crash, or process crash. For a full description of these procedures, see the *Oracle Backup & Recovery Handbook* for the version you are using.

Oracle crash recovery regularly involves the following components:

- Data files, including undo data

- Archived redo logs

- Online redo logs

- Database control file

In recovering a database after an instance crash, Oracle uses this data in the following two-step process:

### 1. Roll forward

Oracle sequentially applies redo records, as necessary, from its online redo logs to the corresponding data blocks. This ensures that the recovered database contains all data written by the application prior to failure of the database.

### 2. Roll back

Oracle chains through the undo data for each uncommitted transaction and rolls back all changes to the database accordingly. This process, which is also called transaction recovery, ensures that the recovered database is consistent on the transaction level; for example, that it does not contain a debit without a corresponding credit.

Though this process does not by itself constitute a disaster recovery solution, the same process enables seamless recovery when a RecoverPoint point-in-time snapshot is available.

## Oracle database protection with RecoverPoint

The following are among the options that Oracle provides for protecting its databases that can be integrated with RecoverPoint replication. If a database is shut down normally, the process of getting to a point of consistency during restart requires minimal work. If the database terminates abnormally, restarting will take longer, depending on the number and size of transactions that were in flight at the time of termination. A RecoverPoint disaster recovery image without Oracle hot backup is similar to an abnormally terminated database. The Oracle restart procedure transforms the replica image into a transactionally consistent image by completing committed transactions and rolling back uncommitted transactions during database initialization. Using RecoverPoint, the user creates a consistency group whose replication sets contains all of the volumes associated with the Oracle instance and then processes the consistency group based on the type of recovery required:

- **Application-consistent recovery from a shutdown (a.k.a. "cold" backup)**

   The user creates a consistency group that represents the Oracle application.  The consistency group contains all of the volumes for the application; including data files, online redo log files, and configuration files. Optionally, control files may be included as well. This method produces a copy from which you can restore the database, if necessary, with 100 percent reliability. Because normal operations must be halted, however, while this "cold" backup is being created, this method is not appropriate for systems that must operate on a 24×7 basis. In addition, any changes to the database made before or after the "cold" backup will not be available as an application-consistent recovery point, but will be a crash-consistent recovery point.

   When Oracle is shut down the user will then create a RecoverPoint bookmark for the specific consistency group to identify the image as a "cold" backup image. This bookmark can be used to identify a point-in-time recovery image that represents a fully restorable and restartable Oracle database image.

- **Crash-consistent recovery during operations (a.k.a. "hot" or "fuzzy" backup)**

   This process enables the creation of crash-consistent images without requiring system shutdown.  This process is performed by default by RecoverPoint for all applications as part of the RecoverPoint write-splitting operations.  As Oracle writes are sent to the production volumes, RecoverPoint splitters also intercept them and send a copy to the RecoverPoint appliance for further processing.  These writes represent the on-disk consistent data, which is the same data that remains on external storage even when an application crashes.  When Oracle is restarted from a server crash, it needs to error check its data and log volumes before completing the restart process.  When Oracle is restarted from a RecoverPoint crash-consistent image, it will perform the same error-checking process.

- **Application-consistent recovery during operation**

   This process enables the creation of application-consistent images without requiring system shutdown. It is required that all data files belonging to the

relevant tablespaces, and the relevant archive log files and control files are flushed from the servers in-memory buffers to disk. To ensure that Oracle can recover from these images, Oracle must write additional information to the log file; that is, information that is not required when crash-consistent images are sufficient. This may have adverse impact on system performance, and may limit both the frequency at which it is desirable to create application-consistent images.

Using this feature with RecoverPoint requires that the user script several commands to both the Oracle Server and to the RecoverPoint appliance. Using scripting, the user first places the appropriate tablespace or database into backup mode (for example, ALTER TABLESPACE BEGIN BACKUP or ALTER DATABASE BEGIN BACKUP). Oracle will update the LOG files to indicate that the TABLESPACE or DATABASE is in Oracle backup mode and will ensure that the appropriate in-memory buffers are flushed to disk. Once Oracle backup mode is set, the script will then create a RecoverPoint bookmark for the specific consistency group to identify the image as an application-consistent image. This bookmark can be used to identify an image that can be used to recover the database back to the specific point in time and restart the database for operations.

## Oracle Recovery Manager

Oracle developed Recovery Manager (RMAN) as a management tool for DBAs who perform backup and recovery activities for Oracle databases. With RMAN, the DBA can manage backup activities for an entire enterprise from a single central location. It enables the recording of all backups in its recovery catalog. In restoring a data file, the information in that same recovery catalog can be used to identify the particular backup needed to perform the required recovery operation.

RMAN also supports *incremental backup*; that is, where Oracle backs up only those disk blocks in which data has changed since the last backup. This method is useful for reducing the amount of time needed to perform the backup, which, as noted above, is important when working in hot backup mode. Recovery from such backups, however, is time-consuming, and there is data loss corresponding to the database activity that has occurred since the last backup.

In providing all of this functionality, RMAN takes resources away from the Oracle host applications. Creation of a backup can be quite time-consuming. Moreover, recovery of a database using the RMAN backups can be a slow and painstaking process, made even more so when, as is often the case, it involves the inconvenience of mounting and dismounting backup tapes.

## Oracle procedure for recovering from data corruption

Oracle recommends the following procedure to recover from a data corruption problem:

1. Identify the most recent Oracle backup of the database that is not corrupted.

2. Apply archived redo log files to roll forward the database files to the latest point at which the data is not corrupted.

This procedure is effective, but complex, time-consuming, and mostly manual. Instead, when the customer adds RecoverPoint to their configuration, it becomes easier for them to achieve local and remote protection for their SAN-based configurations.

## Using RecoverPoint to protect Oracle environments

High-availability Oracle environments can use RecoverPoint to achieve local and remote protection across SAN storage devices with complete protection against many possible disaster scenarios. As shown in Figure 1, this type of environment provides resiliency against failures within the data center infrastructure. It can help improve recovery from a regional disaster, all with the added benefit of immediate and instantaneous application recovery.

Oracle products are inherently high-availability applications that provide enterprise-class reliability without compromising security, performance, or scalability. To enhance the built-in availability features for Oracle, consider the following requirements for a data protection solution:

- Protection from infrastructure failure (storage array, switch, and so on)

- Protection from local or regional disaster

- Protection from data corruption

Many companies are deploying continuous data protection (CDP) as a way to meet their recovery time objectives (RTO) and recovery point objectives (RPO). A true CDP implementation ensures that all changes to an application's data are tracked and retained consistently. In effect, CDP creates an electronic journal of application snapshots, one for every instant in time that data modification occurs.

## Advantages of RecoverPoint

RecoverPoint preserves a record of the write transactions that take place with the environment, providing crash- or application-consistent recovery points within the environment. For local replication, RecoverPoint captures every write and preserves them in a local journal; for remote replication, transactions are grouped based on user-specified policies, with significant write changes preserved in a journal at the DR site.

This preservation of writes ensures that if data is lost or corrupted, such as from a server failure, virus, Trojan horse, software errors, or end-user errors, it is always possible to recover a clean copy of the affected data. For local recovery, the recovery point is to the previous write, for remote recovery the recovery point will be at the prior significant point in time. Another advantage for RecoverPoint is that this data recovery can be performed at either the local or remote locations. These recovery points can be immediately accessed and mounted back to production environments

in seconds — much less time than is the case with disk-based snapshots, tape backups, or archives.

## Local and remote recovery

The integration of CDP technology and remote replication protects data against catastrophic events that can bring entire data centers to a standstill. RecoverPoint delivers superior data protection by allowing both local and remote replication with no application degradation.  As a result, organizations can deploy geographically dispersed data centers for maximum protection from local or regional failure or disaster. With the combination of journaling, CDP for local replication, and CDP technology with continuous remote replication (CRR), customers implementing RecoverPoint have a high degree of protection for data corruption and hardware failures, as well as disasters.

With RecoverPoint, every time the Oracle application writes to the local storage subsystem, it writes it in parallel to the local RecoverPoint appliance.  This enables quick recovery from array failure and/or complete site failure and the ability to roll back to any point in time within the protection window configured.

## Application-aware bookmarking for recovery

For each consistency group defined within the RecoverPoint system, RecoverPoint efficiently maintains a transactional consistent journal or history log that enables convenient rollback to any point in time, enabling instantaneous recovery of all of the volumes associated with the consistency group.  The journal volume is used to roll back the replica volumes to the appropriate point in time so that they can then be used for recovery of the production data.  This type of rollback is called *crash consistent*, since the replica volumes are rolled back to a consistent point in time.

To add application-awareness into the journal, customized scripts would be used to place the appropriate Oracle databases or tablespaces into hot backup mode, and once Oracle is in this mode a bookmark is written into the journal to show that the specific image represents an application-consistent image of Oracle with the database or tablespaces in hot backup mode.
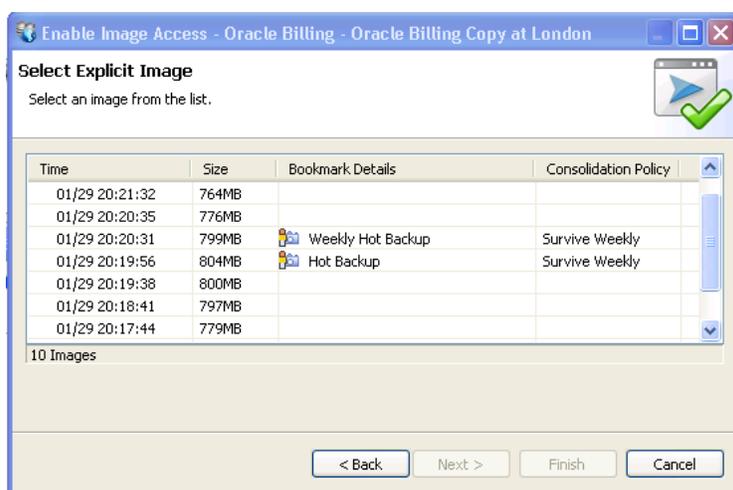
Figure 2. Oracle bookmarks

The bookmark shown in Figure 2 was generated from a shell script that invoked ssh to write the bookmark.  The following code snippet shows the command.  In this example, the variable RPA is presumed to be set earlier in the script to the management IP address of the RecoverPoint cluster:

```
ssh admin@RPA bookmark_image "group='Oracle Billing' bookmark='Daily hot
backup'"
```

This command can be issued manually from the CLI, or more typically it would be executed as part of a larger script that is used to place Oracle into hot backup mode, bookmark the journal image, and then end hot backup mode. The journal can be used to select an image to instantaneously recover based on a specific application event (hot backup or checkpoint, for example), or user-initiated annotation (such as quiesce). The journal volume can be maintained at the local and/or remote sites and is maintained without impacting application performance or availability of the production host application.

By selecting images from the journal, the administrator can be assured that a transactional consistent recovery point is selected and the production image can be immediately mounted and the application restarted.  The user also can select a specific point in time to roll back and forward as needed.  All of these capabilities can occur at the local or remote DR site and is a very effective way to perform DR tests or fire drills.  This powerful capability allows creation of time-based and transactional consistent images at any point in time without impacting the production image.

## Customer environment example

A large international customer with data centers on both sides of the Atlantic Ocean and a mission-critical Oracle-based ERP system saw the need to supplement the database's backup and recovery capabilities.  The customer implemented RecoverPoint to replicate their Oracle data and log volumes between Boston and Tel Aviv over a VPN connection on top of an existing T1 Internet connection, as shown in the next figure.
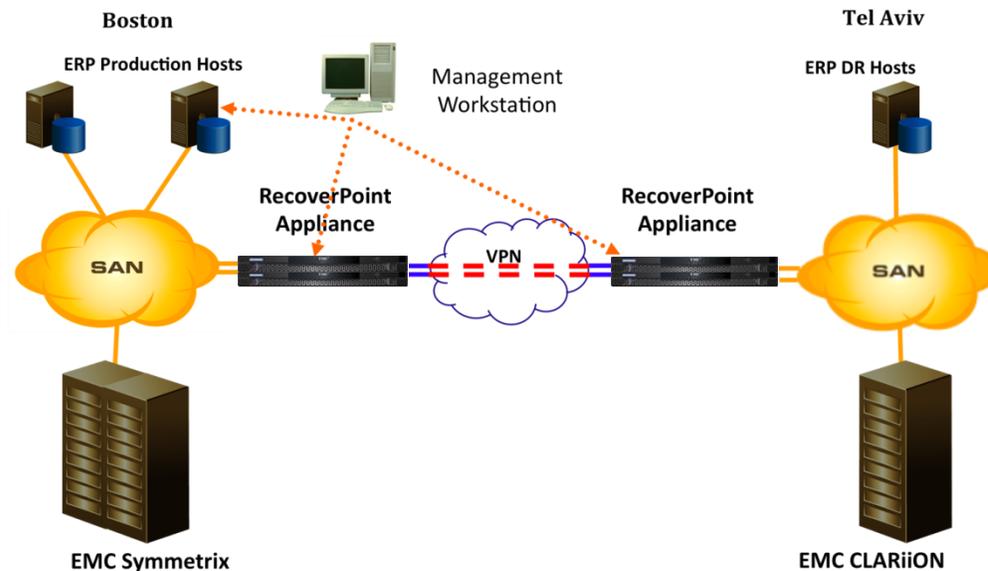
**Figure 3. Example configuration for remote replication**

The RecoverPoint solution provides local and remote data protection for the Oracle environment, with the following customer benefits:

- Concurrent local and remote data protection provides a local copy of the Oracle environment in Boston for operational recovery and a remote copy in Tel Aviv for disaster recovery.

- Ability to recovery the local and/or remote copy of the live Oracle data without impact to the production environment or to either site.

- Maintains write-order consistency of both the local and remote copies of the live Oracle data enabling true point-in-time recovery of restorable images.

- A fully scriptable API enables integration of Oracle with RecoverPoint through application-consistent bookmarks for improved recovery.

- Dramatically reduced bandwidth requirements (up to a 10-to-1 reduction) and delivered the required protection with the limited available bandwidth.

- Protection for the complete range of the customer's business applications (including their Oracle-based applications), from mission-critical to business-critical, using RecoverPoint policy-based data replication.

- Easily integrated into the customer's heterogeneous environment, with EMC Symmetrix® in the main data center, EMC CLARiiON® in the secondary, and a variety of servers, databases, and applications across both data centers.

- Does not require Oracle RMAN and does not impact the production environment or the servers at the remote site.

- Integration with Replication Manager on Windows and Solaris environments to create application-consistent copies of Oracle databases.

# Advanced Oracle protection concepts

## Using Oracle Data Guard and RecoverPoint

Oracle Data Guard, available as part of Oracle's Enterprise Edition, is an Oracle solution to create, maintain, and monitor one or more synchronized standby databases to protect Oracle data from failures, disasters, and corruptions.  Oracle Data Guard can support zero data loss and near zero downtimes.  Data Guard also supports rolling database software upgrades for major releases and patch set upgrades with near zero downtime.   Data Guard can enable automatic and quick failover to a standby database in the event of a primary database failure.  When used in conjunction with Oracle Flashback Database, Data Guard provides a continuous data protection solution.

## Using Data Guard with RecoverPoint CRR for disaster recovery

EMC RecoverPoint remotely protects any volumes created on any hot platforms.  A complete disaster protection solution must account for the remote mirroring of both database and non-database files.  So, irrespective of the presence of Data Guard, customers should utilize RecoverPoint CRR if they seek true enterprise disaster recovery.

The ability for RecoverPoint to recover database volumes back to any consistent point in time is a powerful operational aid to Data Guard customers looking to refresh remote copies of an Oracle database.  For those using Data Guard, EMC RecoverPoint can be used to instantiate the initial standby database, refresh or re-create the new standby database after loss of the production database, and refresh standby database files that may have been invalidated due to nologging operations being run on the production database.

Data Guard complemented with EMC RecoverPoint can uniquely address scalability, high availability, and disaster recovery requirements for a complete environment that includes an Oracle database and other applications, servers and data.

## Using Data Guard with RecoverPoint CDP for operational recovery

Disk-based local-replication for Oracle has been an established best practice for Oracle environments for as long as Oracle has existed.  Oracle introduced the Flashback Database feature with Oracle Database 10g in 2001.  Oracle Flashback Database provides CDP for the Oracle database, and can be used to undo minutes or hours of database updates.  However, unlike Flashback, RecoverPoint will protect the database instance from physical failure where the entire database itself becomes unavailable.  Additionally, RecoverPoint can be used to make a full, R/W mountable copy of the database environment or set up a baseline copy for the ability to apply specific changes for testing.  EMC RecoverPoint enables the creation of a separate environment, independent of the production environment, to build a clone database.

Therefore, if customers need multiple copies of Oracle databases for active workload activities, Flashback Database is not a viable solution and EMC RecoverPoint should be used.

Both EMC RecoverPoint and Oracle Flashback Database can be used to capture changes using CDP technology. However, as with Oracle Data Guard, customers who wish to have CDP recovery capabilities for data outside the Oracle database should use EMC RecoverPoint. Data Guard complemented with Oracle Real Application Clusters can uniquely address scalability, high availability and disaster recovery requirements for an Oracle database and can satisfy aggressive recovery time objectives and recovery point objectives.

Refer to the following link for more info on Oracle Data Guard:

http://www.oracle.com/technology/deploy/availability/htdocs/DataGuardOverview.html

## Using Oracle Real Application Clusters with RecoverPoint

Oracle Real Application Clusters (RAC) is the Oracle database feature that allows two or more instances to service the same database. Oracle RAC supports the transparent deployment of a single database across a cluster of servers, providing fault tolerance from hardware failures or planned outages. Oracle RAC provides very high availability for applications by removing the single point of failure with a single server. If a node in the cluster fails, the Oracle database continues running on the remaining nodes. Individual nodes can be shut down for maintenance with application users continue to work.

### RecoverPoint support

EMC RecoverPoint supports Oracle RAC 10g or 11g for local and remote replication of the Oracle RAC SAN attached volumes. Figure 4 shows a four-node Oracle RAC cluster being remotely replicated to a single-instance Oracle RDBMS environment running in a VMware® ESX® server. The Oracle RAC LUNs are grouped into a single RecoverPoint consistency group, and replication sets are created to map the production LUNs to the remote copy LUNs. In this example, a single consistency group (Oracle_RAC_CG) is created with six replication sets (RSet1-RSet6) and two RecoverPoint journals are created, one at each site. The local journal is typically empty, and is configured in the event that production needs to fail over to the remote site. The DR journal is allocated sufficient space to cover the RPO/RTO policies established by the customer.
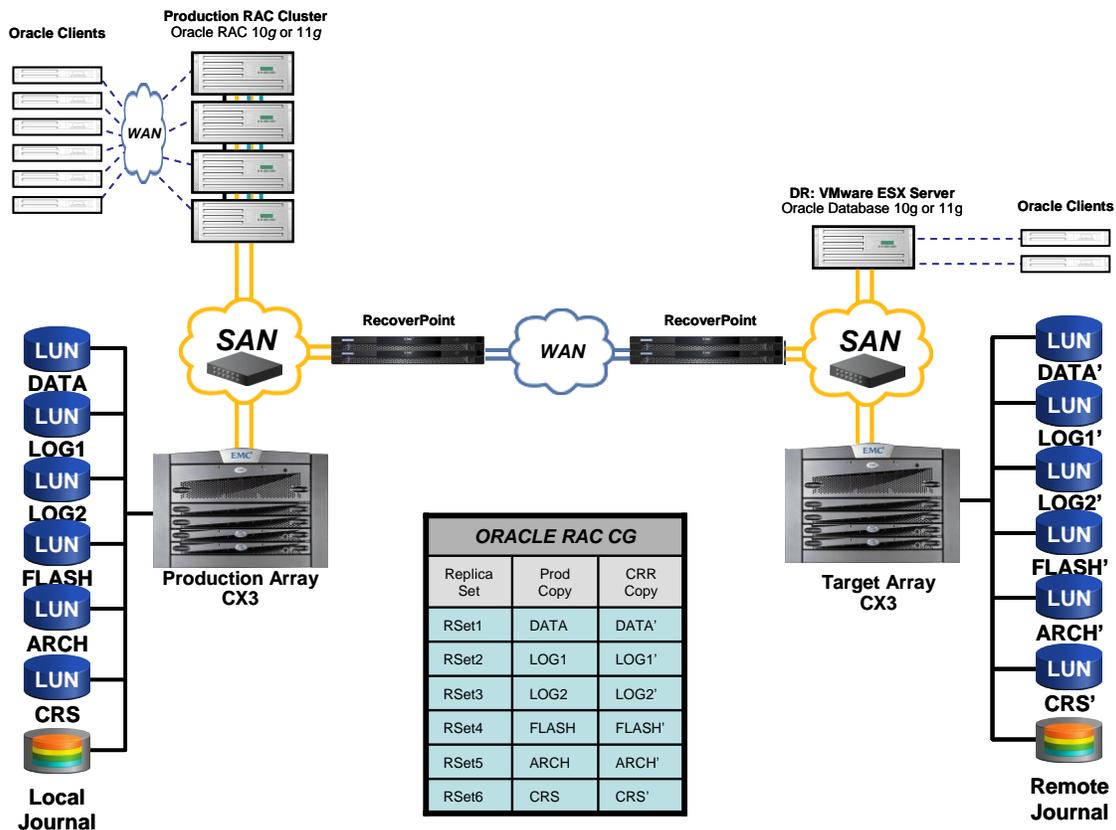
Figure 4. RecoverPoint with Oracle RAC

## Using Oracle Automatic Storage Management with RecoverPoint

Automatic Storage Management (ASM) is a strategic component of the Oracle Enterprise Grid processing model.  Along with simplifying the management, placement, and control of Oracle data, ASM separates the database services from the underlying storage system services.  When the database instances that provide database services access the required Oracle data through an ASM group, the flexibility is built in for easy allocation, deallocation, and reallocation of available storage resources, and migration of data between available storage resources, including, theoretically, heterogeneous storage resources.  The benefit of the grid processing model is the flexibility to scale and shift resources around efficiently to react to changing business requirements.  As a result, the abstraction through ASM between database services and storage services is crucial.

### ASM fundamentals

ASM manages data stored in an ASM group (or multiple ASM groups).  An ASM group is made up of one or more ASM group members.  Each group member is an independently addressable and accessible storage entity from a server host where the ASM service is running.  Figure 5 shows five ASM groups that have one or more volumes of the same size.

**ASM Instance**

Disk Group 1 (8*240GB) | Disk Group 2 (12*100GB) | Disk Group 3 (400GB) | Disk Group 4 (4*200GB) | Disk Group 5 (2*225GB)
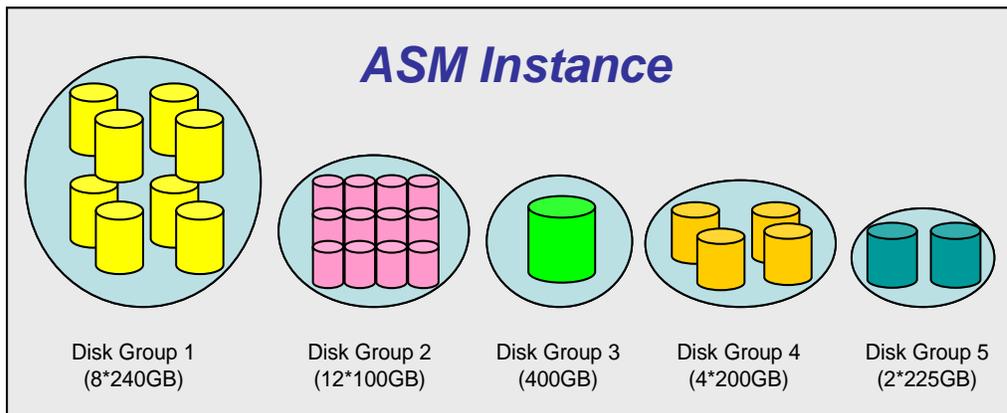
Figure 5. ASM instance and ASM groups

In an Oracle RAC environment a database may be configured to use the storage from one or more ASM Disk Groups.  Special consideration must be taken when using RecoverPoint CDP or CRR to replicate the ASM data for the following reasons:

- Oracle tries to spread out ASM data extents as evenly as possible over all the available ASM members.

- The ASM instance manages the metadata that tracks the data distributed, space used, free space, and such, in all the members.

As ASM controls the data distribution and placement of Oracle data within the members of the ASM group, it is important to ensure that all of the volumes that comprise a specific ASM Disk Group are contained within the same RecoverPoint consistency group.  This ensures that any change to one of the volumes, either due to database updates or due to ASM, are consistently replicated to the local and/or remote copy.

When RecoverPoint is used to replicate a consistency group that contains all of the members of an ASM Disk Group, the ASM managed metadata is also replicated.  This occurs because the ASM group metadata, as well as the logging information that ASM depends on for restarting, is distributed over the different Disk Group members.

When RecoverPoint CRR is used to replicate an ASM Disk Group, the replica LU always matches the production LUN at a particular point in time for every LUN in the ASM Disk Group.  Because of this, even though the ASM metadata may be changing on the primary ASM group, the set of replica LUNs in the RecoverPoint consistency group always reflect a coherent point-in-time state of the ASM group for all the members. So, the replica LUNs can always be accessed at a specific point in time and be used to restart the ASM group by another ASM instance.  This is shown in the following example:

ASM Disk Group 1
Production LUNs

RecoverPoint CG replicates all
LUNs in ASM Disk Group
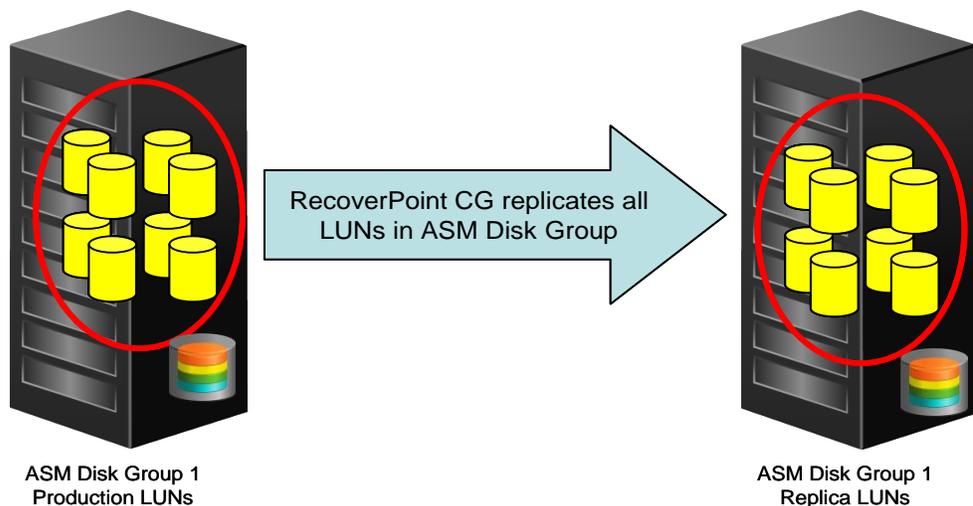
ASM Disk Group 1
Replica LUNs

Figure 6. Using RecoverPoint consistency groups with ASM

Assume there is a database DB1 in ASM Disk Group 1 on the production array. The RecoverPoint consistency group consists of one replication set (ASM DG1) with eight LUNs on the production array and eight replica LUNs on the secondary array. A RecoverPoint journal is also allocated to provide a protection window for the different recovery points. If the primary array becomes completely inaccessible, and operation must switch to using the replica LUNs in the secondary array, the content of the replica LUNs would be a restartable ASM group. The database files within the secondary ASM group, when restarted, would likely also reflect database files in flux and transitions. However, when the ASM group is successfully restarted and remounted, Oracle RDBMS will also be able to get at the correct ASM files that may be in flux, and perform an Oracle "crash-recovery" to mend any database inconsistencies in the ASM files in this ASM group.

## Supported Oracle configurations

RecoverPoint has been tested and fully supports Oracle 9i, 10g, and 11g as a stand-alone instance and in clustered configurations using Oracle Real Application Clusters with raw shared storage as well as VCS or ASM managed storage. It has also been tested to support Oracle 11gR2 ACFS.
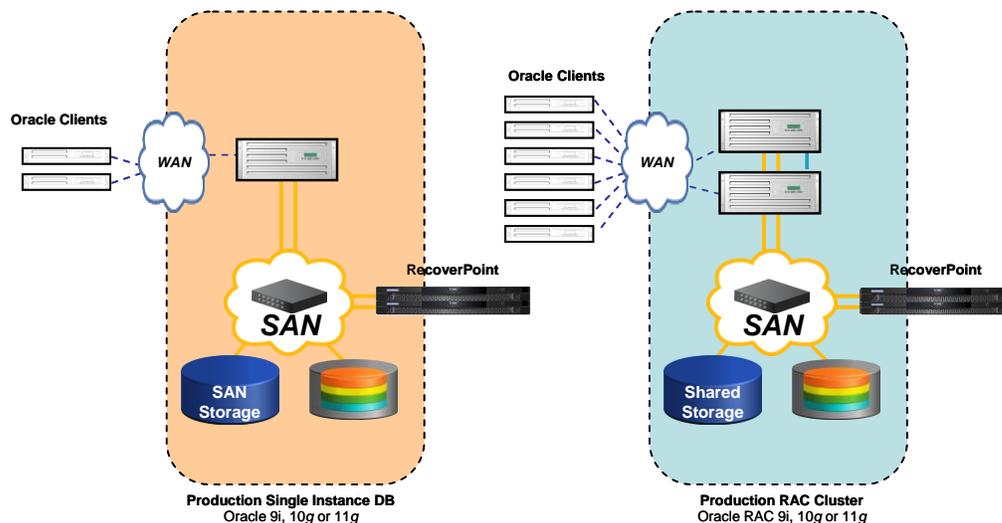
**Figure 7. Supported Oracle configurations**

## Oracle 9i, 10g, and 11g Database stand-alone and RAC, with and without ASM

RecoverPoint supports Oracle 9i, 10g, 11g, and 11g R2 Database as both a single-instance database server, running on a variety of open systems platforms, and as a member of a Real Application Cluster. The supported configurations for Oracle that are supported by RecoverPoint are listed on the EMC Support Matrix (ESM), and available through the EMC E-Lab™ Navigator.

## Support for the Oracle database using RecoverPoint

EMC and Oracle share more than 50,000 mutual customers, including each other. It is important to fully understand the depth to which EMC and Oracle have tested our joint technologies, where we post results of such activities, and how support is handled, all to gain a higher level of comfort in choosing an EMC and Oracle solution.

### Cooperative Support Agreement

EMC and Oracle Worldwide Support organizations have a fully executed cooperative support agreement (CSA) in place. Under this CSA, should a customer initiate a support call to either EMC or Oracle level-1 support organizations, EMC and Oracle have defined internal escalation paths to collaborate as needed to drive toward resolution for every customer's issue.

The CSA helps to ensure that customers can engage either EMC or Oracle support organizations and avoid a finger-pointing scenario where one vendor says a given support request is "not their issue."

### Joint Escalation Center

Given the significance of our mutual installed base, in 2001 EMC and Oracle Support agreed to form the first Joint Escalation Center (JEC). The JEC is designed to provide an

advanced level of support above and beyond the CSA. The JEC is intended to provide a deeper level of service support as well increase the time to resolution for issues encountered by EMC and Oracle shared customers.

Staffed by service engineers from both companies, the EMC and Oracle JEC is physically located in Hopkinton, Mass., with virtual teams in AsiaPac and EMEA. The JEC has the ability to simulate the many diverse networked storage environments customers are using today to support their Oracle-based applications.

All customers' Oracle/EMC interoperability issues are automatically routed to the JEC for resolution as long as they are covered by a valid warranty or maintenance agreement with both companies for the products requiring support. The JEC supports any combinations of EMC and Oracle products qualified in the EMC Support Matrix.

## Conclusion

Enterprise Oracle deployments need protection from unforeseen disasters and natural calamities. Oracle provides Data Guard as a technology to remotely replicate Oracle databases. However, protecting the database alone is not enough to protect the business itself. By implementing the continuous replication features of EMC RecoverPoint, with frequent automated and user-initiated bookmarks, the user can protect Oracle along with the business applications that require Oracle. In the event of a planned or unplanned failover your data is protected and usable. Once a failover situation is no longer needed it is easy to use RecoverPoint to move the current data back to the source side and bring the databases online with minimal downtime and no data loss.

EMC offers a variety of innovative and advanced ways to manage your Oracle storage, reduce costs, and protect your data. Organizations implementing EMC RecoverPoint continuous data protection for Oracle would expect to see the following benefits:

- Local and remote data protection against infrastructure, regional, or corruption disasters

- Minimizing removable media usage, which eliminates backup windows and reduces cost

- Improvements in both recovery point objectives (RPO) and recovery time objectives (RTO) with minimal application downtime during a disaster, or planned server or storage upgrades

- Reduced storage footprint with application-aware volume compression and delta differential data suppression

- Flexible bookmarking of application status into the RecoverPoint journal that can be easily added to existing business processes enabling application-aware recovery

Oracle Data Guard protects your Oracle databases, but EMC RecoverPoint can save you time, protects all your business applications' data continuously, and gives you

the flexibility to do more with your replicated Oracle database and business applications.

## References

More information on EMC RecoverPoint can be found at the RecoverPoint page on EMC.com and in the following documents on the EMC Powerlink website.

- EMC RecoverPoint Family Overview

- Using EMC RecoverPoint Concurrent Local and Remote for Operational Disaster Recovery

- *EMC RecoverPoint CLI Reference Guide* (Powerlink only)

- *EMC RecoverPoint Administrator's Guide* (Powerlink only)

- Disaster Recovery of Oracle Fusion Middleware with EMC RecoverPoint  (jointly published with Oracle)

- Disaster Recovery of Oracle Fusion Middleware and Oracle Database Server with EMC RecoverPoint

- *Replicating Oracle with EMC RecoverPoint – Technical Notes* (P/N 300-007-595, Powerlink only)

The following can be found on the Oracle website:

- *Oracle Database Backup and Recovery Basics 10g Release 2 (10.2)* (B14192-03)

- *Oracle Database Backup and Recovery Advanced User's Guide 10g Release 2 (10.2)* (B14191-02)

- *Oracle Data Guard Concepts and Administration 10g Release 2 (10.2)* (B14239-05)