



# OPTIMIZING ORACLE DBA EFFICIENCY

Delivering real advantages in performance, management, and cost

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## THE JOURNEY TO PRIVATE CLOUD COMPUTING

The journey to private cloud computing for Oracle begins and ends with virtualization. Removing the physical 1:1 relationships between Oracle database instances and the server hardware they run on unlocks new capabilities for Oracle DBAs whose ongoing challenges include:

- Oracle storage resource optimization
- Patching and maintenance
- Application development and test
- Backup, recovery, and deduplication
- Disaster recovery and business continuance

With virtualization, DBAs can set up and deploy more instances of Oracle on the same hardware in less time. Virtualization also improves the mobility of databases by allowing Oracle instances to be moved between servers and operating systems transparently without application impact.

The result? Oracle DBAs can meet their tactical and strategic management challenges in less time and with less effort. EMC® can prove this. EMC and Oracle have over 70,000 joint customers, and EMC itself has been on this journey as one of the largest Oracle database and applications deployments in the world. Based on real-life customer and EMC Global IT examples, EMC has developed a suite of EMC Proven™ Solutions paving a path to private cloud computing.

In the next few pages, this EMC Perspective will lay out how to optimize your current environment, meeting today's business need, while you begin to plan for private cloud. It will discuss how EMC and Oracle technologies can simplify the daily tasks and processes of Oracle DBAs, in an integrated and collaborative way.

## ORACLE STORAGE RESOURCE OPTIMIZATION

All Oracle databases are not created equal. The applications deployed on each will vary, and their workloads will change over time as the value of data changes. This could include an OLTP financials application that experiences spikes in workload during end-of-quarter processing, or a data warehouse environment where complex queries are run periodically to analyze vital customer statistical information. Due to the varying nature of Oracle workloads, the underlying storage infrastructure should be approached not as a single, monolithic entity, but as an intelligent, self-adjusting tiered-storage architecture.

EMC tiered-storage platforms allow Oracle DBAs the choice of optimizing their infrastructure for performance, scalability, and flexibility. This starts by first choosing the appropriate tier of storage itself, between high-performance Enterprise Flash Drives (EFDs), high-capacity SATA drives, and traditional Fibre Channel (FC) drives.

Equally as important for maximizing Oracle DBA efficiency is choosing the appropriate storage-to-server connectivity. Traditionally, many Oracle customers deploy FC SANs to exploit high performance and scalability. However, running Oracle database workloads over IP-based protocols, such as NFS or iSCSI, has become an attractive solution. It delivers the lower cost and ease of implementation of NAS, and the ability to efficiently share data quickly over existing internal local area networks. EMC "unified storage" is a single platform that uses multi-protocol connectivity. Oracle DBAs can now run Oracle on SAN, NAS, or combinations of both and switch between both file and block protocol access as needed.

Many IT organizations have embraced the concept of running their entire Oracle database environments over NFS given the cost efficiency it provides by leveraging existing corporate networks. For those Oracle customers wanting to run Oracle workloads on NFS specifically, EMC worked closely with Oracle to integrate EMC unified storage platforms with Oracle's Direct NFS (DNFS) feature in the Oracle database. Oracle DNFS is designed to make running

## ORACLE DIRECT NFS INTEGRATION WITH EMC

EMC best practices for Oracle outline testing Oracle DNFS with EMC across both DSS and OLTP workloads, demonstrating a 30 to 50 percent savings in CPU overhead as shown in Figure 1.

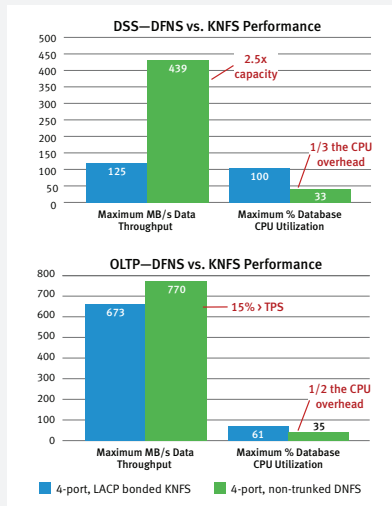


Figure 1: Savings in CPU overhead

To learn more, read [Optimizing EMC Celerra IP Storage on Oracle 11g Direct NFS](#)

## HOW EMC FAST IMPROVES TCO

As depicted in Figure 2, EMC best practices for Oracle outline a tested use case where FAST was able to drive a 15 percent reduction in overall storage cost by intelligently adjusting Oracle OLTP workloads across EFDs and SATA drives. Similarly, EMC Global IT recently moved EMC’s own Oracle data warehouse to EFDs and achieved a tenfold performance increase for one-day processing, and a 180 percent increase in overall batch reports.

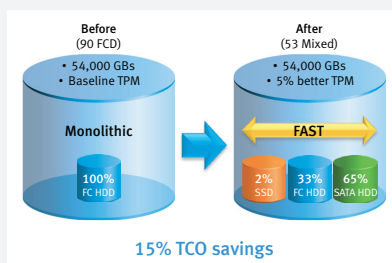


Figure 2: Reducing overall storage cost

To learn more, see [Leveraging Fully Automated Storage Tiering \(FAST\) with Oracle Database Applications](#)

[EMC IT’s Migration to the Open, Expandable Oracle BI Grid](#)

Oracle over NFS faster and easier to configure. (See Figure 1.) Performance is better because Oracle bypasses the operating system and generates exactly the requests it needs. Data is cached just once—in user space—which saves memory with no second copy in kernel space. Oracle also improves performance by load balancing across multiple network interfaces if they are available.

## FULLY AUTOMATED STORAGE TIERING (FAST)

One of the greatest challenges with a tiered-storage approach has been keeping the tiered-storage model you design and deploy today relevant and applicable to your Oracle workloads that change over the next day, week, or month. Traditionally, many manual steps were required to constantly analyze Oracle workloads running on storage, then prioritize and reconfigure the storage architecture to map to Oracle performance and capacity requirements.

EMC designed Fully Automated Storage Tiering (FAST) to make it dramatically faster and easier to tier storage constantly over time as Oracle workloads adjust over time. You can set the prioritization levels you see fit for specific Oracle workloads based on database or application, and have these adjust at specific times, or as specific capacity or performance thresholds are reached. (See Figure 2.)

EMC FAST technology creates storage pools out of mixed drive types such as EFD, FC, and SATA drives supported by EMC storage platforms. The storage objects (LUNs) created inside a storage pool can span all available tiers within that pool. EMC FAST technology monitors data temperatures and automatically moves the hot and cold data at sub-LUN granularity to the right tiers available within a pool.

The technology provides very low latencies to the data that is accessed most frequently. This improves application response times and significantly reduces the amount of investment in Flash drives. The data migration is a completely non-disruptive process that is controlled by defining simple storage relocation policies.

Oracle DBAs benefit from FAST because it targets the most frequently accessed data, thereby delivering improved application performance while reducing the amount of tuning and administration required. Tiered storage and FAST can deliver dramatic performance benefits for both Oracle OLTP and data warehouse environments while decreasing total cost of ownership through intelligent storage tiering.

## FAST CACHE FOR UNIFIED STORAGE

While EMC FAST provides automation of the overall storage tiering process across EFD, FC, and SATA drives, many Oracle database environments are primarily concerned with maximizing the use of EFDs alone to increase performance of their most latency sensitive applications.

To address this, EMC developed “FAST Cache” technology as a means to introduce an extra layer of cache using EFDs between DRAM cache and rotating spindles. (See Figure 3.)

EMC FAST Cache technology is part of the EMC FAST suite of EMC products and creates a faster medium for storing frequently accessed data on EFDs.

The database application hot and cold data is automatically identified and hot data is cached by this newly created cache layer on EFDs. Cold data is then flushed out of FAST Cache, automatically and transparently, depending on usage patterns. Once the hot data is cached by Flash Cache, the FAST Cache handles the majority of the I/O, and the underlying rotating spindles will receive very few IOPS. This effect enables three major benefits to Oracle DBAs:

- You can deploy the database on fewer rotating spindles
- You can deploy the database on slower spindles, such as 10,000 rpm drives or SATA drives, and achieve the same performance levels
- You can use more of the rotating spindles’ available capacity without significantly impacting overall application latency

## FAST CACHE IMPROVES PERFORMANCE AND REDUCES TCO

EMC testing demonstrated three scenarios for incorporating FAST Cache in an existing baseline Oracle database environment running entirely on 45 600-GB FC drives.

1. Adding 8 73-GB EFDs and FAST Cache to the existing environment
2. Adding 8 73-GB EFDs and FAST Cache to the existing environment, but removing 25 of the 45 FC drives
3. Adding 8 73-GB EFDs and FAST Cache to the existing environment, but replacing all 45 FC drives with 45 2-TB SATA drives

As shown in Figure 3, in all three cases there was a 143 percent increase in transactions per minute for the Oracle Database 11g environment over the baseline environment. This demonstrates the ability of FAST Cache to not only increase performance dramatically, but also drive storage consolidation and cost reduction by cutting the number of IOPS to the underlying rotating spindles.

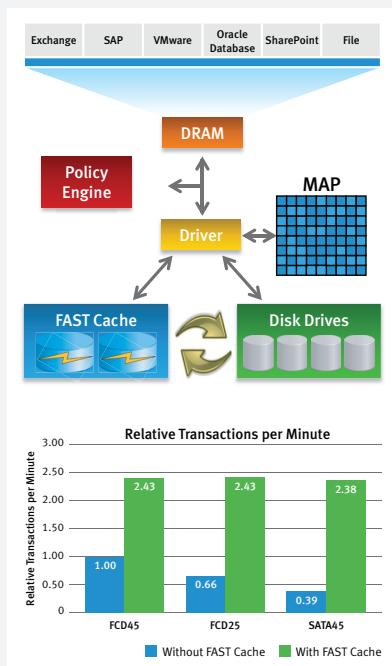


Figure 3: Increased transactions per minute with FAST Cache

To learn more, see [Leveraging EMC FAST Cache with Oracle OLTP Database Applications](#)

## VIRTUAL PROVISIONING

One of the biggest challenges facing DBAs is storage provisioning for Oracle database applications. Administrators typically allocate space based on anticipated future growth. This is done to mitigate recurring operational activities such as incrementally increasing storage allocations, or adding discreet blocks of storage as space is consumed. This approach results in more storage allocated than is actually needed over an extended period of time. This increases cost. In other examples, database administrators may pre-allocate large amounts of storage for data files or tablespaces to ensure sufficient free space within the database. The operating system sees space as completely allocated but internally only a fraction of the allocated space might be used. (See Figure 4.)

EMC Virtual Provisioning can address all these issues. Virtual provisioning allows more storage to be presented to a host operating system than is physically available. Virtual provisioning can allocate physical storage only when the storage is actually written to, allowing more efficient storage use and lower cost. Virtual provisioning also stripes the data across disks in the thin pool regardless of whether a small or large thin device or database object is created, and alleviates the need for time-consuming storage-layout planning. EMC Virtual Provisioning allows the seamless addition of more physical storage as the Oracle database application's demand grows. While increasing the available capacity, more physical disks can also improve the application's I/O performance because of wider striping and more back-end spindles to drive I/O traffic.

## PATCHING AND MAINTENANCE

### SNAPS VS. CLONES

Different types of replication are available to Oracle DBAs depending on their intended use. The most common use case is the creation of full volume-for-volume copies of the entire Oracle database environment. These are used to create fully recoverable copies of the Oracle database. This process leverages EMC clones that provide not just full copies of the actual data, but also add an EMC technology called consistency groups. These are important because many Oracle databases will span multiple LUNs within the storage array. As transactions continue to be processed during the replication process it is critical to assure, with clones, that the new copy is transactionally consistent with the source database so that it can be used for effective and fast recovery.

Although clones are useful for full recovery, they are also more expensive given the amount of storage they consume.

With this in mind, EMC enables the use of "snaps" as a cost-effective alternative to clones. Snaps are space-saving copies that store the data in memory versus disk. Because RAM is much faster for storage and retrieval than physical drive space, one benefit is speed. Point-in-time images are made quickly without causing undo impact to host applications. Another benefit is the extra storage space this leaves available for other information. EMC snap copies take a smaller percentage of the capacity required for the source, and that's only the space necessary to protect the original data's integrity, which would subsequently be overwritten on the source volume.

Depending on the use case, DBAs should leverage combinations of clones and snaps for full recovery and/or temporary usable copies of Oracle data.

## EMC REPLICATION MANAGER

To enable Oracle DBAs to take advantage of the speed and efficiency benefits of EMC replication, EMC developed a technology called EMC Replication Manager.

## INCREASE PERFORMANCE AND RECLAIM STORAGE WITH EMC VIRTUAL PROVISIONING

EMC best practices for Oracle outlined a tested use case where applying EMC Virtual Provisioning™ helped Oracle DBAs reclaim over 56 percent of storage capacity (see Figure 4), improving the efficiency of managing Oracle for performance and capacity planning. In addition, EMC Virtual Provisioning allows you to dynamically allocate more storage resources to Oracle database workloads, increasing performance up to 90 percent without consuming more storage capacity.

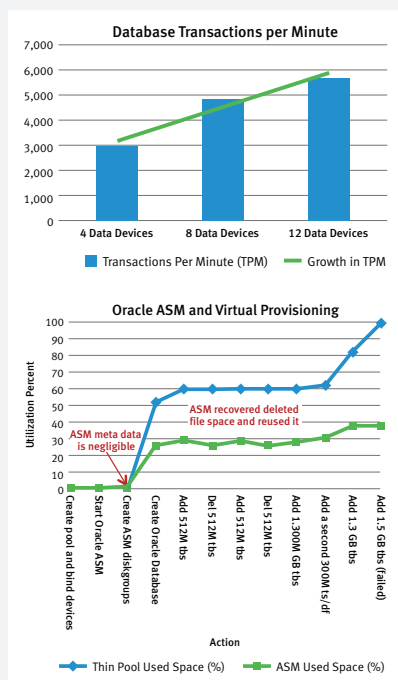


Figure 4: Reclaiming storage capacity

You can learn more by reading [Implementing Virtual Provisioning on EMC Symmetrix VMAX with Oracle Database 10g and 11g](#)

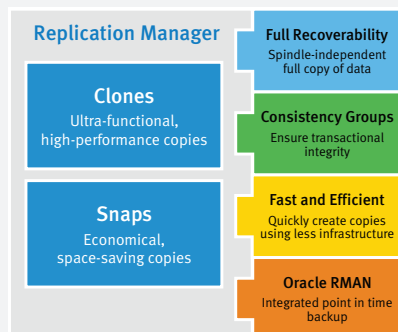


Figure 5: EMC Replication Manager for Oracle DBAs

EMC Replication Manager, depicted in Figure 5, manages EMC point-in-time replication technologies through a centralized management console presentable to Oracle DBAs. Replication Manager coordinates the entire data replication process—from discovery and configuration to the management of multiple, application consistent disk-based replicas. Auto-discover your replication environment and enable streamlined management by scheduling, recording, and cataloging replica information including auto-expiration. This proves beneficial to Oracle DBAs in several key areas:

- Point-and-click, wizard-driven management of EMC clone and snap replication technologies eases management chores
- Ability to create a gold copy of the Oracle production database makes it quick and easy to create a backup that can be used if there is a patch, upgrade, or database corruption problem
- Automated scheduling, mounting, dismounting, and expiration of Oracle replicas saves valuable time
- Dedicated user accounts and access privileges provide Oracle DBA self-sufficiency

## APPLICATION DEVELOPMENT AND TEST

Every Oracle database environment requires an associated development and test environment, which is often much larger than the production systems it supports.

Oracle developers, QA, and IT teams have key requirements that must be addressed to enable effective creation, testing, and deployment of applications. These requirements include:

- Isolated “sand box” environments for application development and pre-deployment testing
- Support for creating realistic test environments to verify compatibility of applications with other elements of the deployment infrastructure
- Collaboration within and among geographically distributed teams, including passing complete information about configurations between development teams, QA, and support to reproduce problems
- Automated regression tests, including some that may require shutdown and/or reboot cycles
- The ability to introduce simulated failure conditions into the QA cycle for stress testing

One of the most significant challenges facing enterprise development teams is the loss of productivity resulting from team members contending for finite hardware resources. Because the number of systems is often limited by capital budgets and by facilities constraints (such as rack space, network ports, HVAC, and power), access to hardware becomes a significant bottleneck that may slow down or stall projects.

VMware® virtualization technology allows multiple operating systems and software applications to run concurrently on a single x86 (Intel or AMD processor) computer as individual virtual machines. Those virtual machines encapsulate entire physical systems—hardware configuration, operating system, and applications—into a self-contained package that can run on any system. This provides Oracle DBAs several key benefits:

- Consolidate multiple virtual test machines onto a single physical system
- Move between operating system environments without repartitioning or rebooting
- Create libraries of virtual machines for each operating system and network configuration with preconfigured test environments and tools
- Suspend and restore virtual machine instances on demand to maximize hardware utilization
- Allow several developers simultaneous access to a virtual machine

## RAPID PROVISIONING WITH VMWARE FOR ORACLE

VMware and EMC have developed best practices for Oracle to leverage combinations of EMC unified storage platforms with VMware for Oracle development and test. A recent best-practices use case demonstrated how to set up 10 Oracle virtual machines in 10 minutes for development and test.

To learn more, read [Rapid Deployment and Scale Out for Oracle E-Business Suite Enabled by EMC RecoverPoint, EMC Replication Manager, and VMware vSphere](#)

## EMC REPLICATION MANAGER WITH VMWARE

Combining VMware with the capabilities of EMC Replication Manager allows Oracle DBAs to benefit from a complete, integrated development and test environment that is able to support multiple storage protocols, multiple storage tiers, and the benefits of virtualization from a centrally managed platform.

Combining EMC Replication Manager with Oracle Rapid Clone scripts allows Oracle DBAs 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 repeated scale-out of dev/test environments.

## BACKUP, RECOVERY, AND DEDUPLICATION

For many Oracle customers the backup and recovery process is the primary source of disaster recovery. As Oracle database environments grow over time, this can present challenges in terms of the time and performance impact required during Oracle backup and recovery operations.

### EMC REPLICATION WITH ORACLE RMAN

EMC clone and snap replication technologies combined with Oracle RMAN are able to dramatically improve the efficiency of Oracle backup and recovery in several key areas:

- **Fit your backup window**—Use EMC replication to create a point-in-time copy of the Oracle database. When doing so, the production database will now only be in hot backup mode for a few minutes, at the most, while the EMC replication takes place. Oracle DBAs can then perform the Oracle backup off the copy instead of the production instance, while the production database remains active.
- **Faster recovery times**—DBAs can now recover from the last full Oracle backup taken with EMC replication in seconds, allowing RMAN to recover additional committed transactions from that time forward.
- **Reduce performance impact from running backup on production**—DBAs can off-load backups from production using EMC replication where the backup is performed on another server using different devices. Combining this with Oracle RMAN Block Change Tracking can considerably speed up incremental backups by directly reading only the changed blocks before backup, as opposed to a full database scan.

### EMC DATA DOMAIN DEDUPLICATION WITH ORACLE RMAN

A second challenge with Oracle backup and recovery is that, over time, the size of Oracle data being backed up will increase dramatically. This often limits the amount of full backups that can be effectively processed within required backup windows, and can also lead to long recovery times (not to mention the high costs of backup storage required).

The EMC Data Domain® Appliance Series incorporates high-throughput, scalable deduplication storage for Oracle environments to address these challenges. The Data Domain Appliance becomes the initial backup target for Oracle RMAN where advanced capabilities, including deduplication and compression, are applied to the database before sending the Oracle data to the target backup medium. (See Figure 6.)

As data is sent to a Data Domain system, a checksum is taken of everything that's about to be stored. The system checks that it has already stored the data, and if not, the data is then stored through the file system to disk. Then the backup I/O is internally read back from disk and checksummed again. Next, the system compares it to the original checksum taken at write time. This allows the system to know for sure that the data is readable, the blocks are readable, and the data within those blocks is correct.

Specifically, this can provide the following benefits to Oracle DBAs:

## STREAMLINING THE BACKUP-RECOVERY ARCHITECTURE WITH ORACLE RMAN AND EMC DATA DOMAIN

An EMC best practice for Oracle documented a tested use case where leveraging Oracle RMAN with Data Domain achieved an 84 to 92 percent reduction in the amount of backup storage required in just five weeks, dramatically streamlining the Oracle backup-recovery architecture and setting the stage for greater overall efficiency (92 percent for Oracle on EMC unified storage with NFS; 84 percent for Oracle on EMC unified storage with FCP).

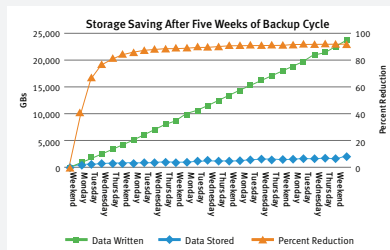


Figure 6: Oracle RMAN with EMC Data Domain

To learn more, read [EMC Backup and Recovery for Oracle 11g OLTP Enabled by EMC CLARiiON, EMC Data Domain, EMC Networker, and Oracle Recovery Manager using NFS](#)

[EMC Backup and Recovery for Oracle 11g OLTP Enabled by EMC CLARiiON, EMC Data Domain, EMC Networker, and Oracle Recovery Manager using Fibre Channel](#)

- **Retain backups longer**—By deduplicating data before it is backed up, more data can be stored online at lower cost. This allows for the retention of more Oracle data for longer periods of time, and the performance of more frequent full backups vs. incremental backups.
- **Replicate smarter**—Data Domain systems only move deduplicated data over existing networks with up to 99 percent bandwidth efficiency for fast, cost-effective disaster recovery.
- **Recover reliably from disk**—By allowing recovery from full backups vs. incremental, recoveries are more reliable and less complex.

## DISASTER RECOVERY AND BUSINESS CONTINUANCE

Over time, as the data within the Oracle database becomes more critical to the business, backup-recovery alone will not suffice in terms of data protection. Disaster recovery must also be a focus. EMC has worked with Oracle in this area for many years, and today includes best practices for the use of EMC disaster-recovery solutions, which can be leveraged with or without Oracle Data Guard.

A primary focus between EMC and Oracle has been how to protect and recover not just database files but also the middleware and applications data that runs on top of them. To recover the “business” itself, including all database, middleware, and applications information, EMC RecoverPoint provides Oracle DBAs with a compelling solution.

## EMC RECOVERPOINT

EMC RecoverPoint is a comprehensive data-protection solution providing concurrent local and remote data protection. It is fully leveraged through EMC Replication Manager as an additional replication solution for Oracle DBAs.

For local replication, RecoverPoint writes data to a local journal and then to a local volume. Here, RecoverPoint can synchronously track every write in the local journal and distribute the write to the local volume—all without impacting application performance.

For remote replication, RecoverPoint transfers significant writes—based on application recovery time or recovery point objectives—to a remote site where they are saved in a history journal as shown in Figure 7.

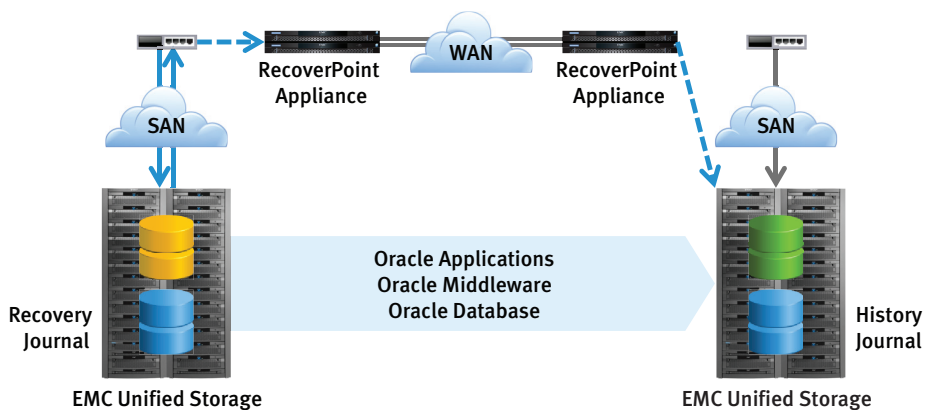


Figure 7: EMC RecoverPoint for Oracle

Once the RecoverPoint appliance receives the write it will bundle it up with others into a package. Redundant blocks are eliminated from the package and remaining writes are sequenced and stored with their corresponding timestamp and bookmark information. The package is then compressed and scheduled for delivery across the IP network to the remote appliance.

Once the remote appliance receives the package, it validates the checksum to ensure the package was not corrupted during transmission. The data is then uncompressed and written to the journal volume. Once the data has been written to the journal volume it is then distributed to the remote volumes to ensure write-order sequencing is preserved.

In the case of Oracle, RecoverPoint supports synchronous, asynchronous, and snapshot modes. All Oracle LUNs are grouped into a consistency group and replication sets are created to map the production LUNs to the local and/or remote LUNs. There are several options for recovery:

- **Application-consistent recovery from a shut down (also known as a cold backup)**—The user creates a consistency group that represents the Oracle application, containing all files for the application including data files, online redo log files, configuration files, and, optionally, control files. This method allows for recovery with 100 percent reliability. Because operations must be halted while the cold backup is taken, this is not ideal for 24x7 operating environments.
- **Crash-consistent recovery during operations**—This enables crash-consistent images without shut down. As a write is issued to the production volumes, RecoverPoint splitters intercept it and send a copy of the write to the RecoverPoint appliance for further processing. These captured writes represent on-disk consistent data. When Oracle is restarted from a server crash, it must open the database, then perform recovery operations. Oracle uses the redo logs to recover the committed data and undoes any in-process transactions on the failed instance.
- **Application-consistent recovery during operations**—This enables creation of application consistent images without application shutdown. It requires that all data files belonging to the relevant Oracle tablespaces, archive logs, and control files are flushed from the servers in memory buffers to disk. This procedure involves placing the appropriate tablespaces or databases into hot backup mode. Once backup mode is set, RecoverPoint creates a bookmark for the specific consistency group to identify the image as an application consistent image.

EMC has worked with Oracle to document best practices and tested use cases around EMC RecoverPoint. This includes leveraging EMC RecoverPoint as the single complete solution to protect all tiers of the Oracle environment, including databases, middleware, and applications.

This also includes use cases to combine RecoverPoint with Oracle DataGuard. In such cases, Oracle DataGuard replicates the Oracle database files and archive, as well as redo logs, while RecoverPoint manages data protection for the Oracle middleware and applications data. In either scenario, for those Oracle environments where application-consistent recovery is a requirement EMC RecoverPoint provides an ideal solution.

## EMC—SUPPORTING YOUR JOURNEY TO THE PRIVATE CLOUD

A top customer concern around private cloud computing is ensuring tight integration and support. That's why EMC, VMware, and Oracle have worked very closely on the testing, qualification, and support of Oracle in VMware environments. All Oracle technologies supported for use with VMware are documented on Oracle MetaLink and EMC. Oracle and VMware maintain close collaboration on support through our multivendor escalation center run by the EMC E-Lab™.

### EMC PROVEN SOLUTIONS FOR ORACLE

EMC offers a portfolio of validated solutions, services, and technologies that can increase efficiency and lower deployment risks. In short, everything you need to build the infrastructure that is right for you. This portfolio targets each area of the Oracle infrastructure stack with the goals of driving efficiency and lowering risk.

## EMC CONSULTING

Once you decide to deploy Oracle within the data center, a continuous lifecycle begins, moving from initial development, to test, to deployment, to ongoing migration, to new releases of Oracle and the deployment of new features with each release.

This process repeats itself for every new Oracle deployment inside the business. Having a trusted partner with deep Oracle expertise is a powerful asset in maximizing the efficient use of each new Oracle deployment, and ensuring infrastructure and applications can align to deliver back to the business.

The EMC Consulting Practice for Oracle can help you get started quickly—and it will be there at each step of your Oracle journey.

**Plan**—Initial discovery phases are good times to meet with EMC to share ideas, learn from what other EMC customers have done, and receive general guidance.

**Build**—The build phase can be improved greatly by scheduling an EMC workshop where your IT staff meets with EMC experts who share recommendations and guidelines on planning the most efficient Oracle deployment.

**Manage**—Post-deployment, EMC experts can help provide recommendations on the key integration points of Oracle and EMC software to make ongoing management more efficient in the areas of performance, replication, virtualization, backup, recovery, or disaster recovery.

**Support**—EMC and Oracle maintain a dedicated, joint escalation center where all Level 2 or higher support issues are automatically sent, ensuring faster resolution.

### CONTACT US

For more information on specific ways EMC can improve the operation of your information infrastructure, contact your EMC sales representative, call 1-866-464-7381, or visit our website at [www.EMC.com](http://www.EMC.com).

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