# Table of Contents

Introduction .................................................. 1
Overview of DR Solutions with Oracle VM ............. 2
  Continuous availability explained ....................... 2
  Disaster recovery explained ............................ 2
Oracle Maximum Availability Architecture ............. 3
Application centric Vs. Oracle VM centric solutions ... 3
Choose your DR solution path ............................. 4
Overview of Oracle VM Deployment Architectures ... 4
Symmetrical hardware deployment ....................... 4
Asymmetrical hardware deployment ..................... 5
Application Centric DR Solutions ....................... 5
  A dual active/active solution using MAA applications 6
Oracle VM Centric DR Solutions ....................... 6
  A single active/passive DR solution using Oracle VM 7
  A dual active/passive DR solution using Oracle VM 7
  A dual active/active DR solution using Oracle VM 9
References .................................................... 9
Introduction

Oracle offers a complete product portfolio that includes servers, storage, applications, middleware and database products that will allow you to piece together a custom disaster recovery (DR) solution for your business systems. Oracle VM 3 is simply one of many components that must be integrated along with other disaster recovery software and applications into an overall business continuity solution for your enterprise.

There are several different approaches to integrating Oracle VM into a disaster recovery environment all of which work with SAN or NAS. Use this white paper to choose a DR solution that best fits your needs. Once you know which direction you want to take using this paper, you will then follow other more technically detailed white papers describing exact steps for the DR solution path you choose.
Overview of DR Solutions with Oracle VM

The deployment architecture for disaster recovery or continuous availability using Oracle’s Maximum Availability Architecture (MAA) is built around two or more clustered server pools with each pool residing at a different partner site. The clustered server pools provide the first level of protection for business systems through the high availability features and capabilities in Oracle VM, which are discussed in the following white papers and documentation:

» Oracle VM 3 White Paper: Server Pool Deployment Planning Considerations for Scalability and Availability
» Oracle VM 3 Concepts Guide: Understanding Server Pools
» Oracle VM 3 Concepts Guide: Understanding High Availability (HA)

The business systems or applications are then installed, configured and deployed on the Oracle VM platform you have built for high availability using clustered server pools. Using the clustered server pools as the starting point, you can then protect your mission critical applications using highly complex continuously available solutions and protect your business critical applications using relatively simple disaster recovery paradigms.

Should you use continuous availability or disaster recovery as the protection scheme for your business systems? The choice of protection scheme used to achieve business continuity is completely up to your unique requirements for recovery point objective, recovery time objective, recovery consistency objective and budget constraints. This white paper discusses several different protection schemes to help you make the choice.

Continuous availability explained

Continuous availability is different from disaster recovery. Continuous availability in the context of this white paper implies that there is 100% availability of mission critical applications even after the total loss of all computing resources at single data center. This means internal or external customers may experience a delay in processing orders or transactions, but there is no loss of in-flight data and orders are eventually committed. The recovery transaction capacity objective (RTO) is fixed at 50% since it is assumed 50% of the virtual machines will be lost during an outage of either site.

There is no virtual server product on the market that is able to provide continuously available computing using just the virtual server product by itself; Oracle VM is no different in this respect than any competing product. Oracle VM provides a stable high availability platform for continuous computing, but it is really the way the applications for a given business system are deployed and implemented that provides the continuous availability across multiple partner sites.

Continuous availability with Oracle VM is an application centric approach to disaster recovery using a wide range of Oracle products certified for Oracle’s Maximum Availability Architecture (MAA). This is the Oracle VM recommended solution for disaster recovery.

Needless to say designing and implementing a continuously available business system is complex as well as expensive to deploy and maintain. Enterprise application integration is beyond the scope of this paper, so designing and implementing the various application tiers relies on you reading and understanding HA and DR guides provided by the various Oracle MAA products that are part of your business system.

Disaster recovery explained

Unlike continuous availability, disaster recovery implies that there is an interval of time where an entire business system is completely unavailable for a short period of time known as the recovery time objective (RTO). The actual time it takes to recover will vary between minutes or hours depending on number of Oracle VM guests, physical disks and adjustments you need to make to the configuration for each of the Oracle VM guests, if any.
Disaster recovery also means you will be at risk of losing whatever transactions were committed between last time a valid replication of storage was completed and the point that a disaster occurs. Part of the process for planning the implementation of a business system is determining how often a point-in-time (PIT) backup of the business system will occur. How far you have to go back in time to successfully recover the business system is known as the recovery point objective (RPO). If you are using synchronous storage replication then your RPO will be the last transaction that was committed and written to disk which should be measured in minutes. You will lose any transactions that were in-flight at the point when a complete or partial outage occurs at the primary site.

If you are using asynchronous storage replication then your RPO will be the last time you flushed everything to disk and completed a valid replication of storage to the partner storage at the recovery site. This could be measured in minutes or hours depending on the frequency of replicating your storage to the recovery site. With asynchronous storage replication, you will lose any transactions that were in-flight at the point when a complete or partial outage occurs at the primary site, plus all committed transactions that were written to disk but not replicated to the recovery site.

There are two other concerns for designers when thinking about a recovery process: the consistency of entities in the database commonly known as the recovery consistency objective (RCO) and in the case of virtual server environments, the capacity to process transactions after a failover has occurred.

**Oracle Maximum Availability Architecture**

The Maximum Availability Architecture (MAA) is a framework for integrating various Oracle products such as databases, middleware, applications and web services into a cohesive, fault tolerant mission critical business system built for high availability and disaster recovery from the ground up. This application centric approach to disaster recovery relies on the HA and DR capabilities of the Oracle products running on virtual machines rather than features or capabilities of Oracle VM.

There are several different levels of solutions that can be implemented using MAA capable products from traditional active-passive and active-standby disaster recovery to robust active-active solutions for continuous availability. Using MAA to implement a continuously available business system is the preferred solution for disaster recovery with Oracle VM.

The MAA framework goes way beyond just the Oracle Database and includes many other Oracle products built from the ground up for high availability and continuous availability. The white paper entitled *Maximize Availability with Oracle Database 12c* is a good starting point for understanding the breadth of solutions available using other Oracle products. You can also find many more MAA resources at Oracle’s Maximum Availability Architecture Best Practices Blueprint OTN site to learn more about MAA as well as all the various products certified to work within the framework.

**Application centric Vs. Oracle VM centric solutions**

We have two major directions or paths you can follow for accomplishing disaster recovery:

- Application centric solutions: these solutions rely solely on MAA capable Oracle products to accomplish disaster recovery and treat the Oracle VM guests as if they are stand alone servers with no regard to Oracle VM at all.
- Oracle VM centric solutions: these solutions rely on replicating the Oracle VM storage repositories to a partner recovery site, taking ownership of the repositories and then starting the Oracle VM guests at the recovery site.

Both solution paths are explained in more detail beginning with the next section of this paper.
Choose your DR solution path

The solutions presented in this paper are described at a conceptual level to help you make the best choice for your unique requirements. Once you know which direction you want to take using this paper, you will then follow other more technically detailed white papers describing exact steps for the DR solution path you choose.

There is no requirement that you follow a single solution path with Oracle VM. For example, you might have some customer facing business systems that represent significant revenue streams for your company and must always be available even during a complete outage at a single site. For this situation, you might want to maintain one or more server pools that take advantage of the application centric approach providing continuous availability with zero downtime using Oracle MAA capable applications.

Continuing with this example, let’s assume you also have other business systems that are built using non-Oracle MAA capable applications and can tolerate an outage with an RTO of a few hours. The same Oracle VM Managers being used for the application centric server pools can also host server pools using an Oracle VM centric approach to DR.

Figure 1 below builds on the concept and illustrates how you might use different DR solutions for various server pools to accomplish what you need. How you deploy the solutions is quite flexible and completely up to your unique requirements.

![Image of server pools](image_url)

**Figure 1:** You may use different DR solutions together with the same Oracle VM Manager

Notice in the above diagram that different server pools can have different partner or recovery sites and server pools are built to contain applications or business systems with common service level agreements for recovery time objectives. An Oracle VM Manager can also have server pools that are not part of a DR solution running alongside server pools that are part of a DR solution.

Overview of Oracle VM Deployment Architectures

Deployment architecture refers to how you utilize servers, networking and storage to build your Oracle VM environment. Oracle VM 3 allows quite a bit of latitude when it comes to architecting complex solutions that fit the requirements and capabilities of global or independent data center operations.

Symmetrical hardware deployment

For best performance and higher availability, Oracle recommends that the hardware platform be identical at both sites for an Active/Standby or Active/Active business continuity model. For example, if you have six Oracle X3-2 servers and 40TB of disk space on an Oracle ZS3-4 at your primary site, then you should deploy the identical
hardware and capacity at the recovery site. This ensures that the disaster recovery site will be sized correctly to avoid unexpected results from Oracle VM guests not being able to start at the recovery due to fewer compute resources being available such as available memory, CPUs, differing network and storage capacities, etc.

**Asymmetrical hardware deployment**

Asymmetrical hardware deployment means either of the partner sites can have more or less hardware resources with completely different server models, different memory, CPU, network and storage capacity. The advantage to this paradigm is that data centers can utilize existing equipment or find less costly solutions for either the primary or recovery site. In fact, one of the primary benefits of virtualized guest operating systems is hardware independence. Basically, each site can be built using servers and storage from entirely different manufacturers.

The obvious disadvantage to using an asynchronous hardware deployment is that there is a distinct possibility that the recovery site may not have the resources of the primary site causing some Oracle VM guests fail on the recovery site due to computing resources being wholly utilized by the first few Oracle VM guests that are able to start after a failover.

**Application Centric DR Solutions**

Rather than deploy a DR solution using Oracle VM, application centric solutions take advantage of application-integrated high availability built into a wide variety of Oracle products that fall within Oracle's Maximum Availability Architecture (MAA) framework. If you need zero downtime with zero data loss, Oracle recommends application centric solutions for maximum protection of business systems from outages of entire sites rather than use only Oracle VM for disaster recovery.

Application centric DR does not involve replicating or failing over Oracle VM storage repositories and Oracle VM guests. Application centric solutions rely on the HA/DR capabilities built into the underlying products and features of the application and database tiers. This means the Oracle VM Guests are treated as if they are stand alone servers, so the Oracle VM storage repositories and Oracle VM guests are not replicated to other sites.

As an example, you might deploy Oracle VM, databases and applications in the following manner using an Oracle VM application centric approach:

- Oracle VM provides a virtual server platform for virtual machines at multiple independent sites; the storage repositories are not replicated so the virtual machines are treated as standalone servers
- Oracle ZFS storage appliances provide the local storage needed by independent Oracle VM sites as well as remote storage replication needed by some of the applications and databases
- Oracle Grid Infrastructure uses Clusterware and Real Application Clusters (RAC) to provide multi-instance databases for HA at a single site
- Oracle Active Data Guard manages reads/writes, ensures data integrity and access between multi-instance RAC databases at multiple sites
- Oracle Fusion middleware has the capability of brokering communications between applications at multiple sites
- Oracle WebLogic Server has HA build into the product and can also be configured for multi-site protection of Java applications
- Oracle Site Guard provides site monitoring, scheduled DR integrity checks and the automation engine to orchestrate the failover or switchover using the all of above applications including ZFS

There are many more Oracle applications built around Oracle's Maximum Availability Architecture that can work together to achieve several levels of DR without relying on replicating Oracle VM storage repositories or Oracle VM Guests.
A dual active/active solution using MAA applications

This solution is predicated on deploying each business system on Oracle VM guests that are active and processing transactions across multiple partner sites. MAA documentation describes this as a Production Site and an Active Replica Site using a combination of RAC, Flashback, Active Data Guard and Golden Gate further protected with RMAN and Oracle Secure Backup.

Simply put, the Oracle VM guests are treated as stand-alone physical servers deploying database, middleware and application tiers using the high availability features and capabilities inherent in Oracle’s MAA certified product suite across multiple partner sites. Oracle VM provides protection against single points of failure at each partner site, but the applications protect against outages of entire sites, not Oracle VM.

Just like all other Oracle VM DR solutions discussed in this paper, Oracle VM is configured and maintained independently at all partner sites. However, unlike the other DR solutions, you do not replicate any of the storage used for Oracle VM pool file systems, storage repositories or in any way use Oracle VM to accomplish disaster recovery: the MAA capable applications handle all the application continuance.

Basically, the applications are running concurrently at one or more partner sites with transactions being actively balanced between the applications running at all sites. From an Oracle VM perspective, no distinction is made between primary or recovery site roles with this solution since Oracle VM guests at all partner sites are actively participating in keeping the business system running.

Oracle VM Centric DR Solutions

In these cases, you could deploy a traditional DR solution using an Oracle VMcentric approach where you rely on replicated Oracle VM storage objects such as repositories as well as physical disks and NFS used by the Oracle VM guests to achieve protection from outage of entire sites.

The following three Oracle VM solutions are simply variations of the first single active/passive solution discussed below.
A single active/passive DR solution using Oracle VM

This traditional DR solution is an Oracle VM centric approach built around synchronous or asynchronous storage replication of Oracle VM repositories and storage used by the business systems being hosted on Oracle VM guests. You will replicate storage repositories as well as any LUNs and NFS being used by the Oracle VM guests in the active pool from the primary site to the recovery site.

Basically, you have a single server pool actively running Oracle VM guests at a primary site and a standby server pool at a recovery site not running any Oracle VM guests at all. The standby server pool at the recovery site is just waiting to take over running replicated copies of Oracle VM guests from the primary site. The Oracle VM servers that are part of the standby server pool are sitting idle.

Figure 3: Single active/passive DR using replicated Oracle VM storage objects

A dual active/passive DR solution using Oracle VM

Both partner sites have an active server pool as well as a standby server pool with this solution. We are simply maintaining a second server pool at each of the partner sites to also act as a standby server pool for an active server pool at the opposite site. You will replicate storage repositories as well as any LUNs and NFS being used by the Oracle VM guests in the active pool from partner Site A to Site B standby server pool. You will do the same for the active server pool at partner Site B to Site A standby server pool.
This solution simply piggybacks on the unidirectional active/standby solution and is really meant to show how you can design your own solution using the basic building blocks of clustered server pools. You can scale this up so you have eight active server pools and eight standby server pools being managed by a single Oracle VM Manager at each of the partner sites. Like the unidirectional active/standby solution, this also leaves you with a lot of idle Oracle VM servers.

Figure 4: Dual active/passive DR using replicated Oracle VM storage objects
A dual active/active DR solution using Oracle VM

This solution is an Oracle VM centric approach built around synchronous or asynchronous storage replication of Oracle VM repositories and storage used by the business systems being hosted on Oracle VM guests. In this case, each server pool in the DR scenario is running its own Oracle VM guests so hardware resources are not sitting idle.

![Diagram of dual active/active DR solution using replicated Oracle VM storage objects](image)

Figure 5: Dual active/active DR using replicated Oracle VM storage objects

This solves the problem of idle Oracle VM servers in the standby server pools sitting around doing nothing. In this scenario you have a single active server pool running Oracle VM guests at a primary site and a server pool at the recovery site running its own Oracle VM guests not related to the virtual machines at the primary site.

However, this means you will need to ensure the standby server pool at the recovery site has enough idle resources to run its own Oracle VM guests plus the Oracle VM guests from the primary site if a failover occurs. In this case, you would need to create some sort of automation that periodically audits the standby server pool to ensure it always has the resources to start all the Oracle VM guests from the active server pool at the primary site. An alternative of course is to simply stop all the Oracle VM guests running on the SiteB server pool before starting the virtual machines replicated from the primary site.

References

Please visit the following web sites for more information about Oracle virtualization:

» Oracle Virtualization
» Oracle VM at Oracle Technology Network
» Oracle VM Documentation and User Guides