ORACLE VM

Oracle VM 3:
Getting Started With Disaster Recovery

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Introduction

Oracle offers a complete product portfolio that includes servers, storage, applications, middleware and database products that will allow you to piece together a fully automated disaster recovery (DR) solution for your business systems. Oracle VM 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.

Oracle Site Guard with Oracle Enterprise Manager Cloud Control provides end-to-end disaster recovery automation for the entire Oracle stack. It is also extensible to integrate with non-Oracle infrastructure components. Oracle Site Guard is the centerpiece of our disaster recovery solution for both standard Oracle VM as well as the Oracle Private Cloud Appliance. The solution is engineered to seamlessly transition application workloads and Oracle VM guests to multiple disaster recovery sites.

Our solution goes beyond disaster recovery by allowing you the flexibility to transition Oracle VM guests to different server pools at the same site or geographically dispersed sites with the click of the single button. Oracle Site Guard opens a whole new vista of uses beyond disaster recovery in terms of operational mobility. Envision migrating entire business systems from development into production in a single, hands-off operation, or migrating Oracle VM guests from a legacy Oracle VM environment to a newly deployed Oracle VM platform with even more compute power. You can even use our DR solution to transition workloads from one data center to another during scheduled maintenance.

The concept behind our Oracle VM DR solution is simple. However, the inherent flexibility of our solution requires a significant investment in planning and forethought of design. This document uses broad brush strokes to paint a conceptual picture of disaster recovery using Oracle Site Guard with Oracle Enterprise Manager Cloud Control. Once you understand the basic concepts behind the solution, you will follow other more technically detailed white papers describing exact steps for planning and implementing Oracle VM DR using Site Guard.

Overview of Disaster Recovery for Oracle VM

Oracle VM can be deployed as a disaster recovery (DR) environment across multiple sites. In fact, we encourage our customers to design disaster recovery so any DR site can act as recovery site for any other DR site. The number of DR sites is limited only by the available compute resources in your organization and is completely dependent upon the unique requirements of the business systems and applications you are trying to protect.

We have a single, highly flexible and extensible solution for Oracle VM DR that is built around Oracle Site Guard. Our Oracle VM DR using Oracle Site Guard is quite nimble, allowing Oracle customers the ability to implement fully automated application failover for Oracle and non-Oracle products with or without virtual machine failover.

Oracle Site Guard

All disaster recovery solutions for Oracle VM are orchestrated by Oracle Site Guard which is a required component for any Oracle VM DR solution. Oracle Site Guard is bundled with Oracle Enterprise Manager Cloud Control and provides end-to-end disaster recovery automation for the entire Oracle stack.

If you already have Oracle Enterprise Manager 12c or 13c, then you already have Oracle Site Guard. You are able to start using Oracle Site Guard out-of-the-box and do not need to enable the product beyond licensing your Oracle and non-Oracle applications for use with various Oracle Enterprise Manger product life cycle management packs.

Beginning with release 12.1.0.5 of Oracle Enterprise Manager Cloud Control, Oracle Site Guard began shipping with highly specialized automation written specifically to manage switchovers and failovers of Oracle VM Guests from one DR site to another. This means Oracle Site Guard can seamlessly integrate a variety of methods to transition application workloads from anywhere to anywhere:

- Active/Passive with Oracle VM guest failover
- Active/Passive without Oracle VM guest failover
- Active/Standby without Oracle VM guest failover
- Active/Active without Oracle VM guest failover

Oracle VM DR using Oracle Site Guard

Oracle VM DR using Oracle Site Guard will transition entire virtual machines and applications from one Oracle VM Manager to a different Oracle VM Manager. Oracle VM DR using Oracle Site Guard is a very flexible solution with many possibilities for solving many problems in the data center beyond disaster recovery. Oracle Site Guard is deployed exactly the same way for standard Oracle VM as well as Oracle Private Cloud Appliance.

The basic concept is simple allowing you to stop specific Oracle VM guests residing at one DR site and then start a copy of the same Oracle VM guests at another DR site. The Oracle VM guests you want to migrate are organized by storage repositories. Oracle Site Guard will automatically orchestrate stopping applications and Oracle VM guests and restarting the virtual machines and applications at another site in the correct order. Oracle Site Guard will even completely automate the entire Oracle Data Guard process for transitioning Oracle Database data and workloads from one site to another.

Oracle VM DR for Oracle Private Cloud Appliance

Oracle Private Cloud Appliance is a converged infrastructure system designed for rapid, convenient deployment of a private cloud at an industry-leading price point. Oracle VM DR is implemented the same exact way using Oracle Site Guard whether you are implementing the solution on Oracle Private Cloud Appliance or standard Oracle VM 3.

Disaster recovery for other Oracle Engineered Systems

Each engineered system uses a custom implementation of Oracle VM that is highly optimized for each respective hardware platform. Oracle Site Guard can be used to orchestrate disaster recovery on other engineered systems, but you will need to follow specific instructions provided with each engineered system. Please refer to specific system documentation on the Oracle Technology Network to find guidelines appropriate for implementing disaster recovery on a given engineered system.

- Oracle Database Appliance documentation and best practices
- Oracle Exadata Database Machine documentation and best practices
- Oracle Exalogic Elastic Cloud documentation and best practices
- Oracle Exalytics In-Memory Machine documentation and best practices

Transitioning Applications to Other Sites

Role transitions

Data centers typically use their "disaster recovery" environment for much more than recovering from catastrophic failures of hardware and software. We employ the term **site transition** throughout our documentation as a catchall phrase to mean failover, switchover or migration of Oracle VM guests from one site or Oracle VM manager to another Oracle VM Manger at the same site or a completely different site.

Failover

Failover is the most commonly used term to describe a transition of Oracle VM guests from one site to another. However, the term failover generally implies Oracle VM guests are being recovered at an alternate site after a catastrophic, unplanned outage has occurred at a primary site. This means you have to first get the Oracle VM guest operating systems running at an alternate site and then restore application data from the last transaction consistent backup known to be good. Catastrophic failures are a rare event for most customers with a stable data center.

Switchover

A switchover is probably one of the most common use cases for a disaster recovery platform. A switchover is a planned transition of Oracle VM guests and workloads to another disaster recovery site. This means all applications and Oracle VM guests are shut down in an orderly and transaction consistent manner, the storage replication synchronized to the alternate site(s) and the Oracle VM guests started again at the alternate site. In this case, there is no need to recover from a backup as long as the storage replication between sites includes the Oracle VM storage repositories, the applications and the application data.

Migration

Our Oracle VM DR using Oracle Site Guard can also be used to permanently migrate entire business systems contained in one or more Oracle VM storage repositories to another server pool or a server pool being managed by another Oracle VM Manager. Data centers can take advantage of this capability to promote a business system from development to production or move an entire business system to another Oracle VM manager at the same site or an Oracle VM Manager at another site.

If this is done in a switchover context as explained a little later in this document, then the transition from one site to another will be transaction consistent, meaning you can simply restart the Oracle VM guests at an alternate site without having to restore applications.

Site transition methodologies

Disaster recovery is all about protecting the applications that keep your company in business and generating revenues. Oracle VM guests are simply containers providing the compute resources needed to run the applications just like any physical server. The advantage of virtual machines is being able to move the servers to another physical location without having to load everything into a truck and ship it across country.

To help understand disaster recovery for Oracle VM we first need to understand how DR is accomplished with physical servers. Disaster recovery for physical servers can take advantage of two methods for transitioning the applications to an alternate site:

- Lift and ship: physically move the servers to another location along with the applications and data. In the virtual server world this is known as **virtual machine failover**. This assumes the virtual machines are moved to alternate DR sites over the network and can include both manual or automatic failover of applications and data
- Standby servers: a second set of servers sitting idle at another location waiting for applications and data. In the virtual server world, this is known as **application failover**. This assumes a second set of virtual machines are sitting idle at alternate DR sites waiting for applications and data – this does not incorporate VM failover at all

Oracle VM DR using Site Guard gives you the choice of using one or more of the following methodologies using MAA best practices. Which methodologies you choose to utilize is up to you and your unique requirements – you can use all of them in a single DR environment if that helps accomplish your goals:

- Active/Passive with Oracle VM guest failover – virtual machine failover
- Active/Passive without Oracle VM guest failover – application failover
- Active/Standby without Oracle VM guest failover – application failover
- Active/Active without Oracle VM guest failover –application failover

Active/Passive with Oracle VM guest failover

This site transition methodology is built on the concept of **virtual machine failover**. An active/passive site transition begins with Oracle VM guests and applications existing at only a single site as shown in Figure 1 below. All role transition types and site transition methodologies we discuss in this document work seamlessly with this solution. All of our remaining documentation for planning and implementing Oracle VM DR is based on this solution.

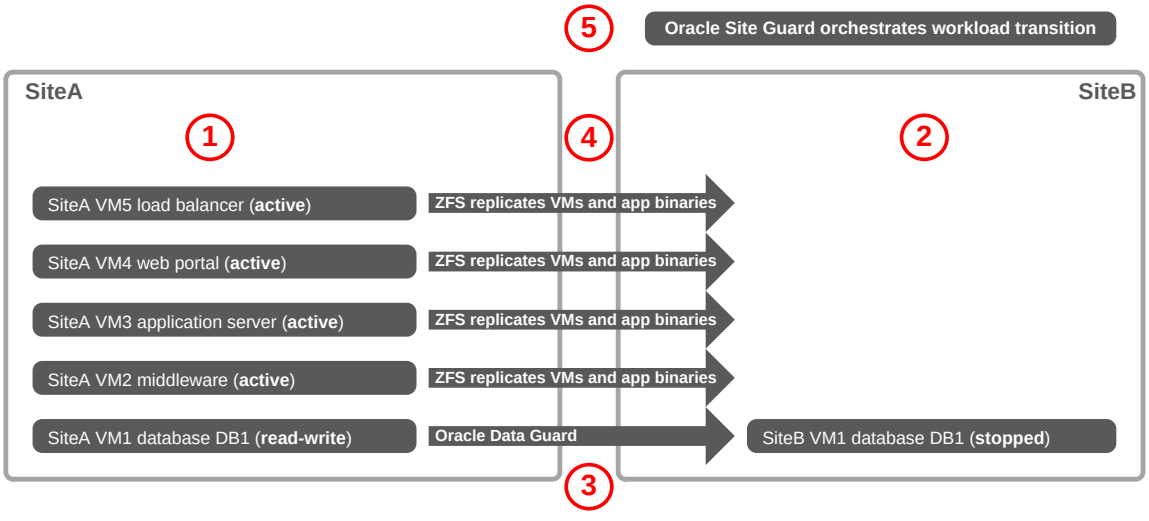

Figure 1: Active/passive is the only transition strategy that makes sense with Oracle VM guest failover

This is the only solution out of the four methods for site transitions where virtual machine failover makes sense. This

method relies on maintaining a synchronized copy at alternate sites of the Oracle VM storage repositories, application binaries using remote storage replication and application data using Oracle Data Guard. Please refer to Table 1 below for more detailed information about the differences this solution offers over the other three site transition methodologies.

This is probably the most popular method for site transitions and has the most flexibility for delivering operational mobility, yet the least robust solution in terms of disaster recovery. This is an excellent solution for switchovers or more permanent migrations of entire business systems. But recovery times are much longer and challenging in the case of a catastrophic loss of compute resources and data at the primary site during a failover.

The recovery times are longer for Oracle VM guest failover solutions because it takes extra time to release ownership and delete storage repositories at the primary site. Time is also consumed at the alternate site due to discovering the replicated repositories, taking ownership, migrating and starting the Oracle VM guests.

The following table explains a few key concepts about this site transition methodology.

Table 1: Key concepts for active/passive transitions with Oracle VM guest failover

Item	Description	How it is Used
1	SiteA Oracle VM guests	All Oracle VM guests only exist at the primary site during normal operations (this does not include VMs running databases – see item 2). Everything about the Oracle VM guests and applications are copied to the alternate sites. The Oracle VM guests are deleted from the primary site and the replicated versions of the Oracle VM guests are restarted at the alternate sites during a site transition
2	SiteB Oracle VM guests	Only Oracle VM guests running Oracle databases must exist at both the primary site and alternate sites to remain in compliance with Oracle database requirements for maximum availability and data integrity. No other Oracle VM guests from the primary site should exist at the alternate site.
3	Oracle Data Guard	Oracle Data Guard is Oracle's supported and certified way of keeping application data at alternate sites synchronized with databases at the primary
4	Storage level replication	Storage level replication is used to keep storage synchronized between primary and alternate DR sites. Only Oracle VM storage repositories and LUNs/NFS file systems containing application binaries are replicated – not application data
5	Oracle Site Guard	Oracle Site Guard controls the Oracle VM Manager and the applications to orchestrate an automated and seamless site transition of applications in the following way: » *Oracle Site Guard stops the Oracle VM guests or leaves them running depending on your requirements* » *Oracle Site Guard stops the applications and unmounts any file systems used by applications* » *Oracle Site Guard works with ZFS storage to present the replicated storage to the alternate site* » *Oracle Site Guard mounts any file systems needed by applications at alternate site* » *Oracle Site Guard works with Oracle Data Guard to make the alternate site the active site* » *Oracle Site Guard starts databases and applications in correct order at alternate site*

Active/Passive without Oracle VM guest failover

This site transition methodology is built on the concept of **application failover**. This is a different approach from the first method that includes virtual machine failover. This is a standard MAA solution using Oracle Site Guard. This solution can be implemented using the same deployment architecture that we explain in our documentation for Oracle VM DR using Site Guard. You don't do anything different with servers, server pools, storage arrays, storage repositories, network IDs, Oracle VM Managers or any other aspect of our normal Oracle VM DR solution using virtual machine failover – it just works.

This version of active/passive site transition begins with Oracle VM guests and applications existing at the primary

site and a standby version of each virtual machine at the alternate site as shown in Figure 2 below. The Oracle VM storage repositories containing Oracle VM guests are not replicated to any alternate sites. All Oracle VM guests are stationary and never transition to other sites. Please refer to Table 2 below for more detailed information about the differences this solution offers over the other three site transition methodologies.

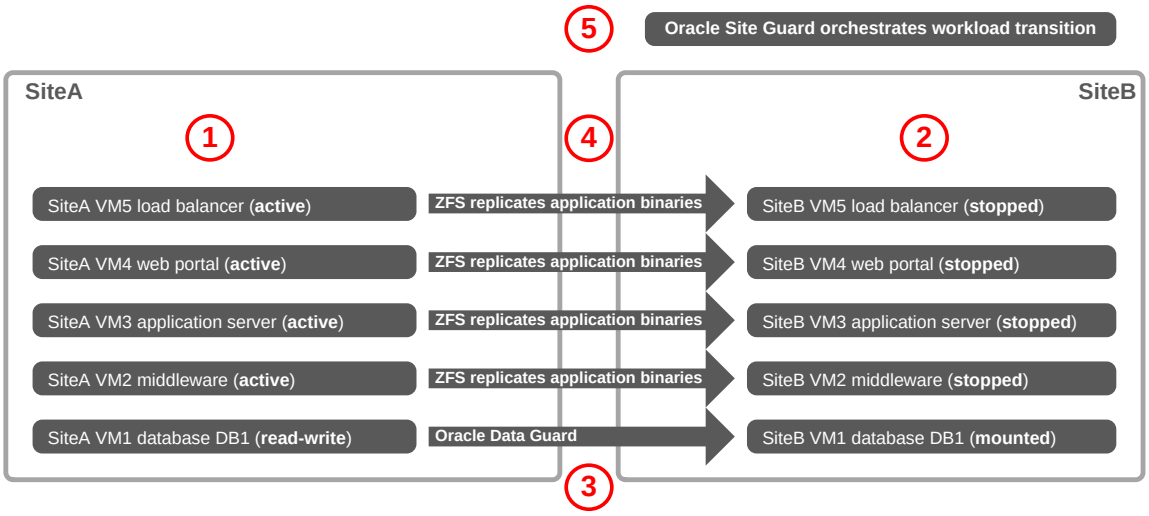

Figure 2: Active/passive transition strategy also works well without Oracle VM guest failover

The following table explains a few key concepts about this site transition methodology.

Table 2: Key concepts for active/passive transitions without Oracle VM guest failover

Item	Description	How it is Used
1	SiteA Oracle VM guests	The Oracle VM guests running at the primary site remain stationary or local to the primary site during transitions. No copies are replicated to alternate sites for the purpose of moving or migrating the primary site virtual machines. You should always capture transaction consistent backups to tape to restore if the need arises, but the copies are not part of the site transition process
2	SiteB Oracle VM guests	A second set of Oracle VM guests exist at alternate sites for each Oracle VM guest at the primary site. Oracle VM guests running Oracle databases must exist at both the primary site and alternate sites to remain in compliance with Oracle database requirements for maximum availability and data integrity
3	Oracle Data Guard	Oracle Data Guard is Oracle's supported and certified way of keeping application data at alternate site synchronized with databases at the primary
4	Storage level replication	Storage level replication is used to keep storage synchronized between primary and alternate DR sites. Only LUNs/NFS file systems containing application binaries are replicated – not application data or Oracle VM storage repositories
5	Oracle Site Guard	Oracle Site Guard controls the Oracle VM Manager and the applications to orchestrate an automated and seamless site transition of applications in the following way: » *Oracle Site Guard stops the Oracle VM guests or leaves them running depending on your requirements* » *Oracle Site Guard stops the applications and unmounts any file systems used by applications* » *Oracle Site Guard works with ZFS storage to present the replicated storage to the alternate site* » *Oracle Site Guard mounts any file systems needed by applications at alternate site* » *Oracle Site Guard works with Oracle Data Guard to make the alternate site the active site* » *Oracle Site Guard starts databases and applications in correct order at alternate site*

Active/Standby without Oracle VM guest failover

This site transition methodology is built on the concept of **application failover**. This is a standard MAA solution using Oracle Site Guard. This solution can be implemented using the same deployment architecture that we explain in our documentation for Oracle VM DR using Site Guard. You don't do anything different with servers, server pools, storage arrays, storage repositories, network IDs, Oracle VM Managers or any other aspect of our normal Oracle VM DR solution using virtual machine failover – it just works.

This version of active/standby site transition begins with Oracle VM guests and applications existing at the primary site and a standby version of each virtual machine at the alternate site as shown in Figure 3 below. The Oracle VM storage repositories containing Oracle VM guests are not replicated to any alternate sites. All Oracle VM guests are stationary and never transition to other sites. Please refer to Table 3 below for more detailed information about the differences this solution offers over the other three site transition methodologies.

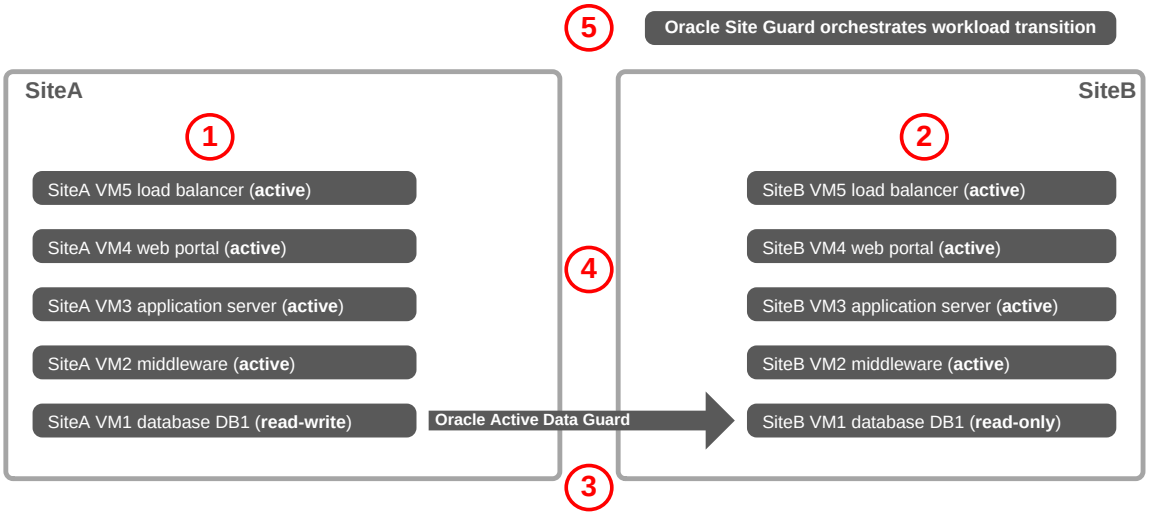

Figure 3: Active/Standby precludes Oracle VM guest failover since all virtual machines are running at all sites

The following table explains a few key concepts about this site transition methodology.

Table 3: Key concepts for active/standby transitions without Oracle VM guest failover

Item	Description	How it is Used
1	SiteA Oracle VM guests	The Oracle VM guests running at the primary site remain stationary or local to the primary site during transitions. No copies are replicated to alternate sites for the purpose of moving or migrating the primary site virtual machines. You should always capture transaction consistent backups to tape to restore if the need arises, but the copies are not part of the site transition process
2	SiteB Oracle VM guests	A second set of Oracle VM guests exist at alternate sites for each Oracle VM guest at the primary site. Oracle VM guests running Oracle databases must exist at both the primary site and alternate sites to remain in compliance with Oracle database requirements for maximum availability and data integrity
3	Oracle Data Guard	Oracle Data Guard is Oracle's supported and certified way of keeping application data at alternate site synchronized with databases at the primary
4	Storage level replication	Storage level replication is used to keep storage synchronized between primary and alternate DR sites. Only LUNs/NFS file systems containing application binaries are replicated – not application data or Oracle VM storage repositories
5	Oracle Site Guard	Oracle Site Guard controls the Oracle VM Manager and the applications to orchestrate an automated and seamless site transition of applications in the following way:

Item	Description	How it is Used
		» *Oracle Site Guard stops the Oracle VM guests or leaves them running depending on your requirements* » *Oracle Site Guard stops the applications and unmounts any file systems used by applications* » *Oracle Site Guard works with ZFS storage to present the replicated storage to the alternate site* » *Oracle Site Guard mounts any file systems needed by applications at alternate site* » *Oracle Site Guard works with Oracle Data Guard to make the alternate site the active site* » *Oracle Site Guard starts databases and applications in correct order at alternate site*

Active/Active without Oracle VM guest failover

This site transition methodology is built on the concept of **application failover**. This solution can be implemented using the same deployment architecture that we explain in our documentation for Oracle VM DR using Site Guard. You don't do anything different with servers, server pools, storage arrays, storage repositories, network IDs, Oracle VM Managers or any other aspect of our normal Oracle VM DR solution using virtual machine failover – it just works.

Active/active site transition is completely different than any other solution offering the highest degree of availability. The Oracle VM guests and applications for the same business system are running at both the primary and alternate site have active workloads with read-write access to the databases at both sites as shown in Figure 4 below. The Oracle VM storage repositories containing Oracle VM guests and the application binaries are not replicated to any alternate sites. This means all Oracle VM guests are stationary and never transition to other sites. Please refer to Table 4 below for more detailed information about the differences this solution offers over the other three site transition methodologies.

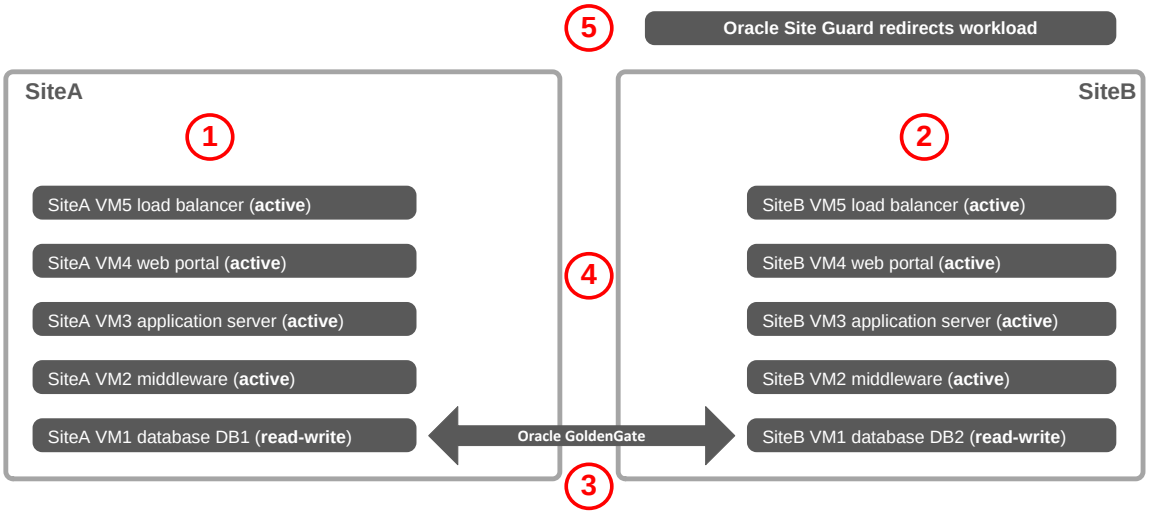

Figure 4: Active/Active precludes Oracle VM guest failover since all virtual machines are running at all sites

The following table explains a few key concepts about this site transition methodology.

Table 4: Key concepts for active/active transitions without Oracle VM guest failover

Item	Description	How it is Used
1	SiteA Oracle VM guests	The Oracle VM guests running at the primary site remain stationary or local to the primary site during transitions. No copies are replicated to alternate sites for the purpose of moving or migrating the primary site virtual machines. You should always capture transaction consistent backups to tape to restore if the need

Item	Description	How it is Used
		arises, but the copies are not part of the site transition process
2	SiteB Oracle VM guests	A second set of Oracle VM guests exist at alternate sites for each Oracle VM guest at the primary site. Oracle VM guests running Oracle databases must exist at both the primary site and alternate sites to remain in compliance with Oracle database requirements for maximum availability and data integrity
3	Oracle Active Data Guard	Active Data Guard is Oracle's supported and certified way of keeping application data synchronized at all sites in real time. Oracle Site Guard does not manage or control Active Data Guard
4	Storage level replication	Storage level replication is used to keep storage synchronized between primary and alternate DR sites. Only LUNs/NFS file systems containing application binaries are replicated – not application data or Oracle VM storage repositories
5	Oracle Site Guard	Oracle Site Guard controls the Oracle VM Manager and the applications to orchestrate an automated and seamless site transition of applications in the following way: » *Oracle Site Guard stops the Oracle VM guests or leaves them running depending on your requirements*

Planning for Maximum Flexibility

Our solution is all about flexibility and application mobility, not just disaster recovery. Whether you are using SAN, NAS or a combination of both in your environment, we give you a degree of latitude not found with other virtual server products with the push of a single button.

Oracle Site Guard can be configured to take advantage of many different combinations of application failover and virtual machine failover within single or multiple server pools to transition Oracle VM guests to other sites as shown in Figure 5 below. Notice that any of the four storage repositories contained in SiteA Pool1 on the left of the illustration can use a completely different method shown in the middle to transition each repository to a completely different location on the right of the illustration.

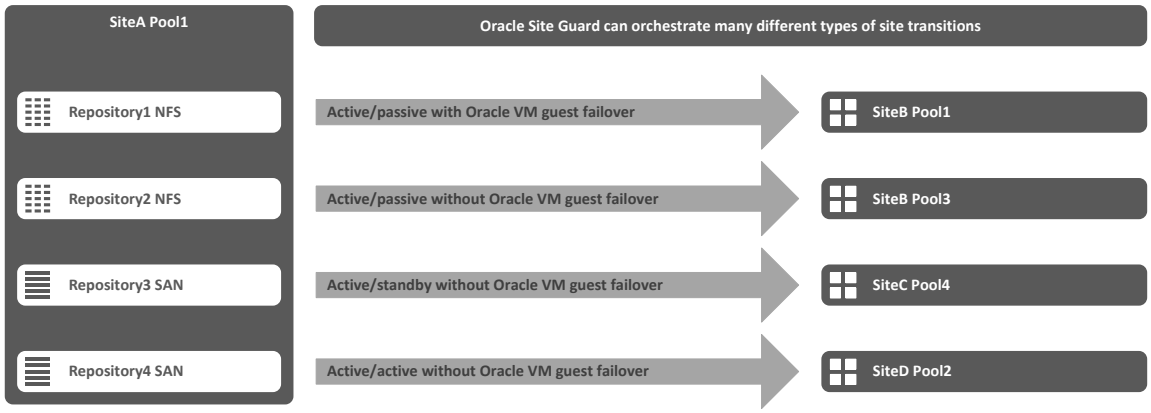

Figure 5: Our Oracle VM DR using Oracle Site Guard is a single solution with many capabilities

Another key factor to consider is DR does not need to be a one-way street; business systems can be transitioned from any site to any site. The Oracle VM environment at each site can be actively running applications instead of sitting idle waiting for a failover or switchover.

Storage repositories are the key to maximum flexibility

A smart, well designed deployment model for storage repositories allows your data center to transition a single

business system or all business systems to a multitude of different sites as illustrated in Figure 6 below. Organizing your Oracle VM guests into different storage repositories is the key to maintaining maximum flexibility for application mobility. This means you should group like Oracle VM guests together into the same storage repository. However, don't get carried away by assigning a single Oracle VM to a single storage repository; a single repository for a single virtual machine is not practical or scalable.

Keep Oracle VM guests belonging to the same business system in the same group of storage repositories. For example, don't mix Oracle VM guests for supply chain management (SCM) with Oracle VM guests for your customer relationship management (CRM) in the same repositories. Don't mix Oracle VM guests hosting databases with the Oracle VM guests hosting middleware and applications for the same business system; databases for each business should always be maintained in storage repositories separate from the applications.

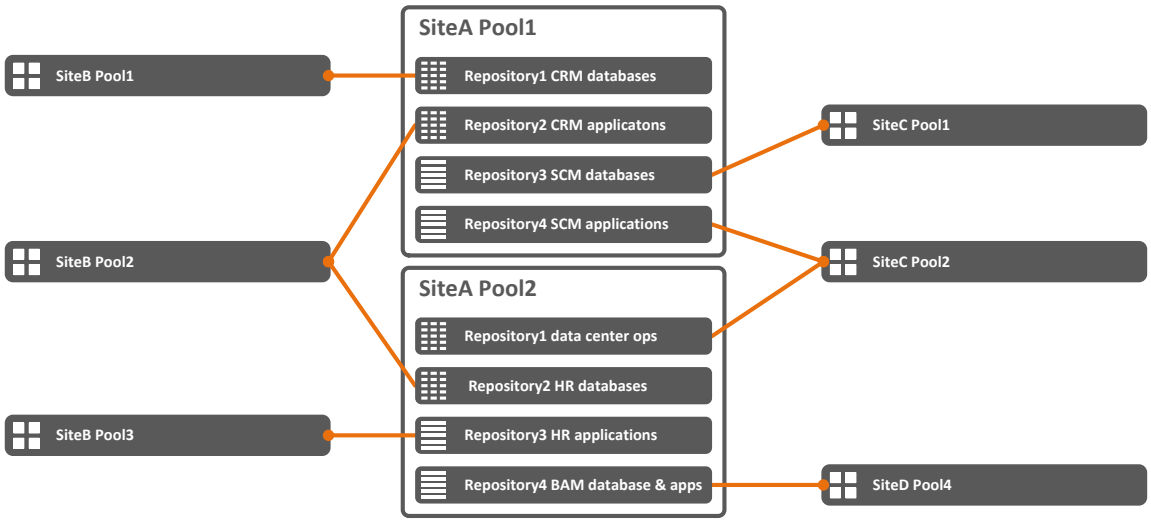

Figure 6: Oracle VM guests in the same storage repository can be transitioned to any combination of other DR sites

Deployment Architecture

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.

It is important that you follow our documented best practices for both networking and storage to achieve maximum scalability, flexibility and resilience for your Oracle VM DR environment. Our best practices for storage and networking will help achieve maximum flexibility by allowing you to mix application and virtual machine failover solutions together using the same Oracle VM Managers and server pools.

DR sites are independent of each other

The Oracle VM Managers, Oracle VM servers and server pools are completely independent of each other. You install the Oracle VM Managers using completely different UUIDs, different virtual MAC address ranges for VNICs and the network infrastructure can be different at each site with the exception of Oracle VM network IDs used for virtual machine traffic. The server pool file systems, Oracle VM Manager database, number of server pools and number of servers in each can be different at each site. In fact, the manufacturer, model and quantity of Oracle VM servers can be different at each site. Please refer to our planning and implementation documentation attached to

Doc ID 1959182.1 found on My Oracle Support for more detailed information about site preparation.

Always use Oracle Data Guard

Protecting data integrity is the single most important goal for any business. Applications can always be reinstalled, but lost or corrupted data cannot be replaced without incurring significant losses in revenue while data are being recovered. Virtual machine failover does not magically protect your data; you still need to protect data integrity using two key strategies: validated tape backups and Oracle Data Guard.

Oracle Data Guard is not only a smart business decision, it is required by Oracle database as the only certified and supported way to protect data for any disaster recovery solution from any software vendor, including Oracle VM DR using Oracle Site Guard.

Always include tape backup with any DR solution

Normal backup to tape is a crucial element of any disaster recovery product or solution in the market place. It would be a serious mistake to rely solely on RAID, storage replication or even Oracle Data Guard for data protection. Remember that human errors and corrupted data are faithfully recorded to RAID disks and replicated to other sites just the same as good data, so you really need periodic backups to ensure you can recover from the worst case scenarios.

An example of deployment architecture

The diagram shown in Figure 7 illustrates a few basic concepts of the deployment architecture designed for active/passive transition with Oracle VM guest failover.

We show only two DR sites, but there is no limitation to how many sites can be incorporated into a DR environment for Oracle VM DR using Oracle Site Guard. This is a conceptual look at the architecture only. Please refer to our support note Doc ID 1959182.1 on My Oracle Support for links to other, more detailed white papers about planning deployment architecture.

The deployment architecture shown in Figure 7 on page 12 is specifically for our Oracle VM DR with virtual machine failover. But the same deployment architecture supports all four site transition methodologies:

- Active/Passive with Oracle VM guest failover – virtual machine failover
- Active/Passive without Oracle VM guest failover – application failover
- Active/Standby without Oracle VM guest failover – application failover
- Active/Active without Oracle VM guest failover –application failover

In an effort to keep the example as simple as possible the diagram shows an almost idle SiteB acting as a recovery site for SiteA. In reality, SiteB can have its own independent workload of Oracle VM guests hosting other business systems that are protected by SiteA.

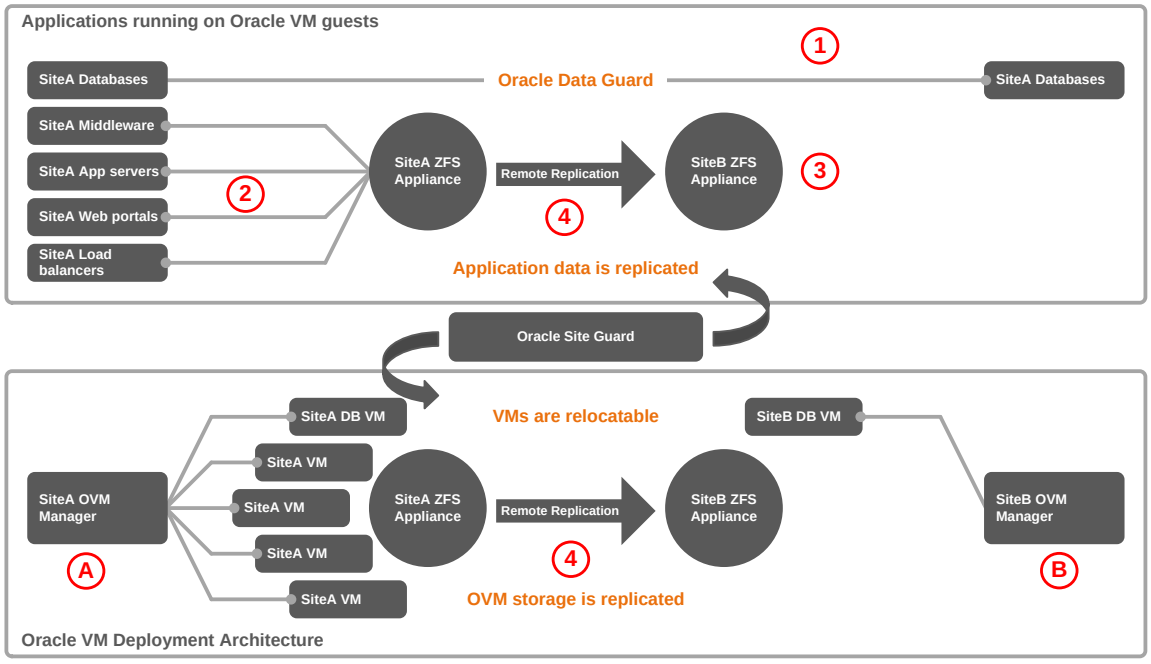

Figure 7: Conceptual look at how Oracle VM guests and applications are deployed for virtual machine failover

We have separated the applications from the Oracle VM deployment architecture into two different boxes above. Site Guard sits in the middle because it is responsible for orchestrating all site transitions of storage, applications and virtual machines. Hardware architecture is not shown here since it is always independent of the applications.

The following table explains a few key concepts about this deployment architecture for active/Passive site transition with Oracle VM guest failover.

Table 5: Components of deployment architecture before a site transition

Item	Description	How it is Used
1	Oracle databases are protected with Oracle Data Guard	Notice that Oracle Data Guard is used to keep any Oracle databases synchronized at both sites which means you will need at least one Oracle VM guest running at the alternate site at all times; virtual machines running Oracle databases may not be failed or switched over to alternate sites to remain a supported solution. This approach ensures Oracle certified data integrity for the most critical component of any business system. So in the case of Oracle databases, the Oracle VM guests never transition to other sites; only the workload transitions to other DR sites, even if everything else uses virtual machine failover.
2	Applications hosted on Oracle VM guests at SiteA	Applications are running on the SiteA Oracle VM guests (item D). The applications only run at one site or the other even if you are implementing application failover with stationary virtual machines.
3	Storage	You will need one or more storage arrays at each site with storage replication enabled and licensed. All Oracle VM storage repositories, application binaries and application data are contained on the storage arrays whether you are using PCA or standard Oracle VM. Any storage platform can be used but only ZFS appliances are currently integrated into our Site Guard solution. It is very easy to integrate custom automation into Oracle Site Guard for storage platforms we don't currently support out-of-the-box.
4	Storage level replication	Storage level replication used to copy Oracle VM storage repositories and application binaries to other DR sites whether you are using PCA or standard Oracle VM. Application data are also contained on the storage arrays at each site, but you should use Oracle Data Guard to keep the data synchronized between sites instead of storage level replication.

Item	Description	How it is Used
A & B	Independent Oracle VM Managers	Each site has an independent Oracle VM Manager and server pools. It is important to note that the manager UUID, pool file systems and management database at each site are unique.

Let's take a look at the deployment after we have switched over the Oracle VM guests and applications from SiteA to SiteB in Figure 8 below. Notice that it is simply a mirror image of Figure 7 above. The primary difference is that storage level replication and Oracle Data Guard replication have been reversed since SiteB is now the primary site for the SiteA Oracle VM guests, applications and databases.

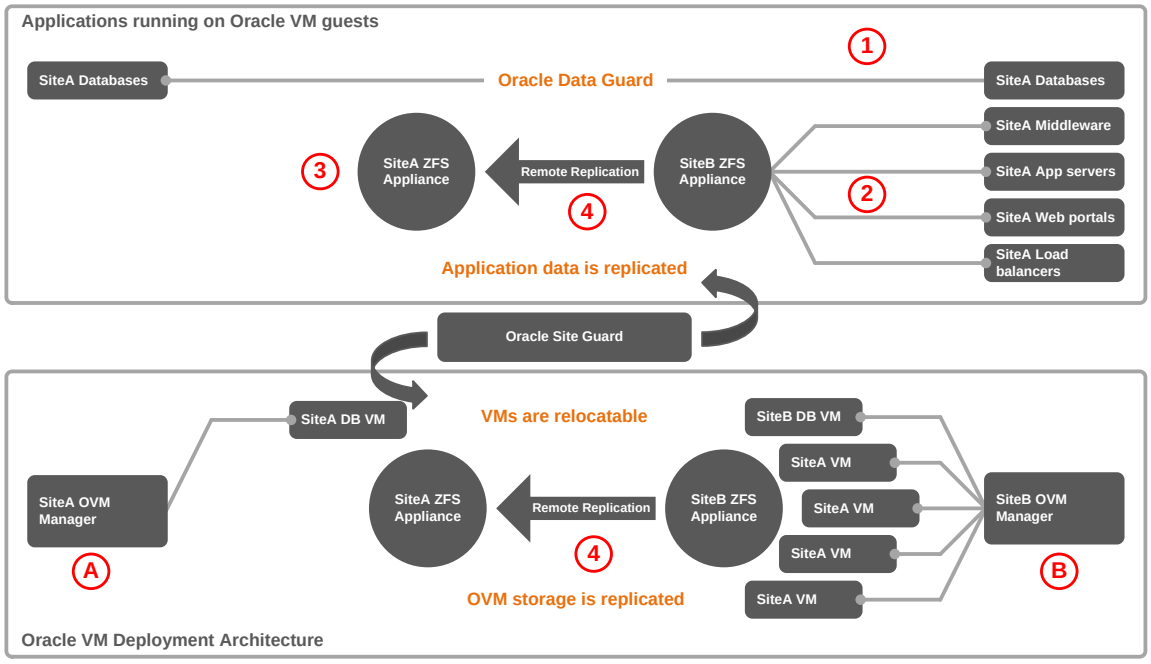

Figure 8: Conceptual look at how Oracle VM guests and applications are transitioned to alternate site by Oracle Site Guard

Although we don't show it in our illustration, SiteA can remain up and running other Oracle VM guests that belong to a completely different business system or Oracle VM guests that are never transitioned to other sites.

Limitations to Virtual Machine Failover

Most customers gravitate toward implementing Oracle VM DR using only virtual machine failover in combination with either manually or automatically restarting applications at the alternate sites. This approach works well for planned and intentional switchovers and migrations. But, an exclusively virtual machine failover strategy can be problematic during an actual outage for any disaster recovery product from any software vendor.

There are a few very important limitations that you need to consider when implementing virtual machine failover with any disaster recovery product on the market. These limitations are non-existent when using a purely application failover strategy, which, by-the-way can still incorporate virtual machine failover – but, if you want faster recovery times, you might want to consider pure application failover without Oracle VM guest failover.

The choice to go strictly with a virtual machine failover strategy is completely up to you and your unique requirements. Either way, Oracle VM DR using Oracle Site Guard can accommodate your needs in terms of virtual

machine and application failover in a wide variety of ways.

Challenges posed by a complete site failure

If you incur a complete outage at a primary site, then the only option is failover instead of a switchover, which means the Oracle VM guests and applications will be in crash consistent state. A crash consistent state means you must restore your applications from a validated transaction consistent backup after you have started the Oracle VM guests at an alternate site. Your recovery time objective (RTO) will be impacted by the additional amount of time it takes to restore applications to the desired recovery point objective (RPO).

This is the reason we stress the importance of protecting Oracle databases using Oracle Data Guard with application only failover even if you choose to use virtual machine failover for everything else.

Challenges posed by different IP namespaces

There is one other very important caveat about multisite DR environments that impacts your ability to use virtual machine failover as a DR solution: there is no way for Site Guard or Oracle VM to automatically change IP addresses, subnets, subnet masks, routes or hostnames as the virtual machines start at an alternate site.

Site Guard will be able to start the Oracle VM guests at the alternate site with no problem, but if the guest operating system starts on a different subnet at the alternate site, then there is no way for any application to log into the guest operating system since the network won't be accessible – the only access to the guest OS at that point is to start a console session and change the IP address, subnet mask and default route by hand.

Therefore, virtual machine failover will only work in those situations where the IP namespace is the same at all alternate sites. This is usually accomplished by using extended VLANs across data centers. Alternatively, you can implement static IP assignment through DHCP where IP assignment is predicated on the MAC address of each Oracle VM guests at all sites. You can also implement NAT within the network infrastructure. NAT cannot be implemented on the Oracle VM servers since inbound and outbound traffic for virtual machines bypasses this layer.

Virtual machine network IDs need to match

The network ID for each virtual machine network must match at all sites. This requirement only applies to virtual machine networks, not Oracle VM management networks such as server management, cluster heartbeat or live migration.

Adding support for other storage arrays

We are always working to improve and enhance the capabilities of our Oracle VM DR using Oracle Site Guard. Our current release of the product includes full automation for ZFS Storage Appliances only. But, we are working to add prepackaged automation for other storage platforms.

The good news is that Oracle Site Guard can easily incorporate any custom automation you write for storage platforms we do not yet support out-of-the-box. You can use any programming or scripting language you are comfortable using to write custom automation including bash, ksh, perl, Python, Java, C++ or C; anything really. Custom automation will simply perform all the tasks needed to accomplish a final synchronization of replicated storage from the primary DR site to the alternate site.

If you do not have the expertise to write a custom bash or ksh script, then Oracle Site Guard can be configured to perform your site transitions in three distinctly different stages instead of a single fluid process. This would allow your storage administrators to perform the storage related tasks manually, then give control back to you after they have finished getting the storage ready. In this case, the entire process would be something like the following:

- Stage 1: Have Site Guard automatically vacate the primary site: this means having Oracle VM stop the Oracle VM guests and release ownership of the storage repositories
- Stage 2: Manually transition storage to alternate site: this means waiting for your storage administrators to perform the final synchronization and make the replicated LUNs and NFS available to the servers at the alternate site
- Stage 3: Have Site Guard Automatically bring up the alternate site: this means having Oracle VM take ownership of the storage repositories and start the Oracle VM guests at the alternate site

Oracle Site Guard is very flexible and highly extensible so it is easy to surmount almost any challenge in your data center.

Next Steps

Please refer to Doc ID1959182.1 on My Oracle Support to get started with planning and implementing disaster recovery with Oracle VM DR using Oracle Site Guard. The support note includes links to implementation methodologies for each solution path, planning white papers, step-by-step examples and helpful videos.

Additional References

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

- Oracle Virtualization
- Oracle VM at Oracle Technology Network
- Oracle VM Documentation
- Oracle Site Guard at Oracle Technology Network

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