Oracle® Fusion Middleware

Continuous Availability for Oracle WebLogic Server

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Contents

Preface

Oracle WebLogic Server Continuous Availability provides an integrated solution for building maximum availability architectures that span data centers in distributed geographical locations. This document describes the features and benefits of Oracle WebLogic Server Continuous Availability, the architectures it supports and how you can use the continuous availability features in the supported architectures, and design considerations and recommendations.

Audience

This document is intended for administrators, developers, and others whose role is to configure and manage Oracle WebLogic Server with continuous availability requirements.

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Related Documents

For more information, see the following Oracle Fusion Middleware documents:

- *Administering Zero Downtime Patching Workflows*
- *Using Oracle WebLogic Server Multitenant*
- *Developing JTA Applications for Oracle WebLogic Server*
- *Administering JDBC Data Sources for Oracle WebLogic Server*
- *Administering Oracle Coherence*

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

1

Introduction to WebLogic Continuous Availability

Oracle WebLogic Server Continuous Availability provides an integrated solution for building maximum availability architectures (MAA) that span data centers in distributed geographical locations.

1.1 What Is Continuous Availability?

Continuous availability is the ability of a system to provide maximum availability by employing both high availability and disaster recovery solutions to ensure that applications are available when they are needed.
Typically, a high availability solution provides redundancy in one data center. Disaster recovery solutions provide the ability to safeguard against natural or unplanned outages at a production site by having a recovery strategy for applications and data to a geographically separate standby site.

Oracle WebLogic Server Continuous Availability provides an integrated solution for building maximum availability architectures (MAA) that span data centers in distributed geographical locations. Integrated components include Oracle WebLogic Server, Oracle Coherence, Oracle Traffic Director, and Oracle Site Guard. The major benefits of this integrated solution are faster failover or switchover, increased overall application availability, data integrity, reduced human error and risk, recovery of work, and local access of real-time data.

1.2 Continuous Availability Terminology

Learn a comprehensive list of common terms that apply to Oracle WebLogic Server Continuous Availability.

- Active-active: An active-active solution deploys two or more active servers to improve scalability and provide high availability. In active-active deployments, all instances handle requests concurrently. When an entire domain or site fails, transactions can be recovered by an active server in a different domain either collocated in the same site or on a different site.
- Active-passive: An active-passive solution involves setting up and pairing a standby site at a geographically different location with an active (production) site. The standby site may have equal or fewer services and resources compared to the production site. Application data, metadata, configuration data, and security data are replicated periodically to the standby site. The standby site is normally in

a passive mode; it is started when the production site is not available. This model is usually adopted when the two sites are connected over a WAN, and network latency does not allow clustering across the two sites.

- WebLogic Server cluster: A Weblogic Server cluster is a collection of WebLogic Server server instances running simultaneously and working together to provide increased scalability and reliability. In a cluster, most resources and services are deployed identically to each Managed Server, enabling failover and load balancing.
- Coherence cluster: A Coherence cluster is a collection of Java Virtual Machines (JVM) processes, called Coherence servers, that run Coherence. A Coherence cluster consists of multiple Coherence server instances that distribute data in-memory to increase application scalability, availability, and performance. Application data is automatically and transparently distributed and backed up across cluster members.
- Stretch cluster: A stretch cluster is a cluster in which nodes can span data centers within a proximate geographical range, usually with guaranteed, relatively low latency networking between the sites. Stretch clusters are also referred to as extended clusters.
- High availability: High availability is the ability of a system or device to be available when it is needed. A high availability architecture ensures that users can access a system without loss of service. Deploying a high availability system minimizes the time when the system is down, or unavailable, and maximizes the time when it is running, or available.
- Disaster recovery: Disaster recovery is the ability to safeguard against natural or unplanned outages at a production site by having a recovery strategy for applications and data to a geographically separate standby site.
- Switchover: Switchover is the process of reversing the roles of the production site and the standby site. Switchovers are planned operations done for periodic validation or to perform planned maintenance on the current production site. During a switchover, the current standby site becomes the new production site, and the current production site becomes the new standby site.
- Failover: Failover is the process of making the current standby site the new production site after the production site becomes unexpectedly unavailable (for example, due to a disaster at the production site).
- Latency: Latency is the time that it takes for packets to travel from one cluster to another, and can be a factor of many things, including the length of the path between the sites and any layers in between. Typically latency is determined by using utilities such as `traceroute` or `ping` to send test packets from one site to another. The latency or round-trip time (RTT) has a direct effect on the response time that any one user experiences when accessing the system. The effects of high latency can be seen even with only one user on the system.
- Metropolitan area network (MAN): A MAN is a telecommunications or computer network that spans an entire city or campus. The MAN standard for data communication specified in the IEEE 802.6 standard is called distributed-queue dual-bus (DQDB). With DQDB, networks can extend up to 20 miles (30 km) long and operate at speeds of 34–155 Mbit/s. A stretch cluster topology is appropriate in a MAN.
- Wide Area Network (WAN): A WAN is a telecommunications or computer network that extends over large geographical distances and between different LANs, MANs and other localized computer networking architectures. Wide area networks are

often established with leased telecommunication circuits. Distance and latency of a WAN need to taken into consideration when determining the type of topology you can configure.

1.3 Continuous Availability Key Features

Oracle WebLogic Server Continuous Availability provides maximum availability, reliability, and application stability during planned upgrades or unexpected failures. It builds on the existing high availability features in Oracle WebLogic Server, Oracle Coherence, and Oracle Fusion Middleware.
Continuous Availability supports the key features described in the following sections.

- Automated Cross-Site XA Transaction Recovery
- WebLogic Server Zero Downtime Patching
- WebLogic Server Multitenant Live Resource Group Migration
- Coherence Federated Caching
- Coherence GoldenGate HotCache
- Oracle Traffic Director
- Oracle Site Guard

1.3.1 Automated Cross-Site XA Transaction Recovery

Automated cross-site XA transaction recovery provides automatic recovery of XA transactions across an entire domain, or across an entire site with servers running in a different domain or at a different site. Cross-site transaction recovery uses the leasing framework to automate cross-site recovery. The leasing design follows the existing model for database leasing of transaction recovery service (TRS) migration within a cluster.

In active/active architectures, transactions can be recovered when an entire domain or site fails by having an active server running in a different domain either collocated at the same site or at a different site. In active/passive architectures, the server at the passive (standby) site at a different location can be started when the production site is no longer available.

For more information, see Transaction Recovery Spanning Multiple Sites or Data Centers in *Developing JTA Applications for Oracle WebLogic Server*. For design considerations when using cross-site XA transaction recovery in continuous availability architectures, see Cross-Site XA Transaction Recovery.

Automated cross-site XA transaction recovery also takes advantage of the WebLogic Server high availability features described in WebLogic Server High Availability Features.

1.3.2 WebLogic Server Zero Downtime Patching

WebLogic Server Zero Downtime Patching (ZDT Patching) provides an automated mechanism to orchestrate the rollout of patches while avoiding downtime or loss of sessions. It reduces risks and downtime of mission-critical applications that require availability and predictability while applying patches.

Using workflows that you define, you can patch or update any number of nodes in a domain with little or no manual intervention. Changes are rolled out to one node at a time, allowing a load balancer such as Oracle Traffic Director to redirect incoming traffic to the remaining nodes until the node has been updated.

The ZDT custom hooks feature identifies certain points, referred to as extension points, in a patching workflow where additional commands can be executed to modify the rollout. A user can specify an extension to be run at one or more predefined extension points in the workflow that is executed either on the Administration server node, or on a remote node. See Modifying Workflows Using Custom Hooks in *Administering Zero Downtime Patching Workflows*.

You can use ZDT Patching to update Coherence applications while maintaining high availability of the Coherence data during the rollout process.

For an overview of the features in ZDT Patching,see Introduction to Zero Downtime Patching in *Administering Zero Downtime Patching Workflows*.

1.3.3 WebLogic Server Multitenant Live Resource Group Migration

In WebLogic Server Multitenant environments, you can migrate partition resource groups that are running from one cluster/server to another within a domain without impacting the application users. A key benefit of migrating the resource groups is that it eliminates application downtime for planned events.

Resource groups are a collection of (typically) related deployable resources, such as Java EE applications and the data sources, Java Message Service (JMS) artifacts, and other resources that the applications use. When you migrate a resource group, you change the virtual target used by the resource group from one physical target (cluster/server) to another. After migration, the virtual target points to the new physical target (cluster/server).

For more information about resource groups and migration, see the following topics in *Using Oracle WebLogic Server Multitenant*:

- Configuring Resource Groups
- Migrating Resource Groups: Main Steps and WLST Example

1.3.4 Coherence Federated Caching

The Oracle Coherence federated caching feature replicates cache data asynchronously across multiple geographically distributed clusters. Cached data is replicated across clusters to provide redundancy, off-site backup, and multiple points of access for application users in different geographical locations.

Federated caching supports multiple replication topologies. These include:

- Active-passive: Replicates data from an active cluster to a passive cluster. The passive site supports read-only operations and off-site backup.
- Active-active: Replicates data between active clusters. Data that is put into one active cluster is replicated at the other active clusters. Applications at different sites have access to a local cluster instance.
- Hub and spoke: Replicates data from a single hub cluster to multiple spoke clusters. The hub cluster can only send data and the spoke clusters can only receive data. This topology requires multiple geographically dispersed copies of a

cluster. Each spoke cluster can be used by local applications to perform read-only operations.

See Federating Caches Across Clusters in *Administering Oracle Coherence*.

1.3.5 Coherence GoldenGate HotCache

The Oracle Coherence GoldenGate HotCache feature detects and reflects database changes in cache in real time. Third-party updates to the database can cause Coherence applications to work with data that can be stale and out-of-date. Coherence GoldenGate HotCache solves this problem by monitoring the database and pushing any changes into the Coherence cache in real time. It employs an efficient push model that processes only stale data. Low latency is assured because the data is pushed when the change occurs in the database.

In Maximum Availability Architectures, when the database is replicated to a secondary site during failover, the database changes are reflected to the cache using GoldenGate HotCache.

See Integrating with Oracle Coherence GoldenGate HotCache in *Integrating Oracle Coherence*.

1.3.6 Oracle Traffic Director

Oracle Traffic Director is a fast, reliable, and scalable software load balancer that routes HTTP, HTTPS, and TCP traffic to application servers and web servers on the network. It distributes the requests that it receives from clients to available servers based on the specified load-balancing method, routes the requests based on specified rules, caches frequently accessed data, prioritizes traffic, and controls the quality of service. Oracle Traffic Director is a layer-7 software load balancer and is not meant to replace a global load balancer.

The architecture of Oracle Traffic Director enables it to handle large volumes of application traffic with low latency. For high availability, you can set up pairs of Oracle Traffic Director instances for either active-passive or active-active failover. As the volume of traffic to your network grows, you can easily scale the environment by reconfiguring Oracle Traffic Director with additional back-end servers to which it can route requests.

There is a tight integration between Oracle Traffic Director and Continuous Availability features such as Zero Downtime Patching and Live Partition Migration to provide zero downtime to applications, either during a rolling upgrade process or during partition migration. This integration allows for applications to be highly available without requiring any changes.

For design considerations when using Oracle Traffic Director in continuous availability architectures, see Oracle Traffic Director. For general information about Oracle Traffic Director, see Introduction in *Administering Oracle Traffic Director*.

1.3.7 Oracle Site Guard

Oracle Site Guard, a component of Oracle Enterprise Manager Cloud Control, is a disaster recovery solution that enables administrators to automate complete site switchover or failover, thereby minimizing downtime for enterprise deployments. Because Oracle Site Guard operates at the site level, it eliminates the need to tediously perform manual disaster recovery for individual site components like

applications, middleware, databases, and so on. The traffic of an entire production site can be redirected to a standby site in a single operation.

Administrators do not require any special skills or domain expertise in areas like databases, applications, and storage replication. Oracle Site Guard can continuously monitor disaster recovery readiness, and it can do this without disrupting the production site.

You can manage an Oracle Site Guard configuration by using either the Enterprise Manager Command-Line Interface (EMCLI) or a compatible version of Oracle Enterprise Manager Cloud Control (Cloud Control).

See Understanding Oracle Site Guard Concepts in *Oracle Site Guard Administrator's Guide*.

1.4 Value-Added WebLogic Server and Coherence High Availability Features

Oracle Continuous Availability leverages the high availability features in WebLogic Server and Coherence, such as clustering, singleton services, session replication, Coherence persistence, Coherence clusters, and more.
In addition to the features described in Continuous Availability Key Features, Oracle Continuous Availability also takes advantage of the key features described in the following sections.

1.4.1 WebLogic Server High Availability Features

The following WebLogic Server features can be used with the Oracle Continuous Availability features to provide the highest level of availability:

- Clustering: A WebLogic Server cluster consists of multiple WebLogic Server server instances running simultaneously and working together in a domain to provide increased scalability and reliability. See Clustering.
- Singleton services: Services such as server and service migration, persistent data stores, and leasing make singleton services such as JMS and JTA highly available in a WebLogic Server cluster. See Singleton Services.
- Session Replication: Session replication is a feature of WebLogic Server clusters that is used to replicate the data stored in a session across different server instances in the cluster. See Session Replication.
- Transaction and data source features:
  - Active GridLink data sources that use Fast Connection Failover to provide rapid failure detection of Oracle Real Application Clusters (Oracle RAC) nodes, and failover to remaining nodes for continuous connectivity. For design considerations when using Active Gridlink in continuous availability architectures, see Data Sources. See Using Active GridLink Data Sources in *Administering JDBC Data Sources for Oracle WebLogic Server*.
  - Transaction logs in the database (JDBC TLogs) that store information about committed transactions coordinated by the server that may not have been completed. WebLogic Server uses the TLogs when recovering from system crashes or network failures. See Using Transaction Log Files to Recover Transactions in *Developing JTA Applications for Oracle WebLogic Server*.

- No transaction TLog writes (No TLog) where you eliminate writes of the transaction checkpoints to the TLog store. See XA Transactions without Transaction TLog Write in *Developing JTA Applications for Oracle WebLogic Server*.
- Logging Last Resource (LLR) transaction optimization which is a performance enhancement option that enables one non-XA resource to participate in a global transaction with the same ACID (atomicity, consistency, isolation, durability) guarantee as XA. See Logging Last Resource Transaction Optimization in *Developing JTA Applications for Oracle WebLogic Server*.

  These features work with Oracle Data Guard which replicates databases to make transaction logs needed for recovery to be highly available. See Introduction to Oracle Data Guard in *Oracle Data Guard Concepts and Administration*.

For more information about high availability in Oracle Fusion Middleware, see Introduction to High Availability in *High Availability Guide*.

1.4.2 Coherence Persistence and Clusters

Coherence persistence is a set of tools and technologies that manage the persistence and recovery of Coherence distributed caches. Cached data is persisted so that it can be quickly recovered after a catastrophic failure or after a cluster restart due to planned maintenance. Persistence and federated caching can be used together as required. See Persisting Caches in *Administering Oracle Coherence*.

When an application asks for an entry to the Coherence cache, if the entry does not exist in the cache and does exist in the database, then Coherence updates the cache with the database value. This is called Read-Through caching. See Read-Through Caching in *Developing Applications with Oracle Coherence*.

Coherence clusters consist of multiple Coherence server instances that distribute data in-memory to increase application scalability, availability, and performance. Application data is automatically and transparently distributed and backed up across cluster members. See Configuring and Managing Coherence Clusters in *Administering Clusters for Oracle WebLogic Server*.

1.5 Disaster Recovery for Oracle Database

Oracle WebLogic Server 12c provides strong support for integrating with the High Availability (HA) features of Oracle Database. Integrating with these HA features minimizes database access time while allowing transparent access to rich pooling management functions that maximize both connection performance and application availability.
Oracle Continuous Availability takes advantage of the HA database features described in this section. The integration of all these products contributes to managing and orchestrating the failover and switchover of the Oracle Database, and makes the failover of the database fast and automatic.

- Oracle Data Guard ensures high availability, data protection, and disaster recovery for enterprise data. It provides a comprehensive set of services that create, maintain, manage, and monitor one or more standby databases to enable production Oracle databases to survive disasters and data corruptions. Oracle Data Guard maintains these standby databases as transactionally consistent copies of the primary database. If the primary database becomes unavailable

because of a planned or an unplanned outage, then Oracle Data Guard enables you to switch any standby database to the production role, thus minimizing the downtime associated with the outage. See Introduction to Oracle Data Guard in *Data Guard Concepts and Administration*.

- Oracle Active Data Guard is a comprehensive solution to eliminate single points of failure for mission critical Oracle Databases. It prevents data loss and downtime by maintaining a synchronized physical replica (standby) of a production database (primary). If there is an outage, client connections quickly failover to the standby and resume service. Active Data Guard achieves the highest level of data protection through deep integration with Oracle Database, strong fault isolation, and unique Oracle-aware data validation. System and software defects, data corruption, and administrator error that affect a primary are not mirrored to the standby. Idle redundancy is eliminated by directing read-only workloads and backups to active standby databases for high return on investment. See Getting Started with Oracle Data Guard in *Data Guard Concepts and Administration*.
- Oracle Data Guard broker logically groups these primary and standby databases into a broker configuration that enables the broker to manage and monitor them together as an integrated unit. It sends notifications to WebLogic Active GridLink which then makes new connections to the database in the failover site, and coordinates with Oracle Clusterware to fail over role-based services. Oracle Site Guard uses Oracle Data Guard broker to perform the failover or switchover of the databases. See Oracle Data Guard Broker Concepts in *Data Guard Broker*.
- Oracle Real Application Clusters (Oracle RAC) is a clustered version of Oracle Database that allows running multiple database instances on different servers in the cluster against a shared set of data files, also known as the database. The database spans multiple hardware systems and yet appears as a single unified database to the application. See Introduction to Oracle RAC in *Real Application Clusters Administration and Deployment Guide*.
- Oracle Clusterware manages the availability of instances of an Oracle RAC database. It works to rapidly recover failed instances to keep the primary database available. If Oracle Clusterware cannot recover a failed instance, then the broker continues to run automatically with one fewer instance. If the last instance of the primary database fails, then the broker provides a way to fail over to a specified standby database. If the last instance of the primary database fails, and fast-start failover is enabled, then the broker can continue to provide high availability by automatically failing over to a pre-determined standby database. See Introduction to Oracle Clusterware in *Oracle Clusterware Administration and Deployment Guide*.
- Oracle GoldenGate is a high-performance software application that uses log-based bidirectional data replication for real-time capture, transformation, routing, and delivery of database transactions across heterogeneous systems. Oracle GoldenGate allows for databases to be in active-active mode. Applications that use Oracle GoldenGate must have tolerance for data loss due to the asynchronous nature of Oracle GoldenGate replication. See Introduction to Oracle GoldenGate in *Administering Oracle GoldenGate*.
- Oracle Database 12c Global Data Services (GDS) streamline the delivery of database services on a global scale, which is key to deploying databases in MAA environments.These technologies oversee replication and failover while performing load balancing within and across data centers, optimizing resource utilization and streamlining database management practices in a distributed database environment. GDS works by enabling a Global Service across Oracle Real Application Clusters (RAC) and single-instance Oracle databases

interconnected via Oracle Data Guard, Oracle GoldenGate, or any other replication technology. Client access to this distributed infrastructure is completely transparent. GDS implementations are easy to apply to Oracle WebLogic Server with minimal changes. See Introduction to Global Data Services in *Database Global Data Services Concepts and Administration Guide*.

- Application Continuity (AC) is available with the Oracle RAC, Oracle RAC One Node and Oracle Active Data Guard options that masks outages from end users and applications by recovering the in-flight database sessions following recoverable outages. Application Continuity enables replay, in a non-disruptive and rapid manner, of a database request when a recoverable error makes the database session unavailable. The request can contain transactional and nontransactional calls to the database and calls that are executed locally at the client or middle tier. After a successful replay, the application can continue where that database session left off. See Ensuring Application Continuity in *Oracle Database Development Guide.*

WebLogic Server Active GridLink integrates with the Oracle Database 12c features like Application Continuity and Global Data Services to provide the highest possible availability. Application Continuity will replay transactions when encountered with unplanned database outages. End-user applications will not receive errors or even know that there have been outages. Active GridLink, Application Continuity, and Data Guard provide protection for planned and unplanned database outages in highly available environments.

These technologies oversee replication and failover while performing load balancing within and across data centers, optimizing resource utilization and streamlining database management practices in a distributed database environment.

2

Supported MAA Architectures for Continuous Availability

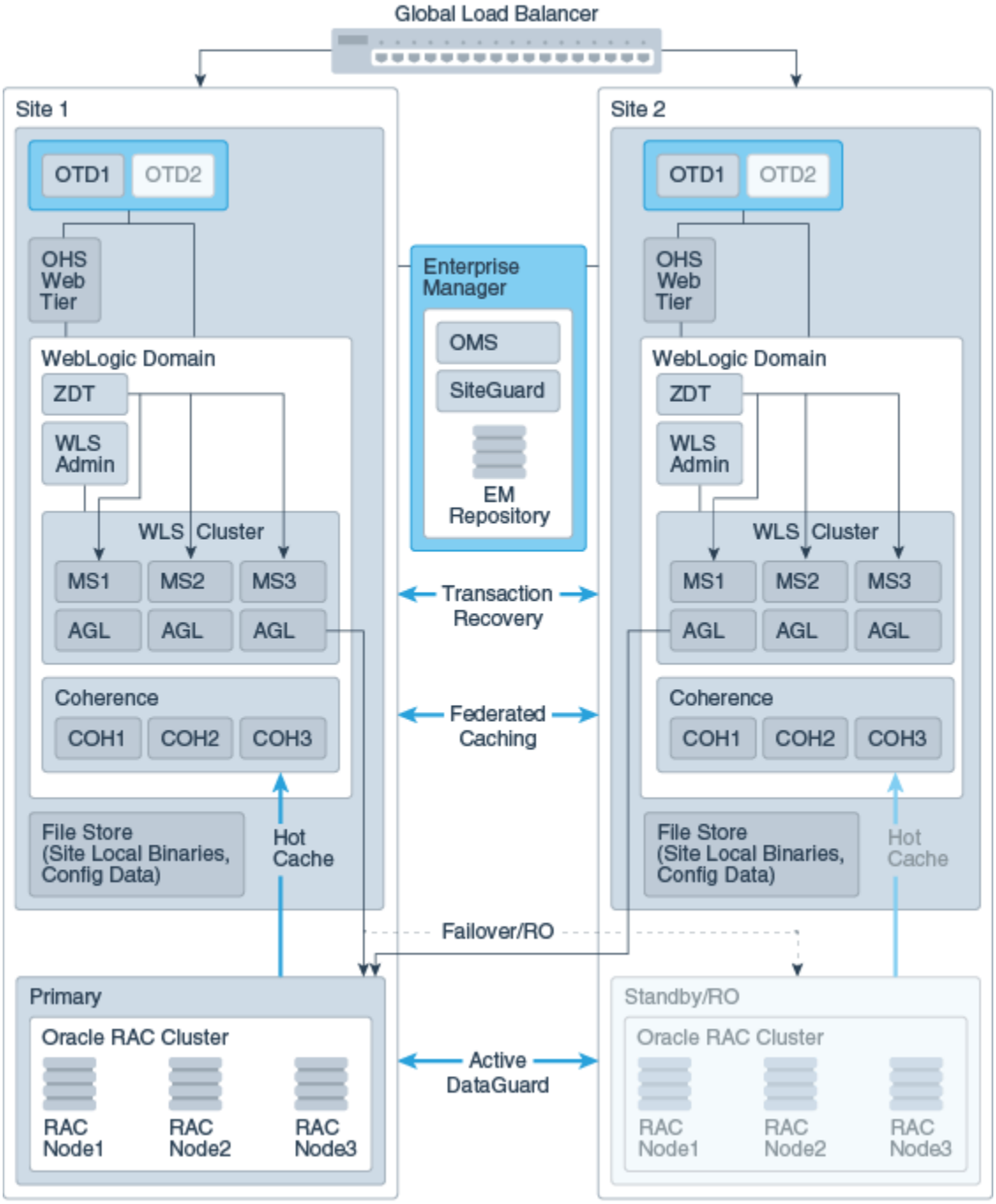
The maximum availability architecture (MAA) solutions supported in Oracle WebLogic Server Continuous Availability can be used to protect an Oracle WebLogic Server system against downtime across multiple data centers.
This chapter describes these MAA solutions and also explains how the Continuous Availability features can be used with each architecture. For design considerations and best practices, see Common Design Considerations for Continuous Availability. The supported MAA solutions include:

- Active-Active Application Tier with an Active-Passive Database Tier
- Active-Passive Application Tier with an Active-Passive Database Tier
- Active-Active Stretch Cluster with an Active-Passive Database Tier

2.1 Active-Active Application Tier with an Active-Passive Database Tier

One supported MAA architecture is an active-active application infrastructure tier that is used in conjunction with an active-passive database tier, and in which both tiers span two sites. The application infrastructure tier is active in both sites, and the database tier is active in one site but on standby in the second.
Figure 2-1 shows a recommended continuous availability solution using an active-active application infrastructure tier with an active-passive database tier. For design considerations and best practices, see Design Considerations for Active-Active Application Tier Topology.

Figure 2-1 Topology for an Active-Active Application infrastructure Tier with an Active-Passive Database Tier



The key aspects of this sample topology include:

- A global load balancer.
- Two instances of Oracle Traffic Director (OTD) at each site, one active and one passive. Oracle Traffic Director can balance requests to the web tier or to the WebLogic Server cluster.
- Oracle HTTP Server (OHS) Web Tier (optional component based on the type of environment).

- Two separate WebLogic Server domains configured in two different data centers, Site 1 and Site 2. The domains at both sites are active and must be configured with symmetric topology. See Active-Active Application Tier With Active-Passive Database Tier Design Considerations. The domains include:
  - A collection of Managed Servers (MS1, MS2, and MS3) in a WebLogic Server cluster, managed by the WebLogic Server Administration Server in the domain. In this sample, Active Gridlink (AG) is being used to connect the Managed Servers to the primary database. (Although generic DataSource or MultiDataSource can be used, Active Gridlink is preferable because it offers high availability and improved performance). The Zero Downtime Patching (ZDT) arrows represent patching the Managed Servers in a rolling fashion.
  - A Coherence cluster (COH1, COH2, and COH3) managed by the WebLogic Server Administration Server in the domain. Coherence persistent caching is used to recover cached data in case of a failure in the Coherence cluster. Read-Through caching or Coherence GoldenGate cache is used to update cache from the database.
- A file store for the configuration data, local binaries, logs, and so on.
- Oracle Site Guard, a component of Oracle Enterprise Manager Cloud Control, that orchestrates the failover and switchover of sites.
- Two separate Oracle RAC database clusters in two different data centers. The primary active Oracle RAC database cluster is at Site 1. Site 2 contains an Oracle RAC database cluster in standby (passive) read-only mode. The clusters can contain transaction logs, JMS stores, and application data. Data is replicated using Oracle Active Data Guard. (Although Oracle recommends using Oracle RAC database clusters because they provide the best level of high availability, they are not required. A single database or multitenant database can also be used.)

This topology uses the continuous availability features as follows:

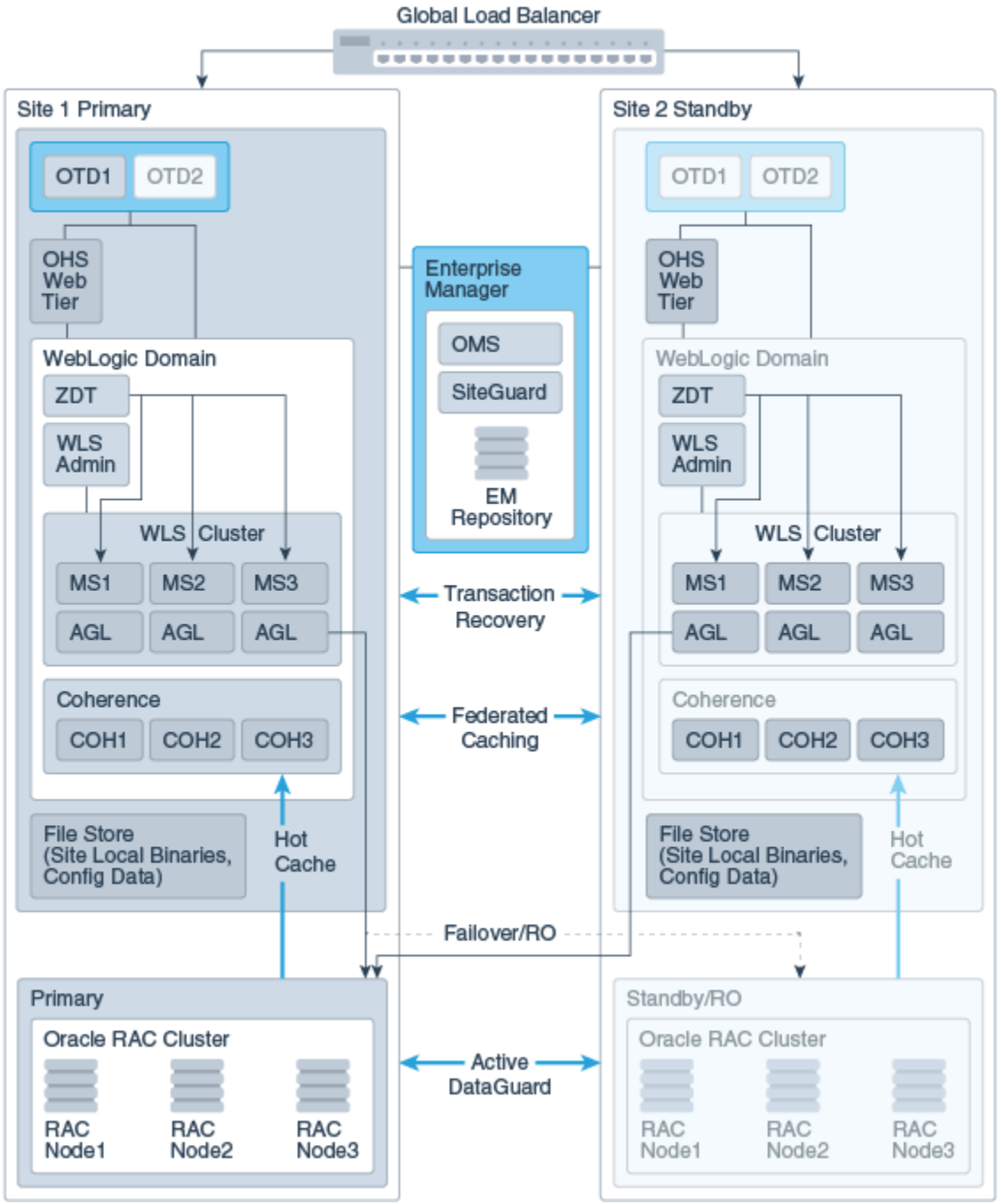
- Automated cross-site XA transaction recovery: Because both domains are active, you can use the full capabilities of this feature, as described in Automated Cross-Site XA Transaction Recovery. In this architecture, transactions can be recovered automatically, without any manual intervention.
- WebLogic Zero Downtime Patching: Because both domains are active, you can orchestrate the roll out of updates separately on each site. See WebLogic Server Zero Downtime Patching.
- Coherence federated caching: You can use the full capabilities of this feature, as described in Coherence Federated Caching. Cached data is replicated between clusters. Applications in different sites have access to a local cluster instance.
- Coherence HotCache: Updates the Coherence cache in real time for any updates that are made on the active database. See Coherence GoldenGate HotCache.
- Oracle Traffic Director: Adjusts traffic routing to application servers depending on server availability. You can achieve high availability with Oracle Traffic Director by having a pair of instances configured at each site, either active-active or active-passive. See Oracle Traffic Director.
- Oracle Site Guard: Because only the database is in standby mode in this architecture, Oracle Site Guard controls database failover only. It does not apply to the application architecture tier because both domains are active. See Oracle Site Guard.

2.2 Active-Passive Application Tier with an Active-Passive Database Tier

Another supported MAA architecture is an active-passive application infrastructure tier with an active-passive database tier and in which both tiers span two sites. At the first site, the application infrastructure is active, and the database tier is passive. At the second, both tiers are on standby.

Figure 2-2 shows a recommended continuous availability topology using an active-passive application infrastructure tier with an active-passive database tier. For design considerations and best practices, see Design Considerations for Active-Passive Application Tier Topology.

Figure 2-2 Topology for an Active-Passive Application infrastructure Tier with an Active-Passive Database Tier



The key aspects of this topology include:

- A global load balancer.
- Two instances of Oracle Traffic Director (OTD) at each site. Oracle Traffic Director can balance requests to the web tier or to the WebLogic Server cluster. At Site 1, one instance is active and one is passive. On Site 2 they are both on standby. When Site 2 becomes active, the Oracle Traffic Director instances on that site will start routing the requests.

- Oracle HTTP Server (OHS) Web Tier (optional component based on the type of environment).
- Two separate WebLogic Server domains configured in two different data centers, Site 1 and Site 2. The domain at Site 1 is active and the domain at Site 2 is in standby (passive) mode. The configuration of each active-passive domain pair must be identical. See Active-Passive Application Tier With Active-Passive Database Tier Design Considerations.

  The domains include:

  - A collection of Managed Servers (MS1, MS2, and MS3) in a WebLogic Server cluster, managed by the WebLogic Server Administration Server in the domain. In this sample, Active Gridlink (AG) is being used to connect the Managed Servers to the primary database. (Although generic DataSource or MultiDataSource can be used, Active Gridlink is preferable because it offers high availability and improved performance). The Zero Downtime Patching (ZDT) arrows represent patching the Managed Servers in a rolling fashion.
  - A Coherence cluster (COH1, COH2, and COH3) managed by the WebLogic Server Administration Server in the domain. Coherence persistent caching is used to recover cached data in case of a failure in the Coherence cluster. Read-Through caching or Coherence GoldenGate cache is used to update cache from the database.
- A file store for the configuration data, local binaries, logs, and so on.
- Oracle Site Guard, a component of Oracle Enterprise Manager Cloud Control, that orchestrates the failover and switchover of sites.
- Two separate Oracle RAC database clusters in two different data centers. The primary active Oracle RAC database cluster is at Site 1. Site 2 contains an Oracle RAC database cluster in standby (passive) read-only mode. The clusters can contain transaction logs, JMS stores, and application data. Data is replicated using Oracle Active Data Guard. (Although Oracle recommends using Oracle RAC database clusters because they provide the best level of high availability, they are not required. A single database or multitenant database can also be used.)

This architecture uses the continuous availability features as follows:

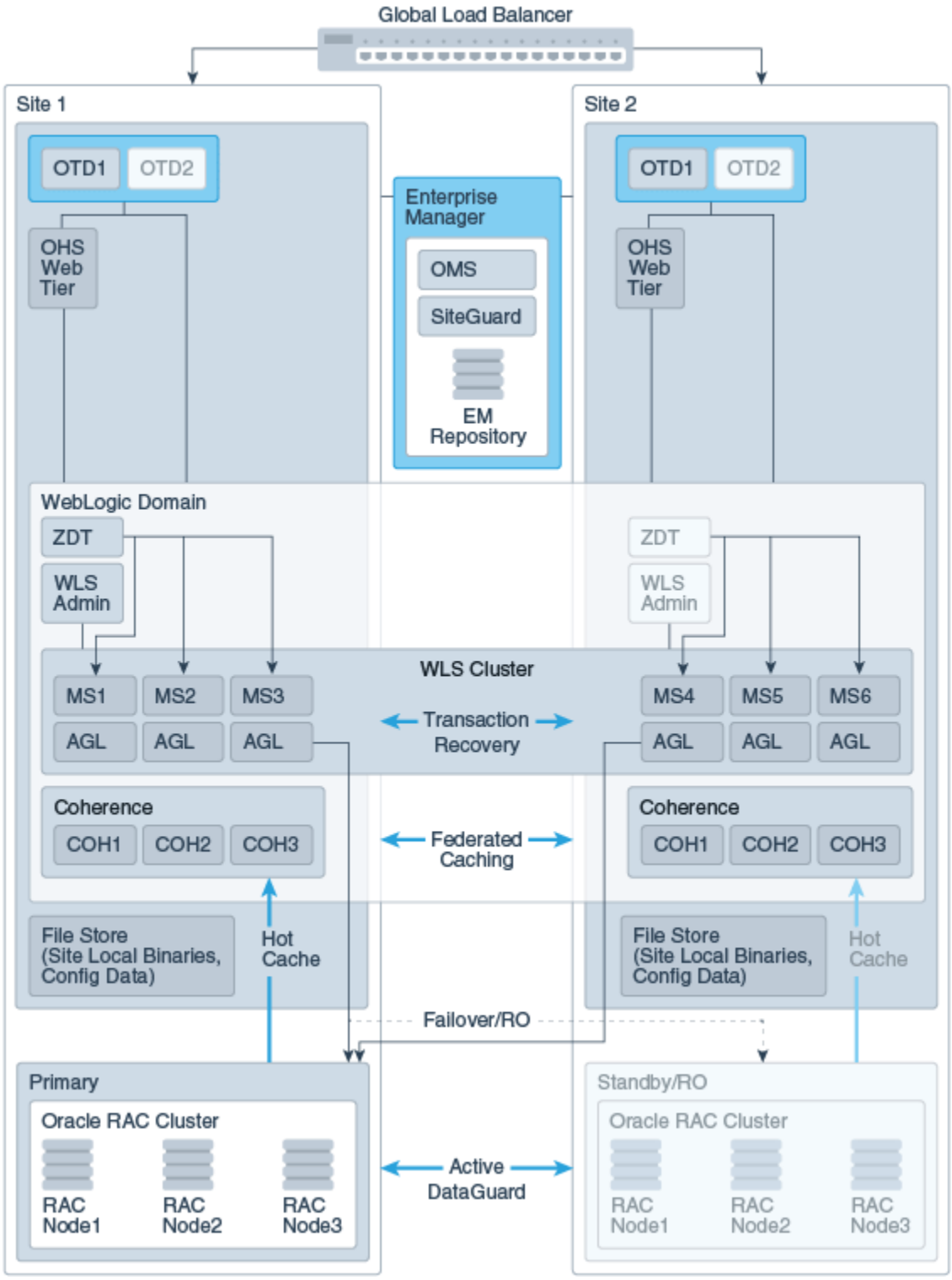
- Automated cross-site XA transaction recovery: Because the domain at Site 2 is in standby mode, during failover, you must first start the domain at Site 2. After you start the domain, you can use the cross-site XA transaction recovery features, as described in Automated Cross-Site XA Transaction Recovery.
- WebLogic Server Zero Downtime Patching: In this architecture, you can use the Zero Downtime Patching feature on the active domain in Site 1 as described in WebLogic Server Zero Downtime Patching. Because the servers are not running in the standby (passive) domain at Site 2, you can use OPatch. When the servers become active, they will point to the patched Oracle home. See Patching Your Environment Using OPatch in *Patching with OPatch*
- Coherence federated caching: In this architecture, the passive site supports read-only operations and off-site backup. See Coherence Federated Caching.
- Coherence HotCache: In this architecture, updates on the active database at Site 1 update the Coherence cache in real time and the database updates are replicated to Site 2. When the data replication occurs on Site 2, HotCache updates the cache in real time. See Coherence GoldenGate HotCache.

- Oracle Traffic Director: In this architecture, Oracle Traffic Director is in standby mode on the standby (passive) domain at Site 2. When Site 2 becomes active after failover, the Oracle Traffic Director instance on the standby site is activated (by Oracle Site Guard using a script that is run before or after failover) and the Oracle Traffic Director instance will start routing requests to the recently started servers. See Oracle Traffic Director.
- Oracle Site Guard: In this architecture, when Site1 fails, Oracle Site Guard will initiate the failover using scripts that specify what should occur and in what order. For example, it can start WebLogic Server, Coherence, web applications, and other site components in a specific order. You can execute the scripts either pre- or post-failover. Oracle Site Guard integrates with Oracle Data Guard broker to fail over the database. See Oracle Site Guard.

2.3 Active-Active Stretch Cluster with an Active-Passive Database Tier

Another supported MAA architecture is an active-active stretch cluster application infrastructure tier with an active-passive database tier and in which the two tiers span two sites. Both sites are configured with a WebLogic Server stretch cluster, and all server instances in each cluster are active. The database tier is active at the first site, but on standby at the second.
Figure 2-3 shows a recommended continuous availability solution using an active-active stretch cluster application infrastructure tier with an active-passive database tier. For design considerations and best practices, see Design Considerations for Active-Active Stretch Cluster Topology.

Figure 2-3 Topology for an Active-Active Stretch Cluster Application Infrastructure Tier and an Active-Passive Database Tier



The key aspects of this topology include:

- A global load balancer.

- Two instances of Oracle Traffic Director (OTD) at each site, one active and one passive. Oracle Traffic Director can balance requests to the web tier or to the WebLogic Server cluster.
- Oracle HTTP Server (OHS) Web Tier (optional component based on the type of environment).
- WebLogic Server configured as a cluster that stretches across two different data centers, Site 1 and Site 2. All servers in the cluster are active. The cluster can be either dynamic or static. See Clustering.
- The domain includes:
  - A WebLogic Server cluster that consists of a group of Managed Servers (MS1, MS2, and MS3) at Site 1 and another group of Managed Servers (MS4, MS5, and MS6) at Site 2. The Managed Servers are managed by the WebLogic Server Administration Server at Site 1. In this sample, Active Gridlink (AG) is being used to connect the Managed Servers to the primary database. (Although generic DataSource or MultiDataSource can be used, Active Gridlink is preferable because it offers high availability and improved performance). The Zero Downtime Patching (ZDT) arrows represent patching the Managed Servers in a rolling fashion.
  - A Coherence cluster at each site (COH1, COH2, and COH3) managed by the WebLogic Server Administration Server in the domain. Coherence persistent caching is used to recover cached data in case of a failure in the Coherence cluster. Read-Through caching or Coherence GoldenGate cache is used to update cache from the database.
- A file store for the configuration data, local binaries, logs, and so on.
- Oracle Site Guard, a component of Oracle Enterprise Manager Cloud Control, that orchestrates the failover and switchover of sites.
- Two separate Oracle RAC database clusters in two different data centers. The primary active Oracle RAC database cluster is at Site 1. Site 2 contains an Oracle RAC database cluster in standby (passive) read-only mode. The clusters can contain transaction logs, JMS stores, and application data. Data is replicated using Oracle Active Data Guard. (Although Oracle recommends using Oracle RAC database clusters because they provide the best level of high availability, they are not required. A single database or multitenant database can also be used.)

This architecture uses the continuous availability features as follows:

- Automated cross-site XA transaction recovery: Because all of the servers are in the same cluster, you can use the existing WebLogic Server high availability features, server and service migration, to recover transactions.
  - In whole server migration, a migratable server instance, and all of its services, is migrated to a different physical machine upon failure. See Whole Server Migration in *Administering Clusters for Oracle WebLogic Server*.
  - In service migration, in the event of failure, services are moved to a different server instance within the cluster. See Service Migration in *Administering Clusters for Oracle WebLogic Server*.
- WebLogic Zero Downtime Patching: Because all of the servers in the cluster are active, you can use the full capabilities of this feature as described in WebLogic Server Zero Downtime Patching.
- Coherence federated caching: You can use the full capabilities of this feature, as described in Coherence Federated Caching.

- Coherence HotCache: You can use the full capabilities of this feature, as described in Coherence GoldenGate HotCache.
- Oracle Traffic Director: Adjusts traffic routing to application servers depending on server availability. You can use the full capabilities of this feature, as described in Oracle Traffic Director.
- Oracle Site Guard: Because only the database is in standby mode in this architecture, Oracle Site Guard controls database failover only. It does not apply to the application architecture tier because all servers in the cluster are active. See Oracle Site Guard.

3

Common Design Considerations for Continuous Availability

Oracle provides recommended design considerations and best practices for the supported Maximum Availability Architecture (MAA) solutions that support continuous availability. MAA architectures span data centers in distributed geographical locations. See Supported MAA Architectures for Continuous Availability. Oracle MAA is Oracle's best practices blueprint based on proven Oracle high availability technologies, expert recommendations and customer experiences. The goal of MAA is to achieve optimal high availability for Oracle customers at the lowest cost and complexity.
The recommendations in this chapter apply to all of the MAA architectures that support continuous availability. Recommendations that are specific to a particular architecture are provided in the subsequent chapters.

Topics in this chapter include:

3.1 Potential Failure Scenarios

Potential failure scenarios range from unexpected full and partial site failures to maintenance outages.
The design considerations and recommendations provided in this document apply to the following potential failure scenarios:

- Full site failure - With full site failure, the database, the middle-tier application server, and all user connections fail over to a secondary site that is prepared to handle the production load.
- Partial site failure - In the context of this document, partial failures are at the mid-tier. Partial site failures at the mid-tier can consist of the entire mid-tier (WebLogic Server and Coherence), WebLogic Server only failure, Coherence cluster failure, or a failure in one instance of Oracle Traffic Director when two instances are configured for high availability.
- Network partition failure - The communication between sites fails.
- Maintenance outage - During a planned maintenance all components of a site are brought down gracefully. A switchover will take place from one site to the other.

The behavior of the continuous availability features in the different failure scenarios are described in the following sections:

- Active-Active Application Tier With Active-Passive Database Tier Failure Scenarios
- Active-Passive Application Tier With Active-Passive Database Tier Failure Scenarios
- Active-Active Stretch Cluster with an Active-Passive Database Tier Failure Scenarios

3.2 Global Load Balancer

When a global load balancer is deployed in front of the production and standby sites, it provides fault detection services and performance-based routing redirection for the two sites. Additionally, the load balancer can provide authoritative DNS name server equivalent capabilities.
In the event of a primary-site disaster and after the standby site has assumed the production role, a global load balancer is used to reroute user requests to the standby site. Global load balancers such as F5 –BigIP Global Traffic Manager (GTM) and Cisco –Global Site Selector (GSS) also handle DNS server resolution (by off loading the resolution process from the traditional DNS servers).

During normal operations, the global load balancer can be configured with the production site's load balancer name-to-IP mapping. When a DNS switchover is required, this mapping in the global load balancer is changed to map to the standby site's load balancer IP. This allows requests to be directed to the standby site, which now has the production role.

This method of DNS switchover works for both site switchover (planned) and failover (unplanned). One advantage of using a global load balancer is that the time for a new name-to-IP mapping to take effect can be almost immediate. The downside is that an additional investment must be made for the global load balancer. For instructions for performing a DNS switchover, see Manually Changing DNS Names in *Disaster Recovery Guide*.

3.3 Oracle Traffic Director

In an MAA environment you should configure an Oracle Traffic Director failover group. Combining two instances of Oracle Traffic Director using one or two virtual IP (VIP) addresses ensures high availability. Both the hosts in the failover group must run the same operating system version, use identical patches and service packs, and run Oracle Traffic Director instances of the same configuration.
When two Oracle Traffic Director instances are grouped by a virtual IP address (VIP) for high availability, they are in active-passive failover mode. The VIP receives requests and routes them to the Oracle Traffic Director instance that is designated as the primary instance. If the primary instance is not reachable, requests are routed to the backup instance.

For active-active failover mode, two failover groups are required. Each failover group must have a unique VIP, and consist of the same nodes, each with the primary and backup roles reversed. Each instance in the failover group is designated as the primary instance for one VIP and the backup for the other VIP. See Configuring Oracle Traffic Director for High Availability in *Administering Oracle Traffic Director*.

If you are running Oracle Traffic director on a Linux platform in high availability mode (both active-passive and active-active), you need to ensure that Oracle Traffic Director is the only consumer of the `Keepalived` process on all the hosts that are used for configuring the failover group. `Keepalived` is a process that runs on Linux. It is a health-check framework and implements a Hot Standby protocol. There can be no other applications running on these hosts that require the `Keepalived` process.

Although Oracle HTTP Server and Apache Plugins can also be used in Continuous Availability architectures to load balance requests to WebLogic Servers, they do not provide the integration you receive with Oracle Traffic Director.

The following sections provide some specific guidelines for configuring Oracle Traffic Director for continuous availability.

Network Preparation

- Allocate one virtual IP address for each site to be used for the failover group of Oracle Traffic Director. The addresses must belong to the same subnet as that of the nodes in the failover group. They should be DNS resolvable and accessible over the network. Ensure that for the network interface on which the failover-group virtual IP is created is the same on all the Administration Node hosts. This is a requirement for smooth migration of the failover group from the primary site to the standby site.
- At the standby site, ensure that the primary site's host names and the primary site's virtual IP resolve to the IP addresses of the corresponding peer systems. This can be set up by creating aliases for host names in the /etc/hosts file. For both disaster recovery deployment options, make sure aliases for all the systems and the virtual IP names exist.

Best Practices

1. Oracle recommends that you test the standby site periodically. This will help mitigate failures at both sites. Test the standby site by switching its role with the current primary site:
   a. Follow the site switchover procedure to switch over the standby site to the new primary site.
   b. Once testing is complete, follow the site switchback procedure to reverse the roles.

   Periodic testing validates that both the primary and standby sites are completely functional and mitigates the risk of failure at both sites. It also validates the switchover and switchback procedures.
2. Do not configure project-level and share-level replication within the same project.
3. Ensure that the Oracle Traffic Director setup resides on shared storage and gets replicated to the remote site, making the Oracle Traffic Director binaries and latest configuration data available at the standby site during a site failure or site maintenance event. All the Oracle Traffic Director binaries, configuration data, logs, and security data should be replicated to the remote site using existing replication technology.
4. Use the Scheduled replication mode for projects and shares in these cases:
   a. Data does not change frequently.
   b. The Recovery Point Objective value falls within your scheduled replication window.

5. Use the Continuous replication mode for projects and shares in these cases:
   a. The standby site is required to be as close as possible to the primary site.
   b. The Recovery Point Objective value is a range of a few seconds, and the allowance is for very little data loss. Data is of a critical nature.
6. Snapshots and clones can be used at the target site to off load backup, test, and development types of environments.
7. When configuring a local standby site (disaster recovery within the data center), consider disabling SSL on the replication channel. Removing the encryption algorithm enables a higher replication throughput.
8. Always enable SSL when replication is across a wide area network. For the OTD instance synchronization-based standby disaster recovery option, there must be a remote sync tool and a time-based scheduler application on the Administration Server host at each site for transferring the OTD instance changes between sites. Ensure that the NIS settings are configured and the NIS service is started

3.4 Web Tier

Configuring a web tier is optional in continuous availability MAA architectures. Web Tier products such as Oracle HTTP Server (OHS) and Oracle WebLogic Server Proxy Plug-In are designed to efficiently front-end WebLogic Server applications.
When possible, Oracle recommends using Oracle Traffic Director (OTD) to handle all load balancing to WebLogic server instances. You should not front end your web tier with Oracle Traffic Director in cases where there are:

- Static contents like HTML, Images, Java Script, and so on. Oracle Traffic Director integrates with Continuous Availability features such as Zero Down Time Patching to provide maximum availability to applications during the rollout process and Live Partition Migration to provide continuous availability during the migration of application and resources in a MT partition from one WebLogic Cluster to another.
- Middleware configurations that already make use of Oracle HTTP Server or WebLogic Server Proxy Plug-In.

Use existing replication technology or methods to keep Web Tier binaries and configuration consistent between sites.

OHS and WebLogic Server Proxy Plug-in can be used with other WebLogic Server Continuous Availability features but might require manual intervention and do not offer the same level of availability as Oracle Traffic Director.

For more information about Oracle HTTP Server and WebLogic Server Proxy Plug-Ins, see:

- Introduction to Oracle HTTP Server in *Administering Oracle HTTP Server*.
- Overview of Oracle WebLogic Server Proxy Plug-In in *Using Oracle WebLogic Server Proxy Plug-Ins*.

3.5 WebLogic Server

WebLogic Server features such as clustering, singleton services, session replication, and others can be used with the Continuous Availability features to provide the highest level of availability.

The following sections provide the design considerations for these WebLogic Server features in a continuous availability MAA architecture:

- Clustering
- Singleton Services
- Session Replication
- Data Sources
- Security
- Storage
- Zero Downtime Patching
- Cross-Site XA Transaction Recovery

3.5.1 Clustering

A WebLogic Server cluster consists of multiple WebLogic Server server instances running simultaneously and working together to provide increased scalability, reliability, and high availability. A cluster appears to clients as a single WebLogic Server instance. The server instances that constitute a cluster can run on the same machine, or be located on different machines. You can increase a cluster's capacity by adding additional server instances to the cluster on an existing machine, or you can add machines to the cluster to host the incremental server instances. Each server instance in a cluster must run the same version of WebLogic Server.

WebLogic Server supports two types of clusters:

- Dynamic clusters - Dynamic clusters consist of server instances that can be dynamically scaled up to meet the resource needs of your application. When you create a dynamic cluster, the dynamic servers are preconfigured and automatically generated for you, enabling you to easily scale up the number of server instances in your dynamic cluster when you need additional server capacity. Dynamic clusters allows you to define and configure rules and policies to scale up or shrink the dynamic cluster.

  In dynamic clusters, the Managed Server configurations are based off of a single, shared template. It greatly simplifies the configuration of clustered Managed Servers, and allows for dynamically assigning servers to machine resources and greater utilization of resources with minimal configuration.

  Dynamic cluster elasticity allows the cluster to be scaled up or down based on conditions identified by the user. Scaling a cluster can be performed on-demand (interactively by the administrator), at a specific date or time, or based on performance as seen through various server metrics.

  When shrinking a dynamic cluster, the Managed Servers are shut down gracefully and the work/transactions are allowed to complete. If needed, singleton services are automatically migrated to another instance in the cluster.

- Static clusters - In a static cluster the end-user must configure new servers and add them to the cluster, and start and stop them manually. The expansion and shrinking of the cluster is not automatic; it must be performed by an administrator.

In most cases, Oracle recommends the use of dynamic clusters to provide elasticity to WebLogic deployments. The benefits of dynamic clusters are minimal configuration, elasticity of clusters, and proper migration of JMS and JTA singleton services when shrinking the cluster.

However, there are some instances where static clusters should be used:

- If you need to manually migrate singleton services. Dynamic clusters do not support manual migration of singleton services.
- If your configuration consists of Oracle Fusion Middleware upper stack products such as Oracle SOA Suite and Oracle Business Process Management. These products do not provide support for dynamic clusters in this release.

3.5.2 Singleton Services

A singleton service is a service running on a Managed Server that is available on only one member of a cluster at a time. WebLogic Server allows you to automatically monitor and migrate singleton services from one server instance to another.

Pinned services, such as JMS-related services and user-defined singleton services are hosted on individual server instances within a WebLogic cluster. To ensure that singleton JMS or JTA services do not introduce a single point of failure for dependent applications in the cluster, WebLogic Server can be configured to automatically or manually migrate them to any server instance in the cluster.

Within an application, you can define a singleton service that can be used to perform tasks that you want to be executed on only one member of a cluster at any give time. Automatic singleton service migration allows the automatic health monitoring and migration of user-defined singleton services.

Singleton services described in the following sections include:

- Server and Service Migration
- Data Stores
- Leasing

3.5.2.1 Server and Service Migration

Oracle WebLogic Server supports two distinct types of automatic migration mechanisms:

- Whole server migration, where a migratable server instance, and all of its services, is migrated to a different physical machine upon failure. When a failure occurs in a server that is part of a cluster that is configured with server migration, the server is restarted on any of the other machines that host members of the cluster. See Whole Server Migration in *Administering Clusters for Oracle WebLogic Server*.
- Service migration, where failed services are migrated from one server instance to a different available server instance within the cluster. In some circumstances, service migration performs much better then whole server migration because you are only migrating the singleton services as opposed to the entire server. See Service Migration in *Administering Clusters for Oracle WebLogic Server*.

Both whole server and Service migration require that you configure a database leasing table. See Leasing.

Instructions for configuring WebLogic Server to use server and service migration in an MAA environment are provided in Using Whole Server Migration and Service Migration in an Enterprise Deployment in *Enterprise Deployment Guide for Oracle SOA Suite*.

3.5.2.2 Data Stores

There are two kinds of persistent data stores for Oracle WebLogic Server transactions logs and Oracle WebLogic Server JMS: database-based and file-based.

Keeping persistent stores in the database provides the replication and high availability benefits inherent in the underlying database system. With JMS, TLogs and the application in the same database and replication handled by Oracle Data Guard, cross-site synchronization is simplified and the need for a shared storage sub-system such as a NAS or a SAN is alleviated in the middle tier. See Database.

However, storing TLogs and JMS stores in the database has a penalty on system performance. This penalty is increased when one of the sites needs to cross communicate with the database on the other site. Ideally, from a performance perspective, shared storage that is local to each site should be used for both types of stores and the appropriate replication and backup strategies at storage level should be provisioned in order to guarantee zero data loss without performance degradation. Whether using database stores will be more suitable than shared storage for a system depends on the criticality of the JMS and transaction data, because the level of protection that shared storage provides is much lower than the database guarantees.

You can minimize the performance impact of database stores, especially when there is a large concurrency, by using techniques such as global hash partitions for indexes (if Oracle Database partitioning is available). For recommendations about minimizing the performance impact, see Using Persistent Stores for TLOGs and JMS in an Enterprise Deployment in *Enterprise Deployment Guide for Oracle SOA Suite*.

In active-active and active-passive topologies, keeping the data stores in the database is a requirement. Oracle recommends keeping WebLogic Server stores such as JMS and JTA stores, in a highly available database such as Oracle RAC and connecting to the database using Active GridLink data sources for maximum performance and availability.

In the case of an active-active stretch cluster, you can choose between keeping the data stores in a shared storage sub-system such as a NAS or a SAN, or in the database.

3.5.2.3 Leasing

Leasing is the process WebLogic Server uses to manage services that are required to run on only one member of a cluster at a time. Leasing ensures exclusive ownership of a cluster-wide entity. Within a cluster, there is a single owner of a lease. Additionally, leases can failover in case of server or cluster failure which helps to avoid having a single point of failure. See Leasing in *Administering Clusters for Oracle WebLogic Server*.

For database leasing we recommend the following:

- A highly available database such as Oracle RAC and Active GridLink (AGL).
- A standby database, and Oracle Data Guard to provide replication between the two databases.

When using database leasing, Oracle WebLogic Servers may shut down if the database remains unavailable (during switchover or failover) for a period that is longer than their server migration fencing times. You can adjust the server migration fencing

times as described in the following topics in *Administering Clusters for Oracle WebLogic Server*:

- Migratable Server Behavior in a Cluster
- Cluster Master Role in Whole Server Migration

3.5.3 Session Replication

WebLogic Server provides three methods for replicating HTTP session state across servers in a cluster:

- In-memory replication - Using in-memory replication, WebLogic Server copies a session state from one server instance to another. The primary server creates a primary session state on the server to which the client first connects, and a secondary replica on another WebLogic Server instance in the cluster. The replica is kept up-to-date so that it may be used if the server that hosts the servlet fails.
- JDBC-based persistence - In JDBC-based persistence, WebLogic Server maintains the HTTP session state of a servlet or JSP using file-based or JDBC-based persistence. For more information on these persistence mechanisms, see Configuring Session Persistence in *Developing Web Applications, Servlets, and JSPs for Oracle WebLogic Server*.
- Coherence*Web - Coherence*Web is not a replacement for WebLogic Server's in-memory HTTP state replication services. However, you should consider using Coherence*Web when an application has large HTTP session state objects, when running into memory constraints due to storing HTTP session object data, or if you want to reuse an existing Coherence cluster. See Using Coherence*Web with WebLogic Server in *Administering HTTP Session Management with Oracle Coherence*Web*.

Depending on the latency model, tolerance to session loss, and performance, you should choose the method that best fits your requirement.

- When the latency is small, such as in MAN networks (stretch cluster topology), Oracle recommends WebLogic Server in-memory session replication. However, if a site experiences a failure there is the possibility of session loss.
- When the latency is large (WAN networks), Active-Active, or Active-Passive topologies, and when your applications cannot tolerate session loss, Oracle recommends database session replication.

In most cases, in-memory session replication performs much better than database session replication. See Failover and Replication in a Cluster in *Administering Clusters for Oracle WebLogic Server*.

3.5.4 Data Sources

WebLogic Active GridLink Data Sources integrate with Oracle RAC databases and Oracle Data Guard to provide the best performance, high scalability and the highest availability. The integration with Oracle RAC enables Active GridLink to do Fast Connection Failover (FCF), Runtime Load Balancing (RCLB) and Affinity features. Active GridLink can handle planned maintenance in the database without any interruptions to end-users while allowing all work to complete.

Oracle recommends keeping WebLogic Server stores such as JMS and JTA stores, and leasing tables in a highly available database such as Oracle RAC and connecting

to the database using Active GridLink data sources. Storing the stores and leasing tables in the database provides the following advantages:

- Exploits the replication and other high availability aspects inherent in the underlying database system.
- Enhances handling of disaster recovery scenarios. When JMS, the TLogs and the application are in the same database and the replication is handled by Data Guard, there is no need to worry about cross-site synchronization.
- Alleviates the need for a shared storage sub-system such as a NAS or a SAN. Usage of the database also reduces overall system complexity since in most cases a database is already present for normal runtime/application work.

You can configure your Active GridLink URL to minimize the time to failover between databases. See Supported AGL Data Source URL Formats in *Administering JDBC Data Sources for Oracle WebLogic Server*.

3.5.5 Security

It is important that you determine your security needs and make sure that you take the appropriate security measures before you deploy WebLogic Server and your Java EE applications into a production environment. See Ensuring the Security of Your Production Environment in *Securing a Production Environment for Oracle WebLogic Server*.

3.5.6 Storage

The Oracle Fusion Middleware components in a given environment are usually interdependent on each other, so it is important that the components in the topology are in sync. Some of the storage artifacts that you need to take into consideration in an MAA environment are classified as static and dynamic.

- **Static artifacts** are files and directories that do not change frequently. These include:
  - home: The Oracle home usually consists of an Oracle home and an Oracle WebLogic Server home.
  - Oracle Inventory: This includes `oraInst.loc` and `oratab` files, which are located in the `/etc` directory.
- **Dynamic or runtime artifacts** are files that change frequently. Runtime artifacts include:
  - Domain home: Domain directories of the Administration Server and the Managed Servers.
  - Oracle instances: Oracle Instance home directories.
  - Application artifacts, such as `.ear` or `.war` files.
  - Database artifacts, such as the MDS repository.
  - Database metadata repositories used by Oracle Fusion Middleware.
  - Persistent stores, such as JMS providers and transaction logs. See Data Stores.

  - Deployment plans: Used for updating technology adapters such as file and JMS adapters. They need to be saved in a location that is accessible to all nodes in the cluster to which the artifacts are deployed.

For maximum availability, Oracle recommends using redundant binary installations. Each node should have its own Oracle home so that when you apply Zero Downtime Patches, only servers in one node need to come down at a time.

For recommended guidelines regarding shared storage for artifacts such as home directories and configuration files, see Using Shared Storage in *High Availability Guide*.

3.5.7 Zero Downtime Patching

Zero Downtime Patching (ZDT Patching) provides continuous application availability during the process of rolling out upgrades, even though the possibility of failures during the rollout process always exists. In an MAA environment, Oracle recommends patching one site at a time, and staggering the update to the other site to ensure that the sites remain synchronized. In the case of a site failure scenario, allow for the failed site to resume before resuming ZDT Patching.

When using ZDT Patching, consider the following:

- Rollout shuts down one node at a time, so the more nodes in a cluster, the less impact it has on the cluster's ability to handle traffic.
- If a cluster has only two nodes, and one node is down for patching, then high availability cannot be guaranteed. Oracle recommends having more than two nodes in the cluster.
- If you include a Managed Server on the same node that includes the Administration Server, then both servers must be shutdown together to update Oracle home.
- Two clusters can have servers on the same node sharing an Oracle home, but both clusters need to be shutdown and patched together.
- If your configuration contains two Oracle homes, then Oracle recommends that you create and patch the second Oracle home on a nonproduction machine so that you can test the patches you apply, but this is not required. The Oracle home on that node must be identical to the Oracle home you are using for your production domain.

3.5.8 Cross-Site XA Transaction Recovery

Cross-site XA transaction recovery uses the leasing framework to automate cross-site recovery. The leasing design requirements for cross-site transaction recovery are essentially the same as those defined for database leasing of transactions recovery service as described in Leasing. The leasing table is created automatically when the Managed Servers are started and the site is configured. There is one leasing table per site for all domains in the site.

See Transaction Recovery Spanning Multiple Sites or Data Centers in *Developing JTA Applications for Oracle WebLogic Server*.

Oracle recommends that you always use hostnames (not static IPs) to specify the listen address of Managed Servers and that you configure the hostnames identically on all sites. As hostnames between sites are identical but IPs are not, the hostname

provides the dynamic ability to simply start an identically configured server or domain on the recovery site.

Table 3-1 lists the recommended settings for the JTA MBean properties that can be configured in a continuous availability MAA topology. See also JTAMBean in *MBean Reference for Oracle WebLogic Server*.

Table 3-1 Configurable MBean Properties for Cross-Site XA Transaction Recovery

Configuration Property	Description	Recommended Setting
CrossSiteRecoveryLease Expiration	Specifies the time, in seconds, after which a lease expires making it eligible for recovery by another site.	30 seconds (default)
CrossSiteRecoveryRetryInterval	Specifies the interval at which the recovery site servers check the leasing table to see if the lease has expired and if the owning serves are down.	60 seconds (default)
CrossSiteRecoveryLease Update	Specifies the frequency at which the servers renew their leases	10 seconds (default)

3.6 Coherence

Coherence features such as federated caching, persistence, and GoldenGate Hot Cache can be used together with the Continuous Availability features to provide the highest level of availability.
The following sections provide the design considerations for Coherence in a continuous availability MAA architecture.

- Coherence Federated Caching
- Coherence Persistent Cache
- Coherence GoldenGate Hot Cache

3.6.1 Coherence Federated Caching

For Coherence running federated caching (but not stretch clusters), these are some of the ramifications:

- Coherence data reaches the other site at some point in an ordered fashion (in Coherence, ordering is per Coherence partition), even after network partition or remote cluster outage.
- The remote site may read stale data for a period of time after the local site is being updated.
- Update conflicts are possible, and we identify these and call out to an application-specific conflict resolver.

Coherence federated caching implements an eventual consistency model between sites for the following reasons:

- The data center can be anywhere; the location is not constrained by latency or available bandwidth.
- Tolerance for unavailability of the remote data center or cluster is extremely desirable. Note that it is very hard to tell the difference between communications being down and a remote cluster being down, and it is not necessary to differentiate.
- Full consistency in active-active configurations requires some sort of distributed center concurrency control, as well as synchronous writes. This can have a significant impact on performance and is not desirable. Instead, where consistency matters, you can use stretch clusters with synchronous replications. In this case, it is reasonable to assert a maximum latency between data centers, with guaranteed bandwidth.

3.6.2 Coherence Persistent Cache

Cached data is persisted so that it can be quickly recovered after a catastrophic failure or after a cluster restart due to planned maintenance. In multi-data center environments, Oracle recommends using Coherence persistence and federated caching together to ensure the highest level of protection during failure or planned maintenance events.

Persistence is only available for distributed caches and requires the use of a centralized partition assignment strategy. There are two persistence modes:

- Active persistence - cache contents are automatically persisted on all mutations and are automatically recovered on cluster/service startup.
- On-demand persistence - a cache service is manually persisted and recovered upon request using the persistence coordinator.

See Persisting Caches in *Administering Oracle Coherence*.

3.6.3 Coherence GoldenGate Hot Cache

Within a single Coherence cluster with a mix of data, where some of the data is owned by the database and some of it is owned by Coherence, you can use both Coherence Read-Through cache and Coherence GoldenGate Hot Cache.

The choice between HotCache and Read-Through cache comes down to (1) whether Read-Through may lead to stale reads if the database is updated behind Coherence's back and (2) whether the real-time nature of HotCache is preferred for other reasons. There can also be situations where both HotCache and Read-Through are used together, for example to push real-time updates via HotCache, but then to handle the case where data was removed due to eviction or expiration.

3.7 Database

Oracle Database provides several products such as Oracle Data Guard, Oracle Real Application Clusters (Oracle RAC) and others that can be integrated to provide high availability of the database in MAA architectures. See Disaster Recovery for Oracle Database. Regardless of the topology, the goal is to minimize the time that it will take for switchover and failover of your databases.

To achieve high availability of your database for both planned and unplanned outages, Oracle recommends using an active-passive configuration with a combination of the following products:

- Oracle RAC as the highly available database.
- Oracle Data Guard because it eliminates single points of failure for mission critical Oracle Databases. It prevents data loss and downtime by maintaining a synchronized physical replica of a production database at a remote location. If the production database is unavailable for any reason, client connections can quickly, and in some configurations transparently, failover to the synchronized replica to restore service. Applications can take advantage of Oracle Data Guard with little or no application changes required.

  In a WebLogic Server continuous availability MAA architecture, Oracle recommends using the Oracle Data Guard maximum availability protection mode. This protection mode provides the highest level of data protection that is possible without compromising the availability of a primary database. It ensures zero data loss except in the case of certain double faults, such as failure of a primary database after failure of the standby database. See Oracle Data Guard Protection Modes in *Data Guard Concepts and Administration*.

  > **Note:**
  >
  > Oracle Data Guard can only be used in active-passive configurations, but guarantees zero-data loss.

- Oracle Active Data Guard, an option built on the infrastructure of Oracle Data Guard, allows a physical standby database to be opened read-only while changes are applied to it from the primary database. This enables read-only applications to use the physical standby with minimal latency between the data on the standby database and that on the primary database, even while processing very high transaction volumes at the primary database. This is sometimes referred to as real-time query.

  An Oracle Active Data Guard standby database is used for automatic repair of data corruption detected by the primary database, transparent to the application. In the event of an unplanned outage on the primary database, high availability is maintained by quickly failing over to the standby database. An Active Data Guard standby database can also be used to off-load fast incremental backups from the primary database because it is a block-for-block physical replica of the primary database.

  Oracle Active Data Guard provides a far sync feature that improves performance in zero data loss configurations. An Oracle Data Guard far sync instance is a remote Oracle Data Guard destination that accepts redo from the primary database and then ships that redo to other members of the Oracle Data Guard configuration. Unlike a standby database, a far sync instance does not have data files, cannot be opened, and cannot apply received redo. These limitations yield the benefit of using fewer disk and processing resources. More importantly, a far sync instance provides the ability to failover to a terminal database with no data loss if it receives redo data using synchronous transport mode and the configuration protection mode is set to maximum availability. See Far Sync in *Oracle Data Guard Concepts and Administration*.

- Oracle Data Guard broker as a distributed management framework that automates and centralizes the creation, maintenance, and monitoring of Data Guard configurations. Some of the operations Data Guard Broker can perform is the creation, management, monitoring of the Data Guard configurations, invoking switchover or failover to initiate and control complex role changes across all databases in the configuration, and configuring failover to occur automatically.

  You can enable Oracle Data Guard fast-start failover to fail over automatically when the primary database becomes unavailable. When fast-start failover is enabled, the Oracle Data Guard broker determines if a failover is necessary and initiates the failover to the specified target standby database automatically, with no need for database administrator intervention. See Managing Fast-Start Failover in *Oracle Data Guard Broker*.

  Deploying Data Guard broker with Oracle Data Guard is essential before Oracle Site Guard can be used for disaster recovery.
- Active GridLink makes the scheduled maintenance process at the database servers transparent to applications. When an instance is brought down for maintenance at the database server, draining ensures that all work using instances at that node completes and that idle sessions are removed. Sessions are drained without impacting in-flight work.
- Application continuity protects you during planned and unplanned outages. Use Application Continuity and Active GridLink for maximum availability during unplanned down events.
- Global Data Services (GDS) or Data Guard broker with Fast Application Notifications (FAN) to drain across sites. When you use Active Data Guard, work can complete before switching over to secondary database.

If your configuration requires that you have an active-active database configuration, Oracle recommends:

- Oracle GoldenGate, which allows for databases to be in active-active mode. Both read and write services are active-active on the databases on both sites. See Configuring Oracle GoldenGate for Active-Active High Availability in *Administering Oracle GoldenGate*.

  When using Oracle Golden Gate, Application Continuity and Active GridLink can be used within a site (intra-site) to handle planned and unplanned down database events. Application Continuity *cannot* be used to replay transactions during failover or switchover operations across sites (inter-site). Application Continuity does not support failover to a logically different database –including Oracle Logical Standby and Oracle Golden Gate. Replay has a strict requirement that it applies to databases with verified no transaction loss.

> **Note:**
>
> Because of the asynchronous replication nature of Oracle GoldenGate, applications must tolerate data loss due to network lag.

- Implementing conflict resolution with full active/active for all applications/schema that are using Oracle GoldenGate.
- Designing an environment that requires web affinity to avoid seeing stale data (stick at a site in conversation). Global Data Services (GDS) can provide affinity to the database that is local to the site and manage global services.

When environments require an active-active database, a combination of these technologies can be used to maximize availability and minimize data loss in planned maintenance events.

3.8 Oracle Enterprise Manager and Oracle Site Guard

Oracle Site Guard, a part of Oracle Enterprise Manager, provides flexible and seamless orchestration of switchovers and failovers between disaster recovery sites, thereby minimizing downtime for enterprise deployments. The disaster recovery automation features in Oracle Site Guard eliminate the need for human intervention and prevent human-induced errors in the switchover or failover process.
For information about how to configure Oracle Site Guard for switchovers and failovers between sites, see Configuring Oracle Site Guard in *Site Guard Administrator's Guide*.

For Site Guard best practices, see the *Automating Disaster Recovery using Oracle Site Guard for Oracle Exalogic* white paper at `http://www.oracle.com/technetwork/database/availability/maa-site-guard-exalogic-exadata-1978799.pdf`.

4

Design Considerations for Active-Active Application Tier Topology

In an active-active application tier topology, two or more active server instances at distributed geographic locations are deployed to handle requests concurrently and thereby improve scalability and provide high availability. When designing an active-active solution, consider Oracle's best practices.
In addition to the general best practices recommended for all continuous availability MAA architectures as described in Common Design Considerations for Continuous Availability, the following sections describe the design considerations and failure scenarios that apply to the MAA architecture shown in Active-Active Application Tier with an Active-Passive Database Tier.

- Active-Active Application Tier With Active-Passive Database Tier Design Considerations
- Active-Active Application Tier With Active-Passive Database Tier Failure Scenarios

4.1 Active-Active Application Tier With Active-Passive Database Tier Design Considerations

Consider Oracle's best practice design recommendations for continuous availability in an active-active application tier topology with an active-passive database tier.
To take full advantage of continuous availability features in an active-active topology, consider the following:

- Active-active domains must be configured with symmetric topology; they must be similar and use the same domain configurations such as domain and server names, port numbers, user accounts, load balancers and virtual server names, and the same version of the software. Host names (not static IPs) must be used to specify the listen address of the Managed Servers. In this topology if you configure cross-site transaction recovery the configurable MBean properties, `SiteName`, `RecoverySiteName`, are site specific. You can use any existing replication technology or methods that you currently use to keep these sites in sync.

> **Note:**
>
> When you are taking advantage of Cross-Site XA Transaction recovery, there are some configuration parameters (see Table 3-1), as well as the Site Name and Recovery Site name that are specific to a site. You should not overwrite these parameters and names when replicating the configuration.

- In this topology network latency is normally large (WAN network). If applications require session replication between sites you must choose either database session replication or Coherence*Web. See Session Replication.

- Server and service migration only applies intra-site (within a site) in an active-active topology. See Server and Service Migration.
- JMS is supported only intra-site in this topology. JMS recovery during failover or planned maintenance is not supported across sites.
- Zero Downtime Patching is only supported intra-site (within a site) in an active-active topology. You can upgrade your WebLogic homes, Java, and applications in each site independently. Keep upgrade versions in sync to keep the domains symmetric at both sites.
- You can design applications to minimize data loss during failures by combining different Continuous Availability features. For example, you can use a combination of cross-site XA transaction recovery, Coherence federated cache, Coherence HotCache or Coherence Read-Through cache.

  If the Coherence data is backed up in the database and there is a network partition failure, federated caching is unable to perform the replication and data becomes inconsistent on both sites since the Coherence clusters can independently continue doing work. Once the communication between the sites resumes, backed up data is pushed from the database to Coherence via Coherence HotCache or Coherence Read-Through cache, and eventually data in the Coherence cache is synchronized. See Coherence.
- In an active-active topology, Oracle Site Guard can only switchover or failover the database. See Active-Active Application Tier With Active-Passive Database Tier Failure Scenarios.
- Figure 4-1 and Figure 4-2 represent results found during benchmark testing using the cross-site transaction recovery default parameter settings. These figures illustrate the latency incurred in recovering transactions across sites when the mid-tier failed. Figure 4-1 shows that when the latency between sites is 1s, the average recovery time was between 170 and 180 ms. Figure 4-2 shows that when the latency between the sites is 77ms, the average transaction recovery time was between 90 and 100ms.

  As latency increases, the cross-site transaction recovery parameters `CrossSiteRecoveryLeaseExpiration`, `CrossSiteRecoveryRetryInterval`, and `CrossSiteRecoveryLeaseUpdate` will need to increase to adjust to latency. If the database where the cross-site transaction recovery leasing table is kept is remote to one of the sites, tuning these values is especially important. See Cross-Site XA Transaction Recovery.

Figure 4-1 Cross-Site Transaction Recovery with 1 Second Latency Between Sites

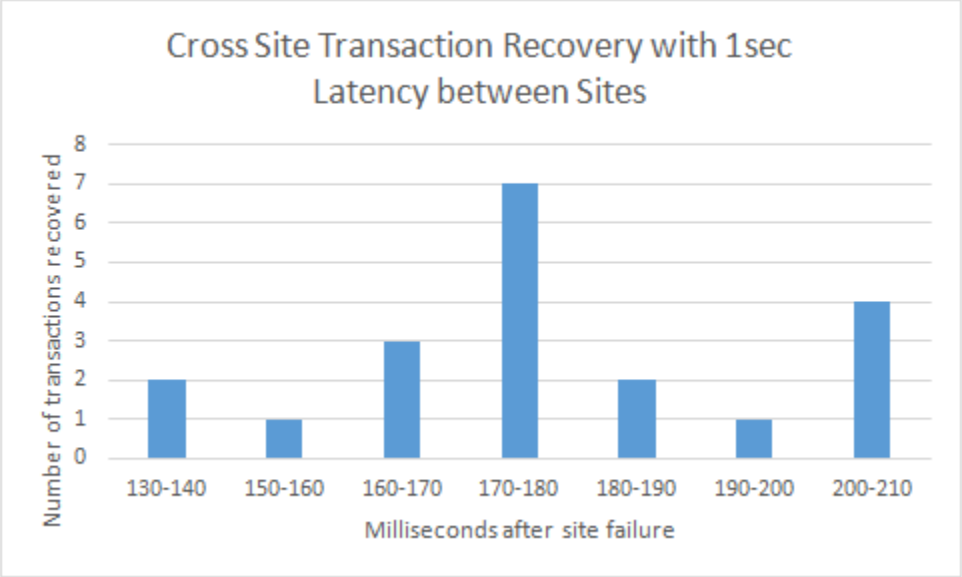
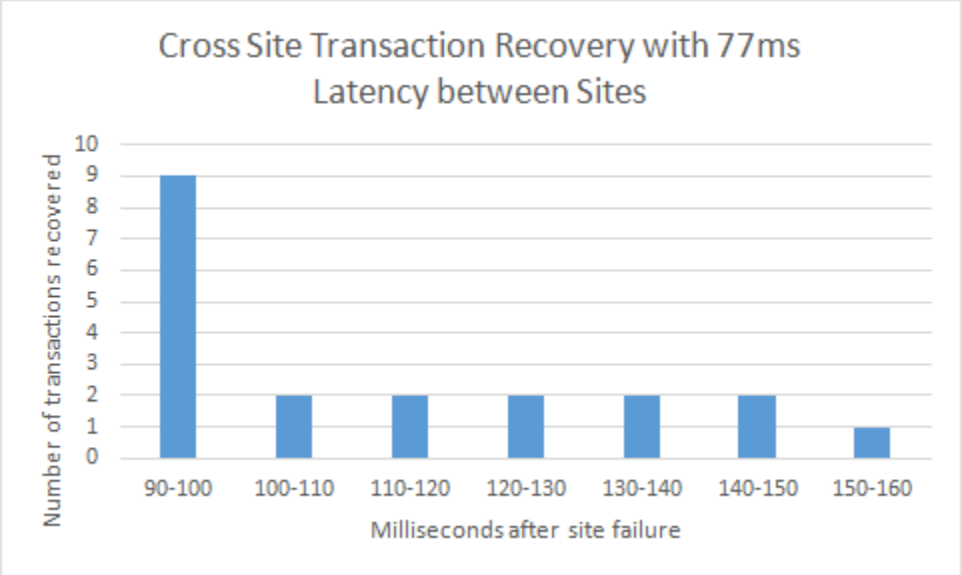


Figure 4-2 Cross-Site Transaction Recovery with 77ms Latency Between Sites



4.2 Active-Active Application Tier With Active-Passive Database Tier Failure Scenarios

Learn how the Continuous Availability features are used in each of the different potential failure scenarios for an active-active application tier topology.
Table 4-1 describes the different failure scenarios and how each Continuous Availability feature applies. For an explanation of the different failure scenarios, see Potential Failure Scenarios.

Table 4-1 Active-Active Application Tier and Active/Passive Database Tier Failure Scenarios

Continuous Availability Features	Complete Site Failure	Partial Site/Mid-Tier Failure (WebLogic Server/Coherence/OTD)	Maintenance Outage	Network Partition Failure
Transaction Recovery Across Sites	• Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover/ switchover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles from primary to secondary. • JDBC TLog is replicated to the database on Site 2 by database replication technology such as Oracle Data Guard or Oracle Active Data Guard. • Transactions are recovered on Site 2 using cross-site transaction recovery.	If the primary site leasing table has expired, then the servers on Site 2 automatically take ownership of the TLog tables and start transaction recovery.	• End-user invokes switchover operation in Oracle Site Guard to initiate the orchestration of the switchover operation. • Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover/ switchover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles from primary to secondary. • JDBC TLog is replicated to the database on Site 2. • Transactions are recovered on Site 2 using cross-site transaction recovery.	• Site 1 continues processing its transactions. • If the transaction fails before writing transactions to the store, then servers on Site 2 remain alive. If the transaction fails because the transaction log store could not be reached, the server shuts itself down (default behavior). • Server trying to connect to leasing table writes warning of inability to recover for recovery site.
Oracle Traffic Director	Oracle Traffic Director on Site 2 continues to route traffic to the servers running on its site.	Oracle Traffic Director on Site 2 continues to route traffic to server running on its site.	• Oracle Traffic Director on Site 2 continues to route traffic to the servers running on its site.	Oracle Traffic Director on Site 1 and Oracle Traffic Director on Site 2 continue to route traffic to the server running on its site.

Table 4-1 (Cont.) Active-Active Application Tier and Active/Passive Database Tier Failure Scenarios

Continuous Availability Features	Complete Site Failure	Partial Site/Mid-Tier Failure (WebLogic Server/Coherence/OTD)	Maintenance Outage	Network Partition Failure
Oracle Site Guard	Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover/ switchover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles in the database from primary to secondary.	No-op.	• End-user invokes switchover operation in Oracle Site Guard to initiate the orchestration of the switchover operation. • Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover/ switchover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles in the database from primary to secondary	No-op.
Coherence Federated Caching	Coherence cluster on Site 2 becomes active.	Because replication is asynchronous, the cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the other site comes back up.	Because replication is asynchronous, the cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the other site comes back up.	Because replication is asynchronous, the cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the network connectivity is re-established between the two sites.

5

Design Considerations for Active-Passive Application Tier Topology

In an active-passive application tier topology, an active site is paired with a passive site that is on standby at a geographically different location. When designing an active-passive solution, consider Oracle's best practices.
In addition to the general best practices recommended for all continuous availability MAA architectures as described in Common Design Considerations for Continuous Availability, the following sections describe the design considerations and failure scenarios that apply to the MAA architecture shown in Active-Passive Application Tier with an Active-Passive Database Tier.

- Active-Passive Application Tier With Active-Passive Database Tier Design Considerations
- Active-Passive Application Tier With Active-Passive Database Tier Failure Scenarios

5.1 Active-Passive Application Tier With Active-Passive Database Tier Design Considerations

Consider Oracle's best practice design recommendations for continuous availability in an active-passive application tier topology with an active-passive database tier.
To take full advantage of continuous availability features in an active-passive topology, consider the following:

- All active-passive domain pairs must be configured with symmetric topology; they must be identical and use the same domain configurations such as directory names and paths, port numbers, user accounts, load balancers and virtual server names, and software versions. Host names (not static IPs) must be used to specify the listen address of the Managed Servers. When hostnames between sites are identical (IPs are not), the hostname provides the dynamic ability to start an identically configured server or domain on the recovery site.
- There are no latency considerations in this topology. The only requirement is that stores such as JMS and JTA TLogs are kept in the database.
- In passive mode, WebLogic Server servers are configured but not running. When there is a failure, the WebLogic Server servers in the passive site are brought up and JTA and JMS transactions/messages are recovered. Work then takes place in the second site.
- JMS is supported in this topology. The passive site should contain an exact copy of the domain on the primary site to ensure that the configuration of the JMS servers, stores, and destinations are the same.

  In the case of a failover or switchover, if the store and/or JMS server is targeted at the cluster, you must start the same number of servers in the cluster. This process is required because each JMS server + store + destination is specific to the server on which it was running. If you have MyServer1 and MyServer2 in the primary

domain, there is a JMS Server + store on each of those servers. It is possible that the queues on those servers contain messages. If you restart only one server, you only recover the messages for that one server.

The standby domain cannot be running during the replication phase, and started only after the initial data center is confirmed as down. This process is necessary to prevent data corruption and to force recovery. If two JMS server/stores are writing/updating the same exact data, unexpected results occur. Also, message recovery only happens on JMS server startup. Then, the JMS server reads the full store contents and recreates destination state.

Asynchronous replication can result in lost messages (message was written in the primary datacenter but not copied) or duplicate messages (message was consumed/deleted in the primary data center, but remains in the replicated data center).

See Recommendations for Oracle WebLogic Server Java Message Service (JMS) and Transaction Logs (TLogs) in *Disaster Recovery Guide*.

- Zero Downtime Patching upgrades your WebLogic homes, Java, and applications in a rolling fashion in the active site. During a planned maintenance and switchover to the passive site and after servers have been started, use Zero Downtime Patching to upgrade WebLogic, Java, or applications. To keep the domains symmetric at both sites, keep upgrade versions on both sites in sync.
- In the active-passive topology, Coherence is in Standby mode, not passive mode like WebLogic Server. The standby site has a backup of the cache data from the active site. With Coherence Federated Cache in active-passive mode, this replication happens asynchronously but it happens constantly.
- In this topology Oracle recommends using Oracle Site Guard to orchestrate the failover/switchover of all site components: Oracle Traffic Director, WebTier, WebLogic Server, Coherence, and the database.

5.2 Active-Passive Application Tier With Active-Passive Database Tier Failure Scenarios

Learn how the Continuous Availability features are used in each of the different failure scenarios for an active-passive application tier topology.
Table 5-1 describes the different failure scenarios and how each Continuous Availability feature applies. For an explanation of the different failure scenarios, see Potential Failure Scenarios.

Table 5-1 Active-Passive Application Tier and Active/Passive Database Tier Failure Scenarios

Continuous Availability Features	Complete Site Failure	Partial Site/Mid-Tier Failure (WebLogic Server/Coherence/OTD)	Maintenance Outage	Network Partition Failure
Transaction Recovery Across Sites	• Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover/ switchover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles from primary to secondary. • JDBC TLog is replicated to database on Site 2 using database replication technology such as Oracle Data Guard or Oracle Active Data Guard. • Transactions are recovered when the servers are restarted.	• Oracle Site Guard integrates with Oracle Data Guard to orchestrate database and application infrastructure switchover. • Transactions are recovered when the servers start.	• Oracle Site Guard, in conjunction with Oracle Data Guard, orchestrates database and application infrastructure switchover. • JDBC TLog is replicated to database on Site 2 using database replication technology such as Oracle Data Guard or Oracle Active Data Guard. • Transactions are recovered when the servers are started.	No-op.
Oracle Traffic Director	Oracle Traffic Director instance on the standby site is activated (by Oracle Site Guard using a failover script that specifies what should occur and in what order. The script can be run before or after failover).	• Oracle Traffic Director instance on the standby site is activated (by Oracle Site Guard using a failover script that specifies what should occur and in what order. The script can be run before or after failover). • Oracle Traffic Director starts routing traffic to servers on Site 2.	Oracle Traffic Director instance on the standby site is activated (by Oracle Site Guard using a failover script that specifies what should occur and in what order. The script can be run before or after failover).	No-op.

Table 5-1 (Cont.) Active-Passive Application Tier and Active/Passive Database Tier Failure Scenarios

Continuous Availability Features	Complete Site Failure	Partial Site/Mid-Tier Failure (WebLogic Server/Coherence/OTD)	Maintenance Outage	Network Partition Failure
Oracle Site Guard	Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover/ switchover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles from primary to secondary.	Oracle Site Guard fails over only the mid-tier.	• Customer initiates shut down of Site 1 using Oracle Site Guard. • Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles in the database from primary to secondary.	No-op.
Coherence Federated Caching	Coherence cluster on Site 2 becomes active. The cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache.	Coherence cluster on Site 2 becomes active. The cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the remote site comes back up.	Coherence cluster on Site 2 becomes active. The cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the remote site is brought back up.	Cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the network connectivity is re-established between the two sites.

6

Design Considerations for Active-Active Stretch Cluster Topology

In an active-active stretch cluster topology, cluster nodes can span data centers within a proximate geographical range, and usually with guaranteed, relatively low latency networking between the sites.
In addition to the general best practices recommended for all continuous availability MAA architectures as described in Common Design Considerations for Continuous Availability, the following sections describe the design considerations and failure scenarios that apply to the MAA architecture shown in Active-Active Stretch Cluster with an Active-Passive Database Tier.

- Active-Active Stretch Cluster with an Active-Passive Database Tier Design Considerations
- Active-Active Stretch Cluster with an Active-Passive Database Tier Failure Scenarios

6.1 Active-Active Stretch Cluster with an Active-Passive Database Tier Design Considerations

Consider Oracle's best practice design recommendations for continuous availability in an active-active stretch cluster topology with an active-passive database tier.
To take full advantage of continuous availability features in an active-active stretch cluster, consider the following:

- In a multi-data center, active-active stretch cluster environment session replication across data centers can cause serious performance degradation in the system. Oracle recommends defining two different replication groups (one for each site) to minimize the possibility of replication occurring across the two sites.

> **Note:**
>
> Using replication groups is a best effort to replicate state only to servers in the same site, but is not a deterministic method. If one single server is available in one site, and other servers are available in the other site, replication occurs across the MAN and continues for that session even if servers come back online in the same site.

- An active-active stretch cluster only works in the metro latency model. Latency can be no longer than 10 ms.
- For contention and security reasons, Oracle does not recommend using shared storage across sites.
- Both sites are managed with a single Administration Server that resides in one of the two sites. Each site uses individual shared storage for JMS and Transaction

Logs (TLogs), or alternatively the database is used as persistent store. Disk mirroring and replication from Site1 to Site2, and in reverse, can be used to provide a recoverable copy of these artifacts in each site. A unique Oracle WebLogic Server Administration Console is used to configure and monitor servers running on both sites. The WebLogic Server infrastructure is responsible for copying configuration changes to all the different domain directories used in the domain.

- If an Administration Server fails, the same considerations that apply to an Administration Server failure in a single data center topology apply to a multi-data Center active-active stretch cluster topology. Address node failures using the standard failover procedures described in Failing Over or Failing Back Administration Server in *High Availability Guide* (that is restarting the Administration Server in another node that resides in the same data center pointing to the shared storage that hosted the Administration Server domain directory). Also, deploy the appropriate backup and restore procedures to make regular copies of the Administration Server domain directory. If there is a failure that affects the site hosting the Administration Server (involving all nodes), you need to restart the server in a different site. To do so, use the existing storage replication technology to copy the Administration Server domain directory available in the failover site. Restore the server/ directory (including both the domain and applications directory) in the failover site so that the exact same domain directory structure is created for the Administration Server domain directory as in the original site. Restart Node Manager in the node where the Administration Server is restored.

  Likely, the Administration Server is failed over to a different subnet requiring the use of a different virtual IP (VIP) that is reachable by other nodes. Make the appropriate changes in the hostname resolution system in this subnet so that this VIP maps to the original Virtual Hostname that the Administration Server used as the listen address in Site1. For example, in Site1, `ADMINHOSTVHN1` maps to `10.10.10.1`, while in Site2 either local `/etc/hosts` or DNS server has to be updated so that `ADMINHOSTVHN1` maps to `20.20.20.1`. All servers use `ADMINHOSTVHN1` as the address to reach the Administration Server. If the Administration Server is front ended with an Oracle HTTP Server and LBR, clients are agnostic to this change. If clients directly access the Administration Server listen hostname, they must be updated in their DNS resolution also.

  Also, if host name verification is enabled for the Administration Server, update the appropriate trust stores and key stores with new certificates. Use the instructions in the Oracle Fusion Middleware Enterprise Deployment Guide for Oracle SOA Suite.

  Verify that the Administration Server is working properly by accessing both the Oracle WebLogic Server Administration Console and Oracle Enterprise Manager Fusion Middleware Control.

- Servers that are remote to the Administration Server take longer to restart than the servers that are collocated. The reason is that all the communications with the Administration Server (for retrieving the domain configuration upon start) and initial connection pool creation and database access is affected by the latency across sites. See Administration Server High Availability Topology in *High Availability Guide*.

- Automated server migration across sites is not recommended unless a database is used for JMS and TLog persistence, otherwise a constant replica of the appropriate persistent stores must be set up between the sites.

- It is unlikely (depending on the infrastructure at the customer site) that the Virtual IPs used in one site are valid for migration to the other. It usually requires extra intervention to enable a listen address initially available in Site1 in Site2 and vice versa. This intervention can be automated in pre-migration scripts, but in general the RTO increases compared to a standard automated server migration (taking place in the scope of single data center).
- Transactions and JMS recovery across sites takes place using service or server migration inside a WebLogic Server stretch cluster. See Server and Service Migration. For server or service migration of JMS or JTA, Oracle recommends using database leasing on a highly available database. When configured with consensus non-database leasing, servers in the stretch cluster could fail to reboot and require the entire domain to be restarted when the environment experiences network partition failure.
- Zero Downtime Patching in an active-active stretch cluster topology orchestrates the updates to all servers in the stretch cluster across both sites. See Zero Downtime Patching.
- In an active-active stretch cluster topology, only stretch the WebLogic Server cluster across the two sites. Coherence should have a Coherence cluster on each site using federated caching to replicate data across the two active sites. When a Coherence cluster is stretched across sites, it is susceptible to split brain.
- Oracle Site Guard works for active-passive topology or components only. In an active-active stretch cluster topology, Oracle Site Guard can only failover/ switchover the database.
- Table 6-1 lists the recommended settings to configure database leasing in a stretch cluster topology. See the following MBean descriptions in *MBean Reference for Oracle WebLogic Server*:
  - ClusterMBean
  - JDBCConnectionPoolParamsBean

Table 6-1 Recommended Settings for DataBase Leasing in a Stretch Cluster

Configuration Property	MBean/ Command	Description	Recommended Setting
DatabaseLeasingBasisConnectionRetryCount	ClusterMBean	The maximum number of times Database Leasing tries to obtain a valid connection from the Data Source.	5 (Default value is 1)
DatabaseLeasingBasisConnectionRetryDelay	ClusterMBean	The length of time, in milliseconds, Database Leasing waits before attempting to obtain a new connection from the Data Source when a connection has failed.	2000 (Default value is 1000)

Table 6-1 (Cont.) Recommended Settings for DataBase Leasing in a Stretch Cluster

Configuration Property	MBean/ Command	Description	Recommended Setting
TestConnectionOnReserve	JDBCConnectionPoolParamsBean	Enables WebLogic Server to test a connection before giving it to a client.	Enabled. For leasing the Data Source. The servers remain in a running state during switchover.
-Dweblogic.cluster.jta.SingletonMasterRetryCount	Server start up command	Specifies the retry count for the singleton master to get elected and open its listen ports. The singleton master might not be immediately available on the first try to deactivate JTA.	4 (The default value is 20) Because DatabaseLeasingBasisConnectionRetryCount is set to 5, this property can be decreased to 4. This setting can reduce the time cost during database server booting.

- Figure 6-1 and Figure 6-2 represent results found during benchmark testing that show the degradation observed in the overall system throughput (both sites working together) for different latencies. Figure 6-1 shows that for a latency of around 20-milliseconds round-trip time (RTT), the throughput decreases by almost 25%. Figure 6-2 shows the increase in time taken to deploy an application (as compared to a deployment with all servers and database in the same site).

  Considering the data provided and the performance penalties observed in many tests, Oracle recommends not to exceed 10 ms of latency (RTT) for active-active stretch cluster topologies when the latency affects communication between the two sites.

Figure 6-1 Throughput Degradation With Latency in a Stretch Cluster

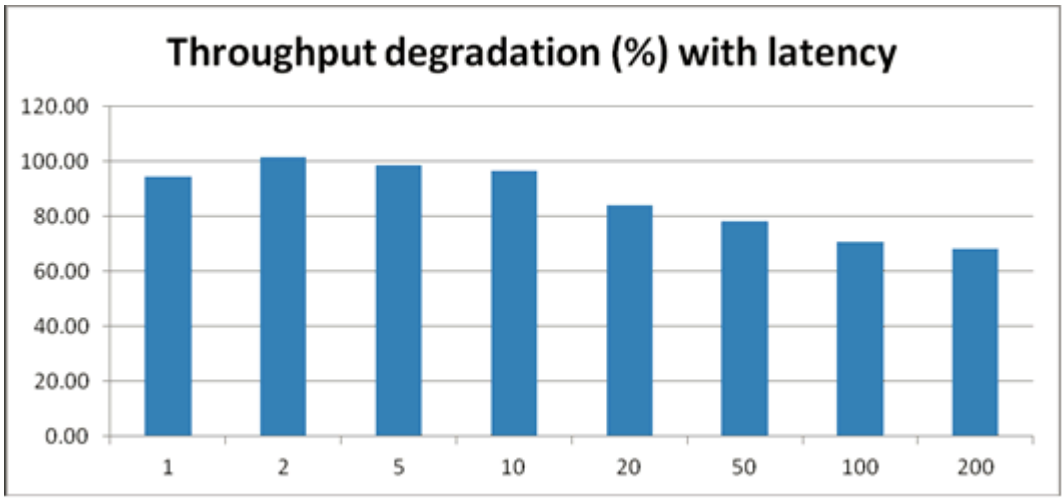
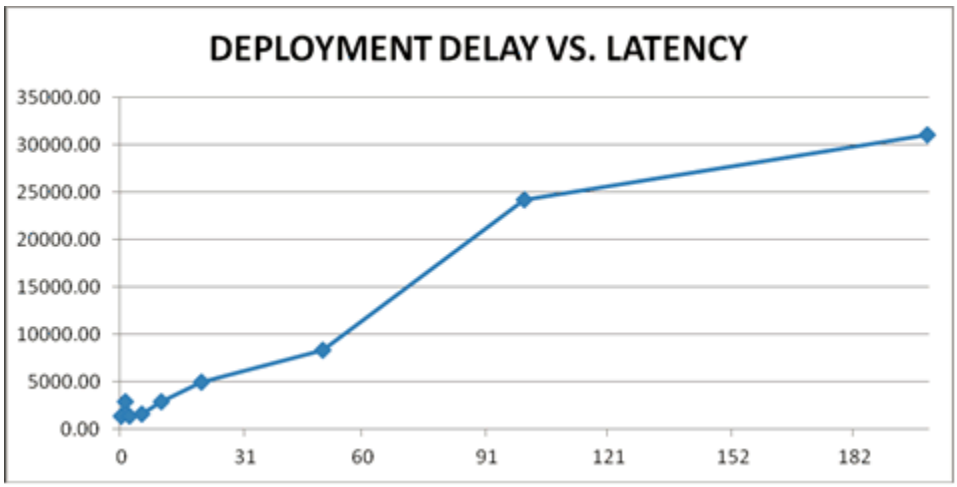


Figure 6-2 Deployment Delay Vs. Latency in a Stretch Cluster



6.2 Active-Active Stretch Cluster with an Active-Passive Database Tier Failure Scenarios

Learn how the Continuous Availability features are used in each of the different failure scenarios for an active-active stretch cluster topology.

Table 6-2describes the different failure scenarios and how each Continuous Availability feature applies. For an explanation of the different failure scenarios, see Potential Failure Scenarios.

Table 6-2 Active-Active Stretch Cluster and Active/Passive Database Tier Failure Scenarios

Continuous Availability Features	Complete Site Failure	Partial Site/Mid-Tier Failure (WebLogic Server/Coherence/OTD)	Maintenance Outage	Network Partition Failure
Transaction Recovery Across Sites	• Oracle Site Guard integrates with Oracle Data Guard broker to perform database failover/ switchover. Site Guard calls Oracle Data Guard broker to perform the failover and Site Guard switches the roles from primary to secondary. • JDBC TLog is replicated to database on Site 2. • Migrates servers and services using WebLogic Server server and service migration features.	Either service migration occurs so that transactions can be recovered on an available server in the stretch cluster, or server migration occurs and transactions are recovered on the migrated server.	• Application infrastructure in Site 1 is shutdown gracefully so that the servers can complete work before shutting down. • Oracle Site Guard integrates with Oracle Data Guard to orchestrate database and application infrastructure switchover. • JDBC TLog is replicated to database on Site 2. • Either service migration occurs so that transactions can be recovered on an available server in the stretch cluster, or server migration occurs and transactions are recovered on the migrated server.	• The site that is collocated with the database continues processing transactions. The site that is remote to the database gets connection exceptions and transactions fail. • Site 2 cannot communicate to the database so transactions fail. • If there is intra server transaction participation, transactions will fail and rollback or retry commit depending on the transaction state. When communication resumes, transactions eventually commit/rollback.
Oracle Traffic Director	Oracle Traffic Director on Site 2 continues to route traffic to the servers on its site.	Oracle Traffic Director on Site 2 continues to route traffic to the servers on its site.	• Oracle Traffic Director on Site 1 is stopped. • Oracle Traffic Director on Site 2 continues to route traffic to the servers on its site.	Oracle Traffic Director on both Sites 1 and 2 continue to route traffic to the servers on their respective sites.

Table 6-2 (Cont.) Active-Active Stretch Cluster and Active/Passive Database Tier Failure Scenarios

Continuous Availability Features	Complete Site Failure	Partial Site/Mid-Tier Failure (WebLogic Server/Coherence/OTD)	Maintenance Outage	Network Partition Failure
Oracle Site Guard	Oracle Site Guard orchestrates database failover	No-op.	Oracle Site Guard orchestrates database switchover.	No-op.
Zero Downtime Patching	The behavior is dependent on the ZDT rollback setting. If rollback is enabled, then the workflow is rolled back. If rollback is not enabled, then ZDT rollout stops and waits for manual intervention from the end user.	The behavior is dependent on the ZDT rollback setting. If rollback is enabled, then the workflow is rolled back. If rollout is not enabled, then ZDT rollout stops and waits for manual intervention from the end user.	The behavior is dependent on the ZDT rollback setting. If rollback is enabled, then the workflow is rolled back. If rollback is not enabled, then ZDT rollout stops and waits for manual intervention from the end user.	The behavior is dependent on the ZDT rollback setting. If rollback is enabled, then the workflow is rolled back. If rollback is not enabled, then ZDT rollout stops and waits for manual intervention from the end user.
Coherence Federated Caching	Because replication is asynchronous, the cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the other site comes back up.	Because replication is asynchronous, the cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the other site comes back up.	Because replication is asynchronous, the cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the other site comes back up.	Cache data eventually becomes consistent either through Coherence Hot Cache or Read-Through cache, or when the network connectivity is re-established between the two sites.