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OPTIMIZED SOLUTIONS

Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster

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Introduction

Modern business application deployments such as enterprise resource planning (ERP) can be complex, time-consuming, and expensive to deploy, with many interoperating and customized components. For mission-critical operation all applications, databases, operating systems, servers, networking, storage systems, and backup software must be configured correctly. Identifying bottlenecks, tuning the database, optimizing server and storage performance, and ensuring the availability of key systems, are all essential to ensure that service-level agreements are met. Complicating matters, sourcing infrastructure components from a wide variety of vendors—with their separate support contracts and organizations—can add risk, complexity, and cost to an already challenging process.

Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster addresses these concerns by providing an innovative way to accelerate deployment and reduce operational costs throughout the Oracle E-Business Suite lifecycle. Multiple layers of Oracle E-Business Suite infrastructure can be consolidated onto a high-performance, highly available Oracle SuperCluster system to reduce total cost of ownership (TCO) and improve Oracle E-Business Suite deployment speed, application performance, and availability. Integrated in a preconfigured, pretested, and ready-to-deploy the Oracle SuperCluster engineered system, the solution provides a complete and optimized infrastructure for Oracle E-Business Suite, built around robust compute, networking, storage, virtualization, and management resources. Using Oracle SuperCluster, Oracle E-Business Suite administrators are left free to concentrate on the application itself while relying on a carefully predefined and pretested hardware and software infrastructure.

This technical white paper describes the deployment of Oracle E-Business Suite on Oracle SuperCluster. It includes an example mapping for consolidating production, quality assurance service (QAS), backup, and disaster recovery (DR) systems within the flexible Oracle SuperCluster framework along with development and test systems. Relevant embedded technologies are also described along with other Oracle Optimized Solutions that can contribute to Oracle E-Business Suite deployments.

Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster

Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster simplifies and accelerates deployment by enabling the consolidation of Oracle E-Business Suite onto a single, highly available and scalable Oracle SuperCluster platform. A complete, factory-assembled enterprise infrastructure, Oracle SuperCluster dramatically reduces infrastructure complexity while lowering the time needed to get from concept to service deployment. Oracle's proven, tested, application-to-disk infrastructure runs in the prebuilt and pretested Oracle SuperCluster, eliminating the need for complex, multitier, multivendor hardware configurations. Because the entire environment is engineered and optimized to work together, IT organizations can get services based on Oracle E-Business Suite up and running faster. Predictable, high-performance applications take advantage of a highly scalable, available, and serviceable platform to eliminate the potential pitfalls and time-consuming troubleshooting. Oracle SuperCluster provides both time savings as well as reduced complexity.

Oracle SuperCluster—Everything Needed for Oracle E-Business Suite Deployment

Oracle SuperCluster is a complete, pre-engineered, and pretested high-performance enterprise infrastructure solution that is faster and easier to deploy than a collection of individual servers and other components. The system combines innovative Oracle technology—the computing power of Oracle's SPARC servers, the performance and scalability of Oracle Solaris, the optimized database performance of Oracle Database 11*g* accelerated by Oracle Exadata Storage Servers, and a high-bandwidth, low-latency InfiniBand network fabric—into a scalable, engineered system that is optimized and tuned for consolidating enterprise applications (Figure 1).

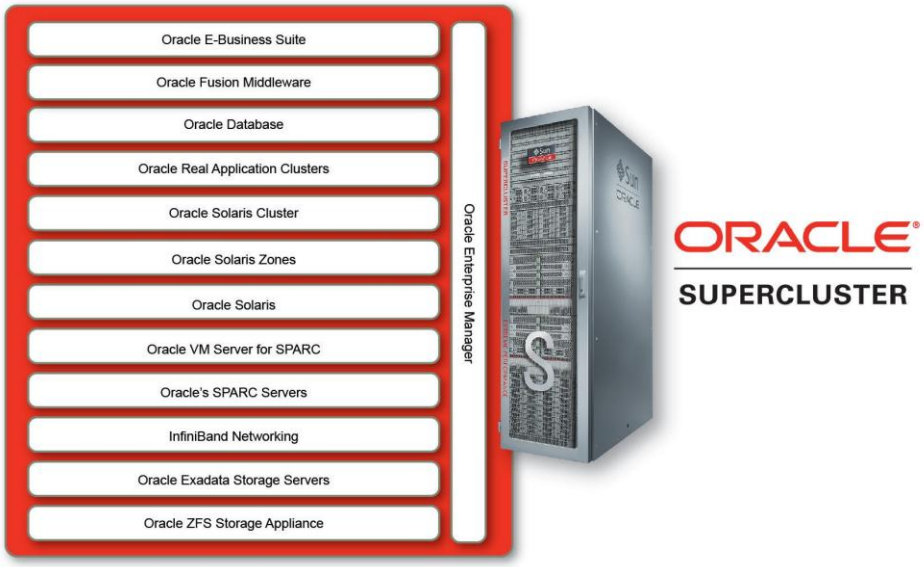

Figure 1. Oracle SuperCluster provides a complete infrastructure for Oracle E-Business Suite in a single enclosure.

All components within the Oracle SuperCluster system, including Oracle's SPARC servers, Oracle ZFS Storage Appliances, and Oracle Exadata Storage Servers, are interconnected over a fully redundant InfiniBand fabric. Built-in no-cost virtualization enables consolidation and helps ensure that applications are isolated from one another and remain highly available, virtually eliminating resource contention and service disruption. With Oracle SuperCluster, the service instances, application servers, and Oracle Database software are all consolidated on the

system, eliminating much of the integration effort and deployment time typically associated with clustered solutions and providing other benefits, including:

- Simplified deployment resulting from the consolidation of one or more Oracle E-Business Suite instances coupled with the use of Oracle Solaris Zones clusters.
- Lower physical infrastructure complexity and maintenance costs resulting from deploying fewer physical servers
- Agile virtualization and configuration of services that streamline business processes
- Distribution of system resources providing for higher server utilization and lower infrastructure costs

Platform Infrastructure

The core components of Oracle SuperCluster provide many unique technical advantages to Oracle E-Business Suite applications.

- **Oracle's SPARC T-Series Servers**. SPARC T-Series servers are designed with performance and consolidation in mind. Each SPARC server includes four or eight sockets for up to eight SPARC processors and up to 1 TB or 4 TB of memory. Chip multithreading technology built into each processor supports up to 256 or 1024 threads per server, providing increased computational density for consolidated Oracle E-Business Suite deployments while staying within constrained envelopes for power and cooling. Very high levels of integration help reduce latency and improve overall system security and reliability.
- **Oracle Exadata Storage Servers**. Oracle Exadata Storage Server delivers extreme database performance to Oracle E-Business Suite applications in a highly available, highly secure environment. Optimized for use with Oracle Database, Oracle Exadata Storage Server employs a massively parallel architecture and Exadata Smart Flash Cache to accelerate Oracle Database processing and speed I/O operations. Intelligent software enables Oracle Exadata Storage Server to quickly process database queries and return only the relevant rows and columns to the database server. By pushing SQL processing to Oracle Exadata Storage Server, all disks can operate in parallel, reducing database server CPU consumption while using significantly less bandwidth to move data between storage and database servers. Oracle Exadata Storage Server returns a query result set rather than entire tables, eliminating network bottlenecks, and freeing database server resources. As a result, users often see a 10-fold performance increase when scanning and analyzing data.
- **Oracle ZFS Storage Appliance**. Providing 60 TB of disk capacity for shared file systems, the Oracle ZFS Storage appliance uses flash-enabled Hybrid Storage Pools to accelerate Oracle E-Business Suite application response time. Easy-to-use DTrace Analytics optimize performance with minimal intervention, and powerful storage controllers run multiple data services, increasing efficiency and deployment flexibility. Oracle Solaris ZFS and self-healing technologies provide superior data integrity, while cluster failover and flash-based write caches ensure data high availability for Oracle E-Business Suite applications.
- **InfiniBand Fabric**. Oracle SuperCluster is built around an InfiniBand fabric for rapid exchange of data among the cluster components. The high-speed, low-latency InfiniBand fabric utilizes a pair of redundant InfiniBand switches to interconnect all Oracle SuperCluster components including the SPARC T-Series servers, Oracle Exadata Storage Servers, and Oracle ZFS Storage Appliances. The InfiniBand fabric is designed specifically for application clusters comprised of Oracle's rackmount servers and storage systems. Using an InfiniBand interconnect delivers the extreme scale, application isolation, and elasticity needed to consolidate and virtualize core Oracle E-Business Suite enterprise business applications.
- **Oracle Solaris**. Optimized for servers, Oracle Solaris delivers high performance, massive threading and batch processing, and high I/O rates critical to the most demanding Oracle E-Business Suite applications. Scalability enhancements, including support for 64-bit memory addressing, large pages, enhanced resource locking with mutex backoff algorithms, enhanced kernel data structures, and library optimizations, enable the platform to support large-scale Oracle E-Business Suite workloads. In addition, integrated server, storage, and network virtualization and resource control mechanisms support the vertical and horizontal scalability and optimized utilization needed for consolidating high-demand enterprise Oracle E-Business Suite applications and growing data sets.

More information on Oracle SuperCluster can be found in the white papers "A Technical Overview of the Oracle's SuperCluster T4-4" and "Oracle SuperCluster T5-8: Servers, Storage, Networking, and Software—Optimized and Ready to Run."

Network Infrastructure and Remote Management

Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster is designed to create a fully functional Oracle E-Business Suite deployment that can be placed into production quickly, while merging smoothly into the IT infrastructure and taking advantage of existing data center assets where possible. An example interconnect diagram for a two-node Oracle Super Cluster deployment platform for Oracle E-Business Suite is shown in Figure 2.

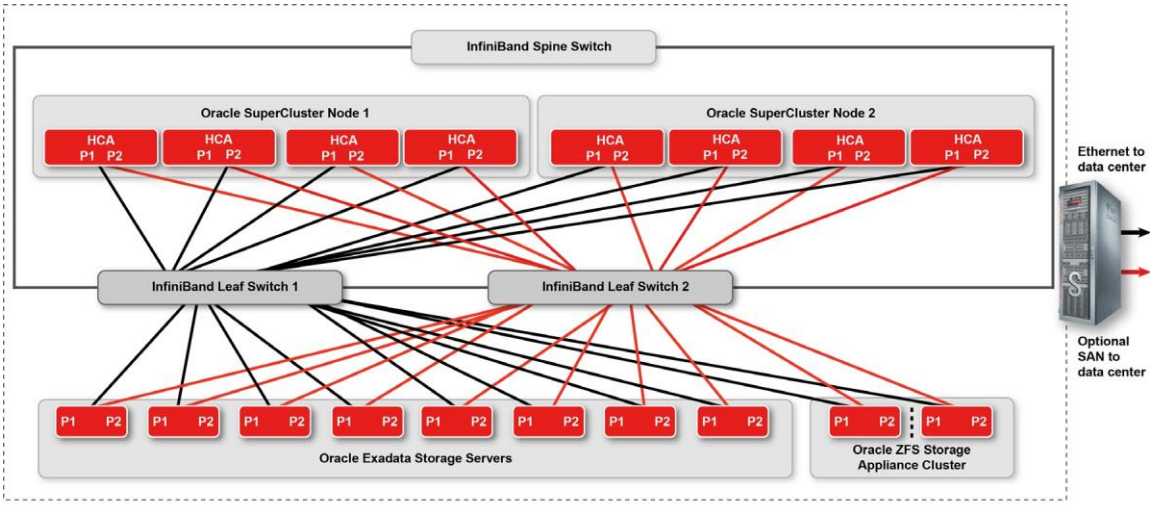

Figure 2. For high availability and ease of deployment, Oracle SuperCluster interconnects all system components over a high-performance, fully redundant InfiniBand fabric (example of a two-node Oracle SuperCluster shown).

- **Redundant networking**. The architecture uses redundant network components and links to promote application availability. Each database or application domain features dual connections to the InfiniBand networks, using separate interface cards connected to separate PCI buses, to support communication with the cluster interconnect, Oracle Exadata Storage Servers, and storage appliances. All tiers within the Oracle SuperCluster architecture communicate using the internal InfiniBand network. Separate redundant 10 gigabit Ethernet interfaces are used for connection to the rest of the data center, and they support incoming client connections and external Oracle E-Business Suite application servers. With optional Fibre Channel cards in Oracle SuperCluster, the solution supports connections to existing SAN data storage.
- **Built-in remote management tools**. All components within Oracle SuperCluster are connected to a dedicated gigabit Ethernet management network, ensuring physical isolation of management traffic. The management software stack includes Oracle Enterprise Manager Ops Center 12*c* to govern Oracle SuperCluster components and Oracle Enterprise Manager Cloud Control to manage the Oracle Database. To simplify software maintenance, Oracle tests and aggregates patches for Oracle SuperCluster components. Patches are integration tested for compatibility and stability, verified, and then bundled together for distribution. As a result the entire software stack, even patches and upgrades applied previously, goes through load and stress testing before being released to ensure that patch combinations work as expected.

Built-in Virtualization for Simplified Oracle E-Business Suite Application Consolidation

With Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster, built-in virtualization technologies isolate workloads and enable resource controls, supporting consolidation of Oracle E-Business Suite

deployments within a single platform. Applications certified on Oracle Solaris releases 8, 9, 10, and 11 can run simultaneously on Oracle SuperCluster without modification. Organizations that use Oracle E-Business Suite can consolidate applications securely using Oracle virtualization technologies, while at the same time protecting sensitive data, maintaining application availability, and shifting system resources to where they are needed most.

- **Oracle VM Server for SPARC**. Oracle VM Server for SPARC (previously called Sun Logical Domains) is a built-in firmware-based hypervisor on SPARC T-Series servers that supports multiple virtual machines, called domains, on a single system. The hypervisor allocates subsets of system resources (memory, I/O, and CPU) to each domain, isolating each Oracle Solaris instance and Oracle E-Business Suite workload to a virtual machine with dedicated resources. For I/O-intensive workloads on Oracle SuperCluster, separate I/O domains can be configured to take advantage of the massive number of I/O ports, enabling I/O performance at bare-metal speed within a virtualized environment.
- **Oracle Solaris Zones**. Oracle Solaris Zones is a lightweight virtualization technology that uses flexible, software-defined boundaries, to create multiple private execution environments within a single Oracle Solaris instance. Oracle E-Business Suite applications running within zones are completely isolated, preventing processes in one zone from affecting processes running in another. Zones support fault isolation, feature extremely fast boot times, and can be configured to instantly restart Oracle E- Business Suite applications. Because zones make it easy to prioritize applications and adjust resource allocations, they are ideal for consolidated Oracle E-Business Suite workloads.

Oracle VM Server for SPARC and Oracle Solaris Zones are complementary virtualization technologies that work together to isolate Oracle E-Business Suite applications and control system resources. In Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster, Oracle VM Server for SPARC defines at least two virtual servers or domains: one for the underlying database and one or more for the application tier. Figure 3 illustrates a two-node Oracle SuperCluster configuration. Oracle SuperCluster is available in various node and rack configurations to suite business requirements. Please refer to oracle.com/supercluster for more information.

To optimize performance of Oracle Exadata Storage Servers, Oracle Solaris 11 runs in the database domains to support the database and, optionally, Oracle Real Application Clusters (Oracle RAC). To support web applications and services, Oracle Solaris Zones are configured in the application domains, allowing zone clusters to be created in conjunction with Oracle Solaris Cluster. Though Oracle Solaris 11 is recommended, and Oracle E-Business Suite is certified for Oracle Solaris 11, some non-Oracle applications may not be. Please refer to https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=761568.1 for support information on various Oracle E-Business Suite modules.

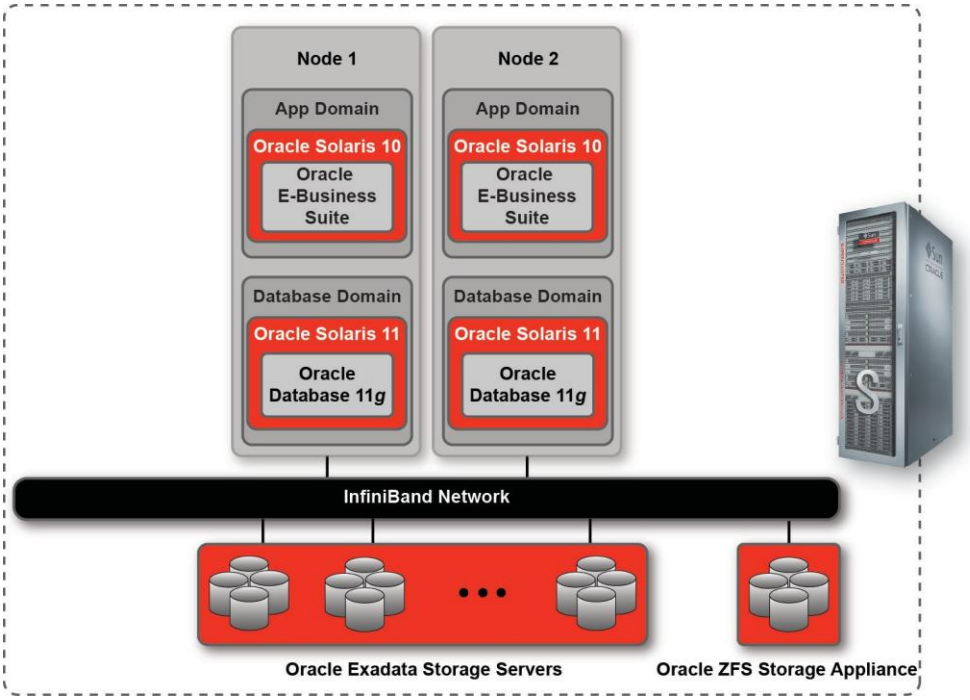

Figure 3. Built-in no-cost virtualization technologies provide workload isolation and resource controls (two-node Oracle SuperCluster configuration shown).

High Availability Features to Keep Oracle E-Business Suite Running

Mission-critical Oracle E-Business Suite applications must be available 24x7x365. To that end, Oracle recommends using an architecture that is integrated, tested, and validated to work together to reduce the risk of deployment problems, interoperability issues, and unplanned downtime.

- **No single point of failure**. The Oracle SuperCluster system provides full built-in redundancy—from compute nodes to storage, network switches to network interface cards (NICs), and power distribution units (PDUs) to power supplies—to support the demands of mission-critical Oracle E-Business Suite applications.
- **Oracle RAC**. Oracle RAC is the preferred implementation option to optimize availability for mission-critical Oracle E-Business Suite workloads. Oracle RAC supports the transparent deployment of the database across the servers within the Oracle SuperCluster system, providing high availability of database services in the event of hardware failures or planned outages.
- **Oracle Solaris Cluster**. Oracle Solaris Cluster optimizes the availability of Oracle E-Business Suite applications by detecting, isolating, and containing failing cluster nodes. Agents—software programs that enable Oracle or non-Oracle applications to take full advantage of Oracle Solaris Cluster features—specify the actions to be taken if a node or service fails or becomes unavailable. In this solution, Oracle E-Business Suite application specific agents are used to manage the availability of components in the complete solution. In addition to Oracle RAC and Oracle Database agents, the HA for Oracle E-Business Suite data service provides a mechanism for the orderly startup and shutdown, fault monitoring, and automatic failover of Oracle E-Business Suite. High-availability protection for specific components includes the Web Server, Forms Server, Concurrent Manager Server, and the Reports Server.
- **Virtual clustering**. Oracle Solaris Cluster supports virtual clustering, allowing Oracle Solaris Zones to function in the same role as physical cluster nodes. Applications that run within dedicated zone clusters are associated with specific cluster management policies. Agent actions can be layered, such as first trying to restart the service in a

different zone before attempting to restart it on a different server. These capabilities help Oracle E-Business Suite applications achieve the required levels of service.

» **Highly available NFS storage**. In the Oracle E-Business Suite environment, application servers access shared file systems for binaries, configuration files, and log files. Accessed over the high-speed InfiniBand network, Oracle ZFS Storage Appliances provide a highly available shared file system. These appliances are configured for redundancy, and they use the built-in self-healing and data integrity features of Oracle Solaris ZFS with cluster failover and flash-based write caches to increase data availability.

Backup, Restore, and Disaster Recovery Solutions

Additional Oracle Optimized Solutions are available to provide backup, restore, and disaster recovery solutions for both short-term data protection and long-term data preservation on Oracle SuperCluster. Appropriate technology varies according to the type of data (structured or unstructured), data protection needs, recovery time, performance, capacity, and service level requirements. For very fast backups to disk storage, the Oracle ZFS Storage Appliance in Oracle SuperCluster can be used to generate and store file system snapshots, storing them either locally or remotely to other Oracle ZFS Storage Appliances (Figure 4). Alternatively, snapshots can be stored to Exadata Storage Expansion Racks from Oracle that are directly connected to the InfiniBand fabric, creating a solution that takes advantage of the Fast Recovery Area in Oracle Exadata Storage Server to instantly get back up and running.

For structured data in Oracle Database, backups can be done with Oracle Recovery Manager (Oracle RMAN) either to disk or to tape through Oracle Secure Backup. Oracle offers Oracle Optimized Solution for Backup and Recovery, which is designed to perform network backups of heterogeneous clients, including Oracle SuperCluster. For backup, recovery, and long-term archival, tape remains the most cost- effective and reliable storage media available. For Oracle E-Business Suite deployments where longer retention periods and greater capacity are required, Oracle Secure Backup and tape storage can be used for backup, vaulting, and archiving.

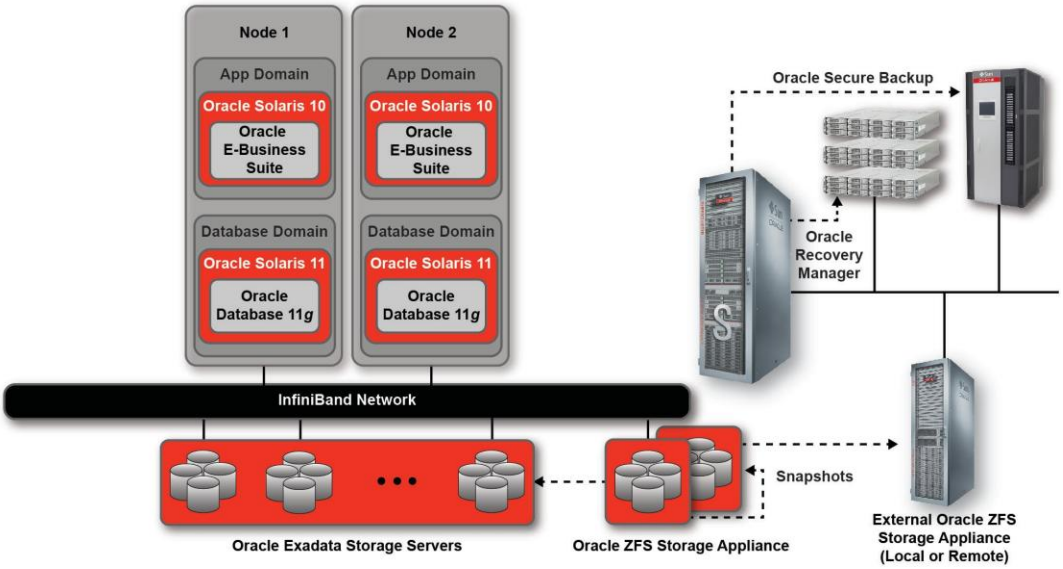

Figure 4. Oracle E-Business Suite on Oracle SuperCluster integrates with Oracle backup tools (two-node Oracle SuperCluster shown).

For disaster recovery scenarios, Oracle Optimized Solution for Disaster Recovery includes best practices that take advantage of Oracle Active Data Guard, Oracle RAC, Oracle Automatic Storage Management, Oracle Flashback, and Oracle SuperCluster. Oracle Active Data Guard can be deployed in conjunction with the snapshot and cloning

features of Oracle ZFS Storage Appliance, enabling easy and efficient database cloning to create a remote standby database. For more information about backup, restore, and disaster recovery solutions, see the “Oracle Optimized Solution for Backup and Recovery” and “Oracle Optimized Solution Disaster Recovery” sections.

Built-in Security Technology and Comprehensive Tools for Secure Deployment

There is no single product or solution that can prevent all types of security attacks. Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster provides a comprehensive and flexible set of security capabilities, and each security mechanism reinforces the others to deliver end-to-end security. Security is designed from the inside out to satisfy the security risk requirements for different business needs when deploying Oracle E-Business Suite.

Salient security capabilities provided with Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster are discussed in the following sections.

Cryptographic Acceleration for Oracle E-Business Suite

Security has taken unprecedented importance in all facets of the IT industry. Therefore, organizations are proactively adopting cryptographic mechanisms to protect their businesses and information from unauthorized access and to ensure the confidentiality and integrity of data during transit and in storage. Adopting SSL/TLS encryption for data in transit and using encrypted data at rest has become critical for delivering end-to-end security for multitier business applications and to meet regulatory compliance mandates. Cryptographic operations, however, are heavily
compute-intensive, burdening the host system with additional CPU cycles and impacting network bandwidth, potentially resulting in significant degradation of overall throughput of the system and its hosted business applications.

» **The Role of SPARC T-Series Processors.** The SPARC T5 processor is the fifth generation of Oracle’s SPARC T-Series family, and it leverages a fundamental redesign of the core within the SPARC multicore/multithreaded processor architecture to provide approximately three times the single-threaded throughput gains compared to its predecessor. The SPARC T5 processor also includes on-chip/on-core based cryptographic acceleration. As a result, the SPARC T5 processor eliminates the need for expensive custom hardware and software development by integrating high-performance computing, security, and I/O onto a single chip. As a result, the on-board streams processing unit (SPU) is designed to achieve wire-speed encryption and decryption on the processor's 10 GbE ports. The logical depiction of the SPU in the SPARC T5 processor is shown in Figure 5.

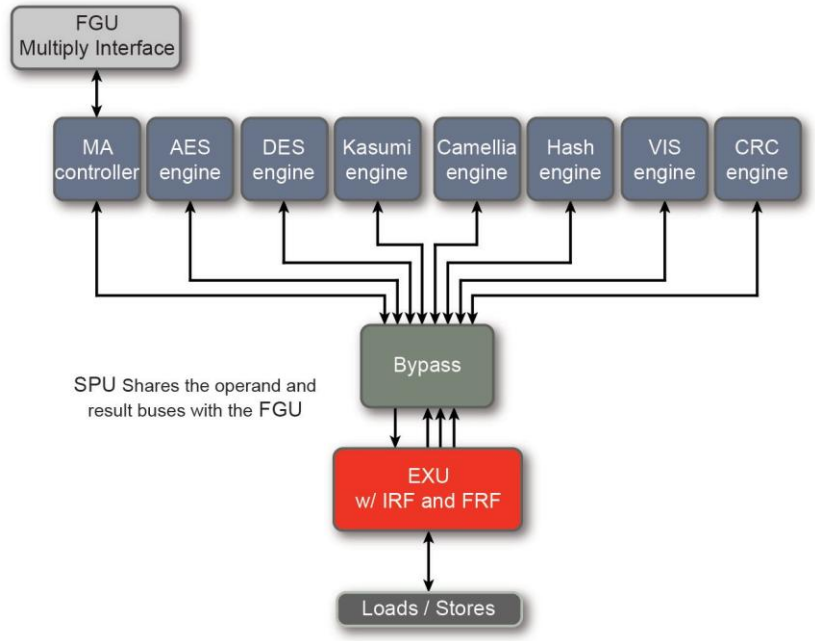

Figure 5. Oracle's SPARC T5 processor—logical depiction of stream-processing unit (SPU).

» **Cryptographic Framework Speeds Oracle E-Business Suite Security.** The use of SPARC T5 hardware-assisted cryptographic acceleration for end-to-end Oracle E-Business Suite security yields tangible, immediate, and cost-efficient results in the form of faster secure transactions and better response times. These improvements are all accomplished without any additional security equipment costs, changes in power usage profiles, or elaborate system configurations. In practice, the Cryptographic Framework feature of Oracle Solaris acts as the core intermediary between the applications and the underlying hardware. The framework enables Oracle E-Business Suite and other applications to automatically leverage the hardware-assisted cryptographic acceleration functions. The Cryptographic Framework libraries provide a set of cryptographic services and application programming interfaces (APIs) whereby both kernel and Oracle E-Business Suite application modules can transparently delegate the cryptographic operations to hardware without adding any new code.

  Oracle E-Business Suite 12 infrastructure components also gain significant security operation performance by offloading and delegating cryptographic operations. The on-core cryptographic acceleration capability of the SPARC T5 processor accelerates security for Oracle HTTP Server, Oracle Application Server, Oracle Database, Oracle ZFS Storage Appliance, and the network. SPARC T5 processor–based servers have demonstrated high-performance enterprise security with consistent scalability for Oracle E-Business Suite 12 applications and Oracle Database, while also delivering reductions in space, power consumption, and cost.

More information on securing Oracle E-Business Suite applications can be found in the white paper, "Securing Oracle E-Business Suite Applications Using Oracle Solaris 11 on SPARC T5 and SPARC M5-32 Servers."

Secure Isolation

The various functional components in this solution share the compute, memory, and network resources of the underlying platform, and multiple systems interconnect through a common network. This architecture requires a mechanism that provides isolation to protect each function from any potential security compromise in any part of the system that could propagate to the rest of the system. The following isolation mechanisms form an integral part of the security provided by Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster.

» **System Virtual Machine (Hypervisor Virtual Machine) Isolation.** Oracle VM Server for SPARC provides confined virtual environments (*logical domains*) to deploy Oracle E-Business Suite applications and Oracle

Database. Processing inside the logical domain cannot affect the operation or processes outside the virtual machine.

- **Hosted Virtual Machine Isolation.** Oracle Solaris Zones provide a confined environment for the execution of the different components of Oracle E-Business Suite, such as Web Services, Form Services, and Concurrent Processing. Applications operating inside the virtual environment created by Oracle Solaris Zones cannot affect the operation of processes outside the virtual machine.
- **Network Isolation.** Network isolation protects in-transit data. Network traffic is easily isolated by configuring virtual networks (VLANs) within Oracle Solaris to provide greater security and data protection.

Access Control

Secure access control, an important aspect of any system, ensures that authenticated users access only what they are authorized to—and no more. There are two main ways to implement access control security in Oracle E-Business Suite: "traditional" Oracle E-Business Suite responsibility-based security (usually referred to as *function security*) and Role-Based Access Control (RBAC). These two methods overlap in functionality, and RBAC incorporates and builds upon responsibility-based security. My Oracle Support Document 1537100.1 discusses the main similarities and differences between the two types of security setups. For more information, see "Function Security and Role Based Access Control (RBAC) in Oracle E-Business Suite."

To limit access, administrators can also make a subset of Oracle E-Business Suite Release 12 functionality accessible via the internet to external users. For more information, please refer to My Oracle Support Document 380490.1, "Oracle E-Business Suite Release 12 Configuration in a DMZ."

Data Protection

Oracle Database provides multiple ways to secure data.

- To protect the data physically stored within the database, **Transparent Data Encryption (TDE)** provides automatic encryption/decryption of an entire tablespace or specific columns of a table, without the user or application having to manage the encryption key. This functionality is performed by specifying the `ENCRYPT` keyword along with the column name when a table is created.
- **Oracle Data Masking** protects confidential data in non-production environments: data can be shared with non-production users without revealing sensitive information. For example, names, social security numbers, and salary information can be masked before being made available to non-production environments such as development and test (see Figure 6).

LAST_NAME	SSN	SALARY
AGUILAR	203-33-3234	40,000
BENSON	323-22-2943	60,000

LAST_NAME	SSN	SALARY
ANSKEKSL	323-23-1111	60,000
BKJHHEIEDK	252-34-1345	40,000

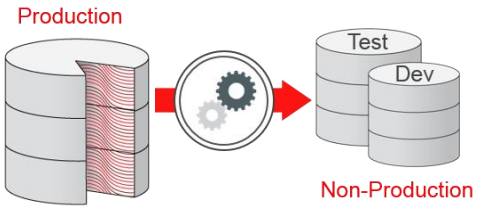

Figure 6. Using Oracle Data Masking to protect sensitive information in non-production environments.

- **Oracle Database Vault** protects against insider threats, helps meet regulatory compliance requirements, and enforces separation of duties. My Oracle Support Document 1091083.1 provides information on integrating Oracle E-Business Suite Release 12 with Oracle Database Vault.

Compliance

The number and complexity of regulations designed to protect data privacy, to secure data at or below specified acceptable levels, and to enforce transparency and accountability make compliance a prevalent business concern.

- The Oracle Solaris audit facility, which is enabled by default in Oracle Solaris 11, records actions taken by users and services on the operating system. The audit facility uses policies that can track system, administrator, and end-user activity.
- To ensure proper governance, risk management, and compliance management (GRC) , the following security mechanisms can be used with Oracle Optimized Solution for Oracle E-Business Suite on Oracle SuperCluster:
  - The **flexfield value set** security feature (new in Oracle E-Business Suite 12.2) can be used to help ensure that different administrators have non-overlapping responsibilities. The primary intent of this feature is to prevent fraud or theft by an individual acting alone. This separation of duties (SoD) is a requirement for many regulations such as Sarbanes-Oxley (SOX) Act, Health Insurance Portability and Accountability Act (HIPPA), and European Union Data Protection Directive.
  - The Oracle E-Business Suite security system can be integrated with **Oracle Audit Vault and Database Firewall** to consolidate database audit trails into a secure centralized repository, detect and alert on suspicious activities (including privileged users), and provide out-of-the-box compliance reports for SOX, Payment Card Industry (PCI), and other regulations.
- For many organizations, the greatest GRC challenge is creating a consolidated view of compliance, risk, and internal controls. Oracle Enterprise Governance, Risk, and Compliance Manager helps provide a reduction in overlapping policies, risks, and controls. The white paper "Harnessing Oracle Governance Risk and Compliance Applications to Improve Your E-Business Suite 12.1 Upgrade" provides specific recommendations for when and how to leverage Oracle Enterprise Governance, Risk, and Compliance Manager to help fully realize the benefits of Oracle E-Business Suite Release 12.

Security Best Practices for Oracle E-Business Suite Deployments

In today's environment, a properly secured system is critical. The entire Oracle E-Business Suite deployment should observe the following general best practices.

- Keep software up to date.
- Restrict network access to critical services.
- Follow the principle of least privilege.
- Monitor system activity.
- Keep up to date on latest security information.

My Oracle Support Document 403537.1, "Secured Configuration Guide for Oracle E-Business Suite Release 12," provides practical advice for securing configurations of the Oracle E-Business Suite Release 12.0, 12.1, and 12.2. This document provides recommendations for securing different areas of an Oracle E-Business Suite deployment, including:

- Securing client connections on the network
- Managing user privileges
- Configuring the database for auditing
- Securing the Application Server
- Enabling and using Oracle E-Business Suite audit features
- Securing the desktop used to run web browsers that connect to Oracle E-Business Suite
- Hardening the overall system

The document also provides a set of scripts to verify the proper setting of many of the configuration parameters.

For more information on securing Oracle E-Business Suite, Oracle Database, and Oracle Solaris 11, please refer to the security resources listed in Table 2 on page 26.

Oracle In-Memory Applications Speed Business Planning

As demand volatility increases, value chain networks grow in complexity and planners are faced with exploding data volumes and the increased need for near-real time responsiveness to sudden problems in the supply chain. It is becoming crucial to simulate changing business models faster to continuously adapt to the competitive and customer value chain landscape, before problems actually happen. To deal with the challenges of today's global economy, companies need to transform their supply chains into information and demand-driven value chains. When performance and scalability are critical, Oracle SuperCluster provides the scalability and extensive performance optimizations in engineering of hardware and software to work together. These innovations are available only with the complete Oracle technology stack.

To help organizations address complex value chain planning challenges, Oracle has introduced two new Oracle Value Chain Planning in-memory applications on Oracle engineered systems. Oracle In-Memory Consumption-Driven Planning and Oracle In-Memory Performance-Driven Planning enable extreme performance for the demand-driven value chains. Both applications can each simultaneously leverage a variety of ERP back-end systems, including Oracle E-Business Suite. Oracle Value Chain Planning solutions enable best-in-class processes, such as demand sensing, shaping for profitability, fast event- driven scenario simulation, and supply chain risk management. By deploying Oracle Value Chain Planning on Oracle SuperCluster, customers have seen improvement across all aspects of their planning processes, including data collection, plan snapshot times, plan run times, plan flush times, and archival of plan data for analysis. Existing benchmarks show up to 40% reduction in data collection and plan run times.

Oracle In-Memory Performance-Driven Planning

Oracle In-Memory Performance-Driven Planning is the newest addition to the Oracle Value Chain Planning solution and enables the next generation of near real time interactive planning, simulation, and analysis. This in-memory application process optimization not only reduces run times of some key batch processes by five times or more, but also totally eliminates many batch processes altogether. Instead of requiring the complete plan to be written out, it has a new capability to quickly surface just the key incremental changes to let planners complete a “simulate, then analyze” cycle in seconds instead of hours. This capability is achieved by elevating most of the processing from disk to memory by leveraging the architecture of Oracle SuperCluster.

This faster in-memory performance also enables planners to make better and more informed decisions by evaluating more scenarios with more comprehensive analysis and taking advantage of complex analytics and visualization. Oracle’s in-memory planning solution enables users to take advantage of the new capabilities to create a personalized “watch list” of key performance indicators and a completely new visualization capability that eliminates a lot of manual steps in a typical planner's day. Planners can then react immediately to specific events that they care about and not have to spend a lot of time to view the full plan results to look for small details, greatly reducing the time to analyze and execute their supply chain plans.

For more information on Oracle Value Chain Planning, refer to the Oracle white paper “Oracle Value Chain Planning on Oracle Engineered Systems.”

Oracle In-Memory Consumption-Driven Planning

With the increasing availability of Point of Sale (POS) and other downstream data over the last decade, companies selling through retail channels have strived to use such data to drive their upstream supply chains. The availability of granular data, down to the item, store, and day level, offers the promise of transforming business processes in areas

such as demand, replenishment, promotion, and new product planning. However, limitations in computing power have precluded taking full advantage of the huge amounts of data involved.

A new approach is needed to enable planning at a more granular level. Oracle In-Memory Consumption-Driven Planning leverages the latest innovations in hardware and software technology from Oracle to provide a solution with unparalleled performance and scalability. Using Oracle's industry-leading Demantra Demand Management product as a starting point, and enhanced to run on Oracle SuperCluster, the solution also includes new out-of-the-box scalable functionality to enable consumption- driven planning and replenishment business processes. Leveraging the increased performance made possible by Oracle SuperCluster, Oracle In-Memory Consumption-Driven Planning enables comprehensive, time-phased planning capability at the store and day level. The new in-memory architecture enables the planning system to calculate these complex performance indicators and generate the exception alerts very quickly by doing the processing completely in-memory. With this type of performance, running forecasting and replenishment plans at the store and daily level is possible.

Oracle In-Memory Consumption-Driven Planning is thus helping to bring manufacturers closer to achieving the vision of the demand-driven value chain. Oracle SuperCluster provides the extreme step- change in scalability and cost-performance to move granular consumption-driven planning from custom early adopters to the mainstream market. Oracle SuperCluster provides massive data processing throughput, with enough flash memory to store and manage an entire planning data set of a size not feasible with traditional disk-based systems. Oracle SuperCluster also provides unique storage servers integrated with the database that optimizes large data set processing. Oracle SuperCluster can support hundreds of concurrent Demantra forecast engines running in parallel to solve the largest forecasting problems in minutes instead of days.

For more information on Oracle In-Memory Consumption-Driven Planning, refer to the Oracle white paper "Oracle In-Memory Consumption-Driven Planning."

Mapping an Oracle E-Business Suite Deployment to Oracle SuperCluster

A typical large-scale Oracle E-Business Suite deployment can be complex, with users at the edge of the network, data center infrastructure hosting the Oracle E-Business Suite modules and components, and storage systems handling information management. Within the data center, a typical Oracle E-Business Suite deployment consists of separate development (DEV), quality assurance service (QAS), production (PRD), and test systems for each Oracle E-Business Suite application. Oracle E-Business Suite components are commonly deployed with the application and database server layers residing on a single system or with the application and database layers residing on separate systems.

The independent hosting of each layer on separate physical servers results in increasing complexity and infrastructure sprawl that makes adding new Oracle E-Business Suite services expensive and time consuming. Because individual servers must be sized for peak demand—a condition that usually occurs only once a week or once a month—they experience very low utilization rates for the rest of the time. With so many servers often running only at 10 to 20 percent of capacity, resource utilization is low, power and cooling demands are high, and data center floor space is over consumed and underutilized. As a result, enterprises running multiple Oracle E-Business Suite applications can quickly find themselves with a large and fragmented environment (Figure 7).

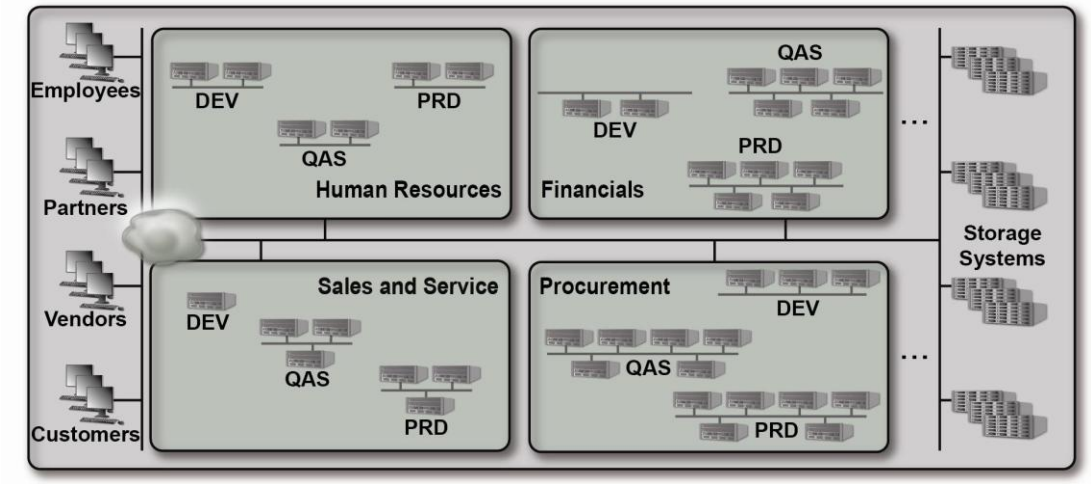

Figure 7. Different development, test, and production systems for each Oracle E-Business Suite application can rapidly lead to complexity and server sprawl.

Consolidating to Oracle SuperCluster

To greatly simplify Oracle E-Business Suite deployments, production environments for each module can be consolidated onto an Oracle SuperCluster system. Though housed in a single physical rack, the Oracle SuperCluster supplies sophisticated networking and virtualization to provide all of the performance and reliability of deploying Oracle E-Business Suite on separate physical systems. Because Oracle E-Business Suite QAS systems typically approximate the size and scale of production systems, they can be deployed on a separate, local Oracle SuperCluster facilitated through Oracle Active Data Guard. Test and development systems can be deployed at a different geographical site in order to maintain physical isolation. Facilitated by Oracle Optimized Solution for Enterprise Cloud Infrastructure, this solution provides a complete optimized architecture for a remote enterprise cloud infrastructure deployment. The remote Oracle SuperCluster provides smaller development, testing, and sandbox environments and also serves as a disaster recovery system. This optimal solution orchestrates the environments for Oracle E-Business Suite deployment with Oracle SuperCluster systems and displaces multiple costly sprawled systems, thereby reducing complexity and resulting in lower TCO (Figure 8).

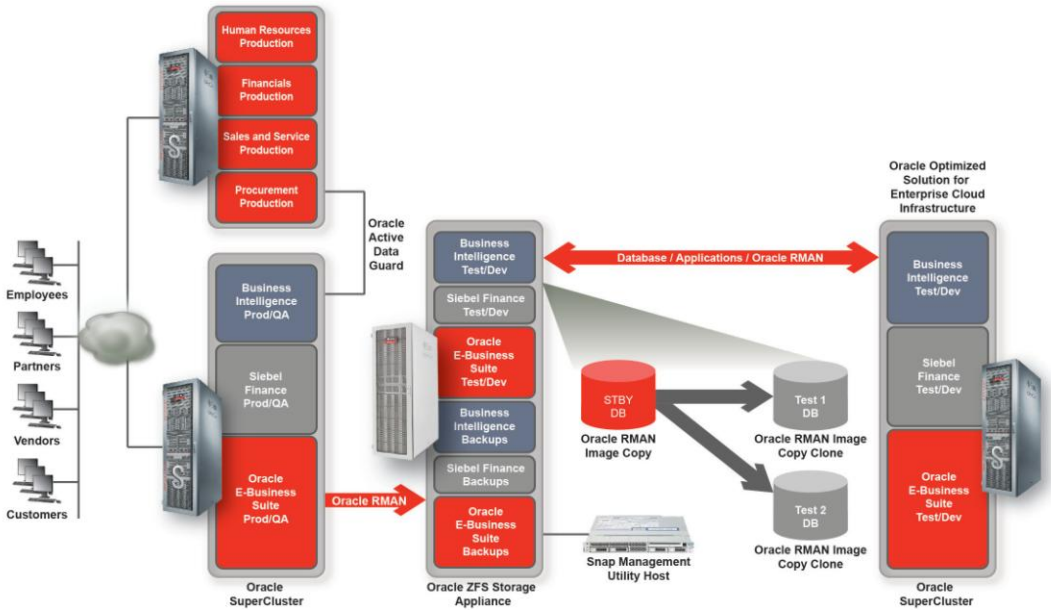

Figure 8. Simplify and reduce TCO by consolidating Oracle E-Business Suite and other Oracle application environments on Oracle SuperCluster systems, using Oracle ZFS Storage Appliance and Oracle Optimized Solution for Enterprise Cloud Infrastructure to provide backup and disaster recovery services.

For more information on Oracle Optimized Solution for Enterprise Cloud Infrastructure, see the following website: oracle.com/us/solutions/oos/enterprise-cloud-infrastructure/overview/index.html.

A Basic Production System

The production system contains live data and it is where business processes are executed. To ensure the highest performance and availability, Oracle recommends a two-domain (application, database) Oracle E-Business Suite deployment on Oracle SuperCluster systems. In this configuration, applications run in Oracle Solaris Zones within an application domain (logical domain or LDom) and can be configured for failover by utilizing Oracle Solaris Cluster with Oracle E-Business Suite applications. Databases run in a separate database domain connected to Oracle Exadata Storage Servers.

Figure 9 illustrates a two-node Oracle SuperCluster system with consolidated production of Oracle E-Business Suite applications. Oracle Process Manager and Notification Server (Oracle PMN) provides the web services that run across the two Oracle Solaris 10 domains in an Oracle Solaris Zone cluster using agents provided with Oracle Solaris Cluster for use with Oracle E-Business Suite. Likewise, another Oracle Solaris Zone cluster is provided for Oracle Concurrent Manager configured in Parallel Concurrent Processing mode. In addition, an external Oracle Database proxy resource is configured in the same zone cluster running Oracle Concurrent Manager (Oracle CM) to monitor and represent the availability of the specific database services provided by the Oracle RAC 11*g* Release 2 database domains. The Oracle E-Business Suite system has a dependency on such database services. This resource enables the coordination of availability between the two types of domains in Oracle SuperCluster systems.

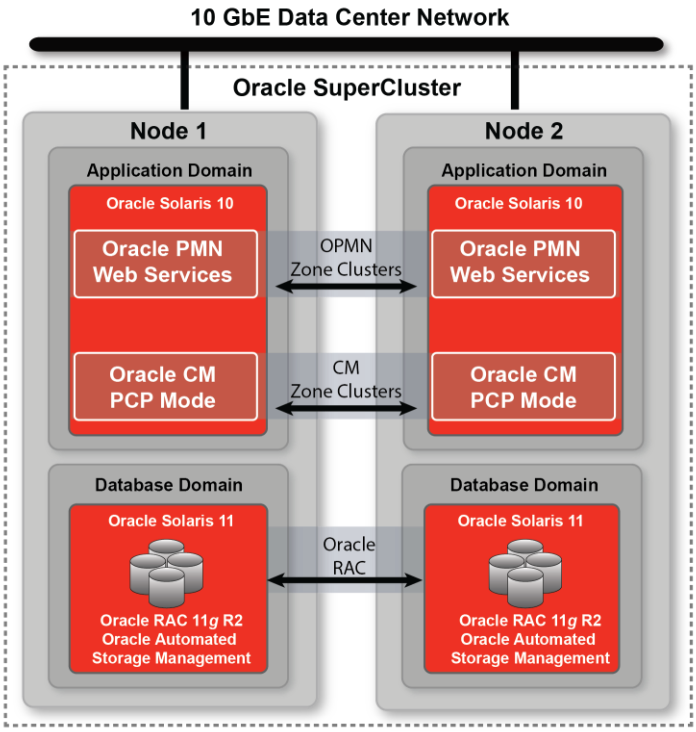

Figure 9. Smaller deployments can consolidate Oracle E-Business Suite and other application production onto a two- node Oracle SuperCluster system.

Figure 10 illustrates Oracle E-Business Suite running multiple instances in an application domain with Oracle Solaris Zone clusters providing failover, between the application instances, running on separate Oracle SuperCluster nodes. Additional domain instances can be configured to host additional Oracle E- Business Suite or other applications modules, as shown, or to provide operational or administrative separation.

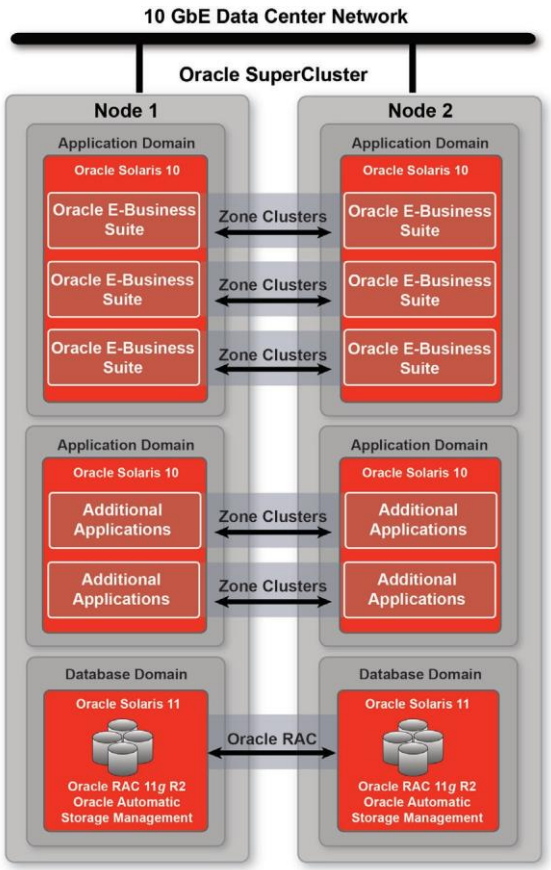

Figure 10. Multiple E-Business Suite applications or additional application instances can be hosted flexibly.

Quality Assurance, Disaster Recovery, and Other Systems

When creating, building, and testing Oracle E-Business Suite applications, a number of independent systems must be used.

- **Quality assurance system**. Ideally, a quality assurance system is identical to the production system so that issues can be found and fixed during the verification process. With the ability to control the system, engineers can work together to conduct exhaustive tests on configurations, new functionality, and implementation changes prior to deployment in the production system. If a duplicate environment is not possible, a smaller system can be used in a ratio that enables technical staff to forecast the performance impact.
- **Backup and recovery system**. The Oracle SuperCluster platform and Oracle E-Business Suite applications are designed for resiliency and high availability; however, protection of data from natural and manmade disasters is essential to business operations. Oracle Solaris operating system and unstructured data (i.e., non-database data) reside in shared file systems on Oracle ZFS Storage Appliance. This data must be backed up in order to provide for a quick recovery process in the event of a disaster. Oracle Database is a vital element of Oracle SuperCluster and must be backed up as well, to ensure against loss of business- or mission-critical data. For more information on backup and recovery, see the section “Oracle Optimized Solution for Backup and Recovery.”
- **Disaster Recovery (DR) system**. Because Oracle E-Business Suite QAS systems typically approximate the size and scale of the production systems, remotely located QAS, (or development, test, training and sandbox) systems can serve double duty as a disaster recovery system on a separate Oracle SuperCluster, as previously shown in Figure 8. With production and QAS/DR systems deployed on different sites, Oracle Active Data Guard can

provide transactional consistency and active-active failover for services. For more information on DR see the section “Oracle Optimized Solution Disaster Recovery.”

» **Development and test system**. Customization efforts and the development of new functionality typically take place on a small server and database. All maintenance activities, including break-fixes for production processes, tend to be performed on these systems as well.

» **Training and sandbox systems**. Using a small system and database, the training and sandbox systems make it easy for developers to gain experience with applications, test various scenarios prior to incorporating them into the mainstream code base, and conduct feasibility studies for customer-specific requirements or requests.

In many of these environments, developers frequently test new functionality and software products, patch applications, and perform upgrades. Toward this end, many developers and test engineers are given root access to enable them to perform tasks independently, which would be less than ideal on a production system.

Scaling Production Environments with Oracle SuperCluster

Customers deploying enterprise solutions are frequently looking for the ability to expand in the future without disrupting current operations. Oracle SuperCluster is offered in a choice of modular configurations that can scale and expand easily. This modular approach helps ensure the highest quality for integration and testing. For example, Figure 11 shows Oracle SuperCluster in half-rack and full-rack configurations, enabling organizations to initially invest in the half-rack option and expand to a full rack, expanding the initial Oracle SuperCluster configuration when growth is required. Multi-rack configurations are also available for larger deployments. For database storage expansion, Oracle’s Exadata Storage Expansion Rack is available in quarter-rack, half-rack, and full-rack configurations.

Figure 11. Expansion is easy with Oracle SuperCluster (left side) which is available in half-, full-, and multi-rack configurations and Exadata Storage Expansion Rack (right side) which is available in quarter-, half-, and full-rack configurations.

Oracle E-Business Suite applications can be scaled up to additional processor threads as more performance is required using Oracle’s built-in virtualization technologies to manage and utilize available resources. Oracle E-Business Suite and unstructured data storage can also be easily backed up or expanded using Oracle ZFS Storage Appliances, while additional Exadata Storage Expansion Racks can be added for database storage scalability beyond the Oracle SuperCluster chassis. Additionally, multiple Oracle SuperCluster systems can be cabled together and connected to Exadata Storage Expansion Racks for larger deployments. For more information on Oracle SuperCluster, refer to the following website: oracle.com/supercluster. For more information on Exadata

Storage Expansion Racks, refer to the following website: oracle.com/us/products/database/exadata/expansion-storage- rack/overview/index.html.

Consolidation of Quality Assurance, Disaster Recovery, and Other Systems

Oracle E-Business Suite QAS/DR systems can be consolidated onto a single Oracle SuperCluster system to simplify deployments and shorten the time needed to get a new QAS system up and running. As with the application domain on production systems, Oracle Solaris Zones provide a complete runtime environment for an Oracle E-Business Suite applications environment, including all required programming tools. The Oracle Database instance used for Oracle E-Business Suite would be just another instance that is run in the database domain, in a zone and stored on the shared Oracle Exadata Storage Servers. Each zone provides full resource containment and control and fault and security isolation to ensure applications do not hamper one another's access to resources or impact execution. Developers and administrators can manage compute, memory, and I/O resources on a fine-grained basis (statically or during operation) to ensure applications have access to an appropriate amount of resources and no workload consumes the entire platform. As a result, programmers can maintain a one application per server deployment model while simultaneously sharing hardware resources.

Consolidating onto a Single Oracle SuperCluster System

As described, full-scale installations with the need for isolated QAS and DR systems would typically deploy multiple Oracle SuperCluster systems in physically separate geographic locations. For smaller deployments with more modest processing needs and no DR requirement, a single Oracle SuperCluster could be configured to house both production as well as QAS/DEV/test systems. Figure 12 illustrates a two-node Oracle SuperCluster that houses a two-node production system conveniently consolidated into a single rack.

As with the two-node Oracle SuperCluster configuration described previously, each server is divided into two domains (application and database) using Oracle VM Server for SPARC. The application domain is further subdivided into isolated areas using Oracle Solaris Zones. Oracle Solaris Cluster is used to combine zones into clusters to enable failover for critical application services. Oracle Database and Oracle RAC run in the database domain connected to the Oracle Exadata Storage Servers to support highly available data access and can also be run in zones.

In such a configuration, all production, quality assurance, development, and other systems run in isolated zones. Development systems can run Oracle Solaris Zones to maintain the one-application-per-server model preferred by developers, while the production system can run clustered servers to ensure high availability. The QAS system replicates all or part of the production environment, enabling applications to be tested in the same environment in which they are deployed.

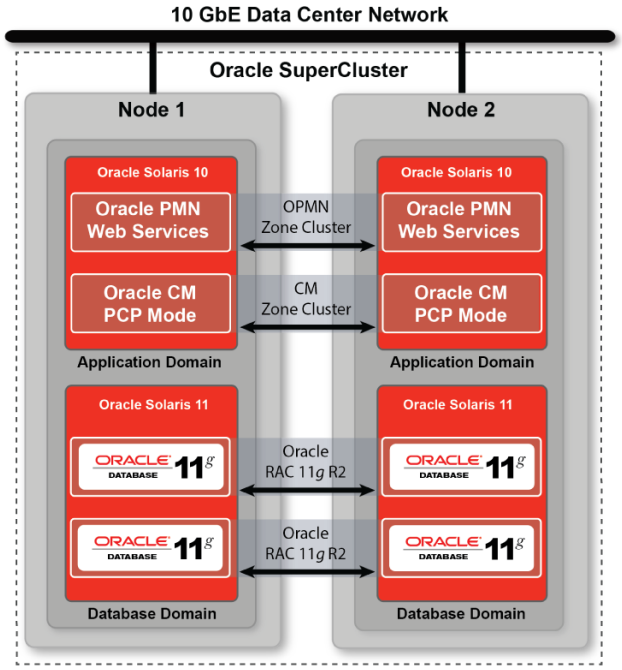

Figure 12. Oracle E-Business Suite deployments with moderate performance or scalability requirements can be consolidated onto a single Oracle SuperCluster system.

Additional Oracle Optimized Solutions for Oracle E-Business Suite Deployments

Oracle Optimized Solutions are designed, tested, and fully documented architectures that are tuned for optimal performance and availability. These solutions are based on uniquely matched components including the Oracle E-Business Suite enterprise applications, Oracle SuperCluster servers, storage, operating systems, virtualization, database and middleware. Oracle Optimized Solutions are proven to save money, reduce integration risks, and improve user productivity. Built with flexibility in mind, they can be deployed as complete solutions or easily adapted into existing environments. The Oracle Optimized Solution approach helps ease Oracle E-Business Suite deployment with optimized backup, recovery, and disaster recovery, and it lowers risk even further by enhancing the complete end-to-end deployment through appropriate services from Oracle Consulting.

Oracle Optimized Solution for Backup and Recovery

Oracle SuperCluster delivers extreme compute power, unmatched scalability, accelerated processing, and database optimization with integrated components taken from the tiers in Oracle's technology stack. Oracle Optimized Solution for Backup and Recovery matches the innovation built into Oracle SuperCluster, providing higher capacity and performance with greater operational efficiency at less cost. Oracle offers a complete, pretested, high-performance solution that can be applied to back up Oracle E-Business Suite on Oracle SuperCluster, which delivers virtually unlimited scalability with centralized management. The solution accelerates data protection processing and management that more than meets enterprise requirements, while providing breakthrough cost structures and industry-leading performance. Oracle Optimized Solution for Backup and Recovery deployed on Oracle SuperCluster provides comprehensive support with support for Oracle E-Business Suite data and Oracle Database as well as Oracle Solaris operating system components and the network infrastructure. Using Oracle

RMAN and Oracle Active Data Guard data protection software, administrators can back up data residing on the preconfigured Oracle ZFS Storage Appliance.

This data can also be backed up to high-performing encrypted tape, for cost-effective, long-term storage. Oracle Optimized Solution for Backup and Recovery can be four times less expensive than comparable competitive tape backup solutions. Oracle Secure Backup—the tape management software component for tape backup—employs the lowest-cost tape storage media and is ideal for older backup copies and long-term data retention. When Oracle Optimized Solution for Backup and Recovery is deployed in replicated configurations, it eliminates the need for complex third party de-duplication techniques, because simple tape and disk backups can be performed at one or both sites for complete data protection.

Protecting Oracle E-Business Suite on Oracle SuperCluster

Oracle Optimized Solution for Backup and Recovery features a scalable, multitier architecture that includes backup clients, media servers, administrative servers, Oracle's disk storage devices, and encrypted tape devices, as shown in Figure 13. Designed to be software-agnostic, the solution can work with Oracle RMAN, Oracle Secure Backup, Symantec NetBackup, or other non-Oracle backup software. For illustration purposes, the following explanation refers to use of Oracle Secure Backup software throughout for the tape management component of the solution.

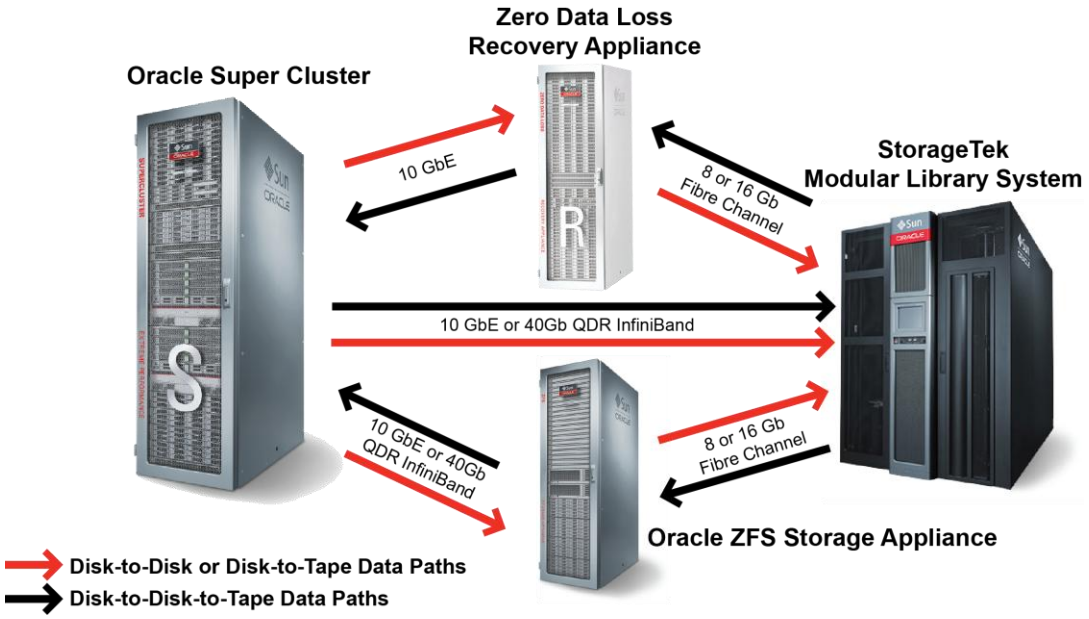

Figure 13. Oracle Optimized Solution for Backup and Recovery supports heterogeneous clients.

Note that in Oracle SuperCluster disk-only environments, no backup software is required. Disk backups can be completed using the operating system and Oracle Database tools, such as Oracle RMAN, alone.

There are three elements within Oracle SuperCluster that must be backed up in order to protect against loss of data and operations.

» **Oracle E-Business Suite and Oracle Solaris**. The applications, operating system, domains, Oracle Solaris Zones, and iSCSI zones within Oracle SuperCluster must be backed up in order to provide for a quick recovery process in the event of a disaster. Applications installed on the internal Oracle ZFS Storage Appliance are backed up with Network Data Management Protocol since they are installed on NFS shares.

- **Oracle Database**. Oracle Database is a vital element of Oracle SuperCluster and must be backed up to ensure against loss of business- or mission-critical data.
- **Oracle SuperCluster network infrastructure**. The Oracle SuperCluster network infrastructure consists of the switch configurations for the InfiniBand fabric. Once the switches inside Oracle SuperCluster are configured, their configuration information must be backed up to preserve the settings. The switch configuration data is stored on an NFS share on the Oracle Storage ZFS Appliance that is internal to Oracle SuperCluster.

The data protection features of Oracle Optimized Solution for Backup and Recovery provide a complete backup and recovery capability for the data storage, network switching infrastructure, operating system, domains, zones, and database. The result is an end-to-end solution that ensures the fastest, most reliable backup and recovery for Oracle SuperCluster.

For more information on backup and recovery, refer to the Oracle white paper "Oracle Optimized Solution for Backup and Recovery of Oracle SuperCluster."

Oracle Optimized Solution for Disaster Recovery

Oracle E-Business Suite running on the Oracle SuperCluster platform is designed for high availability. At the same time, enterprise deployments need protection from unforeseen disasters and natural calamities. Planning for disaster recovery depends on many factors, including cost, existing infrastructure capabilities, requirements for compliance with government regulation, and other business objectives. A practical and cost efficient approach to ensure uninterrupted business operations during a disaster is to have an independent copy of the operating environment up and running at a geographically distant, remote secondary site. In this scenario the remote site hosts a redundant application tier and a synchronized standby database. Remote disaster recovery sites do not have to simply sit idle until called upon for service recovery. To increase the return on investment of disaster recovery site resources and improve productivity, the remote infrastructure can be leveraged for essential non-time-critical activities, such as development and test work along with analysis and reporting tasks, as previously illustrated in Figure 8.

Disaster Recovery Strategy for Oracle E-Business Suite on Oracle SuperCluster

Oracle SuperCluster uses a complete framework of technologies to provide disaster recovery support of Oracle E-Business Suite applications and databases deployed on this platform. Oracle Optimized Solution for Disaster Recovery ensures that all data, applications, and systems are replicated and ready for operation if the primary site becomes unavailable. Through full system integration and duplication of all system components at the remote disaster recovery site, the solution provides faster and more complete operations recovery than other options and eliminates the need for high-performance systems to recover production operations.

Figure 14 shows the basic configuration for Oracle Optimized Solution for Disaster Recovery in a local primary and remote secondary site for disaster recovery protection. Oracle E-Business Suite applications are run on the Oracle SuperCluster platform using Oracle ZFS Storage Appliance for storage and Oracle's StorageTek SL3000 tape library for onsite backup and archiving. Oracle Active Data Guard and Oracle ZFS Storage Appliance provide replication of both applications and unstructured data from the primary site to the secondary site, continually or periodically, depending on business needs. Tape backups can be run at both the local and remote sites for increased redundancy and protection of valuable data.

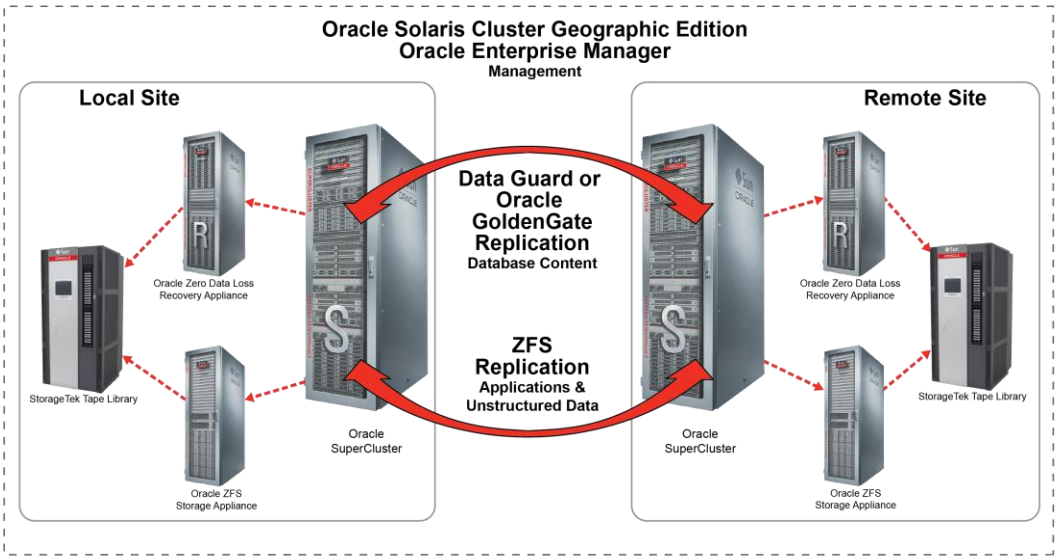

Figure 14. Oracle SuperCluster can be deployed as a part of an effective disaster recovery topology.

Oracle E-Business Suite Application and Database Data Failover

In the Oracle SuperCluster platform, applications and unstructured data (i.e., non-database data) reside in shared file systems on Oracle ZFS Storage Appliance. Snapshot-based replication and remote replication of data is supported from the source Oracle ZFS Storage Appliance to any number of target appliances. In the event of a disaster that impacts service of the primary appliance, administrators activate service at the remote disaster recovery site. When the primary site has been restored, normal service is then resumed and recovery time is dramatically reduced, compared to traditional offline backup architectures.

Oracle Active Data Guard is included with Oracle Database and provides management, monitoring, and automation tools to create and maintain synchronized standby copies of production databases for protection against failures, corruption, and disasters at the primary site. If the primary site fails, operations can be quickly transferred to the secondary site for uninterrupted service. Oracle Active Data Guard improves return on investment of disaster recovery sites. Because the standby databases are fully operational, they can also be used to minimize downtime during planned maintenance on the primary production environment. Moreover, adding Oracle Active Data Guard allows read-only access to standby databases to offload queries, reporting, and backups from the primary database, improving overall performance of the environment.

Planning for protection from disasters and other catastrophic events is essential for businesses and organizations. Oracle Optimized Solution for Disaster Recovery supports a range of options to provide the disaster recovery solution that best meets an organization's needs. For more information on disaster recovery, refer to the Oracle white paper "Oracle Optimized Solution for SuperCluster Disaster Recovery."

Oracle Consulting Services

Oracle SuperCluster engineered systems provide the high performance and productivity for IT processes, transactions, applications, and workloads critical to the success of business organizations. To help reduce the deployment risk and take maximum advantage of this technology, Oracle Consulting delivers a suite of services that can help organizations implement and migrate new technology solutions while staying focused on critical business

needs. Services provided by Oracle Consulting helps to plan, architect, and implement a solution based on unique business environments, helping organizations achieve a successful low-risk deployment. Oracle Consulting and Oracle Advanced Customer Support Services together provide five categories of services for architecture optimization with proven success for faster adoption as depicted in the Figure 15.

Figure 15. Drive faster adoption and lower deployment risk with five architecture optimization services provided by Oracle Consulting and Oracle Advanced Customer Support Services.

Optimized Solutions Goals for Oracle E-Business Suite

Oracle Consulting will provide a pre-built architecture optimized to rapidly migrate, upgrade, and implement Oracle E-Business Suite and other Oracle Applications by significantly simplifying the effort to move, upgrade, and implement Oracle Applications on Oracle engineered systems. This process leverages organizations existing investments, skills, and operations, while offering the most cost effective solution—with very low overall risk. The following are the goals of Oracle Consulting:

- **Ensure Rapid Adoption**. Provide a pre-configured, integrated, complete system and architecture that is standards-based, rapidly deployable, scalable, highly available, manageable, and secure without compromising performance.
- **Maximize Value**. Provide IT strategy and architecture services to help maximize the value of IT portfolios and quickly harness new solutions, such as Oracle's servers & storage, engineered systems, big data, and cloud solutions.

A summary of Oracle Consulting services for architecture optimization is shown in Table 1.

TABLE 1. ARCHITECTURE OPTIMIZATION SERVICES OVERVIEW

Oracle Consulting IT Strategy and Architecture	» *IT strategy and architecture services help maximize the value of IT portfolios and quickly harness new solutions, such as Oracle servers, storage, engineered systems, big data, and cloud solutions.* » *Business architecture services ensure business process optimization and provide organizational change management.* » *These services leverage certified architectures and best-practice methodologies.*
Oracle Consulting Application and Upgrade Services	» *Provides functional and technical expertise for Oracle E-Business Suite and Oracle's Siebel, PeopleSoft, and JD Edwards applications* » *Provides delta training, fit/gap analysis, and configuration to ensure application optimization* » *Provides exposure to pre-GA releases and training for new releases* » *Provides customizations, extensions, modifications, localizations, and integrations (CEMLI) analysis (free service)*
Oracle Consulting Oracle Migration Factory	» *Provides platform migration services that include Oracle hardware, Oracle Database, and technology migrations* » *Leverages Oracle Migration Factory for a lower cost, reduced risk, factory-based approach. Provides Automated Database Migration Service option with Oracle Advanced Customer Support via Oracle Advanced Support Gateway* » *Provides an integrated testing solution that ensures migration quality, scalability, and the availability of Oracle Applications and technology*
Oracle Advanced Customer Support Hardware Installation and Configuration: Fixed Scope/Fixed Price	» *Delivers comprehensive installation, configuration, and testing services to shorten time to deployment and enhance new server and storage stability and performance* » *Provides system installation, including critical patches, updates, and common upgrades such as CPUs and memory using proven methodologies and best practices*
Oracle Advanced Customer Support Preproduction Support and Readiness and Go-Live Support: Fixed Scope/Fixed Price	» *Assesses go-live and operational readiness and provides a dedicated Technical Account Manager to guide go-live plan* » *Provides a production support review and plan*

Who better to advise about, architect, assist with, and assess Oracle engineered systems than the experts who built them? For more information on the available Oracle Consulting services, please refer to the following websites: Oracle Consulting for Oracle E-Business Suite, Oracle Consulting for Oracle Engineered Systems, and Oracle Migration Factory.

Summary and More Information

The complexity of business applications continues to challenge many IT organizations, especially as modules are added. The complete infrastructure offered by Oracle SuperCluster enables IT staff to simplify the data center by consolidating Oracle E-Business Suite systems on a pre-tested, ready-to-deploy architecture that can reduce time to deploy, risk, and cost. By taking advantage of Oracle's integrated solution, IT organizations can put more workloads on a high-performance, highly-available system with a very compact data center footprint to achieve significantly better resource utilization, further reducing costs and increasing return on investment. Production, QAS/DR, development, and test systems can all be isolated from one another, and clustering techniques can ensure that applications and databases remain available for users.

Innovative integration and intelligent engineering built into the Oracle SuperCluster enables enterprises to take advantage of incremental scalability to easily meet future growth requirements while accelerating Oracle E-Business Suite application performance, simplifying administration tasks, and reducing day-to- day management demands. Each Oracle SuperCluster is installed and configured by specification and IT managers can rely on system solidity,

right out of the box, enabling production sooner and reducing overall costs. In addition, the elimination of expensive non-Oracle specialty hardware and security management software reduces the number of software licenses required and lowers overall acquisition costs. These unique characteristics work together to help IT organizations improve overall productivity, lower total cost of ownership, and reduce deployment risk.

For more information on Oracle's technology stack for Oracle E-Business Suite environments, see the references in Table 2.

TABLE 2. REFERENCES FOR MORE INFORMATION

Websites	
Oracle Optimized Solutions	oracle.com/optimizedsolutions
Oracle SuperCluster	oracle.com/supercluster
Oracle's SPARC T-Series servers	oracle.com/goto/tseries
Oracle Solaris	oracle.com/solaris
Oracle Solaris Cluster	oracle.com/us/products/servers-storage/solaris/cluster/overview/index.html
Oracle ZFS Storage Appliance	oracle.com/us/products/servers-storage/storage/unified-storage
Oracle's Exadata Storage Expansion Racks	oracle.com/us/products/database/exadata/expansion-storage-rack/overview/index.html
Oracle E-Business Suite	oracle.com/us/products/applications/ebusiness/overview/index.html
Oracle Optimized Solution for Backup and Recovery	oracle.com/us/solutions/oos/oracle-backup-and-recovery/overview/index.html
Oracle Optimized Solution for Disaster Recovery	oracle.com/technetwork/server-storage/hardware-solutions/oo-soln-disaster-recovery-1970458.html
Oracle Technology Network	oracle.com/technetwork/index.html
Oracle Consulting	oracle.com/us/products/consulting/overview/index.html
Oracle SuperCluster White Paper	
"A Technical Overview of Oracle SuperCluster T5-8"	oracle.com/technetwork/server-storage/sun-sparc-enterprise/documentation/o13-045-sc-t5-8-arch-1982476.pdf
Oracle's Exadata Database Machine White Papers	
"E-Business Suite on Exadata: Oracle Maximum Availability Architecture White Paper"	oracle.com/technetwork/database/features/availability/maa-ebs-exadata-197298.pdf
"Oracle SuperCluster T5-8: Servers, Storage, Networking, and Software—Optimized and Ready to Run"	oracle.com/us/products/servers-storage/servers/sparc/supercluster/supercluster-t5-8/ssc-t5-8-wp-1964621.pdf
Oracle Solaris White Papers	
"Oracle Solaris and Oracle SPARC T4 Servers—Engineered Together for Enterprise Cloud Deployments"	oracle.com/us/products/servers-storage/solaris/solaris-and-sparc-t4-497273.pdf
"Oracle Solaris and Oracle Solaris Cluster: Extending Oracle Solaris for Business Continuity"	oracle.com/technetwork/server-storage/solaris-cluster/documentation/solaris-cluster-businesscontinuity-168285.pdf

Oracle Database White Paper

"Oracle Database 11*g* Release 2 High Availability"	oracle.com/technetwork/database/features/availability/twp-databaseha-11gr2-1-132255.pdf

Backup, Recovery, High Availability, and Disaster Recovery White Papers

"Oracle Optimized Solution for Backup and Recovery of Oracle SuperCluster"	oracle.com/technetwork/server-storage/hardware-solutions/oos-ocs-backup-recovery-1973464.pdf
"Oracle Data Guard 11*g* Data Protection and Availability for Oracle Database"	oracle.com/technetwork/database/features/availability/twp-dataguard-11gr2-1-131981.pdf

Oracle Solution Support Document

Oracle Support Document 1558827.1, "Oracle Optimized Solution for Oracle E-Business Suite"	support.oracle.com/epmos/faces/DocumentDisplay?id=1558827.1

Security Resources

Oracle E-Business Suite System Administrator's Guide – Security (Release 12.1)	docs.oracle.com/cd/E18727_01/doc.121/e12843/T156458T156461.htm
Oracle E-Business Suite Security Guide (Release 12.2)	docs.oracle.com/cd/E26401_01/doc.122/e22952/T156458T156461.htm
Oracle Database Security Guide 11g Release 2 (11.2)	docs.oracle.com/cd/E11882_01/network.112/e36292/title.htm
My Oracle Support Document 946372.1 – Secure Configuration of Oracle E-Business Suite Profiles	support.oracle.com/epmos/faces/DocumentDisplay?id=946372.1
Oracle Database Security Guide 12c Release 1 (12.1)	docs.oracle.com/database/121/DBSEG/E48135-11.pdf
Oracle Solaris 11 Security Guidelines	docs.oracle.com/cd/E26502_01/pdf/E29014.pdf

Appendix A: Analyzing the Solution's Characteristics

To understand the behavior of the architecture under peak load conditions, determine optimum utilization, verify the scalability of the solution, and exercise high availability features, Oracle engineers recently ran the Oracle E-Business Suite Applications R12 Benchmark, using Oracle Database on Oracle's SPARC SuperCluster T4-4. The following sections provide an overview and the results of the testing that was done.

Oracle Application Testing Suite

For improved productivity and greater streamlining, business software must deliver rich functionality and robust performance, maintained at high volume levels that are representative of business environments. Oracle Application Testing Suite benchmark is focused on ERP applications and represents a mixed workload intended to model the most common transactions, operating on the most widely used enterprise application modules. Definitions of the transactions that comprise the benchmark load were obtained through collaboration with functional consultants and are representative of typical customer workloads. A set of the Oracle Application Testing Suite transactions were selected to model Oracle E- Business Suite application workloads, in order to exercise batch and online transaction processing performance. Several benchmark transactions from HR Self-Service Flow, Payroll Batch Processing, Order Management Flow, and Financials Flow workloads were used in the performance testing. This section provides an overview of various system performance results when running the Oracle Application Testing Suite benchmark model workloads on SPARC SuperCluster T4-4.

Performance Testing Configuration and Methodology

Performance testing on Oracle SuperCluster systems follows the methodology developed for sizing Oracle E-Business Suite applications. Selected transactions from common business flows in Oracle E-Business Suite applications have been scripted to automate the load generation. This testing allows large numbers of simulated concurrent users to exercise the system under test. The described methodology allows for repeatable tests to verify performance, scalability and processing accuracy, while tailoring application and environment attributes. Table A1 lists benchmark software versions used in the testing conducted at Oracle.

TABLE A1. ORACLE E-BUSINESS SUITE ON ORACLE SUPERCLUSTER

Virtualization	Oracle VM Server for SPARC Oracle Solaris Containers on Oracle Solaris 10
Operating environment	Oracle RAC VM: Oracle Solaris 11 Application Server VM: Oracle Solaris 10 8/11
Clustering	Oracle Solaris Cluster 3.3 5/11 (OSC3.3u1)
Management	Oracle Enterprise Manager Ops Center 11*g* Release 1 Oracle Enterprise Manager Grid Control (for database)
Database	Oracle RAC 11*g* Release 2 Oracle's Exadata Storage Server Software version 11.2.3.2 Compute nodes: Exadata Storage Server Software version 11.2.0.3 DB + bundle patches
Benchmark workloads used to model Oracle E-Business Suite results on Oracle SuperCluster	Oracle Application Testing Suite workloads » *HR Self-Service Flow* » *Payroll Batch Processing* » *Order Management Flow* » *Financials Flow*

Overview of Performance Testing Scenarios and Testing Results

A standard configuration approach that was described in the "A Basic Production System" section of this white paper was used to generate transactional load on a multi-node Oracle E-Business Suite 12.1.3 environment deployed on Oracle SuperCluster. The Oracle Application Testing Suite benchmark software was installed on a single NFS4 mount point in the application domain, enabling multiple nodes in the deployment to share the Application Tier File System. The database components of Oracle Application Testing Suite benchmark were deployed in database domains. The Resource Controls feature of Oracle Solaris Zones was not used in this testing, so both the database tier and the application tier used all the domain system resources without any restrictions.

The performance results illustrated in this document were obtained on a highly available SPARC SuperCluster T4-4 system as it could be deployed at a customer site, not on a special-purpose, performance-tuned benchmark setup. There are many critical differences between real-world and one-time benchmark configurations. Designed to reduce latency and overhead, increase throughput and bandwidth, and simplify configurations overall, most benchmarks generally do not implement high availability features. For example, in benchmarks, most data typically is stored on striped local disks instead of using highly available shared storage. For these reasons, the performance results disclosed in this document are designed to provide general guidance for real-world deployments, not to be compared with published benchmark results from Oracle or other vendors.

HR Self Service Flow

Workload description:

- **Cash Expenses**. The user creates and submits a consolidated expense report that includes various expenses such as airfare, car rental, hotel, meal and entertainment.
- **Credit Card Expenses**. This expense is similar to a cash expenses except that these expenses are paid using a credit card.
- **Timecards**. The user creates a timecard entry with information about his/her project along with the tasks worked on and the time spent on each task.
- **Retrieve Payslip**. Self-explanatory.

Table A2 shows throughput metrics and user load distribution.

TABLE A2. THROUGHPUT METRICS AND WORKLOAD DISTRIBUTION

Throughput Metrics	User Load Distribution
Number of cash expenses created	Cash Expenses 25%
Number of credit cash expenses created	Credit Card Expenses 25%
Number of timecards created	Timecards 25%
	Payslip Retrieval 25%

Table A3 shows the Java Virtual Machine (JVM) configuration.

TABLE A3. JVM CONFIGURATION

Per-Application Node OACore JVMs		
Number of Users	Count	Heap Size
2000	12	1.5 GB

In tests with self-service users, workloads scaled smoothly when tested separately with 2000 users. Response time increased only imperceptibly, while CPU and memory utilization rose predictably. Measured HR Self-Service online transaction processing performance results are provided in Figure A1. Measured performance for CPU and memory utilization for the database tier and application tier are provided in Table A4.

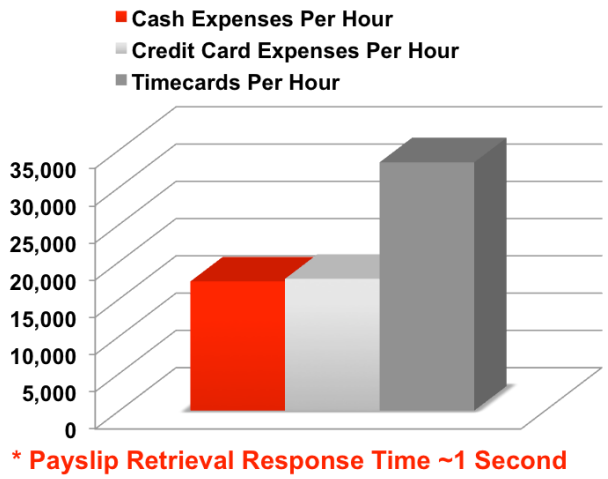

Figure A1. Results for 2000-user performance test for HR Self-Service benchmark online transaction processing.

TABLE A4. MEASURED SYSTEM PERFORMANCE FOR HR SELF-SERVICE ONLINE TRANSACTION PROCESSING PERFORMANCE

	PER-NODE CPU AVERAGES		PER-NODE MEMORY FOOTPRINT		PER-ORACLE EXADATA STORAGE SERVER STATISTICS	
USER COUNT	DATABASE TIER	APPLICATION TIER	DATABASE TIER	APPLICATION TIER	EXADATA SMART FLASH LOGGING	EXADATA SMART FLASH CACHE
2000	37%	45%	88 GB	27 GB	100%	77%

Payroll Batch Processing

Workload description:

- **Payroll Process**. This test performs calculations to complete the gross-to-net calculation including earnings, deductions and taxes.
- **PrePayments**. This test distributes the net pay according to personal pay method: Direct Deposit, Check or Cash.
- **NACHA**. This test creates a bank interface flat file to be dispatched to banks.
- **Check Writer**. This test allocates check numbers, creates and prints the pay check along with the paper payslip.
- **Costing**. This test associates the payroll transaction data with the General Ledger (GL) accounts.

Applications benchmark configuration:

- Two Concurrent Processing nodes in a Parallel Concurrent Processing (PCP) setup
- Total number of Standard Manager processes: 128
- No node affinity; concurrent requests were load balanced on both CP nodes as well as both instances in clustered database

Tuning parameters:

- Key PAY_ACTION_PARAMETERS
  - CHUNK_SIZE = 20 for Payroll process
  - CHUNK_SIZE = 2600 for PrePayments, NACHA and Costing processes
  - CHUNK_SHUFFLE=Y

The Payroll batch processing could process 925,000 paychecks per hour. Measured performance for Payroll throughput is provided in Figure A2. Measured performance results for both CPU and memory utilization are provided in Table A5.

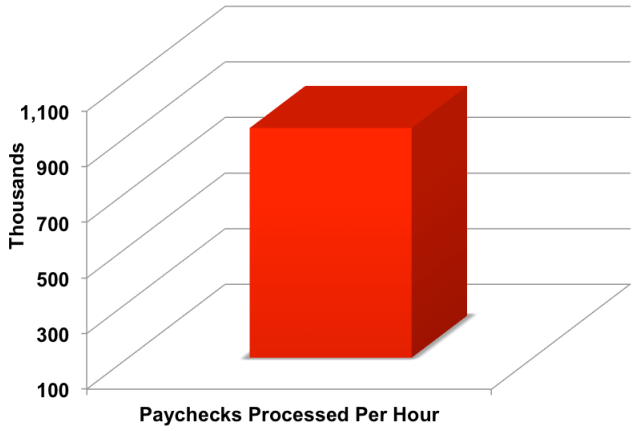

Figure A2. Payroll batch processing measured performance results.

TABLE A5. MEASURED SYSTEM PERFORMANCE FOR PAYROLL BATCH PROCESSING PERFORMANCE

PER-NODE CPU AVERAGES		PER-NODE MEMORY FOOTPRINT	PER-ORACLE EXADATA STORAGE SERVER STATISTICS	
AVERAGE	PEAK	DATABASE TIER	EXADATA SMART FLASH LOGGING	EXADATA SMART FLASH CACHE
15%	47%	52 GB	100%	83%

Order Management Flow

Workload description:

- **Create Order**. The user creates and books a five line order from the "Orders" page.
- **Pick Release**. The user navigates to the "Shipping -> Release Sales Order" page, retrieves a sales order by order number, and releases the sales order for delivery.
- **Ship Order**. The user navigates to the "Shipping -> Transactions" page, finds a particular order in a range of sales orders, completes the confirmation steps, and acknowledges that the shipment is complete.
- **Generate Invoice**. The user navigates to the "Transactions -> Transactions" page and generates invoice by entering the source, reference number, and line item information for five lines.

Table A6 shows the throughput metrics and user load distribution.

TABLE A6. THROUGHPUT METRICS AND WORKLOAD DISTRIBUTION

THROUGHPUT METRICS	USER LOAD DISTRIBUTION
Number of order lines created	Create Order 40%
Number of invoice lines created	Pick Release 20%
	Ship Order 20%
	Generate Invoice 20%

Table A7 shows the JVM configuration.

TABLE 7A. JVM CONFIGURATION

Per-Application Node OACore JVMs		
Number of Users	Count	Heap Size
	1	1.5 GB

Per-Application Node OAForms JVMs		
Number of Users	Count	Heap Size
	4	1.5 GB

The workload scaled smoothly when tested separately with 3000 concurrent Forms users executing Order Management transactions. Response time only increased imperceptibly, while CPU and memory utilization rose predictably. The measured performance results for Order Management Online Transaction Processing are provided in Figure A3. The measured performance results for CPU and memory utilization are provided in Table A8.

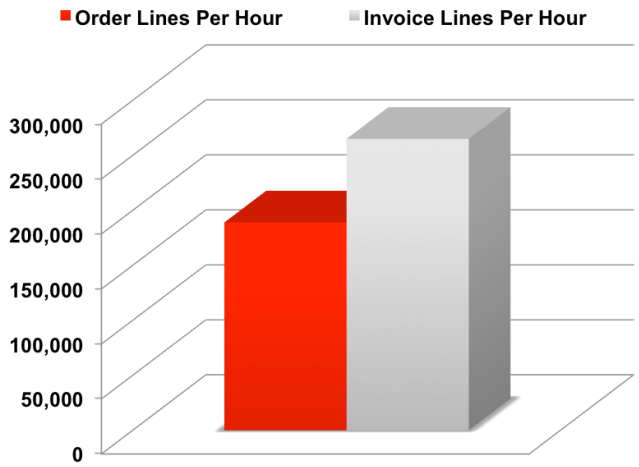

Figure A3. Results for 3000-user performance test for Order Management Flow online transaction processing.

TABLE A8. MEASURED SYSTEM PERFORMANCE FOR ORDER MANAGEMENT FLOW ONLINE TRANSACTION PROCESSING PERFORMANCE

	PER-NODE CPU AVERAGES		PER-NODE MEMORY FOOTPRINT		PER-ORACLE EXADATA STORAGE SERVER STATISTICS	
USER COUNT	DATABASE TIER	APPLICATION TIER	DATABASE TIER	APPLICATION TIER	EXADATA SMART FLASH LOGGING	EXADATA SMART FLASH CACHE
3000	50%	12%	66 GB	94 GB	100%	79%

Financials Order Flow

Workload description:

- **Fixed Asset: Create Asset**. The user creates a fixed asset and then queries for a specific asset using asset number.
- **GL: Journal Entry**. The user creates a journal entry in general ledger and queries for a particular account, and checks the balance and journal details.
- **INV: Insert Miscellaneous Transactions**. The user submits an inventory transaction by creating a five-line miscellaneous receipt.
- **INV: Retrieve Item**. The user queries for and views the on-hand availability and quantities of specific items.

Table A9 shows the throughput metrics and user load distribution.

TABLE A9. THROUGHPUT METRICS AND WORKLOAD DISTRIBUTION

THROUGHPUT METRICS	USER LOAD DISTRIBUTION
Number of Fixed Assets created	Fixed Asset : Create Asset 25%
Number of General Ledger Journal entries created	GL : Journal Entry 25%
Number of Inventory Miscellaneous transactions completed	INV : Insert Misc Trx 25%
	INV : Retrieve Item 25%

Table A10 shows the JVM configuration.

TABLE A10. JVM CONFIGURATION

Per-Application Node OACore JVMs		
Number of Users	Count	Heap Size
2000	2	1.5 GB

Per-Application Node OAForms JVMs		
Number of Users	Count	Heap Size
2000	3	1.5 GB

In tests with HTML and Forms users (2000), the workloads scaled smoothly. Response time increased only imperceptibly, while CPU and memory utilization rose predictably. Measured performance results for Financials Online Transaction Processing are provided in Figure A4. Measured performance results for CPU and memory utilization are provided in Table A11.

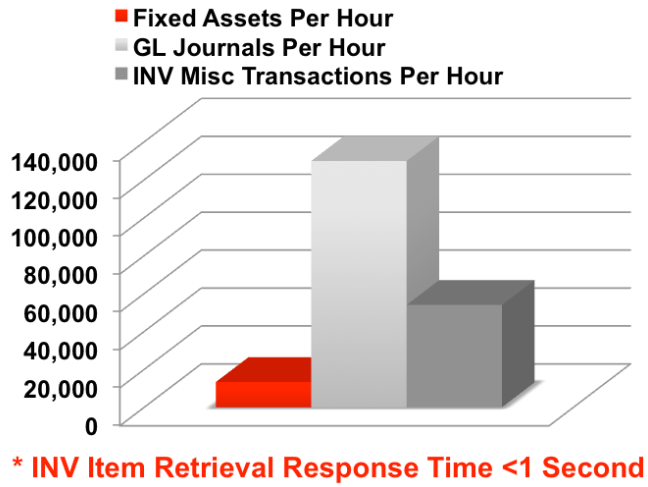

Figure A4. 2000-user measured performance results for Financials Flow online transaction processing.

TABLE A11. MEASURED SYSTEM PERFORMANCE FOR FINANCIAL FLOW ONLINE TRANSACTION PROCESSING

	PER-NODE CPU AVERAGES		PER-NODE MEMORY FOOTPRINT		PER-ORACLE EXADATA STORAGE SERVER STATISTICS	
USER COUNT	DATABASE TIER	APPLICATION TIER	DATABASE TIER	APPLICATION TIER	EXADATA SMART FLASH LOGGING	EXADATA SMART FLASH CACHE
2000	11%	7%	61 GB	48 GB	100%	84%

Backup and Recovery Performance Testing and Results

Backup and recovery tests were done to show the performance of the Oracle SuperCluster for backup and recovery and to test the ability to clone an entire Oracle E-Business Suite environment.

For an Oracle E-Business Suite deployment on Oracle SuperCluster systems, there are only two key areas of the system that need to be backed up to recover or clone the entire system: the Oracle E-Business Suite code tree that is installed on the internal network-attached storage and the database that is installed on the Oracle Exadata Storage Servers. For all the backup and recovery tests, Oracle Optimized Solution for Backup and Recovery was used with a deployment of Oracle ZFS Storage Appliance and a tape configuration consisting of a StorageTek SL3000 tape library and StorageTek T10000C tape drives from Oracle. There are no performance differences between disk and tape backups of the Oracle E- Business Suite environment with the exception of the tape system being required to mount tapes to begin the backup or restore. Both disk and tape backup methods could easily take full advantage of the Oracle SuperCluster extreme I/O abilities for backup and restore.

For both half-rack and full-rack Oracle SuperCluster configurations, the backups can be done in approximately one hour and restores can be done in approximately one and a half hours, even if the database consumes the entire capacity of the Oracle Exadata Storage Servers. The database used to test the environments consisted of a database that was ~350 GB and had up to ~750 GB of archive logs.

TABLE A12. MAXIMUM BACKUP AND RESTORE RUNTIMES

ORACLE SUPERCLUSTER CONFIGURATION	USABLE DATABASE CAPACITY (TB)	FAST RECOVERY AREA CAPACITY (TB)	MAXIMUM BACKUP RUNTIME (HRS)	MAXIMUM RESTORE RUNTIME (HRS)
HALF RACK	8.4	2.1	1	1.5
FULL RACK	16.9	4.2	1	1.5

TABLE A13. ORACLE E-BUSINESS SUITE TEST DATABASE MAXIMUM BACKUP AND RESTORE RUNTIMES

ORACLE SUPERCLUSTER CONFIGURATION	USED DATABASE CAPACITY (TB)	FAST RECOVERY AREA USAGE (TB)	MAXIMUM BACKUP RUNTIME (MINUTES)	MAXIMUM RESTORE RUNTIME (MINUTES)
HALF RACK	.35	.75	12	16
FULL RACK	.35	.75	6	8

Performance Result Conclusions

The results demonstrate that Oracle E-Business Suite on Oracle SuperCluster can deliver extreme throughput at high concurrency in a highly available configuration with headroom for unexpected high seasonal load or future growth.

- The optimum number of JVMs and Forms are configured to process thousands of web-based or Forms based online workloads.
- The CPU and memory requirements depend on the type of the online modules with Forms consuming more memory and less CPU, and web-based modules consuming more CPU and less memory.
- The InfiniBand (IB) interconnect in Oracle SuperCluster provides customers a choice to configure Concurrent Manager on the Application tier without a performance impact and with additional processing capacity in the Database tier.
- Businesses are able to run batch processes on a single Oracle RAC instance with equal or better performance when one node is taken down for maintenance.

Solution High Availability Test Results

To validate the high availability of the overall solution, numerous rigorous failure tests were performed under load on the Application and Web architecture tiers, as well as on the whole Oracle Solaris 10 application domain (Applications VM), on the whole Oracle Solaris 11 database domain (Database VM), and on a complete SPARC T4-4 server node. The tables in the following sections list the measured results. The numbers provided in this document are for the indication of activity duration and are based on the cluster being configured using default settings.

Oracle Web Server Node Failure

The zone cluster node that was abruptly rebooted was running the Oracle Web Server and one instance of Oracle Process Manager and Notification Server/OC4J (Oracle Containers for Java/J2EE). The other zone cluster node was running the other instance of Oracle Process Manager and Notification Server/OC4J. Upon failure of the zone cluster node, Oracle Solaris Cluster detects the failure and immediately fails over Oracle Web Server and logical host associated with that instance on the SPARC SuperCluster client access network, as well the logical host of the impacted Oracle Process Manager and Notification Server/OC4J on the internal IB network. The fast failover of the logical host ensures that users are disconnected right away and are able to reconnect as soon as service recovery is completed. The failed zone cluster node is automatically rebooted by Oracle Solaris. Oracle Solaris Cluster then automatically re-establishes the zone cluster and restarts the Oracle Process Manager and Notification Server/OC4J instance.

Table A14 shows the results of failing the zone cluster node running Oracle Web Server and one instance of Oracle Process Manager and Notification Server/OC4J.

- Failure detection time is the duration between the time of the fault injection and the time the zone cluster node is declared out of the zone cluster membership.
- Service recovery time is the duration between the detection time and the time Oracle Web Server has successfully failed over.
- Full redundancy recovery time is the duration between the detection time and the time the impacted Oracle Process Manager and Notification Server/OC4J instance is available again.

TABLE A14. WEB SERVER NODE FAILURE DETECTION AND RECOVERY RESULTS

PROCESS STAGE	TIME (IN SECONDS)
Failure detection time	11
Service recovery time	12
Full redundancy recovery time	65

Oracle Process Manager and Notification Server/OC4J Instance Failure

Oracle Web Server and one instance of the Oracle Process Manager and Notification Server/OC4J are running on the redundant zone cluster node prior to this test. On the other zone cluster node, all the processes of the other Oracle Process Manager and Notification Server/OC4J instance are killed. Oracle Solaris Cluster detects the failure and immediately restarts the Oracle Process Manager and Notification Server/OC4J instance. The logical host associated with the failed Oracle Process Manager and Notification Server/OC4J instance is not failed over as the failed Oracle Process Manager and Notification Server/OC4J instance is being restarted. Only user sessions using the impacted Oracle Process Manager and Notification Server/OC4J instance are disconnected upon the failure of that instance and are able to reconnect to the redundant Oracle Process Manager and Notification Server/OC4J instance to obtain services right away. User sessions using the other Oracle Process Manager and Notification Server/OC4J instance are not impacted. When the impacted Oracle Process Manager and Notification Server/OC4J instance is recovered, new user sessions will be load balanced again to this instance.

Table A15 shows the results of failing all the processes of an Oracle Process Manager and Notification Server/OC4J instance. The faulted instance is automatically restarted by Oracle Solaris Cluster.

- Failure detection time is the duration between the time of the fault injection and the time Oracle Solaris Cluster detects that the processes have failed.
- Service recovery time is the amount of time it takes the system to restore a service after a service has failed.
- Full redundancy recovery time is the duration between the detection time and time the Oracle Process Manager and Notification Server/OC4J instance is available again.

TABLE A15. ORACLE PROCESS MANAGER AND NOTIFICATION SERVER/OC4J FAILURE DETECTION AND RECOVERY RESULTS

PROCESS STAGE	TIME (IN SECONDS)
Failure detection time	0
Service recovery time	0
Full redundancy recovery time	113

Note that the recovery time of the impacted Oracle Process Manager and Notification Server/OC4J instance is greater than the recovery time from the previous test (Oracle Web Server node failure) because Oracle Solaris

Cluster needs to perform a restart (STOP/START), whereas the previous test just performed a START. The additional 48 seconds (113–65) can be attributed to Oracle Solaris Cluster performing a STOP and cleanup for all Oracle Process Manager and Notification Server/OC4J components prior to performing a START. The service recovery time is immediate due to active/active Oracle Process Manager and Notification Server/OC4J deployment.

Oracle Concurrent Manager Node Failure

An instance of Oracle Concurrent Manager is running on each zone cluster node, within a Parallel Concurrent Processing configuration, prior to one zone cluster node being abruptly rebooted. Oracle E-Business Suite Parallel Concurrent Processing ensures that batch reports are still processed on Oracle Concurrent Manager running on the redundant zone cluster node. Additionally, batch reports that were running on the failed Oracle Concurrent Manager are automatically restarted on the redundant Oracle Concurrent Manager on the redundant zone cluster node. The failed zone cluster node is automatically rebooted by Oracle Solaris. Oracle Solaris Cluster then automatically re-establishes the zone cluster and restarts the Oracle Concurrent Manager instance.

Table A16 shows the results of failing one of the zone cluster nodes that runs Oracle Concurrent Manager. The faulted zone is automatically rebooted by Oracle Solaris. Oracle Solaris Cluster then automatically restarts the Oracle Concurrent Manager instance in the zone.

- Failure detection time is the duration between the time of the fault injection and the time the zone cluster node leaves the zone cluster membership.
- Full redundancy recovery time is the duration between the detection time and time the Oracle Concurrent Manager instance is available again.

TABLE A16. ORACLE CONCURRENT MANAGER NODE FAILURE DETECTION AND RECOVERY RESULTS

PROCESS STAGE	TIME (IN SECONDS)
Failure detection time	13
Full redundancy recovery time	35

Oracle Solaris 10 Application Domain Failure

The Oracle Solaris 10 application domain that was abruptly failed was running an instance of Oracle Process Manager and Notification Server/OC4J and Oracle Concurrent Manager within separate zone cluster nodes prior to this test. Upon failure, the Oracle Solaris 10 application domain panics and needs to be manually rebooted. Upon failure of the Oracle Solaris 10 application domain, Oracle Solaris Cluster detects the failure and immediately fails over the logical host associated with the failed Oracle Process Manager and Notification Server/OC4J instance to the surviving zone cluster node. The fast failover of the logical host ensures that user sessions using that instance are disconnected right away and are able to reconnect to the other Oracle Process Manager and Notification Server/OC4J instance before the impacted Oracle Process Manager and Notification Server/OC4J instance is recovered. Batch reports remain unaffected, as described in the previous test (Oracle Concurrent Manager node failure).

Table A17 shows the results of failing one of the application domains containing one node each of the two zone clusters. The impacted zone cluster nodes run the Oracle Process Manager and Notification Server/OC4J and Oracle Concurrent Manager instances, but not Oracle Web Server.

- Failure detection time is the duration between the time of the fault injection and the time the Oracle Solaris 10 application domain leaves the global cluster membership.
- Service recovery time is the duration between detection time to when the logical host for the impacted Oracle Process Manager and Notification Server/OC4J instance has failed over, enabling impacted users to reconnect. The Oracle Solaris 10 application domain is then manually rebooted.

» Full redundancy recovery time is the duration from when the zone cluster nodes rejoined and the time the Oracle Process Manager and Notification Server/OC4J and Oracle Concurrent Manager instances are available again.

TABLE A17. ORACLE SOLARIS 10 APPLICATION DOMAIN FAILURE DETECTION AND RECOVERY RESULTS

PROCESS STAGE	TIME (IN SECONDS)
Failure detection time	0
Service recovery time	10
Full redundancy recovery time:	
• Oracle Concurrent Manager	27
• OracleProcess Manager and Notification Server/OC4J	50

Database Domain Failure

The Oracle Solaris 11 database domain that was abruptly failed was running an instance of Oracle RAC prior to this test. Upon failure, the Oracle Solaris 11 database domain panics and Oracle Clusterware detects the failure. Once the Oracle Solaris 11 database domain is manually rebooted, Oracle Clusterware then automatically re-establishes the cluster and restarts the failed Oracle RAC instance.

Table A18 shows the results of failing one of the database domains containing one Oracle RAC instance.

» Failure detection time is the duration between the time of the fault injection and the time the Oracle Solaris 11 database domain node leaves the Oracle Clusterware cluster membership.

» Database services recovery time is the duration between the time the node failure has been detected and the time the surviving Oracle RAC instance completed the dead instance recovery activities.

» Full redundancy recovery time is the duration between the time the Oracle Solaris 11 database domain has been rebooted and joined the Oracle Clusterware cluster membership and the time the failed Oracle RAC instance is available again.

TABLE A18. ORACLE DATABASE DOMAIN FAILURE DETECTION AND RECOVERY RESULTS

PROCESS STAGE	TIME (IN SECONDS)
Failure detection time	64
Database services recovery time	8
Full redundancy recovery time	155

SPARC T4-4 Server Failure

The SPARC T4-4 node was abruptly powered off while running Oracle Web Server and an instance of Oracle Process Manager and Notification Server/OC4J. Oracle Concurrent Manager was running within separate zone cluster nodes in the Oracle Solaris 10 application domain. The Oracle RAC instance in the Oracle Solaris 11 database domain was running prior to this test. Upon failure, Oracle Solaris Cluster detects the failure and immediately fails over Oracle Web Server and logical hosts associated with the failed instances to the surviving zone cluster node, as described in the earlier test (Oracle Web Server node failure). Oracle Clusterware also detects the database domain failure and initiates the database services recovery.

Once the SPARC T4-4 node is rebooted and the Oracle Solaris 10 application domain is rebooted, Oracle Solaris Cluster then automatically re-establishes the zone clusters and restarts the failed Oracle Process Manager and Notification Server/OC4J instance and the Oracle Concurrent Manager instance. Oracle Clusterware also automatically re-establishes the Oracle RAC cluster and restarts the failed Oracle RAC instance.

Tables A19 and A20 show the results of failing one of the SPARC T4-4 servers.

For the Oracle Solaris 10 application domain:

- Failure detection time is the duration between the time of the fault injection and the time the application domain leaves the global cluster membership.
- Application services recovery time is the duration between the detection time and the time Oracle Web Server is available again.
- After the SPARC T4-4 server is powered on and the Oracle Solaris 10 application domain has been rebooted, the full redundancy recovery time for the Oracle Process Manager and Notification Server/OC4J and Oracle Concurrent Manager instances is the duration between the time the zone cluster nodes joined their respective zone cluster membership and the time the Oracle Process Manager and Notification Server/OC4J and Oracle Concurrent Manager instances are available again.

TABLE A19. SPARC T4-4 NODE FAILURE DETECTION AND RECOVERY RESULTS

PROCESS STAGE	TIME (IN SECONDS)
Failure detection time	9
Application services recovery time	22
Full redundancy recovery time:	
• Oracle Concurrent Manager	25
• Oracle Process Manager and Notification Server/OC4J	40

For the Oracle Solaris 11 database domain:

- Failure detection time is the duration between the time of the fault injection and the time the database domain leaves the Oracle Clusterware membership.
- Database services recovery time is the duration between the detection time and the time the dead instance recovery is completed by the surviving Oracle RAC instance.
- After the SPARC T4-4 server is powered on and the Oracle Solaris 11 database domain has been rebooted, the full redundancy recovery time for the database is the duration between the time the database domain joins the Oracle Clusterware membership and the time the Oracle RAC instance is restarted.

TABLE A20. DETECTION AND RECOVERY RESULTS

PROCESS STAGE	TIME (IN SECONDS)
Failure detection time	61
Database services recovery time	5
Full redundancy recovery time	152

Testing Conclusion and More Information

The previous system performance testing conducted at Oracle was accomplished with Oracle Application Testing Suite deployed on Oracle's SPARC SuperCluster T4-4. Preliminary testing on Oracle SuperCluster T5-8 indicates approximately a 200 percent performance improvement in compute tasks and approximately a 30 percent performance improvement in I/O tasks.

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