



An Oracle White Paper
8-Apr-14

Managing Oracle SuperCluster

Best Practice and Potential Benefits

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Document Updates

- V1.0 / Feb 2014 – First version, Supercluster T5-8 and M6-32

Related Documents

General

- [Oracle's Secret Sauce: Why Engineered Systems are Rocking the Tech Industry](#) (Forbes Magazine article)

SuperCluster

- [A Technical Overview of Oracle SuperCluster](#)
- [Owners Guide](#) (link)
- [Oracle Optimized Solutions](#)
- [Secure Oracle Database Consolidation Using SuperCluster T4-4](#)
- [Oracle SuperCluster: Taking Reliability and Availability to the Next Level](#)

Exadata

- [Exadata Owners Guide](#)
- [Exadata Database Machine Hardware and Software Modification Restrictions](#)
- 'Managing Exadata; Administration Tasks and Tools'. Available from your Oracle account team.
- 'Managing Exadata; A Guide to Maximising Operational Management Benefits.' Available from your Oracle account team.
- [Expert Oracle Exadata](#) by Kerry Osborne, Randy Johnson and Tanel Poder. Apress 2011. ISBN 978-1-4302-3393-3/0.
- [Who manages the Exadata machine ?](#) by Arup Nanda (blog article).
- [Cost comparison for Business Decision Makers; Oracle Exadata Database Machine vs IBM Power Systems](#), by the Factpoint Group, October 2012
- [The Operational Impact of Deploying an Oracle Engineered Systems \(Exadata\)](#)
- [Managing Oracle Exadata using Enterprise Manager Cloud Control 12c](#)

Exalogic

- [Exalogic Owners Guide](#)
- 'Managing Oracle Exalogic (Physical); Maximising Operational Management Benefits.'
- 'Managing Oracle Exalogic (Physical); Administration Tasks and Tools'.
- [Cost comparison for Business Decision Makers; Oracle Exalogic Elastic Cloud vs IBM Power Systems](#), by the Factpoint Group, October 2013

Background to this document

This document aims to assist I.T. managers and senior executives who are evaluating or planning SuperCluster deployments in understanding how it can fit into their existing support processes and organisations.

Oracle SuperCluster represents a new approach to I.T. infrastructure in which new, more intelligent software combines existing and new hardware. It is natural that when planning for its adoption organisations want to be sure that they can manage it effectively on a day to day basis in the context of their existing skill sets, procedures and organisational structures.

As well as radically increased performance and capacity, SuperCluster is simpler to manage and so offers the potential for more agile and lower cost administration. This paper will review what makes this possible and the best practices required to maximize operational efficiency, specifically examining;

1. Process: What tasks does the SuperCluster support organisation need to be able to do?
2. Technology: What tools and techniques are recommended to optimise SuperCluster administration?
3. People: What is the right organisation structure for the various administration teams?

If you are also planning or using other Oracle engineered systems such as Exadata, Exalogic and Exalytics, many of the general principles will apply, but details will differ. Companion papers are available covering the operational management of these systems

Audience

The document is aimed primarily at Operations, Infrastructure and Support managers as well as administration team leaders. However, it is also very relevant to technical architects, project managers and anyone with an interest in how SuperCluster systems should be managed.

Scope

This document is concerned purely with the day-to-day administration tasks required in order to consistently meet service levels around availability and performance once the machines have been installed and configured. It does not cover general solution architecture, setup and configuration of the machine or migration of applications onto the platform. Other papers address these equally important topics.

Best Practices and Recommendations

Within this document are many recommendations and best practices. Following these will enable you to provide the optimal level of support for Oracle SuperCluster. However, they are not mandatory. If resource, architecture or cost constraints mean that you cannot follow them to the letter it does not mean that you cannot use SuperCluster, just that your operational support processes should be refined and improved over time.

Product Updates

Oracle technologies in general, and Engineered Systems (including Oracle SuperCluster) in particular, are continuously being developed. However, it is hoped that the general concepts will remain useful and appropriate to future Oracle SuperCluster implementations.

Executive Overview

The purpose of this document is to provide a guide based on experience from both Oracle Internal IT and our customers on how Oracle SuperCluster can be adopted by IT support organizations.

Oracle Engineered Systems bring Oracle hardware and software together, providing world beating performance and capacity, but perhaps more importantly simplifying I.T. Oracle SuperCluster now in its third iteration is an successful Engineered System, combining highly optimised Exadata and Exalogic functionality with the SPARC/Solaris platform. This provides an excellent platform on which to consolidate Oracle applications and databases along with a wide range of proven ISV applications whether or not they make use of the Oracle database or Oracle Weblogic Server.

With the current market trend to Commoditise IT, many believe that low cost hardware and low cost software will drive efficiencies in their organization. However those that have taken that path have found that the cost of provisioning and running I.T. services have increased dramatically as the focus on lower infrastructure cost has led to increased operational complexity. Studies have shown that Engineered Systems customers including Oracle SuperCluster can save in excess of 40% of their traditional administration and management costs due to its optimised and simplified architecture.

Oracle SuperCluster is the same but different.

It is built from standard Oracle SPARC servers and combines Oracle Solaris with an integrated and low overhead virtualisation layer, which enables consolidation with isolation. The use of the OVM Server for SPARC technology allows the Oracle SuperCluster machine to be configured with two types of domains;

- **Database domains** take advantage of the Exadata platform. The Database Domain is a pre-defined configuration that provides 11gR2 and Oracle 12c database services, Exadata Storage Cells with the unique Storage Cell software. It is designed to reduce complexity and provide standardisation across the entire database technology stack so that, whilst the DBA role is largely unchanged, management of all infrastructure components is greatly simplified. Database domains are managed in the same way as an Exadata Database machine.
- **Application domains** act as a consolidation or application-specific environments for both Oracle and non Oracle software certified on Solaris. While it is possible to run Oracle 11gR2 and Oracle 12c databases in the Application domains, they will not be able to take advantage of the unique Exadata functionality available in the Database domains. Application domains can optionally take advantage of the Exalogic application enhancements to optimise the performance of Oracle middleware and applications. Application domains are managed in the same way as standard SPARC Solaris servers.

Oracle SuperCluster is Easier to manage.

Within both domain types many standard administration tasks are simplified, for example;

- **Provisioning of environments:** Since all compute resources are already configured, provisioning of new database instances or application environments on SuperCluster is simply a software configuration to define resources to be available. Using Solaris Zones virtualised environments within both domain types can be deployed, monitored and managed with ease. Enterprise Manager then allows IaaS, DBaaS, MWaaS or SaaS environments to be configured and managed.

- **Performance Tuning:** This is of course a very common administration task but one that is required much less frequently with SuperCluster because of the extreme performance which is delivered and because all components are pre-configured and optimised. It is also easier since all components are monitored as one and an auto tune service (`ssctuner`) runs continuously to monitor and tune the low level infrastructure in real time. Since database domains are essentially Exadata machines there is a much-reduced need for complex indexes structures and application – specific code hints on the database, which in turn simplifies tuning.
- **Patching:** All I.T. systems benefit from proactive maintenance. This is a straightforward and fully documented process that is simpler on SuperCluster than on traditional platforms. Oracle provides Quarterly patch bundles which contain updates for all infrastructure components as well as Oracle database software. All elements of the bundle are pre-tested, pre-certified and fully documented, which greatly reduces preparation and testing effort. In addition, the Oracle Platinum Support service, which is a zero cost enhancement to Premier Support for Engineered Systems, includes the application of these patches by Oracle (but under your control). Staying up to date with the latest fixes and enhancements becomes much more practical, which in turn minimises the risk of experiencing problems.

Maximising Efficiency and Agility.

Oracle SuperCluster brings a new approach to Oracle infrastructures and, as with the introduction of any new technology, the most benefit will be realised if current procedures can be reviewed and tuned to the simplified operational model that SuperCluster enables. In order to maximise operational efficiency and agility the following guidelines should be followed;

1. People – evolve towards a single administration team or a more unified structure
2. Technology – make full use of the Oracle Enterprise Manager 12c toolset
3. Processes – ensure your processes adopt Oracle best practice for all administration tasks
4. Services – adopt Oracle Platinum Support, which is free for SuperCluster customers

Oracle is here to help

SuperCluster (along with other Oracle Engineered Systems) enables customers to be self-sufficient in managing their complete Oracle environments at less cost and with more flexibility than traditional platforms.

Because of its standardised nature, Oracle can provide Platinum Support at no additional cost for all qualified SuperCluster configurations. This provides remote monitoring, rapid problem notification and resolution along with quarterly patch application carried out alongside your I.T. teams.

In addition, Oracle offers a full range of services to address all aspects of planning, implementing, migrating onto and managing SuperCluster. Our aim is to help you reach your operational goals as quickly as possible: complete self-sufficiency, a fully managed service, or anything in between.

Oracle SuperCluster Architecture

Oracle SuperCluster is a member of Oracles Engineered Systems family. These are pre-certified and pre-tested combinations of software and hardware designed to provide the optimal platform for specific workloads and based on 2 different SPARC Server building blocks. This paper assumes that the reader is familiar with what Oracle SuperCluster is and how it can benefit an organization. While the following is a high level overview of SuperCluster Architecture for further details, [A Technical Overview of Oracle SuperCluster¹](#) should be considered recommended reading.

Oracle SuperCluster is a multipurpose system that has been designed, tested and integrated to run mission critical enterprise applications and rapidly deploy cloud services while delivering extreme performance and efficiency, cost savings and simplified administration. It is well suited to multi-tier applications with web, database and application components. This versatility combined with powerful virtualisation capabilities, makes it an ideal platform on which to consolidate large numbers of different workloads, or to deploy complex multi-user environments.

There are currently 2 SuperCluster variants, T5-8 Oracle SuperCluster and M6-32 Oracle SuperCluster, with the latter designed to optimise extremely large scale or memory intensive workloads. More details are available in the Technical Overviews noted in Related Documents section.

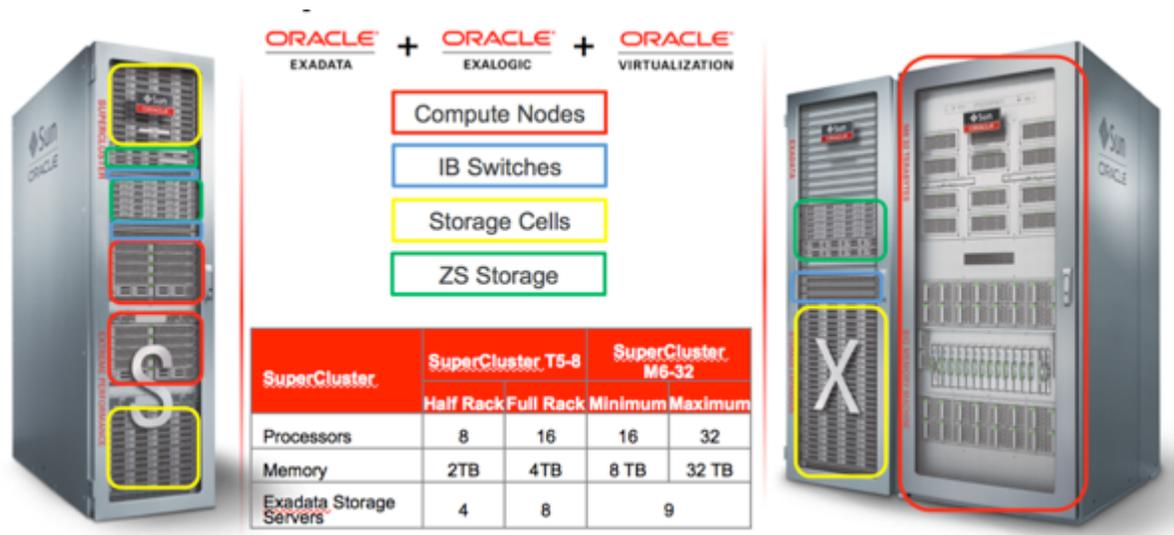


Figure 1 Oracle SuperCluster high-level hardware architecture

¹ <http://www.oracle.com/technetwork/server-storage/sun-sparc-enterprise/documentation/o13-045-sc-t5-8-arch-1982476.pdf>

The overall physical architecture is shown in Figure 1. The SuperCluster architecture combines SPARC based servers with Exadata Storage Cells and the ZS3-ES Storage Appliance connected by a high speed Infiniband network fabric.

This approach enables a high degree of isolation between applications, which may have varied security, reliability and performance requirements. Exadata Storage Servers can either be configured with High Performance Drives (10K RPM,) or High Capacity Drives (7.2K RPM,). Other than the hard drive type, the firmware and flash capacity are identical across all Storage Servers. With the optional Storage Server Expansion Rack it is possible to build Oracle SuperClusters with both Storage Server variants to enable data tiering if required.

Complementing the SPARC server hardware, the operating system throughout is Oracle Solaris., Oracle Solaris 11 is required for the Database Domains, while the choice of Solaris 11 or 10 is available for the Application domains. Each domain can be further virtualised through the use of Solaris Zones, which allows Solaris 8, and 9 branded zones as well as native zones in the Solaris 10 Application domains, and Solaris 10 branded zones and Solaris 11 Zones in the Solaris 11 domains. The use of OVM Server for SPARC for domaining and Solaris Zones within the domains allows the entire SuperCluster Solaris environment to be managed in just the same way as traditional SPARC environments.

The Infiniband technology which transports all I/O within the SuperCluster components provides very high bandwidth, low latency, hardware-level reliability and security and applications that follow Oracle MAA recommendations require no changes to run on the SuperCluster platform. Large scale environments can be created easily by connecting one or more SuperCluster machines together via the Infiniband fabric, along with other Oracle Engineered Systems, such as Exadata, Exalogic, Exalytics or a ZS Storage Appliance as a centralised backup store.

SuperCluster machines are connected to existing data centre infrastructure using the provided 10 GbE ports provisioned in all of the domains.

The M6-32 variant of the SuperCluster adds a third layer of virtualisation whereby the M6-32 is divided into either 2 or 4 PDoms (Physical Domains) which are physically isolated server environments. Each of these physical domains are then further split up into Application and Database Domains using the OVM Server for SPARC technology in much the same way that the T5-8s are domained in the SuperCluster T5-8 variant.

SuperCluster Domains

Oracle SuperCluster provides availability and workload isolation via horizontal scaling utilizing independent domains instead of multiple separate servers. The configuration of the SuperCluster can be varied to suit the architecture. The number, type and size of the different domain types can be adjusted depending on these requirements, and each of these domains can be further virtualised through the use of Solaris Zones. CPU and Memory can then be reallocated among the domains, although at the present time this requires a reboot of the affected domains. Domains can be one of 2 flavours:

- **Database Domains** – Adopts the personality of an Oracle Exadata machine, consisting of Oracle Exadata compute nodes, storage cells, Exadata software, Oracle 11g or 12c Database software and Infiniband connectivity. These domains can also be configured with external FC SAN or NAS connectivity, which can be used for running legacy DB, applications, or for data migration purposes. In general, it is expected that the DB domains be used purely for 11gR2 or above DB workloads using the Exadata storage cells.

- **Applications Domains** – Is essentially a Solaris 10 or Solaris 11 SPARC server with Infiniband access to the DB domains, and the internal ZS3-ES storage appliance. As in the DB domains, they can also be provisioned with FCAL cards for external SAN connectivity. Any application that is supported on Solaris 10 or 11 on SPARC is supported within the Application Domains². This includes all supported versions of the Oracle database, although it is preferred to run 11gR2 or above workloads in the DB domain, as this can take advantage of the Exadata Storage Server optimisations.. The use of Solaris Zones allows additional workload separation as well as the ability to run Solaris 8, 9 10 and 11 workloads.

While there are no enforced configuration rules, it is expected that domains will be configured in pairs (or more) so that workloads can be balanced or failover between these domains for availability and serviceability reasons.

Domain rules for SuperCluster exist and Oracle can advise on how best to architect your SuperCluster machine for your workload requirements. Generally this work is completed once and at installation time only. However resources (CPU, Memory) can then be moved between domains as required. For more information on Domain configurations the reader is advised to read [A Technical Overview of Oracle SuperCluster](#)³. For best practice deployments Oracle also create [Optimized Solutions](#)⁴ for best practice on deployment and configuration to reduce the complexity for key Oracle and non Oracle Applications..

Database Domain

The Database Domain is an Exadata platform with the added ability to take advantage of Solaris Zones to provide additional segregation and security as well as the basis of a flexible and agile Database-as-a-Service / Database Cloud platform. It is therefore managed in almost exactly the same way as an Exadata Database Machine where the only difference is the ability to virtualise a compute node with Solaris Zones. When configured in this way, each Solaris Zone appears to the DBA as an Exadata Database Compute node.

Compared to traditional Oracle database platforms, the Database Domains are the same except for the connectivity to the Exadata Storage Servers.

Oracle 11gR2 or Oracle 12c on SuperCluster is exactly the same database code version as Oracle on any other platform. Applications already running Oracle 11gR2 should require no changes to run against a SuperCluster Exadata database. Standard elements include;

- Oracle 11gR2 or 12c Enterprise Edition Database with ASM and any other standard options
- Oracle Solaris
- Oracle Solaris Zones
- Oracle VM for SPARC (Solaris Logical Domains)

² Please validate with the ISV as some may exclude SuperCluster Support. When this is an issue please engage ISV team <http://solarisapps.us.oracle.com/contact> to work with the ISV.

³ <http://www.oracle.com/technetwork/server-storage/sun-sparc-enterprise/documentation/o13-045-sc-t5-8-arch-1982476.pdf>

⁴ <http://www.oracle.com/technetwork/server-storage/hardware-solutions/index.html>

- Cisco Management Network Switch

All of these components are installed, configured and managed almost exactly the same as they would be on non Oracle SuperCluster platforms.

Oracle Databases must be running 11gR2 or above to take advantage of the Storage Servers. SuperCluster supports the running of older Oracle database versions by making use of traditional storage. Customers can choose to migrate to 11gR2 or 12c as part of the SuperCluster deployment, or may choose the first migrate the databases unchanged into the application domains, and then optionally upgrade in situ, and then migrate to the Database Domains, to fully leverage the SuperCluster Database advantages.

The SuperCluster has been sized and tuned, specifically for running Databases in the Database Domains, and provides a fully optimised platform out of the box without the need for large amounts of integrating, tuning and testing on the part of the customer.

The alternative requires a large investment in time and effort to study compute requirements, research the available products and technologies, solicit vendor proposals, select component products, order, receive and install the components, apply firmware and software patches, obtain and install device drivers and finally, test, tune and document the resulting system. The resulting system, even if perfectly tuned would still not be able to match the benefits that accrue from the use of the intelligent databases storage provided by the Exadata Storage Servers.

What is different to a normal RAC Database?

These differences not only explain the performance and capacity increases, but also why the amount of administration required is actually less than that of an Oracle database systems on traditional hardware platforms. There are two major differences (assuming you already run Oracle 11gR2 using RAC and ASM)

1. **Pre-engineered.** All the components in the machine are pre-configured, pre-tested, pre-certified pre-installed, patched and supported by Oracle. Although there is considerable flexibility on how the machine is configured they are constrained to reflect the most optimum configuration choices; “the best approach to the use of Exadata is not to deviate too much from the standard configuration that is provided (with the exception of Database and ASM parameters) as these have been extensively tested and have been found to provide optimum performance, availability, resilience and reliability”⁵. This simplified architecture translates into a reduced need for ongoing administration through which the O/S, storage and network components require little more administration than automated monitoring and simplified patching.
2. **New components;**
 - a. **Exadata Storage Cells**, run the Exadata Storage Cell firmware. Exadata Storage Cells are Database Aware Storage units that, in conjunction with the DBMS enables automated smart scan (also known as query off-load) processing and in Memory data processing. Storage cells cannot be directly accessed or changed and require minimal administration.

⁵ From the Oracle white paper, ‘Exadata Database Machine Hardware and Software Modification Restrictions’, February 2013.

- b. The Infiniband Network, that is used for all communications and data transfer within the SuperCluster machine. This is managed based on standard TCP/IP principals but requires minimal administration.

“The pre-configured nature of Oracle Exadata gives us the ability to take advantage of dramatically reduced configuration management and system integration requirements, radically lowering the risk of adoption.”⁶

Application domain

The Application domain is designed as a general purpose machine ideally suited to application consolidation. It provides a flexible Infrastructure-as-a Service platform to run Oracle middleware and business applications, along with ISV’s and partner’s applications that have traditionally run on Solaris SPARC servers. It is administered in almost exactly the same as that of a traditional SPARC system.

Compared to traditional SPARC servers, the SuperCluster application domain has many similar components. These include;

- Oracle Solaris
- Oracle Solaris Zones
- Oracle Networking
- Oracle Hardware
- Oracle ZS-ES Storage
- Cisco Management Network Switch

What is Different to a normal SPARC Server?

The Application domain is indistinguishable from a traditional SPARC server to a Systems Administrator, other than two key elements;

- Infiniband Networking. This is used for internal communication within the SuperCluster enabling extremely fast networking between Database Domains and Application domains as well as connectivity to the ZS-ES storage array. It lays the foundation for further optimizations at the middleware and application layer by taking advantage of Exalogic enhancements and further middleware optimizations.
- ZS-ES Storage. Although this is a standard unified storage device, it features compression, performance and reliability optimizations and is built in to the SuperCluster. ZS Storage has been specifically engineered to hold the binaries and configurations for both middleware and applications as well as providing a centralized repository for Oracle Zones. Although the ZS-ES storage appliance is specific to engineered systems it utilizes the same hardware and administration tools as the Oracle ZS Storage Appliance that is widely utilized by customers

⁶ From the white paper, ‘Reducing Operational Costs and Improving Quality at the US Department of Homeland Security’. 2012

globally and integrates into Oracle Enterprise Manager for administration and monitoring from a single console.

SuperCluster Systems Management Toolset

Oracle’s primary administration and management toolset is **Oracle Enterprise Manager 12c** (Enterprise Manager). It provides consistent and centralised systems management capabilities and tools for all aspects of all Oracle systems covering applications, middleware, database, server and storage. Enterprise Manager 12c provides a uniquely powerful machine – wide view of SuperCluster operations that graphically combines hardware, software and network information. Many administration tasks are possible directly from Enterprise Manager with no console access, significantly reducing the overall management effort required.

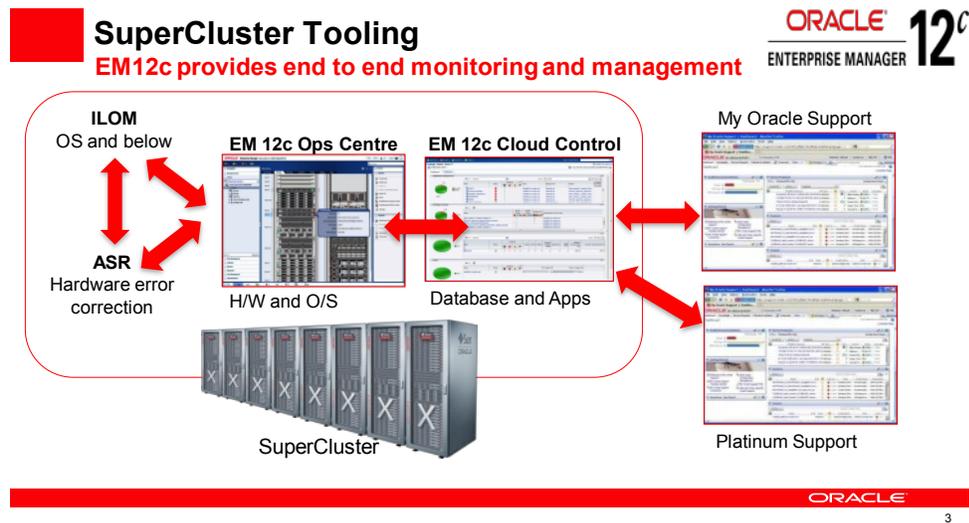


Figure 2 Integration of Enterprise Manager 12c with SuperCluster and My Oracle Support

The core Enterprise Manager infrastructure, connectors and the SuperCluster plug-ins are free of charge, but for further automation of many software administration tasks, Enterprise Manager Packs are recommended, covering Oracle Database, Oracle Fusion Middleware and other Oracle Applications. Many Customers are also taking advantage of the Cloud Management pack to provide self-service provisioning, with automated metering and chargeback of service provision.

More information on the use of Enterprise Manager 12c to manage the SuperCluster environment is found in later sections of this paper, in the Appendix and on OTN.

Oracle SuperCluster can run multiple versions of Oracle Databases on either Exadata Storage Cells (11gR2, 12c) or previous generations on external storage or the internal ZS-ES Storage array. A complete Database as a Service offering can be created with segregation of services whilst reducing administration and provisioning

complexity. Further details on how to implement Database As A Service using of Oracle Tools and the pre-built deployment functionality of SuperCluster can be found in the White Paper [Accelerating Deployment of Enterprise Database Cloud Using an Oracle Optimized Solution](#)⁷ as well as the White Paper [Best Practices for Deploying Oracle Solaris Zones with Oracle Database 11g on Oracle SuperCluster](#)⁸

⁷ <http://www.oracle.com/technetwork/server-storage/engineered-systems/sparc-SuperCluster/db-cloud-using-sparc-SuperCluster-1875862.pdf>

⁸ <http://www.oracle.com/technetwork/server-storage/engineered-systems/sparc-SuperCluster/deploying-zones-11gr2-SuperCluster-1875864.pdf>

Potential for reduced administration effort

Administration of large scale I.T. environments is challenging. These systems are complex, with many interconnected parts, both at the hardware and software levels. On traditional platforms this environment will have been procured from multiple vendors and the design, implementation and testing work will be unique.

As a result, even simple tasks can take large amounts of time, for example;

- Performance monitoring and tuning require significant effort involving multiple teams using a range of different, partially overlapping and possibly conflicting procedures and tools.
- Provisioning new environments (a very common, in some cases, almost continuous task) can take weeks or months.
- Patching is often ignored for as long as possible or becomes the responsibility of a full time, dedicated patching team because of the complexity and risk of such changes in a traditional heterogeneous environment.
- Problem reproduction and resolution can require many different experts using different tools from multiple teams and rely on liaison with multiple vendor support organisations.
- Proving compliance with internal and external standards often takes large amounts of time away from business-related projects and technical administration work.

Very little of this work is directly related to improving service levels or the provision of enhanced functionality, which is what business stakeholders are really interested in.

Oracle SuperCluster can change this. Running Applications on Oracle SuperCluster can release administration teams from a significant part of this tedious, manual and inevitably error-prone work to spend more time on business related projects such as functional upgrades, strategic architecture, consolidation and enhanced integration between systems. There are two fundamental reasons for this;

- **Simplified Architecture.** SuperCluster has a simplified architecture, in which all elements are pre-integrated, pre-certified, pre-tuned and pre-tested. The Oracle database is Exadata – aware and the SuperCluster Database domain is optimised to run the Oracle database. This makes the platform and the database simpler to manage.
- **Simplified Administration Tools.** Administration of all components, from database to disk, by all members of all administration teams, is carried out using a *single*, centralised toolset with built-in knowledge of the SuperCluster components and architecture intelligence. This is Enterprise Manager 12c.

Much of what would otherwise require the involvement of multiple support teams and large amounts of management overhead and logistical co-ordination, can, with SuperCluster, be completed via a leaner, more streamlined processes, potentially by a single unified administration team. If implemented as a private database or applications cloud, basic administration can be carried out on a self service basis by developers and other technical end users.

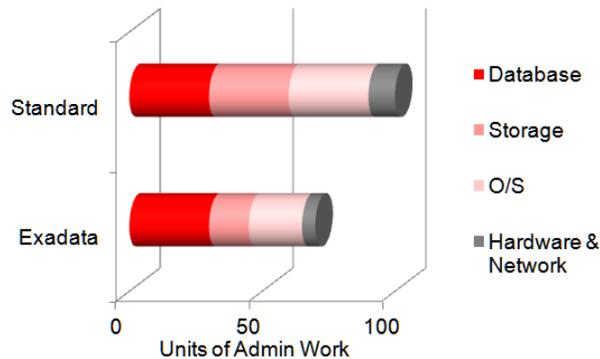


Figure 3 Administration task balance for SuperCluster Database Domain, compared to traditional database platforms

As it has just one job to do (running Oracle database), the degree of optimisation is greatest in the database domains. For this reason those Applications or systems that utilise the database domains will see the greatest change in operational efficiency. Figure 3 above shows the potential reduction in the total amount of administration work required when running databases on Oracle SuperCluster (Database Domain).

The bulk of the savings related to greatly simplified management of the storage, network and O/S components as the Oracle software has not changed. Most estimates agree that an overall reduction of 20% - 40% is achievable and this is confirmed by an increasing number of customers reporting such savings. Examples include;

- The UK on-line travel organisation, thetrainline.com, who report a reduction in administration effort of 45% following the adoption of Exadata as their strategic database platform in 2013.
- The Global I.T. services organisation who report a 50% reduction in administration effort for their very large Oracle PeopleSoft application estate following the migration onto an Engineered Systems platform in 2012.

As little as 20% of all SuperCluster administration effort involves anything other than standard Oracle DBA work. Hence the DBA team is best positioned to be the focus of all administration for database domains.

The chart below shows that as Oracle SuperCluster (or a mix of Oracle Engineered Systems) becomes the platform for more of a companies' Oracle estate, operational benefits continue to reduce and agility continues to rise. Once the majority of Oracle systems have been consolidated there is a real potential for the total administration effort for all Oracle systems to reduce by **20-40%**.

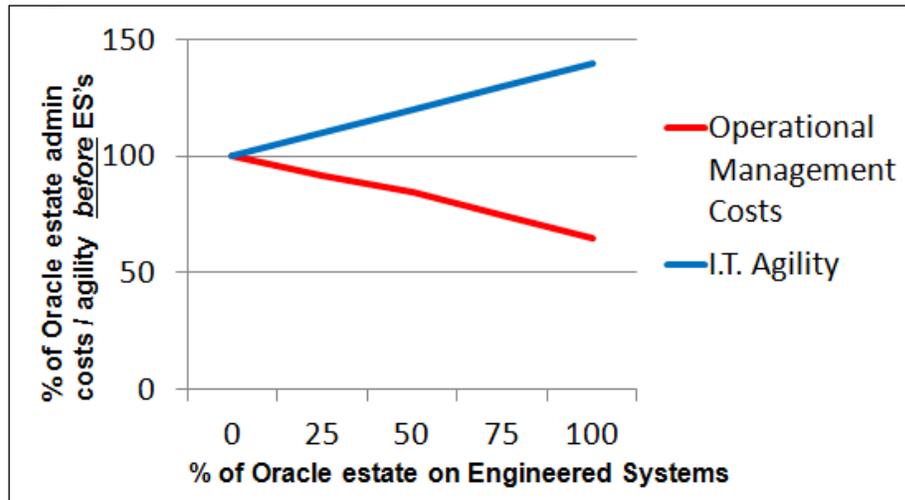


Figure 4 SuperCluster Operational Management Benefits are Cumulative

This improved agility which enables the business to respond to market dynamics and dramatically reduce time to market, allows the IT department to demonstrate positive business impact.

Realising these benefits

Although some efficiency gains and savings accrue simply due to the move to SuperCluster, operational benefits can be maximised by a review and evolution of current administration practices in four areas;

- Organisation. Evolve towards a more unified organisation structure. This could be one or multiple teams and must take account of any outsourcing arrangements.
- Technology. Make optimal use of the full Oracle Enterprise Manager 12c toolset, including Ops Centre, to standardise and automate administration tasks. Integrate EM 12c into MOS and your existing enterprise monitoring solution and helpdesk / ticketing application.
- Processes. Plan to update some of your administration tasks in order to adopt Oracle best practises for SuperCluster.
- Expert Assistance. Make use of appropriate services from Oracle Education, Consulting and Support in order to become as efficient and self-sufficient as early as possible

These four areas are complementary but independent. They do not all need to be addressed on day 1 and they can be tackled in any order. In many cases organizational streamlining will occur naturally over time. For many customers the adoption of EM 12c to standardise and consolidate many tasks into a single framework itself drives organisational and process change towards optimal efficiency. Over time, highly skilled resources become freed up to work on strategic projects which deliver real business benefits through I.T. innovation rather than spending the majority of time administrating existing systems.

Oracle SuperCluster Administration Overview

This section will review the primary administration requirements for each of the major SuperCluster components (hardware, database domain and application domain), focusing on the differences from a traditional platform, and the major systems management tools. In summary;

- Database domains are managed in exactly the same way as Exadata machines, but with the (optional) use of Oracle Solaris Zones as a virtualisation technology.
- Application domains are managed in essentially the same way as traditional SPARC Solaris systems

Please note that Oracle provides a set of [Oracle Optimized Solution Documentation](#)⁹ that are especially applicable to Application domains. This document summarises and highlights some of these along with additional MOS notes and official SuperCluster documentation. It is also worth noting that although not explicit, the [Oracle Maximum Availability Architecture](#)¹⁰ documentation covering Exadata is also perfectly applicable to SuperCluster.

All of these recommendations are advised as best practice, but are not mandatory; it is for you, the customer, to devise and implement your own operational best practices.

Oracle ACS Services can be engaged to assist in the creation of a detailed Run Book to document administration standards and best practice procedures for each task.

Administration Tasks

In any I.T. environment there are a number of standard tasks which administration teams must be able to carry out. These apply equally to Oracle SuperCluster systems.

Monitor and Alert	Real time and historical tracking of availability and performance, define thresholds and automated alerting rules
Provision	Create a new instance or copy of a component on the machine. Can involve installation, cloning or configuration
Configuration Management	Real time and historical tracking of (and comparisons between) configuration details and adherence to security and best practise standards
Tune	Ensure optimal speed of operation
Backup	Take a copy of data or software to be used during recovery
Patch	Make changes to software, primarily to fix problems.
Problem Management	Diagnose, reproduce and resolve problems. Manage Oracle service requests
Replace	Replace a hardware component.
Meter and Charge	Track usage of services and components per user / department and calculate a cost over a period.

Figure 5 Basic I.T. Administration Tasks

⁹ <http://www.oracle.com/technetwork/server-storage/hardware-solutions/index.html>

¹⁰ <http://www.oracle.com/technetwork/database/features/availability/maa-best-practices-155366.html>

The Meter and Charge task is not one that most organisations currently undertake, but is one of the fundamental elements of providing ‘Something’-as-a-Service. It is an essential tool to change behaviour of teams by making them aware of the consumption of resources, and thereby making the business more aware of the impact of their decisions. As a result it is likely to become more important as the deployment of private clouds becomes more widespread.

SuperCluster Components

The following chart is one view of the technology components that exist in each SuperCluster machine, combined with the standard administration tasks.

Figure 6 shows which tasks will (or may) need to be carried out for each technology component. This will not be 100% applicable for all customers across all configurations in all data centres. However it provides an excellent planning aid when thinking about how your teams may operate SuperCluster systems in context of your own procedures.

SuperCluster Technology Components To Do Lists									
Owner	Component	Monitor	Provision	Configure	Tune	Backup	Problem Analyse	Patch	Replace
SuperCluster Admin Team	Hardware	Y					Y	Y	Y
	Application Domain	Y				Y	Y	Y	
	Infiniband Network Switches	Y				Y	Y	Y	Y
	ZS-ES Storage	Y	Y			Y	Y	Y	Y
	Solaris	Y	Y	Y		Y	Y	Y	
	PDU	Y							Y
	Management Switch	Y				Y	Y	Y	Y
Database Domain Administrator	Zones	Y	Y	Y		Y	Y	Y	
	Database Domains	Y	Y		Y	Y	Y	Y	
	Grid Infrastructure	Y	Y	Y	Y	Y	Y	Y	
	ASM	Y		Y	Y	Y	Y	Y	
	DBMS	Y	Y	Y	Y	Y	Y	Y	
	Database	Y	Y	Y	Y	Y	Y	Y	
Application Admin Team	Database Service	Y	Y	Y	Y		Y		
	Business Applications	Y	Y		Y	Y	Y		

Figure 6 SuperCluster Administration Task List - per Technology Component

Note that the database tasks are 95% business as usual for most DBA’s and that management of the underlying infrastructure components is significantly simpler and easier than on traditional platforms. For those customers who are adopting Oracle SuperCluster as a Database as a Service platform a Task list may look like Figure 7.

SuperCluster Technology Components To Do Lists - Database as a Service									
Owner	Component	Monitor	Provision	Configure	Tune	Backup	Problem Analyse	Patch	Replace
SuperCluster Admin Team	Hardware	Y					Y	Y	Y
	PDU	Y							Y
	Infiniband Network Switches	Y				Y	Y	Y	Y
	Management Switch	Y				Y	Y	Y	Y
	ZS-ES Storage	Y	Y			Y	Y	Y	Y
	Database Domains	Y	Y		Y	Y	Y	Y	
	Solaris	Y	Y	Y		Y	Y	Y	
	Zones	Y	Y	Y		Y	Y	Y	
	Grid Infrastructure	Y	Y	Y	Y	Y	Y	Y	
	ASM	Y		Y	Y	Y	Y	Y	
	DBMS	Y	Y	Y	Y	Y	Y	Y	
	Database	Y	Y	Y	Y	Y	Y	Y	
	Database Service	Y	Y	Y	Y	Y	Y	Y	

Figure 7 SuperCluster Administration Task List - per Technology Component - Database As A Service

Some tasks may only be required very rarely, while others may be done as part of another task. To a large extent, the Operating Systems management and most Hardware related tasks are sufficiently abstracted through the use of tooling, that a DBA could easily be trained on these simplified non-DBA related tasks so that they could become the sole or main administrators of the SuperCluster.

Wherever possible all tasks should be standardised and automated. By taking advantage of OEM and OEM OpsCentre configurations management can be captured and audited as changes are made to the system. This audit trail then provides another source of information with regards to incident management and ultimately root cause analysis.

Oracle can provide services, which address many of these tasks for you, either for a fixed initial period or as an on-going maintenance service. [The Platinum Service](#)¹¹ builds on standard Oracle Premier Support to provide remote monitoring, fault resolution and quarterly patching, at no additional cost.

Oracle strongly recommends you make use of appropriate training, support and consulting services to ensure best practise for all operational management tasks. Please see Appendix 2 – Oracle Services for SuperCluster.

Administration Tools - Enterprise Manager 12c

Enterprise Manager 12c is Oracle’s strategic systems management toolset. It supports all elements of an Oracle environment, from applications, through middleware and database to hardware and is fully SuperCluster aware. It provides centralised, standardised and automated support for;

- Automated setup and discovery
- Monitoring and alerting
- Configuration management and compliance
- Performance analysis and tuning
- Provisioning and patching

¹¹ Oracle Platinum Services - <http://www.oracle.com/us/support/premier/engineered-systems-solutions/platinum-services/overview/index.html?ssSourceSiteId=ocomes>

- Problem Diagnosis and Resolution
- Integration with 3rd party systems management tools and with My Oracle Support

Using Enterprise Manager 12c, you see an integrated and real time view of all the SuperCluster components at machine level, with a schematic of storage cells, compute nodes and switches, and a software/system view of database systems/clusters. From here it is simple to drill into individual components. With its built-in knowledge of SuperCluster (as well as Exadata, Exalogic and Exalytics), the Enterprise Manager 12c toolset enables these capabilities to be used by administration teams to manage the SuperCluster machine as a single engineered system as well as the individual infrastructure, database domains (Exadata) and application domains.

Although the standard hardware, operating system, database, application and middleware administration tools (such as OAM and the WLS Console) can of course be used to manage individual components, Enterprise Manager 12c provides a holistic administration shell around all components for all administration tasks. It is accessed via a consistent, but customisable web based user interface and stores detailed information about the operation of all SuperCluster components in a single shared repository. Highly granular roles allow it to be used by specified staff for a wide range of specified purposes.

3rd party tools will recognise many of the individual SuperCluster components, but will not recognize the sum of these components as a SuperCluster system and they will NOT be aware of the Exadata software, Exalogic Elastic Cloud Software, the Infiniband fabric or any Exalogic optimizations within the Oracle business applications. Although they may still be useful for very specific tasks against individual components (such as Solaris utilities or pre-built database or WLS scripts), Oracle recommends Enterprise Manager 12c as the primary administration toolset.

Effective management of SuperCluster systems does not need significant re-skilling or re-tooling, but a slight extension (or repositioning) of what the administration teams already know, which can be significantly simplified through the use of Enterprise Manager 12c.

For those running other Enterprise Monitoring Tools, Oracle Enterprise Manager eases the Operational Monitoring integration effort by providing connectors into existing frameworks. This can dramatically reduce the need for creating and maintaining rules and script monitors within the framework, and relying on the Oracle provided tools to keep track of new technologies and further innovations within the SuperCluster platform.

Enterprise Manager 12c consists of a number of complementary components;

1. **Enterprise Manager Cloud Control Core (free)**. Basic monitoring and management of the overall SuperCluster system. Shares data with Enterprise Manager OC.
2. **Enterprise Manager Ops Center (free)**. In depth understanding, analysis and management of SuperCluster firmware, hardware, IB and Ethernet networks and Solaris OS, including Zones and Oracle VM for SPARC. Has its own console and repository which is integrated with the Enterprise Manager CC repository
3. **Enterprise Manager Packs for Oracle Database**. In depth understanding, analysis and management of Exadata database domains within SuperCluster
4. **Enterprise Manager Packs for Fusion Middleware**. In depth understanding, analysis and management of Oracle Middleware components deployed in the SuperCluster application domains.

5. **Enterprise Manager Packs for Oracle Applications.** In depth understanding, analysis and management of E-Business Suite, PeopleSoft, Siebel, JD Edwards and Fusion Applications running on SuperCluster. Note that these are actually referred to as Application Management ‘Suites’.
6. **Enterprise Manager Cloud Management Packs.** Enables definition, monitoring and management of SuperCluster resources to support Infrastructure-, Database-, Middleware- or Applications-as-a-Service where these elements are deployed, managed and potentially charged for, on a self service basis.
7. **Enterprise Manager Testing tools.** Automated analysis and testing of end user behavior (RUEI), Oracle database (RAT), and Oracle Applications (ATS) deployed on SuperCluster.
8. **Enterprise Manager Connectors (free).** Provide out of the box integration with a range of non-Oracle systems management tools and service desk applications.

Using Enterprise Manager 12c, all SuperCluster components are managed in a consistent manner, in which administration data, both real time and historical, is held in a single logical repository and accessed by multiple administration teams using consistent, easy to use, easy to secure screens.

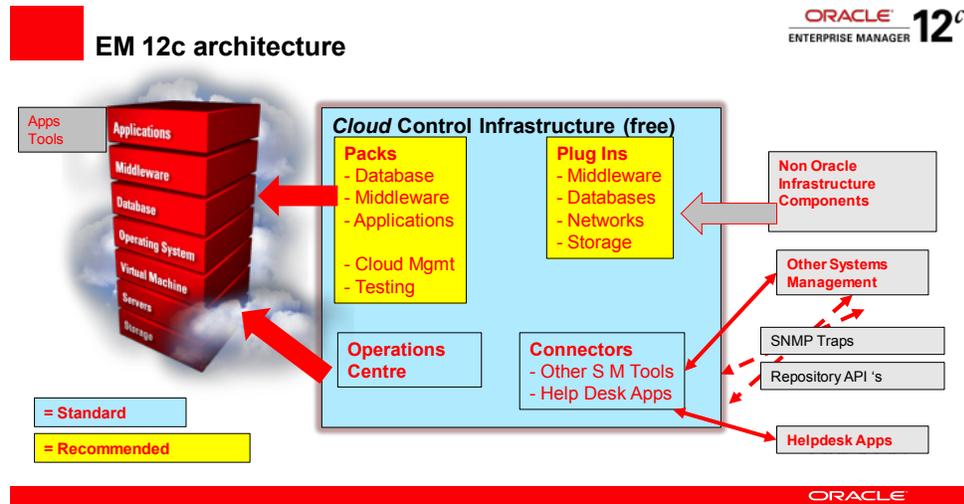


Figure 8. Oracle Enterprise Manager 12c Architecture

In order to optimise productivity and agility in managing SuperCluster (and all Engineered Systems), Oracle recommends that customers take the opportunity presented by the new SuperCluster environment to re-visit and refresh administration procedures and to acquire, deploy and make full use of the appropriate Enterprise Manager 12c Database, Middleware and Cloud Management Packs, Application Management Suites and testing tools. The alternative approach of creating and maintaining manual procedures and customized scripts will create an additional administrative and maintenance burden, and neutralise the operational efficiency savings that could be gained from the use of Engineered Systems.

Since Enterprise Manager covers all the technology layers involved in a transaction, from what the end user sees on their browser through application modules and application server code, to database processing and data stored on disk, this toolset enables business transactions to be tracked and traced through their whole life, which in turn greatly facilitates root cause analysis, problem diagnosis and performance tuning and functional testing.

Administration Details

Initial commissioning and set up is a one-time task required in order to set up SuperCluster for the first time. Currently this is completed by Oracle Advanced Customer Support (ACS) and takes around 3 days. The ACS OneCommand tool is used to configure all aspects of the machine according to customer needs and initial usage plans. As the subject of this paper is ongoing day to day management we will not consider this further.

After this there are certain tasks that the SuperCluster admin team needs to be able to carry out. For Database domains these will be database-centric and for Application domains they may either be database-centric (where older versions of Oracle Database are deployed) or application and middleware-centric. In general administration of Application domains is no different from administration of standard Solaris instances on SPARC servers.

Tools for each Task

The chart below shows which element of the Enterprise Manager suite should be used as the primary tool for each task.

Owner	Component	Provision	Monitor	Configure	Tune	Backup	Patch	Upgrade	Meter & Charge
SuperCluster Admin Team	Hardware		OC	CLI			CLI		
	PDU		OC						
	Infiniband Network Switches		OC	CLI			CLI		
	Management Switch		OC	CLI			CLI	CLI	
	ZS-ES Storage		OC	BUI	BUI	BUI	BUI	BUI	EM
	Database Domain		OC	CLI	EM	EM	CLI		
	Application Domain		OC	CLI			CLI	CLI	EM
	Solaris Zones		OC	CLI			CLI	CLI	EM
Database Domain Administrator	Database Service	EM	EM	EM	EM				EM
	Database	EM	EM	EM	EM	EM	EM	EM	EM
	DBMS		EM	EM	EM	EM	EM	EM	
	Grid Infrastructure		EM	EM	EM	EM	EM	EM	
Application Admin Team	ASM		EM	EM	EM	EM	EM	EM	
	Business Applications	EM	EM	EM	EM		EM		

Figure 9 SuperCluster Task List – Tools per Task

Hardware administration tools

ILOM monitors and manages hardware and can be used even without the operating system. It receives telemetric data from key components and using the Oracle Automated Service Request (ASR) tool it can trigger an automated replacement process for failed hardware via My Oracle Support Service Request. Whilst at the same time feed data centrally to Enterprise Manager Ops Centre.

EM 12c Ops Centre can monitor the physical hardware and Operating Systems of the Oracle SuperCluster, It delivers a converged hardware monitoring solution for SuperCluster integrated across the infrastructure stack. With advanced virtualization monitoring and reporting capabilities, application-to-disk management, intelligent configuration management, and more, Oracle EM

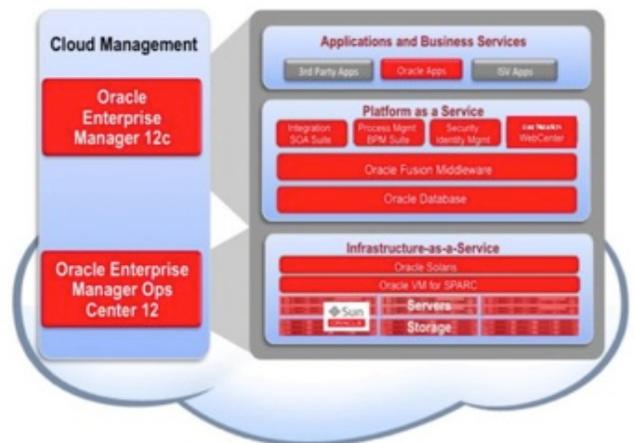


Figure 10 Oracle EM 12c and Ops Center 12c; who manages what

12c Ops Center helps IT managers reduce complexity and streamline and simplify infrastructure monitoring. The inclusion of Oracle Enterprise Manager Ops Center as a standard component of every SuperCluster enables data centre administrators to monitor the storage, network, servers, Oracle Solaris, and virtualized environments from a single interface. This improves operational efficiency and lowers operational costs. Oracle Enterprise Manager Ops Center acts a single console to visualise multiple server architectures and myriad operating systems; Oracle Enterprise Manager Ops Center can manage the components in SuperCluster using asset discovery, configuration management, virtualization management, and comprehensive compliance reporting. Oracle Enterprise Manager Ops Center automates workflow and enforces compliance via policy-based management.

With EM 12c Ops Center, IT staff can implement and enforce operations standardisation and best practices, regulatory compliance, and security policies while efficiently deploying infrastructure to meet business requirements all whilst being facilitated by a browser interface enabling a reduction of complexity and for tasks that for many would result in tier 3 support or engineering teams to be engaged and coordinated through a workflow. Figure 11 shows the browser-based user interface for Oracle Enterprise Manager Ops Center.

You can inspect performance, availability and usage by databases, services and clusters and get software alerts on the database, cluster and ASM, as well as alerts on all hardware components. The Infiniband network and switches can be fully monitored with alerts, performance metrics and configuration standards. Storage cells can be monitored and administered via Enterprise Manager 12c. All compute nodes and storage cells are automatically grouped so that you can administer components at group level.

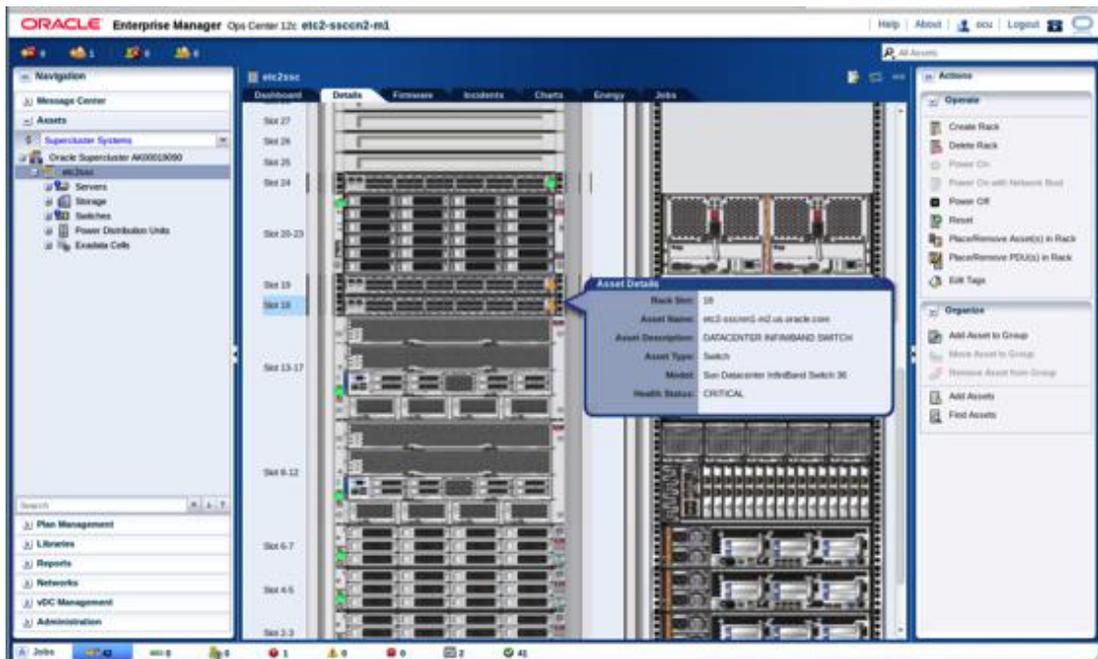


Figure 101 The Oracle Enterprise Manager Ops Centre Interface

Common Administration Components

The SuperCluster infrastructure contains components that are common to both Database and Application domains. The key components are:

- Oracle VM Server for SPARC. The Physical Servers within SuperCluster can be subdivided into either Database Domains or Application Domains using the OVM Server for SPARC technology. It uses a specific technique called “root domains” whereby each domain is allocated a number of dedicated PCIe slots on the server. This completely avoids any virtualisation overhead, and each domain runs at bare metal performance. More Details can be found in the white paper [Implementing Root Domains with Oracle VM Server for SPARC](#)¹².
- Solaris Zones. The Application and Database Domains can be further virtualised through the use of Solaris Zones which includes network virtualisation and provides an essential tool for providing additional workload segregation and license containment within an Oracle SuperCluster. At the same time Oracle Zones are portable enabling a route to live to be enabled by encapsulating known working configurations and moving them between environments.
- The Domaining feature of OVM Server for SPARC and Solaris Zones are *the key difference between SuperCluster and Exadata/Exalogic*
- Infiniband Switch. Network used for all internal communications and data shipping. Based on quad data rate (QDR) InfiniBand technology. Consists of software and hardware.
- Cisco Management Switch. Standard administrative 48-port Cisco 4948 Gigabit Ethernet switch allowing customers to connect their existing management network to the SuperCluster machine. Consists of software and hardware. Can be swapped by the customer for a preferred management switch.
- PDU. Power Distribution Unit., which includes Rack-level power metering capability with the ability to set threshold and alarm levels preventing overloaded circuits by providing a visible warning when the current power demand is close to the maximum.

Database Domain Administration

As already noted, other than the additional ability to use Oracle Zones, SuperCluster Database Domains are almost identical to Exadata database machines. Therefore operational management best practices are also the same, as detailed in the two white papers; ‘Managing Exadata; Administration Tasks and Tools’ paper and ‘Managing Exadata; A Guide to Maximising Operational Management Benefits.’ Both are available from your Oracle account team.

The key components are;

- Database Service. A logical database object that typically map to a fixed group of users and database objects. It represents a workload which users / applications connect to rather than to a specific DB instance (or SID). One or more DB schemas with common users, attributes and service levels. Can run on 1 or more compute nodes.

¹² <http://www.oracle.com/technetwork/server-storage/vm/ovm-sparc-rootdomains-wp-1914481.pdf>

- Database. Physical customer data defined as 1 or more tables and stored physically on 1 or more disks across 1 or more storage cells. Also includes Datafiles, Control Files, Online Redo Log Files, Archived Redo Log Files, Parameter Files, Alert and Trace Log Files & Backup Files.
- DBMS. Oracle 11gR2 software that manages the data. Consists of Oracle binaries (the ‘Oracle home’), processes and configuration files. 1 or more per Exadata machine.
- Grid Infrastructure. Oracle 11gR2 software that ensures continuous access to the same data through multiple compute nodes. Includes RAC, voting disks and filesystem.
- ASM. Automatic Storage Manager. Oracle software that manages how data is placed on disk and uses its own dedicated Oracle Database instance. ASM can be thought of as part of the Grid Infrastructure, although there are some separate management tasks that apply to it.
- Compute Node. A Solaris 11 instance that runs the DBMS and Grid Infrastructure. This can either be directly in a Database Domain, or a Solaris Zone running inside the Database Domain. Each Database domain has at least 4 Cores of a SPARC CPU, Memory, InfiniBand Host Channel Adapter, and 10GbE connectivity. Customer-specific software can be installed but should be limited to agents, for example backup or monitoring agents required by customer standards. Changes to the standard configuration Solaris OS are *not encouraged* but can be made to accommodate your own corporate standards (for example, the addition of backup or monitoring clients) or to optimise memory usage, but the impact of any such changes should be confirmed with Oracle Support.
- Storage Server. A server that runs Oracle Exadata Firmware. Each cell contains 2 Intel Xeon processors, 12 disks (high capacity or high performance) and 4 flash memory cards as well as InfiniBand connectivity, management interface for remote access and power supplies. The configuration cannot be changed and no additional software can be installed on them.

The storage cell command line interface (CLI) is required because at present nothing can directly connect to or be installed on the storage cells, including the Enterprise Manager agent. Therefore it is required for some software cell management tasks, most significantly cell patching. For Security reasons the only route to access the CLI is directly from a Database Domain via SSH.

Applications Domain Administration

Application domains are almost identical to standard SPARC Solaris environments and are managed in very much the same way. This is where the [Oracle Optimized Solution Documentation](#)¹³ provide excellent guidance. Unlike the database domain, application domains are much more general purpose so that the components present will vary between customer configurations. However, the full list would include;

- Business Applications. These could be packaged Applications from Oracle or ISV’s or bespoke applications, typically a 2 or 3 tier application connected back to an Oracle Database.
- Middleware. This could be Oracle Exalogic Middleware, Oracle Fusion Middleware or 3rd party middleware. Oracle Exalogic Middleware contains optimisations which ensure that key services such as WebLogic Server, Coherence and SOA Suite make full use of the Infiniband network to increase business performance.

¹³ <http://www.oracle.com/technetwork/server-storage/hardware-solutions/index.html>

- Legacy Oracle DBMS. A pre-11g database not taking advantage of the Exadata Storage Cells. The DBMS will address data physically hosted on either the integral ZS-ES storage or external storage.
- -ES Storage. The ZS Storage Appliance provides a central resource pool for binaries and zones alike enabling rapid provisioning and cloning along with data availability and a consolidation point for replication.
- Oracle Solaris Cluster + GeoCluster. Oracle Solaris Cluster provides an optional orchestration framework to provide High Availability for services outside of the Oracle Database. Many of the Oracle Optimised Solutions take advantage of Oracle Solaris Cluster to reduce administration outages whilst orchestrating the service. Solaris GeoCluster extends Oracle Solaris Cluster by providing a Disaster Recovery Orchestration framework ensuring failover between sites can be orchestrated in an operational manner reducing risk of human error.

As per the Database Domain the primary administration and management toolset is Oracle Enterprise Manager 12c. It provides consistent and centralised systems management capabilities and tools for all aspects of all Oracle systems covering applications, middleware, database, server and storage.

Enterprise Manager can be used in the application domain to orchestrate Virtual Data Centres enabling provisioning, reporting, management and decommissioning of virtual networks and instances to enable virtual DataCentre deployments. Once configured by the SuperCluster administration team, self-service access can be created to application or end user teams to enable them to build, deploy and decommission services dramatically reducing time to market for the end users whilst releasing key IT resources to focus on further innovations for the business.

Exalogic

It is worth making a note at this time that the licensing and adoption of the Exalogic Software on SuperCluster does not affect the administration of the Application Domains. On SuperCluster the Exalogic Software licence enables the optimisations in the Oracle Middleware and Application stacks to improve performance by taking advantage of the underlying Infiniband network.

Some of these features can be reported in Oracle Enterprise Manager 12c however from a SuperCluster standpoint it is not required to apply any further administration tasks or best practice over and above what you would normally do for the Oracle Middleware and Applications.

Key Administration Tasks

This section provides some more specific details on the selected administration tasks.

Patching

Pro-active management tasks such as patching have direct correlation to operational impact. The standardised nature of Oracle Engineered Systems across multiple customers and internally, enables problem management across multiple customers, based on incident management and analysis internally within Oracle. Engineering pro-actively resolves issues in the Quarterly Maintenance Updates, as well as introduce new functionality that has been fully integrated and tested throughout the complete stack.

The Oracle SuperCluster is designed with standard configurations so that it can be maintained as a single entity, bringing multiple infrastructure components, Operating System, Database and Middleware components into regular quarterly releases. This takes the form of patch bundles, where all the patches are pre-tested, pre-certified and documented with specific installation procedures. This is in contrast with

traditional infrastructures, where creating a patch set which is compatible through all layers of the heterogeneous stack takes significant engineering and testing effort by internal resources with no control of vendor release cadence or compatibility. Due to the standardized and homogenous nature of Engineered Systems, Oracle is able to perform this integration testing of all patches within the stack, and by releases them all as a pre-integrated patch bundle as Oracle SuperCluster Quarterly maintenance updates and available from [My Oracle Support](#). In addition the Platinum Support Service includes a patching service to apply quarterly updates to the system remotely.

SuperCluster Patching Best Practices and known Patching Issues is documented on [MOS Note 1569461.1](#). Although not explicit, it is recommended that as part of the operational procedure creation the following best practices are adopted;

- Develop, test and use a patch plan which defines your own procedures in the context of your environment.
- Have a quarterly patching process. However, especially for the production systems in large SuperCluster environments, it is acceptable to do this every 6 months. We strongly recommend that all customers keep their systems no more than 6 months behind the latest PSU.
- Before patching the production system, apply patches in a representative test environment that is as identical to production as possible
- Before and after any patching activity (or as a minimum once every quarter) run the *Exachk for SuperCluster* utility. This will audit important configuration settings across the SuperCluster compute nodes, storage system and network switches, and verify them against supported version levels and best practices. See [MOS Support Document 1528666.1 How to validate my SuperCluster configuration and perform Health Check](#)¹⁴.
- Prior to applying each patch carefully review and then follow the instructions in the ‘readme’ file as distributed in the quarterly update

Provisioning

The availability of Solaris Zones as an additional virtualisation technology within SuperCluster enables the encapsulation of complete environments and workloads and also provides an ideal means to segregate resources and controls. Solaris Zones can be utilised in both domain types. Within database domains these come pre packaged and is discussed in the White Paper [Best Practices for Deploying Oracle Solaris Zones with Oracle Database 11g on SuperCluster](#). The `ssc_exavm` tool is used to manage the zone creation and database and physical data deployment using a single administration command. Once provisioned EM12c can then take advantage of the pre-built virtualised RAC framework to provision new database instances or to define and manage a full a DbaaS environment.

Within application domains EM 12c Ops Centre can be utilised to provision Solaris Zones and then to monitor and release resources as required.

Hardware component Replacement

- ¹⁴ <https://support.oracle.com/epmos/faces/DocumentDisplay?id=1528666.1>

Over the lifetime of a SuperCluster hardware components will need to be replaced, either because they fail or as they degrade over time. These may include storage disks, cables, fans or network card. There should be zero or minimal impact on users as all components are architected to be replaceable whilst providing service uptime. Replacement is straightforward, with all parts and compatibility details provided and certified by Oracle.

ILOM should detect any failures and alert will be triggered into Enterprise Manager and if implemented an ASR process will trigger a My Oracle Support Request.

A failed hardware item, such as a fan, cable, network card, Infiniband HCA, flash card or storage disk will be detected by the system. The system will then pass this data through to Enterprise Manager and ASR. In Enterprise Manager it will show up on the components home page and related reports.

Simultaneously ASR will collect all required telemetry and diagnostic data and create both an alert and a new service request, where it should prompt pro-active contact from Oracle support with a view to resolving the issue. This, along with any other SRs will show up on Enterprise Manager's Support Workbench

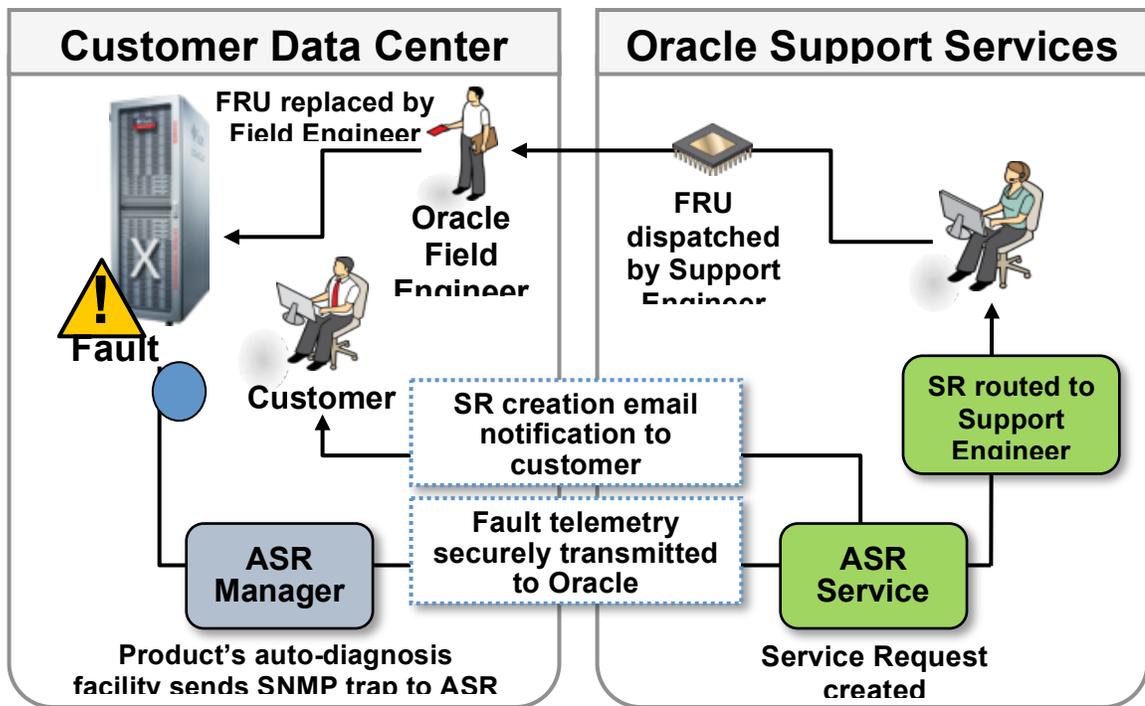


Figure 12 ASR Hardware fault Diagnosis and repair process

More details on ASR can be found on the [Oracle Website¹⁵](http://www.oracle.com/us/support/systems/premier/auto-service-request-155415.html) ASR is available for use on all Oracle hardware and only needs to be implemented once in each Data Centre. EM 12c OC can also be used to view ILOM data about hardware faults, including dependent components, and to create SR's.

¹⁵ <http://www.oracle.com/us/support/systems/premier/auto-service-request-155415.html>

All SuperCluster machines come with a spares pack, which includes disks, flash cards and cables.

Organisational Impact

It should be clear from the preceding chapters that Oracle SuperCluster is a single machine that provides a complete, but highly flexible compute platform. There are potentially 3 areas to be managed; the basic hardware and infrastructure, database domains and application domains. As a result it offers a choice of deployment models;

1. As a database machine (in which only database domains are configured)
2. As an application machine (in which only application domains are configured) ¹⁶
3. As a dual environment (in which both database and application domains are configured)

Although the same list of administration tasks, as discussed above, will apply to all, the details of how they are carried out for each can be different *and therefore the organizational options for each will vary also.*

Clearly an amount of architecture and administration training will be required for some individuals in the organisation in order to maximise the efficiency of SuperCluster operations. This may involve staff across one or multiple teams but a more unified approach to administration will both minimise the cost and maximise the effectiveness of training.

However, since your existing specialised teams will have virtually all the basic skills required, any changes you decide on can be implemented in a way that suits your culture and priorities.

Database Domains

A design goal for Oracle SuperCluster and all other Oracle Engineered Systems is to consolidate and minimise operational management. For Exadata machines and the Database Domain within Oracle SuperCluster this is achieved in a number of ways. The Exadata Storage Cells have an immediate impact by removing the need for complex storage provisioning and management. Since these compute nodes essentially run a single programme (Oracle Database 11g), the systems administration role becomes significantly simplified. At the same time the internal private network over IB between nodes reduce the networking tasks required for Oracle RAC management. To take full advantage management of these savings in the context of different organisations, a number of models have been adopted by our customers.

Within the constraints of organisational change we are looking for the model that allows for on-going support of the Database Domains with minimum overhead and maximum agility. There are essentially three options;

1. Stay as you are (multiple specialist teams)
2. A SuperCluster DBA (SDBA) Team
3. An Extended SuperCluster DBA (ESDBA) team

¹⁶ Note that of a minimum of 2 database domains are required but these can be extremely small and need not actually be used.

The ideal support structure for the Database Domain is a single unified SuperCluster DBA (SDBA) team that is centred on the current DBA team and is self sufficient in managing all aspects of the Database Domains, including hardware, firmware, network, storage cells and the Solaris O/S as well as the actual database software. Since in excess of 80% of all Database Domain administration work will be standard Oracle DBA work, option 3 is the theoretical ideal. This is encouraged in many cases where existing DBAs have considerably more skill and ability than simply installing and running the database. They may well have a good working knowledge of Solaris and certainly if they already use ASM, they will know something about storage architectures. Whether or not they have used RAC, they will very likely be aware of basic network concepts. However, your existing specialised teams will have virtually all the skills required so any changes you decide on can be implemented gradually, in a way that suits your culture and priorities.

The primary difference between Exadata and SuperCluster database domains is that in the latter it is possible to use Solaris Zones to provide an additional virtualisation layer. These Zones are created using the same installation process that is used when provisioning the Clusterware grid in both Exadata and SuperCluster, and are usually implemented by Oracle at install time. With this in mind the introduction of Oracle Zones into Database Domains should not need any significant changes to the operational team structure.

For those customers who are configuring SuperCluster as a Database as a Service platform Option 3 becomes the default option. As previously discussed, Figure 11 SuperCluster Administration Task List - per Technology Component shows the consolidation of tasks and the applicability for a DBA to adopt further responsibility. This is especially true, as the Database Domain software has been engineered to reduce the operational management burden.

SuperCluster Technology Components To Do Lists - Database as a Service										
Owner	Component	Monitor	Provision	Configure	Tune	Backup	Problem			Replace
							Analyse	Patch		
SuperCluster Admin Team	Hardware	Y						Y		Y
	PDU	Y								Y
	Infiniband Network Switches	Y				Y	Y	Y	Y	Y
	Management Switch	Y				Y	Y	Y	Y	Y
	ZS-ES Storage	Y	Y			Y	Y	Y	Y	Y
	Database Domains	Y	Y		Y	Y	Y	Y	Y	
	Solaris	Y	Y	Y		Y	Y	Y	Y	
	Zones	Y	Y	Y		Y	Y	Y	Y	
	Grid Infrastructure	Y	Y	Y	Y	Y	Y	Y	Y	
	ASM	Y		Y	Y	Y	Y	Y	Y	
	DBMS	Y	Y	Y	Y	Y	Y	Y	Y	
	Database	Y	Y	Y	Y	Y	Y	Y	Y	
	Database Service	Y	Y	Y	Y	Y		Y		

Figure 11 SuperCluster Administration Task List - per Technology Component

In many cases the SuperCluster DBA Team could also be responsible for managing additional Engineered Systems including Exadata because the tasks are extremely similar.

Application domains

As with Database domains, Application domains are optimised for consolidation, but intended for middleware and application components. Although the same EM 12c toolset is used there can also be a need to use additional administration tools specific to the software being run. In addition it is possible for a Solaris administrator to customise the domains to suit their best practice and standards but doing so will deviate from normal (standardised) SuperCluster deployments.

Customers generally adopt 1 of 2 management structures for the Application domain that allows for the introduction and on-going support of the application with minimum overheads and maximum agility;

- Stay as you are (multiple specialist teams)
- A SuperCluster Administration Team (SCA) team

The ideal support structure for the Application domain is a single unified SuperCluster Applications Administration team. This should be centred on either the current software administration team or the O/S Systems Administration team.

It is worth remembering that application domains may have Fibre Channel HBA's added to provide access from the applications to existing storage frameworks, which will typically continue to be managed by the existing storage administration team.

To a large extent, the management of the Application Domains is no different from the management of standard SPARC Solaris servers, albeit restricted to a much more standardised operating model by virtue of the Engineered System configuration.

In the absence of an SDBA team for the Database domains, the “stay as you are” option, with a “Systems” team, an Applications Team, and a Storage Team may be the most preferred option. However, given that in almost all cases the SuperCluster will include both Database Domains and Application Domains, it may make sense to merge the Application Domain “Systems” team into the SDBA function as well creating an ESDBA team. .

The introduction of Exalogic software on SuperCluster has no real impact on the choice of Operational team structure. The Exalogic Software stack introduces key optimisations of middleware components such as Weblogic server and Coherence to enable the full use of the Infiniband network. However these optimisations are largely self managing and do not require any significant increase in administrative skills. Please refer to the ‘Managing Exalogic’ white papers for more detail.

One team to manage the whole machine?

Although having a single team responsible for all technology components of the machine (as is common with the SDBA team) across both database and application domains is an attractive idea, this is only realistic where;

- No Application Domains are configured, *or*
- Application Domains are used purely to host 9i and / or 10g versions of the Oracle database.

In these scenarios, all domains will be used to run Oracle database and so the SDBA team can potentially manage all elements of the SuperCluster machine.

If application domains are used to host any other software than pre-11g Oracle databases it is likely that there will need to be separate administration team(s) responsible for managing the Application aspects.

If the application domains will be making use of external Storage via FC cards, it is also likely that the existing Storage teams will need to be involved in those aspects.

One very widespread aspect of the operational model is a separation between Platform and Application Teams. The SCA and / or SDBA teams become suppliers (of infrastructure services) to Application administration teams who focus their time and attention on business functionality and business services. For

the applications administrators there are two significant benefits of unified Supercluster infrastructure administration;

- They have only 1 or 2 teams to work with, rather than the traditional 4 or 5
- The agility and flexibility of the underlying infrastructure platform improves

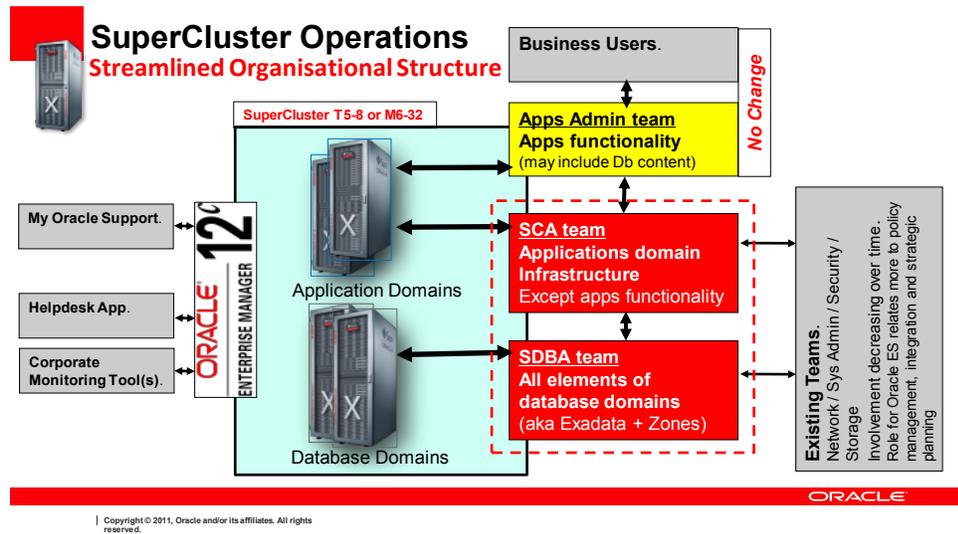


Figure 12 Ideal SuperCluster Operational Structure

Figure 12 Ideal SuperCluster Operational Structure ; shows two teams focussed on database and applications domains respectively, with access to the existing specialist teams of needed, with the applications admin (or development) teams and end users being largely unaffected, other than having only the SuperCluster Admin team to liase with. Efficiency gains for all teams should follow from the shared use of the single centralised EM 12c environment for monitoring, management and root cause analysis of all components.

As Oracle Engineered Systems (including Oracle SuperCluster) become ever more widespread, we are seeing evidence that a more unified approach to administration, enabled by the simplified standardised and optimised architecture, contributes noticeably to improved staff retention. The, additional skills and increase in responsibility and self-sufficiency helps to provide a greater level of job satisfaction which improves morale whilst also reducing operational complexity.

With this in mind it is possible to achieve the ESDBA team structure shown in Figure 13 with this usecase the team have extended responsibility and skills for managing both types of Domains. However the Application domain owner becomes responsible for the business applications and the application code. This team requires the system administrator skills along with Database administrator skills working together as a single team.

SuperCluster Technology Components To Do Lists - One Team acting as the Platform Provider									
Owner	Component	Monitor	Provision	Configure	Tune	Backup	Problem		
							Analyse	Patch	Replace
Extended SuperCluster DBA Team	Hardware	Y					Y	Y	Y
	PDU	Y							Y
	Infiniband Network Switches	Y				Y	Y	Y	Y
	Management Switch	Y				Y	Y	Y	Y
	ZS-ES Storage	Y	Y			Y	Y	Y	Y
	Database Domains	Y	Y		Y	Y	Y	Y	
	Application Domain	Y				Y	Y	Y	
	Solaris	Y	Y	Y		Y	Y	Y	
	Zones	Y	Y	Y		Y	Y	Y	
	Grid Infrastructure	Y	Y	Y	Y	Y	Y	Y	
	ASM	Y		Y	Y	Y	Y	Y	
	DBMS	Y	Y	Y	Y	Y	Y	Y	
	Database	Y	Y	Y	Y	Y	Y	Y	
	Database Service	Y	Y	Y	Y		Y		
Application Admin Team	Business Applications	Y	Y		Y	Y	Y		

Figure 13 Supercluster Technology Components Task list - 1 Team as a platform provider

Outsourced Administration

It is common for IT Services such as System Administration or Database Management to be outsourced. Oracle continues to partner and provide Outsourcers and cloud providers with skills for managing Oracle SuperCluster and other Engineered Systems. All of the contents in this document applies to outsourcers as well. Many are already Engineered Systems aware and mature in operational models for providing optimal return of value to their customers by taking advantage of the Engineered Systems design.

Conclusion

Oracle SuperCluster is a single architecture that combines extreme processing speed and extreme capacity in a uniquely optimised and simplified package. It is an ideal platform for strategic consolidation of Oracle systems and software of all types. Compared to traditional I.T. environments and Oracle infrastructures it enables far quicker implementation and significantly more efficient operational management whilst saving up to 40% of administration time and effort. As well as providing the basis for optimising any existing outsourcing arrangements, this frees up highly skilled resources to work more closely on business projects or strategic initiatives and offers a much more agile and responsive service to internal and external customers. In order to maximise these operational benefits SuperCluster users should consider streamlining and unifying administration teams, make full use of Oracle Enterprise Manager (including Operations Centre), and update their procedures for each administration task. In order to become self-sufficient and realise these benefits as soon as possible, customers are recommended to make use of Oracles wide range of SuperCluster services.

Oracle Engineered Systems are not just about performance and capacity; they make administration simpler and easier too.

Appendix 1 – Oracle Enterprise Manager 12c

Oracle Enterprise Manager Cloud Control 12c (Enterprise Manager) uses a holistic approach to manage the SuperCluster and provides comprehensive lifecycle management from monitoring to management and ongoing maintenance for the entire engineered system. It provides a unified view of hardware and software. Lights-out monitoring within Enterprise Manager is optimized for SuperCluster where metrics and thresholds are predefined so that administrators can get timely notifications when issues arise. In addition, hardware and software incidents are automatically detected and service requests logged to reduce problem resolution time.

Functionality

Enterprise Manager 12c is much faster and simpler to install and setup than previous versions. There are a number of optional packs which are strongly recommended for SuperCluster customers, depending on what you are using SuperCluster for;

- Enterprise Manager Operations Manager (for hardware and firmware management)
- Ops Center is part of the core Enterprise Manager (i.e. provided free of charge)
<http://www.oracle.com/technetwork/oem/ops-center/index.html>
- Real Application Testing
<http://www.oracle.com/uk/products/database/options/real-application-testing/overview/index.html>
- WebLogic Server Pack
<http://www.oracle.com/technetwork/oem/soa-mgmt/ds-em12c-wls-mgmt-pack-ee-1552456.pdf>
- Coherence Pack
<http://www.oracle.com/technetwork/oem/pdf/511864.pdf>
- SOA Suite Pack
<http://www.oracle.com/technetwork/oem/pdf/511870.pdf>
- Application Management Suites (EBS / PS / Siebel / JDE / Fusion)
<http://www.oracle.com/technetwork/oem/app-mgmt/index.html>
- FMW Cloud Management Pack
<http://www.oracle.com/technetwork/oem/pdf/512030.pdf>
- Database Cloud Management Pack
<http://www.oracle.com/technetwork/oem/cloud-mgmt/index.html>
- Database lifecycle Pack
<http://www.oracle.com/technetwork/oem/pdf/511949.pdf>
- Database Tuning Pack
<http://www.oracle.com/technetwork/database/manageability/ds-tuning-pack-db12c-1964661.pdf>

Architecture and Implementation Guidelines

Enterprise Manager is intended to be the primary management system for your whole Oracle environment. When used as intended, Enterprise Manager is a critical application, whose job is to monitor and manage the operation of your entire Oracle estate, including SuperCluster and non-SuperCluster systems. As such it must be configured with the very highest levels of robustness – as defined in Oracle's Maximum Availability Architecture (MAA).

MAA (and common sense) therefore requires that the Enterprise Manager environment;

- Is physically separate from all monitored and managed targets
- Is installed onto physical hardware, not as a VMWare or OVM guest
- Has the repository hosted on a RAC clustered database.
- Has the OMS (application) hosted on a clustered WebLogic Server domain.
- Has a remote standby database managed by Oracle Dataguard
- Has clearly defined and well managed security controls, auditing and admin procedures

Integration and co-existence

We assume that Oracle systems will need to co-exist with others. Enterprise Manager can be integrated seamlessly into heterogeneous I.T. environments in a number of ways.

- **Connectors** provide pre-built, bi-directional transfer of information between Enterprise Manager and other management systems. They are configured from the Enterprise Manager 12c Self Update page and there are two types;
 - Systems Management (IBM Tivoli, HP Openview, BMC Patrol, CA etc). These can exchange a wide range of configuration, performance and alert data.
 - Helpdesk Applications (BMC Remedy, CA ServiceDesk, HP Service Center etc). These typically exchange alert and service request / ticket information.
- For details of available connectors, please see;
<http://www.oracle.com/technetwork/oem/extensions/index.html>
- **Plug-ins.** These provide pre-built, one way transfer of configuration and performance data from a wide range of non-Oracle systems into Enterprise Manager in order that the Oracle administration teams can see a more complete view of the I.T landscape rather than Oracle components alone. Plug-ins cover;
 - Databases
 - Middleware
 - Networks
 - Storage
 - Hosts / Servers. Information on the servers hosting Oracle software is collected by Enterprise Manager by default. No plug-ins are required.
- **DIY Reporting.** If the provided dashboards, reports and analyses are not sufficient, it is possible and supported to build bespoke reports using Oracle Business Intelligence tools within the OBI EE Suite, with its pre-build meta-data layer.
- **Data Extraction.** This is possible using either any SQL based tool against the published Enterprise Manager repository database views, or using the published PL/SQL or Java API's. One area where this may be useful is to load Enterprise Manager data into a capacity planning tool or corporate CMDB. *No updates to Enterprise Manager data are supported via these mechanisms.*

Enterprise Manager Benefits

As well as making specific administration tasks easier and more standardised, Enterprise Manager provides wider benefits across your Administration teams

- **Enhanced Collaboration:** Enterprise Manager 12c enables *centralised* monitoring of the whole system in one tool, providing a consolidated view of how the machine is performing from the fans to

the database software. It's highly granular security model allows use by all teams involved in managing SuperCluster, thus facilitating collaboration amongst them.

- **Maximum Performance:** Enterprise Manager 12c database diagnostics and tuning packs provide detailed SuperCluster Database Domain specific performance analysis and automated tuning recommendations.
- **Optimum Agility:** Enterprise Manager 12c database Life cycle management pack provides SuperCluster Database Domain configuration management and automated database change, provisioning and patching processes.
- **Minimise Risk:** Enterprise Manager 12c Real Application Testing provides accurate predictions based on complete workloads as opposed to samples and hence minimise the risk of change.
- **Minimise Operational costs:** Enterprise Manager 12c requires minimal set up and provides end to end monitoring, analysis, management and automation for *the whole Oracle estate* from day 1 and can be easily integrated with existing high level help desk and management tools

There are many reviews and surveys which confirm the productivity benefits of Enterprise Manager and the Diagnostic, Tuning and Lifecycle Management Packs. One such is a Total Economic Impact Analysis from Forester Research in 2009 ¹⁷, which found that for a sample organization, proper use of Enterprise Manager and Packs enabled;

- Reduction in ongoing costs of managing IT configurations, compliance, patching, and provisioning.
- Increased administrator and IT operations staff productivity through standardization of “golden” configuration standards, and by replacing error-prone manual tasks with automation.
- Increased response to business needs and ability to scale environment through automated mass deployment.
- A 20% reduction (over three years) in capital spending on servers monitored by Oracle Enterprise Manager.
- Overall the sample organization achieved a risk-adjusted and a **very favorable 124% ROI** over a three-year period with a **payback period of 15 months**.

¹⁷ “The Total Economic Impact™ Of Oracle Enterprise Manager with the Configuration Management and Provisioning And Patch Automation Packs – A Multi-Customer analysis.”

Appendix 2 – Oracle Services for SuperCluster

Training

There are a number of courses that may well fit if you are running or plan to run an Oracle SuperCluster.

Please see here the [SPARC SuperCluster - Learning Path](#)

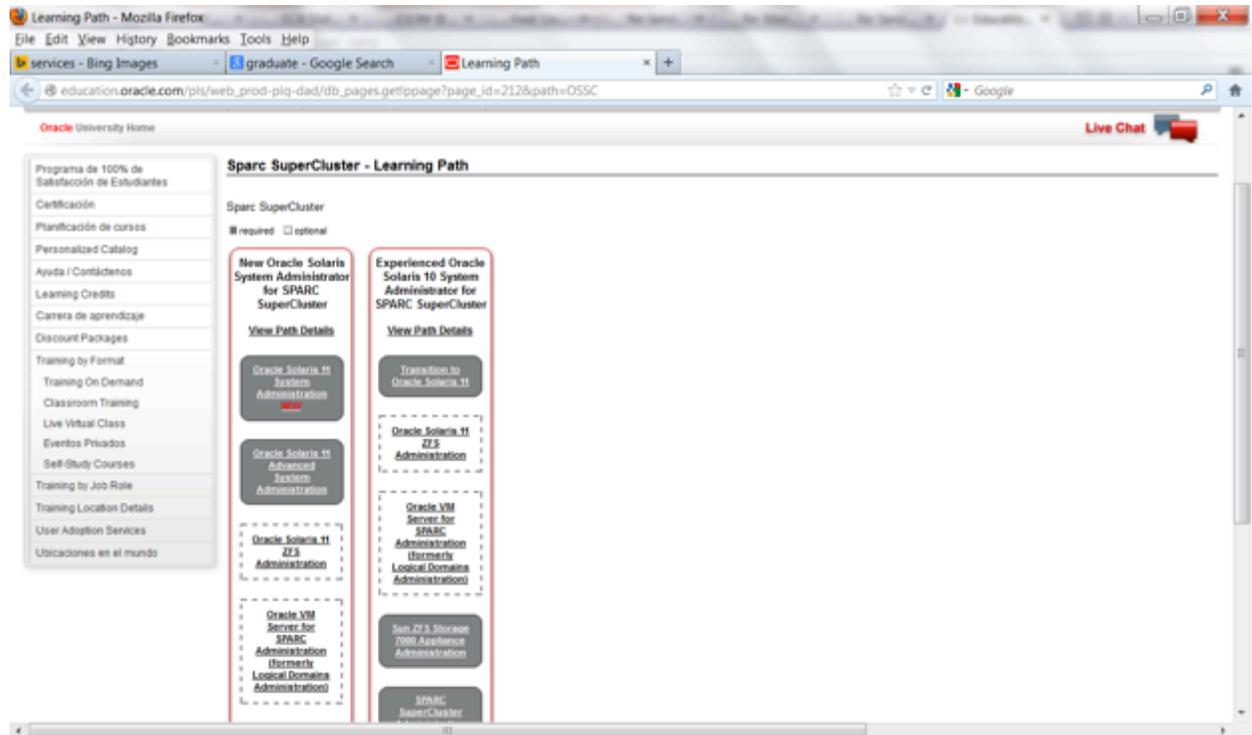


Figure 14 Screenshot of the SuperCluster Learning Path

New Oracle Solaris System Administrator for SPARC SuperCluster

The following courses are mandatory:

- [Oracle Solaris 11 System Administration](#) **NEW**
- [Oracle Solaris 11 Advanced System Administration](#)
- [Sun ZFS Storage 7000 Appliance Administration](#)
- [SPARC SuperCluster Administration and Maintenance Seminar](#) **NEW**

and the following courses are optional:

- [Oracle Solaris 11 ZFS Administration](#)
- [Oracle VM Server for SPARC Administration \(formerly Logical Domains Administration\)](#)

Experienced Oracle Solaris 10 System Administrator for SPARC SuperCluster

The following courses are mandatory:

- [Transition to Oracle Solaris 11](#)
- [Sun ZFS Storage 7000 Appliance Administration](#)
- [SPARC SuperCluster Administration and Maintenance Seminar](#) **NEW**

and the following courses are optional:

- [Oracle Solaris 11 ZFS Administration](#)
- [Oracle VM Server for SPARC Administration \(formerly Logical Domains Administration\)](#)

You may also want to take a look at [Exadata Learning Path](#) and [Exalogic Learning Path](#)

If you have experience in another platforms or UNIX flavors there is also training for you...

Solaris 11 for UNIX administrators (D82701GC10)

The Oracle Solaris 11 System Administration for Experienced UNIX/Linux Administrators course is for skilled AIX/Linux/HP-UX administrators who need to make informed decisions as they adopt, deploy, and administer Oracle Solaris 11 in their data centers. The course is extensively built around a hands-on experience, meant to impart application-level skills and knowledge to successfully administer Oracle Solaris 11.

If you have some Solaris knowledge you should start here...

Oracle Solaris 11 for New Oracle Solaris System Administrator

- [UNIX and Linux Essentials](#)

Please note that Virtualization is a separate topic. Please see her all related [Virtualization](#) courses.

Last but not least, Oracle University can work on an skill assessment to build the correct training plan for the customer - NTR: Need Training Review -. A TNR is a practical way for OU (and targeted customer audiences) to understand existing skill and knowledge levels and cross-pillar training needs at a subjective, high level. It is a way to identify relevant learning paths and courses, and a starting point to define custom or tailored learning.

It is very useful to provide the customer with a training plan that is relevant for the people on their team, given their current levels of knowledge of our Oracle training curriculum.

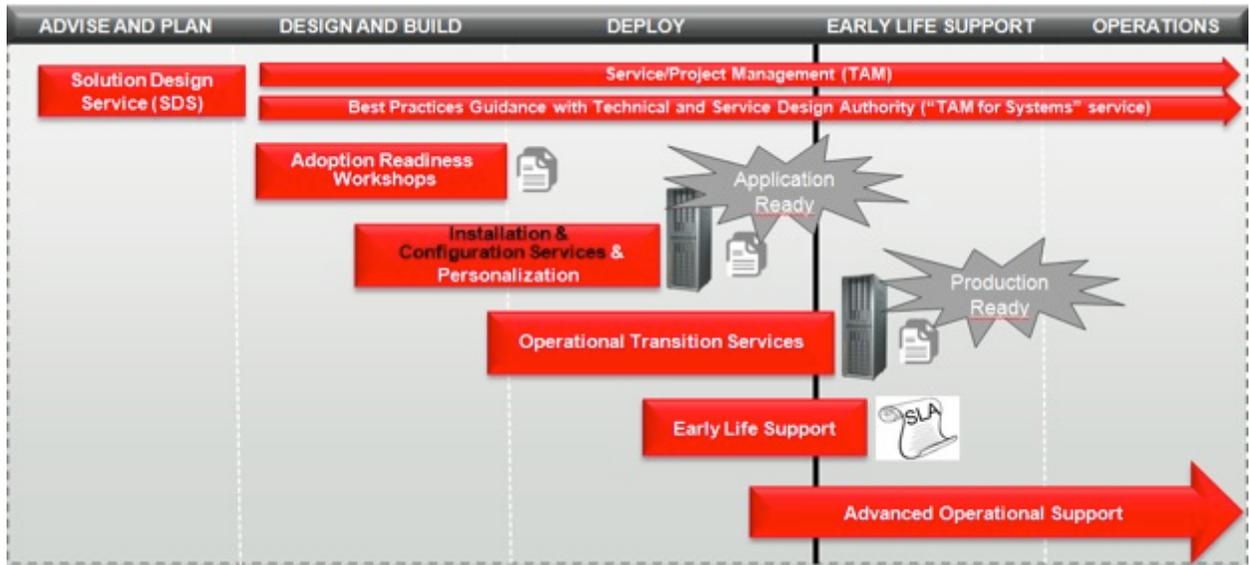
Technical Support

As well as standard Premier Support and Platinum Support, a range of additional support packages are available to help you manage your SuperCluster environment.

System Installation and Configuration of SuperCluster has to be carried out by Oracle support engineers. Although all other services are optional, experience shows that making use of both fixed scope and annual services helps ensure the fastest transfer of practical SuperCluster administration skills to your in-house teams, the smoothest implementation and the least interruptions to the services once implemented.



Oracle can also provide services since the very early phases of Planning and Design through the operation of the platform.



Migration Factory

Oracle can also assist you helping to migrate or upgrade to the latest Oracle technologies from older versions of Oracle or non-Oracle software and hardware with a proven factory approach and best-practices.

Oracle Migration Factory accelerates migrations and technology upgrades while reducing risk and cost through dedicated experts, standardized methodology and tools, and automation. Oracle migration experts plan, architect, implement, and project manage a solution based on your unique environment.

Oracle has the resources and expertise to work with your IT staff on migrating legacy hardware and software environments to the latest Oracle technologies including Database migrations or upgrades, server & storage migrations, Middleware, BI and Applications migrations or Engineered Systems migrations.

Please see more info on Oracle Migration Factory

<http://www.oracle.com/us/products/consulting/migration-factory/overview/index.html>



Oracle is committed to developing practices and products that help protect the environment

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