Oracle Exalogic:
A Guide to Maximizing Operational Management Benefits

Exalogic Management
A Guide to Planning the Support and Administration of Physical Oracle Exalogic systems

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Note: This document addresses physical Exalogic systems. However, most of the general principals and much of the information provided will also hold true for virtualised systems, which are discussed in a companion paper to be available at a later date.

Related Documents

- Cost comparison for Business Decision Makers; Oracle Exadata Database Machine vs IBM Power Systems. White Paper by the Factpoint Group, October 2012. Many points apply equally to Exalogic
- Oracle's Secret Sauce: Why Engineered Systems are Rocking the Tech Industry (Forbes Magazine article)
- Oracle Fusion Middleware Exalogic Enterprise Deployment Guide. Oracle documentation
- Managing Exalogic Elastic Cloud with Oracle Enterprise Manager Cloud Control 12c (Oracle White Paper)

Engineered Systems Acceleration Team

Jules Lane is a member of the UK ESAT team. This is a group of highly experienced Oracle architects and product experts who work with Oracle account teams to provide high level assistance to all Engineered Systems customers through the provision of the formal ‘Excite’ process and informal advice and guidance covering both business case development and implementation and operational advice.

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Background to this document

This document aims to assist I.T. managers and architects who are evaluating or planning for Exalogic deployments in understanding how it can fit into their support organisations.

The Oracle Exalogic Elastic Cloud is a proving to be a very popular solution for many application projects. It is a new approach and involves some new technology. So it is natural that when planning for Exalogic adoption organisations want to be sure, not only that it works but also that they can manage it effectively on a day to day basis in the context of their existing skill sets and organisational structures.

As well as radically increased availability, scalability, capacity and performance, the architectural simplification means that Exalogic is simpler to manage than traditional alternatives and so offers the potential for more agile and lower cost administration. This paper will explain how that is possible by addressing these key questions:

1. How is Exalogic different to traditional Oracle middleware and application platforms?
2. Process. How are administration processes different with Exalogic?
3. Technology. What tools are recommended to optimise Exalogic administration?
4. People. What impact, if any, might Exalogic have on support organisations?

If you are also planning or using other Oracle engineered systems such as Exadata and Exalytics, the general principals will apply, but details will differ.

Audience

The document is aimed primarily at Operations, Infrastructure, Support, Development and Middleware managers. However, it is also very relevant to technical architects, project managers and anyone with an interest in how an Exalogic system should be managed.

Version

Although this document addresses physical Exalogic systems, many of the general principals and much of the information provided will also hold true for virtualised systems, which are discussed in a companion paper. Note that deployment of Exalogic as a private cloud is not dependent on the use of virtualisation.

Product Updates

Oracle technologies in general, and Engineered Systems (including Exalogic) in particular, are advancing rapidly. As new versions of both hardware and software components are released some of the details in this document will become outdated. However, the general concepts will remain useful and appropriate to future Exalogic implementations.

________________________________________________________________________

1 A companion paper is available which addresses the administration tasks and tools in more detail.
1 EXECUTIVE SUMMARY

Background

Oracle Exalogic Elastic Cloud is a member of the Oracle Engineered Systems family of products, in which hardware and software are engineered together to provide extreme performance, reliability and scalability for business applications. Engineered Systems are becoming ever more widely adopted and at the time of writing (Dec 2012) there are over 2,700 Engineered Systems installed worldwide and the number increases weekly. Exalogic is a true paradigm shift in application processing as it contains a fully integrated stack - from applications to disk highly optimised to run java based middleware, Oracle and 3rd party business applications. They run many times faster, process much more data in a given time and be deployed as a cloud. The primary drivers for a move to Exalogic are typically:

- Improved performance and capacity as well as faster project implementations which allows the business to respond more quickly to opportunities
- Lower business risk due to the pre-integrated and pre-certified nature of the system as well as the one stop support offered by Oracle
- Reduced cost and complexity during implementation and operation

Exalogic can be used to support specific critical applications or as a strategic application consolidation platform.

Operational Management

The complete integration of hardware, software, networking and storage into a single system creates the potential for significantly reduced administration and management costs and greatly improved I.T. agility as compared to traditional platforms. As more of your Oracle estate is consolidated onto Engineered Systems the total cost of ownership of these Oracle systems should reduce and your overall agility and responsiveness improve.

Like any new technology, Exalogic management will benefit from some consideration and planning of people, processes and technology. In order to maximise these operational management benefits three aspects of systems administration should be considered:

- Optimally structured administration teams – evolution towards a single unified team
- Using the right management tools – Oracle Enterprise Manager 12c
- Follow Oracle best practise when carrying out administration tasks

Although each customer must determine for themselves how best to organize and carry out the ongoing management of their Exalogic machine(s), some key points to take into account are;

Exalogic is the same, but different.

It is built from standard x86 based hardware components and runs standard Oracle Linux, Solaris and Oracle WebLogic Server Suite. On this platform many popular business applications can be installed and managed in a standard manner. However::

- The Elastic Cloud software is new and unique. It includes Exabus, which is a set of hardware, firmware and software optimisations that enable the OS, middleware components and even certain Oracle applications to make full use of the Infiniband fabric and the unique built-in application delivery controller (Oracle Traffic Director).
- The embedded ZFS storage and Infiniband networking may be new to you.
- All components are designed, engineered, certified and supported to work together in a limited number of pre-defined configurations, so that the architecture is actually simpler.
Exalogic is easier to manage.

Being pre-defined and more self-managing, it is simpler. So it requires fewer tasks, less administration effort and simpler tooling than large applications on traditional non-integrated platforms. Whilst the core middleware or applications administration role is largely the same (as for non-Exalogic environments) there is significantly less work required to manage storage, O/S and networks and some administration tasks are simplified, for example:

- **Provisioning of new environments.** This is a frequently recurring task that is almost constant in some organisations. Since Exalogic is a shared pool of high density compute, storage and network resources, provision of new environments for development, testing or other projects is simply a case of re-configuring these existing shared resources, taking hours rather than weeks. If implemented as a cloud computing platform the provisioning process can be fully automated and reduced to minutes and even offered to users on a self service model.

- **Performance Tuning.** A very common administration task but one which is easier with Exalogic because all components are pre-configured and balanced to ensure that traditional bottlenecks (typically network communications and memory access) do not apply. In addition there is a much reduced need for complex indexes structures and application – specific code hints.

- **Patching.** Like any I.T. system, Exalogic will benefit from regular patching. This is a straightforward and fully documented process which is simpler than on traditional platforms since Oracle provides patches for all Exalogic components in the form of pre-certified and pre-tested bundles. This makes keeping current much more practical for many customers.

The support organisation need not change.

Your existing systems administration team structure will be quite capable of managing Exalogic. However, for ongoing administration you should consider moving towards a two team approach in which:

- The existing applications administration team(s) continue to operate the same, perhaps with minor alterations to accommodate Exalogic specific processes or optimisations

Administration of the core Exalogic platform is carried out by either:

- An *extended* admin team that owns all aspects of the Exalogic hardware and runtime middleware, but co-ordinates experts from the existing specialist teams in carrying out non-software tasks.

- A *single unified* administration team that manages all aspects of your Exalogic systems. This team should be centered on the current sys admin or middleware admin team.

Administration Tools

Oracle Enterprise Manager 12c (EM) is Oracle’s strategic systems management toolset for centrally managing all Oracle systems and it is now Exalogic - aware.

- The core EM infrastructure for Exalogic is provided *free of charge*. Where necessary it integrates with lower level tools such as ILOM, ASR, OC and storage cell commands, as well as with your existing systems management and helpdesk tools.

- Optional EM Packs offer more automated and advanced Diagnostics, Tuning and Change Management functionality for WebLogic Suite, Coherence and other Fusion Middleware components as well as all major Oracle business applications.

- Optional EM Packs enable the self service provisioning, resource management and metering and chargeback requirements of cloud computing, turning Exalogic into a ‘Platform as a Service’ environment.
The Oracle Application Testing Suite is the ideal toolset with which to confirm or predict the performance of applications running on Exalogic following infrastructure configuration changes and patching.

Outstanding Customer Support

Every Exalogic system comes with Oracle Platinum Services, a complete set of support services including 24/7 fault monitoring, faster response and restore times, and patch deployment services. Oracle can also provide a range of professional services which can address all aspects of managing Exalogic for you, from initial configuration to ongoing patching to specific help and advice to complete management of the whole system.
2 EXALOGIC ARCHITECTURE REFRESHER

Exalogic Elastic Cloud (Exalogic) is a complete engineered system; hardware, firmware and software pre-engineered to work together. It is a standards based data Center building block that provides a fully integrated private cloud infrastructure that can support a wide range of mission critical workloads. All resources are balanced and optimised, enabling extreme performance. Exalogic is the most logical choice of platform for Oracle business applications and Oracle Fusion Middleware and is a certified platform for over 340 ISV applications. It incorporates the best practices from many thousands of customer deployments and a huge amount of R&D effort over many years.

As well as extreme reliability, performance and capacity, a major distinguishing feature (and in many cases a primary part of the business case) is easier management and faster project deployment. As a sophisticated and very flexible I.T. platform, Exalogic of course needs an appropriate level of administration.

However, the work required is typically much less than that needed to manage traditional, less integrated application platforms from multiple vendors.

Fig 1 – Exalogic X3-2 Hardware Architecture

The hardware architecture is summarised above, showing that it is a combination of servers, storage and networking – all designed, built, supported and intended to be managed together.

Exalogic systems can be bought as an eighth, quarter, half or full machine (or rack) and up to 8 machines can be connected into the internal Infiniband network. For optimised data access and backup, Oracle Exadata machines and ZFS Storage appliances can be added into the Infiniband fabric.

2.1 Physical or Virtualised

Exalogic can be implemented in either of two ways.

- Physical. In this configuration WebLogic Server, Coherence and Tuxedo (or even non-java business applications) are run on a physical O/S. This configuration would not include Oracle VM and middleware and applications running on the Exalogic platform are deployed and managed in very much the same way as they are on traditional platforms; new deployments will be
associated with appropriate physical compute, storage, memory and I/O resources. There will be no Oracle Control and Enterprise Manager will be the primary administration tool. Although most Exalogic deployments to date have been of this type, Oracle’s vision for Exalogic is as a fully virtualised platform.

- Virtualised. In this mode logical vServers are defined, which consist of Oracle VM templates with a guest Oracle Linux OS and specific amounts of physical compute, storage, memory and I/O resources, optionally pre-configured with middleware and applications. This approach allows for maximum levels of resource sharing and agility as vServers can share physical resources and can be provisioned in minutes. Pre-configured OVM templates for Oracle Applications are available to download. Oracle’s strategy for Exalogic is focused firmly on increasing deployment of virtualised configurations.

Both of these Exalogic implementation styles can support the creation of a private cloud. In a virtualised system Exalogic Control is used to define, manage and monitor cloud users and services whilst in a physical system equivalent functionality is provided by Enterprise Manager with the Cloud Management Pack.

Although this document primarily addresses physical Exalogic systems, many of the general principals will also hold true for virtualised ones.

2.2 Exalogic Technology Components

A complete Exalogic system consists of a number of components.

- The base package. This is delivered from the factory and is configured during the initial set up process. It includes;
  - The X3-2 hardware, as in the diagram above.
  - The Exalogic Elastic Cloud Software (also referred to as Exabus).

- Oracle run-time components (also known as the Oracle Cloud Application Foundation). Although optional, most deployments will include one or more of Oracle WebLogic Server and JRockit, Oracle Coherence and Oracle Tuxedo. These are typically configured during initial set up but can be added later.

- Optional additional software, such as Oracle Fusion Middleware components, Oracle Applications or 3rd party products.

2.2.1 Base Package

2.2.1.1 Hardware

The hardware components of an Exalogic Elastic Cloud X3-2 Full Rack configuration are as follows:

- **Compute Nodes.** 30 x4170 Intel Xeon x86 rack mounted servers, each with 2 x Xeon® Sandy Bridge E5-2690 2.9GHz processors with 8 cores (giving a total of 480 cores), 200 GB of solid state disk storage (giving a physical total of 6 TB of flash memory, of which approximately half is useable) and 256 GB RAM (giving a total of 7.7 TB). A large number of processing cores and lots of memory is of course ideal for typically intensive application server workloads.

- **ZFS 7320 Storage Appliance.** This consists of 2 storage nodes / servers and a disk array of 20 x 3TB hard disks offering 27TB of useable space with built in fault tolerance and replication. There are also 4 x 73GB solid state disks providing a 292 GB read / write cache.

- **Infiniband Switches.** A fully integrated and extremely high performance Quad Data Rate Infiniband I/O backplane connecting all internal components. Bandwidth up to 40 Gb / sec with latency down to 1 millisecond. 4 IB gateway switches are included and since they support...
Infiniband, TCP/IP and Ethernet traffic they can seamlessly manage network connectivity between iB based Exalogic components the rest of the data Center.

- **Management Switch.** 1 GB Ethernet management switch, used for internal administrative and monitoring traffic only.
- **Power supply.** Fully redundant PDU’s.
- **Documentation and Spares Kit.** Including cables and disks,
- **Configuration and Diagnostic tools.** Such as ILOM, ASR and Exachk.
- **Operating System.** All Exalogic compute nodes must run the same O/S, which can be any of:
  - In a physical implementation, Oracle Linux 5.8 or Oracle Solaris 11
  - In a virtualised implementation, an Exalogic - specific version of Oracle VM 3 is deployed as a type 1 hypervisor and OVM images (known as vServers) will run Oracle Linux as the guest O/S, optionally with additional Oracle or 3rd party software.

### 2.2.1.2 Exalogic Elastic Cloud software (Exabus)

This is the defining architectural feature of Exalogic. It is not a single component, but a set of hardware, firmware and software optimisations that ensure optimal use of the Quad Data Rate (QDR) Infiniband network fabric by all of components, thus providing the basis for Exalogic’s reliability, availability, scalability and performance.

Exabus consists of a number of components:

- **Exabus Infiniband Gateways and Switches.** One of the most important and differentiating aspects of Exalogic is the ability of the system to present itself to the datacenter network as a single large computer with a large number of 10 Gigabit Ethernet (10GbE) network interfaces. At the physical level, this is achieved through the use of special gateways that connect directly to external 10GbE ports exposed by standard datacenter switches. Exalogic’s Ethernet-to-Infiniband gateways use a unique Infiniband-to-Ethernet bridge design that allows each Exalogic compute node, through simple software configuration, to have as many as 1000 virtual 10GbE network.
interface cards, each of which appears to the datacenter network as if it is a standard Ethernet device.

- This approach greatly reduces the number of physical network cards, cables, and switches that must be installed, powered, tested, tuned, managed, and maintained while offering improved application performance, security and reliability. This approach also eliminates interoperability issues with existing network management tools and guarantees complete interoperability with existing Ethernet-based switches, firewalls and load balancing appliances, since Exalogic’s use of Infiniband is completely invisible to the rest of the data center.
- Exabus supports the creation of Virtual Local Area Networks (VLANs) within Exalogic as a means of providing application isolation, and transparently isolate inter-cluster communication to non-Ethernet subnets, thereby providing both enhanced security and improved cluster performance.

- **Exabus Software, Firmware and Drivers.** At the software layer, Exabus extends and enhances the Open Fabrics Enterprise Distribution (OFED™). OFED is an industry standard open-source software toolkit for Remote Direct Memory Access (RDMA) and kernel bypass applications. OFED is widely used in high performance Infiniband-based computing systems that require maximum throughput, minimal latency and a unified infrastructure for storage access, network virtualization and cluster Inter-Process Communication (IPC). Exabus includes kernel-level drivers, channel-oriented RDMA and send/receive operations, kernel by-passes of the operating system, both kernel and user-level application programming interface (API) and services for parallel message passing, sockets data exchange, storage and file/database system access. Exabus incorporates a number of reliability, management, and performance features that are not available from any other similar system:
  - Unique support for Exalogic’s Ethernet-over-Infiniband (EoIB) gateways
  - Simplified management and monitoring with full ILOM and Oracle Enterprise Manager OpsCenter integration
  - Quality of Service (QoS) and Partitioning configuration support
  - High Availability Sockets Direct Protocol (SDP)
  - IPv6 support for SDP, EoIB and IP-over-Infiniband (IPoIB)
  - Automatic disabling of degraded physical links (autonomous port-level failover)
  - 100s of separate design fixes and enhancements in the Host Stack and Management Stack, improving compliance, stability, efficiency and performance

- **Oracle Traffic Director (OTD).** This is an application delivery controller unique to Exalogic. As well being the entry point for all web traffic, OTD is provides internal load balancing and failover of http application traffic between components which may spanning multiple compute nodes. It is fully integrated with Exabus (and therefore aware of Infiniband and all other Exalogic components). It provides dynamic ‘traffic shaping’, consisting of high availability through server failover and load balancing, high performance through caching and compression along with dynamic routing, resource usage control and security, with built in monitoring of physical and virtual images and resources. OTD is natively integrated with Oracle WebLogic Server and it is strongly recommended to use OTD for internal Exalogic traffic management. For load balancing of external requests coming into Exalogic, either OTD, other Oracle or 3rd party web servers / load balancers / proxy servers can be used.

- **Virtual Firewall (Infiniband Partitions).** Exalogic supports a powerful physical I/O traffic separation capability called “Infiniband partitions”. In an Exalogic system, the QDR Infiniband fabric is used as the physical foundation on which all other communication networks are virtualized. In Exalogic, the switches in the Exabus I/O backplane of the system enforce the endpoint security rules that determine which applications or software components on any given compute node are allowed to send or receive messages (or even see) to any other. This enforcement happens at the lowest possible layer in the system and is highly secure – even
securing root level access to compute nodes does not compromise the security of the system as a whole and all applications running on other compute nodes on the system are completely unaffected. In combination with Traffic Director and software firewall technologies like Linux /iptables, it is possible to implement so-called De-Militarized Zones (DMZ) on the Exalogic system which are as secure as those implemented using traditional hardware firewall appliances.

More information on Exabus and the Exalogic architecture in general can be found in the document; Oracle Exalogic Elastic Cloud: System Overview on Oracle.com.

2.2.2 Additional Software

2.2.2.1 Oracle Run-time Components

Oracle run-time components execute the actual business software. They are also referred to as the Oracle Cloud Application Foundation. Although not clear from the diagram above, WebLogic Server, Coherence and Tuxedo can be run on either a physical O/S or on the Oracle Linux OVM guest.

Any versions certified for Oracle Linux or Solaris can be run, but more recent versions will have specific optimisations which are only activated when running on Exalogic (see below).

- **WebLogic Server (WLS EE).** This provides the runtime environment for all Java applications and tools and includes the JRockit JVM (or Hotspot if running on Solaris). All elements of WLS can be implemented in the normal way across Exalogic compute nodes and all architectural options and standard WLS administration tools are available.
- **Coherence.** This offers an in-memory data grid which provides the highest levels of performance and availability for data processing functions. There may be one Coherence cluster shared by all applications running on the machine or (more likely) multiple clusters used by different applications.
- **Tuxedo.** This provides a transaction processing / application server environment for Cobol, C and C++ applications.

2.2.2.2 Additional Software

The additional software installed will depend on the use to which the customer wants to put their Exalogic system, as this is the business software that end users and developers need to use. It can include:

- Additional Oracle Fusion Middleware products, such as SOA Suite or WebCenter Suite.
- Oracle business applications (all of which run on WebLogic Server and may increasingly contain their own Exalogic optimisations), such as E-Business Suite, PeopleSoft, Siebel and Fusion Apps
- 3rd party packaged or bespoke applications which are certified to run on Oracle Linux or Solaris.

2.2.2.3 Enterprise Manager

This is the strategic systems management toolset for all Oracle applications, middleware, database and hardware. EM 12c is Exalogic – aware and includes:

- EM Cloud Control to manage the software running on the Exalogic system.
- EM Operations Center to manage the hardware and O/S components in more detail.
- Exalogic Control can conveniently be thought of as the EM component which is used to manage virtual resources and services in a virtualised implementation. It is the administration tool used to map physical resources to virtual services in order to implement Exalogic as a private cloud, enabling an Infrastructure-as-a-Service (IaaS) platform. Under the covers it is actually an
customised and combined version of Operations Center and OVM Manager. It is not required for a physical implementation.
3 HOW IS EXALOGIC DIFFERENT?

Compared to traditional application platforms, Exalogic is the same but different.

Traditional application server platforms used to run Oracle software will be constructed using components from many vendors, possibly including HP, Red Hat, Net App, Cisco, VMWare, F5 and Oracle. All of these components will have to be evaluated, procured, architected, implemented and tested. This will require a complex project typically taking between 1 and 3 months and involving many teams and multiple vendors. Since few, if any, of these components will have been designed to work together then the responsibility for this integration and testing will fall to the IT Department. To deliver optimal performance requires complex configuration well as source code tuning and repeated rounds of testing.

Even more importantly from the viewpoint of this paper, ongoing management and support of such a system involves multiple teams of experts using multiple (probably overlapping and conflicting) tools and co-ordination of multiple vendors. This is the reason why businesses often feel that I.T. lacks agility; in such an environment changes can simply not be made quickly, so that business opportunities may be missed.

3.1 Exalogic uses standard building blocks . . .

Exalogic uses standard hardware and software components, including Intel based compute servers, the Linux or Solaris O/S, an IP based network, Oracle WebLogic Server, Oracle Fusion Middleware and Oracle business applications and these components behave essentially the same as they do on traditional, non-Exalogic platforms. Exalogic runs any programs which are supported by Oracle Linux or Solaris x86 without change.

3.2 . . . but they are implemented differently

It is the differences that not only explain the performance and capacity increases, but also why the amount of administration required for Exalogic can be less than for Oracle systems on traditional platforms. In general, there are five major differences.

1. Exalogic components are all designed and engineered to work together
2. Some of the components may be new to you as the latest technologies have been used
3. Exalogic includes Exabus, a set of unique software and firmware optimisations to maximise performance, availability, security and ease of management
4. WLS, Coherence and Tuxedo have Exalogic – specific optimisations to make best use of the enhanced network and compute resources in order to maximise performance.
5. Exalogic systems provide a pool of compute resources, either physically or virtually shared across multiple applications and user communities.
6. All this means that Exalogic enables a new approach to service provision predicated on a new and much more agile operational model.

3.2.1 Pre-engineered to work together.

With the appropriate investment of resources and time it is possible for customers to study their aggregate 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. Today for the majority of organisations this is business as usual.

Such a system, however, cannot equal an Exalogic system for the simple reason that with Exalogic, the design of the components themselves is influenced by the requirements of the Exalogic system: Oracle
Managing Exalogic (Physical)

has made optimizations and enhancements to Exalogic components, Oracle Fusion Middleware and Oracle Enterprise Manager that cannot be made by customers or by any 3rd party.

Since all components in the machine are pre-designed, pre-tested, pre-certified pre-installed and supported by Oracle, most administration tasks become simpler, easier, more standardised, less error prone, more easily audited and much more easily automated.

3.2.2 New components

Although based firmly on industry standard components, Exalogic includes some technology which, depending on your experience, may be new to your organisation. These elements include;

1. Infiniband (IB) networking. IB networking is used for all communications and data transfers within the Exalogic machine and can be used to connect multiple Oracle Engineered Systems together to create a very high performance, multi-purpose computing environment. Use of IB is a low level change which is largely invisible as applications using Ethernet or IP are unaware of IB as they use EoIB or IPoIB protocols. Infiniband network administration is no more complex than standard TCP/IP network configuration.

2. ZFS Storage. Although this is a standard NAS device, it features optimised compression, performance and reliability optimisations and is built in to the Exalogic machine. With ZFS, storage has been specifically engineered to hold the binaries and configurations for both middleware and applications therefore reducing the number of installations and simplifying configuration management on the Exalogic system.

3. Oracle Linux (OL). This is directly derived from and 100% compatible with Red Hat Enterprise Linux. It is the default OS for physical Exalogic systems and is used as the Guest OS in virtualised ones. Oracle Solaris is available as an alternative base OS in physical systems.

3.2.3 Exalogic Optimisations

Because we know the exact details of the environment in which each component is operating, Oracle can optimise the way Exalogic components use the internal network, memory and storage in order to optimise performance, availability and security. These optimisations are of two types;

3.2.3.1 Generic Optimisations (Exabus)

These will benefit any software running on the Exalogic machine, whether it is Oracle, 3rd party or bespoke and whether Exalogic is supporting physical or virtual environments. The collection of Exalogic – specific optimisations are referred to as Exabus. The purpose of Exabus is primarily to integrate Infiniband networking seamlessly into all the hardware, software and firmware distributed throughout the system. Examples include;

- Changes to the firmware and drivers in the network switches which increase performance by skipping protocol stack conversions
- Use of Exalogic solid state disk caching to increase the speed and capacity of local (shared) data read and write operations such as JMS queues and run time metadata.
- Built in high availability at network and storage levels
- Native Infiniband integration with any other engineered systems, such as additional Exalogic machines, ZFS storage appliances or Exadata Database machines.
- The ability to define Infiniband partitions, which ensure application isolation and security.
### 3.2.3.2 Oracle software Optimisations

Both the Oracle run time container and Oracle business software products are being optimised for Exalogic and we can expect such optimisations to develop further over future releases.

**Oracle Run-Time Component optimisations**

These will benefit any applications executed by the Oracle WLS, Coherence or Tuxedo. They make up a further level of optimisations *engineered directly into these products* in order to take best advantage of the generic Exabus optimisations. These optimisations are now included in all current WLS and Coherence distributions as standard, but can only be activated when they are running on the Exalogic platform. The software optimizations address performance limitations that only become apparent when the software is running on Exalogic's high-density computing nodes and very fast Infiniband switches, enabling the WebLogic Suite of products to utilize the benefits of this state of the art hardware to the maximum. Examples include;

- **WebLogic Server.** Session replication uses the SDP layer of IB networking to maximise performance of large scale data operations as this avoids some of the typical TCP/IP network processing overhead. When processing HTTP requests, WLS makes native use of the SDP protocol when called by the Oracle Traffic Director or when making http requests to it. Through its Active Gridlink for RAC feature, WLS JDBC connections and connection pools can be configured to use the low level SDP protocol when communicating natively with Exadata over the IB fabric.

- **Coherence.** Cluster communication has been dramatically redesigned to further minimise network latency when processing data sets across caches. Its elastic data feature increases performance in conjunction with the compute nodes built in solid state drives by optimising both the use of RAM and garbage collection processing to minimise network and memory use. When sending data between caches it uses only an RDMA level IB verb set, thus avoiding nearly all the TCP/IP network processing overhead.

- **Tuxedo** has been similarly enhanced to make increasing use of SDP and RDMA protocols in order to optimise the performance of inter – process communications within and between compute nodes.

**Oracle business software optimisations**

Exalogic – specific changes to other Oracle Fusion Middleware components (such as SOA Suite) and Oracle Applications (such as EBS) which allow these products to take best advantage of both the run time container and Exabus enhancements are expected in upcoming releases of those products.
4 POTENTIAL FOR REDUCED ADMINISTRATION EFFORT

The New York Times (10th April 2012) has described the problem of inefficiency in IT operations:

“It can take up to six months, research shows, to get a new business application up and running, from buying the hardware to fine-tuning the software. An estimated 70% of corporate technology budgets is spent on installing, updating and maintaining current technology… although the problem has been developing for a long time, technology managers and analysts agree it is growing worse.”

Administration of complex business applications and middleware is tough. These systems have many interconnected moving parts, involving both hardware and software. 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 configuration management require much manual effort involving multiple teams using a range of different, partially overlapping procedures and tools.
- Provisioning of new environments (a very common, even continuous task) can take weeks or months
- Patching is often either ignored as long as possible or becomes the domain of a full time, dedicated patching team because of the complexity and perceived risk of such changes.
- 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.

Running critical applications on Oracle Engineered Systems such as Exadata and Exalogic can free up the administration team 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 and enhanced integration between systems. There are two fundamental reasons for this;

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

Much of what would otherwise require the involvement of one or more support teams can, with Exalogic and Exadata, be done faster by a more unified administration team, or even (if implemented as a private cloud) on a self service basis by developers and end users.

Factpoint Group TCO Study October 2012

“Oracle Engineered Systems require 40% fewer systems administrator hours to maintain and operate annually, including easier deployment and tuning, quicker support calls because of less finger-pointing and faster service with a single vendor. And they will become even easier to operate over time as users become more proficient and organize around the benefits of integrated infrastructure.”
The chart above shows the potential reduction in the total amount of administration work required when running applications on Oracle Engineered Systems. Although savings are possible across all components the largest savings are likely to made in the areas of storage, network, operating system and hardware administration. Exalogic should not involve any significant database work. Most estimates agree that a reduction of 20% - 40% is a realistic target once administration teams are up to speed, the organisation structure is optimised and Enterprise Manager is properly implemented.

4.1 Examples of easier administration

The tasks that applications admin teams typically have to dedicate inordinate amounts of time to include:

- Monitoring and SLA management
- Provisioning / cloning of new apps environments
- Configuration Control and Management
- Performance Tuning
- Root Cause Analysis and Problem Resolution
- Patching
- Project Management and team co-ordination

The degree of operational management benefit when running applications on Exalogic will vary between tasks and technology components: some administration tasks are much easier, some are largely the same and some traditional tasks are required less often on Exalogic platforms.

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2 Source: Oracle internal research and anecdotal customer and partner evidence.
Fig 1. Potential for Applications Administration Savings with Engineered Systems.

The chart above shows approximate values for potential savings for some common tasks when carried out on Oracle Engineered systems, as compared to traditional platforms. It shows that some benefits accrue from Exalogic as a platform and some from the proper use of Enterprise Manager to administer components. The rationale for these figures is discussed briefly below.

Note that these figures are for illustration only, they will vary for each organisation depending on a wide range of factors and they are not guaranteed.

Monitoring and SLA management
Exalogic makes this easier because all components are designed to work together and are pre-tuned for optimal performance. Improved application SLA’s can be offered due to the improved performance and they will be met more consistently because unexpected problems and bottlenecks will be less common.

Enterprise Manager monitors all application components out of the box, with no manual set up required. This extends from the users browser, through internal parts of Oracle business applications to the physical network and disks. EM is Exalogic and Exadata – aware and reports performance, availability and configuration data, and the relationships between components in real time and historically. Application topology both within and between environments can be viewed graphically and out of the box metrics and thresholds are provided which are specific to Exalogic. By grouping Exalogic components as they relate to business functions, EM enables SLA’s to be defined at the level of individual business components, specific functional areas or user communities. They are then automatically monitored, alerted and reported on and separately cover performance and availability.

Provisioning
Setting up a new environment for a business or I.T. project is a very common request for applications teams and the ability to do this much faster is a major benefit of Exalogic and Exadata.

Because they consist of very dense, shared compute resources, there is no need to design, procure, integrate and test hardware and network components when a new environment is needed. The hardware and software resources for a new application development or test environment consisting of WebLogic Server (and perhaps Coherence) clusters, multiple JVMs, compute nodes, memory, shared storage and dedicated network channels and ports can all be configured and made available in minutes.
Automated and standardised Enterprise Manager procedures can be run to clone or install single or multiple application software images from the central EM library; these can be triggered by end users on a self service basis if a private cloud is implemented.

<table>
<thead>
<tr>
<th>Traditional</th>
<th>Exalogic / Exadata</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hardware (procurement and) installation and configuration</td>
<td>Not needed</td>
</tr>
<tr>
<td>2. OS installation and configuration</td>
<td>Not needed</td>
</tr>
<tr>
<td>3. Network configuration</td>
<td>Simple configuration</td>
</tr>
<tr>
<td>4. Storage (procurement and) provisioning</td>
<td>Simple configuration</td>
</tr>
<tr>
<td>5. Database cloning and configuring (Exadata only)</td>
<td>Automated with EM</td>
</tr>
<tr>
<td>6. Middleware installation and configuration</td>
<td>Automated with EM</td>
</tr>
<tr>
<td>7. Hardware and software integration, testing and re-configuration</td>
<td>Reduced effort</td>
</tr>
<tr>
<td>8. Application installation and configuration</td>
<td>Automated with EM</td>
</tr>
<tr>
<td>9. Application / middleware configuration and performance testing</td>
<td>Reduced effort</td>
</tr>
</tbody>
</table>

**Fig 2. Application provisioning steps; Traditional platforms and Exalogic.**

The chart above compares how the provisioning process works for traditional and Engineered Systems platforms and a real example of this is shown in Appendix 3.

In a virtualised Exalogic environment Oracle VM templates are available for the Oracle business applications which can also be deployed by EM. In the future Exalogic will support Oracle Virtual Assembly Builder, which will enable the definition of complete multi-tier applications environments consisting of hardware, network and software resources (‘assemblies’). As with standard applications images and OVM templates, these can be deployed by EM in a single shot.

**Performance tuning**

This is both less common and easier with Exalogic than traditional platforms.

It is less common due to the much higher run time performance enabled by the dense and balanced compute power and integral Infiniband network fabric. Although all applications will benefit from this, Oracle applications are increasingly being optimised specifically for the Exalogic and Exadata platforms. In traditional systems a common performance bottleneck is SQL processing in the database and the use of Exadata across the Infiniband fabric often removes the problem altogether. When tuning is needed, it is simpler because the simplified, pre-configured and pre-tuned architecture means that there are fewer ‘knobs to twiddle’. Because you will be running a standard configuration (such as a half Exalogic rack and a quarter Exadata rack) Oracle best practise advice can be very specific.

EM tracks application transactions across all components and provides administrators with automated configuration and compliance reporting, automated middleware diagnostics and tuning advisors. Exalogic – specific alerts can trigger automated resource allocation or operator notifications. If the bottleneck is the database EM will flag this up immediately and recommend Exadata – specific options to resolve it.

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**Factpoint Group TCO Study October 2012**

“It was clear from customer experience that Oracle Engineered Systems tight integration of hardware and software allows for pre-tuning for higher performance without customer staff needing to spend time on tinkering with the system. Some customers were so impressed with initial “out of the box” performance that they spent no additional time on tuning. Others noted that if you’ve migrated from a traditional solution, chances are you will see a performance boost right out of the box without any tuning, but that there are still opportunities to improve on that for specific scenarios.”
Configuration Management

Analysis, comparison and reporting of detailed component configurations is a key element of many other administration tasks and a major part of proving audit compliance.

The pre-configured and standardised nature of Exalogic turns this traditionally very time consuming and error prone task into something that is accurate and requires minimal administration effort. Application configuration itself will not be different for Exalogic, other than to ensure that any Exalogic or Exadata optimisations are activated.

Enterprise Manager automatically discovers all Exalogic components, tracks their configurations over time, detects changes in real time and enables easy configuration comparisons of all types. Hardware and software configurations are uploaded to My Oracle Support (MOS) daily which enables accurate patch predictions and faster problem resolution. EM constantly evaluates your configuration for compliance with Exalogic and Oracle applications best practise and incidents can be raised where they are not.

Problem Diagnosis and Resolution

The greatly improved performance of Exalogic in general reduces the need for problem resolution and its simplified architecture and single vendor nature makes the process faster and easier.

Where problems are experienced, getting to the bottom of the issue is simpler and faster because the various technology components are pre-configured in standard patterns so the number of possible combinations is reduced. Oracle support will be aware of your configuration and will be the only vendor responsible for any component.

Factpoint Group TCO of Oracle Engineered study, October 2012:

- A major logistics company noted “On-line application and related overnight batch processing times have reduced by 2 – 10x. This basically means a lot less handholding and a lot less exception management,” said the CIO.
- The manager of the administration team at this company sees benefits in diagnosing and troubleshooting performance issues with single-vendor Exalogic compared to a mixed vendor environment. “Before Exalogic, when we would open a Service Request with Oracle support we would spend the first half-day answering questions about what exactly are you running this on, how much memory do you have etc. When we log in a ticket on our Exalogic, they know what we have. It’s just a question of whether we have a quarter-rack or a half-rack, if that even comes up.”
- Because the entire stack is Oracle, customers avoid the game of “Whose problem is this anyway?” that often characterizes multivendor environments. “Deciphering whose problem it is can be the lion’s share of where the work is spent,” said the director of information systems operations at a major retailer that runs its Oracle software on IBM Power Systems hardware.
- At another customer, a telecommunications firm caught up in a finger-pointing episode that lasted months, an administrator added: “A lot of the time was proving we really had a problem.”

Enterprise Manager facilitates root cause analysis as it will monitor and manage alerts for all components. The Real User Experience Insight (RUEI) and Business Transaction Management (BTM) tools are seamlessly integrated and can pin-point performance bottlenecks and the source or errors across all components from browser, through in-memory caches, application code and JVM to database and disk. Hardware and software configurations are uploaded to MOS daily which enables faster problem resolution.

Note that alerting and critical problem resolution can be done for you by Oracle at no extra cost as part of Oracle Platinum Support using EM 12c.
Patching

Many customers traditionally avoid patching until it is absolutely necessary. 94% of service requests in August 2012 related to bugs which had already been fixed in an existing patch set.\(^3\)

Exalogic patching is requires much less administration effort than patching of traditional multi-vendor platforms. This is because every quarter Oracle provides a cumulative patch bundle containing pre-certified, pre-tested and fully documented patches for hardware, firmware, OS and WebLogic Server components.

EM uploads configuration data and patch levels to MOS daily which enables accurate patch analysis and recommendations. The application of patches to individual components (including Oracle applications, WLS, Coherence, Linux / Solaris and firmware) within each Exalogic environments can be automated and standardised using EM.

Since patching is easier and more reliable on Exalogic, it becomes possible to stay much more current. This in turn minimises the risk of suffering from problems caused by bugs that have already been fixed and eliminates the cost of extended support.

\(\text{Note that if you are running a certified Exalogic configuration, the application of quarterly patch bundles can be done for you (or with you) by Oracle at no extra cost as part of Oracle Platinum Support.}\)

Project Management and team co-ordination

Managing and co-ordinating administration tasks such as provisioning and patching across multiple specialist teams carries a large overhead in terms of project management cost and elapsed time. In most large traditional I.T. environments the complexity and uniqueness of each environment means there is no practical alternative to this approach.

Most customers using Exalogic are moving towards a more unified platform administration structure, reflecting the fact that all components are pre-integrated and have been designed to be managed as a single unit. Whether the operational management of the Exalogic infrastructure is dedicated to a single unified team or operational procedures between existing multiple teams are streamlined, the applications administration team will receive an improved service and they will have fewer other teams to co-ordinate with. This will result in improved agility and reduced management costs due to easier and faster project management, planning and communication along with a reduction in delays and inconsistency.

Enterprise Manager facilitates and complements this streamlining since all EM tools all share a common UI and a common repository. Use of EM can be delegated in a secure manner to members of all administration teams, helping to create a unified virtual team. The potential for inconsistency and confusion common where multiple overlapping management tools are used is virtually eliminated.

4.2 Realising these benefits

These efficiencies and savings will not just occur by magic. In order to fully realise the benefits, three aspects of systems administration should be reviewed and optimised;

- **People.** Evolve towards a more unified organisation structure. This could be one or multiple teams and should take account of any outsourcing arrangements.
- **Technology.** Make optimal use of Oracle Enterprise Manager to standardise and automate administration tasks and link it into MOS and your existing enterprise monitoring solution.

\(^3\) Oracle internal analysis of SR’s, September 2012
- **Process.** Plan for some of the administration tasks to be different and adopt Oracle best practise when carrying them out. Note that virtualisation will involve far more significant changes.

They do not all need to be addressed on Exalogic day 1, or even at all. Although they are independent, the maximum operational management benefit will be realised if they are all optimised in a co-ordinated manner. This of course will be a gradual process and the time needed will depend on many factors, including the efficiency of your current Oracle administration processes, your familiarity with EM and your use of Oracle (and partner) services.

Nintendo Games are implementing Exalogic for a new customer facing (and currently highly secret) project. Dave Tempero, Snr Dir of I.T. Operations has some advice for others embarking on Engineered Systems projects. “Oracle Enterprise Manager and Operations Center are very useful management tools, and companies should be sure they’re included in the project.”

He added that “Additionally, management of the staff running the systems can get complicated. Nintendo has its networking team managing the Infiniband and network switch, the database team managing the databases, the Unix team managing the Unix engineering and the hardware team managing the box. That’s an awful lot of people to get to work together,” Tempero said. “I think over the next few years we’re going to get to a single team responsibility.”

*From Oracle customers build the Exalogic business case, Oct 2012*
5 ORGANISATIONAL IMPACT (PEOPLE)

A key aspect of optimised operational management is the way different roles and teams are organised and the efficiency of the processes that connect them on a day to day basis. What is required is a management structure that allows the introduction and ongoing support of the Exalogic platform with minimum overheads and maximum agility.

“The long term health of both IT and ultimately the business will depend on bringing multiple teams more closely together, particularly as virtualisation and private cloud require much closer co-ordination and automation.” – from ‘Engineering I.T. for Agility’ – CIO Magazine, 28/8/2012.

Exalogic is a standard data Center building block which is highly optimised to support middle tier application server processing. So it is natural to think about slotting Exalogic into your current administration structure just like any other new server.

Although this is quite possible it will prevent realisation of the maximum operational management benefits. This is because the Exalogic Elastic Cloud software has many unique optimisations of the way these standard hardware components operate, Exalogic introduces some major innovations, such as internal use of Infiniband (it’s the same but different) but most importantly, all these components are designed to be administered and managed together (it’s an engineered system).

There are essentially three options:

- Traditional multiple administration teams with shared ownership
- Extended (or Exalogic) systems administration team (ESA team) with single ownership
- A single, unified Exalogic administration team (EA team)

The next section discusses some of the pros and cons of each approach, which will vary for each customer, as will the ability of any customer to make changes to their administration structure.

Appendix 1 provides a high level RASCI chart for each to show who owns each management task for each approach. RASCI charts are part of the ITIL standard and provide a very useful way of summarising the people or teams involved in any given task or set of tasks.

Business Application Administration

Where packaged business applications (such as Oracle E-Business Suite or Siebel) are deployed on the platform there will likely be an application administration team who work very closely with the business and who manage and monitor the application code, data and quite possibly the runtime middleware components for their application (as opposed to shared resources), but not the underlying OS, hardware and network on which it runs. If the company depends on bespoke applications this application support role tends to be provided by the development team It is likely that these teams will remain in place, even if management of the underlying platform becomes more unified.

5.1 Multiple Administration Teams.

The traditional approach (and still by far the most common approach in large organisations) to managing multiple servers within complex environments is to have multiple specialist teams, each of which owns and manages one aspect of the technology stack using their preferred management tools. A simplified example is shown below.
Administration roles for Middle Tier / App Server Infrastructure

Traditional multi-team Structure

- **System Admin**
  - Multiple Servers
  - Operating Systems (and Middleware ?)
  - Monitor, tune, provision, configure, patch

- **Network Admin**
  - Physical Network Management
  - QoS, Bandwidth Optimisation, Security
  - IP Address / DNS Management / VLans

- **Storage Admin**
  - Shared Storage Management
  - Provision Luns, manage quotas
  - Backup / Recovery

- **Middleware Admin**
  - Provision and manage AS software
    - such as Oracle WLS, IBM WAS, Apache etc

- **Application Admin**
  - Application Management
    - Monitor, tune, provision, configure, patch etc.

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**Fig 3 – Typical application server administration roles and tasks**

How many teams there are and the limits of their specific responsibilities will vary with each customer. In smaller companies it is more common to find more combined, multi-skilled teams, but especially in larger organisations (where there are many environments and specialisation can be afforded) multiple teams, each focussed on a different part of the technology stack are the norm. It should be noted that there may not always be a formal middleware Administration team as this role may be included in the remit of either the applications admin or systems admin teams. There may even be additional teams not shown on the chart, such as:

- Development teams which may manage their own middleware products and environments, most likely where bespoke applications are important.
- Production Support team who provide basic operations support for just the production environment but who would call on the other specialist teams to carry out updates, patching, tuning and problem resolution.

However many teams there are, each person and team will have a very specific role, set of tasks and processes, vendor relationships and administration tools. This simplifies their job and provides an optimised and well defined environment for the management of that particular layer of the technology stack in isolation.

However, there are many dependencies and often overlapping responsibilities between teams. Often the processes and tools used vary from group to group. The result is that for many mundane, repetitive tasks much time is spent idle waiting for others to complete their part of the overall process before the entire task can be completed. For example, if a system administrator is installing and configuring a new server, he needs to have storage provisioned by the storage administrator. Until this task is complete the project is stalled. A great deal of time is spent on overall project management, communication and co-ordination of repeated tactical activities across the multiple teams, with little time left to focus on new strategic initiatives or projects.

Since Exalogic is built from industry standard components this silo’d support approach can work for Exalogic administration, but it is only recommended where Exalogic is deployed;

- Tactically, as a point solution to support one or a small proportion of applications and the corporate strategy is for most applications to continue to run on traditional multi-vendor systems.
- To support a pilot project which primarily aims to evaluate performance and capacity rather than its administration or cost of ownership.
5.2 EA (Extended) administration team

In this model, the responsibility of one of the administration teams is extended, so that they to own (i.e. are responsible for) all aspects of the administration of all Exalogic components. Where work is required on aspects of the machines that they are not familiar with, they will call upon the appropriate specialist team to carry it out and will manage the process to completion. Over time they will gain knowledge and thus become more self sufficient and may even evolve into a unified team (see next section).

Who should be at the core of this EA team is not an easy question to answer. With Exadata it is obvious; the extended / unified admin team will be based on the DBA group. However for Exalogic the core of the admin team is quite hard to define as there is a much greater variety of organisation structures found in middleware and applications management. Either the systems administration or the Oracle middleware administration team will be best placed to becoming the Center of Exalogic management.

The storage and network administrators will retain ownership of the policies directly under their responsibility such as data backup and recovery or network security, service levels and IP address rules. Where any physical administration is required there is still significant project management overhead as other teams will need to be consulted, scheduled and engaged. It is also still quite usual for each team to use completely different management tools from different vendors which can cause inconsistency and confusion between teams when for example trying to identify the root cause of performance problems or apply patches.

This extended ownership model can provide increased agility in responding to business requests as well as improved efficiency managing shared resources. In addition, the application administration team (performing day-to-day tactical tasks needed to manage specific applications owned by a specific business unit) will also become more efficient and responsive because they will primarily co-ordinate only with the EA team, rather than four or five separate teams in the traditional model.

This extended administration team is a good step forward; however, it does not make the most of the potential that Exalogic offers for higher levels of operational agility. It is very appropriate however where Exalogic is relatively new to an organisation and only a small proportion of critical applications are running on it.

5.3 ELA team: Unified Exalogic Administration team
Factpoint Group TCO Study October 2012

“Possibly Oracle Engineered Systems most revolutionary aspect for IT managers lies in the way they are breaking down silo’ed job roles and organizational structures, introducing flexibility into rigid, long-standing IT practices. The emergence of more unified teams may help restructure IT departments into more efficient operations and in time this should reduce costs. In the meantime I.T. will be able to do more without adding headcount. Oracle Engineered Systems will become even easier to operate over time as users become more proficient and organize around the benefits of an integrated infrastructure.”

The Exalogic Administration (ELA) team is a single unified team which both owns and manages all aspects of Exalogic machines. This is the ideal administration structure for Exalogic because Exalogic is explicitly designed to be administered and maintained as a single, integrated system, allowing simplified management processes to apply to all the roles across all technology components.

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**Administration roles for Middle Tier / App Server Infrastructure**

**Unified Exalogic Systems Administration (Physical)**

- **Exalogic Admin**
  - Own and manage the Exalogic system as single integrated unit
  - Monitor, tune, provision, configure, patch
    - Compute Nodes
    - OS
    - IB Network
    - ZFS storage
    - Exabus s/w
    - Oracle WLS and Coherence
    - Oracle Fusion Middleware
    - OVM ands OVAB / Cloud resources

- **Application Admin**
  - Co-ordinate with the Exalogic team
  - Application Management
  - Monitor, tune, provision, configure, patch etc.

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**Fig 5 – Unified Exalogic administration**

The application administration team will obviously work very closely with the ELA team and their efficiency should improve further because they will not need to co-ordinate with anyone else.

In this model the ELA team will need to be rounded out with some additional skills, typically covering the hardware, firmware and network components. This can be provided by training existing ESA team members, by adding one or two additional staff to the team from the existing specialist groups or both. Oracle education, support and consulting services can of course provide advice and skills transfer.

Streamlined processes are further enabled by using a single centralised management toolset which can standardise and automate monitoring, provisioning and management of all components, both physical and virtual, across all machines. This is Oracle Enterprise Manager 12c.

A single EA team is the recommended organisation structure, especially where Exalogic is seen as a strategic platform for a high proportion of a company’s application systems. Along with the right tooling and adoption of best practices it will enable optimal realisation of the operational management benefits made possible by physical Exalogic implementations.

Of course in many larger organisations such a change will be seen as highly controversial, and not something that can be undertaken easily. For this reason the recommendation is to try to evolve gradually and as other initiatives allow, from multiple silo’d teams to a single unified team, via the extended administration team using EM 12c to create a virtual community from day 1.
Please note that this topic is addressed for virtualised Exalogic systems in a separate White paper on OTN paper called ‘Evolution from the Traditional DataCenter to Exalogic – the Operational Perspective’.

## 5.4 Impact of Cloud Computing on Administration Roles

Regardless of the technology platform and whether or not virtualisation is used the cloud computing paradigm tends to encourage the evolution of a slightly more refined set of administrative roles:

- **Cloud / Service User.** Typically the end user. Could be a developer who needs access to a WLS and Coherence and SOA Suite environment in which to develop a bespoke engineering support application or a business user who wants access to a service management application for her engineers. Services are requested and usage monitored via a self service web portal.

- **Cloud / Service Administrator.** Packages the resources available on the platform (whether virtual or physical) into services which are presented to the end user on the self service portal. These resources are typically CPU, memory, network access, storage quota and run time components such as WLS and SOA Suite. Responsible also for defining charging rules and administering the portal.

- **Cloud Infrastructure Administrator.** Responsible for managing the hardware and software environment on which the cloud services are defined and run.

Who carries out administration tasks will vary in this model, depending on what type of cloud service is offered:

- In the Infrastructure-as-a-Service (IaaS) model (where the service offered might be simply an ‘empty’ Oracle Linux OS environment with some available memory and disk storage the developer would install and administer their own software into the Linux (cloud) service and the Linux software would be managed by the Cloud Infrastructure Administrator.

- In the Platform-as-a-Service (PaaS) model (where the service offered could be more complete, including WLS, and optionally SOA Suite and WebCenter Suite etc.) the Cloud Infrastructure Administrator would install and administer this software and the developer would just manage her own code.

- In the Software-as-a-Service (SaaS) model (where the service offered might be a fully operational Field Service Application ready for the business users to log into and start using the whole environment would be fully managed by the Cloud Infrastructure Administrator, probably in conjunction with the Applications Administration team (if the app was bought), or the development team (if it was built).

| The administration of virtualised Exalogic systems implemented as a private cloud is significantly different in terms of tasks and roles, and will be covered in detail in a companion paper |
6 ADMINISTRATION TOOLS (TECHNOLOGY)

Exalogic is designed to be managed as a single system. This is facilitated by Oracle Enterprise Manager 12c. EM 12c is an integrated administration toolset which is Exalogic aware. Although the standard application and middleware administration tools (such as OAM and the WLS Console) can of course be used to manage individual components, EM 12c provides a holistic administration shell around all components for all administration tasks. It is accessed via a consistent web based user interface and stores detailed information about the operation of all Exalogic components in a single shared repository. Highly granular roles allow its use by specified staff for specified purposes to be securely delegated.

3rd party tools will recognise many of the Exalogic components but not in the context of the Exalogic system and they will NOT be aware of the Exalogic Elastic Cloud Software, the Infiniband fabric or any Exalogic optimisations. Although they may still be useful for very specific tasks against individual components (such as Linux utilities or pre-built WLS scripts), Oracle recommend EM 12c as the primary administration toolset.

Effective management of physical Exalogic systems does not need significant re-skilling or re-tooling, but a slight extension (or repositioning) of what the administration teams already know and increased deployment and use Oracle Enterprise Manager.

6.1 Enterprise Manager for Exalogic

EM 12c consists of a number of complementary parts;

1. EM Cloud Control Core (Free). Basic monitoring and management of the Exalogic system.
2. EM Packs for Fusion Middleware. In depth understanding, analysis and management of the Exalogic runtime container and additional middleware components
3. EM Packs for Oracle Applications. In depth understanding, analysis and management of E-Business Suite, PeopleSoft, Siebel, JD Edwards and Fusion Apps running on Exalogic. Note that these are actually referred to as Application Management ‘Suites’.
4. EM Cloud Management Pack for Fusion Middleware. Enables definition, consumption, monitoring and management of Exalogic resources (Infrastructure), middleware (Platform) and applications (Software) deployed and potentially charged for, on a self service basis.
5. EM Operations Center (Free). In depth understanding, analysis and management of Exalogic firmware, hardware and network components, including physical and environmental aspects.
6. Exalogic Control (Free). Only required to manage virtualised Exalogic environments.

All of these components run together as part of a single application which manages all Exalogic components in a consistent manner, in which administration data, both real time and historical is held in a single central repository and which is accessed by multiple administration teams using a consistent set of easy to use, easy to secure and highly tailorable screens.

In order to optimise productivity and agility in managing Exalogic (and all Engineered Systems), Oracle recommends that rather than developing and then becoming dependent upon manual procedures and bespoke administration scripts, customers take the opportunity presented by the new Exalogic environment to re-visit and refresh administration procedures and acquire, deploy and make full use of the appropriate EM Middleware Management Packs and Application Management Suites.

Since EM covers all the technology layers involved in a transaction, from what the end user sees on their browser to the data stored on disk, this toolset enables business transactions to be tracked and traced through their whole life, both individually and as applications. This greatly facilitates root cause analysis, problem diagnosis and performance tuning.

The capabilities described in this paper relate to EM 12c R2.
6.2 EM Cloud Control Core

Following automated discovery and grouping, EM CC provides a machine – wide view of all Exalogic components, which allows analysis and correlation of components across the whole software and hardware stack. High level metrics and summaries are provided at the level of deployed applications, WebLogic domains, Coherence clusters, SOA deployments, Oracle Traffic Director, physical compute nodes, Infiniband switches and the ZFS Storage appliance. Different high level views can be selected focused on hardware or software which emphasise operational status, KPI's, Responsiveness and loading, alerts & policy violations, or recent configuration changes and drilled into for more detail. These dashboards are highly configurable so as to make EM use as quick easy and intuitive as possible for each team and individual administrator. EM CC is free.

Fig 4. EM provides a holistic view of the Exalogic system

Oracle Enterprise Manager includes a new target type to represent the Oracle Exalogic appliance as a unit. This target type - Elastic Cloud Infrastructure - contains monitoring and configuration metrics for each discrete component in a fabric. These metrics are collected by the Enterprise Manager agent through the Ops Center JMX client. Details Collected include switch details, storage appliance details, compute node details (including associated "Host" target GUID), switch ports configuration, switch rack location and network topology (switch port - device association metric). The availability and Performance Metrics Collected include alerts, incidents and status of all components, plus power, utilization and temperature (compute nodes), switch ports throughput and Ops Center user-defined group associations.

Further user defined metrics can be set up for any component. EM can correlate application processes and messages to JVM processing, and on to Java calls to Database. Administrators can see Database wait states and the SQL calls made by Java. Administrators can bridge the gap between middleware and Database by simply drilling down from Java to the Database for diagnosing SQLs further with the database diagnostics tools.
6.3 EM for Fusion Middleware.

For effective application management and performance monitoring, administrators need visibility into performance at all tiers of the stack, proactive notifications of potential issues, an ability to perform deep diagnostics in each tier, and an ability to perform cross-tier diagnostics. The EM Fusion Middleware Management packs provide this as well as full-lifecycle management for Oracle WebLogic, SOA suite, Coherence, Identity Management, WebCenter Suite, and Business Intelligence Enterprise Edition. EM provides a single console to manage these assets from a business and service perspective, including user experience management, change and configuration management, patching, provisioning, testing, performance management, business transaction management, and automatic tuning for these diverse environments.


6.4 EM for Applications.

For each Oracle packaged application EM provides a comprehensive Application Management Suite. These enable the capabilities of EM to be applied to the specific components of each application and also provide further in depth addition application – specific monitoring, analysis and lifecycle management functionality. The suites include Oracle Real User Experience Insight (RUEI). RUEI is very powerful, Oracle applications – aware tool which takes a copy of all traffic sent across the network between the users browser and Exalogic, loads this into a repository and then provides a rich set of out of the box reports which allow detailed analysis of individual user sessions or business transactions. The analysis will tend to focus on either performance or functionality, providing a unique insight into how users actually use the application. RUEI has zero performance overhead, is highly secure and requires no application changes. RUEI is also available for generic web based applications.

For applications testing Oracle provides the Application Testing Suite (ATS). ATS is Oracle applications – aware but can also be used to automate testing of any bespoke web based or SOA application.

6.5 EM for Hardware.

EM Operations Center (EM OC) is the Enterprise Manager component specifically developed to monitor and manage the hardware, network and firmware components of Oracle servers. Hardware – related data is collected by the Enterprise Manager agent through the Ops Center JMX client. Explicit use of EM OC (in addition to EM Cloud Control) can be useful to administrators working at a detailed level with these components as it provides comprehensive hardware fault monitoring, detailed OS and network performance and configuration monitoring, OS patch automation and configuration and compliance reporting. EM OC is free.
7 ADMINISTRATION TASKS (PROCESSES)

Initial commissioning of Exalogic is a one-time task required in order to set up Exalogic for the first time. Currently this must be done by Oracle Advanced Customer Support (ACS) and takes around 3 days. As the subject of this paper is ongoing day to day management we will not consider this further.

After this there are certain ongoing tasks which the Exalogic admin team needs to be able to carry out, which will vary by technology component. Many tasks are very much the same as they would be in a traditional environment although they can often be less complex and less frequent as a result of the pre-engineered nature of an Engineered System. The key skills required are not fundamentally different to traditional applications platforms because the basic components are not different. In most organisations Intel hardware, Linux, network and applications teams exist already, although they will likely be spread across multiple teams.

There will be a need for some training around the new components unique to Exalogic (Exabus, OTD) and the newer capabilities of Enterprise Manager (see below). If Infiniband is new to your organisation a little training in that will help also. Oracle provides a range of Exalogic training, please see the appendices and OTN for more details.

7.1 Task List

The primary administration tasks that the Exalogic administration team (however structured) must be able to carry out on a regular basis are the following.

- **Monitoring.** Keeping track of all operational aspects of a component, such as availability, performance and usage. Includes historical tracking and comparisons as well as defining automated alerting conditions and incident management rules.

- **Provisioning.** Creation of a new environment to support a business project. May involve any of cloning, installation, deployment and configuration of hardware resources and / or software.

- **Configuration.** Making changes to the way a component is configured in response to business projects, performance tuning or problem resolution and often as part of other tasks.

- **Tune.** Identify and implement changes to a component in order to optimise or improve performance.

- **Backup.** Take a copy of a component or related data for use during recovery.

- **Problem Analysis.** Diagnose and clarify any operational problems and identify root causes and potential resolution.

- **Patch.** Apply quarterly Exalogic patches bundles or one off patches to a software component or firmware element of a hardware component.

- **Replace.** Replace a hardware component

The chart below 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 Centers. However it provides an excellent planning aid when thinking about how your teams will operate your Exalogic systems.
Administration of the middleware runtime components and business applications is only very slightly different than it would be on traditional platforms. Management of the underlying infrastructure components is significantly simpler and easier than on traditional platforms. Some tasks may only be required very occasionally and some of them may not need explicitly doing, but may be done as part of another task. Wherever possible they should be standardised and automated. Wherever possible they should be standardised and automated. Wherever possible they should be standardised and automated.

Oracle can provide services which address many of these tasks for you, either for a fixed initial period or as an ongoing maintenance service. If you prefer to manage your Exalogic systems yourself we strongly recommend you make use of appropriate training, support and consulting services to become self sufficient and ensure best practise. Please see the Appendices and OTN for details of services.

### 7.2 Change Testing

Testing is not included as a specific task because it is a process which should occur as an essential step in many tasks before any major changes are made live. Many administration tasks result in the need to make changes to the configuration of the Exalogic infrastructure. This can be as a response to new project requirements which require additional software installs, problem resolution or performance tuning tasks. Any such change should be applied first to a realistic test environment and the effects analysed before the change is applied to a production environment.

The process of running tests and analysing the results manually can be very complex, error prone, time consuming and in the end of limited value. However it can be made both cost effective and genuinely valuable by the use of automated testing tools. For Exalogic the ideal tools for this job are provided by the Oracle Application Testing Suite. This is a set of integrated testing tools which are pre-optimised for Oracle middleware and business applications and consist of:

- **Functional Testing.** Oracle Functional Testing provides the easiest and fastest way to create automated scripts that simulate complex Web transactions. For both functional and load tests, users can build Web application test scripts simply by pointing and clicking. Further, they can
create tests for .NET and J2EE Web applications as well as Web services and emerging Web technologies such as Ajax.

- **Load Testing.** Oracle Load Testing easily yet rigorously stress tests the performance and scalability of Web applications and Web services. It simulates thousands of virtual users accessing the application simultaneously and measures the effect of the workloads on performance.

- **Test Accelerators.** These provide complete out-of-the-box functional and load testing solutions for Oracle business applications.

- **Test Manager.** Oracle Test Manager manages the entire Web application testing process. Users define testing requirements, specify and execute tests to validate those requirements, and then manage the defects that those tests reveal. By coordinating the testing process in a single, unified platform, Oracle Test Manager synchronizes with third-party test automation tools and provides a comprehensive way to manage quality as a process throughout the Web application development lifecycle.

- **Application Replay.** This tool can be used to test the performance impact of any type of infrastructure change on applications (*including patching*). It captures and replays actual production workloads based on Oracle Real User Experience Insight user sessions. It maintains all production characteristics during replay such as timing, order, concurrency, dependency, etc. It can be used in conjunction with RAT to include persistent data processing as part any transactions and is set up and managed through EM. The key benefits of AR are:
  - Faster and therefore more frequent testing as there is no script development or maintenance needed
  - More accurate results and predictions because complete production workloads are used rather than sampled or artificial simulations.

More information on Oracle testing tools can be found at: [http://www.oracle.com/technetwork/oem/app-quality-mgmt/index.html](http://www.oracle.com/technetwork/oem/app-quality-mgmt/index.html)

### 7.3 Future Planning

As you become familiar with managing Exalogic and the huge amount of compute power that it provides you will probably start to plan for future consolidation and / or workload growth and evaluate which existing workloads running on traditional platforms can be migrated onto it. You may also be planning a private cloud deployment to maximise agility and responsiveness. EM provides facilities to assist such initiatives.

**Capacity Planning**

Capacity planning in an Exalogic environment is really no different than for any other application server. You need to consider, for each major resource (CPU, Memory, Storage and I/O):

- How much have we used?
- What new projects are coming down the line?
- At what rate will the resources get used up?
- Which will run out soonest?
- How can I reduce use of that resource to delay an upgrade

Although it does not have an explicit capacity planning component, EM provides a lot of very useful information to assist in this quite complex task;
Standard reports on current and historical resource usage
Performance baselines can be used to compare current usage with that a previous point in time and clarify growth trends
Ability to read any EM repository data and build your own customised reports using Oracle Business Intelligence or reporting tools of choice or export that data into other tools.

Consolidation Planning
Core EM includes a Consolidation Planning application which applies to any compute workloads. It helps you to plan a guided migration path to a shared cloud platform. It provides consolidation advice based on technical as well as business aspects of existing systems, such as processor architecture, Line of Business ownership, location, lifecycle stage etc. It offers a variety of consolidation choices, such as;
- Physical-to-Physical (P2P)
- Physical-to-Virtual (P2V)
- Database Consolidation on Exadata
- Application Consolidation on Exalogic

For more information on using the Consolidation Planner please review Chapter 3 of the Oracle Enterprise Manager Cloud Administration Guide

Architectural Options; Cloud and Virtualisation
Many companies are now starting to embrace a cloud computing approach, which adds a much greater degree of automation, so that provisioning and resource management can be managed on a self service basis. Although the tooling for implementing Exalogic as a private cloud does not change (EM provides the required automation, a self service portal and metering and chargeback), administration roles and responsibilities will change, as will the details of administration tasks. Cloud computing is seen very much as a potentially attractive option for most customers at this stage.

Virtualisation is now commonplace. It has enabled consolidation and better utilisation of compute resources. This document has assumed that Exalogic will be implemented as a physical system, without virtualisation. However both Exalogic and EM 12c support advanced Oracle virtualisation technologies (including Oracle VM, the Linux guest OS and Exalogic Control. Future Exalogic development will increasingly be predicated on a virtualised approach. A companion paper will be available soon which discusses the operational management of virtualised Exalogic systems.

Note that with Exalogic, implementation of a private cloud and use of virtualisation are independent options. However, the highest levels of agility, and the lowest costs of management are achieved when both approaches are combined.

Defining and Managing a Private Cloud
EM is the core technology on which all of Oracles cloud offerings are based, both the Oracle Public Cloud and a private infrastructure middleware or application cloud running on your Exalogic systems. By combined use of middleware and applications management packs and the Cloud Management Pack for Oracle Middleware, EM provides;
- An out of the box, customisable self service portal allowing end users to request services, track usage and charges and carry out basic (start / stop) management.
- Automated, real time provisioning of any Oracle Fusion Middleware components or Applications based on deployment profiles and standard ‘gold’ images.
- Resource control through quotas and performance-based resource management policies and retirement policies.
• Metering and chargeback based on fixed cost, utilization metrics, and configuration parameters of the underlying hardware and software infrastructure (hosts, storage, WLS etc).
• Chargeback Reports, such as Charge Trend Report, Charge Summary Report, Usage Trend, report, Usage Summary Report
• Automated agent deployment and configuration with OMS though the Exalogic Proxy
• Programmatic access to the Self-Service Portal which allows the above functionality to be driven from your own intranet or SS Portal

More information on cloud computing with Oracle Enterprise Manager is available at; http://www.oracle.com/technetwork/oem/cloud-mgmt/index.html


Moving to a Virtualised Exalogic Environment

A physical Exalogic system can offer real improvements over traditional platforms in terms of ease of management and deployment flexibility through the use of Enterprise Manager with its centralised administration of all components, from applications to disk, its automated provisioning and patching procedures and its cloud management capabilities.

However, a virtualised environment takes this to another level. Virtualised Exalogic systems offer;

• Even faster provisioning through pre-built OVM template and multi-tier OVAB assemblies
• Even more flexible cloud services with more flexible and granular resource sharing
• Management with Exalogic Control in conjunction with Enterprise Manager

A companion paper addressing administration of virtualized Exalogic environments, including cloud definition and management in detail is planned to be available in 2013.
8 INTEGRATED MANAGEMENT OF EXALOGIC AND OTHER SYSTEMS

In almost all cases Exalogic will not be the only system in use. There may be other Exalogic machines (such as test and development), there will very likely be database servers (which may or may not be Oracle Exadata), there will very likely be other servers running other Oracle middleware or applications and there will probably be many non-Oracle systems as well.

Ideally organisations will want to have an overall view of how all systems are running and the ability to follow transactions and workloads across machine boundaries and to compare performance, availability and configurations across machines as well.

This is a huge topic and here we just provide some recommendations to facilitate the integration of Exalogic into more heterogeneous environments.

Managing Exadata, Exalogic and Exalytics together

- Where Exalogic is operating alongside other Engineered Systems machines, such as Exadata, Exalytics, other Exalogic machines as well as ZFS Storage appliances (for backup) they will all communicate via the Infiniband network fabric.

- Administration and support of all Oracle Engineered systems should come within the remit of a single group. The basic components of all are the same; Oracle Linux (or Solaris), Intel based hardware, Infiniband networking and ZFS storage. Within this there should be separate teams with very close co-operation between them;
  - An architecture and governance team concerned with overall Oracle Engineered Systems strategy and optimising management of them.
  - Exadata will be managed by a single unified team focussed on the DBA role
  - Exalogic will be managed by two sub-teams within the same group; an infrastructure admin team and an applications admin team
  - Exalytics will be managed by two sub-teams within the same group; an infrastructure admin team and a B.I. applications admin team

- At some point in the future, if the Engineered systems estate grows to many machines, this could structure could evolve so that there is a single infrastructure team responsible for all the components up to and including the OS for all machines, with separate teams in the same group focussed on database, middleware and applications administration.

Systems management tool architecture

- A single Enterprise Manager 12c instance should be used to monitor and manage all Engineered Systems components as it is Exadata and Exalogic - aware. All relevant EM Packs for database, middleware and applications should be deployed. The EM implementation should comply with Oracle MAA best practices and be integrated with MOS. See Appendix 2

- The platinum support service currently requires a dedicated and separate EM 12c instance and gateway to be deployed for use by Oracle support engineers.

Integrating with non-Oracle systems management tools

- In most datacenters 3rd party administration tools will be in use to manage non-Oracle systems. They will be able to see and, to some extent monitor, some elements of Oracle Engineered Systems, since these are built from industry standard components and reside on the same network as other datacenter devices. However 3rd party tooling will not be aware of the Exalogic Elastic Cloud Software, the Exadata Storage Software or Infiniband partitions and so may not provide accurate information or alerts. As already noted is the recommend that Oracle Enterprise Manager 12c is used to monitor and manage all Engineered Systems components
• EM 12c can be integrated with other systems administration tools such as IBM Tivoli, BMC Patrol, Microsoft Operations Manager and HP Openview, as well as help desk applications such as BMS Remedy and CA ServiceDesk via out of the box connectors. See Appendix 2.

All of these points can be summarised in the diagram below.

Support Services

The platinum support service is currently available for Exadata, Exalogic and SuperCluster.
9 CONCLUSION

As well as massive increases in application performance, availability and capacity Exalogic can provide an application platform which is much more agile and much easier to manage than traditional multi-vendor systems. It is built with industry standard hardware components and standard Linux or Solaris operating system. What is different is that all components are connected via the Infiniband network fabric and the unique Elastic Cloud Software which optimizes application speed and enables secure application isolation. Administration tasks are often simpler and faster than on traditional platforms, especially provisioning, patching, problem resolution and performance tuning. Although your existing administration teams will probably have most of the skills necessary to manage Exalogic, optimal efficiency will be achieved if the applications administration team is complemented by a single unified infrastructure administration team which looks after everything from the run time middleware to the disks and fans. The use of a single holistic management toolset, Enterprise Manager 12c, enables all administrators to work as efficiently as possible and encourages an evolution towards a more unified organisation structure. Finally, in order to help you gain the highest possible return on your investment in engineered systems, Oracle offers a wide range of services ready and willing to lead the way.

The integrated nature of all components within Exalogic combined with a single management toolset means that the time and effort required to manage environments is much reduced, in turn reducing cost of ownership over time. Some traditional support roles will change and in each of these roles there is a great opportunity to spend more time on delivery of new solutions and less time on day-to-day maintenance.

The end results of streamlining operational management for Exalogic will be;

- Better operational management processes,
- Minimized cost of ownership,
- Increased agility in responding to business initiatives,
- Improved Exadata admin visibility and satisfaction
- An increased likelihood of project success for everyone involved.

The deployment of one of Oracle’s engineered systems can provide an opportunity to rethink and optimise your systems management approach in order to better align your datacenter operations around growing industry trends of consolidation and cloud computing.

"When you bring together the separate roles in an I.T. administration organisation, that is when you provide the very best solution for the customer."

Jeff White – Technology VP, Epsilon (US Marketing Services Company)

Gartner estimate that by 2015 over 35% of all server sales will be in the form of Engineered Systems. Oracle is the original developer of Engineered Systems and Exalogic, Exalytics and Exadata are the leading examples.
10 APPENDIX 1 – RASCI CHARTS FOR EXALOGIC OPERATING MODELS

This Appendix provides a suggested, high level RASCI chart for each of the 3 potential organisation structures for an Exalogic administration team. Each customer should develop more detailed charts for the organisation structure that they plan to use. Oracle consulting and advanced support services can assist with this work.

The RASCI approach is a part of the ITIL standard. It provides a useful way of summarising which people or teams are involved in any given task or set of tasks. A number of different roles are relevant to any tasks as follows;

- **R = Responsible** The person who is ultimately responsible for delivering the project and/or task successfully.
- **A = Accountable** Person who has ultimate accountability and authority; they are the person to whom “R” is accountable.
- **S = Supportive** Person or team of individuals who are needed to do “the real work.”
- **C = Consulted** Someone whose input adds value and/or buy-in is essential for ultimate implementation.
- **I = Informed** Person or groups of individuals who need to be notified of results or actions taken but don’t need to be involved in the decision-making process.

Every task requires an R and an A. If there is no S it means that the R includes an implied S.

### Multiple Silo’d Administration teams

<table>
<thead>
<tr>
<th>Task</th>
<th>Apps</th>
<th>OS Sys Admin</th>
<th>Network</th>
<th>Storage</th>
<th>Server</th>
<th>Security</th>
<th>CIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>C/I</td>
<td>A</td>
</tr>
<tr>
<td>Monitoring</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>C/I</td>
<td>A</td>
</tr>
<tr>
<td>Configuration Mgmt</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>C/I</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Tuning</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>C/I</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Patching</td>
<td></td>
<td>R</td>
<td>S</td>
<td>S</td>
<td>C/I</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Compute Node O/S</td>
<td></td>
<td>R</td>
<td>S</td>
<td>S</td>
<td>C/I</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>ZFS Storage Appliance</td>
<td></td>
<td>R</td>
<td></td>
<td></td>
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<tr>
<td>Infiniband Switches</td>
<td></td>
<td>R</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Management Switch</td>
<td></td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exabas / Elastic Cloud S/W</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>S</td>
<td>C/I</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>WLS, Coherence etc.</td>
<td>R</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Applications</td>
<td>R</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back up and restore</td>
<td></td>
<td>S</td>
<td>R</td>
<td></td>
<td></td>
<td>C/I</td>
<td>A</td>
</tr>
<tr>
<td>Problem Resolution</td>
<td></td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>S</td>
<td>C/I</td>
<td>A</td>
</tr>
<tr>
<td>Replacing H/W</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>C/I</td>
<td>A</td>
</tr>
</tbody>
</table>

Note – multiple overlapping responsibilities leading to high management overheads and low agility. In larger organisations there may well be an additional team – the middleware administration team.

### Extended Administration Team
Note – single team responsible, with support from others, resulting in reduced management overheads and improved agility.

Unified Exalogic Administration Team

Note – single team responsible and self sufficient, resulting in low management overheads and high agility.

In a virtualised environment implemented as a private cloud these roles will be different as many of these tasks will be carried out in a self service basis by either end users of ‘cloud administrators’
11 APPENDIX 3 - FASTER PROVISIONING | CUSTOMER EXAMPLE

A real example of this is shown diagram below, which is taken from a presentation given at Oracle Open World 2012 by India’s second largest bank (HDFC Bank).

It shows their provisioning process before and after the use of EM Cloud Management Pack. Although their project involved databases on Exadata, exactly the same principal will apply to provisioning of middleware or application environments on Exalogic.
12 APPENDIX 4 – ORACLE SERVICES FOR EXALOGIC

A range of services are available. Oracle recommends that Exalogic customers make good use of these to ensure they manage their Exalogic systems as well as possible and become self sufficient as fast as possible.

Technical Support

In addition to standard Oracle technical support (‘premier support’), all Exalogic customers running certified configurations have the Oracle Platinum Service available to them at no additional cost. It includes;

- 24 x 7 remote fault monitoring via a dedicated EM 12c instance with the following SLA’s;
  - 5 minute fault notification
  - 15 minute service restoration or escalation to Exalogic development
  - 30 minute joint problem diagnosis session with Exalogic Development

- Patching and upgrades

More information is available here:

Consulting

Oracle consulting offers a range of services that relate to design and development of Exalogic solutions and migration of applications onto that platform.

The Oracle Exalogic Start-Up Pack delivers an integrated service package and product expertise to ensure an optimized plan and deployment of an Oracle Exalogic system. Oracle’s service experts deliver a suite of services that begins with strategic architectural design and planning. Oracle then installs and configures the system and software according to Oracle best practices. Oracle support engineers provide supportability reviews throughout pre-production as you execute the architectural design plans.

Also available are Enterprise Manager Success Packs, which provide targeted high impact assistance in the implementation of core EM and Packs into your Exalogic environment

More information is available here.

Training

Oracle provide a range of training, in all formats, which will help administration teams become self sufficient. The core course is the Exalogic Elastic Cloud Administration Course, shown below.

A current list is available here.