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# Practical Oracle Database Appliance

*EASY-TO-MANAGE DEPLOYMENT AND VIRTUALIZATION*

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Foreword by Sohan DeMel

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*For your convenience Apress has placed some of the front matter material after the index. Please use the Bookmarks and Contents at a Glance links to access them.*


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# Contents at a Glance

# Introduction

The world of information technology has changed rapidly since the inception of computers during the '60s and '70s. These changes have helped propel many different aspects of our economy to include what and how businesses conduct daily operations. With these changes to organizations, especially internally with information technology, faster and better ways of achieving business goals have been pushed and developed.

As businesses start to depend more on data stored within their systems, faster ways of processing and reporting data have developed. Over time, organizations have asked for ways to improve processing, achieve greater throughput, and report more quickly. This eventually led to the development of systems that could leverage both software and hardware resources together, leading to the development of engineered systems.

After the development of engineered systems, such as the Exadata, many organizations were left with a difficult choice of either a massive expense for an engineered system (Exadata) or to build their own. This decision affects a large number of small- to medium-sized businesses. Oracle recognized this, leading to the birth of the Oracle Database Appliance.

## What Is the Oracle Database Appliance?

At a high level, the Oracle Database Appliance is a server and storage and network hardware, combined with network, cluster, and database software and templates. The Oracle Database Appliance is a fully supported, integrated system consisting of hardware and software components. Being that it is an integrated system, it is engineered to work at both the software and hardware layers, is simple to configure and maintain, and preconfigured to work with database workloads. Additionally, it is designed to help organizations minimize costs, increase adoption time, and lower risk in database deployment and maintenance.

## How This Book Came to Be Written

The authors of this book have been in the information technology industry for many years. In that time, we have seen and dealt with many different platforms across a wide range of applications and databases. During this time, however, we have not seen a compact, engineered system that can be a benefit to organizations more than the Oracle Database Appliance. The idea for this book came about while many of us were implementing Oracle Database Appliances for a variety of customers. As we implemented the Oracle Database Appliance in various environments, we would run into a problem or two and realized there was not a single complete body of work for this appliance. Sure, there were Oracle documents, but at some level, finding information was a challenge. At that moment we realized, when there were issues, surely we were not the only ones hitting them. The desire to write this book grew even more when all of us met at a conference and began talking about issues with the Oracle Database Appliance. We all agreed that the industry needed a book about this complex yet simple engineered system. All of the authors of this book had a desire to share our knowledge, which we have gained from using the Oracle Database Appliance. Hence, the need for this book was kicked into motion!

# Why Buy This Book

If you are a DBA or a manager who deals with databases on a regular basis, this book is going to provide you with information on using the Oracle Database Appliance. No matter how complex an environment your organization has, you will be able to use the information in this book to bring the Oracle Database Appliance, throughout its life cycle, within your organization.

An understanding of what the Oracle Database Appliance can do will radically improve your ability to quickly implement complex solutions, while ensuring rapid deployments of databases. At the same time, you will develop ideas on how to uniquely use this appliance when moving from homegrown solutions to out-of-the-box solutions.

CHAPTER 1



# Oracle Database Appliance

The Oracle Database Appliance (ODA) is a newer member of Oracle's Engineered Systems family of products. It is meant as an entry-level appliance to provide a pain-free, Oracle Database implementation experience. An ODA implementation saves time and money by providing an easier path to deploying a highly available database solution using a combination of the Oracle Database Enterprise edition and Oracle Unbreakable Linux (OEL) clustered across two nodes.

## Why an Appliance?

Traditional hardware deployments can take anywhere from weeks to months to implement, depending on the procurement and the deployment model that a company employs. Upgrades to Oracle database versions can also be a challenge because each hardware/software combination needs certification at various levels to ensure a smooth upgrade.

The evolution of the Oracle Database is very important to understand as we look at the engineered systems. Oracle has incorporated a variety of enhancements as it evolved the Oracle Database product. Through its evolution, the complexity of the software has increased. From a very simplistic relational database management system (RDBMS) in Oracle V4 to the reintroduction of Oracle Real Application Clusters, which was released as part of V9, Oracle has revolutionized the RDBMS and clusterware spectrum.

The database administrator (DBA) role has evolved as a result of the enhancements to the Oracle Database product line. Roles and responsibilities have increased, and coordination with multiple infrastructure groups that have a disparate goal has also increased. As Oracle introduced versions 10 and 11 of the database, the life of a DBA became more complicated, particularly with the addition of Automatic Storage Management (ASM) and Grid Infrastructure (GI). The DBA is now in charge of volume management and for ensuring that all aspects of the infrastructure meet the requirements of the Oracle stack.

Complexity has its own perils, and problem resolution time is greatly increased as the number of components increase. Virtualization of hardware and platform can also make things worse if all aspects of infrastructure are not fully evaluated properly. The infrastructure and software costs to ensure complete compliance can be very expensive for an organization, and innocently updating firmware in one piece of the infrastructure can cause turmoil in other aspects of the infrastructure or software.

The human element is very important as we talk about the advances in infrastructure and software. DBAs have seen their responsibilities increase with each release of the Oracle database stack. They are now expected to understand all aspects of the RDBMS, infrastructure, OS, and network to deliver a comprehensive and defect-free solution to the customer. Delivery of such a solution requires extensive coordination with various infrastructure groups, and may require costly upgrades or purchases.

The ODA is an entry-level appliance meant to help with infrastructure and software deployment, as well as upgrades. It comes as a complete, boxed solution meant for small- and medium-sized businesses, as well as enterprises, for rapid deployment of hardware and software. The ODA was introduced at Oracle OpenWorld 2011, with a second version, the X3-2, shipping in April of 2013. The ODA is the first appliance to support pay-as-you go licensing. It provides customers the ability to start with as few as 2 cores and move up to 32 cores (X3-2), as needed.

Management costs and build costs are significantly reduced because the ODA comes preconfigured with interconnect and storage, as well as a tuned OS. The ODA also includes the option to virtualize the appliance, which can result in significant savings to the organization by providing a complete boxed solution for virtualizing applications and the database.

Businesses and enterprises often struggle with deadlines, and by using a traditional model of deployment, which includes procurement as part of the project budget, it is often very hard to provide the agility that is required for a business to bring ideas to fruition quickly. A typical deployment cycle can range from 30 to 90 days, which can make a product that requires a database harder to get to market. Figure 1-1 shows a typical deployment cycle in a traditional system vs. that with an ODA, based on deployment experience with Oracle Real Application Clusters (RAC). This may vary by the deployment maturity model of an organization.

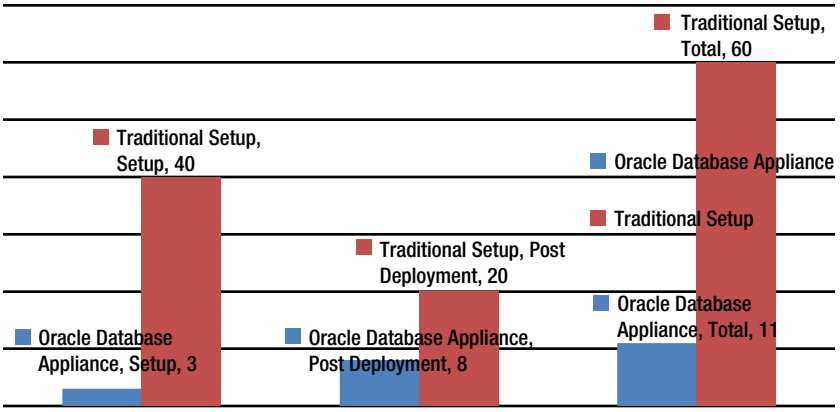


***Figure 1-1.*** *Traditional server vs. ODA with RAC*

The disparity between a traditional setup and the setup of an ODA is huge. It may differ based upon the practices and processes implemented by an organization. Traditionally, the process to deploy hardware includes the following steps:

1. Procurement of hardware
2. Delivery of hardware
3. Setup of hardware
4. Network connectivity and switch setup
5. OS setup and tuning
6. Database software setup
7. Best practices post setup

These steps are just some of the many required to get a system up and running, and may differ based on the infrastructure model an organization uses. Organizations have always had the ability to pre-buy and pre-provision infrastructure, as well as build a shared model to support the business. This can be cost effective in some cases, but can also be problematic because continuous understanding of new business requirements is a must. Business requirements drive the complexity of the infrastructure according to the availability model. Requirements can drive the need to prepare an environment that can support various business initiatives and provide an on-demand framework that allows faster provisioning. The ODA can be used as an enabler for a private cloud-based framework or a simple provisioning model.

The ODA's unique licensing model, as well as the ability to provide virtualization out of the box, can help organizations build a scalable model for deploying applications and databases at a fraction of the time and cost. The ODA comes as a complete package, which makes Oracle responsible for all components. This allows the organization to focus on the business rather than the technology, and frees up the DBA's time to focus on design rather than setup and coordination. A traditional ODA deployment exercise consists of the following:

1. Procure hardware
2. Install hardware
3. Set up the database appliance
4. Implement organizational best practices

The steps needed to implement an ODA are significantly less than a traditional setup because Oracle bundles hardware and software as one unit and allows for management and maintenance of the stack as one, which is not how traditional infrastructure is managed.

# The Appliance Hardware

ODA is marketed using the tagline "Simple, Reliable, Affordable." Currently, it is available in two hardware configurations: the original and the ODA X3-2. Billed as part of Oracle's strategy for "Hardware, Software, Complete," the ODA brings forward a simple cluster that includes two database server nodes, storage, as well as cluster interconnect and simplified management built into the appliance itself.

## Oracle Database Appliance V1

To date, Oracle has shipped more than 1,000 Oracle Database Appliances.[1] The original ODA is a complete unified box solution that contains two 2U Sun M4370 servers, along with storage and networking components. The total size of the ODA V1 is 4U in datacenter rack terms. Figures 1-2 and 1-3 show the front and back of the appliance, respectively, and highlight the simplicity of the ODA's design.

***Figure 1-2.*** *The front of the Oracle Database Appliance V1*

[1]Oracle, "Customers Worldwide Simplify Database Management with Oracle Database Appliance," http://www.oracle.com/us/corporate/press/1940385, April 29 2013.

***Figure 1-3.*** *The back of the Oracle Database Appliance V1*

Each ODA unit consists of two physical servers, and each physical server consists of a server node and an Integrated Lights Out Management (ILOM) component. Chapter 2 delves into detail about the ILOM and explains the importance of the ILOM in the ODA unit. Table 1-1 lists the specifications of the ODA V1 from the Oracle Database Appliance Datasheet. (My Oracle Support Note 1385831.1 provides the same information.)

***Table 1-1.*** *Oracle Database Appliance V1 Specs*

| Component | Specification |
|---|---|
| **CPU** | 2x 6-core Intel Xeon X5675 3.07GHz |
| **Memory** | 96GB RAM (12 x DDR3-1333 8GB DIMMs) |
| **Network** | 2x 10GbE (SFP+) PCIe card<br>6x 1GbE PCIe card<br>2x 1GbE (Intel 82571) onboard integrated redundant cluster interconnect |
| **Internal Storage** | 2x 500GB SATA - for operating system<br>1x 4GB USB internal |
| **RAID Controller** | 2x LSI SAS9211-8i SAS HBA |
| **Shared Storage** | 20x 600GB - 3.5" SAS 15k RPM HDD (Seagate Cheetah) - for RDBMS DATA (any slot except the top row of disks)<br>4x 73GB - 3.5" SAS2 SSDs - for RDBMS REDO (slot in the top row of four disks)<br>SSD from STEC (ZeusIOPS - multilevel cell (MLC) version with SAS interface) |
| **Operating System** | Oracle Enterprise Linux 5.5 (on ODA software version 2.1), 5.8 (on ODA software version 2.2) x86_64 |

The ODA comes with a very powerful Intel Xeon processor, as well as enough memory and storage to accommodate a variety of Online Transaction Processing( OLTP) and some smaller data warehouse workloads. The network interconnect is built into the appliance, which removes the need for a switch for the interconnect for communication between the nodes. In terms of storage, depending on the ODA software version and redundancy layer, you can have between 4 and 6 terabytes (TB) of space.

Each ODA comes two 500GB drives per server node, which are mirrored and used for the OS, as well as software that hosts the OS, clusterware, and the Oracle Database homes (250GB is unallocated). There are twenty 600GB SAS drives per appliance and four 73GB SSDs for online redo only. The shared disks on the ODA are connected via two LSI

controllers, which are connected to an onboard SAS expander. Each SAS expander, in turn, is connected to 12 of the hard disks in the ODA. Oracle uses Linux multipathing to avoid disk-path failures. Solid-state drives (SSD) have been added for redo to overcome rotating disk latency, because the controller of the rotating disk has no cache. Disk sizing on the ODA depends on many factors, including the version of the ODA software that is running on the appliance. Table 1-2 shows the various disk configurations and configuration options that are supported on the ODA.

***Table 1-2.*** *ODA Disk Configurations*

| Configuration Option | Disk Group | Type/Redundancy | Backup Type | Space Available (GB) | Software Version Supported |
|---|---|---|---|---|---|
| **1** | DATA | **HIGH** | External | **3200** | **All versions** |
| **1** | RECO | **HIGH** | External | **488** | **All versions** |
| **1** | REDO | **HIGH** | None | **91** | **All versions** |
| **2** | DATA | **HIGH** | Local | **1600** | **All versions** |
| **2** | RECO | **HIGH** | Local | **2088** | **All versions** |
| **2** | REDO | **HIGH** | None | **91** | **All versions** |
| **3** | DATA | **NORMAL** | External | **4800** | **2.4 and above** |
| **3** | RECO | **NORMAL** | External | **733** | **2.4 and above** |
| **3** | REDO | **HIGH** | External | **91** | **2.4 and above** |
| **4** | DATA | **NORMAL** | Local | **2400** | **2.4 and above** |
| **4** | RECO | **NORMAL** | Local | **3133** | **2.4 and above** |
| **4** | REDO | **NORMAL** | None | **91** | **2.4 and above** |

Table 1-2 illustrates various disk configuration options supported by the ODA. As you can see, the space has approximately 4TB usable due to all disk groups being triple-mirrored (high redundancy) in configuration options 1 and 2. Depending on which configuration you chose, you will have more space in DATA or RECO disk groups.

Oracle Database Appliance 2.4 introduced the option to allow mirrored (normal redundancy) disk groups for DATA and RECO. This is highlighted in Table 1-2 as configuration options 3 and 4. This was done primarily to allow customers the choice of space based on the environment that the ODA is being deployed. Typically, the recommendation is to deploy mirroring (normal redundancy) on development/test systems.

The ODA runs Oracle Enterprise Linux OS with support only for the Unbreakable Enterprise Kernel (UEK) as of software version 2.2. The following is a snapshot of ODA software version 2.6:

```
Linux oda01 2.6.32-300.32.5.el5uek #1 SMP Wed Oct 31 22:06:21 PDT 2012 x86_64 x86_64 x86_64 GNU/Linux
Enterprise Linux Enterprise Linux Server release 5.8 (Carthage)
```

Looking at the ODA box from the outside, there are a lot of connections that need to be made. Figure 1-4 points out the various connections, which are then described in Table 1-3. Oracle also provides an easy scheme for setup. The setup poster is shown in Figure 1-5.

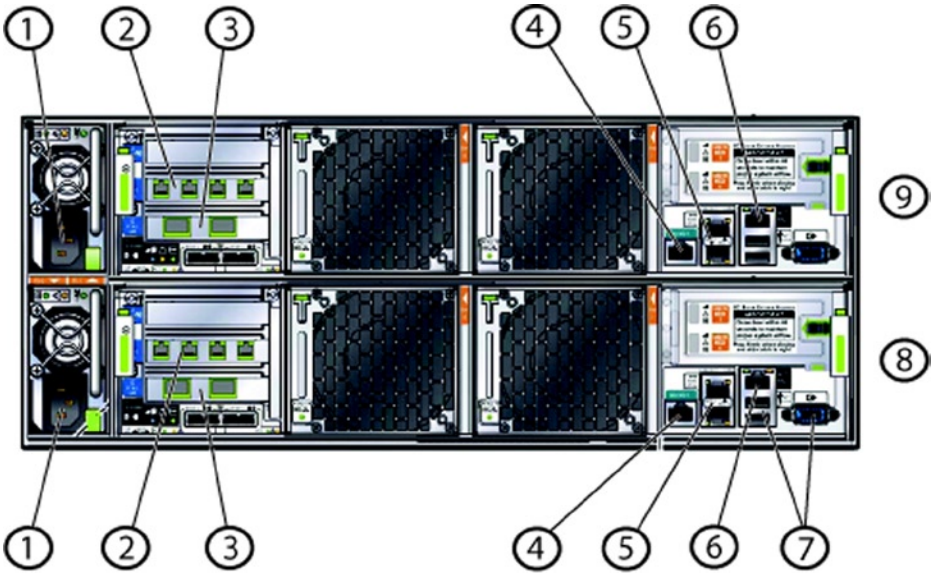


***Figure 1-4.*** *Oracle Database Appliance V1 callouts*

***Table 1-3.*** *Oracle Database Appliance Connector Descriptions*[2]

| Callout | Label | Ethernet | Bond | Description |
|---|---|---|---|---|
| 1 | | | | Power connectors. |
| 2 | PCIe 1 | Eth 7, 6, 5, 4 (left to right) | bond1, bond2 | Eth 4 and Eth 5 are configured as bond1. Eth 6 and Eth 7 are configured as bond 2. These ports are used for custom configurations or for separate backup, disaster recovery, and network management. |
| 3 | PCIe 0 | Eth 8, Eth 9 | xbond0 | Two 10 GbE ports. In 10 GbE systems, these are connected to the public network. |
| 4 | SerMgt | | | Serial connector to Oracle ILOM and system console. |
| 5 | Net 0, Net 1 | Eth2, Eth3 | bond0 | Two 1 GbE connectors. In 1 GbE systems, these are connected to the public network. |
| 6 | NetMgt | | | Ethernet connection for Oracle ILOM. |
| 7 | USB and Video | | | Used for connecting to system console. |
| 8 | | | | Server Node 0. |
| 9 | | | | Server Node 1. |

[2]Part of the MOS Note 1385831.1.

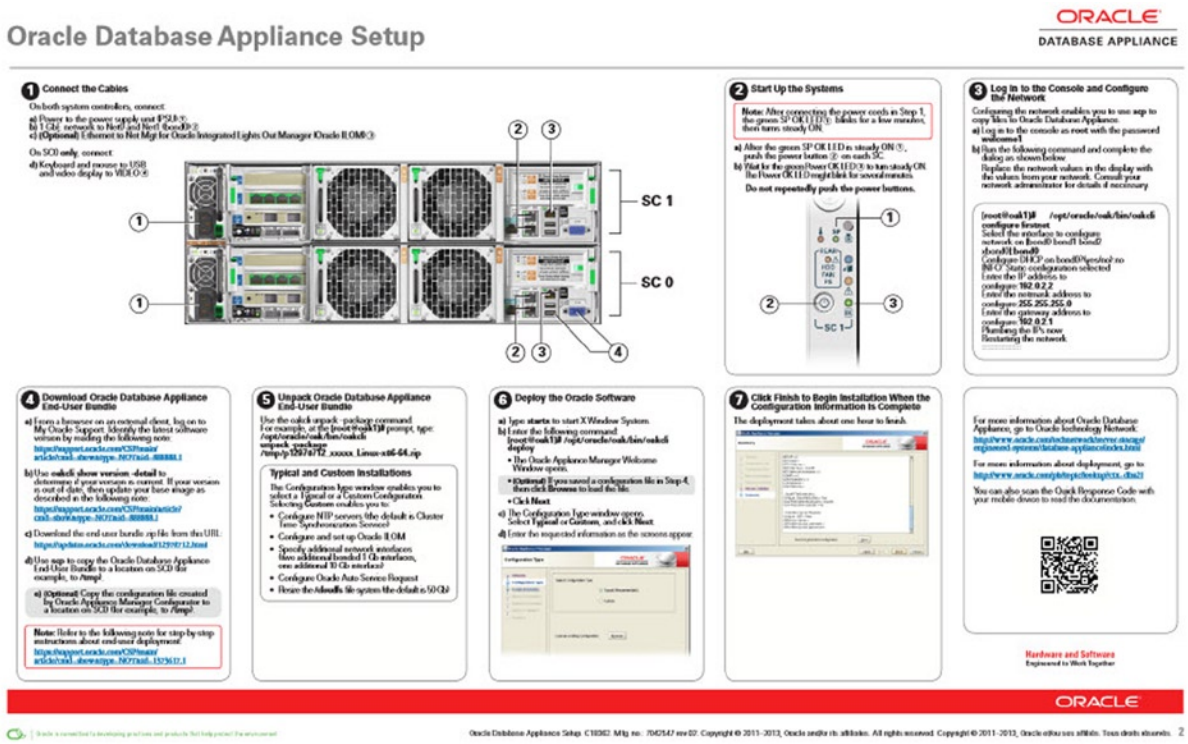


***Figure 1-5.*** *ODA V1 setup poster*[3]

The ODA setup poster is a simple and easy-to-understand method for installing and setting up the appliance. The poster is a step-by-step guide that explains connecting the cables to deploy the software, which results in a fully functional clustered database server. Figure 1-5 shows this in detail. Oracle updates the poster with every release. The poster is available in the documentation web site for ODA at `http://docs.oracle.com/cd/E22693_01`.

The ODA comes with fully redundant hardware and includes two 10 gigabit Ethernet (GbE) interfaces that are bonded together via the Linux operating system to provide redundancy, as well as two 3×2, 1GbE interfaces that are also bonded together for purposes of redundancy. There is a connector for the ILOM, as well as USB and VGA for keyboard and external monitor connections, if needed.

The ODA is unique in the sense that it has an onboard interconnect that is used to connect the two database servers. The interconnect is 1GbE and uses an Intel 82571 board; it is not bonded. That is why there are two cluster interconnects leading to two HAIP devices seen from the clusterware. Since the private interconnects are internal to the appliance, no external cabling is required for them.

The ODA is managed by Oracle Appliance Kit (OAK), which is a proprietary piece of software that is specific to the ODA. The OAK and various ODA software features are discussed in subsequent chapters. Virtualization is added to the ODA platform as an option, and it is also discussed in subsequent chapters.

[3]Oracle, Oracle Database Appliance documentation, `http://docs.oracle.com/cd/E22693_01/doc.21/e40077.pdf`.

# Oracle Database Appliance X3-2

The ODA X3-2 is the second generation of the ODA devices. It has a lot of new features, as well as more capacity than its predecessor. Figure 1-6 shows the appliance from the front.

***Figure 1-6.*** *Oracle Database Appliance X3-2*

The Oracle Database Appliance X3-2 expands the capabilities found in the ODA V1 and packs a punch in terms of hardware and storage capabilities. Oracle has taken a slightly different approach in terms of hardware architecture for the X3-2. The server nodes and the storage rack are now two separate units that are connected together, and there is an option to add an expansion storage rack to double the storage capacity of the appliance.

The X3-2 is more modular in structure than the version 1 appliance and it provides flexibility. Customers are able to expand storage by adding an additional storage rack. They can create a storage rack and a server node rack in their datacenters; however, we recommend installing the components together.

The X3-2 is still a 4U rack mountable unit, but it is divided into two individual 2U units. The server units are 1U each, and the storage unit is 2U as well. The expansion rack, if selected, will add another 2U to the system. Table 1-4 lists the complete specifications for the X3-2 box, but the short story is that the box features Intel Xeon E5-2690 processors, 256GB of memory, two 10GbE external copper connections, and two 10GbE internal network interconnects. Also included are shared, serial-attached SCSI (SAS) disks. The internal disks are now 600GB, up from the previous 500GB configuration that was in V1.

***Table 1-4.*** *Oracle Database Appliance X3-2 Specs*

| Component | Specification |
|---|---|
| **CPU** | Two 8-core Intel® Xeon® processors E5-2690 |
| **Memory** | 256GB (sixteen 16GB RDIMMs at 1600 MHz) |
| **Network** | Four 100/1000/10G Base-T Ethernet ports (onboard)<br>1x dual-port 10GBase-T interconnect for cluster communication |
| **Internal Storage** | Two 2.5-inch 600GB 10K rpm SAS-2 HDDs (mirrored) OS |
| **RAID Controller** | 1x dual-port internal SAS-2 HBA<br>2x dual-port external SAS-2 HBA |
| **Shared Storage** | Twenty 2.5-inch 900GB 10K rpm SAS-2 HDDs<br>Four 2.5-inch 200GB SAS-2 SLC SSDs per shelf for database redo logs<br>Optional storage expansion with additional storage shelf doubles storage capacity<br>External NFS storage support |
| **Operating System** | Oracle Enterprise Linux 5.8 x86_64 |

ODA X3-2 provides a packed spec sheet. It is a powerful successor to the original ODA. Oracle has added a little more complexity in the install, which accommodates the flexibility of having a storage shelf that is separate from the actual server units. This allows for adding a second shelf as needed, but you will now need to ensure that the cabling is done appropriately per the setup poster that is provided with the appliance.

As with the original ODA, the setup poster for the X3-2 is enhanced to be a handy resource to help with the installation. Figure 1-7 shows the poster, which is updated with each version of the software. Currently, the setup poster has instructions on setting up the ODA as a bare metal or a virtualized environment.

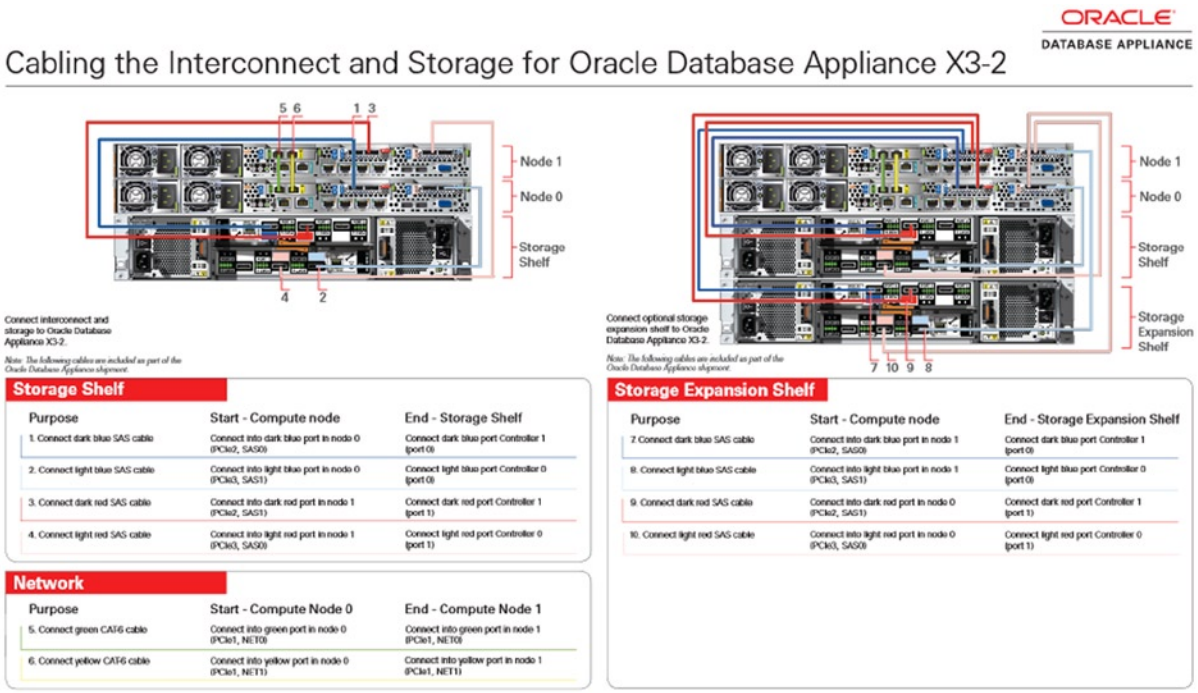


***Figure 1-7.*** *Oracle Database Appliance X3-2 setup poster*

If you look at a poster, you'll see that it suggests a deviation from the original design, in which there is a connection and cables that need to run between the server nodes, as well as from the server nodes to the storage shelf, and optionally to an additional storage shelf as well. Figure 1-8 shows what the server node looks like. Table 1-5 describes the callouts from Figure 1-8.

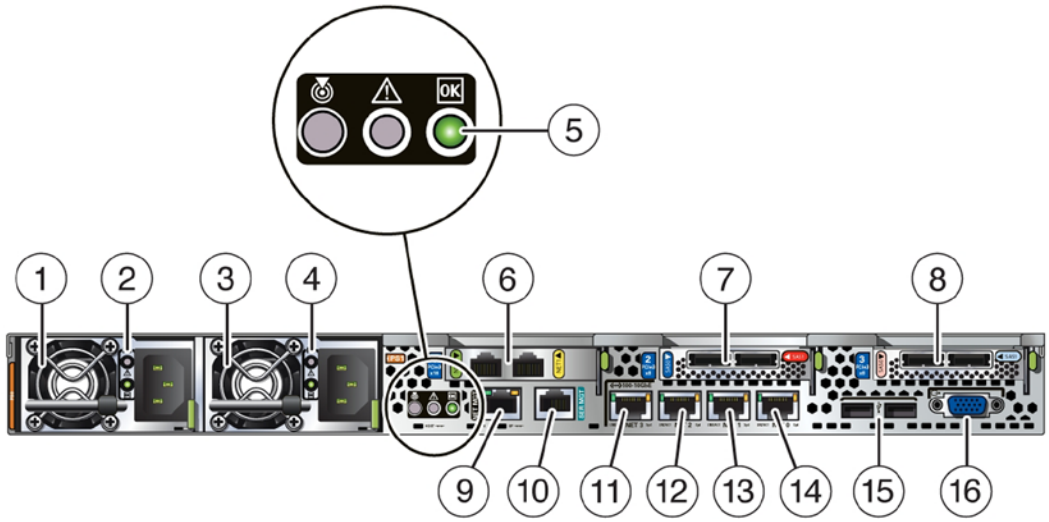


***Figure 1-8.*** *Oracle Database X3-2 server node rear*

***Table 1-5.*** *Callouts for the ODA Server Node Rear*

| Callout | Legend | Callout | Legend |
|---|---|---|---|
| **1** | Power Supply (PS) 0 with fan module. | **9** | NetMgt port. 10/100BASE-T port used to connect to Oracle Integrated Lights Out Manager (Oracle ILOM) SP. |
| **2** | Power Supply (PS) 0 status indicators: Service Required LED: amber, AC OK LED: green. | **10** | Serial management (SerMgt)/RJ-45 serial port. |
| **3** | Power Supply (PS) 1 with fan module. | **11** | Network (NET) 100/1000/10000 Mbps Base-T EthernetRJ-45 connector: NET 3. |
| **4** | Power Supply (PS) 1 status indicators: Service Required LED: amber, AC OK LED: green. | **12** | Network (NET) 100/1000/10000 Mbps Base-T Ethernet port with RJ-45 connector: NET 2. |
| **5** | System status indicators: Locator LED: white, Service Required LED: amber, Power/OK LED: green. | **13** | Network (NET) 1100/1000/10000 Mbps Base-T Ethernet port with RJ-45 connector: NET 1. |
| **6** | PCIe card slot 1. Provides two 10GBase-T Ethernet with RJ-45 connector ports for private interconnect between server nodes. | **14** | Network (NET) 100/1000/10000 Mbps Base-T Ethernet port with RJ-45 connector: NET 0. |
| **7** | PCIe card slot 2. Provides two SAS-2 connectors used to connect servers to the storage shelf and storage expansion shelf. | **15** | USB 2.0 connectors (2). |
| **8** | PCIe card slot 3. Provides two SAS-2 connectors used to connect the servers to the storage shelf and the storage expansion shelf. | | |

The storage shelf is an independent component. You can see the structure and components that are part of the storage shelf in Figure 1-9. Table 1-6 describes the various callouts.

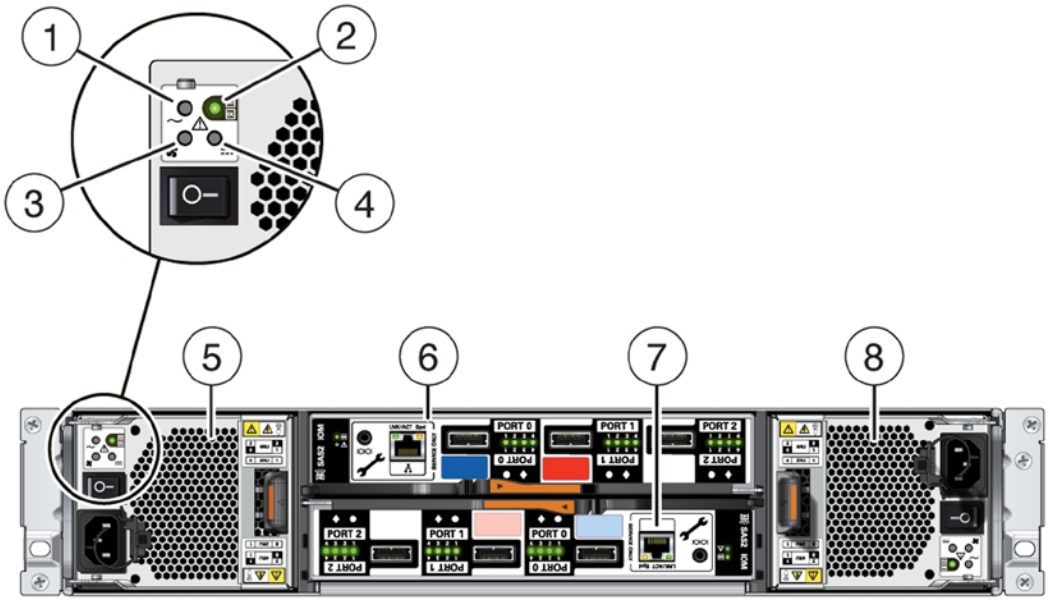


***Figure 1-9.*** *Oracle Database Appliance X3-2 storage shelf*

***Table 1-6.*** *Oracle Database Appliance Storage Shelf Callouts*

| Callout | Legend |
|---|---|
| **1** | AC power fail indicator |
| **2** | Power supply status indicator |
| **3** | Fan fail indicator |
| **4** | DC power fail indicator |
| **5** | Power supply with fan module 0 |
| **6** | I/O module 1 |
| **7** | I/O module 0 |
| **8** | Power supply with fan module 1 |

Due to the addition of the storage shelf and large-sized drives, Oracle Database Appliance X3-2 provides a lot more storage space than its predecessor. And its workload capability has been expanded significantly to accommodate various data mart–style workloads.

ODA X3-2 supports the same four disk configurations shown earlier in Table 1-2, but the sizing is different. Table 1-7 outlines the sizing options available on the X3-2 platform.

***Table 1-7.*** *ODA X3-2 Disk Configurations*

| Configuration Option | Disk Group | Type/Redundancy | Backup Type | Space Available (GB) | W/Expansion Shelf (GB) |
|---|---|---|---|---|---|
| **1** | DATA | **HIGH** | External | **4800** | **9600** |
| **1** | RECO | **HIGH** | External | **733** | **1466** |
| **1** | REDO | **HIGH** | None | **248** | **496** |
| **2** | DATA | **HIGH** | Local | **2400** | **4800** |
| **2** | RECO | **HIGH** | Local | **3133** | **6266** |
| **2** | REDO | **HIGH** | None | **248** | **496** |
| **3** | DATA | **NORMAL** | External | **7200** | **14400** |
| **3** | RECO | **NORMAL** | External | **1100** | **2200** |
| **3** | REDO | **HIGH** | External | **248** | **496** |
| **4** | DATA | **NORMAL** | Local | **3600** | **7200** |
| **4** | RECO | **NORMAL** | Local | **4700** | **9400** |
| **4** | REDO | **NORMAL** | None | **248** | **496** |

# Summary

This chapter looked at the Oracle Database Appliance (ODA)—both the original and the X3-2 models. Originally, the ODA was geared toward small- and medium-sized businesses, but it has gained popularity in the enterprise sector as well. The all-in-one, all-encompassing architecture that allows for capacity on demand are the features that have drawn praise. Simplicity of deployment and management allow for cost savings over traditional infrastructure deployment models. An ODA provides high availability and redundancy out of the box, and applies Oracle's best practices to the system.

CHAPTER 2

# Integrated Lights Out Management

The Oracle Database Appliance (ODA) is a bundle of two server nodes that include storage and embedded cluster networking. Each server node has an Integrated Lights Out Manager (ILOM) interface that is used for management and maintenance tasks. This chapter will dive into what an ILOM is and how to use it in the context of the Database Appliance.

## Introduction to ILOM

An ILOM is a service processor (SP) that is embedded into all Oracle Sun Server–based products. The aim of an ILOM is to provide support for a server in a manner such that access to the datacenter is not required for day-to-day support functions. An ILOM also provides access to a variety of diagnostic features and has integration with Oracle's Automatic Service Request (ASR) to provide call-home functionality to report hardware failures to Oracle for fast support.

The Oracle ILOM service processors provide a wide array of features, and its functional aspects improve with every release of the ILOM. The ODA V1 and X3-2 come with different ILOM versions, due to the enhancements in the service processor itself, but at its core, the ILOM allows for the following:

- Remote KVMS capabilities
- Remote boot from image
- Fault display
- Integration with a variety of authentication systems, such as LDAP (Lightweight Directory Access Protocol ), SSL (Secure Sockets Layer), Radius, and Active Directory
- Remote syslog setup
- SNMP- and SMTP-based alerting
- Environmental reporting
- System serial console redirection (LAN)
- Monitoring host states remotely
- Access to various part and serial numbers

This chapter will focus on these features in the context of the ODA. The Oracle Appliance Kit (OAK), also known as the Oracle Appliance Manager, is the software that manages installation and patching, and in some cases, the gathering of diagnostic information and integration of the ILOM with ASR. However, it is still important to understand the ILOM and the basic functions it performs.

Figure 2-1 shows the starting screen that you see when you log in to an ILOM via your browser. The screen has three main components. The layout is a bit different from the ODA V1 layout in terms of design, but most common functionalities have stayed the same.

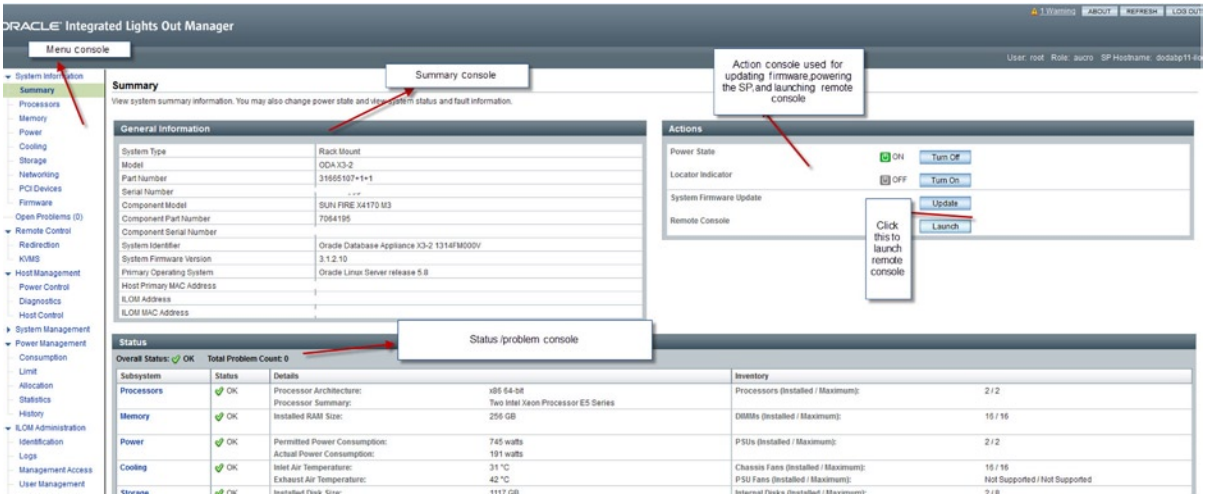


***Figure 2-1.*** *The ILOM running on an ODA X3-2 Sun Fire X4170 M3*

The General Information section is the primary place to look at for basic system information per server node in a visually pleasing manner. Information you'll find there includes:

- System type
- Model
- Part number
- Component model
- ILOM and system MAC address
- Primary operating system

The Actions section is the place that provides easy access to various commonly used functions that an ILOM user will need to access. These include updating the firmware, powering the server on or off, and recycling the service processor by toggling various options of the power state. You can also turn on the locator beacon so that the system can be located in the datacenter (new to X3-2), and you can use the remote console to access the server nodes.

The Status section provides a real-time status on the physical state of components that are contained within a server node. The Status section looks at the following:

- Processors
- Memory
- Power
- Cooling
- Storage
- Networking

The Summary screen shown in Figure 2-1 is rich in information and allows you to get a lot of information summarized quickly. The menu section on the left allows getting more detailed information on each of the components. The menu also includes options for setup and customization of the ILOM

Figure 2-2 shows the summary screen from the original Database Appliance. As you can see, the new interface in Figure 2-1 provides a much easier way to find information, and the menu navigation is much more intuitive. As we go through the features in the sections to follow, we will point how to get to various locations from both ILOMs.

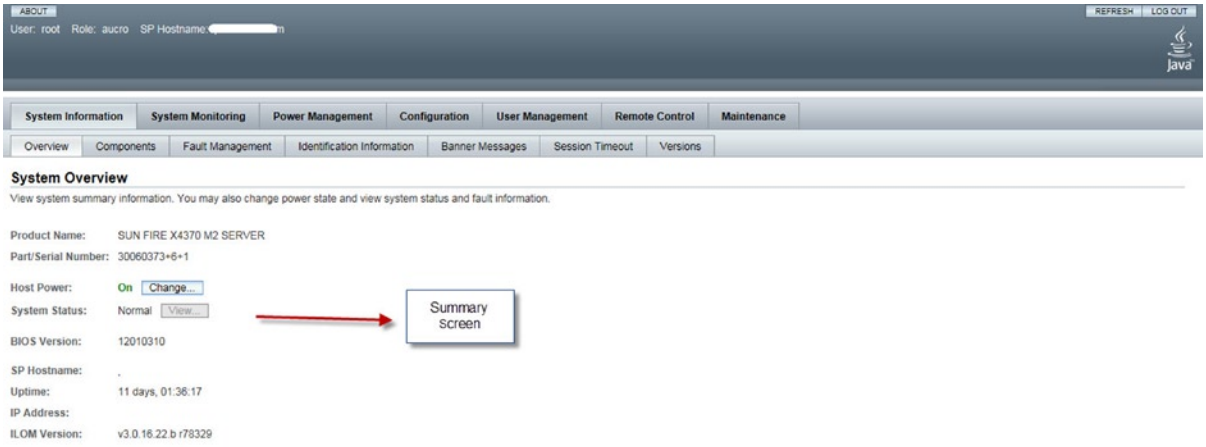


***Figure 2-2.*** *ILOM from the original ODA (V1 X4370 M2)*

# ILOM Features

The ILOM is capable of providing a vast array of services. Looking at the ILOM and all its features are beyond the scope of this book, but we will look at a few of the important features that are needed from the perspective of managing an ODA.

## Remote KVMS Service

The Remote KVMS (Keyboard, Video, Mouse ,Storage is a very important part of the ILOM and is probably what you will use based on your familiarity and experience with remote access to the appliance. The Remote KVMS service allows you to remotely control a server node from a browser. The Remote KVMS uses Virtual Network Computing (VNC) to access the server nodes. Thus you should be sure to open the firewall ports shown in Table 2-1 on your workstation.

***Table 2-1.*** *Firewall Ports Needed for RKVMS Access*

| Ports | Service | Type |
|---|---|---|
| 443 | TCP | HTTPS (inbound) |
| 5120 | TCP | Remote CD (outbound) |
| 5121 | TCP | Remote keyboard and mouse |
| 5123 | TCP | Remote Floppy |
| 6577 | TCP | CURI (API) - TCP and SSL |
| 7578 | TCP | Video Data (bi-directional) |
| 161 | UDP | SNMP V3 Access (inbound) |
| 3072 | UDP | Trap Out (outbound only) |

The setup of an ILOM is covered later in the chapter, but once an ILOM is setup, the Remote KVMS allows access to the server console. Remote KVMS also allows remote installation, which is needed to do a bare-metal server installation. Access to the remote control feature is a bit different between V1 and X3-2 of the ODA, but both offer the same in terms of functionality.

Figure 2-3 shows a cutout of the location of the remote control features in ODA V1 vs. ODA X3-2. The remote control feature is much more easily accessible on the ODA X3-2 via the main screen. By contrast, it takes a couple of clicks to get to the remote control feature on the ODA V1.

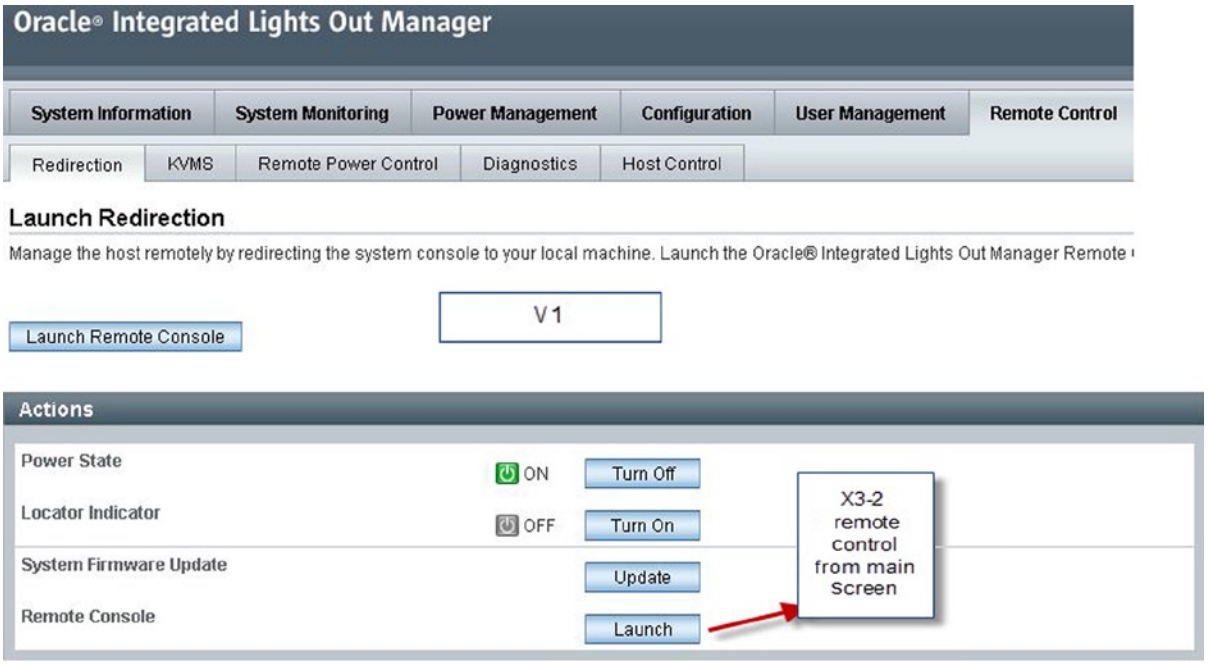


***Figure 2-3.*** *Remote Console options in ODA V1 (top) and ODA X3-2 (bottom)*

The remote console is an easy way to get access to the server console, to configure a server, or to diagnose issues, if remote connectivity to the server itself is not available. Once the remote console is launched, you see a login prompt similar to what you see when you log in to a Unix machine. This allows you to log in to the server from the console.

The remote console provides access to the console messages and allows users to log in to the system. Each server node (SN) has its own ILOM, so in the context of an ODA, there are two ILOMs. This is very important because each physical server in the ODA has its own ILOM that has to be used for managing and maintaining that physical server.

## Integrated Shell

The ILOM is also accessible via a shell that is integrated into the service processor. That shell is a convenient way to access and operate an ILOM. The ILOM shell can be accessed via various methods, as follows:

- The NET MGT port on the server node (serial connection)
- The server node using ipmitool over TCP
- TCP to SSH (Secure Shell) directly into the ILOM
- IPMITool over LAN, locally or from any device that supports ipmitool

The integrated shell is used to configure the ILOM for the first time. It can be used by the datacenter team to prepare the ODA for configuration. The integrated shell is also used to perform basic functions like ILOM password changes, checking for system faults, gaining access to the console, and so forth.

The integrated shell is accessible via the `ipmitool` command. It can also be accessed on the server nodes and remotely using ipmitool with the lanplus protocol. The ipmitool can be accessed via the host for which the SP manages the hardware (as root; the IPMI device in Linux only allows root access). For example:

```
# ipmitool sunoem cli
Connected. Use ^D to exit.
```

Another way to connect to the SP is via the lanplus protocol. This approach can be used on a remote machine where ipmitool is installed. Here's an example:

```
[root@mxt101 ~]# ipmitool -I lanplus -H <ilom hostname/address> -U <ilom username>
-P <ilom user's password> sunoem cli
Connected. Use ^D to exit.
->
```

The ILOM can be accessed remotely via native SSH as well. Here's how that is done:

```
$ ssh <ilom username>@<ilom hostname/address>
Password:

Oracle(R) Integrated Lights Out Manager

Version 3.0.16.10.d r74499

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->
```

The ILOM integrated shell provides a pretty rich command set and allows you to perform a variety of tasks directly from the interface itself. Table 2-2 lists some of the key commands and how they can be accessed.

***Table 2-2.*** *Common ILOM CLI Commands*

| ILOM CLI Command | Description |
|---|---|
| `show /SYS power_state fault_state` | Shows the `power_state` (On or Off) for the host, and the fault state. OK means nothing faulted. If the ILOM/SP detects failure, the fault state will not be OK. |
| `stop /SYS` | Stops the host in a graceful way. If the host doesn't respond or doesn't go down, you can force the host to stop by adding `-f`. For example:<br>`stop -f /SYS` |
| `start /SYS` | Starts a host. |
| `show faulty` | Lists all detected failures, if any. |
| `start /SP/console` | Starts text-based console access. |
| `set /SP/users/root password=welcome1` | Sets a new password for the ILOM. |
| `set /SP/network pendingipdiscovery=static pendingipaddress=10.0.0.1 pendingipnetmask=255.255.255.0 pendingipgateway=10.0.0.255 commitpending=true` | Configures the network for the ILOM. |
| `reset /SP` | Resets the SP, which means the host as well as the SP will be rebooted. |
| `Show /SP/version` | Displays the current SP version. |

In order to access and execute these commands remotely, it is very important to ensure that that the ILOM integrated shell is accessible and available. We discussed the ports needed for Remote KVMS in Table 2-1. You should also consider the ports listed in Table 2-3. Ports are based on standard Oracle defaults and can be configured based on requirements.

***Table 2-3.*** *Ports Used for ILOM Access*

| Port | Type | Description |
|---|---|---|
| 22 | SSH over TCP | SSH - Secure Shell (inbound) |
| 69 | TFTP over UDP | TFTP (outbound) |
| 80 | HTTP over TCP | Web (user-configurable; inbound) |
| 123 | NTP over UDP | NTP - Network Time Protocol (outbound) |
| 161 | SNMP over UDP | SNMP - (user-configurable; inbound) |
| 162 | IPMI over UDP | IPMI - Platform Event Trap (PET) (outbound) |
| 389 | LDAP over UDP/TCP | LDAP (user-configurable; outbound) |
| 443 | HTTPS over TCP | (user-configurable; inbound) |
| 514 | Syslog over UDP | Syslog - (outbound) |
| 623 | IPMI over UDP | IPMI (bidirectional) |
| 546 | DHCP over UDP | DHCP (bidirectonal) |
| 1812 | RADIUS over UDP | RADIUS (outbound ) |

## Security Management

The ILOM allows account management and integration with a variety of popular authentication protocols. Discussing them all in detail would be out of the scope of this book. We will look at Active Directory integration as part of this section and also discuss how to manage users locally.

## Local Account Management

The ILOM provides a secure way to authenticate and perform day-to-day functions via locally authenticated accounts. This is the default authentication method to get access to an ILOM. ILOM Account management allows an administrator to provision accounts for a variety of functions. Table 2-4 lists all the roles that are available to users.

***Table 2-4.*** *Roles Available for ILOM Authentication*

| Role | Description |
|---|---|
| a (Admin) | Complete admin privileges |
| u (User) | Provides access to allow creation and deletion of users and to configure authentication services |
| c (Console) | Access to console functions that allow for BIOS updates |
| r (Reset) | Allow for control of the host power, as well as power cycle the SP |
| o (Read Only) | Allows for read-only access to logs and environmental information |

Based on the role selected (Administrator, Operator, Advanced Roles), various privileges are given to the user. Users can be created via the ILOM GUI or via the command line.

Figure 2-4 and the preceding command-line example shows some of the various means that can be used to add a user to the ILOM for local authentication. The roles and privilege assignment, as well as user deletion, can also be done via the GUI or the command line, depending on your comfort level.

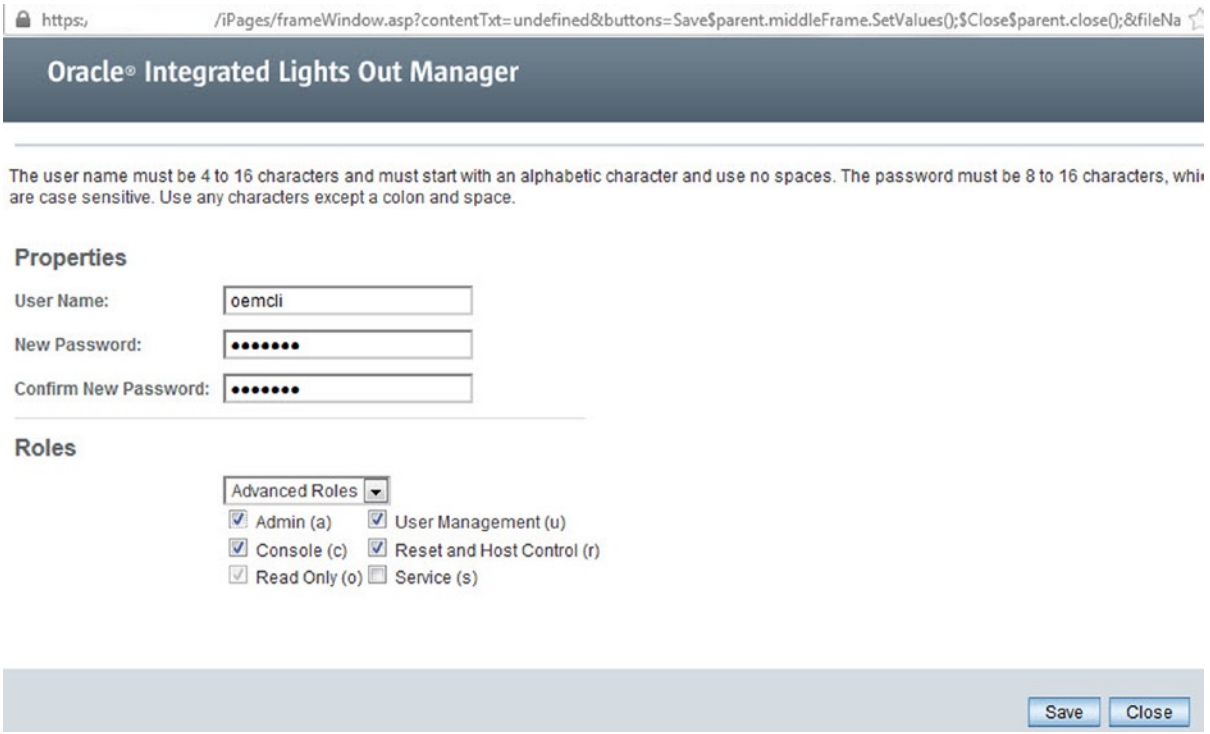


***Figure 2-4.*** *Add User screen*

The following is an example of a command to create a new user named `rick`:

```
create /SP/users/rick password=my_secret role=administrator
```

Having created the user, you can modify the user's role as follows:

```
set /SP/users/rick role=operator
```

You can also delete the user:

```
delete /SP/users/rick
```

It is very important to understand the roles and privileges available, and to assign them appropriately to secure your environment. Also take care to change the default ILOM root password immediately after deployment.

## Alerting and Syslog Setup

Logging is a very important way of understanding and debugging issues. The Oracle ILOM provides various ways of disseminating logging information. Syslog is disabled by default, but it is the preferred way to centralize logging. SNMP traps can also be set to allow for alerting to remote systems.

Syslog is an ILOM service that needs to be enabled and configured. The process to enable syslog on the ILOM is to add the IP address of the syslog server. Figure 2-5 and Figure 2-6 show the syslog configuration screen that is available in ODA V1 and ODA X3-2, respectively. That screen can be used to configure the ILOM to send data to an external syslog server.


***Figure 2-5.*** *ODA V1 syslog setup*

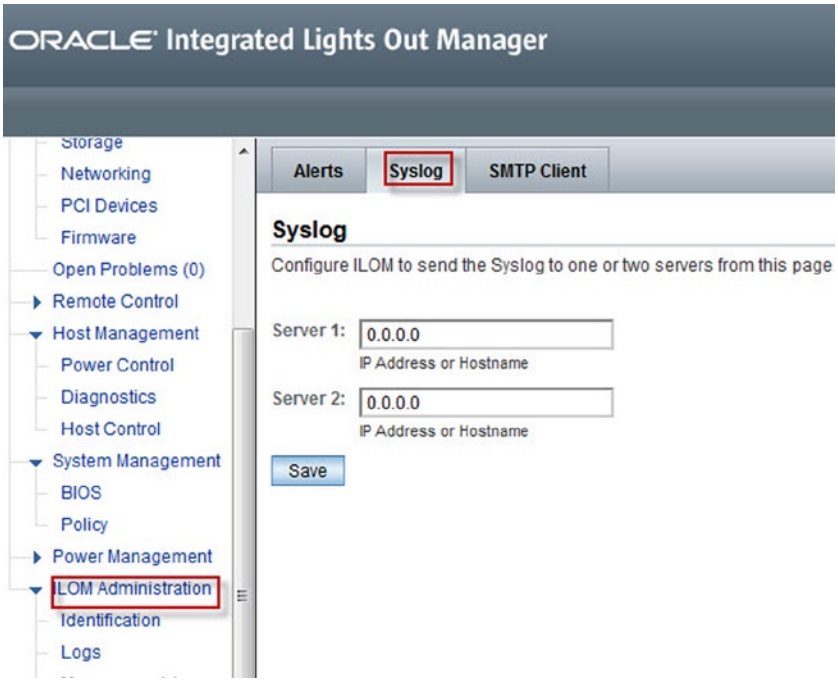


***Figure.*** *2-6. ODA X3-2 syslog setup*