Oracle® Enterprise Manager Ops Center: Managing Datacenter Complexity
Executive Summary

Today datacenter managers struggle with a fragmented infrastructure consisting of a wide range of proprietary and single-purpose tools. Complicating the issue is the widespread use of virtualization solutions to increase resource utilization and consolidate hardware resources in the datacenter. The result is a complex, hard-to-manage infrastructure that cannot scale to meet growing demand. Oracle® Enterprise Manager Ops Center delivers a converged hardware management solution for Sun environments that integrates management across the infrastructure stack. With advanced virtualization management and reporting capabilities, application-to-disk management, intelligent configuration management and more, Oracle Enterprise Manager Ops Center helps IT managers reduce complexity and streamline and simplify infrastructure management.

Introduction

IT systems are evolving to address key business requirements, and there is greater dependency and reliance on enterprise computing resources. However, today's datacenters consume physical space at a rapid rate, overuse power, and are costly, complex, and difficult to manage. As a result, there is an urgent need for increased datacenter performance and efficiency. Toward this end, IT departments are rushing to upgrade to new infrastructure and virtualize systems to affect better resource utilization.

While providing significant improvements, these technologies contribute change and complexity at a time when datacenters are already understaffed and overburdened. Placing just two or three virtual environments on an existing server can double or triple the administrative workload for IT staff if not implemented properly. In addition, introducing virtualization technologies adds greater complexity by blurring existing lines of responsibility. Virtual deployments can cross traditional groups of dedicated administrative staff, creating doubt about which group is responsible for managing business services and the underlying infrastructure. Datacenter administrators are caught in the middle with tools that fail to keep
pace with technological developments. Forced to cope with a disconnected set of single-purpose tools, and struggling with scripts and labor-intensive manual processes, IT organizations face a breaking point where they are no longer able to manage various datacenter infrastructure layers or scale effectively to support rapid change and complexity.

Oracle Enterprise Manager Ops Center addresses this challenge with a converged approach that integrates hardware management across the infrastructure stack, helping organizations to streamline operations, increase productivity, and reduce system downtime. Unique and comprehensive application-to-disk management capabilities come together within Oracle Enterprise Manager to further simplify administration, increase efficiency, and break down barriers between management silos.
Introducing Oracle Enterprise Manager Ops Center

Oracle Enterprise Manager Ops Center is the most comprehensive management solution for Sun hardware infrastructure, but supports heterogeneous environments as well. Offering a single console to manage multiple server architectures and myriad operating systems, Oracle Enterprise Manager Ops Center capabilities include asset discovery, provisioning of firmware and operating systems, automated patch management, patch and configuration management, virtualization management, and comprehensive compliance reporting. An open, extensible system that can be integrated with existing datacenter management tools, Oracle Enterprise Manager Ops Center manages across the entire infrastructure stack—from firmware, operating systems and virtual machines, to servers, storage, and network fabrics.

Oracle Enterprise Manager Ops Center automates workflow and enforces compliance via policy-based management, all through a single intuitive interface. With Oracle Enterprise Manager Ops Center, IT staff can implement and enforce datacenter standardization and best practices, regulatory compliance, and security policies while efficiently deploying infrastructure to meet business requirements. Figure 1 shows the intuitive browser-based user interface for Oracle Enterprise Manager Ops Center.

Figure 1. The Oracle Enterprise Manager Ops Center interface provides comprehensive management functions from a single console.
Oracle Enterprise Manager Ops Center Architecture

Oracle Enterprise Manager Ops Center utilizes a unique three-tier architecture that supports rapid scalability and secure management with a centralized enterprise controller and distributed proxy controllers to manage datacenter assets. The combination of an enterprise controller, proxy controllers, and other architectural components provides layer-by-layer, end-to-end management of the complete hardware stack from servers and operating systems to virtualization, storage, and networking. Figure 2 illustrates the Oracle Enterprise Manager Ops Center three-tier architecture.

Oracle Enterprise Manager Ops Center Enterprise Controller

A centralized server that consolidates management of systems, the Oracle Enterprise Manager Ops Center Enterprise Controller is the core of Oracle Enterprise Manager Ops Center. Connecting to managed systems through proxy controllers, it generates the browser interface, routes commands from users to the proper proxy controller, and communicates with Oracle Support and other external data sources.

Oracle Enterprise Manager Ops Center can operate in either connected or disconnected mode. By default, Oracle Enterprise Manager Ops Center operates in connected mode, enabling the software to download operating system (OS) patches and other new software automatically using internet access. It is possible to use a combination of connected and disconnected modes to maintain datacenters. For example, the enterprise controller can be switched to connected mode to check for patches, connected...
to the internet to get information, disconnected from the internet, and switched back to disconnected mode when finished.

**Oracle Enterprise Manager Ops Center Proxy Controller**

Proxy controllers monitor and manage systems within individual security domains and communicate status back to the enterprise controller. The enterprise controller places actions in a job queue on the proxy controller in chronological order. When a job stops, the next job in the queue is started.

Utilizing multiple proxy controllers creates an architecture that supports massive scalability and enhances performance by distributing the network load and reducing the amount of traffic between the enterprise and proxy controllers. It also contributes to greater security by isolating each security domain managed by a proxy controller.

**Oracle Enterprise Manager Ops Center Agent Controllers**

Agent controllers are lightweight Java™ software that perform management, OS patching, and compliance monitoring operations for OS assets and virtual OS instances. Hardware management tasks such as firmware provisioning do not require the use of agents. Agent controllers are installed on operating systems and virtualized environments managed by Oracle Enterprise Manager Ops Center and communicate with a specific proxy controller, retrieving commands from designated proxies, performing required actions, and notifying the proxy of the results. The agent controllers can be viewed for information such as status, current version, and any available updates.

**Oracle Enterprise Manager Ops Center Knowledge Base**

The Knowledge Base contains metadata on consistent, supported configurations for the Oracle Solaris and Linux operating systems. For example, an OS release could be noted in the Knowledge Base as requiring a specific firmware revision and a particular set of patches before being deployed. Knowledge Base data can include patch dependencies, standard patch compatibilities, withdrawn patches, and download and deployment rules. The Knowledge Base also maintains URLs for vendor downloads and retrieves download components from the appropriate vendor download site.

**Other Architecture Components**

Oracle Enterprise Manager Ops Center contains several other components that perform important management functions.

- **Oracle Enterprise Manager Ops Center Virtual Controller.** Oracle Enterprise Manager Ops Center lets IT staff manage virtual server assets and resources created by Oracle Solaris Containers or Oracle VM Server for SPARC. The Oracle Enterprise Manager Ops Center Virtualization Controller manages and monitors the agent software on a virtual asset as if it were a physical component.

- **Libraries.** The libraries of Oracle Enterprise Manager Ops Center store and manage cached data, images, patches, and metadata. This can include copies of operating systems, OS patches, firmware
revisions, virtual appliance images, and golden master images. The libraries are organized into the following categories.

- **The OS Provisioning Library.** The OS provisioning library manages the OS images and profiles. Maintained in ISO format, the images can be used to provision one or more systems with an OS.

- **The Firmware Provisioning Library.** The firmware provisioning library manages firmware images, the supporting metadata, and the profiles for the firmware.

- **The Updates Library.** The updates library is used to manage updates or patches for the Oracle Solaris and Linux operating systems, as well as Microsoft Windows.

  NOTE: Oracle Enterprise Manager Ops Center uses Microsoft System Center Configuration Manager (SCCM) for updating the Windows operating system. The Windows Update functionality depends on the SCCM agent installed on the managed systems. SCCM can be configured to install agents on managed Windows systems either automatically or through a manual process.

- **Storage Libraries.** When a guest or virtual image is created, the configuration information for its operating system, data, CPU, memory, and network details are saved as metadata in a storage library. Oracle Enterprise Manager Ops Center supports two types of storage libraries—Fibre Channel and Network Attached Storage (NAS), depending on the virtualization type. Once controlled by Oracle Enterprise Manager Ops Center, storage libraries can provide disk resources to virtual machines. Should migration of the storage from one virtual machine to another become necessary, Oracle Enterprise Manager Ops Center can orchestrate moving the underlying storage in a process that is transparent to operators. For more information on storage virtualization support in Oracle Enterprise Manager Ops Center, see the Utilize Resources More Efficiently section in this paper.

### Key Capabilities and Features

Oracle Enterprise Manager Ops Center delivers a converged hardware management with powerful features that dramatically improve IT efficiency. With these features IT staff can:

- Extend asset management to storage and network resources
- Streamline operations and speed deployments
- Reduce risk
- Speed problem resolution and increase uptime
- Improve compliance
- Utilize resources more efficiently
Extend Asset Management to Storage and Networks

Successfully deploying infrastructure to support new business services requires a comprehensive view of all datacenter assets. Along with management of core server and virtual machine assets, Oracle Enterprise Manager Ops Center integrates storage and network asset management for a complete, single view of infrastructure resources.

With support for Oracle’s Sun ZFS Storage Appliances, Oracle Enterprise Manager Ops Center can correlate storage use by managed servers and includes fully integrated alarm management and simplified virtualization management. Oracle Enterprise Manager Ops Center discovers storage resources on the network and presents them as storage options to virtual machines when creation wizards are run. In addition, Oracle Enterprise Manager Ops Center offers network asset management features including network fabric management for Oracle’s Infiniband and Ethernet switches, and the ability to discover and manage network topology and Infiniband port connectivity.

Streamline Operations and Speed Deployments

Adding new equipment in the datacenter can be labor-intensive, and rolling out new business and application services can require significant time investments. Performing these processes manually increases the risk of costly errors and occupies valuable skilled staff. In order to remain competitive, organizations need to be as agile as possible. Oracle Enterprise Manager Ops Center includes features that can simplify and automate deployment processes and help IT staff to implement new services rapidly.

Simplified Asset Discovery

Asset discovery determines the hardware, operating systems, and virtualization tools present in the datacenter. Oracle Enterprise Manager Ops Center adds support for new assets such as storage, network fabrics, and server clusters, making it easier to discover and manage a wide range of infrastructure assets.

- Automatic discovery searches for embedded or open service tags on subnets associated with the configured network interfaces of every proxy controller.
- Custom discovery performs asset discovery according to user-specified targets such as IP addresses, IP range, subnets, or host name, and standard protocols such as SSH, IPMI, Telnet, and SNMP.
- A Discover and Manage Assets Wizard uses a combination of service tags and custom discovery to quickly discover and manage assets.
- The Declare Assets method makes it possible for administrators to declare one or more bare metal systems in preparation for OS provisioning, even if the systems have no service processor.

Figure 3 shows the Oracle Enterprise Manager Ops Center dashboard. The dashboard makes it easy to see discovered assets, topologies, and their relationship to each other through a simple graphical interface.
Automated Provisioning

New deployment plans—comprised of OS images and profiles—can be used to automate the entire provisioning cycle in a single workflow, including hardware configuration, firmware updates, virtual machine deployment, operating system provisioning, and patch updates. These complete plans can be stored and managed in the image library to support standardized deployments, similar to golden OS images. OS provisioning is supported for Oracle Solaris 8, 9, and 10, Oracle Enterprise Linux, Red Hat Linux, SuSE Linux, and Microsoft Windows (via integration with Microsoft System Center Configuration Manager). Oracle Enterprise Manager Ops Center enables OS provisioning on single systems or groups of systems.

Firmware Provisioning

Firmware provisioning installs server firmware updates using firmware images and profiles that are created and stored in the firmware provisioning library. Oracle Enterprise Manager Ops Center automates firmware provisioning at a single chassis or system level, and at the datacenter level. The provisioning process is similar, regardless of the hardware, operating system, or underlying technology being deployed. Firmware compliance reports can also be used to provision firmware by running the firmware compliance reports and applying updates based on the report output.

Oracle Enterprise Manager Ops Center installs BIOS, service processor, RAID controller, and disk drive firmware. All Oracle firmware is automatically downloaded with the correct installation guidelines embedded in the parcel. Oracle Enterprise Manager Ops Center automates the process of acquiring
required installation software, gathering intelligence on how to perform installations, and creating the environment necessary for successful installation. For example, when installing disk drive firmware, Oracle Enterprise Manager Ops Center boots the server from a network distributed mini-root, automatically updates and installs the drive firmware, and reboots the server. Oracle Solaris Enterprise Manager Ops Center does the heavy lifting so the datacenter staff can focus on other tasks.

Unprecedented Server Management
Oracle Enterprise Manager Ops Center offers a comprehensive server management feature set that spans all server architectures from Oracle, including Oracle Sun SPARC Enterprise M-Series, Oracle Sun SPARC Enterprise T-Series, Oracle SPARC T3 servers, and x86-based systems. These features include specialized virtualization deployment and configuration for each server type, full FRU awareness across all SPARC and x86 processor-based families, deep service processor configuration capabilities, multilevel firmware provisioning of chassis and FRU components, and comprehensive fault awareness due to combined in-band and out-of-band monitoring intelligence.

With Oracle Enterprise Manager Ops Center, administrators can
- Capture and control first boot service processors
- Deploy hypervisors and control domains (on Oracle servers with chip multithreading technology)
- Choose a quad processor board configuration with mirrored memory on Oracle Sun SPARC Enterprise M-Series servers
- Install operating systems on bare metal virtual machines
- Invoke operational scripts and procedures
With comprehensive deployment plan capabilities, administrators can combine all of these once diverse and isolated tasks into a single workflow.

Reduce Risk
Updating operating systems can be a complex, time-consuming, and unpredictable process. Unforeseen dependencies in the software can produce unexpected results. Traditionally, patching an operating system requires administrators to manually review the software for potential conflicts.

Oracle Enterprise Manager Ops Center reduces the risk and complexity inherent in updating operating systems and helps to standardize the patch installation process. Administrators can utilize OS update profiles to create consistent, repeatable patching routines. An innovative dependency resolver automates the process of checking for potential conflicts before the updates are applied, and Oracle Enterprise Manager Ops Center provides the ability to simulate the patch process, compare and audit patch consistency, and return systems to a prior state in the event of a problem. Utilizing the OS update management features contained in Oracle Enterprise Manager Ops Center can help minimize downtime, maintain change tracking, and automate the process of patching without user intervention, greatly reducing the uncertainty associated with OS updates. In addition, Oracle Enterprise Manager Ops Center offers intelligent patching that supports Oracle Solaris Cluster environments.
System Catalogs

A system catalog helps maintain version control by generating a list of installed Oracle Solaris and Oracle Enterprise Linux software components after actions are performed on the OS. System catalogs can be utilized to change component configurations without first having to create or edit an OS update profile. Modifying the system in this manner provides a quick way for administrators to make changes and can be used to install, uninstall, or upgrade a component. Alternatively, a catalog can be saved as a profile to be used to update the OS. Administrators also can make two managed systems look alike by comparing and making the two catalogs match each other.

Detecting and Deploying Updates

Depending on the operating system in use, Oracle Enterprise Manager Ops Center provides a number of tools and reports for identifying and handling updates to the system. With Oracle Enterprise Linux and Oracle Solaris, update reports can detect the presence of a recommended update and deploy it. Even Microsoft Windows systems can be updated through integration with Microsoft SCCM within Oracle Enterprise Manager Ops Center.

Speed Problem Resolution and Increase Uptime

Typical management solutions in heterogeneous datacenters inundate operators with alerts that bear no relationship to the business services being offered. When multiplied by the number of consoles that must be checked for the different management solutions, it can be difficult for administrators to prioritize their response to alerts. Oracle Enterprise Manager Ops Center contains a number of features to help speed problem resolution and increase uptime.

Extensive Monitoring

Designed to support monitoring and management of large numbers of assets with a single console, Oracle Enterprise Manager Ops Center offers extensive monitoring capabilities. Administrators can define rules with parameters that determine when alerts are triggered, enabling them to avoid sifting through massive volumes of alerts to find those pertaining to specific resources. The rules are bundled by asset type into monitoring profiles that can be edited or customized for specific asset types. Critical path systems can be grouped together to create a monitoring profile that contains more stringent rules for group members.

Energy Awareness

Oracle Enterprise Manager Ops Center allows datacenter staff to observe and take action against energy misuse, and supports viewing energy consumption in terms of real dollars. Oracle Enterprise Manager Ops Center correlates energy draw to CPU, temperature, and fan information and the data can be aggregated per rack, business owner, or any other logical group combination. For Oracle's SPARC processor-based servers, Oracle Enterprise Manager Ops Center can change the energy policy on the service process or between performance mode and elastic mode, enabling the datacenter to
optimize its investment without spending recklessly on electricity. Figure 4 shows an energy management dashboard.

Figure 4. Oracle Enterprise Manager Ops Center provides comprehensive energy management features.

**Dynamic Problem Management**

Providing enhanced problem management features and helping to facilitate Information Technology Infrastructure Library (ITIL) best practices for problem resolution, Oracle Enterprise Manager Ops Center implements a help desk approach to managing problems. Operators are able to communicate with each other through the Oracle Enterprise Manager Ops Center Messaging Center and problems can be assigned to specific staff to monitor problem status and resolution. A series of options allow users to respond with status updates, notes, or even operational plans.

Operational procedures can be established according to different types of alert, and invoked automatically to provide an automated response or resolution. Oracle Enterprise Manager Ops Center contains the intelligence to consolidate multiple alerts into a single problem automatically, just as alerts based on different attribute and rule logic also can be correlated to a single problem.

**Improve Compliance**

Many industries now must be able to demonstrate compliance with internal, regulatory, or legislative bodies. Comprehensive reporting functions in Oracle Enterprise Manager Ops Center provide insight into all phases of the asset lifecycle and can help datacenter managers maintain compliance.
• **Problem Reports.** Reports can be generated on problems or specific managed assets and can include details such as problem severity level, status, type of problem, or asset groups affected by the problem. Good for audit trails, these reports can be used to determine the steps needed to improve service levels.

• **Firmware Compliance Reports.** Running a firmware compliance report against a firmware profile associated with that report can determine whether an asset is in compliance with the profile specifications. Utilizing the compliance reporting process makes it possible to maintain consistent firmware versions across the datacenter.

• **Update Reports.** An update report can be used to query specific operating systems and functions in the same fashion as firmware compliance reports. The update report checks for OS compliance and recommends the necessary patches and software packages.

• **Server Provisioning Reports.** Oracle Enterprise Manager Ops Center generates reports on server provisioning actions taking place over a specific period of time and details the action, user, profiles utilized, and the outcome of the provisioning operation.

• **Hardware Configuration Reports.** Most datacenters mandate tracking hardware changes and maintaining equipment inventories. The hardware configuration reporting function in Oracle Enterprise Manager Ops Center helps administrators to automate the process of obtaining detailed change histories and hardware inventory.

**Utilize Resources More Efficiently**

Many datacenter systems are configured to handle peak demand, leaving them under-utilized the rest of the time. Virtualization leverages under-utilized systems to provide greater resource usage, more flexibility, better scaling, and increased security and isolation. Oracle Enterprise Manager Ops Center enables the effective use of virtualization with comprehensive management across three key Oracle virtualization technologies—Dynamic Domains, Oracle Solaris Containers, and Oracle VM Server for SPARC. These three technologies provide different methods for virtualizing system environments, but with Oracle Enterprise Manager Ops Center, they can all be managed within a single solution.

Dynamic Domains is a hardware-based virtualization technology built into Oracle Sun SPARC Enterprise M-Series servers that allows partitioning of available hardware resources to provide completely isolated hardware domains. Each domain can run a separate operating system with dedicated hardware resources and remain completely isolated from all other domains. Oracle Solaris Containers is an operating system-based virtualization technology that comes with Oracle Solaris. Oracle Solaris Containers create isolated execution environments for applications and can be created, deleted, reconfigured, and rebooted independently of other containers. Utilizing Oracle Solaris Containers makes it possible for administrators to deploy applications in a protected manner that is both secure and isolated.

Virtualization can also be accomplished with domains using Oracle VM Server for SPARC, a hypervisor-based virtualization technology specifically for Oracle's Sun SPARC Enterprise T-Series and Oracle T3 servers. This approach utilizes a lightweight firmware-based hypervisor to subdivide
supported platform resources, such as CPUs, memory, network, and storage, into partitions called domains. Each domain can run an independent operating system.

Oracle Enterprise Manager Ops Center provides complete lifecycle management across all of these virtualization technologies. With Oracle Enterprise Manager Ops Center, administrators can create, configure, and delete virtual machines as needed, as well as monitor and manage virtual machine resources. Management capabilities for virtual machines include dynamically reconfiguring CPU, storage, and I/O resources for each virtual machine, or moving virtual machines from one system to another. With Oracle Enterprise Manager Ops Center, IT staff can ensure they are maximizing resource utilization with simple and efficient virtualization management.

Integration

Today’s datacenters are heterogeneous and complex, and require management solutions capable of interoperating in order to maximize value. A key feature of Oracle Enterprise Manager Ops Center is the ability to integrate with other datacenter services and tools, greatly extending infrastructure management capabilities within a single console. Some of this integration and extended capability is included with Oracle Enterprise Manager Ops Center, such as integration with Enterprise Manager Grid Control and My Oracle Support. Additional integration is available through rich APIs and command-line interfaces. As a result, administrators can maximize the value of Oracle Enterprise Manager Ops Center and achieve very high operational efficiencies.

Integrated Application-to-Disk Management

To maximize IT efficiency, datacenters must be able to manage across the entire IT stack in an integrated and unified way. Oracle Enterprise Manager provides a unique capability in the industry for managing across the stack—from applications to disk—with a fully integrated solution. A key component of this solution is Oracle Enterprise Manager Ops Center, which provides the primary hardware management capabilities. Oracle Enterprise Manager Ops Center is integrated into the overall Oracle Enterprise Manager solution through a bi-directional management connector, which passes key configuration, status, alarm, and compliance information. Oracle Management Connector for Ops Center bridges infrastructure management and business service stability and helps close the gap between application architects and system administrators.

As a result, IT staff gains access to a single, focused event console that makes it possible to understand how hardware, virtualization, software compliance, and operating system performance issues are affecting production business services. Utilizing the single console facilitates the isolation and resolution of problems much more quickly. Database administrators can see how underlying infrastructure layers are performing when they have database performance issues or service downtime issues to investigate. Conversely, systems administrators gain application awareness from within Oracle Enterprise Manager Ops Center to understand and predict the impact of transaction volumes on the infrastructure. The relationship between infrastructure and application architectures becomes visible without significant investment of time and expense in custom coding and third-party integration efforts.
Integrated Hardware Management and Support

Integration with My Oracle Support offers some powerful features that help to simplify and expedite the management of datacenter hardware. Oracle Enterprise Manager Ops Center makes it possible for administrators to verify contract and warranty information for each asset and correlates asset serial numbers to Oracle Support IDs. Automated service requests based on specified hardware alarms and faults can be initiated, tracked, and managed through the Oracle Enterprise Manager Ops Center console. Oracle Enterprise Manager Ops Center automatically forwards all the supporting debugging information and data files to My Oracle Support. In addition, new OS patches and updates can be received from My Oracle Support and are pushed down to Oracle Enterprise Manager Ops Center. These proactive functions can help facilitate problem resolution and free datacenter staff for other duties.

Integration with Third-Party Tools

Powerful APIs allow third-party tools, such as enterprise management or orchestration tools, to drive the actions of Oracle Enterprise Manager Ops Center. Oracle Enterprise Manager Ops Center also can be configured to drive third-party tools, such as Windows OS patching tools, through use of a driver API. The APIs provide access through industry-standard protocols, such as Web Services-Management, or through a Java Management Extensions API. In addition, a rich command-line interface provides further opportunities for integration using common scripting languages.

Conclusion

Datacenter managers everywhere face management challenges as infrastructure environments virtualize and scale, and fragmented management and point tools fail to provide the visibility needed. Oracle is helping to streamline operations, increase productivity, reduce downtime, and remove management barriers with Oracle Enterprise Manager Ops Center. With the ability to manage today’s increasingly heterogeneous, diverse, and complex datacenters, Oracle Enterprise Manager Ops Center helps IT staff create dynamic, scalable, datacenter infrastructure that adapts to ever-changing business priorities and demands.
For More Information

More information on Oracle Enterprise Manager Ops Center and related technologies can be found in the references listed in Table 1.

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