Oracle® Enterprise Manager

An Oracle Technical White Paper

November 1998

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<div align="right">Oracle Enterprise Manager</div>

INTRODUCTION

Businesses continue to face the challenge of simplifying, and lowering the cost of, the management of the systems that run on their corporate, interconnected networks. With the right set of tools, administrators can ensure the highest level of system performance and availability, allowing users to be more productive, and businesses to lower operational costs.

Effective systems management for the Oracle environment requires that teams of administrators have the ability to:

- Centrally view their managed systems.
- Associate and organize disparate, but linked services, such as databases and applications.
- Effectively monitor and respond to the health of these systems 24 hours a day.

Oracle® Enterprise Manager is the comprehensive management framework for the Oracle environment. The tools it provides enable administrators to maintain the highest level of performance and availability. The framework, built upon a powerful, flexible architecture, includes:

- A robust, centralized console
- A rich set of tools
- The extensibility to detect, solve and simplify the problems of any managed environment

This paper describes the power, scalability, and reliability of the Oracle Enterprise Manager architecture. It also discusses how database and systems administrators can use the Oracle Enterprise Manager framework components to effectively manage any environment.

THE THREE-TIER ARCHITECTURE

Oracle Enterprise Manager is composed of a lightweight, 3-tiered architecture that offers flexible deployment options, round-the-clock reliability, and unparalleled scalability. The 3-tier model moves data-intensive business logic off the client, and recasts it as shared services on the middle-tier.

The first tier is comprised of Java™ clients, such as consoles or database administration applications. The first tier clients communicate with the second tier, the Oracle® Management Server, via standard CORBA interfaces and IIOP. The Oracle Management Server is responsible for housing critical management services, and operating as the 'communication depot' for all management notifications. One of the most important responsibilities of the Oracle Management Server is distributing tasks to the Oracle® Intelligent Agents, which run on the third tier. The Intelligent Agents are responsible for execution of tasks and on-going monitoring of networked systems. Oracle Management Servers communicate with Intelligent Agents over Net8™. This architecture, which underlies the Enterprise Manager framework, is described in more detail below.
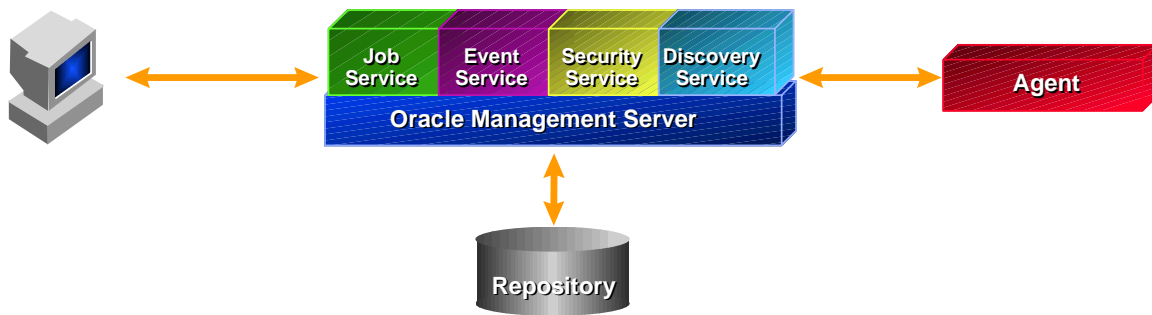
Figure 1: Oracle Enterprise Manager's Robust Framework is Built Upon a Scalable, Reliable Three-Tier Architecture.

First Tier: Centralized Consoles and Management Applications

The primary responsibility of first tier Enterprise Manager clients is to present the user interface to administrators, for all their management tasks. First tier clients depend upon second tier Management Servers for the bulk of their application logic. In this way, the first tier accommodates the needs of both installed applications and thin client systems, without the overhead and processing burden of housing critical management services. This allows Oracle Enterprise Manager clients to offer full functionality, regardless of how they are deployed. Whether run as installed applications, or from within a web browser, they are virtually the same.

The Enterprise Manager Console, and other management applications, can be run from within a web browser. This provides extraordinary flexibility to administrators in any environment. As simple as connecting to a well-known URL, the browser-based Console provides the same user interface, all the same functionality, and a consistent set of task-based tools, available from the installed Console

Second Tier: Central, Scalable and Reliable — Oracle Management Servers

The second tier component of Oracle Enterprise Manager, the Oracle Management Server, is the framework engine. The Oracle Management Server maintains centralized intelligence, and distributed control between clients and managed nodes. The Oracle Management Server is responsible for all the back-end management application logic, and the critical services required by the management framework. These services include the job system, event system, paging and email services, and services responsible for fail-over and load-balancing, when more than one Oracle Management Server is deployed.

The Oracle Management Server is also responsible for all connections and communications with the Enterprise Manager Repository. The Repository is simply a set of tables stored in an Oracle database. The Enterprise Manager framework uses the Repository as its persistent back-end store, where it maintains system data, application data, and the state of managed entities distributed throughout the environment. The data stored in a single repository represents a Domain. Any number of administrators within that Domain can access and share the data stored in the Repository.

Scalability in the management framework is achieved with a 'collaborative peer' mechanism, which balances the workload between multiple Oracle Management Servers within a domain. Each piece of work requested of the Oracle Management Server, such as submitting a job, registering an event, or sending a notification to a console, is stored in the Repository. Using the collaborative peer mechanism, Oracle Management Server peers share the same state maintained in the Repository, and

each Oracle Management Server can process any operation. When an Oracle Management Server acquires an operation, it stamps the operation with its unique name and locks it, so that no other Oracle Management Server will attempt to process it. When the Oracle Management Server completes the work, it updates the work status, releases the task, and looks for additional work in the work queue, maintained in the Repository. This mechanism, and the granular nature of work tasks, allows the work load generated by multiple Consoles and Agents to be evenly distributed across all Oracle Management Servers.

When multiple Oracle Management Servers are configured for a domain, each one provides fault-tolerance and failover for any work for which it is responsible. Each Oracle Management Server is responsible for communicating with the others. In this way, they know that it is up, and whether or not it is available for work. Peer Oracle Management Servers can easily identify when any one becomes unavailable. Oracle Management Server availability information is also stored in the repository. For example, if Oracle Management Server _1 notices that Oracle Management Server _2 has not indicated its availability within specified failover time, Oracle Management Server _1 will identify Oracle Management Server _2 as unavailable. At that time, any work Oracle Management Server _2 had in it's queue would be released, and reassigned to available Oracle Management Servers.

Depending on the number of targets managed (Intelligent Agents), and notifications processed between Agents and Consoles, scalability and reliability can be increased, simply by adding more Management Servers to the environment.

Third Tier: Managed Services and Autonomous Intelligent Agents

The third tier is comprised of managed services or targets, such as databases, application servers, nodes, or applications. One such application is the Intelligent Agent, a process that runs on each of the nodes on which managed services reside. It functions as the executor of jobs and events sent by the Oracle Management Server, after they are received from Consoles and management applications.

The agent works independently from the Console, the Management Server, or network connections. Once an Agent is assigned a task from the Management Server, it will perform the work at the time scheduled. Examples of tasks performed by the Agent include:

- Executing SQL scripts
- Monitoring available space in a database tablespace
- Performing weekly database backups
- Monitoring the real time database physical I/O rate

If an Agent cannot contact the Oracle Management Server, it will hold any notifications that are addressed to the Management Server. As soon as contact is reestablished, it sends the notifications. This ensures that no notifications are lost between Agents, Management Servers, and Management Applications. Examples of notifications sent from the Agent to the Oracle Management Server include job completion status, or the status of an event being monitored. These notifications are then sent on to the appropriate Console users.

The Intelligent Agent also supports the Simple Network Management Protocol (SNMP), enabling third-party applications to communicate with the Agent. Event triggers can be distributed to SNMP

consoles, such as HP OpenView™. The agent also provides direct access to Oracle's database
Management Information Base variables.

Architectural Extensibility

To offer vital framework functionality, the Enterprise Manager architecture on each tier can be easily
extended. On the first tier, multiple Consoles and clients can access one or more Oracle Management
Servers, to share information stored in a single repository. On the second tier, multiple Management
Servers can be added for increased scalability and reliability. Finally, the number of managed nodes
and Agents can be increased to meet the needs of any managed environment.

*Figure 2: Enterprise Manager's 3-Tier Architecture is Extensible, to Handle any Number of Clients and
Managed Services*

Across all three-tiers, the Enterprise Manager architecture establishes the foundation for the robust
Enterprise Manager framework.

THE ENTERPRISE MANAGER FRAMEWORK: COMPONENTS AND SERVICES

The Enterprise Manager framework includes the base components and services that are required for
nearly any management environment. The components and services offer fundamental management
functionality, while being extensible to other Oracle and third-party management tools.

From an administrator's perspective, the Console is the central framework component. The Console
is the primary interface for performing management tasks, launching management applications, and
accessing framework services, such as the Job and Event system. From within the Console, you can

- Manage Enterprise Manager administrators.

- Define the topology of services to be managed within your Domain.

- Create logical groupings of services, to simplify management across many similar targets.

- Create and track jobs scheduled to execute across your networked systems, and events that are monitoring the health of those systems.

The Console's graphical display includes menus, toolbars, and four customizable panes. These panes include the Navigator, Groups, Event System, and Job System. Any Oracle management applications can be launched from within the Console.
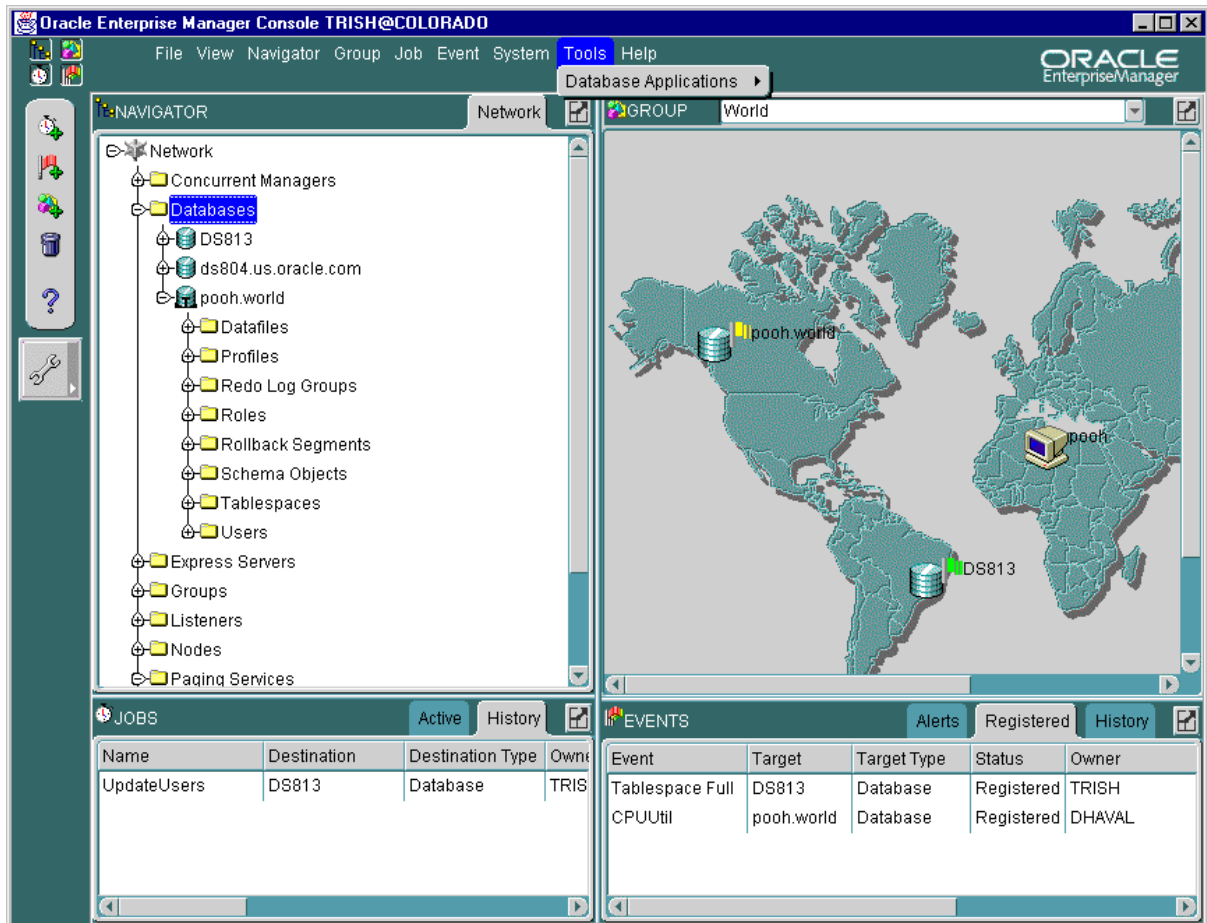

Figure 3: The Enterprise Manager Console is the Central View of the Managed Network. Use it to Perform Administration Tasks, Submit Jobs, Monitor Events, and Launch Integrated Tools.

Defining and Working with Enterprise Manager Administrators

In large organizations, it is common for several administrators to share responsibilities across a distributed set of managed services. It is also common for administrators to have varying degrees of responsibility. Regardless of responsibility level, all administrators must have appropriate, consistent, and timely access to vital management information. They also need to share key information with other team members. Because the centralized Repository stores all management data for any given environment, Oracle Enterprise Manager is designed to support teams of administrators that collaboratively manage distributed systems.

Defining Administrator Responsibilities and Schedules

Upon first using Enterprise Manager, or when a new administrator joins the group, someone designated as a Superuser can define the appropriate responsibilities for each Enterprise Manager user. Enterprise Manager includes one default Superuser, SYSMAN, which can be used for the first login. The SYSMAN user can create other Superusers and normal administrators, depending on the level of responsibility of each administrator within the organization. When creating additional Enterprise Manager administrators, you can control access to certain Console services, such as the Job and Event systems. Also upon account creation, new administrators are given a console password, which provides access to the Console services available through the Oracle Management Server. By connecting to the Management Server, administrators are automatically connected to the Repository, so it is not necessary for each administrator to connect to the Repository directly. The database repository connection and access to repository data is the responsibility of the Oracle Management Server and is transparent to users of the Console.
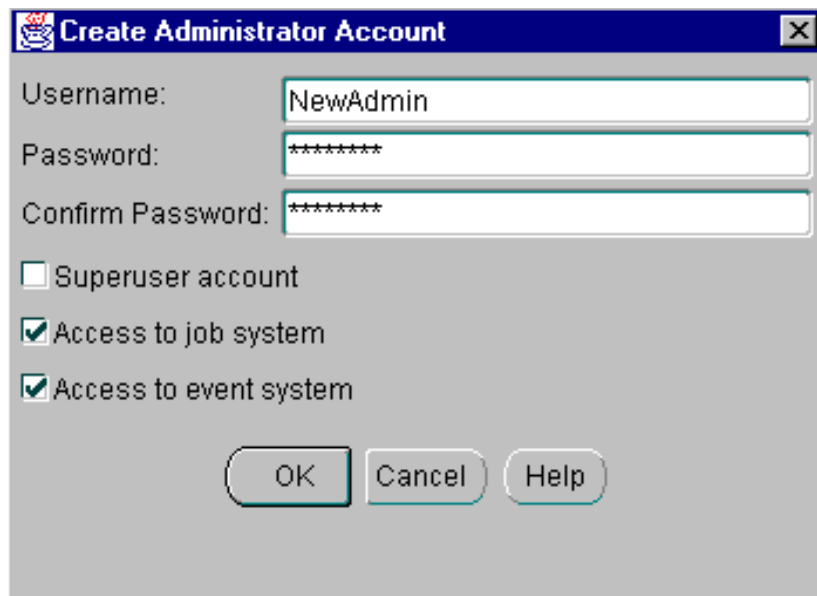

Figure 4: Each Enterprise Manger Administrator is Given a Separate Account, Used to Log into the Console, Perform Management Tasks, and Access the Shared Repository of Management Information

With access to the Console, you can set up your own Enterprise Manager environment, by defining Administrator Preferences. Administrator Preferences include:

- Your secure password

- Pager and email settings and configurations

- Schedule definition for receiving notifications by paging and/or email

- Permissions for other administrators, which determine the level of access other administrators have on the jobs, events, and groups you create

- Preferred credentials for each service you will manage

Because each administrator has specific responsibilities, Enterprise Manager allows each to define permission levels for other administrators, for the jobs, events, and groups they create. Permission levels include:

- *None* — No object permissions

- *View* — View, inspect, and receive notifications on objects

- *Modify* — Edit permissions on the object's properties, except certain properties reserved for full permissions

- *Full* — Delete, or modify permissions for other administrators, and change the ownership of the object

After defining default permissions, when creating a new job, group, or event, the other administrators will automatically have access to it, based on the permissions defined for them.

For example, in *Figure 5*, Trish has given Preeti (another administrator in her organization) "Full" permissions on the objects she creates. Therefore, when Trish creates an event, such as a database Up/Down event, Preeti's console will display that event, any alerts associated with it, and any other information that may be pertinent to ensuring that any problems are adequately addressed. Also, because both Preeti and Trish have been configured to receive notifications, each will be paged when event escalation, or job completion notifications are sent.
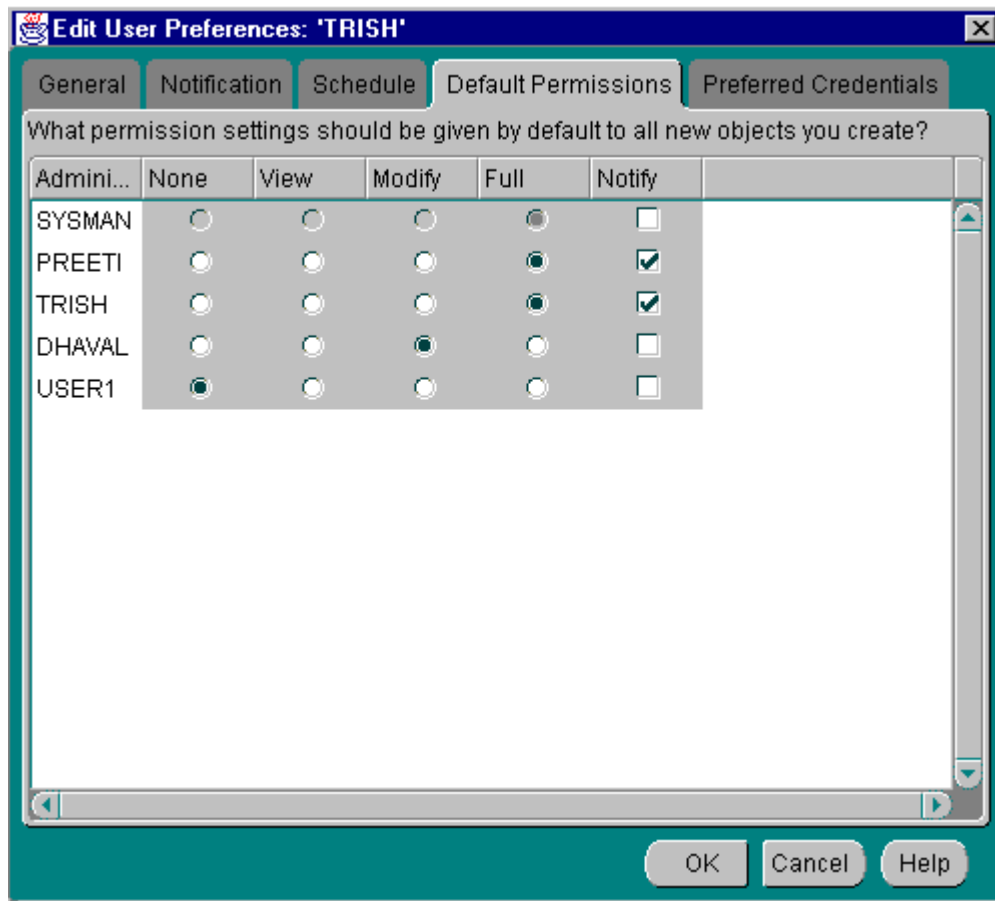
Figure 5: Each Enterprise Manager Administrator Sets Access Levels to the Jobs, Events, and Groups He Creates, by Defining Permission Levels for Each Other Administrator in the Domain

Defining the Domain Topology

In order for administrators to be most effective, they must be able to identify, and clearly organize, the complete set of managed services in their network — that is, the databases, nodes, application servers, applications, or other services. Oracle Enterprise Manager extends the administrators reach beyond the dataserver, providing a centralized management foundation for the complete set of Oracle products. Oracle® Parallel Server, Oracle® Application (Web) Server, Oracle InterOffice™, Oracle® Video Server, and even complex features such as Oracle Replication all take advantage of Oracle Enterprise Manager, as their base management environment. Oracle Enterprise Manager offers a comprehensive set of management services that can run on hosts, databases, and applications, to monitor the health of your environment, and to check for specific conditions.

Automated Discovery

Using the Intelligent Agent, Oracle Enterprise Manager automatically discovers all services across the network. The navigator displays a hierarchical view of this information, providing administrators with a high-level view of their environment, and allowing simple and efficient management of those services. Each of the discovered services is then available to other applications, for targeted management, and for grouping, job scheduling, and event monitoring from within the Console.
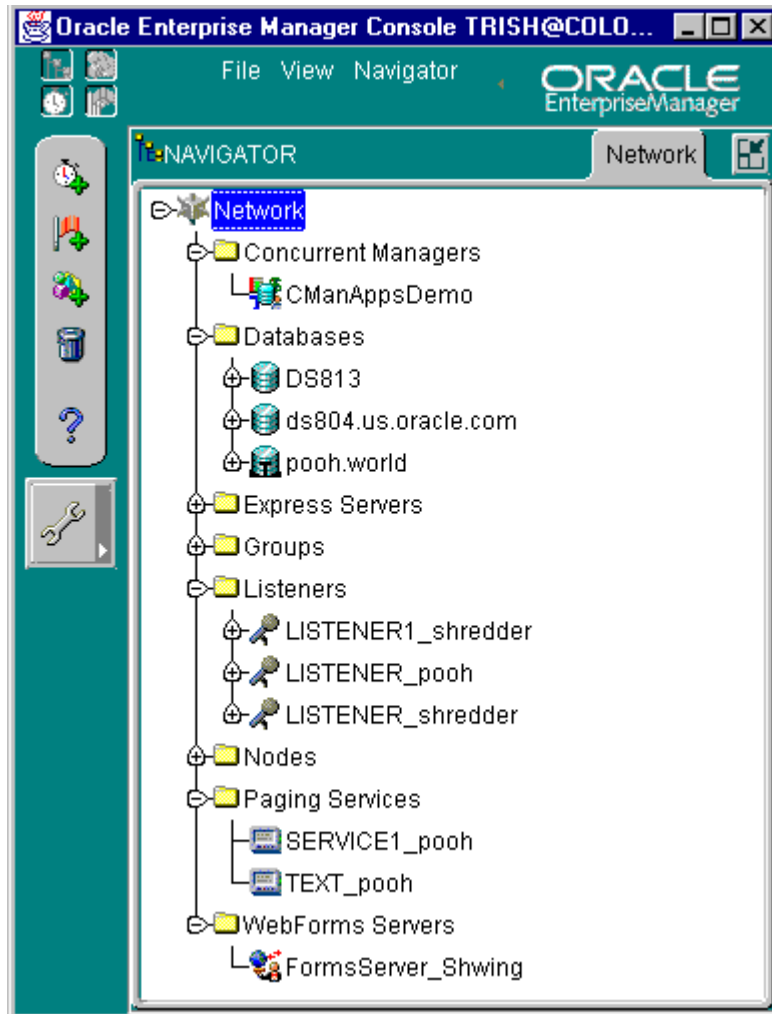
Figure 6: Automated Discovery Using the Intelligent Agent Populates the Navigator with a Complete View of the Managed Services in the Network

Simplifying and Securing Access through Preferred Credentials

After discovering the services in their managed network, administrators need easy, secure access to them, for efficient management. Each console user defines credentials for the managed services for which they are responsible. These credentials are used whenever the administrator needs secure access to a managed service, such as a database or application. Preferred Credentials are used throughout the Console, for management within the Navigator, for jobs, and, if necessary, for events. By using these stored Preferred Credentials, users are not troubled with continuous login requests for the various systems they manage. The Console also offers the ability to override Preferred Credentials, if the user wishes to do that.

Associating Managed Services

When administrators are responsible for a set of services or a group of applications, they need to be able to logically organize those systems as a unit. This makes for efficient management. For example, a single application may access numerous databases, which can reside on various nodes

throughout the network. Despite this complexity, administrators need to manage all of these disparate systems as if they were a single entity.

The Group System allows administrators to create logical associations between similar or disparate managed services. Using a simple drag-and-drop action, these service can easily be grouped into a single unit. The list of groups appears in the Navigator, and a graphic representation appears in the Groups pane. The Groups pane can be customized with the background that best represents its components. For example, if an administrator is responsible for several systems in Europe, she can use a background that has a map of Europe, and place each system in the country where it resides. Then, because Groups are available to the Event system, if something occurs on any of those systems, she will know where and what has occurred, through the visual alert displayed on the system inside the Groups pane.
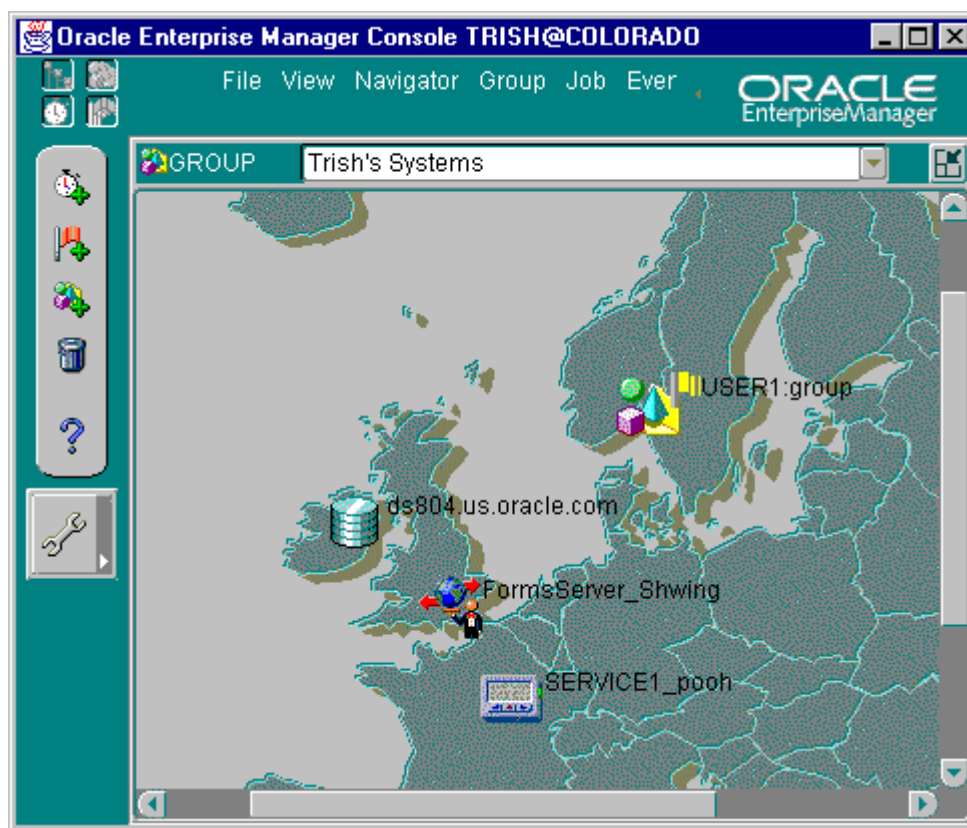

Figure 7: Use the Groups Pane to Logically Associate Services for more Scalable, Efficient Management

END-TO-END MONITORING AND PROBLEM RESPONSE

The most critical responsibilities for all administrators is monitoring and ensuring the health of the systems they manage. Early indication and rapid response to problems is key to maintaining system performance and availability. Using the Intelligent Agent as its back-end, the Event and Job systems provide the ability to identify, and respond to conditions that indicate problems, or potential problems, on any managed service or group.

Event Monitoring

The Event system offers a base set of event tests that can be run on managed services, to check for specific conditions, such as a database down, 24-hours a day. The intuitive interface enables users to register events on multiple services, with a customizable polling interval. Depending on the event test being run, users can also set thresholds for when they want to be notified. When these thresholds are met, or other test conditions exist, they appear, as warnings or alerts, on the console. Additionally, on-call administrators are proactively notified, via e-mail and paging, which allows around-the-clock monitoring.

By opening an event occurrence within the Console, administrators can examine the details of the triggered event in the Event Viewer. The Event Viewer provides valuable event information administrators may need, to respond to an issue. Using the Log, administrators can assign an event to another administrator, or enter knowledgeable information he may have about how to address the issue. The Event Viewer, and all the information in the Event Viewer, is accessible by any administrator with 'view' permissions on that event.
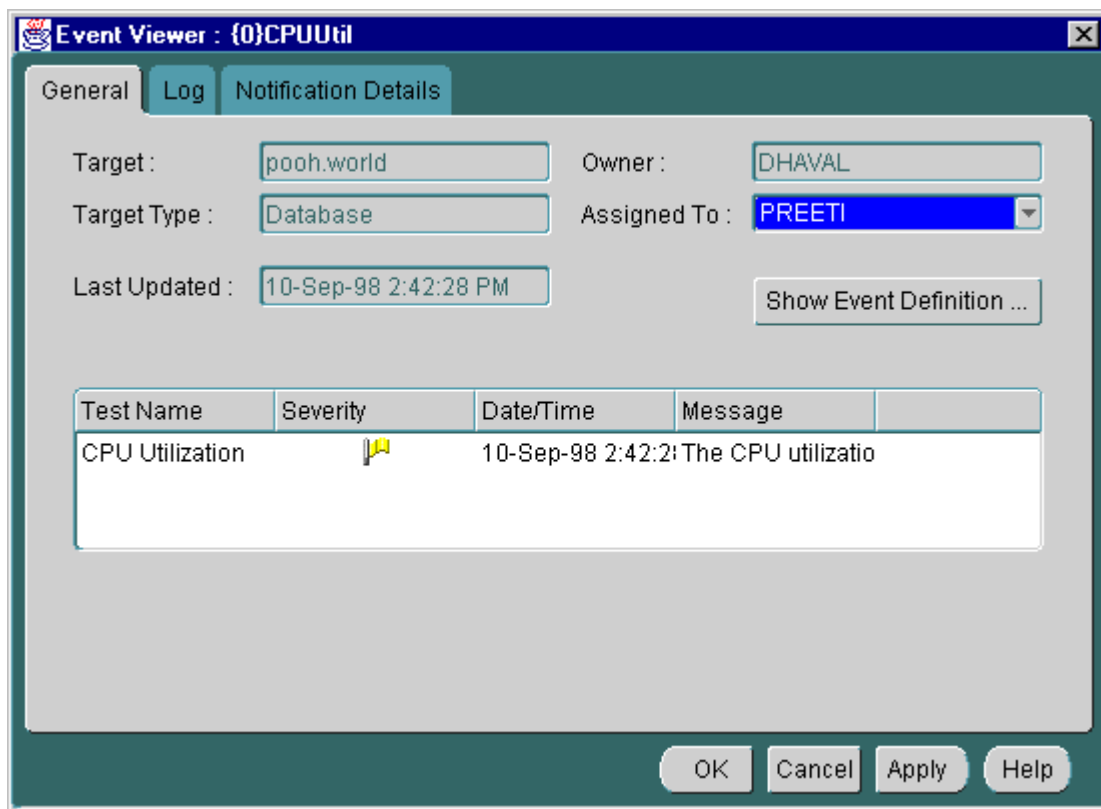

Figure 8: Use the Event Viewer to Examine Event Details, such as When the Event Occurred, Who it is Assigned to, and the List of Administrators Paged Regarding the Event. The Log Allows Administrators to Manually Enter Text Information about the Event

Tightly integrated with the Job system, the Event system also allows for automatic problem correction. Administrators can resolve problems without intervening, by choosing a "fix-it job," a task to be performed on the appropriate service, to fix a problem as soon as it happens.

Job Execution and Scheduling

The Job system provides the ability to automate redundant and repetitive tasks, such as running a regularly planned database backup or executing a SQL script across multiple databases. The Job system also offers the power to perform complex operations on distributed services at varied intervals.

Administrators can use any of the pre-defined job tasks offered with the base system, or define their own tasks, such as using SQL or writing an OS command. Any tasks can be grouped to create a job, which can then be scheduled to run on any managed service.

The powerful job dependency functionality allows administrators to execute tasks, based on the success or failure of previous tasks. For example, an administrator wants to notify users before shutting down a system, but the notification fails. She can delay the system shutdown, to avoid unnecessary negative impact on the uninformed users. She may choose to perform different tasks, depending on the success or failure of a previous task, or choose to halt a job midway, depending upon the outcome of specific tasks.
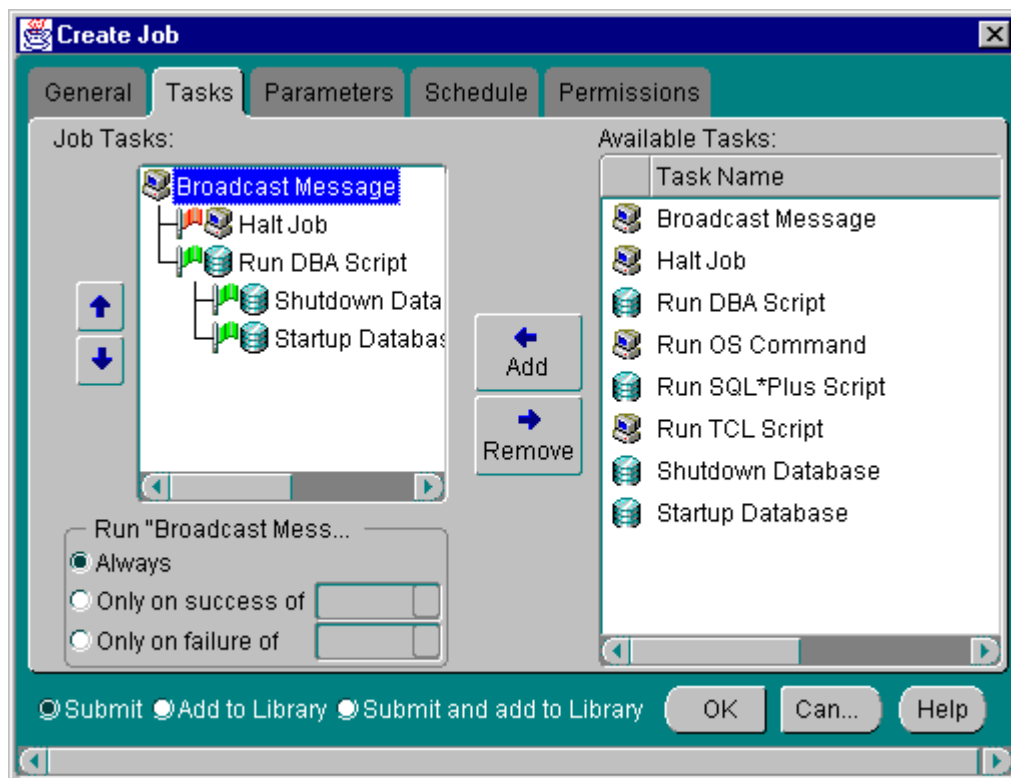

Figure 9: Define Dependencies between the Various Tasks within a Job to Ensure that a Task Runs Only when the Conditions are Right for that Task to Run

Once the job tasks are defined, the flexible scheduling mechanism within the Job system allows administrators to submit jobs immediately, on a regular or repeated schedule, on a specific date or day of the month, or upon event occurrence.

CONCLUSION

Oracle Enterprise Manager provides administrators with the power to perform any critical management operation. The essential framework components and services— the Console, job system, event system, Groups, and security— are available from the Console. They are extensible for use by any other integrated management application. Every management application available with Enterprise Manager derives the benefit of the scalable, reliable underlying architecture, which serves as the foundation for the Enterprise Manager framework.

ORACLE ENTERPRISE MANAGER PRODUCT FAMILY

Also part of the Oracle Enterprise Manager product family are the Oracle® Diagnostics Pack, Oracle® Tuning Pack, Oracle® Change Management Pack, Oracle® Management Pack for Oracle8*i*, Oracle® Management Pack for Oracle Applications and Oracle® Management Pack for SAP/R3. All are fully integrated into the Oracle Enterprise Manager Console and framework, and provide a unified system management framework for end-to-end management of your Oracle environment.

Built upon open Internet standards, such as Java, CORBA, and IIOP, these products provide the first management framework designed to support Internet computing. All applications can be accessed from anywhere a browser is available. A reliable and scalable multi-administrator repository leverages your administrative staff, by providing cooperative management. Using the Oracle Enterprise Manager product family, administrators and IT managers can insure higher-productivity, deliver better services, and reduce the overall cost of their information systems.

ORACLE®