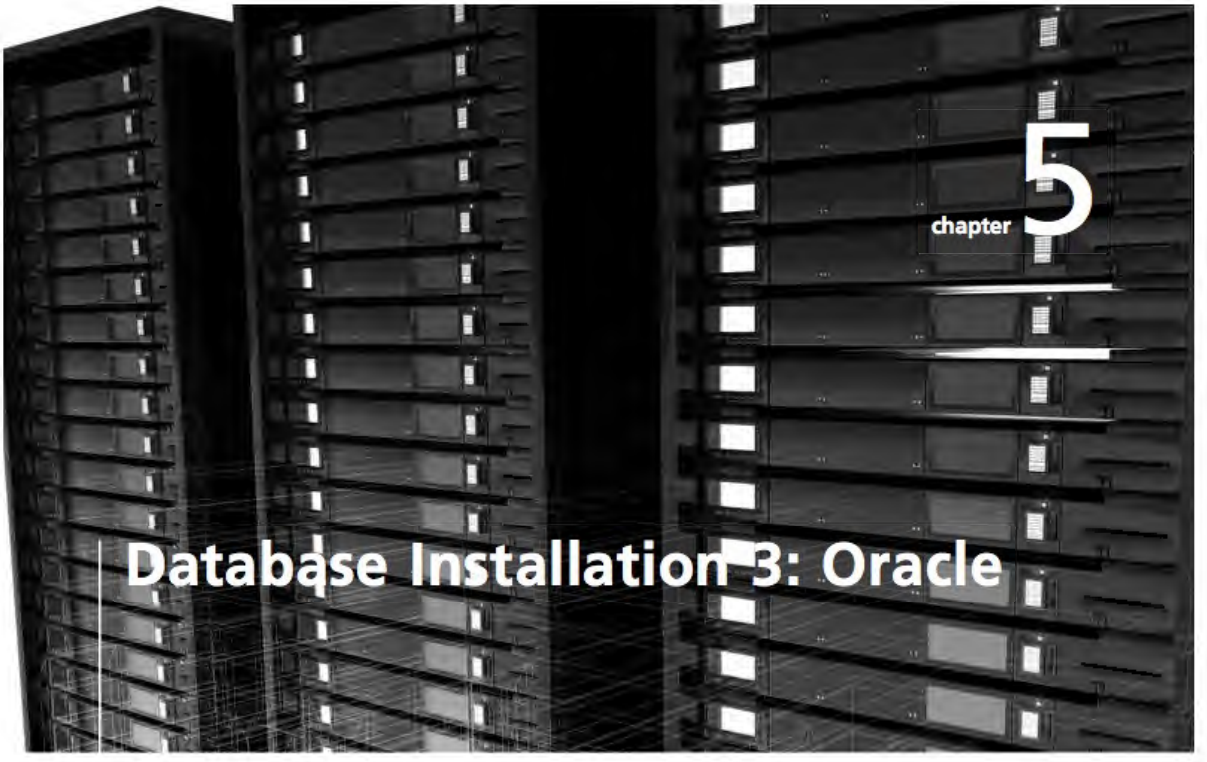

chapter 5

Database Installation 3: Oracle

After reading this chapter and completing the exercises, you will be able to:

- Identify the considerations that an administrator must take into account prior to installation
- Install Oracle for Windows and UNIX-based operating systems
- Configure Oracle 2008 Services for Windows and UNIX-based platforms
- Secure the installation and configuration of Oracle

Security In Your World

Joseph Michael has worked in the database management field for over 15 years and has witnessed a number of enormous changes over the last decade. A data storage engineer at heart, he has had to make large adjustments to his database administration strategy in order to accommodate the industry shift toward database security. His position has become much more demanding, yet he has remained flexible and eager to learn. Recently, Joseph was promoted to Senior DBA of his company's enterprise data architecture, and was asked to lead a major overhaul of the organization's data storage solution.

The plan was to deploy new Oracle database servers to accommodate the growing organization's data storage and management needs. After many hours of researching, planning, testing, and meeting with practically every person in the organization, the day finally came for the installation and deployment to take place. Joseph, very diligent in his process, decided to take advantage of the Enterprise Edition of Oracle. Meticulous, he carefully took an inventory of the environment to ensure that every device and application on the network would satisfy the requirements of this edition. He put forth great effort in planning the data storage needs, choosing the features and optional components that would best suit the complex environment. He familiarized himself with the privacy laws and ethical standards for his organization, and in a collaborative effort with the networking team, he ensured that the network and data architecture was in full compliance.

In the end, Joseph made informed and effective security decisions. He added more firewalls to isolate the servers, closed all unnecessary ports, hardened the operating systems, and planned encryption for the data in storage and in transit. He applied all of the necessary security patches and created security policies for passwords and data access. He also implemented the most restrictive and limited access control possible. While most administrators would create an account using a general predefined set of privileges, Joseph decided to build accounts using most-restricted access first, only adding additional access when the need was justified.

The migration was planned for off-hours, and due to Joseph's diligence, the data migration was executed seamlessly. Although everything seemed to be working fine, he knew that the real test would come during work hours the following day.

He arrived at work early and in good spirits, feeling confident about the work that he had done, yet unfortunately for Joseph, the employees were not feeling as confident and excited as he. The restrictive nature of the database access caused much frustration and chaos. Users, unable to access their data, caused productivity to drop to an all-time low. Frustrated and angry about the newly implemented restrictions,

(continued)

individuals at every level of the organization were calling Joseph to complain and reject the new database. Despite his attempts to explain the importance of security, the employees expressed their disapproval and concerns with the new system. Many even went as far as to question Joseph's knowledge and experience.

Joseph didn't necessarily take a wrong approach here. Although this is the ideal situation from a security standpoint, the ideal security solution is rarely the ideal business solution. Even the most comprehensive packages and strategies can result in disaster.

Oracle provides a comprehensive, multifaceted suite of solutions for applying security throughout an organization, yet, as we can learn from Joseph, choosing the right security measures is a delicate task that should not be taken lightly. Understanding these tools and what solutions they offer can help us close in on our security and business needs.

This chapter will discuss the different applications and features available within the Oracle suite, as well as provide a step-by-step approach to installing Oracle Database on Windows and UNIX-based machines.

Planning for an Oracle Deployment

Throughout its history, the Oracle Corporation has taken a comprehensive approach to offering business data solutions, but nothing displays this more than its progression over the last five years. Refer to Table 5-1 for a complete history of Oracle. Oracle has greatly extended its primary database focus and expanded its business support by developing products that interact at each layer of an infrastructure. It has broadened its range of support from applications that are integrated at the user level to hardware developed to sustain the performance and clustering of servers. A number of different solutions can be purchased and integrated to create a robust business solution.

Year	Version	Comments
1977		Software Development Laboratories founded
1979	Oracle 2	Was renamed Relational Software, Inc., and released their first database for VAX machines; included IBM's SQL and did not support transactions; OS support did not extend beyond Digital Equipment's -VAX/VMS
1982	Oracle 2.3	Renamed Oracle Corporation, and extended support of computers to include DEC VAX-11, PDP-11, and IBM mainframes
1983	Oracle 3	New version written in C language, supported COMMIT and ROLLBACK for transactions, included support for UNIX and any hardware with a C compiler
1984	Oracle 4	Read consistency support added, as well as a broader range of hardware and software compatibility

Table 5-1 History of Oracle (*continues*)

Year	Version	Comments
1985	Oracle 5	Support for client-server environments as well as the increased development of customized interfaces to support a variety of business needs; this includes its first spreadsheet application
1986	Oracle 5.1	Distributed query support and clustering were added to allow for larger environmental support
1988	Oracle 6	Relational Database Management System; supported PL/SQL within forms for more flexibility, added row/level locking and real-time backups; business support being developed to keep up with the growing commercial networks
1989	Oracle ERP	Oracle released its first ERP product and finds a place in the commercial world
1990	Oracle Applications release 8	Oracle business support applications are released, including its first client/server application and GUI support for PCs and Macs
1992	Oracle 7	Referential integrity, stored procedures, and triggers are added to the database as database administration features; application development tools and security components are offered
1994		Oracle introduces the first media server on the market, which included an array of tools for multimedia objects
1997	Orace 8	Support of object-oriented development and multimedia applications are integrated
1999	Oracle 8i	The *i* stands for Internet, Oracle's attempt at making the database better integrated with the Internet and online processing; Oracle JVM is included
2000	Oracle E-Business Suite 11i	Applications developed for enterprise organizations to support their business needs
2001	Oracle 9i	400 added features to support the Internet and business, including XML support, RAC, and clustering
2003	Oracle Database 10g	The *g* stands for grid computing and architecture that the current versions of Oracle are built upon
2005	Oracle 10 Release 2	Announces Oracle Enterprise Linux, also known as the unbreakable Linux project for improved support and reliability for enterprise environments
2007	Oracle 11g	Released for Linux and Microsoft Windows users
2009	Oracle Middleware 11g	Acquired BEA a year before, adds BEA products and introduces Oracle Fusion Middleware 11g
2010	Oracle 11g release 2	Oracle acquires Sun Micrososystems

Table 5-1 History of Oracle (*continued*)

With variety come cost and complexity. Many organizations cannot pay the price for a fully integrating Oracle solution that spans every level of the business architecture, so administrators and designers must find a solution that meets both business and budget needs. Effective planning is vital to the success of any data maintenence strategy, but due to its cost and complexity, understanding the requirements and available components of Oracle is even more important in developing the most efficient and cost-effective solution.

In this section, we will explore the hardware, software, and networking requirements for the Oracle database. We will review the different editions currently available, as well as the major features that these editions offer. Supported platforms will also be explored along with licensing and help resources.

Checking the Requirements

Before an installation of an Oracle database server, administrators need to verify the hardware, software, and network compatibility on which the Oracle Server will be running. Supported platforms must also be considered. This section will cover the hardware, software, and network requirements of an Oracle database server.

Hardware Requirements

Hardware requirements for an Oracle database server include processor speed, hard disk storage, main memory, and virtual memory (swappable memory) storage amounts. The minimum requirements for an installation of Oracle on 64-bit version platforms are: AMD64 or EM64T processor, 5.22 GB of hard drive space of which 150 MB must be available within the temporary directory, 1 GB of RAM, and 2 GB of virtual memory (or double the RAM). The minimum requirements for an installation of Oracle on 64-bit version platforms are: 550 MHz processor (800 MHz on Windows Vista), 4.76 GB of hard drive space of which 200 MB must be available within the temporary directory, 1 GB of RAM, and 2 GB of virtual memory (or double the RAM). These requirements are the lowest possible resources necessary to run the basic application. Attempting to run Oracle using the minimum requirements will cause a number of services to fail. Many variables must be considered when choosing the hard drive space, memory space, and CPU speed necessary to run an Oracle database. Here are a few of the variables that must be considered:

- *Hard Disk Space*—The needs of the hard drive will depend on the size of the operating system, the databases data files, redo files, archived redo files, and control files. Although the size requirement of the operating system can be pretty straightforward, the control files, redo files, and archive redo files are dynamic and often fluctuate as changes are being made to the database. The dynamic nature of these files can make it very difficult for their size to be estimated. In terms of the size of the data files, the database engineer must have a good idea of how much data will be stored within the tables of the database. This size is often greatly underestimated since it requires knowledge of each row of data as well as the number of rows of data that will be included. Therefore, hard drive space cannot be limited and it is better to overestimate than it is to underestimate the required storage.

Oracle provides a number of best-practice recommendations for the storage and placement of files during installation and configuration. These recommendations have been grouped together and named Optimal Flexible Architecture (OFA). During configuration, the Database Configuration Assistant (DBCA) uses the OFA automatically. One of the recommendations within the OFA is that the database files are placed separately from the file system of the operating system. These recommendations are made to ensure optimal performance and can be found within the Oracle database support documentation.

- *The Main Memory or RAM*—This area is the most utilized within the database architecture. It is here that the system stores space for users' connections, query executions, and SQL statements reused by the system. Retrieving data from this memory is much faster and more efficient than reading and writing to the hard disk files, and therefore, the reason for Oracle's strong performance and speed. The utilization of this memory is dependent on the number of queries, data objects, and user connections, so it is difficult to determine how much memory is necessary.
- *The CPU*—This will be determined by the number of simultaneously used instances and applications at any given time of the day. This is another set of variables that is difficult to determine prior to the system launch and should be carefully considered during the planning stages.

Another consideration regarding hardware is the maximum resources allotted for each specific edition of Oracle Database. The edition of Oracle that is deployed defines the hardware capabilities. For limitations as to how large a database can be, how many CPUs can be used, and how much addressable memory is available per user, refer to Table 5-2. More detail regarding each edition of Oracle is provided later in the chapter.

Edition	CPUs supported	Maximum addressable memory	Maximum database size
Oracle Express	1	1 GB	4 GB
Oracle Standard One	2 Sockets	OS maximum	No maximum
Oracle Standard	4 Sockets	OS maximum	No maximum
Oracle Enterprise	No maximum	OS maximum	No maximum

Table 5-2 Oracle editions and hardware limitations

Operating System Requirements

Oracle supports a number of different operating systems, yet the operating system on which it resides determines the features and optional components that the database can deploy. For this reason, the platform choice should be considered carefully and should be in line with the overall database goals. If the operating system of the machine on which Oracle is installed is overlooked, necessary components may not function, and as a result the business's needs will not be met. Just as with MySQL and Microsoft SQL Server, careful consideration of the operating system could make the difference between a robust data management machine and an inflexible storage component.

64-bit and 32-bit

Oracle Database is available in both 32-bit (x86) and 64-bit (x64) versions. This is the case for both Windows and UNIX-based systems. Choosing the correct version is important to the functionality of the database. A 32-bit version of Oracle can run on either 32-bit or 64-bit platforms, while a 64-bit version of Oracle can only run on a 64-bit platform. Keep in mind that installing a 32-bit version of Oracle on a 64-bit operating system will not increase its performance and will result in limited capability. To fully leverage the capability of Oracle, it is recommended that the 64-bit version be installed on a 64-bit

platform and a 32-bit version on a 32-bit platform operating system. Table 5-3 displays the supported platforms for all editions of Oracle Database.

Windows-based platforms	Linux-based platforms	Other UNIX-based platforms
32-bit • Windows 2000 with Service Pack 1 or later • Microsoft Windows 2000 • Windows Server 2003 • Windows Server 2003 • Windows XP Professional • Windows Vista (Business, Enterprise, and Ultimate) 64-bit • Windows Server 2003 (all x64 editions) • Windows Server 2003 (all x64 editions) • Windows XP Professional x64 • Windows Vista x64 (Business, Enterprise, and Ultimate)	32-bit • Asianux 2 SP2 • Asianux 3 • Oracle Enterprise Linux 4 • Oracle Enterprise Linux 5 • Red Hat Enterprise Linux 4 • Red Hat Enterprise Linux 5 • SUSE Enterprise Linux 10 64-bit • Asianux 2 SP2 • Asianux 3 • Oracle Enterprise Linux 4 • Oracle Enterprise Linux 5 • Red Hat Enterprise Linux 4 • Red Hat Enterprise Linux 5 • SUSE 10	Solaris • Solaris 9 Update 7 or later • Solaris 10 HP-UX • HP-UX 11i V1 (11.11) PA-RISC • HP-UX 11i v2 (11.23) • HP-UX 11i v3 (11.31) AIX • AIX 5L version 5.3, TL 05, Service Pack 06 • AIX 6L version 6.1, TL 00, Service Pack 04 or later

Table 5-3 Oracle supported platforms

It is important to take note of the service packs and package requirements for each operating system. Compatibility is specific to the service packs and packages. For a complete list of supported operating systems, including service packs and package requirements, please see Oracle's installation documentation at *http://www.oracle.com/technetwork/indexes/documentation/index.html*.

Other Software Requirements

Before installing Oracle Database, a few additional software requirements must be considered. The software requirements for Oracle will be dependent on the operating system on which the database will be installed, along with any additional components that are chosen to fulfill the purpose of the database. For example, Linux and Windows will require different software compilers for an Oracle database installation because they are different types of operating systems. The type of compiler isn't dependant on the type of operating system alone. The purpose of the database plays a role as well, so two Windows installations can require different compilers if both installations individually required different Oracle components to fulfill their purpose within the environment. Therefore, an administrator should check Oracle's supporting installation documentation for the specific operating system and any additional installed option components for prerequisites.

Network Resource Requirements

Consideration must be given to network requirements. A database ultimately shares its data over a network and the effectiveness of the communication and connections established on this network will be determined by network hardware and software that is installed. Changes in network hardware and software may be necessary to accomodate the increased activity that an implementation of Oracle database server will cause. An environment that is being prepared for an initial installation of Oracle should be tested to ensure that it can effectively handle the amount of data that will be transferred across segments of the network. Check network cards, switches, cables, and other hardware devices to determine how well they operate under heavy traffic conditions. Network software must also be considered; for example, Oracle requires TCP/IP with SSL and named pipes in order to communicate with other devices on a network.

Preinstallation Decisions

Hardware and software needs are not the only considerations when implementing a database into an environment. There are several other equally important components to planning a database architecture. This section will explore these components and help to ensure that decisions are made that best serve a specific environment's needs. Topics will include Oracle Database editions, additional database features, licensing packages, and support contracts.

Choosing an Edition

Just as with MySQL and Microsoft SQL Server, Oracle packages its software in different editions. Oracle database is available in four main editions. These editions have been created with specific deployment scenarios in mind. It is important to note that Oracle offers more than just software editions to provide a solution for specific environments. Similar to Microsoft, Oracle has a number of optional features that offer a way to specifically meet the needs of a variety of environments. This section will review the different editions of the Oracle database server.

Oracle has established itself as the most comprehensive and powerful database solution available on the market by including the development of middleware applications and hardware components built and designed specifically to support the Oracle database server application. These additional components, when combined with the Oracle database server application, provide for the most efficient and reliable use of resources within an environment.

Becoming familiar with what each edition has to offer will ensure the best, most cost-effective solution to meet a particular environment's needs.

- *Express Edition (XE)*—This edition is intended for beginning users and first-time database deployment. It provides an easy, user-friendly approach to installation and development. Express Edition offers a solution for small environments and individuals looking for a database solution that is easy to deploy at no cost to the user.
- *Oracle Database Standard Edition One (SEO)*—Oracle SEO offers a viable solution for single-server environments looking to implement a simply managed, full-featured database

at low cost. Although recommended for smaller departments and Web development environments, it easily scales in environments where there is an increased demand.

- *Oracle Database Standard Edition (SE)*—Oracle SE is a full-featured database that offers support for all types of environments. Although suggested for small to midsize organizations, Oracle SE provides a highly scalable secure solution for enterprise networks as well.
- *Enterprise Edition*—The Enterprise Edition of Oracle is designed for environments that require high-volume, query-intensive, mission-critical data management. Oracle EE includes all of the components available within the Oracle Database as well as many features that are not available within all other editions. These additional features are described below and are undoubtedly the reason EE is a viable solution for high-demand networks.
  - *Virtual Private Database (VPD)*—Also known as Row Level Security or Fine Grained Access Control, this feature provides a method for applying security to specific rows of a table. Used when privileges associated with objects are not strict enough, VPDs allow policies to be created that identify access control for specific rows and tables of a database.
  - *Advanced Replication*—A tool that allows for bidirectional copying of database objects, procedures, and indexes. Advanced Replication enables updatable snapshots and improves performance and availability of applications by allowing faster replication and more objects to be replicated.
  - *Transparent Application Failover (TAF)*—Redirects user connections to surviving databases in cases where the connections fail. TAF reduces failover time and improves availability through transparent redirection.
  - *Fast Start Fault Recovery*—Shortens the time it takes to write a change from buffer to disk. Fast Start Fault Recovery reduces the time for recovery from failure by reducing the amount of data that hasn't been written to disk.
  - *Oracle Data Guard*—Enables the creation of failover databases for instances of failure. Data Guard improves the availability of the system by offering secondary servers for failover.
  - *Online Index Rebuild*—Eliminates the need for processes participating in online operation to maintain exclusive access to tables. Online Index Rebuild increases performance and reliability by allowing the rebuild of an online index while updates and configuration changes are occurring.
  - *Transportable Tablespaces*—Enables data to be moved by copying datafiles and integrating tablespace structural information only, increasing performance by speeding up the process of moving data.
  - *Materialized View*—Tool that allows for the precomputing of data and prejoining of tables, increasing performance by improving query performance.
  - *Bitmap Indexes*—A unique, two-dimensional index structure for fast combinations of low-cardinality data columns that improves performance by increasing response time of complex queries.
  - *Oracle Parallel Query (OPQ)*—A divide-and-conquer approach to large-table and full-table scans. OPQ improves performance by increasing the response time of complex queries.
  - *Parallel DML*—Allows for updates and changes to a database at the same time, improving data loading and manipulation speeds.

- *Parallel Indexing Rebuilding*—Rebuilds table indexes in a very short time, increasing the response times for data manipulation and retrieval while only requiring a single CPU system.
- *Parallel Index Scans*—Allows simultaneous full-index scans and reads of data blocks, increasing the response times for data manipulation and retrieval.
- *Parallel Backup and Recovery*—Allows backups to happen concurrently, tremendously increasing the speed of backups in large databases.
- *Oracle Connection Manager (CMAN)*—Provides scalability by supporting large volumes of concurrent user connections.
- *Oracle Streams*—A tool that provides synchronization of replicated databases, it improves performance and availability by enabling high-speed system replication, data sharing, and failover software.

Oracle Extra-Cost Enterprise Edition Options

In addition to the editions noted in the previous section, Oracle offers many optional extra-cost components for the Enterprise Edition of the database. These can be purchased separately from the Enterprise Edition features listed in the previous section and they provide an option for the added tools necessary to create a more robust database management architecture. The cost of these additional options ranges from $20 to $41,500. First and foremost, choosing the right fit for an organization requires familiarity with what optional components are available.

- *Oracle Real Application Clusters (RAC)*—An application that provides increased scalability and fault tolerance by enabling a single Oracle Database to run on a cluster of servers.
- *Oracle RAC One Nod*—An application that adds to Oracle RAC by including the ability to integrate multiple databases into one cluster, further enhancing the scalability and fault tolerance of the architecture.
- *Oracle Advanced Compression*—Tools that have been designed to provide advance compression services for all types of currently active and previously archived data objects.
- *Advanced Security Option*—An application that offers encryptions and authentication tools to keep data confidential and secure both inside the database and while in transit.
- *Oracle Data Mining*—Sophisticated suite of artificial intelligence tools designed to locate trends and predictive behavior within stored data.
- *Oracle Data Profiling and Quality*—A group of tools that verify the quality, reliability, and integrity of a database.
- *Database Vault*—Helps organizations comply with regulatory mandates (e.g., HIPAA) by providing tools that safeguard from internal threats. These sets of tools use internal controls (e.g., access rules and policies) to avoid exposure of data within the environment.
- *Label Security*—A set of tools designed to provide multitiered security capabilities for protecting data by classifying data for which access rights and privileges are then assigned and monitored.
- *Oracle In-Memory Database Cache*—Improves application transaction response times by providing enhancements in cache technology that minimize communication delays that are often due to computer hardware and processes.

- *Oracle Partitioning*—Designed for very large databases (100 GB or larger). This application partitions large tables and indexes, dividing them into smaller, more manageable components.
- *Oracle OLAP*—An online analytical processing server that provides centralized management and advanced analytical capabilities (e.g., budgeting, forecasting) for data within an environment.
- *Oracle Active Data Guard*—Improves performance and ensures data recovery by maintaining a replica of a main database to act as a secondary database for workload sharing and failsafe.
- *Oracle Real Application Testing*—Designed to ensure availability of a server by testing the potential effects that a new application will have on an environment before that application is installed.
- *Oracle Total Recall*—Designed to enable the tracking of the history of a table, for auditing and compliance purposes.
- *Oracle Spatial*—Designed to support spatial 3-D data for integration into Web and enterprise applications.
- *Oracle Change Management Pack*—Aids in the change management needs of an organization. The change management pack provides version and update control as well as manages and monitors changes on a network.
- *Oracle Configuration Management Pack*—Obtains configuration information from the network systems, and uses this information to monitor and identify the configuration of the environment, greatly lessening problem resolution time.
- *Oracle Diagnostic Pack*—Provides a set of tools that monitor and diagnose issues with the performance of the databases of an environment.
- *Oracle Provisioning and Patch Automation Pack*—A set of tools designed to provide seamless application patch deployment across an organization.
- *Oracle Tuning Pack*—Online tools providing an automatic solution to tuning of the schema structure and data usage of the Oracle database.

Licensing Options

As mentioned earlier, Oracle deployment can be quite a costly venture. A separate license is required for each edition of the Oracle Database, and the cost is dependent on the number of users utilizing the application. If the number of users cannot be identified or counted, or the cost per user is much greater than the cost of the processor, the number of processors can be used for licensing. In addition, an edition can be licensed for a specific time period. You can license an edition of Oracle Database for either one to five years or perpetually. Refer to Tables 5-4 and 5-5 for a cost comparison of the different user and processor licenses. Additional costs are required for any of the optional features described in the previous section. The specific terms of each license are provided in this section.

- *Express Edition (XE)*—This edition is free for use and distributed on a Windows or Linux platform. It is developed for servers with only one CPU, and is restricted to using 4 GB of user data and only 1 GB of RAM.

Edition	1-year license	2-year license	3-year license	4-year license	5-year license	Perpetual
Standard One	$36.00	$63.00	$90.00	$108.00	$126.00	$180.00
Standard	$70.00	$123.00	$175.00	$210.00	$245.00	$350.00
Enterprise	$190.00	$333.00	$475.00	$570.00	$665.00	$950.00

Table 5-4 Licensing cost per user

Edition	1-year license	2-year license	3-year license	4-year license	5-year license	Perpetual
Standard One	$1160.00	$2030.00	$2900.00	$3480.00	$4060.00	$5800.00
Standard	$3500.00	$6125.00	$8750.00	$10,500.00	$12,250.00	$17,500.00
Enterprise	$9500.00	$16,250.00	$23,750.00	$28,500.00	$33,250.00	$47,500.00

Table 5-5 Licensing cost per processor

- *Oracle Database Standard Edition One (SEO)*—This edition is licensed on a per-user or per-processor basis. It was developed for servers that use one to two processors. If the number of CPUs on a server exceeds two, the user must upgrade to the Standard license. There are no restrictions placed on memory usage or user data storage. To qualify for a license for this edition, there must be at least five or more users.
- *Oracle Database Standard Edition (SE)*—This edition is licensed on a per-user or per-processor basis. It was developed for servers that use four processors or fewer. If the number of CPUs on a server exceeds four, the user must upgrade to the Enterprise license. There are no restrictions placed on memory usage or user data storage. To qualify for a license for this edition, there must be at least five or more users.
- *Enterprise Edition*—This edition is licensed on a per-user or per-processor basis. It has been developed to run on servers that use four or more processors. There are no restrictions put on memory usage or user data, but it this edition requires the most cost per unit. To qualify for a license for this edition, there must be at least 25 or more users.

In per-processor licensing, the term processor is defined differently for different editions. In the Standard and Standard One editions of the database, the term *processors* refers to the number of sockets or physical CPUs. This essentially means that those processors deemed multi-core (e.g., Dual Core, Quad Core), which enable the installation of several instances of SQL Server on one machine, are only considered to be one physical CPU or socket by the Oracle licensing standards for these editions. On the other hand, the Enterprise Edition depends on the hardware being used. The core is multiplied by a specific CPU type factor. For example, to determine the licensing cost of an AMD multi-core processor, one would multiply the number of users by a factor of .50. For more information regarding Enterprise Edition's licensing by processor, see the Oracle support documentation online.

Free Unlimited Downloads of Oracle

Oracle offers a free download of all editions of the Oracle Database for purposes of education, testing, or development. Personal information (e.g., name and organization) or a license key are not required to download. The downloads permit unlimited usage of full versions of the software, and there are no restrictions on the usage of these applications. This may seem like a poor decision for Oracle, yet similarly to open-source applications, these free downloads have contributed to the development and success of Oracle. The free dowloads can be found at *http://www.oracle.com/technology/software/index.html*.

Locating Help

5

As with any major or minor hardware and software installation, being able to locate help is vital to the success of the installation as well as the future reliability of your environment. Oracle has built a well-established community consisting of users, administrators, developers, CFOs, and more. There are several opportunities to share Oracle knowledge. The Oracle community spans forums and blogs. This section covers a few of these areas.

- *Technical Support*—Several levels of technical support are offered with the licensing of Oracle. Contracts can be formed to provide aid for any product available. Whether help is necessary over the phone, in person, or online, you can find resources for a variety of concerns (e.g., technical support, database consultation, and object development). For more information regarding Oracle's technical support policy, go to *http://www.oracle.com/us/support/index.htm*.
- *Oracle Community*—The Internet continues to provide an opportunity for peer and expert support, yet there is no better resource than that which can be found within the product manufacturer's main site. The Oracle Community site maintains a number of the largest interactive member areas in the world. Here one can find forums specific for partners, CFOs, programmers, and customers. Also available on this site are blogs, user groups, and general technical support discussion areas. The Oracle Community can be found at *http://www.oracle.com/us/community/index.htm*.
- *Oracle University*—This is the No. 1 resource for educational information regarding Oracle products. This site provides videos, tutorials, self-paced courses, and instructor-led training on all things Oracle. The Oracle University can be located by going to *http://education.oracle.com*.
- *Oracle's Knowledge Center*—This resource provides a comprehensive collection of online manuals, installation guides, and release notes for all Oracle Products. Oracle's Documentation Library is located at *http://dev.mysql.com/doc/*.
- *Metalink*—Metalink is a support service provided to all Oracle customers free of charge. It is a warehouse of knowledge that users can search to find well-known issues and to obtain bug reports.
- *Bloggers*—Blogs have become a fantastic resource, especially in the technology fields. Many people who work with Oracle or have experience with the application blog about their experiences and share their knowledge at this blog site: *http://blogs.oracle.com*.

- *Twitter*—Twitter has become a popular way to keep people informed on a minute-by-minute basis. Microsoft uses Twitter as a way for users to ask questions and for Oracle professionals to send out alerts relevant to upgrades, bugs, and other software-related support at *http://twitter.com/ORACLE*.

Installation

Once a user has obtained the desired copy of Oracle, verified that the hardware and software requirements have been met, and decided on the best purpose and design (by choosing desired edition and extra-cost options) that fit the needs of the environment, installation can begin. If prerequisites have not been met, Oracle will require updates before the installation process.

The Oracle University Installer

The Oracle University Installer (OUI) is a Java-based application that provides a graphical user interface to help ease the installation of some of the most complex Oracle deployments. The OUI guides an administrator through installing Oracle using a step-by-step wizard. Using the OUI enables an administrator to record selections made within a typical Oracle installation. These recordings are placed in a file called the response file. A **response file** holds the specifications of a typical Oracle installation for the purpose of creating silent installations.

A **silent installation** is an installation of an application that completes without prompting a user for setting specifications. Silent installations use the settings recorded within response files and enable administrators to add Oracle to user machines without interruption or user interference. The OUI's silent files and response files help administrators install Oracle on a large number of machines quickly and consistently. Before performing a silent installation, administrators should familiarize themselves with the settings in the response file template for that specific Oracle product.

For Windows installations, the OUI can be run from the system's administrative account, using the system's administrative privileges. With UNIX-based systems, an administrator must create a privilege from where to run the OUI.

Step-by-Step Installation for Windows

This section will include the steps for installing the Oracle Database Server on a Windows 64-bit machine. The instructional steps provided in this section are intended to provide steps for installing the Enterprise Edition 64-bit edition server using the Oracle University Installer. For this installation, the DVDs or a downloaded version of the DVD for Oracle Database are needed. In this section, the installation will derive from the downloaded version of Oracle Database 11g.

From the directory where the downloaded files were unzipped, double-click the directory setup.exe file to start the OUI (Figure 5-1).

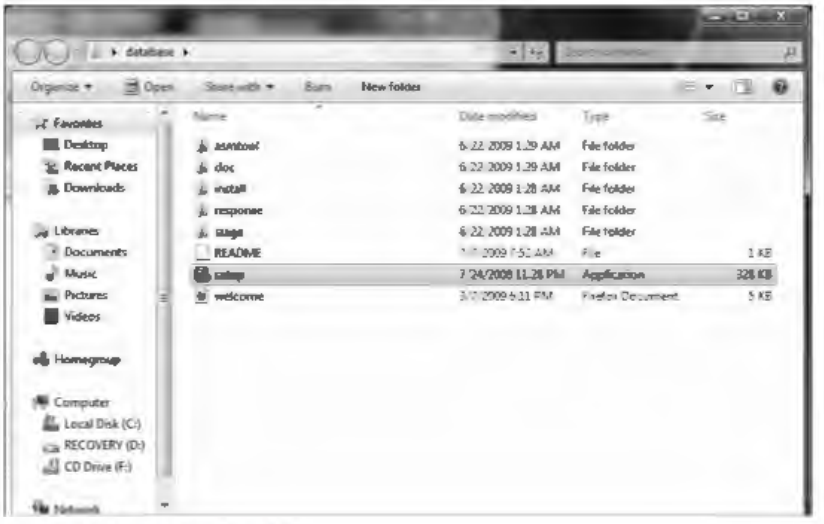

Figure 5-1 Locating the setup file

5

1. There are two different types of installations for the Oracle Database, basic and advanced. The basic installation creates a default database quickly and with minimal user involvement. The advanced option is for custom installations that require very specific software and database configurations. For instance, the advanced installation allows administrators to choose components of the database individually, whereas the basic installation automatically chooses the typical components, yet provides a list of non-default components from which an administrator can choose. These instructions will display a basic installation. Therefore, on the OUI welcome screen, choose the Basic Installation (Figure 5-2). The windows that appear following this selection will depend on the type of installation chosen.

The advanced installation is recommended because it limits the number of unnecessary features that are installed on a system, creating an easier environment to control and secure. The advanced installation is not shown here because the possibilities are too numerous to present, but it is highly recommended that specific features are chosen and installed individually. To see a list of available components within the custom or advanced installation of the database, choose advanced installation and then choose Custom from the Installation Type window.

The OUI welcome screen also prompts the user to provide a global name and system password for the intended database. To ensure a secure installation, be sure to create a strong database password, as Oracle will allow weak passwords for this account. For the purpose of this installation tutorial, input the database name as SecureData and the password

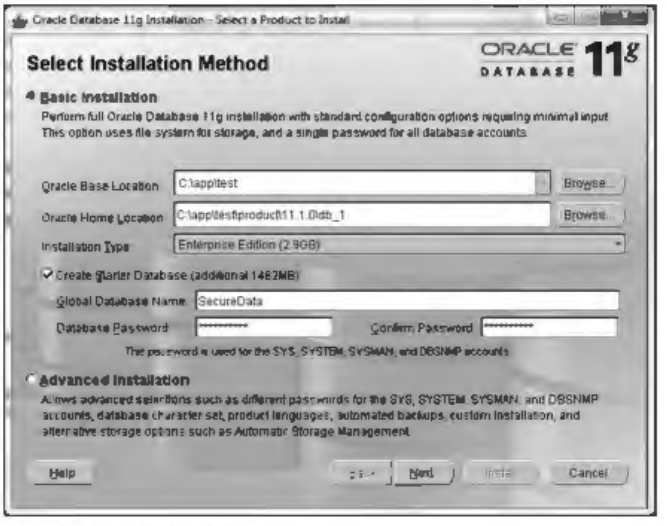

Figure 5-2 OUI welcome screen

as SecurePass. Once the installation type has been chosen and the database has been given a name and a password, click **Next.**

1. The following screen is for obtaining and receiving security and configuration updates and alerts, as well as for creating a Metalink account. Administrators are given the option to provide an e-mail address from which to be informed of security and configuration issues or to use their Metalink for these alerts (Figure 5-3). See the security section for more information regarding security and Metalink. Once this information has been input, click **Next.**
2. Oracle will now conduct a system check to ensure all prerequisites and indicate any errors found, warnings to be noted, and verification checks that were completed (Figure 5-4). If errors are found, they must be fixed before the installation can continue. Once the prerequisites have all been satisfied, click **Next.**
3. The Configuration Manager (Figure 5-5) provides an option where the administrator can have the current machine's configuration associated with their Metalink account. Click **Next** to move forward with the installation.
4. The next window displays the installation summary (Figure 5-6), a complete summary of components that will be installed on the machine. Click **Install** to begin the installation.
5. Once the installation begins, the progress window will appear, displaying the progress of the installation (Figure 5-7).
6. Once the installation completes, the Configuration Assistant Window appears (Figure 5-8) and begins the creation of the database. When complete, a

Figure 5-3 Options for receiving alerts

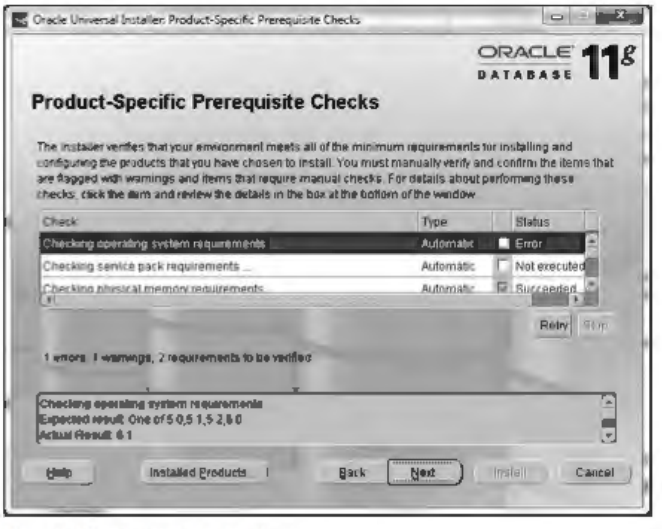

Figure 5-4 The prerequisite check

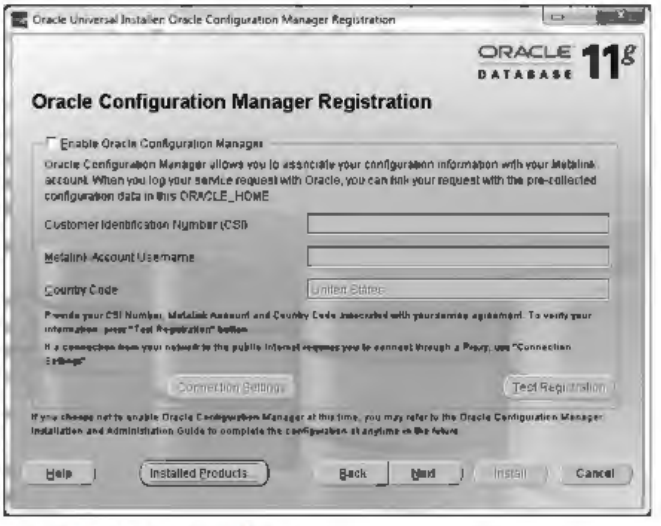

Figure 5-5 Configuration Manager

Figure 5-6 Installation Summary

Figure 5-7 Progress window

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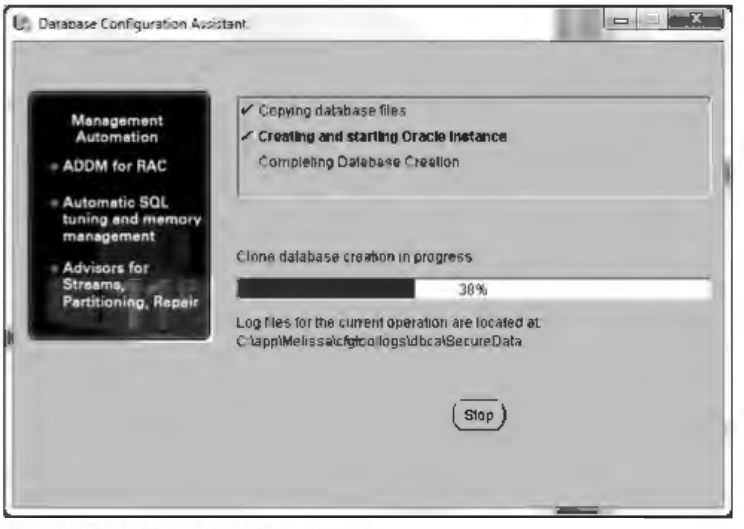

Figure 5-8 Configuration Assistant window

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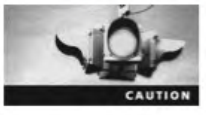
Figure 5-9 Configuration Assistant confirmation window

Configuration Assistant confirmation window will appear (Figure 5-9), providing the location of the log files, the Global Database Name, the System Identifier (SID), the server Parameter Filename, the Database Control URL, and the location of the encryption key for the Management Repository. By default, Oracle encrypts the Enterprise Management Data Repository and it is set to secure. Click **Password Management** to review the accounts that contain passwords.

7. Ensure that all unused system administrative accounts are locked (Figure 5-10). Click the cell of an account to lock it. A checkmark will be present in the column titled Lock Account? for all accounts that are currently locked. Also be sure to set strong usernames and passwords for those accounts that are left unlocked for use. It is not secure to leave default passwords for unlocked accounts unchanged. The accounts that are unlocked by default are Sys, System, DBSNMP, and SYSMAN. Once the appropriate accounts are locked or assigned strong usernames and passwords, click **OK** to return to the Configuration Assistant confirmation page and click **OK** on this page to confirm the end of the installation.



The accounts that are shown here are not locked during a manual installation of Oracle. If a manual installation of Oracle is being conducted, it is extremely important to the security of the environment that these accounts are locked and chosen to expire in correspondence with the version of Oracle that is being installed.

8. At this point, installation has completed. An installation summary and reminder page will appear (Figure 5-11). Review the information and click **Exit**, and then click **Yes** if prompted to confirm.

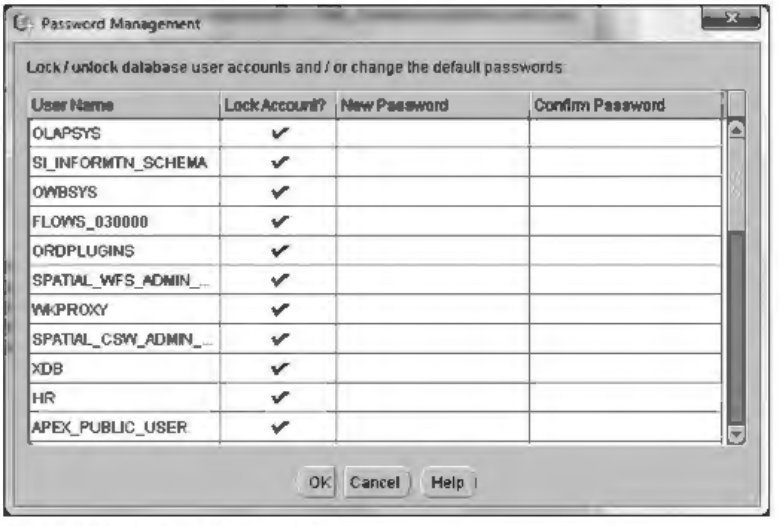


Figure 5-10 Confirm locked accounts

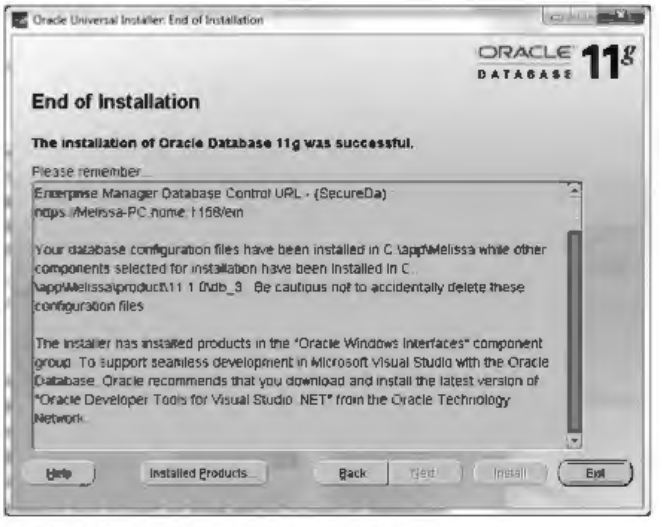


Figure 5-11 Installation summary and reminder

Quick Installation for UNIX-based Systems

This section includes the steps for installing the Oracle Database Server on a Linux 64-bit machine. The instructional steps displayed are for installing the Enterprise Edition 64-bit edition server.

From the directory where the downloaded files were unzipped, open a terminal window and type **./runInstaller.sh** to start the OUI.

1. On the OUI Welcome screen, choose the Basic Installation. The windows that appear following this selection will depend on the type of installation chosen. Provide a global name and system password for the intended database, and then click **Next**.
2. Ensure that the Inventory directory is the correct directory and set the operating system group name, and then click **Next**.
3. Once the prerequisites have all been satisfied and the installation is error-free, click **Next**.
4. The Configuration Manager provides an option whereby the administrator can have the current machine's configuration associated with his Metalink account. Click **Next** to move forward with the installation.
5. Review the summary of components that will be installed on the machine. Click **Install** to begin the installation.
6. Click **Password Management** to lock and assign passwords to unlocked accounts. Unlock **orainstRoot.sh** and **root.sh** as the root user.
7. Open a terminal window and type the following to verify:

```
su -
<rootpassword>
cd /u01/app/oracle/oraInventory
./orainstRoot.sh
cd ./product/11.1.0/db_1
./root.sh
exit
exit
```

8. Click **OK** on the OUI window and then click **Exit** to end the installation.

Additional Security Considerations for an Oracle Database

Maintaining a great hold on the data solution market since the early 1980s, Oracle Corporation is a well-respected and trusted organization, which accounts greatly for its success. Although less expensive and equally as efficient alternative solutions exist, Oracle holds a majority of the data management market and can be found in most of the world's largest organizations. These characteristics are the reason the Oracle database is one of the greatest commodities for potential intruders. It is vital that considerations for securing an Oracle database are addressed early in the planning stage and continue throughout the life of the system. This section addresses the basic security concerns from planning to the installation and early administration of an Oracle database.

Security Checklist

As mentioned earlier, security must be addressed in all stages of database deployment. Security planning should include administrators, network architecture engineers, and designers, as well as a best-practice strategy to keep the Oracle database secure. A multilayered approach should be considered early in the deployment stages. This section will review early Oracle security considerations at different points of deployment.

- *Harden the operating system*—Research the platform on which the database resides and identify any ports that are left open as a default setting. Close those ports that are unnecessary or not being used (e.g., FTP, Telnet).
- *Close ports for unused applications and services*—Ensure that unused applications and services of the system are not providing a channel intruders can invade. Search the system for unused applications and services and ensure that any ports that provide transit or allow communication are closed or disabled.
- *Use firewalls*—Firewalls can be used for both isolation and security for the database. It is a best practice to use firewalls whenever possible to provide an extra layer of security for the database.
- *Apply the newest security patches*—Security patches are critical to maintaining a reliable database. As security holes are found within operating systems, manufacturers create software called patches to protect these holes. Without the most up-to-date security patches, the platform is vulnerable to intrusion.
- *Restrict run time*—Run time is the system that supports the execution of a computer program. Java is an example of a run-time machine that supports the execution of Oracle. Intruders can manipulate Java (as well as other run-time machines) by redirecting the execution of a piece of malware that may be residing on the computer. Therefore, it is important that permissions are explicitly set as to who and from what location run-time systems can execute.
- *Restrict using IP address*—Just as access can be restricted using environmental object names, it also can be restricted using environmental object addresses. Minimize unwanted intruders by explicitly identifying the IP addresses or range of IP addresses that have permission through the firewall and to access the machines.
- *Include only required software*—Although this chapter has reviewed a typical installation, it is recommended that the custom installation mode is chosen within an environment. Keeping unnecessary features at a minimum will result in a less-complex environment that offers the administrator more security control.
- *Choose database security*—Newer installed versions of Oracle by default include security configuration options such as auditing and password policy settings. There is an option to disable this feature, yet doing so will limit the security options available to the administrator. Therefore, unless Security Vault is installed, do not disable security features during install.
- *Apply Oracle patches*—As mentioned, patches are extremely important to maintain a reliable platform. This is just as important to applications, so apply the newest patches to ensure that all identified security holes within Oracle have been fixed.

- *Use encryption to transfer*—Encryption is vital to the success of secure data transfer and storage in today's society. To apply strong security to your Oracle database, encrypt all client-to-server and client-to-client communications.
- *Use encryption to store*—Protecting the storage of your data is equally as important as protecting it in transit. Hard disks should apply encryption techniques to add an extra layer of security to the database.
- *Enforce stringent access control*—As with any discussion of security, it is important to remind readers of the importance of the principle of least privilege. In database terms, this equates to restriction of access at the row level. Row-level restriction can be cumbersome, but it will ensure that access is explicitly controlled.
- *Restrict users with operating system access*—A user with access to the operating system, or the main system directories, essentially has access to the database as well. Limiting the number of users with permission to access or modify critical operating system directories–or the paths associated with them–can greatly minimize external threats.

Take Advantage of Oracle's Security Suite

Oracle provides a number of applications to support the confidentiality, integrity, and availability of the database. Although these applications can be costly as add-ons when budgetary restrictions may limit an organization, Oracle highly suggests that careful risk-measurement studies are conducted before dismissing them altogether. Oracle's suite of security applications, such as Oracle Security, Label Security, Database Vault, Identity Management, Transparent Encryption, and Secure Backup offer a comprehensive multilayered approach to securing the environment and maintaining privacy of the data within it. These tools address each of the security items listed in this chapter by using best-practice strategies while protecting the database from both internal and external unauthorized access. Encryption, security-based data classifications, internal realms, and real-time access controls are a few of the strategies included within these applications.

Password Policies and User Accounts

During the automatic installation and configuration of Oracle Database, Oracle installs a number of preset user accounts. Measures are taken by Oracle automatically to secure these accounts. For example, unless the database is manually created, most of the default user accounts are locked and assigned passwords are set to expire. Although these measures are taken, it is necessary that administrators take steps to further secure these accounts to ensure privacy throughout the database.

A password is the first defense in maintaining a secure account. The default password for all unlocked accounts needs to be changed either during or immediately after an install. If the database is created using the interactive or progress modes, the passwords can be changed during the installation. On the other hand, if the database is created using the silent mode, the passwords are changed after the installation has completed or are specified within the specific template chosen for the database creation.

Although Oracle will allow for all administrative accounts (Sys, System, DBSNMP, and SYSMAN) to use the same password, different passwords should be specified for each. This will minimize the chance of all passwords being breached at the same time.

Whether for a user or an administrator, passwords should follow strong security standards. Oracle allows "_", "&", and "#" symbols to be used within usernames and passwords. Strong passwords use these symbols in conjunction with a mixture of letters and numbers, both lowercase and uppercase, creating a password of considerable length (8–15 characters).

Creating strong passwords for default user accounts during the installation of Oracle is only one step to ensuring secure account protection. Ensuring users in the environment follow appropriate password standards is another. This involves the creation and strict enforcement of policies within the Oracle server. Several options provided in the server environment enable administrators to develop secure policies. Here is a list of password characteristics available within the server that can be combined to develop a password policy for the environment:

- *Complexity*—A policy can be created that identifies the required length and character type combination (e.g., number, letter, upper, lower, symbols) of a password. It also determines whether a user can use common or dictionary words.
- *Failed attempts*—A password that has been attempted too many times without avail can be an indication of an intruder. Therefore, it is best to lock an account that has had too many failed password attempts. The number of failed password attempts and the way these are handled in the environment can be identified as part of the password policy.
- *Expired passwords*—This component of a password policy specifies the length of time a user can use a password before being forced to change it. This is to minimize the damage and risk that can be done if a password is breached.
- *Reused passwords*—The number of password changes that a user must wait to reuse a password is specified here.

Passwords are critical to the security of our accounts. Following best-practice guidelines such as those listed in this section, along with the creation and enforcement of policies within the Oracle server will ensure success in any environment.

Chapter Summary

- Oracle offers a number of software and hardware components that can be integrated at each level of an organization. From user interface to supporting hardware, Oracle offers a comprehensive solution to any organization.
- There are 32-bit and 64-bit versions of Oracle available. It is highly suggested that a 32-bit version of Oracle be used on a 32-bit platform, and a 64-bit version of Oracle be used on a 64-bit platform to ensure that the database applications are used to their fullest potential.
- Supported platforms for Oracle are dependent on their edition. These include all current versions of 32-bit and 64-bit Windows platforms beginning with Windows 2000. Linux Asianux 2 and 3, Oracle Enterprise Linux 4 and 5, Red Hat Linux 4 and 5, and SUSE 10 are also supported in both 32-bit to 64-bit versions. UNIX-based platforms include Solaris 9 and 10, HP-UX 11v1–3, and AIX5L and 6L. Specific service packs are required for each version of a platform.

- Four main editions of the Oracle Database are available: Express, Oracle Database Standard One, Oracle Database Standard, and Enterprise.
- Oracle Enterprise Edition is the most robust of all of the Oracle editions. This edition of Oracle includes more features embedded into the application than any other database editions available; several extra-cost options exist that extend its capability and add to its value.
- A host of tools are available as extra add-on support to the Oracle database environment. These separately installed applications can be purchased to extend the Oracle capabilities within a business architecture and include such topics as security, compression, analysis, and change management.
- Licensing can be purchased on a per-user or per-processor basis. Restrictions for Oracle applications vary based on the edition purchased. Licenses can be purchased on a yearly or perpetual basis.
- Full-featured installations of all Oracle products can be installed at no charge and without time and use restrictions by developers and users intending to learn about and test the application.
- Oracle has developed a well-established support community both online and off. A vast amount of knowledge and resources can be found to support Oracle users, developers, and administrators.
- The online Oracle Community is one of the most comprehensive and popular resources, and is a great starting point for those looking for Oracle-related tutorials, videos, blogs, and forums.
- MetaLink is a support service offered to all licensed Oracle users, providing bug reporting and technical support specific to a user's system.
- The Oracle University Installer and the Database Configuration Assistant are two tools that automate the installation of Oracle. Both of these tools can be used to create automatic or silent installations for deployment on several client or server machines at once.
- Oracle holds a majority of the data management market and can be found in most of the world's largest organizations. These characteristics are the reason the Oracle database is one of the greatest targets for potential intruders.
- Oracle offers a number of security-related applications to help organizations maintain their confidentiality, integrity, and availability. These applications also focus on privacy laws compliancy, ensuring that regulations and standards are being followed.
- Security should be multitiered and include strategies for all levels of a network and database environment. Security needs to protect an organization from both internal and external threats and include strategies for protecting network architecture, storage of data, transmission of data, and the access of information.
- Passwords are the first defense to securing a network. They should follow strict guidelines, and policies need to be created and enforced to ensure that these guidelines are being met.

Key Terms

response file A file that holds the specification of a typical Oracle installation for the purpose of creating silent installations.

silent installation An installation of an application that completes without prompting a user for setting specifications.

Review Questions

1. List the decisions a network administrator needs to make prior to Oracle database installation.
2. Explain why installing the minimum hardware requirements is not suggested.
3. The Enterprise Edition of Oracle offers both cost options and additional features. What is the difference between these two categories?
4. List the extra features and extra-cost options that are available with the Enterprise Edition of Oracle.
5. Of the additional options and features available for Oracle, identify the security-specific applications.
6. Explain the advantages and disadvantages of offering an unrestricted, freely downloadable full version of Oracle Database to learners and developers.
7. List and define two support resources available through Oracle's Web site.
8. Explain how silent installations can benefit an organization.
9. Identify the differences between a basic and an advanced installation.
10. Explain two different password policies that can be enforced on an Oracle Server.
11. List three security practices to follow during installation of Oracle.

Case Projects

Case Project 5-1: Estimating Required Hardware

Write a paper defining a strategy for estimating the disk space, virtual memory, processor, and network requirements for an installation.

Case Project 5-2: Oracle University

Using Oracle's Online University, list all of the available resources currently provided within The Oracle University.

Case Project 5-3: Oracle Metalink

Explore the Metalinks resource by going to *http://support.oracle.com/CSP/ui/flash.html* and registering for a free account. Write a paper discussing the potential security risks associated with Metalink. How could hackers use Metalink to intrude into a system?

Case Project 5-4: Implementing Security Measures

Suppose that you are in charge of implementing security for a large organization. Outline the security measures that you would implement to protect a new installation of Oracle.

Hands-On Projects

Hands-On Project 5-1: Creating a Password Policy

Research all of the password variables available for a server and create a password policy to be enforced. Include characteristics such as password complexity, failed attempts, expiration, and reuse.