

Building Unbreakable Systems with Oracle

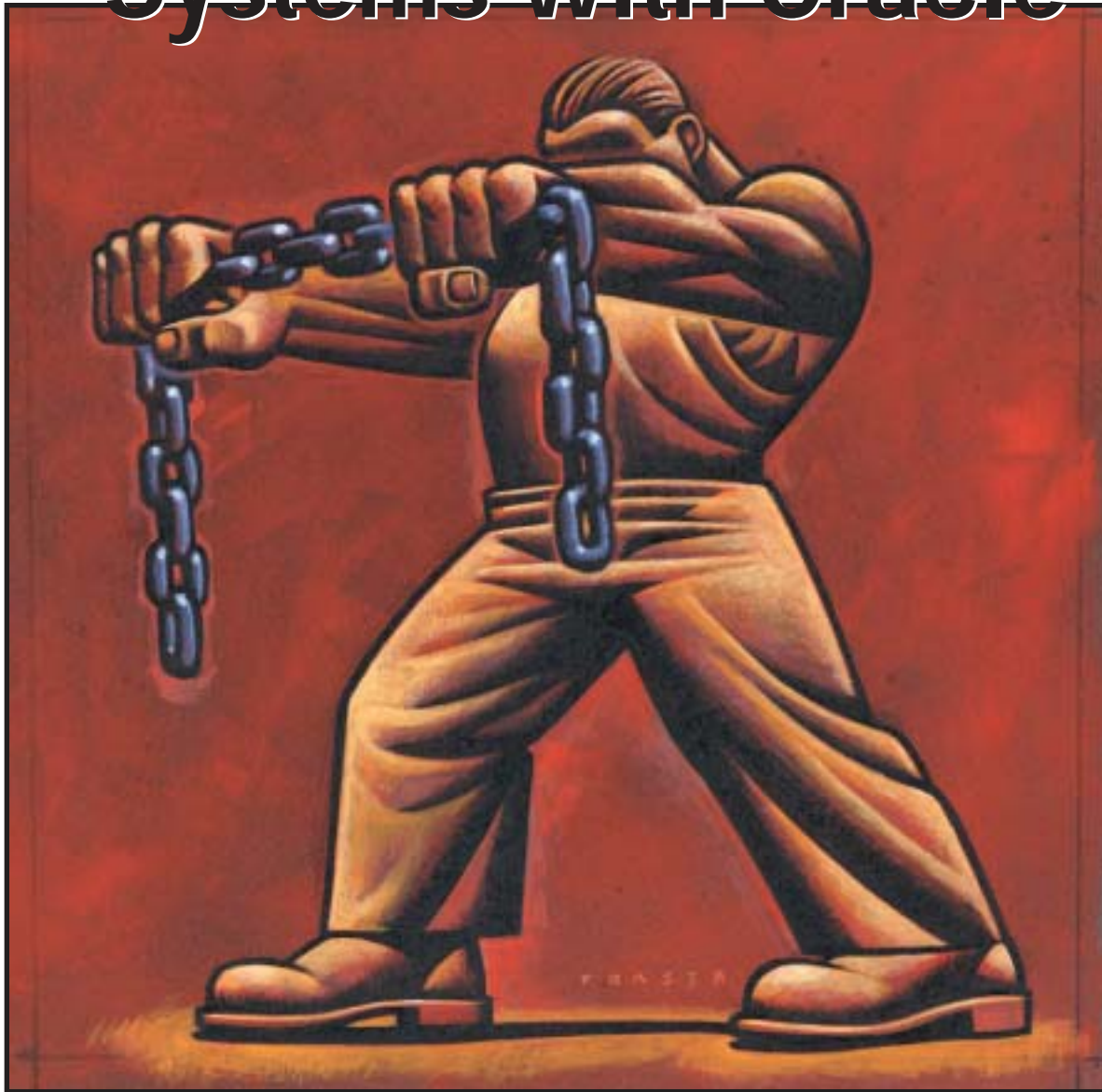


ILLUSTRATION BY DOUGLAS FRASER

*How the enhanced availability, security,
and manageability features of Oracle9i
make your system 'unbreakable.'*

The elimination of downtime, long a dream of IT managers, has played a key role in the evolution of the Oracle database. Declarations that Oracle9i Database is “unbreakable” and that you “can’t break it, can’t break in” might sound like overzealous marketing, but they actually reflect a holistic approach to keeping data available, manageable, and secure.

Are the features of Oracle9i Database revolutionary enough to deserve such strong statements about invulnerability? Will new data-security and backup procedures have a significant impact on your day-to-day environment? When it’s time to modify, expand, or maintain critical business systems, how much time and money would you save if you could perform these activities with zero downtime?

CAN’T BREAK IT: HIGH-AVAILABILITY COMPUTING

Today’s businesses demand applications that are available at all times. Businesses and enterprises have users around the globe who require access 24 hours a day, seven days a

week. Consequences of downtime are severe and include frustrated customers, reduced sales, and bad press. The antithesis of downtime is high availability, and Oracle has set a bold new standard: Oracle9i, the world’s first database designed for continuous availability.

Juan Loaiza, Oracle’s vice president of high-availability systems, often speaks to IT audiences on this subject. “A true high-availability solution must protect against many types of failures and changes,” he says. “In everything from human errors to hardware failure to management of change, Oracle9i Database has unique capabilities that competitive products can’t match. For example, something as simple as restoring data that a user deleted a few hours ago requires a complex and expensive procedure using competitors’ products but with Oracle9i is extremely simple and quick.”

Loaiza explains how Oracle tackled the problems of downtime. “With Oracle9i Database, we have addressed the basic reasons why information systems stop working. Oracle9i has the ability to reverse mistakes made by users. It can survive hardware

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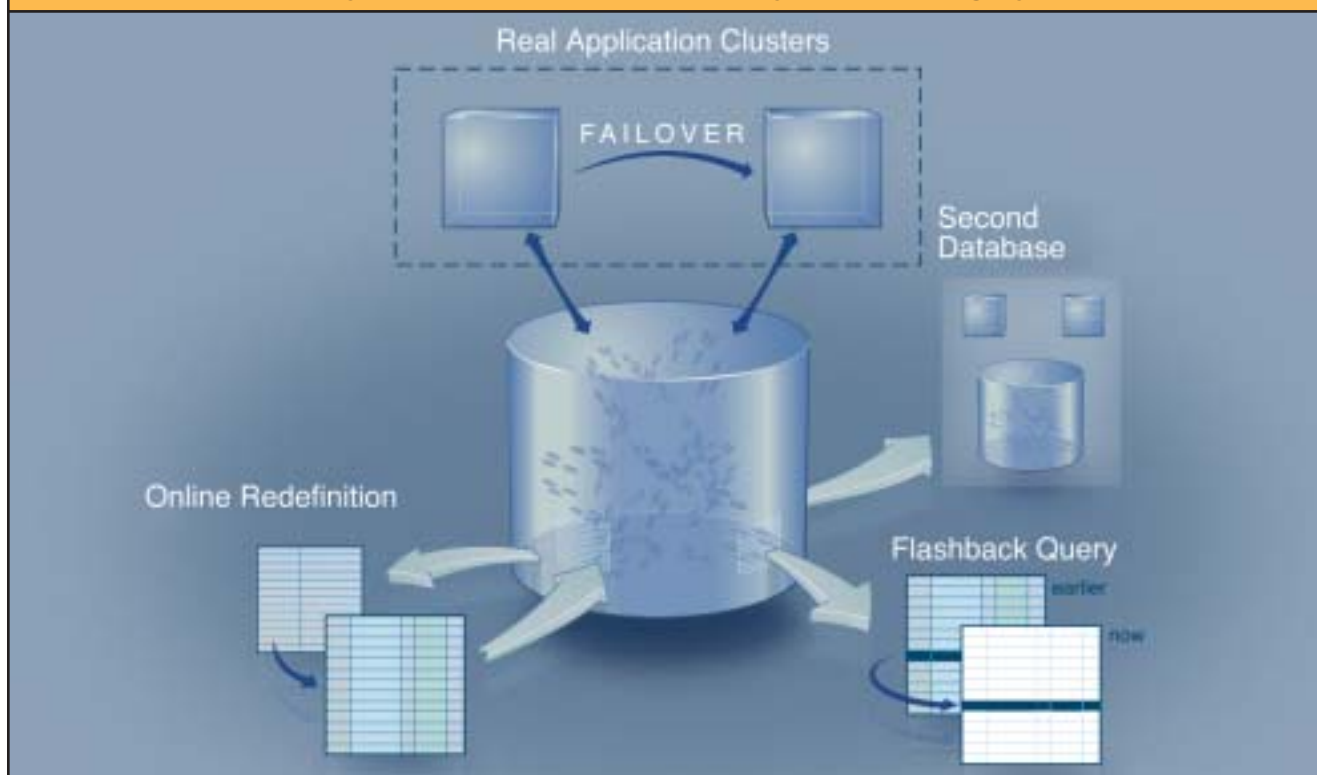
—Juan Loaiza, Oracle Vice President

failures and natural disasters. Oracle9i also tolerates change. With Oracle9i, customers can continuously evolve business data to match the changing needs of the marketplace. Customers can easily add processing capacity and perform hardware maintenance. All these changes occur on the fly, with no need for downtime. These are capabilities that every business needs.”

Unplanned downtime includes unforeseen circumstances such as system, hardware, data-storage, and site failures, or—the largest single cause of downtime—human error.

Before Oracle9i, certain routine maintenance operations required system administrators or DBAs to take the system down. This is no longer the case. For example, Oracle9i includes dynamic resource management—the ability to dynamically add CPUs, memory, and storage space to the server or remove them from it, without shutting the system down.

Oracle9i offers many new features that keep your data highly available.



Scalability, Availability, and Fault Tolerance with Real Application Clusters

Oracle9i's Real Application Clusters (RAC) allows developers to deploy applications in a clustered environment without modifications, making it possible to scale applications more easily while ensuring greater uptime. Administrators can add or remove nodes to perform online maintenance without interrupting the database service.

Oracle9i's RAC also thwarts system failures. Each server in a cluster is able to access the entire database. If one server in a cluster goes down, other servers immediately take over so that no failure occurs. RAC spreads the work of the database across multiple servers, providing nonstop service to users. The clusters automatically extend the availability of any application—even those that are homegrown or from other vendors.

Oracle9i's RAC makes it easier to build scalable systems, including database services that are larger than the largest computer you can purchase today. Now you can incrementally increase CPU power by dynamically adding it to the system.

Protected Data Brings Peace of Mind

With Oracle9i's comprehensive data-protection and -recovery features, data is never compromised, regardless of failure. Oracle9i's Data Guard provides the strongest set of data-protection and -recovery features available today. Typical standby databases protect data against disasters via a single mechanism: failover processing to a standby server. Data Guard goes beyond this to provide both physical and logical standby databases, with zero data loss in any event. By keeping a real-time copy of data, Data

Guard protects against any sort of corruption, human error, or disaster, regardless of the condition that caused the failure. As an added benefit, Data Guard allows administrators to leverage failover sites, using them for reporting, backup, and maintenance activities.

Recovery Manager Automates Backup

Every business performs backup operations, knowing that disk failures, data corruption, and human error can damage or delete the data in a RAID subsystem. Oracle9i Recovery Manager (RMAN) ensures the integrity of backed-up data, restores it from backup, and recovers changes to that data to a specific point in time.

RMAN manages the backup, restore, and recovery processes. It automatically keeps track of the files needed to restore the database within a user-specified time window. While the database remains online, RMAN can restart interrupted operations, address issues with corrupted log files, and restore individual data blocks.

Flashback Query Undoes Human Errors

Think of Oracle9i's Flashback Query as a time machine for data. This self-service error-correction feature lets you view data as it was at a previous point in time, compare it with current data, and then reconstruct it as needed. For example, if John Smith calls and asks you to delete his account, and you accidentally delete the account for the wrong John Smith, Flashback Query lets you roll the clock back to restore the incorrectly deleted account. Developers use this feature to build self-service error-correction capabilities into their applications, empowering users to undo errors as soon as they discover them.

Loaiza explains why Flashback Query is an important innovation. "Databases have always maintained information on how to undo

High Availability: Critical to Acxiom

Acxiom, headquartered in Little Rock, Arkansas, and with operations in the United Kingdom, France, Spain, Germany, Japan, and Australia, provides businesses with accurate views of their customers.

The company offers customer-data-integration software, database-management services, and customer-data content through its proprietary software solutions. Customers include large retailers, such as Sears, Roebuck and Co. (Acxiom enables the creation of a single view of each customer's transaction history); financial institutions, such as Bank One (Acxiom helps this bank ascertain response rates and profitability of direct marketing efforts); and 12 of the top 15 credit-card issuers.

Acxiom systems architect Tim Donar explains one of his company's challenges. "We have about 300 UNIX servers on our site, and that represents just over 200 terabytes of storage connected to all the servers. The 200 terabytes break down into Oracle servers that range in size from 1 terabyte to 6 terabytes of raw data. Our customer with 6 terabytes of raw data has about 24 terabytes of storage on his Compaq Alpha servers."

He says that Oracle9i's high availability is important, because some Acxiom contracts specify that the database will be available 99.9 percent of the time. Oracle9i's Real Application Clusters provides even greater availability. With improved performance and added features, Oracle9i's RAC is also easier to manage than the earlier version.

Donar is finding Oracle9i's Flashback Query feature a valuable tool. "I call it undo-redo, or an easy way to recover if you accidentally delete some data. Desktop applications have always had undo-redo, and now Oracle9i has it too. Oracle9i is unbreakable, but that doesn't prevent humans from pressing the wrong button. Before Oracle9i's Flashback Query, a restore was required to recover lost data. Now, using the Flashback option, human error can be easily undone."



When Protecting Data Is Paramount: the PCASSO Project

A groundbreaking medical information project is putting Oracle's unbreakable security to the test. SAIC, the largest employee-owned research and engineering firm in the nation, partnered with the University of California San Diego School of Medicine to develop and test a health information system called Patient Centered Access to Secure Systems Online (PCASSO). PCASSO lets patients securely view their own health information and allows health-care providers to view their patients' complete medical records over the internet. The program is evaluating the safety and effectiveness of using state-of-the-art security to accomplish this goal.

Oracle Label Security, a security option in Oracle8i included with Oracle9i Enterprise Edition, is critical to PCASSO. "From the outset, we wanted to use label-based access control to separately protect several sensitivity levels of medical information," says Dixie Baker, corporate VP of technology and CTO for SAIC's health-care practice. "In defining those levels, we needed to separately protect highly sensitive information that—by law—requires special protection. This 'deniable' data includes patient history

related to HIV/AIDS, abortion, adoption, mental health, sexually transmitted diseases, and genetic information. Label-based access control is ideal for this purpose."

Dave Mattia, DBA for the project, adds that the controls in the database were an important consideration. "Label-based access control is self-contained within the Oracle database via the Label Security component. With it, we were able to define our own labels in the database rather than relying on the label controls in a trusted operating system, as was the case when we were using Trusted Oracle7 Release 7.2."

To further ensure security, the team selected Sun's Trusted Solaris 8 operating system. "Even though the label-based access-control components in the operating system and the database don't shake hands, we considered it important to make sure that we utilized these operating system labels for the protections they provide. For example, a user logged into the system at a particular label is permitted only to execute programs and access files that are defined at that label. Programs and multilevel system directories at different labels are not accessible, or

even visible, to that user," Mattia says.

"The labels in the operating system and database have different roles," adds Baker. "At the operating system level, they essentially provide virtual firewalls between the different levels, but the labels in the database protect individual patient records."

The team used Oracle Policy Manager to establish the policy and label information. User roles include primary and secondary provider, patient, and researcher. Three sensitivity levels are automatically assigned based on pre-established rules, and a primary provider can assign a fourth level (patient deniable). "Whenever a user connects to the database, there is a default label-based value for that user defined in the Oracle policy. A user with 'select' privileges still needs label-based access control privileges in order to view label-based information. It's an extra layer of protection," says Mattia.

The PCASSO database contains the records of over 178,000 patients, and user feedback has been positive. The research project has demonstrated that label-based access control is very useful in health care, Baker concludes.

changes. However, they kept this information to themselves, using it only to back out of partially completed transactions. Flashback Query gives the user direct access to the hidden undo mechanisms of the database."

CAN'T BREAK IN: ORACLE9i IS TOPS IN SECURITY

Keeping your systems highly available means keeping them secure, a real challenge in the era of the internet. User communities have expanded from small groups of known users accessing data via an intranet to millions of users accessing data through the internet. Disseminating

information over the internet increases risk. Among the best ways to reduce security risk is to safeguard critical information by providing multiple layers of security mechanisms.

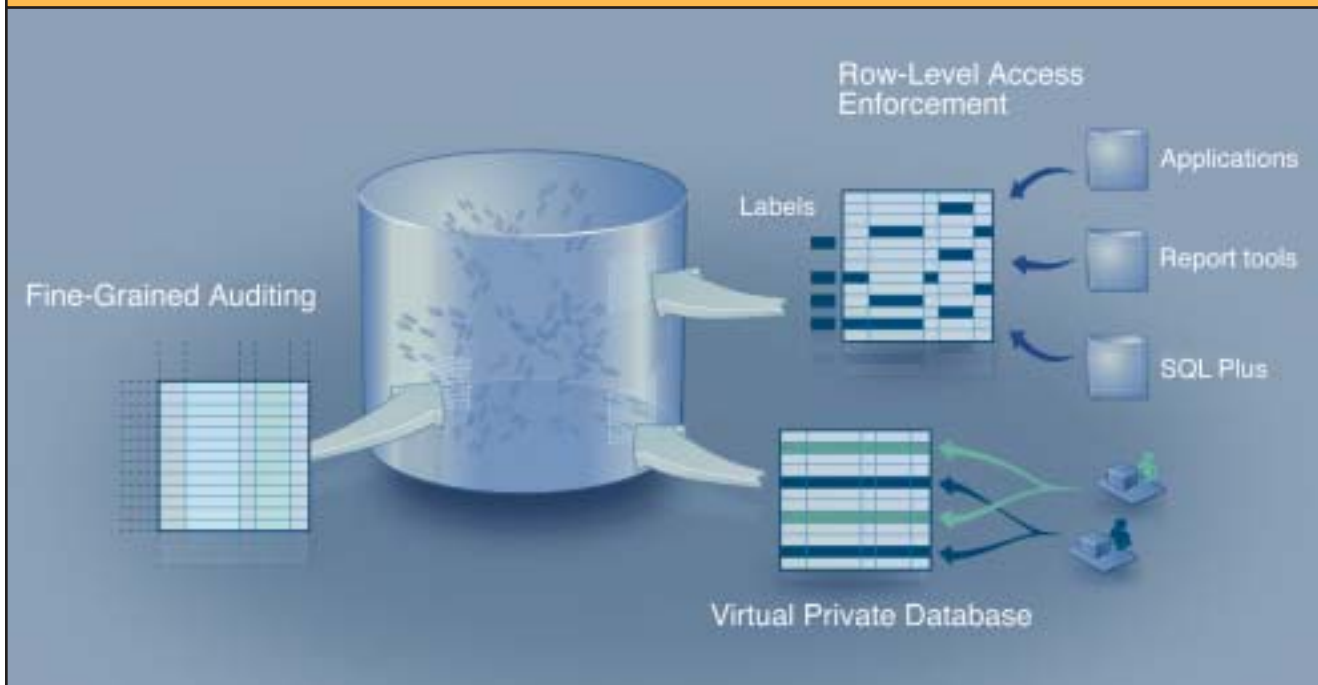
Oracle's unbreakable security is based on this layered approach: a failure of any single security mechanism does not result in lost or compromised data. Oracle9i secures data as it travels from your browser to your application server and database. Oracle9i encrypts sensitive data within the database, restricts user access at the row level, provides a single point of entry to all authorized applications, and quickly detects data misuse.

Fine-grained, extensible auditing automatically detects and issues alerts when users misuse their privileges.

Oracle9i is the industry's only database solution to successfully complete 14 independent security evaluations, against every major security evaluation criteria. Microsoft SS2000 has completed only one and IBM DB2 none.

"Security evaluations aren't new to Oracle," says Mary Ann Davidson, Oracle's chief security officer. "We've been doing security evaluations for ten years, and we consider security in every aspect of the development life cycle. Each new database release builds on prior functionality."

Oracle9i's many security features are "layered" to protect your data against all types of security threats and misuse of access privileges.



Robust, Standards-Based Encryption

Network data has been encrypted via Oracle Advanced Security since Oracle7. Oracle9i also supports encryption of selected data within the database. Sensitive information that warrants encryption might include credit-card numbers, Social Security information or other national identity numbers, trade secrets, and medical information about individuals.

A PL/SQL package can be used to encrypt and decrypt stored data. The package supports bulk data encryption using either the Data Encryption Standard (DES) or the Triple DES (3DES) algorithm and includes procedures for encrypting and decrypting data.

Security is enhanced even further because encryption protects the user password or cookie that accesses applications.

Need-to-Know Access Control

Database consolidation has made granular access controls extremely important, because vast quantities of information are stored in a single database. In the area of access control,

Oracle9i enforces the principle of least privilege, which grants users only the privileges they need to perform their functions, but no more.

Oracle Label Security, a security option for Oracle9i, extends Virtual Private Database (VPD) to enforce label-based access control in the database. Oracle Label Security provides automatic labeled data management and VPD out of the box.

VPD lets multiple users have secure direct access to mission-critical data. Within a single database, VPD enables data-access control by user with the assurance of physical data separation. For internet access, VPD ensures that online customers see only their own accounts. Web-hosting companies can maintain multiple companies' data in the same Oracle9i database while permitting each company to see only its own data.

VPD lowers the costs of deploying applications. Security is established in the database rather than in each application that accesses data. The database enforces security, no matter how a user accesses the data. Security can't be bypassed by a user using an ad hoc query tool. This technology enables organizations to build hosted,

Web-based applications. Indeed, many Oracle applications use VPD to enforce data separation for hosting.

VPD secures data in the database by providing security at the row level, across all applications, by attaching a security policy directly to a table or view. Label-based access control lets organizations assign sensitivity labels to information, ensure that data is marked with the correct sensitivity label, and control access to that data based on labels. For example, a health-care provider may differentiate between "patient confidential" information and "public" information.

VPD is enabled by associating one or more security policies (collections of label, user-authorization, and security-enforcement options) with tables or views. Direct or indirect access to a table with an attached security policy causes the database to consult a function that implements the policy. The policy function returns an access condition known as a predicate (a WHERE clause), which the database appends to the user's SQL statement, dynamically modifying the user's data access.

Oracle Label Security policies can be applied to entire application

Manageability in Action at Staffordshire University

Staffordshire University's School of Computing is one of the largest computing faculties in the United Kingdom. Its full-time computing students, all developers-in-training, learn their skills on an Oracle9i database.

Managing the database is made easy by new features in Oracle9i. Carl Dudley, associate dean in the Faculty of Computing, appreciates dynamic reconfiguration, which allows on-the-fly addition of memory without taking the system down. He cites other new features that contribute to manageability. "You can reorganize the structure of the objects in the database while the database is online. This is going to be a big boon for people with large databases, which can be cumbersome to reorganize."

He also likes new tools that automatically monitor operations and issue alerts if problems are spotted. "These tools help you do 'health checks' on the system," says Dudley. "They are easy to use, so you can be up and running a lot more quickly."

Dudley appreciates Oracle9i's ability to suspend and later resume the execution of large database operations in the event of space allocation failures. After the error condition is corrected, the suspended operation automatically resumes. The statements that make this possible are called resumable statements.

"Before Oracle9i, you could have been inserting a million records into an Oracle database, and you could get into the 999,000s and you might receive an 'out of space' error from the system informing you, 'I'm rolling everything back because you don't have enough space to finish this operation. You'll have to fix the problem and start all over,'" explains Dudley.

Now, when there is a space issue, the system sends a page to the DBA. "With Oracle9i, the problem can be fixed remotely, and you can resume the operation from where you had the problem," Dudley continues. "That's a nice feature that works well, unless you get that page at 3 in the morning. That's the only downside."

schemas or to specific application labels. Label definitions, user authorizations, and enforcement options are defined on a per-policy basis; for example, a health-care policy might have labels such as Patient-Only, Laboratory, and Physician.

Fine-Grained Auditing Detects Misuse of User Privileges

A good security policy must include an examination of system activity to ensure that users behave as authorized. Auditing tracks user activity and assists in spotting any misuse of privileges. Oracle9i includes fine-grained auditing that lets you monitor data access based on content. In this way, you can specify auditing conditions and gather specific information about the environment and query result. This additional information helps you reconstruct audited events and review them to see whether a user has misused his or her privileges.

For example, a health-care facility needs to track in detail access to its patients database and to sensitive health information in order to guard against security breaches. Such a health-care facility would need enough detail to find out what data was accessed, not simply that the SELECT privilege was used by employee MARY BETH on the PATIENTS table. Fine-grained auditing allows examinations at this level.

MANAGING UNBREAKABLE

As enterprises increase their reliance on the internet, manageable IT infrastructure has become a critical success factor. Demands for application performance and 24/7 availability can cause complexities in systems management that lead to in-

creases in costs. The solution? Products with built-in intelligence to automate routine tasks and to make real-time recommendations to their administrators.

Manageability includes the abilities to do the following, without shutting the system down:

- Configure and install products
- Automate routine administrative tasks
- Detect and correct system performance issues
- Tune systems for maximum performance
- Guarantee that data is backed up and ready for recovery
- Support packaged applications from other vendors
- Manage multiple versions of applications

Behind the Scenes of High Availability and Security

Running your business with optimal speed, minimal interruptions, and around-the-clock availability requires not only layers of integrated technologies, hardware, databases, application servers, and applications but also an end-to-end management solution. Oracle9i's built-in intelligence makes the database easier to manage.

The end result of effective manageability is that it lets companies realize two critical metrics of today's e-business systems: availability and performance. If an application is both available and performing to expectations, its users and administrators consider it a success. On the other hand, poor manageability reduces the responsiveness of the system to its administrators, resulting in decreased effectiveness and increased downtime.



Keith Lyon, product marketing manager for Oracle9i, explains the close relationship between manageability and its two cousins: performance and availability. "Customers on your Web site will first notice whether it's available, and then they'll pay attention to its performance. Manageability is important because it's how you achieve performance and availability. IT providers care about manageability because it's an internal virtue that lets you provide availability and performance to your customers."

For example, Oracle9i Database allows administrators to divide large tables into smaller, more-manageable pieces without changing any underlying code. This means that smaller partitions can be modified, allowing the bulk of data to remain unaffected during maintenance. The database lets you perform, online, most maintenance operations, including table reorganization, index rebuilding, moving a table, and changing a table type—all without taking the system down.

With its dynamic resource-management capabilities, Oracle9i Database accommodates hardware-configuration changes, such as the addition or subtraction of processors in an SMP server system, with no disruption to service.

Unbreakable data centers benefit from Oracle9i's extensive monitoring

to detect problems at the earliest possible moment, before users even notice them. Oracle9i includes functionality to automate all phases of the life cycle for applications: when they are installed, configured, tuned, monitored, diagnosed, and upgraded.

The All-in-One Management Tool

Oracle Enterprise Manager is Oracle's systems-management tool for all components of the IT stack. It combines a graphical console, mid-tier management servers, and remote intelligent agents and offers the ability to detect, solve, and prevent the full range of problems that can arise in a production environment.

The Oracle Enterprise Manager product family consists of diagnostic, tuning, and change-management packs, all of which are fully integrated into a single console to provide end-to-end management of the Oracle environment. "Oracle Enterprise Manager is meant to be 'the' solution for manageability," says Lyon. "It's comprehensive, it includes hooks for third parties to extend it, and it still lets people have the flexibility to create really key solutions."

All Oracle Enterprise Manager applications can be accessed from anywhere, via a standard Web browser, allowing administrative and IT managers to increase productivity, deliver better services, and reduce the total cost of information systems.

No More Planned Downtime

The manageability built into Oracle9i eliminates the need for planned downtime. The database stays up and running while system changes are taking place. "Certainly Oracle9i is built to withstand disasters," says Lyon. "But in reality, IT people spend a lot of time just doing maintenance—making adjustments and installing new versions of the software and all that. So manageability is really critical, because without it, making these changes is actually very intrusive. Anything you can do to avoid planned downtime makes life a lot easier."

Oracle9i's manageability reduces the complexity involved in operating the database, automates processes, extends intelligence into the database to make it self-managing, and provides tools to handle spikes in workload. Through the Oracle Enterprise Manager interface, administrators are able to manage the entire stack, throughout the life cycle.

Oracle9i Database: Truly Unbreakable

Oracle's Loaiza sums up the reasons Oracle calls Oracle9i Database unbreakable. "With Oracle9i, we have addressed the basic reasons information systems stop working. Oracle9i has the ability to back out of mistakes made by users. It can survive hardware failures, natural disasters, and security breaches.

"This database also tolerates change," adds Loaiza. "With Oracle9i, customers can continuously evolve business data to match the changing needs of the marketplace. In addition, customers can easily add processing capacity and perform hardware maintenance. All these changes occur on the fly, with no need for downtime. These are capabilities that every business needs." ■

New management features of Oracle9i automate many common administrative tasks.



For more on
Unbreakable

www.oracle.com/oramag/mar02/unbreakable.html