Oracle9*i* Database on Windows: Development and Deployment

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EXECUTIVE OVERVIEW

In recent years, the Windows operating system and its underlying technologies have seen greater use in software development and application server/mid-tier deployment. In that time, Oracle has introduced a plethora of technologies integrated with Windows. With the release of Oracle9*i*, Oracle enhances many of these features to make developing and deploying on the Windows platform easier, faster, and more cost-effective.

Application development has been greatly improved through new features in Oracle9*i* Windows data access. Depending on their requirements, developers have the flexibility to choose among four different Windows data access methods: Oracle Objects for OLE, the Oracle Provider for OLE DB, ODBC, and the COM Automation Feature. In Oracle9*i*, these data access methods have been enhanced with better globalization support with Unicode, XML support, and improved performance.

Application and mid-tier deployment using Oracle9*i* on Windows have been made more robust and integrated. The Oracle Services for Microsoft Transaction Server (MTS) has been redesigned to provide better availability and performance for transaction management on Windows. Oracle Fail Safe provides high availability solutions for more Oracle server nodes on Windows, while providing better integration and manageability. Oracle9*i* has made further improvements by integrating with Windows 2000 native security and Active Directory.

ORACLE ON WINDOWS

The Internet has provided unprecedented opportunity for enhancing commerce and collaboration. Organizations taking advantage of this new era of information management are being rewarded with opportunities to reduce costs and increase revenue. Many organizations are choosing the Windows operating system to provide the development and deployment infrastructure for their new computing needs.

With the first Oracle database release on Windows NT in 1993, Oracle had made a commitment to offer the best information management solutions available on Windows. Since that time, Oracle technology has adapted to the latest changes in

Windows computing starting from the early client/server solutions to the Internet applications in the present. Today, Oracle remains a leader on the Windows platform through its world-class database and its close integration with the operating system's underlying technologies. Oracle has over 20 years of data management expertise and is the only vendor with the technology, experience, and services needed to deploy business-critical applications on Windows— whether on a corporate intranet or the Internet.

Oracle9*i* for Windows provides all the features needed to run a business, whether it is used for departmental or company-wide deployment. It allows users to take advantage of the cost-effectiveness and ease of use of Windows, while providing the scalability, reliability, and performance traditionally available from Oracle.

Two areas where Oracle has made considerable improvements are in application development and deployment on Windows.

APPLICATION DEVELOPMENT

One of the great benefits of using Oracle products is their immense flexibility by adhering to open standards. This fact is especially true when developing applications with Oracle9*i* on Windows.

Oracle9*i* provides flexibility for Windows application development by fully supporting multiple methods of COM and ODBC data access. Additionally, Oracle9*i* has improved the feature set of these data access methods. Oracle9*i* data access exposes new database features, such as full Unicode support, while providing better performance and stability.

With this immense choice in application development methods, Oracle allows businesses to employ the data access technology that best fits their feature and performance requirements. Developers are able to deploy their database applications more quickly by using the data access method with which they are most familiar, rather than having to learn a new one.

Oracle9*i* provides a number of data access methods using native Windows technologies. COM data access using Visual Basic, Active Server Pages, or Visual C++ languages is popular among Windows developers. Oracle provides COM developers database access through three different programming interfaces: Oracle Objects for OLE, the Oracle Provider for OLE DB, and the COM Automation Feature. Oracle also provides more traditional data access through the Oracle ODBC Driver.

Oracle Objects for OLE

Oracle Objects for OLE (OO4O) is a COM-based database connectivity tool that combines optimized access to Oracle databases with easy to use interfaces. OO4O can be employed in a variety of environments, ranging from web applications to client/server applications. It is accessible from virtually any programming or scripting language that supports COM, such as Visual Basic, Visual C++,

Microsoft Office, Active Server Pages, Internet Information Server (IIS), and MTS/COM+.

Because it is an Oracle native driver, OO4O provides fast performance on Windows clients to Oracle databases; it does not incur the overhead of ODBC and OLE DB drivers. OO4O has been developed and has evolved specifically for use with Oracle database servers. It provides easy access to advanced Oracle features that are otherwise cumbersome or inaccessible to use from ODBC and OLE DB-based components, such as ActiveX Data Objects (ADO).

OO4O consists of an in-process COM Automation Server, a C++ class library, and the Oracle Data Control. Architecturally, OO4O resides as a thin layer on top of the Oracle Call Interface (OCI), which provides much of the underlying database access plumbing. C/C++ programmers can use OCI directly. However, many Windows programmers use OO4O because of its ease of use and its accessibility from scripting languages, such as Visual Basic, unlike OCI.

OO4O permits access to all of Oracle's major database features including:

- Full support for PL/SQL, including seamless access to PL/SQL cursors
- Tunable client-side, scrollable, and updateable cursors
- Support for array fetches, updates, and inserts resulting in reduced network roundtrips
- Connection pooling to enhance middle-tier application scalability
- Multiplexing to allow user sessions to share an Oracle network connection, such as in a web environment
- Thread safety allowing safe access to Automation objects in multi-threaded environments
- Full support for MTS/COM+-coordinated transactions
- Seamless access to advanced Oracle data types
    - Object References (REFs), Object Instances (Objects), Nested Tables, VARRAYs, BLOBs, CLOBs, NCLOBs and BFILEs
- Easy to use interface for describing schema objects
- Full support for accessing Advanced Queuing capabilities
- Asynchronous processing
- OO4O Code Wizard for Stored Procedures which generates VB or ASP code that executes PL/SQL and Java stored procedures

XML Support

XML is quickly becoming one of the common data formats for Internet applications. In Oracle9*i*, OO4O introduces XML support, allowing users to easily extract and insert data from Oracle in XML format. OO4O users can now flexibly

render XML from a dynaset object. The XML support includes the ability to use advanced data types and to control the XML output format.

Full Unicode Support

As more business applications become Internet-centric and globally accessible, the need to simplify application development in multiple written languages arises. Unicode is the universal character set standard that encodes all characters from languages worldwide. It provides the basis for global computing by allowing applications to be written once, then deployed in any and all languages.

OO4O and the Oracle9*i* database add this globalization support with full UCS2 Unicode support. Using Unicode in OO4O is transparent, requiring no application code changes. This makes developing global applications with OO4O easy and fast.

Enhanced Oracle Services for MTS

Many OO4O users employ MTS/COM+ for their transaction and object management. The Oracle Services for MTS acts as a proxy between the Oracle database and MTS/COM+ to perform these management tasks. The Oracle Services for MTS has been re-architected to improve the availability and scalability of OO4O applications using this application stack. The new architecture removes the single point of failure and bottlenecks that were present in previous versions. This redesign can be adopted transparently without having to make any application code changes. The improvements to the Oracle Services will be discussed further in the Application Deployment section of this white paper.

Database Events

OO4O in Oracle9*i* includes support for publishing, detecting, and subscribing to database events. By allowing OO4O to publish and subscribe to events, Windows clients can interact closely with the Oracle database. This functionality allows server-side events to initiate client and middle-tier actions, and vice-versa.

This feature supports asynchronous notification of database events to interested subscribers. Under this model, the client can subscribe to one or more database events. Each database event that the client is interested in is stored as a subscription. When a database event of interest is triggered, the client subscriber's database event handler for that event is fired and the subscriber is notified.

The database event subscriber is required to create a subscription, based on the database event of interest. At the time of subscription creation, the subscriber should provide an event handler. The database event handler should be an automation object that implements the NotifyDBEvents method. OO4O invokes the NotifyDBEvents method of the event handler when the particular database event is fired.

ADO and the Oracle Provider for OLE DB

The Oracle Provider for OLE DB gives ActiveX Data Objects (ADO) developers high performance and efficient access to Oracle databases. Because it is a native OLE DB provider, it offers data access optimizations and access to Oracle-specific database features, such as support for LOBs, PL/SQL, and REF CURSORs. All these Oracle features and data access optimizations are generally not available in other third-party Oracle OLE DB providers and the OLE DB-ODBC Bridge. By adhering closely to the Microsoft OLE DB specification, the Oracle provider allows ADO developers to take full advantage of OLE DB without having to sacrifice using advanced Oracle functionality.

The Oracle Provider for OLE DB was built to improve data access functionality, performance, and reliability for ADO developers. The provider supports the following general features:

- Scrollable and updateable rowsets
    - Updateable rowsets created using joins (available with the client cursor engine)
- Local and distributed/MTS-coordinated transactions
- OS authentication, which allows Oracle to authorize users via the operating system's security mechanisms
- Several schema rowsets
- ADOX
- Data shaping services with select statements
- MDAC 2.1, 2.5, and 2.6

The provider supports the following Oracle-specific features:

- PL/SQL
    - Procedures and functions returning multiple rowsets
    - Packaged and non-packaged PL/SQL
- LOBs and N-data types
    - LOB parameters with stored procedures
    - Binding NCHAR parameters with SQL statements
- Database links
- Oracle Password Expiration feature

Full Unicode Support

As more applications become Internet-accessible, the need to support customers around the world becomes necessary. Applications must support these customers

in their native languages without making the software development process cumbersome.

In Oracle9*i*, the Oracle OLE DB provider adds full UCS2 Unicode support to help Windows developers support their users globally. Developers can use Unicode in their ADO/OLE DB applications transparently, requiring no application code changes.

Enhanced Oracle Services for MTS

As with OO4O users, many ADO/OLE DB users employ MTS/COM+ for their transaction and object management. The Oracle OLE DB provider can use the redesigned Oracle Services for MTS without needing any application code modifications. Using the new Oracle9*i* Services for MTS improves the availability and scalability of ADO/OLE DB applications by removing the single point of failure and bottleneck that was present in previous versions. These improvements to the Oracle Services will be discussed further in the Application Deployment section of this white paper.

The Oracle OLE DB provider is built to handle the high-volume, high-load of Internet application environments. The provider leverages Oracle's proven Internet infrastructure to ensure highly reliable, fast-performing, and secure data access. Current ADO and OLE DB programmers can easily migrate to the Oracle provider because it complies with the latest OLE DB and ADO specifications while allowing access to Oracle's advanced features.

COM Automation Feature

Oracle customers on Windows platforms often possess familiarity with COM Automation solutions. COM Automation allows the invocation of COM objects through the IDispatch interface. Among other uses, it is heavily employed in Visual Basic programming and provides a means for manipulating Microsoft Office applications and data through their Automation interfaces.

The Oracle9*i* COM Automation Feature provides PL/SQL and Java packages that allow stored procedure developers to call COM Automation servers. This allows Oracle server-side events to invoke actions in Windows clients. Stored procedure programmers can now access and manipulate any COM Automation server, such as Microsoft Office. For example, the COM Automation Feature can be designed to automatically compile and graph sales data that resides in an Oracle database using a Microsoft Excel spreadsheet. Or it can be automated to email this data to a set of sales managers using Microsoft Exchange. In fact, the COM Automation Feature is not limited to calling Microsoft COM objects; it can be used to manipulate any COM Automation server or custom COM Automation object.

The COM Automation Feature provides several main advantages:

- Straightforward APIs make it easy for PL/SQL and Java developers to incorporate COM Automation objects into their routines

- Preexisting COM Automation objects can be leveraged into Oracle solutions by calling them through the COM Automation Feature
- The Oracle database can be used to drive integration with Windows applications

These PL/SQL and Java packages expose APIs to instantiate COM objects, get and set their properties, and invoke their methods. Developers can call these APIs from PL/SQL and Java subprograms, stored procedures, stored functions, and triggers. There are no restrictions as to where the COM objects can reside. They can be either local to the database server or be accessed remotely through the Distributed Component Object Model (DCOM).

ODBC

The Oracle ODBC driver permits a more traditional way Windows applications can access the Oracle database server. Recently introduced functionality in Oracle9*i* ODBC includes:

- Expanded Unicode support
  - Unicode data types
  - SQL statements encoded in Unicode.
- Multiple Oracle homes support
- Performance improvements in ODBC catalog functions
- Better scalability and availability with the Oracle9*i* Services for MTS

APPLICATION DEPLOYMENT

Deploying applications on Windows requires close integration with native Windows services and middle-tier servers to ensure proper application interoperability. Oracle9*i* provides this tight integration with Windows, allowing organizations to take advantage of core operating system and server functionality with Oracle9*i*'s advanced feature set. Oracle's integration ensures transparent interoperability that is scalable, available, and secure. In this way, organizations can focus resources on building their application business logic, rather than correcting product incompatibilities or inefficiencies on Windows.

Oracle9*i* includes many sets of tools for ensuring optimized application deployment environments. The Oracle Services for Microsoft Transaction Server feature a new design that makes transactional applications better performing, more scalable, and available. When deploying mission-critical Oracle servers on Windows clusters, Oracle Fail Safe ensures that those servers remain available by providing robust fail over support through the Microsoft Cluster Server. Oracle9*i* integrates with native Windows security and directory tools that both improve database security and make user management easier.

Oracle Services for Microsoft Transaction Server

Many Oracle customers on Windows platforms use Microsoft Transaction Server (MTS) in the middle-tier. MTS is an application server for COM objects and transactions in distributed environments. At the core of MTS is the Distributed Transaction Coordinator (DTC), which coordinates transactions between distributed resource managers. In Windows 2000, the MTS executive is replaced by enhancements to COM+ services.

The Oracle Services for Microsoft Transaction Server integrate the DTC with Oracle databases. The services, which act as a proxy, allow customers to use Oracle databases as resource managers in DTC-coordinated transactions. Specifically, the services provide the following transaction operations:

- Enlistment - Context maintenance for global transactions
- Completion - Translation of two-phase commit calls between DTC and Oracle
- Recovery - Resolution of in-doubt DTC transactions
- Connection pooling - Caching of transactional database connection resources

In Oracle9*i*, the Oracle Services for MTS feature a new architecture for improved performance, scalability, and availability. Previously, each database was associated with only one resource manager proxy that participated in DTC transactions on behalf of the database. An integration layer for the Oracle Services for MTS allowed middle-tier applications to participate in transactions. Additionally, the Oracle Services for MTS ran as a Windows service, requiring extra-process communication with MTS.

The new Oracle9*i* Services for MTS architecture improves greatly over this previous design. Each MTS server now maintains its own cache of resource manager proxies, so that any database may have numerous proxies associated with it. This cache of proxies is maintained by the Oracle Services for MTS integration layer, which runs directly inside the MTS server process. This integration layer handles transaction enlistment and completion among the application, DTC, and database.

In a multiple MTS deployment, this model leads to better availability because no proxy can become a single point of failure. Moreover, it leads to better overall performance as no single proxy can become a bottleneck to the database and extra-process communication has been reduced by moving the Oracle Services for MTS integration layer into the MTS process.

In Oracle9*i*, each MTS server runs a recovery daemon. Recovery is driven by the database, which requests the final outcome of in-doubt transactions through reenlistment. A PL/SQL package runs a periodic recovery job, which contacts the recovery daemon associated with the dubious transaction. The daemon requests the transaction result from DTC and informs the database of the result. A

database administration account, named MTSSYS, is created upon installation for DTC recovery.

The Oracle Services for MTS allow developing applications with a variety of data access interfaces, including OO4O, OCI, ADO/OLE DB, and ODBC. In general, OO4O and OCI provide better performance and compatibility with Oracle. OO4O and OCI use connection pooling provided by Oracle's resource dispensers. The Oracle Provider for OLE DB and the Oracle ODBC driver employ Microsoft resource management for database connections.

Although the Oracle Services for MTS itself only runs on Windows, it can operate with Oracle databases on any operating system. This situation is ideal for customers using a Windows middle-tier to access UNIX-based Oracle servers.

Oracle Fail Safe

Oracle Fail Safe is a core feature of Oracle9*i* that provides high-availability for mission-critical solutions deployed on Windows clusters. A cluster eliminates individual host systems as points of failure. Oracle Fail Safe release 3.2 works with Microsoft Cluster Server (MSCS) to ensure that if a failure occurs on one cluster node, then the Oracle databases and applications running on that node will fail over (move) automatically and quickly to a surviving node.

Oracle Fail Safe is optimized for Windows customers with database and application workloads that can be handled by a single system. Oracle Fail Safe solutions can be deployed on all commodity Windows NT and Windows 2000 clusters. It supports up to four-node clusters on Windows 2000 Datacenter Server, the maximum node configuration available on Windows today. Supported products include:

- Oracle databases (Oracle9*i*, Oracle8*i*, and Oracle8)
- Oracle *i*AS, with the exception of Oracle9*i* Caches
- Oracle Applications release 11*i*
- Oracle Developer Forms and Reports Servers
- Oracle Forms Load Balancer Server
- Oracle HTTP Server
- Applications installed as Windows services

SAP, Baan, PeopleSoft, Lawson, J.D. Edwards, and other applications vendors also have validated their software solutions with Oracle Fail Safe.

Oracle Fail Safe includes two main components, a server and a manager. The server component, Oracle Services for MSCS, works with the cluster software to ensure fast automatic fail over during planned and unplanned outages. The manager, Oracle Fail Safe Manager, is an easy-to-use graphical interface that works with Oracle Fail Safe Server on one or more clusters to perform configuration, management, verification, and static load balancing. Together, these components

provide a rich set of features and integrated troubleshooting tools that enable rapid deployment of highly available databases and applications.

Security

Oracle9*i* provides tight integration with the native Windows security model to better safeguard application security. Windows 2000 has numerous technologies implementing Microsoft's public key infrastructure (PKI) security. Oracle9*i* includes two features that improve usage of the Oracle PKI on Windows:

- Oracle wallets in Windows registry
- Microsoft Certificate Store integration

Oracle Wallets in Windows Registry

Oracle wallets can now be stored in the Windows registry, providing increased security for Oracle wallets on Windows clients. Without this feature, Oracle wallets are often stored on the Windows file system. If the operating system file permissions are not secure, the Oracle wallets are also insecure. Insecure file permissions may come from improper administration or lack of operating system file security, such as on Windows 98. On Windows systems, therefore, PKI security is improved by storing Oracle wallets in the user profile area of the Windows registry. This registry area is accessible only to the properly logged-in user. Multiple Oracle wallets can be used and stored from the profile area.

Single sign-on for Oracle PKI applications is enabled through the Oracle Wallet Manager and Oracle Enterprise Login Assistant tools. The Wallet Manager creates encrypted Oracle wallets, while the Enterprise Login Assistant creates the decrypted wallet. The decrypted wallet is then used by Oracle PKI applications for SSL authentication. Both of these tools are enhanced to support the storage and location of Oracle wallets in the registry, as well as the default file system if required.

Microsoft Certificate Store Integration

Oracle's integration with the Microsoft Certificate Store allows Oracle PKI applications to interoperate with products that use Windows PKI. When this feature is enabled, Oracle PKI security uses Microsoft CryptoAPIs to access the Microsoft Certificate Store. The CryptoAPIs are used for operations, such as signing, encryption, decryption, verification, and validation. The Wallet Resource Locator (WRL) determines the PKI type and other relevant information.

With this feature, Oracle and non-Oracle applications can leverage the same set of PKI credentials (such as certificates, keys, revocation lists, and trustpoints) for public key security services, such as authentication and encryption. Because only one set of credentials is needed, user administration now becomes easier and simpler.

Directory

Directory servers often make user and resource management easier by centralizing administration. Oracle9*i* includes two features that leverage Active Directory (AD) on Windows:

- Native authentication and AD
- Net9 naming with AD

Native Authentication and Active Directory

Oracle customers often require enterprise-scale security and schema management. This is especially true for businesses with large user populations. Oracle security and administration are integrated with Windows 2000 through Active Directory.

Oracle provides native authentication through Windows authentication mechanisms, allowing the operating system to perform user identification for Oracle databases. Oracle supports the core Kerberos security protocol on Windows 2000. With native authentication enabled, users can leverage single sign-on to access Oracle simply by logging onto Windows, reducing end-user administration and eliminating redundant security credentials.

Oracle enterprise user mappings allow many Windows users to access multiple databases as a single global database user. These enterprise user mappings may be stored in Active Directory. For instance, an entire LDAP organizational unit (OU) in Active Directory can be mapped to one database user.

Oracle also stores enterprise role mappings in Active Directory. With enterprise roles, privileges for multiple databases can be managed at the domain level through directories. This is accomplished by assigning Windows users and groups to the Oracle enterprise roles registered in AD.

Net9 Naming with Active Directory

Oracle leverages Active Directory to improve database connectivity information management. Traditionally, end-users reference databases with Net9-style names resolved through the TNSNAMES.ORA configuration file. This file must be administered on each client machine. With Oracle9*i*, Net9 names can be stored and resolved through Active Directory. Centralizing such information in a directory eliminates administrative overhead and relieves users from configuring their individual client machines.

Furthermore, various tools in Windows 2000, such as Windows Explorer and Active Directory Users and Computers, can now connect to databases and test database connectivity. Oracle tools have also been enhanced. The Oracle Database Configuration Assistant automatically registers database objects with Active Directory. The Oracle Net9 Manager, meanwhile, registers net service objects with the directory. These enhancements further simplify administration.

CONCLUSION

As technology in Windows application development and deployment has evolved from client/server to the Internet, so has Oracle. Oracle9*i* offers unprecedented flexibility for customers to choose the application tools and architecture that fit their requirements without sacrificing performance, scalability, ease of use, and security. By designing Oracle9*i* with Windows in mind, customer software applications can achieve seamless interoperability between the operating system and the database.

For more information on the Oracle9*i* database, please read the Oracle white paper, *Oracle9i: A Family of Database Products.* For more information regarding Oracle on Windows, please read the technical white papers, *Oracle9i Database Architecture on Windows* and *Oracle9i Database: Integration with Windows.* Please visit the following web sites for Oracle on Windows online information:

http://www.oracle.com/nt/

http://otn.oracle.com/tech/nt/

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