Oracle® Database Gateway for DRDA

User's Guide

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Preface

The Oracle Database Gateway for DRDA provides users with transparent access to DB2.

Intended Audience

This guide is intended for anyone responsible for installing, configuring, and administering the gateway, and also for application developers.

Read this guide if you are responsible for writing applications that access DRDA databases through the gateway.

You must understand the fundamentals of Oracle Database Gateway and the operating system you are working on before using this guide to install or administer the gateway.

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

Access to Oracle Support

Oracle customers that have purchased support have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.

Related Documents

Oracle Database Heterogeneous Connectivity User's Guide

Oracle Database Administrator's Guide

Oracle Database Concepts

Oracle Database Error Messages

Oracle Database Performance Tuning Guide

Oracle Database Security Guide

Typographic Conventions

The following typographic conventions are used in this guide:

Convention	Description
`monospace`	Monospace type indicates commands, directory names, user names, path names, and file names.
italics	Italic type indicates variables, including variable portions of file names. It is also used for emphasis and for book titles.
UPPERCASE	Uppercase letters indicate Structured Query Language (SQL) reserved words, initialization parameters, and environment variables.
Bold	Bold type indicates screen names and fields.
SQL*Plus prompts	The SQL*Plus prompt, SQL>, appears in SQL statement and SQL*Plus command examples. Enter your response at the prompt. Do not enter the text of the prompt, "SQL>", in your response.

SQL*Plus Prompts

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Storage Measurements

Storage measurements use the following abbreviations:

- KB, for kilobyte, which equals 1,024 bytes
- MB, for megabyte, which equals 1,048,576 bytes
- GB, for gigabyte, which equals 1,073,741,824 bytes

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Introduction to the Oracle Database Gateway for DRDA

The following sections provide information about the architecture, uses, and features of the Oracle Database Gateway for DRDA:

Overview ofthe Oracle Database Gateway for DRDA

The Oracle Database Gateway for DRDA gives you access to your Oracle data and DB2 data with a single set of applications while you continue to use existing IBM applications to access your DB2 data. The gateway enables you to:

- Integrate heterogeneous database management systems so that they appear as a single homogeneous database system.
- Read and write data from Oracle applications to data in DB2 UDB for z/OS, DB2 Universal Database™ for iSeries™ (DB2 UDB for iSeries), and DB2 Universal Database.

Oracle Database 12*c* Release 2 (12.2) provides the foundation for the next generation of the Oracle Database Gateways, which delivers enhanced integration capabilities by exploiting Oracle Database Heterogeneous Services.

As an integrated component of the Oracle database, Heterogeneous Services can take advantage of the powerful SQL parsing and distributed optimization capabilities of the Oracle database. This integration also ensures that the gateway can immediately take advantage of any enhancements made to future releases of the Oracle database. For detailed information on Oracle Heterogeneous Services, refer to *Oracle Database Heterogeneous Connectivity User's Guide*.

The gateways are even more tightly integrated with Oracle Database 12*c* Release 2 (12.2) than previous versions, enabling improved performance and enhanced functionality while still providing transparent integration of Oracle and non-Oracle data. For example, connection initialization information is available in the local Oracle database, reducing the number of round trips and the amount of data sent over the network. SQL execution is also faster, because, statements issued by an application are parsed and translated once and can then be reused by multiple applications.

Gateway Capabilities

Oracle Database Gateway for DRDA enables you to integrate your heterogeneous system into a single, seamless environment. If data is moved from a DRDA database to an Oracle database, then no changes in application design or function are needed. The gateway handles all differences in both data types and SQL functions between the application and the database. As a result, end users and application programmers are not required to know either the physical location or the storage characteristics of the data.

This transparency not only enables you to integrate heterogeneous data seamlessly, it also simplifies your gateway implementation, application development, and maintenance. The gateway capabilities are as follows:

- Transparency at All Levels
- Extended Database Services
- Extended Advanced Networking_ Internet and Intranet Support
- Dynamic Dictionary Mapping
- SQL
- Data Definition Language
- Data Control Language
- Passthrough and Native DB2 SQL
- Stored Procedures
- Languages
- Oracle Database Technology and Tools
- SQL*Plus
- Two-Phase Commit and Multi-Site Transactions
- Site Autonomy
- Migration and Coexistence
- Security
- DRDA UDB Server Encryption support

Transparency at All Levels

Oracle Database Gateway for DRDA gives you transparency at the following levels:

- Location

  Users can access tables by name and do not need to know the physical location of the tables.

- Network

  The gateway exploits the Oracle Net technology to allow users to access data across multiple networks without concern for the network architecture. TCP/IP protocol is supported. This release supports IPV4 and IPV6 between Oracle database and the gateway, and also between the gateway and the DB2 server.

- Operating System

  Users can access data stored under multiple operating systems without being aware of the operating systems that hold the data.

- Data Storage

  The gateway provides the ability for data to be accessed regardless of the database or file format.

- Access Method

  You can utilize a single dialect of SQL for any data store, eliminating the need to code for database-specific access methods or SQL implementations.

Extended Database Services

Following are some of the Oracle database services available through the gateway:

- SQL functions

  Your application can access all your data using Oracle SQL. The method by which the gateways are integrated with the Oracle database ensures that the latest features of each database release are always available immediately to the gateway.

- Distributed capabilities

  Heterogeneous data can be integrated seamlessly because Oracle distributed capabilities, such as `JOIN` and `UNION`, can be applied against non-Oracle data without any special programming or mapping.

- Distributed query optimization

  The Oracle database can utilize its advanced query optimization techniques to ensure that SQL statements are executed efficiently against any of your data. The data distribution and storage characteristics of local and remote data are equally considered.

- Two-phase commit protection

  The Oracle database two-phase commit mechanism provides consistency across data stores by ensuring that a transaction that spans data stores is still treated as a single unit of work. Changes are not committed (or permanently stored) in any data store unless the changes can be committed in all data stores that will be affected.

- Stored procedures and database triggers

  The same Oracle stored procedures and database triggers can be used to access all of your data, thereby ensuring uniform enforcement of your business rules across the enterprise.

Extended Advanced Networking, Internet and Intranet Support

The gateway integration with the Oracle database extends the benefits of the Oracle Internet and Oracle Net software to non-Oracle data and extends the benefits of the Oracle client/server and server/server connectivity software. These features include:

- Application server support

Any Internet or intranet application that can access data in the Oracle database can also incorporate information from data stores accessible through the gateways. Web browsers can connect to the Oracle database using any application server product that supports Oracle software.

- Implicit protocol conversion

  Oracle and Oracle Net can work together as a protocol converter, allowing applications to transparently access other data stores on platforms that do not support the clients network protocol. An Oracle database can use TCP/IP to communicate with the gateway and another data store.

- Advanced Security

  Non-Oracle data can be protected from unauthorized access or tampering during transmission to the client. You can do this by using the hardware-independent and protocol-independent encryption and checksum services of Advanced Security.

- Wireless communication

  Oracle Mobile Agents, an Oracle industry-leading mobile technology, enables wireless communication to Oracle database or to any databases that are accessible through the gateways. This gives your field personnel direct access to enterprise data from mobile laptop computers.

Dynamic Dictionary Mapping

The simple setup of the gateway does not require any additional mapping. Before an application can access any information, the application must be told the structure of the data, such as the columns of a table and their lengths. Many products require administrators to manually define that information in a separate data dictionary stored in a hub. Applications then access the information using the hub dictionary instead of the native dictionaries of each database. This approach requires a great deal of manual configuration and maintenance on your part. As administrators, you must update the data dictionary in the hub whenever the structure of a remote table is changed.

Inefficient duplication is not necessary with Oracle Database Gateway for DRDA. The gateway uses the existing native dictionaries of each database. Your applications access data using the dictionaries designed specifically for each database, which means no redundant dictionary ever needs to be created or maintained.

SQL

Oracle Database Gateways ease your application development and maintenance by allowing you to access any data using a uniform set of SQL. Changes to the location, storage characteristics, or table structure do not require any changes to your applications. ANSI and ISO standard SQL are supported, along with powerful Oracle extensions.

Data Definition Language

Oracle Applications can create tables in target data stores by using native data definition language (DDL) statements.

Data Control Language

You can issue native data control language (DCL) statements from an Oracle environment, allowing central administration of user privileges and access levels for heterogeneous data stores.

Passthrough and Native DB2 SQL

Execution of native DB2 SQL can be passed through the gateway for execution directly against DB2. This enables applications to send statements, such as a DB2 `CREATE TABLE`, to the gateway for execution on a target DB2 system.

Stored Procedures

The gateway enables you to exploit both Oracle and non-Oracle stored procedures, leveraging your investments in a distributed, multi-database environment. Oracle stored procedures can access multiple data stores easily, without any special coding for heterogeneous data access.

Oracle Stored Procedures

Oracle stored procedures enable you to access and update DB2 data using centralized business rules stored in the Oracle database. Using Oracle stored procedures can increase your database performance by minimizing network traffic. Instead of sending individual SQL statements across the network, an application can send a single `EXECUTE` command to begin an entire PL/SQL routine.

Native DB2 Stored Procedures

The gateway can execute DB2 stored procedures using standard Oracle PL/SQL. The Oracle application executes the DB2 stored procedure as if it were an Oracle remote procedure.

Languages

Any application or tool that supports the Oracle database can access over thirty different data sources through the Oracle gateways. A wide variety of open system tools from Oracle Corporation and third-party vendors can be used, even if the data is stored in legacy, proprietary formats. Hundreds of tools are supported, including ad hoc query tools, Web browsers, turnkey applications, and application development tools.

Oracle Database Technology and Tools

The gateway is integrated into the Oracle database technology, which provides global query optimization, transaction coordination for multi-site transactions, and support for all Oracle Net configurations. Tools and applications that support the Oracle database can be used to access heterogeneous data through the gateway.

SQL*Plus

You can use SQL*Plus for moving data between databases. This product gives you the ability to copy data from your department databases to corporate Oracle database instances.

Two-Phase Commit and Multi-Site Transactions

The gateway can participate as a partner in multi-site transactions and two-phase commit. How this occurs depends on the capabilities of the underlying data source, meaning that the gateway can be implemented as any one of the following:

- Full two-phase commit partner
- Commit point site
- Single-site update partner
- Read-only partner

The deciding factors for the implementation of the gateway are the locking and transaction-handling capabilities of your target database.

Oracle Database Gateway for DRDA by default is configured as a commit point site, that is, commit confirm protocol. Optionally, you can configure the gateway as read-only if you choose to enforce read-only capability through the gateway. Other protocols are not supported.

Site Autonomy

All Oracle database products, including gateways, supply site autonomy. For example, administration of a data source remains the responsibility of the original system administrator. Site autonomy also functions such that gateway products do not override the security measures established by the data source or operating environment.

Migration and Coexistence

The integration of a data source through the gateway does not require any changes to be made to applications at the data source. The result is that the Oracle database technology is non-intrusive, providing coexistence and an easy migration path.

Security

The gateway does not bypass existing security mechanisms. Gateway security coexists with the security mechanisms already used in the operating environment of the data source.

Functionally, gateway security is identical to that of an Oracle database, as described in the *Oracle Database Security Guide*. Oracle database security is mapped to the data dictionary of the data source.

DRDA UDB Server Encryption support

This release of Gateway for DRDA provides complete UDB server Encryption support. Refer to the following new parameters for various options:

- HS_FDS_AUTHENTICATE_USER
- HS_FDS_ENCRYPT_SESSION
- HS_FDS_TRUSTSTORE_FILE
- HS_FDS_TRUSTSTORE_PASSWORD

Terms

The terms used in this guide do not necessarily conform to the IBM terminology. The following list presents several terms and their meanings as used within this guide:

DRDA data is, generically, any database data accessed through DRDA.

DRDA database is the collection of data that belongs to a DRDA server

DRDA server is a database server that can be accessed through DRDA. IBM terminology for a DRDA server is a DRDA Application Server, or AS.

DRDA server type is a specific database product or program that can act as a DRDA server.

Oracle database is any Oracle Database 12*c* Release 2 (12.2) instance that communicates with the Oracle Database Gateway for DRDA to distribute database access operations to a DRDA server. The Oracle database can also be used for non-gateway applications.

DB2 Universal Database is a generic name for all implementations of IBM's DB2 Database product. DB2/UDB is frequently used as an abbreviation for the DB2 Universal Database for Unix, Linux, and Windows product.

Architecture

The Oracle Database Gateway for DRDA works with the Oracle database to shield most of the differences of the non-Oracle database from Oracle applications.

The architecture consists of the following main components:

- Client

  The client is an Oracle application or tool.

- Oracle database

  The gateway instance is accessed by an Oracle database with procedural and distributed options. Usually, the Oracle database is installed on the same host as the gateway, but this is not a requirement. The Oracle database and the gateway communicate in the normal Oracle database-to-server manner.

  If the Oracle database is not on the host where the gateway resides, then you must install the correct Oracle networking software on the platform where the server resides. For Oracle database, you must install Oracle Net on the Oracle database machine.

- Oracle Database Gateway for DRDA

  The gateway must be installed on hosts that are running the appropriate operating system.

  If the Oracle database is not on the same host, then you must also install Oracle Net so that the gateway and Oracle database can communicate.

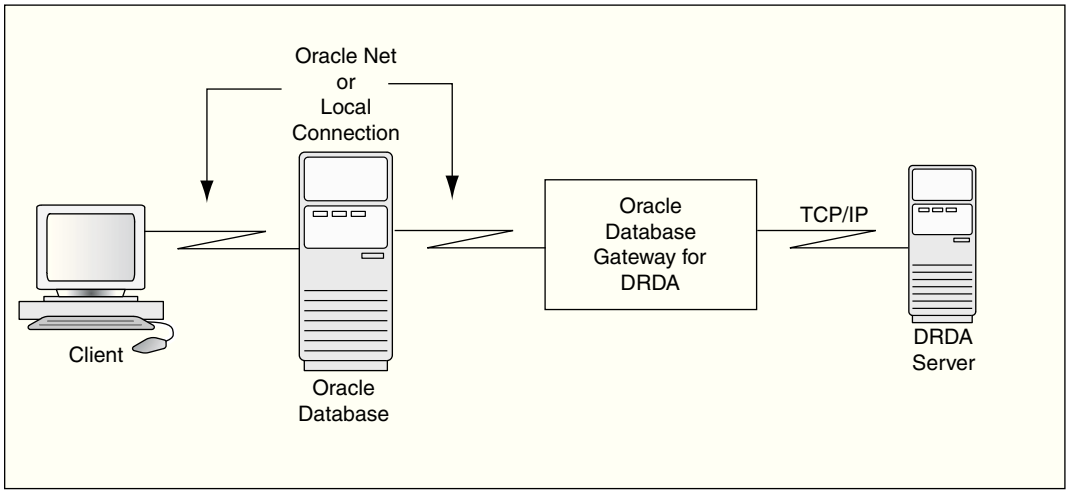
- DRDA server

  The DRDA server must be on a system accessible to the host via a network.

Multiple Oracle databases can access the same gateway.

Figure 1-1 illustrates the gateway architecture.

Figure 1-1 The Gateway Architecture



Implementation

When the gateway is installed on your host, it has some of the same components as an Oracle database instance on your host. The gateway has the following components:

- A base file directory, similar to the one associated with an Oracle instance `ORACLE_HOME` environment variable
- A gateway system identifier (SID), comparable to an Oracle instance `ORACLE_SID`
- Oracle Net to support communication between the Oracle database and the Oracle Database Gateway for DRDA

The gateway does not have:

- Control, redo log, or database files
- The full set of subdirectories and ancillary files that are associated with an installed Oracle database

Because the gateway does not have background processes and does not need a management utility, such as Oracle Enterprise Manager, you do not need to start the gateway product. Each Oracle database user session that accesses a particular

gateway creates an independent process on the host. This process runs the gateway session and executes network operations to communicate with a DRDA server.

How the Gateway Works

The gateway has no database functions of its own. Instead, it provides an interface by which an Oracle database can direct part or all of a SQL operation to a DRDA database.

The gateway that is supporting the DRDA server is identified to the Oracle database using a database link. The database link is the same construct that is used to identify other Oracle databases. Tables on the DRDA server are referenced in SQL as:

table_name@dblink_name

or

owner.table_name@dblink_name

If you create synonyms or views in the Oracle database, then you can refer to tables on the DRDA server by using simple names as though the table were local to the Oracle database.

When the Oracle database encounters a reference to a table that is on the DRDA server, the applicable portion of the SQL statement is sent to the gateway for processing. Any host variables that are associated with the SQL statement are bound to the gateway and, therefore, to the DRDA server.

The gateway is responsible for sending these SQL statements to the DRDA server for execution and for fielding and returning responses. The responses are either data or messages. Any conversions between Oracle data types and DRDA data types are performed by the gateway. Both the Oracle database and the application read and process only Oracle data types.

SQL Differences

Not all SQL implementations are the same. The Oracle database supports a larger set of built-in functions than the databases that are currently accessed through the gateway. The Oracle database and the gateway work together to convert SQL to a form that is compatible with the specific DRDA server.

During this conversion, an Oracle database function can be converted to a function that is recognizable to the specific DRDA server. For example, the Oracle database `NVL` function is converted to the DB2 `VALUE` function.

Alternatively, the Oracle database withholds functions that are not executable by the DRDA server and performs them after rows are fetched from the DRDA database. This processing only applies to `SELECT` statements. The Oracle database and the gateway cannot perform this kind of manipulation on `UPDATE`, `INSERT`, or `DELETE` statements because doing so changes transaction semantics.

Oracle Tools and the Gateway

Use the Oracle Database Gateway to run applications, such as Oracle database tools, that read and write data that is stored in DRDA databases.

While the Oracle Database Gateway for DRDA provides no new application or development facilities, it extends the reach of existing Oracle database tools to include data in non-Oracle databases that support DRDA.

Using the Oracle Database Gateway for DRDA with other Oracle products can greatly extend the capabilities of the stand-alone gateway.

SQL*Plus

Use SQL*Plus and the Oracle Database Gateway for DRDA to create a distributed database system, providing an easy-to-use transfer facility for moving data between the distributed databases. One possible use is to distribute the data in your corporate Oracle database to departmental DRDA databases. You can also distribute data in your corporate DRDA database to departmental Oracle databases.

Features

Following is a list of important features that characterize Oracle Database Gateway for DRDA:

- Heterogeneous Services Architecture
- Performance Enhancements
- Fetch Reblocking
- Oracle Database Passthrough Supported
- Retrieving Result Sets Through Passthrough
- Support for TCP/IP
- Native Semantics
- Columns Supported in a Result Set
- EXPLAIN_PLAN Improvement
- Heterogeneous Database Integration
- Minimum Impact on Existing Systems
- Application Portability
- Remote Data Access
- Support for Distributed Applications
- Application Development and End User Tools
- Password Encryption Utility
- Support for DB2 UDB for z/OS Stored Procedures
- IBM DB2 Universal Database Support
- DB2 z/OS ASCII and UNICODE Table Support
- Read-Only Support
- Support for Graphic and Multi-byte Data
- Support for DB2 Universal Database on Intel Hardware
- Data Dictionary Support for DB2 Universal Database

Heterogeneous Services Architecture

Oracle Database Gateway for DRDA utilizes the Oracle Heterogeneous Services component within the Oracle database. Heterogeneous Services is the building block for the next generation of Oracle database gateways.

For detailed information about heterogeneous services, refer to *Oracle Database Heterogeneous Connectivity User's Guide*.

Performance Enhancements

Oracle Database Gateway for DRDA contains several internal performance enhancements. This product has shown major improvements in response time and CPU utilization for all relevant address spaces for a variety of workloads compared to version 10 gateways. The actual performance improvement at your site might vary, depending on your installation type and workload.

Fetch Reblocking

The array size of the application for `SELECT` is effective between the application and the Oracle database. However, the array blocksize and the block fetch between the Oracle database and the gateway are controlled by two Heterogeneous Services initialization parameters: `HS_RPC_FETCH_SIZE` and `HS_RPC_FETCH_REBLOCKING`. These parameters are specified in the gateway initialization file. Refer to *Oracle Database Heterogeneous Connectivity User's Guide* for more information.

Oracle Database Passthrough Supported

You can use the Oracle database `DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE` method to pass commands or statements available in your DRDA server through the gateway.

Retrieving Result Sets Through Passthrough

Oracle Database Gateway for DRDA provides a facility to retrieve result sets from a `SELECT` statement issued with passthrough. Refer to "Retrieving Results Sets Through Passthrough" for additional information.

Support for TCP/IP

This release of the gateway only supports the TCP/IP communication protocol between the gateway and the DRDA server. Refer to *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium*, or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* depending on your platform.

Native Semantics

This release of the gateway supports the ability to selectively enable or disable post-processing of various SQL functions by the DRDA server. Refer to "Native Semantics" for further information.

Columns Supported in a Result Set

Oracle Database Gateway for DRDA supports up to 1000 columns in a result set.

EXPLAIN_PLAN Improvement

The `EXPLAIN_PLAN` table contains the actual SQL statements passed to the DRDA server from the Oracle database through the gateway.

Heterogeneous Database Integration

The gateway support for ANSI-standard SQL enables read/write access to DRDA databases. Even if your data exists on different platforms in different applications, new applications can use all data, regardless of location.

Minimum Impact on Existing Systems

The gateway does not require installation of additional Oracle software on your OS/390 (MVS), AS/400, UNIX based, or Microsoft Windows target system. The database interface that it uses is provided by IBM and is built into the DRDA database products and network facilities that already exist on these platforms.

Configuring an IBM system for DRDA access typically consists of defining the network resources involved and establishing access security definitions specific to the target database.

Application Portability

The gateway's ability to interface with heterogeneous databases makes it possible to develop a single set of portable applications that can be used against both Oracle and IBM databases, and any other databases for which Oracle provides gateways.

Remote Data Access

Location flexibility is maximized because the gateway architecture permits network connections between each of the components. The application can use the Oracle client-server capability to connect to a remote Oracle database through Oracle Net. The Oracle database can connect to a remote gateway using a database link. The gateway connects to a DRDA server through network facilities.

The benefits of remote access are:

- Provides a means to allocate the appropriate resource to a given task

  You can, for example, move application development off expensive processors and onto cost-efficient workstations or microcomputers.
- Expands the number of available data sources

  Without remote access, you are limited to the data available in the local environment. With remote access, only your networks limit your data sources.
- Provides a means to tailor an application environment to a given user

  For example, some users prefer a block-mode terminal environment, while others prefer a bit-mapped, graphics driven terminal environment. Remote access can satisfy both because you are not constrained by the interface environment imposed by the location of your data.

Support for Distributed Applications

Because the gateway gives your application direct access to DRDA data, you eliminate the need to upload and download large quantities of database data to other processors. Instead, you can access data where it is, when you want it, without having

to move the data between machines and risk unsynchronized and inconsistent data. Avoiding massive data replication can also reduce aggregate disk storage requirements over all your systems.

However, if your system design requires moving data among the machines in a network, SQL*Plus and the gateway can simplify the data transfer. With a single SQL*Plus command, you can move entire sets of data from one node of the network to another and from one database to another.

You can pass commands and statements specific to your DRDA database through the gateway to be executed by the DRDA database. For example, you can pass native DB2 SQL through the gateway for DB2 to execute. You can also execute stored procedures defined in non-Oracle databases.

Application Development and End User Tools

Through the gateway, Oracle extends the range of application development and end-user tools you can use to access your IBM databases. These tools increase application development and user productivity by reducing prototype, development, and maintenance time. Current Oracle database users do not have to learn a new set of tools to access data stored in DRDA databases. Instead, they can access Oracle database and DRDA data with a single set of tools.

With the gateway and the application development tools available from Oracle you can develop a single set of applications to access Oracle database and DRDA data. Users can use the decision support tools available from Oracle to access Oracle database and DRDA data. These tools can run on remote machines connected through Oracle Net to the Oracle database.

When designing applications, keep in mind that the gateway is designed for retrieval and relatively light transaction loads. The gateway is not currently designed to be a heavy transaction processing system.

Password Encryption Utility

Oracle Database Gateway for DRDA includes a utility to support encryption of plain-text passwords in the Gateway Initialization File. Refer to Chapter 15, "Security Considerations" in *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* for details.

Support for DB2 UDB for z/OS Stored Procedures

Oracle Database Gateway for DRDA supports the native stored procedures.

IBM DB2 Universal Database Support

Oracle Database Gateway for DRDA supports IBM DB2 Universal Database.

DB2 z/OS ASCII and UNICODE Table Support

Oracle Database Gateway for DRDA supports EBCDIC, ASCII, and UNICODE table for DB2 z/OS. The character set selection is defined during table creation.

Read-Only Support

The current release enables the gateway to be configured as a read-only gateway. In this mode, the user will not be able to modify data or call remote procedures at the DRDA database.

Support for Graphic and Multi-byte Data

The current release of the gateway adds support for DB2 `GRAPHIC` and `VARGRAPHIC` data types. Refer to Developing Applications for more information.

Support for DB2 Universal Database on Intel Hardware

The current release of the gateway adds support for DRDA servers running on Microsoft Windows and Linux on Intel hardware.

Data Dictionary Support for DB2 Universal Database

The current release of the gateway also provides Oracle data dictionary support for DB2 UDB.

2
Release Information

The following sections describe release information specific to the Oracle Database Gateway for DRDA.

Product Set

The following product components are included in the product installation media:

- Oracle Database Gateway for DRDA, 12*c* Release 2 (12.2)
- Oracle Net, 12*c* Release 2 (12.2)

Changes and Enhancements

The following sections describe the changes and enhancements unique to this release of the gateway:

Remote Insert Rowsource

A remote insert rowsource feature allows remote insert requiring local Oracle data to work through the Oracle database and Oracle Database Gateway. This functionality requires that the Oracle database and the Oracle Database Gateway to be version 12.2 or later.

By Oracle Database design, some distributed statement must be executed at the database link site. But in certain circumstances, there is data needed to execute these queries that must be fetched from the originating Oracle Database. Under homogeneous connections, the remote Oracle database would call back the source Oracle database for such data. But in heterogeneous connections, this is not viable, because this means that the Foreign Data Store would have to query call back functions, or data, that can only be provided by the Oracle instance that issued the query. In general, these kinds of statements are not something that can be supported through the Oracle Database Gateway.

The following categories of SQL statements results in a callback:

- Any DML with a sub-select, which refers to a table in Oracle database.
- Any `DELETE`, `INSERT`, `UPDATE` or "`SELECT... FOR UPDATE...`" SQL statement containing SQL functions or statements that needs to be executed at the originating Oracle database.

  These SQL functions include `USER`, `USERENV`, and `SYSDATE`; and involve the selection of data from the originating Oracle database.
- Any SQL statement that involves a table in Oracle database, and a `LONG` or `LOB` column in a remote table.

An example of a remote `INSERT` statement that can work through the remote insert rowsource feature is as follows:

```
INSERT INTO gateway_table@gateway_link select * from local_table;
```

Gateway Password Encryption Tool

The Gateway Password Encryption tool (`g4drpwd`) has been replaced by a generic feature that is now part of Heterogeneous Services. Refer to Chapter 15, "Security Considerations" in *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* for details.

Result Sets and Stored Procedures

The Oracle Database Gateway for DRDA provides support for stored procedures that return result sets. By default, all stored procedures and functions do not return a result set to the user. To enable result sets, set the `HS_FDS_RESULTSET_SUPPORT` parameter in the initialization parameter file.

> **See Also:**
>
> Initialization Parameters for information about editing the initialization parameter file and the `HS_FDS_RESULTSET_SUPPORT` parameter. For further information about Oracle support for result sets in non-Oracle databases see *Oracle Database Heterogeneous Connectivity User's Guide*.

> **Note:**
>
> If you set the `HS_FDS_RESULTSET_SUPPORT` gateway initialization parameter, you must change the syntax of the procedure execute statement for all existing stored procedures or errors will occur.

When accessing stored procedures with result sets through the Oracle Database Gateway for DRDA, you will be in the sequential mode of Heterogeneous Services. The gateway returns the following information to Heterogeneous Services during procedure description:

- All the input arguments of the remote stored procedure

- None of the output arguments
- One out argument of type ref cursor (corresponding to the first result set returned by the stored procedure)

Client programs have to use the virtual package function `DBMS_HS_RESULT_SET.GET_NEXT_RESULT_SET` to get the ref cursor for subsequent result sets. The last result set returned is the out argument from the procedure.

The limitations of accessing result sets are as follows:

- Result sets returned by a remote stored procedure have to be retrieved in the order in which they were placed on the wire.
- On execution of a stored procedure, all result sets returned by a previously executed stored procedure will be closed, regardless of whether the data has been completely retrieved or not.

In the following example, the UDB stored procedure is executed to fetch the contents of the `EMP` and `DEPT` tables from UDB:

```
CREATE PROCEDURE REFCURPROC (IN STRIN VARCHAR(255), OUT STROUT VARCHAR(255) )
  RESULT SETS 3  LANGUAGE SQL
BEGIN
  DECLARE TEMP CHAR (20);
 DECLARE C1 CURSOR WITH RETURN TO CALLER FOR
      SELECT * FROM TKHOEMP;
  DECLARE C2 CURSOR WITH RETURN TO CALLER FOR
     SELECT * FROM TKHODEPT;
 OPEN C1;
 OPEN C2;
 SET STROUT = STRIN;
 END
```

Product Migration

Refer to *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* for information on migrating product configurations from previous releases for additional changes or requirements.

Known Problems

The problems that are documented in the following section are specific to the Oracle Database Gateway for DRDA, and are known to exist in this release of the product. If you have any questions or concerns about these problems, contact Oracle Support Services.

A current list of problems is available online. Contact your local Oracle office for information about accessing this online information.

Known Restrictions

The following restrictions are known to exist for the products in the 12*c* Release 2 (12.2). Restrictions are not scheduled to change in future releases. Refer to

Developing Applications, for information or limitations when developing your applications.

DB2 Considerations

The following considerations exist in the 12*c* Release 2 (12.2):

DD Basic Tables and Views

The owner of DD basic tables and views is `OTGDB2`. This cannot be changed.

SUBSTR Function Post-Processed

The `SUBSTR` function can be used with the Oracle database in ways that are not compatible with a DRDA server, such as DB2 UDB for z/OS. Therefore, the `SUBSTR` function is post-processed. However, it is possible to allow the server to process it natively using the "Native Semantics" feature. Refer to Developing Applications, for details.

Data type Limitations

Refer to "DRDA Data type to Oracle Data type Conversion " for detailed information about data types.

Null Values and Stored Procedures

Null values are not passed into, or returned from, calls to stored procedures through the gateway.

String Concatenation of Numbers

DB2 Universal Database does not support string concatenation of numbers. For example,

```
SELECT 2||2 FROM table@dblink
```

is not allowed.

GLOBAL_NAMES Initialization Parameter

If `GLOBAL_NAMES` is set to `TRUE` in the Oracle database `INIT.ORA` file, then in order to be able to connect to the gateway, you must specify the Heterogeneous Services (HS) initialization parameter, `HS_DB_DOMAIN`, in the Gateway Initialization Parameter file to match the value of the `DB_DOMAIN` parameter of the Oracle database. Refer to *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* , depending on your platform, for more information.

DRDA Package and DB2 considerations

The gateway utilizes a package for statement execution. This package will be implicitly bound upon the first time the gateway connects to the target DB2 system. Ensure that the user ID connecting to the DB2 system has the necessary privileges to bind a package. Refer to *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* , depending on your platform, for more information.

Date Arithmetic

In general, the following types of SQL expression forms do not work correctly with the gateway because of DB2 limitations:

```
date + number
number + date
date - number
date1 - date2
```

DB2 does not allow number addition or subtraction with date data types. The date and number addition and subtraction *(`date + number, number + date, date - number`)* forms are sent through to the DB2 where they are rejected.

Also, DB2 does not perform date subtraction consistently. When you subtract two dates *(`date1 - date2`)*, differing interpretations of date subtraction in DB2 cause the results to vary by server.

> **Note:**
>
> Avoid date arithmetic expressions in all gateway SQL expressions until date arithmetic problems are resolved.

Row Length Limitation

Because of a restriction of the DRDA architecture, rows with aggregate length exceeding 32 KB in DRDA representation cannot be stored or retrieved.

LONG Data type in SQL*Plus

SQL*Plus cannot fetch `LONG` columns from the Oracle Database Gateway for DRDA.

Stored Procedures and Transaction Integrity

IBM DB2 has introduced a feature called Commit on Return for stored procedures. This feature allows DB2 to perform an automatic commit after a stored procedure runs successfully. This feature is enabled when the procedure is created. To ensure data integrity, the Oracle Database Gateway for DRDA does not support this feature in a heterogeneous environment. When attempting to call a stored procedure that has this

feature enabled, through the gateway, the gateway will return an error, ORA-28526 or PLS-00201 (identifier must be declared).

SQL Limitations

The SQL limitations for Oracle Database Gateway for DRDA are described in the following sections:

Oracle ROWID Column

The DB2 ROWID column is not compatible with the Oracle ROWID column. Because the ROWID column is not supported, the following restrictions apply:

- UPDATE and DELETE are not supported with the WHERE CURRENT OF CURSOR clause. To update or delete a specific row through the gateway, a condition style WHERE clause must be used. (Bug No. 205538)

  When UPDATE and DELETE statements are used in precompiler and PL/SQL programs, they rely internally on the Oracle ROWID function.

- Snapshots between Oracle database and DB2 are not supported.

  Snapshots rely internally on the Oracle ROWID column.

Oracle Bind Variables

Oracle bind variables become SQL parameter markers when used with the gateway. Therefore, the bind variables are subject to the same restrictions as SQL parameter markers.

For example, the following statements are not allowed:

```
WHERE :x IS NULL
WHERE :x = :y
```

CONNECT BY Is Not Supported

Oracle Database Gateway for DRDA does not support CONNECT BY in SELECT statements.

3

Using the Oracle Database Gateway for DRDA

Using the Oracle Database Gateway for DRDA involves connecting to the corresponding gateway system and the remote DRDA database associated with the gateway.

DRDA Gateway Features

This section describes the following DRDA gateway features:

CHAR Semantics

This feature allows the gateway to optionally run in `CHAR` Semantics mode. Rather than always describing UDB `CHAR` columns as `CHAR(n BYTE)`, this feature describes them as `CHAR(n CHAR)` and `VARCHAR(n CHAR)`. The concept is similar to Oracle database `CHAR` Semantics. You need to specify `HS_NLS_LENGTH_SEMANTICS=CHAR` gateway parameter to activate this option. Refer to Initialization Parameters for more detail.

Multi-byte Character Sets Ratio Suppression

This feature optionally suppresses the ratio expansion from UDB database to Oracle database involving multi-byte character set. By default, Oracle Database Gateway for DRDA assumes the worst ratio to prevent data being truncated or insufficient buffer size situation. However, if you have specific knowledge of your UDB database and do

not want the expansion to occur, you can specify `HS_KEEP_REMOTE_COLUMN_SIZE` parameter to suppress the expansion. Refer to Initialization Parameters for more detail.

IPv6 Support

Besides full IPv6 support between Oracle databases and the gateway, IPv6 is also supported between this gateway and UDB database. Refer to the `HS_FDS_CONNECT_INFO` parameter in Initialization Parameters for more detail.

Gateway Session IDLE Timeout

You can optionally choose to terminate long idle gateway sessions automatically with the gateway parameter `HS_IDLE_TIMEOUT`. Specifically, when a gateway session is idle for more than the specified time limit, the gateway session is terminated with any pending update rolled back

Processing a Database Link

The database and application administrators of a distributed database system are responsible for managing the database links that define paths to the Oracle Database Gateway for DRDA. The tasks are as follows:

- Creating Database Links
- Dropping Database Links
- Examining Available Database Links
- Limiting the Number of Active Database Links

Creating Database Links

To create a database link and define a path to a remote database, use the `CREATE DATABASE LINK` statement. The `CONNECT TO` clause specifies the remote user ID and password to use when creating a session in the remote database. The `USING` clause points to a tnsnames.ora connect descriptor.

> **Note:**
>
> If you do not specify a user ID and a password in the `CONNECT TO` clause, then the Oracle database user ID and password are used.

> **See Also:**
>
> Refer to Chapter 15, "Security Considerations" in *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* for details.

The following example creates a database link to access information in the DRDA server:

```
CREATE PUBLIC DATABASE LINK dblink
CONNECT TO userid IDENTIFIED BY password
USING 'tns_name_entry';
```

where:

`dblink` is the complete database link name.

`user id` is the user ID used to establish a session in the remote database. This user ID must be a valid DRDA server user ID. It must be authorized to any table or file on the DRDA server that is referenced in the SQL commands. Length restrictions on user IDs are dependent on the authorization system used by the DRDA server. In many cases this limit is eight characters, but in other cases, it may be longer. See DB2 platform documentation for limitations.

`password` is the password used to establish a session in the remote database. This password must be a valid DRDA server password. Length restrictions on passwords are dependent on the authorization system used by the DRDA server. In many cases this limit is eight characters, but in other cases, it may be longer. See DB2 platform documentation for limitations.

`tns_name_entry` specifies the Oracle Net connect descriptor used to identify the gateway.

Guidelines for Database Links

Database links are active for the duration of a gateway session. If you want to close a database link during a session, then use the `ALTER SESSION CLOSE DATABASE LINK dblink` statement.

Dropping Database Links

You can drop a database link with the `DROP DATABASE LINK` statement. For example, to drop the public database link named `DBLINK`, use the statement:

```
DROP PUBLIC DATABASE LINK dblink;
```

> **Note:**
>
> A database link should not be dropped if it is required to resolve an in-doubt distributed transaction. Refer to *Oracle Database Administrator's Guide* for additional information about dropping database links.

> **See Also:**
>
> *Oracle Database SQL Language Reference* for additional information about dropping database links

Examining Available Database Links

The data dictionary of each database stores the definitions of all the database links in that database. The USER_DB_LINKS data dictionary view shows the privately defined database links, that is, those accessible to the current Oracle user. The ALL_DB_LINKS data dictionary views show all accessible (public and private) database links.

Limiting the Number of Active Database Links

You can limit the number of connections from a user process to remote databases with the parameter OPEN_LINKS. This parameter controls the number of remote connections that any single user process can concurrently use with a single SQL statement. Refer to *Oracle Database Administrator's Guide* for additional information about limiting the number of active database links.

Accessing the Gateway

To access the gateway, complete the following steps on the Oracle database:

1. Example 3-1
2. Example 3-2
3. Example 3-3

Example 3-1 Login to the Oracle Database

Login to the Oracle database to access the gateway

Example 3-2 Create a database link to the DRDA Database

For example, use:

```
CREATE PUBLIC DATABASE LINK DRDA
CONNECT TO ORADRDA IDENTIFIED BY oracle_pw
USING 'tns_name_entry'
```

Example 3-3 Retrieve data from the DRDA Database

This query fetches the TABLE table in the schema SECURE, using the name ORADRDA as the DRDA server user profile. The ORADRDA user profile must have the appropriate privileges on the DRDA server to access the SECURE.TABLE files:

```
SELECT * FROM SECURE.TABLE@DRDA
```

The following is an example of the error messages that are displayed if insufficient privileges are displayed:

```
ORA-28500: connection from ORACLE to a non-Oracle system returned this message:
[Oracle][ODBC DB2 Wire Protocol driver][UDB DB2 for Windows, UNIX, and
Linux]ORADRDA DOES NOT HAVE PRIVILEGE TO PERFORM OPERATION SELECT ON THIS
OBJECT SECURE.TABLE.
ORA-02063: preceding 2 lines from DRDA
```

Accessing i5/OS File Members

Access to i5/OS files and file members is not specifically controlled by DRDA or the gateway. However, DB2 UDB for iSeries uses a naming convention that implies that the file member name is the same as the name of the file being addressed. For example, accessing `schema.table` implies that table is the file name and also that table is the file member name being accessed.

To access file members with names that differ from the associated file name, you must create a view within the file so that DB2 UDB for iSeries can reference the correct file member.

One method for creating this view involves issuing the i5/OS command `Create Logical File` (`CRTLF`). This action creates a logical association between the file name and the file member name.

> **See Also:**
>
> For additional information, refer to the i5/OS Command Language (CL) documentation or to the DB2 UDB for iSeries SQL reference document.

Using the Synonym Feature

You can provide complete data, location, and network transparency by using the synonym feature of Oracle database. When a synonym is defined, the user need not know the underlying table or network protocol being used. A synonym can be public, which means it is available to all Oracle users. A synonym can also be defined as private, available only to the user who created it. Refer to *Oracle Database Reference* for details on the synonym feature.

The following statement creates a system-wide synonym for the `EMP` file in the DRDA server with ownership of `ORACLE`:

```
CREATE PUBLIC SYNONYM EMP FOR ORACLE.EMP@DRDA
```

Performing Distributed Queries

The Oracle Database Gateway technology enables the execution of distributed queries that join data in an Oracle database and in DRDA servers and data from any other data store for which Oracle provides a gateway. These complex operations can be completely transparent to the users requesting the data.

The following example joins data between an Oracle database, DB2 UDB for z/OS, and a DRDA server:

```
SELECT o.custname, p.projno, e.ename, sum(e.rate*p.hours)
FROM orders@DB2 o, EMP@ORACLE7 e, projects@DRDA p
WHERE o.projno = p.projno
AND p.empno = e.empno
GROUP BY o.custname, p.projno, e.ename
```

A combination of views and synonyms, using the following SQL statements, keeps the process of distributed queries transparent to the user:

```
CREATE SYNONYM orders for orders@DB2;
CREATE SYNONYM PROJECTS for PROJECTS@DRDA;
CREATE VIEW details (custname,projno,ename,spend)
AS
SELECT o.custname, p.projno, e.ename, sum(e.rate*p.hours)
FROM orders o, EMP e, projects p
WHERE o.projno = p.projno
AND p.empno = e.empno
GROUP BY o.custname, p.projno, e.ename
```

The following SQL statement retrieves information from these three data stores in one command:

```
SELECT * FROM DETAILS;
```

The results of this command are:

```
CUSTNAME   PROJNO     ENAME      SPEND
---------  ---------  ---------  ---------
ABC Co.    1          Jones      400
ABC Co.    1          Smith      180
XYZ Inc.   2          Jones      400
XYZ Inc.   2          Smith      180
```

Two-Phase Commit Processing

To fully participate in a two-phase commit transaction, a server must support the `PREPARE TRANSACTION` statement. The `PREPARE TRANSACTION` statement ensures that all participating databases are prepared to `COMMIT` or to `ROLLBACK` a specific unit of work.

Oracle database supports the `PREPARE TRANSACTION` statement. Any number of Oracle database can participate in a distributed two-phase commit transaction. The `PREPARE TRANSACTION` statement is performed automatically when a `COMMIT` is issued explicitly by an application or implicitly at the normal end of the application.

The gateway does not support the `PREPARE TRANSACTION` statement. This limits the two-phase commit protocol when the gateway participates in a distributed transaction. The gateway becomes the commit focal point site of a distributed transaction. The gateway is configured as commit/confirm, so it is always the commit point site, regardless of the commit point strength setting. The gateway commits the unit of work after verifying that all Oracle databases in the transaction have successfully committed their work. The gateway must coordinate the distributed transaction so that only one gateway instance can participate in a two-phase commit transaction.

Two-phase commit transactions are recorded in the `HS_TRANSACTION_LOG` table (see the initialization parameter `HS_FDS_TRANSACTION_LOG`), which is created during installation. This table is created when the `o2pc.sql` script is run. The owner of this table also owns the package. Refer to "DRDA Gateway Package Binding Considerations" on *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows*, depending on your platform, for more information.

Distributed DRDA Transactions

Because the HS_TRANSACTION_LOG table is used to record the status of a gateway transaction, this table must be in at the database where the DRDA update takes place. Therefore, all updates that take place over the gateway must be local to the IBM database.

> **Note:**
>
> - Updates to the HS_TRANSACTION_LOG table cannot be part of an IBM distributed transaction.
> - The default commit mode on OS400 V5R1 and later is READ UNCOMMITTED (*CHG) and this requires files to be journaled. Hence, the object specified by the HS_TRANSACTION_LOG initialization parameter must be journaled.

For additional information about the two-phase commit process, refer to *Oracle Database Heterogeneous Connectivity User's Guide*.

Replicating in a Heterogeneous Environment

Oracle Database Gateway for DRDA provides a number of options for replicating Oracle and non-Oracle data throughout the enterprise.

Oracle Database Triggers

When updates are made to Oracle database, synchronous copies of Oracle and non-Oracle data can be maintained automatically by using Oracle database triggers.

Oracle Snapshots

Oracle Database Gateway for DRDA can use the Oracle snapshot feature to automatically replicate non-Oracle data into Oracle database. The complete refresh capability of Oracle snapshot can be used to propagate a complete copy or a subset of the non-Oracle data into Oracle database at user-defined intervals.

Copying Data from Oracle Database to DRDA Server

This Oracle SQL INSERT command now works with the CALLBACK feature:

```
INSERT INTO DRDA_table SELECT * FROM local_table
```

Alternatively, you could use sqlplus COPY command. The COPY command enables you to copy data from Oracle database to a DRDA server. To copy data from your Oracle database to the DRDA server, you can also use:

```
COPY FROM username/password@connect_identifier -
INSERT destination_table -
USING query
```

For example, to select all rows from the local Oracle `EMP` table, insert them into the `EMP` table on the DRDA server, and commit the transaction, use:

```
COPY FROM scott/tiger@ORACLE -
INSERT scott.EMP@DRDA -
USING SELECT * FROM EMP
```

The SQL*Plus `COPY` command supports `APPEND`, `CREATE`, `INSERT`, and `REPLACE` commands. However, `INSERT` is the only command supported when copying to the DRDA server. For more information about the `COPY` command, refer to *SQL*Plus User's Guide and Reference*.

Copying Data from DRDA Server to Oracle Database

The `CREATE TABLE` command enables you to copy data from a DRDA server to Oracle database. To create a table on your Oracle database and to insert rows from a DRDA server table, use:

```
CREATE TABLE table_name
AS query
```

A SQL `INSERT` into an Oracle table can be done selecting data from the gateway as follows:

```
INSERT INTO local_table SELECT * FROM drda_table
```

The following example creates the table `EMP` in your local Oracle database and inserts the rows from the `EMP` table on the DRDA server:

```
CREATE TABLE EMP
AS SELECT * FROM scott.EMP@DRDA
```

Alternatively, you can use the SQL*Plus `COPY` command to copy data from a DRDA server to Oracle database. For more information about the `COPY` command, refer to *SQL*Plus User's Guide and Reference*.

Tracing SQL Statements

SQL statements issued through the gateway can be changed before reaching the DRDA database. These changes are made to make the format acceptable to the gateway or to make Oracle SQL compatible with DRDA server SQL. Oracle database and the gateway can change the statements depending on the situation.

For various reasons, you might need to assess whether the gateway has altered the statement correctly or whether the statement could be rewritten to improve performance. SQL tracing is a feature that allows you to view the changes made to a SQL statement by the Oracle database or the gateway.

SQL tracing reduces gateway performance. Use tracing only when testing and debugging your application. Do not enable SQL tracing when the application is running in a production environment. For more information about enabling SQL tracing, refer to the section on "SQL Tracing and the Gateway " in Error Messages_ Diagnosis_ and Reporting.

4
Developing Applications

The following sections provide information that is specific to the Oracle Database Gateway for DRDA.

Gateway Appearance to Application Programs

An application that is written to access information in a DRDA database interfaces with an Oracle database. When developing applications, keep the following information in mind:

- You must define the DRDA database to the application by using a database link that is defined in the Oracle database. Your application should specify tables that exist on a DRDA database by using the name that is defined in the database link. For example, assume that a database link is defined so that it names the DRDA database link `DRDA`, and also assume that an application needs to retrieve data from an Oracle database and from the DRDA database. Use the following SQL statement joining two tables together in your application:

  ```
  SELECT EMPNO, SALARY
  FROM EMP L, EMPS@DRDA R
  WHERE L.EMPNO = R.EMPNO
  ```

  In this example, `EMP` is a table on an Oracle database, and `EMPS` is a table on a DRDA server. You can also define a synonym or a view on the DRDA server table, and access the information without the database link suffix.
- You can read and write data to a defined DRDA database. `SELECT`, `INSERT`, `UPDATE`, and `DELETE` are all valid operations.
- A single transaction can write to one DRDA database and to multiple Oracle databases.
- Single SQL statements, using `JOINS`, can refer to tables in multiple Oracle databases, in multiple DRDA databases, or in both.

Fetch Reblocking

Oracle database supports fetch reblocking with the `HS_RPC_FETCH_REBLOCKING` parameter.

When the value of this parameter is set to `ON` (the default), the array size for `SELECT` statements is determined by the `HS_RPC_FETCH_SIZE` value. The `HS_RPC_FETCH_SIZE` parameter defines the number of bytes sent with each buffer from the gateway to the Oracle database. The buffer may contain one or more qualified rows from the DRDA server. This feature can provide significant performance enhancements, depending on your application design, installation type, and workload.

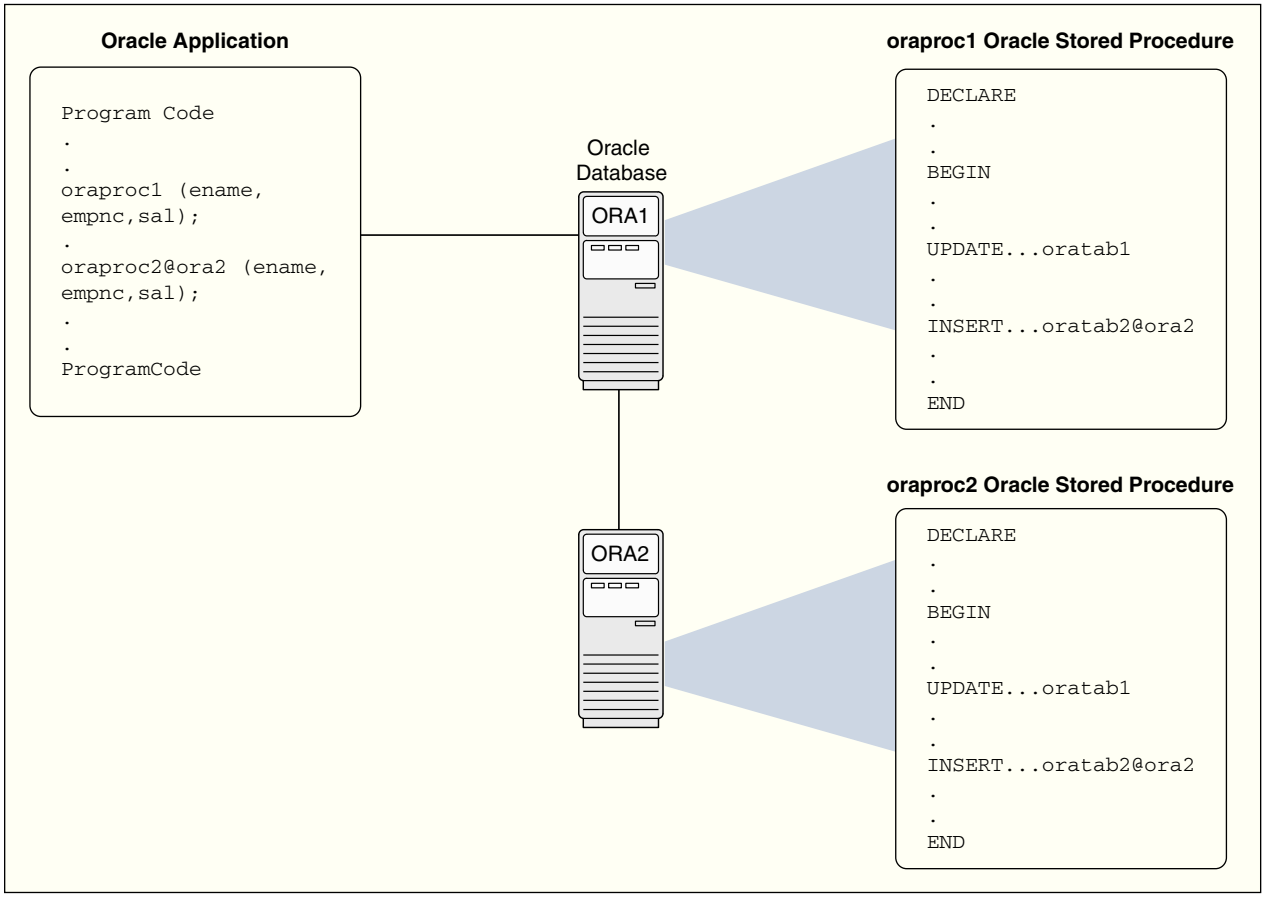
The array size between the client and the Oracle database is determined by the Oracle application. Refer to *Oracle Database Gateway Installation and Configuration Guide for IBM AIX on POWER Systems (64-Bit), Linux x86-64, Oracle Solaris on SPARC (64-Bit), Oracle Solaris on x86-64 (64-Bit) and HP-UX Itanium* or *Oracle Database Gateway Installation and Configuration Guide for Microsoft Windows* , depending on your platform, for more information.

Using Oracle Stored Procedures with the Gateway

The gateway stored procedure support is an extension of Oracle stored procedures. An Oracle stored procedure is a schema object that logically groups together a set of SQL and other PL/SQL programming language statements to perform a specific task. Oracle stored procedures are stored in the database for continued use. Applications use standard Oracle PL/SQL to call stored procedures.

Oracle stored procedures can be located in a local instance of Oracle database and in a remote instance. Figure 4-1 illustrates two stored procedures: `oraproc1` is a procedure stored in the `ORA1` Oracle instance, and `oraproc2` is a procedure stored in the `ORA2` Oracle instance.

Figure 4-1 Calling Oracle Stored Procedures in a Distributed Oracle Environment



To maintain location transparency in the application, a synonym can be created:

```
CREATE SYNONYM oraproc2 FOR oraproc2@ora2;
```

After this synonym is created, the application no longer needs to use the database link specification to call the stored procedure in the remote Oracle instance.

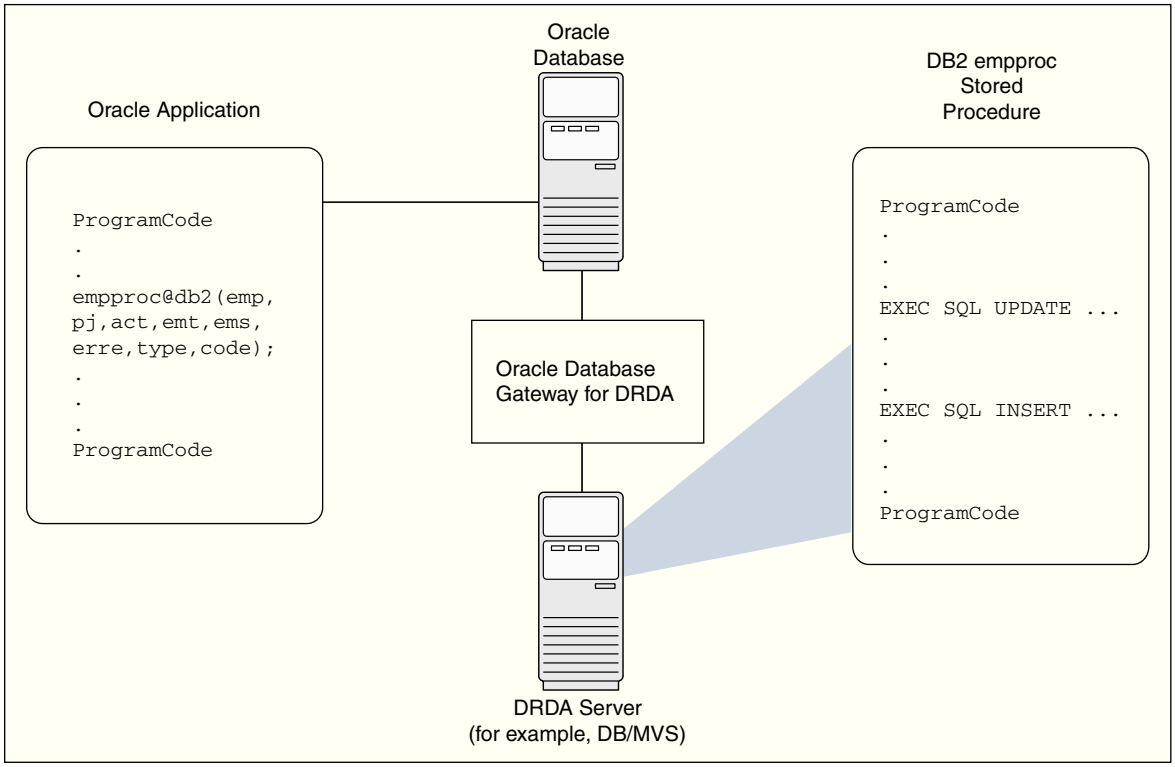
In Figure 4-1, the second statement in `oraproc1` is used to access a table in the `ORA2` instance. In the same way, Oracle stored procedures can be used to access DB2 tables through the gateway.

Using DRDA Server Stored Procedures with the Gateway

The procedural feature of the gateway enables invocation of native DRDA server stored procedures. After the stored procedure is defined to the DRDA server, the gateway is able to use the existing DRDA server definition to run the procedure. The gateway does not require special definitions to call the DB2 stored procedure. Standard Oracle PL/SQL is used by the Oracle application to run the stored procedure.

In Figure 4-2, an Oracle application calls the `empproc` stored procedure that is defined to the DRDA server (for example, DB2 UDB for z/OS).

Figure 4-2 Running DRDA Server Stored Procedures



From the perspective of the application, running the DB2 stored procedure is no different from invoking a stored procedure at a remote Oracle database instance.

Oracle Application and DRDA Server Stored Procedure Completion

For an Oracle application to call a DB2 stored procedure, it is first necessary to create the DB2 stored procedure on the DB2 system by using the procedures documented in the IBM reference document for DB2 SQL.

After the stored procedure is defined in DB2, the gateway is able to access the data using a standard PL/SQL call. For example, an employee name, `John Smythe`, is passed to the DB2 stored procedure `REVISE_SALARY`. The DB2 stored procedure retrieves the salary value from the DB2 database in order to calculate a new yearly salary for `John Smythe`. The revised salary that is returned as result is used to update the `EMP` table of Oracle database:

```
DECLARE
  INPUT VARCHAR2(15);
  RESULT NUMBER(8,2);
BEGIN
  INPUT := 'JOHN SMYTHE';
  REVISE_SALARY@DB2(INPUT, RESULT);
  UPDATE EMP SET SAL = RESULT WHERE ENAME = INPUT;
END;
```

When the gateway receives a call to run a stored procedure on the DRDA server, it first does a lookup of the procedure name in the server catalog. The information that defines a stored procedure is stored in different forms on each DRDA server. For

example, DB2 UDB for iSeries uses the tables QSYS2.SYSPROCS and QSYS2.SYSPARMS. The gateway has a list of known catalogs to search, depending on the DRDA server that is being accessed.

The search order of the catalogs is dependent on whether the catalogs support Location designators (such as LUNAME in SYSIBM.SYSPROCEDURES), and authorization or owner IDs (such as AUTHID in SYSIBM.SYSPROCEDURES or OWNER in SYSIBM.SYSROUTINES).

Some DRDA servers allow blank or public authorization qualifiers. If the DRDA server that is currently connected supports this form of qualification, then the gateway will apply those naming rules when searching for a procedure name in the catalog.

The matching rules will first search for a public definition, and then an owner qualified procedure name. For more detailed information, refer to the IBM reference document for DB2 SQL.

Procedural Feature Considerations with DB2

The following are special considerations for using the procedural feature with the gateway:

- PL/SQL records cannot be passed as parameters when invoking a DB2 stored procedure.
- The gateway supports the GENERAL and DB2SQL linkage conventions of DB2 stored procedures. Both linkage conventions require that the parameters that are passed to and from the DB2 stored procedure cannot be null.

Result Sets and Stored Procedures

The Oracle Database Gateway for DRDA provides support for stored procedures that return result sets. By default, all stored procedures and functions do not return a result set to the user. To enable result sets, set the HS_FDS_RESULTSET_SUPPORT parameter in the initialization parameter file.

> **See Also:**
>
> Initialization Parameters for information about editing the initialization parameter file and the HS_FDS_RESULTSET_SUPPORT parameter. For further information about Oracle support for result sets in non-Oracle databases see *Oracle Database Heterogeneous Connectivity User's Guide*.

> **Note:**
>
> If you set the HS_FDS_RESULTSET_SUPPORT gateway initialization parameter, you must change the syntax of the procedure execute statement for all existing stored procedures or errors will occur.

When accessing stored procedures with result sets through the Oracle Database Gateway for DRDA, you will be in the sequential mode of Heterogeneous Services.

The gateway returns the following information to Heterogeneous Services during procedure description:

- All the input arguments of the remote stored procedure
- None of the output arguments
- One out argument of type ref cursor (corresponding to the first result set returned by the stored procedure)

Client programs have to use the virtual package function `DBMS_HS_RESULT_SET.GET_NEXT_RESULT_SET` to get the ref cursor for subsequent result sets. The last result set returned is the out argument from the procedure.

The limitations of accessing result sets are as follows:

- Result sets returned by a remote stored procedure have to be retrieved in the order in which they were placed on the wire.
- On execution of a stored procedure, all result sets returned by a previously executed stored procedure will be closed, regardless of whether the data has been completely retrieved or not.

In the following example, the UDB stored procedure is executed to fetch the contents of the `EMP` and `DEPT` tables from UDB:

```
CREATE PROCEDURE REFCURPROC (IN STRIN VARCHAR(255), OUT STROUT VARCHAR(255) )
  RESULT SETS 3  LANGUAGE SQL
BEGIN
  DECLARE TEMP CHAR (20);
 DECLARE C1 CURSOR WITH RETURN TO CALLER FOR
      SELECT * FROM TKHOEMP;
  DECLARE C2 CURSOR WITH RETURN TO CALLER FOR
     SELECT * FROM TKHODEPT;
 OPEN C1;
 OPEN C2;
 SET STROUT = STRIN;
 END
```

OCI Program Fetching from Result Sets in Sequential Mode

The following example shows OCI program fetching from result sets in sequential mode:

```
OCIEnv *ENVH;
OCISvcCtx *SVCH;
OCIStmt *STMH;
OCIError *ERRH;
OCIBind *BNDH[3];
OraText arg1[20];
OraText arg2[255];
OCIResult *rset;
OCIStmt *rstmt;
ub2 rcode[3];
ub2 rlens[3];
sb2 inds[3];
OraText *stmt = (OraText *) "begin refcurproc@UDB(:1,:2,:3); end;";
OraText *n_rs_stm = (OraText *)
  "begin :ret := DBMS_HS_RESULT_SET.GET_NEXT_RESULT_SET@UDB; end;";

/* Prepare procedure call statement */
```

```
/* Handle Initialization code skipped */
OCIStmtPrepare(STMH, ERRH, stmt, strlen(stmt), OCI_NTV_SYNTAX, OCI_DEFAULT);

/* Bind procedure arguments */
inds[0] = 0;
strcpy((char *) arg1, "Hello World");
rlens[0] = strlen(arg1);
OCIBindByPos(STMH, &BNDH[0], ERRH, 1, (dvoid *) arg1, 20, SQLT_CHR,
             (dvoid *) &(inds[0]), &(rlens[0]), &(rcode[0]), 0, (ub4 *) 0,
             OCI_DEFAULT);

inds[1] = -1;
OCIBindByPos(STMH, &BNDH[1], ERRH, 1, (dvoid *) arg2, 20, SQLT_CHR,
             (dvoid *) &(inds[1]), &(rlens[1]), &(rcode[1]), 0, (ub4 *) 0,
             OCI_DEFAULT);

inds[2] = 0;
rlens[2] = 0;
OCIDescriptorAlloc(ENVH, (dvoid **) &rset, OCI_DTYPE_RSET, 0, (dvoid **) 0);
OCIBindByPos(STMH, &BNDH[2], ERRH, 2, (dvoid *) rset, 0, SQLT_RSET,
             (dvoid *) &(inds[2]), &(rlens[2]), &(rcode[2]),
             0, (ub4 *) 0, OCI_DEFAULT);

/* Execute procedure */
OCIStmtExecute(SVCH, STMH, ERRH, 1, 0, (CONST OCISnapshot *) 0,
               (OCISnapshot *) 0, OCI_DEFAULT);

/* Convert result set to statement handle */
OCIResultSetToStmt(rset, ERRH);
rstmt = (OCIStmt *) rset;

/* After this the user can fetch from rstmt */
/* Issue get_next_result_set call to get handle to next_result set */
/* Prepare Get next result set procedure call */

OCIStmtPrepare(STMH, ERRH, n_rs_stm, strlen(n_rs_stm), OCI_NTV_SYNTAX,
               OCI_DEFAULT);

/* Bind return value */
OCIBindByPos(STMH, &BNDH[1], ERRH, 1, (dvoid *) rset, 0, SQLT_RSET,
             (dvoid *) &(inds[1]), &(rlens[1]), &(rcode[1]),
             0, (ub4 *) 0, OCI_DEFAULT);

/* Execute statement to get next result set*/
OCIStmtExecute(SVCH, STMH, ERRH, 1, 0, (CONST OCISnapshot *) 0,
               (OCISnapshot *) 0, OCI_DEFAULT);

/* Convert next result set to statement handle */
OCIResultSetToStmt(rset, ERRH);
rstmt = (OCIStmt *) rset;

/* Now rstmt will point to the second result set returned by the
remote stored procedure */

/* Repeat execution of get_next_result_set to get the output arguments */
```

PL/SQL Program Fetching from Result Sets in Sequential Mode

Assume that the table LOC_EMP is a local table exactly like the UDB EMP table. The same assumption applies for LOC_DEPT. OUTARGS is a table with columns corresponding to the out arguments of the SQL Server stored procedure.

```
create or replace package rcpackage is  type RCTYPE is ref cursor;end rcpackage;/
declare
  rc1 rcpackage.rctype;
  rec1 loc_emp%rowtype;
  rc2 rcpackage.rctype;
  rec2 loc_dept%rowtype;
  rc3 rcpackage.rctype;
  rec3 outargs%rowtype;
  out_arg varchar2(255);

begin

  -- Execute procedure
  out_arg := null;
  refcurproc@UDB('Hello World', out_arg, rc1);

  -- Fetch 20 rows from the remote emp table and insert them into loc_emp
  for i in 1 .. 20 loop
    fetch rc1 into rec1;
    insert into loc_emp (rec1.empno, rec1.ename, rec1.job,
    rec1.mgr, rec1.hiredate, rec1.sal, rec1.comm, rec1.deptno);
  end loop;

  -- Close ref cursor
  close rc1;

  -- Get the next result set returned by the stored procedure
  rc2 := dbms_hs_result_set.get_next_result_set@UDB;

  -- Fetch 5 rows from the remote dept table and insert them into loc_dept
  for i in 1 .. 5 loop
    fetch rc2 into rec2;
    insert into loc_dept values (rec2.deptno, rec2.dname, rec2.loc);
  end loop;

  --Close ref cursor
  close rc2;

  -- Get the output arguments from the remote stored procedure
  -- Since we are in sequential mode, they will be returned in the
  -- form of a result set
  rc3 := dbms_hs_result_set.get_next_result_set@UDB;

  -- Fetch them and insert them into the outarguments table
  fetch rc3 into rec3;
  insert into outargs (rec3.outarg, rec3.retval);

  -- Close ref cursor
  close rc3;

end;
/
```

Database Link Behavior

A connection to the gateway is established through a database link when it is first used in an Oracle database session. In this context, a connection refers to both the connection between the Oracle database and the gateway and to the DRDA network connection between the gateway and the target DRDA database. The connection remains established until the Oracle database session ends. Another session or user can access the same database link and get a distinct connection to the gateway and DRDA database.

Oracle Database SQL Construct Processing

One of the most important features of the Oracle Database Gateways products is providing SQL transparency to the user and to the application programmer. Foreign SQL constructs can be categorized into four areas:

- Compatible
- Translated
- Compensated
- Native semantics

Compatible SQL Functions

Oracle database automatically forwards compatible SQL functions to the DRDA database, where SQL constructs with the same syntax and meaning are on both Oracle database and the DRDA database. These SQL constructs are forwarded unmodified. All of the compatible functions are column functions. Functions that are not compatible are either translated to an equivalent DRDA SQL function or are compensated (post-processed) by Oracle database after the data is returned from the DRDA database.

Translated SQL Functions

Translated functions have the same meaning but different names between the Oracle database and the DRDA database. But all applications must use the Oracle function name. These SQL constructs that are supported with different syntax (different function names) by the DRDA database, are automatically translated by the Oracle database and then forwarded to the DRDA database. Oracle database changes the function name before sending it to the DRDA database, in a manner that is transparent to your application.

Compensated SQL Functions

Some advanced SQL constructs that are supported by Oracle database may not be supported in the same manner, by the DRDA database. Compensated functions are those SQL functions that are either not recognized by the DRDA server or are recognized by the DRDA server but the semantics of the function are interpreted differently when comparing the DRDA server with the Oracle database. If a `SELECT` statement containing one of these functions is passed from the Oracle database to the gateway, then the gateway removes the function before passing the SQL statement to

the DRDA server. The gateway passes the selected DRDA database rows to Oracle database. Oracle database applies the function.

Post-Processing

Oracle database can compensate for a missing or incompatible function by automatically excluding the incompatible SQL construct from the SQL request that is forwarded to the DRDA database. Oracle database then retrieves the necessary data from the DRDA database and applies the function. This process is known as post-processing.

The gateway attempts to pass all SQL functions to DRDA databases. However when a DRDA database does not support a function that is represented in the computation, the gateway changes that function. For example, if a program runs the following query against a DB2 UDB for z/OS database:

```
SELECT COS(X_COOR) FROM TABLE_X;
```

Because the database does not support many of the `COS` functions, the gateway changes the query to the following:

```
SELECT X_COOR FROM TABLE_X;
```

All data in the `X_COOR` column of `TABLE_X` is passed from the DB2 UDB for z/OS database to the Oracle database. After the data is moved to the Oracle database, the `COS` function is performed.

If you are performing operations on large amounts of data that are stored in a DRDA database, then keep in mind that some functions require post-processing.

Native Semantic SQL Functions

Some SQL functions that are normally compensated may also be overridden, through the Native Semantics facility. If a SQL function has been enabled for Native Semantics, then the function may be passed on to the DRDA database for processing, instead of being compensated. The SQL function is then processed natively in the DRDA database. Refer to "Native Semantics" for more information.

DB2 UDB for z/OS SQL Compatibility

Table 4-1 describes how Oracle database and the gateway handle SQL functions for a DB2 UDB for z/OS.

Table 4-1 SQL Compatibility, by Oracle SQL function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
ABS	-	-	Yes	Yes
ACOS	-	-	Yes	Yes
ADD_MONTHS	-	-	Yes	
ASCII	-	-	Yes	Yes
ASIN	-	-	Yes	Yes

Table 4-1 (Cont.) SQL Compatibility, by Oracle SQL function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
ATAN	-	-	Yes	Yes
ATAN2	-	-	Yes	Yes
AVG	Yes	-	-	-
BITAND	-	-	Yes	Yes
CAST	-	-	Yes	Yes
CEIL	-	CEILING	-	Yes
CHARTOROWID	-	-	Yes	-
CHR	-	-	Yes	Yes
CONCAT	Yes	-	-	-
CONVERT	-	-	Yes	Yes
COS	-	-	Yes	Yes
COSH	-	-	Yes	Yes
COUNT(*)	Yes	-	-	-
COUNT (DISTINCT colname)	Yes	-	-	-
COUNT (ALL colname)	Yes	-	-	COUNTCOL
COUNT (column)	Yes	-	-	COUNTCOL
DECODE	-	-	Yes	Yes
DUMP	-	-	Yes	Yes
EXP	-	-	Yes	Yes
FLOOR	Yes	-	-	Yes
GREATEST	-	-	Yes	Yes
HEXTORAW	-	-	Yes	Yes
INITCAP	-	-	Yes	Yes
INSTR	-	-	Yes	Yes
INSTRB	-	-	Yes	Yes
LAST_DAY	-	-	Yes	-
LEAST	-	-	Yes	Yes
LENGTH	-	-	Yes	Yes
LENGTHB	-	-	Yes	Yes
LN	-	-	Yes	Yes
LOG	-	-	Yes	Yes
LOWER	Yes	-	-	LCASE
LPAD	-	-	Yes	Yes
LTRIM	-	-	Yes	Yes
MAX	Yes	-	-	-

Table 4-1 (Cont.) SQL Compatibility, by Oracle SQL function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
MIN	Yes	-	-	-
MOD	-	-	Yes	Yes
MONTHS_BETWEEN	-	-	Yes	-
NEW_TIME	-	-	Yes	-
NEXT_DAY	-	-	Yes	-
NLS_INITCAP	-	-	Yes	Yes
NLS_LOWER	-	-	Yes	Yes
NLS_UPPER		-	Yes	Yes
NLSSORT	-	-	Yes	Yes
NVL		VALUE		
NVL2	-	-	Yes	Yes
POWER	-	-	Yes	Yes
RAWTOHEX	-	-	Yes	Yes
REPLACE	-	-	Yes	Yes
REVERSE	-	-	Yes	Yes
ROUND	-	-	Yes	Yes
ROWIDTOCHAR	-	-	Yes	-
RPAD	-	-	Yes	Yes
RTRIM	-	-	Yes	Yes
SIGN	-	-	Yes	Yes
SIN	-	-	Yes	Yes
SINH	-	-	Yes	Yes
SOUNDEX		-	Yes	-
SQRT	-	-	Yes	Yes
STDDEV	-	-	Yes	Yes
SUBSTR	-	-	Yes	Yes
SUBSTRB	-	-	Yes	Yes
SUM	Yes	-	-	-
SYSDATE	-	-	Yes	
TAN	-	-	Yes	Yes
TANH	-	-	Yes	Yes
TO_CHAR	-	-	Yes	-
TO_DATE	-	-	Yes	-
TO_MULTI_BYTE	-	-	Yes	-
TO_NUMBER	-	DECIMAL	-	Yes
TO_SINGLE_BYTE	-	-	Yes	-

Table 4-1 (Cont.) SQL Compatibility, by Oracle SQL function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
TRANSLATE	-	-	Yes	Yes
TRIM	-	STRIP	Yes	Yes
TRUNC	-	-	Yes	Yes
UID	-	-	Yes	-
UPPER	Yes	-	-	UCASE
USER	-	-	Yes	-
USERENV	-	-	Yes	-
VARIANCE	-	-	Yes	Yes
VSIZE	-	-	Yes	Yes

DB2 UDB for Unix, Linux, and Windows Compatibility

Table 4-2 describes how Oracle database and the gateway handle SQL functions for a DB2/UDB database.

Table 4-2 DB2 UDB for Unix, Linux, and Windows Compatibility, by Oracle SQL Function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
ABS	Yes	-	-	Yes
ACOS	-	-	Yes	Yes
ADD_MONTHS	-	-	Yes	-
ASCII	-	-	Yes	Yes
ASIN	-	-	Yes	Yes
ATAN	-	-	Yes	Yes
ATAN2	-	-	Yes	Yes
AVG	Yes	-	-	-
BITAND	-	-	Yes	Yes
CAST	-	-	Yes	Yes
CEIL	-	CEILING	-	Yes
CHARTOROWID	-	-	Yes	-
CHR	Yes	-	-	Yes
CONCAT	Yes	-	-	-
CONVERT	-	-	Yes	Yes
COS	Yes	-	-	Yes
COSH	-	-	Yes	Yes

Table 4-2 (Cont.) DB2 UDB for Unix, Linux, and Windows Compatibility, by Oracle SQL Function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
COUNT(*)	Yes	-	-	-
COUNT (DISTINCT colname)	Yes	-	-	-
COUNT (ALL colname)	Yes	-	-	COUNTCOL
COUNT (column)	Yes	-	-	COUNTCOL
DECODE	-	-	Yes	Yes
DUMP	-	-	Yes	Yes
EXP	Yes	-	-	Yes
FLOOR	Yes	-	-	Yes
GREATEST	-	-	Yes	Yes
HEXTORAW	-	-	Yes	Yes
INITCAP	-	-	Yes	Yes
INSTR	-	-	Yes	Yes
INSTRB	-	-	Yes	Yes
LAST_DAY	-	-	Yes	-
LEAST	-	-	Yes	Yes
LENGTH	-	-	Yes	Yes
LENGTHB	-	-	Yes	Yes
LN	Yes	-	-	Yes
LOG	-	-	Yes	Yes
LOWER	Yes	-	-	LCASE
LPAD		-	Yes	Yes
LTRIM	-	-	Yes	Yes
MAX	Yes	-	-	-
MIN	Yes	-	-	-
MOD	Yes	-	-	Yes
MONTHS_BETWEEN	-	-	Yes	-
NEW_TIME	-	-	Yes	-
NEXT_DAY	Yes	-	Yes	-
NLS_INITCAP	-	-	Yes	Yes
NLS_LOWER	-	-	Yes	Yes
NLS_UPPER			Yes	Yes
NLSSORT	-	-	Yes	Yes
NVL	-	VALUE	-	-
NVL2	-	-	Yes	Yes

Table 4-2 (Cont.) DB2 UDB for Unix, Linux, and Windows Compatibility, by Oracle SQL Function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
POWER	Yes	-	-	Yes
RAWTOHEX	-	-	Yes	Yes
REPLACE	Yes	-	-	Yes
REVERSE	-	-	Yes	Yes
ROUND	Yes	-	-	Yes
ROWIDTOCHAR		-	Yes	-
RPAD			Yes	Yes
RTRIM	-	-	Yes	Yes
SIGN	Yes	-	-	Yes
SIN	Yes	-	-	Yes
SINH	-	-	Yes	Yes
SOUNDEX	-	-	Yes	-
SQRT	Yes	-	-	Yes
STDDEV	-	-	Yes	Yes
SUBSTR	-	-	Yes	Yes
SUBSTRB	-	-	Yes	Yes
SUM	Yes	-	-	-
SYSDATE	-	-	Yes	-
TAN	Yes	-	-	Yes
TANH	-	-	Yes	Yes
TO_CHAR	-	-	Yes	-
TO_DATE	-	-	Yes	-
TO_MULTI_BYTE	-	-	Yes	-
TO_NUMBER	-	DECIMAL	-	Yes
TO_SINGLE_BYTE	-	-	Yes	-
TRANSLATE	-	-	Yes	Yes
TRIM	-	-	Yes	Yes
TRUNC	Yes	-	-	Yes
UID	-	-	Yes	-
UPPER	Yes	-	-	UCASE
USER	-	-	Yes	-
USERENV	-	-	Yes	-
VARIANCE	-	-	Yes	Yes
VSIZE	-	-	Yes	Yes

DB2 UDB for iSeries Compatibility

Table 4-3 describes how Oracle database and the gateway handle SQL functions for a DB2 UDB for iSeries database.

Table 4-3 DB2 UDB for iSeries Compatibility, by Oracle SQL Function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
ABS	-	ABSVAL	-	Yes
ACOS	-	-	Yes	Yes
ADD_MONTHS	-	-	Yes	-
ASCII	-	-	Yes	Yes
ASIN	-	-	Yes	Yes
ATAN	-	-	Yes	Yes
ATAN2	-	-	Yes	Yes
AVG	Yes	-	-	-
BITAND	-	-	Yes	Yes
CAST	-	-	Yes	Yes
CEIL	-	CEILING	-	Yes
CHARTOROWID	-	-	Yes	-
CHR	-	-	Yes	Yes
CONCAT	Yes	-	-	-
CONVERT	-	-	Yes	Yes
COS	Yes	-	-	Yes
COSH	Yes	-	-	Yes
COUNT(*)	Yes	-	-	-
COUNT (DISTINCT colname)	Yes	-	-	-
COUNT (ALL colname)	Yes	-	-	COUNTCOL
COUNT (column)	Yes	-	-	COUNTCOL
DECODE	-	-	Yes	Yes
DUMP	-	-	Yes	Yes
EXP	Yes	-	-	Yes
FLOOR	Yes	-	-	Yes
GREATEST	-	-	Yes	Yes
HEXTORAW	-	-	Yes	Yes
INITCAP	-	-	Yes	Yes
INSTR	-	-	Yes	Yes
INSTRB	-	-	Yes	Yes
LAST_DAY	-	-	Yes	-

Table 4-3 (Cont.) DB2 UDB for iSeries Compatibility, by Oracle SQL Function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
LEAST	-	-	Yes	Yes
LENGTH	-	-	Yes	Yes
LENGTHB	-	-	Yes	Yes
LN	Yes	-	-	Yes
LOG	-	-	Yes	Yes
LOWER	Yes	-	No	LCASE
LPAD	-	-	Yes	Yes
LTRIM	-	-	Yes	Yes
MAX	Yes	-	-	-
MIN	Yes	-	v	-
MOD	-	-	Yes	Yes
MONTHS_BETWEEN	-	-	Yes	
NEW_TIME	-	-	Yes	
NEXT_DAX	-	-	Yes	
NLS_INITCAP	-	-	Yes	Yes
NLS_LOWER	-	-	Yes	Yes
NLS_UPPER	-	-	Yes	Yes
NLSSORT	-	-	Yes	Yes
NVL	-	VALUE	-	-
NVL2	-	-	Yes	Yes
POWER	-	--	Yes	Yes
RAWTOHEX	-	-	Yes	Yes
REPLACE	-	-	Yes	Yes
REVERSE	-	-	Yes	Yes
ROUND	-	-	Yes	Yes
ROWIDTOCHAR	-	-	Yes	-
RPAD	-	-	Yes	Yes
RTRIM	-	-	Yes	Yes
SIGN	-	-	Yes	Yes
SIN	Yes	-	-	Yes
SINH	Yes	-	-	Yes
SOUNDEX	-	-	Yes	-
SQRT	Yes	-	-	Yes
STDDEV	Yes	v	-	Yes
SUBSTR	-	-	Yes	Yes
SUBSTRB	-	-	Yes	Yes

Table 4-3 (Cont.) DB2 UDB for iSeries Compatibility, by Oracle SQL Function

Oracle SQL Function	Compatible	Translated	Compensated	Native Semantics Candidate
SUM	Yes	-	-	-
SYSDATE	-	-	Yes	-
TAN	Yes	-	-	Yes
TANH	Yes	-	-	Yes
TO_CHAR	-	-	Yes	-
TO_DATE	-	-	Yes	-
TO_MULTI_BYTE	-	-	Yes	-
TO_NUMBER	-	DECIMAL	-	Yes
TO_SINGLE_BYTE	-	-	Yes	-
TRANSLATE	-	-	Yes	Yes
TRIM	-	-	Yes	Yes
TRUNC	-	-	Yes	Yes
UID	-	-	Yes	-
UPPER	-	TRANSLATE	-	UCASE
USER	-	-	Yes	-
USERENV	-	-	Yes	-
VARIANCE	-	VAR	-	Yes
VSIZE	-	-	Yes	Yes

Native Semantics

Some of the advanced SQL constructs that are supported by Oracle database may not be supported in the same manner by the DRDA database. In this case, the Oracle database compensates for the missing or incompatible functionality by post-processing the DRDA database data with Oracle database functionality

> **See Also:**
>
> "Oracle Database SQL Construct Processing" for more information

This feature provides maximum transparency, but may impact performance. In addition, new versions of a particular DRDA database may implement previously unsupported functions or capabilities, or they may change the supported semantics as to make them more compatible with Oracle database functions.

Some of DRDA servers also provide support for user-defined functions. The user may choose to implement Oracle database functions natively in the DRDA database. This enables the DRDA server to pass the function to the underlying database

implementation (for example, DB2). Native Semantics provides a method of enabling specific capabilities to be processed natively by the DRDA server.

Native Semantics Considerations

Various considerations must be taken into account when enabling the Native Semantic feature of a particular function because Native Semantics has advantages and disadvantages, which are typically a trade-off between transparency and performance.

- One such consideration is the transparency of data coercions. Oracle database provides coercion (implicit data conversion) for many SQL functions. This means that if the supplied value for a particular function is not correct, then Oracle database will coerce the value (change it to the correct value type) before processing it. However, with the Native Semantic feature enabled, the value, exactly as provided, will be passed to the DRDA server for processing. In many cases, the DRDA server will not be able to coerce the value to the correct type and will generate an error.
- Another consideration involves the compatibility of parameters to a particular SQL function. For instance, Oracle database implementation of `SUBSTR` allows negative values for the string index, whereas most DRDA server implementations of `SUBSTR` do not allow negative values for the string index. However, if the application is implemented to invoke `SUBSTR` in a manner that is compatible with the DRDA server, then the function will behave the same in either Oracle database or the DRDA server.
- Another consideration is that the processing of a function at the DRDA server may not be desirable due to resource constraints in that environment.

Refer to the "HS_FDS_CAPABILITY" for details on enabling or disabling these capabilities. Refer to the *Oracle Database SQL Language Reference* for Oracle database format of the following capabilities.

SQL Functions That Can Be Enabled

The following list contains SQL functions that are disabled (`OFF`) by default. They can be enabled (turned `ON`) as an option:

ABS	ACOS
ASCII	ASIN
ATAN	ATAN2
BITAND	CAST
CEIL	CHR
CONVERT	COS
COSH	COUNTCOL
DECODE	DUMP

EXP	FLOOR
GREATEST	HEXOTRAW
INITCAP	INSTR
INSTRB	LEAST
LENGTH	LENGTHB
LN	LOG
LOWER	LPAD
LTRIM	MOD
NLS_INITCAP	NLS_UPPER
NLS_LOWER	NLSSORT
NVL2	POWER
RAWTOHEX	REPLACE
REVERSE	ROUND
RPAD	RTRIM
SIGN	SIN
SINH	SQRT
STDDEV	SUBSTR
SUBSTRB	TAN
TANH	TO_NUMBER
TRANSLATE	TRIM
TRUNC	UPPER
VARIANCE	VSIZE

SQL Functions That Can Be Disabled

The following SQL functions are enabled (ON) by default:

- GROUPBY
- HAVING
- ORDERBY
- WHERE

ORDERBY controls sort order, which may differ at various sort locations. For example, with ORDERBY ON, a DB2 sort would be based on Extended Binary Coded Decimal Interchange Code (EBCDIC) sorting order, whereas with ORDERBY OFF, an Oracle database sort would be based on ASCII sorting order.

The other three functions, GROUPBY, HAVING, and WHERE, can take additional processing time. If you need to minimize the use of expensive resources, then you should choose the settings of these functions so that the processing is performed with cheaper resource. The above listed functions can also be disabled.

SQL Set Operators and Clauses

The WHERE and HAVING clauses are compatible for all versions of the DRDA server. This means that these clauses are passed unchanged to the DRDA server for processing. Whether clauses GROUP BY and ORDER BY are passed to the DRDA server, or compensated by Oracle database, is determined by the Native Semantics Parameters (see the previous section).

The set operators UNION and UNION ALL are compatible for all versions of the DRDA server, meaning that they are passed unchanged to the DRDA server for processing. The set operators INTERSECT and MINUS are compensated on all versions of the DRDA server except DB2/UDB. For DB2/UDB, INTERSECT is compatible and MINUS is translated to EXCEPT.

DRDA Data type to Oracle Data type Conversion

To move data between applications and the database, the gateway binds data values from a host variable or literal of a specific data type to a data type understood by the database. Therefore, the gateway maps values from any version of the DRDA server into appropriate Oracle data types before passing these values back to the application or Oracle tool.

Table 4-4 lists the data type mapping and restrictions. The DRDA server data types that are listed in the table are general. Refer to documentation for your DRDA database for restrictions on data type size and value limitations.

Table 4-4 Data Type Mapping and Restrictions

DRDA server	Oracle External	Criteria	If Oracle uses large varchar (32k)
CHAR(N)	CHAR(N)	N < = 2000	
VARCHAR (N)	VARCHAR2(N)	N < = 4000	N <= 32767
	LONG	4000 < N	32767 < N

Table 4-4 (Cont.) Data Type Mapping and Restrictions

DRDA server	Oracle External	Criteria	If Oracle uses large varchar (32k)
LONG VARCHAR(N)	VARCHAR2(N)	N 4000	N <= 32767
LONG VARCHAR(N)	LONG	4000 < N	32767 < N
CHAR(N) FOR BIT DATA	RAW(N)	N 255	
VARCHAR(N) FOR BIT DATA	RAW(N)	1 N 2000	1 <= N <= 32767
VARCHAR(N) FOR BIT DATA	LONG RAW	2000 < N	N < 32767
LONG VARCHAR(N) FOR BIT DATA	RAW(N)	1 <= N <= 2000	1 <= N <= 32767
LONG VARCHAR(N) FOR BIT DATA	LONG RAW	2000 < N	N < 32767
DATE	DATE	Refer to Performing Date and Time Operations	
TIME	CHAR(8)	See Performing Date and Time Operations	
TIMESTAMP	CHAR(26)	See Performing Date and Time Operations	
GRAPHIC	CHAR(2N)	N <= 1000	
VARGRAPHIC	VARCHAR2(2N)	N <= 2000	N <= 16370
	LONG	2000 <= N	16370 < N
LONG VARGRAPHIC	VARCHAR2(2N)	N <= 2000	N <=16370
	LONG	2000 < N	16370 < N
Floating Point Single	FLOAT(24)	n/a	
Floating Point Double	FLOAT(53)	n/a	
Decimal (P, S)	NUMBER(P,S)	n/a	
CLOB	LONG	n/a	
BLOB	LONG RAW(N)	n/a	
DBLOB	LONG	n/a	
SMALLINT	NUMBER(5)	n/a	
INTEGER	NUMBER(10)	n/a	

Performing Character String Operations

The gateway performs all character string comparisons, concatenations, and sorts using the data type of the referenced columns, and determines the validity of character string values passed by applications using the gateway. The gateway automatically converts character strings from one data type to another and converts between character strings and dates when needed.

Frequently, DRDA databases are designed to hold non-character binary data in character columns. Applications executed on DRDA systems can generally store and retrieve data as though it contained character data. However, when an application accessing this data runs in an environment that uses a different character set, inaccurate data may be returned.

With the gateway running on the host, character data retrieved from a DB2 UDB for iSeries or DB2 UDB for z/OS host is translated from EBCDIC to ASCII. When character data is sent to DB2 UDB for iSeries or DB2 UDB for z/OS from the host, ASCII data is translated to EBCDIC. When the characters are binary data in a character column, this translation causes the application to receive incorrect information or errors. To resolve these errors, character columns on DB2 UDB for iSeries or DB2 UDB for z/OS that hold non-character data must be created with the `FOR BIT DATA` option. In the application, the character columns holding non-character data should be processed using the Oracle data types `RAW` and `LONG RAW`. The `DESCRIBE` information for a character column defined with `FOR BIT DATA` on the host always indicates `RAW` or `LONG RAW`.

Converting Character String Data types

The gateway binds character string data values from host variables as fixed-length character strings. The bind length is the length of the character string data value. The gateway performs this conversion on every bind.

The `DRDA VARCHAR` data type can be between `1` and `32767` characters in length if the Oracle database is configured to use maximum `VARCHAR2` size of `32767`. Otherwise, the limit is `4000`. If the `DRDA VARCHAR` data type is greater than the Oracle configured `VARCHAR2` limit size, then it is converted to an Oracle `LONG` data type.

The `DB2 VARCHAR` data type can be no longer than `32767` bytes, which is much shorter than the maximum size for the Oracle `LONG` data type. If you define an Oracle `LONG` data type larger than `32767` bytes in length, then you receive an error message when it is mapped to the `DB2 VARCHAR` data type.

Performing Graphic String Operations

DB2 `GRAPHIC` data types store only double-byte string data. Sizes for DB2 `GRAPHIC` data types typically have maximum sizes that are half that of their character counterparts. For example, the maximum size of a `CHAR` may be 255 characters, whereas the maximum size of a `GRAPHIC` may be 127 characters.

Oracle database does not have a direct matching data type, and the gateway therefore converts between Oracle character data types to DB2 Graphic data types. Oracle database character data types may contain single, mixed, or double-byte character data. The gateway converts the string data into appropriate double-byte-only format depending upon whether the target DB2 column is a `Graphic` type and whether Gateway Initialization parameters are set to perform this conversion. For more configuration information, refer to Initialization Parameters.

Performing Date and Time Operations

The implementation of date and time data differs significantly in IBM DRDA databases and Oracle database. Oracle database has a single date data type, `DATE`, which can contain both calendar date and time of day information.

IBM DRDA databases support the following three distinct date and time data types:

`DATE` is the calendar date only.

`TIME` is the time of day only.

TIMESTAMP is a numerical value combining calendar date and time of day with microsecond resolution in the internal format of the IBM DRDA database.

Processing TIME and TIMESTAMP Data

There is no built-in mechanism that translates the IBM TIME and TIMESTAMP data to Oracle DATE data. An application must process TIME data types to the Oracle CHAR format with a length of eight bytes. An application must process the TIMESTAMP data type in the Oracle CHAR format with a length of 26 bytes.

An application reads TIME and TIMESTAMP functions as character strings and converts or subsets portions of the string to perform numerical operations. TIME and TIMESTAMP values can be sent to a DRDA server as character literals or bind variables of the appropriate length and format.

Processing DATE Data

Oracle and IBM DATE data types are mapped to each other. If an IBM DATE is queried, then it is converted to an Oracle DATE with a zero (midnight) time of day. If an Oracle DATE is processed against an IBM DATE column, then the date value is converted to the IBM DATE format, and any time value is discarded.

Character representations of dates are different in Oracle format and IBM DRDA format. When an Oracle application SQL statement contains a date literal, or conveys a date using a character bind variable, the gateway must convert the date to an IBM DRDA compatible format.

The gateway does not automatically recognize when a character value is being processed against an IBM DATE column. Applications are required to distinguish character date values by enclosing them with Oracle TO_DATE function notation. For example, if EMP is a synonym or view that accesses data on an IBM DRDA database, then you should not use the following SQL statement:

```
SELECT * FROM EMP WHERE HIREDATE = '03-MAR-81'
```

you should use the following:

```
SELECT * FROM EMP WHERE HIREDATE = TO_DATE('03-MAR-81')
```

In a programmatic interface program that uses a character bind variable for the qualifying date value, you must use this SQL statement:

```
SELECT * FROM EMP WHERE HIREDATE = TO_DATE(:1)
```

The above SQL notation does not affect SQL statement semantics when the statement is executed against an Oracle database table. The statement remains portable across Oracle and IBM DRDA-accessed data stores.

Any date literal other than insert value is checked to match the Oracle NLS_DATE_FORMAT before sending to DB2 for processing. TG4DB2 v10.2 does not check to match the NLS_DATE_FORMAT format. If such compatibility is desired, then you need to specify NODATECHK/ON value as part of HS_FDS_CAPABILITY parameter. You can then use any DB2 acceptable date formats:

- YYYY-MM-DD (ISO/JIS)
- DD.MM.YYYY (European)
- MM/DD/YYYY (USA)

For example:

```
SELECT * FROM EMP WHERE HIREDATE = '1981-03-03'
```

The `TO_DATE` requirement also does not pertain to input bind variables that are in Oracle date 7-byte binary format. The gateway recognizes such values as dates. For DB2 UDB for z/OS, if you install the gateway supplied `DATE EXIT`, then you can also use two additional Oracle date formats: DD-MON-RR and DD-MON-YYYY

Performing Date Arithmetic

The following forms of SQL expression generally do not work correctly with the gateway:

```
date + number
number + date
date - number
date1 - date2
```

The date and number addition and subtraction *(`date + number,number + date,date - number`)* forms are sent through to the DRDA server, where they are rejected. The supported servers do not permit number addition or subtraction with dates.

Because of differing interpretations of date subtraction in the supported servers, subtracting two dates *(`date1 - date2`)* gives results that vary by server.

> **Note:**
>
> Avoid date arithmetic expressions in all gateway SQL until date arithmetic problems are resolved.

Dates

Date handling has two categories:

- Two-digit year dates, which are treated as occurring 50 years before or 50 years after the year 2000.
- Four-digit year dates, which are not ambiguous with regard to the year 2000.

Use one of the following methods to enter twenty-first century dates:

- The `TO_DATE` function

  Use any date format including a four-character year field. Refer to the *Oracle Database SQL Language Reference* for the available date format string options.

  For example, `TO_DATE('2008-07-23', 'YYYY-MM-DD')` can be used in any `SELECT`, `INSERT`, `UPDATE`, or `DELETE` statement.

- The `NLS_DATE_FORMAT` parameter

  `ALTER SESSION SET NLS_DATE_FORMAT` should be used to set the date format used in SQL.

NLS_DATE_FORMAT Support

The following table lists the four patterns that can be used for the NLS_DATE_FORMAT in ALTER SESSION SET NLS_DATE_FORMAT:

DB2 Date Format	Pattern	Example
EUR	DD.MM.YYYY	30.10.1994
ISO	YYYY-MM-DD	1994-10-30
JIS	YYYY-MM-DD	1994-10-30
USA	MM/DD/YYYY	10/30/1994

The Oracle database default format of 'DD-MON-YY' is not permitted with DB2.

The following example demonstrates how to enter and select date values in the twenty-first century:

```
ALTER SESSION SET NLS_DATE_FORMAT = 'YYYY-MM-DD';
INSERT INTO EMP (HIREDATE) VALUES ('2008-07-23');
SELECT * FROM EMP WHERE HIREDATE = '2008-07-23';
UPDATE EMP SET HIREDATE = '2008-07-24'
   WHERE HIREDATE = '2008-07-23';
DELETE FROM EMP WHERE HIREDATE = '2008-07-24';
```

Oracle TO_DATE Function

The Oracle TO_DATE function is preprocessed in SQL INSERT, UPDATE, DELETE, and SELECT WHERE clauses. TO_DATE functions in SELECT result lists are not preprocessed.

The TO_DATE function is often needed to provide values to update or compare with date columns. Therefore, the gateway replaces the information included in the TO_DATE clause with an acceptable value before the SQL statement is sent to DB2.

Except for the SELECT result list, all TO_DATE functions are preprocessed and turned into values that are the result of the TO_DATE function. Only TO_DATE(literal) or TO_DATE(:bind_variable) is permitted. Except in SELECT result lists, the TO_DATE(column_name) function format is not supported.

The preprocessing of the Oracle TO_DATE functions into simple values is useful in an INSERT VALUES clause because DB2 does not allow functions in the VALUES clause. In this case, DB2 receives a simple value in the VALUES list. All forms of the TO_DATE function (with one, two, or three operands) are supported.

Performing Numeric data type Operations

IBM versions of the DRDA server perform automatic conversions to the numeric data type of the destination column (such as integer, double-precision floating point, or decimal). The user has no control over the data type conversion, and this conversion can be independent of the data type of the destination column in the database.

For example, if PRICE is an integer column of the PRODUCT table in an IBM DRDA database, then the update shown in the following example inaccurately sets the price of an ice cream cone to $1.00 because the IBM DRDA server automatically converts a floating point to an integer:

```
UPDATE PRODUCT
SET PRICE = 1.50
WHERE PRODUCT_NAME = 'ICE CREAM CONE    ';
```

Because `PRICE` is an integer, the IBM DRDA server automatically converts the decimal data value of 1.50 to 1.

Mapping the COUNT Function

Oracle database supports the following four operands for the `COUNT` function:

- `COUNT(*)`
- `COUNT(DISTINCT colname)`
- `COUNT(ALL colname)`
- `COUNT(colname)`

Some DRDA servers do not support all forms of `COUNT`, specifically `COUNT(colname)` and `COUNT(ALL colname)`. In those cases the `COUNT` function and its arguments are translated into `COUNT`(*). This may not yield the desired results, especially if the column being counted contains `NULL`s.

For those DRDA servers that do not support the above forms, it may be possible to achieve equivalent functionality by adding a `WHERE` clause. For example,

```
SELECT COUNT(colname) FROM table@dblink WHERE colname IS NOT NULL
```

or

```
SELECT COUNT(ALL colname) FROM table@dblink WHERE colname IS NOT NULL
```

You can also use native semantics to indicate support for all `COUNT` functions with the following parameter in your gateway initialization file:

```
HS_FDS_CAPABILITY=(COUNTCOL=YES)
```

Refer to SQL Limitations for known DRDA servers that do not support all forms of `COUNT`.

Performing Zoned Decimal Operations

A zoned decimal field is described as packed decimal on Oracle database. However, an Oracle application such as a Pro*C program can insert into a zoned decimal column using any supported Oracle numeric data type. The gateway converts this number into the most suitable data type. Data can be fetched from a DRDA database into any Oracle data type, provided that it does not result in a loss of information.

Passing Native SQL Statements through the Gateway

The passthrough SQL feature enables an application developer to send a SQL statement directly to the DRDA server without the statement being interpreted by Oracle database. `DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE` SQL passthrough statements that are supported by the gateway are limited to nonqueries (`INSERT`, `UPDATE`, `DELETE`, and DDL statements) and cannot contain bind variables. The gateway can run native SQL statements using `DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE`.

DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE is a built-in gateway function. This function receives one input argument and returns the number of rows affected by the SQL statement. For data definition language (DDL) statements, the function returns zero.

DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE are reserved names of the gateway and are used specifically for running native SQL.

The 12*c* Release 2 (12.2) of Oracle Database Gateway for DRDA enables retrieval of result sets from queries issued with passthrough. The syntax is different from the DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE function. Refer to "Retrieving Results Sets Through Passthrough" for more information.

Processing DDL Statements through Passthrough

As noted above, SQL statements that are processed through the DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE function are not interpreted by the Oracle database. As a result, the Oracle database will not know if such statements are making any modifications to the DRDA server. This means that unless you keep the cached information of the Oracle database up to date after changes to the DRDA server, the database may continue to rely upon inaccurate or outdated information in subsequent queries within the same session.

An example of this occurs when you alter the structure of a table by either adding or removing a column. When an application references a table through the gateway (for example, when you perform a query on it), the Oracle database caches the table definition. Now, suppose that within the same session, the application subsequently alters the table's form, by using DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE to add a column. Then, the next reference to the table by the application will return the old column definitions of the table and will ignore the table's new column. This is because the Oracle database did not process the statement and, so, has no knowledge of the alteration. Because the database does not know of the alteration, it has no reason to requery the table form, and, so, it will use the already-cached form to handle any new queries.

In order for the Oracle database to acquire the new form of the table, the existing session with the gateway must be closed and a new session must be opened. This can be accomplished in either of two ways:

- By ending the application session with the Oracle database and starting a new session after modifications have been made to the DRDA server; or
- By running the ALTER SESSION CLOSE DATABASE LINK command after making any modifications to the DRDA server.

Either of the above actions will void the cached table definitions and will force the Oracle database to acquire new definitions on the next reference.

Using DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE

To run a passthrough SQL statement using DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE, use the following syntax:

```
number_of_rows = DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE@dblink ('native_DRDA_sql');
```

where:

`number_of_rows` is a variable that is assigned the number of rows affected by the passthrough SQL completion. For DDL statements, a zero is returned for the number of rows affected.

`dblink` is the name of the database link used to access the gateway.

`native_DRDA_sql` is a valid nonquery SQL statement (except `CONNECT`, `COMMIT`, and `ROLLBACK`). The statement cannot contain bind variables. The DRDA server rejects native SQL statements that cannot be dynamically prepared. The SQL statement passed by the `DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE` function must be a character string. For more information regarding valid SQL statements, refer to the SQL Reference for the particular DRDA server.

Examples

1. Insert a row into a DB2 table using `DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE`:

```
DECLARE
  num_rows integer;
BEGIN
num_rows:=DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE@dblink
('INSERT  INTO SCOTT.DEPT VALUES (10,''PURCHASING'',''PHOENIX'')');
END;
/
```

2. Create a table in DB2 using `DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE`:

```
DECLARE
  num_rows integer;
BEGIN
  num_rows:=DBMS_HS_PASSTHROUGH.EXECUTE_IMMEDIATE@dblink
  ('CREATE TABLE MYTABLE (COL1 INTEGER, COL2 INTEGER, COL3 CHAR(14),
  COL4 VARCHAR(13))');
END;
/
```

Retrieving Results Sets Through Passthrough

Oracle Database Gateway for DRDA provides a facility to retrieve results sets from a `SELECT` SQL statement entered through passthrough. Refer to *Oracle Database Heterogeneous Connectivity User's Guide* for additional information.

Example

```
DECLARE
  CRS binary_integer;
  RET binary_integer;
  VAL VARCHAR2(10)
BEGIN
  CRS:=DBMS_HS_PASSTHROUGH.OPEN_CURSOR@gtwlink;
  DBMS_HS_PASSTHROUGH.PARSE@gtwlink(CRS,'SELECT NAME FROM PT_TABLE');
BEGIN
  RET:=0;
  WHILE (TRUE)
  LOOP
    RET:=DBMS_HS_PASSTHROUGH.FETCH_ROW@gtwlink(CRS,FALSE);
    DBMS_HS_PASSTHROUGH.GET_VALUE@gtwlink(CRS,1,VAL);
    INSERT INTO PT_TABLE_LOCAL VALUES(VAL);
  END LOOP;
```

```
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
      BEGIN
        DBMS_OUTPUT.PUT_LINE('END OF FETCH');
        DBMS_HS_PASSTHROUGH.CLOSE_CURSOR@gtwlink(CRS);
      END;
    END;
END;
/
```

Oracle Data Dictionary Emulation on a DRDA Server

The gateway optionally augments the DRDA database catalogs with data dictionary views modeled on the Oracle data dictionary. These views are based on the dictionary tables in the DRDA database, presenting that catalog information in views familiar to Oracle users. The views created during the installation of the gateway automatically limit the data dictionary information presented to each user based on the privileges of that user.

Using the Gateway Data Dictionary

The gateway data dictionary views provide users with an Oracle-like interface to the contents and use of the DRDA database. Oracle products require some of these views. The gateway supports the DB2 UDB for z/OS, DB2 UDB for iSeries, and DB2/UDB catalog views.

You can query the gateway data dictionary views to see the objects in the DRDA database and to determine the authorized users of the DRDA database. The Oracle Database Gateway for DRDA supports many Oracle catalog views. Refer to Oracle DB2 Data Dictionary Views for descriptions of Oracle DB2 catalog views. These views are completely compatible with the gateway.

Using the DRDA Catalog

Each DRDA database has its own catalog tables and views, which you might find useful. Refer to the appropriate IBM documentation for descriptions of these catalogs.

5

Error Messages, Diagnosis, and Reporting

The following sections provide information about error messages and error codes specific to the Oracle Database Gateway for DRDA:

Interpreting Gateway Error Messages

The gateway architecture consists of different components. Any component may detect and report an error condition while processing SQL statements that refer to one or more DRDA database tables. This means that errors can be complex, involving error codes and supporting data from multiple components. In all cases, however, the application ultimately receives a single error code or a return code.

As most gateway messages exceed the 70 character message area in the Oracle SQL Communications Area (SQLCA), the programmatic interfaces and Oracle Call Interfaces, that you use to access data through the gateway should use SQLGLM or OERHMS to view the entire text of messages. Refer to the programmer's guide to the Oracle precompilers for additional information about SQLGLM, and refer to the *Oracle C++ Call Interface Programmer's Guide* for additional information about OERHMS.

Errors encountered when using the gateway can originate from many sources, as follows:

- Errors detected by the Oracle database
- Errors detected by the gateway
- Errors detected in the DRDA software, either on the client or server side
- Communication errors
- Errors detected by the server database

Errors Detected by the Gateway

Errors detected by the Oracle database are reported back to the application or tool with the standard `ORA` type message. Refer to *Oracle Database Error Messages* for descriptions of these errors. For example, the following error occurs when an undefined database link name is specified:

```
ORA-02019:  connection description for remote database not found
```

Errors in the `ORA-9100` to `ORA-9199` range are reserved for the generic gateway layer (components of the gateway that are not specific to DRDA). Messages in this range are documented in *Oracle Database Error Messages*.

Errors Detected in the DRDA Software

Errors detected in the DRDA gateway, on the client or server side, are usually reported with error ORA-28500, followed by a gateway-specific expanded error message. There are two return codes reported in the expanded message:

- drc specifies DRDA-specific errors.
- grc specifies generic gateway errors detected in the DRDA layer. These errors are documented in the *Oracle Database Error Messages*.

> **Note:**
>
> Error code ORA-28500 was error code ORA-09100 prior to gateway version 8. Error code ORA-28501 was listed as ORA-09101 prior to gateway version 8.

The values in parentheses that follow the drc values are used for debugging by Oracle Support Services. The errp field indicates the program (client or server) that detected the error. If present, errmc lists any error tokens.

For example, the following error message is returned when the database name specified with the DRDA_REMOTE_NAME parameter in the initsid.ora file is not defined at the DRDA server:

```
ORA-28500: connection from ORACLE to non-Oracle system returned the message:
```

Errors Detected by the DRDA Server

Errors detected by the DRDA server are reported with an ORA-28500 followed by a gateway-specific expanded error message. Refer to IBM documentation for the specific database being used. Also refer to Mapped Errorsfor some SQL errors that get translated.

> **Note:**
>
> Error code ORA-28500 was error code ORA-09100 prior to gateway version 8. Error code ORA-28501 was listed as ORA-09101 prior to gateway version 8.

For example, the following error message indicates that the DRDA server did not find the DB2 database name specified in the HS_FDS_CONNECT_INFO parameter in the initSID.ora file:

```
ORA-28500: connection from ORACLE to a non-Oracle system returned this message:
[Oracle][ODBC DB2 Wire Protocol driver]Remote Database Not Found: UNKNOWN
```

Mapped Errors

Some SQL errors are returned from the DRDA server and are translated to an Oracle error code. This is needed when the Oracle instance or gateway provides special handling of an error condition.

The following is an example of a translated object does not exist error:

```
ORA-00942: table or view does not exist
[Oracle][ODBC DB2 Wire Protocol driver][UDB DB2 for OS/390 and z/OS]PCASTRO.XXX IS
AN UNDEFINED NAME.
```

SQL Tracing and the Gateway

When developing applications, it is often useful to be able to see the exact SQL statements that are being passed through the gateway. The following sections describe setting appropriate trace parameters and setting up the debug gateway.

SQL Tracing in the Oracle Database

Oracle database has a command for capturing the SQL statement that is actually sent to the gateway. This command is called `EXPLAIN PLAN`. The `EXPLAIN PLAN` command is used to determine the execution plan that Oracle database follows to execute a specified SQL statement. This command inserts a row, which describes each step of the execution plan, into a specified table. If you are using cost-based optimization, then this command also determines the cost of executing the statement. The syntax of the command is:

```
EXPLAIN PLAN [ SET STATEMENT_ID = 'text' ]
    [ INTO [schema.]table[@dblink] ] FOR statement
```

For detailed information on this command, refer to the *Oracle Database SQL Language Reference*.

> **Note:**
>
> In most cases, `EXPLAIN PLAN` should be sufficient to extract the SQL statement that is actually sent to the gateway, and thus sent to the DRDA server. However, certain SQL statement form have post-processing performed on them in the gateway.

A

Oracle DB2 Data Dictionary Views

The following section covers the Oracle Database Gateway for DRDA data dictionary views accessible to all users of Oracle database. Any user with `SELECT` privileges for DB2 catalog tables can access most of the views.

N/A is used in the tables to denote that the column is not valid for the gateway.

Supported Views

The following is a list of Oracle data dictionary views that are supported by the gateway for DB2 UDB for z/OS, DB2 UDB for iSeries, and DB2/UDB DRDA servers.

- `ALL_CATALOG`
- `ALL_COL_COMMENTS`
- `ALL_CONS_COLUMNS`
- `ALL_CONSTRAINTS`
- `ALL_INDEXES`
- `ALL_IND_COLUMNS`
- `ALL_OBJECTS`
- `ALL_SYNONYMS`
- `ALL_TAB_COMMENTS`
- `ALL_TABLES`
- `ALL_TAB_COLUMNS`
- `ALL_USERS`
- `ALL_VIEWS`
- `COL_PRIVILEGES`
- `DICTIONARY`
- `DUAL`
- `TABLE_PRIVILEGES`
- `USER_CATALOG`
- `USER_COL_COMMENTS`
- `USER_CONSTRAINTS`
- `USER_CONS_COLUMNS`
- `USER_INDEXES`
- `USER_OBJECTS`
- `USER_SYNONYMS`

- USER_TABLES
- USER_TAB_COLUMNS
- USER_TAB_COMMENTS
- USER_USERS
- USER_VIEWS

ALL_CATALOG

The ALL_CATALOG view contains all tables, views, synonyms, and sequence accessible to the user.

Column name	Description
OWNER	Owner of the object
TABLE_NAME	Name of the object
TABLE_TYPE	Type of object

ALL_COL_COMMENTS

The ALL_COL_COMMENTS view contains comments on columns of accessible tables and views.

Column name	Description
OWNER	Owner of the object
TABLE_NAME	Object name
COLUMN_NAME	Column name
COMMENTS	Comments on column

ALL_CONS_COLUMNS

The ALL_CONS_COLUMNS view contains information about accessible columns in constraint definitions.

Column name	Description
OWNER	Owner of the constraint definition
CONSTRAINT_NAME	Name of the constraint definition
TABLE_NAME	Name of the table with a constraint definition
COLUMN_NAME	Name of the column specified in the constraint definition
POSITION	Original position of column in definition

ALL_CONSTRAINTS

The ALL_CONSTRAINTS view contains constraint definitions on accessible tables.

Column name	Description
OWNER	Owner of the constraint definition
CONSTRAINT_NAME	Name of the constraint definition
CONSTRAINT_TYPE	Type of the constraint definition
TABLE_NAME	Name of the table with constraint definition
SEARCH_CONDITION	Text of the search condition for table check
R_OWNER	Owner of the table used in referential constraint
R_CONSTRAINT_NAME	Name of the unique constraint definition for referenced table
DELETE_RULE	Delete rule for a referential constraint
STATUS	Status of a constraint
DEFERRABLE	Whether the constraint is deferrable
DEFERRED	Whether the constraint was initially deferred
VALIDATED	Whether all data obeys the constraint
GENERATED	Whether the name of the constraint is user or system generated
BAD	Constraint specifies a century in an ambiguous manner
RELY	Whether an enabled constraint is enforced or unenforced
LAST_CHANGE	When the constraint was last enabled
INDEX_OWNER	N/A
INDEX_NAME	N/A

ALL_INDEXES

The ALL_INDEXES view contains description of indexes on tables accessible to the user.

Column name	Description
OWNER	Owner of the index
INDEX_NAME	Name of the index
INDEX_TYPE	Type of the index
TABLE_OWNER	Owner of the indexed object
TABLE_NAME	Name of the indexed object
TABLE_TYPE	Type of the indexed object
UNIQUENESS	Uniqueness status of the index
COMPRESSION	N/A
PREFIX_LENGTH	0
TABLESPACE_NAME	Name of the tablespace containing the index
INI_TRANS	N/A
MAX_TRANS	N/A

Column name	Description
INITIAL_EXTENT	N/A
NEXT_EXTENT	N/A
MIN_EXTENTS	N/A
MAX_EXTENTS	N/A
PCT_INCREASE	N/A
PCT_THRESHOLD	Threshold percentage of block space allowed per index entry
INCLUDE_COLUMN	Column ID of the last column to be included in an index-organized table
FREELISTS	Number of process freelists allocated to this segment
FREELIST_GROUPS	Number of freelist groups allocated to this segment
PCT_FREE	N/A
LOGGING	Logging information
BLEVEL	Depth of the index from its root block to its leaf blocks. A depth of 1 indicates that the root block and the leaf block are the same.
LEAF_BLOCKS	Number of leaf blocks in the index
DISTINCT_KEYS	Number of distinct indexed values. For indexes that enforce UNIQUE and PRIMARY KEY constraints, this value is the same as the number of rows in the table.
AVG_LEAF_BLOCKS_PER_KEY	N/A
AVG_DATA_BLOCKS_PER_KEY	N/A
CLUSTERING_FACTOR	N/A
STATUS	State of the index: VALID
NUM_ROWS	Number of rows in the index
SAMPLE_SIZE	Size of the sample used to analyze the index
LAST_ANALYZED	Date on which an index was most recently analyzed
DEGREE	Number of threads per instance for scanning the index
INSTANCES	Number of instances across which the index is to be scanned
PARTITIONED	Whether the index is partitioned
TEMPORARY	Whether the index is on a temporary table
GENERATED	Whether the name of the index is system generated
SECONDARY	N/A
BUFFER_POOL	Whether the index is a secondary object
USER_STATS	N/A
DURATION	N/A
PCT_DIRECT_ACCESS	N/A
ITYP_OWNER	N/A
ITYP_NAME	N/A
PARAMETERS	N/A

Column name	Description
GLOBAL_STATS	N/A
DOMIDX_STATUS	N/A
DOMIDX_OPSTATUS	N/A
FUNCIDX_STATUS	N/A
JOIN_INDEX	N/A
IOT_REDUNDANT_PKEY_ELIM	N/A

ALL_IND_COLUMNS

The ALL_IND_COLUMNS view contains the columns of indexes on all tables that are accessible to the current user.

Column names	Description
INDEX_OWNER	Owner of the index
INDEX_NAME	Name of the index
TABLE_OWNER	Owner of the table or cluster
TABLE_NAME	Name of the table or cluster
COLUMN_NAME	Column name or attribute of object type column
COLUMN_POSITION	Position of a column or attribute within the index
COLUMN_LENGTH	Indexed length of the column
CHAR_LENGTH	Maximum codepoint length of the column
DESCEND	Whether the column is sorted in descending order (Y/N)

ALL_OBJECTS

The ALL_OBJECTS view contains objects accessible to the user.

Column name	Description
OWNER	Owner of the object
OBJECT_NAME	Name of object
SUBOBJECT_NAME	Name of the subobject
OBJECT_ID	Object number of the object
DATA_OBJECT_ID	Dictionary object number of the segment that contains the object
OBJECT_TYPE	Type of object
CREATED	N/A
LAST_DDL_TIME	N/A
TIMESTAMP	N/A
STATUS	State of the object
TEMPORARY	Whether the object is temporary

Column name	Description
GENERATED	Whether the name of this object system is generated
SECONDARY	N/A

ALL_SYNONYMS

The ALL_SYNONYMS view contains all synonyms accessible to the user.

Column name	Description
OWNER	Owner of the synonym
SYNONYM_NAME	Name of the synonym
TABLE_OWNER	Owner of the object referenced by the synonym
TABLE_NAME	Name of the object referenced by the synonym
DB_LINK	N/A

ALL_TABLES

The ALL_TABLES view contains description of tables accessible to the user.

Column name	Description
OWNER	Owner of the table
TABLE_NAME	Name of the table
TABLESPACE_NAME	Name of the tablespace containing the table
CLUSTER_NAME	N/A
IOT_NAME	Name of the index organized table
PCT_FREE	N/A
PCT_USED	N/A
INI_TRANS	N/A
MAX_TRANS	N/A
INITIAL_EXTENT	N/A
NEXT_EXTENT	N/A
MIN_EXTENTS	N/A
MAX_EXTENTS	N/A
PCT_INCREASE	N/A
FREELISTS	Number of process freelists allocated to this segment
FREELIST_GROUPS	Number of freelist groups allocated to this segment
LOGGING	Logging attribute
BACKED_UP	N/A

Column name	Description
NUM_ROWS	Number of rows in the table
BLOCKS	N/A
EMPTY_BLOCKS	N/A
AVG_SPACE	N/A
CHAIN_CNT	N/A
AVG_ROW_LEN	Average length of a row in the table in bytes
AVG_SPACE_FREELIST_BLOCKS	Average freespace of all blocks on a freelist
NUM_FREELIST_BLOCKS	Number of blocks on the freelist
DEGREE	Number of threads per instance for scanning the table
INSTANCES	Number of instances across which the table is to be scanned
CACHE	Whether the cluster is to be cached in the buffer cache
TABLE_LOCK	Whether the table locking is enabled or disabled
SAMPLE_SIZE	Sample size used in analyzing this table
LAST_ANALYZED	Date on which this table was most recently analyzed
PARTITIONED	Whether this table is partitioned
IOT_TYPE	Whether the table is an index-organized table
TEMPORARY	Can the current session only see data that it placed in this object itself?
SECONDARY	N/A
NESTED	Whether the table is a nested table
BUFFER_POOL	Default buffer pool for the object
ROW_MOVEMENT	N/A
GLOBAL_STATS	N/A
USER_STATS	N/A
DURATION	N/A
SKIP_CORRUPT	N/A
MONITORING	N/A
CLUSTER_OWNER	N/A
DEPENDENCIES	N/A
COMPRESSION	N/A

ALL_TAB_COLUMNS

The ALL_TAB_COLUMNS view contains columns of all tables, views, and clusters accessible to the user.

Column name	Description
OWNER	Owner of the table or view
TABLE_NAME	Table or view name

Column name	Description
COLUMN_NAME	Column name
DATA_TYPE	Data type of the column
DATA_TYPE_MOD	Data type modifier of the column
DATA_TYPE_OWNER	Owner of the data type of the column
DATA_LENGTH	Maximum length of the column in bytes
DATA_PRECISION	N/A
DATA_SCALE	Digits to the right of decimal point in a number
NULLABLE	Whether the column permits nulls? Value is *n* if there is a NOT NULL constraint on the column or if the column is part of a PRIMARY key.
COLUMN_ID	Sequence number of the column as created
DEFAULT_LENGTH	N/A
DATA_DEFAULT	N/A
NUM_DISTINCT	Number of distinct values in each column of the table
LOW_VALUE	For tables with more than three rows, the second lowest and second highest values. These statistics are expressed in hexadecimal notation for the internal representation of the first 32 bytes of the values.
HIGH_VALUE	N/A
DENSITY	N/A
NUM_NULLS	Number of nulls in the column
NUM_BUCKETS	Number of buckets in histogram for the column
LAST_ANALYZED	Date on which this column was most recently analyzed
SAMPLE_SIZE	Sample size used in analyzing this column
CHARACTER_SET_NAME	Name of the character set
CHAR_COL_DECL_LENGTH	Length of the character set
GLOBAL_STATS	N/A
USER_STATS	N/A
AVG_COL_LEN	Average length of the column (in bytes)
CHAR_LENGTH	Displays the length of the column in characters
CHAR_USED	N/A

ALL_TAB_COMMENTS

The ALL_TAB_COMMENTS view contains comments on tables and views accessible to the user.

Column name	Description
OWNER	Owner of the object
TABLE_NAME	Name of the object
TABLE_TYPE	Type of the object

Column name	Description
COMMENTS	Comments on the object

ALL_USERS

The ALL_USERS contains information about all users of the database.

Column name	Description
USERNAME	Name of the user
USER_ID	N/A
CREATED	N/A

ALL_VIEWS

The ALL_VIEWS view contains text of views accessible to the user.

Column name	Description
OWNER	Owner of the view
VIEW_NAME	Name of the view
TEXT_LENGTH	ALL_VIEWS view will return 0 for TEXT_LENGTH column
TEXT	ALL_VIEWS view will return NULL for TEXT column
TYPE_TEXT_LENGTH	Length of the type clause of the typed view
TYPE_TEXT	Type clause of the typed view
OID_TEXT_LENGTH	Length of the WITH OID clause of the typed view
OID_TEXT	WITH OID clause of the typed view
VIEW_TYPE_OWNER	Owner of the type of the view, if the view is a typed view
VIEW_TYPE	Type of the view, if the view is a typed view
SUPERVIEW_NAME	N/A

COLUMN_PRIVILEGES

The COLUMN_PRIVILEGES view contains grants on columns for which the user is the grantor, grantee, or owner, or, the grantee is PULBLIC.

Column name	Description
GRANTEE	Name of the user to whom access was granted
OWNER	Username of the owner of the object
TABLE_NAME	Name of the object
COLUMN_NAME	Name of the column
GRANTOR	Name of the user who performed the grant
INSERT_PRIV	Permission to insert into the column

Column name	Description
UPDATE_PRIV	Permission to update the column
REFERENCES_PRIV	Permission to reference the column
CREATED	Timestamp for the grant

DICTIONARY

The DICTIONARY view contains list or data dictionary tables.

Column name	Description
TABLE_NAME	Table name
COMMENTS	Description of the table

DUAL

The DUAL view contains list of dual tables.

Column name	Description
DUMMY	A dummy column

TABLE_PRIVILEGES

The TABLE_PRIVILEGES view contains grants on objects for which the user is the grantor, grantee, or owner, or, the grantee is PUBLIC.

Column name	Description
GRANTEE	Name of the user to whom access is granted
OWNER	Owner of the object
TABLE_NAME	Name of the object
GRANTOR	Name of the user who performed the grant
SELECT_PRIV	Permission to select data from an object
INSERT_PRIV	Permission to insert data into an object
DELETE_PRIV	Permission to delete data from an object
UPDATE_PRIV	Permission to update an object
REFERENCES_PRIV	N/A
ALTER_PRIV	Permission to alter an object
INDEX_PRIV	Permission to create or drop an index on an object
CREATED	Timestamp for the grant

USER_CATALOG

The USER_CATALOG view contains tables, views, synonyms, and sequences owned by the user.

Column name	Description
TABLE_NAME	Name of the object
TABLE_TYPE	Type of the object

USER_COL_COMMENTS

The USER_COL_COMMENTS view contains comments on columns of tables and views owned by the user.

Column name	Description
TABLE_NAME	Name of the object
COLUMN_NAME	Name of the column
COMMENTS	Comments on the column

USER_CONSTRAINTS

The USER_CONSTRAINTS view contains constraint definitions on tables owned by the user.

Column name	Description
OWNER	Owner of the constraint definition
CONSTRAINT_NAME	Name associated with the constraint definition
CONSTRAINT_TYPE	Type of the constraint definition
TABLE_NAME	Name associated with the table with constraint definition
SEARCH_CONDITION	Text of the search condition for table check
R_OWNER	Owner of table used in referential constraint
R_CONSTRAINT_NAME	Name of the unique constraint definition for referenced table
DELETE_RULE	Delete rule for referential constraint
STATUS	Status of a constraint
DEFERRABLE	Whether the constraint is deferrable
DEFERRED	Whether the constraint was initially deferred
VALIDATED	Whether all data obeys the constraint
GENERATED	Whether the name of the constraint is user or system generated
BAD	Constraint specifies a century in an ambiguous manner
LAST_CHANGE	When the constraint was last enabled
INDEX_OWNER	N/A
INDEX_NAME	N/A

USER_CONS_COLUMNS

The USER_CONS_COLUMNS contains information about columns in constraint definitions owned by the user.

Column name	Description
OWNER	Owner of the constraint definition
CONSTRAINT_NAME	Name associated with the constraint definition
TABLE_NAME	Name associated with table with constraint definition
COLUMN_NAME	Name associated with column specified in the constraint definition
POSITION	Original position of column in definition

USER_INDEXES

The USER_INDEXES view contains description of the user's indexes:

Column name	Description
INDEX_NAME	Name of the index
INDEX_TYPE	Type of index
TABLE_OWNER	Owner of the indexed object
TABLE_NAME	Name of the indexed object
TABLE_TYPE	Type of the indexed object
UNIQUENESS	Uniqueness status of the index
COMPRESSION	N/A
PREFIX_LENGTH	0
TABLESPACE_NAME	Name of the tablespace containing the index
INI_TRANS	N/A
MAX_TRANS	N/A
INITIAL_EXTENT	N/A
NEXT_EXTENT	N/A
MIN_EXTENTS	N/A
MAX_EXTENTS	N/A
PCT_INCREASE	N/A
PCT_THRESHOLD	Threshold percentage of block space allowed per index entry
INCLUDE_COLUMN	Column ID of the last column to be included in index-organized table
FREELISTS	Number of process freelists allocated to a segment
FREELIST_GROUPS	Number of freelist groups allocated to a segment
PCT_FREE	N/A
LOGGING	Logging information

Column name	Description
BLEVEL	Depth of the index from its root block to its leaf blocks. A depth of 1 indicates that the root and leaf block are the same.
LEAF_BLOCKS	Number of leaf blocks in the index
DISTINCT_KEYS	Number of distinct indexed values. For indexes that enforce UNIQUE and PRIMARY KEY constraints, this value is the same as the number of rows in the table.
AVG_LEAF_BLOCKS_PER_KEY	N/A
AVG_DATA_BLOCKS_PER_KEY	N/A
CLUSTERING_FACTOR	N/A
STATUS	State of the indexes: VALID
NUM_ROWS	Number of rows in the index
SAMPLE_SIZE	Size of the sample used to analyze the index
LAST_ANALYZED	Date on which the index was most recently analyzed
DEGREE	Number of threads per instance for scanning the index
INSTANCES	Number of instances across which the index is to be scanned
PARTITIONED	Whether the index is partitioned
TEMPORARY	Whether the index is on a temporary table
GENERATED	Whether the name of the index is system generated
SECONDARY	N/A
BUFFER_POOL	Whether the index is a secondary object
USER_STATS	N/A
DURATION	N/A
PCT_DIRECT_ACCESS	N/A
ITYP_OWNER	N/A
ITYP_NAME	N/A
PARAMETERS	N/A
GLOBAL_STATS	N/A
DOMIDX_STATUS	N/A
DOMIDX_OPSTATUS	N/A
FUNCIDX_STATUS	N/A
JOIN_INDEX	N/A
IOT_REDUNDANT_PKEY_ELIM	N/A

USER_OBJECTS

The USER_OBJECTS view contains objects owned by the user.

Column name	Description
OBJECT_NAME	Name of the object

Column name	Description
SUBOBJECT_NAME	Name of the subobject
OBJECT_ID	Object number of the object
DATA_OBJECT_ID	Dictionary object number of the segment that contains the object
OBJECT_TYPE	Type of object
CREATED	N/A
LAST_DDL_TIME	N/A
TIMESTAMP	N/A
STATUS	State of the object: VALID
TEMPORARY	Whether the object is temporary
GENERATED	Was the name of this object system generated?
SECONDARY	N/A

USER_SYNONYMS

The USER_SYNONYMS view contains the private synonyms of the user.

Column name	Description
SYNONYM_NAME	Name of the synonym
TABLE_OWNER	Owner of the object referenced by the synonym
TABLE_NAME	Name of the object referenced by the synonym
DB_LINK	N/A

USER_TABLES

The USER_TABLES view contains description of the tables owned by the user.

Column name	Description
TABLE_NAME	Name of the table
TABLESPACE_NAME	Name of the tablespace containing the table
CLUSTER_NAME	N/A
IOT_NAME	Name of the index organized table
PCT_FREE	N/A
PCT_USED	N/A
INI_TRANS	N/A
MAX_TRANS	N/A
INITIAL_EXTENT	N/A
NEXT_EXTENT	N/A
MIN_EXTENTS	N/A

Column name	Description
MAX_EXTENTS	N/A
PCT_INCREASE	N/A
FREELISTS	Number of process freelists allocated to a segment
FREELIST_GROUPS	Number of freelist groups allocated to a segment
LOGGING	Logging information
BACKED_UP	N/A
NUM_ROWS	Number of rows in the table
BLOCKS	N/A
EMPTY_BLOCKS	N/A
AVG_SPACE	N/A
CHAIN_CNT	N/A
AVG_ROW_LEN	Average length of a row in the table in bytes
AVG_SPACE_FREELIST_BLOCKS	Average freespace of all blocks on a freelist
NUM_FREELIST_BLOCKS	Number of blocks on the freelist
DEGREE	Number of threads per instance for scanning the table
INSTANCES	Number of instances across which the table is to be scanned
CACHE	Whether the cluster is to be cached in the buffer cache
TABLE_LOCK	Whether table locking is enabled or disabled
SAMPLE_SIZE	Sample size used in analyzing this table
LAST_ANALYZED	Date on which this table was most recently analyzed
PARTITIONED	Indicates whether this table is partitioned
IOT_TYPE	If this is an index organized table
TEMPORARY	Can the current session only see data that it placed in this object itself?
SECONDARY	N/A
NESTED	If the table is a nested table
BUFFER_POOL	The default buffer pool for the object
ROW_MOVEMENT	N/A
GLOBAL_STATS	N/A
USER_STATS	N/A
DURATION	N/A
SKIP_CORRUPT	N/A
MONITORING	N/A
CLUSTER_OWNER	N/A
DEPENDENCIES	N/A
COMPRESSION	N/A

USER_TAB_COLUMNS

The USER_TAB_COLUMNS view contains columns of the tables, views, and clusters owned by the user.

Column name	Description
TABLE_NAME	Name of the table, view, or cluster
COLUMN_NAME	Name of the column
DATA_TYPE	Data type of column
DATA_TYPE_MOD	Data type modifier of the column
DATA_TYPE_OWNER	Owner of the data type of the column
DATA_LENGTH	Maximum length of the column in bytes
DATA_PRECISION	N/A
DATA_SCALE	Digits to the right of a decimal point in a number
NULLABLE	Whether the column permits nulls. Value is *n* if there is a NOT NULL constraint on the column or if the column is part of a PRIMARY key.
COLUMN_ID	Sequence number of the column as created
DEFAULT_LENGTH	N/A
DATA_DEFAULT	N/A
NUM_DISTINCT	Number of distinct values in each column of the table
LOW_VALUE	For tables with more than three rows, the second lowest and second highest values. These statistics are expressed in hexadecimal notation for the internal representation of the first 32 bytes of the values.
HIGH_VALUE	N/A
DENSITY	N/A
NUM_NULLS	Number of nulls in the column
NUM_BUCKETS	Number of buckets in histogram for the column
LAST_ANALYZED	Date on which this column was most recently analyzed
SAMPLE_SIZE	Sample size used in analyzing this column
CHARACTER_SET_NAME	Name of the character set
CHAR_COL_DECL_LENGTH	Length of the character set
GLOBAL_STATS	N/A
USER_STATS	N/A
AVG_COL_LEN	Average length of the column (in bytes)
CHAR_LENGTH	Length of the column in characters
CHAR_USED	N/A

USER_TAB_COMMENTS

The USER_TAB_COMMENTS view contains comments on the tables and views owned by the user.

Column name	Description
TABLE_NAME	Name of the object
TABLE_TYPE	Type of the object
COMMENTS	Comments on the object

USER_VIEWS

The USER_VIEWS view contains text of views owned by the user.

Column name	Description
VIEW_NAME	Name of the view
TEXT_LENGTH	Length of the view text
TEXT	First line of the view text
TYPE_TEXT_LENGTH	Length of the type clause of the typed view
TYPE_TEXT	Type clause of the typed view
OID_TEXT_LENGTH	Length of the WITH OID clause of the typed view
OID_TEXT	WITH OID clause of the typed view
VIEW_TYPE_OWNER	Owner of the type of the view, if the view is a typed view
VIEW_TYPE	Type of the view, if the view is a typed view
SUPERVIEW_NAME	N/A

USER_USERS

The USER_USERS view contains information about the current user.

Column name	Description
USERNAME	Name of the user
USER_ID	N/A
ACCOUNT_STATUS	Indicates if the account is locked, expired or unlocked
LOCK_DATE	Date on which the account was locked
EXPIRE_DATE	Date of expiration of the account
DEFAULT_TABLESPACE	N/A
TEMPORARY_TABLESPACE	N/A
CREATED	N/A
EXTERNAL_NAME	Name of the external user

B
Initialization Parameters

The Oracle database initialization parameters in the `init.ora` file are distinct from gateway initialization parameters. Set the gateway parameters in the initialization parameter file using an agent-specific mechanism, or set them in the Oracle data dictionary using the `DBMS_HS` package. The gateway initialization parameter file must be available when the gateway is started. Changes made to the initialization parameters only take effect in the next gateway session.

The following sections contain a list of the gateway initialization parameters that can be set for each gateway and their description. It also describes the initialization parameter file syntax.

Initialization Parameter File Syntax

The syntax for the initialization parameter file is as follows:

- The file is a sequence of commands.
- Each command should start on a separate line.
- End of line is considered a command terminator (unless escaped with a backslash).
- If there is a syntax error in an initialization parameter file, none of the settings take effect.
- Set the parameter values as follows:

  ```
  [SET][PRIVATE] parameter=value
  ```

  Where:

  parameter is an initialization parameter name. It is a string of characters starting with a letter and consisting of letters, digits and underscores. Initialization parameter names are case sensitive.

  value is the initialization parameter value. It is case-sensitive. An initialization parameter value is either:

  1. A string of characters that does not contain any backslashes, white space or double quotation marks (")
  2. A quoted string beginning with a double quotation mark and ending with a double quotation mark. The following can be used inside a quoted string:
     - backslash (\) is the escape character
     - \n inserts a new line
     - \t inserts a tab
     - \" inserts a double quotation mark

- \\ inserts a backslash

  A backslash at the end of the line continues the string on the next line. If a backslash precedes any other character then the backslash is ignored.

For example, to enable tracing for an agent, set the `HS_FDS_TRACE_LEVEL` initialization parameter as follows:

```
HS_FDS_TRACE_LEVEL=ON
```

`SET` and `PRIVATE` are optional keywords. You cannot use either as an initialization parameter name. Most parameters are needed only as initialization parameters, so you usually do not need to use the `SET` or `PRIVATE` keywords. If you do not specify either `SET` or `PRIVATE`, the parameter is used only as an initialization parameter for the agent.

`SET` specifies that, in addition to being used as an initialization parameter, the parameter value is set as an environment variable for the agent process. Use `SET` for parameter values that the drivers or non-Oracle system need as environment variables.

`PRIVATE` specifies that the initialization parameter should be private to the agent and should not be uploaded to the Oracle database. Most initialization parameters should not be private. If, however, you are storing sensitive information like a password in the initialization parameter file, then you may not want it uploaded to the server because the initialization parameters and values are not encrypted when uploaded. Making the initialization parameters private prevents the upload from happening and they do not appear in dynamic performance views. Use `PRIVATE` for the initialization parameters only if the parameter value includes sensitive information such as a username or password.

`SET PRIVATE` specifies that the parameter value is set as an environment variable for the agent process and is also private (not transferred to the Oracle database, not appearing in dynamic performance views or graphical user interfaces).

Oracle Database Gateway for DRDA Initialization Parameters

This section lists all the initialization file parameters that can be set for the Oracle Database Gateway for DRDA. They are as follows:

- HS_TRANSACTION_MODEL
- IFILE
- HS_FDS_CONNECT_INFO
- HS_FDS_RECOVERY_ACCOUNT
- HS_FDS_RECOVERY_PWD
- HS_FDS_FETCH_ROWS
- HS_FDS_TRACE_LEVEL
- HS_FDS_TRANSACTION_LOG
- HS_IDLE_TIMEOUT
- HS_FDS_MBCS_TO_GRAPHIC
- HS_FDS_GRAPHIC_TO_MBCS
- HS_FDS_TIMESTAMP_MAPPING
- HS_FDS_DATE_MAPPING
- HS_FDS_QUOTE_IDENTIFIER
- HS_FDS_CAPABILITY
- HS_FDS_ISOLATION_LEVEL
- HS_FDS_PACKAGE_COLLID
- HS_NLS_LENGTH_SEMANTICS
- HS_KEEP_REMOTE_COLUMN_SIZE
- HS_FDS_RESULTSET_SUPPORT
- HS_FDS_REMOTE_DB_CHARSET
- HS_FDS_SUPPORT_STATISTICS
- HS_FDS_RSET_RETURN_ROWCOUNT
- HS_FDS_AUTHENTICATE_USER
- HS_FDS_ENCRYPT_SESSION
- HS_FDS_VALIDATE_SERVER_CERT
- HS_FDS_TRUSTSTORE_FILE
- HS_FDS_TRUSTSTORE_PASSWORD
- HS_FDS_SQLLEN_INTERPRETATION
- HS_FDS_ARRAY_EXEC

HS_CALL_NAME

Property	Description
Default value	None
Range of values	Not applicable

Specifies the remote functions that can be referenced in SQL statements. The value is a list of remote functions and their owners, separated by semicolons, in the following format:

[owner_name.]function_name

For example:

```
owner1.A1;owner2.A2;A3
```

If an owner name is not specified for a remote function, the default owner name becomes the user name used to connect to the remote database (specified when the Heterogeneous Services database link is created or taken from user session if not specified in the DB link).

The entries for the owner names and the function names are case-sensitive.

HS_DB_DOMAIN

Property	Description
Default value	`WORLD`
Range of values	1 to 199 characters

Specifies a unique network sub-address for a non-Oracle system. The `HS_DB_DOMAIN` initialization parameter is similar to the `DB_DOMAIN` initialization parameter, described in the *Oracle Database Reference*. The `HS_DB_DOMAIN` initialization parameter is required if you use the Oracle Names server. The `HS_DB_NAME` and `HS_DB_DOMAIN` initialization parameters define the global name of the non-Oracle system.

> **Note:**
>
> The `HS_DB_NAME` and `HS_DB_DOMAIN` initialization parameters must combine to form a unique address in a cooperative server environment.

HS_DB_INTERNAL_NAME

Property	Description
Default value	`01010101`
Range of values	1 to 16 hexadecimal characters

Specifies a unique hexadecimal number identifying the instance to which the Heterogeneous Services agent is connected. This parameter's value is used as part of a transaction ID when global name services are activated. Specifying a nonunique number can cause problems when two-phase commit recovery actions are necessary for a transaction.

HS_DB_NAME

Property	Description
Default value	`HO`
Range of values	1 to 8 characters

Specifies a unique alphanumeric name for the data store given to the non-Oracle system. This name identifies the non-Oracle system within the cooperative server environment. The `HS_DB_NAME` and `HS_DB_DOMAIN` initialization parameters define the global name of the non-Oracle system.

HS_DESCRIBE_CACHE_HWM

Property	Description
Default value	`100`
Range of values	`1` to `4000`

Specifies the maximum number of entries in the describe cache used by Heterogeneous Services. This limit is known as the describe cache high water mark. The cache contains descriptions of the mapped tables that Heterogeneous Services reuses so that it does not have to re-access the non-Oracle data store.

If you are accessing many mapped tables, increase the high water mark to improve performance. Increasing the high water mark improves performance at the cost of memory usage.

HS_LANGUAGE

Property	Description
Default value	System-specific
Range of values	Any valid language name (up to 255 characters)

Provides Heterogeneous Services with character set, language, and territory information of the non-Oracle data source. The value must use the following format:

`language``[_territory.character_set]`

> **Note:**
>
> The globalization support initialization parameters affect error messages, the data for the SQL Service, and parameters in distributed external procedures.

Character Sets

Ideally, the character sets of the Oracle database and the non-Oracle data source are the same. In almost all cases, `HS_LANGUAGE` should be set exactly the same as Oracle database character set for optimal character set mapping and performance. If they are not the same, Heterogeneous Services attempts to translate the character set of the non-Oracle data source to the Oracle database character set, and back again. The translation can degrade performance. In some cases, Heterogeneous Services cannot translate a character from one character set to another.

> **Note:**
>
> The specified character set must be a superset of the operating system character set on the platform where the agent is installed.

As more Oracle databases and non-Oracle databases use Unicode as database character sets, it is preferable to also run the gateway in Unicode character set. To do so, you must set `HS_LANGUAGE=AL32UTF8`. However, when the gateway runs on Windows, the Microsoft ODBC Driver Manager interface can exchange data only in the double-byte character set, UCS2. This results in extra ratio expansion of described buffer and column sizes. Refer to HS_FDS_REMOTE_DB_CHARSET for instruction on how to adjust to correct sizes.

Language

The language component of the `HS_LANGUAGE` initialization parameter determines:

- Day and month names of dates
- AD, BC, PM, and AM symbols for date and time
- Default sorting mechanism

Note that Oracle does not determine the language for error messages for the generic Heterogeneous Services messages (`ORA-25000` through `ORA-28000`). These are controlled by the session settings in the Oracle database.

Territory

The territory clause specifies the conventions for day and week numbering, default date format, decimal character and group separator, and ISO and local currency symbols. Note that the level of globalization support between the Oracle database and the non-Oracle data source depends on how the gateway is implemented.

HS_LONG_PIECE_TRANSFER_SIZE

Property	Description
Default value	64 KB
Range of values	Any value up to 2 GB

Sets the size of the piece of LONG data being transferred. A smaller piece size means less memory requirement, but more round-trips to fetch all the data. A larger piece size means fewer round-trips, but more of a memory requirement to store the intermediate pieces internally. Thus, the initialization parameter can be used to tune a system for the best performance, with the best trade-off between round-trips and memory requirements, and network latency or response time.

HS_OPEN_CURSORS

Property	Description
Default value	50
Range of values	1 to the value of OPEN_CURSORS initialization parameter of Oracle database

Defines the maximum number of cursors that can be open on one connection to a non-Oracle system instance.

The value never exceeds the number of open cursors in the Oracle database. Therefore, setting the same value as the OPEN_CURSORS initialization parameter in the Oracle database is recommended.

HS_RPC_FETCH_REBLOCKING

Property	Description
Default value	ON
Range of values	OFF or ON

Controls whether Heterogeneous Services attempts to optimize performance of data transfer between the Oracle database and the Heterogeneous Services agent connected to the non-Oracle data store.

The following values are possible:

- OFF disables reblocking of fetched data so that data is immediately sent from agent to server.
- ON enables reblocking, which means that data fetched from the non-Oracle system is buffered in the agent and is not sent to the Oracle database until the amount of fetched data is equal or higher than the value of HS_RPC_FETCH_SIZE initialization parameter. However, any buffered data is returned immediately when a fetch indicates that no more data exists or when the non-Oracle system reports an error.

HS_RPC_FETCH_SIZE

Property	Description
Default value	50000
Range of values	1 to 10000000

Tunes internal data buffering to optimize the data transfer rate between the server and the agent process.

Increasing the value can reduce the number of network round-trips needed to transfer a given amount of data, but also tends to increase data bandwidth and to reduce latency as measured between issuing a query and completion of all fetches for the query. Nevertheless, increasing the fetch size can increase latency for the initial fetch results of a query, because the first fetch results are not transmitted until additional data is available.

HS_TRANSACTION_MODEL

Property	Description
Default Value	COMMIT_CONFIRM
Range of Values	COMMIT_CONFIRM, READ_ONLY, READ_ONLY_AUTOCOMMIT, SINGLE_SITE, SINGLE_SITE_AUTOCOMMIT

Specifies the type of transaction model that is used when the non-Oracle database is updated by a transaction.

The following values are possible:

- COMMIT_CONFIRM provides read and write access to the non-Oracle database and allows the gateway to be part of a distributed update. To use the commit-confirm model, the following items must be created in the non-Oracle database:
  - Transaction log table. The default table name is HS_TRANSACTION_LOG. A different name can be set using the HS_FDS_TRANSACTION_LOG parameter. The transaction log table must be granted SELECT, DELETE, and INSERT privileges set to public.
  - Recovery account. The account name is assigned with the HS_FDS_RECOVERY_ACCOUNT parameter.
  - Recovery account password. The password is assigned with the HS_FDS_RECOVERY_PWD parameter.

    COMMIT_CONFIRM does not apply to Oracle Database Gateway for ODBC. The default value for Oracle Database Gateway for ODBC is SINGLE_SITE.
- READ_ONLY provides read access to the non-Oracle database.
- READ_ONLY_AUTOCOMMIT provides read access to the non-Oracle database that do not have logging.
- SINGLE_SITE provides read and write access to the non-Oracle database. However, the gateway cannot participate in distributed updates.
- SINGLE_SITE_AUTOCOMMIT provides read and write access to the non-Oracle database that do not have logging. Any update is committed immediately, and the gateway cannot participate in distributed updates.

IFILE

Property	Description
Default value	None
Range of values	Valid parameter file names

Use the `IFILE` initialization parameter to embed another initialization file within the current initialization file. The value should be an absolute path and should not contain environment variables. The three levels of nesting limit do not apply.

> **See Also:**
>
> *Oracle Database Reference*

HS_FDS_CONNECT_INFO

Property	Description
Default Value	None
Range of Values	Not applicable

`HS_FDS_CONNECT_INFO` that describes the connection to the non-Oracle system.

The default initialization parameter file already has an entry for this parameter. The syntax for `HS_FDS_CONNECT_INFO` for the gateways are as follows:

```
HS_FDS_CONNECT_INFO=IP_address:Port_number/Database_name,Type
```

Where `IP_address` is the hostname or IP address of the DB2 DRDA server

`Port_number` is the port number of the DB2 DRDA server.

`Database_name` is the database name of the DB2 server

`Type` (case insensitive) is one of the following:

- ZOS (DB2 UDB for z/OS),
- IOS (DB2 UDB for iSeries), or
- LUW (DB2 UDB for Linux, Unix, or Windows)

This release of gateway can support IPv6. If IPv6 address format is to be specified, you would need to wrap square brackets around the IPv6 specification to indicate the separation from the port number.

For example,

```
HS_FDS_CONNECT_INFO=[2001:0db8:20C:F1FF:FEC6:38AF]:1300/DB2M,ZOS
```

HS_FDS_RECOVERY_ACCOUNT

Property	Description
Default Value	RECOVER
Range of values	Any valid user ID

Specifies the name of the recovery account used for the commit-confirm transaction model. An account with user name and password must be set up at the non-Oracle system. For more information about the commit-confirm model, see the HS_TRANSACTION_MODEL parameter.

For DRDA, HS_FDS_RECOVERY_ACCOUNT specifies the user ID that is used by the gateway if a distributed transaction becomes in doubt. This user ID must have execute privileges on the package and must be defined to the IBM database.

If a distributed transaction becomes in doubt, then the Oracle database determines the status of the transaction by connecting to the IBM database, using the HS_FDS_RECOVERY_ACCOUNT. If this parameter is missing, then the gateway attempts to connect to a user ID of ORARECOV.

The name of the recovery account is case-sensitive.

HS_FDS_RECOVERY_PWD

Property	Description
Default Value	RECOVER
Range of values	Any valid password

Specifies the password of the recovery account used for the commit-confirm transaction model set up at the non-Oracle system. For more information about the commit-confirm model, see the HS_TRANSACTION_MODEL parameter.

HS_FDS_RECOVERY_PWD is used with the HS_FDS_RECOVERY_ACCOUNT. The recovery user connects to the IBM database if a distributed transaction is in doubt.

The name of the password of the recovery account is case-sensitive.

HS_FDS_FETCH_ROWS

Property	Description
Default Value	100
Range of Values	Any integer between 1 and 1000
Syntax	HS_FDS_FETCH_ROWS=*num*

HS_FDS_FETCH_ROWS specifies the fetch array size. This is the number of rows to be fetched from the non-Oracle database and to return to Oracle database at one time. This parameter will be affected by the HS_RPC_FETCH_SIZE and HS_RPC_FETCH_REBLOCKING parameters.

HS_FDS_TRACE_LEVEL

Property	Description
Default Value	OFF
Range of values	OFF, ON, DEBUG

Specifies whether error tracing is turned on or off for gateway connectivity.

The following values are valid:

- OFF disables the tracing of error messages.
- ON enables the tracing of error messages that occur when you encounter problems. The results are written by default to a gateway log file in LOG directory where the gateway is installed.
- DEBUG enables the tracing of detailed error messages that can be used for debugging.

HS_FDS_TRANSACTION_LOG

Property	Description
Default Value	HS_TRANSACTION_LOG
Range of Values	Any valid table name

Specifies the name of the table created in the non-Oracle system for logging transactions. For more information about the transaction model, see the HS_TRANSACTION_MODEL parameter.

HS_IDLE_TIMEOUT

Property	Description
Default Value	0 (no timeout)
Range of Values	0-9999 (minutes)
Syntax	HS_IDLE_TIMEOUT=*num*

This feature is only available for Oracle Net TCP protocol.

When there is no activity for a connected gateway session for this specified time period, the gateway session would be terminated automatically with pending update (if any) rolled back.

HS_FDS_MBCS_TO_GRAPHIC

Property	Description
Default Value	FALSE

Property	Description
Range of Values	FALSE|TRUE
Syntax	HS_FDS_MBCS_TO_GRAPHIC={*FALSE*|*TRUE*}

If set to TRUE, any single-byte character meant to insert to DB2 (var)graphic column would be converted to equivalent double-byte value before the insert operation.

HS_FDS_GRAPHIC_TO_MBCS

Property	Description
Default Value	FALSE
Range of Values	FALSE|TRUE
Syntax	HS_FDS_GRAPHIC_TO_MBCS={*FALSE*|*TRUE*}

If set to TRUE, any double-byte characters in DB2 (var)graphic column that can have equivalent single-byte equivalent would be translated to equivalent single-byte before sending to the user.

HS_FDS_TIMESTAMP_MAPPING

Property	Description
Default Value	CHAR
Range of Values	CHAR|DATE|TIMESTAMP
Syntax	HS_FDS_TIMESTAMP_MAPPING={*CHAR*|*DATE*|*TIMESTAMP*}

If set to CHAR , then non-Oracle target timestamp would be mapped to CHAR(26). If set to DATE (default), then non-Oracle target timestamp would be mapped to Oracle DATE. If set to TIMESTAMP, then non-Oracle target timestamp would be mapped to Oracle TIMESTAMP.

HS_FDS_DATE_MAPPING

Property	Description
Default Value	DATE
Range of Values	DATE|CHAR
Syntax	HS_FDS_DATE_MAPPING={*DATE*|*CHAR*}

If set to CHAR, then non-oracle target date would be mapped to CHAR(10). If set to DATE, then non-Oracle target date would be mapped to Oracle date.

HS_FDS_QUOTE_IDENTIFIER

Property	Description
Default Value	TRUE
Range of Values	TRUE|FALSE
Syntax	HS_FDS_QUOTE_IDENTIFIER={*FALSE*|*TRUE*}

By default, the gateway will quote identifiers if the FDS supports it. However, we give the user the ability to overwrite the behavior.

HS_FDS_CAPABILITY

Property	Description
Default Value	None
Range of Values	Refer to SQL Functions That Can Be Enabled
Syntax	HS_FDS_CAPABILITY= {*FUNCTION/{ON|OFF|SKIP}*},...

If the HS_FDS_CAPABILITY is set to ON then the specified function will be sent to DB2 for processing. In other words, post processing will be not needed for that function.

If the HS_FDS_CAPABILITY is set to OFF then the specified function will be not be sent to DB2 for processing. In other words, it will be post processed.

If the HS_FDS_CAPABILITY is set to SKIP then the specified function will be stripped from the SQL statement sent to DB2. In other words the function will be ignored.

HS_FDS_TRANSACTION_ISOLATION

Property	Description
Default Value	READ_COMMITTED
Range of Values	{READ_UNCOMMITTED|READ_COMMITTED|REPEATABLE_READ|SERIALIZABLE|NONE}
Syntax	HS_FDS_ISOLATION_LEVEL={{READ_UNCOMMITTED|READ_COMMITTED|REPEATABLE_READ|SERIALIZABLE|NONE}

HS_FDS_TRANSACTION_ISOLATION specifies the isolation level that is used for the transaction that the gateway opens on the non-Oracle database.

The isolation level NONE is only valid against DB2 iSeries. It specifies level NO COMMIT. This isolation level will force an HS_TRANSACTION_MODEL of SINGLE_SITE_AUTOCOMMIT. Please refer to DB2's documentation regarding this level.

The isolation levels of READ_UNCOMMITTED, READ_COMMITTED, REPEATABLE_READ, and SERIALIZABLE are the four isolation levels defined in the SQL standard and adopted by both both ANSI and ISO/IEC. For additional information regarding them, see *Oracle Database Concepts*.

Use caution when specifying an isolation level lower than the Oracle transaction isolation level being used, as the gateway transaction will have different Preventable Read Phenomena from what will occur in the Oracle database transaction.

HS_FDS_PACKAGE_COLLID

Property	Description
Default Value	ORACLEGTW
Range of Values	An alphanumeric string 1 to 18 characters in length
Syntax	HS_FDS_PACKAGE_COLLID=*collection_id*

HS_FDS_PACKAGE_COLLID specifies the package collection ID. Note that in DB2 UDB for iSeries, the collection ID is actually the name of an AS/400 library.

> **Note:**
>
> Any change to this parameter will cause a new package to be implicitly bound by the gateway. For DB2 for UDB iSeries, prior to attempting a connection, one should use the iSeries SQL command CREATE SCHEMA or CREATE COLLECTION to create an iSeries library with the name as specified for HS_FDS_PACKAGE_COLLID. This COLLECTION or SCHEMA should be created under the id specified in the CONNECT TO phrase of the Oracle SQL command CREATE DATABASE LINK.

HS_NLS_LENGTH_SEMANTICS

Property	Description
Default Value	BYTE
Range of values	BYTE | CHAR
Syntax	HS_NLS_LENGTH_SEMANTICS = { BYTE | CHAR }

This release of gateway has Character Semantics functionality equivalent to the Oracle Database Character Semantics, that is, NLS_LENGTH_SEMANTICS. When HS_NLS_LENGTH_SEMANTICS is set to CHAR, the (VAR)CHAR columns of UDB database are to be interpreted as having CHAR semantics. The only situation the gateway does not honor the HS_NLS_LENGTH_SEMANTICS=CHAR setting is when both Oracle database and the gateway are on the same multi-byte character set

HS_KEEP_REMOTE_COLUMN_SIZE

Property	Description
Default Value	OFF
Range of Values	OFF | LOCAL | REMOTE | ALL
Syntax	HS_KEEP_REMOTE_COLUMN_SIZE = OFF | LOCAL |REMOTE |ALL

Property	Description
Parameter type	String

HS_KEEP_REMOTE_COLUMN_SIZE specifies whether to suppress ratio expansion when computing the length of (VAR)CHAR datatypes during data conversion from UDB database to the gateway, and then to the Oracle database. When it is set to REMOTE, the expansion is suppressed between the non-Oracle database to the gateway. When it is set to LOCAL, the expansion is suppressed between the gateway and Oracle database. When it is set to ALL, the expansion is suppressed from the non-Oracle database to the Oracle database.

When the parameter is set, the expansion is suppressed when reporting the remote column size, calculating the implicit resulting buffer size, and instantiating in the local Oracle database. This has effect only for remote column size from the non-Oracle database to Oracle database. If the gateway runs on Windows and HS_LANGUAGE=AL32UTF8, then you must not specify this parameter, as it would influence other ratio related parameter operation. It has no effect for calculating ratio for data moving from Oracle database to non-Oracle database through gateway during INSERT, UPDATE, or DELETE.

HS_FDS_RESULTSET_SUPPORT

Property	Description
Default Value	FALSE
Range of values	TRUE | FALSE
Syntax	HS_FDS_RESULTSET_SUPPORT = { TRUE | FALSE }

Enables result sets to be returned from stored procedures. By default, all stored procedures do not return a result set to the user.

> **Note:**
>
> If you set this initialization parameter, you must do the following:
>
> - Change the syntax of the procedure execute statement for all existing stored procedures, to handle result sets.
> - Work in the sequential mode of Heterogeneous Services.

HS_FDS_REMOTE_DB_CHARSET

Property	Description
Default Value	None
Range of values	Not applicable
Syntax	HS_FDS_REMOTE_DB_CHARSET

This parameter is valid only when HS_LANGUAGE is set to AL32UTF8 and the gateway runs on Windows. As more Oracle databases and non-Oracle databases use Unicode as database character sets, it is preferable to also run the gateway in Unicode character set. To do so, you must set HS_LANGUAGE=AL32UTF8. However, when the gateway runs on Windows, the Microsoft ODBC Driver Manager interface can exchange data only in the double-byte character set, UCS2. This results in extra ratio expansion of described buffer and column sizes. To compensate, the gateway can re-adjust the column size if HS_FDS_REMOTE_DB_CHARSET is set to the corresponding non-Oracle database character set. For example, HS_FDS_REMOTE_DB_CHARSET=KO16KSC5601.

HS_FDS_SUPPORT_STATISTICS

Property	Description
Default Value	TRUE
Range of values	{TRUE|FALSE}
Syntax	HS_FDS_SUPPORT_STATISTICS= {TRUE|FALSE}

We gather statistics from the non-Oracle database by default. You can choose to disable the gathering of remote database statistics by setting the HS_FDS_SUPPORT_STATISTICS parameter to FALSE.

HS_FDS_RSET_RETURN_ROWCOUNT

Property	Description
Default Value	FALSE
Range of values	{TRUE|FALSE}
Syntax	HS_FDS_RSET_RETURN_ROWCOUNT= {TRUE|FALSE}

When set to TRUE, the gateway returns the row counts of DML statements that are executed inside a stored procedure. The row count is returned as a single row, single column result set of type signed integer.

When set to FALSE, the gateway skips the row counts of DML statements that are executed inside a stored procedure. This is the default behavior, and it is the behavior of 11.1 and older gateways.

HS_FDS_AUTHENTICATE_USER

Property	Description
Default Value	CLEARTEXT
Range of values	{CLEARTEXT|ENCRYPT|ENCRYPT_BOTH|CLIENT|KERBEROS}
Syntax	HS_FDS_AUTHENTICATE_USER= {CLEARTEXT|ENCRYPT|ENCRYPT_BOTH| CLIENT|KERBEROS}

Specifies the way in which user ID and password are sent to the remote DB2 server and authenticated. Valid values are:

- CLEARTEXT : user ID and password are sent in clear text to server (default).
- ENCRYPT : password is sent encrypted to server.
- ENCRYPT_BOTH : user ID and password are sent encrypted to server.
- CLIENT : user ID is validated on the client side instead of by the server.
- KERBEROS : uses Kerberos to authenticate user ID.

HS_FDS_ENCRYPT_SESSION

Property	Description
Default Value	NONE
Range of values	{NONE|SSL|DB2|NOTRUST_SSL}
Syntax	HS_FDS_ENCRYPT_SESSION = {NONE|SSL|DB2|NOTRUST_SSL}

Specifies the way the session to DB2 is encrypted. Valid values are:

- NONE : data session is not encrypted (default).
- SSL : Use SSL to encrypt data session.
- DB2 : Use DB2 encryption protocol for data session (supported only on DB2 for Linux,, UNIX, Windows, and DB2 for z/OS).
- NOTRUST_SSL: This option is equivalent to the SSL setting, with initialization parameter HS_FDS_VALIDATE_SERVER_CERT = DISABLED

HS_FDS_VALIDATE_SERVER_CERT

Property	Description
Default Value	ENABLED
Range of values	{ENABLED|DISABLED}
Syntax	HS_FDS_VALIDATE_SERVER_CERT = {ENABLED|DISABLED}

Specifies whether the driver validates the certificate that is sent by the database server when SSL encryption is enabled through HS_FDS_ENCRYPT_SESSION. When using SSL server authentication, any certificate sent by the server must be issued by a trusted Certificate Authority. Valid values are:

- ENABLED : the gateway validates the certificate that is sent by the database server. Any certificate from the server must be issued by a trusted Certificate Authority in the truststore file. The truststore information is specified using the HS_FDS_TRUSTSTORE_FILE and HS_FDS_TRUSTSTORE_PASSWORD initialization parameters.
- DISABLED : the gateway does not validate the certificate that is sent by the database server.

HS_FDS_TRUSTSTORE_FILE

Property	Description
Default Value	none
Range of values	*path to truststore file*
Syntax	HS_FDS_TRUSTSTORE_FILE = *path to truststore file*

Specifies the path that specifies the location of the truststore file. The truststore file contains a list of the valid Certificate Authorities (CAs) that are trusted by the client machine for SSL server authentication.

HS_FDS_TRUSTSTORE_PASSWORD

Property	Description
Default Value	none
Range of values	*password*
Syntax	HS_FDS_TRUSTSTORE_PASSWORD= *password*

Specifies the password required to access the truststore.

HS_FDS_SQLLEN_INTERPRETATION

Property	Description
Default Value	64
Range of values	{64|32}
Syntax	HS_FDS_SQLLEN_INTERPRETATION= {64|32}

This parameter is only valid for 64 bit platforms. ODBC standard specifies SQLLEN (of internal ODBC construct) being 64 bit on 64 bit platforms, but some ODBC driver managers and drivers violate this convention, and implement it as 32 bit. In order for the gateway to compensate their behavior, you need to specify HS_FDS_SQLLEN_INTERPRETATION=32 if you use these types of driver managers and driver.

HS_FDS_ARRAY_EXEC

Property	Description
Default Value	FALSE
Range of values	{TRUE|FALSE}
Syntax	HS_FDS_ARRAY_EXEC= {TRUE|FALSE}

If set to `TRUE`, the gateway will use array operations for insert, update, delete statements containing binds against the remote data source. The array size is determined by the value of the `HS_FDS_FETCH_ROWS` init parameter.

If set to `FALSE`, the gateway will not use array operations for insert, update, and delete statements. Instead, a single statement will be issued for every value.

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