Oracle® AI Database

SQL Translation and Migration Guide

Release 26ai
G44241-01
October 2025

Oracle AI Database SQL Translation and Migration Guide, Release 26ai

G44241-01

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Preface

This guide describes the installation, configuration, and administration tasks for all activities related to migrating applications developed for non-Oracle databases, such as DB2, Sybase, and legacy applications, to Oracle Database. This guide also provides migration scenarios that users may implement in sequence.

Audience

This guide is for database administrators and application developers who are interested in migrating from databases other than Oracle to an Oracle Database.

Related Documents

For more information, see the following documents in the Oracle Database documentation set:

- *Oracle Database SQL Language Reference*
- *Oracle Database Administrator's Guide*
- *Oracle Database Development Guide*
- *Oracle Database Reference*

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

Changes in This Release for Oracle AI Database SQL Translation and Migration Guide

This preface contains the changes in this book for Oracle AI Database 26ai.

Desupport of MySQL Client Library Driver for Oracle

The MySQL Client Library Driver for Oracle is desupported in Oracle AI Database 26ai. The MySQL Client library driver, `liboramysql`, was deprecated in Oracle Database 21c. It is now desupported. There is no replacement. This desupport does not affect the ability of older Oracle Database Client releases that use `liboramysql` to connect to the database. However, the features available to use through these clients eventually can be limited.

1

Introduction to Tools and Products that Support Migration

Before migrating your application to Oracle Database, you must be aware of several key points that are described in *Oracle Database Concepts*.

When discussing the migration of a database-centered enterprise, it is useful to keep in mind that the actual migration of database schema and data is only a part of the process. The migration of a core business solution often involves several databases and applications that work together to deliver the product and services that drive the revenue of an organization. For more information about preparing a migration plan, see *Oracle SQL Developer User's Guide*.

1.1 Oracle Database Features for Migration Support

Oracle Database 12*c* introduced a large set of features that collectively enhance the migration process of non-Oracle database applications to Oracle Database.

1.1.1 SQL Translation Framework

A key part of migrating non-Oracle databases to Oracle Database involves the conversion of non-Oracle SQL statements to SQL statements that are acceptable to Oracle Database. The conversion of the non-Oracle SQL statements of the applications is a manual and tedious process. To minimize the effort, or to eliminate the necessity for converting these statements, Oracle Database 12c introduced a new feature called SQL Translation Framework. SQL Translation Framework receives these SQL statements from client applications, and then translates them at run-time.

The SQL Translation Profile registers the SQL Translater inside the database so it can handle the SQL translation for non-Oracle client application. If an error occurs while a SQL statement is executed, then the SQL Translator can translate the Oracle error code and the `ANSI SQLSTATE` into the vendor-specific values expected by the application. The translated statements are then saved in the SQL Translation Profile, to be examined and edited at the user's discretion.

The advantages of SQL Translation Framework follow:

- The translation of SQL statements, Oracle error codes, and `ANSI SQLSTATE` is automatic.
- The translations are centralized and examinable.
- The user has the option to extract translations and insert them back into the application.

1.1.2 Support for Identity Columns

Oracle Database 12*c* implements ANSI-compliant `IDENTITY` columns. Migration from database systems that use identity columns is simplified and can take advantage of this new functionality.

This feature implements auto increment by enhancing DEFAULT or DEFAULT ON NULL semantics for use by SEQUENCE.NEXTVAL and SYS_GUID, supports built-in functions and implicit return of default values.

1.1.2.1 Creating Identity Columns

Example 1-1 creates a table with an identity column, which is generated by default. When explicit nulls are inserted into the identity column, the sequence generator creates values by default. For further details, see *Oracle Database SQL Language Reference*.

Example 1-1 How to create an identity column

```
CREATE TABLE t1 (c1 NUMBER GENERATED BY DEFAULT ON NULL AS IDENTITY,
                 c2 VARCHAR2(10));
INSERT INTO t1(c2) VALUES (‘abc');
INSERT INTO t1 (c1, c2) VALUES (null, ‘xyz');
SELECT c1, c2 FROM t1;
```

1.1.3 Implicit Statement Results

Starting with Oracle Database 12*c* Release 2 (12.2), Oracle implicitly returns to the client application the results of SQL statements executed within a stored procedure, bypassing the explicit use REF CURSORs. This feature eliminates the overhead of re-writing the client-side code.

Implicit statement results enable the user to write a stored procedure, where each intended query (the statement after the FOR keyword) is part of the OPEN cursor variable. When code is migrated to Oracle Database from other vendors environments, the PL/SQL layer adds the equivalent capability and enables SELECT statements to pass the results to the client. The stored procedures can then return the results directly to the client with the DBMS_SQL.RETURN_RESULT procedure. The SQL*Plus FORMAT command and its variations may be invoked to customize the output.

For information about the DBMS_SQL package, see *Oracle Database PL/SQL Packages and Types Reference*. For information about how to use format output, *SQL*Plus User's Guide and Reference*.

1.1.3.1 JDBC Support for Implicit Results

Starting with Oracle Database 12*c* Release 2 (12.2), JDBC applications provide support for implicit results through the following new functions:

- getMoreResults
- getMoreResults(int)
- getResultSet

You can use these methods to retrieve and process the implicit results returned by PL/SQL procedures or blocks, as demonstrated in Example 1-2.

For more information, see *Oracle Database JDBC Developer's Guide*

1.1.3.1.1 Processing Implicit Results in JDBC

Example 1-2 Retrieving and Processing Implicit Results from PL/SQL Blocks

Suppose you have a procedure called foo:

```
 create procedure foo as
  c1 sys_refcursor;
  c2 sys_refcursor;
begin
  open c1 for select * from hr.employees;
  dbms_sql.return_result(c1); --return to client
  -- open 1 more cursor
  open c2 for select * from hr.departments;
  dbms_sql.return_result (c2); --return to client
end;
```

The following code demonstrates how to retrieve the implicit results returned by PL/SQL procedures using the JDBC `getMoreResults` methods:

```
String sql = "begin foo; end;";
...
Connection conn = DriverManager.getConnection(jdbcURL, user, password);
 try {
        Statement stmt = conn.createStatement ();
        stmt.executeQuery (sql);

        while (stmt.getMoreResults())
        {
              ResultSet rs = stmt.getResultSet();
              System.out.println("ResultSet");
              while (rs.next())
             {
                   /* get results */
             }
         }
      }
```

1.1.3.2 OCI Support for Implicit Results

Starting with Oracle Database 12*c* Release 2 (12.2), Oracle Call Interface (OCI) provides support for implicit results through a new function, `OCIStmtGetNextResult()`. It is called iteratively by C applications to retrieve each implicit result from stored procedures and anonymous blocks. Implicit results consume rows directly from a stored procedure without going through a `RefCursor`.

> **See Also**
>
> *Oracle Call Interface Programmer's Guide*

1.1.3.2.1 Processing Implicit Results in OCI

Example 1-3 shows how to use the `OCIStmtGetNextResult()` function to retrieve and process the implicit results returned by either a PL/SQL stored procedure or an anonymous block:

Example 1-3 Using OCIStmtGetNextResult() to Process Implicit Results

```
OCIStmt *stmthp;
  ub4      rsetcnt;
  void    *result;
  ub4      rtype;
  char    *sql = "begin foo; end;";
```

```
  OCIHandleAlloc((void *)envhp, (void **)&stmthp,
                 OCI_HTYPE_STMT, 0, (void **)0);

  /* Prepare and execute the PL/SQL procedure. */
  OCIStmtPrepare(stmthp, errhp, (oratext *)sql, strlen(sql),
                OCI_NTV_SYNTAX, OCI_DEFAULT);
  OCIStmtExecute(svchp, stmthp, errhp, 1, 0,
                (const OCISnapshot *)0,
                (OCISnapshot *)0, OCI_DEFAULT);

  /* Now check if any implicit results are available. */
  OCIAttrGet((void *)stmthp, OCI_HTYPE_STMT, &rsetcnt, 0,
            OCI_ATTR_IMPLICIT_RESULT_COUNT, errhp);

  /* Loop and retrieve the implicit result-sets.
   * ResultSets are returned in the same order as in the PL/SQL
   * procedure/block.
   */
  while (OCIStmtGetNextResult(stmthp, errhp, &result, &rtype,
                              OCI_DEFAULT) == OCI_SUCCESS)
{    /* Check the type of implicit ResultSet, currently
     * only supported type is OCI_RESULT_TYPE_SELECT
*/    if (rtype == OCI_RESULT_TYPE_SELECT)
{      OCIStmt *rsethp = (OCIStmt *)result;
       /* Perform normal OCI actions to define and fetch rows. */
    }    else
      printf("unknown result type %d\n", rtype);
     /* The result set handle should not be freed by the user. */
  }   OCIHandleFree(stmthp, OCI_HTYPE_STMT); /* All implicit result-sets are also freed.
*/
```

1.1.3.3 ODBC Support for Implicit Results

Starting with Oracle Database 12*c*, ODBC applications provide support for implicit results through a new function, `SQLMoreResults()`. ODBC driver is enhanced to make use of the following new OCI APIs that enhance the migration process:

- `OCIStmtGetNextResult()` function
- `OCI_ATTR_IMPLICIT_RESULT_COUNT` attribute
- `OCI_RESULT_TYPE_SELECT` attribute

ODBC support for implicit results enables the migration of Sybase and SQL Server applications that use multiple result sets bundled in the stored procedures. Oracle achieves this by sending the statements or procedures to the server, where the non-Oracle SQL is translated to Oracle syntax.

1.1.3.3.1 Processing Implicit Results in ODBC

Example 1-4 and Example 1-5 demonstrate how to retrieve implicit results in ODBC.

Example 1-4 Using ODBC to return implicit results with DBMS_SQL.RETURN_RESULT

```
create or replace procedure foo
is
c1 sys_refcursor;
c2 sys_refcursor;
begin
  open c1 for select employee_id, first_name from employees where employee_id=7369;
  dbms_sql.return_result(c1);
  open c2 for select department_id, department_name from departments where rownum <=2;
```

```
  dbms_sql.return_result(c2);
end;
/
```

Example 1-5 Using ODBC to return implicit results with SQLMoreResults

```
SQLLEN enind,jind;
SQLUINTEGER eno = 0;
SQLCHAR empname[STR_LEN] = "";
//Allocate HENV, HDBC, HSTMT handles
rc = SQLPrepare(hstmt, "begin foo(); end;", SQL_NTS);
rc = SQLExecute(hstmt);
//Bind columns for the first SELECT query in the procedure foo( )
rc = SQLBindCol (hstmt, 1, SQL_C_ULONG, &eno, 0, &jind);
rc = SQLBindCol (hstmt, 2, SQL_C_CHAR, empname, sizeof (empname),
&enind);
…
//so on for all the columns that needs to be fetched as per the SELECT
//query in the procedure.
//Fetch all results for first SELECT query
while ((rc = SQLFetch (hstmt)) != SQL_NO_DATA)
{
//do something
}
//Again check if there are any results available by calling
//SQLMoreResults. SQLMoreResults will return SQL_SUCCESS if any
//results are available else returns errors appropriately as explained
//in MSDN ODBC spec.
rc = SQLMoreResults ( hstmt );
if( rc == SQL_SUCCESS)
{
//If the columns for the second SELECT query are different the rebind
//the columns for the second SELECT SQL statement.
rc = SQLBindCol (hstmt, 1,…);
rc = SQLBindCol (hstmt, 2,…);
…
//Fetch the second result set
while ((rc = SQLFetch (hstmt)) != SQL_NO_DATA)
//do something
}
SQLFreeStmt(hstmt,SQL_DROP);
SQLDisconnect (hdbc);

SQLFreeConnect (hdbc);
SQLFreeEnv (henv);
```

1.1.4 Enhanced SQL to PL/SQL Bind Handling

In earlier releases of Oracle Database, a SQL expression could not invoke a PL/SQL function that had a formal parameter or return type that was not a SQL data type.

Starting with Oracle Database 12*c*, a PL/SQL anonymous block, a SQL CALL statement, or a SQL query can invoke a PL/SQL function that has parameters of the following types:

- `Boolean`
- Record declared in a package specification
- Collection declared in a package specification

The SQL TABLE operator is also enhanced, so that you can query on PL/SQL collections of locally scoped types as an argument to TABLE operator. Here, the collections can be of nested table types, VARRAY, or PL/SQL index table that are indexed by PLS_INTEGER.

This feature extends the flexibility of the TABLE operator, and enables easy migration of non-Oracle stored procedure code to PL/SQL.

1.1.4.1 Invoking a Subprogram with a Nested Table Parameter

Example 1-6 shows how to dynamically call a subprogram with a nested table formal parameter. See *Oracle Database PL/SQL Language Reference* for more information on this topic.

Example 1-6 Invoking a subprogram with a nested table formal parameter

```
CREATE OR REPLACE PACKAGE pkg AUTHID CURRENT_USER AS

  TYPE names IS TABLE OF VARCHAR2(10);

  PROCEDURE print_names (x names);
END pkg;
/
CREATE OR REPLACE PACKAGE BODY pkg AS
  PROCEDURE print_names (x names) IS
  BEGIN
    FOR i IN x.FIRST .. x.LAST LOOP
      DBMS_OUTPUT.PUT_LINE(x(i));
    END LOOP;
  END;
END pkg;
/
DECLARE
  fruits   pkg.names;
  dyn_stmt VARCHAR2(3000);
BEGIN
  fruits := pkg.names('apple', 'banana', 'cherry');

  dyn_stmt := 'BEGIN print_names(:x); END;';
  EXECUTE IMMEDIATE dyn_stmt USING fruits;
END;
```

1.1.5 Native SQL Support for Query Row Limits and Row Offsets

Starting with Oracle Database 12*c*, Oracle provides a row limiting clause that enables native SQL support for query row limits and row offsets. If your application has queries that limit the number of rows returned or offset the starting row of the results, this feature significantly reduces SQL complexity for such queries.

1.1.5.1 Limiting Bulk Selection

Example 1-7 shows how to limit bulk selection with the FETCH FIRST clause. See *Oracle Database SQL Language Reference* for more information on this topic.

Example 1-7 How to limit bulk selection

```
DECLARE
  TYPE SalList IS TABLE OF employees.salary%TYPE;
  sals SalList;
BEGIN
  SELECT salary BULK COLLECT INTO sals FROM employees
```

```
    WHERE ROWNUM <= 50;

  SELECT salary BULK COLLECT INTO sals FROM employees
    SAMPLE (10);

  SELECT salary BULK COLLECT INTO sals FROM employees
    FETCH FIRST 50 ROWS ONLY;
END;
/
```

1.1.6 JDBC Driver Support for Application Migration

Many applications that you want to migrate to Oracle Database from other databases have Java applications that use JDBC to connect to the database. To facilitate SQL translation, Oracle Database 12c introduced a new set of JDBC APIs that are specific to SQL translation.

See Also

- "SQL Translation of JDBC Applications"
- API Reference for SQL Translation of JDBC Applications
- Complete documentation of the `oracle.jdbc` package in *Oracle AI Database JDBC Java API Reference*
- `http://www.oracle.com/technetwork/database/enterprise-edition/jdbc-112010-090769.html` for an updated list of JDBC drivers

1.1.7 ODBC Driver Support for Application Migration

ODBC driver supports the migration of third-party applications to Oracle Databases by using the SQL Translation Framework. This enables non-Oracle database SQL statements to run against Oracle Database. See "How to Use SQL Translation Framework" before beginning to migrate third-party ODBC application to Oracle Database.

To use this feature with an ODBC application, you must specify the service name, which was created as part of SQL Translation Framework setup, as the `ServerName=` entry in the `.odbc.ini` file.

If you require support for translation of Oracle errors (ORA errors) to your the native database, once your application starts running against Oracle Database, then you must enable the `SQLTranslateErrors=T` entry in the `.odbc.ini` file. See "SQL Translation of ODBC Applications" for more information on this topic.

1.2 Other Oracle Products that Enable Migration

Oracle recommends the use of several Oracle products as part of an overall migration strategy.

1.2.1 OEM Tuning and Performance Packs

For every type of migration, a few of the SQL statements used in the application must change, and some indexes must be re-built. Oracle SQL Tuning and Performance Packs provide guidance for the optimization step of the application migration.

1.2.2 Oracle GoldenGate

Oracle GoldenGate is a comprehensive software package for enabling the replication of data in heterogeneous data environments. The product set enables high availability solutions, real-time data integration, transactional change data capture, data replication, transformations, and verification between operational and analytical enterprise systems.

Oracle GoldenGate enables the exchange and manipulation of data at the transaction level among multiple, heterogeneous platforms across the enterprise. Its modular architecture provides the flexibility to extract and replicate selected data records, transactional changes, and changes to DDL (data definition language) across a variety of topologies.

When you migrate very large databases, the actual process of copying data from one database to another is time-consuming. During this time, the enterprise must continue delivering services using the old solution, which changes some of the data. These run-time changes must be captured and propagated to Oracle Database. Oracle GoldenGate captures these changes and enables side-by-side testing to ensure that the new solution performs as planned.

1.2.3 Oracle Database Gateways

Oracle Database Gateways address the needs of disparate data access. In a heterogeneously distributed environment, Gateways make it possible to integrate with any number of non-Oracle systems from an Oracle application. They enable integration with data stores such as IBM DB2, Microsoft SQL Server and Excel, transaction managers like IBM CICS and message queuing systems like IBM WebSphere MQ.

For more information about Oracle Database Gateways, see http://www.oracle.com/technetwork/database/gateways/index.html

1.2.4 Oracle SQL Developer

Oracle SQL Developer, as described in *Oracle SQL Developer User's Guide*, has a large suite of features that enable migration, including the following features:

- Support for database migration, such as schema, data, and server-side objects, from non-Oracle databases to Oracle Database (Migration Wizard)
- Support for application migration, including SQL statement pre-processing and data type translation support (Application Migration Assistant)

1.3 Migration Support for Other Database Vendors

Oracle provides migration support for applications running on various databases.

1.3.1 Application Support in Third-Party Databases

Table 1-1 provides information about the applications supported in several third-party databases. Note that while translation framework is available for DB2 LUW, a translator for DB2 is not available.

Table 1-1 Supported Applications in Databases

Application	SQL Server	DB2 LUW	DB2 AS400	Sybase ASE	Teradata	Informix
Oracle SQL Developer	Yes	Yes	No	Yes	Yes	No
Oracle Migration Workbench	No	No	Yes	No	No	Yes
SQL Translation Framework (SQL Translation Profile)	Yes	Yes	Yes	Yes	Yes	Yes
SQL Translation Framework (SQL Translator)	yes	Partial	No	Yes	No	No

1.3.2 Third-Party Database Version Support

This section lists the supported database versions for migration using Oracle SQL Developer.

The Table 1-2 table does not provide a comprehensive list. SQL translation may not work properly for every database listed on the table.

Table 1-2 Supported Database Versions for Migration Using Oracle SQL Developer

RDBMS	Supported Versions
SQL Server	7.0, 2000, 2005,2008
Sybase Adaptive Server (ASE)	12, 15
Access	97, 2000, 2002 and 2003
DB2	AS400 V4R3, V4R5
DB2 LUW	8, 9
Teradata	12
Informix	7.3, 9.1, 9.2, 9.3, 9.4

2

SQL Translation Framework Overview

Various client-side applications, designed to work with non-Oracle Databases, cannot be used with Oracle Database without significant alterations. This is because SQL dialect varies among vendors of database technologies and different vendors use different syntaxes to express SQL queries and statements.

Starting with Oracle Database 12*c*, there is a new mechanism called SQL Translation Framework. It translates the SQL statements of a client program from a foreign (non-Oracle) SQL dialect into the SQL dialect used by the Oracle Database SQL compiler.

In addition to translating non-Oracle SQL statements, the SQL Translation Framework may be used to substitute an Oracle SQL statement with another Oracle statement to address a semantic or performance issue. In this way, you can address an application issue without patching the client application.

The SQL translation framework consists of two basic components: SQL Translator, and SQL Translation Profile.

The SQL Translator

The SQL Translator is a software component, provided by Oracle or third-party vendors, which can be installed in Oracle Database. It translates the SQL statements of a client program before they are processed by the Oracle Database SQL compiler. If an error results from translated SQL statement execution, then Oracle Database SQL compiler generates an Oracle error message.

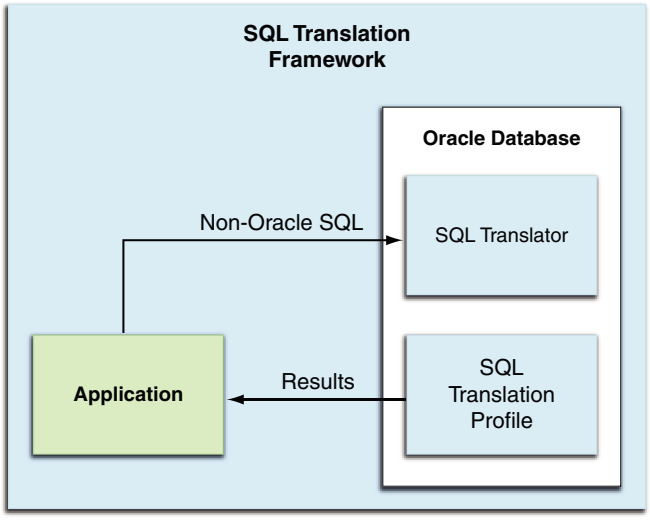
The SQL Translator automatically translates non-Oracle SQL to Oracle SQL, thereby enabling the existing client-side application code to run largely unchanged against an Oracle Database. This reduces the cost of migration to Oracle Database storage significantly. As a corollary, the translation feature may be used in other scenarios, where it may be expedient to intervene between the original SQL statement submitted by the client and its actual execution.

The SQL Translation Profile

The SQL Translation Profile is a database object that contains the set of captured non-Oracle SQL statements, and their translations or translation errors. The SQL Translation Profile is used to review, approve, and modify translations. A profile is associated to a single translator. However, a translator can be used in one or more SQL Translation Profiles. Typically, there is one SQL Translation Profile per application, otherwise applications can share translated queries. You can export profiles among various databases.

The following figure illustrates the run-time overview the SQL Translation Framework.

Figure 2-1 SQL Translation Framework at Runtime



2.1 Architecture of SQL Translation Framework

The key component of SQL Translation Framework is the SQL Translation Profile. The profile is a collection of non-Oracle statements that are processed through the translator. The application determines which profile to use when connecting to the Oracle Database. The translator handles the actual translation work.

In most cases, the non-Oracle SQL statements and errors are translated by a SQL Translator registered in the profile. The translator may be supplied by Oracle or by a third-party vendor. If the translator does not have a translation for a particular SQL statement or error, then you may register your own custom translation. You may also wish to register your own custom translation to override the default translator and to customize your translation results.

2.2 How to Use SQL Translation Framework

Perform the following steps to use SQL Translation Framework:

1. Install a SQL Translator, either from Oracle or a third-party vendor, in Oracle Database.
2. Create a SQL Translation Profile and register the SQL Translator with the profile.
3. Create a Database service and specify the SQL Translation Profile as a service attribute to which the application can connect.

   Note that setting the SQL Translation Profile at the service level ensures that everything running through that listener service is translated automatically.

   The translator can also be activated at connection level by using the `ALTER SESSION` statement or the `LOGON` triggers.
4. Link the application with an Oracle driver to connect the application to Oracle Database. You must also change the connection settings to connect to the Database service with the SQL Translation Profile.
5. Test all functionality of the application against Oracle Database. As the application runs, the SQL Translation Profile translates SQL statements of the application from the third-party SQL dialect to semantically-equivalent Oracle syntax and register them in the profile.

If the translator does not have a translation for a particular SQL statement or error, then you may register your own translation to fill its place.

6. Verify the custom translations and edit them, if required. Alternatively, register new ones to ensure that the application performs as intended, until testing is complete.

   Oracle recommends establishing a test environment and rigorously testing the application, ideally through a regression test suite.

7. Set up the server-side application objects and data in the production Oracle Database for deployment to a production environment.
8. Create a database service with the profile set as a service attribute and change the connection settings of the application, so that it connects to the database service in the production database. The application is expected to run as tested.

Oracle recommends that the application be monitored to guard against the possibility of errors due to unavailability of translation of any SQL statement. You must first disable the automatic translation of new and unseen SQL statements in the profile; when any such statement is encountered, it raises an error that is logged. In cases of alerts for mis-translation, you must make adjustments to the profile.

See Also

- The new `DBMS_SQL_TRANSLATOR` PL/SQL package and updated `DBMS_SQL` and `DBMS_SERVICE` PL/SQL packages in the *Oracle Database PL/SQL Packages and Types Reference*.
- Updated `GRANT` and `REVOKE` statements and new system privileges in the *Oracle Database SQL Language Reference*.
- *Oracle Database PL/SQL Packages and Types Reference*
- *Oracle Database Administrator's Guide*

2.3 When to Use SQL Translation Framework

Use SQL Translation to migrate a client application that uses SQL statements with vendor-proprietary SQL syntax.

Note

Currently, SQL Translators are available only for Sybase and SQL Server, and there is limited support for DB2.

SQL Translation Framework is designed for use with open API applications, such as ODBC or JDBC, and applications that use SQL statements that may be translated into semantically-equivalent Oracle syntax. These applications must relink to the Oracle ODBC or JDBC driver and then execute through the translation service.

Following are the possible scenarios for the connection mechanism:

- If the application uses ODBC, JDBC, OLE DB or .NET driver, or data provider to connect to the database, then the driver or data provider for Oracle must be replaced.
- No direct translator is available for DB2. For more information, refer to "Migration Support for Other Database Vendors".

If the application uses IBM DRDA network protocol to connect to DB2, then the database connection settings must be changed to connect to Oracle through DRDA Application Server for Oracle.

- If the application uses a vendor-proprietary C client API (the case of Sybase), then the API calls must be replaced with appropriate Oracle OCI APIs.

3

SQL Translation Framework Configuration

The SQL Translation Framework may be installed and configured using Oracle SQL Developer, or from the command line interface. In either case, the user must have the necessary permissions to install SQL Translator.

3.1 Installing and Configuring SQL Translation Framework with Oracle SQL Developer

You can use the DBA Navigator in Oracle SQL Developer 3.2 to install and manage the translator and translation profile.

3.1.1 Overview of Oracle SQL Developer Migration Support

The SQL Translation framework is installed as part of Oracle Database installation. However, it must be configured to recognize the non-Oracle SQL dialect of the application and you must install at least one translator to fully utilize the framework.

Before using the SQL Translation feature, you must migrate your data, schema, stored procedures, triggers, and views. Oracle implements database schema migration and data migration through Oracle SQL Developer functionality. Oracle SQL Developer simplifies the process of migrating a non-Oracle database to an Oracle Database through the use of Migration Wizard. The Migration wizard provides convenient and comprehensive guidance through the phases involved in migrating a database.

Oracle SQL Developer captures information from the source non-Oracle database and displays it in a captured model, which is a representation of the structure of the source database. This representation is stored in a migration repository, which is a collection of schema objects that Oracle SQL Developer uses to store migration information.

The information in the repository is used to generate the converted model, which is a representation of the structure of the destination database as it will be implemented in the Oracle database. You can then use the information in the captured model and the converted model to compare database objects, identify conflicts with Oracle reserved words, and manage the migration progress. When you are ready to migrate, generate the Oracle schema objects, and then migrate the data.

This section describes how to perform the subsequent tasks that enable automatic run-time migration. These examples use SQL Translator with a JDBC application that runs against a Sybase database; they can be easily adapted for other client/database configurations. Note that Oracle SQL Developer is shipped with an installed Sybase translator.

See *Oracle SQL Developer User's Guide* for more information.

3.1.2 Setting Up Oracle SQL Developer 3.2 for Windows

Oracle SQL Developer 3.2 is shipped with Oracle Database 11*g* JDBC drivers and there is no client for Windows in this release. If you are using a Windows system, then you must enable

Oracle SQL Developer 3.2 to use Oracle Database 12*c* JDBC driver, so that all the features of the current release are enabled. Perform the following steps to achieve this:

- Rename the `sqldeveloper\jdbc\lib` folder to `sqldeveloper\jdbc\lib_11g`.
- Create a new empty folder as `sqldeveloper\jdbc\lib`.
- Unzip Oracle Database 12*c* JDBC JAR files into the new `sqldeveloper\jdbc\lib` folder.

  See *Oracle Database JDBC Developer's Guide* for more information about Oracle Database 12*c* JDBC files.

3.1.2.1 Setting Up Oracle SQL Developer 3.2 Startup

Oracle SQL Developer automatically uses JDBC drivers found in any `ORACLE_HOME\client` directory. To override this behavior and make Oracle SQL Developer use JDBC drivers in the `sqldeveloper\jdbc\lib` directory, create a new `sqldeveloper.bat` file in the `sqldeveloper` directory:

```
set ORACLE_HOME=%CD%
start sqldeveloper.exe
```

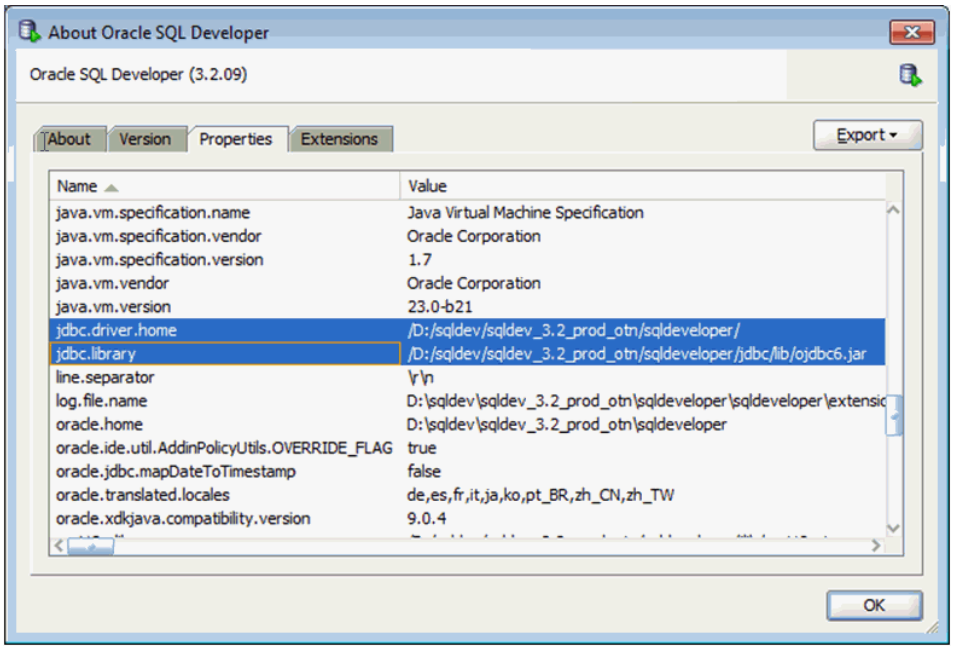
3.1.2.2 Starting Oracle SQL Developer

Run the `sqldeveloper.bat` file to run Oracle SQL Developer.

To check the JDBC driver configuration:

1. Select **About** from **Help** menu.
2. Select **Properties**. It must display the configuration as shown in Figure 3-1:

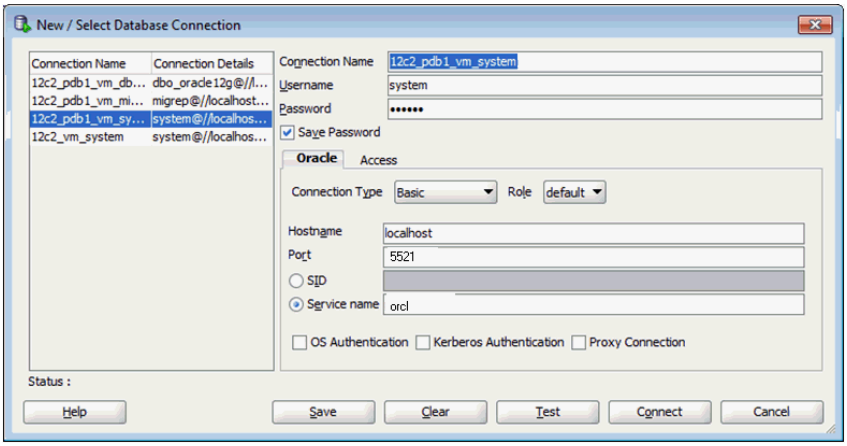
Figure 3-1 Checking JDBC Configuration for Oracle SQL Developer



3.1.3 Creating a Connection to Oracle Database

Create a connection to the Database with the credentials as shown in Figure 3-2:

Figure 3-2 Creating an Oracle Database Connection



You can use the following command to check the database you are connected to and the JDBC driver being used:

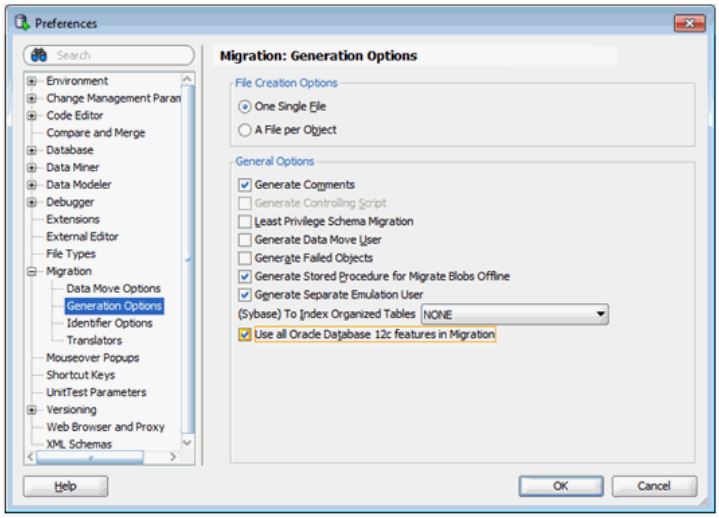
```
show jdbc
```

Setting Up Migration Preferences

You must set up the migration preferences in the following way:

1. Select **Preferences** from the Tools menu.
2. Select **Generation Options** from **Migration** option on the left panel, as shown in Figure 3-3.

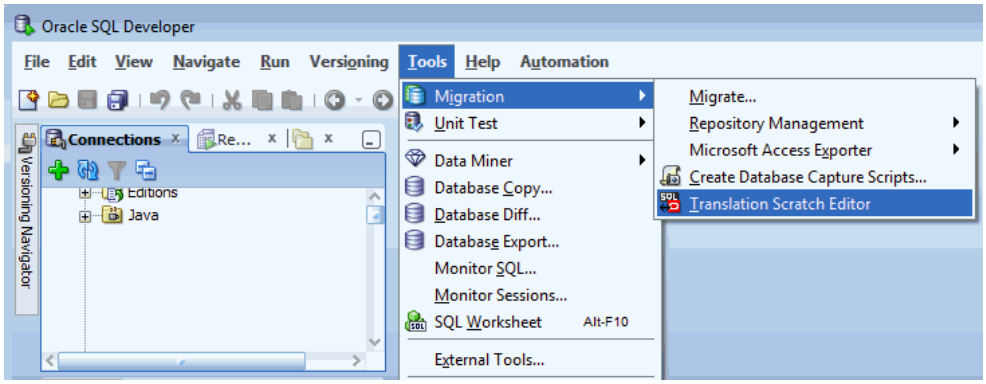
Figure 3-3 Setting Up Migration Preferences in Oracle SQL Developer



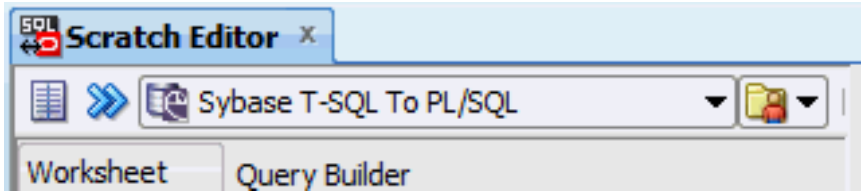
3.1.4 Testing SQL Translation

Perform the following steps to determine whether Sybase SQL Translator is properly installed or not:

1. Open Oracle SQL Developer.
2. From the **Tools** menu, select **Migration**, and then select **Translation Scratch Editor**.



3. In the Scratch Editor toolbar, select **Sybase T_SQL To PL/SQL** option, which is the Sybase translator.

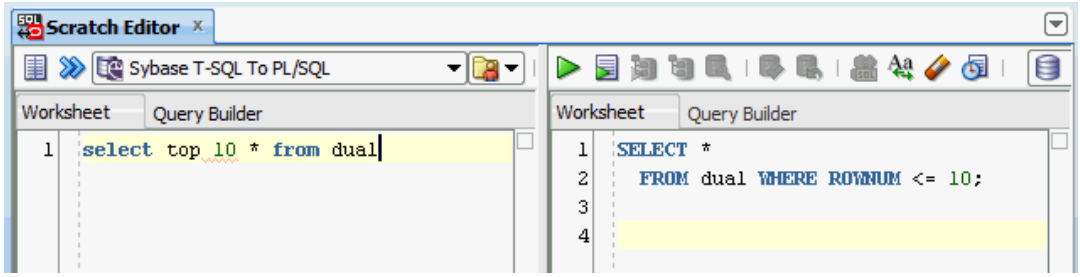


4. In the left panel of the **Scratch Editor**, enter the following query in Sybase SQL dialect:

```
select top 10 * from dual
```

5. Click the **Translate** icon.

   The translated query text is displayed in the right panel of the editor.



3.1.5 Creating a Translation Profile and Installing SQL Translator

Oracle SQL Developer is installed with Oracle Database 12*c*. It loads Java classes of the Sybase Translator, approximately 15 MB, into Oracle Database. Due to the size and the number of Java classes loaded, Oracle recommends you to install the translator locally, and not over a WAN.

If the translator is installed under a user profile that has a pre-existing migration repository, the translator picks up the context of the database, such as name changes. Therefore, you must create a new user with the following specifications:

- `CONNECT`, `RESOURCE`, and `CREATE VIEW` privileges
- Access to storage in the `SYSTEM` and/or `USER` tablespace

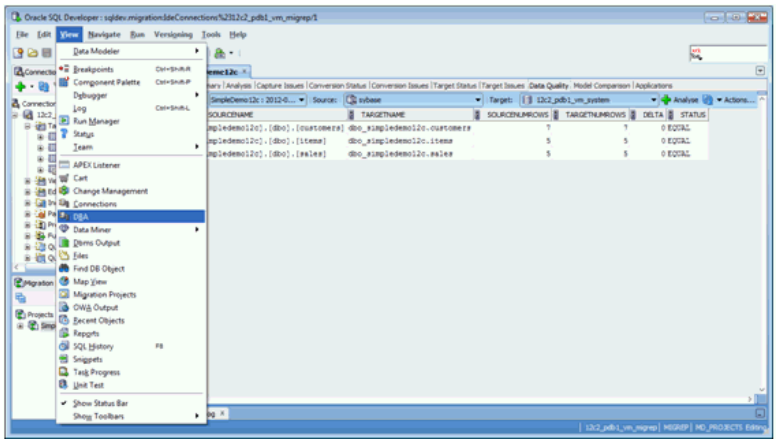
3.1.5.1 Installing SQL Translator

To install SQL Translator:

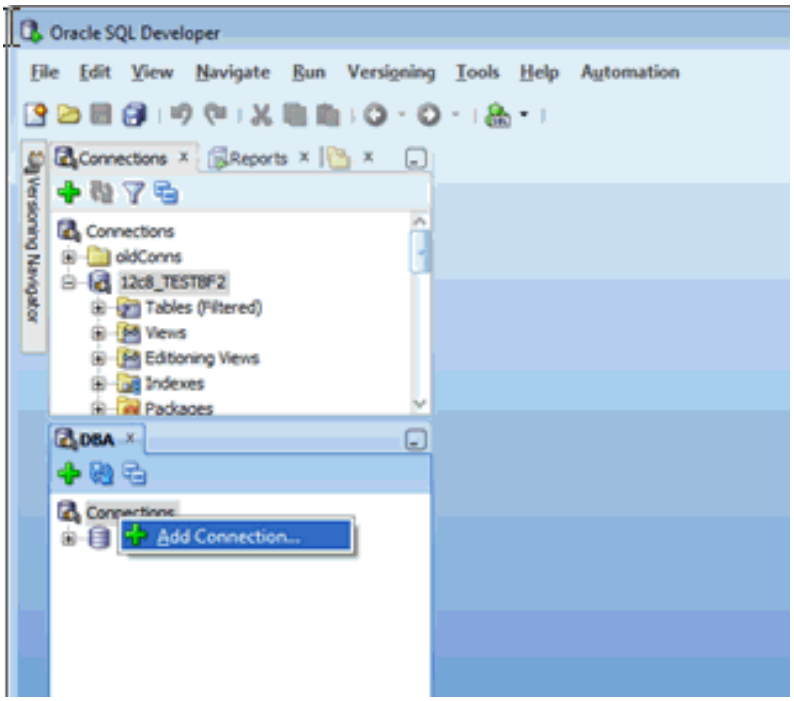
1. Log into the database using `ADMIN` privileges.
2. At the command line, enter the following commands.

   ```
   GRANT CONNECT, RESOURCE, CREATE VIEW TO TranslUser identified by TranslUser;
   ALTER USER TranslUser QUOTA UNLIMITED ON SYSTEM;
   ```

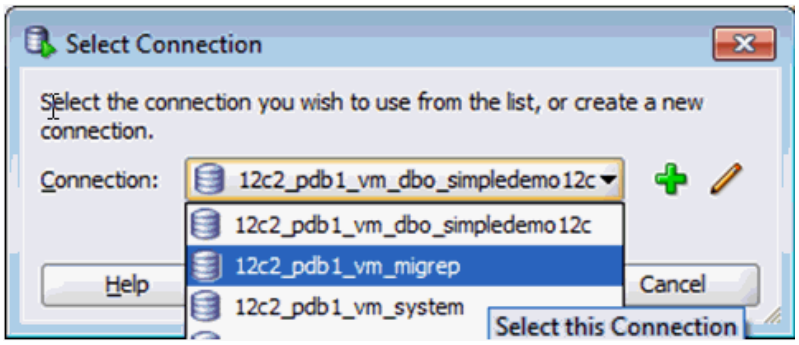
3. From the View menu, select **DBA**.



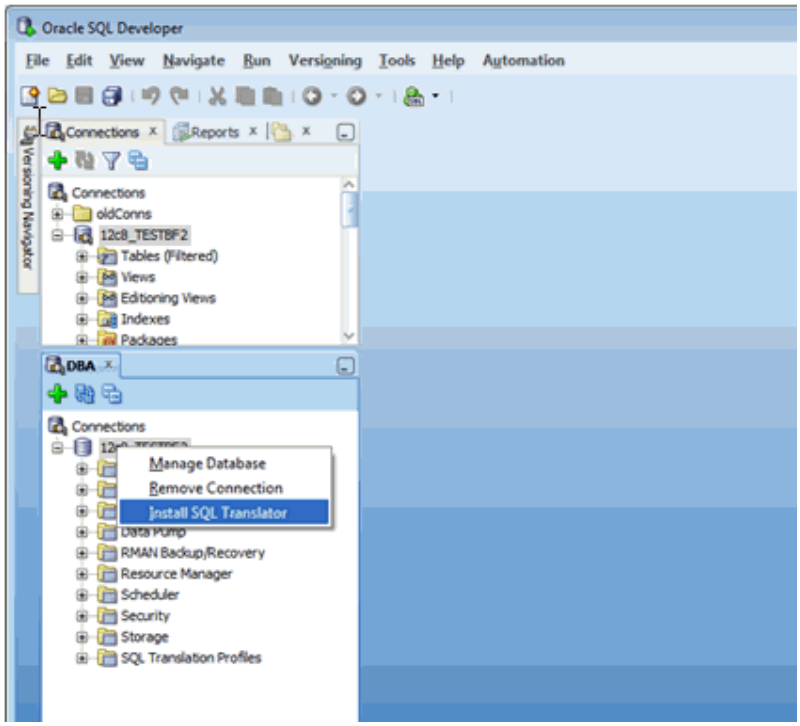
4. In the DBA Navigator, right-click **Connections** and select **Add Connection.**



5. In the **Select Connection** box, select the connection if you want to use an existing connection. If you want to create a new connection, then add the information for `transluser` discussed in step 2.



6. Click **Connect**.
7. In the DBA navigator, right-click the connection created in the preceding steps, and select **Install SQL Translator**.

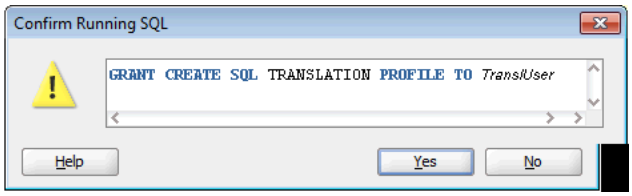


The Install SQL Translator dialog box opens.

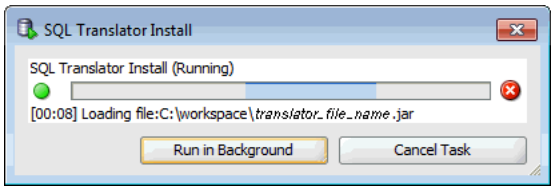
You must have special permissions to install the SQL Translator and create a SQL Translation Profile. You will be prompted to provide the SYS password, so that these privileges can be granted. Refer to "Granting Necessary Permissions for Installing the SQL Translator" for more information about these privileges.

8. Create a SQL Translation Profile, following steps described in "Creating a Translation Profile ".
9. Verify that the user has sufficient privileges to run the translation profile.

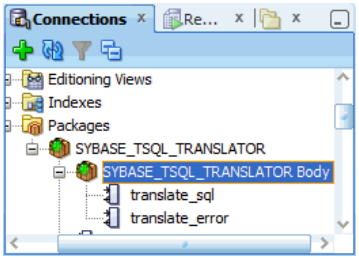
You may have to login as SYS user to grant additional privileges.



10. Install SQL Translator.



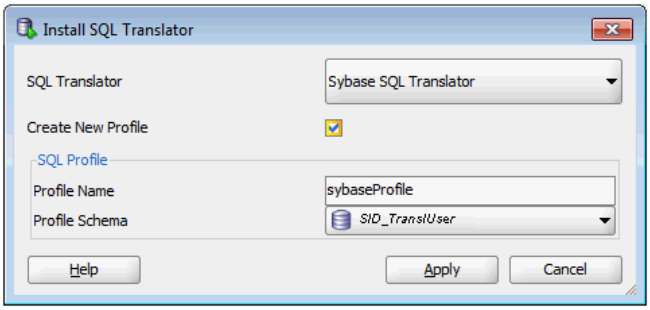
11. To ensure that both the Profile and Translator are properly installed, verify whether the appropriate package and Java class files are present or not in the Connections pane.



3.1.5.2 Creating a Translation Profile

To create a translation profile:

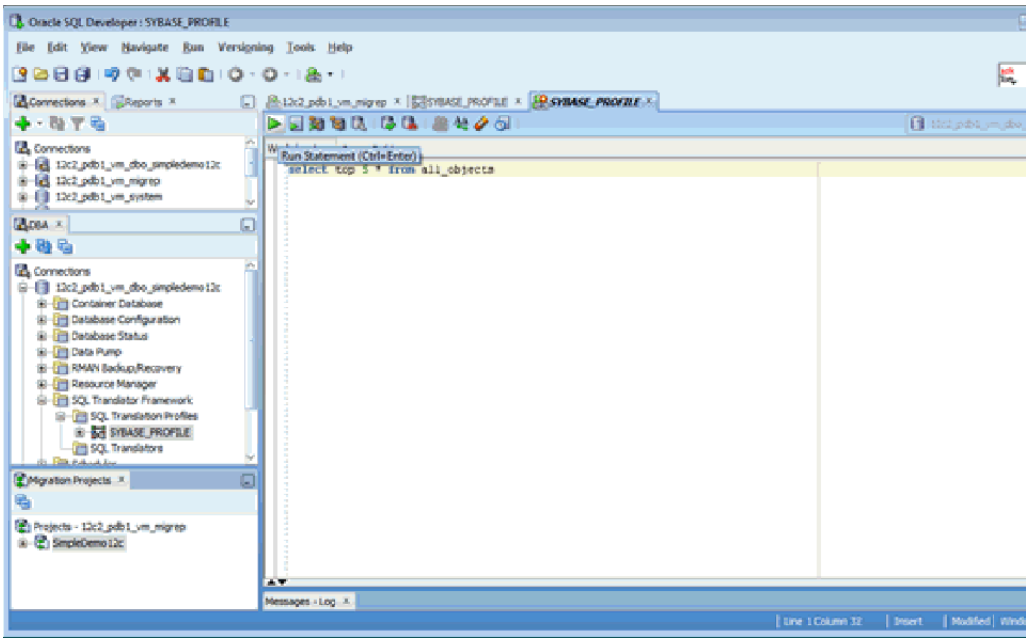
1. From the SQL Translator drop-down box, select **Sybase** or **SQL Translator**.
2. Check **Create New Profile**.
3. Enter ***SYBASE_PROFILE*** in Profile Name field.
4. In Profile Schema, select the name of the user created in section "Creating a Translation Profile and Installing SQL Translator".
5. Click **Apply**.



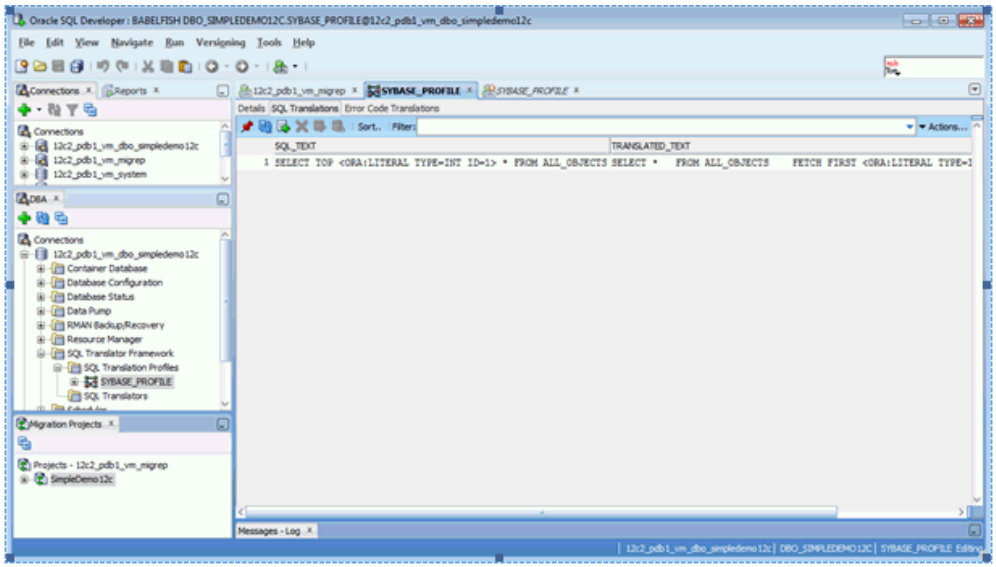
3.1.6 Using the SQL Translator Profile

To test the SQL Translation Profile, use SQL Worksheet:

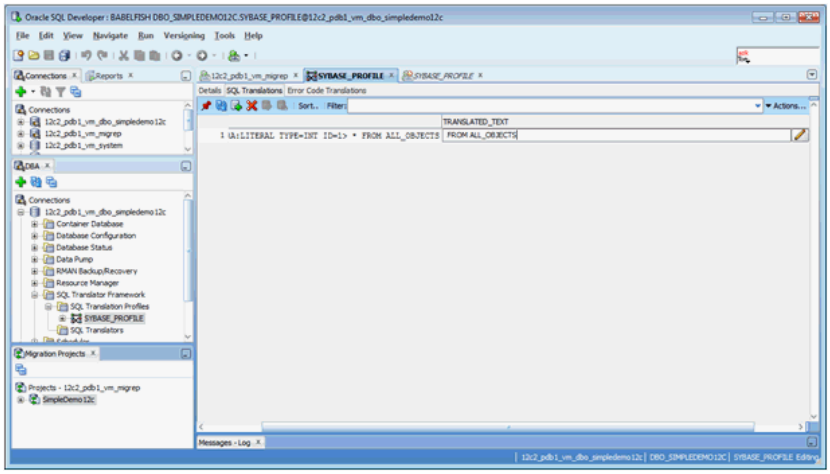
1. Right-click the `SYBASE_PROFILE` node.
2. Select **Open SQL Worksheet with Profile**.
3. Enter a T-SQL statement that you want to translate.

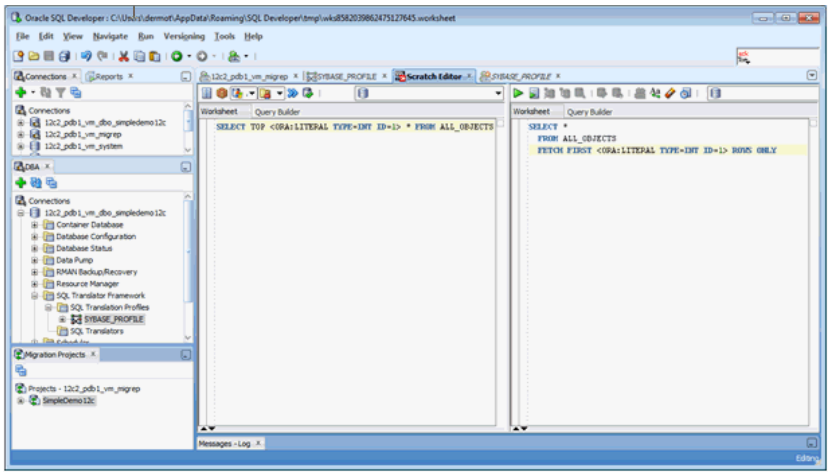


4. Click `SYBASE_PROFILE` and select the SQL Translation tab to inspect the profile and view the translated statement.



An alternative way to view the profile SQL in a better way when you double-click on it, the fingerprint and template open in a Translation Scratch Editor as shown in the following images:





3.2 Installing and Configuring SQL Translation Framework from Command Line

There are several processes that you must complete to successfully install and configure the SQL Translation Framework from command line interface.

3.2.1 Installing Oracle Sybase Translator

To install Oracle Sybase Translator, Use Oracle SQL Developer as described in "Installing and Configuring SQL Translation Framework with Oracle SQL Developer".

3.2.2 Setting up a SQL Translation Profile

Perform the following steps to set up a SQL Translation Profile through a command-line interface:

1. Login as a `system` user.

   ```
   > sqlplus system/<password>
   ```

2. Grant create privileges to the standard user.

   This allows the standard user to create a SQL Translation Profile.

   ```
   SQL> grant create sql translation profile to <user>;
   ```

3. Login as a standard user.

   ```
   sqlplus <user>/<password>
   ```

4. Invoke the methods of `DBMS_SQL_TRANSLATOR` PL/SQL package to create and configure the translation profile.

   ```
   SQL> exec dbms_sql_translator.create_profile('sybase_profile')
   SQL> exec dbms_sql_translator.set_attribute('sybase_profile',
        dbms_sql_translator.attr_translator,
        'migration_repo.sybase_tsql_translator')
   ```

5. Grant all privileges for the SQL Translation Profile to Oracle Sybase translation schema.

   ```
   SQL> grant all on sql translation profile sybase_profile to migration_repo;
   ```

3.2.3 Setting Up a Database Service to Use the SQL Translation Profile

This section describes how to add a database service in a standard environment and in an Oracle Real Application Clusters environment.

Setting Up a Database Service in a Standard Environment

To set up a database service in a standard environment:

1. Login as a DBA
2. Issue the following commands to use the `DBMS_SERVICE` PL/SQL package to create and invoke the database service:

   ```
   SQL> declare
     params dbms_service.svc_parameter_array;
   begin
     params('SQL_TRANSLATION_PROFILE') := 'user.sybase_profile';
     dbms_service.create_service('sybase_service', 'network_name', params);
     dbms_service.start_service('sybase_service');
   end;
   /
   ```

3.2.3.1 Setting Up a Database Service in Oracle Real Application Clusters

To set up a database service in Oracle Real Application Clusters:

1. Add the database service:

   ```
   srvctl add service -db db_name -service sybase_service
   -sql_translation_profile user.sybase_profile
   ```

2. Start the database service:

   ```
   srvctl start service -db db_name -service sybase_service
   ```

3.2.4 Testing Sybase SQL Translation Using the SQL Translation Profile

Perform the following steps to test the translation:

1. Login as a standard user:

   ```
   sqlplus user/password
   ```

2. Specify the SQL Translation Profile at the SQL prompt:

   ```
   SQL> alter session set sql_translation_profile = sybase_profile;
   ```

3. Force the database to treat SQL*Plus as a foreign SQL application:

   ```
   SQL> alter session set events = '10601 trace name context forever, level 32';
   ```

4. Run a SQL query that uses Sybase SQL dialect. For example:

   ```
   select top 3 * from emp;
   ```

5. The query returns the following results:

   ```
   EMPNO   ENAME    JOB         MGR   HIREDATE       SAL    COMM    DEPTNO
   ------------------------------------------------------------------------
   7369    SMITH    CLERK       7902  17-DEC-80      800                20
   7499    ALLEN    SALESPERSON 7698  20-FEB-81     1600     300        30
   7521    WARD     SALESPERSON 7698  22-FEB-81     1250     500        30
   ```

3.3 Granting Necessary Permissions for Installing the SQL Translator

This section discusses the privileges that you must have to install the SQL Translator. The `SYBASE_PROFILE` created here has the following two users:

- `MIGREP`, where the translator is installed
- `TARGET_USER`, where the profile is installed

To grant privileges necessary for installing the SQL Translator:

1. Connect as `SYS` to grant the required privileges:

   ```
   connect sys/oracle as sysdba
   ```

2. Allow `MIGREP` to create a view and have access to unlimited quota:

   ```
   GRANT connect, resource, create view to MIGREP;
   ALTER USER MIGREP QUOTA UNLIMITED ON USERS;
   ```

3. Allow `TARGET_USER` to create a view and have access to unlimited quota:

   ```
   GRANT connect, resource, create view to TARGET_USER;
   ALTER USER MIGREP QUOTA UNLIMITED ON TARGET_USER;
   ```

4. Allow `MIGREP` to load a SQL Translator:

   ```
   BEGIN
     DBMS_JAVA.GRANT_PERMISSION(UPPER('MIGREP'), 'SYS:java.lang.RuntimePermission',
   'getClassLoader', '');
   END;
   /
   ```

5. Allow `TARGET_USER` to create profiles:

   ```
   GRANT CREATE SQL TRANSLATION PROFILE TO TARGET_USER;
   ```

6. Allow TARGET_USER to explicitly alter the session to use a profile:

```
GRANT ALTER SESSION TO TARGET_USER;
```

   This privilege is not granted in SQL Developer by default.

7. Allow the translator to make reference to the profile:

```
CONNECT TARGET_USER/TARGET_USER;
GRANT ALL ON SQL TRANSLATION PROFILE SYBASE_PROFILE TO MIGREP;
```

8. Allow the profile to make reference to the translator:

```
CONNECT MIGREP/MIGREP;
GRANT EXECUTE ON SYBASE_TSQL_TRANSLATOR TO TARGET_USER;
```

4

SQL Translation of JDBC and ODBC Applications

Oracle provides SQL Translation mechanisms for use with JDBC and ODBC applications.

4.1 SQL Translation of JDBC Applications

Consider the concepts necessary to understanding how to use SQL Translator with a JDBC application.

4.1.1 SQL Translation Profile

A SQL Translation Profile is a database schema object that directs how SQL statements in non-Oracle dialects are translated into Oracle SQL dialects. It also directs how Oracle error codes and `SQLSTATES` are translated into the SQL dialect of other vendors.

When you want to migrate a client application written for a non-Oracle SQL database to Oracle, you can create a SQL Translation Profile and configure it to translate the SQL statements and errors for the application. At runtime, the application sets the profile for the connection in Oracle Database to translate its SQL statements and errors. This profile is set using the `oracle.jdbc.sqlTranslationProfile` property.

When necessary, you can register custom translations of SQL statements and errors with the SQL Translation Profile on the Server. When a SQL statement or error is translated, then first, the custom translation is looked up and then, the translator is invoked only if no match is found.

See "Architecture of SQL Translation Framework" and "Setting up a SQL Translation Profile".

4.1.2 Error Message Translation

You may prefer receiving error messages in the form of messages that used to be thrown by the native database. You must then use the error message translation file, which translates error messages when there is no valid connection to the database. Once a connection to the database is established, the JDBC driver bypasses this file completely and all errors are handled by the translator on the server. Similar to query translation, you can also register custom error translations on the server.

The error message translation file is not written by a specific component. You must provide the file for translation and specify the name of the file. You can also provide the file path as the value of the corresponding connection property.

The error message translation file is in XML format; it contains a series of error translations. Each error translation contains the following information:

Translation Error	Type
ORA error number	positive integer
Oracle error message	String
Translated error code	positive integer

Translation Error	Type
Translated SQL State	positive integer

4.1.3 Converting JDBC Standard Parameter Markers

Before submitting the SQL statements for translation., the JDBC driver internally converts the JDBC standard parameter markers (?) into Oracle style parameter markers of the format `:b<n>`.

Here, the naming format for the parameter markers is `:b<n>`, where `n` is an incremental number to specify the position of the (?) marker in the JDBC `PreparedStatement`.

Consider the `UPDATE employees SET salary = salary * ? WHERE employee_id = ?` `PreparedStatement` statement, where, the first parameter marker (?) will become `:b1` and the second parameter marker (?) will become `:b2`.

After conversion, the driver sends the following query to the server for translation:

```
UPDATE employees SET salary = salary * :b1 WHERE employee_id = :b2
```

Note that any query that contains "?" as a parameter marker fails during the connection translation phase if you change the value of the `processEscapes` property to `FALSE`. For a successful translation, you must retain the default value of the `processEscapes` property.

Converting parameter markers helps the driver to automatically reorder any parameter changes that occurred at translation. At the time of conversion, any custom translation that must be registered on the server should be registered from the Oracle style parameter marker version; the server receives the statements. Note that, the custom translation must have the same number of parameter markers in the Oracle style as in the original query.

For more information about supported JDBC APIs, API Reference for SQL Translation of JDBC Applications .

4.1.4 Executing the Translated Oracle Dialect Query

After the JDBC standard parameter markers are converted into Oracle style parameter markers, the driver makes a round-trip to the server for translating the query into Oracle dialect. Once the translated query is received by the server, any reordering in the parameters in handled transparently by the driver, and the query is executed as a normal query.

If a query cannot be translated due to the unavailability of translation, then the server can either raise an error or return a `NULL`, based on the value of the `DBMS_SQL_TRANSLATOR.ATTR_RAISE_TRANSLATION_ERROR` profile attribute. If the server returns a `NULL`, then the original untranslated query is assumed to be the query translated by the driver and executed.

The driver keeps the translation in the local caches to save the future round-trip.

Note that the JDBC driver can support the translation errors (when the query cannot be translated due to the unavailability of translation) set by either value of the `DBMS_SQL_TRANSLATOR.ATTR_RAISE_TRANSLATION_ERROR` attribute. However, the value must be set on the server before the connection is established. Because a change in the value of this attribute in the middle of a session may result in inconsistent behavior, Oracle recommends that you do not flip the value of this attribute during a session. See *Oracle Database PL/SQL Packages and Types Reference* for more information about the `TRANSLATE_SQL` procedure.

4.1.5 Error Translation

If any `SQLException` is thrown during the query execution, the driver transparently makes a trip to the server and translates the exception from Oracle codes to the original vendor-specific code. So, the resulting `SQLException` has both vendor-specific code and `SQLSTATE` along with the Oracle-specific `SQLException` as the cause.

Similar to query translation, custom error translations can also be registered on the server and given priority over standard translation. The `DBMS_SQL_TRANSLATOR.ATTR_RAISE_TRANSLATION_ERROR` attribute has the same effect on custom error translation as on query translation.

Note that the errors are translated only after a connection to the server is established. So, for errors that occur before the connection to the server is established, Error Message Translation is used.

4.1.6 Using JDBC Driver for SQL Translation

Example 4-1 demonstrates how to use a JDBC driver for SQL translation. You must first grant the `CREATE SQL TRANSLATION PROFILE` privilege to `HR` as follows:

```
conn system/manager;
grant create sql translation profile to HR;
exit
```

Now, connect to the database as `HR` and execute the following SQL statements:

```
drop table sample_tab;
create table sample_tab (c1 number, c2 varchar2(100));
insert into sample_tab values (1, 'A');
insert into sample_tab values (1, 'A');
insert into sample_tab values (1, 'A');
commit;
exec dbms_sql_translator.drop_profile('FOO');
exec  dbms_sql_translator.create_profile('FOO');
exec  dbms_sql_translator.register_sql_translation('FOO','select row of select c1, c2
from sample_tab
where c1=:b1 and c2=:b2','select c1, c2 from sample_tab where c1=:b1 and c2=:b2');
```

Now, you can run the following program that translates SQL statements that use JDBC standard parameter markers.

Example 4-1 Translating Non-Oracle SQL Statements to Oracle SQL Dialect Using JDBC Driver

```
public class SQLTransPstmt
{
  static String url="jdbc:oracle:thin:@localhost:5521:jvx1";
  static String user="HR", pwd="hr";
  static String PROFILE = "FOO";
  static String primitiveSql = "select row of select c1, c2 from sample_tab where c1=?
and c2=?";

// Note that this query contains JDBC style parameter markers
// But the preceding custom translation registered in SQL is using Oracle style markers

  public static void main(String[] args) throws Exception
  {
    OracleDataSource ods = new OracleDataSource();
```

```
    ods.setURL(url);

    Properties props = new Properties();
    props.put("user", user);
    props.put("password", pwd);

    // The Following connection property makes the connection translating
    props.put(OracleConnection.CONNECTION_PROPERTY_SQL_TRANSLATION_PROFILE, PROFILE);
    ods.setConnectionProperties(props);
    Connection conn = ods.getConnection();
    System.out.println("connection for SQL translation: "+conn);

    try{
      // Any statements created using a translating connection are
      // automatically translating. If you want to get a non-translating
      // statement out of a translating connection please have a look at
      // the oracle.jdbc.OracleTranslatingConnection Interface.
      // Refer to "OracleTranslatingConnection Interface"
      // for more information
      PreparedStatement trStmt = conn.prepareStatement(primitiveSql);
      trStmt.setInt(1, 1);
      trStmt.setString(2, "A");
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery();
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();

      trStmt.close();
    }catch (Exception e) {
      e.printStackTrace();
    }


    conn.close();
  }
}
```

4.2 SQL Translation of ODBC Applications

Consider the concepts necessary to understanding how to use SQL Translator with an ODBC application.

4.2.1 SQL Translation profile

For ODBC applications, the SQL Translation Profile is set at the service level. So, you do not require to set it in the `.odbc.ini` file.

4.2.2 Error Message Translation

You may prefer receiving error messages in the form of messages that used to be thrown by the native database. In such cases, when the application is set to run on Oracle Database, you must set the `SQLTranslateErrors=T` entry in the `.odbc.ini` file to translate the `ORA` errors to their native form.

4.2.3 Translating Error Messages

Example 4-2 demonstrates how to use the ODBC driver in SQL translation. The SQL statement used in the example uses Sybase `TOP N` syntax.

Note that you must set the `ServerName=` entry in the `.odbc.ini` file with the Database service name created in "How to Use SQL Translation Framework" section. Also, set the 'SQLTranslateErros=T entry in the `.odbc.ini` file, if you require translation of Oracle errors to native database errors.

Example 4-2 Translating Non-Oracle SQL to Oracle SQL Dialect Using ODBC Driver

```
int main()
{
 HENV m_henv;          /* environment handle */
 HDBC m_hdbc;          /* connection handle */
 HSTMT m_hstmt;        /* statement handle */
 int retCode;          /* return code */
 char dbdsn[100];      /* Initialize with the DSN name of connection */
 const  char szUID[10];/*Initialize with appropriate Username of DB */
 const char szPWD[10]; /* Initialize with appropriate Password */

 char query1[100]="select top 3 col1 from babel_tab3 order by col1";
 SQLLEN paramInd = SQL_NTS;
 SQLUINTEGER   no = 0;

 //Allocate HENV, HDBC, HSTMT handles
 retCode = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &m_henv);
 if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
 {
    printf ("SQLAllocHandle failed \n");
    printSQLError (1, m_henv);
 }

 retCode = SQLSetEnvAttr (m_henv, SQL_ATTR_ODBC_VERSION, (void *) SQL_OV_ODBC3,
           SQL_IS_INTEGER);
 if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
 {
    printf ("SQLSetEnvAttr failed\n");
    printSQLError (1, m_henv);
 }

 retCode = SQLAllocHandle (SQL_HANDLE_DBC, m_henv, &m_hdbc);
 if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
 {
    printf ("SQLAllocHandle failed\n");
    printSQLError (2, m_hdbc);
 }

 retCode = SQLConnect (m_hdbc, (SQLCHAR *) dbdsn,SQL_NTS,
                       (SQLCHAR *) szUID, SQL_NTS,
                       (SQLCHAR *) szPWD, SQL_NTS);
 if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
 {
    printf ("SQLConnect failed to connect\n");
    printSQLError (2, m_hdbc);
 }

 retCode = SQLAllocHandle (SQL_HANDLE_STMT, m_hdbc, &m_hstmt);
 if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
```

```
{
   printf ("SQLAllocHandle with SQL_HANDLE_STMT failed\n");
   printSQLError (3, m_hstmt);
}

/* Prepare and Execute the Sybase Top-N syntax SQL statements */

retCode = SQLPrepare (m_hstmt, (SQLCHAR *) query1, SQL_NTS);
if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
{
   printf ("SQLPrepare failed\n");
   printSQLError (3, m_hstmt);
}

retCode=SQLExecute(m_hstmt);
if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
{
   printf ("SQLExecute-failed\n");
   printSQLError (3, m_hstmt);
}

while (retCode = SQLFetch(m_hstmt)!=SQL_NO_DATA)
{
   retCode=SQLGetData(m_hstmt,1,SQL_C_ULONG, &no, 0, &paramInd);
   if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
   {
      printf ("SQLFetch failed\n");
      printSQLError (3, m_hstmt);
   }
   printf("Value is %d\n",no);
}

retCode = SQLCloseCursor (m_hstmt);
if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
   printf ("SQLCloseCursor failed\n");

printf ("cleanup()\n");
retCode = SQLFreeHandle (SQL_HANDLE_STMT, m_hstmt);
if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
{
   printf ("SQLFreeHandle failed\n");
   printSQLError (3, m_hstmt);
}

retCode = SQLDisconnect (m_hdbc);
if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
{
   printf ("SQLDisconnect failed\n");
   printSQLError (2, m_hdbc);
}

retCode = SQLFreeHandle (SQL_HANDLE_DBC, m_hdbc);
if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
{
   printf ("SQLFreeHandle failed\n");
   printSQLError (2, m_hdbc);
}

retCode = SQLFreeHandle (SQL_HANDLE_ENV, m_henv);
if (retCode != SQL_SUCCESS && retCode != SQL_SUCCESS_WITH_INFO)
{
   printf ("SQLFreeHandle failed\n");
```

```
            printSQLError (1, m_henv);
        }
    }
```

5

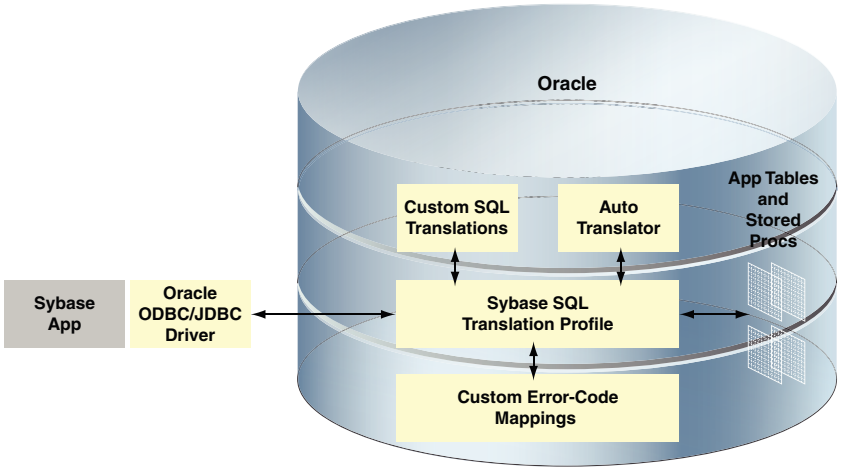
Example: Application Migration Using SQL Translation Framework

Consider an example of migrating a Sybase JDBC Application, and the information contained in the migration reports: how it may be used to tune the migration for optimal results.

5.1 Migrating a Sybase JDBC Application

Figure 5-1 illustrates how an application that is coded to query a Sybase database may use SQL Translation Framework to query information stored in Oracle Database instead.

Figure 5-1 Sybase Application Running Against Oracle Database



5.1.1 Application Overview

The Sybase database used in this example has three tables and five procedures and includes the following features:

- `IDENTITY` columns
- `INSERT` statements into tables with `IDENTITY` columns
- `VARCHAR` columns with size greater than `4000` characters
- Multiple implicit result sets returned from procedures

A Java application connects to this Sybase database using JDBC.

5.1.2 Setting Up Migration

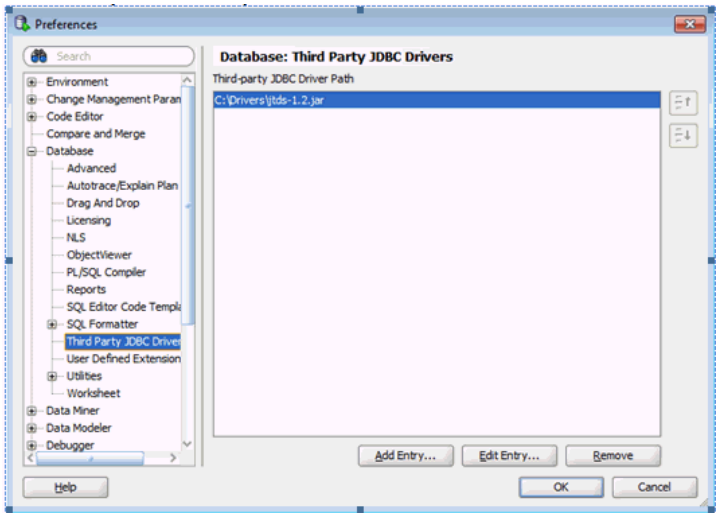
The migration process has four phases - Capture, Convert, Generate, and Data Move. It is best practice to complete each phase of the migration process, review any issues on the Summary page, and then continue to the next phase. The Migration Wizard enables you to

complete each step in turn and then return back to the wizard to complete further steps. To do this, after completing each phase, select the **Proceed to Summary Page** check box and click **Next**.

Perform the following steps to set up migration:

1. Download the JDBC driver JTDS 1.2.
2. Add JTDS as a third-party JDBC driver as follows:
   a. Select **Preferences** from the **Tools** menu.
   b. Select **Third Party JDBC Driver** from the **Database** option on the right panel, as shown in Figure 5-2.

Figure 5-2 Setting JTDS JDBC Driver



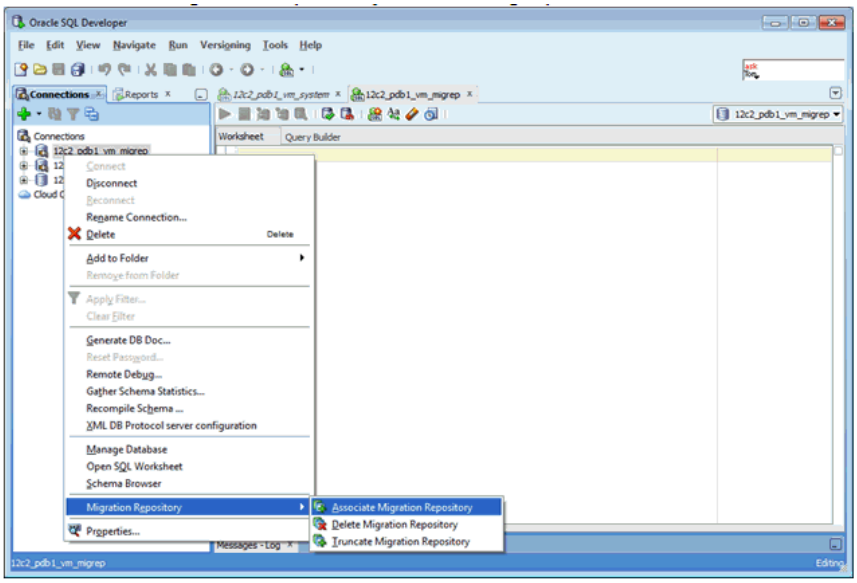
3. Click **Add Entry**.

   The Select Path Entry box is displayed.
4. Select the `jtds-1.2.jar` file and click **Select**.
5. Click **OK**.
6. Connect to the Oracle Database where you want to migrate the information.
7. Verify that the connection is using Oracle Database 12c JDBC drivers, with the following command:

   ```
   show jdbc
   ```
8. Create a new user `migrep` in Oracle database, for the migration repository, with the following command:

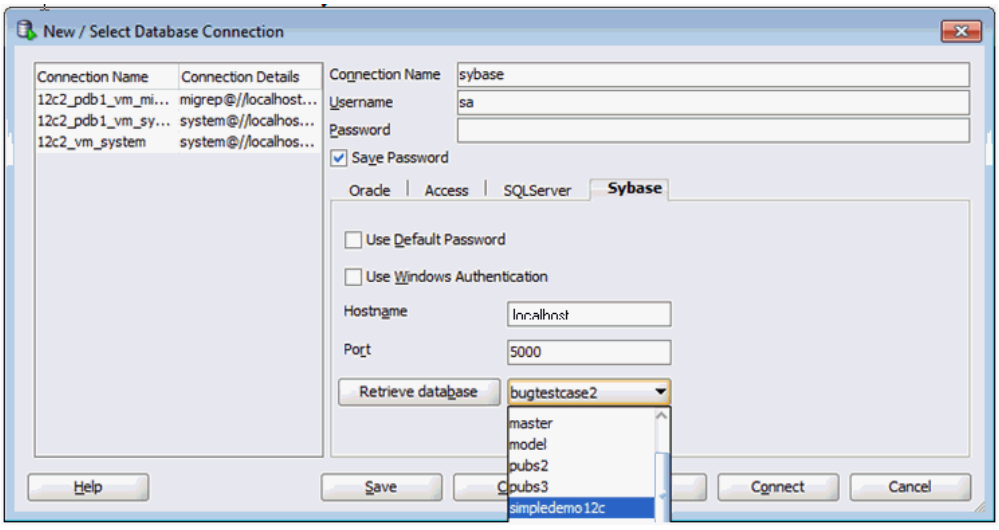
   ```
   GRANT CONNECT,RESOURCE,CREATE VIEW to migrep INDENTIFIED BY migrep;
   ALTER USER migrep QUOTA UNLIMITED to users;
   ```
9. Connect to the database as the `migrep` user and associate the migration repository with the user, as shown in Figure 5-3.

Figure 5-3 Associating a User with Migration Repository



10. Create a connection to the Sybase database, in this example, `simpledemo12c`, as shown in Figure 5-4.

Figure 5-4 Creating a Connection to the Sybase Database

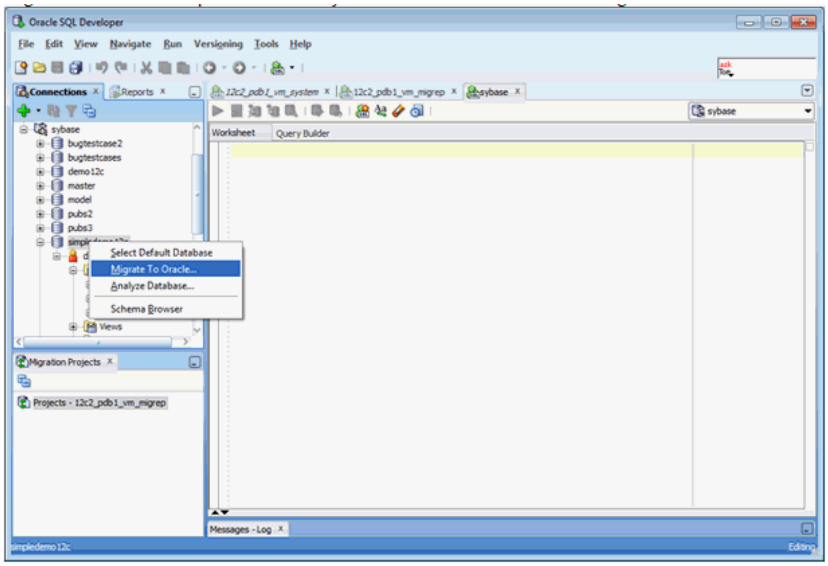


5.1.3 Capturing Migration

Perform the following steps to capture migration:

1. Right-click on the `simpledemo12c Sybase` database and select the **Migrate to Oracle** option, as shown in Figure 5-5.

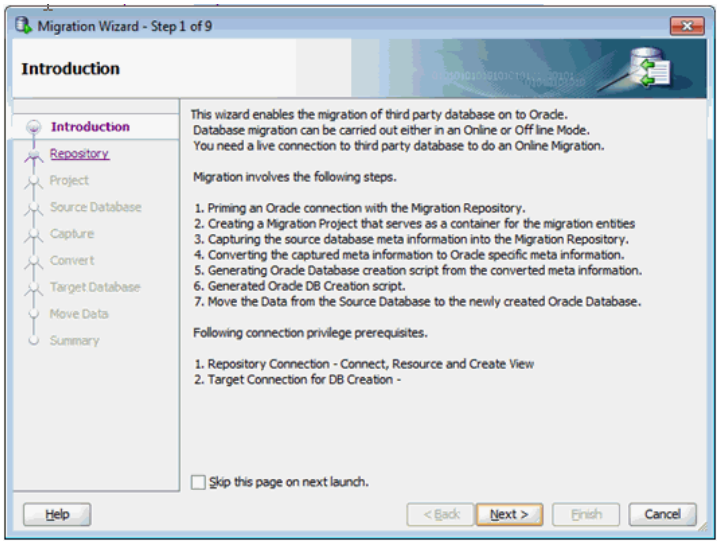
Figure 5-5 Starting Capture Phase of Migration Process



This opens the Migration Wizard, as shown in Figure 5-6.

Click **Next**.

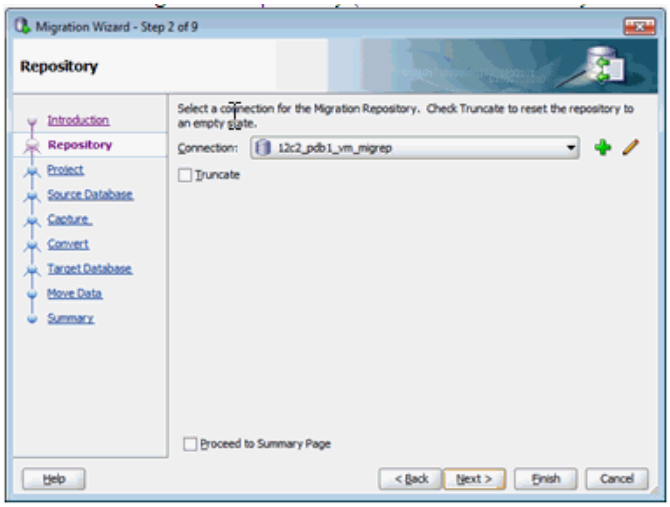
Figure 5-6 Migration Wizard Introduction Screen



2. Choose the Migration Repository, as shown in Figure 5-7.

   Click **Next**.

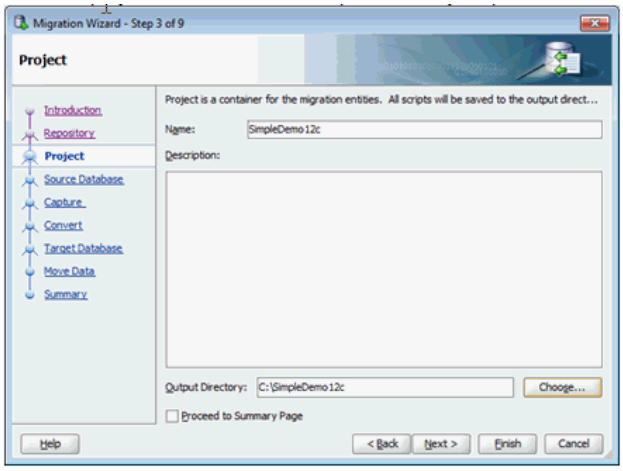
Figure 5-7 Choosing the Migration Repository



3. Enter a project name and specify an output directory to place files, as shown in Figure 5-8.

   Click **Next**.

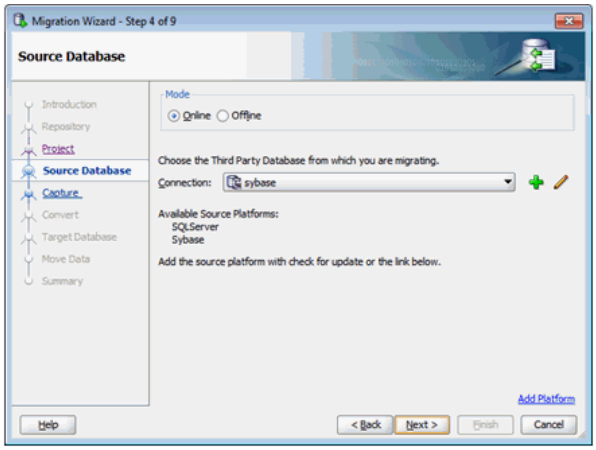
Figure 5-8 Specifying Project Name and Output Directory



4. Select the database connection and the mode, as shown in Figure 5-9.

   Click **Next**.

Figure 5-9 Selecting the Database Connection and Mode

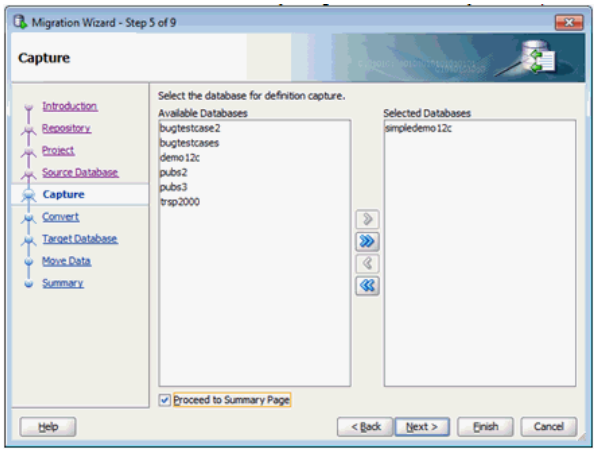


5. Select the database, in this case, `simpledemo12c`, by moving it from **Available Databases** to **Selected Databases**, as shown in Figure 5-10.

   Click **Proceed to Summary Page** to review the Capture phase before moving to the next phase of the migration process.

   Click **Next**.

Figure 5-10 Selecting the Database to be Migrated



The capture phase saves a snapshot of the selected database at this point of time. Only the object definitions are captured, not the actual table data. This captured snapshot can be viewed in the Migration Projects navigator.

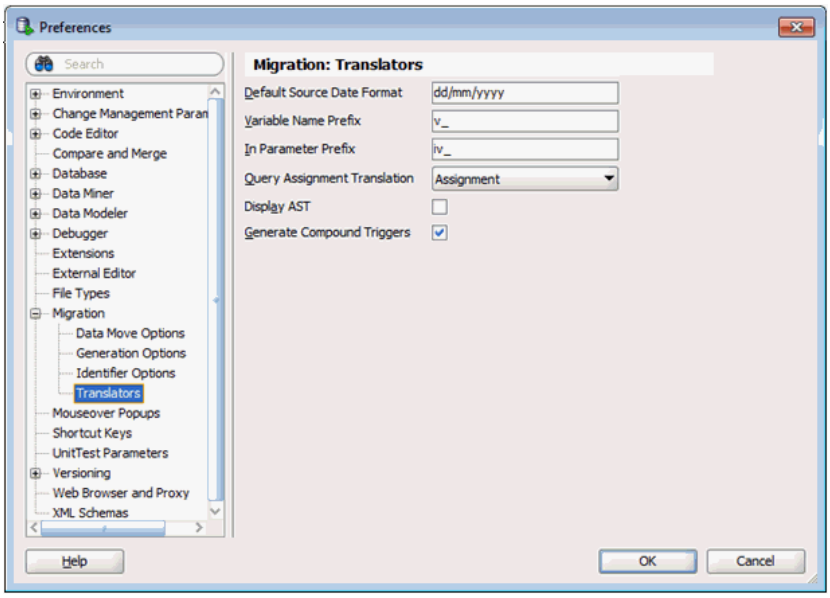
Note that the snapshot is not a connection to the database, and it only enables you to browse through the information saved in the Migration Repository.

5.1.4 Setting Migration Preferences

Before starting the conversion phase, you must set the migration preferences. Perform the following steps to achieve this:

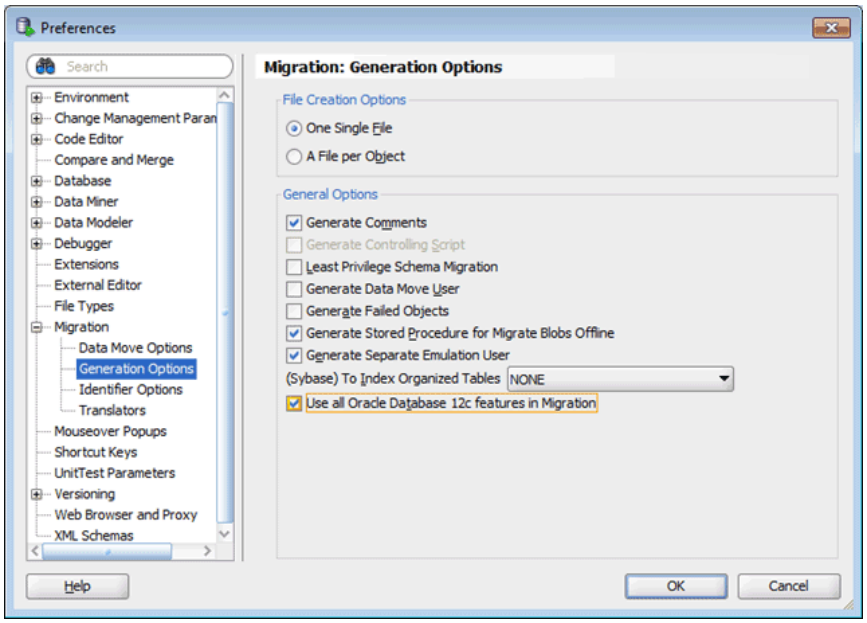
1. From the Tools menu, select **Preferences**, then **Migration**, and then **Translators**. Select the **Generate Compound Triggers** option.

Figure 5-11 Setting Migration Preferences



2. From the Tools menu, select **Preferences**, then **Migration**, and then **Generation Options**. Select the **Use all Oracle Database 12c features in Migration** option.

Figure 5-12 Setting Migration Preferences

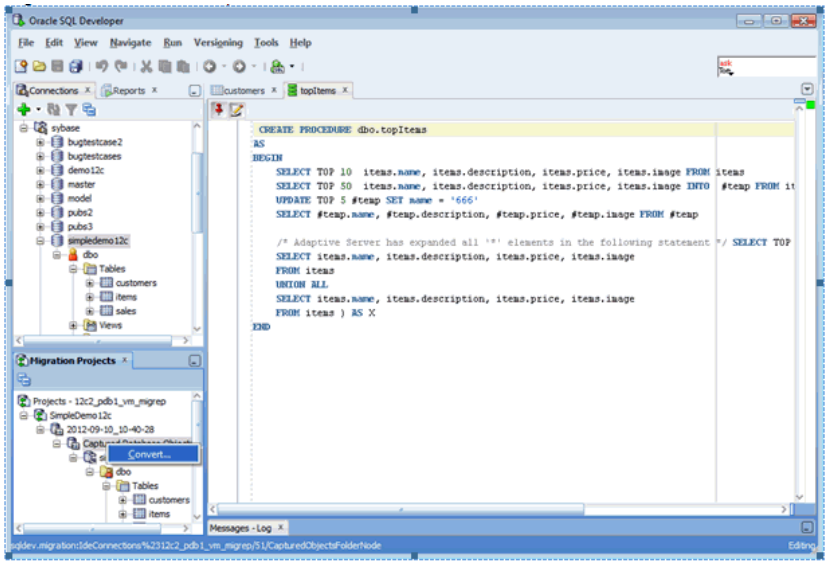


5.1.5 Converting Migration

Perform the following steps to start convert phase of the migration process:

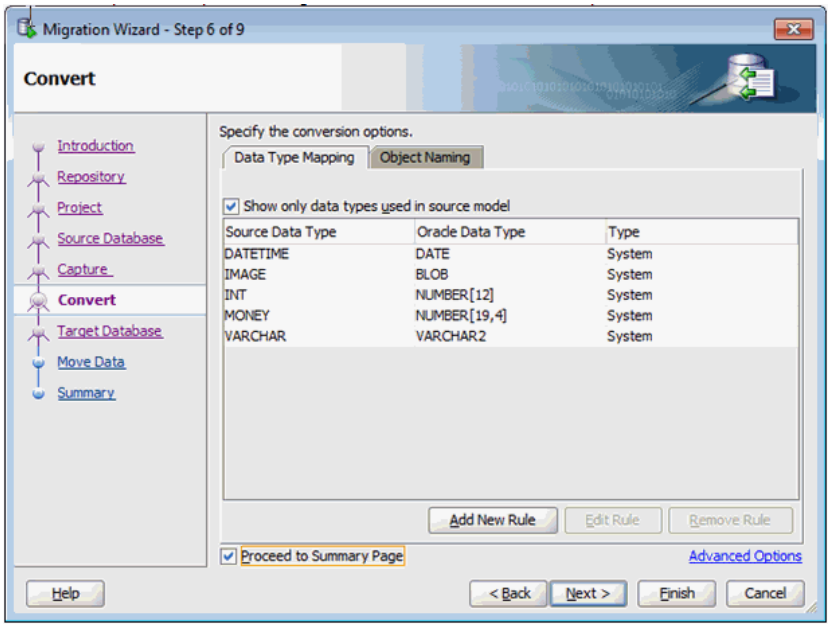
1. Right-click the Capture Model node and choose **Convert**, as shown in Figure 5-13.

Figure 5-13 Starting Convert Phase of Migration Process



The Migration Wizard is opened at the Convert phase, as shown in Figure 5-14.

Figure 5-14 Converting the Migrated Data



2. Select Proceed to Summary Page and click **Next**.
3. Click **Finish**.

During the convert phase, object names are resolved to valid Oracle names. Data types are converted to Oracle Database types and T-SQL defined objects like stored procedures, views, and so on are converted to Oracle PL/SQL. A converted model is created that can be browsed in the Migration Projects navigator. The converted procedures can be reviewed in the converted model.

Note that the converted model is not an actual Oracle database, but a prototype of an Oracle Database. The information is still stored only in the Migration Repository tables.

5.1.6 Generating a Migration

The migration generation phase creates the objects in the target Oracle Database. A script is created and it is run against a selected Oracle connection in the following two ways:

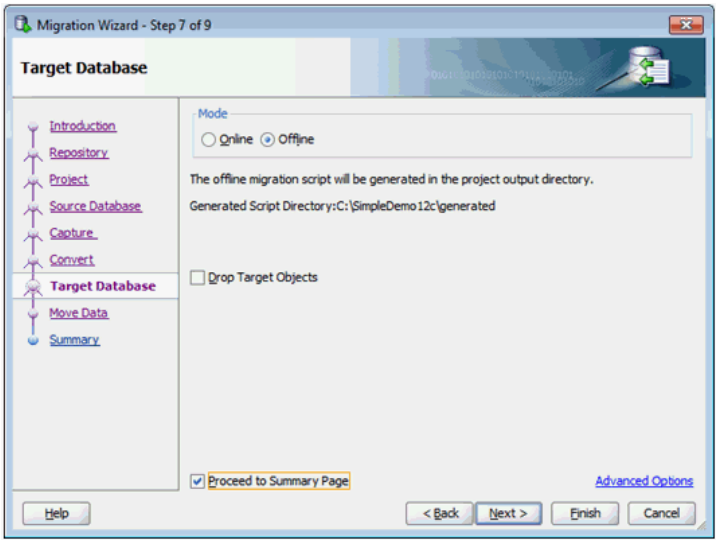
- In `offline` mode, the script is opened in a SQL Worksheet and you have to select the connection and run it manually.
- In `online` mode, you must provide the target connection in the wizard and the wizard runs the script automatically.

The following steps demonstrate how to perform the generate phase of the migration process in `offline` mode:

1. Right-click on **Converted Database Objects** in the Migration Projects panel and select **Generate Target**.
2. Select `offline` as the database mode in the Migration Wizard, as shown in Figure 5-15.

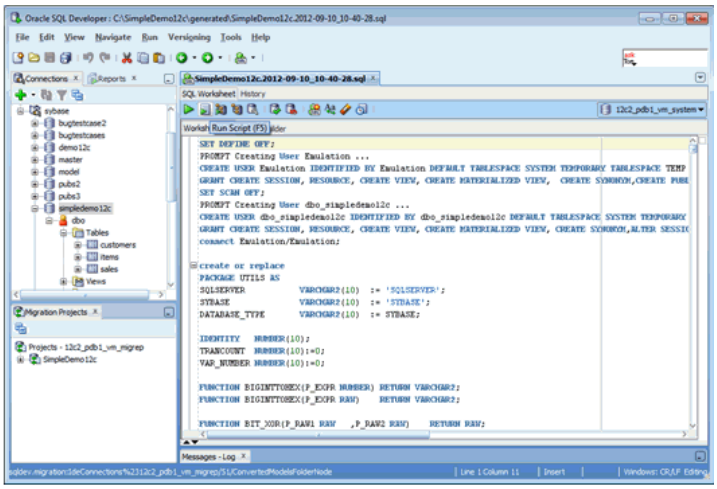
   Click **Next**.

Figure 5-15 Selecting the Database Mode



3. Choose a connection in the target Oracle Database, as shown in Figure 5-16.

Figure 5-16 Creating Oracle Database Connection for Target User dbo_simpledemo12c

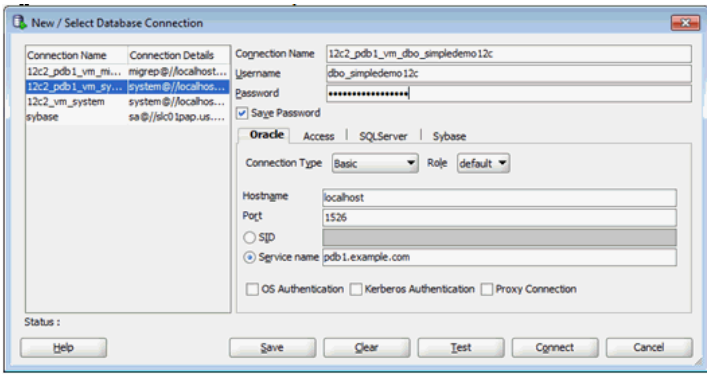


The database objects are not created under the connection selected in this step. However, this connection *must* have enough privileges to create other users and objects.

5.1.6.1 Creating a Target Oracle User

Create a connection to the newly created user (described in step 3), as shown in Figure 5-17. At this point, the Sybase database objects are migrated to Oracle Database, but the data is not migrated till now.

Figure 5-17 Targeting an Oracle User



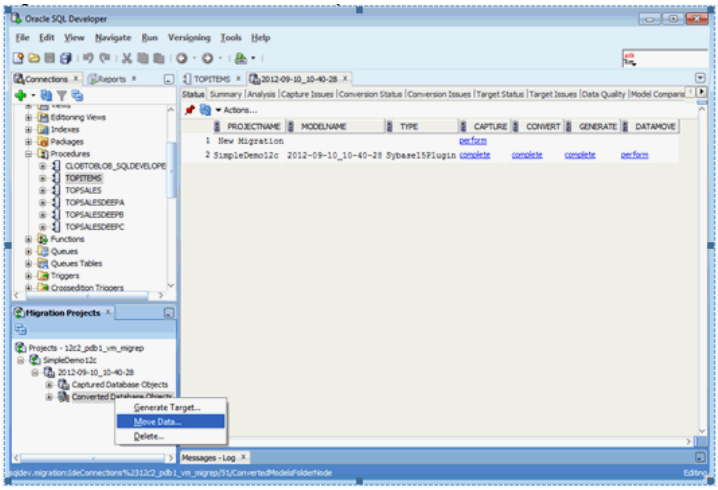
5.1.7 Moving the Data

Perform the following steps to move the data to Oracle Database:

1. Right-click the **Converted Database Objects** node and select **Move Data**, as shown in Figure 5-18.

   Click **Next**.

Figure 5-18 Moving the Data from Sybase Database to Oracle Database



2. Select `online` as the data move mode in the Move Data screen.

   You can select `offline` as the data move mode if the migration process involves large amount of data.

3. Click **Next**. The Summary screen appears.

4. Click **Finish**.

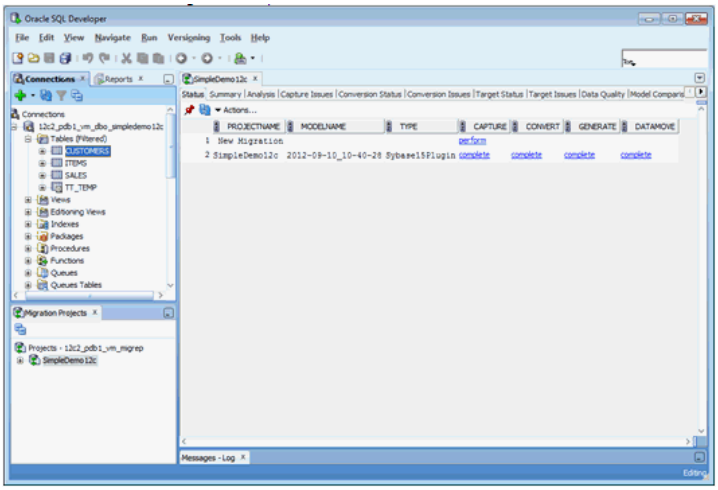
   You can browse the database objects to verify the data is moved to Oracle database.

> **See Also**
>
> *Oracle SQL Developer User's Guide*

5.2 Generating Migration Reports

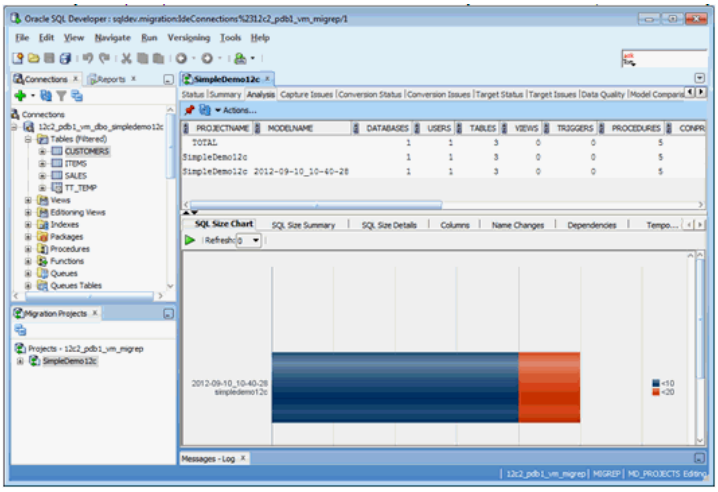
Oracle SQL Developer provides a number of reports on the migration process to help identify tasks and issues to resolve. Click or double-click on the migrated project in the Migration Projects navigator. A report will appear on the right panel with a number of tabs and children reports, as shown in Figure 5-19.

Figure 5-19 Generating Migration Reports



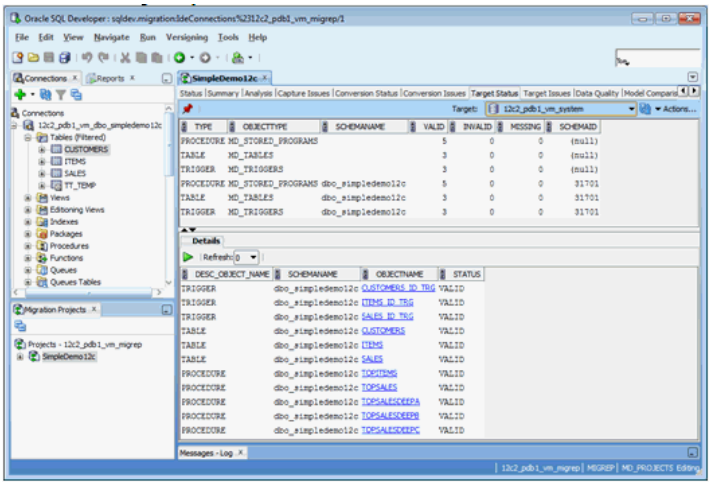
The Analysis report provides information about the size of the migrated database like the number of objects, line sizes, and so on, as shown in Figure 5-20.

Figure 5-20 Migration Analysis Report



The Target Status report provides information about the status of the migrated objects in the Target database. First, select a target connection with enough privileges to view the status of other schema objects and then select **refresh**. Objects that are present in the converted model, but are missing from the target Oracle Database, are listed as missing. These objects can be either valid or invalid.

Figure 5-21 Target Status Report



The Data Quality tab provides information about the number of rows in the target Oracle Database compared with the source database. Perform the following steps to compare the databases:

1. Select a converted model, a source connection, and a target connection.
2. Click **Analyse**.
3. Click **Refresh**.

   This performs a `count(*)` function on each table in the source and the target database. So, it is advisable not to perform this operation on production data.

6

API Reference for SQL Translation of JDBC Applications

Consider the APIs that are part of the `oracle.jdbc` package, specifically the elements of `oracle.jdbc` that assist in SQL translation. To successfully migrate JDBC applications, it is important to understand the translation properties, interfaces, and the error translation mechanisms.

See Also

- Complete documentation of the `oracle.jdbc` package in *Oracle AI Database JDBC Java API Reference*

6.1.1 Translation Properties

The translation properties are listed in Table 6-1

Table 6-1 Translation Properties

Property	Description
sqlTranslationProfile	Specifies the name of the transaction profile
sqlErrorTranslationFile	Specifies the path of the SQL error translation file

6.1.1.1 sqlTranslationProfile

The property `oracle.jdbc.sqlTranslationProfile` specifies the name of the transaction profile.

Declaration

```
oracle.jdbc.sqlTranslationProfile
```

Constant

```
OracleConnection.CONNECTION_PROPERTY_SQL_TRANSLATON_PROFILE
```

The value of the constant is `oracle.jdbc.sqlTranslationProfile`. This is also the property name.

Property Value

The value is a string. There is no default value.

Remarks

The property `sqlTranslationProfile` can be set as either a system property or a connection property. The property is required to use SQL translation. If this property is set then all statements created by the connection have SQL translation enabled unless otherwise specified.

6.1.1.2 sqlErrorTranslationFile

The property `oracle.jdbc.sqlErrorTranslationFile` specifies the path of the SQL error translation file.

Declaration

```
oracle.jdbc.sqlErrorTranslationFile
```

Constant

```
Oracle.connection.CONNECTION_PROPERTY_SQL_ERROR_TRANSLATION_FILE.
```

Property Value

The value is a path name. It has no default value.

Exceptions

An error in establishing a connection results in a SQLException but without a valid connection. However the SQL error translation file path is available either as a system property or connection property and will be used to translate the error.

Remarks

This file is used only for translating errors which occur when connection establishment fails. Once the connection is established this file is bypassed and is not considered even if it contains the translation details for any error which occurs after the connection is established. The property `sqlErrorTranslationFile` can be either a system property or a connection property. The content of this file is used to translate Oracle SQLExceptions into foreign SQLExceptions when there is no valid connection.

6.1.2 OracleTranslatingConnection Interface

This interface is only implemented by a Connection object that supports SQL Translation. The main purpose of this interface is to get non-translating statements (including `preparedStatement` and `CallableStatement`) from a translating connection.

The public interface `oracle.jdbc.OracleTranslatingConnection` defines the factory methods for creating translating and non-translating `Statement` objects.

The `OracleTranslatingConnection` enumerations are listed in Table 6-2:

Table 6-2 OracleTranslatingConnection Enumeration

Name	Description
SqlTranslationVersion	Provides the Keys to the map

The `OracleTranslatingConnection` methods are listed in Table 6-3:

Table 6-3 OracleTranslatingConnection Methods

Name	Description
createStatement()	Creates a `Statement` object with option to translate or not translate SQL.
prepareCall()	Creates a `CallableStatement` object with option to translate or not translate SQL.
prepareStatement()	Creates a `PreparedStatement` object with option to translate or not translate SQL.
getSQLTranslationVersions()	Returns a map of all the translation versions of the query during SQL Translation.

6.1.2.1 SqlTranslationVersion

The `SqlTranslationVersion` enumerated values specify the keys to the getSQLTranslationVersions() method.

Syntax

```
public enum SqlTranslationVersion {
  ORIGINAL_SQL,
  JDBC_MARKER_CONVERTED,
  TRANSLATED
}
```

The following table lists all the `SqlTranslationVersion` enumeration values with a description of each enumerated value.

Member Name	Description
`ORIGINAL_SQL`	Specifies the original vendor specific sql
`JDBC_MARKER_CONVERTED`	Specifies that JDBC parameter markers ('?') is replaced with Oracle style parameter markers (':b*n*'). Hence consecutive '?'s will be converted to `:b1`, `:b2`, `:b3` and so on. This change is required to take care of any changes in the order of parameters during translation. This version is sent to the server for translation. Hence any custom translations on the server must be registered from this version and not the `ORIGINAL_SQL` version.
`TRANSLATED`	Specifies the translated query returned from the server

6.1.2.2 createStatement()

This group of methods create a `Statement` object, and specify whether the statement supports SQL translation. If the value of parameter `translating` is `TRUE`, then the returning statement supports translation and is identical to the corresponding version in the java.sql.Connection interface without the translating argument. If the value is `FALSE`, then the returning statement does not support translation.

Syntax	Description
`public Statement createStatement( boolean translating) throws SQLException;`	Creates a `Statement` object with option to translate or not translate SQL.
`public Statement createStatement( int resultSetType, int resultSetConcurrency, boolean translating) throws SQLException;`	Creates a `Statement` object with the given type and concurrency with option to translate or not translate SQL.
`public Statement createStatement( int resultSetType, int resultSetConcurrency, int resultSetHoldability, boolean translating) throws SQLException;`	Creates a `Statement` object with the given type, concurrency, and holdability with option to translate or not translate SQL.

Parameters

Parameter	Description
`resultSetType`	Specifies the `int` value representing the result set type.
`resultSetConcurrency`	Specifies the `int` value representing the result set concurrency type.
`resultSetHoldability`	Specifies the `int` value representing the result set holdability type.
`translating`	Specifies whether or not the statement supports translation.

Return Value

The `createStatement()` method returns a `Statement` object.

Exceptions

The `createStatement()` method throws `SQLException`.

Example

Import the following packages before running the example:

```
import java.sql.*;
import java.util.Properties;

import oracle.jdbc.OracleConnection;
import oracle.jdbc.OracleTranslatingConnection;
import oracle.jdbc.pool.OracleDataSource;
```

Run the following SQL statements:

```
conn system/manager;
grant create sql translation profile to HR;

conn username/pwd;
```

```
drop table sample_tab;
create table sample_tab (c1 number, c2 varchar2(100));
insert into sample_tab values (1, 'A');
insert into sample_tab values (2, 'B');
commit;
exec dbms_sql_translator.drop_profile('FOO');
exec  dbms_sql_translator.create_profile('FOO');
exec  dbms_sql_translator.register_sql_translation('FOO','select row of (c1, c2) from
sample_tab','select c1, c2 from sample_tab');
```

Example 6-1 Using the createStatement() method

```
public class SQLTransStmt
{
  static String url="jdbc:oracle:thin:@localhost:5521:orcl";
  static String user="username", pwd="pwd";
  static String PROFILE = "FOO";
  static String primitiveSql = "select row of (c1, c2) from sample_tab";

  public static void main(String[] args) throws Exception
  {
    OracleDataSource ods = new OracleDataSource();
    ods.setURL(url);

    Properties props = new Properties();
    props.put("user", user);
    props.put("password", pwd);
    props.put(OracleConnection.CONNECTION_PROPERTY_SQL_TRANSLATION_PROFILE, PROFILE);
    ods.setConnectionProperties(props);
    Connection conn = ods.getConnection();
    System.out.println("connection for SQL translation: "+conn);

    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println("Call:
oracle.jdbc.OracleTranslatingConnection.createStatement(true)");
      Statement trStmt = trConn.createStatement(true);
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery(primitiveSql);
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();
      trStmt.close();
    }catch (Exception e) {
      e.printStackTrace();
    }

    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println("Call:
oracle.jdbc.OracleTranslatingConnection.createStatement(false)");
      Statement trStmt = trConn.createStatement(false);
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery(primitiveSql);
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();
      trStmt.close();
    }catch (Exception e) {
      System.out.println("expected Exception: "+e.getMessage());
    }
```

```
    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println("Call: oracle.jdbc.OracleTranslatingConnection.
createStatement(ResultSet.TYPE_SCROLL_SENSITIVE, ResultSet.CONCUR_UPDATABLE, true)");
      Statement trStmt = trConn.createStatement(ResultSet.TYPE_SCROLL_SENSITIVE,
ResultSet.CONCUR_UPDATABLE, true);
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery(primitiveSql);
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      System.out.println("move resultset back to 2nd row...");
      trRs.absolute(2);
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();
      trStmt.close();
    }catch (Exception e) {
      e.printStackTrace();
    }

    try{
      conn.setAutoCommit(false);
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println("Call:
oracle.jdbc.OracleTranslatingConnection.createStatement(ResultSet.TYPE_SCROLL_SENSITIVE,
ResultSet.CONCUR_UPDATABLE,
 ResultSet.HOLD_CURSORS_OVER_COMMIT, true)");
      Statement trStmt = trConn.createStatement(ResultSet.TYPE_SCROLL_SENSITIVE,
ResultSet.CONCUR_UPDATABLE, ResultSet.HOLD_CURSORS_OVER_COMMIT, true);
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery(primitiveSql);
      trRs.last();
      System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.updateString(2, "Hello");
      trRs.updateRow();
      conn.commit();
      System.out.println("accept the update and list all of the rows again...");
      trRs.beforeFirst();
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();
      trStmt.close();
    }catch (Exception e) {
      e.printStackTrace();
    }

    conn.close();
  }
}
```

6.1.2.3 prepareCall()

This group of methods create a `CallableStatement` object, and specify whether the statement supports SQL translation. If the value of parameter `translating` is `TRUE`, then the returning statement supports translation. If the value is `FALSE`, then the returning statement does not support translation.

Syntax	Description
`public CallableStatement prepareCall( String sql, boolean translating) throws SQLException;`	Creates a `CallableStatement` object with option to translate or not translate SQL
`public CallableStatement prepareCall( String sql, int resultSetType, int resultSetConcurrency, boolean translating) throws SQLException;`	Creates a `CallableStatement` object with the given type and concurrency with option to translate or not translate SQL
`public CallableStatement prepareCall( String sql, int resultSetType, int resultSetConcurrency, int resultSetHoldability, boolean translating) throws SQLException;`	Creates a `CallableStatement` object with the given type, concurrency, and holdability with option to translate or not translate SQL

Parameters

Parameter	Description
`sql`	Specifies the `String` SQL statement value to be sent to the database; may contain one or more parameters
`resultSetType`	Specifies the `int` value representing the result set type
`resultSetConcurrency`	Specifies the `int` value representing the result set concurrency type
`resultSetHoldability`	Specifies the `int` value representing the result set holdability type
`translating`	Specifies whether or not the statement supports translation

Return Value

The `prepareCall()` method returns a `CallableStatement` object.

Exceptions

The `prepareCall()` method throws `SQLException`.

Example

Import the following packages before running the example:

```
import java.sql.*;
import java.util.Properties;

import oracle.jdbc.OracleConnection;
import oracle.jdbc.OracleTranslatingConnection;
import oracle.jdbc.pool.OracleDataSource;
```

Run the following SQL statements:

```
conn system/manager;
grant create sql translation profile to HR;

conn username/pwd;

create or replace procedure sample_proc (p_num number, p_vchar in out varchar2) AS
begin
    p_vchar := 'p_num'||p_num||',  p_vchar'||p_vchar;
end;
/

exec dbms_sql_translator.drop_profile('FOO');
exec  dbms_sql_translator.create_profile('FOO');
exec  dbms_sql_translator.register_sql_translation('FOO', 'exec sample_proc(:b1, :b2)',
'{call sample_proc(:b1, :b2)}');
```

Example 6-2 Using the prepareCall() method

```
public class SQLTransCstmt
{
  static String url="jdbc:oracle:thin:@localhost:5521:orcl";
  static String user="username", pwd="pwd";
  static String PROFILE = "FOO";
  static String primitiveSql = "exec sample_proc(:b1, :b2)";

  public static void main(String[] args) throws Exception
  {
    OracleDataSource ods = new OracleDataSource();
    ods.setURL(url);

    Properties props = new Properties();
    props.put("user", user);
    props.put("password", pwd);
    props.put(OracleConnection.CONNECTION_PROPERTY_SQL_TRANSLATION_PROFILE,
      PROFILE);
    ods.setConnectionProperties(props);
    Connection conn = ods.getConnection();
    System.out.println("connection for SQL translation: "+conn);

    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println(
        "Call: oracle.jdbc.OracleTranslatingConnection.prepareCall(sql, true)");
      CallableStatement trStmt = trConn.prepareCall(primitiveSql, true);
      trStmt.setInt("b1", 1);
      trStmt.setString("b2", "A");
      trStmt.registerOutParameter("b2", Types.VARCHAR);
      System.out.println("execute for: "+primitiveSql);
      trStmt.execute();
      System.out.println("out param: "+trStmt.getString("b2"));

      trStmt.close();
    }catch (Exception e) {
      e.printStackTrace();
    }

    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println(
        "Call: oracle.jdbc.OracleTranslatingConnection.prepareCall(sql, false)");
      CallableStatement trStmt = trConn.prepareCall(primitiveSql, false);
```

```
      trStmt.setInt(1, 1);
      trStmt.setString(2, "A");
      System.out.println("execute for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery();
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();

      trStmt.close();
    }catch (Exception e) {
      System.out.println("expected Exception: "+e.getMessage());
    }

    conn.close();
  }
}
```

6.1.2.4 prepareStatement()

This group of methods create a `PreparedStatement` object, and specify whether the statement supports SQL translation. If the value of parameter `translating` is `TRUE`, then the returning statement supports translation. If the value is `FALSE`, then the returning statement does not support translation.

Syntax	Description

`public PreparedStatement prepareStatement(`
`  String sql,`
`  boolean translating)`
`throws SQLException;`
	Creates a `PreparedStatement` object with option to translate or not translate SQL

`public PreparedStatement prepareStatement(`
`  String sql,`
`  int resultSetType,`
`  int resultSetConcur,`
`  boolean translating)`
`throws SQLException;`
	Creates a `PreparedStatement` object with the given type and concurrency with option to translate or not translate SQL

`public PreparedStatement prepareStatement(`
`  String sql,`
`  int resultSetType,`
`  int resultSetConcur,`
`  int resultSetHold,`
`  boolean translating)`
`throws SQLException;`
	Creates a `PreparedStatement` object with the given type, concurrency, and holdability with option to translate or not translate SQL

Parameter	Description
`sql`	Specifies the `String` SQL statement value to be sent to the database; may contain one or more parameters
`resultSetType`	Specifies the `int` value representing the result set type
`resultSetConcur`	Specifies the `int` value representing the result set concurrency type
`resultSetHold`	Specifies the `int` value representing the result set holdability type

Parameter	Description
`translating`	Specifies whether or not the statement supports translation

Return Value

The `prepareStatement()` method returns a `PreparedStatement` object.

Usage Notes

When the "?" placeholder is used with the `prepareStatement()` method, the driver internally changes the "?" to Oracle-style parameters because the server side translator can only work with Oracle-style markers. This is necessary to distinguish the bind variables. If not, any change in the order of the bind variables will be indistinguishable. The replaced oracle style markers follow the format `:b`*<n>* where *<n>* is an incremental number. For example, `exec sample_proc(?,?)` becomes `exec sample_proc(:b1,:b2)`.

To further exemplify, consider a scenario of a vendor format where the vendor query selecting top three rows is `SELECT * FROM employees WHERE first_name=? AND employee_id=? TOP 3`. The query has to be converted to oracle dialect. In this case the following translation is to be registered on the server:

From:

```
SELECT * FROM employees WHERE first_name=:b1 AND employee_id=:b2 TOP 3
```

To:

```
SELECT * FROM employees WHERE first_name=:b1 AND employee_id=:b2 AND ROWNUM <= 3
```

See SqlTranslationVersion and "SQL Translation of JDBC Applications" for more information.

Exceptions

The `prepareStatement()` method throws `SQLException`.

Example

Import the following packages before running the example:

```
import java.sql.*;
import java.util.Properties;

import oracle.jdbc.OracleConnection;
import oracle.jdbc.OracleTranslatingConnection;
import oracle.jdbc.pool.OracleDataSource;
```

Run the following SQL statements:

```
conn system/manager;
grant create sql translation profile to USER;

conn username/pwd;
drop table sample_tab;
create table sample_tab (c1 number, c2 varchar2(100));
insert into sample_tab values (1, 'A');
insert into sample_tab values (1, 'A');
insert into sample_tab values (1, 'A');
commit;
```

```
exec dbms_sql_translator.drop_profile('FOO');
exec  dbms_sql_translator.create_profile('FOO');
exec  dbms_sql_translator.register_sql_translation('FOO','select row of select c1, c2
from sample_tab
 where c1=:b1 and c2=:b2','select c1, c2 from sample_tab where c1=:b1 and c2=:b2');
```

Example 6-3 Using the prepareStatement() method

```
public class SQLTransPstmt
{
  static String url="jdbc:oracle:thin:@localhost:5521:orcl";
  static String user="username", pwd="pwd";
  static String PROFILE = "FOO";
  static String primitiveSql = "select row of select c1, c2 from sample_tab
    where c1=:b1 and c2=:b2";

  public static void main(String[] args) throws Exception
  {
    OracleDataSource ods = new OracleDataSource();
    ods.setURL(url);

    Properties props = new Properties();
    props.put("user", user);
    props.put("password", pwd);
    props.put(OracleConnection.CONNECTION_PROPERTY_SQL_TRANSLATION_PROFILE,
      PROFILE);
    ods.setConnectionProperties(props);
    Connection conn = ods.getConnection();
    System.out.println("connection for SQL translation: "+conn);

    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println("Call:
        oracle.jdbc.OracleTranslatingConnection.prepareStatement(sql, true)");
      PreparedStatement trStmt = trConn.prepareStatement(primitiveSql, true);
      trStmt.setInt(1, 1);
      trStmt.setString(2, "A");
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery();
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
        trRs.close();
        trStmt.close();
      }catch (Exception e) {
      e.printStackTrace();
    }

    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println("Call:
        oracle.jdbc.OracleTranslatingConnection.prepareStatement(sql, false)");
      PreparedStatement trStmt = trConn.prepareStatement(primitiveSql, false);
      trStmt.setInt(1, 1);
      trStmt.setString(2, "A");
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery();
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();

      trStmt.close();
    }catch (Exception e) {
```

```
    System.out.println("expected Exception: "+e.getMessage());
    }

    try{
      OracleTranslatingConnection trConn = (OracleTranslatingConnection) conn;
      System.out.println("Call:
        oracle.jdbc.OracleTranslatingConnection.prepareStatement(
        sql, ResultSet.TYPE_SCROLL_SENSITIVE, ResultSet.CONCUR_UPDATABLE, true)");
      PreparedStatement trStmt = trConn.prepareStatement(
        primitiveSql, ResultSet.TYPE_SCROLL_SENSITIVE,
        ResultSet.CONCUR_READ_ONLY, true);
      trStmt.setInt(1, 1);
      trStmt.setString(2, "A");
      System.out.println("executeQuery for: "+primitiveSql);
      ResultSet trRs = trStmt.executeQuery();
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));

      System.out.println("trRs.beforeFirst and show resultSet again...");
      trRs.beforeFirst();
      while (trRs.next())
        System.out.println("C1:"+trRs.getInt(1)+", C2:"+trRs.getString(2));
      trRs.close();
      trStmt.close();
    }catch (Exception e) {
    e.printStackTrace();
    }

  conn.close();
  }
}
```

6.1.2.5 getSQLTranslationVersions()

Returns a map of all the translation versions of the query during SQL Translation. In case of an exception, and if `suppressExceptions` is true, then the translated version in the map is `NULL`.

Syntax

```
public Map<SqlTranslationVersion, String> getSqlTranslationVersions(
  String sql,
  boolean suppressExceptions)
throws SQL Exception;
```

Return Value

Map with all translation versions of a query. See SqlTranslationVersion `enum` for more details about returning versions.

Exception

This method throws `SQLException` if there is a problem in query translation, provided `suppressExceptions` is false.

6.1.3 Error Translation Configuration File

An XML configuration file (path) is provided as a value of the `oracle.jdbc.sqlErrorTranslationFile` property. This file contains the translations information for errors. These errors occur when a connection to the server cannot be

established and thus translation cannot happen on the server. Error messages are of the type that define the state of the database that prevents the connection from being established.

The structure of the configuration XML file is defined in the DTD as follows:

```
<!DOCTYPE LocalTranslationProfile[

<!ELEMENT LocalTranslationProfile (Exception+)>
<!ELEMENT Exception (ORAError, ErrorCode, SQLState )>
<!ELEMENT ORAError (#PCDATA)>
<!ELEMENT ErrorCode (#PCDATA)>
<!ELEMENT SQLState (#PCDATA)>
]>
```

where,

- `ORAError` is an `int` value and specifies the error code for the oracle error.
- `ErrorCode` is an `int` value and specifies the vendor error code, that is, the translated code.
- `SQLState` is a `String` value and specifies the vendor SQL state.

Glossary

adapter

A real-time, proprietary tool used to enable access to data stored in one database from another database. Adapters are commonly used to translate SQL, map data types, and facilitate the integration of SQL statements, triggers, and stored procedures.

custom SQL translation

A scenario in which users can register their customer-specific translations of SQL statements with the SQL Translation Profile. During the translation of non-Oracle statements, the profile looks up the custom translations first. Then, if no match is found, it invokes the SQL Translator.

data integration

The exchange of data between different databases, either asynchronously in real-time transactions or synchronously as batch processes.

data integration framework

A set of tools and processes used to enable data exchanges between different databases. Traditional frameworks include many nightly processes such as large batch extractions and feeds, and bulk loading of data. Newer frameworks can include small daily processes and feeds occurring in near real time.

database schema migration

The process of identifying and converting tables, columns, and other objects in a non-Oracle schema to conform to the naming, size, and other conventions required by Oracle Database.

error translation

A scenario in which users can register vendor-specific translations of error codes and messages with the SQL Translation Profile. During SQL execution, client applications rely on vendor-specific error codes and messages. When errors occur, the translated error codes and messages are returned instead of the Oracle error codes and messages.

migration

The process of modifying a non-Oracle application, including all of its components (such as architecture, data, SQL code, and client) to use the Oracle RDBMS rather than a proprietary database management system.

migration repository

A data store in Oracle Database that Oracle SQL Developer uses to manage the metadata for the source and target schema models during a migration. Multiple migration repositories can be used to migrate from several databases to Oracle Database at the same time.

Oracle Database Gateways

A set of Oracle products that support data integration with non-Oracle systems synchronously using consistent APIs.

Oracle GoldenGate

An Oracle product that supports modular, transaction-level data integration between diverse data sources that are stored in SQL Server, Sybase, DB2, Oracle, and other databases.

Oracle SQL*Loader

A fast, flexible, and free Oracle utility that supports loading data from flat files into Oracle Database. It supports several data formats and many different encodings. It also supports parallel data loading.

Oracle SQL Developer Migration Wizard

An Oracle tool that enables the migration of a third-party database to an Oracle database in batch mode. Migration includes data, schemas, objects, triggers, and stored procedures.

SQL dialect

A variation or extension of SQL implemented by a database vendor. When migrating client applications from third-party databases to Oracle, all non-Oracle SQL statements must be translated into Oracle SQL. Because these non-Oracle SQL statements are embedded within the source code of client applications, locating and translating them is a time-consuming, manual task. This release enhances the Oracle database to accept non-Oracle SQL statements from external vendors, and translate them automatically at run time before execution.

SQL Translation Profile

A database schema object that directs how non-Oracle SQL statements are translated into Oracle SQL dialects. This schema also contains translations of error codes, SQLSTATEs, and error messages to be returned when errors occur during the SQL execution.

When migrating a client application with non-Oracle SQL statements to Oracle, the user creates a SQL Translation Profile and configures it to translate the SQL statements and errors

for the application. At run time, the application sets the translation profile in the Oracle database to translate its SQL statements and errors.

SQL Translator

The SQL Translator is a software component, provided by Oracle or third-party vendors, which can be installed in Oracle Database. It translates the SQL statements of a client program before they are processed by the Oracle Database SQL compiler. If an error results from translated SQL statement execution, then Oracle Database SQL compiler generates an Oracle error message.

SQLSTATE

A status parameter defined by the ANSI SQL standard. It is a 5-character string that indicates the status of a SQL operation. Some of these values are:

- `00`*XXX*: Unqualified Successful Completion
- `01`*XXX*: Warning
- `02`*XXX*: No Data
- `07`*XXX*: Dynamic SQL Error
- `08`*XXX*: Connection Exception
- `09`*XXX*: Triggered Action Exception

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