Compatibility, compilation and execution of PL/SQL code on the database system IBM DB2 10

Abstract. The article presents the support mechanisms to run applications written in PL/SQL Oracle DB2 environment version 10.1. It presents possibilities compile and execute applications written in PL/SQL using SQL, PL/SQL and Oracle objects. This version implements new elements of support (compatibility) for Oracle in comparison to the previous versions. Paper presents a detailed possibilities of support from DB2 for PL/SQL language and shows how to configure DB2 to work with the language PL/SQL.

Streszczenie. W artykule przedstawiono mechanizmy wsparcia uruchamiania aplikacji napisanych w języku PL/SQL Oracle w środowisku wersji DB2 10.1. Zaprezentowano możliwości kompilacji i wykonywania aplikacji napisanych w języku PL/SQL z użyciem języka SQL, PL/SQL i obiektów Oracle. W wersji tej wprowadzono nowe elementy wsparcia (kompatybilności) dla systemu Oracle w stosunku do poprzednich wersji. Artykuł przedstawia szczegółowe możliwości wsparcia ze strony DB2 dla języka PL/SQL.

Keywords: IBM DB2 10.5, Oracle, PL/SQL, DB2_COMPATIBILITY VECTOR.

Introduction

Database management system IBM DB2 10.1 is designed for managing data in traditional relational structures, as well as a hierarchy XML. DB2 allows to operate Oracle SQL language dialects and PL / SQL (Oracle version 10g, 11g and 12c). Therefore, many applications written for Oracle database management after some changes may be running in the DB2 environment (given in the literature estimated that about 97% of the syntax of PL / SQL, and about 91% of the objects PL / SQL can be directly transferred to DB2 - indicative values are given on the basis of the report generated tool MEET DB2).

It should be noted that, despite the transferability of PL/SQL code for DB2 are not implemented all the features of the language, but each new version of DB2 introduces new features such as object-relational programming (e.g. objects NESTED TABLE). This is an important element affecting feasibility of migrating data and applications between systems. Users who work with the Oracle database can use DB2 of the many new levels of compatibility. The purpose of these changes is the ability to quickly be run on DB2 applications written in PL / SQL.

DB2 can support syntax of PL/SQL and SQL PL. The method of support for PL/SQL and SQL PL is shown in Figure 1.

In order to ensure compatibility with Oracle version of DB2 uses CLPPlus command-line processing utility that allows to run SQL commands and PL / SQL code, and is similar to an existing DB2 command line processor (CLP). CLPPlus environment is presented in figure 2.

Support for most data types of PL / SQL is implemented as a standard on DB2, and for others data types can be enabled through the configuration of registry variable. The registry variable DB2_COMPATIBILITY VECTOR, briefly described later in this article, can control which of these compatibility is enabled by setting.

DB2 setting to allow the PL / SQL use in order to perform Oracle application

To run Oracle applications on DB2, it must be configured properly. This is done by changing the registry set: DB2_COMPATIBILITY VECTOR using the db2set
command. This registry variable is used to enable one or more DB2 compatibility features. Full compatibility level is achieved by assigning a registry variable DB2_COMPATIBILITY_VECTOR for value ORA. Setting the registry variable to enable handling all compatibility features of Oracle is shown in the following example:

db2set DB2_COMPATIBILITY_VECTOR=ORA
db2stop
db2start

Setting the registry variable to disable handling all compatibility features of Oracle is shown in the following example:

db2set DB2_COMPATIBILITY_VECTOR=

db2stop

db2start

The registry variable: DB2_COMPATIBILITY_VECTOR

DB2_COMPATIBILITY_VECTOR registry variable can set various functions that exist in the Oracle database. (not all apply to Oracle, some of which applies to Sybase and SQL Server), depending on customer needs. It should be noted that some functionality (marked (*) in Table 1) can be included but are not to be used in existing databases. This would only apply to newly created databases. The value of the registry variable is given as a hexadecimal value, or used the value of the ORA to include all functionality. The value of DB2_COMPATIBILITY_VECTOR for value ORA. Setting the registry variable to enable handling all compatibility features of Oracle is shown in the following example:

db2set DB2_COMPATIBILITY_VECTOR=ORA

db2stop

db2start

Table 1. DB2_COMPATIBILITY_VECTOR registry variable values

<table>
<thead>
<tr>
<th>Bit position</th>
<th>Compatibility feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ROWNUM pseudocolumn</td>
<td>Enables the use of ROWNUM as a synonym for ROW_NUMBER() OVER() and permits ROWNUM to appear in the WHERE clause of SQL statements.</td>
</tr>
<tr>
<td>2</td>
<td>DUAL table</td>
<td>Resolves unqualified references to the DUAL table as SYSIBM.DUAL.</td>
</tr>
<tr>
<td>3</td>
<td>Outer join operator</td>
<td>Enables support for the outer join operator, which is the plus sign (+).</td>
</tr>
<tr>
<td>4</td>
<td>Hierarchical queries</td>
<td>Enables support for hierarchical queries using the CONNECT BY clause.</td>
</tr>
<tr>
<td>5</td>
<td>NUMBER data type (*)</td>
<td>Enables support for the NUMBER data type and associated numeric processing.</td>
</tr>
<tr>
<td>6</td>
<td>VARCHAR2 data type (*)</td>
<td>Enables support for the VARCHAR2 and NVARCHAR2 data types and associated character string processing.</td>
</tr>
<tr>
<td>7</td>
<td>DATE data type (*)</td>
<td>Enables the interpretation of the DATE data type as the TIMESTAMP(0) data type, a combined date and time value.</td>
</tr>
<tr>
<td>8</td>
<td>TRUNCATE TABLE</td>
<td>Enables alternative semantics for the TRUNCATE statement, under which IMMEDIATE is an optional keyword that is assumed to be the default if not specified.</td>
</tr>
<tr>
<td>9</td>
<td>Character literals</td>
<td>Enables the assignment of the CHAR or GRAPHIC data type, instead of the VARCHAR or VARGRAPHIC data type, to character and graphic string constants whose byte lengths are less than or equal to 254.</td>
</tr>
<tr>
<td>10</td>
<td>Collection methods</td>
<td>Enables the use of methods to perform operations on arrays, such as first, last, next, and previous.</td>
</tr>
<tr>
<td>11</td>
<td>Oracle data dictionary-compatible views (*)</td>
<td>Enables the creation of Oracle data dictionary-compatible views.</td>
</tr>
<tr>
<td>12</td>
<td>PL/SQL compilation</td>
<td>Enables the compilation and execution of PL/SQL statements and language elements.</td>
</tr>
<tr>
<td>13</td>
<td>Insensitive cursors</td>
<td>Enables cursors that are defined with WITH RETURN to be insensitive if the select-statement does not explicitly specify FOR UPDATE.</td>
</tr>
<tr>
<td>14</td>
<td>INOUT parameters</td>
<td>Enables the specification of DEFAULT for INOUT parameter declarations.</td>
</tr>
<tr>
<td>15</td>
<td>LIMIT and OFFSET clauses</td>
<td>Enables the use of the MySQL- and PostgreSQL-compatible LIMIT and OFFSET clauses on fullselect, UPDATE, and DELETE statements.</td>
</tr>
<tr>
<td>16</td>
<td>SQL data-access-level enforcement</td>
<td>Enables routines to enforce SQL data-access levels at runtime.</td>
</tr>
<tr>
<td>17</td>
<td>Oracle database link syntax</td>
<td>Enables Oracle database link syntax for accessing objects in other databases.</td>
</tr>
</tbody>
</table>

Entered elements of the PL/SQL language, compilation and execution

PL/SQL code can be compiled and executed using DB2 interfaces. This allows the use of existing solutions written in PL/SQL, which ultimately will work with DB2 data server (support of PL / SQL must be included on the DB2 server by listed earlier registry DB2_COMPATIBILITY_VECTOR). Supported interfaces include command line processor (CLP), CLPPlus and IBM Data Studio (Figure 3). Enabling this parameter practically provides the most functionality for PL/SQL code.

There are also restrictions to the language PL/SQL:
- PL/SQL procedures, functions, triggers and packages can only be created from the main partition in a partitioned database environment (DPF - Database Partitioning Feature).
- The NCLOB data type is not supported for use in PL/SQL statements or in PL/SQL contexts when the database is not defined as a Unicode database. In Unicode databases, the NCLOB data type is mapped to a DBCLOB data type.
- The XMLTYPE data type is not supported.
We can execute the following PL/SQL statements:

- **Anonymous blocks**
  For example:
  ```plsql
  SET SERVEROUTPUT ON;
  BEGIN
    dbms_output.put_line(‘Hello’);
  END;
  ```

  The anonymous block statement, which does not persist in the database, can consist of up to three sections: an optional declaration section, a mandatory executable section, and an optional exception section.

- **CREATE OR REPLACE FUNCTION statement** (Fig. 4)
- **CREATE OR REPLACE PACKAGE statement** (Fig. 7)
- **CREATE OR REPLACE PACKAGE BODY statement** (Fig. 8)
- **CREATE OR REPLACE PROCEDURE statement** (Fig. 5)
- **CREATE OR REPLACE TRIGGER statement**
- **DROP PACKAGE statement**
- **DROP PACKAGE BODY statement**

PL/SQL procedures and functions can be invoked from other PL/SQL statements or from DB2 SQL PL statements. We can call a PL/SQL procedure from SQL PL by using the CALL statement (Fig. 6).

   The following statements and language elements are supported in PL/SQL contexts:

- **Type declarations:**
  - Associative arrays
  - Record types
  - VARRAY types
- **Subtype declarations**
- **Variable declarations:**
  - %ROWTYPE
  - %TYPE
- **Basic statements, clauses, and statement attributes:**
  - Assignment statement
  - NULL statement
  - RETURNING INTO clause
  - Statement attributes, including SQL%FOUND, SQL%NOTFOUND, and SQL%ROWCOUNT
- **Control statements and structures:**
  - Exception handling
  - CASE, EXIT, FOR, GOTO, IF, LOOP, RETURN, WHILE statement
  - Static cursors:
  - REF CURSOR support:
  - Error support:
    - RAISE_APPLICATION_ERROR procedure
    - RAISE statement
    - SQLCODE function
    - SQLERRM function

These elements of the language are very important. Many of these elements PL/SQL are used in practice in Oracle.

   We can create PL/SQL procedures and functions from a DB2 command line processor (CLP) script.

   For this purpose formulate PL/SQL procedure or function definitions within a CLP script file. Save the file. Execute the script from the CLP. Next issue the following command:

   ```
   db2 -td/ -vf script.db2
   ```

   For procedures, use the CALL statement. For functions, execute queries or other SQL statements that contain references to those functions. For example (Fig. 6):

   ```plsql
   CALL update_comp(‘test’);
   ```

   Most of the PL/SQL examples are based on a PL/SQL sample schema that represents employees in an organization as in Oracle (Fig 4. and 5.). Code PL/SQL is based on a sample schema given in the documentation [4], [5].

   ```plsql
   CREATE OR REPLACE FUNCTION emp_comp (p_sal NUMBER, p_comm NUMBER) RETURN NUMBER IS
   BEGIN
     RETURN (p_sal + NVL(p_comm, 0)) * 24;
   END;
   ```

   Fig. 4. The sample code object FUNCTION in PL/SQL

   ```plsql
   CREATE OR REPLACE PROCEDURE update_comp(p_name IN VARCHAR2) AS
   BEGIN
     UPDATE emp SET sal = emp_comp(sal, comm)
     WHERE name = p_name;
   END update_comp;
   ```

   Fig. 5. The sample code object PROCEDURE in PL/SQL

   ```plsql
   CREATE OR REPLACE PACKAGE emp_admin IS
   FUNCTION get_dept_name (p_deptno NUMBER) RETURN VARCHAR2;
   FUNCTION update_emp_sal (p_empho NUMBER, p_raise NUMBER) RETURN NUMBER;
   PROCEDURE hire_emp (p_empho NUMBER, p_name VARCHAR2, p_job VARCHAR2, p_sal NUMBER, p_hiredate DATE, p_comm NUMBER, p_mgr NUMBER, p_deptno NUMBER);
   PROCEDURE fire_emp (p_empho NUMBER);
   END emp_admin;
   ```

   Fig. 7. The sample code object PACKAGE in PL/SQL
PL/SQL procedures and functions are stored together with other objects DB2. They are available in the same way as a standard DB2 objects. Figure 11 shows the procedures and functions written in PL / SQL. PL/SQL packages are available in an additional collection ‘PL/SQL packages’.

REFERENCES


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