DB2 Archive tables

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18 April 2017

This paper will help in understanding the concepts of archive tables which includes its creation, maintenance and the significance of such an object. The concepts explained here is applicable for DB2 versions 11 and 12.

Introduction

Archive tables are useful to store huge volumes of historical data that are not often referenced. The original table is called an archive-enabled table. Once we configure the archive table set up, DB2 can automatically move rows that are deleted from an archive-enabled table to the associated archive table. When we do a DML operation on an archive-enabled table, we can specify whether we want those SQLs to include the data from the archive table.

DDL Operations

CREATE: Once we create a base table, we can tag the archive table to it using ENABLE ARCHIVE option in the ALTER table statement. Hence the base table will be referred as archive-enabled table. We can un-tag the archive table from the base table using DISABLE ARCHIVE option. While implementing this ALTER table statement, no other clause is allowed within this single statement.

```
ALTER TABLE EMPL
ENABLE ARCHIVE USE EMPL_R;
---------+---------+---------+---------+---------+------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+---------+------+
```

Note: An archive table is not created implicitly and must be created before executing the above ALTER statement. If not, the Alter statement will fail with a -204 stating that the archive table name is undefined. The archive table should have the same DDL as the base table

Note: A base table can have only one archive table.

ALTER: Most of the common DML operations are not possible on the archive table or archive enabled table except ADD COLUMN statement. We would end up getting the sql error -20180 or -750 as shown below.

```
ALTER TABLE EMPL ALTER COLUMN NAME
SET DATATYPE CHAR(15);
+---------+---------+---------+---------+---------+------+
DSNT408I SQLCODE = -20180,
ERROR: COLUMN NAME IN TABLE DB2DBA.EMPL CAN NOT BE ALTERED AS SPECIFIED

ALTER TABLE EMPL_R ALTER COLUMN NAME SET DATATYPE CHAR(12);
+---------+---------+---------+---------+---------+------+
DSNT408I SQLCODE = -20180,
ERROR: COLUMN NAME IN TABLE DB2DBA.EMPL_R CANNOT BE ALTERED AS SPECIFIED

RENAME TABLE EMPL TO EMP420
+---------+---------+---------+---------+---------+------+
DSNT408I SQLCODE = -750,
ERROR: THE SOURCE DB2DBA.EMPL CANNOT BE RENAMED OR ALTERED AS SPECIFIED

RENAME TABLE EMPL_R TO EMPL_ARC
+---------+---------+---------+---------+---------+------+
DSNT408I SQLCODE = -750,
ERROR: THE SOURCE DB2DBA.EMPL_R CANNOT BE RENAMED OR ALTERED AS SPECIFIED

ALTER TABLE EMPL RENAME COLUMN SALARY TO SAL;
+---------+---------+---------+---------+---------+------+
DSNT408I SQLCODE = -750,
ERROR: THE SOURCE DB2DBA.EMPL CANNOT BE RENAMED OR ALTERED AS SPECIFIED
```

DBA Procedure to perform any DML Operations on the archive table:

1. Disable archiving for base table (archive enabled table)
2. Perform change on base table
3. Perform change on archive table
4. Enable archiving for base table

An example for the above procedure – Increase the length of a column

To increase the length of a column, below steps needs to followed.

```
ALTER TABLE EMPL
DISABLE ARCHIVE;
---------+---------+---------+---------+---------+-------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+---------+-------+
ALTER TABLE EMPL
ALTER COLUMN NAME
SET DATA TYPE CHAR(15);
---------+---------+---------+---------+---------+-------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+---------+-------+
ALTER TABLE EMPL_R
ALTER COLUMN NAME
SET DATA TYPE CHAR(15);
---------+---------+---------+---------+---------+-------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+---------+-------+
ALTER TABLE EMPL
ENABLE ARCHIVE USE EMPL_R;
---------+---------+---------+---------+---------+-------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+---------+-------+
```

- Following activities are not possible on an archive enabled or an archive table directly.

    - RENAME TABLE.....TO....
    - ALTER TABLE..... ALTER COLUMN
    - ALTER TABLE..... RENAME COLUMN
    - ALTER TABLE.....DROP COLUMN
    - ALTER TABLE....ROTATE PARTITION
- If we add the column in base table, then the column is added to the associated archive table automatically.

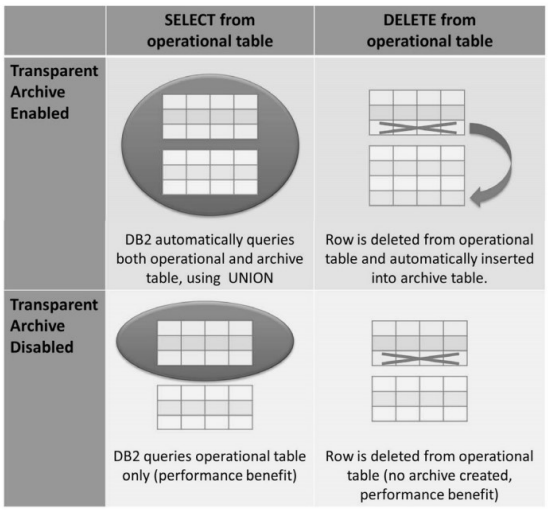
```
ALTER TABLE EMPL
ADD COLUMN DEPT CHAR(5);
-------+---------+---------+---------+---------+---------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
```

DROP: If we drop the archive enabled table, then the archive table will get dropped implicitly. We cannot drop the archive table until the relation is there. If we try to drop then sql error -478 will raised as shown below.

```
DROP TABLE EMPL_R;
-------+---------+---------+---------+---------+---------+
DSNT408I SQLCODE = -478,
ERROR: ALTER, DROP, OR REVOKE AFFECTING OBJECT TYPE TABLE CANNOT BE PROCESSED BECAUSE
OBJECT DB2DBA.EMPL OF TYPE TABLE IS DEPENDENT ON IT
```

DML Operations

Creating archive table for base table does not mean archiving is enabled. Archiving will depend on couple of in-built global variables. The result of DML operations on base table will vary as per the archiving enabled or not as shown below.



DML on archive enabled and archive tables will depend upon following built-in global variables

- SYSIBMADM.MOVE_TO_ARCHIVE
- SYSIBMADM.GET_ARCHIVE

SYSIBMADM.MOVE_TO_ARCHIVE

This global variable can have 3 possible values

Option	Description
E	Specifies that a delete of a row in an base table will result in storing a copy of the deleted row in the associated archive table.
N	Specifies that a delete of a row in an base table will not result in storing a copy of a deleted row in the associated archive table.
Y	Specifies that a delete of a row in an archive-enabled table will result in storing a copy of the deleted row in the associated archive table. Additionally, when the global variable is set to 'Y', an insert or update or merge operation that specifies the archive-enabled table as the target of the statement will return an error.

The default value is determined from the value of the subsystem parameter MOVE_TO_ARCHIVE_DEFAULT in macro DSN6SPRM. The default value for this parameter is N. Some work examples regarding this concept is shown below.

- In below example INSERT on archive enable table is failed since the variable MOVE_TO_ARCHIVE is set to Y

```
SET SYSIBMADM.MOVE_TO_ARCHIVE = 'Y' ;
---------+---------+---------+---------+-------+---------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+-------+---------+
INSERT INTO EMPL
VALUES(1,'RAJESH',32.6,'DB2')
---------+---------+---------+---------+-------+---------+
DSNT408I SQLCODE = -20555,
ERROR: AN ARCHIVE-ENABLED TABLE IS NOT ALLOWED IN THE SPECIFIED CONTEXT. REASON CODE 2
```

- In below example INSERT on archive enable table is successful since the variable MOVE_TO_ARCHIVE is set to E

```
SET SYSIBMADM.MOVE_TO_ARCHIVE = 'E' ;
---------+---------+-------+---------+---------+---------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+-------+---------+---------+---------+
INSERT INTO EMPL
VALUES(1,'RAJESH',32.6,'DB2')
---------+---------+-------+---------+---------+---------+
DSNE615I NUMBER OF ROWS AFFECTED IS 1
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+-------+---------+---------+---------+
```

- In below example archiving is done by DELETE since the variable MOVE_TO_ARCHIVE is set to E

```
SET SYSIBMADM.MOVE_TO_ARCHIVE = 'E' ;
---------+---------+-------+---------+---------+---------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+-------+---------+---------+---------+
INSERT INTO EMPL VALUES(1,'RAJESH',32.6,'DB2')
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+-------+---------+---------+---------+
DELETE FROM EMPL WHERE ID=1 ;
---------+---------+-------+---------+---------+---------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+-------+---------+---------+---------+
SELECT * FROM EMPL_R ;
---------+---------+---------+---------+-------+---------+
   ID NAME SALARY DEPT
---------+---------+---------+---------+-------+---------+
   1 RAJESH 32.60 DB2
```

- In below example archiving is not done by DELETE since the variable MOVE_TO_ARCHIVE is set to N

```
SET SYSIBMADM.MOVE_TO_ARCHIVE = 'N' ;
-------+---------+---------+---------+---------+---------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
-------+---------+---------+---------+---------+---------+
INSERT INTO EMPL
VALUES(2,'RAJU',42.6,'DBA') ;
-------+---------+---------+---------+---------+---------+
DSNE615I NUMBER OF ROWS AFFECTED IS 1
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
-------+---------+---------+---------+---------+---------+
DELETE FROM EMPL WHERE ID=2 ;
-------+---------+---------+---------+---------+---------+
DSNE615I NUMBER OF ROWS AFFECTED IS 1
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
-------+---------+---------+---------+---------+---------+
SELECT * FROM EMPL_R ;
-------+---------+---------+---------+---------+---------+
   ID NAME SALARY DEPT
-------+---------+---------+---------+---------+---------+
   1 RAJESH 32.60 DB2
-------+---------+---------+---------+---------+---------+
```

NOTE:

- DELETE and TRUNCATE are only SQL's which perform archiving. UPDATE or MERGE SQL's cannot perform any archiving irrespective of global variables.
- Irrespective of global variables we can perform all DML activities on archive table.

SYSIBMADM.GET_ARCHIVE

This global variable can have 2 possible values

Option	Description
Y	Specifies that when a table-reference is an archive-enabled table, the table reference includes rows in the associated archive table.
N	Specifies that when a table-reference is an archive-enabled table, the table reference does not include rows in the associated archive table. This is the default value.

Example for SYSIBMADM.GET_ARCHIVE = 'N'

```
SET SYSIBMADM.GET_ARCHIVE = 'N' ;
---------+---------+---------+---------+---------+-------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+---------+-------+
SELECT * FROM EMPL;
---------+---------+---------+---------+---------+-------+
   ID NAME SALARY DEPT
---------+---------+---------+---------+---------+-------+
   2 RAJU 42.60 DBDBA
DSNE610I NUMBER OF ROWS DISPLAYED IS 1
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 100
---------+---------+---------+---------+---------+-------+
SELECT * FROM EMPL_R ;
---------+---------+---------+---------+---------+-------+
   ID NAME SALARY DEPT
>---------+---------+---------+---------+---------+-------+
   3 RAJU1 42.60 DBDBA
DSNE610I NUMBER OF ROWS DISPLAYED IS 1
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 100
--------+---------+---------+---------+---------+---------+
```

In above example the select on base table will not perform any query transformation. since SYSIBMADM.GET_ARCHIVE is set to 'N'.

Example for SYSIBMADM.GET_ARCHIVE = 'Y'

```
SET SYSIBMADM.GET_ARCHIVE = 'Y' ;
---------+---------+---------+---------+---------+-------+
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 0
---------+---------+---------+---------+---------+-------+
SELECT * FROM EMPL;
---------+---------+---------+---------+---------+-------+
   ID NAME SALARY DEPT
---------+---------+---------+---------+---------+-------+
   2 RAJU 42.60 DBDBA
   3 RAJU1 42.60 DBDBA
DSNE610I NUMBER OF ROWS DISPLAYED IS 2
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 100
-------+---------+---------+---------+---------+---------+
SELECT * FROM EMPL_R ;
-------+---------+---------+---------+---------+---------+
   ID NAME SALARY DEPT
-------+---------+---------+---------+---------+---------+
   3 RAJU1 42.60 DBDBA
DSNE610I NUMBER OF ROWS DISPLAYED IS 1
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 100
-------+---------+---------+---------+---------+---------+
```

In above example the select on base table will perform implicit union operation with archive table as we discussed since enabled global variable SYSIBMADM.GET_ARCHIVE.

DCL Operations

Providing access on archive-enabled table to the user will allow the user to all the archiving concepts. Need not provide access on archive table unless the user wants to perform DML activities directly on archive table.

Catalog information

- TYPE= 'R' refers archive table in SYSIBM.SYSTABLES

- ARCHIVING_SCHEMA and ARCHIVING_TABLE. If the table is an archive-enabled table, this columns contains the schema name and table name of the archive table. If the table is an archive table, this column contains the schema name and table name of the archive-enabled table.

```
SELECT CREATOR, NAME, TYPE, ARCHIVING_SCHEMA ,ARCHIVING_TABLE
FROM SYSIBM.SYSTABLES
WHERE NAME IN ('EMPL','EMPL_R');
-----+---------+---------+---------+---------+---------+
CREATOR NAME TYPE ARCHIVING_SCHEM ARCHIVING_TAB
-----+---------+---------+---------+---------+---------+
DB2DBA EMPL T DB2DBA EMPL_R
DB2DBA EMPL_R R DB2DBA EMPL
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 100
---------+---------+---------+---------+---------+-----+
```

Utility maintenance

LOAD REPLACE: LOAD REPLACE is not allowed on archive enabled table. LOAD REPLACE is not allowed on an archive-enabled table. LOAD REPLACE is allowed on the table space that contains the archive table.

```
DSNU076I -DSNT 058 01:21:39.09 DSNURWI - KEYWORD=REPLACE
INVALID FOR ARCHIVE ENABLED TABLE SPACE=DBADTEST.EMPL
```

QUIESCE REPORT TABLESPACESET: Archive table relations are also reported in REPORT TABLESPACESET.

RECOVER VERIFYSET: The RECOVER utility verifies that all related objects including archive and archive enabled tables that are required to perform a point-in-time recovery are included in the RECOVER control statement. VERIFYSET YES is the default.

CHECK DATA: You cannot run CHECK DATA with the SHRLEVEL REFERENCE option on a table space that contains an archive-enabled table when one of the following options is specified: DELETE YES LOBERROR INVALIDATE, AUXERROR INVALIDATE, XMLERROR INVALIDATE

Archive bind options

ARCHIVESENSITIVE is a bind option introduced in DB2 V11 exclusively for the archive enabled tables. If SQL Select statement is on the archive enabled table, then two access paths are prepared. One access path is for retrieving rows from base base table and another path is for retrieving rows from base table and the archive table. The global variable GET_ARCHIVE determines which access path is to be picked. This default behavior governed by bind option ARCHIVESENSITIVE.

For packages ARCHIVESENSITIVE (default YES)

(No space between ARCHIVE and SENSITIVE)

- BIND PACKAGE

- REBIND PACKAGE
- CREATE TRIGGER (implicit trigger package)

For UDFs and Stored Procedures ARCHIVE SENSITIVE (default YES)

(Space between ARCHIVE and SENSITIVE)

- CREATE FUNCTION (SQL scalar)
- ALTER FUNCTION (SQL scalar)
- CREATE PROCEDURE (SQL native)
- ALTER PROCEDURE (SQL native)

Example: Below are example creating stored procedure with ARCHIVE SENSITIVE YES and ARCHIVE SENSITIVE NO

```
CREATE PROCEDURE COUNT1(OUT P_CNT INT)
ARCHIVE SENSITIVE NO
SELECT COUNT(*) INTO P_CNT FROM DB2DBA.EMPL #

CREATE PROCEDURE COUNT2(OUT P_CNT INT)
APPLCOMPAT V11R1
ARCHIVE SENSITIVE YES
SELECT COUNT(*) INTO P_CNT FROM DB2DBA.EMPL #
```

Catalog information:

```
SELECT NAME, OWNER, APPLCOMPAT,ARCHIVESENSITIVE
FROM SYSIBM.SYSPACKAGE
WHERE NAME LIKE 'COUNT%'
WITH UR
---------+---------+---------+---------+-------+---------+
NAME      OWNER     APPLCOMPAT    ARCHIVESENSITIVE
---------+-------+---------+---------+---------+---------+
COUNT1    DB2DBA    V10R1         N
COUNT2    DB2DBA    V11R1         Y
DSNE610I NUMBER OF ROWS DISPLAYED IS 2
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 100
-------+---------+---------+---------+---------+---------+
```

As we discussed COUNT1 will have one access path and COUNT2 will have two access paths as shown below catalog information from SYSIBM.SYSPACKSTMT. The record for second access path is identified by the EXPANSION_REASON = 'Y'. which will use when archiving is enabled.

```
SELECT NAME,STMTNO,EXPLAINABLE,STATEMENT,EXPANSION_REASON
FROM SYSIBM.SYSPACKSTMT
WHERE NAME LIKE 'COUNT%' AND STMTNO > 0;
+---------+---------+---------+---------+---------+------+
NAME   STMTNO  EXPLAINABLE STATEMENT       EXP
+---------+---------+---------+---------+---------+------+
COUNT1 1       Y           SELECT COUNT(*) INTO :H..
COUNT2 1       Y           SELECT COUNT(*) INTO :H..
COUNT2 1       Y           SELECT COUNT(*) INTO :H.. A
DSNE610I NUMBER OF ROWS DISPLAYED IS 3
DSNE616I STATEMENT EXECUTION WAS SUCCESSFUL, SQLCODE IS 100
+---------+---------+---------+---------+---------+------+
```

EXPANSION_REASON column in plan tables

If the SYSIBMADM.GET_ARCHIVE global variable is set to Y and the ARCHIVESENSITIVE bind option is set to YES then DB2 implicitly adds certain syntax to the query. When that query transformation occurs, the EXPANSION_REASON column will have 'A'. This column is added in following explain tables.

- PLAN_TABLE
- DSN_COLDIST_TABLE
- DSN_DETCOST_TABLE
- DSN_FILTER_TABLE
- DSN_FUNCTION_TABLE
- DSN_KEYTGTDIST_TABLE
- DSN_PGRANGE_TABLE
- DSN_PGROUP_TABLE
- DSN_PREDICATE_SELECTIVITY
- DSN_PREDICAT_TABLE
- DSN_PTASK_TABLE

- DSN_QUERYINFO_TABLE
- DSN_QUERY_TABLE
- DSN_SORTKEY_TABLE
- DSN_SORT_TABLE
- DSN_STATEMENT_CACHE_TABLE
- DSN_STATEMNT_TABLE
- DSN_STRUCT_TABLE
- DSN_VIEWREF_TABLE

Archive vs Temporal

Archive	Temporal (SYSTEM TIME)
Before image data of UPDATE sql will not be archived	Before image data of UPDATE sql will be archived
We can get image of data at particular past instance of time	We can get image of data at particular past instance of time
ROW BEGIN/ROW END/TRANS ID columns are required for base table	No additional columns required
Compatible with Business Time	Not compatible with Business Time
In SYSIBM.SYSTABLES catalog table, type: 'A' says archive table	In SYSIBM.SYSTABLES catalog table, type: 'H' says history table
ARCHIVING_SCHEMA, ARCHIVING_TABLE columns in SYSIBM.SYSTABLES are used to relate base and archive table	VERSIONING_SCHEMA,VERSIONING_TABLE columns in SYSIBM.SYSTABLES are used to relate base and archive table
EXPANSION_REASON=A in plan tables refers access path referring archive table	EXPANSION_REASON=S in plan tables refers access path referring history table

Archive	Temporal (SYSTEM TIME)
Implicit UNION ALL query transformation is Controlled by SYSIBMADM.GET_ARCHIVE	Implicit UNION ALL query transformation is Controlled by CURRENT TEMPORAL SYSTEM_TIME special register & SYSTIMESENTIVE RE/BIND option
REORG with DISCARD option can be performed	REORG with DISCARD option cannot be performed

Restrictions

Restrictions for archive table

We cannot tag any kind of DB2 table as archive table or archive enabled table. There are a set of rules to be followed or else we will get the following errors:

```
-20554: TABLE table-name WAS SPECIFIED AS AN ARCHIVE TABLE, BUT THE TABLE DEFINITION IS NOT
VALID FOR AN ARCHIVE TABLE. REASON CODE = reason-code.

-766: THE OBJECT OF A STATEMENT IS A TABLE FOR WHICH THE
REQUESTED OPERATION IS NOT PERMITTED

-20525: THE REQUESTED ACTION IS NOT VALID FOR TABLE table-name
BECAUSE THE TABLE IS THE WRONG TYPE OF TABLE. REASON CODE = reason-code.
```

Archive table eligibility rules

1. The table cannot be following type
    - Existing Archive-enabled table or Archive table.
    - System-period temporal table or its history table
    - Temporary table
    - View or MQT
    - Auxiliary or XML table
    - Clone table or base table of clone
    - Table involved in referential integrity
    - Table with incomplete table definition.
    - Table is not the only table in the table space.
    - The table contains a security label column
2. The table should not contain an identity column.
3. The archive table should have the same number of columns as the archive enabled table.
4. If the archive-enabled table has a row change timestamp column/ ROWID column, the corresponding archive table column must be a row change timestamp column / ROWID column with the GENERATED ALWAYS attribute.
5. Following column attributes of archive table should match with that of archive-enabled table:
    - Name
    - Data type and Data type length (excluding inline LOB length or XML length in the base table, precision, and scale)
    - Null attribute
    - Field procedure
    - CCSID , FOR BIT, SBCS, or MIXED DATA attribute

Rules for archive enabled table

- Should not have clone table.
- The table must not have a column mask or row permission defined.
- The table must not have a column mask or row permission defined.
- A system-period temporal table.
- The table must be the only table in the table space.

- The table must not already be defined as an archive-enabled table or an archive table.

Note: Archive enabled table can have parent key, foreign key, LOB column, XML column.

Bibliography

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