

# Static SQL on DB2 for z/OS - Packages, Collections and Plans, Oh my!

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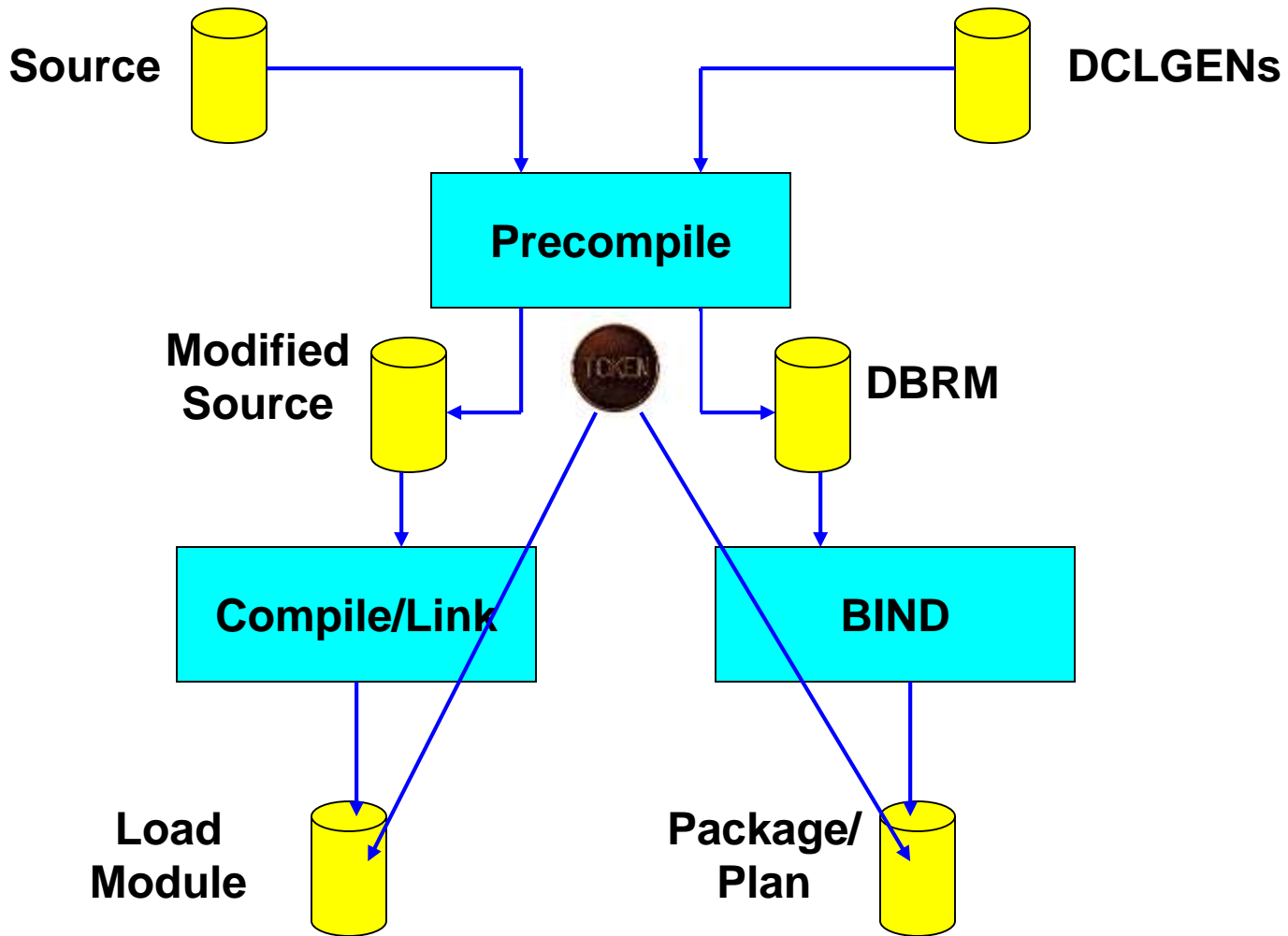
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# Upcoming DB2 Schedule

DB2 classes guaranteed to run before the end of the year

11/14/2016	<a href="#">SQ1000 Cross Platform SQL Essentials</a>	<a href="#">Distance Learning, VC</a>	<a href="#">Register</a>
11/16/2016	<a href="#">SQ1010 Cross Platform SQL – Dealing with Complex Queries</a>	<a href="#">Distance Learning, VC</a>	<a href="#">Register</a>
11/29/2016	<a href="#">DB1042 DB2 for z/OS Advanced Embedded Programming</a>	<a href="#">Distance Learning, VC</a>	<a href="#">Register</a>
11/29/2016	<a href="#">DB1032 DB2 for z/OS SQL Optimization, Performance &amp; Tuning</a>	<a href="#">Distance Learning, VC</a>	<a href="#">Register</a>
12/12/2016	<a href="#">DB1041 Advanced SQL for DB2</a>	<a href="#">Distance Learning, VC</a>	<a href="#">Register</a>

# Program Preparation – Static SQL



# Precompile

```
//DB2PRE      EXEC PGM=DSNHPC,  
// PARM='HOST( IBMCOB ), STDSQL( NO ), APOST, APOSTSQL,  
//          SOURCE, XREF, NEWFUN( YES ), VERSION( AUTO ) '  
//STEPLIB     DD   DSN=DB1A.SDSNEXIT, DISP=SHR  
//           DD   DSN=DSNB10.SDSNLOAD, DISP=SHR  
//SYSIN       DD   DSN=ODYDS.COBOL.CNTL( LOTSASQ1 ), DISP=SHR  
//SYSLIB      DD   DSN=THEMIS.DCLGEN, DISP=SHR  
//SYSCIN      DD   DSN=&&DSNHOUT, DISP=( MOD, PASS ), UNIT=VIO,  
//           DD   SPACE=( 800, ( 500, 500 ) )  
//DBRMLIB     DD   DSN=THEMIS.DB2.DBRMLIB( LOTSASQ1 ), DISP=SHR  
//SYSPRINT    DD   SYSOUT=*  
//SYSTEM      DD   SYSOUT=*
```

# Precompile

```
//DB2PRE EXEC PGM=DSNHPC,  
// PARM='HOST(TPMCOB) STDSQL(NO), APOST, AP  
//  
//STEPLIB DD DSN=DSNEXIT, DISP=SHR  
// DD DSN=DSNLOAD, DISP=SHR  
//SYSIN DD DSN=ODYNS.COBOL.CNTL(LOTSASQ1), DISP=SHR  
//SYSLIB DD DSN=THEMIS.DCLGEN, DISP=SHR  
//SYSCIN DD DSN=&&DSNHOUT, DISP=(MOD,PASS), UNIT=VIO,  
// SPACE=(800,(500,500))  
//DBRMLIB DD DSN=THEMIS.DB2.DBRMLIB(LOTSASQ1), DISP=SHR  
//SYSPRINT DD SYSOUT=  
//SYSTEM DD
```

DCLGENs

Source Code

Modified Source

Output DBRM

# Precompile

```
//DB2PRE EXEC PGM=DSNHPC,  
// PARM='HOST( IBMCOB ), STDSQL( NO ), APOST, APOSTSQL,  
// SOURCE, XREF, NEWFUN( YES ), VERSION( AUTO ) '  
//STEPLIB DD DSN=DB1A.SDSNEXIT, DISP=SHR  
// DD DSN=DSNB10.SDSNLOAD, DISP=SHR  
//SYSIN DD DSN=ODYDS.COBOL.CNTL( LOG ), DISP=SHR  
//SYSLIB DD DSN=THEMIS.DCLGEN, DISP=SHR  
//SYSCIN DD DSN=&&DSNHOUT, DISP=( MOD, PASS ), UNIT=VIO,  
// SPACE=( 800, ( 500, 500 ) )  
//DBRMLIB DD DSN=THEMIS.DB2.DBRMLIB( LOTSASQ1 ), DISP=SHR  
//SYSPRINT DD SYSOUT=*  
//SYSTEM DD SYSOUT=*
```

Generate a  
Version

# Generated Code

## Generated Code in Working Storage

```
01 SQL-PLIST5. ←
  05 SQL-PLIST-CON PIC S9(9) COMP-4 VALUE +2638848.
  05 SQL-CALLTYPE PIC S9(4) COMP-4 VALUE +30.
  05 SQL-PROG-NAME PIC X(8) VALUE 'COBSAMPL'.
  05 SQL-TIMESTAMP-1 PIC S9(9) COMP-4 VALUE +386702250.
  05 SQL-TIMESTAMP-2 PIC S9(9) COMP-4 VALUE +427650293.
  05 SQL-SECTION PIC S9(4) COMP-4 VALUE +1.
  05 SQL-CODEPTR PIC S9(9) COMP-4.
  05 SQL-VPARMPTR PIC S9(9) COMP-4 VALUE +0.
  05 SQL-APARMPTR PIC S9(9) COMP-4 VALUE +0.
  05 SQL-STMT-NUM PIC S9(4) COMP-4 VALUE +99.
  05 SQL-PVAR-LIST5.
    10 PRE-SQLINIT PIC
    10 PRE-SQ
```

```
EXEC SQL
  SELECT DEPTNAME
         ,MANAGER
         ,REPORTS_TO
  INTO
         :WS-DEPTNAME
         ,:WS-MANAGER INDICATOR :WS-MANAGER-IND
         ,:WS-REPORTS-TO
  FROM DEPARTMENT
  WHERE DEPTNO = :WS-DEPARTMENT
END-EXEC
```

```
PERFORM SQL-INITIAL UNTIL SQL-INIT-DONE
```

```
CALL 'DSNHLI' USING SQL-PLIST5 ←
```

```
IF SQLCODE < 0 GO 0 9999-SQL-ERROR ELSE ←
IF SQLCODE > 0 AND SQLCODE NOT = 100
OR SQLWARNO = 'W' GO TO 9999-SQL-ERROR ELSE
MOVE 1 TO SQL-INIT-FLAG
END-IF
END-IF
```

```
WHENEVER SQLWARNING GO TO 9999-SQL-ERROR
WHENEVER SQLERROR GO TO 9999-SQL-ERROR
WHENEVER NOT FOUND CONTINUE
```

Generated  
Code  
in the  
Procedure  
Division



# Bind

```
//BIND      EXEC  PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//STEPLIB   DD    DSN=DB1A.SDSNEXIT,DISP=SHR
//          DD    DSN=DSNB10.SDSNLOAD,DISP=SHR
//DBRMLIB   DD    DSN=THEMIS.DB2.DBRMLIB,DISP=SHR
//SYSTSPRT  DD    SYSOUT=*
//SYSPRINT  DD    SYSOUT=*
//SYSOUT    DD    SYSOUT=*
//SYSTSIN   DD    *
  DSN SYSTEM(DB1A)
  BIND PACKAGE(THEMISCL) MEMBER(LOTSASQ1) ACT(REP) -
    ISOLATION(CS) VALIDATE(BIND) CURRENTDATA(NO) QUALIFIER(THEMIS82) -
    OWNER(ODYDS) EXPLAIN(YES) RELEASE(DEALLOCATE) -
    APCOMPARE(WARN) APREUSE(NONE)
/*
```

# Bind

```
//BIND EXEC PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//STEPLIB DD DSN=DB1A.SDSNEXIT,DISP=SHR
// DD DSN=DSNB10.SDSNLOAD,DISP=SHR
//DBRMLIB DD DSN=THEMIS.DB2.DBRMLIB,DISP=SHR
//SYSTSPRT DD SYSOUT=*
//SYSPRINT DD SYSOUT=*
//SYSOUT DD SYSOUT=*
//SYSTSIN DD *
DSN SYSTEM(DB1A)
BIND PACKAGE(THEMISCL) MEMBER(LOTSASQ1) ACT(REP) -
ISOLATION(CS) VALIDATE(BIND) CURRENTDATA(NO) QUALIFIER(THEMIS82) -
OWNER( ) PLAN(YES) .LOCATE) -
APCOM REUSE(NO)
/*
```

Input DBRM Library

Collection

Program (Package)

# Bind

```
//BIND EXEC PGM=IKJEFT01,DYNAMNBR=20,COND=(4,LT)
//STEPLIB DD DSN=DB1A.SDSNEXIT,DISP=SHR
// DD DSN=DSNB10.SDSNLOAD,DISP=SHR
//DBRMLIB DD DSN=THEMIS.DB2.DBRMLIB,DISP=SHR
//SYSTSPRT DD SYSOUT=*
//SYSPRINT DD SYSOUT=*
//SYSOUT DD SYSOUT=*
//SYSTSIN DD *
DSN SYSTEM(DB1A)
BIND PACKAGE(THEMISCL) MEMBER(LOTSASQ1) ACT(REP) -
ISOLATION(CS) VALIDATE(BIND) CURRENTDATA(NO) QUALIFIER(THEMIS82) -
OWNER(ODYDS) EXPLAIN(YES) RELEASE(DEALLOCATE) -
APCOMPAR(WARN) APREUSE(NONE)
/*
```

Authorization

Many other  
options

Tables to  
be used

[http://www.ibm.com/support/knowledgecenter/SSEPEK\\_11.0.0/comref/src/tpc/db2z\\_bindrebindoptions.html](http://www.ibm.com/support/knowledgecenter/SSEPEK_11.0.0/comref/src/tpc/db2z_bindrebindoptions.html)

# Versions

```
SELECT COLLID, NAME, VERSION, BINDTIME
FROM SYSIBM.SYSPACKAGE
WHERE COLLID = 'THEMISCL'
      AND NAME = 'LOTSASQ1'
ORDER BY BINDTIME DESC
```

COLLID	NAME	VERSION	BINDTIME
THEMISCL	LOTSASQ1	2016-11-06-03.19.12.815872	2016-11-07-11.22.28.795877
THEMISCL	LOTSASQ1	2016-11-06-03.18.29.658309	2016-11-05-23.19.21.364195
THEMISCL	LOTSASQ1	2016-11-06-03.08.36.597796	2016-11-05-23.08.43.719571
THEMISCL	LOTSASQ1	2016-11-06-03.08.13.707358	2016-11-05-23.08.21.402029
THEMISCL	LOTSASQ1	2016-11-06-02.39.44.069303	2016-11-05-22.39.51.873771

# Consistency Token

```
SELECT NAME, VERSION, HEX(CONTOKEN) AS TOKEN
FROM SYSIBM.SYSPACKAGE
WHERE COLLID = 'THEMISCL'
AND NAME = 'LOTSASQ1'
ORDER BY VERSION DESC
```

NAME	VERSION	TOKEN
LOTSASQ1	2016-11-06-03.19.12.815872	1A33534F13EFC029
LOTSASQ1	2016-11-06-03.18.29.658309	1A33534A0F4DB159
LOTSASQ1	2016-11-06-03.08.36.597796	1A33530318F50931
LOTSASQ1	2016-11-06-03.08.13.707358	1A33530101A317AD
LOTSASQ1	2016-11-06-02.39.44.069303	1A33523507E2ADE4

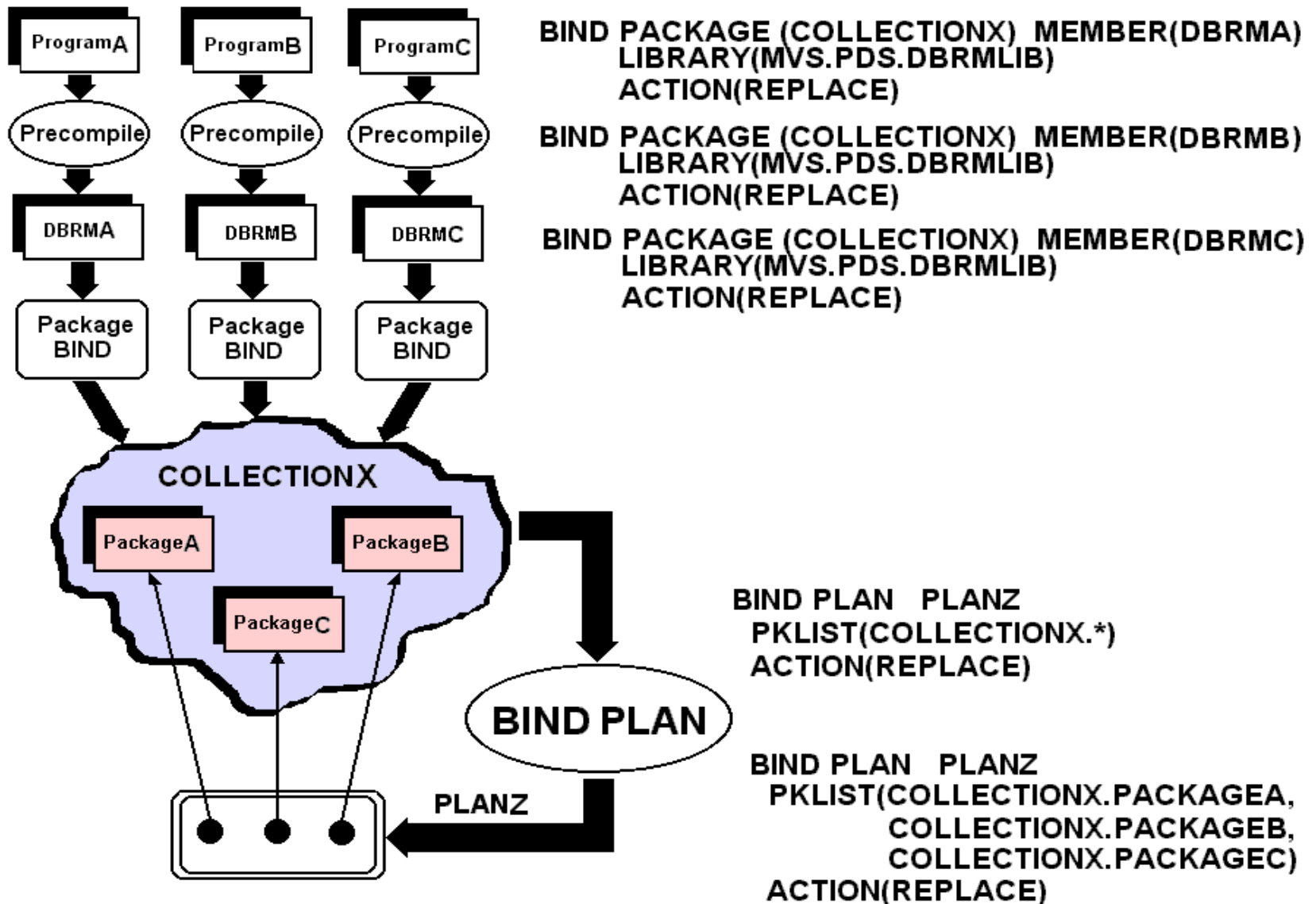
# Packages

**COLLECTION PACKAGE**

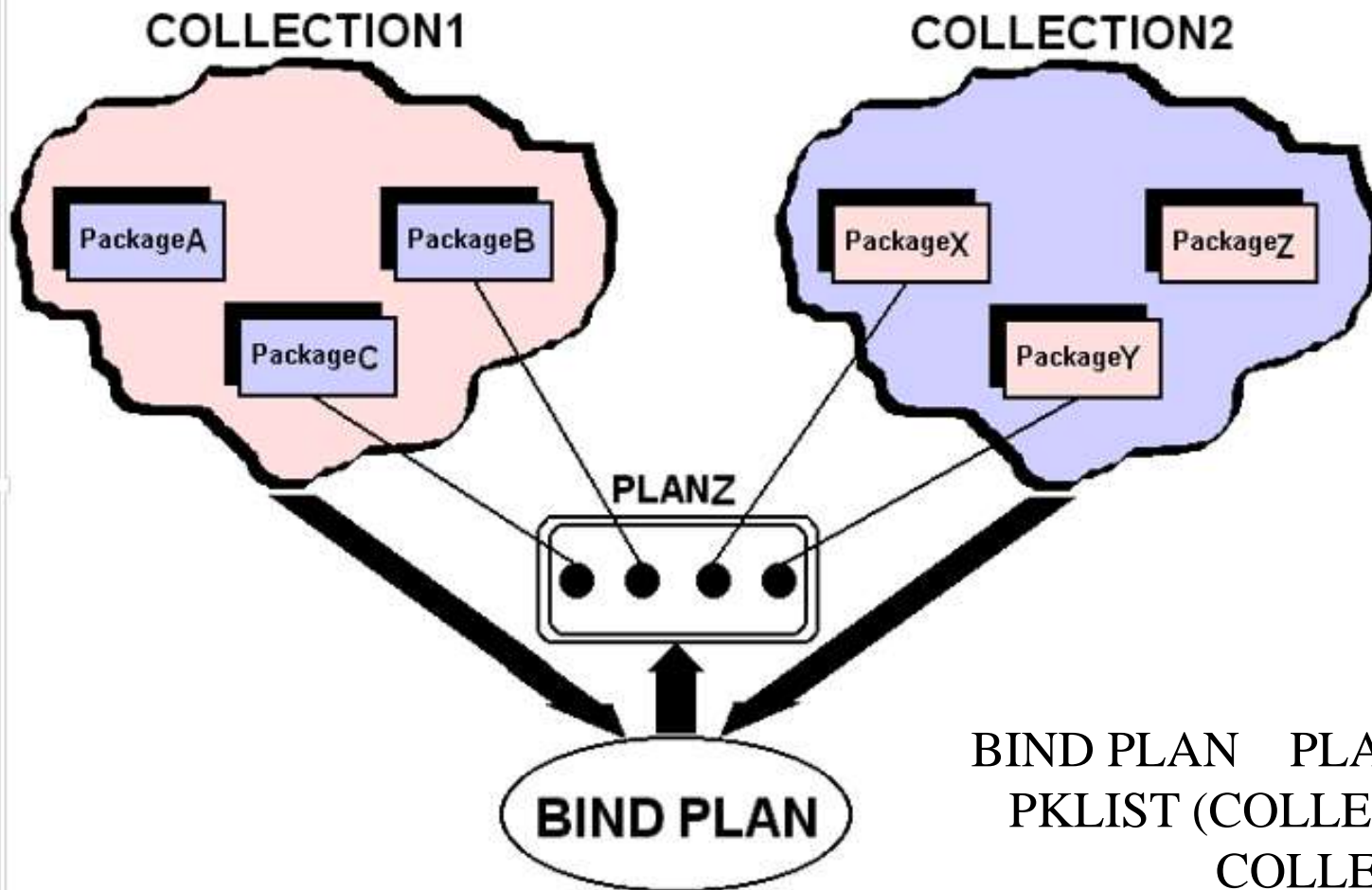
**LOCATION**

**VERSION**

# BIND PLAN Single Collection



# BIND PLAN Multiple Collections



```
BIND PLAN  PLANZ  
PKLIST (COLLECTION1.*,  
        COLLECTION2.P*)  
ACTION(REPLACE)
```



# BIND Listings

```
BIND PACKAGE(THEMISCL) MEMBER(COBSAMPL) ACT(REP) ISOLATION(CS) VALIDATE(BIND)
CURRENTDATA(NO) QUALIFIER(ODYED)
DSNT254I  -7A DSNTBCH2 BIND OPTIONS FOR
          PACKAGE = D71A.THEMISCL.COBSAMPL.(.)
          ACTION      REPLACE
          OWNER        ODYED
          QUALIFIER    ODYED
          VALIDATE     BIND
          EXPLAIN      NO
          ISOLATION    CS
          RELEASE
          COPY
DSNT255I  -7A DSNTBCH2 BIND OPTIONS FOR
          PACKAGE = D71A.THEMISCL.COBSAMPL.(.)
          SQLERROR     NOPACKAGE
          CURRENTDATA  NO
          DEGREE       1
          DYNAMICRULES
          DEFER
          NOREOPT      VARS
          KEEP DYNAMIC NO
          IMMEDIATE    NO
          DBPROTOCOL   DRDA
          OPTHINT
          ENCODING     EBCDIC(00037)
          PATH
DSNT232I  -7A SUCCESSFUL BIND FOR
          PACKAGE = D71A.THEMISCL.COBSAMPL.(.)
```

```
BIND PLAN(DB2TEST) PKLIST(THEMISCL.*) ACT(REP) ISOLATION(CS) VALIDATE(BIND)
DSNT252I  -7A DSNTBCH1 BIND OPTIONS FOR PLAN DB2TEST
          ACTION      ADD
          OWNER        ODYED
          VALIDATE     BIND
          ISOLATION    CS
          ACQUIRE     USE
          RELEASE      COMMIT
          EXPLAIN      NO
          DYNAMICRULES RUN
DSNT253I  -7A DSNTBCH1 BIND OPTIONS FOR PLAN DB2TEST
          NODEFER     PREPARE
          CACHESIZE    0000
          QUALIFIER    ODYED
          CURRENTSERVER
          CURRENTDATA  NO
          DEGREE       1
          SQLRULES     DB2
          DISCONNECT   EXPLICIT
          NOREOPT      VARS
          KEEP DYNAMIC NO
          IMMEDIATE    NO
          DBPROTOCOL   DRDA
          OPTHINT
          ENCODING     EBCDIC(00037)
          PATH
DSNT200I  -7A BIND FOR PLAN DB2TEST SUCCESSFUL
```

# BIND Qualifier

PROGRAM

```
EXEC SQL
  SELECT ...
  INTO ...
  FROM EMPLOYEE
  WHERE ...
END-EXEC
```

BIND PACKAGE . . .  
QUALIFIER (TEST)

RESULT



FROM TEST.EMPLOYEE

BIND PACKAGE . . .  
QUALIFIER (PROD)

RESULT



FROM PROD.EMPLOYEE

# Debugging

## Precompiler listing

```
RETURN CODE IS 4
DSNH206I W      DSNHANAL LINE 99 COL 19  STATEMENT REFERENCES COLUMN
"WS-DEPARTMENT WHICH IS NOT DECLARED IN THE SPECIFIED TABLE(S)
SELECT DEPTNAME,MANAGER,REPORTS_TO INTO:WS-DEPTNAME, :WS-MANAGER INDICATOR
:WS-MANAGER-IND, :WS-REPORTS-TO, FROM DEPARTMENT WHERE DEPTNO=WS-DEPARTMENT
```

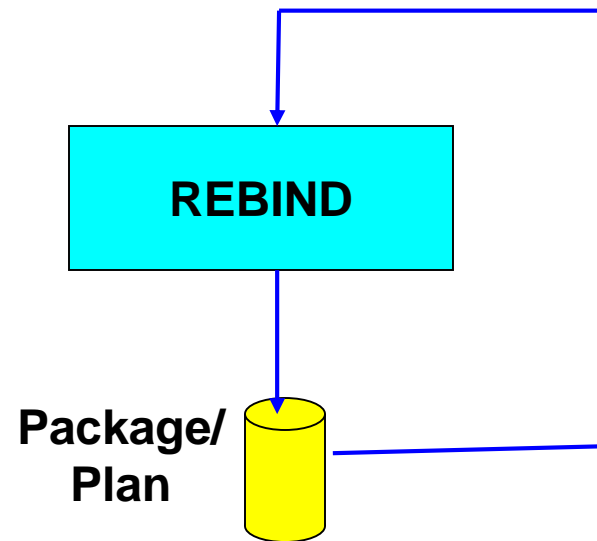
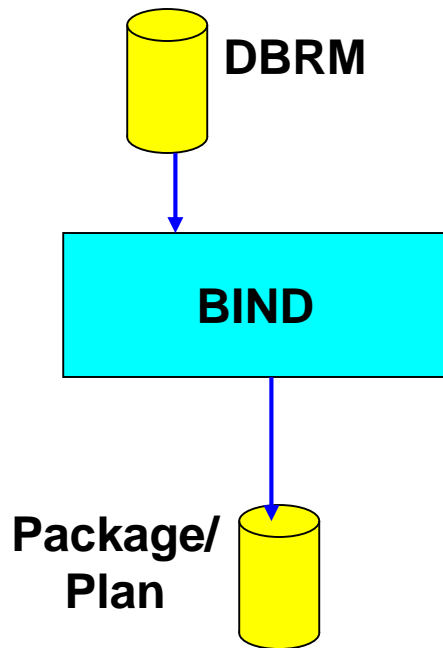
## Program

```
98 006100 EXEC SQL
99 006200 SELECT DEPTNAME
100 006300 ,MANAGER
101 006400 ,REPORTS_TO
102 006500 INTO
103 006600 :WS-DEPTNAME
104 006700 ,:WS-MANAGER INDICATOR :WS-MANAGER-IND
105 006800 ,:WS-REPORTS-TO
106 006900 FROM DEPARTMENT
107 007000 WHERE DEPTNO = WS-DEPARTMENT
108 007100 END-EXEC
```

## BIND listing

```
DSNX200I -7A BIND SQL ERROR
        USING ODYED AUTHORITY
        PLAN=(NOT APPLICABLE)
        DBRM=COBERR
        STATEMENT=99
        SQLCODE=-206
        SQLSTATE=42703
        TOKENS=WS-DEPARTMENT
        CSECT NAME=DSNXORSO
        RDS CODE=-100
DSNT233I -7A UNSUCCESSFUL BIND FOR
        PACKAGE = D71A.THEMISCL.COBERR. ()
```

# BIND vs REBIND



# Running the Program

```
//MRG      EXEC PGM=IKJEFT01
//STEPLIB DD DSN=THEMIS.DB2.LOADLIB,DISP=SHR
//          DD DSN=DSNB10.SDSNLOAD,DISP=SHR
//SYSTSIN  DD *
           DSN SYSTEM(DB1A)
           RUN PROGRAM(LOTSASQ1) PLAN(THEMISPL)
           END
/*
//SYSOUT   DD SYSOUT=*
//SYSTSPRT DD SYSOUT=*
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
```

# Running the Program

- The program is invoked via the TSO Monitor (IKJEFT01) in this case.
- Upon the first SQL call, the package list in plan THEMISPL will be searched for a matching package. Consistency token is used to find the match.
- If no match is found..... SQLCODE: -805

```
DSNT408I  SQLCODE = -805, ERROR:  DBRM OR PACKAGE NAME DA1A..LOTSASQ1.1A33534F1-  
3EFC029 NOT FOUND IN PLAN THEMISPL. REASON 03  
DSNT418I  SQLSTATE   = 51002 SQLSTATE RETURN CODE  
DSNT415I  SQLERRP    = DSNXEPM SQL PROCEDURE DETECTING ERROR  
DSNT416I  SQLERRD    = -251  0  0  -1  0  0 SQL DIAGNOSTIC INFORMATION  
DSNT416I  SQLERRD    = X'FFFFFF05' X'00000000' X'00000000' X'FFFFFFF'  
X'00000000' X'00000000' SQL DIAGNOSTIC INFORMATION
```

# Possible Causes of -805

- Compile worked but BIND failed resulting in no package
- Bind succeeded but placed the resulting package in a collection not included in the PLAN?
- Wrong DB2 subsystem?
- Wrong PLAN?
- Wrong load library?
- If versioning is not used, someone else ran a BIND that overlaid the existing package.