

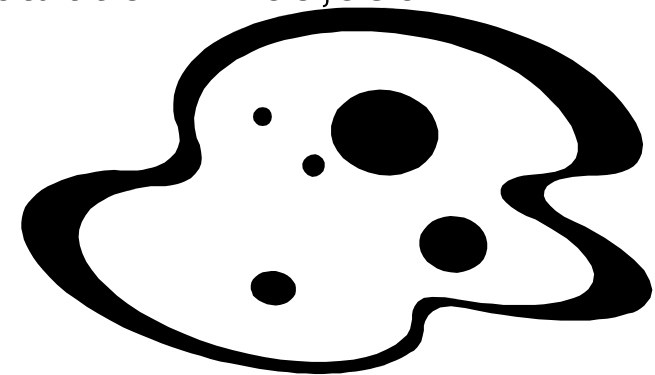
AGENDA

- Overview of LOB concepts and architecture
- CREATE LOB
- ALTER LOB
- DROP LOB
- Populate LOB
- Migrate LOB
- Utilities



DB2 for z/OS LARGE OBJECTS (LOB)

- Pictures, images, text documents, and movies
- 3 types
 - ❑ BLOB – Binary Large Object – audio, image data
 - ❑ CLOB – Character Large Object – SBCS, mixed character data
 - ❑ DBCLOB – Double Byte Character Large Object
- Each data set of a LOB table space → 64GB; 254 data sets / table space → max of 16TB for a non-partitioned LOB table space
- Max of 4096 partitions; 1 LOB table space / partition → 65,536 TB
- Usually accessed via GUI interfaces
- Maintenance on ISPF can be challenging



LOB ARCHITECTURE

BASE TABLE SPACE

1 **BASE TABLE** **3**

KEY	ROWID 4	COL 2	LOB IND
A	Lob 1 value	User data A	LOB indicator 1
B	Lob 2 value	User data B	LOB indicator 2

**GENERATED ALWAYS
GENERATED BY DEFAULT**

- Rows represent LOBs
- LOB's stored outside Base table
- Base table space may be partitioned
- If partitioned – 1 LOB TS / Partition

5

**Auxiliary Index
based on ROWID
Used to navigate to
LOB data**

2 **LOB TABLE SPACE**

AUXILIARY TABLE

ROWID	LOB Data
Lob 1 value	LOB data for data row A
Lob 2 value	LOB data for data row B

Create Objects for LOB data

➤ Manual

- ❑ Most flexibility, but most time consuming
- ❑ Implement your own naming convention

➤ CURRENT RULES special register = 'STD' (V8 and higher)

- ❑ DB2 will create all the necessary LOB objects



MANUAL CREATION of LOB Objects



- Create the **BASE** table
 - ❑ Table space must be in the same database where the LOB table space(s) are stored
 - ❑ Base table must contain a **ROWID**
 - Unique value related to auxiliary tables
 - Only need 1 / base table
- Create the **LOB table space**
 - ❑ Need 1 LOB table space for each LOB column in the base table
- Create the **Auxiliary table** – 1 per LOB table space
- Create the **Auxiliary index** (only can have 1 / aux table)

```
--create base table
CREATE TABLE TB01
  ( FKEY INTEGER, ...
    FROWID ROWID,
    FCLOB CLOB(10M),....) ...
```

```
--create LOB table space
CREATE LOBTABLESPACE LTS01 ... LOG NO;
```

```
--create auxiliary table for LOB column FCLOB
CREATE AUXTABLE AUXTB01 IN DB
  STORES TB01
  COLUMN FCLOB;
```

```
--create index for auxiliary table
CREATE UNIQUE INDEX AUXIX01
  ON AUXTB01...
```

Creation Using the CURRENT RULES = 'STD'



- CURRENT RULES is a service register - certain statements get executed in accordance
 - ❑ DB2 Rules (DB2)
 - ❑ SQL Standard (STD)
- **SET CURRENT RULES** option
 - ❑ CURRENT RULES DB2 – have to create LOB objects manually
 - ❑ **CURRENT RULES STD** – DB2 creates all the auxiliary objects at the time the base table is created (LOB TS, Aux TB, Aux IX)
 - Do not have to explicitly specify a ROWID
 - Implicitly generates an index for a ROWID column (GENERATED BY DEFAULT)

DDL Using CURRENT RULES = 'STD'

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help

EDIT          SYS09062.T134447.RA000.DBA104.R0109872          Columns 00001 00072
Command ==> _____ Scroll ==> CSR
***** ***** Top of Data *****
==MSG> -Warning- The UNDO command is not available until you change
==MSG>          your edit profile using the command RECOVERY ON.
0          SET CURRENT SQLID='DBA104';
0          SET CURRENT RULES = 'STD';
000003     CREATE TABLE DBA104.BOOK_BASE_TABLE
000004         (BOOK_NUMBER          CHAR(10) FOR SBCS DATA NOT NULL
000005             WITH DEFAULT,
000006             DESCRIPTION          CHAR(32) FOR SBCS DATA NOT NULL
000007             WITH DEFAULT,
000008             BOOK_TEXT              CLOB(1 M) FOR SBCS DATA NOT NULL,
000009             BOOK_COVER             BLOB(1 M) NOT NULL)
000010     AUDIT NONE
000011     DATA CAPTURE NONE
000012     CCSID          EBCDIC
000013     NOT VOLATILE;
000014     SET CURRENT RULES = 'DB2';
000015     COMMIT;
***** ***** Bottom of Data *****

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```


Creation Using the *CURRENT RULES* = 'STD'

Session A - [24 x 80]

File Edit View Communication Actions Window Help

DB2 Admin ----- DSNC Tables, Views,
Command ==> _

Commands: GRANT MIG

Line commands:
 C - Columns A - Auth L - List X - Indexes S - Table space D - Database
 V - Views T - Tables P - Plans Y - Synonyms SEL - Select prototyping
 ? - Show all line commands

Sel	Name	Owner	T	DB Name	TS Name	Cols	Rows	Checks
*	*	*	*	*	*	*	*	*
	BOOK_BOOK_ARE0DQQD	DBA104	X	DSNDB04	LAREZSMW	3	-1	0
	BOOK_BOOK_AREZMKCL	DBA104	X	DSNDB04	LAREYEEY	3	-1	0

***** END OF DB2 DATA *****

Table Name: BOOK_BASE_TABLE
CLOB Column: BOOK_TEXT
BLOB Column: BOOK_COVER

TSNAME is an 8 character string beginning with an 'L' followed by 7 random characters

- ✓ **TBNAME is the 1st 5 characters of the name of the base table**
- ✓ **2nd 5 characters are the 1st 5 characters of the name of the LOB column**
- ✓ **The last 8 characters are randomly generated**

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GENERATED ROWID COLUMN

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
----- Row 1 to 5 of 5
Command ==> _                               Scroll ==> PAGE

Line commands:
T - Tables X - Indexes A - Auth GR - Grant H - Homonyms I - Interpret
UR - Update runstats LAB - Label COM - Comment DI - Distribution stats
? - Show all line commands

Select Column Name          Col No Col Type Length Scale Null Def FP   Col Card
      *                    * *      *          *      * *   *   *
----->-----
      BOOK_NUMBER           1 CHAR      10         0 N   Y   N       -1
      DESCRIPTION           2 CHAR      32         0 N   Y   N       -1
      BOOK_TEXT              3 CLOB        4         0 N   N   N       -1
      BOOK_COVER             4 BLOB         4         0 N   N   N       -1
      DB2_GENERATED_ROWID    5 ROWID       17         0 N   A   N       -1
***** END OF DB2 DATA *****

```

✓ ROWID is a unique and permanent identifier for ea. row in the base table
 ✓ ROWID is a varchar 17
 ✓ Only 1 ROWID column – even if there are multiple LOB columns

```

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```

ALTER TABLE TO ADD LOB COLUMNS

Session A - [24 x 80]

File Edit View Communication Actions Window Help

DB2 Admin ----- DB1S ALTER Table ----- Row 1 to 4 of 4
 Command ==> alter_ Scroll ==> PAGE

New owner ==> DBA104 > Old owner : DBA104
 New name ==> BOOK_AUTHOR > Old name : BOOK_AUTHOR
 Volatile ==> NO Action : DROP New DB ==> SSEMMD01
 Rows/Page : 49.349397 Partitions: 0 New TS ==> SS01TS01
 Commands : CONTINUE PRIMKEY ADD REL
 Line commands :
 I - Insert U - Update D - Delete R - Repeat LAB - Label COM - Comment
 M - Move A - After B - Before X - Index RES - Reset update

Sel	Column Name	Col No	Col Type	Length	Scale	N	D	Col No	Type	Old Operation
*		*	*	*		*	*	*	*	*
	AUTHID	1	INTEGER	4	0	N	N	1		
	ISBN	2	VARCHAR	13	0	N	N	2		
*	BOOK_TITLE	3	VARCHAR	50	0	Y	Y	3		
*	BOOK_COVER	4	BLOB	33972	0	N	N	0	INSERT	

***** END OF DB2 DATA *****

Altering a table works the same way

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ALTER TABLE TO ADD LOB COLUMNS

Session A - [24 x 80]

File Edit View Communication Actions Window Help

DB2 Admin ----- Edit Statement ----- Columns 00001 00072
 Command ==> Scroll ==> CSR

```

000082 -----
000083 -- Table=DBA104.BOOK_AUTHOR In SSEMMD01.SS01TS01
000084 -----
000085 -- SET CURRENT RULES = 'STD';
000086 -----
000087 -- CREATE TABLE DBA104.BOOK_AUTHOR
000088 -- (AUTHID INTEGER NOT NULL ,
000089 -- ISBN VARCHAR(13) FOR SBCS DATA NOT NULL
000090 -- ,
000091 -- BOOK_TITLE VARCHAR(50) FOR SBCS DATA
000092 -- WITH DEFAULT NULL ,
000093 -- BOOK_COVER BLOB(33972) NOT NULL ,
000094 -- CONSTRAINT AUTHID
000095 -- PRIMARY KEY (AUTHID,ISBN) ) IN SSEMMD01.SS01TS01
000096 -- AUDIT NONE
000097 -- DATA CAPTURE NONE
000098 -- CCSID EBCDIC
000099 -- NOT VOLATILE;
000100 -----
000101 -----
  
```

A

B

DB2 Admin will generate the SET CURRENT RULES = 'STD' syntax which tells DB2 to build the auxiliary objects

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DB2 9 Enhancements for Creating Tables with LOB Columns

- Automatic Creation of Objects – do not specify the IN clause
 - ❑ DB2 will create the name of the base data base and base table space
 - ❑ If LOB objects are involved, DB2 will create the auxiliary objects automatically
- If you do not define a ROWID before defining a LOB column, DB2 will generate a hidden ROWID column and place it at the end of the table

AUXR Display Associated AUX Data Columns

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Tables, Views, and Aliases ---- Row 1 to 3 of 3
Command ==>
Scroll ==> CSR

Commands: GRANT MIG
Line commands:
C - Columns A - Auth L - List
V - Views T - Tables P - Plan
? - Show all line commands

Sel Name Schema
-----
* *
BOOK_BASE_TABLE DBA104
BOOK_BASE_TABLE2 DBA104
BOOK_BASE_TABLE3 DBA104
*****
    
```



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S AUX cols for: DBA104.BOOK_B Row 1 to 2 of 2
Command ==> _
Scroll ==> PAGE

Line commands: T - Table C - Column

Auxiliary Table: DBA104.BOOK_BASE_TABLE3
S Owner Name Column Part
* * * *
-----
DBA104 BOOK_BOOK_AVZK0CRZ BOOK_TEXT 1
DBA104 BOOK_BOOK_AVZL1K74 BOOK_COVER 1
***** END OF DB2 DATA *****
    
```

Display of the LOB columns defined in the base table

New Table – Put an S to list the table space DB2 created

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Tables, Views, and Aliases ----- Row 1 to 3 of 3
Command ==>
Commands: GRANT MIG
Line commands:
C - Columns A - Auth L - List X - I
V - Views T - Tables P - Plans Y - S
? - Show all line commands

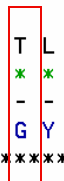
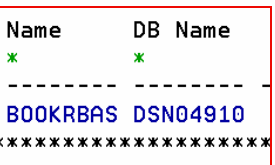
Sel  Name                Schema  T DB M
*   *
-----
BOOK_BASE_TABLE         DBA104  T LOB
BOOK_BASE_TABLE2       DBA104  T DSN
BOOK_BASE_TABLE3       DBA104  T DSN
***** END OF DB2 DATA *****
    
```



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Table Spaces ----- Row 1 to 1 of 1
Command ==> _
Commands: GRANT MIG DIS STA STO
Line commands:
T - Tables D - Database A - Auth G - Storage group ICS - Image copy
DIS - Display table space STA - Start table space STO - Stop table spa
? - Show all line commands

Select Name          DB Name      Parts Bpool  L E S I C Tables  Act. pages  Segsz  T L
*   *
-----
BOOKRBAS            DSN04910    1 BP1      R N A Y Y         1          -1     4 G Y
***** END OF DB2 DATA *****
    
```



DB2 Admin generated a Global Universal Table Space for the base table

```

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```

AUX – Display Auxiliary Objects

Session A - [24 x 80]

```
DB2 Admin ----- DB1S Tables, Views, and Aliases ----- Row 1 to 3 of 3
Command ==>
Scroll ==> CSR

Commands: GRANT MIG
Line commands:
C - Columns A - Auth L - List X - Indexes S - Table space D - Database
V - Views T - Tables P - Plans Y - Synonyms SEL - Select prototyping
? - Show all line commands
```

Sel	Name	Schema	T	DB
*	*	*	*	*
---	---	---	---	---
	BOOK_BASE_TABLE	DBA104	T	LO
	BOOK_BASE_TABLE2	DBA104	T	DS
	BOOK_BASE_TABLE3	DBA104	T	DS
***** END OF				

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Session A - [24 x 80]

```
DB2 Admin ----- DB1S Tables, Views, and Aliases ----- Row 1 to 2 of 2
Command ==>
Scroll ==> CSR

Commands: GRANT MIG
Line commands:
C - Columns A - Auth L - List X - Indexes S - Table space D - Database
V - Views T - Tables P - Plans Y - Synonyms SEL - Select prototyping
? - Show all line commands
```

Sel	Name	Schema	T	DB Name	TS Name	Cols	Rows	Checks
*	*	*	*	*	*	*	*	*
---	---	---	---	---	---	---	---	---
	BOOK_BOOK_AVZK0CRZ	DBA104	X	DSN04910	LAVZJJL7	3	-1	0
	BOOK_BOOK_AVZL1K74	DBA104	X	DSN04910	LAVZKSAY	3	-1	0
***** END OF DB2 DATA *****								

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Names are automatically generated by DB2

Drill up to the tablespace

LOB Table Space – generated by DB2

Session A - [24 x 80]

File Edit View Communication Actions Window Help

DB2 Admin ----- DB1S Table Spaces ----- Row 1 to 1 of 1
 Command ==> _ Scroll ==> CSR

Commands: GRANT MIG DIS STA STO
 Line commands:
 T - Tables D - Database A - Auth G - Storage group ICS - Image copy status
 DIS - Display table space STA - Start table space STO - Stop table space
 ? - Show all line commands

Select	Name	DB Name	Parts	Bpool	L	E	S	I	C	Tables	Act. pages	Segsz	T	L
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	LAVZJL7	DSN04910	0	BP4	A	N	A	Y	Y	1	-1	0	0	Y

***** END OF DB2 DATA *****

Name is automatically generated by DB2

Type O represents a LOB TS

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Auxiliary Table – Use XC to display auxiliary index and its columns as generated by DB2

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
-----
DB2 Admin ----- DB1S Tables, Views, and Aliases ----- Row 1 to 2 of 2
Command ==>
Scroll ==> CSR

Commands: GRANT MIG
Line commands:
C - Columns A - Auth L - List X - Indexes S - Table space D - Database
V - Views T - Tables P - Plans Y -
? - Show all line commands

Sel Name Schema T DB
-----
* * * * *
XC_ BOOK_BOOK_AVZK0CRZ DBA104 X DS
BOOK_BOOK_AVZL1K74 DBA104 X DS
***** END OF
    
```



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
-----
DB2 Admin DB1S Indexes and Columns/Key Targets of DBA104. > Row 1 to 3 of 3
Command ==>
Scroll ==> PAGE

L
-----
Sel Type Schema Name Seq Order Type Type Length N D S
-----
* * * * *
INDEX DBA104 IBOOK_BOOK_AVZKDIX 0 U
COL AUXID 1 A VARCHAR 17 N B S
COL AUXVER 2 A SMALLINT 2 N B S
***** END OF DB2 DATA *****
    
```

DB2 generated the name of the index and the columns

BR Line command to display data

```

Session B - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DSNC Tables, Views, and Aliases ----- Row 4 from 6
Command ==>                                     Scroll ==> CSR

Commands: GRANT MIG
Line commands:
C - Columns A - Auth L - List X - Indexes S - Table space D - Database
V - Views T - Tables P - Plans Y - Synonyms SEL - Select prototyping
? - Show all line commands

Sel  Name
-----*
bR  EMP_PHOTO_RESUM
*****

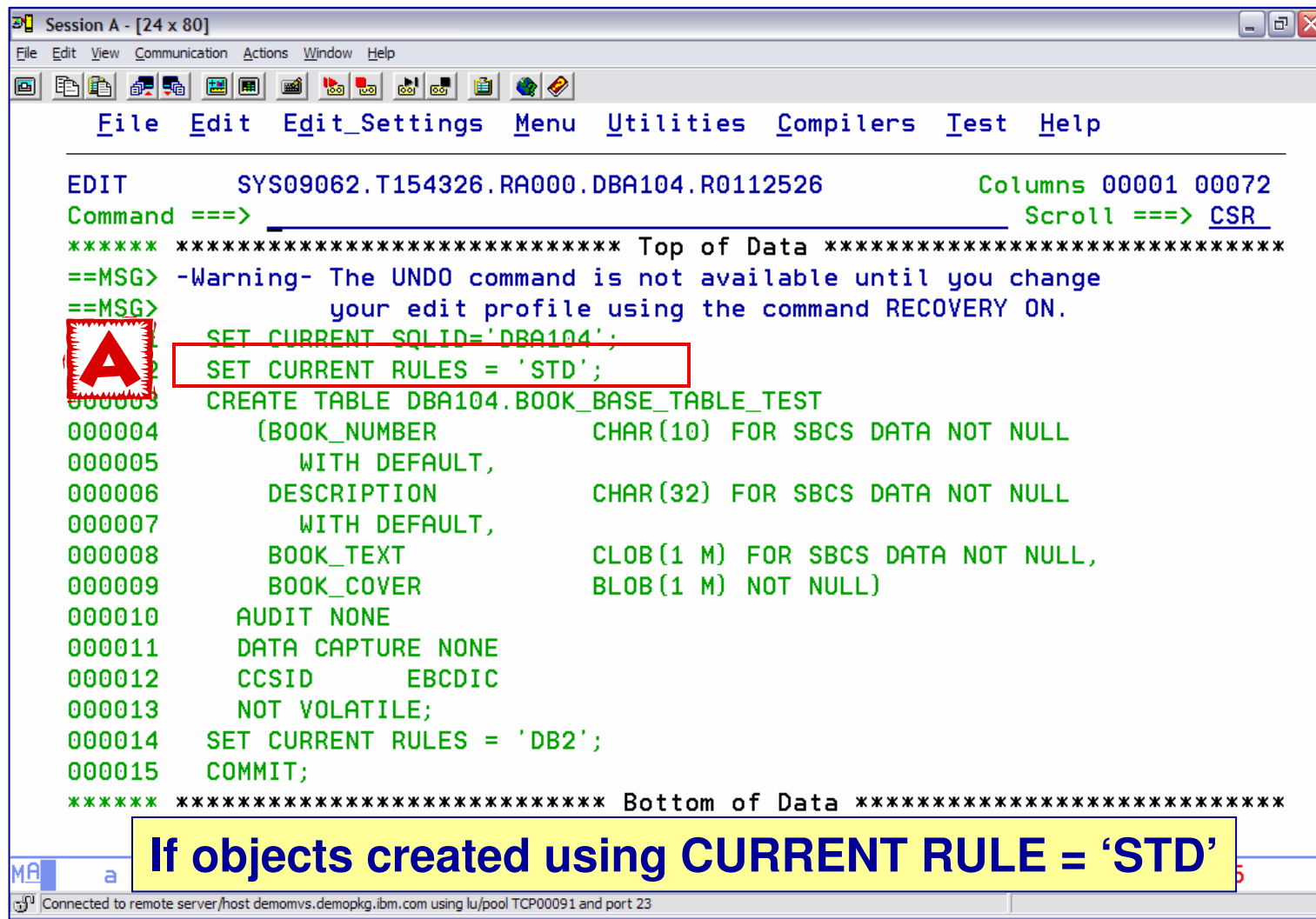
Session B - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin -- DSNC BROWSE DSN8810.EMP_PHOTO_ > ----- Line 00000000 Col 561 640
Command ==> _                                     Scroll ==> CSR

***** Top of Data *****
RESUME
-----
000612 Resume: Delores M. Quintana Personal Information Address:
001A26 Resume: Heather A. Nicholls Personal Information Address:
003621 Resume: Bruce Adamson Personal Information Address:
002707 Resume: James H. Walker Personal Information Address:
***** Bottom of Data *****
    
```



BLOB – display up to 128 bytes in hex
CLOB – display up to 256 bytes in character
DBCLOB – display up to 128 bytes in hex
ROWID – is displayed in hex

DB2 ADMIN DDL or GEN Commands



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help

EDIT      SYS09062.T154326.RA000.DBA104.R0112526      Columns 00001 00072
Command ==> _____ Scroll ==> CSR
***** ***** Top of Data *****
==MSG> -Warning- The UNDO command is not available until you change
==MSG>          your edit profile using the command RECOVERY ON.
A SET CURRENT SQLID='DBA104';
  SET CURRENT RULES = 'STD';
000003 CREATE TABLE DBA104.BOOK_BASE_TABLE_TEST
000004     (BOOK_NUMBER          CHAR(10) FOR SBCS DATA NOT NULL
000005     WITH DEFAULT,
000006     DESCRIPTION            CHAR(32) FOR SBCS DATA NOT NULL
000007     WITH DEFAULT,
000008     BOOK_TEXT                CLOB(1 M) FOR SBCS DATA NOT NULL,
000009     BOOK_COVER               BLOB(1 M) NOT NULL)
000010     AUDIT NONE
000011     DATA CAPTURE NONE
000012     CCSID          EBCDIC
000013     NOT VOLATILE;
000014     SET CURRENT RULES = 'DB2';
000015     COMMIT;
***** ***** Bottom of Data *****

If objects created using CURRENT RULE = 'STD'
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```

Specify either the DDL or GEN COMMAND next to a table with LOB columns

The screenshots show a sequence of SQL commands in a DB2 command window:

```

01 SET CURRENT SQLID='PUBLIC';
02 CREATE LOB TABLESPACE DSN8D81L
03     IN DSN8D81L
000004     USING STOGROUP DSN8G810
000005     PRIQTY -1 SECQTY -1
000006     ERASE NO
000007     GBPCACHE CHANGED
000008     LOG NO
000009     DSSIZE 4 G
000010     BUFFERPOOL BPO
000011     LOCKSIZE ANY
000012     LOCKMAX SYSTEM
000013     CLOSE YES
000014     DEFINE YES;
000015     GRANT USE OF TABLESPACE DSN8D81L TO "PUBLIC";
000016     CREATE LOB TABLESPACE DSN8S81B
000017     IN DSN8D81L

```

The second screenshot shows the continuation of the commands:

```

000018     USING STOGROUP DSN8G810
000019     PRIQTY -1 SECQTY -1
000020     ERASE NO
000021     GBPCACHE CHANGED
000022     LOG NO
000023     DSSIZE 4 G
000024     BUFFERPOOL BPO
000025     LOCKSIZE ANY
000026     LOCKMAX SYSTEM
000027     CLOSE YES
000028     DEFINE YES;
000029     GRANT USE OF TABLESPACE DSN8S81B TO "PUBLIC";
000030     CREATE LOB TABLESPACE DSN8S81B
000031     IN DSN8D81L
000032     USING STOGROUP DSN8G810
000033     PRIQTY -1 SECQTY -1
000034     ERASE NO
000035     GBPCACHE CHANGED

```

The third screenshot shows the final part of the commands:

```

000036     LOG NO
000037     DSSIZE 4 G
000038     BUFFERPOOL BPO
000039     LOCKSIZE ANY
000040     LOCKMAX SYSTEM
000041     CLOSE YES
000042     DEFINE YES;
000043     GRANT USE OF TABLESPACE DSN8D81L.DSN8S81B TO "PUBLIC";
000044     SET CURRENT SQLID='DSN8810';
000045     CREATE TABLE DSN8810.EMP_PHOTO_RESUME
000046     (EMPNO          CHAR(6) FOR SBCS DATA NOT NULL,
000047     EMP_ROWID       ROWID NOT NULL GENERATED ALWAYS,
000048     PSEG_PHOTO      BLOB(500 K) WITH DEFAULT NULL,
000049     EMP_PHOTO       BLOB(100 K) WITH DEFAULT NULL,
000050     ) FOR SBCS DATA WITH DEFAULT NULL,
000051     IN DSN8D81L.DSN8S81B

```

A yellow box highlights the output for objects created outside the current rule:

```

000053     IN DSN8D81L.DSN8S81B

```

Output for objects created outside of the CURRENT RULE

DDL COMMAND (cont)

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help

EDIT      SYS09057.T153305.RA000.DBA104.R0178489      Columns 00001 00072
Command ==>
000054    AUDIT NONE
000055    DATA CAPTURE NONE
000056    CCSID      EBCDIC
000057    NOT VOLATILE;
000058    CREATE AUXILIARY TABLE DSN8810.AUX_BMP_PHOTO
000059    IN DSN8D81L.DSN8S81M
000060    STORES DSN8810.EMP_PHOTO
000061    CREATE AUXILIARY TABLE DSN8810.AUX_EMP_PHOTO
000062    IN DSN8D81L.DSN8S81L
000063    STORES DSN8810.EMP_PHOTO
000064    CREATE AUXILIARY TABLE DSN8810.AUX_EMP_PHOTO
000065    IN DSN8D81L.DSN8S81N
000066    STORES DSN8810.EMP_PHOTO
000067    CREATE UNIQUE INDEX DSN8810.AUX_EMP_PHOTO
000068    ON DSN8810.AUX_BMP_PHOTO
000069    PADDED
000070    USING STOGROUP DSN8G810
000071    PRIQTY -1 SECQTY -1

Display Filter View Print Op

```



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help

EDIT      SYS09057.T153305.RA000.DBA104.R0178489      Columns 00001 00072
Command ==>
000072    ERASE NO
000073    FREEPAGE 0 PCTFREE 10
000074    GBPCACHE CHANGED
000075    BUFFERPOOL BP2
000076    CLOSE YES
000077    COPY NO
000078    DEFINE YES
000079    PIECESIZE 4 G;
000080    CREATE UNIQUE INDEX DSN8810.AUX_PSEG_PHOTO
000081    ON DSN8810.AUX_PSEG_PHOTO
000082    PADDED
000083    USING STOGROUP DSN8G810
000084    PRIQTY -1 SECQTY -1
000085    ERASE NO
000086    FREEPAGE 0 PCTFREE 10
000087    GBPCACHE CHANGED
000088    BUFFERPOOL BP2
000089    CLOSE YES

Display Filter View Print Option

```



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help

EDIT      SYS09057.T153305.RA000.DBA104.R0178489      Columns 00001 00072
Command ==>
000090    COPY NO
000091    DEFINE YES
000092    PIECESIZE 4 G;
000093    CREATE UNIQUE INDEX DSN8810.XAUX_EMP_RESUME
000094    ON DSN8810.AUX_EMP_RESUME
000095    PADDED
000096    USING STOGROUP DSN8G810
000097    PRIQTY -1 SECQTY -1
000098    ERASE NO
000099    FREEPAGE 0 PCTFREE 10
000100    GBPCACHE CHANGED
000101    BUFFERPOOL BP2
000102    CLOSE YES
000103    COPY NO
000104    DEFINE YES
000105    PIECESIZE 4 G;
000106    COMMIT;

***** ***** Bottom of Data *****

Display Filter View Print Options Help

```

DROP IMPACT REPORT

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DSNC DROP Impact Analysis Details ----- Row 1 to 8 of 8
Command ==> _ Scroll ==> CSR

SQL Statement: DROP TABLE          "DBA104"."BOOK_BASE_TABLE3"

Commands: RE-SORT  DROP
Line commands:  S - Show object  DRD - DROP RESTRICT on DROP

Sel Type  Object Name/Grantor>Grantee  Owner  Note
  *      *                          *      *
-----
S        DSNDB04.BOOK1NL2              DBA104  Implicit
T        BOOK_BASE_TABLE3           DBA104
S        DSNDB04.LA08310B           DBA104  LOB
T        BOOK_BOOK_A0841Z70         DBA104  Aux. Table
X        IBOOK_BOOK_A084FTW         DBA104
S        DSNDB04.LA08348S           DBA104  LOB
T        BOOK_BOOK_A083TRE7         DBA104  Aux. Table
X        IBOOK_BOOK_A0837I6         DBA104
***** END OF DB2 DATA *****

```

Display dependent auxiliary tables and indexes for LOB objects

MA a 02/015

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DROP LOB Objects

- DROP objects created via the **CURRENT RULE = 'STD'**
 - ❑ Enforcing PK index
 - ❑ Enforcing unique key index
 - ❑ Index on ROWID column on base table if applicable
 - ❑ Auxiliary Table
 - ❑ Auxiliary Index
 - ❑ TS for base table and auxiliary table
- DROP base table or base table space **manually created**
 - ❑ Auxiliary table and auxiliary index are dropped
 - ❑ LOB tablespace remains



Accessing LOB Data

➤ **LOB Host Variable** – value generated by DB2

- ❑ Maximum size 2GB
- ❑ Restrictions:
 - Host language
 - Amount of storage available to the program

➤ **LOB Locator**

- ❑ Access subset of LOB data
- ❑ Generated by DB2 when a LOB string is assigned to a host variable previously identified as a LOB Locator
- ❑ Types
 - BLOB-LOCATOR
 - CLOB-LOCATOR
 - DBCLOB-LOCATOR

01 BLOB-LOCATOR USAGE IS SQL TYPE IS BLOB-LOCATOR.

```
SELECT BOOK_TEXT  
INTO BOOK_TEXT_LOCATOR  
FROM BOOK_BASE_TABLE
```

Accessing LOB Data

➤ LOB File Reference Variables

- ❑ Used to import / export data between a LOB column and an external file outside of DB2
- ❑ Use less CPU and avoid using application storage
- ❑ Bypasses any restrictions of the program language
- ❑ 3 types
 - BLOB_FILE
 - CLOB_FILE
 - DBCLOB_FILE

```
01 MY-BLOB-FILE SQL TYPE IS BLOB_FILE.
```

APAR PK22910 – File Reference Variable Support

➤ **LOAD**

- ❑ Allow an input field value to contain the name of a file containing LOB values
- ❑ NULL input file will create a NULL LOB value

➤ **UNLOAD**

- ❑ Store the value of a LOB column in a file and record the name of the file in the unloaded record of the base table
- ❑ NULL LOB values will result in a NULL output file name
- ❑ If the file does not exist, it will be created using the attributes of a TEMPLATE

Populating a LOB – Data is on a Client

- **Cross-Loader**
- **Application**
- **DB2 for LUW import**
- **DB2 Extenders**
- **FTP data to the host**



Populating a LOB – Data on the Host

- Use the **LOAD** utility
 - ❑ LOAD data as **normal data columns** from a LOAD INPUT file
 - ❑ Use **File Reference Variables** when each LOB value is stored in a separate input file
 - ❑ **Cross Loader** (requires PTF UQ03227 for DB2 V8)

- **Application program**



Populating a LOB – Data on the Host



➤ **LOAD utility** using normal data columns

❑ **Objects <32k**

- Loads LOB data as normal fields from the LOAD input file
- Always LOAD into the base table
- DB2 loads the LOB to the auxiliary table

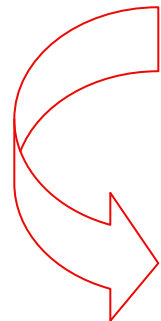
❑ Using **file reference variables** when each LOB values are in separate input files (DB2 9)

• Normal input file

- Contains the data for the non-LOB columns and the names of the LOB input files (BLOBF, CLOBF, DBCLOBF)
- LOAD syntax contains names of input files for LOB
- Base data + file names for LOB data cannot > 32k

• LOB input file

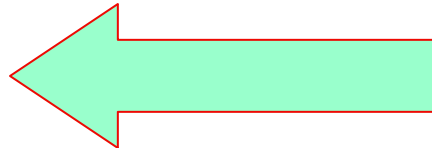
- Can be PDS, sequential file, HFS directory
- Contains the entire LOB value



LOAD Syntax for using File Reference Variables

1 //SYSREC DD *
"000001","UN.DB1.TS1.RESUME(AI3WX3JT)","UN.DB1.TS1.PHOTO(AI3WX3JT)"
"000002","UN.DB1.TS1.RESUME(AI3WX5BS)","UN.DB1.TS1.PHOTO(AI3WX5BS)"
"000003","UN.DB1.TS1.RESUME(AI3WX5CC)","UN.DB1.TS1.PHOTO(AI3WX5CC)"
"000004","UN.DB1.TS1.RESUME(AI3WX5CK)","UN.DB1.TS1.PHOTO(AI3WX5CK)"

LOAD DATA FORMAT DELIMITED
INTO TABLE MY_EMP_PHOTO_RESUME
(EMPNO CHAR,
RESUME VARCHAR CLOBF,
PHOTO VARCHAR BLOBF)



Populating (LOADING) a LOB – Data on the host

❑ **Cross Loader (load data directly from another table)** APAR PQ90263

- LOB value can be > 32k
- DB2 uses a separate buffer for the LOB data – above the 16mb line
- Each LOB column has 8 bytes of information
 - The length of the base data + 8 bytes for each LOB column cannot be > 32k

➤ **Application – INSERT**



- ❑ Use a host variable large enough to hold the entire LOB value
- ❑ Use a host variable not large enough to hold the entire LOB – using LOB LOCATORS
 - Loading the LOB in pieces
- ❑ Use File Reference variables (DB2 9)

Unloading a LOB

- **Application**
 - ❑ **One Host Variable**
 - ❑ **LOB Locators**
 - ❑ **File Reference Variable**
- **DB2 UNLOAD Utility**
 - ❑ **TEMPLATE**
 - ❑ **File Reference Variable**



UNLOAD SYNTAX

TEMPLATE LOBFRV1 DSN 'UNLDTEST.&DB..&TS..RESUME'

DSNTYPE(PDS) UNIT(SYSDA)

TEMPLATE LOBFRV2 DSN 'UNLDTEST.&DB..&TS..RESUME'

DSNTYPE(PDS) UNIT(SYSDA)

UNLOAD DATA FROM TABLE DSN8910.EMP_PHOTO_RESUME

(EMPNO CHAR(6),

RESUME VARCHAR(255) **CLOBF LOBFRV1**,

PHOTO VARCHAR(255) **BLOBF LOBFRV2**)

SHRLEVEL CHANGE

OUTPUT

```
"000001","UN.DB1.TS1.RESUME(AI3WX3JT)","UN.DB1.TS1.PHOTO(AI3WX3JT)"
"000002","UN.DB1.TS1.RESUME(AI3WX5BS)","UN.DB1.TS1.PHOTO(AI3WX5BS)"
"000003","UN.DB1.TS1.RESUME(AI3WX5CC)","UN.DB1.TS1.PHOTO(AI3WX5CC)"
"000004","UN.DB1.TS1.RESUME(AI3WX5CK)","UN.DB1.TS1.PHOTO(AI3WX5CK)"
...
```

IBM DB2 ADMINISTRATION TOOL

- New utility template – **LOBCOLDDN**
- **ALC, RDEF, Rename DB, MIG, and UNLOAD** will generate a LOBTEMPLATE statement into the work statement list (WSL)
- If LOBTEMPLATE is specified the LOB columns are unloaded **before** passing control to DB2 Unload or the IBM DB2 High Performance Unload
- **MIG** supports LOB unloading when using Work Statement List or non-Work Statement List
- All other functions require the use of Work Statement List

DB2 Admin Templates

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
----- Row 1 to 9 of 9
Command ==> Scroll ==> CSR

Line commands: A - Add E - Edit D - Delete

Sel  Name          Creator  Remarks
*   *             *
----->
  CCCOPY          KLTAYLO  Template for primary or backup image copy dat
  CCDISCRD        KLTAYLO  Template for optional data set of discarded r
  CCFILTER        KLTAYLO  Template for optional filter data set used by
  CCPUNCH         KLTAYLO  Template for data set used to receive the LOA
  CCSORTIN        KLTAYLO  Template for temporary work data set for sort
  CCSRTOUT        KLTAYLO  Template for temporary work data set for sort
  CCUNLOAD        KLTAYLO  Template for unload data set used by REORG IN
  EMCOPY3         DBA104   Morellie Copy
  KKCOPY          DNET315
***** END OF DB2 DATA *****

A_

```

Create a LOB Template

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Utility Template ----- 10:44
Command ==>

Enter name and optional remark:

TEMPLATE ==> LOBTMPLT (Template Name)
Remark ==> Template for unloading LOB columns >

Common Options:
UNIT ==> SYSDA (Device Number, Type or Group Name)
DSN ==> ?_

Change other common options ==> N (Yes or No)
Change disk options ==> N (Yes or No)
Change tape options ==> N (Yes or No)

Statement ==> TEMPLATE
  
```

Using the ? To bring up a list of variables to be included in the DSN

MA a 11/020
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List of Variables to Choose From

Session A - [24 x 80]

File Edit View Communication Actions Window Help

DB2 Admin ----- DB1S Utility Template - Dataset Name----- 10:47
 Command==> _

Select symbolic variables or enter non-symbolic characters. Processing for this panel occurs in left to right, and top to bottom sequence. Hit ENTER to process any current choices.

A DSN Model: &US..&DB..&TS..LOB.D&DT..T&TI.

Non-Symbolic characters ==> More: +

Symbolic Variables:

JOBNAME	==>	MVS jobname	STEPNAME	==>	MVS step name
UTILID	==>	Utility ID	SSID	==>	Subsystem ID
ICTYPE	==>	Image Copy Type	UTILNAME	==>	Utility Name
SEQ	==>	Sequence Number	LOCREM	==>	IC DDN usage

B Dataset name may be too long or is invalid:
 -----1-----2-----3-----4-----5-----6-----7-
 DBA104.DBNAMEDB.TSNAMETS.LOB.D2002172.T125959

MR a A 02/014

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Insert Template Definition into the Template Table



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Statement Execution Prompt ----- 10:51
Option ==> _

DB2 Admin is about to execute the statement below. You have asked to be
prompted before DB2 Admin executes this type of statement. What do you want to
do now (add an A for all stmts. For example 1A - Execute all stmts):
  1 - Execute the statement
  2 - Edit the statement
  3 - Create a batch job with the statement
  4 - Add the statement to the work statement list
CAN - Cancel
Work statement list dsn ==> WSL.LIBRARY
Work statement list name ==> DDLOUT      Action ==> A (Append or Replace)
                                           More:      +
Statement that is about to be executed (first 28 lines, more stmts pending):
INSERT INTO DSNACC.UTEMPLATE (
  NAME          ,CREATEDBY ,MODIFIEDBY
,DSN
,DISPSTATUS,DISPNTerm ,DISPATERM ,DEVICETYPE
,MODELDCB ,BUFNO      ,DATACLAS ,MGMTCLAS
,STORCLAS ,DSVOLSER ,GDGLIMIT ,EXPDL
,RETPD    ,UNITTYPE ,PQTY      ,SQTY
,SPACEUNIT ,PCTPRIME ,MAXPRIME ,NBRSECND
,UNCNT    ,STACK    ,JES3DD  ,TRTCH

```

MA a A 02/014

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New Template is Now Available for Use

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
-----
DB2 Admin -- DB1S TEMPLATES in DSNACC.UTEMPLATE          ----- Row 1 from 10
Command ==>                                           Scroll ==> CSR
INSERT stmt executed
Line commands: A - Add  E - Edit  D - Delete

Sel   Name                Creator  Remarks
*    *                    *      *
----->
      CCCOPY              KLTAYLO  Template for primary or backup image copy dat
      CCDISCRD           KLTAYLO  Template for optional data set of discarded r
      CCFILTER           KLTAYLO  Template for optional filter data set used by
      CCPUNCH            KLTAYLO  Template for data set used to receive the LOA
      CCSORTIN           KLTAYLO  Template for temporary work data set for sort
      CCSRTOUT           KLTAYLO  Template for temporary work data set for sort
      CCUNLOAD           KLTAYLO  Template for unload data set used by REORG IN
      EMCOPY3            DBA104   Morellie Copy
      KKCOPY             DNET315
      LOBTMPLT           DBA104   Template for Unloading LOB Columns
***** END OF DB2 DATA *****

```

MA a 17/002

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Use the + Sign to Associate with the DDN

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
----- Row 1 to 10 of 10
Command ==> Scroll ==> CSR
Select by typing '+'
Line commands: A - Add E - Edit D - Delete

Sel   Name           Creator   Remarks
*     *               *         *
----->
      CCCOPY        KLTAYLO  Template for primary or backup image copy dat
      CCDISCRD     KLTAYLO  Template for optional data set of discarded r
      CCFILTER     KLTAYLO  Template for optional filter data set used by
      CCPUNCH      KLTAYLO  Template for data set used to receive the LOA
      CCSORTIN     KLTAYLO  Template for temporary work data set for sort
      CCSRTOUT     KLTAYLO  Template for temporary work data set for sort
      CCUNLOAD     KLTAYLO  Template for unload data set used by REORG IN
      EMCOPY3      DBA104   Morellie Copy
      KKCOPY       DNET315
+ _   LOBTMPLT      DBA104   Template for Unloading LOB Columns
***** END OF DB2 DATA *****

```

MA a 18/003

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When using a Function which needs to Unload LOB data, the LOBCOLDDN will direct the unloaded data to a PDS

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Specify UTILITY TEMPLATE Usage ----- 10:55
Command ==>

Line commands:
T - Toggle Use On/Off   C - Clear data   ? - Choose Template for the Keyword
E - Edit Template
Template type           ==> UTIL         (UTIL,ALT,MIG,RDEF,RES,OC,MISC)
Generate template statements ==> YES      (Yes/No)
Sel Keyword           Use Template Comment
-----
                                                                More:  -

-  MAPDDN
   PUNCHDDN
   RECOVERYDDN1
   RECOVERYDDN2
   UNLDDN
   WORKDDN      1
   WORKDDN      2
   LOBCOLDDN    /  LOBTMPLT Template for Unloading LOB Columns

Note:                               The LOBCOLDDN data set name cannot exceed 35
                                     bytes.  It must be a PDS.  Do not specify a
                                     member name.

MF  a                               A                               12/003
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```

DB2 ADMINISTRATION TOOL - MIG

- Ability to copy object
 - ❑ Definitions
 - ❑ Data
 - ❑ Catalog Statistics
- Starting
 - ❑ Database
 - ❑ Tablespace
 - ❑ Table

**From one subsystem to another
OR
within the same subsystem**

DB2 ADMIN Data Structure – DS Command

DB2 Admin ----- DSN8 Databases ----- Row 1 to 1 of 1
Command ==>

Commands: GRANT MIG DIS STA
Line commands:
T - Tables S - Table spaces X
DIS - Display database STA - S
? - Show all line commands

Select Name	Owner	Storage Group
ds_	DSN8D81L PLS	DSN8G81

DB2 Admin ----- DSN8 Database Structures ----- Row 1 to 14 of 15
Command ==> _

Line commands: S - Show object DSN - Data sets

Sel Type	Object Name	Qualifier	DBID	PSID/ISOBID	OBID	Note
D-----	DSN8D81L-----		264	0	0	
S	DSN8S81B	DSN8D81L	264	2	1	
T	EMP_PHOTO_RESUME	DSN8810	264	0	3	
Y	EMP_PHOTO_RESUME	PLS	0	0	0	
UC	EMPNO		0	0	0	Primary key
X	XEMP_PHOTO_RESUME	DSN8810	264	5	4	
S	DSN8S81L	DSN8D81L	264	7	6	LOB
T	AUX_PSEG_PHOTO	DSN8810	264	0	8	Auxiliary
X	XAUX_PSEG_PHOTO	DSN8810	264	11	10	
S	DSN8S81M	DSN8D81L	264	13	12	LOB
T	AUX_BMP_PHOTO	DSN8810	264	0	14	Auxiliary
X	XAUX_BMP_PHOTO	DSN8810	264	17	16	
S	DSN8S81N	DSN8D81L	264	19	18	LOB
T	AUX_EMP_RESUME	DSN8810	264	0	20	Auxiliary

MIG – Line command or Primary command

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DSNC Databases ----- Row 1 to 1 of 1
Command ==> Scroll ==> CSR
    
```

```

Commands: GRANT MIG DIS S
Line commands:
T - Tables S - Table space
DIS - Display database STA
? - Show all line commands

Select Name      Owner      Sto
-----
*          *          *
-----
mig_ DSN8D81L PLS DSN
*****

Menu Options View Utili
MA a
Connected to remote server/host demomvs.demopkg.ibm.com using lu/po
    
```

```

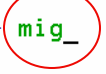
Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DSNC Migrate Table Spaces ----- Row 1 to 4 of 4
Command ==> mig_ Scroll ==> PAGE

Commands: MIG - Generate jobs ADD - Add databases SPACE - Show space info
MIGRI - Add all RI related table spaces

Line commands:
D - Delete T - Show tables ADDRI - Add RI related table spaces
RIT - Show RI related tables

Select Base      Table Space      No of Part Tables LOB      Table RI Relations Added
-----
*          *          *          * *          * *
-----
DSN8D81L DSN8S81B      0          1 YES          0 NA
DSN8D81L DSN8S81L      0          1 YES          0 NA
DSN8D81L DSN8S81M      0          1 YES          0 NA
DSN8D81L DSN8S81N      0          1 YES          0 NA
***** END OF DB2 DATA *****

Menu Options View Utilities Compilers Help
MA a
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02/018
    
```



MIG – Fill in the Parameter Panel

DB2 Admin ----- DB1S Migrate Param
Option ==>

Please specify the following for DB2 Admin Migrate:

Worklist name : MIG (also use

Data set information:
PDS for batch jobs . . . : JCL.MIG
Prefix for datasets . . . : DBA104

Target system parameters:
DB2 subsystem id (SSID) . : DB1S DB2 re
Target system node name . : Submit
DB2 load library : DB2.V9R1.SDSNLOAD
DB2 sample pgm load lib . : DB2.V9R1.SDSNEXIT
New TS storage group . . . : > New IX
New database : > New ow
New grantor : >
Catalog qualifier : > (defau
when s

Display Filter View Print Options Help

MA a

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DB2 Admin ----- DB1S Migrate Parameters ----- 16:00
Option ==>

Please specify the following for DB2 Admin Migrate: DB2 System: DB1S
DB2 SQL ID: DBA104
More: - +

Scope of migrate:

DDL : Y (Yes/No)
Data : Y (Yes/No)
Catalog statistics : N (Yes/No)

DROP on target before CREATE . . : NO (Yes/No, No if scp. is data only)
Create storage group : NO (Yes/No)
Generate GRANT statements . . . : NO (Yes/No)
Run SQL ID : DBA104 (Blank a SQL ID, or <NONE>)

Unload
Parallel

Optional
Run CH
Run RU
Run IM
Run RE

Display

MA a

Connected to remote ser

DB2 Admin ----- DB1S Migrate Parameters ----- 16:00
Option ==>

Please specify the following for DB2 Admin Migrate: DB2 System: DB1S
DB2 SQL ID: DBA104
More: - +

DB2 subsystem id (SSID) . . : DB1S DB2 release :
Target system node name . . : Submit job at local . : NO (Yes/No)
DB2 load library : DB2.V9R1.SDSNLOAD
DB2 sample pgm load lib . . : DB2.V9R1.SDSNEXIT
New TS storage group . . . : > New IX storage group : >
New database : > New owner of objects : >
New grantor : >
Catalog qualifier : > (default SYSIBM , only applicable
when scope contains catalog stats.)

Migrate options:
Generate MIG jobs in batch . . . : NO (Yes/No)
Generate work stmt list : NO (Yes/No)
Use masking for batch migrate . . : YES (Yes/No, N if stmt list is Y)
Combine job steps : YES (Yes/No, Yes if HPU Unload)
Member prefix for combined jobs : ABLOB (default ADBMG)

Display Filter View Print Options Help

MA a

Connected to remote server/host demomvs.demopkg.ibm.com using lu/pool TCP00043 and port 23

22/042

Once completed hit ENTER

MIG - MASK

The image shows two overlapping terminal windows from a DB2 Admin session. The top-left window displays the 'Specify Mask' screen with the following details:

```

DB2 Admin ----- Specify Mask -----
Command ==>

Mask Table Entry:
  Owner . . . . . >
  Name . . . . . >
Data Set:
  Mask DSN . . . MASK.FILE(WLTBLOB1)
Options:
  Edit Mask . . . yes _
    
```

The bottom-right window shows the execution of a command and its output:

```

DB2 Admin ----- Columns 00001 00072
Command ==>                               Scroll ==> CSR

==MSG>      DEFINE: DBNAME*,*TSPC,REXX (MYDEFINE,DEFINE='YES')
==MSG>
==MSG> -Warning- The UNDO command is not available until you change
==MSG>          your edit profile using the command RECOVERY ON.
000100  DBNAME: DSN04052, SSEMMD88
000200  TSNAME: WLTBLCLN, SS88TS01
000500  TBNAME: WLTBLCLNTINTRVWQST*, SS88TB01_BASE
000600  TOWNER: DSN04052, DBA104
000700  TOWNER: DBO, DBA104
***** Bottom of Data *****
    
```

A red square icon with a white letter 'A' is overlaid on the first window. The status bar at the bottom of the second window shows '11/010'.

MIG – TEMPLATE's

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help

EDIT          DBA104.JCL.MIG(ADLOBS1) - 01.00          Columns 00001 00072
Command ==>                                         Scroll ==> CSR
000195 //SYSREC DD DSN=DBA104.MIG.ULD.S1,
000196 //          DISP=(MOD,CATLG),
000197 //          SPACE=(TRK,(1,1),RLSE),
000198 //          UNIT=SYSDA
000199 //SYSPUNCH DD DSN=DBA104.MIG.CNT.S1,
000200 //          DISP=(MOD,CATLG),
000201 //          SPACE=(TRK,(5,5),RLSE),
000202 //          UNIT=SYSDA
000203 //SYSIN DD *
000204   ADMIN LOBTEMPLATE ADL1
000205   DSN 'DBA104.MIG.&DB..&TS.';
000206   ADMIN LOBTEMPLATE ADL2
000207   DSN 'DBA104.MIG.&DB..&TS.';
000208   ADMIN LOBTEMPLATE ADL3
000209   DSN 'DBA104.MIG.&DB..&TS.';
000210   UNLOAD TABLESPACE DSN8D81A.EMPPRTS
000211   FROM TABLE
000212   "DDS0788"."EMP_PHOTO_RESUME"
000213   ;
000214 //          ENDIF
  
```

TEMPLATES

MA a 04/015

Connected to remote server/host demomvs.demopkg.ibm.com using lu/pool TCP00092 and port 23

LOB OUTPUT DATA SET

Session A - [24 x 80]

File Edit View Communication Actions Window Help

Menu Functions Confirm Utilities Help

BROWSE DBA104.MIG.DSN04052.LY8L1QK4 Row 00001 of 02022
 Command ==> Scroll ==> CSR ID

Name	Prompt	Size	Created	Changed
B8XR0X37				
B8XR0X5J				
B8XR0X51				
B8XR0X6M				
B8XR0X66				
B8XR0X70				
B8XR0X78				
B8XR0X8V				
B8XR0YAE				
B8XR0YAX				
B8XR0YBG				
B8XR0YBY				
B8XR0YCG				
B8XR0YC1				
B8XR0YDL				

1 MEMBER / ROW in the Table

File Edit Edit_Settings Menu Utilities Compilers Test Help

EDIT DBA104.JCL.MIG(ABLOBT1) - 01.00 Columns 00001 00072

MA a A 04/015

Connected to remote server/host demomvs.demopkg.ibm.com using lu/pool TCP00043 and port 23

Why do you need to REORG a LOB table space or auxiliary index?

- Performance
- Reclaim physical space

How do you know when to do a REORG?

- ORGRATIO and FREESPACE in SYSLOBSTATS
- DSNUM and EXTENTS in SYSTABLEPART
- DSNUM, EXTENTS, LEAFNEAR, LEAFFAR, and PSEUDO_DEL_ENTRIES in SYSINDEXPART
- REORGINSERTS, REORGDLETES, REORGUPDATES, REORGDISORGLob, REORGMASDELETE, and EXTENTS in SYSTABLESPACES

LST Line command to display LOB stats

The image shows two overlapping screenshots of a DB2 terminal window. The top screenshot shows the command prompt and the execution of the LST command. The bottom screenshot shows the output of the LST command, which is a table of LOB statistics.

Terminal Output (Top Screenshot):

```

DB2 Admin ----- DSN Table Spaces ----- Row 1 to 1 of 1
Command ==>
Scroll ==> CSR

Commands: GRANT MIG DIS STA STO
Line commands:
T - Tables D - Databases
DIS - Display table spaces
? - Show all line commands

Select Name      DB Name
-----
*                *
LST             DSN8S81M DSN8D81M
*****
    
```

Terminal Output (Bottom Screenshot):

```

DB2 Admin -- DSN LOB Stat for DSN8D81L.DSN8S81M ----- Row 1 to 1 of 1
Command ==> _
Scroll ==> CSR

Line commands:
I - Interpret RH - Runstats History

Sel Date/Time of Update   Avg Size   Free Space   Org
-----
*                         *                 *         *
2007-06-29-05.47.40      63117      2540         100.00
***** END OF DB2 DATA *****
    
```

Annotations:

- FREESPACE** – amount of space available for more LOBS (in KB)
 - Updates LOBS are written out – their old space becomes free
 - As FREESPACE approaches 0 → time to RESIZE using REORG SHRLEVEL REF
- ORG RATIO**
 - 100 = Perfect organization
 - 1 = Disorganized
 - 0 = Fully disorganized

REORG of LOB Table Spaces SHRLEVEL NONE

- Performed in-place by moving individual LOB's within the LOB table space (No UNLOAD / LOAD)
 - "Re-chunk" LOB's to ensure where possible that all pages belonging to an individual LOB are stored in contiguous chunks (sets of 16 contiguous pages) within the table space.
- Free space could **not** be reclaimed (No delete / redefine)
- **No access to LOB data** during REORG
- **Logging** was required
- **No inline image copy**
- **Not restartable** in the REORGLOB phase

REORG of LOB Table Spaces DB2 9 ***SHRLEVEL REFERENCE***

- Original LOB TS is drained of writers (no UPDATE access)
- All LOB's are extracted from the original data set → shadow data set
- New auxiliary index is built on the shadow data set
- All access to the LOB data set is stopped
- Switch from the original data sets to the shadow data sets
- Access to the new data set is allowed
- Inline copy is taken
- No logging required

**RECOMMENDED METHOD for
REORG LOB Table Spaces**

IBM DB2 ADMINISTRATION TOOL and DB2 AUTOMATION TOOL support the new SHRLEVEL REF REORG for LOB's

```

Session A - [24 x 80]
DB2 ADMINISTRATION TOOL
DB2 Admin ----- DB1S Specify Utility Options - REORG ONLINE ----- 13:49
Option ==> _

Execute utility on table space DSN8D81A.EMPPTS
using the following options:

REUSE          ==> YES      (Yes/No, reset/reu
SCOPE          ==>         (A-ALL, P-PENDING,
REBALANCE     ==>         (Yes/No, rebalance
                    partitions)
PART RANGE    ==>         : (Example: 1:
LOG           ==> NO      (Yes/No, log recor
SORTDATA      ==>         (Yes/No, sort in c
NOSYSREC      ==>         (Yes/No, sort outp
SORTKEYS      ==>         (Yes/No, sort inde
SHRLEVEL      ==> R      (Type of access al
                    execution, R-Refe

OFFPOSLIMIT   ==>         (integer, default
INDREFLIMIT   ==>         (integer, default
REPORTONLY    ==>         (Yes/No, REORG to
UNLOAD        ==>         (Whether utility c
                    C-Continue(default

MA a
Connected to remote server/host demomvs.demopkg.ibm.com using lu/pool TCP00092 and port 23
    
```

```

Session A - [24 x 80]
DB2 AUTOMATION TOOL
AUTOTOOL V3R1 ----- Online Reorg options ----- 2009/03/04 13:53:19
Option ==> _____ Scroll ==> PAGE
Commands: END - Return to the previous screen.

Creator: DBA104      Name: LOB REORG      User: DBA104

Enter the options to associate with this utility profile

Sharelevel . . . . . ==> R [R - Reference, C - Change, N - None]
Drain Wait . . . . . ==> _____ (blank, 0-1800 seconds)
Retry . . . . . ==> _____ (blank, 0-255)
Retry Delay . . . . . ==> _____ (blank, 1-1800 seconds)
Timeout . . . . . ==> I (A - Abend, T - Term, N - None)

Include Update
Deadline Options ==> N (Y - Yes, N - No) ==> N (Y - Yes, N - No)
Shrlevel Change Options ==> Y (Y - Yes, N - No) ==> N (Y - Yes, N - No)

MA a
Connected to remote server/host demomvs.demopkg.ibm.com using lu/pool TCP00092 and port 23
    
```

REORG of LOB Auxiliary Indexes

- LOAD inserts keys into the auxiliary index
 - ❑ Free space may be consumed
 - ❑ Index splits may occur
 - ❑ REORG Auxiliary Index after a LOAD
- Identical to the REORG for a regular index
- SHRLEVEL
 - ❑ NONE
 - ❑ REFERENCE
 - ❑ CHANGE

**REORG LOB TABLE SPACE
REBUILDS THE AUXILIARY
INDEX**

CHECK LOB DB2 9

- Introduces support of SHRLEVEL REFERENCE and SHRLEVEL CHANGE options for **CHECK LOB** as well as to **CHECK DATA**
- Can only be run against a LOB table space
- Only accesses the LOB table space – does not access the base table or the auxiliary index
- Because CHECK DATA relies on information in the auxiliary table space and index are correct – should run the following 1st
 - ❑ Run a CHECK LOB
 - ❑ Run CHECK INDEX on the auxiliary index
 - ❑ Run CHECK INDEX on the base table indexes
- Reports **Does not report on missing LOBs**
 - ❑ Invalid LOB's – set by RECOVER for an uncorrected column error
 - ❑ Defective LOB's – logically inconsistent; structural defect

CHECK SHRLEVEL REFERENCE

- If object is in CHKP or AUXW status and there are **no errors** → **resets the pending states**
- If object has **errors**, will set the LOB table space to **AUXW status**
- Process
 - ❑ **Drains all the readers and writers** / set the LOB TS in CHKP
 - ❑ If a LOB is found to be invalid → **DSNU7431**
 - Identified by the ROWID and LOB version #
 - Reason code for the error
 - Page number
 - Sets LOB table space to AUXW status (**base table is available**)
 - **Fix an invalid LOB by updating or deleting the entire row**



ONLINE CHECK SHRLEVEL CHANGE

- Allows concurrent read and write access to the target data.
- Runs against shadow copies of the target objects populated by flash (snapshot) copy
- Will NOT set the pending states or reset pending states
- Displays error messages indicating problems
- Process
 - ❑ Create shadow copy
 - ❑ Drains all writers and readers until snapshot is complete (LOB TS is in UTRO status)
 - ❑ Issues message DSNU7431 if an invalid LOB is found
 - ❑ SYSPUNCH – generate REPAIR DELETE statements to delete bad LOB's at a later time
 - ❑ Can use SQL to update / delete LOB's



DB2 ADMINISTRATION TOOL assists with the generation of the CHECK LOB syntax

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Specify Utility Options - CHECK LOB ----- 15:07
Option ==>

Execute utility on table space DSN04910.LAVZJJL7
using the following options:

EXCEPTIONS ==> (Max number of exceptions)
SORTDEVT ==> (Device type)
SORTNUM ==> (Number of sort devices)
DRAIN WAIT ==> (Seconds to wait for drain)
RETRY ==> (Maximum number of retries)
RETRY DELAY ==> (Minimum delay between retries)

CLONE ==> (Yes/No, Y=N, N=Y)
SHRLEVEL ==> C (Type of execution)
    
```

```

DB2 ADMINISTRATION TOOL
File Edit Edit_Settings Menu Utilities Compilers Test Help
EDIT DBA104.SPFTEMP1.CNTL Columns 00001 00072
Command ==> Scroll ==> CSR
000015 /*
000016 /* STEP CLOB1: CHECK LOB TABLESPACE DSN04910.LAVZJJL7
000017 /*
000018 /******
000019 /*
000020 //CLOB1 EXEC DSNUPROC, SYSTEM=DB1S,
000021 // LIB='DB2.V9R1.SDSNLOAD',
000022 // UID=''
000023 //DSNUPROC.SYSIN DD *
000024 CHECK LOB TABLESPACE DSN04910.LAVZJJL7
000025 SHRLEVEL CHANGE
***** ***** Bottom of Data *****
    
```

- CHECK LOB requires the name of the TS
- If the TS was generated by DB2, user has to find the name
- DB2 ADMIN FOUND THE NAME OF THE TABLESPACE

Use CHECK DATA – To find bad LOB's

- Checks **consistency between a base table space** and it's corresponding **LOB table spaces**
- Runs against the **base table space**
- Accesses information from the base table space and all auxiliary indexes
 - ❑ Depends on the information in the LOB table space and auxiliary index is accurate
- Run
 - ❑ After a conditional restart
 - ❑ After a point-in-time recovery
 - ❑ When base table space is in auxiliary check pending (ACHKP) or auxiliary warning state (AUXW)

Possible LOB Column Errors

Message identifies table, row, column and type of error

- AUXERROR REPORT or LOBERROR REPORT
- AUXERROR INVALIDATE or LOBERROR INVALIDATE

ERROR	DESCRIPTION
Orphan LOB Column	LOB in LOB table space, not referenced by the base table. If this is the only error → base table is considered correct.
Missing LOB's	A LOB is referenced by a base table, but it is not in the LOB table space
Out of Synch LOB's	LOB found in the base table and LOB table space, but they are at different levels OR Base table is null or has 0 length, but the LOB exists in the base table space
Invalid LOB's	Uncorrected LOB column error found by a previous execution of CHECK DATA AUXERROR INVALIDATE

CHECK DATA SHRLEVEL REFERENCE

	AUXERROR or LOBERROR REPORT	AUXERROR or LOBERROR INVALIDATE
Base Table not in ACHKP	Drain all SQL writers –	Drains all SQL readers and writers
	Base TS & LOB TS set to UTRO – read is allowed	Base TS & LOB TS set to UTUT – no access to table
Find errors		Base TS = ACHKP – whole table or partition is unavailable → -904
Invalid LOBs		Sets invalid flag in base TS If column was invalid prior to the CHECK run, and remains invalid, the base TS is set to AUXW – table is available

CHECK DATA SHRLEVEL CHANGE

- Base table space is available
- Processing occurs on the shadow copy
- Snapshot to the shadow copy
 - ❑ Writers are drained during this process
 - ❑ All table spaces are in UTRO status
 - ❑ Table spaces are set to UTRW when snapshot is completed
- Does not set or reset any table space stats

CHECK DATA SHRLEVEL CHANGE

	AUXERROR REPORT	AUXERROR INVALIDATE
Find errors	Shadow data sets are deleted	Does not invalidate LOB columns in error – does not set the invalidate flag
	Base TS remains available	
No errors	If the base TS was in ACHKP status prior to the CHECK – remains in ACHKP status	Does not reset the invalid status.
		Does generate REPAIR statements in SYSPUNCH to invalidate the LOB's
DELETE YES	Does not delete the rows, but will generate REPAIR LOCATE DELETE statements in PUNCHDDN	

CHECK DATA - Finds bad LOB's

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 Admin ----- DB1S Specify Utility Options - CHECK DATA ----- 15:18
Option ==> _

Execute utility on table space DSN04910.LAVZJJL7
using the following options:

SCOPE      ==>
AUXERROR   ==>
LOBERROR    ==> R
XMLERROR    ==>
EXCEPTIONS ==>
SORTDEVT    ==>
SORTNUM     ==>
SHRLEVEL    ==> C
CLONE       ==>
    
```

```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
DB2 ADMINISTRATION TOOL
File Edit Edit_Settings Menu Utilities Compilers Test Help
EDIT      DBA104.SPFTEMP1.CNTL          Columns 00001 00072
Command ==>
000055 TEMPLATE UTLPUNCH DSN ''
000056 UNIT SYSDA
000057 ;
000058 CHECK DATA TABLESPACE DSN04910.LAVZJJL7
000059 LOBERROR REPORT
000060 ERRDDN(UTLERR)
000061 SHRLEVEL CHANGE
000062 WORKDDN(UTLUT1,SORTOUT)
000063 PUNCHDDN(UTLPUNCH)
000064 ;
000065 TSODELETE 'DBA104.SYSUT1' ;
000066 TEMPLATE UTLUT1 DSN 'DBA104.SYSUT1'
000067 UNIT SYSDA
000068 ;
000069 TSODELETE 'DBA104.SORTOUT' ;
000070 TEMPLATE UTLOUT DSN 'DBA104.SORTOUT'
000071 UNIT SYSDA
000072 ;
000073 TSODELETE 'DBA104.SYSERR' ;
000074 TEMPLATE UTLERR DSN 'DBA104.SYSERR'
    
```

ONLINE CHECK INDEX

- Run against auxiliary indexes to verify each LOB is represented by an index entry
- Issues warning messages when inconsistencies are found
- Options
 - ❑ SHRLEVEL REFERENCE – RO
 - ❑ SHRLEVEL CHANGE – RW
 - Uses shadow copies
- Action
 - ❑ Does not set pending statuses
 - ❑ Does no correct inconsistencies
- To Fix – REBUILD INDEX

COPY

- FULL or INCREMENTAL
- SHRLEVEL
 - ❑ REFERENCE
 - ❑ CHANGE
- Copy auxiliary indexes
- DB2 9 when using LOG NO on the base table – need to copy – to get a consistent point of recovery; RECOVER TO LASTCOPY
 - ❑ LOB table space
 - ❑ Base table space



RECOVER of LOB Objects

- **Planning** is similar to planning used for objects having application RI
- **2 invalid flags / LOB**
 - ❑ Base table space – LOB indicator – reset by CHECK DATA
 - ❑ LOB table space – reset by RECOVER
- **RECOVER to Point in Time**
 - ❑ Need a common point of consistency
 - Set of image copies
 - Quiescepoint
 - ❑ If base and LOB data is not recovered together → ACHKP (Auxiliary Check Pending)

RECOVER of LOB Objects

- Need to establish a **QUIESCE** point – **TABLESPACESET**
 - ❑ A group of tablespaces that are referentially related
 - ❑ Base tablespace with all its LOB tablespaces

The screenshot shows a terminal window titled "Session A - [24 x 80]" with a menu bar (File, Edit, View, Communication, Actions, Window, Help) and a toolbar. The main content is a JCL script for quiescing a tablespace set. The script includes comments and commands for quiescing the tablespace set DSN04910.LAVZJJL7. A yellow box highlights the text "DB2 ADMINISTRATION TOOL". At the bottom, there is a status bar showing "SDSF HELD OUTPUT DISPLAY ALL CLASSES LINES 40,809 LINE 1-15 (38)" and a connection status "Connected to remote server/host demomvs.demopkg.ibm.com using lu/pool TCP00092 and port 23".

```

EDIT          DBA104.SPFTEMP1.CNTL          Columns 00001 00072
Command ==> _____ Scroll ==> CSR
000011 //*****
000012 //*
000013 //*****
000014 //* STEP QUIESCE: RUN QUIESCE
000015 //*****
000016 //QUIESCE EXEC DSNUPROC,SYSTEM=DB1S,
000017 //          LIB='DB2.V9R1.SDSNLOAD',
000018 //          UID=''
000019 //DSNUPROC.SYSIN DD *
000020 QUIESCE TABLESPACESET DSN04910.LAVZJJL7
000021 WRITE YES
***** ***** Bottom of Data *****

```

DB2 ADMINISTRATION TOOL

Display Filter View Print Options Help

SDSF HELD OUTPUT DISPLAY ALL CLASSES LINES 40,809 LINE 1-15 (38)

MA a A 04/015

Connected to remote server/host demomvs.demopkg.ibm.com using lu/pool TCP00092 and port 23

RECOVER of LOB Objects

➤ RECOVER to Current

- ❑ DB2 applies IC
- ❑ Reads the log and applies the changes
 - If the LOB TS is defined LOG NO → LOB table space is marked invalid (AUXW)
 - Need to run CHECK LOB on LOB TS
 - Need to run CHECK DATA on Base TS – find those that are not synchronized
 - Use SQL Update or delete the entire rows to correct

If the base table space and the LOB table space are both defined LOG NO – can only recover to the last IC

REFERENCES

- DB2 UDB for z/OS home page

<http://www.ibm.com/software/data/db2/zos/index.html>

- LOBs with DB2 for z/OS: Stronger and Faster, SG24-7270

- DB2 9 for z/OS Technical Overview, SG24-7330

- DB2 Tools for z/OS home page

<http://www.ibm.com/software/data/db2imstools>



SUMMARIZE

- LOB's are a critical resource in the realm of DB2 today
- The management of LOB's can be taxing
- Improvements are being delivered with each new release of DB2
- The IBM DB2 Administration Tool can assist with the management of the objects
- The IBM DB2 utilities have provided the means of handling objects > 32k

