IBM DB2 Storage Management Utility

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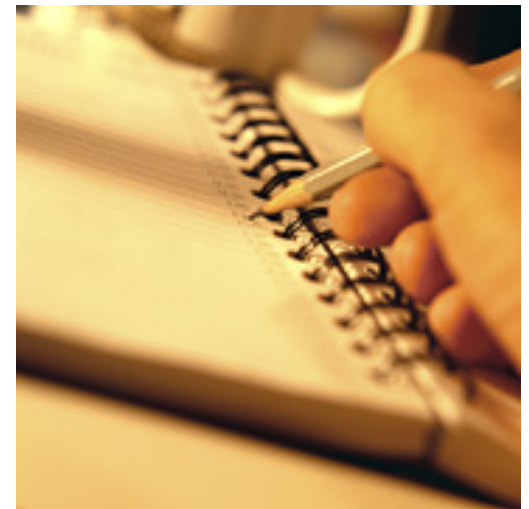
Information Management software

Agenda

- Storage Management Issues

- IBM DB2 Storage Management Utility Overview

- Why SMU DB2?

- Three Challenges

- DB2 SMU Solves these Problems

- Q & A

Ask yourself the following questions:

- Are you being challenged with how to analyze space related factors that impact your DB2 environment?

- Do you need a way to review growth trends to assist with capacity planning?

- Do you ever have the need to view a map of the space used by DB2?

- Do you want a way to easily clean up widows and/or orphans?

In the past ….

- DBA's had to work closely with

    operators, storage managers, systems programmers, and performance analysts

    on storage management issues with their DB2 objects in order to ensure satisfactory performance.
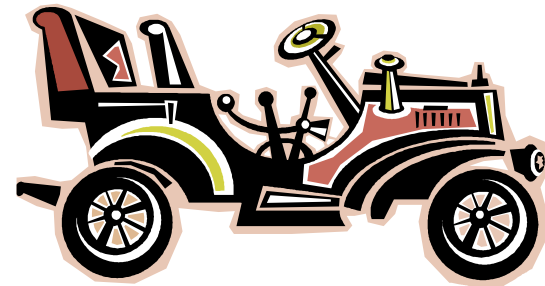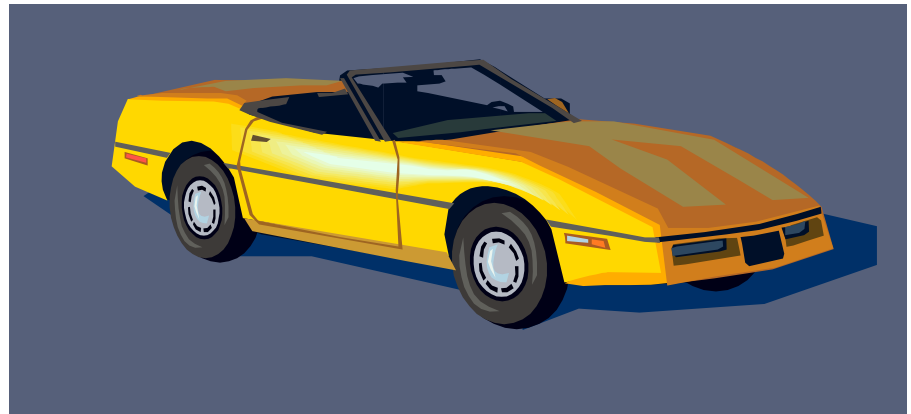
Today …

With the **explosion** of the number of objects being stored in DB2

SMS has become widely used for managing placement of DB2 data sets

HOWEVER, there is still a need to manage data storage in DB2

IBM has provided some facilities to assist you in a couple of the DB2 Data Base Tools offering

- **DB2 Automation Tool**

  - <u>Data Page Display</u> – display and edit data

    - Verification Reports
    - Display contents of a page
    - Repair errors

  - <u>Data Set Manager</u> – relocate objects

    - Display table space or index data set attributes
    - Move TS or IS to another volume
    - Change the STOGROUP of a TS or IS
    - Change the VCAT name
    - Change the size of the TS or IS

Another tool is the …

- **DB2 Administration Tool** – Space Manager feature
  - Displays DB2 and VSAM statistics for DB2 page sets
    - Wildcarding (dbname, tsname, owner, VCAT or STOGROUP)
  - Statistical data is gathered from the DB2 Catalog and merged with information from the VSAM catalogs
  - Alter page set properties
  - Resize page sets to eliminate extents and free unused space
  - Toggle between STOGROUP and VCAT defined spaces
  - Estimate primary and secondary space allocations for new TS and IS
    - Tweak various parameters
      - Table spaces: # rows, avg. row size, pg. size, max rows / page, compression, % free, free pg., segment size, unit type
      - Index spaces: unique, distinct, piecesize
  - Can work against the DB2 Catalog or a copy of the Catalog

In March, 2007, IBM announced a new tool -

- **DB2 Storage Management Utility**
  - Assist in **tuning DB2 performance** by providing space-related information, such as over-allocated data sets, data sets in extents, migrated data sets, and multivolume data sets
  - Provide historical information for **DASD trend analysis and capacity planning**, including information about the number of data sets, number of extents, and the amount of space allocated compared to the amount of space that is used
  - Generate **batch jobs** that can be run after prime hours which helps to reduce processing costs

IBM DB2 STORAGE MANAGEMENT UTILTY Space Management Tool

- **ISPF interface** to display information by volume, database, or DB2 space, which makes it easy to **understand DASD constraints**

- **Verify integrity** of DB2 table spaces and index spaces

- Review **space map pages**

- **Simplify the cleanup** of nonexistent and forgotten DB2 objects

  - View migrated data sets

  - Identify **orphan** data sets

  - Identify **widows**

IBM DB2 STORAGE MANAGEMENT UTILITY

DB2 Catalog

Extract information online or via a batch job

PDS

Scan TS or IS Reads / analyzes pages

Space Map Analysis

Verify integrity

Batch mode

Batch mode

Reports specific for:
Table space information
Segmented table space information
Compressed table space information
Index spaces

Reports:
Summary
Graphs of updated pages
Maps of updated pages
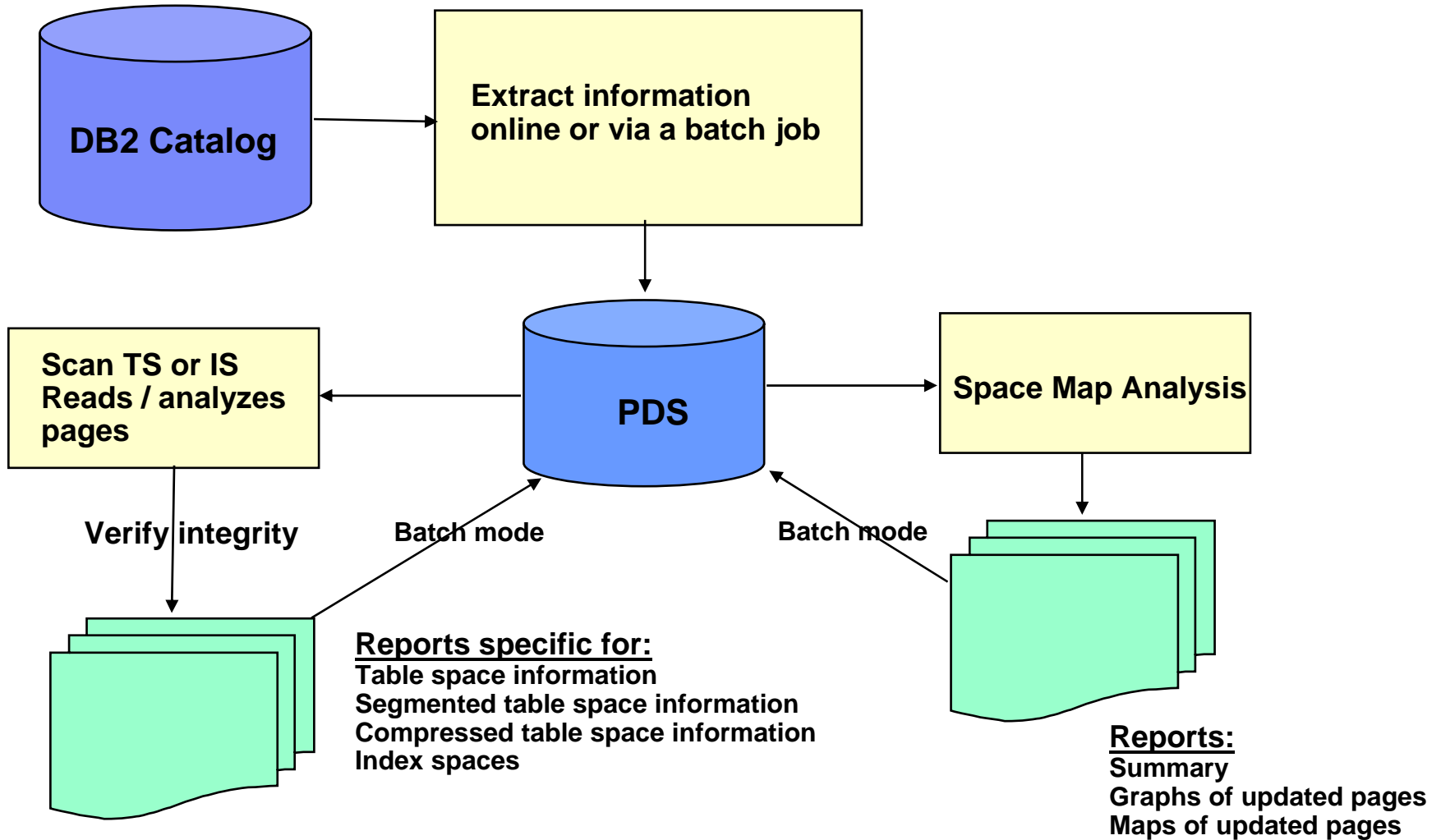
DB2 STORAGE MANAGEMENT UTILITY
Scanning Table Spaces or Index Spaces

- **Verify the integrity** of DB2 table spaces or index spaces using the scan feature

- Can be run online or in batch

- Do **not** have to stop DB2 database(s) or data spaces

- **Output:** a set of statistics and a number of reports

  - Reports are saved in a PDS

- **Scan process**

  - Reads all of the pages of the table space or index space

  - Analyzes the pages it has read to identify

  integrity problems

  - Reports the occurrence of any errors

- Errors can be corrected immediately

DB2 STORAGE MANAGEMENT UTILITY
Space Mapping

- **Analyze the space maps** of table space and index spaces – overall picture of the condition of a given space

- Can be run online or in batch

- Faster than scan – can be used nightly

- **Output:** Numerical reports, graphs, and detailed maps of space

  – Extent and distribution of free space

  – Updated pages

- **Analysis Process**

  – DB2 data set is allocated and opened

  – SMU analyzes the space map page

  – Data sets are closed and de-allocated

DB2 STORAGE MANAGEMENT UTILITY
Manage Exceptions

- **3 types of data spaces as exceptions**

  - **Migrated data sets**
    - Can delete without first recalling them

  - **Orphan** data sets
    - Physical VSAM data sets that exist, but have no corresponding DB2 objects in the DB2 Catalog
    - Delete

  - **Widow** data sets
    - (*ERROR)
    - Data sets that exist in the DB2 Catalog, but have no corresponding VSAM data sets
    - Can be DROPPED

IBM DB2 Storage Management Utility

Three Scenarios

Information Management software

DB2 SMU – Three Scenarios

- Space Management

- Identifying Errors

- Dealing with Widows and Orphans

DB2 SMU Primary Menu

```
DB2SMU-DSNB                    Primary Menu                       10:03
Cmd ===>


              IBM DB2 Storage Management Utility for z/OS v 1.1


     Option ===> _


             0.   User Settings            8.    VCATS
             1.   Volumes                  9.    DASD Summary
             2.   Multivolume             10.    SMS Info
             3.   Databases               11.    Recall Options
             4.   Data Spaces             12.    Batch Job
             5.   Orphans                 13.    Exit
             6.   Widows
             7.   Stogroups              Global Commands
                                         SQL  Dynamic SQL



     Used=    59%      as of Last Extract run on  03/06/07  at  12:26
     Unused=    12.4     of a Single Density Volume.
```

Display SMS Information

```
KTSPSMSD E REPORT MENU --  DISPLAY SMS INFORMATION                    10:26
Cmd ===> _                                             Scroll ===> PAGE
                                                  SPACE 1,158 OF 13,579

Commands:  MENU
Line Commands: ? - Menu  D - Details  L - List I - SMS Info
               S - Scan  P - Spacemap  X - Extents
---------------------------------------------------------------------------

                         I NO. ALLO   % DS           STOR     MGMT     DATA
SEL  DBNAME   SPACE     PT X XTS TRACKS USED VOLSER CLASS    CLASS    CLASS
---  -------  -------   --- - --- ---------------- -------- -------- --------
_    DBASYS3A XEMP1NFB   1 I   1       1100.0DMPD08 DMBASE   DMMGMT   (NULL)
_    DBASYS3A XPROJ1RR   1 I   1       1100.0DMPD26 DMBASE   DMMGMT   (NULL)
_    DBASYS3A XACT1RRS   1 I   1       1100.0DMPD10 DMBASE   DMMGMT   (NULL)
_    DBASYS3A DBASYS3D       1       1100.0DMPD25 DMBASE   DMMGMT   (NULL)
_    DBASYS3A XACT2RRS   1 I   1       1100.0DMPD28 DMBASE   DMMGMT   (NULL)
_    DBASYS3A XDEPT3RR   1 I   1       1100.0DMPD20 DMBASE   DMMGMT   (NULL)
_    DBASYS3A XEMP1RRS   5 I   0       0  0.0*ERROR N/A      N/A      N/A
_    DBASYS3A XDEPT1RR   1 I   1       1100.0DMPD23 DMBASE   DMMGMT   (NULL)
_    DBASYS3A DBASYS3R       1       1100.0DMPD23 DMBASE   DMMGMT   (NULL)
```

DASD Summary History

DASD History Detail

```
KTSPSUMM NB                     DASD HISTORY DETAIL                        10:41
Cmd ===>                                                        Scroll ===> PAGE


 Press PF3 to return to previous screen.
--------------------------------------------------------------------------------


             01/11/07  DATE OF EXTRACT
                11:42  TIME OF EXTRACT


                   66  VOLUMES
               13,577  DATASETS
                    7  MIGRATED DATASETS
                  237  *ERROR DATASETS
                    2  MULTIVOLUME DSETS
               14,113  EXTENTS
                  1.1  EXTENTS/DATASET
    ALLOCATED:
             20,219.4  MB
              421,237  TRACKS
                 31.6  TRACKS/DATASET
    USED:
             11,772.0  MB
              245,402  TRACKS
```

Multi volume Datasets

```
DB2SMU-DSNB                DISPLAY DB2 MULTIVOL DSETS                    14:53
Cmd ===>                                                    Scroll ===> PAGE
                                                            SPACE 1 OF 5

Commands:    MENU
Line Commands: ? - Menu   D - Details  L - List   I - SMS Info
               S - Scan  P - Spacemap  X - Extents
--------------------------------------------------------------------------------
                                PQTY   SQTY NO.     ALLO    USED % DS        D
SEL   DBNAME    SPACE    PT IX   TRKS   TRKS XTS    TRACKS   TRACKS USED VOLSER M
---   --------  -------- --- -- ------ ------ --- -------------------- ------ -
 _    DBA128    BIGTABX  196  I      1      1   1        1    1100.0 DMPD18 *
 _    DBA128    BIGTABX  104  I      1      1   1        1    1100.0 DMPD12 *

      TOTAL         Spaces              2   Extents              2
      TOTAL TRACKS  Allocated           2   Used                 2
```

Space Scan Reporting

```
                    REPORT SELECT LIST                          13:38
Cmd ===>                                        Scroll ===> PAGE
    The following  Full Space Scans   are available for
Table Space   BPABUF
                                Data Base    DBA105
 Select here    ===> _ to perform a new full space scan now.

 Select a line with        S Display reports    D Drop reports
                           E Erase record

 Today is 03/15/07   13:38
                          REORG   COPY                    PAGES
   SEL    DATE    TIME   FACTOR FACTOR EXTENTS      PAGES  REQUIRED RPTS
   ---   --------  -----  ------ ------ ------- ---------- ---------- ----
   _     03/15/07 13:38   71.5    0.0      1         84         5  YES
    ********************** BOTTOM OF LIST ***************************
```

Space Scan Statistics – Choose a number or Enter

```
                    Table Space Stats
Cmd ===> _
            TABLESPACE BPABUF                      ON 03/15/07


   SELECT ENTRY BY NUMBER, OR
    PRESS ENTER TO VIEW IN SEQUENCE


        1. PAGES      PAGES ANALYSIS REPORT
        2. PTRS       OVERFLOW RECORDS POINTERS
        3. FREESPACE  ANALYSIS OF PAGES FREESPACE
        4. DASD       SUMMARY OF DASD SPACE USAGE
        5. ROWS       TABLE ROWS SUMMARY
        6. ROWSPACE   ANALYSIS OF TABLE ROWS SPACE
```

Freespace Analysis

```
                        Table Space Stats
Cmd ===> _
                TABLESPACE BPABUF                    ON 03/15/07


3. FREESPACE ANALYSIS


                            NUMBER        PCT OF
                           OF PAGES      ALL PGS         SIZE
                           --------      -------        -----
        PAGES WITH:
                NO ROOM        60         71.43%         4,096

        ROOM FOR SHORT ROW      0          0%               8

    ROOM FOR AVERAGE ROW        0          0%               8

        ROOM FOR LONG ROW      24         28.57%            8


    FREESPACE SPECIFIED     5%                      REORG FACTOR =  71.4
        FREEPAGE SPECIFIED  0            PRESS ENTER FOR FREESPACE GRAPH
```

DASD Space Analysis

```
                      Table Space Stats
Cmd ===>

            TABLESPACE BPABUF                 ON 03/15/07


4. DASD SPACE ANALYSIS


                        NUMBER       AMOUNT      % USED     % TOTAL
                       OF PAGES     OF SPACE      SPACE       SPACE
                      ---------    --------     --------    --------


            ROWS DATA      59        224K        91.68%      66.58%
    PAGES WITH OVERHEAD    61         15K         6.06%       4.40%
  PAGES W WASTED SPACE     59          0K         0.05%       0.04%
  PAGES WITH FREESPACE     59          5K         2.21%       1.60%
      FORMATTED EMPTY       0          0K                       0%
    UNFORMATTED EMPTY       0          0K                       0%
  ALLOCATED / NOT USED     23         92K        37.70%      27.38%


  TOTAL DATASET SPACE                336K     PCT FREESPACE = 29.0
```

Rows Summary

```
                         Table Space Stats

 Cmd ===>  _
                  TABLESPACE BPABUF                       ON 03/15/07


 5. TABLE ROWS SUMMARY
                                ROWS IN  PCT OF    PAGES  ROWS OVERFLOW COMPRESS
 CREATOR.TABLE                    TABLE   TOTAL OCCUPIED /PAGE     ROWS     ROWS
 ------------------------------ -------- ------- -------- ----- -------- --------


                        .            707  100.0%       59  12.0        0        0


 DROPPED ROWS                           0


 ** TOTALS **                         707  100.0%       59  12.0        0        0
```

No Errors Detected

```
DB2SMU-DSNB-----------------------------------------------------------
Cmd ===> _


     Database - DBA105
  Table Space - BPABUF                            on - 03/15/07



                        61 pages were scanned.


         ********************************************************
         * * * * * * * * * * * * * * * * * * * * * * * * * * * *
         * *                                              * *
         * *    THE TABLE SPACE IS OK.   ALL TESTS PASSED.   * *
         * *            NO   ERRORS WERE DETECTED.        * *
         * *                                              * *
         * * * * * * * * * * * * * * * * * * * * * * * * * * * *
         ********************************************************


             Press ENTER to display statistics.


             Press END to return to the select list.
```

Or, Display by VCAT

```
DB2SMU-DSNB                    SPACES ON VCAT                    14:59
Cmd ===>  _                                      Scroll ===> PAGE
                                                 SPACE 1 OF 219

Commands:  MENU
Line Commands:  ? - Menu  D - Details  I - SMS Info
                S - Scan  P - Spacemap
-----------------------------------------------------------------------
                              PQTY   SQTY NO.     ALLO    USED % DS      D
SEL  DBNAME    SPACE    PT IX  TRKS   TRKS XTS   TRACKS  TRACKS USED VOLSER M
---  --------  -------- --- -- ------ ------ --- -------------------- ------ -
 _   AMEXDB    AMEXBSTS           3      3   1        3      2 66.7 DMPD19 *
 _   AMEXDB    AMEXTS2            3      3   1        3      2 66.7 DMPD28 *
 _   AMEXDB    CREDITRC  1  I     3      3   1        3      2 66.7 DMPD21 *
 _   AMEXDB    CRED11Z4  1  I     3      3   1        3      2 66.7 DMPD29 *
 _   AMEXDB    CRED14KQ  1  I     3      3   1        3      2 66.7 DMPD21 *
 _   DBA019DB  DBA019CC       9,697    970   1    9,705  2,591 26.7 DMPD29 *
 _   DBA019DB  DBRMX     1  I     6      6   1        6      2 33.3 DMPD23 *
 _   DBA019DB  DSNADH01  1  I     3      2   1        4      2 50.0 DMPD22 *
 _   DBA019DB  DSNADX01  1  I     3      2   1        4      2 50.0 DMPD19 *
 _   DBA019DB  DSNAGH01  1  I     3      2   1        4      2 50.0 DMPD23 *
 _   DBA019DB  DSNAGX01  1  I     3      2   1        4      2 50.0 DMPD22 *
 _   DBA019DB  DSNAPH01  1  I     3      2   1        4      2 50.0 DMPD19 *
 _   DBA019DB  DSNAPX01  1  I     3      2   1        4      2 50.0 DMPD22 *
```

Display DB2 Volume

```
DB2SMU-DSNB                    DISPLAY DB2 VOLUMES                        11:33
Cmd ===> sort xt d_                                       Scroll ===> PAGE
                                                          VOLUME 1 OF 68

Commands:   MENU      UNUSED
Line Commands:   ? - Menu   B - DBDs   H - History
                 S - Data Spaces   U - Unused   X - Extents
--------------------------------------------------------------------------------
                 # OF       # OF       ALLO       USED     % VOL    % VOL    AVAIL D
SEL  VOLSER   DATASETS   EXTENTS    TRACKS     TRACKS     ALLO     USED     TRACKS M
---  ------   --------   --------   --------   --------   ------   ------   -------- -
_    *ERROR      242        -          -          -        0.0      0.0
_    DMPD02      107        124        336        280      0.2      0.2              *
_    DMPD03      124        148     10,256      2,730      6.8      1.8              *
_    DMPD04      100        156        833        685      0.6      0.5              *
_    DMPD05       93        107        401        301      0.3      0.2              *
_    DMPD06       89         93        366        217      0.2      0.1              *
_    DMPD07       86         90     16,772     15,847     11.2     10.5              *
_    DMPD08      114        121        314        254      0.2      0.2              *
_    DMPD09      246        259        896        751      0.6      0.5              *
_    DMPD10      716        734     15,873      4,241     10.6      2.8              *
_    DMPD11      106        123     10,975      3,415      7.3      2.3              *
_    DMPD12      250        254     13,430      4,174      8.9      2.8              *
_    DMPD13      250        273      1,491      1,191      1.0      0.8              *
_    DMPD14      116        127     11,070     10,963      7.4      7.3              *
```

Spaces on Error?

```
DB2SMU-DSNB                    SPACES ON *ERROR                         11:33
Cmd ===>  _                                              Scroll ===> PAGE
                                                         SPACE 1 OF 247

Commands:  MENU
Line Commands: ? - Menu  D - Details  L - List  I - SMS Info
               S - Scan  P - Spacemap  X - Extents
-------------------------------------------------------------------------------

                                    PQTY   SQTY NO.     ALLO    USED % DS        D
SEL  DBNAME    SPACE     PT IX      TRKS   TRKS XTS   TRACKS  TRACKS USED VOLSER N
---  --------  --------  --- --    ------  ------ --- --------- ------ ---- ------ -
 _   BBNMMDB2  SSXEMP1    6  I        3      3    0        0       0  0.0 *ERROR
 _   BWBDTEST  XT03X1     5  I        3      3    0        0       0  0.0 *ERROR
 _   CBDBTDG   CBIXTDGE   5  I       12      3    0        0       0  0.0 *ERROR
 _   CBDBTDG   CBIX1O6E   5  I       12      3    0        0       0  0.0 *ERROR
 _   CBDBTDGT  CBIXTDGE   5  I       12      3    0        0       0  0.0 *ERROR
 _   CBDBTDGT  CBIX1L1J   5  I       12      3    0        0       0  0.0 *ERROR
 _   CQMDB     BUFFERPO  25  I       13     13    0        0       0  0.0 *ERROR
 _   CQMDB     DBRMSRV1  25  I       13     13    0        0       0  0.0 *ERROR
 _   CQMDB     DETRSCRV  25  I      100    100    0        0       0  0.0 *ERROR
 _   CQMDB     STATEMEN  25  I      100    100    0        0       0  0.0 *ERROR
 _   CQMDB     SUMMRSCR  25  I      100    100    0        0       0  0.0 *ERROR
 _   CQMDB     SUMMSRV1  25  I       13     13    0        0       0  0.0 *ERROR
 _   CQMDB     THREADSR  25  I       13     13    0        0       0  0.0 *ERROR
 _   CSAUDIT   CSAUDIT             0        0     0        0       0  0.0 *ERROR
```

Start of Widows Analysis

```
DB2SMU-DSNB                      WIDOWS                        12:56
Cmd ===>


   Enter qualifiers below for dataset search.  Dummy datasets will
   be created for all DB2 generated datasets.  All widow datasets
   matching the qualifiers will be dropped.  Widow datasets
   are those datasets which no longer exist but have not been dropped
   from the DB2 Catalog.


          *VCAT Name ===> dsnbcat


      Data Base Name ===> dba105_



When the DB2 DROPs are generated, COMMITs will be generated.

Number of datasets processed between COMMITs ===> 0
  (Enter 0 to COMMIT only after all DROPs are done.)


Press ENTER when done.  Press PF3 to cancel.
```

Index in DB2 Catalog, but not on DASD

```
 File  Edit  Edit_Settings  Menu  Utilities  Compilers  Test  Help

 EDIT       DB2SMU.V1R1.DSNB.SMU.USER(DBA105W) - 01.00      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.
 ==MSG> -CAUTION- Profile is set to STATS ON. Statistics did not exist for
 ==MSG>           this member, but will be generated if data is saved.
 000001   D.I000DSNBCAT.DSNDBD.DBA105.XEMP1
 ****** *************************** Bottom of Data *************************
```

Take Action on Identified Widows

```
DB2SMU-DSNBPRIMARY MENU-------------------------------------------------
Cmd ===>                                                  07/03/14  12:56


     Statements have been saved in member DBA105W

     Specify next action to be performed.



          Option ===> _

                    1 BUILD JCL Convert the statements to JCL.
                    2 EDIT control cards.
                    3 DELETE saved statements.
                    4 PRINT the statements member.

                    5 EXIT now.
                       or  F3, END
```

Add a Job Card and Submit

```
JOBCARD OPTIONS ---------PRIMARY MENU------------------------------------------
Cmd ===>                                                      07/03/14  12:56
                        J O B C A R D   O P T I O N S


        To include a JOB (and JES) statements in the generated Utility JCL,
        enter the names of the library and member.



 JOB card member name ===> JBCRDMDL
                           _


JOB card dataset name ===> 'DB2SMU.V1R1.DSNC.SMU.USER'


                           This library will be opened for READ only.
                           TSO naming conventions will be used.
                           Enclose the name in quotes if it does
                           not begin with your TSO Prefix.


    Press F10  to back up to previous screen.
    Press ENTER to continue.      Press F3   to cancel Utility generate.
```

Linear Data Set exists, but no DB2 Object in Catalog.

```
DB2SMU-DSNB                    ORPHANS                         13:07
Cmd ===>


                      *VCAT Name  ===> dsnbcat


                   Data Base Name  ===> dba105_


    Press ENTER when done.   Press PF3 to cancel.

    Enter qualifiers above for dataset search.   AMS DELETEs will be
    generated for all datasets with the qualifiers which are found
    in the OS Catalog and NOT in the DB2 Catalog.
```

Dataset to be deleted

```
 File  Edit  Edit_Settings  Menu  Utilities  Compilers  Test  Help
_____
EDIT       DB2SMU.V1R1.DSNB.SMU.USER(DBA105A) - 01.00      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.
==MSG> -CAUTION- Profile is set to STATS ON. Statistics did not exist for
==MSG>           this member, but will be generated if data is saved.
000001    DELETE 'DSNBCAT.DSNDBC.DBA105.BPADET.I0001.A001'       CLUSTER
****** *************************** Bottom of Data **************************
```

Delete Now or save for later

```
DB2SMU-DSNB                    PROCESS MEMBER                        15:25
Cmd ===>                                              07/03/14   15:25


           The AMS DEFINE/DELETE statements have been generated.


        Option ===> 5


            1   DO NOW    Invoke AMS to execute the statements.
            2   EDIT      Edit the statements.
            3   DELETE    Delete the member.
            4   PRINT     Print the statements.


            5   END       Changes are saved in member DBA105A
                or  F3
```

In March, 2007, IBM announced a new tool

- **DB2 Storage Management Utility**
  - Display information by volume, database, or data space to assist with identification of DASD constraints
  - Reports – showing space counts and DB2 storage utilization summary information
  - Locate DB2 widows and orphans
  - Scan DB2 TS and IS to verify their integrity
  - Review space map pages to produce detailed reports and graphs showing the condition of the space
  - Display information about over-allocated data sets, data sets in extents, and amount of space allocated compared to amount of space used
  - Maintains historical information to assist with trend analysis

Storage Management

- **ADMINISTRATION TOOL**
  - Scans are done against the DB2 Catalog or a copy of the DB2 Catalog
  - Verification report
  - Estimate space sizes
  - View statistics via DB2 or VSAM definitions
  - Generate REPAIR utility

- **SMU**
  - Scans are done against an extract of the DB2 Catalog
  - Verification reports
    - Double the number of verification checks
  - History
  - Identify Widows and Orphans
  - Repair broken pages

- **AUTOMATION TOOL**
  - Data Page Display – Verification reports
    - Repair broken pages
  - Data Set Manager
    - Display TS & IS attributes
    - Move data sets

Q & A

Conclusion

- **For More Information**
  - For more information about IBM DB2 and IMS Tools, visit our website:

    www.ibm.com/software/data/db2imstools