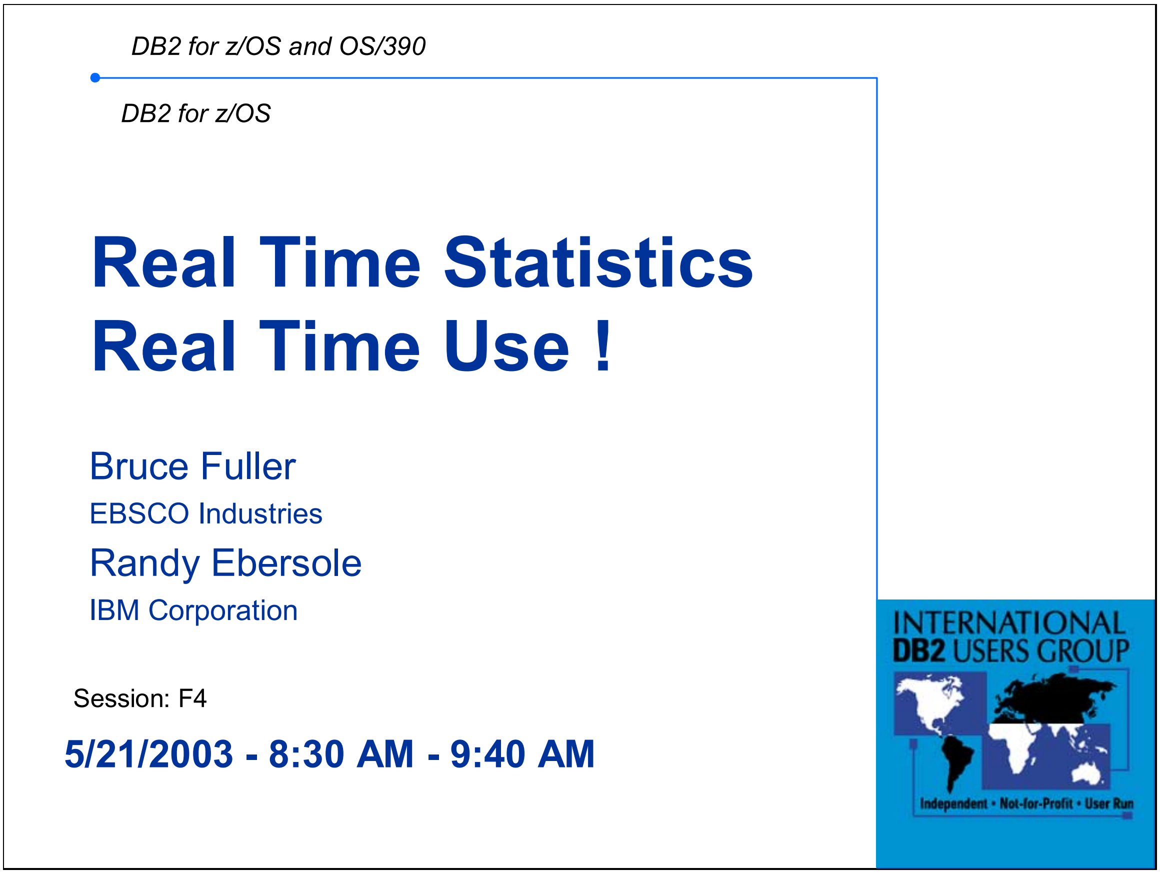


DB2 for z/OS and OS/390

DB2 for z/OS

Real Time Statistics Real Time Use !

Bruce Fuller

EBSCO Industries

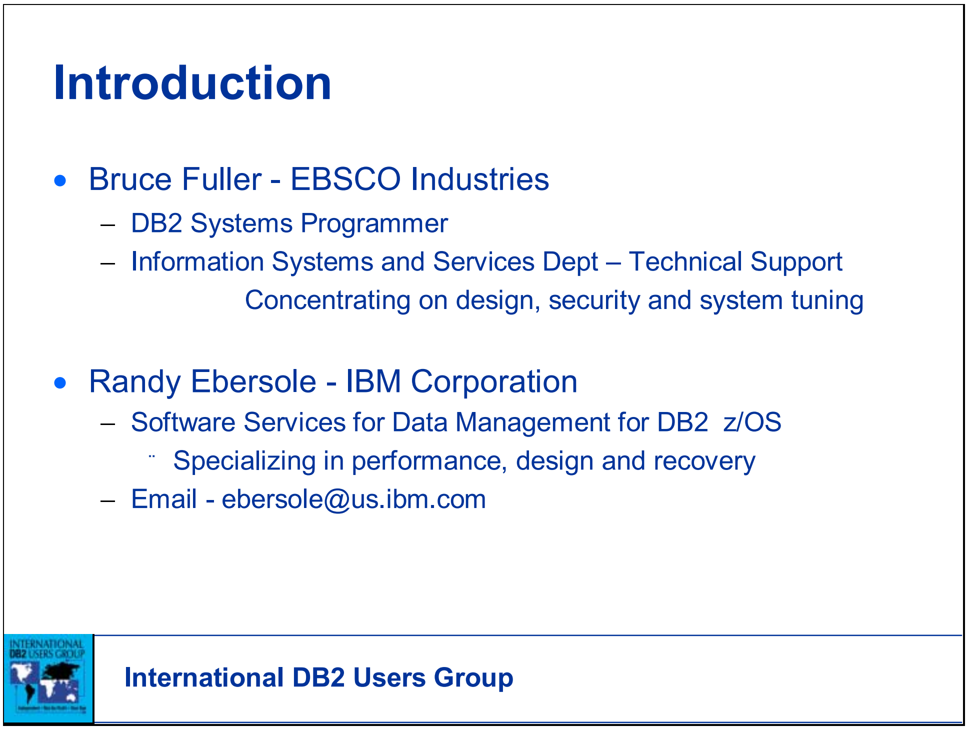
Randy Ebersole

IBM Corporation

Session: F4

5/21/2003 - 8:30 AM - 9:40 AM

DB2 V7 provides Real Time Statistics by gathering important statistics about DB2 objects. These statistics are invaluable in managing DB2 in today's e-business world. This presentation will focus on the benefits Real Time Statistics delivered in a real life implementation.



Introduction

- Bruce Fuller - EBSCO Industries
  - DB2 Systems Programmer
  - Information Systems and Services Dept – Technical Support
    Concentrating on design, security and system tuning

- Randy Ebersole - IBM Corporation
  - Software Services for Data Management for DB2 z/OS
    - Specializing in performance, design and recovery
  - Email - ebersole@us.ibm.com

Bruce and Randy worked on this project together to determine the overall benefits of the information that RTS delivers.

EBSCO Industries, Inc.

- Acronym for Elton B. Stephens Company
- Ranked in the top 200 privately held companies (Fortune Magazine)
- Has sales, service and manufacturing subsidiaries in 19 countries around the world
- Diverse business interests that range between information management services to fishing lure manufacturer
- Core business is journal and periodical subscription services through EBSCO Subscription Services

International DB2 Users Group

Largest subscription agent in the world

Acts as the intermediary between the publishers of content and those who need access to it

Works with over 60,000 publishers

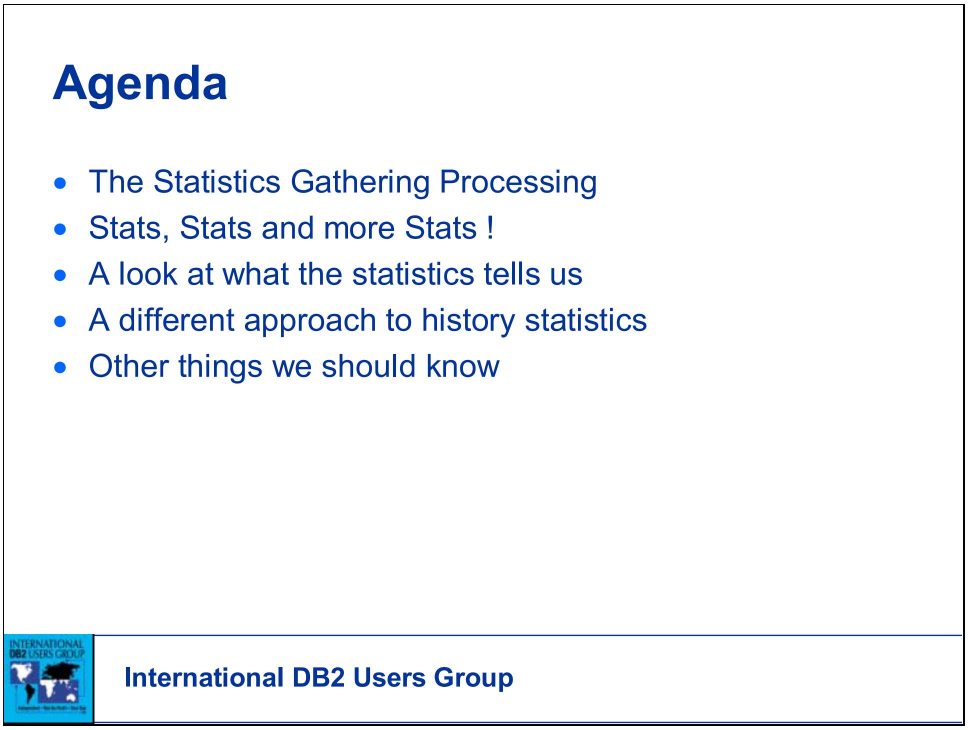
Has 31 offices in 19 countries

Has a title database of 282,000 titles in various formats

    12,000 are online journals

    Over 4,500 CD-ROMs

Has web-based applications that enable acquisition, management and access to online and print journals



Agenda

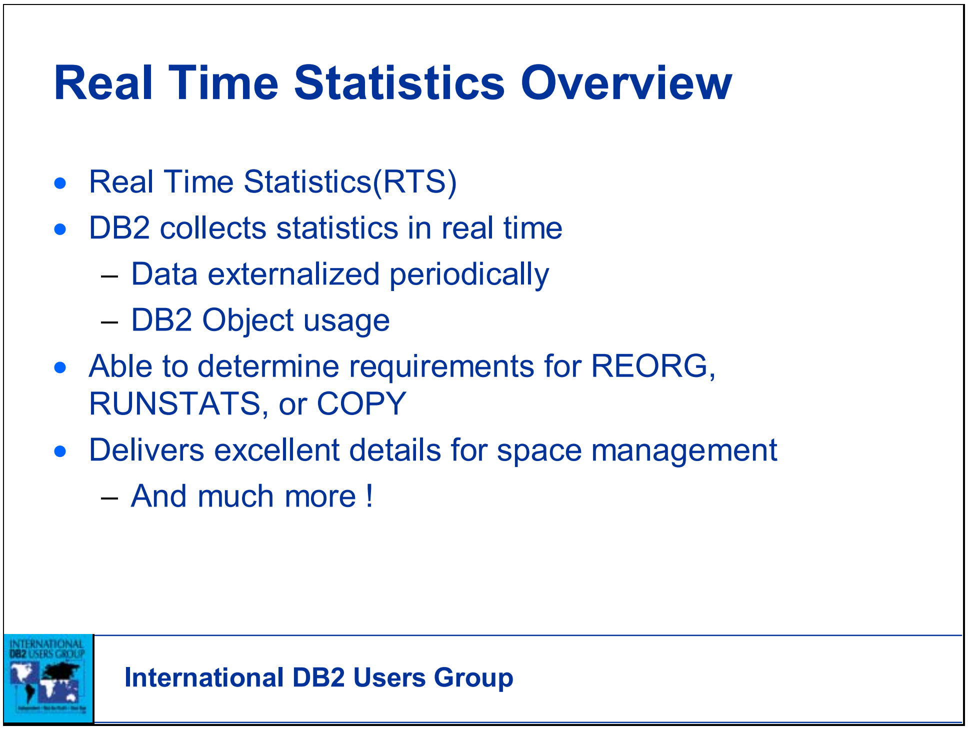
- The Statistics Gathering Processing
- Stats, Stats and more Stats !
- A look at what the statistics tells us
- A different approach to history statistics
- Other things we should know

International DB2 Users Group

Simple, simple install process.

A wealth of good information.

Opportunities to better understand objects use.

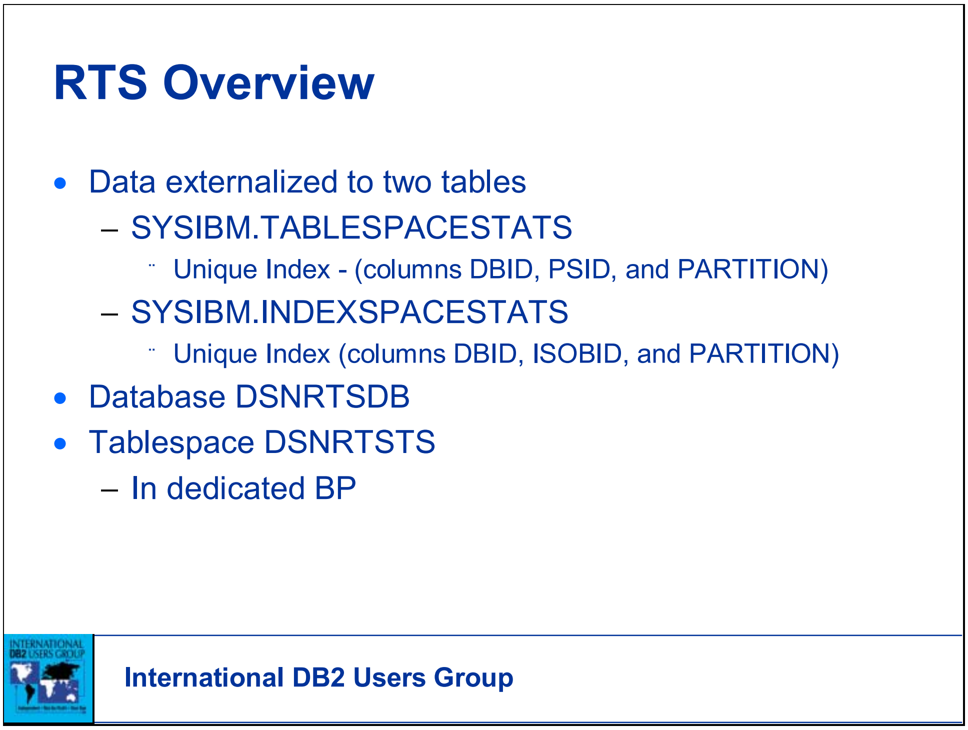


Real Time Statistics Overview

- Real Time Statistics(RTS)
- DB2 collects statistics in real time
  - Data externalized periodically
  - DB2 Object usage
- Able to determine requirements for REORG, RUNSTATS, or COPY
- Delivers excellent details for space management
  - And much more !

RTS SHIPPED IN DB2V7 APARS: PQ48447, PQ48448, PQ56256

RTS STORED PROCEDURE DSNACCOR SHIPPED IN DB2V7 APARS: PQ46859



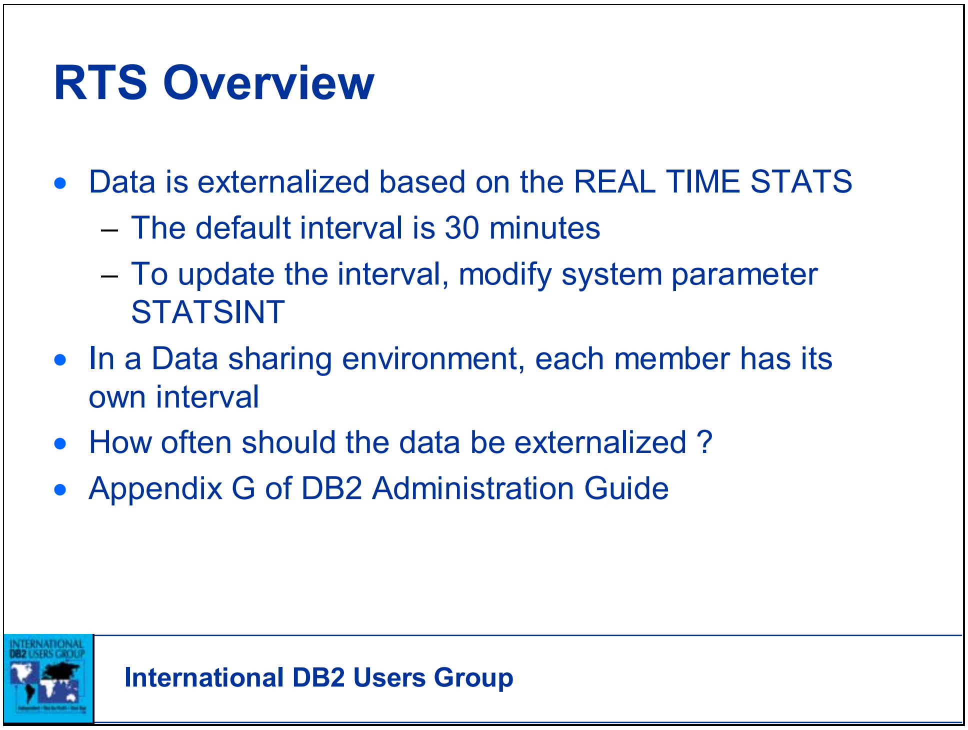
RTS Overview

- Data externalized to two tables
  - SYSIBM.TABLESPACESTATS
    - Unique Index - (columns DBID, PSID, and PARTITION)
  - SYSIBM.INDEXSPACESTATS
    - Unique Index (columns DBID, ISOBID, and PARTITION)
- Database DSNRTSDB
- Tablespace DSNRTSTS
  - In dedicated BP

International DB2 Users Group

The RTS objects are like any other DB2 object, except when you need to work on the RTS objects you need to:

1. Stop the database first
2. Do your work
3. Start the database back in rw mode



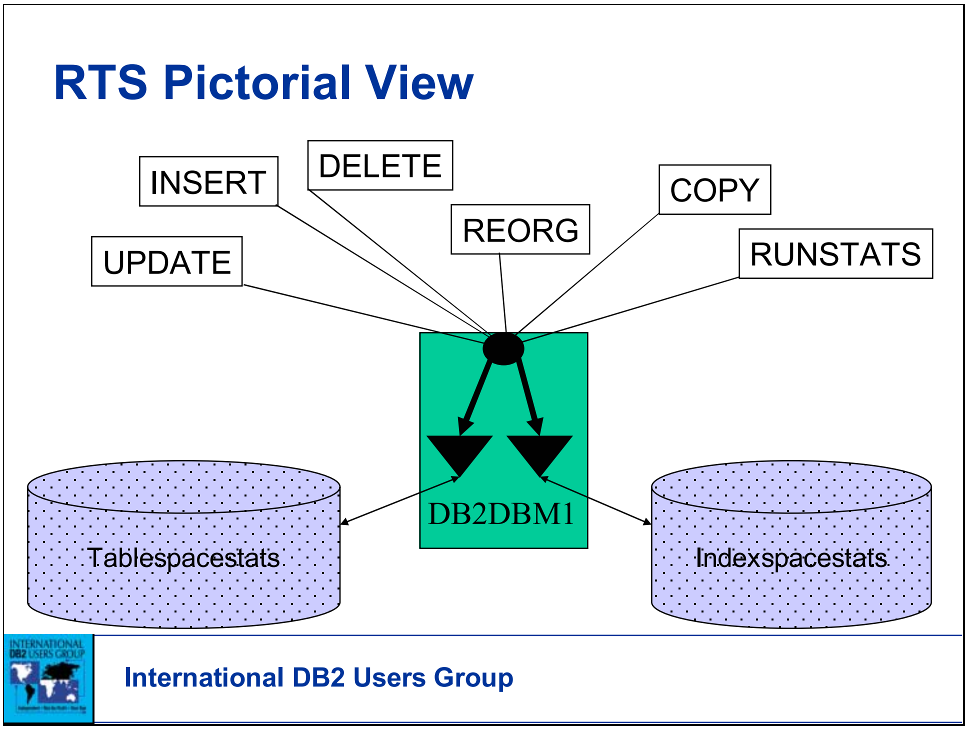
RTS Overview

- Data is externalized based on the REAL TIME STATS
  - The default interval is 30 minutes
  - To update the interval, modify system parameter STATSINT
- In a Data sharing environment, each member has its own interval
- How often should the data be externalized ?
- Appendix G of DB2 Administration Guide

International DB2 Users Group

No measurable overhead was observed associated with the externalization of the statistics.

We took the default interval of 30 min and as of to date did not experiment with other intervals



RTS Pictorial View

INSERT

DELETE

UPDATE

REORG

COPY

RUNSTATS

DB2DBM1

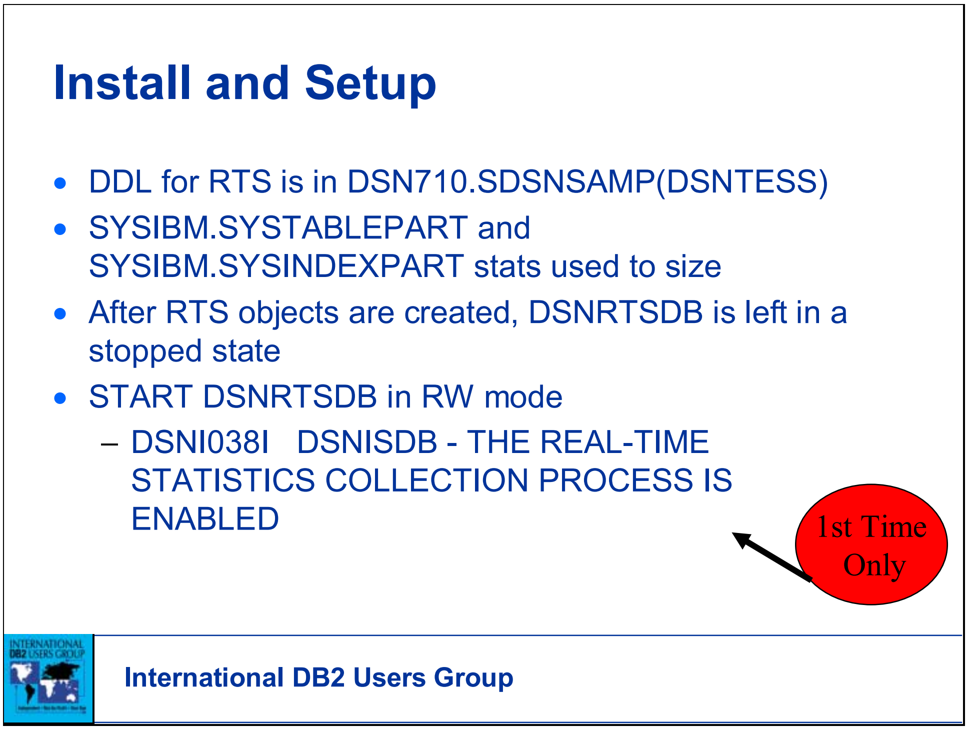
Tablespacestats

Indexspacestats

What makes RTS get updated ? DML that change data and three utilities, reorg, copy and runstats.
When you issue stop database and stop database/spacenam When DB2 stops normally.

If you stop db2 mode(force) the stats are lost. They are not externalized.

Much details on how the running of utilities change the stats.



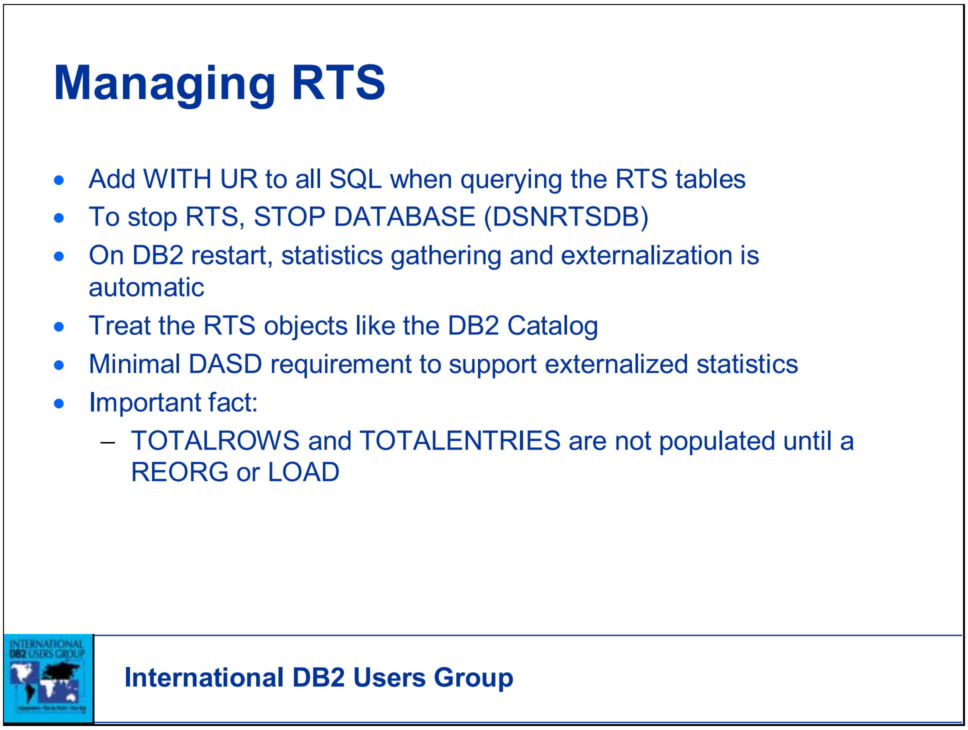
Install and Setup

- DDL for RTS is in DSN710.SDSNSAMP(DSNTESS)
- SYSIBM.SYSTABLEPART and SYSIBM.SYSINDEXPART stats used to size
- After RTS objects are created, DSNRTSDB is left in a stopped state
- START DSNRTSDB in RW mode
  - DSNI038I DSNISDB - THE REAL-TIME STATISTICS COLLECTION PROCESS IS ENABLED

1st Time Only

International DB2 Users Group

Install process is simple and straight forward.



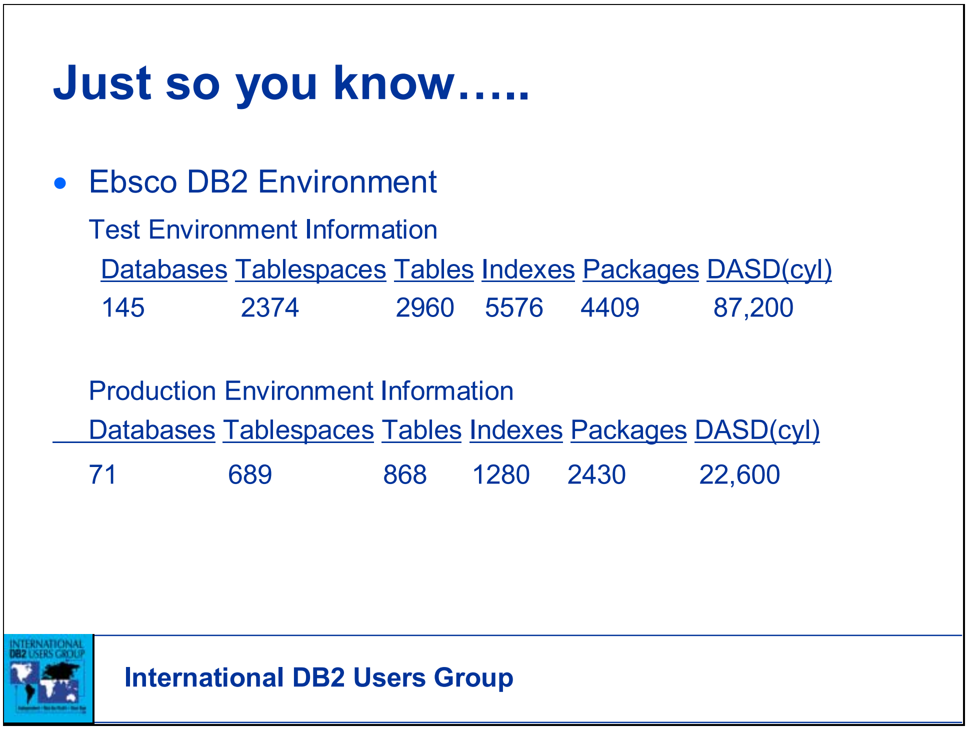
Managing RTS

- Add WITH UR to all SQL when querying the RTS tables
- To stop RTS, STOP DATABASE (DSNRTSDB)
- On DB2 restart, statistics gathering and externalization is automatic
- Treat the RTS objects like the DB2 Catalog
- Minimal DASD requirement to support externalized statistics
- Important fact:
  - TOTALROWS and TOTALENTRIES are not populated until a REORG or LOAD

International DB2 Users Group

Watch the impact of external use of RTS tables by always using WITH UR on SQL.

Less than 200 tracks were used for around 22,000 objects.



Just so you know…..

- Ebsco DB2 Environment

Test Environment Information

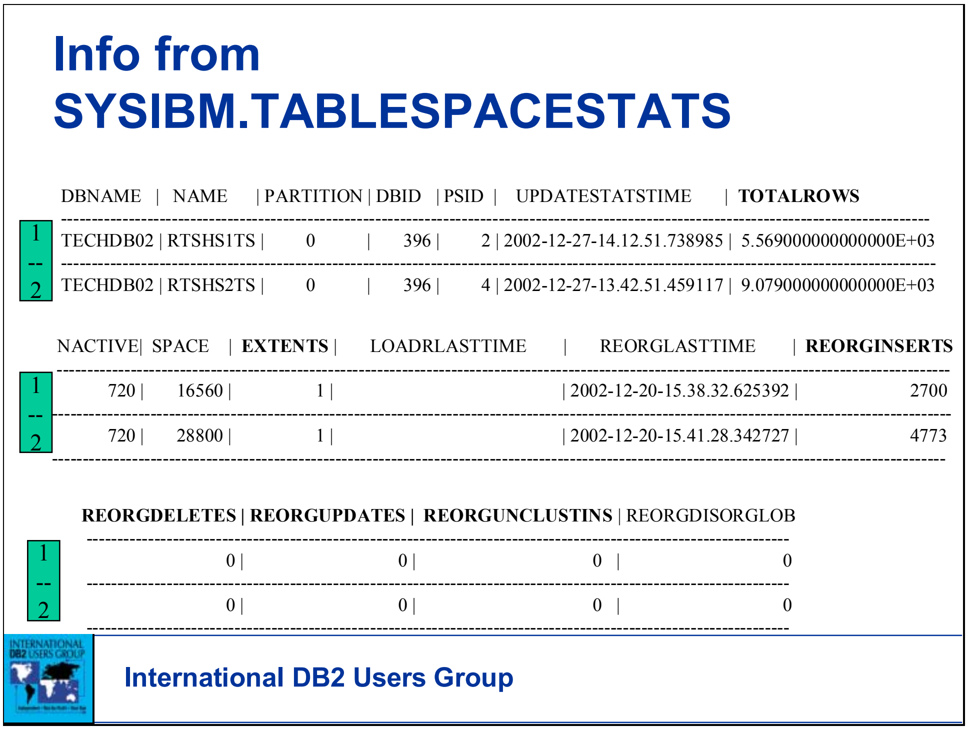
Databases	Tablespaces	Tables	Indexes	Packages	DASD(cyl)
145	2374	2960	5576	4409	87,200

Production Environment Information

Databases	Tablespaces	Tables	Indexes	Packages	DASD(cyl)
71	689	868	1280	2430	22,600

International DB2 Users Group

DB2 use is growing and is being used as the datastore for Ebsco. Partitioned TS are heavily used.



Info from SYSIBM.TABLESPACESTATS

```
   DBNAME   |  NAME     | PARTITION | DBID   | PSID |  UPDATESTATSTIME           | TOTALROWS
   -----------------------------------------------------------------------------------------------------------
1  TECHDB02 | RTSHS1TS |      0      |     396 |       2 | 2002-12-27-14.12.51.738985 |  5.569000000000000E+03
-- -----------------------------------------------------------------------------------------------------------
2  TECHDB02 | RTSHS2TS |      0      |     396 |       4 | 2002-12-27-13.42.51.459117 |  9.079000000000000E+03
```

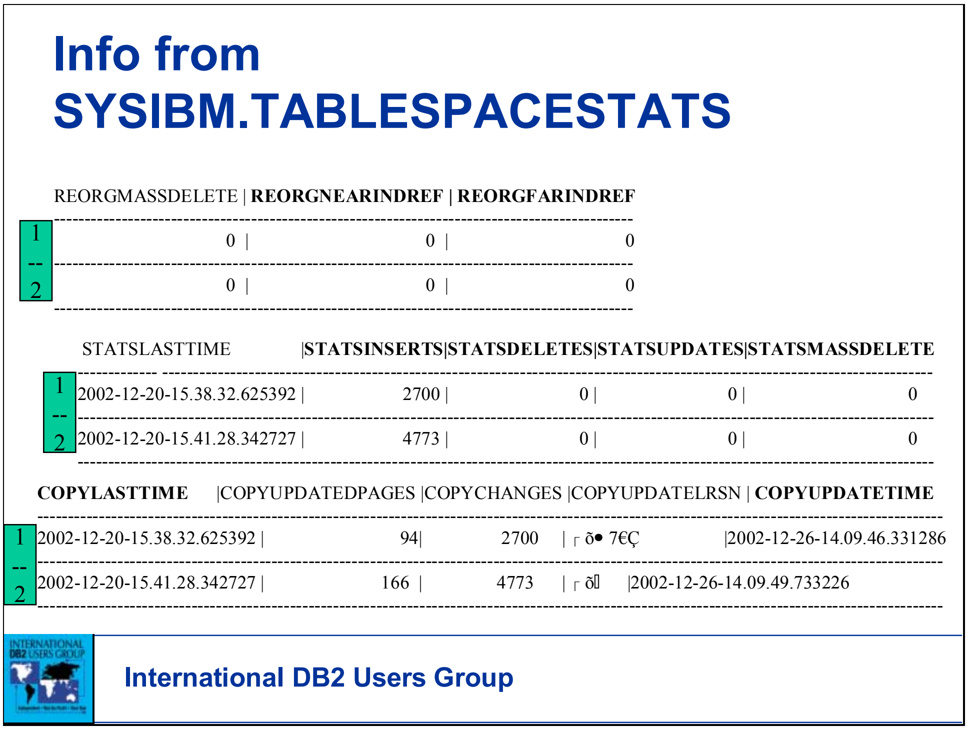
```
   NACTIVE|  SPACE    | EXTENTS |     LOADRLASTTIME      |      REORGLASTTIME         | REORGINSERTS
   ------------------------------------------------------------------------------------------------------------
1       720 |     16560 |          1 |                        | 2002-12-20-15.38.32.625392 |          2700
-- ------------------------------------------------------------------------------------------------------------
2       720 |     28800 |          1 |                        | 2002-12-20-15.41.28.342727 |          4773
   ------------------------------------------------------------------------------------------------------------
```

```
   REORGDELETES | REORGUPDATES |  REORGUNCLUSTINS | REORGDISORGLOB
   ------------------------------------------------------------------
1             0 |            0 |                0 |              0
-- ------------------------------------------------------------------
2             0 |            0 |                0 |              0
   ------------------------------------------------------------------
```

International DB2 Users Group

This is REAL TIME the totalrows are as current as the last interval.

Columns explained in Appendix G of the DB2 Administration Guide(Oct, 2002)

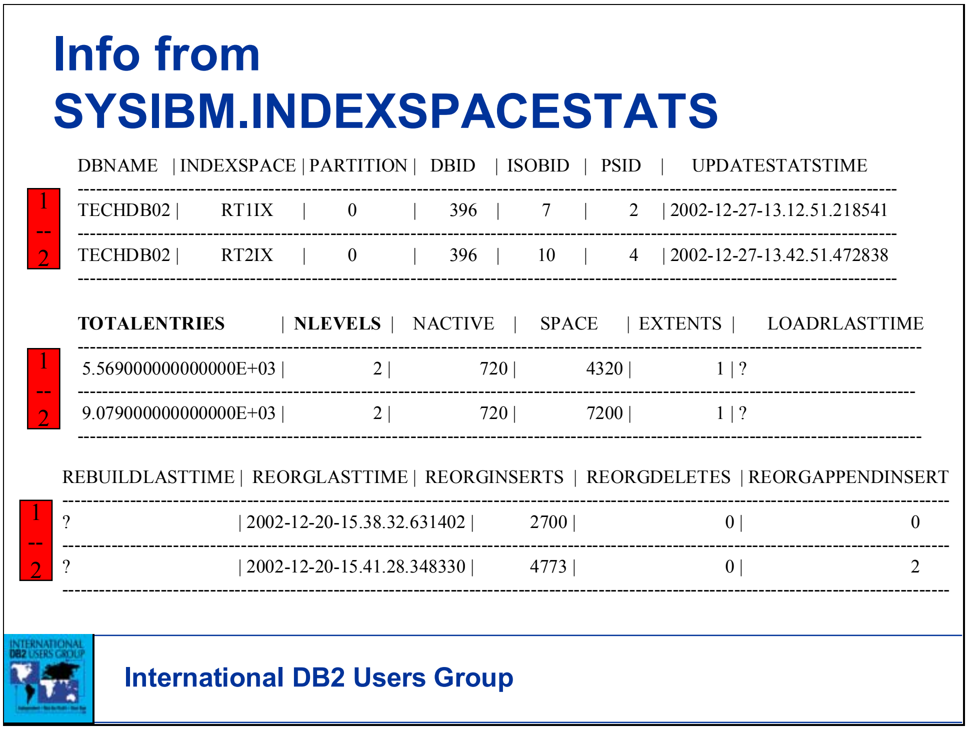


Info from SYSIBM.TABLESPACESTATS

```
    REORGMASSDELETE | REORGNEARINDREF | REORGFARINDREF
    ---------------------------------------------------------------------------------------
1                 0  |                  0  |                    0
--  ---------------------------------------------------------------------------------------
2                 0  |                  0  |                    0
    ---------------------------------------------------------------------------------------

        STATSLASTTIME          |STATSINSERTS|STATSDELETES|STATSUPDATES|STATSMASSDELETE
     ------------ ------------------------------------------------------------------------------------------------------------
1    2002-12-20-15.38.32.625392 |          2700 |            0 |            0 |              0
--   ------------------------------------------------------------------------------------------------------------------------
2    2002-12-20-15.41.28.342727 |          4773 |            0 |            0 |              0
     ------------------------------------------------------------------------------------------------------------------------

  COPYLASTTIME     |COPYUPDATEDPAGES |COPYCHANGES |COPYUPDATELRSN | COPYUPDATETIME
  -------------------------------------------------------------------------------------------------------------------------------
1 2002-12-20-15.38.32.625392 |                 94|          2700    | ┌ õ• 7€Ç            |2002-12-26-14.09.46.331286
--  -----------------------------------------------------------------------------------------------------------------------------
2 2002-12-20-15.41.28.342727 |               166  |          4773    | ┌ õ▯      |2002-12-26-14.09.49.733226
  -------------------------------------------------------------------------------------------------------------------------------
```

International DB2 Users Group

Columns explained in Appendix G of the DB2 Administration Guide(Oct, 2002)

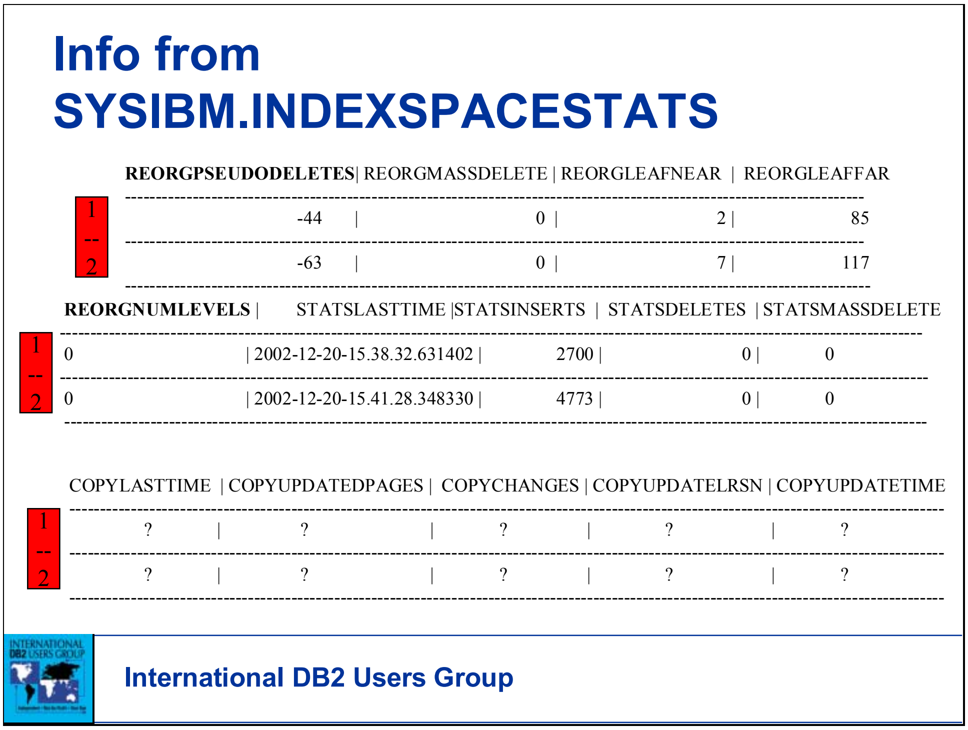


Info from SYSIBM.INDEXSPACESTATS

```
     DBNAME    | INDEXSPACE | PARTITION |  DBID   | ISOBID  |  PSID  |    UPDATESTATSTIME
     ---------------------------------------------------------------------------------------------------
1    TECHDB02 |      RT1IX     |       0         |    396   |       7     |       2    | 2002-12-27-13.12.51.218541
--   ---------------------------------------------------------------------------------------------------
2    TECHDB02 |      RT2IX     |       0         |    396   |      10     |       4    | 2002-12-27-13.42.51.472838
     ---------------------------------------------------------------------------------------------------

     TOTALENTRIES         | NLEVELS |  NACTIVE  |   SPACE   | EXTENTS |   LOADRLASTTIME
     ------------------------------------------------------------------------------------------------------
1     5.569000000000000E+03 |              2 |             720 |          4320 |              1 | ?
--   -----------------------------------------------------------------------------------------------------
2     9.079000000000000E+03 |              2 |             720 |          7200 |              1 | ?
     ------------------------------------------------------------------------------------------------------

   REBUILDLASTTIME |  REORGLASTTIME |  REORGINSERTS  |  REORGDELETES  | REORGAPPENDINSERT
   --------------------------------------------------------------------------------------------------------------
1  ?                          | 2002-12-20-15.38.32.631402 |        2700 |                      0 |                        0
-- --------------------------------------------------------------------------------------------------------------
2  ?                          | 2002-12-20-15.41.28.348330 |        4773 |                      0 |                        2
   --------------------------------------------------------------------------------------------------------------
```

International DB2 Users Group

Columns explained in Appendix G of the DB2 Administration Guide(Oct, 2002)

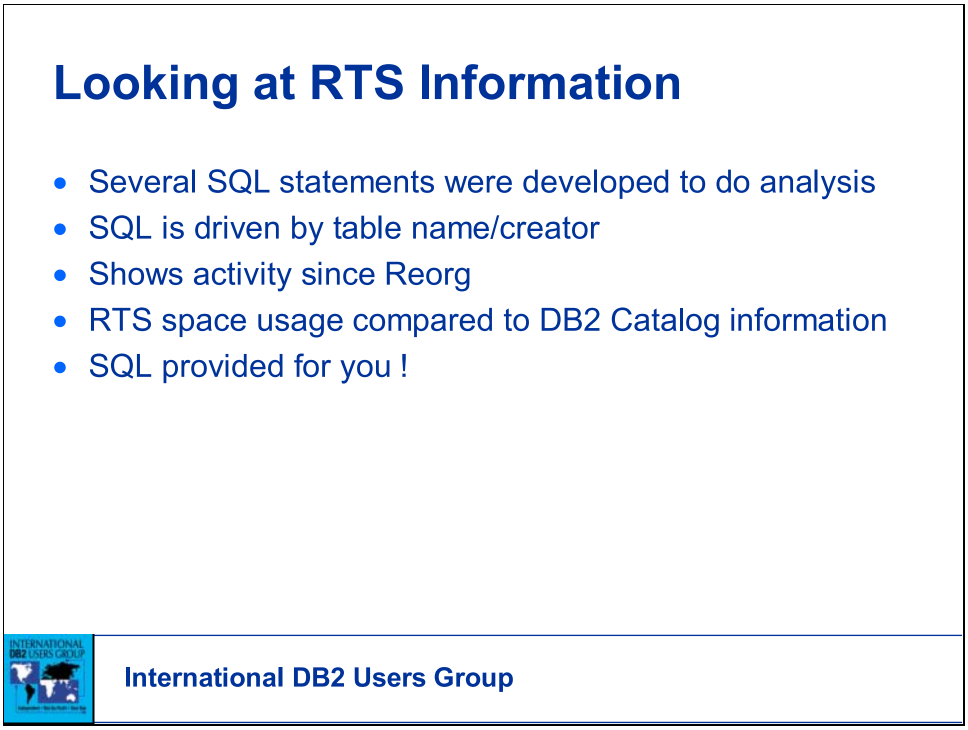


Info from SYSIBM.INDEXSPACESTATS

```
        REORGPSEUDODELETES| REORGMASSDELETE | REORGLEAFNEAR  | REORGLEAFFAR
      ----------------------------------------------------------------------------------------------------------------
  1                   -44      |                         0  |                     2 |                85
  --  ----------------------------------------------------------------------------------------------------------------
  2                   -63      |                         0  |                     7 |               117
      ----------------------------------------------------------------------------------------------------------------
 REORGNUMLEVELS |       STATSLASTTIME |STATSINSERTS  |  STATSDELETES  | STATSMASSDELETE
 ---------------------------------------------------------------------------------------------------------------------------------
1 0                      | 2002-12-20-15.38.32.631402 |            2700 |                       0 |          0
- ---------------------------------------------------------------------------------------------------------------------------------
2 0                      | 2002-12-20-15.41.28.348330 |            4773 |                       0 |          0
  ---------------------------------------------------------------------------------------------------------------------------------

  COPYLASTTIME   | COPYUPDATEDPAGES |  COPYCHANGES | COPYUPDATELRSN | COPYUPDATETIME
  ---------------------------------------------------------------------------------------------------------------------------------
1           ?           |               ?                 |            ?             |            ?                  |           ?
- ---------------------------------------------------------------------------------------------------------------------------------
2           ?           |               ?                 |            ?             |            ?                  |           ?
  ---------------------------------------------------------------------------------------------------------------------------------
```

International DB2 Users Group

Columns explained in Appendix G of the DB2 Administration Guide(Oct, 2002)



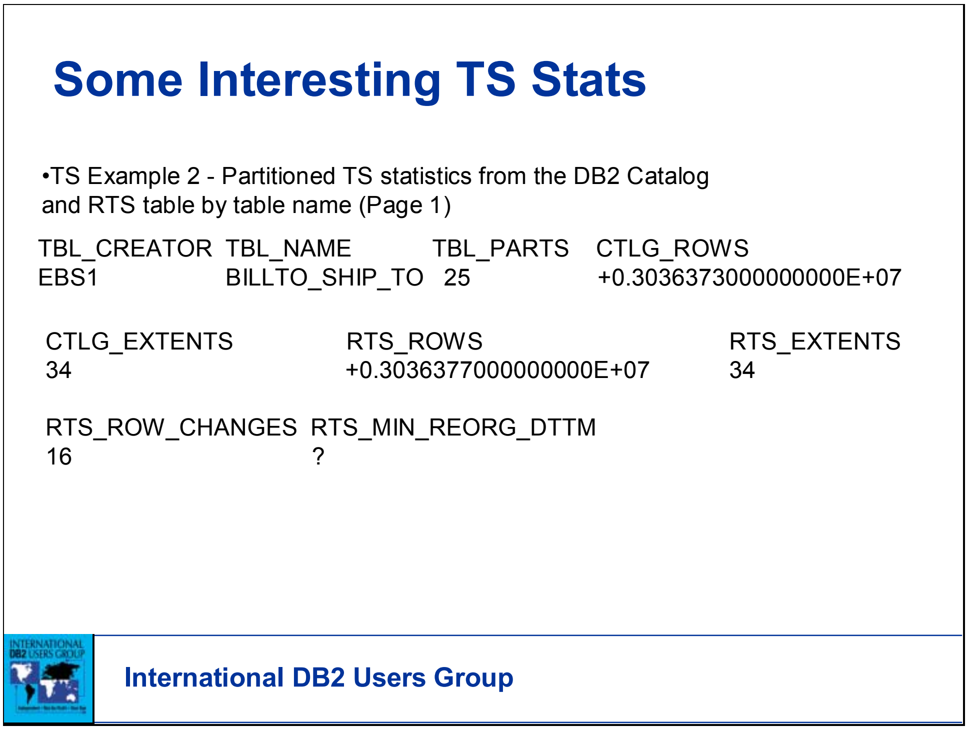
Looking at RTS Information

- Several SQL statements were developed to do analysis
- SQL is driven by table name/creator
- Shows activity since Reorg
- RTS space usage compared to DB2 Catalog information
- SQL provided for you !

International DB2 Users Group

How many rows do you think has changed since the last reorg of table xxxxxxxx ?

NACTIVE and overall space comparisons from RTS and the DB2 Catalog.



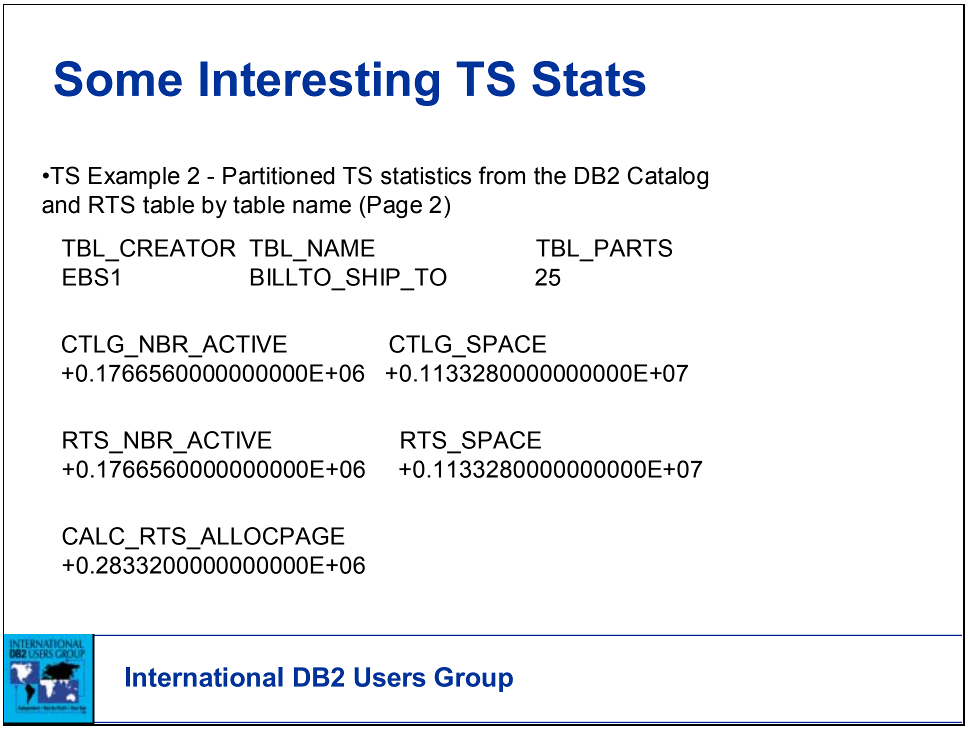
Some Interesting TS Stats

- TS Example 2 - Partitioned TS statistics from the DB2 Catalog and RTS table by table name (Page 1)

```
TBL_CREATOR  TBL_NAME        TBL_PARTS   CTLG_ROWS
EBS1         BILLTO_SHIP_TO  25          +0.30363730000000000E+07

CTLG_EXTENTS           RTS_ROWS                     RTS_EXTENTS
34                     +0.30363770000000000E+07     34

RTS_ROW_CHANGES  RTS_MIN_REORG_DTTM
16               ?
```

International DB2 Users Group

```
SELECT A.CREATOR AS TBL_CREATOR,
A.NAME AS TBL_NAME,
B.PARTITIONS AS TBL_PARTS,
SUM(C.CARDF) AS CTLG_ROWS,  SUM(C.EXTENTS) AS
CTLG_EXTENTS,SUM(D.TOTALROWS) AS RTS_ROWS,
SUM(D.EXTENTS) AS RTS_EXTENTS,
SUM(D.REORGINSERTS + D.REORGDELETES +
D.REORGUPDATES) AS RTS_ROW_CHANGES,
MIN(D.REORGLASTTIME) AS RTS_MIN_REORG_DTTM
FROM SYSIBM.SYSTABLES A, SYSIBM.SYSTABLESPACE B,

SYSIBM.SYSTABLEPART C, SYSIBM.TABLESPACESTATS D
WHERE A.CREATOR = 'EBS1'
AND A.NAME = 'JETS_ACCOUNT'
AND A.TYPE = 'T'
AND A.DBNAME = B.DBNAME
AND A.TSNAME = B.NAME
AND A.DBNAME = C.DBNAME
AND A.TSNAME = C.TSNAME
AND A.DBID   = D.DBID
AND B.PSID   = D.PSID AND C.PARTITION = D.PARTITION
GROUP BY A.CREATOR, A.NAME, B.PARTITIONS ORDER BY
A.CREATOR, A.NAME WITH UR;
```



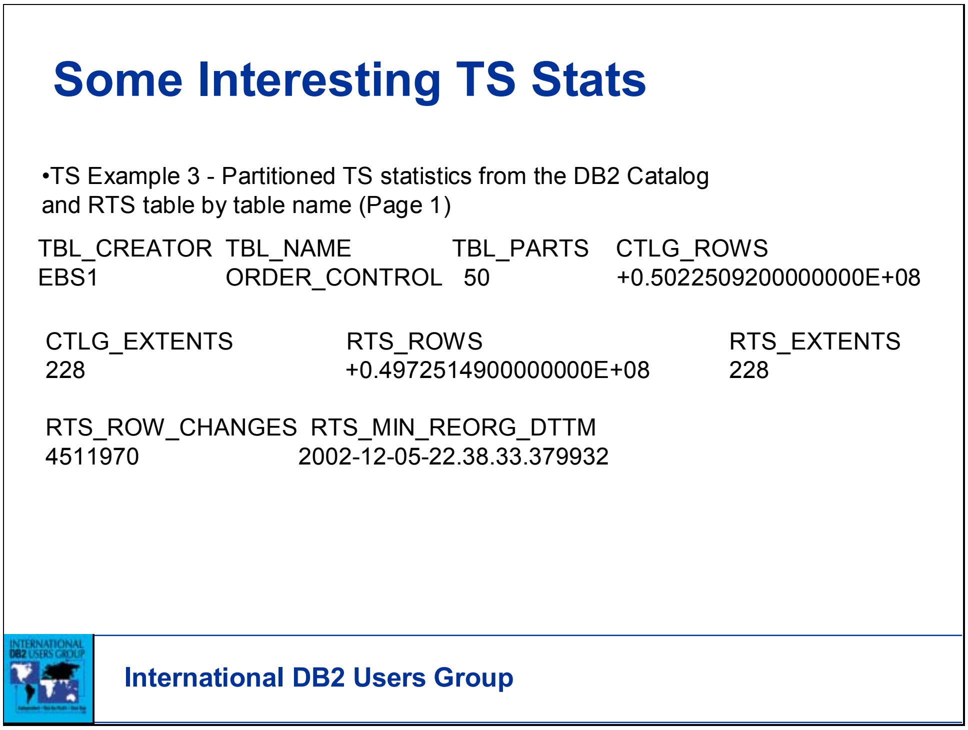
Some Interesting TS Stats

•TS Example 2 - Partitioned TS statistics from the DB2 Catalog and RTS table by table name (Page 2)

```
TBL_CREATOR  TBL_NAME             TBL_PARTS
EBS1         BILLTO_SHIP_TO       25

CTLG_NBR_ACTIVE           CTLG_SPACE
+0.1766560000000000E+06  +0.1133280000000000E+07

RTS_NBR_ACTIVE             RTS_SPACE
+0.1766560000000000E+06   +0.1133280000000000E+07

CALC_RTS_ALLOCPAGE
+0.2833200000000000E+06
```

International DB2 Users Group

```
SELECT A.CREATOR AS TBL_CREATOR, A.NAME AS TBL_NAME,
B.PARTITIONS AS TBL_PARTS, B.NACTIVEF AS
CTLG_NBR_ACTIVE, SUM(C.SPACEF) AS CTLG_SPACE,
SUM(FLOAT(D.NACTIVE)) AS RTS_NBR_ACTIVE,
SUM(FLOAT(D.SPACE)) AS RTS_SPACE,
(SUM(FLOAT(D.SPACE))/4) AS CALC_RTS_ALLOCPAGE FROM
SYSIBM.SYSTABLES A, SYSIBM.SYSTABLESPACE B,
SYSIBM.SYSTABLEPART C, SYSIBM.TABLESPACESTATS D
WHERE A.CREATOR = 'EBS1’

AND A.NAME = 'JETS_ACCOUNT'
AND A.TYPE = 'T' AND A.DBNAME = B.DBNAME
      AND A.TSNAME = B.NAME AND A.DBNAME = C.DBNAME
      AND A.TSNAME = C.TSNAME
      AND A.DBID   = D.DBID AND B.PSID   = D.PSID
AND C.PARTITION = D.PARTITION GROUP BY A.CREATOR,
A.NAME, B.PARTITIONS, B.NACTIVEF
      ORDER BY A.CREATOR, A.NAME WITH UR;
```



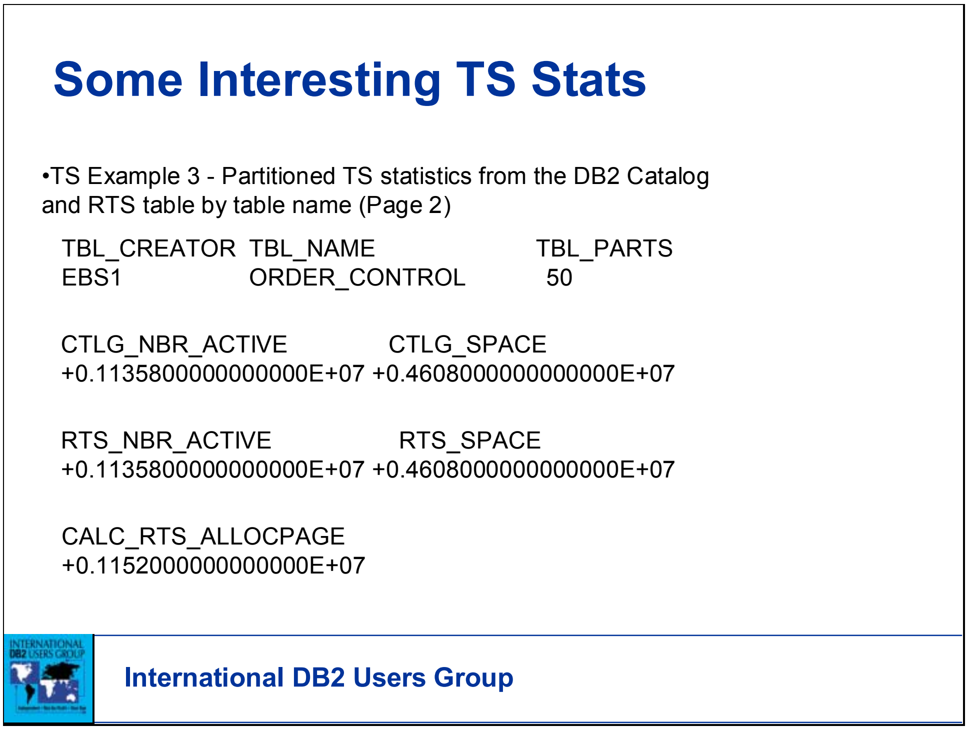
Some Interesting TS Stats

•TS Example 3 - Partitioned TS statistics from the DB2 Catalog
and RTS table by table name (Page 1)

```
TBL_CREATOR  TBL_NAME        TBL_PARTS   CTLG_ROWS
EBS1         ORDER_CONTROL   50          +0.5022509200000000E+08

 CTLG_EXTENTS          RTS_ROWS                      RTS_EXTENTS
 228                   +0.4972514900000000E+08       228

 RTS_ROW_CHANGES  RTS_MIN_REORG_DTTM
 4511970         2002-12-05-22.38.33.379932
```

International DB2 Users Group

```
SELECT A.CREATOR AS TBL_CREATOR,
A.NAME AS TBL_NAME,
B.PARTITIONS AS TBL_PARTS,
SUM(C.CARDF) AS CTLG_ROWS,  SUM(C.EXTENTS) AS
CTLG_EXTENTS,SUM(D.TOTALROWS) AS RTS_ROWS,
SUM(D.EXTENTS) AS RTS_EXTENTS,
SUM(D.REORGINSERTS + D.REORGDELETES +
D.REORGUPDATES) AS RTS_ROW_CHANGES,
MIN(D.REORGLASTTIME) AS RTS_MIN_REORG_DTTM
FROM SYSIBM.SYSTABLES A, SYSIBM.SYSTABLESPACE B,

SYSIBM.SYSTABLEPART C, SYSIBM.TABLESPACESTATS D
WHERE A.CREATOR = 'EBS1'
AND A.NAME = 'JETS_ACCOUNT'
AND A.TYPE = 'T'
AND A.DBNAME = B.DBNAME
AND A.TSNAME = B.NAME
AND A.DBNAME = C.DBNAME
AND A.TSNAME = C.TSNAME
AND A.DBID   = D.DBID
AND B.PSID   = D.PSID AND C.PARTITION = D.PARTITION
GROUP BY A.CREATOR, A.NAME, B.PARTITIONS ORDER BY
A.CREATOR, A.NAME WITH UR;
```



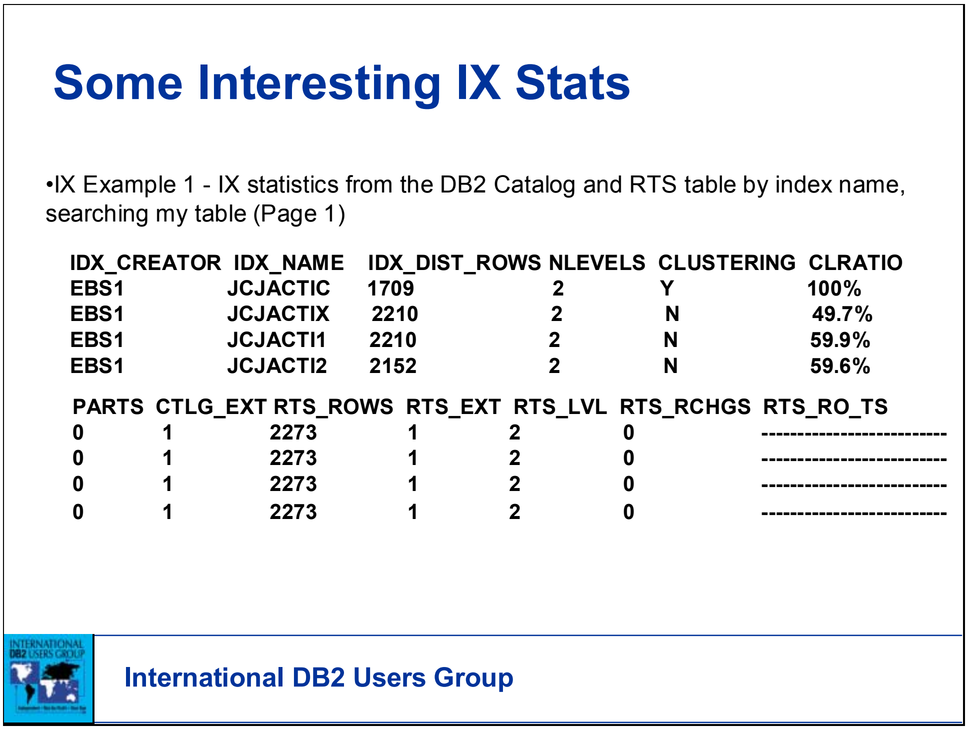
Some Interesting TS Stats

- TS Example 3 - Partitioned TS statistics from the DB2 Catalog and RTS table by table name (Page 2)

```
TBL_CREATOR  TBL_NAME              TBL_PARTS
EBS1         ORDER_CONTROL          50

CTLG_NBR_ACTIVE           CTLG_SPACE
+0.1135800000000000E+07 +0.4608000000000000E+07

RTS_NBR_ACTIVE             RTS_SPACE
+0.1135800000000000E+07 +0.4608000000000000E+07

CALC_RTS_ALLOCPAGE
+0.1152000000000000E+07
```

International DB2 Users Group

```
SELECT A.CREATOR AS TBL_CREATOR, A.NAME AS TBL_NAME,
B.PARTITIONS AS TBL_PARTS, B.NACTIVEF AS
CTLG_NBR_ACTIVE, SUM(C.SPACEF) AS CTLG_SPACE,
SUM(FLOAT(D.NACTIVE)) AS RTS_NBR_ACTIVE,
SUM(FLOAT(D.SPACE)) AS RTS_SPACE,
(SUM(FLOAT(D.SPACE))/4) AS CALC_RTS_ALLOCPAGE FROM
SYSIBM.SYSTABLES A, SYSIBM.SYSTABLESPACE B,
SYSIBM.SYSTABLEPART C, SYSIBM.TABLESPACESTATS D
WHERE A.CREATOR = 'EBS1’
AND A.NAME = 'JETS_ACCOUNT'
AND A.TYPE = 'T' AND A.DBNAME = B.DBNAME
      AND A.TSNAME = B.NAME AND A.DBNAME = C.DBNAME
      AND A.TSNAME = C.TSNAME
      AND A.DBID   = D.DBID AND B.PSID   = D.PSID
AND C.PARTITION = D.PARTITION GROUP BY A.CREATOR,
A.NAME, B.PARTITIONS, B.NACTIVEF
      ORDER BY A.CREATOR, A.NAME WITH UR;
```



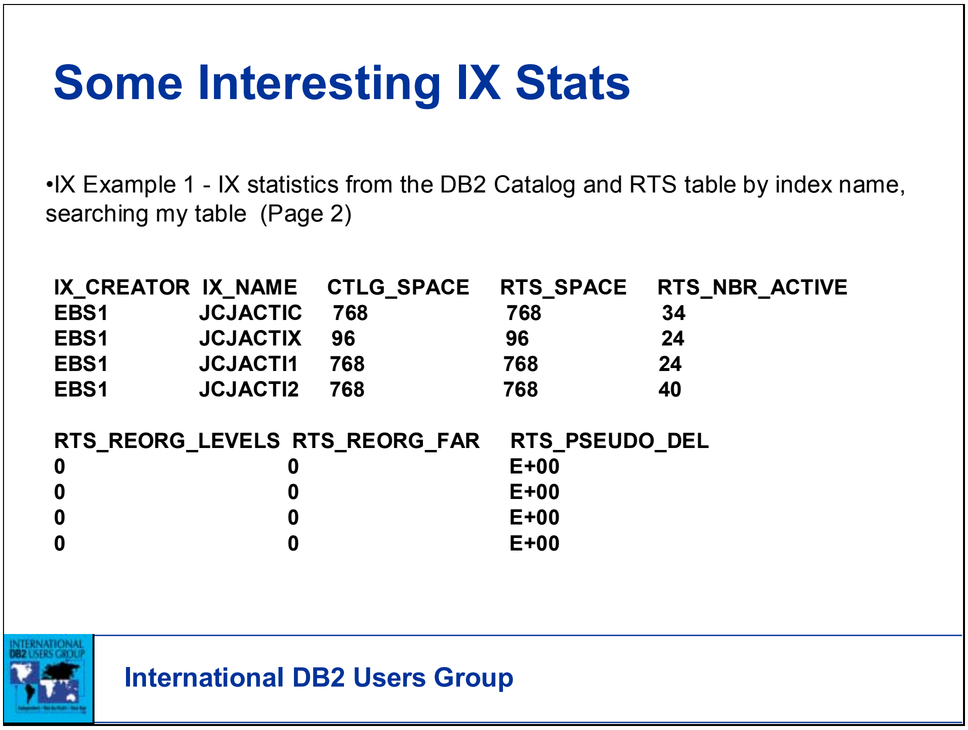
Some Interesting IX Stats

•IX Example 1 - IX statistics from the DB2 Catalog and RTS table by index name, searching my table (Page 1)

```
IDX_CREATOR  IDX_NAME    IDX_DIST_ROWS NLEVELS  CLUSTERING  CLRATIO
EBS1         JCJACTIC    1709              2         Y          100%
EBS1         JCJACTIX     2210             2         N           49.7%
EBS1         JCJACTI1    2210              2         N          59.9%
EBS1         JCJACTI2    2152              2         N          59.6%

PARTS  CTLG_EXT RTS_ROWS  RTS_EXT  RTS_LVL  RTS_RCHGS  RTS_RO_TS
0        1        2273        1        2        0          -------------------------
0        1        2273        1        2        0          -------------------------
0        1        2273        1        2        0          -------------------------
0        1        2273        1        2        0          -------------------------
```

```
SELECT A.TBCREATOR AS TBL_CREATOR, A.TBNAME    AS
TBL_NAME, A.CREATOR   AS IDX_CREATOR,A..NAME      AS
IDX_NAME,  A.FULLKEYCARDF AS IDX_DIST_ROWS, A.NLEVELS
AS NLEVELS,   A.CLUSTERING,  A.CLUSTERRATIOF AS
CLUSTERRATIO  FROM SYSIBM.SYSINDEXES A
WHERE  A.TBCREATOR = 'EBS1'  AND A.TBNAME = 'JETS_ACCOUNT'
ORDER BY A.TBCREATOR, A.TBNAME, A.CREATOR, A.NAME;
```

```
 SELECT A.CREATOR   AS IDX_CREATOR, A.NAME      AS
IDX_NAME, MAX(B.PARTITION) AS PARTS,
SUM(B.EXTENTS) AS CTLG_EXT,
SUM(C.TOTALENTRIES) AS RTS_ROWS,
SUM(C.EXTENTS) AS RTS_EXT, MAX(C.NLEVELS)  AS RTS_LVL,
SUM(C.REORGINSERTS + C.REORGDELETES) AS RTS_RCHGS,
MIN(C.REORGLASTTIME) AS RTS_MIN_RO_TS   FROM
SYSIBM.SYSINDEXES A,
SYSIBM.SYSINDEXPART B,
SYSIBM.INDEXSPACESTATS C WHERE  A.TBCREATOR = 'EBS1'
AND A.TBNAME = 'JETS_ACCOUNT' AND B.IXCREATOR =
A.CREATOR AND B.IXNAME = A.NAME
AND C.DBID = A.DBID AND C.ISOBID = A.ISOBID
AND C.PARTITION = B.PARTITION  GROUP BY A.CREATOR, A.NAME
ORDER BY A.CREATOR, A.NAME  WITH UR;
```



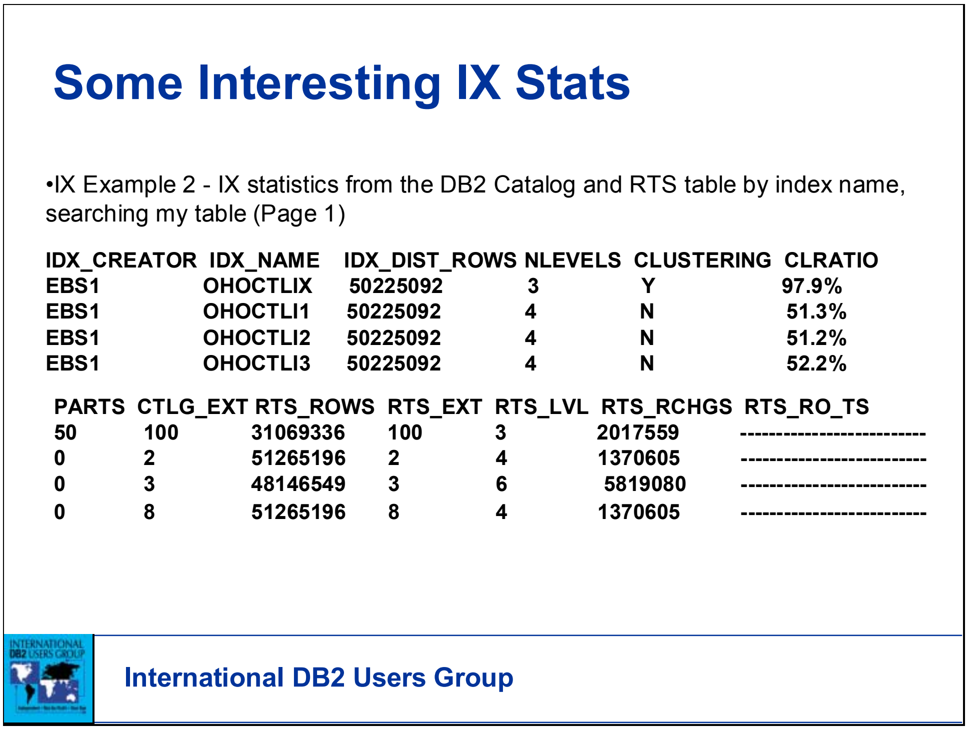
Some Interesting IX Stats

- IX Example 1 - IX statistics from the DB2 Catalog and RTS table by index name, searching my table (Page 2)

```
IX_CREATOR  IX_NAME    CTLG_SPACE    RTS_SPACE    RTS_NBR_ACTIVE
EBS1        JCJACTIC    768           768           34
EBS1        JCJACTIX    96            96            24
EBS1        JCJACTI1    768           768           24
EBS1        JCJACTI2    768           768           40

RTS_REORG_LEVELS  RTS_REORG_FAR    RTS_PSEUDO_DEL
0                 0                E+00
0                 0                E+00
0                 0                E+00
0                 0                E+00
```

International DB2 Users Group

```
SELECT A.CREATOR   AS IDX_CREATOR,
A.NAME      AS IDX_NAME, SUM(B.SPACEF) AS CTLG_SPACE,
SUM(FLOAT(C.SPACE)) AS RTS_SPACE,  SUM(FLOAT(C.NACTIVE))
AS RTS_NBR_ACTIVE,  SUM(C.REORGNUMLEVELS) AS
RTS_REORG_LEVELS, SUM(C.REORGLEAFFAR) AS
RTS_REORG_FAR,  SUM(FLOAT(C.REORGPSEUDODELETES)) AS
RTS_PSEUDO_DEL FROM SYSIBM.SYSINDEXES A,
SYSIBM.SYSINDEXPART B,
SYSIBM.INDEXSPACESTATS C      WHERE
A.TBCREATOR = 'EBSCO'   AND A.TBNAME = 'JETS_ACCOUNT'
AND B.IXCREATOR = A.CREATOR AND B.IXNAME = A.NAME
AND C.DBID = A.DBID  AND C.ISOBID = A.ISOBID
AND C.PARTITION = B.PARTITION  GROUP BY A.CREATOR, A.NAME
ORDER BY A.CREATOR, A.NAME         WITH UR;
```



Some Interesting IX Stats

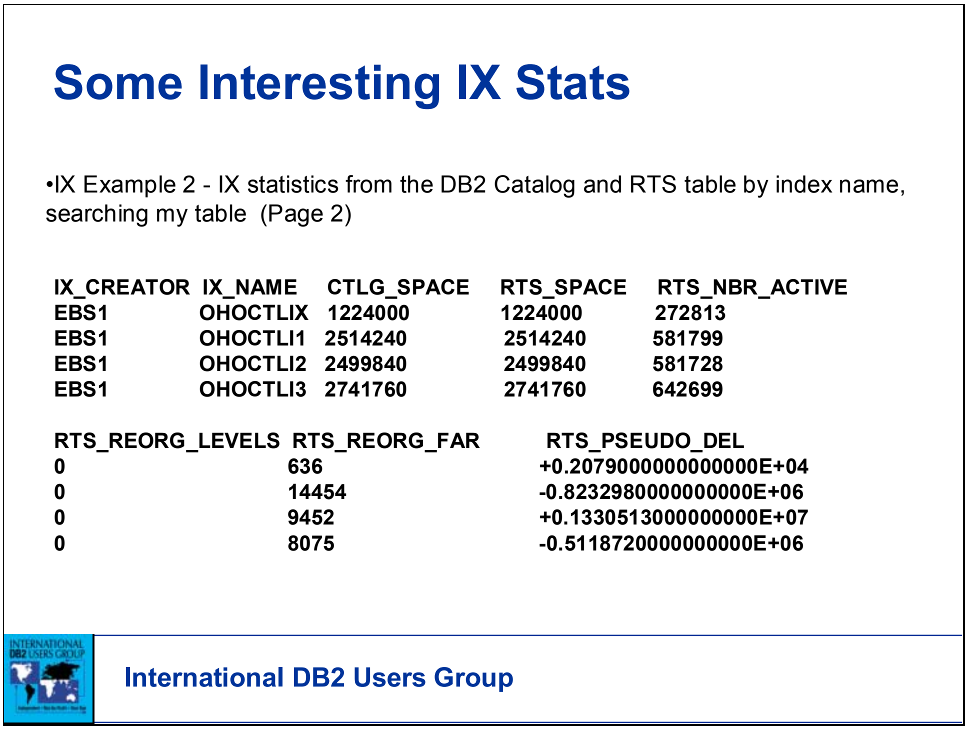
- IX Example 2 - IX statistics from the DB2 Catalog and RTS table by index name, searching my table (Page 1)

```
IDX_CREATOR  IDX_NAME    IDX_DIST_ROWS NLEVELS  CLUSTERING  CLRATIO
EBS1         OHOCTLIX     50225092        3         Y          97.9%
EBS1         OHOCTLI1     50225092        4         N           51.3%
EBS1         OHOCTLI2     50225092        4         N           51.2%
EBS1         OHOCTLI3     50225092        4         N           52.2%

 PARTS  CTLG_EXT RTS_ROWS  RTS_EXT  RTS_LVL  RTS_RCHGS  RTS_RO_TS
 50        100       31069336   100        3         2017559       -------------------------
 0         2         51265196   2          4         1370605       -------------------------
 0         3         48146549   3          6          5819080      -------------------------
 0         8         51265196   8          4         1370605       -------------------------
```

International DB2 Users Group

```
SELECT A.TBCREATOR AS TBL_CREATOR, A.TBNAME    AS
TBL_NAME, A.CREATOR   AS IDX_CREATOR,A..NAME      AS
IDX_NAME,  A.FULLKEYCARDF AS IDX_DIST_ROWS, A.NLEVELS
AS NLEVELS,   A.CLUSTERING,  A.CLUSTERRATIOF AS
CLUSTERRATIO  FROM SYSIBM.SYSINDEXES A
WHERE  A.TBCREATOR = 'EBS1'  AND A.TBNAME = 'JETS_ACCOUNT'
ORDER BY A.TBCREATOR, A.TBNAME, A.CREATOR, A.NAME;
```

```
 SELECT A.CREATOR   AS IDX_CREATOR, A.NAME      AS
IDX_NAME, MAX(B.PARTITION) AS PARTS,
SUM(B.EXTENTS) AS CTLG_EXT,
SUM(C.TOTALENTRIES) AS RTS_ROWS,
SUM(C.EXTENTS) AS RTS_EXT, MAX(C.NLEVELS)  AS RTS_LVL,
SUM(C.REORGINSERTS + C.REORGDELETES) AS RTS_RCHGS,
MIN(C.REORGLASTTIME) AS RTS_MIN_RO_TS   FROM
SYSIBM.SYSINDEXES A,
SYSIBM.SYSINDEXPART B,
SYSIBM.INDEXSPACESTATS C WHERE  A.TBCREATOR = 'EBS1'
AND A.TBNAME = 'JETS_ACCOUNT' AND B.IXCREATOR =
A.CREATOR AND B.IXNAME = A.NAME
AND C.DBID = A.DBID AND C.ISOBID = A.ISOBID
AND C.PARTITION = B.PARTITION  GROUP BY A.CREATOR, A.NAME
ORDER BY A.CREATOR, A.NAME  WITH UR;
```



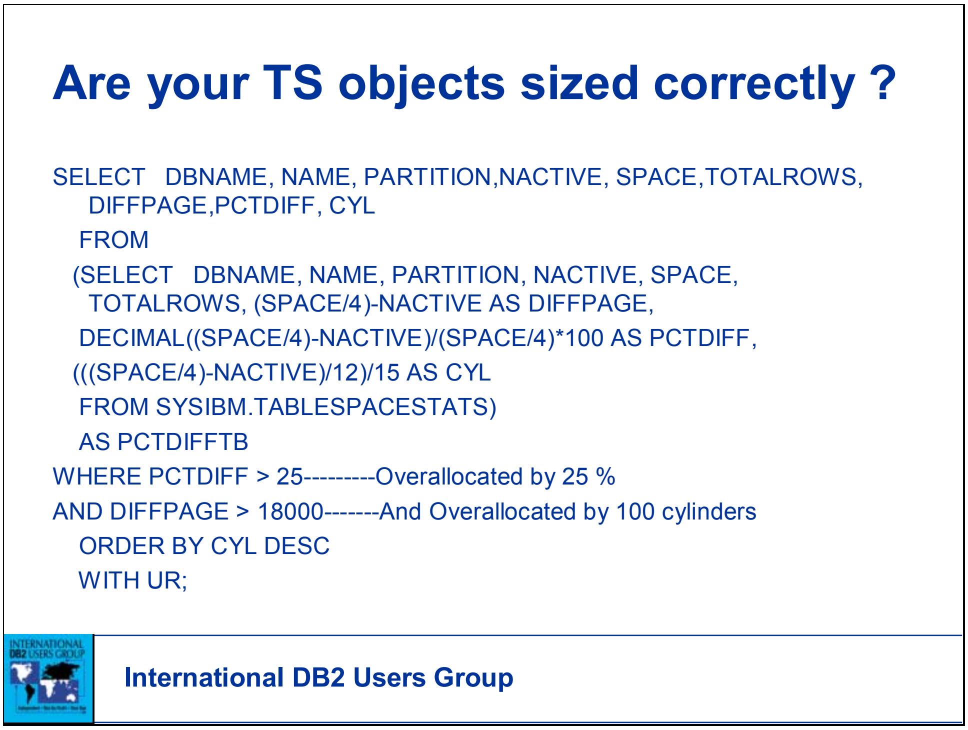
Some Interesting IX Stats

- IX Example 2 - IX statistics from the DB2 Catalog and RTS table by index name, searching my table (Page 2)

```
IX_CREATOR IX_NAME   CTLG_SPACE    RTS_SPACE    RTS_NBR_ACTIVE
EBS1       OHOCTLIX  1224000       1224000      272813
EBS1       OHOCTLI1  2514240       2514240      581799
EBS1       OHOCTLI2  2499840       2499840      581728
EBS1       OHOCTLI3  2741760       2741760      642699

RTS_REORG_LEVELS RTS_REORG_FAR     RTS_PSEUDO_DEL
0                636              +0.2079000000000000E+04
0                14454            -0.8232980000000000E+06
0                9452             +0.1330513000000000E+07
0                8075             -0.5118720000000000E+06
```

International DB2 Users Group

```
SELECT A.CREATOR   AS IDX_CREATOR,
A.NAME      AS IDX_NAME, SUM(B.SPACEF) AS CTLG_SPACE,
SUM(FLOAT(C.SPACE)) AS RTS_SPACE,  SUM(FLOAT(C.NACTIVE))
AS RTS_NBR_ACTIVE,  SUM(C.REORGNUMLEVELS) AS
RTS_REORG_LEVELS, SUM(C.REORGLEAFFAR) AS
RTS_REORG_FAR,  SUM(FLOAT(C.REORGPSEUDODELETES)) AS
RTS_PSEUDO_DEL FROM SYSIBM.SYSINDEXES A,
SYSIBM.SYSINDEXPART B,
SYSIBM.INDEXSPACESTATS C     WHERE
A.TBCREATOR = 'EBSCO'   AND A.TBNAME = 'JETS_ACCOUNT'
AND B.IXCREATOR = A.CREATOR AND B.IXNAME = A.NAME
AND C.DBID = A.DBID  AND C.ISOBID = A.ISOBID
AND C.PARTITION = B.PARTITION  GROUP BY A.CREATOR, A.NAME
ORDER BY A.CREATOR, A.NAME         WITH UR;
```

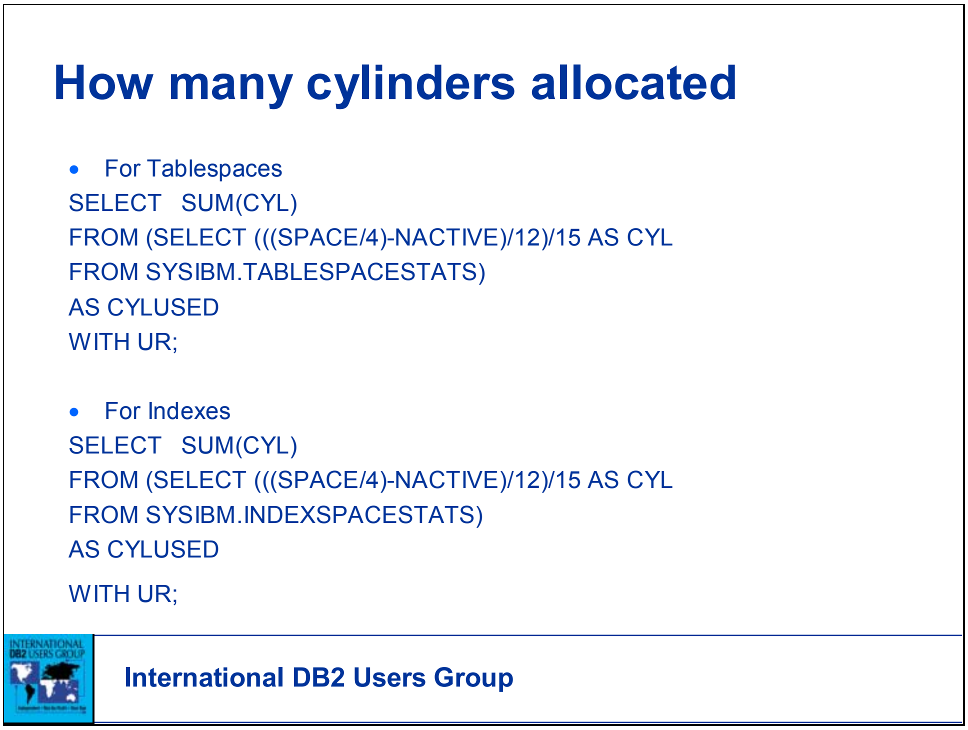


Are your TS objects sized correctly ?

```
SELECT   DBNAME, NAME, PARTITION,NACTIVE, SPACE,TOTALROWS,
    DIFFPAGE,PCTDIFF, CYL
   FROM
  (SELECT   DBNAME, NAME, PARTITION, NACTIVE, SPACE,
    TOTALROWS, (SPACE/4)-NACTIVE AS DIFFPAGE,
   DECIMAL((SPACE/4)-NACTIVE)/(SPACE/4)*100 AS PCTDIFF,
  (((SPACE/4)-NACTIVE)/12)/15 AS CYL
   FROM SYSIBM.TABLESPACESTATS)
   AS PCTDIFFTB
WHERE PCTDIFF > 25---------Overallocated by 25 %
AND DIFFPAGE > 18000-------And Overallocated by 100 cylinders
   ORDER BY CYL DESC
   WITH UR;
```

International DB2 Users Group

Some sample ideas on questions that can be answered with RTS information.



How many cylinders allocated

- For Tablespaces

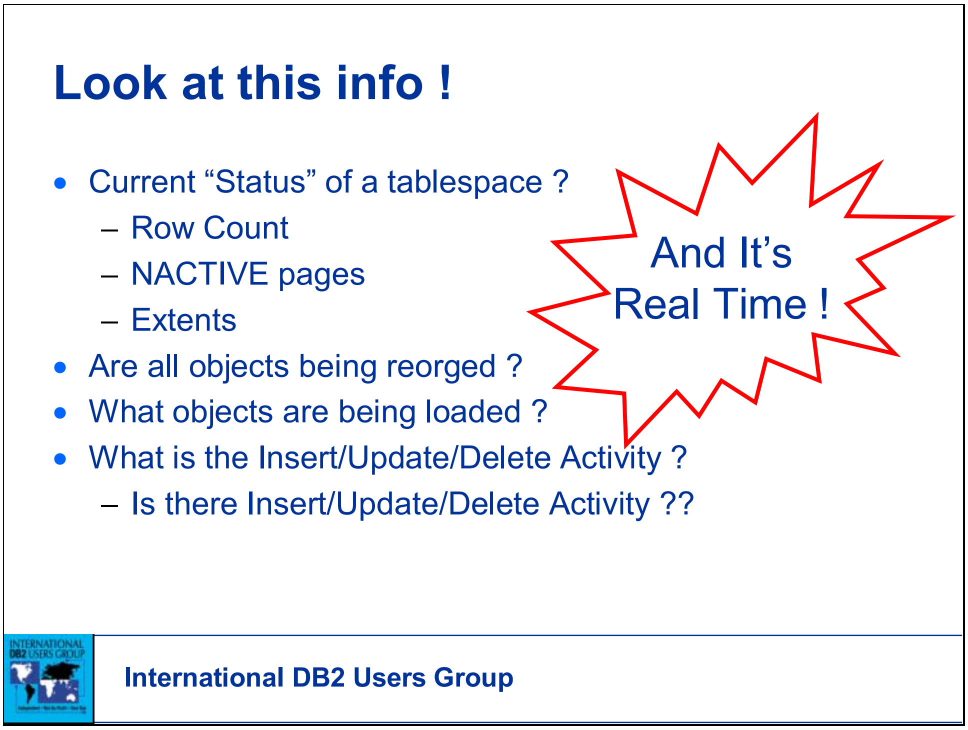
```
SELECT   SUM(CYL)
FROM (SELECT (((SPACE/4)-NACTIVE)/12)/15 AS CYL
FROM SYSIBM.TABLESPACESTATS)
AS CYLUSED
WITH UR;
```

- For Indexes

```
SELECT   SUM(CYL)
FROM (SELECT (((SPACE/4)-NACTIVE)/12)/15 AS CYL
FROM SYSIBM.INDEXSPACESTATS)
AS CYLUSED
WITH UR;
```

International DB2 Users Group

For general questions, here is another effective way to use RTS information.

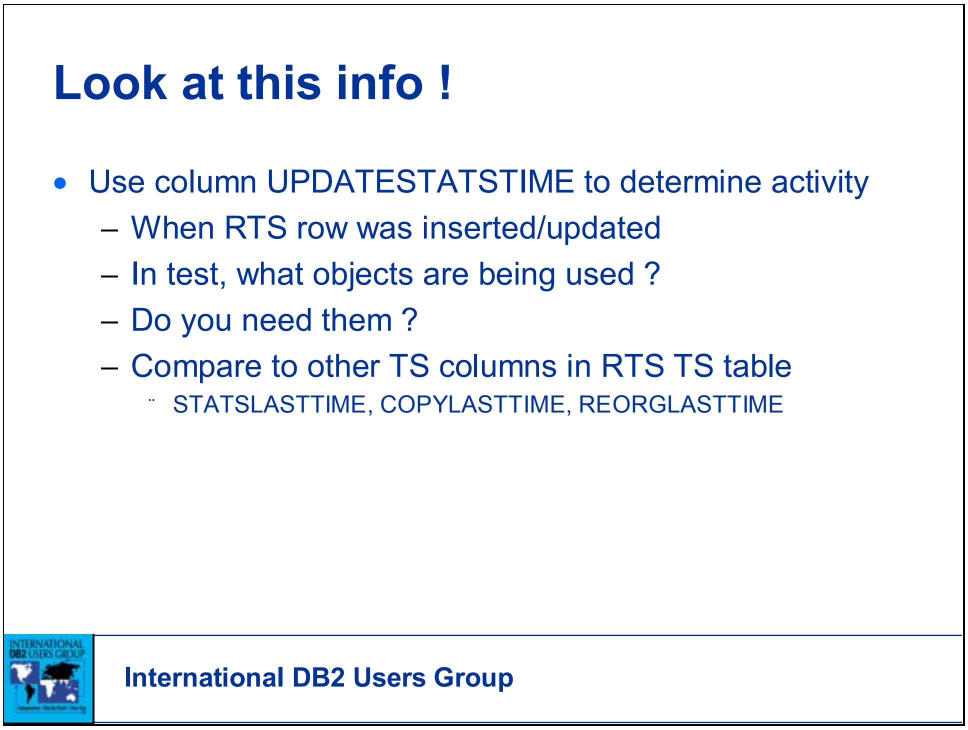


Look at this info !

- Current “Status” of a tablespace ?
  - Row Count
  - NACTIVE pages
  - Extents
- Are all objects being reorged ?
- What objects are being loaded ?
- What is the Insert/Update/Delete Activity ?
  - Is there Insert/Update/Delete Activity ??

And It’s Real Time !

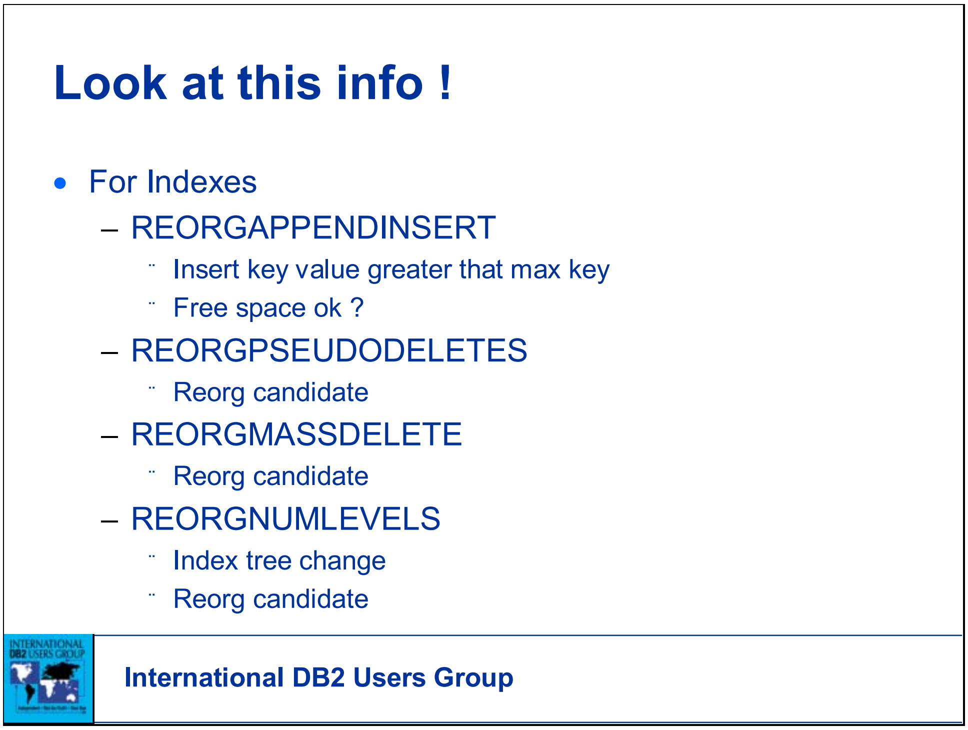
RTS provides a wealth of statistics for review to understand how DB2 objects are being processed.



Look at this info !

- Use column UPDATESTATSTIME to determine activity
  - When RTS row was inserted/updated
  - In test, what objects are being used ?
  - Do you need them ?
  - Compare to other TS columns in RTS TS table
    - STATSLASTTIME, COPYLASTTIME, REORGLASTTIME

Allows for a general viewpoint of object usage.

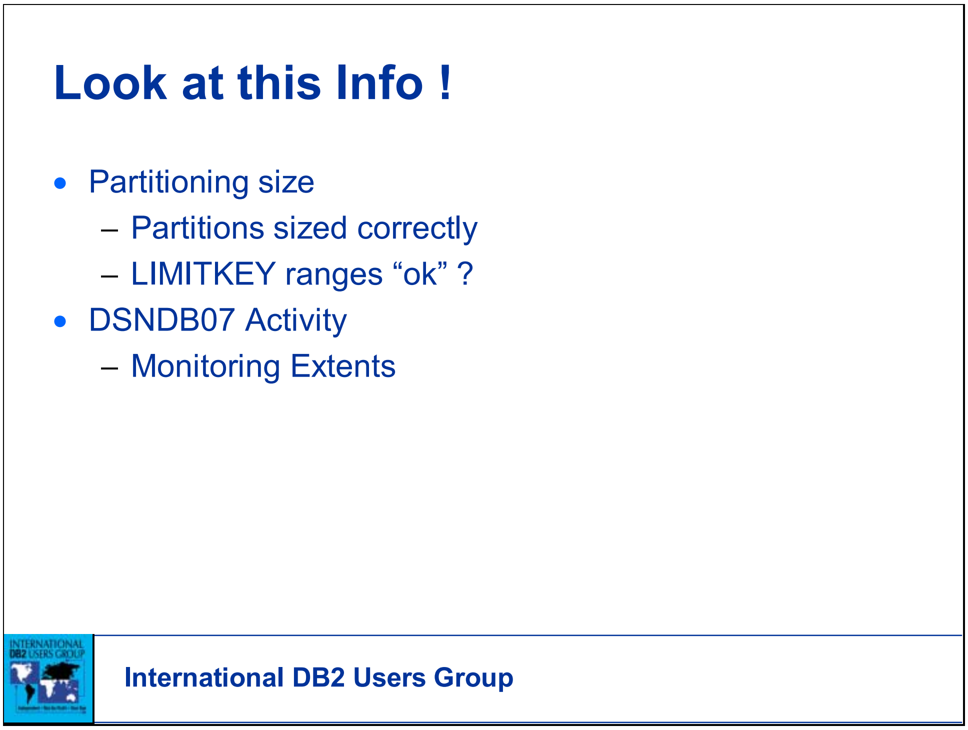


Look at this info !

- For Indexes
  - REORGAPPENDINSERT
    - Insert key value greater that max key
    - Free space ok ?
  - REORGPSEUDODELETES
    - Reorg candidate
  - REORGMASSDELETE
    - Reorg candidate
  - REORGNUMLEVELS
    - Index tree change
    - Reorg candidate

International DB2 Users Group

Much more detail about index usage and processing impact to the indexes.

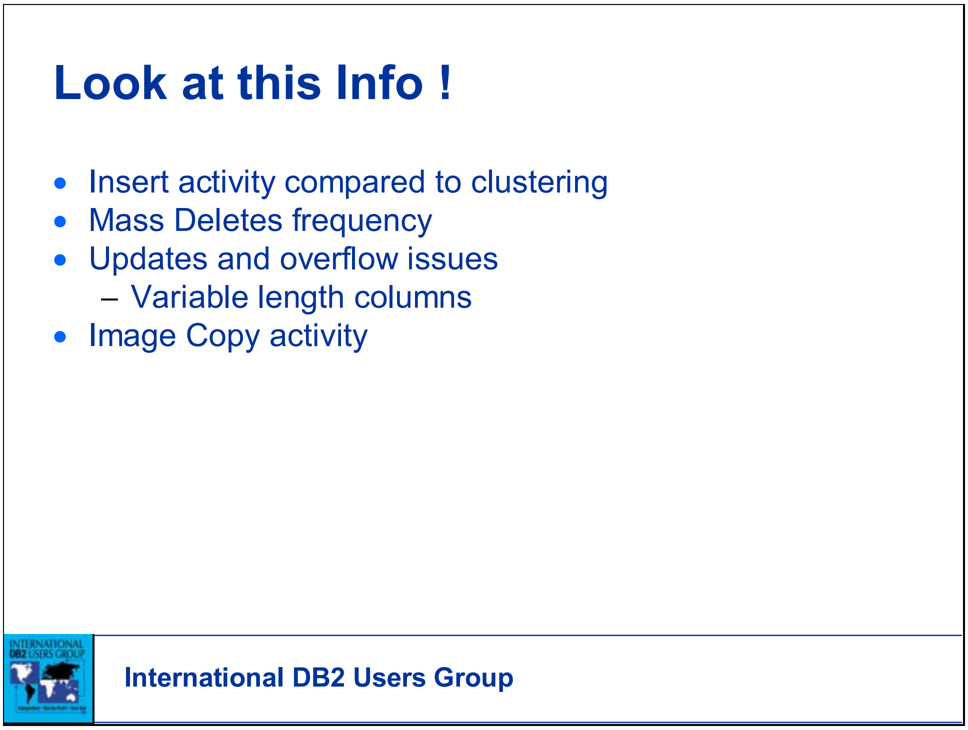


Look at this Info !

- Partitioning size
  - Partitions sized correctly
  - LIMITKEY ranges “ok” ?
- DSNDB07 Activity
  - Monitoring Extents

Capacity and data distribution analysis across partitions.

If DSNDB07 TSs has the ability to extend, RTS can help.

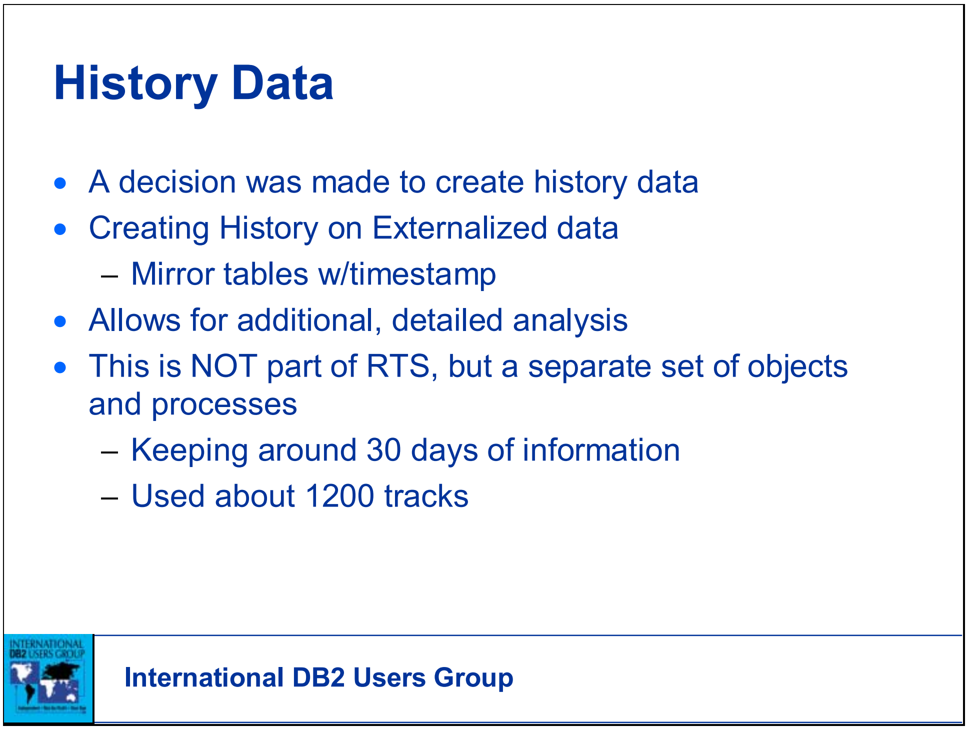


Look at this Info !

- Insert activity compared to clustering
- Mass Deletes frequency
- Updates and overflow issues
  - Variable length columns
- Image Copy activity

International DB2 Users Group

Real time analysis can allow for a more proactive performance steps based on RTS.



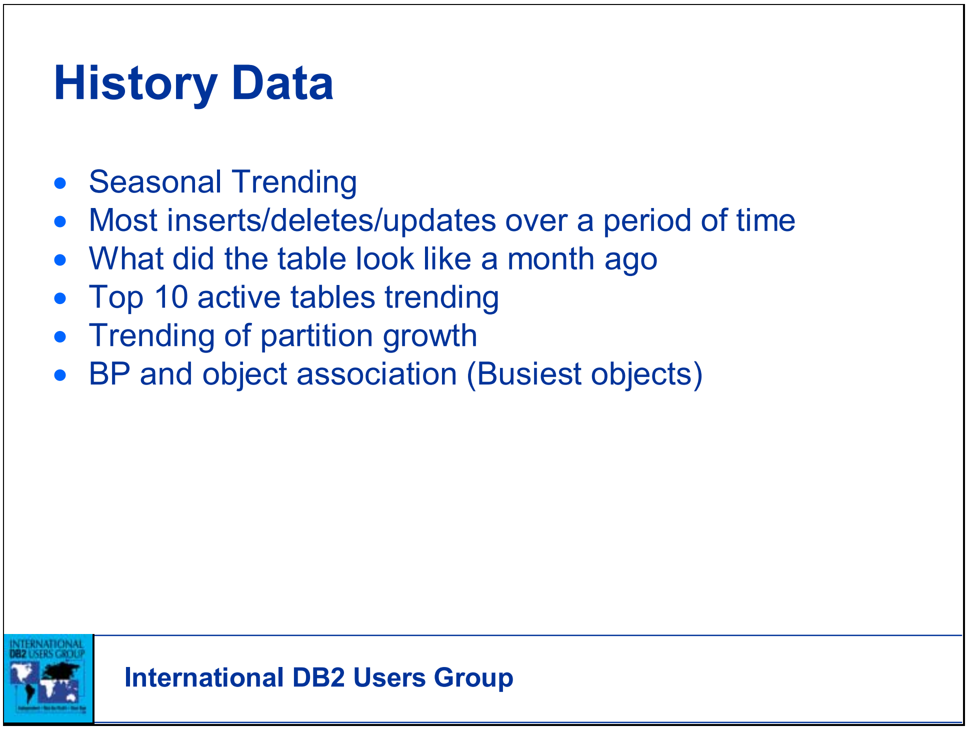
History Data

- A decision was made to create history data
- Creating History on Externalized data
  - Mirror tables w/timestamp
- Allows for additional, detailed analysis
- This is NOT part of RTS, but a separate set of objects and processes
  - Keeping around 30 days of information
  - Used about 1200 tracks

International DB2 Users Group

Wanted to experiment with keeping RTS data in a historical set of tables. Allows for additional level of detailed analysis.

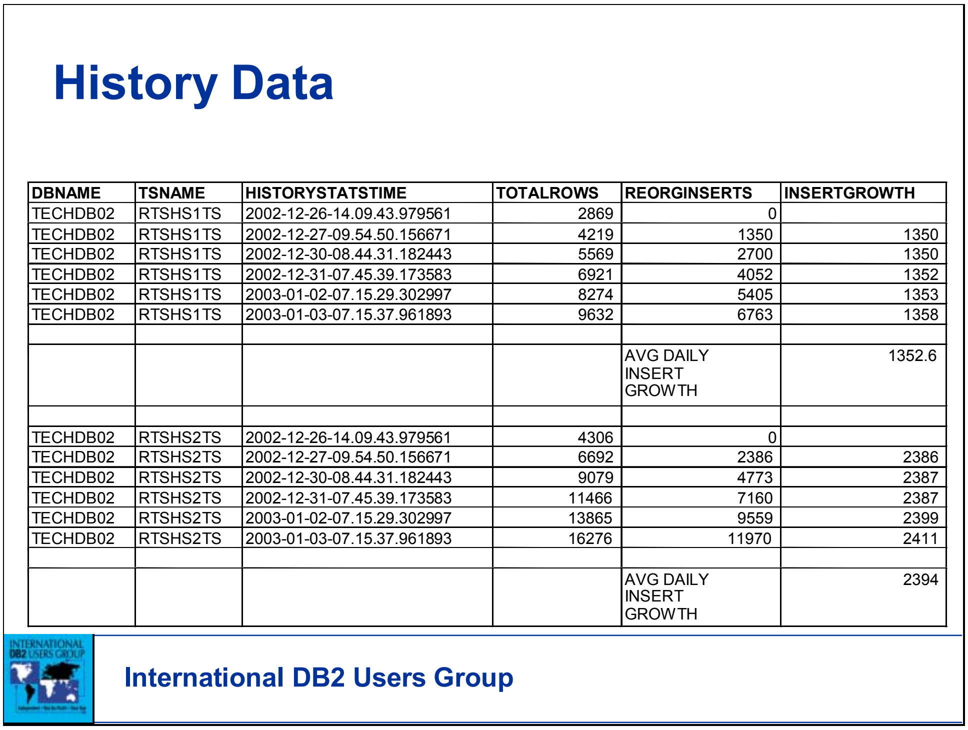
This is not part of RTS.



History Data

- Seasonal Trending
- Most inserts/deletes/updates over a period of time
- What did the table look like a month ago
- Top 10 active tables trending
- Trending of partition growth
- BP and object association (Busiest objects)

Historical data can deliver a wealth of additional facts.

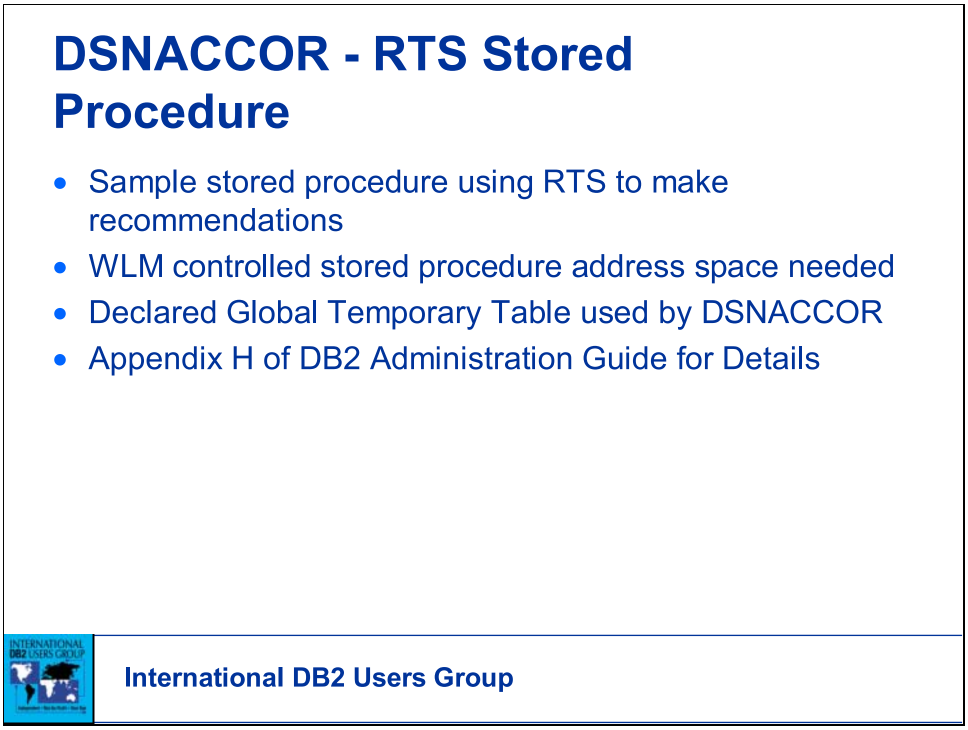


History Data

DBNAME	TSNAME	HISTORYSTATSTIME	TOTALROWS	REORGINSERTS	INSERTGROWTH
TECHDB02	RTSHS1TS	2002-12-26-14.09.43.979561	2869	0	
TECHDB02	RTSHS1TS	2002-12-27-09.54.50.156671	4219	1350	1350
TECHDB02	RTSHS1TS	2002-12-30-08.44.31.182443	5569	2700	1350
TECHDB02	RTSHS1TS	2002-12-31-07.45.39.173583	6921	4052	1352
TECHDB02	RTSHS1TS	2003-01-02-07.15.29.302997	8274	5405	1353
TECHDB02	RTSHS1TS	2003-01-03-07.15.37.961893	9632	6763	1358
				AVG DAILY INSERT GROWTH	1352.6
TECHDB02	RTSHS2TS	2002-12-26-14.09.43.979561	4306	0	
TECHDB02	RTSHS2TS	2002-12-27-09.54.50.156671	6692	2386	2386
TECHDB02	RTSHS2TS	2002-12-30-08.44.31.182443	9079	4773	2387
TECHDB02	RTSHS2TS	2002-12-31-07.45.39.173583	11466	7160	2387
TECHDB02	RTSHS2TS	2003-01-02-07.15.29.302997	13865	9559	2399
TECHDB02	RTSHS2TS	2003-01-03-07.15.37.961893	16276	11970	2411
				AVG DAILY INSERT GROWTH	2394

International DB2 Users Group

One simple example of history data from RTS. More trending and forecasting possibilities.

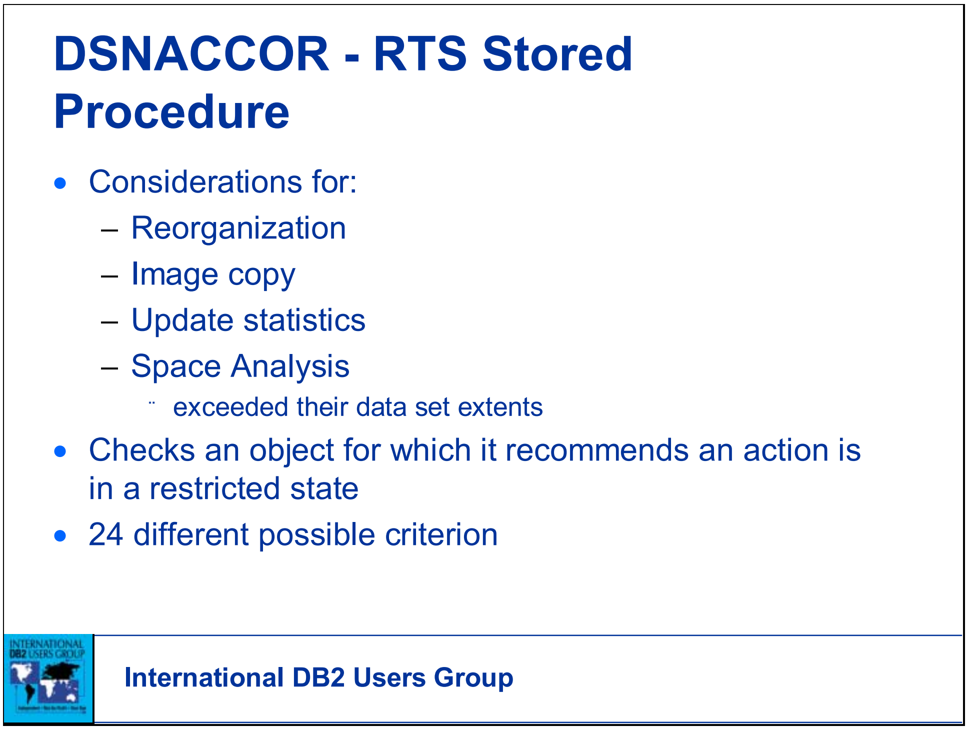


DSNACCOR - RTS Stored Procedure

- Sample stored procedure using RTS to make recommendations
- WLM controlled stored procedure address space needed
- Declared Global Temporary Table used by DSNACCOR
- Appendix H of DB2 Administration Guide for Details

International DB2 Users Group

To provide a more consistent view into the RTS tables, DSNACCOR has been developed. DSNACCOR is not a requirement to access RTS tables.

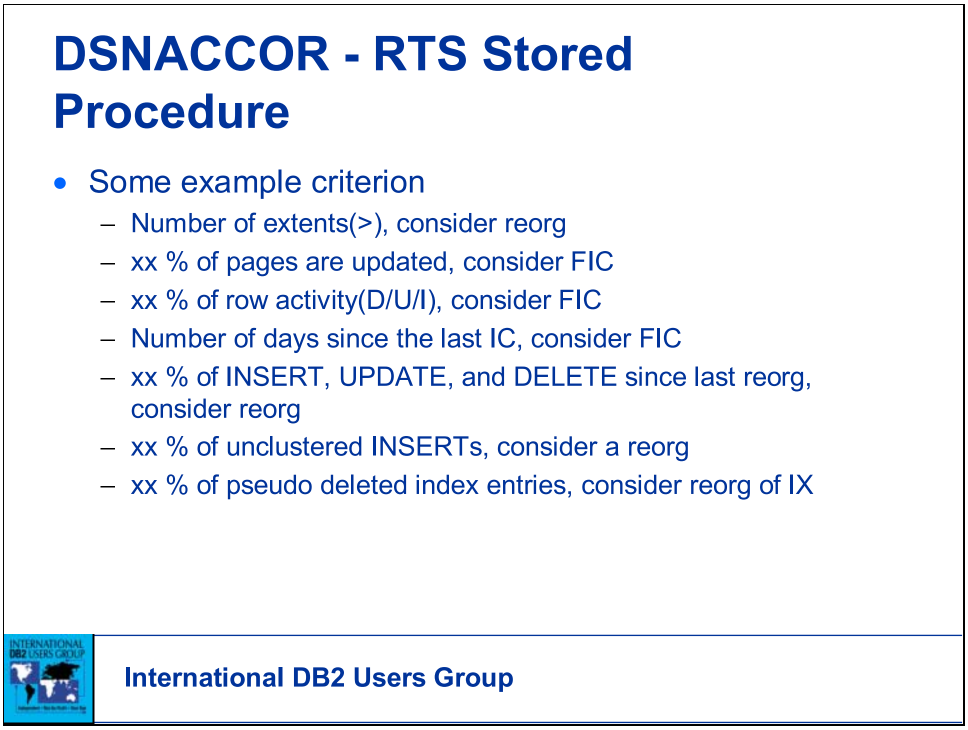


DSNACCOR - RTS Stored Procedure

- Considerations for:
  - Reorganization
  - Image copy
  - Update statistics
  - Space Analysis
    - exceeded their data set extents
- Checks an object for which it recommends an action is in a restricted state
- 24 different possible criterion

International DB2 Users Group

DSNACCOR delivered developed SQL to provide specific analysis of statistics in the RTS tables.

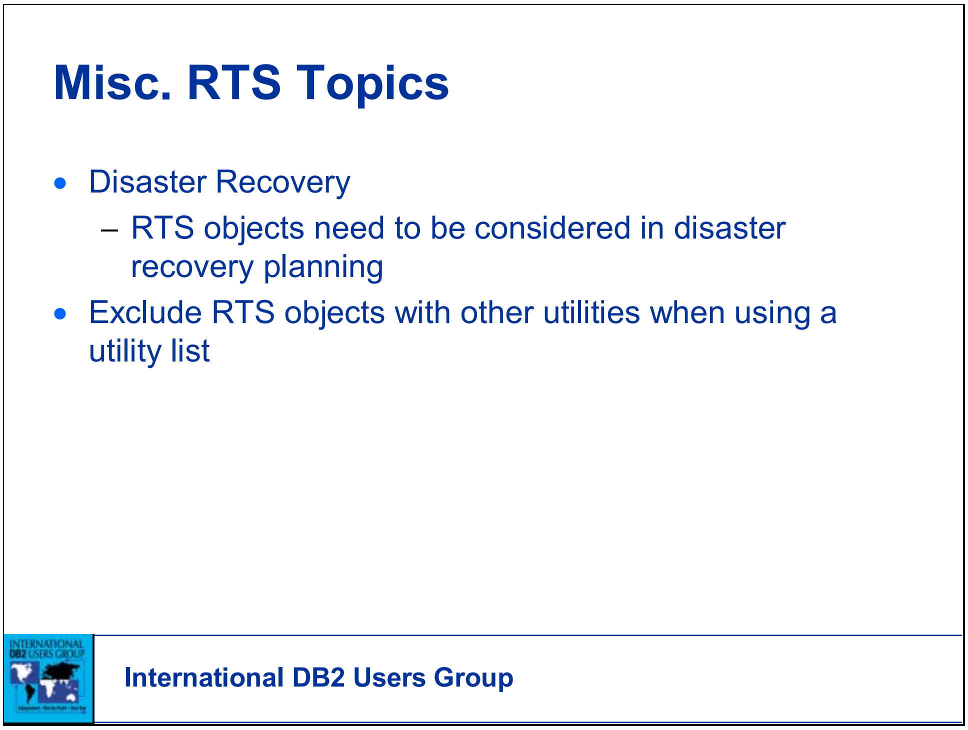


DSNACCOR - RTS Stored Procedure

- Some example criterion
  - Number of extents(>), consider reorg
  - xx % of pages are updated, consider FIC
  - xx % of row activity(D/U/I), consider FIC
  - Number of days since the last IC, consider FIC
  - xx % of INSERT, UPDATE, and DELETE since last reorg, consider reorg
  - xx % of unclustered INSERTs, consider a reorg
  - xx % of pseudo deleted index entries, consider reorg of IX

International DB2 Users Group

Examples of the specific analysis available. IBM DB2 Administration Tool has a built in interface to the RTS data.

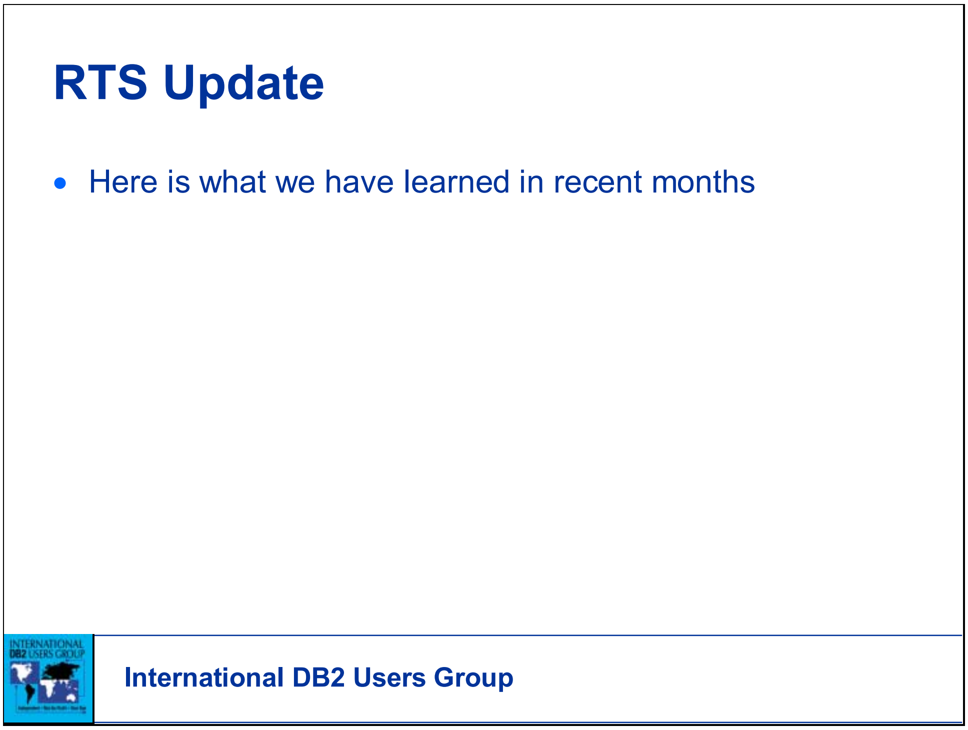


Misc. RTS Topics

- Disaster Recovery
  - RTS objects need to be considered in disaster recovery planning
- Exclude RTS objects with other utilities when using a utility list

International DB2 Users Group

Just some other things to consider.

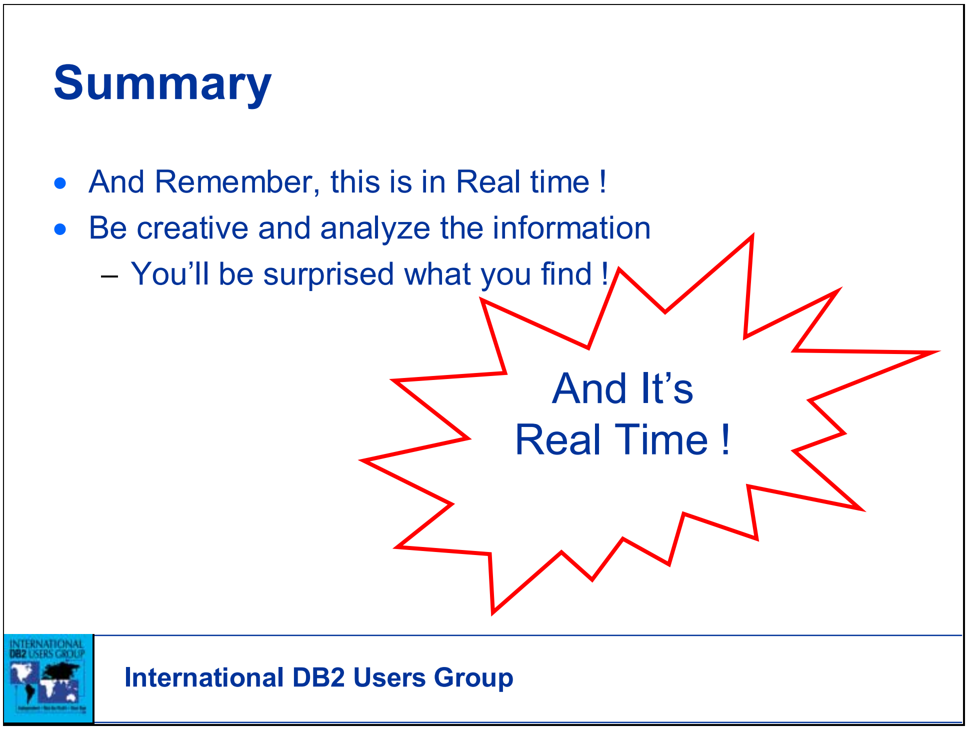


RTS Update

- Here is what we have learned in recent months

International DB2 Users Group

RTS will deliver significant benefit to those who implement this functionality. Be creative in it's use.



Summary

- And Remember, this is in Real time !
- Be creative and analyze the information
  - You'll be surprised what you find !

And It's
Real Time !

Interesting and informative real time information.