

The Nuts and Bolts of Db2 z/OS Recovery

Back to Basics

As a Db2 Database Administrator we are pulled into multiple situations. The most important is when a recovery is needed. This presentation takes us back to the basics when it comes to Db2 z/OS Recovery.

Every day our critical Db2 systems take image copy after image copy of production Db2 databases. Why? Well, there are many answers but the most important is for recovery. This presentation will describe Db2 Recover from start to finish. It is not all about how to physically recover but why you choose one method over another.

Db2 Releases over the years have increase the capability of Recovery to address data availability and data retention. Back to Basic presentation will describe how this change can influence how to address a recovery scenario.

The attendee will leave the presentation with a new foundation of Db2 Recovery

Session Objectives

- Why is this a topic at all?
- How Db2 Recovery Works
- Db2 z/OS Recovery Utilities
- Match the Recovery Situation with correct Recovery
- Make everyone successful

Db2 z/OS Recovery Utilities

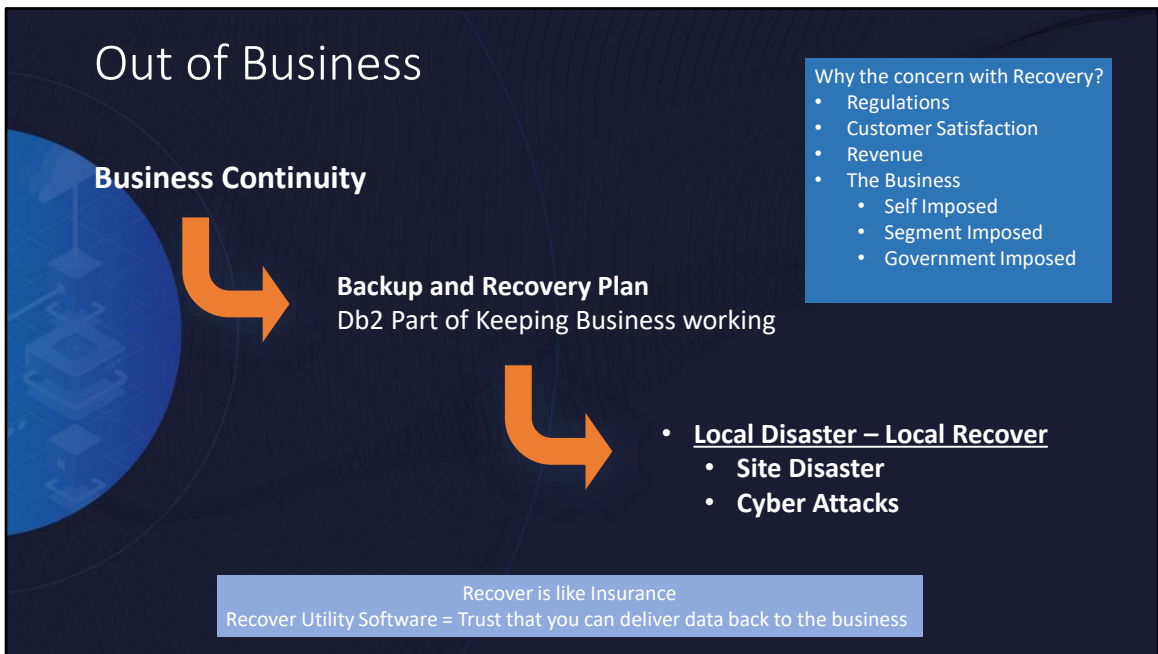
How Db2 Recovery Works

Match the Recovery Situation with the right Recovery

Backup and Recovery Strategy

Various tools that can help us be successful.

Material for the presentation is from the Db2 Administration Guide and Db2 Utility Guide.



For everyone who has been in the industry for a number of years. Recovery has different phases. Early on ... applications were causing issues just because of the infrastructure of DB2 and relational database concept. Then as DB2 grew – we had different reasons for recovery. Hardware and software ones. Today many people will say and document 80 percent of all recovery are application caused recovery ... but there are more and more hardware ones out there.

Pile on to that the explosion of data, the high availability requirements, lack of staff ... Recovery is a Real Challenge ... and when you boil it down it is about availability.

If we didn't rely on this data, our DB2 subsystems would be like junk yards of abandon cars ... we would have abandon TS all over the place.

Reminds me of a recovery story. All stories have a villain and a hero. Next couple of minutes we will look into those villains and how our heroes can save the day.

As Db2 Professionals what's up with Recovery

• Recovery Is a Real Challenge

- Exploding Data Volumes / Db2 Objects
- Staff Productivity and Expertise pressures
 - Recovery was a 'part time' job
 - Many hours go into DR preparation and testing
 - More data, more apps, ... More DBAs?
- Planned downtime pressures
 - Brief outages must be eliminated
 - Consistent, cross DBMS, backups
- Never a good time for an Unplanned outage

We always had to worry about Recovery

- Db2 Subsystem itself
- z/OS Hardware Issues
- Self Inflicted
 - Application Issues
 - Hardware additions/maintenance
 - Oops was that production
- Mother Nature
- New Kid on the Block – Cyber Attack
 - Ransomware

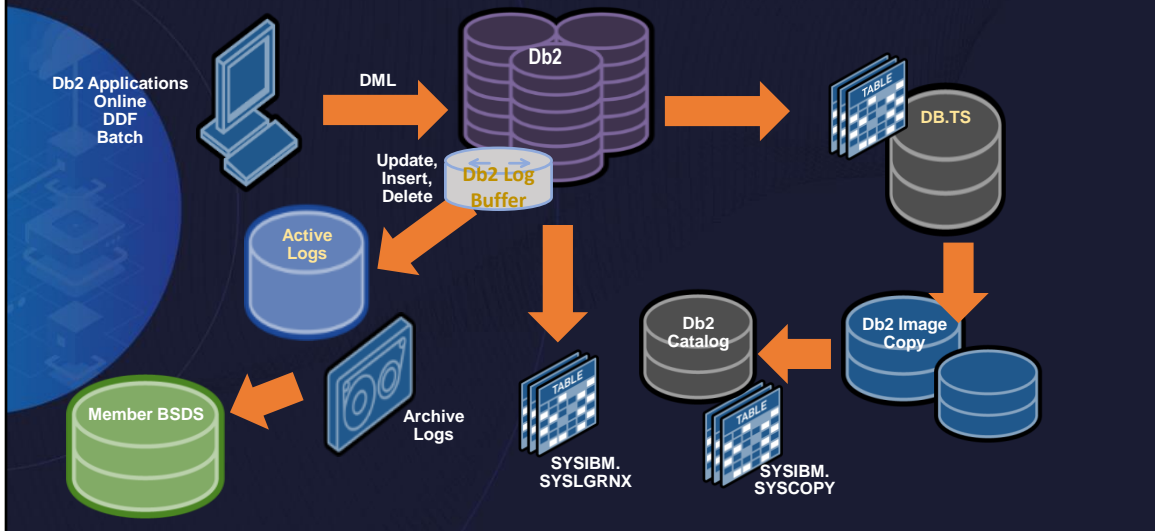
Has anyone done a recovery in the last 6 months ?

Cyber attacks/Ransomware

How is the business going to handle protecting our data

- Ransomware account for over 25% of security attacks
- Average cost of a data breach is the highest it has ever been
- Every Mainframe is under attack
 - The power of the MF makes things worse
 - 98K files / 50 GB encrypted in 4 minutes off platform
- Don't build a fence – you need to protect against infections
 - Discover early

IBM Db2 z/OS Recovery Resources



Digital business drives data volume and complexity of your data and your IT processes. IDC has stated that businesses will experience a 50fold growth in data from 2010 to 2020 and 90% is unstructured data. This data is coming from everywhere. Its no longer business created data, its customer created data. Customers expect to be able to get to this data all the time, any time. They have no tolerance for slow response times or **downtime**. But what have our customers done to ensure that if they have an outage, they can recover with lightning speed???

Nobody advertises when they have these LOCAL recovery events. But you can be sure it happens anywhere from 2 – 10 times every year, requires some type of data recovery and always takes longer than expected.

Large Financial Customer experienced data corruption in 2011 which resulted in a 30 hour outage. So subsequent to the outage, they issued an RTO mandate of 2 hours.

At large Hotelier in Feb 2013, a DBA thought he was running a reorg to purge data from just 1 partition of a TEST table. In fact, he was purging data from ALL partitions...of the PRODUCTION table. After working with BMC Support for 28 hours, all data was recovered using BMC's Recovery suite. The DBA was let go about 2 weeks later.

Government Agency had a localized DASD hardware failure in Feb, 2012 resulting in DB2 databases not being updated and losing consistency. Working with both IBM and BMC, it took 36 hours before applications could be turned on again.

What do we recover in Db2 z/OS Land?

- Tablespaces
- Indexes / Index Spaces
- Partitions
- Datasets
- Db2 page or range of Pages
- Db2 Catalog and Directory
- Entire Db2 Subsystem

Lets discuss Indexes ...

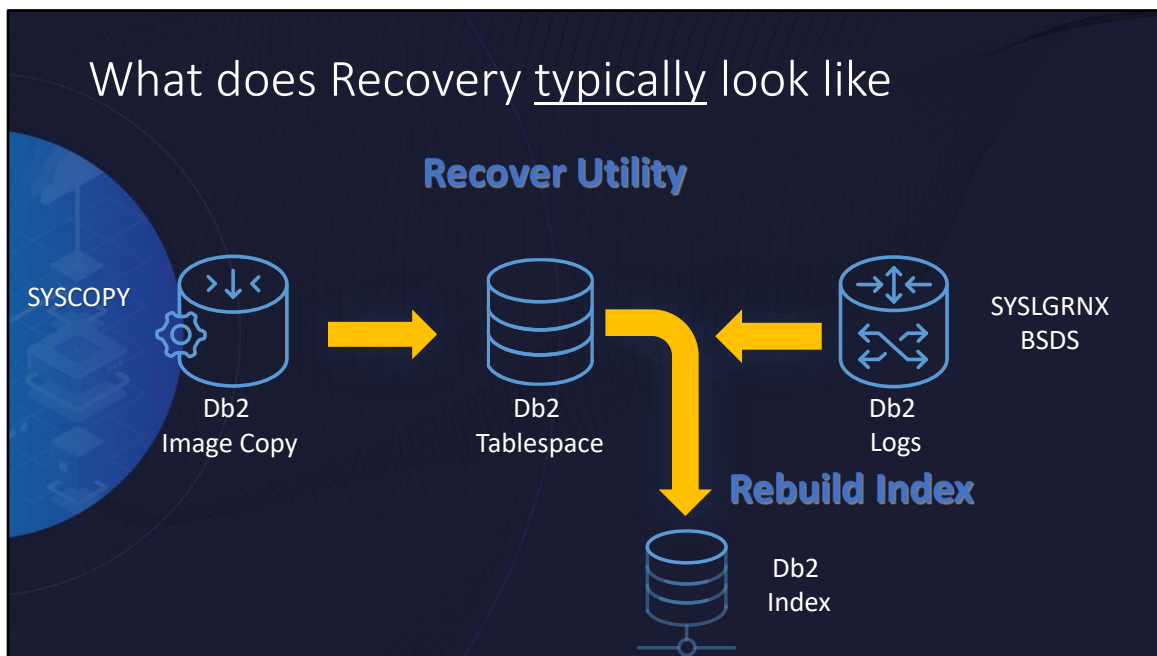
Rebuild Indexes

Recover Indexes

Copy YES

Can you recover an index ?

What does Recovery typically look like



We have to answer these questions and others.

But must prepare for the Worst ... because if it happens the DBAs and System team are on the front lines. All eyes are on your.

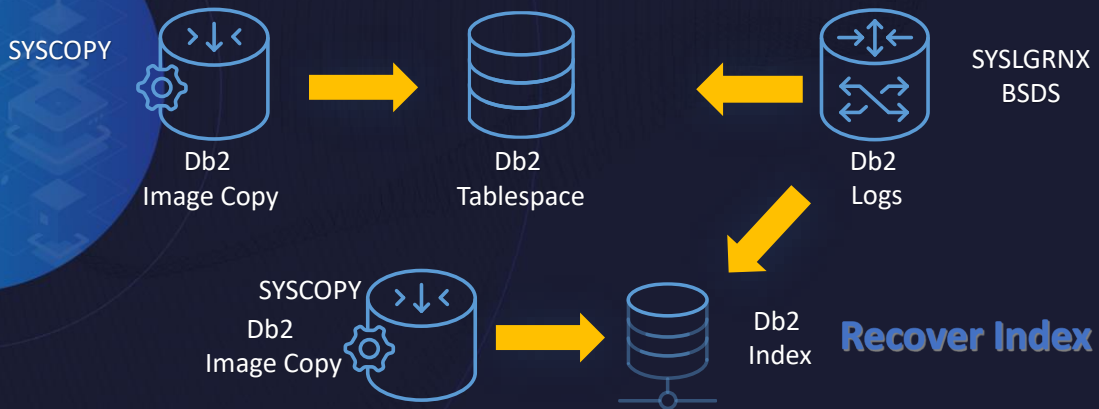
I have listed a few here ...

Does our Backup strategy support our needs. Was at a customer last week, they did have a recovery situation. System Programmers could of recovered to the DR site or Local Subsystem Recovery ... the system side was good to go. However the image copies required to do that type of recovery were not onsite and even if they could get the image copies back ... they would also need to bring back additional log which goes to the second question ... are you keeping your log locally around to match your backups

The last question we will talk about in a bit ... but what if you need to create a point in time copy to a prior point. What did the data look like at that point ... without doing the recovery. We had to do that for a customer who went ahead and did a recovery and the recovery did not fail ... however the object was still compromised. We were able to see the data to a point prior to the recovery and validate the data.

What does Recovery typically look like – take 2

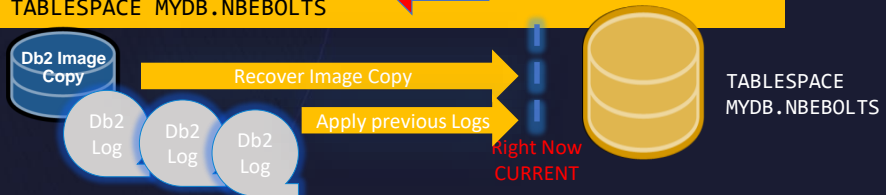
Recover TS Utility



Fundamentals of Recover / Rebuild Utilities

- Fundamentals allow understanding of how to Recover Db2 Objects based on Recover Objective

```
//STEP1 EXEC PGM=DSNUTILB PARM=(ssid,'IBMRECV'),  
//STEPLIB DD DSN=SYS1.DSNEXIT,DISP=SHR  
// DD DSN=SYS1.SDSNLOAD,DISP=SHR  
//SYSPRINT DD SYSOUT=*  
//SYSUDUMP DD SYSOUT=*  
//UTPRINT DD SYSOUT=*  
//SYSIN DD *  
RECOVER  
TABLESPACE MYDB.NBEBOLTS
```



Results of running Recover

```
DSNU000I 114 12:39:50.20 DSNUGUTC - OUTPUT START FOR UTILITY, UTILID = IBMREC  
DSNU1044I 114 12:39:50.20 DSNUGTIS - PROCESSING SYSIN AS EBCDIC  
DSNU050I 114 12:39:50.21 DSNUGUTC - RECOVER TABLESPACE MYDB.NBEBOLTS  
DSNU3031I *DJJ1 114 12:39:50.22 DSNUHUTL - UTILITY HISTORY COLLECTION IS ACTIVE.  
DSNU1569I *DJJ1 114 12:39:50.23 DSNUCAIN - RECOVERY LOGPOINT IS X'00DEFD753351E9F11600'  
DSNU3345I 114 12:39:50.23 DSNUCBMT - MAXIMUM UTILITY PARALLELISM IS 1 BASED ON NUMBER OF OBJECTS  
DSNU515I 114 12:39:50.23 DSNUCBAL - THE IMAGE COPY DATA SET MKTCWR.MYDB.NBEBOLTS.NB0 WITH  
DATE=20240423 AND TIME=122146  
IS PARTICIPATING IN RECOVERY OF TABLESPACE MYDB.NBEBOLTS  
DSNU504I 114 12:39:50.71 DSNUCBRT - MERGE STATISTICS FOR TABLESPACE MYDB.NBEBOLTS -  
NUMBER OF COPIES=1  
NUMBER OF PAGES MERGED=11  
DSNU578I *DJJ1 114 12:39:50.72 DSNUCALA - SYSLGRNX INFORMATION FOR MEMBER DJJ1  
DSNU513I *DJJ1 114 12:39:50.72 DSNUCALA - RECOVER UTILITY LOG APPLY RANGE IS  
RBA 000000005444DA51394 LRSN 00DEFD71868E27712400 TO  
RBA 000000005444DA859FC LRSN 00DEFD71914740A96A00  
DSNU1568I *DJJ1 114 12:39:50.86 DSNUCALA - LOGAPPLY PHASE: 76 LOG RECORDS READ, 12 LOG RECORDS APPLIED  
DSNU1510I 114 12:39:50.86 DSNUCBLA - LOG APPLY PHASE COMPLETE, ELAPSED TIME = 00:00:00  
DSNU500I 114 12:39:50.88 DSNUCBDR - RECOVERY COMPLETE, ELAPSED TIME=00:00:00  
DSNU010I 114 12:39:50.89 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0
```

Controlling IBM Recover Utility

- Db2 Objects

- What objects are you recovering
 - Partition or Data Set Level
- List via LISTDEF
- PAGE

- Recovery Point

- Point in time the data will represent after recovery

- Recover Options

- LOGONLY
- BACKOUT

Power of Three

- Three things control IBM Recover
- Three Recovery Points

Best Practice:

Recover all related tables and indexes to the same point to avoid logical data corruption/inconsistency

When we do have to break out the equipment and get ready to battle.

Two important points we have to address: Recovery Time objective. How long will this recovery take me – because in most cases there is an outage associated with this recovery. The other question is Data Loss ... where am I recovering this object to? Before the bad program, around the time we lost the controller. If we do lose data, is there a way we can get it back. I have been on recovery issues where the recovery was done, object was back in R/W mode and we spent days getting back records which were lost.

What Db2 Objects are we Recovering

- Individual

- Tablespace
- IndexSpace
- Index
- DSNUM
 - ALL / Integer
- PAGE
- ERROR RANGE

- LISTDEF

- Most recovers require group of objects
- LIST Command
- SCOPE (UPDATED/ALL)
 - Only good for point in time recovers
 - UPDATED – only objects changed since point in time specified will be recovered
 - Some restrictions – aka pending states
 - ALL - all objects in the LIST will be processed

Relationships between Objects

Table / Index
LOB Objects
Db2 RI relationships
History Objects
Archive Objects
CLONEs

LISTDEF can be instream with COPY (or any other utility)

LISTDEF can be stored in a dataset or PDS

Called via a DD Statement in Utility JCL (SYSLISTD default)

Specify the DD Statement via OPTIONS LISTDEFDD statement

Test / Review the LISTDEF you created

PREVIEW in the third parameter of EXEC statement

OPTIONS statement OPTIONS PREVIEW

What if you have an issue with one object during the utility

OPTIONS ITEMERROR

PLEASE show me an example ...

```
LISTDEF BUTTERCUP INCLUDE TABLESPACE MYDB.*
```

```
LISTDEF BUTTERCUP INCLUDE TABLESPACE MYDB.*
```

```
EXCLUDE TABLESPACE MYDB.T*
```

Objects to be Recovered

- LIST Command – **LISTDEF**

- Recover multiple objects with one recover statement

- INCLUDE / EXCLUDE

- Tablespace
- Indexspaces
- PARTLEVEL
 - Ranges

- Wildcards available

- Allows control on what is selected

- RI
- DEFINED
- COPY YES/NO
- XML/LOB
- HISTORY and ARCHIVE

Test / Review the LISTDEF you created

PREVIEW in the third parameter of EXEC statement
OPTIONS statement OPTIONS PREVIEW

If you specify OPTIONS EVENT(ITEMERROR,SKIP):

- Each object in the list is placed in UTRW status and the read claim class is held only while the object is being copied.

- The object is not opened by Db2 for an incremental copy when no pages were updated since the last copy or when the criteria is not met for a CHANGELIMIT copy request.

– If you do not specify OPTIONS EVENT(ITEMERROR,SKIP), all of the objects in the list are placed in UTRW status and the read claim class is held on all objects for the entire duration of the COPY.

– Utility processing inserts a SYSCOPY row for each object in the list when the copy of each object is complete.

– Objects in the list have different LRSN values for the START_RBA column for the SYSCOPY rows; the

START_RBA value is set to the current RBA or LRSN at the start of copy processing for that object.

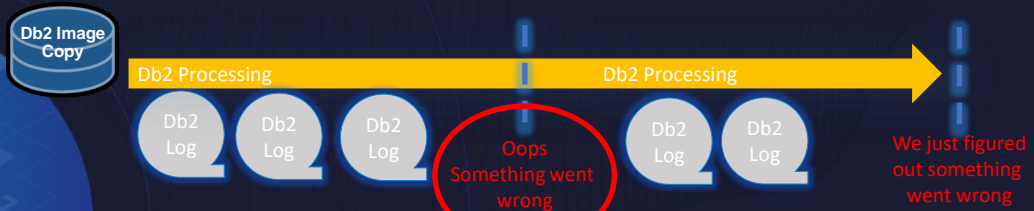
Recovery Point - Where we are taking Objects

- **CURRENT (default)**
 - Related Objects might not need to be recovered
 - Why CURRENT?
 - VSAM dataset lost or corrupted or getting back dropped object
 - Site disaster
- **TORBA / TOLOGPOINT**
 - Recover to this specific point in time using Db2 Recovery Resources
 - Quiesce point in application processing
 - PIT of bad software deployed
 - PIT of hardware issue
 - TORBA for non-data sharing
 - Upon recovery the table data is consistent
 - All inflight URID are removed
 - Parameters
 - VERIFYSET
 - ENFORCE
 - SCOPE

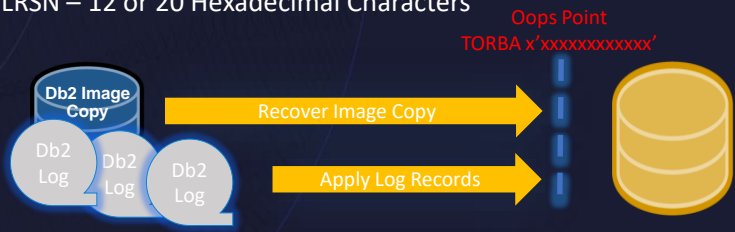
DSNUM ALL

Non Db2 13 or non-UTS need to backup ALL
If backup by part need to recover by part
DSNUM integer
Can use part level copies or ALL copies

TORBA / TOLOGPOINT



- Recovery to the point prior to Oops !
- TORBA or TOLOGPOINT
 - RBA/LRSN – 12 or 20 Hexadecimal Characters



Ways to determine TORBA/TOLOGPOING

- Your Friends
 - Db2 Utility – REPORT RECOVER
 - Db2 – Convert Time/RBA
 - Db2 Log Tools
 - SYSIBM.SYSCOPY

```
DXX1-R ----- IMAGECOPY LIST -
Command ==>

CMD will show commands for this list. Type comman
Lists: ? DB IC IM IP IS IX OEV TS UTL
QUALIFIER: TABLE=TBLHLQ.CR_INDIVIDUAL
Cmd Ctyp Database Tablespace Dsnm Operation
---v---1---v---2---v---3---v---4---v---5
TS CRBMCDDB CRINDDTS 0 QUIESCE
TS CRBMCDDB CRINDDTS 0 QUIESCE
TS CRBMCDDB CRINDDTS 0 REORG LOG(NO)
TS CRBMCDDB CRINDDTS 1 COPY FULL YES
```

```
DJJ1-R ----- CATALOG ROW -----
Command ==>

FROM SYSIBM.SYSCOPY
QUALIFIER: IMAGE COPY=CRBMCDDB.CRINDDTS.0
Column Name Column Value
---v---1---v---2---v---3---v---4---v---5---v---
DSNUM . . . . . 0
ICTYPE . . . . . 0
ICDATE . . . . . 240523
START_RBA . . . . . X'00DF2341CA5988766400'
FILESEQNO . . . . . 0
DEVTYPE . . . . .
IBMREQD . . . . . N
DSNAME . . . . . CRBMCDDB.CRINDDTS
ICTIME . . . . . 141210
SHRLEVEL . . . . .
DSVOLSER . . . . .
TIMESTAMP . . . . . 2024-05-23-14.12.10.074247
ICBACKUP . . . . .
ICUNIT . . . . .
STYPE . . . . . W
PIT_RBA . . . . . X'00000000000000000000'
```


- Example – Bad Program promoted to batch production – CRIN2PK
 - Recover to last Quiesce Point all objects affected

```

DXX1-R ----- TABLE LIST ----- ROW 1 OF 6
Command ==>                               Scroll ==> CSR
                                           02
QUALIFIER: PACKAGE=COLLID.CRIN2PK
C  Table Name                Database Tblspace CoIsPK Type  Rows  Pages
-----1-----2-----3-----4-----5-----6-----7-----v---
BOLTNUTS.CR_HIST_IND        CRBMCDDB CRINHDTs  8  4 T    12K  8192
BOLTNUTS.CR_INDIVIDUAL     CRBMCDDB CRINDDTs  8  2 T   390K  24K
BOLTNUTS.CR_ORDERS         CRBMCDDB CRORRDTS  8  3 T    10K   57

```

bmc AMI Command Center for Db2 Workspace Apps

Reiber-DBA*

DB2 Navigator File Locator Job Browser Performance Schema Management Recovery Management Scratchpad Product Tools

Navigate To

Image Copies for Table: MKTCWR.CR_INDIVIDUAL

DBNAME	TSNAME	DSNUM	START_RBA	ICTYPE	INSTANCE
CRBMCDDB	CRINDDTs	0	X'00DF2998A709CA6BA400'	Q	1
CRBMCDDB	CRINDDTs	0	X'00DF29966FE87F721600'	F	1

```
//SYSIN DD *
LISTDEF NUTSBOLTS INCLUDE TABLESPACE CRBMCDDB.CRINHDTs
                INCLUDE TABLESPACE CRBMCDDB.CRINDDTs
                INCLUDE TABLESPACE CRBMCDDB.CRORRDTS
                INCLUDE TABLESPACE CRBMCDDB.CRODHDTs
RECOVER LIST NUTSBOLTS
        TOLOGPOINT X'00DF2998A709CA6BA400' SCOPE UPDATED
LISTDEF NUTSBOLIS INCLUDE INDEXSPACES TABLESPACE CRBMCDDB.CRINHDTs
                INCLUDE INDEXSPACES TABLESPACE CRBMCDDB.CRINDDTs
                INCLUDE INDEXSPACES TABLESPACE CRBMCDDB.CRORRDTS
                INCLUDE INDEXSPACES TABLESPACE CRBMCDDB.CRODHDTs
REBUILD INDEXSPACE LIST NUTSBOLIS
```

```

DSNUILDR - LISTDEF STATEMENT PROCESSED SUCCESSFULLY
DSNUGUTC - RECOVER LIST NUTSBOLTS TOLOGPOINT X'00DF2998A709CA6BA400' SCOPE UPDATED
DSNUGULM - PROCESSING LIST ITEM: TABLESPACE CRBMCDDDB.CRINHDT5
DSNUGULM - PROCESSING LIST ITEM: TABLESPACE CRBMCDDDB.CRINDDT5
DSNUGULM - PROCESSING LIST ITEM: TABLESPACE CRBMCDDDB.CRORRDTS
DSNUGULM - PROCESSING LIST ITEM: TABLESPACE CRBMCDDDB.CRODHDT5
DSNUCAIN - RECOVERY LOGPOINT IS X'00DF2998A709CA6BA400'
DSNUCALX - PROCESSING SKIPPED FOR TABLESPACE CRBMCDDDB.CRINDDT5 BECAUSE
           THE OBJECT DOES NOT NEED TO BE RECOVERED
DSNUCBMT - RECOVER TABLESPACE CRBMCDDDB.CRINHDT5 START
DSNUCBAL - THE IMAGE COPY DATA SET MKTCWR.CRBMCDDDB.CRINHDT5.IDUG WITH DATE=20240528 IS
PARTICIPATING           IN RECOVERY OF TABLESPACE CRBMCDDDB.CRINHDT5
DSNUCARS - INDEX MKTCWR.CRINHDX1 IS IN REBUILD PENDING
DSNUCARS - INDEX MKTCWR.CRINHDX2 IS IN REBUILD PENDING
DSNUCALA - RECOVER UTILITY LOG APPLY RANGE IS
           RBA 00000000054A6605A268 LRSN 00DF2996D40652DFA400 TO
           RBA 00000000000000000000 LRSN 00DF2998A709CA6BA400
DSNUCALA - LOGAPPLY PHASE: 411 LOG RECORDS READ, 19 LOG RECORDS APPLIED
DSNUCALA - LOG APPLY PHASE COMPLETE, ELAPSED TIME = 00:00:00
DSNUCALC - LOGCSR IS STARTED FOR MEMBER DJJ1, PRIOR CHECKPOINT RBA = X'00000000054A5F4190EC'
DSNUCALC - LOGCSR PHASE: 331057 LOG RECORDS READ, 0 LOG RECORDS APPLIED
DSNUCALC - LOGCSR IS FINISHED FOR MEMBER DJJ1, ELAPSED TIME = 00:00:00
DSNUCALC - LOGCSR PHASE COMPLETE, ELAPSED TIME = 00:00:00
DSNUCBDR - RECOVERY COMPLETE, ELAPSED TIME=00:00:02

```

```

DSNUILDR - LISTDEF STATEMENT PROCESSED SUCCESSFULLY
DSNUGUTC - REBUILD INDEXSPACE LIST NUTSBOLIS
DSNUGULM - PROCESSING LIST ITEM: INDEXSPACE CRBMCDDDB.CRINHDX1
DSNUGULM - PROCESSING LIST ITEM: INDEXSPACE CRBMCDDDB.CRINHDX2
DSNUCRIB - UTILITY PERFORMS DYNAMIC ALLOCATION OF SORT DISK SPACE
DSNUCRIB - INDEXES WILL BE BUILT IN PARALLEL, NUMBER OF TASKS = 6
DSNUCRIB - MAXIMUM INDEX PARALLELISM IS 6 BASED ON NUMBER OF INDEXES
DSNUCRIB - NUMBER OF OPTIMAL SORT TASKS = 2, NUMBER OF ACTIVE SORT TASKS = 2
DSNUCRUL - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS PROCESSED=310
DSNUCRUL - UNLOAD PHASE STATISTICS - NUMBER OF RECORDS PROCESSED=25628
DSNUCRIB - UNLOAD PHASE COMPLETE - ELAPSED TIME=00:00:00
DSNUGSRP - SORT TASK SW01: 12969 RECORDS SORTED, ESTIMATED 479021, VARIATION 97 PERCENT
DSNUGSRP - SORT TASK SW01: USED DFSORT
DSNURBXC - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=12969 FOR INDEX MKTCWR.CRINHDX2
DSNURBXC - SORTBLD PHASE STATISTICS - NUMBER OF KEYS=12969 FOR INDEX MKTCWR.CRINHDX1
DSNUCRIB - SORTBLD PHASE STATISTICS. NUMBER OF INDEXES = 2
DSNUCRIB - SORTBLD PHASE COMPLETE, ELAPSED TIME = 00:00:00
DSNUGSRX - INDEX MKTCWR.CRINHDX1 PARTITION 1 IS IN INFORMATIONAL COPY PENDING
DSNUGSRX - INDEX MKTCWR.CRINHDX1 PARTITION 2 IS IN INFORMATIONAL COPY PENDING
DSNUGSRX - INDEX MKTCWR.CRINHDX1 PARTITION 3 IS IN INFORMATIONAL COPY PENDING
DSNUGSRX - INDEX MKTCWR.CRINHDX2 IS IN INFORMATIONAL COPY PENDING STATE
DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=4

```

Unload

Sort/Build

Rebuild can include phases SORT and BUILD but if running in parallel it can do the sort and build together.

Recovery Point

- TOCOPY

- Why

- Recover to a point in processing where Copy was run
 - Moving data to other Db2 Object (this subsystem or another)

- Image Copy Dataset

- TOLASTCOPY

- TOLASTFULLCOPY

- NOSYSCOPY

- Specify full image copy that is not registered

- INLCOPY, FCCOPY
 - Concurrent copy not supported

- ERROR RANGE

- RESTOREBEFORE lrsn/rba

- Cannot be used with LISTDEF

- Copy can be Full or Incremental
- Copy can be SHRLEVEL Change *
 - leaves objects in non consistent state
 - Convert to TORBA/TOLOGPOINT
- DSNUM ALL – copy must be ALL
- Copy can be bad – Recover will use the previous
- Can copy a single dataset – nonpartitioned
- REUSE
- CURRENTCOPYONLY
- ENFORCE YES/NO
- FLASHCOPY_PPRCP

TOCOPY

```
//SYSIN DD *  
LISTDEF NUTSBOLTS INCLUDE TABLESPACE MYDB.NB*  
EXCLUDE TABLESPACE MYDB.NBA*  
EXCLUDE TABLESPACE MYDB.NBB*  
RECOVER LIST NUTSBOLTS TOCOPY TOLASTCOPY
```



```
DSNUGDFL - RECOVER LIST NUTSBOLTS TOCOPY TOLASTCOPY  
DSNUCDDR - INVALID KEYWORD(S) SPECIFIED FOR TABLESPACE LIST
```

```
//SYSIN DD *  
RECOVER TABLESPACE MYDB.NBCBOLTS  
TABLESPACE MYDB.NBDBOLTS  
TABLESPACE MYDB.NBEBOLTS  
TOCOPY TOLASTCOPY
```



```
//SYSIN DD *  
RECOVER TABLESPACE MYDB.NBCBOLTS TOLASTCOPY  
RECOVER TABLESPACE MYDB.NBDBOLTS TOLASTCOPY  
RECOVER TABLESPACE MYDB.NBEBOLTS TOLASTCOPY
```

07.37.05 STC13211 DSNIO14I *DJJ1 DSNKINSL DATA IN USE DURING ABEND 863

```
863 REASON 00C90101  
863 ERQUAL 5033  
863 TYPE 00000302  
863 NAME MYDB .NBEBOLTS.X'0000000A'  
863 CONNECTION-ID=DB2CALL  
863 CORRELATION-ID=MKTCWR  
863 LUW-ID=USBMCN01.DJJ1LU.DEFFB53395D2=140284
```

```

DSNU050I 116 07:09:55.56 DSNUGUTC - RECOVER TABLESPACE MYDB.NBCBOLTS TABLESPACE MYDB.NDBBOLTS TABLESPACE
MYDB.NBEBOLTS TOCOPY TOLASTCOPY
DSNU1569I *DJJ1 116 07:09:55.58 DSNUCAIN - RECOVERY LOGPOINT IS X'00DEFFAF30968A8B2C00'
DSNU532I 116 07:09:55.58 DSNUCBMT - RECOVER TABLESPACE MYDB.NDBBOLTS START
DSNU515I 116 07:09:55.58 DSNUCBAL - THE IMAGE COPY DATA SET MKTCWR.MYDB.NDBBOLTS.XX0 WITH DATE=20240423 AND
DSNU532I 116 07:10:01.43 DSNUCBMT - RECOVER TABLESPACE MYDB.NBEBOLTS START
DSNU515I 116 07:10:01.43 DSNUCBAL - THE IMAGE COPY DATA SET MKTCWR.MYDB.NBEBOLTS.NB0 WITH DATE=20240423 AND
DSNU532I 116 07:10:02.78 DSNUCBMT - RECOVER TABLESPACE MYDB.NBCBOLTS START
DSNU515I 116 07:10:02.78 DSNUCBAL - THE IMAGE COPY DATA SET MKTCWR.MYDB.NBCBOLTS.XX0 WITH DATE=20240423 AND
DSNU500I 116 07:10:03.41 DSNUCBDR - RECOVERY COMPLETE, ELAPSED TIME=00:00:07
DSNU010I 116 07:10:03.41 DSNUGBAC - UTILITY EXECUTION COMPLETE, HIGHEST RETURN CODE=0

```

Please, Don't forget your indexes

```

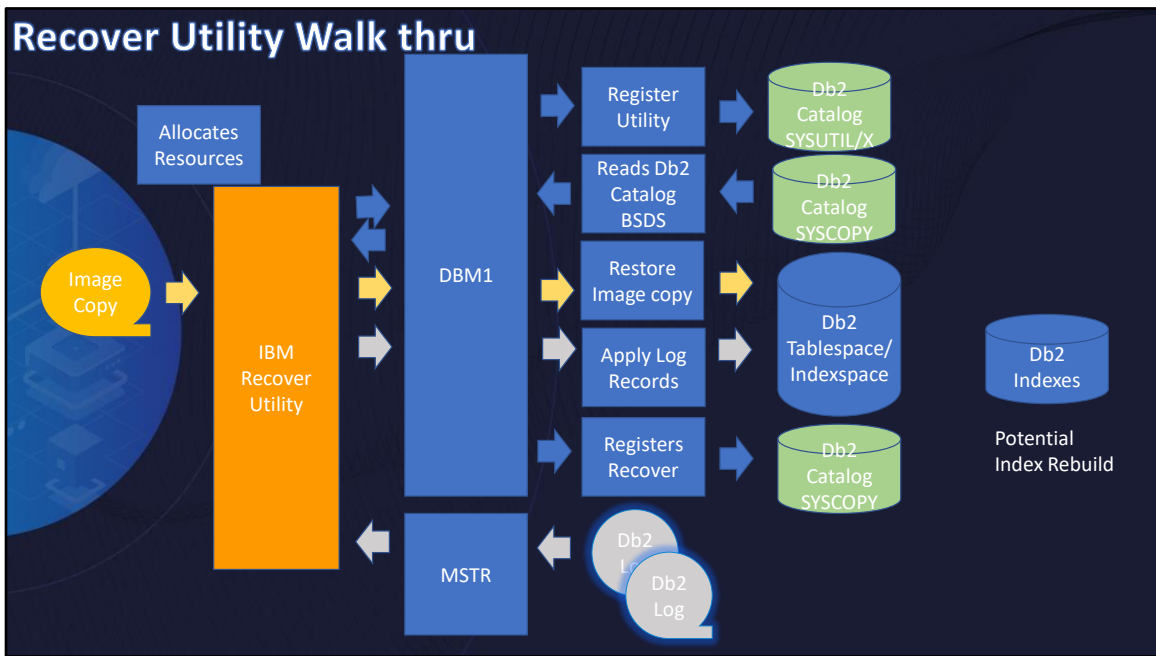
//SYSIN DD *
LISTDEF NUTSBOLTS INCLUDE INDEXSPACES TABLESPACE MYDB.NB*
EXCLUDE INDEXSPACES TABLESPACE MYDB.NBA*
EXCLUDE INDEXSPACES TABLESPACE MYDB.NBB*
REBUILD INDEX LIST NUTSBOLTS

```

```

DSNU830I *DJJ1 116 08:36:11.56 DSNUCARS - INDEX MKTCWR.NBCUPDX1 IS IN REBUILD PENDING
DSNU831I *DJJ1 116 08:36:11.56 DSNUCARS - ALL INDEXES OF MYDB.NDBBOLTS ARE IN REBUILD PENDING
DSNU500I 116 08:36:16.73 DSNUCBDR - RECOVERY COMPLETE, ELAPSED TIME=00:00:05

```



Execution phases of RECOVER

The RECOVER utility operates in these phases:

Phase

Description

UTILINIT

Performs initialization and setup.

RESTORE

Locates and merges any appropriate sequential image copies and restores the table space to a backup level; processes a list of objects in parallel if you specify the PARALLEL keyword.

RESTORER

RESTOREW

PRELOGC

Preliminary LOGCSR phase. Determines uncommitted work that was backed out when the recovery base for an object is a FlashCopy image copy with consistency.

PRELOGA

Preliminary LOGAPPLY phase. Applies the uncommitted work up to the point of consistency for the object with a FlashCopy image copy with consistency recovery base.

LOGAPPLY

Applies any outstanding log changes to the object that is restored from the previous phase or step. If a recover job fails in the middle of the LOGAPPLY phase, it can be restarted from last commit point.

LOGCSR

Analyzes log records and constructs information about inflight, indoubt, inabort, and postponed abort units of recovery. This phase is executed if either the TORBA and TOLOGPOINT option was specified.

LOGUNDO

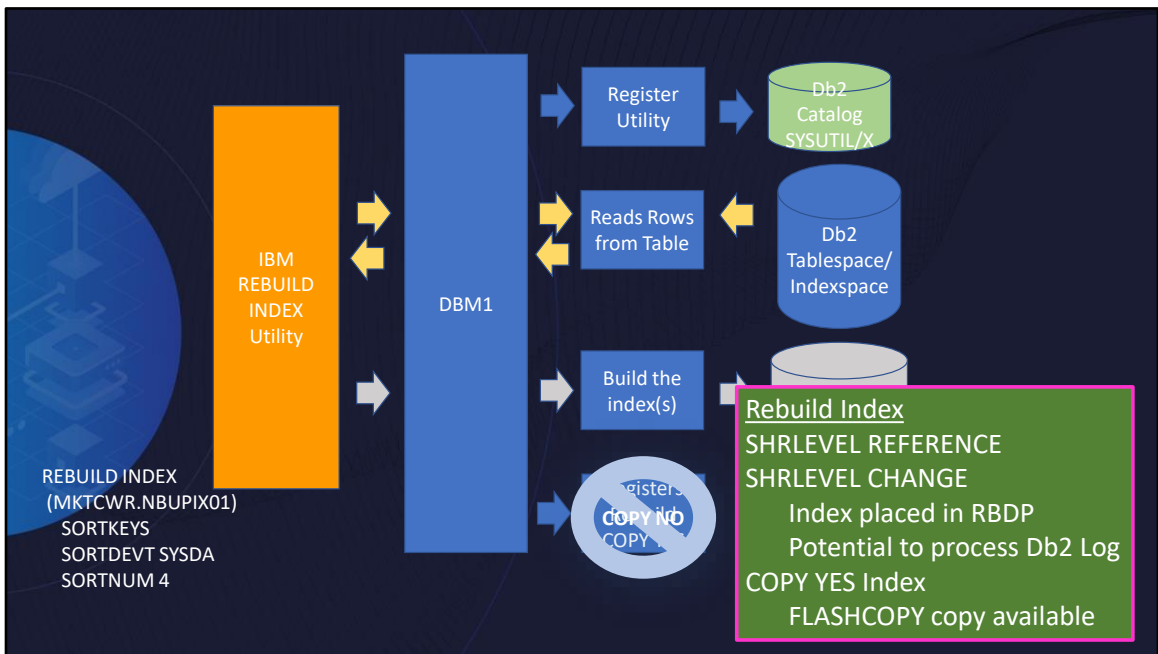
Rolls back any uncommitted

TRANSLAT

Translates the object identifiers (OBIDs) in the recovered data during redirected recovery. The source OBIDs in the pages of the target objects are changed to the target OBIDs.

UTILTERM

Performs cleanup.



Execution phases of REBUILD INDEX

The REBUILD INDEX utility operates in the following phases:

UTILINIT

Performs initialization and setup.

UNLOAD

Unloads index entries.

SORT

Sorts unloaded index entries.

BUILD

Builds indexes.

SORTBLD

Sorts and builds a table space for parallel index build processing.

What is registered in SYSCOPY – does it matter?

```
FROM SYSIBM.SYSCOPY
QUALIFIER: IMAGE COPY=CRBMCDDB.CRORRDT5.0
Column Name      Column Value
-----1-----2-----3-----4-----5-----
DBNAME . . . . . CRBMCDDB
TSNAME . . . . . CRORRDT5
DSNUM . . . . . 0
ICTYPE . . . . . P
ICDATE . . . . . 240528
START_RBA . . . . . X'00DF29A13F78B4DA2000'
FILESEQNO . . . . . 0
DEVTYPE . . . . .
IBMREQD . . . . . N
DSNAME . . . . . CRBMCDDB.CRORRDT5
ICTIME . . . . . 155113
SHRLEVEL . . . . .
DSVOLSER . . . . .
TIMESTAMP . . . . . 2024-05-28-15.51.13.449888
ICBACKUP . . . . .
ICUNIT . . . . .
STYPE . . . . . C
PIT_RBA . . . . . X'00DF2998A709CA6BA400'
GROUP_MEMBER . . . . . DJJ1
```

- PIT_RBA
 - The Point in Time of the recovered object
- START_RBA
 - When the Recovery was done
- Work between those points
 - Is now unavailable, unwanted
 - PIT Range

Recover Options

If you specify BACKOUT YES, the recovery point must be within the most recent Db2 system checkpoints that are recorded in the BSDS for each member.

- Backout Recovery
 - BACKOUT YES/NO
 - BACKOUT YES specifies the recovery of objects to a prior point in time by a log-only backout
 - No image copy is restored
 - Use the log to backout changes made since the log point that is specified in the TOLOGPOINT or TORBA options
 - Any uncommitted transaction at the specified log point is backed out to make the objects transactional consistent

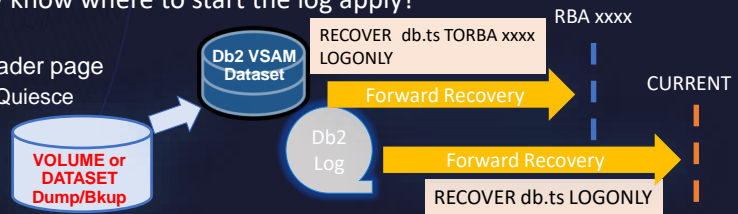


If you specify BACKOUT YES, the recovery point must be within the most recent Db2 system checkpoints that are recorded in the BSDS for each member.

Recover Options

• LOGONLY

- Why would I consider this
 - VSAM Linear datasets of object recovered in other means
 - Hardware backups/Snap Shots/Safe Guarded Copies/DSN1COPY
 - Missing Image Copies or Missing Registration
- Skip Restore Phase - Db2 Base VSAM is recovered by another method
 - Dataset level recover/restore/recall
 - VSAM Repro
 - DSN1COPY
- How does Db2 Recovery know where to start the log apply?
 - Db2 object Header Page
 - HPGRBRBA in the header page
 - Updated by Db2 or Quiesce



Optimize recovery with system installation parameters

(ZPARMs)

DLDFREQ – frequency of LEVELID and HPGRBRBA updates

LOGAPSTG – Fast log apply storage

CHECKFREQ – Checkpoint frequency

PCLOSEN – RO switch checkpoints

PCLOSET – RO switch time

Performance Considerations

- PARALLEL
- ZPARM

Other Db2 Recovery Topics

- System Level Backup / Restore
- Flash Copy Considerations
- Recovery Report
- Using Db2 Log for Recovery

Optimize recovery with system installation parameters

(ZPARAMs)

DLDFREQ – frequency of LEVELID and HPGRBRBA updates

LOGAPSTG – Fast log apply storage

CHECKFREQ – Checkpoint frequency

PCLOSEN – RO switch checkpoints

PCLOSET – RO switch time

Redirected Recovery

- Redirect Recovery of Db2 Object to another Db2 Object
 - Point in Time / Current State
 - Supports Universal Tablespaces (UTS)
- Why
 - Testing Recovery
 - Generate additional copy of data
- Rules
 - Definitions source/target are the same
 - REPAIR CATALOG on target to rectify data version
 - Rebuild your indexes
 - LISTDEF not supported
 - SYSTEM LEVEL Backups not available
 - Same Subsystem



Parting Thoughts

- Recovery is part of Backup and Recovery Strategy
 - They must work together
- Recovery Utility can be a good thing
 - Migrating data between objects/environment
 - Testing / Practice Recovery
- Further Validation
 - Robust recovery validation solutions that estimate, test, and prove recovery time on the systems that maintain production IMS and Db2 data are vital
 - Not part of base Db2 structure
 - Db2 Software Vendors have solutions



IDUG

2024 NA Db2 Tech Conference

The Nuts and Bolts of Db2 z/OS Recovery

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Please fill out your session evaluation!



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