

# Information Management for System z

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## IBM DB2 Recovery Expert V3.1

*DB2 Backup and Recovery advanced features*




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IBM Software Group

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Information Management for System z

## Agenda

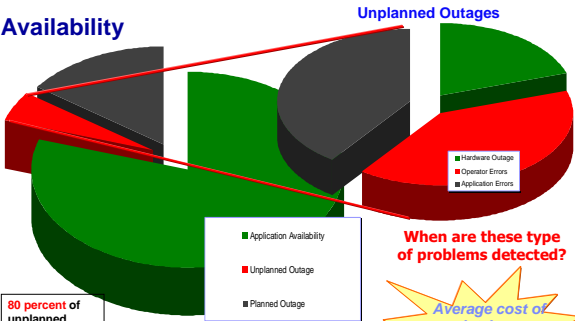
- Availability
- Recovery Expert DBA Features
- RE advanced recovery functions
  - Why FlashCopy?
  - DB2 backup options
  - RE DB2 recovery enhancements
    - Object recovery
    - System recovery



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## Availability



**Unplanned Outages**

- Application Availability
- Unplanned Outage
- Planned Outage

When are these type of problems detected?

80 percent of unplanned downtime is caused by people and process issues

WHAT'S THE COST TO YOUR COMPANY WHEN APPLICATIONS ARE DOWN?

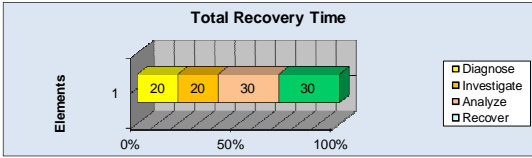
Average cost of database downtime \$1.5M USD/year

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## Once you have an event ...

- Up to 70% of recovery time is "think time"!
  - Not processing time
  - Actual recovery takes up 30%



**Total Recovery Time**

Elements

1

0% 50% 100%

- Diagnose
- Investigate
- Analyze
- Recover

Source: McGladrey and Pullen

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## Recovery Expert is an intelligent backup and recovery manager

- Reduces the complication of recovery!
  - Analyzes your recovery resources
  - Detects and recovers related objects
  - Provides cost-based recovery estimates in real-time
  - Generates the optimized JCL
  - Provides reporting for review and control
  - Drastically reduces DBA think time
  - Automatically can spawn jobs for optimal recovery
  - Efficiently utilizes all backup & recovery assets
- Minimizes the risk!
  - Health check functionality validates the ability to recover to selected points in time
  - Recover plan validation verifies recovery assets are available for recovery.
- Simplifies disaster recovery operations and procedures

**DBA Feature Rich Functionality**

- Schema/Table Versioning
- End to End Drop Object Functionality
- V10 Online Schema Support

**Backups**

- Faster & Less Expensive Backups
- Operational Simplicity

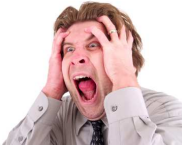


## RE DBA Features



## "Oh NO !!" ..... Have you ever....

- Have you ever.....
  - Incorrectly made application changes?
  - Accidentally dropped an object?
- Now what? Are you prepared?
  - Reversing schema changes can be manual, error prone and time consuming.
  - Dropped object recovery can be a huge nightmare!



```
DSNT408I  SQLCODE = -204
UNDEFINED NAME
```

```
DSNT408I  SQLCODE = -206
COL_NAME NOT VALID
IN THE CONTEXT
WHERE IT IS USED
```

## Back Out Complex Schema Changes

**Without Recovery Expert**

DBA selects method of loading data:

- unload/load method
- DSN1COPY method

If unload/load, DBA needs to unload data:

- Unload from current base table
- Unload from an image copy

Drop Table

Recreate table minus the implemented changes

Load data into table

- LOAD utility
- DSN1COPY

If DSN1COPY, DBA needs to rebuild indexes

Execute RUNSTATS on table/indexes

Recreate views

Grant appropriate authorities on table

Recreate RI

Run CHECK utility to validate data integrity


Recreate any associated triggers

Bind packages that were invalidated

**With Recovery Expert**

- #1 Choose Your Object
- #2 Choose Your Version
- #3 Choose Your Options
- #4 Choose Your Recovery Plan
- #5 Execute Your Recovery Plan

**Point and click!**



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## Recovery Expert Meta Data Repository

- Backup and Recovery Assets Needed:**
  - System Level Backup/Image Copy
  - Archive Logs
  - Up-to-date RE Meta Data Repository
- Two Modes of Drop Object Support**
  - Using Meta Data Repository**
    - Same steps as schema/table versioning
    - Backup & Recovery Assets need to be available
    - Objects will appear in **RED** on object drop down list
  - Log Based Dropped Object func.**
    - Scan the DB2 Log for dropped objects
    - Drop Objects are identified
    - Intelligent Recovery Manager builds recovery plans
      - DDL Only Option is available

## User Interface – Web Browser

IBM DB2 Recovery Expert for z/OS

Recovery Advisor | Log Analysis | System Restore | Log Based Recovery | Specifications | Messages | Logs

**Recovery Advisor**

Select the location that contains the objects you want to recover. This advisor helps you recover data and dropped objects. To start the recovery process, select a Location. A location is a DB2/DB for z/OS and OS/390 subsystem (or data sharing grid).

**Log Analysis**

This wizard allows you to find and store QUIET times based for a set of objects and store this in an RE repository for later use.

**System Restore**

This wizard allows you to build restore JCL using any SLB supported by RE. This includes DFSMSDss.

**The Log Based Recovery Advisor**

This wizard will assist you through the steps of generating DDL and recovering dropped objects at a DB2 location using the DB2 log files.

**The Specifications wizard**

This wizard allows you to build profiles of OBJECTS. You can use these similar to the BACKUP PROFILES in ISPF.

**Recovery Advisor**

Select the objects that you want to recover.

Available objects

Selected objects

Choose your object and include

Using Metadata Repository

Select Point in Time

Select from:

Object definition levels  Recovery history events  Quiet times

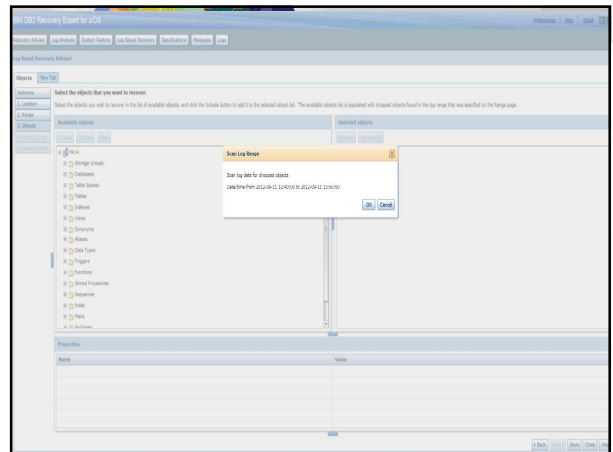
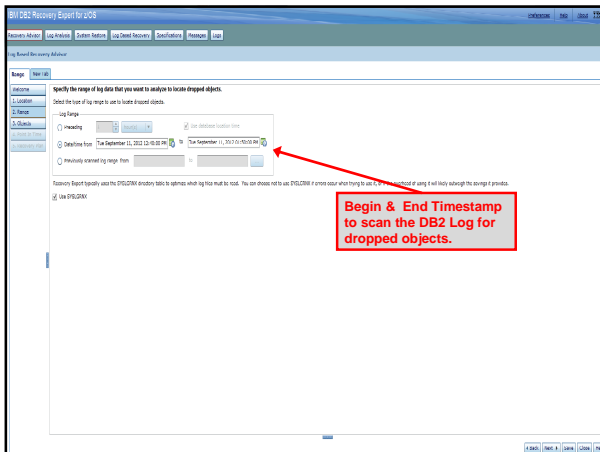
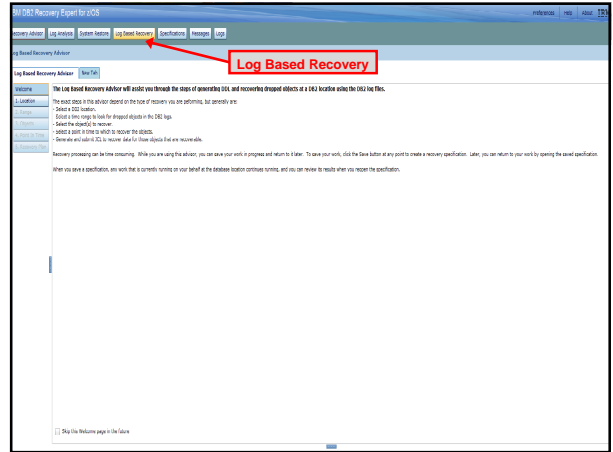
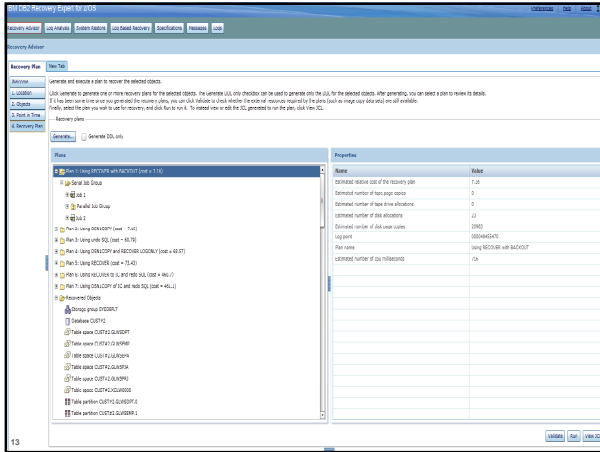
Type	Qualifier	Name	Level Create Timestamp	Level End Timestamp
Table	CUST#2	GLWTEMP	2012-04-26-12.52.17.767917	2012-04-26-16.18.37.522166
Table	CUST#2	GLWTEMP	2012-04-26-16.18.37.522167	2012-04-26-16.19.29.462317
Table	CUST#2	GLWTEMP	2012-04-26-16.19.29.462318	2012-04-26-16.20.05.577254
Table	CUST#2	GLWTEMP	2012-04-26-16.20.05.577255	2012-04-26-16.35.42.401890
Table	CUST#2	GLWTEMP	2012-04-26-16.35.42.401891	2012-04-26-16.36.16.246984
Table	CUST#2	GLWTEMP	2012-04-26-16.36.16.246985	

Select the version of the object to reverse

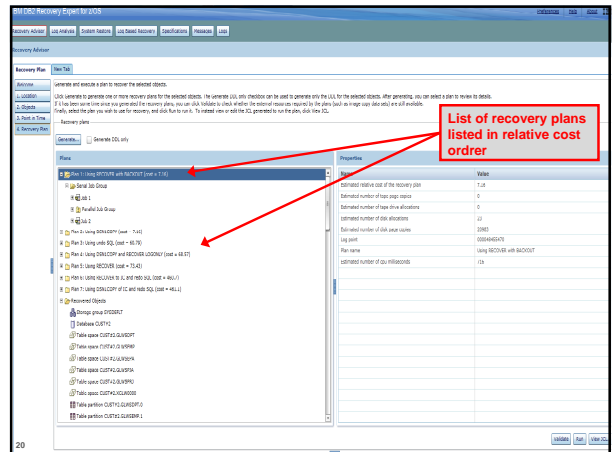
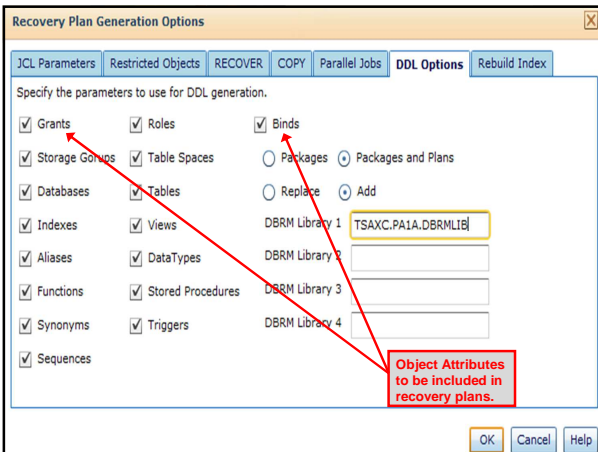
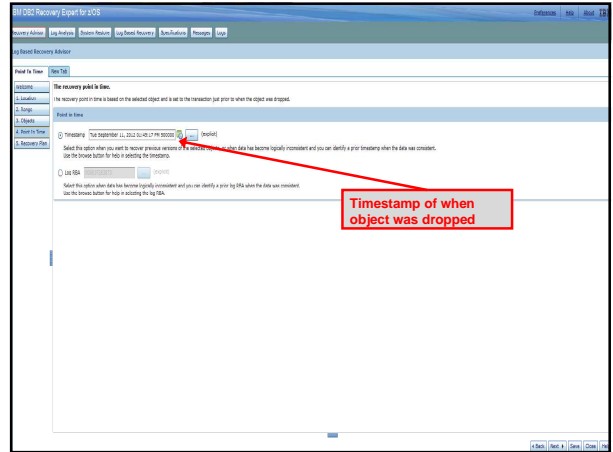
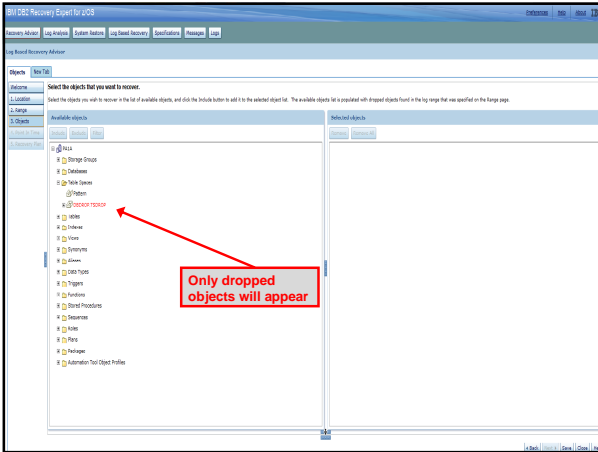
Filter... Refresh

OK Cancel Help


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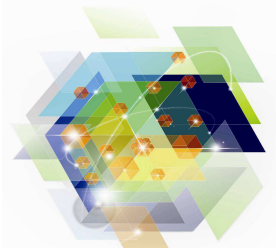
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## RE Advanced Backup & recovery




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## Why FlashCopy Should be Used

- **Cost Savings**
  - Saves CPU and I/O
  - "We would backup more often if it didn't cost so much."
- **Speed**
  - Faster backup and recovery
- **Minimal Disruption to Data Access**
  - Provide fast and effective ways to backup and copy data with no downtime
- **Why FlashCopy Hasn't Been Used**
  - Typically only understood by storage administrators
    - DBAs don't get training

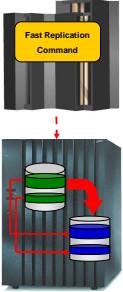


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## FlashCopy Overview

- **Command Issued from z/OS to IBM DS8xxx**
  - Almost instant return to z/OS!
- **Data copy continues inside storage processor**
  - Offloading data copy to storage processor save z/OS CPU and I/O resources!
- **z/OS access to source and target data is possible immediately following fast replication command**
  - Speed!
- **Target Read:** If a track being read on target volume has not yet been copied, the storage processor redirects read to the corresponding source data track
- **Target Update:** When updating track on target volume, the storage processor makes sure track has been copied before allowing update
  - Availability

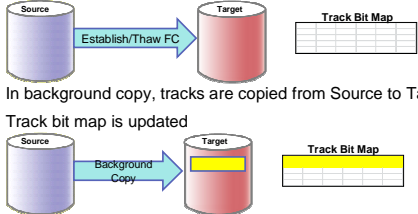


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## FlashCopy – Explained

- **FlashCopy command issued**
  - 1) Source and Target volume relationship established
  - 2) Track bit map created
  - 3) Source and Target volumes available for updates – **Copy is DONE!**
  - 4) In background copy, tracks are copied from Source to Target
  - 5) Track bit map is updated




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## FlashCopy Consistency

- If FlashCopy is used for multiple volumes, they all have to be at a consistent level
  - Dependent writes must be maintained through copy
  - If not maintained, copy **cannot be used** for backup or cloning
- Consistency Options
  - DB2 Backup System
  - DB2 Log Suspend
  - FlashCopy Consistency Groups
    - **Reduced Unavailability Time**




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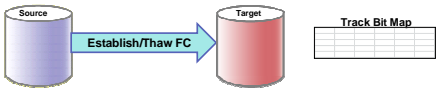
## FlashCopy Consistency - Explained

- FlashCopy Establish
  - 1) S1 is Frozen, no more writes
  - 2) S2 is Frozen, no more writes
  - 3) S3 is Frozen, no more writes
- T1 – T3 have Consistent FlashCopy
- Thaw after Establish Phase
  - 1) Source updates proceed on S1, S2, S3

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## FlashCopy Consistency Example



Track Bit Map			


**Specifications**

- 1) 13 TB of data
- 2) 461 volumes
- 3) DS8300
- 4) 2817-M80 z196
- 5) 4,075.28 trans/second
- 6) Backup Elapsed = 0.26 secs

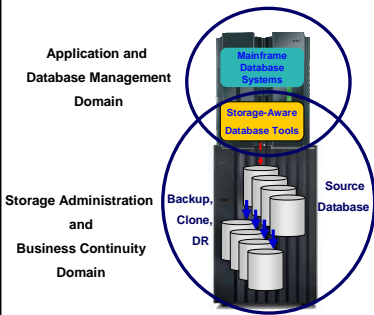
```

Backup summary report
-----
DB2 backup completed:         Backup
DB2 Subsystem:                DB2
DB2 Version:                  10.10
Backup Path:                   /back
Part 1 backup:                 No
Write Back:                   No
Last Checkpoint RBA:         0001185500
Backup Time:                   2013-09-10-09:31:56.320250
Consistency Method:          002 Use Suspend
Support Object Restore:      Yes
IO System Time:               2013-09-10-09:31:56.320308
Backup Elapsed:                00:26 seconds
    
```

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## Storage-aware Data Management Database and Storage Integration



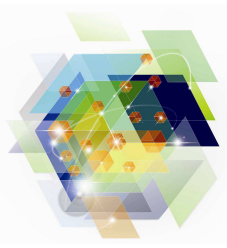
- Organizational Integration
- New Backup Methods
- Business Recovery Monitoring
- Cloning Automation
- Disaster Restart Solutions

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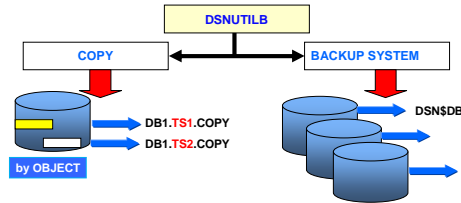
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## DB2 Backup Options

- DB2 Full and Incremental Image Copies
  - SHRLEVEL REFERENCE & SHRLEVEL CHANGE
- DB2 Concurrent Image Copies
  - DFSMsDss
- DB2 FlashCopy Image Copies
- DB2 Backup System
  - Uses DFSMSshm
- Full Volume Dumps
  - ADRDSU
- System Level Backup (SLB)



## DB2 Backup Utilities



**by OBJECT**

- By Tablespace / Indexspace
- FULL / INCREMENTAL
- Sequential COPY
- CONCURRENT COPY
- FLASHCOPY IC
- Registered in: SYSCOPY

**by VOLUME**

- All Volumes as a group
- By COPYPOOL
- Registered in:
  - DBD01
  - BSDS
  - DFSMSshm

## DB2 COPY utility – sequential copies

Sequential copy

Header pages | Data Pages

```

14:14:46.55 DSNUGTC - OUTPUT START FOR UTILITY, UTILID = DNET963.DN
14:14:46.56 DSNUGTIS - PROCESSING SYSIN AS EBCDIC
14:14:46.57 DSNUGTC - COPY TABLESPACE DSNBD1A.DDS1011B DSNUM ALL FULL
YES SH
14:14:46.72 DSNUBID - COPY PROCESSED FOR TABLESPACE DSNBD1A.DDS1011B
NUMBER OF PAGES=3
AVERAGE PERCENT FREE SPACE PER PAGE = 32.56
PERCENT OF CHANGED PAGES = 0.00
ELAPSED TIME=00:00:00
16 14:14:46.79 DSNUBAFI - DB2 IMAGE COPY SUCCESSFUL FOR TABLESPACE
DSNBD1A.DDS
    
```

You can use:

- DSN1COMP
- DSN1COPY
- DSN1PRNT

DFSMSdss copy

Tracks

```

PAGE 0001 5695-DF175 DFSMSDSS VIR12.0 DATA SET SERVICES 2012.016 14:19
PARALLEL
ADR1011(R)R1 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'PARALLEL.'
DUM OPT(2) DATA(INCL)SNSCAT.DSNDBC.DSNBD1A.DDS1011B.J0001.A(1/1/1) -
CAN CONC SHA TOL(ENGF) WAIT(0.0) -
OUTD(SYSCOPY)
ADR1011(R)R1 (01), TASKID 002 HAS BEEN ASSIGNED TO COMMAND 'DUM'
ADR1091(R)R1 (01), 2012.016 14:19:16 INITIAL SCAN OF USER CONTROL STATEME
ADR0141(SCH)DSSU (02), 2012.016 14:19:16 ALL PREVIOUSLY SCHEDULED TASKS COMPL
    
```

You can use:

- ~~DSN1COMP~~
- ~~DSN1COPY~~
- ~~DSN1PRNT~~

## DB2 Flash Copy Image Copies (DB2 V10)

- FlashCopy creates a separate VSAM data set for each partition or piece of the object that is being copied
- Traditional image copy can be created in parallel
  - ICBACKUP=FC in SYSIBM.SYSCOPY
- FlashCopy V2 license is required
- Copies are registered in SYSIBM.SYSCOPY as any other image copy.
  - The LOAD, REBUILD INDEX, and REORG utilities can use these image copies to produce inline image copies of data and indexes.
- Exploitation of FlashCopy image copies by the COPY, REORG, LOAD, REBUILD INDEX, and RECOVER utilities.
- Ability to create consistent COPY SHRLEVEL CHANGE image copies.
- How are they produced?
  - Set DSNZPARM FLASHCOPY\_COPY to YES
    - Creates a FlashCopy ImC automatically. You do not need COPYDDN specified on your utility control statement.
    - If you specify the COPYDDN keyword on your utility and a valid DD for SYSCOPY, DB2 2 ImC, a FlashCopy and a sequential copy, created from the FlashCopy.
  - Specify FLASHCOPY YES or FLASHCOPY CONSISTENT on your utility control statement
- Both settings overwrite zParm settings
- COPYTCOPY allows to generate additional ImCs



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## DB2 Flash Copy Consistent Copies

- **Transaction-Consistent image copy:**
  - FlashCopy technology is used to copy the object and that any uncommitted work included in the copy is backed out of the copy to make the copy consistent (be aware of long running URs)
  - CONSISTENT will potentially use more system resources & take longer to complete

There are three URs that are currently associated with table space DB1.TS1.  
 COPY TABLESPACE DB1.TS1 finds UR3 is committed, and UR1 and UR2 in-flight.  
 RBA of BP externalization all changed pages are last externalized to disk  
 PIT\_RBA is when all active URs that were active at this time need to be rolled back (PIT\_RBA in SYSCOPY)  
 RBA of the first update for all active URs is START\_RBA (recorded in SYSIBM.SYSCOPY)  
 A RECOVER using this FC ImC will need to read the log beginning at this START\_RBA.  
 Initially DB2 creates a FC ImC that contains all the uncommitted data for UR1 and UR2. Then, starting from PIT\_RBA backs out all changes done by UR1 and UR2 up to this point on the FC ImC.  
 There is no work to do for UR3, because it completed prior to the PIT\_RBA.

## RE Controlled System Level Backup Overview

- **A System Level Backup is a backup of the entire DB2 Subsystem at a point in time**
  - Can call DB2 BACKUP SYSTEM **but does not require it**
  - Full System Level Backups
  - Data system Level Backups
  - **Partial (isolated appl.) System Level Backups**
- **Leverages storage-based fast replication to drive the volume backup**
  - Backup in seconds
  - Offloading data copy process to the storage processor saves CPU and I/O resources
  - Faster than data set copies
- **Backup DB2 without affecting applications**
  - Backup windows reduced by replacing image copies
  - Extends processing windows
- **Data consistency ensures data is dependent-write consistent**

## Recovery Expert System Backup and Recovery for DB2

- Intelligent Recovery Manager (DB2) invoked to optimize recovery plans
- Recover DB2 systems or application objects from disk or tape automatically
- **Faster recovery**
  - Instantaneous system-restore process
  - Coordinated and parallel restore and DBMS recovery operations minimize system downtime
- System backup can be used for database object (DB2), or application recovery
  - Data sets flashed to restore data
  - Parallel log apply reduces recovery time
- One system backup used for system, application, and disaster recovery

## Recovery Expert vs Backup / Restore System

- **Recovery Expert System Backup Advantages**
  - Backup Validations
  - Backup Reporting
  - System Backup Health Check
  - Create Image Copy from System Backup
  - Supports IBM, EMC, Hitachi, STK storage
- **Recovery Expert Restore Advantages**
  - Can always recover objects from System Backup
  - Recovery Expert System Restore
  - Automated recovery of objects in Recover/Rebuild Pending after System Restore
- **Feature rich backup and recovery suite....**
  - Dropped object recovery, Recovery versioning
  - Log Analysis services, SQL Based Recovery
  - Dependency analysis
  - Recovery plans

*Why not just use DB2 System Backup?*

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## Create Image Copies from System Level Backup

- Image copies can be generated from a DB2 Recovery Expert generated system level backup (SLB)
- Image copies are registered DB2 image copies
- Image copies can be used by any existing process
  - DSN1COPY – Restore data to another object or system
  - Unload – To transport data to another DBMS
  - Recovery
- All image copies are created at the same point in time
  - No effect on the application for image copy creation
  - Can be run during off peak CPU times
  - Reduces I/O contention caused by performing traditional image copy processing during high transaction activity

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## Recovery Expert System Restore


- Automates Process of Running System Restore
  - Disconnects ICF catalogs
  - Takes volumes offline and back online to clear out allocations that can fail the restore.
  - Executes commands to clear coupling facility structures for Data Sharing
  - Builds jobs to insert system point in time records in BSDSs
  - Makes sure DB2 is down and no tasks are accessing DB2 volumes
  - After System Restore, reports objects in Recover/Rebuild pending
    - Builds JCL to recover those objects from image copies
    - Speeds recovery time by automating this process
  - With Recovery Expert, customers are more prepared for System Restore as it automates many manual processes

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## Recovery Expert's backup validation

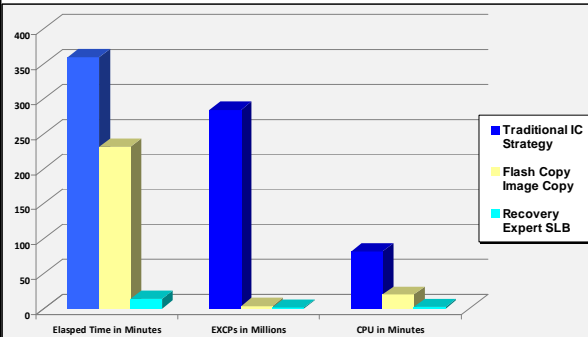
- Protects your critical DB2 for z/OS objects and data
- Extensive validity checking ensures a complete and accurate backup
  - Reports on objects in restricted status
  - Identifies potential problems at backup time!
- Consistent guaranteed backups
  - Finds related objects
  - Reports on "Other" non-DB2 data residing on the DB2 volumes.
  - Verifies all DB2 source & target volumes are:
    - valid, online and available
  - Validates all objects are included for recovery
    - During system configuration analysis
    - At backup "set up" and execution time
    - During health check process

*More wanted in restoration!*



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## Backup Resource Utilization Test Results



Metric	Traditional IC Strategy	Flash Copy Image Copy	Recovery Expert SLB
Elapsed Time in Minutes	~380	~250	~20
EXCPs in Millions	~300	~20	~10
CPU in Minutes	~100	~40	~10

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# Information Management for System z















## RE, an Intelligent Recovery Manager

- Provides cost-based recovery estimates in real-time
  - Intelligent recovery manager analyzes backup and recovery assets.
  - Supplies a list of all available recovery plans
    - User can choose the appropriate recovery plan
  - Applies detailed formulas to identify a relative cost per recovery plan
  - Recovery plans lists least cost plan first
  - 90+% of the time fastest recovery plans is chosen
  - SQL Only Recovery option
  - Drastically reduces 70% recovery think time and RISK!
  - Supplies option to execute jobs in parallel when appropriate to reduce recover time

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## Recovery Expert advantages over native utilities!

Create Image Copy from SLB 	Dropped Object/Versioned Recovery 	Intelligent Recovery engine minimizes "think time" 	Simplicity – one stop shopping for backup & recovery 
Supports ALL vendor storage (IBM, EMC, HDS) 	SQL-based Recovery 	Quiet Time Analysis 	Exclude volumes from System Level Backup (SLB) – saves space 
Guaranteed recovery of objects from a System Level Backup 	Automate and validate your system restore procedure 	Validation of backup assets 	Recover one table from a multi-table tablespace 

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多谢 Simplified Chinese      Спасибо Russian      Thank You English

**Gracias!** Spanish

شكراً Arabic      Obrigado Brazilian-Portuguese

Bedankt Dutch      Merci French      Danke German

நன்றி Tamil      ありがとうございます Japanese      감사합니다 Korean

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