



IBM Software Group

IMS023

# IMS Backup and Recovery Solutions

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# Agenda

- **Overview of Database Recovery Process**
  - ▶ What is Recovery?
  - ▶ IBM Database Recovery Techniques
- **IMS Backup and Recovery Capabilities**
  - ▶ Log Management, DBRC
  - ▶ Backup, Recovery, Backout and Restart processes
- **Backup and Recovery Scenarios**
  - ▶ IMS Online
  - ▶ IMS Batch
  - ▶ Disaster Recovery



IMS owns your mission critical applications and your production databases and need to ensure that availability and integrity work together.  
This presentation will describe how backup and recovery tools can improve existing backup and recovery scenarios.

# What is Recovery ?

## ■ Restoring a failed system to normal

- ▶ Restoring with Data Integrity
- ▶ Restoring to synchronization points

Points of Consistency are application syncpoints

Database protocols assure logs and DB are synchronized

## ■ Recovery of Application Programs Errors

## ■ Restoration of a damaged database due to a failure

- ▶ Hardware, or software failure
- ▶ Application failure
- ▶ Application logic failure
  - Wrong update
  - Update applied at the wrong time

Full Recovery  
Timestamp Recovery  
Point-In-Time Recovery  
Disaster Recovery  
IMS and DB2 Coordinated Recovery

# Restoring a failed system to normal

## ■ System Checkpoints

- ▶ For IMS restart
- ▶ Taken periodically – Manually or automatically
  - CPLOG parameter – changed by /CHA CPLOG
  - /CHECKPOINT command

## ■ Application Synchronization Point

- ▶ Safe Point of DB Consistency
- ▶ Where work is assumed to be complete (UOW complete)
  - Database updates are committed.
  - Log records are written.
  - Resource Manager Locks are released.
  - Output Messages are sent.
- ▶ Point for future application recovery
  - Automatically taken for each new transaction in MPP
  - Explicit checkpoint call required for BMP

# Recovery of Application Programs Errors

## ■ Error Detected at execution time

- ▶ Stop execution, cancel program
- ▶ Backout updates (if not automatic)
- ▶ Correct program error
- ▶ Restart the application If Checkpoint/Restart included
- ▶ or reprocess the transaction

## ■ Error Detected after commit time

- ▶ Data may have been reused
  - Work may span several Resource Managers
- ▶ No backout possible
- ▶ Manual recovery may be complicated
- ▶ Recovery to an earlier time and reprocessing transactions may be the best solution

## Restoration of a damaged database due to failure

- **Hardware**
  - ▶ System Crash
  - ▶ Media Failure
- **Software**
  - ▶ Operating System Failure
  - ▶ IMS Subsystem Failure
- **Application Logic**
  - ▶ Logic Error (wrong field, arithmetic operation error, etc)
  - ▶ Omitted processing
  - ▶ Extra processing

### Some reasons

A DLI batch update job fails after making at least one database update, and Batch backout fails.

A failure has occurred on a physical DASD device.

A failure has occurred in a database recovery utility.

A failure of dynamic backout or batch backout utility has occurred (IMS DB only).

An IMS or DB2 online system failure and emergency restart has not been completed.

Application Error - invalid updates have occurred

# IMS Database Recovery Techniques



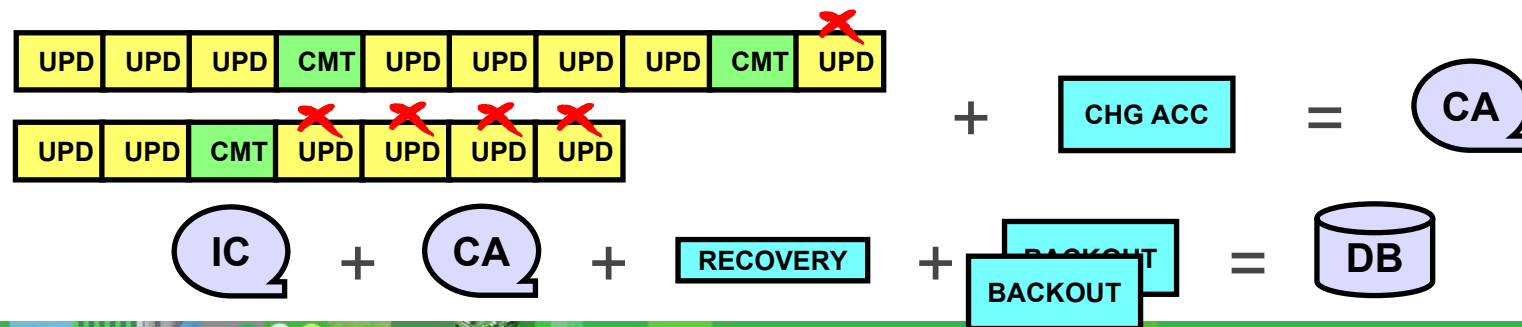
## Full Database Recovery

- ▶ Recover all database updates to last available log record
- ▶ Uses: Last image copy + logs + backout as needed
- ▶ Applies to Disaster Recovery when ICs and logs are on the remote site



## Full Database Recovery with data sharing

- ▶ Multiple concurrent logs
- ▶ Merge updates on logs using Change Accumulation (CA)
  - No CA and backout needed if using IMS ORS or DRF Tools
- ▶ Uses: Last image copy + change accumulation + 2 backouts

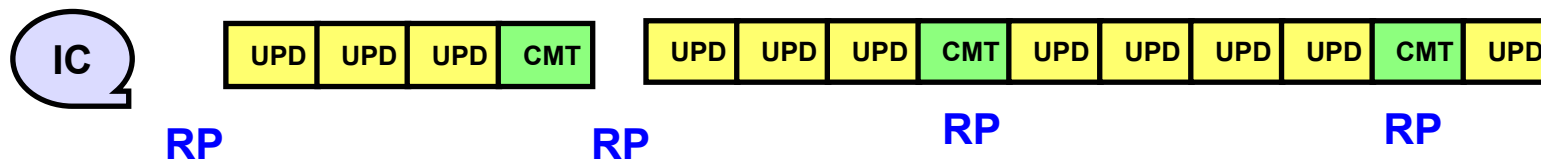


# IMS Database Recovery Techniques ...



## ■ Timestamp Recovery

- ▶ Recover database updates to an earlier state (time) than the last log record
  - Uses: Earlier image copy + some logs data sets
- ▶ Recovery point (RP) Constraints
  - No subsystem has the database open for update at recovery time
  - Change Accumulation may be required if Data Sharing
    - Unless using IMS ORS or DRF Tool

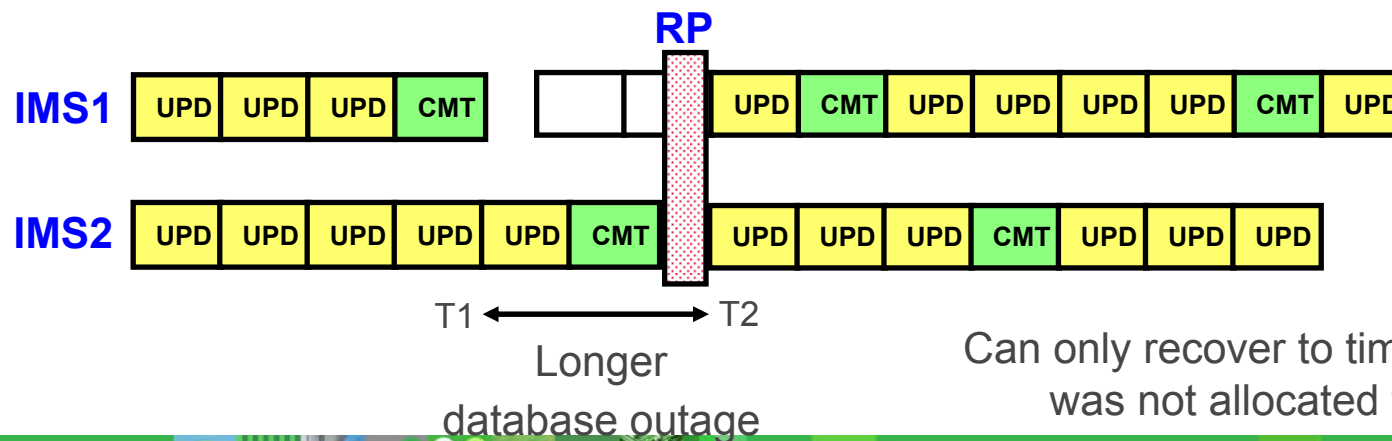




# IMS Database Recovery Techniques ...



- Timestamp Recovery with data sharing
  - ▶ Multiple updaters
  - ▶ Multiple logs
    - Change Accumulation needed
  - ▶ Multiple ALLOC records
  - ▶ Recovery point must be created on each IMS
    - Requires longer data outage
    - /DBR database on all systems before /START on any system
      - All ALLOC records must be closed at the same time



Can only recover to time when DBDS was not allocated to any IMS

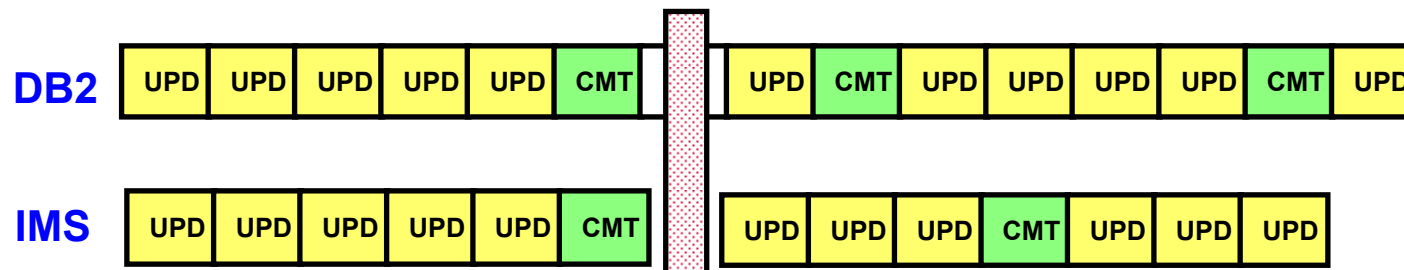
# IMS Database Recovery Techniques ...

- Point-In-Time Recovery (PITR)
  - ▶ Recovery to a timestamp other than a RP (in the middle of an UOW)
  - ▶ Not a DBRC supported Recovery Point when using IMS standard Database Recovery utility
  - ▶ With ***Online Recovery Service (ORS) Tool or Database Recovery Facility (DRF) Tool***
    - Capability to recover IMS DBs to any timestamp, even if in the middle of UOW
    - Only committed updates applied
  - ▶ Use ***IBM Application Recovery for IMS and DB2*** Tool to create DBRC Supported RP
    - To be able to use Timestamp Recovery instead of PITR

# IMS / DB2 Coordinated Timestamp Recovery

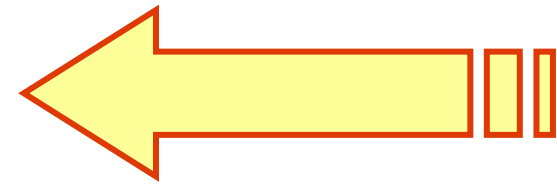
## ■ IMS / DB2 Coordinated Timestamp Recovery

- ▶ Must recover IMS and DB2 to same consistent state (time)
  - Terminology: IMS Time stamp recovery, DB2 PIT recovery
- ▶ IMS and DB2 produce independent log streams
  - No utility to trim logs to a consistent state
- ▶ Must establish concurrent recovery points
  - Use a DB2 quiesce point and an IMS /DBR command
  - Use a DB2 quiesce point with **IMS ORS/DRF** tool (PITR)
  - Use **IBM Application Recovery for IMS and DB2** Tool



# Agenda

- **Overview of Database Recovery Process**
  - ▶ What is Recovery?
  - ▶ IBM Database Recovery Techniques
- **IMS Backup and Recovery Capabilities**
  - ▶ Log Management, DBRC
  - ▶ Backup, Recovery, Backout and Restart processes
- **Backup and Recovery Scenarios**
  - ▶ IMS Online
  - ▶ IMS Batch
  - ▶ Disaster Recovery



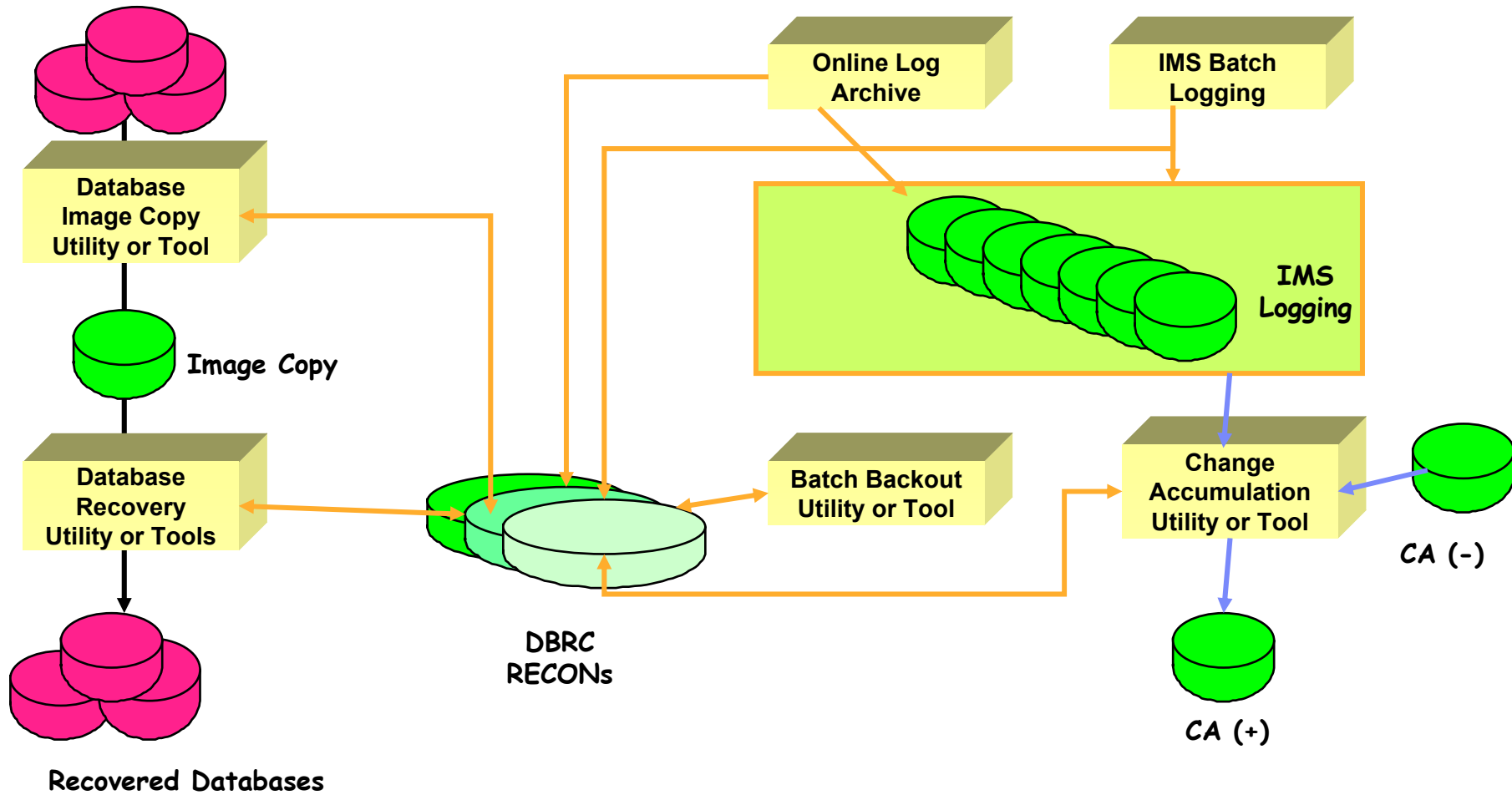
# IMS Backup and Recovery Capabilities

- **Log management**
  - ▶ From Log Archive to Problem Determination
- **Backup process**
  - ▶ Take an Image Copy of the data
- **Database Recovery Control (DBRC)**
  - ▶ The Supervisor of Recovery
  - ▶ Keep track of logs, CAs, and ICs needed for recovery
- **Recovery process (forwards)**
  - ▶ Restore followed by apply of the after-image updates
  
- **Backout process (backwards)**
  - ▶ Remove the updates that cannot be committed
  - ▶ Or remove the updates to a prior point-in-time (even committed ones)
- **Restart Process**

IMS Standard  
Utilities

Enhanced with  
IMS Tools

# IMS Backup and Recovery Capabilities ...



# IMS Backup and Recovery Capabilities ...

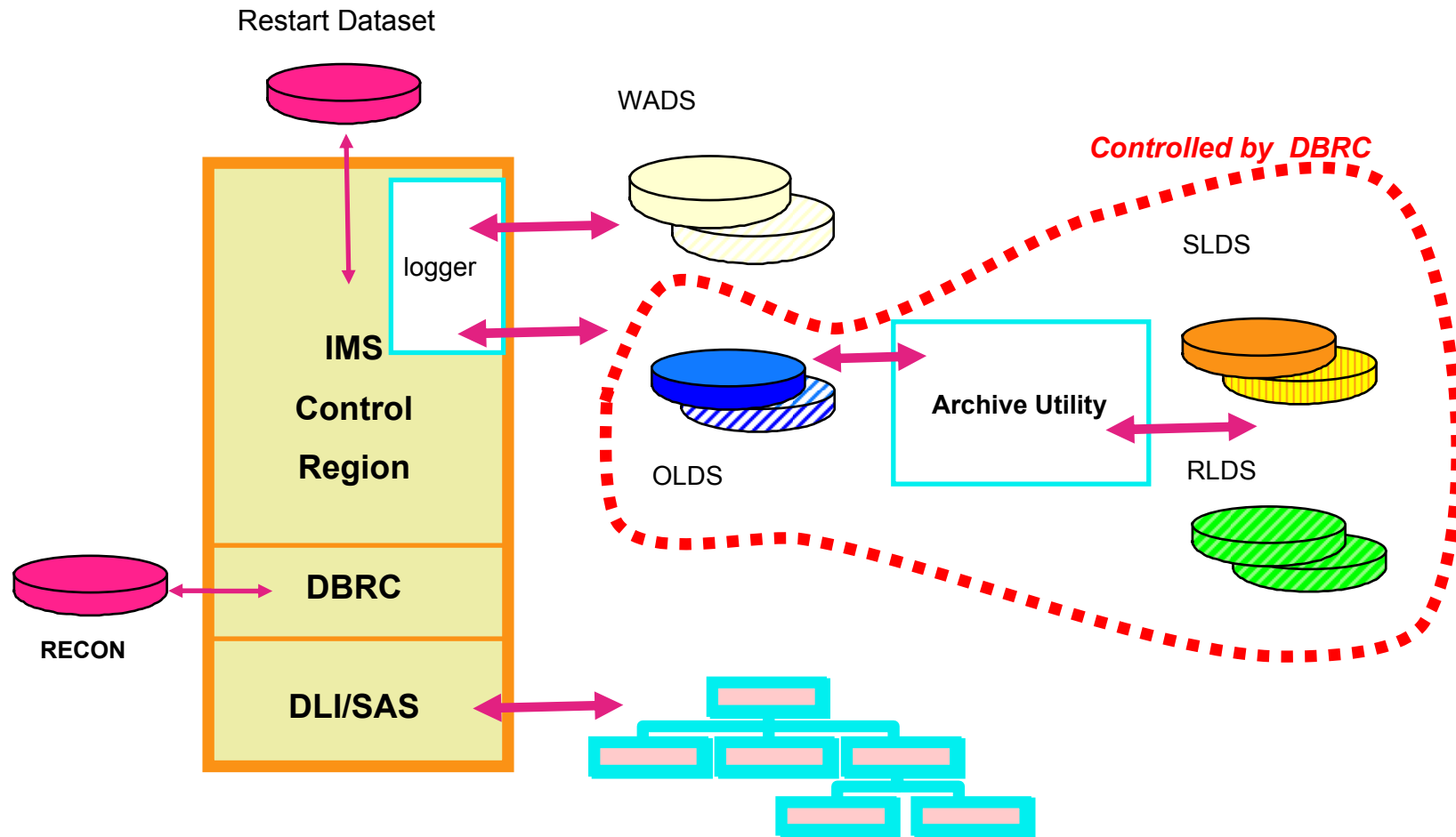
## ■ Database Classification

- ▶ To adapt backup/recovery procedures for each category
- ▶ DBRC **Non-Recoverable** DB
  - Full-function work databases
  - Index
  - DEDB with IMS V8
- ▶ Grouping of databases by application importance
- ▶ Grouping of databases by volume

## ■ DBRC types of grouping

- ▶ For CA
  - CA Group
- ▶ For DBRC Commands
  - DBDS Group
- ▶ For IMS DB /STA, /STO, /DBR, /DBD commands
  - DBDS Group
  - DB Group
  - Recovery Group
- ▶ For ORS and DRF Tools
  - Recovery Group

# IMS Log Management





# IMS Log Management ...

## ■ IMS Log data sets

- ▶ Contain all changes made to the data in the database by an application program

Before image / After image  
Commit status

## ■ Write Ahead Data Set (WADS)

- ▶ 1 or 2 actives
- ▶ Used by Log Write Ahead

## ■ Online Log Data Set (OLDS)

- ▶ Pool of 3 to 100 OLDS pairs
- ▶ Used in wrap-around mode
- ▶ Used in IMS restart

## ■ System Log Data Set (SLDS)

- ▶ Archived OLDS or created by IMS Batch
- ▶ Used in IMS Restart if OLDS unavailable or with Database Recovery

## ■ Recovery Log Data Set (RLDS)

- ▶ An option of the Archive process
- ▶ DB change information only
- ▶ Only used for Database Recovery

## ■ Performance and Integrity

- ▶ Log Write Ahead and WADS

Only complete log buffers written out to OLDS

Incomplete buffers written out to WADS when needed

## ■ Reliability

- ▶ Dual Logging
- ▶ Automated Archive
- ▶ Controlled by DBRC

## ■ Efficient space usage

- ▶ Log Compression (hardware)
- ▶ Non recoverable DB (option)

# IMS Log Management ...

- **Log Archive Utility (DFSUARC0)**
  - ▶ Archive one or several OLDSs to a single SLDS
    - Need “archive needed” status in DBRC
- **Log Recovery Utility (DFSULTR0)**
  - ▶ Correct errors in OLDSs, and batch or online SLDSs
  - ▶ Close (CLS) or Duplicate (DUP) option
- **Log Merge utility (DFSLTMG0)**
  - ▶ Merge of SLDS from two or more IMS systems
    - Start time and stop time
  - ▶ Output used as input to the Log Transaction Analysis utility
  - ▶ Not usable for DB recovery
- **Enhanced log formatting for problem determination**
  - ▶ Using *IMS Problem Investigator for zOS Tool*
  - ▶ In Batch or with ISPF

# IMS Log Management ...

## ■ Change Accumulation Process

- ▶ Merge/Sort and Condense the DB updates in a streamline to allow efficient recovery

Mandatory in a data sharing environment when using IMS standard Database Recovery utility

Not needed if using **IMS ORS or DRF** Tool

- ▶ Using Database Change Accumulation utility (DFSUCUM0)

Can build one or more CA datasets from the same IMS Log(s)

As many jobs/steps as there are CA datasets

- Output of one job used as input of the following one

- ▶ Using **IMS High Performance CA** Tool

Multiple CA processes can run in parallel rather than in sequence

Single pass of each input log dataset

- ▶ Example of CA utilization

One single CA group for all DBDSs

Several CA groups, organized by volume or application

No CA group – CA run occasionally



# IMS Image Copy Solutions

## ■ Image Copy Process

- ▶ To take a copy of the data in the database
- ▶ Clean versus Fuzzy
  - Clean, if no update at the same time. Consistent data guarantee
  - Fuzzy, if the database is still available for update. Log needed for the recovery.
- ▶ Dual copies to be sent on a remote site

## ■ Large Choice of Options

- ▶ Batch IC
  - Clean or Fuzzy (CIC)
- ▶ DFSMS Concurrent Copy, also called Image Copy 2
  - Using DFSMSdss DUMP
  - Clean or Fuzzy
- ▶ HSSP Image Copy option
- ▶ **IMS HP Image Copy** Tool – IC Function
  - Compressed / Stacked output / With Pointer Checking / Dynalloc

# IMS Image Copy Solutions ...

	Image Copy (DFSUDMP0)	HP IC Tool	Image Copy 2 (DFSUDMT0)	Online IC (DFSUICP0)	HSSP Image Copy
Part of base IMS product	Yes	No	Yes	Yes	Yes
Execution	Batch job	Batch job	Batch job	Online (BMP)	Online (BMP)
Hardware requirement	No	No	Yes	No	No
Database data sets supported	Full function and DEDBs	Full function and DEDBs	Full function and DEDBs	Full function only	DEDBs only
Fuzzy copies	CIC option with restrictions	Yes, with restrictions	Yes, without restrictions	Yes, with restrictions	Yes always
- Fuzzy copies of KSDSs (HISAM, SHISAM, Index, PSINDEX)	No	No	Yes	Yes	
- Data sharing with fuzzy copies	Yes	Yes	Yes	No	
Minimal database unavailability for clean image copies	No	No	Yes	No	NA
Multiple data sets copied in one execution	Yes	Yes	Yes with IMS V8	Yes	no
Compressed output	No	Yes	Yes with IMS V7	No	No
Pointer checking	No	Yes	No	No	No
Stacked output	No	Yes	No	No	No
Dynamic allocation	No	Yes	No	No	Yes

# IMS Image Copy Solutions ...

## ■ Database Image Copy 2 Utility (DFSUDMT0)

- ▶ Invokes **DFSMSdss DUMP** to create copy of data set
- ▶ Can produce consistent (**clean**) or concurrent (**fuzzy**) image copy
  - Clean image copy requires /DBR until logical copy completes
  - Fuzzy image copy does not require /DBR
- ▶ IMS database data sets supported
  - HDAM, HIDAM, HISAM, DEDB
  - OSAM, ESDS, KSDS
- ▶ Will produce 1-4 copies
  - 2 copies registered with DBRC at completion of DUMP
  - 2 copies available for shipment offsite
- ▶ Multiple ICs to single output data set

## ▶ Steps

- 1: /DBR for Clean. No /DBR for Fuzzy.
- 2: SMS completes **Logical Copy**.
- 3: /STA DB/AREA after Logical Copy done.
- 4: Appl attempts to update Track 4 before Physical Copy done.
- 5: Controller saves copy of original track in Side File Cache.
- 6: Appl modifies Track 4 on DASD.
- 7: Side File Cache offloaded to Host Side File (Data space).
- 8: Controller merges tracks from Cache/Host Side Files and DASD.
- 9: **Physical Copy** done

### Enhanced with IMS V8

Copy multiple database data sets in one execution  
Copy groups of DBDSs (e.g. DBDSGRP)

# IMS Image Copy Solutions ...

## ■ HSSP Image Copy Option

- ▶ Applies to DEDBs only
- ▶ Creates fuzzy image copy during sequential processing of BMP
- ▶ Eliminates need to read ADS twice
- ▶ Reduces volume of log data needed for later recovery
- ▶ Image copy already has latest updates

# IMS Image Copy Solutions ...

- **IMS HP Image Copy Tool - Image Copy function**
  - ▶ Enhance the IMS Image Copy utility (DFSUDMP0)
    - For both Full Function DB, including HALDB and DEDB
    - Batch Image Copy or Concurrent Image Copy
  - ▶ Enable hash pointer checking during image copy
    - Not available with Concurrent Image Copy
    - Prereqs for full function databases
      - IMS High Performance Pointer Checker
    - Prereqs for DEDB
      - IMS Fast Path Basic Tools
  - ▶ Support compressed image copy output
  - ▶ Allow stacking of multiple output datasets
  - ▶ Allow copying of DBRC DBDS and CAGRP Groups
  - ▶ Can use Dynamic Allocation for input and output datasets

Reduced overall elapsed time  
Reduced tape handling  
Simplified JCL especially if not using GENJCL function of DBRC



# DBRC

## ■ Database Recovery Control (DBRC) Main Focuses

- ▶ Control the availability of resources needed in recovery process
  - Keep track of information necessary for DB recovery
- ▶ Control database access
  - In non data sharing, or data sharing environment
- ▶ Generate JCL for various IMS Utilities
  - Data Base Recovery, Change Accumulation, Image Copy
  - Log Archive, Log Recovery

## ■ RECON datasets

- ▶ DBRC's primary resource
- ▶ Keep track of status for the IMS System and IMS Database activity

## ■ DBRC ISPF Frontend

- ▶ Using *IMS DB Control Suite* Tool

The Repository  
for Recovery  
Data

The Supervisor  
of Database  
Recovery

# DBRC ...

- LIST.HISTORY Graphic Timeline

```

02.070 08:30:25.9                LISTING OF RECON                PAGE 0006
+-----+-----+-----+-----+-----+-----+-----+-----+
| Timeline for DBDS: DIVNTZ04 DBHVSAM1                               | Ref |
|           USID=00000001     AUTHORIZED=00000000                 | Page |
|           RECEIVE=00000000     HARD=00000000                   | 0002 |
+-----+-----+-----+-----+-----+-----+-----+
| -Time- | -Events- | -CA- | -US- | Subsystem |
|        | REORG   |      | ID   | Logs and Allocs |
|        | RECOV   |      |      |              |
+-----+-----+-----+-----+-----+-----+
01.111 12:00:00.0                |      | IMS1 |      |      |      |      |      | 0004
01.111 12:15:00.0                |      | 2   | A   |      |      |      |      | 0003
01.111 12:30:00.0  O              |      |      |      |      |      |      |      | 0003
01.111 12:45:00.0  s              |      |      |      |      |      |      |      |
01.111 12:59:59.9                |      | 2   | D   |      |      |      |      |
01.111 13:00:00.0                |      |      |      |      |      |      |      |
01.111 13:15:00.0                |      | 3   | A   |      |      |      |      | 0003
01.111 13:59:59.9                |      | 3   | D   |      |      |      |      |
01.111 14:00:00.0                |      |      |      |      |      |      |      |
01.112 12:00:00.0                |      | IMS2 |      |      |      |      |      | 0005
01.112 12:15:00.0                |      | 4   | A   |      |      |      |      | 0003
01.112 12:59:59.9                |      | 4   | D   |      |      |      |      |
01.112 13:00:00.0                |      |      |      |      |      |      |      |
01.112 13:15:00.0                |      | 5   | A   |      |      |      |      | 0003
01.112 13:59:59.9                |      | 5   | D   |      |      |      |      |
01.112 14:00:00.0                |      |      |      |      |      |      |      |
+-----+-----+-----+-----+-----+-----+-----+
In the timeline, only the last digit of USID is shown.
IC: B = Batch, U = UIC, O = OIC, C = CIC, s = Stop
Logs: SSID = Open time, C = Log Close,
      v = Vol close, s = DS close
Allocs: D = Dealloc time, A = Alloc time
+-----+-----+-----+-----+-----+-----+-----+
    
```

# IMS Database Recovery Solutions

## ■ **IMS Database Recovery utility (DFSURDB0)**

- ▶ Special IMS Batch Region
- ▶ Recovers a single DBDS per execution
- ▶ No HSAM or GSAM support
- ▶ DBRC GENJCL.RECOV support

## ■ **IMS HP Image Copy Tool – Recovery Function**

- ▶ Replace the IMS Database Recovery utility (DFSURDB0)
- ▶ Recovers a single DBDS per execution
- ▶ Accepts compressed (or normal) image copy
  - Needed to recover a DBDS from a compressed IC created by ICE
- ▶ DBRC GENJCL.RECOV support
- ▶ 2 Operating Modes
  - Native mode
    - Dynamic Allocation for input and output datasets
  - IMS Compatible Mode

# IMS Database Recovery Solutions ...

## ■ IMS Online Recovery Service Tool

- ▶ Online IMS used to recover IMS databases

## ■ IMS Database Recovery Facility Tool

- ▶ Follow-on product to ORS V1
- ▶ Online or Batch Invocation
- ▶ Input data sets read in parallel
- ▶ DB data sets recovered in parallel
- ▶ Recovery Time Options
  - Recover to End of Logs
  - Time Stamp Recovery (Recovery Point)
  - Point-In-Time Recovery (Arbitrary Point)
    - "Image Copy Needed" state is set in RECON for recovered databases after PITR
    - List of Open UOW

## The IBM High Performance DB Recovery Solution

Faster Recovery Process

Parallel Processing

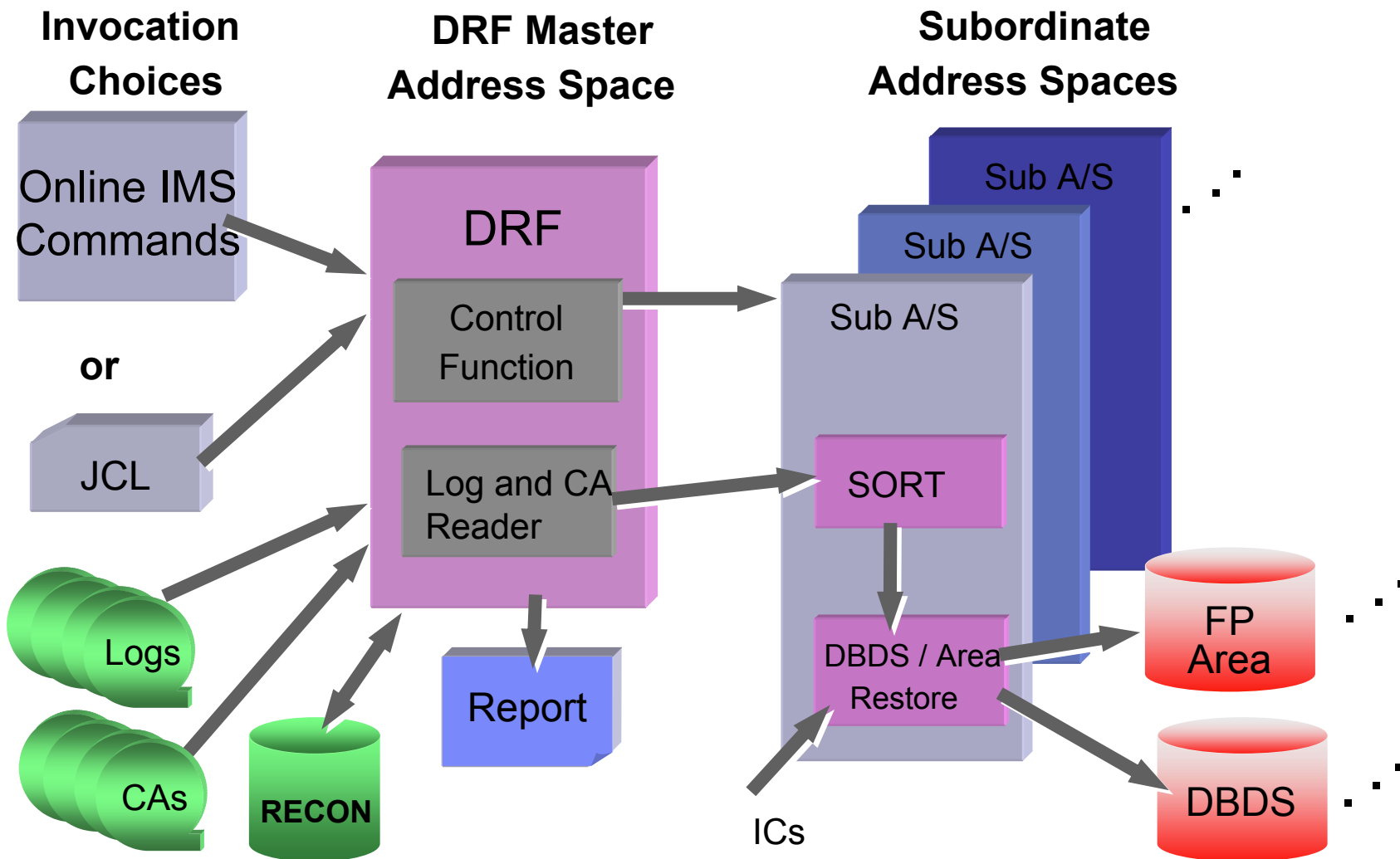
Single Log Pass

CA not required

Timestamp Recovery to Any  
Timestamp

DBRC Controlled

# IMS Database Recovery Solutions ...



## Application Recovery for DB2 and IMS

- **Simplify & coordinate the recovery of both IMS & DB2 data to a common point, cutting the time & cost of data recovery and availability.**
  - ▶ Manage different DB2 & IMS logs and processes
  - ▶ Synchronize DB2 & IMS logs to create a common point in time for recovering data.
  - ▶ Can be used to recover individual IMS or DB2 applications
  
- **ISPF or Batch interfaces**
  
- **New name for DB2 Recovery Manager**

### **Global View of Recovery**

Object Management / Integrity / Automatisation

# Application Recovery for DB2 and IMS ...

## ■ Automated Management of Recovery Objects

- ▶ Generate JCL for ICs, CA, ...
- ▶ Create and merge ICs of DB2 and IMS data
- ▶ Delete obsolete objects (IC, CA, logs)
- ▶ Manage consistency between MVS catalog and DBMS repository (RECON dataset and DB2 catalog)
- ▶ Manage disk space
- ▶ Displays events occurring on the data

**ART****1rst Function**

```
Application Recovery Tool -DB2 Primary Panel
```

```
COMMAND ===>
```

```
1 FIC -Full Image Copy of one or more TS(s)
2 IIC -Incremental Image Copy ...
3 MERGE -Merge Image Copies
4 DELETE -Delete obsolete recovery objects ...
5 MDISK -List/Migrate/Delete ...
```

```
Application Recovery Tool -IMS Primary Panel
```

```
COMMAND ===>
```

```
1 INIT -Update RECON for one or more DB(s)
2 IC -Physical Image Copy ...
3 CA -Change Accumulation ...
4 REORG -RECON data sets online reorg.
5 DELETE -Delete obsolete recovery objects ...
6 MDISK -List/Migrate/Delete ...
```

# Application Recovery for DB2 and IMS ...

## ■ Create Data Consistency Point (optional)

- ▶ Called Virtual Image Copy (VIC) point
  - A point without update
  - Not a real IC
- ▶ Synchronous function
  - Dependent on application scheduling
  - Must occur before an update step
- ▶ “Quiesce” point for selected IMS DBDSs and DB2 Tablespaces
- ▶ Notification of the VIC point in the VIC RECON for this set of databases
  - Only noting the position of logs at a specific PIT
    - Timestamp for IMS
    - RBA for DB2

**ART**

**2nd Function**

Only for Updated DBs

Much less than IC

Less DASD Resources



# Application Recovery for DB2 and IMS ...

## ■ Automate Recovery of Resources

- ▶ Parameter driven process
  - Generates JCL
- ▶ Automatic location of impacted DBs
  - Locates Image Copies and Logs
- ▶ Capability to automate the entire process
  - Deallocation of databases
  - Archive of non-archived updates
  - Construction of the recovery JCL
  - Submission
  - Restart of databases
- ▶ Capacity to choose the VIC point earlier to a specified timestamp

## ■ Provides many additional functions to help in the recovery area

**ART**

**3rd Function**

```

                                IMS and DB2 - Primary Panel
COMMAND ==>>

1 VIC      - Virtual Image Copy on DB(s)/TS(s)
2 MAP      - Map one or more DB(s)/TS(s)
3 RECOV    - Recover on one or more DB(s)/TS(s)
4 CHECK    - Check data on one or more TS(s)

A AOP      - Automatic Operator Program
  
```

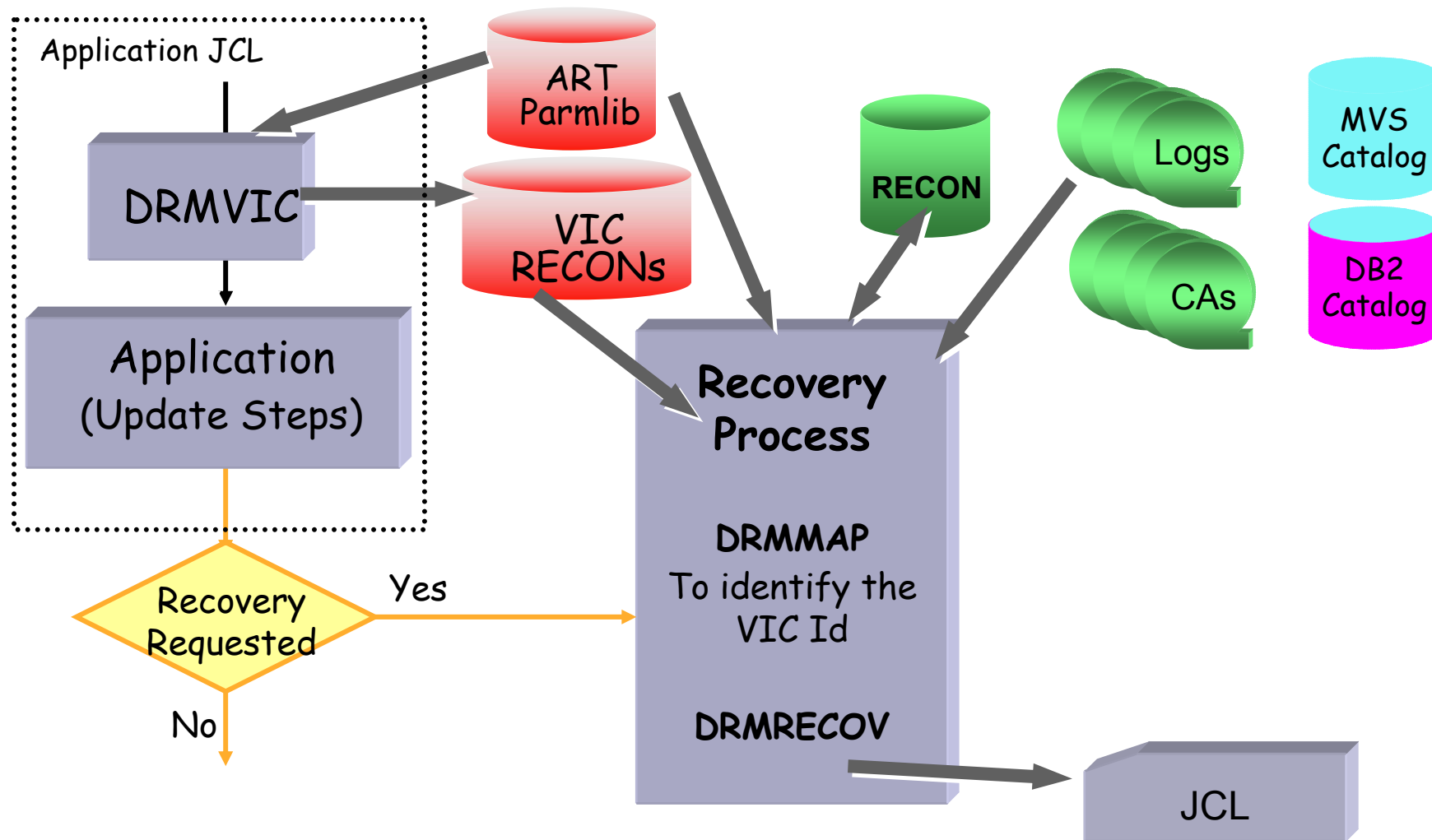
```

//SBOTH EXEC PGM=DRMEXEC,DYNAMNBR=50,REGION=2M,
// PARM=(FUNCTION,'DRMRECOV',IMID,'IMSG',DB2ID,'DB2G')
  
```

**ART**

**+++**

# Application Recovery for DB2 and IMS ...



# Application Recovery for DB2 and IMS ...

## ■ Execution Environment

### ▶ Batch

```
//S1 EXEC PGM=DRMEEXEC, DYNAMNBR=50, REGION=2M,  
// PARM=(FUNCTION, 'Funcname' {,Name, 'Value' })  
//SYSIN DD *
```

**Parameters of the requested function**

### ▶ or ISPF

## ■ ART Parmlib

- ▶ JCL generation skeletons
- ▶ Description of the IMS or DB2 site
  - Definition of several environments
- ▶ Default processing parameters for various functions
- ▶ Standard CLIST of the product
- ▶ ISPF panels
- ▶ Members that allow execution of SQL statements

# IMS Backout Solutions

## ■ Dynamic Backout

- ▶ Automatically performed by IMS online when
  - An application program terminates abnormally
  - An application program issues a rollback call, or tries to access an unavailable database
  - A deadlock occurs
- ▶ Also available for IMS Batch under specific conditions
  - DASD logging, IMS Pseudo-Abend, BKO=Y parameter
  - IMS Batch Backout Manager** Tool to have consistent BKO

## ■ Dynamic Backout during IMS Emergency Restart

- ▶ NOBMP option prevent dynamic backout of BMPs
- ▶ COLDBASE option stops dynamic backout of everything

## ■ IMS Batch Backout

- ▶ To the last checkpoint for BMPs and IMS Batch in a sharing environment
- ▶ To any checkpoint for an IMS Batch in a non-data sharing environment using CHKP control statement

# IMS Batch Backout Process

## ■ **IMS Batch Backout utility (DFSBBO00)**

- ▶ Removes changes in the database which were made by a specific failing program.
- ▶ Uses the PSB used by the program whose effects are to be backed out.
- ▶ A log data set is created during the backout process.

## ■ **IMS Batch Backout Manager Tool**

- ▶ For customers running IMS stand-alone batch work
- ▶ Automatically ensures that abended batch programs get backed out
  - Immediately after failure (if MVS environment still available)
  - Or at restart time (if not done at abend time)
- ▶ Ensures that batch logging is done
  - replace logs specified in job's JCL
  - adds logs if not specified
- ▶ Requires no changes to existing JCL
- ▶ Complements IMS Program Restart Facility Tool

# IMS Program Restart Process

## ■ IMS Standard Restart process

- ▶ IMS Application Extended Checkpoint/Restart facilities
- ▶ For stand-alone batch and BMP

## ■ IMS Program Restart Facility Tool

- ▶ Enhances IMS Application CHKP/RST facilities
  - Help to restart a job at the correct checkpoint
  - ISPF Panels to administer abended jobs
- ▶ Enables restart
  - on any system in sysplex
  - without specifying a checkpoint Id
  - without overriding the JCL with the correct log data set name(s)
- ▶ Can be used to restart programs that do not abend but which end with a non-zero return code

### **PRF**

Easy and quick  
restart of abended  
batch and BMP jobs  
without JCL change  
on any IMS in an  
IMSpex

Less restart errors  
and "time consuming  
and costly" recovery  
activity

# IMS Tools for Backup and Recovery - Summary

## ■ Backup

- ▶ IMS HPIC Copy Function

## ■ Change Accum

- ▶ High Performance Change Accum

## ■ Database Recovery

- ▶ IMS HPIC Recovery Function
- ▶ Online Recovery Services
- ▶ Database Recovery Facility
- ▶ Index Builder
  - For index recovery
- ▶ IMS HP Pointer Checker
  - For Database validation

## ■ Application Recovery

- ▶ Application Recovery for DB2 and IMS

## ■ Batch Backout

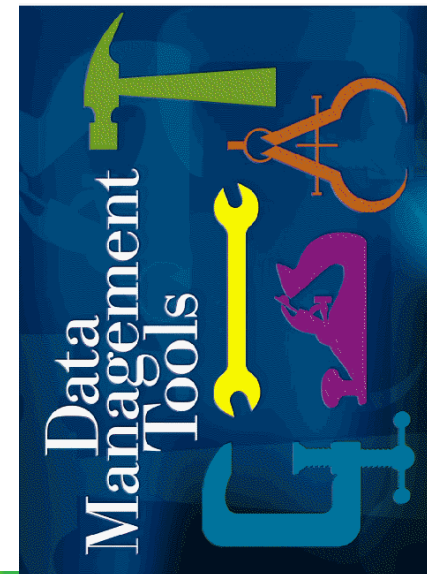
- ▶ Batch Backout Manager

## ■ Program Restart

- ▶ Program Restart Facility

## ■ Recovery Management

- ▶ IMS DB Control Suite
- ▶ IMS Problem Investigator
- ▶ IMS Performance Analyzer



# Agenda

- **Overview of Database Recovery Process**
  - ▶ What is Recovery?
  - ▶ IBM Database Recovery Techniques
- **IMS Backup and Recovery Capabilities**
  - ▶ Log Management, DBRC
  - ▶ Backup, Recovery, Backout and Restart processes
- **Backup and Recovery Scenarios**
  - ▶ IMS Online
  - ▶ IMS Batch
  - ▶ Disaster Recovery





## IMS Online - I/O Errors

### ■ **IMS manages Database I/O Errors**

#### ■ **Write Errors**

- ▶ IMS application program are NOT aware of a DB write error!
- ▶ IMS Tasks performed
  - EEQE created
  - IMS buffer for the erroneous block/CI allocated
  - Log record created
- ▶ Restored by online warm or emergency restart
- ▶ Not retrieved thru IMS Batch Process
- ▶ DBRC can help in maintaining Database Integrity!
  - each EEQE recorded in the DBDS record

#### ■ **Read error**

- ▶ AO status code to the application
- ▶ EEQE created for the data in error

# IMS Online – Application Program Abend

## ■ **Abending online programs**

- ▶ Automatic back-out by the online system using the log records  
From WADS, OLDS, or SLDS
- ▶ Correct the problem that caused the abend
- ▶ Restart Transaction / Program by IMS /START command

## ■ **Abending Dependent Region**

- ▶ Correct the problem that caused the abend
- ▶ Restart Transaction / Program by IMS /START command
- ▶ Restart BMP from the **Latest Checkpoint**



# IMS Online Failure

## ■ Different Situations

- ▶ MVS System Failure
- ▶ Control region Failure
- ▶ System Data Set Failure, including Message Queue datasets

## ■ IMS Emergency Restart

- ▶ Perform all the tasks needed to get a consistent state for IMS resources
- ▶ By reading the IMS logs
- ▶ For UOW where IMS is the Syncpoint Manager (coordinator)  
IMS system pilots the backout/commit of the pending UOW.  
IMS communicates with the other Resource Manager (participant).

# IMS Online Failure ...

## ■ Incomplete IMS Emergency Restart

- ▶ Selective “Cold Start” possible
  - COLDCOMM or COLDBASE for a DBDC system
  - COLDSYS for a DBCTL system
- ▶ Affected Database stopped and flagged in DBRC (if registered)

## ■ Before Cold Start

- ▶ Reestablish MANUALLY database integrity
- ▶ Validate the logs using Log Recovery utility (DFSULTR0)
- ▶ For FF DBs, IMS Batch Backout utility (DFSBB000)
  - to back out programs (PSBs) that were active at the time of failure
- ▶ For DEDBs, Forward recovery of all updated DEDBs
  - Quick solutions to bring the DEDBs to a consistent state
    - IBM Tool: DEDB Fast Recovery

# IMS Online Failure in a Data Sharing Environment

- **IMS Fast DB Recovery Implementation**
  - ▶ Function included in IMS
  - ▶ To avoid Lock Contention on IMS DB Resources owned by the failing IMS
  
- **IMS Emergency Restart**
  - ▶ Still needed ASAP to complete recovery
  
- **IMS Emergency Restart Failure**
  - ▶ Cold Start required
  - ▶ Before Cold Start
    - Reestablish MANUALLY database integrity

# IMS Online - IMS and DB2 Resources

## ■ Environment:

- ▶ IMS Online System as Syncpoint Manager
  - For workload running as IMS transaction or BMP
- ▶ IMS TM/DB and DB2 as Resource Managers

## ■ Integrity Management

- ▶ Using Two Phase Commit Protocol
- ▶ To maintain consistency between several kinds of data

## ■ Main Issue for **BMP** window

- ▶ Recover IMS and DB2 databases to a consistent state
  - To an “equivalent” timestamp
  - Stored in the IMS RECON for IMS
  - Stored in the DB2 SYSIBM.SYSCOPY for DB2
- ▶ Create backup/ICs that are usable to recover
- ▶ Application Recovery for DB2 and IMS Tool can help in creating Timestamp for Timestamp Recovery
- ▶ IMS ORS/DRF can perform Point-In-Time Recovery to any timestamp.

# IMS Batch Failure

## ■ Application Program with or without checkpoint/restart logic

- ▶ Backout needed to leave the data in a consistent state
- ▶ Job restartable after backout
  - To any checkpoint or to the beginning
- ▶ With or without DBRC

## ■ Option 1 – Manual Backout and Manual Restart

- ▶ Steps
  - Close current batch SLDS
  - Run batch backout utility
- ▶ Remarks:
  - SLOW manual process
  - Reaction time to initialabend
  - JCL preparation and submission
  - Scope for errors causing further delay

## IMS Batch Failure ...

### ■ Option 2 – Backout using IMS Batch Backout Manager Tool

- ▶ IMS provides automatic backout under specific conditions. The tool provides automatic backout in any cases.
- ▶ Batch Backout control dataset (BBDS) used to save information needed in the event of an unexpected termination of backout process
- ▶ BBM functions executed whenever an IMS Batch application abends.

### ■ Option 2 – Restart using IMS Program Restart Facility Tool

- ▶ Make sure the abended job run under BBM control  
BCM001I CKPTID TRACKING IS ACTIVE message in the job log
- ▶ Performs backout functions
- ▶ Then application restart begins  
Easier with IMS Program Restart Facility  
Automatically supports IMS Extended Restart by supplying the correct  
CHKPTID without JCL Changes



## IMS Batch - Appli.Logic Error with IMS and DB2 Updates

### ■ Application Logic Error in a Batch Environment

- ▶ The program completes successfully.  
IMS and DB2 updates are performed
- ▶ Not an application abend, followed by backout which leave the data in a consistent state

### ■ Option 1 – Recovery / Reprocess

- ▶ Steps:  
Recover the data to some previous point of consistency  
Correct the application program  
Replay the work
- ▶ Remarks:  
All the work following the Batch is lost.  
Not doable in an online environment where many transactions have been processed on many databases after this batch application error

### ■ Option 2 – Manual Changes

- ▶ Steps:  
Edit/Correction of the data
- ▶ Remarks  
High Risk  
Log analysis tool required  
DB2 Log Analysis Tool / IMS Problem Investigator

# IMS Disaster Recovery

## ■ Tactics

- ▶ Daily or Weekly Backup with/without a quiesce of all update activity
  - Truck or electronic transfer of recovery data
    - Secondary ICs
    - Secondary logs, CA datasets
- ▶ Remote logging
  - IMS Remote Site Recovery
    - Log data sent in real-time as transaction are being processed
    - Asynchronous transmission
- ▶ Remote Copy
  - DASD Synchronous Remote Copy – IBM PPRC
    - Limited distance
    - No data loss
    - Impact on the local system
  - DASD Asynchronous Remote Copy – IBM XRC
    - Using System Data Mover
    - Minimal data loss

### The Ideal View

Recovery with No Loss of  
Data

Minimal Cost

No Impact on Prod.  
Environment