



IBM Advanced Technical Support

Maximizing IMS Database Availability



Agenda

- Why are databases unavailable?
 - ▶ We will discuss the reasons

- What can we do about it?
 - ▶ We will see how we can eliminate or minimize the outages



Why are IMS databases unavailable?

- System unavailability
 - ▶ Addressed by Parallel Sysplex
 - ▶ Disaster recovery
 - Application design
 - ▶ Applications which cannot run with concurrent updates
 - ▶ Data processed outside of IMS
 - Reorganizations
 - ▶ For database performance
 - ▶ For database restructure
 - Database recoveries
 - ▶ Image copies
 - ▶ Full recoveries
 - ▶ Timestamp recoveries
- Not covered in this presentation
- We'll talk about these reasons and how to minimize these database outages



Reorganizations



Reorganizations

- For database performance – typical reorg
 - ▶ “Optimizes” data placement in data sets
 - Puts segments near segments from which they are chained
 - ▶ Reduces I/Os required to process the database
 - Reduces CPU utilization
- For database restructure – less typical reorg
 - ▶ Adds, deletes, moves segment types in the database
 - ▶ Modifies segment definitions
 - ▶ Changes physical characteristics
 - Block sizes
 - Randomization parameters
 - Compression
 - ...



Reorganizations

- Three categories of reorganizations
 - ▶ Offline
 - Database is not available during the reorganization
 - ▶ Online – almost
 - Database is available during almost all of the reorganization
 - Short outage required
 - ▶ Online – truly
 - Database is available during all of the reorganization
 - Absolutely no outage whatsoever



Offline

Database is not available during the reorganization



Full function (non-HALDB) reorganizations

- HD Unload, HD Reload, HISAM Unload, HISAM Reload, Prereorganization, Database Scan, Prefix Resolution, and Prefix Update
 - ▶ These utilities are supplied in the IMS product
 - They perform the reorganization functions
 - Unload, reload, update logical relationships, rebuild secondary indexes
 - They are not designed for optimum performance
 - ▶ Databases are unavailable during the reorganization process



Full function (non-HALDB) reorganizations

- **IMS Tools: HP Unload, HP Load, Index Builder, HP Prefix Resolution, and IMS Parallel Reorganization**
 - ▶ These tools are not part of the IMS product
 - *They shorten the reorganization process*
 - *They simplify the management of reorganizations*
 - ▶ Databases are unavailable during the reorganization process



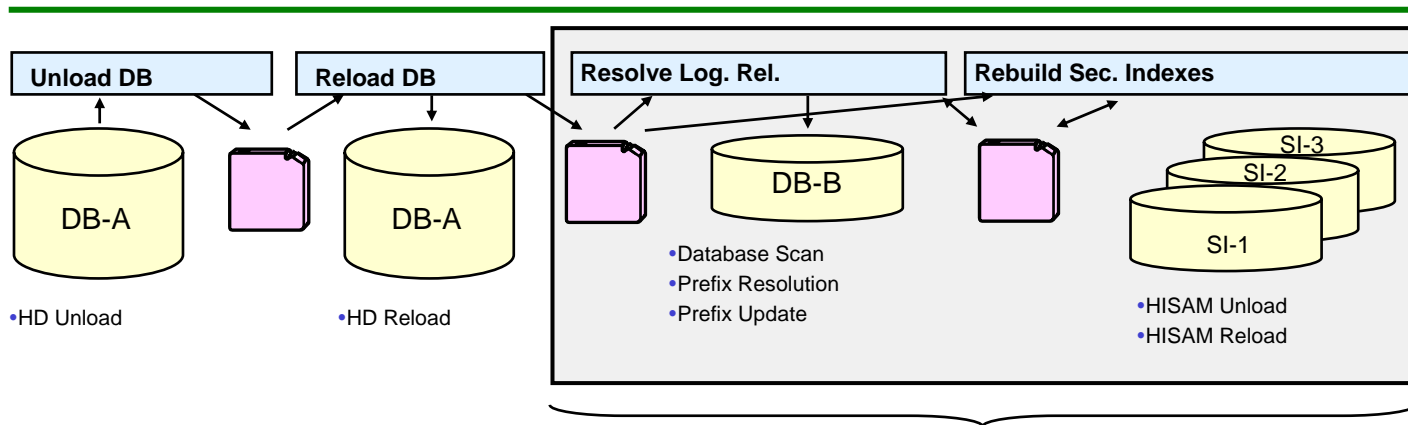
HALDB reorganizations

- HALDB has two basic advantages for reorganizations
 - ▶ Parallelism
 - Partitions may be reorganized in parallel
 - Smaller partitions provide shorter elapsed times
 - ▶ Elimination of much of the work
 - Secondary indexes and logical relationships do not have to be updated during the reorganization
 - They are dynamically updated when they are first used
 - Self-healing pointers
 - ▶ Performance
 - *Much shorter outages for reorganizations*
 - *Could reduce the elapsed time by 90% or 95%!*

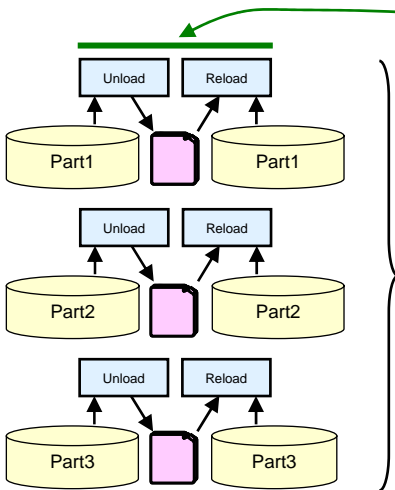


HALDB reorganizations

Non-HALDB reorganization



HALDB reorganization



Eliminate these steps

Elapsed time

- Reorganize partitions in parallel
- Create enough partitions to fit in your window

HALDB reorganizations

- IMS product utilities
 - ▶ HD Unload and HD Reload may be used
- IMS Tools
 - ▶ HP Unload and HP Load may be used
 - ▶ IMS Parallel Reorganization may be used
 - ▶ Index Builder may be used
 - Eliminates the need to heal pointers after the reorganization
 - ▶ Performance
 - *The IMS Tools further shorten the reorg process*



Online - Almost

Database is available during almost all of the reorganization



Online Reorganization Facility (ORF)

- **Online Reorganization Facility (ORF)** is an IMS tool
 - ▶ Reorganizes full function databases, including HALDB
 - ▶ Allows several types of restructures
- **Availability**
 - ▶ Allows concurrent updates from IMS online systems
 - ▶ A very short outage is required
- **Technique**
 - ▶ Uses shadow data sets (reorganizes and renames them)
- **Restrictions**
 - ▶ No external logical relationships
 - ▶ CICS and ODBA (e.g. DB2 stored procedures) are not supported
 - ▶ Concurrent batch (DLI or DBB) not allowed



Online - Truly

Database is available during all of the reorganization



HALDB Online Reorganization

- **HALDB Online Reorganization**
 - ▶ Standard part of IMS Version 9
 - Not a separate product or feature
- Absolutely no outages
- Data set sizes may be changed
- Restrictions
 - ▶ Cannot make DBD changes
 - ▶ Cannot make partition selection changes
- Supports:
 - ▶ Secondary indexes, logical relationships, data sharing, ...



Fast Path DEDB Reorganizations

- Fast Path Data Entry Database (DEDB)
 - ▶ Database is architected for online reorganizations
 - Designed to facilitate online reorganization
 - ▶ IMS product includes online reorganization capability
 - **High-Speed DEDB Direct Reorganization** utility
 - Absolutely no outage
 - Reorganizes area (partition) in the same data set
 - Reads and rewrites segments within units of work (sets of CIs)
 - Supports concurrent updates
 - Supports data sharing
 - Restriction:
 - Restructures not allowed



Reorganizations Summary

- Full function non-HALDB
 - ▶ IMS tools can significantly reduce outage time
 - ▶ ORF tool reduces outage to a very short time
 - ▶ Conversion to HALDB may provide significant benefits
- HALDB
 - ▶ Partitioning and self-healing pointers significantly reduce offline reorganization times
 - ▶ IMS tools can significantly reduce outage time for offline reorgs
 - ▶ IMS V9 HALDB Online Reorganization has no outage
 - Part of the IMS product
- Fast Path DEDB
 - ▶ Real online reorganization with no outage
 - Part of the IMS product



Image Copies



Image Copies

- Clean IC vs. Fuzzy IC
 - ▶ Clean IC
 - All segment images are from the same time
 - Recovery may be done without logs
 - Database is not available for update for some time
 - ▶ Fuzzy IC
 - Segment images are from different times
 - Recovery requires logs
 - Database is available for update during the IC process



Image Copies

- IMS product provides four image copy utilities
 - ▶ Image Copy
 - ▶ Image Copy 2
 - ▶ Online Image copy
 - ▶ Fast Path DEDB HSSP image copy
- IMS tools
 - ▶ High Performance Image Copy (HPIC)



Image Copies in IMS Product

- **Database Image Copy (DFSUDMP0)**
 - ▶ Clean and fuzzy image copies
 - Fuzzy IC not valid for KSDSs
 - KSDS: (P)HIDAM indexes and secondary indexes

- **Database Image Copy 2 (DFSUDMT0)**
 - ▶ Uses concurrent copy capability of the DASD subsystem
 - ▶ Clean and fuzzy image copies
 - Valid for all types of data sets: OSAM, ESDS, and KSDS
 - Outage for clean copies is much shorter
 - Database unavailable only during the logical copy



Image Copies in IMS Product

- **Online Database Image Copy (DFSUICP0)**
 - ▶ Runs in online system – special BMP
 - Uses online buffer pools – performance implications
 - ▶ Does not support Fast Path databases
 - ▶ Valid for all data set types: OSAM, ESDS, **KSDS**
 - ▶ Fuzzy image copies
 - Updates allowed only in the same online system
 - Limited data sharing support



Image Copies in IMS Product

- **Fast Path DEDB High-Speed Sequential Processing (HSSP)**
 - ▶ Fast Path DEDBs only
 - ▶ HSSP is an option for BMP application programs
 - High speed process to read the database
 - Anticipatory reads eliminate many read waits
 - ▶ HSSP has an image copy option
 - Produces an image copy while application processes the area
 - Fuzzy image copy
 - Concurrent updates are allowed in any data sharing system



Image Copy Tool

- **High Performance Image Copy (HPIC)**
 - ▶ HPIC V3
 - Extends the Database Image Copy (DFSUDMP0) utility
 - Ease of use capabilities
 - Same restrictions as Database Image Copy
 - ▶ HPIC V4
 - Adds Concurrent Copy, FlashCopy, and SnapShot support
 - Concurrent Copy
 - Can make fuzzy image copies of all data sets, including KSDSs
 - FlashCopy and SnapCopy
 - Can make fuzzy image copies of data sets except KSDSs
 - Faster copies of database data sets



Image Copies Summary

- Clean image copies
 - ▶ Available with
 - Image Copy, Image Copy 2, and HPIC
 - Image Copy 2 and HPIC can minimize the outage

- Fuzzy image copies
 - ▶ Available for OSAM and ESDSs with
 - Image Copy, Image Copy 2, and HPIC
 - ▶ Available for KSDSs with
 - Image Copy 2 and HPIC V4
 - ▶ Available for DEDBs with
 - Image Copy, Image Copy 2, HSSP, and HPIC



Database Recoveries



Database Recoveries

- Database recoveries are done for two reasons
 - ▶ Full recovery
 - Due to DASD failure
 - Puts database back to its last state
 - RAID technology has eliminated the need for most of these
 - ▶ Timestamp recovery (to a previous state)
 - Usually due to an application processing error
 - Related databases must be recovered to the same time
 - Database must be recovered to a *recovery point*
 - Time when there were no uncommitted updates
 - No transactions in-flight
 - ▶ Most recoveries today are timestamp recoveries



Database Recoveries

- Preparing for timestamp recoveries
 - ▶ Creating recovery points
 - Database must be quiesced (/DBRed or /DBDed or ...)
 - For data sharing, database must be quiesced on all systems at the same time
 - DBRC enforces these rules
 - Database data set cannot have an ALLOC record which spans the time
 - Creating recovery points is a significant cause of database unavailability
 - Many installations /DBR their databases once every day for this purpose
 - Outages are not caused by failures
 - They are caused to prepare for potential failures



Database Recoveries

- Eliminating recovery points
 - ▶ Database Recovery Facility (DRF) tool
 - Has Point-in-Time-Recovery (PITR) capability
 - Recovers databases to any time
 - Does not require a recovery point
 - Recovers only committed updates
 - Eliminates the need to create recovery points
 - Databases may remain available
 - Daily /DBRs are not needed



Database Recoveries

- **Database Recovery Facility (DRF) tool**
 - ▶ Fast recovery capability
 - Recovery multiple database data sets in parallel
 - Reads inputs only once for multiple recoveries
 - Reads input logs in parallel
 - Reads image copies in parallel
 - Reads change accum data sets in parallel
 - Writes data sets sequentially after sorting log record updates
 - ▶ DRF provides a faster way to recover



Database Recoveries

- **High Performance Change Accumulation (HPCA) tool**
 - ▶ HPCA provides a faster way to create Change Accum data sets
 - ▶ HPCA V1.3 adds **PITR support**
 - Includes only committed updates up to this time



Database Recoveries

- **Index Builder** tool
 - ▶ Creates or rebuilds indexes from indexed databases
 - Eliminates need for image copies and logs
 - ▶ Faster than database recovery for these indexes



Database Recoveries Summary

- Most outages are used to create recovery points
 - ▶ May be eliminated with DRF
- Actual recoveries may be shortened with tools
 - ▶ DRF
 - ▶ HPCA
 - ▶ Index Builder



Summary



Maximizing Database Availability

ON DEMAND BUSINESS™

- Practices to minimize database outages

Best ← → **Not So Good**

