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IMS Version 7 Database Enhancements

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Abstract

IMS Version 7 introduces many enhancements to IMS. This presentation explains many new database capabilities. This session covers improved DBRC support for Image Copies and initial loads, Change Accumulation enhancements, Image Copy 2 improvements, advances in I/O error handling for DEDBs, enhancements in compression support for DEDBs and Open DB Access (ODBA).

High Availability Large Database (HALDB) and Online Recovery Service (ORS) are covered only in a high level overview because more thorough explanations of these functions are given in other presentations at this conference.

IMS Version 7

OPEN for BUSINESS

Availability

Performance
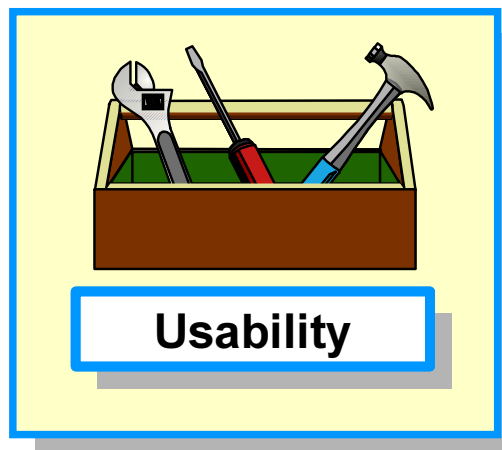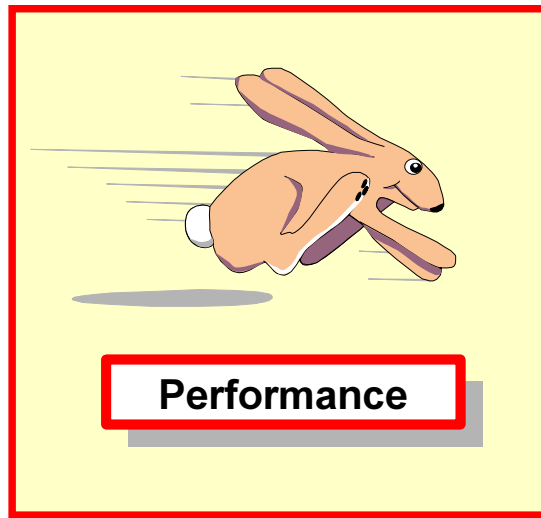
Usability

IMS Version 7

⚠ **Database Enhancements**

- ► High Availability Large DB (HALDB)

- ► Online Recovery Service (ORS)

- ■ Change Accum enhancements

- ■ Image Copy 2 compression

- ■ DBRC GENMAX and RECOVPD

- ■ DBRC support for database initial loads

- ■ I/O error handling for DEDBs

- ■ DEDB Scan segment expansion

- ■ ALTER support for OSAM and VSAM CF structures

- ► Open DB Access (ODBA)

HALDB (High Availability Large Database)

⚠ **Large Database**

- Databases are partitioned
  - ▸ Up to 1001 partitions per database
  - ▸ Partitions have up to 10 data set groups

Up to 10,010 data sets per database!

Greater than 40 terabytes

⚠ **High Availability Database**

- Partition independence
  - ▸ Allocation, authorization, reorganization, and recovery are by partition

- Self healing pointers
  - ▸ Reorganization of partition <u>does not require</u> changes to secondary indexes or logically related databases which point to it

⚠ **Compatibility**

- Full function applications do not have to be changed

Session E53

Online Recovery Service (ORS)

⚠ **Online recovery of databases**

- Logs are read once for all database data sets

- Parallel reads of inputs
  - ▸ Image copies, change accumulations, and logs

- Parallel writes of outputs
  - ▸ Databases recovered in parallel

- Change accumulation not required for data sharing

- Time stamp recovery to any time

Session E46

Change Accumulation Enhancements

⚠ **Data sharing limits merging of logs in IMS V6**

- Cannot merge incomplete log set
  - ▸ Merging requires /DBRs or termination of all IMS systems
  - ▸ "Spills" unmergable logs

⚠ **IMS V7 eliminates this restriction**

- Merges all records up to end of oldest log
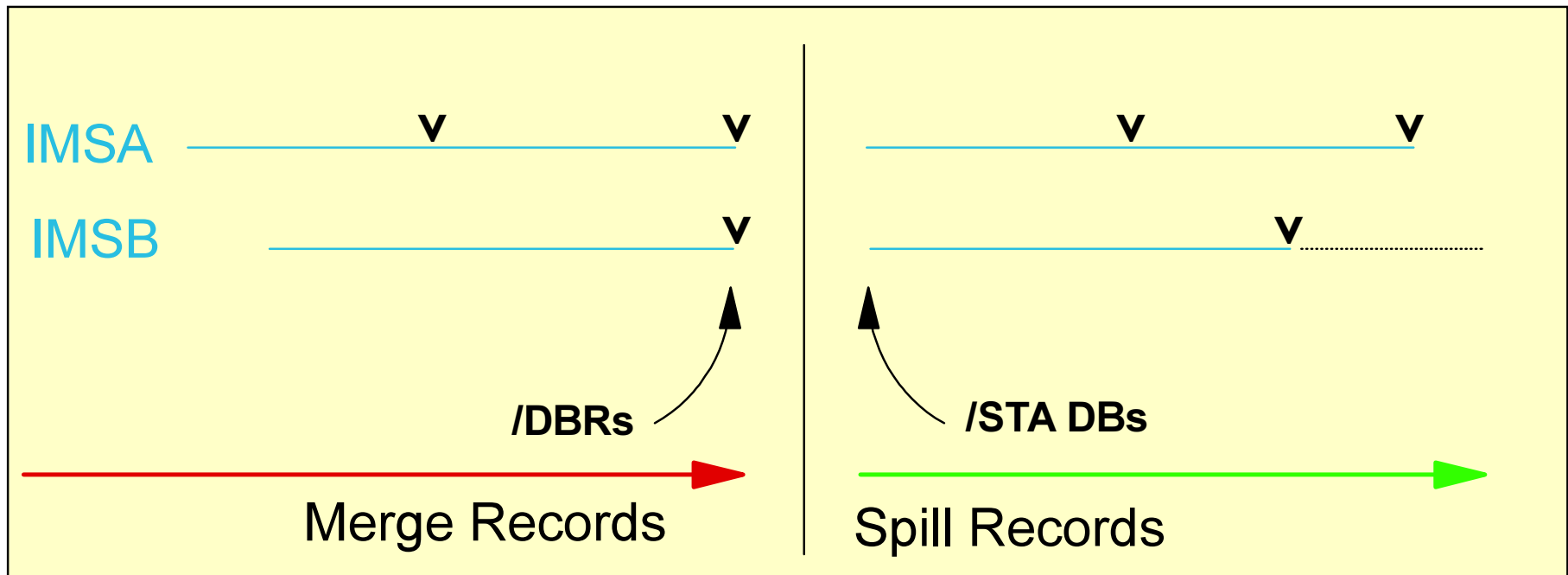- "Spills" only records with later time stamps

Usability

Availability

IMS V6 Change Accum Illustration

⚠ **/DBRs are used so that CA may merge records**

> Merge vs. spill decision based on DBRC ALLOC record times

IMSA

IMSB

/DBRs

/STA DBs

Merge Records

Spill Records

V: end of volume

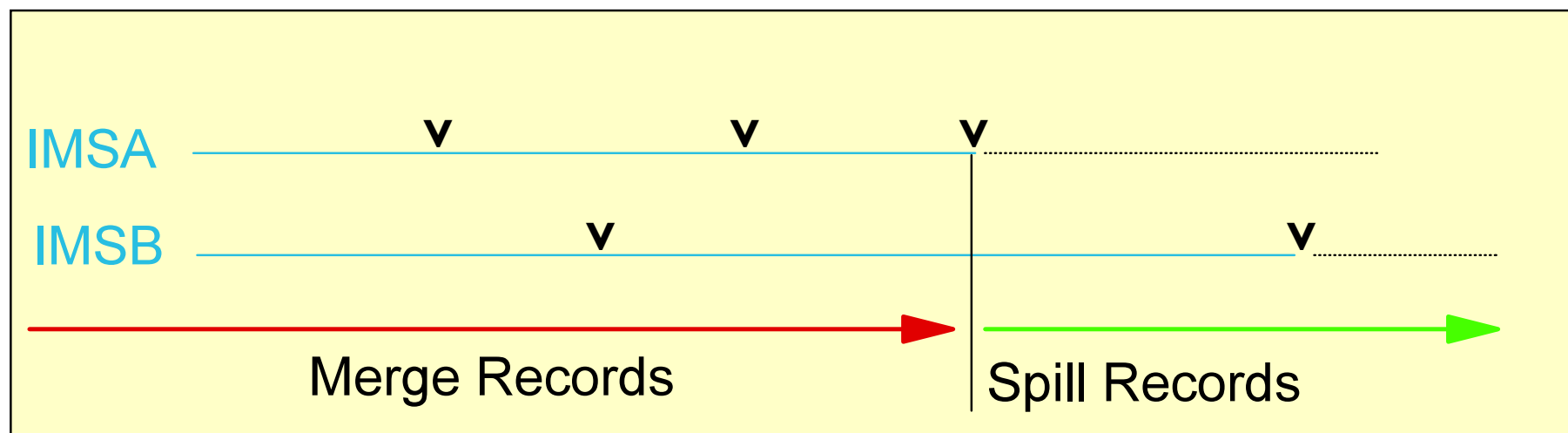——— : log is input to Change Accumulation

············· : log is not input to Change Accumulation

IMS V7 Change Accum Illustration

⚠ **/DBRs are not needed**

- Fewer spill records are created

Merge vs. spill decision based on earliest end time for each input log stream

IMSA

IMSB

Merge Records

Spill Records

V: end of volume

——— : log is input to Change Accumulation

·········· : log is not input to Change Accumulation

Change Accumulation Enhancements

⚠ **Sort efficiency automation**

- Automatically calculates sort key length

- Simplifies user interface

  ‣ User does not specify size

  ‣ Value in "ID" statement is ignored

- Avoids unnecessarily large sizes

  ‣ Large sizes have negative performance effect

Usability

Performance

Image Copy 2 Enhancement

⚠ **Compression may be used for Image Copy 2 copies**

- Invoked by control statement or GENJCL.IC keyword

- Invokes COMPRESS for DFSMSdss DUMP

- DFSMSdss RESTORE automatically expands data

  ▶ RESTORE is invoked by IMS Database Recovery and ORS

⚠ **Benefits**

Usability

- Smaller space requirements

DBRC GENMAX and RECOVPD Enhancement

⚠ **RECOVPD will not cause changes in GENMAX value**

- ■ RECOVPD and GENMAX will operate independently

  - ▶ GENMAX is max. number of ICs that DBRC tracks

  - ▶ DBRC keeps all ICs that are not older than RECOVPD

- ■ Previous releases increased GENMAX when RECOVPD required more ICs

- ■ IMS V7 will not increment GENMAX when RECOVPD requires more ICs

⚠ **Benefit**

Usability

- ■ Users will not have to manually reset GENMAX

GENMAX and RECOVPD Enhancement

⚠ **Example of GENMAX and RECOVPD interaction in previous releases:**

GENMAX=2 and RECOVPD=10 days
IC taken on each day in table:

Day	#ICs in RECONs	Age of oldest IC in RECONs
1	1	0
8	2	7
9	3*	8
15	3	7
22	3	13

* GENMAX increased to 3

GENMAX and RECOVPD Enhancement

⚠ **Example of GENMAX and RECOVPD interaction in IMS V7:**

GENMAX=2 and RECOVPD=10 days
IC taken on each day in table:

Day	#ICs in RECONs	Age of oldest IC in RECONs
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9	3	8
15	3	7
22	2	7

DBRC PROCOPT=L and LS Support

⚠ **DBRC support for initial loads**

- 'Image Copy Needed' flag set
  - ▸ Prevents updates which cannot be recovered

- REORG record written for each database data set
  - ▸ Prevents recovery using IC taken before initial load

⚠ **Benefits**

- Improved data integrity

- Elimination of user actions
  - ▸ CHANGE.DBDS ICON
  - ▸ NOTIFY.REORG

Usability

Availability

PROCOPT=L and LS Support

⚠ **PROCOPT=L|LS with previous releases:**

⚠ **RECON actions:**

- IC Needed not set

- REORG record not written

⚠ **Subsequent GENJCL.RECOV**

- Could fail due to lack of Image Copy
  - ‣ Database could not be recovered!

- Could use IC before "reload" and logs after "reload"
  - ‣ This could destroy database!

PROCOPT=L and LS Support

⚠ **PROCOPT=L|LS with IMS V7:**

⚠ **RECON IC Needed flag set:**

- IC must be taken before subsequent updates of the database

- Makes database recoverable

⚠ **RECON REORG record written:**

- Database recovery will not accept a combination of:
  - ▶ IC before the REORG record
  - ▶ Logs after the REORG record

- Prevents destruction of database

DEDB I/O Error Handling

⚠ **New way of handling write errors for DEDBs**

- Write error CIs kept in memory

- Write error CIs may be read from memory

- Area not stopped after write errors for 10 CIs

⚠ **Benefits**

- Increased CI availability

- Increased area availability

- Processing similar to full function

Availability

DEDB I/O Error Handling

⚞ **IMS V6 handling of write errors**

- ▪ Write EQE created in CI1 and kept in memory

- ▪ Data sharing partners notified

- ▪ CI is no longer available

  - ► Requests for CI result in 'AO' status code

- ▪ If more than 10 write errors for ADS

  - ► ADS is stopped

  - ► Area stopped if no remaining ADS

DEDB I/O Error Handling

⚠ **IMS V7 uses processes similar to full function**

⚠ **Write error causes creation of EEQE and creation of I/O Toleration (IOT) buffer in memory**

- CI stored in IOT buffer for subsequent reads and writes

- CI written to log at system checkpoint

  ► Buffer restored on subsequent restarts of IMS system

- EEQE written in RECONs

- EEQE notification sent to data sharing systems

SDEP SCAN Expansion of Compressed Data

⚠ **SDEPs may be compressed with segment edit/compression exit**

- Previous releases did not include SCAN utility support for segment edit/compression exit

- Users could expand during scan process by using Scan exit routine

  ▶ Different exit routine or different coding required for each compression routine

⚠ **IMS V7 eliminates need for Scan exit for expansion**

- Scan utility option to invoke exit

  ▶ Users may continue to use old techniques for compatibility

Usability

Parallel Sysplex Data Sharing Enhancement

⚠ **ALTER support for OSAM and VSAM structures**

- Structure size may be changed while in use

- OS/390 V2R10 allows AUTOALTER support
  - ► When structure reaches user defined threshold
    - System dynamically adjusts structure's data element to directory entry ratio or
    - System dynamically adjusts size of structure

- Available in IMS V6 via PQ38946

Availability

Usability

Open Database Access (ODBA)

△ **Available in IMS V6 with PQ15784**

△ **Callable interface to IMS DBCTL or IMS TM/DB**

- Similar to CICS connection to DBCTL (DRA)
- Caller is in MVS address space outside of IMS TM or CICS
  - ► Such as DB2 Stored Procedure

△ **Caller connects to IMS, schedules PSB, issues DL/I calls, commits work, ...**

- Uses AIB interface
- Supports two-phase commits
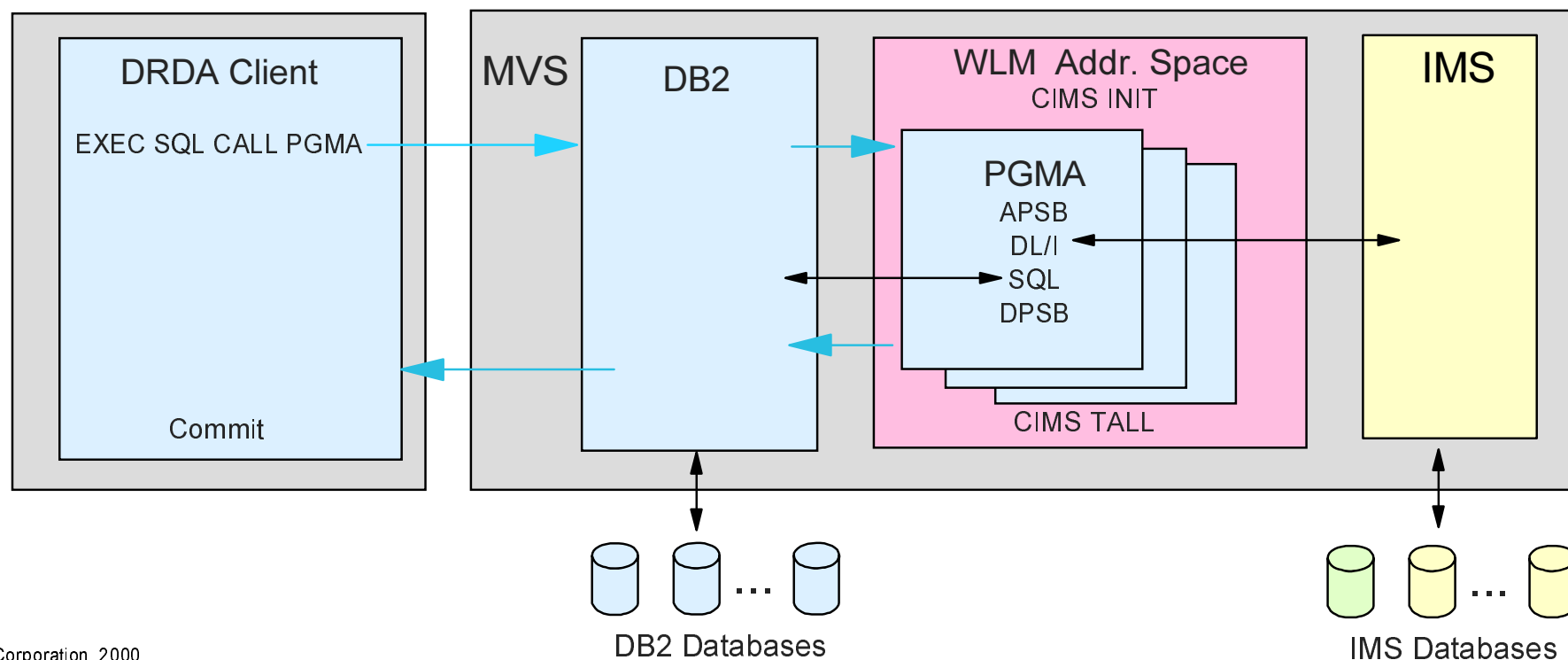
Usability

△ **Prerequisites**

- OS/390 Release 3 or later
- Resource Recovery Services (RRS/MVS)

Session E67

ODBA DB2 Stored Procedure Example

▲ **DB2 stored procedure example**

- DRDA Client issues SQL for stored procedure

- DB2 invokes stored procedure

- Stored procedure does SQL and DL/I calls

- Client program does commit when stored procedure returns

Improved Database Availability

⚠ **Shorter database outages**

- HALDB shortens the reorganization window
  - ▶ Parallel reorgs of partitions
  - ▶ Database Scan, Prefix Resolution, Prefix Update, HISAM Unload, and HISAM Reload are not used with logical relationships and secondary indexes

⚠ **Fewer database outages**

- /DBRs not required to make Change Accum efficient
  - ▶ Merge vs. spill decision changed by IMS V7

- /DBRs not required to create recovery points
  - ▶ ORS can do point-in-time recovery to any time

- DEDB write errors tolerated
  - ▶ Recovery may be delayed until convenient

DBA Impacts of IMS V7

⚠ **CA enhancements and ORS affect:**

- /DBR schedules

- Change Accumulation schedules

- Image Copy frequencies
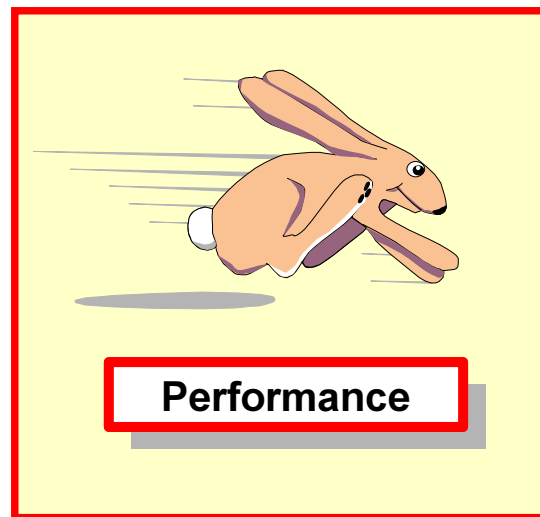
⚠ **HALDB affects:**

- Database maintenance windows

- Free space allocations

- Reorganization frequencies

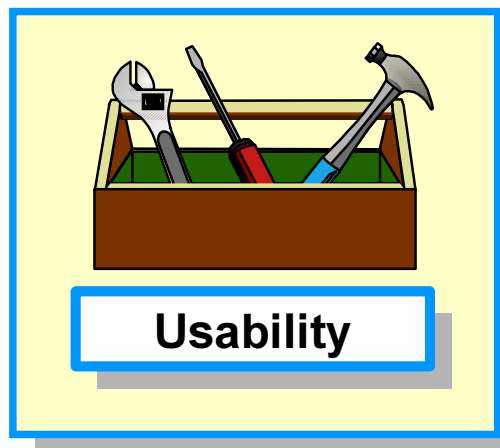**It will be advantageous to change your "rules of thumb"**

IMS Version 7

The world depends on it

Availability

Performance

- HALDB
- ORS
- DBRC
- Change Accum
- ...

- HALDB
- ORS
- DBRC
- Change Accum
- IC2
- DEDB I/O error handling
- ...

Usability

- HALDB
- ORS
- ODBA
- DBRC
- Change Accum
- ...