

IMS and DB2 Coordinated Disaster Recovery

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IBM Advanced Technical Skills (ATS)

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IBM Disaster Recovery Solutions

- IMS *Recovery* Solutions
 - IMS databases are recovered using image copies and/or logs
 - IMS Full Database recovery or IMS Timestamp recovery
- IMS *Restart* Solutions
 - IMS system and databases are mirrored to remote site
 - IMS Recovery Expert product: System Level Backup
 - GDPS and Storage Mirroring
- IMS *Restart & Recovery* Solution
 - IMS system and databases are mirrored to remote site
 - Additional transmitted data allows for forward recovery
- *Coordinated* IMS and DB2 *Restart & Recovery* Solution
 - Approach 1: SLB contains both IMS and DB2 volumes
 - Approach 2: Separate SLBs for IMS and DB2 and PITR log recovery

IMS and DB2 Disaster Recovery Tutorials



- IBM developerWorks
 - www.ibm.com/developerworks
 - External IBM website with articles, tutorials and demonstrations
- IMS Disaster Recovery Tutorials
 - Four parts:
 - Part 1: Overview of all solutions
 - Part 2: IMS Base and IMS Tool solutions
 - Part 3: IMS Recovery Expert Disaster and Local Recovery
 - Part 4: Coordinated IMS and DB2 Disaster Recovery
 - Downloadable demonstration file
 - Demos are installed on hard disk and viewed with internet browser

IMS and DB2 Disaster Recovery Tutorials

- developerWorks URL for Tutorials
 - http://www.ibm.com/developerworks/views/data/libraryview.jsp?search_by=IMS+disaster+recovery+solutions

Title	Type	Date
Exploring IMS disaster recovery solutions. Part 1: Overview Every customer needs a Disaster Recovery (DR) plan. The strategies used differ from one customer to another and they differ in time to recovery and loss of data. For IMS, there are five types of disaster recovery solutions: restart, recovery, recovery and restart, coordinated IMS and DB2 restart, and coordinated IMS and DB2 disaster recovery and restart. While the Storage Mirroring recovery solutions are classified as restart solutions, we will focus only on the non-Storage Mirroring IMS disaster recovery solutions in this series.	Articles	29 Mar 2012
Exploring IMS disaster recovery solutions. Part 2: IMS Base and IMS Tools recovery solutions Every customer needs a Disaster Recovery (DR) plan. The strategies used differ from one customer to another and they differ in time to recovery and loss of data. For IMS, there are five types of DR solutions: restart, recovery, recovery and restart, coordinated IMS and DB2 restart, and coordinated IMS and DB2 disaster recovery and restart. Here in Part 2, we explore the recovery solutions that use only the IMS base functions and some of the functions in the IMS Tools.	Tutorial	12 Apr 2012
Exploring IMS disaster recovery solutions. Part 4: Coordinated IMS and DB2 solutions Every customer needs a disaster recovery (DR) plan. The strategy will differ from one customer to the next. For IMS, there are two types of DR solutions: 1) IMS specific, and 2) Storage Mirroring. In this tutorial, we explore the IMS specific DR solutions. There are solutions that use only the IMS base product and solutions that use the IBM IMS Tools products. For each DR solution, there will be a discussion of the key concepts related to that solution.	Tutorial	03 May 2012
Exploring IMS disaster recovery solutions. Part 3: IMS Recovery Expert solutions Every customer needs a Disaster Recovery (DR) plan. The strategies used differ from one customer to another and they differ in time to recovery and loss of data. For IMS, there are five types of DR solutions: restart, recovery, recovery and restart, coordinated IMS and DB2 restart, and coordinated IMS and DB2 disaster recovery and restart. Here in Part 3, we explore both the recovery and recovery and restart solutions provided by the IMS Recovery Expert product.	Tutorial	19 Apr 2012
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RTO vs. RPO

- Recovery Time Objective (RTO)
 - Time allowed to recover the applications
 - All critical operations are up and running again
 - Considerations include:
 - Recovery of databases and network
- Recovery Point Objective (RPO)
 - Amount of data lost in the disaster
 - Last point-in-time when all data was consistent
 - Considerations include:
 - Frequency of creating recovery points
 - Frequency of transfer of data to remote site

Recovery vs. Restart: Comparison

- *Coordinated* IMS and DB2 *DR* Solutions
 - RTO is low based on:
 - Performance of Storage-Based Fast Replication
 - Volumes are restored from the SLB at the remote site
 - Databases are recovered in parallel in one pass of logs
 - RPO is medium based on:
 - Frequency of SLB creation and Log transmission
 - Method of data transmission (ex. Virtual Tape)
 - Operational complexity is low
 - Automation provided by IBM Tools

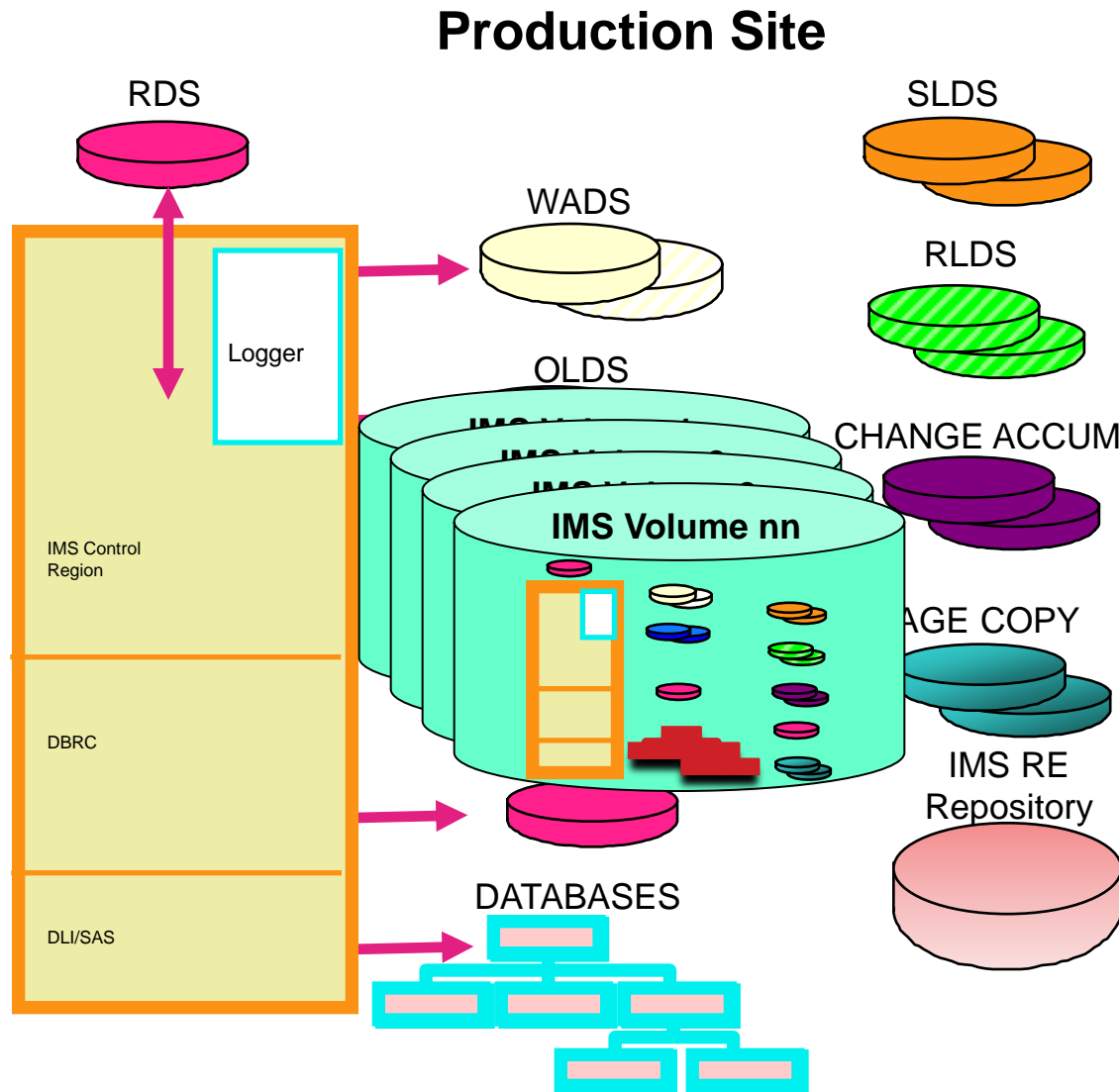
Coordinated IMS and DB2 DR Solutions



- *Coordinated* IMS and DB2 *Restart* Solution
 - Combined SLB created from IMS and DB2 volumes
 - Separate analysis is performed on IMS and DB2
 - Volumes combined under one Recovery Expert product
 - At Primary site, one SLB is created
 - One Flashcopy for all volumes (IMS & DB2)
 - At Remote site, after SLB is restored
 - IMS and DB2 are restarted individually
 - Restart with Dynamic Backout and Undo/Redo processing occur

Coordinated DR - IMS Recovery Expert

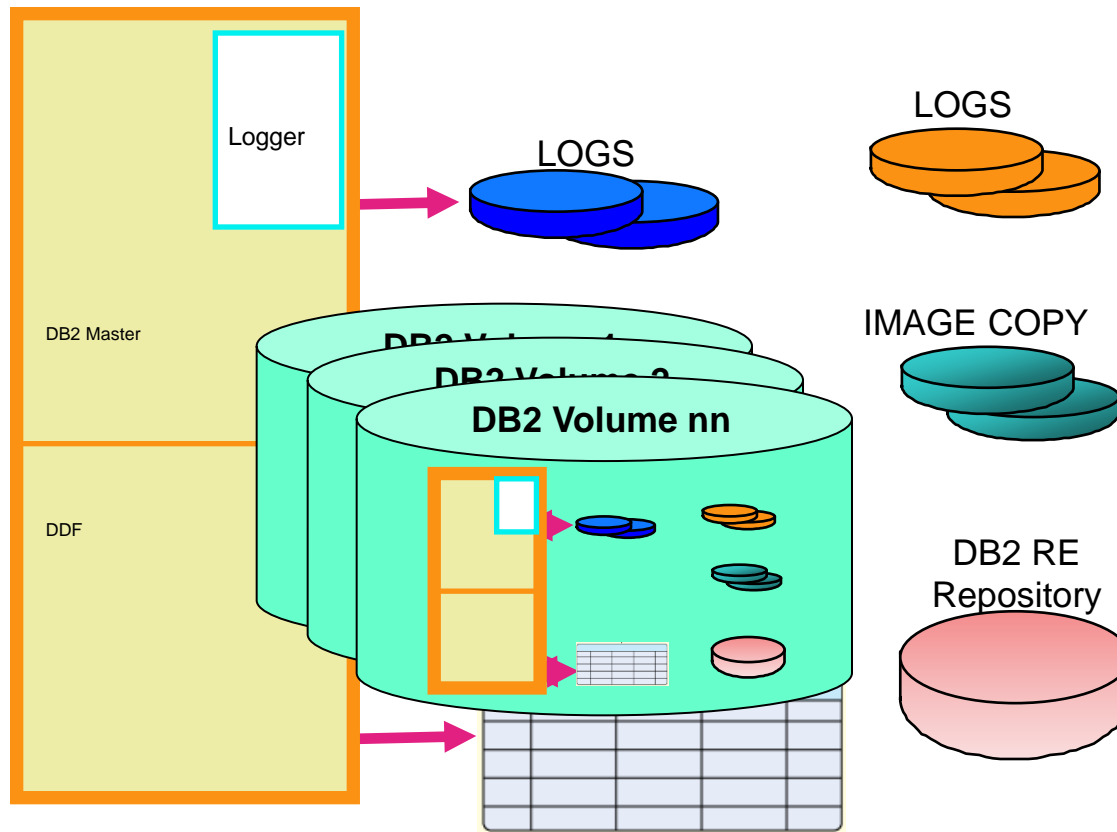
IMS System Analysis



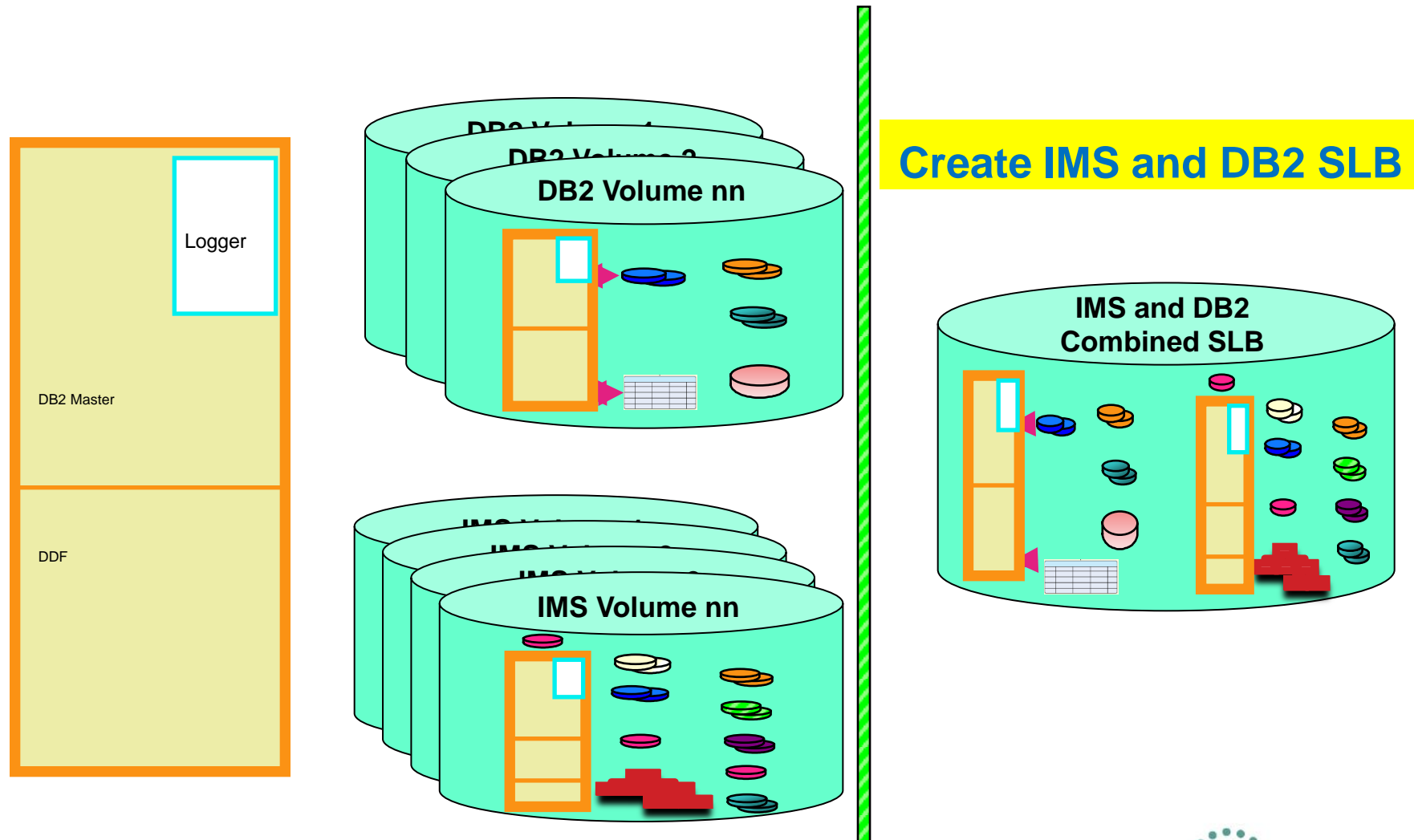
Coordinated DR - DB2 Recovery Expert

Production Site

DB2 System Analysis



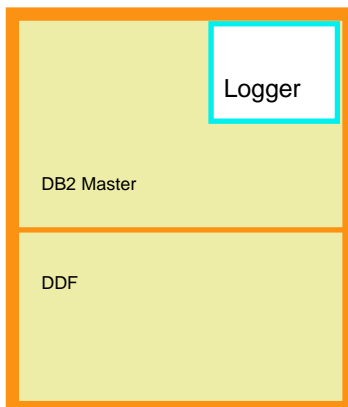
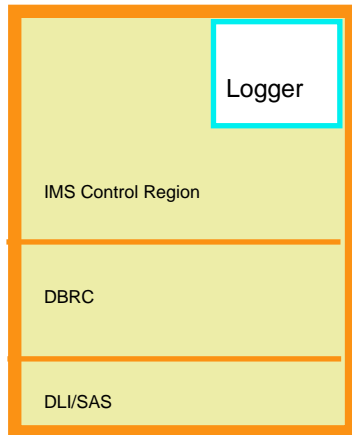
Coordinated DR - DB2 RE or IMS RE



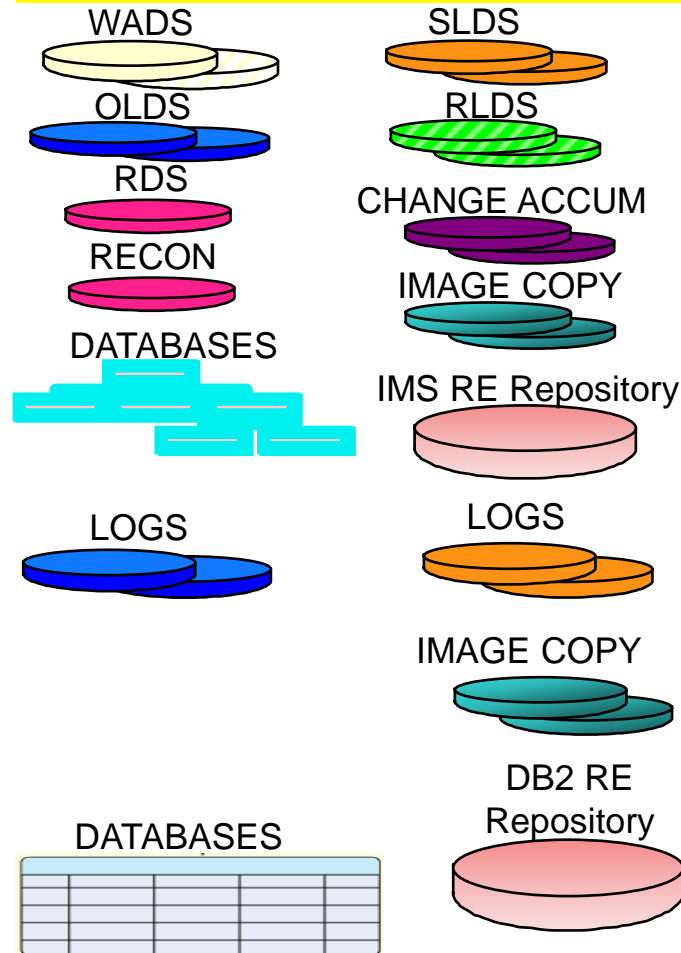
Coordinated DR - IMS and DB2 Restart

Remote Site

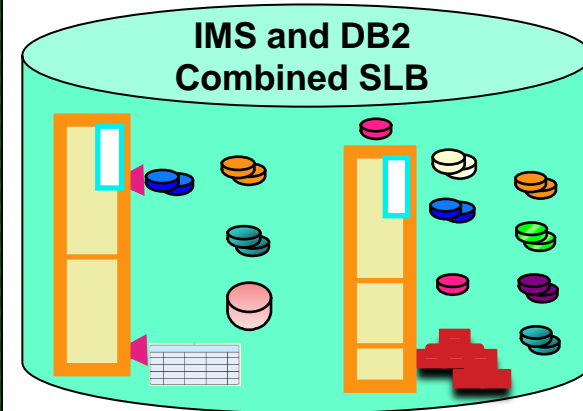
Restart IMS/DB2



Restore SLB for IMS/DB2



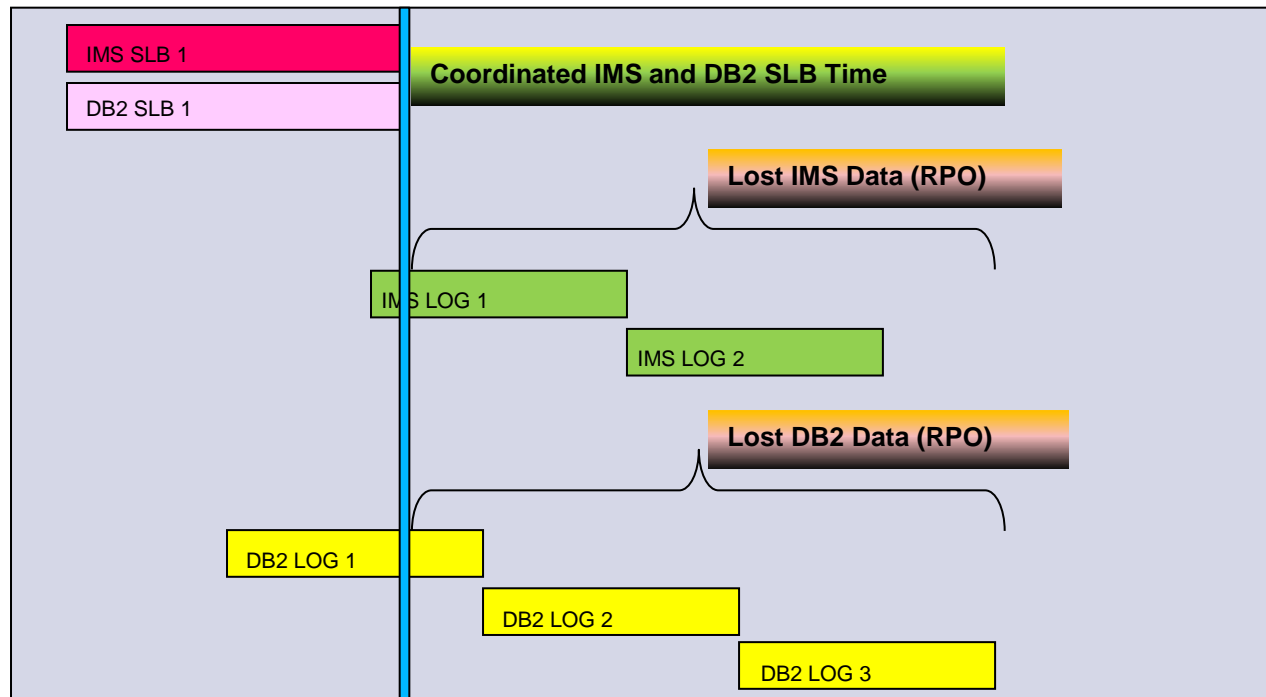
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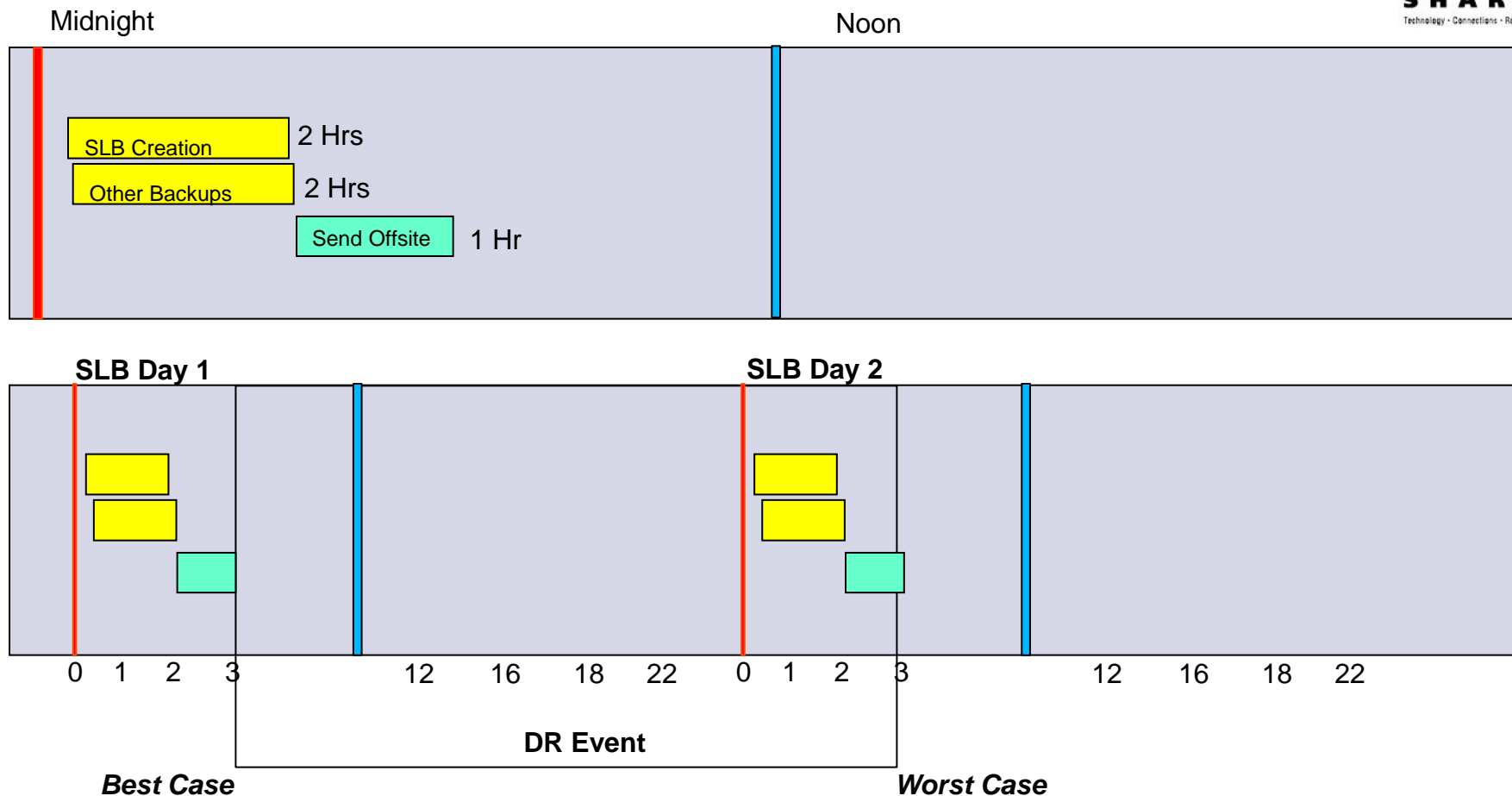
Coordinated IMS and DB2 DR: Combined SLB



- Coordinated Recovery Point (RP)
 - RPO = Changes Past the Last SLB
 - RTO = Time to restore the Combined SLB and restart IMS and DB2

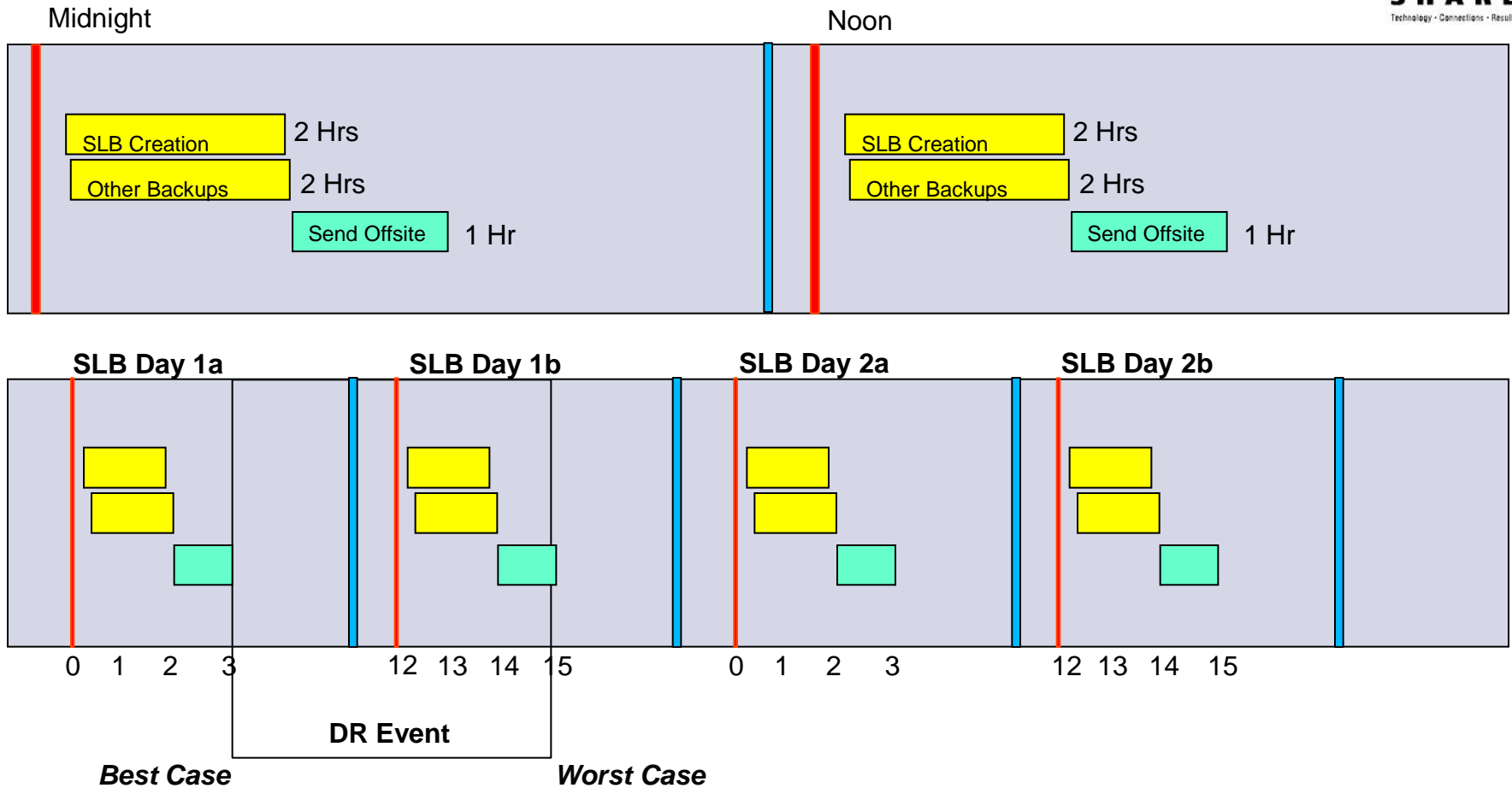


Defining RPO (SLBs Created Once/Day)



DR Event	RPO Best Case	RPO Worst Case
DR Event	SLB Day 1 = SLB + 3 Hrs	SLB Day 2 = SLB + 27 Hrs

Defining RPO (SLBs Created Twice/Day)



DR Event	RPO Best Case	RPO Worst Case
DR Event	SLB 1a = SLB + 3 Hrs	SLB 1b = SLB + 15 Hrs

Defining RTO



Recovery at Remote Site	RTO Time
DR Event	6 Hours

Coordinated IMS and DB2 DR Solutions



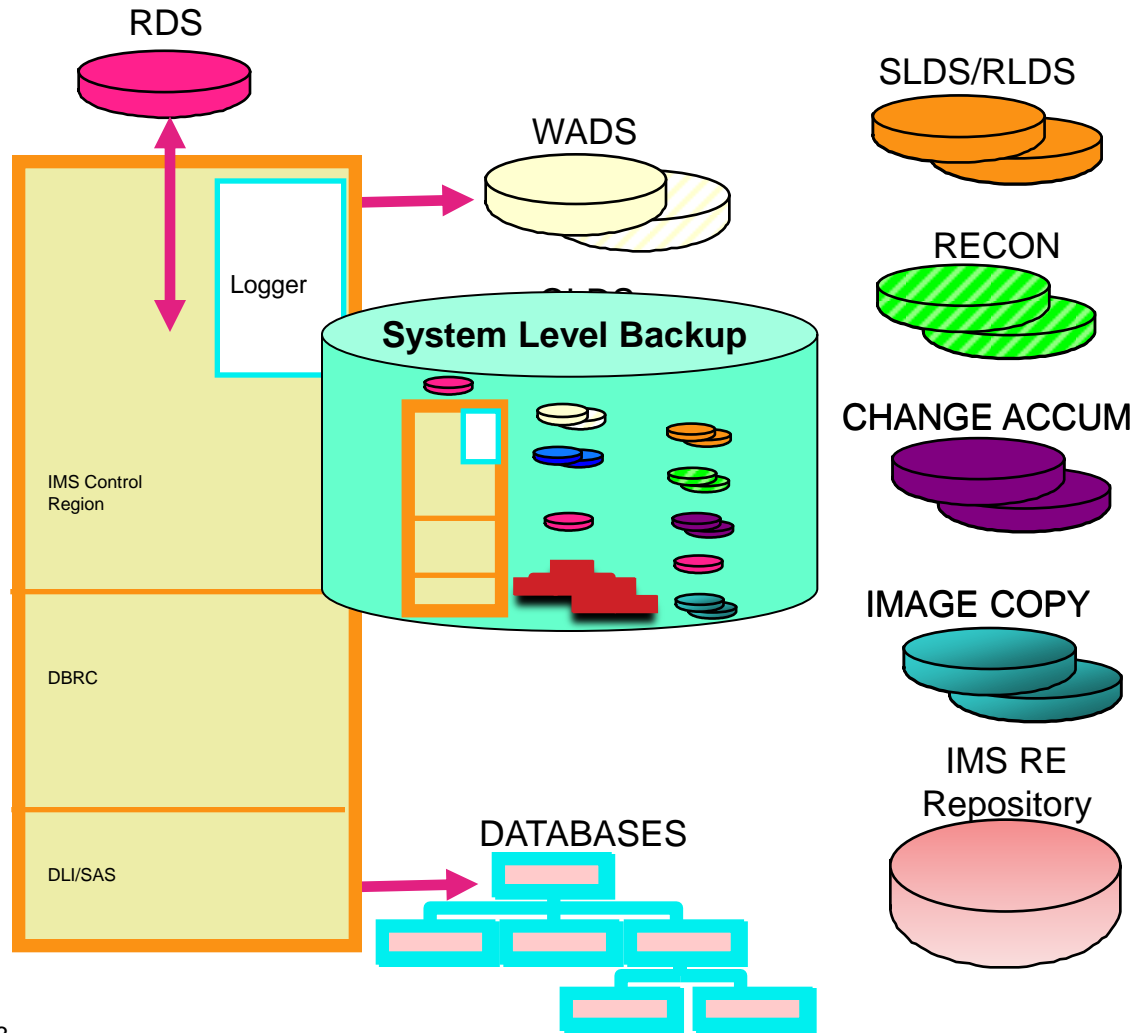
- Benefits from *Coordinated* IMS & DB2 *Restart* Solution
 - Native FlashCopy performs better than DFSMSdss
 - Shorter IMS and DB2 unavailability time
 - Validation during SLB creation
 - Identifies and maps missing volumes
 - Offloading features
 - Encryption
 - Compression
 - Volume stacking on tapes to reduce number of tapes
 - Parallel offloading of volumes to tape
 - Repeatable process

Coordinated IMS and DB2 DR Solutions

- *Coordinated* IMS and DB2 *Recovery & Restart* Solution
 - Separate SLBs created for IMS and DB2 volumes
 - Separate analysis is performed on IMS and DB2
 - At Primary site:
 - Separate SLB is created for IMS and for DB2
 - Two Flashcopies for each set of volumes (IMS & DB2)
 - Archived logs are transmitted to remote site
 - Log Timestamps are recorded in DR PDS
 - At Remote site:
 - IMS and DB2 SLBs are restored
 - Point In Time Recovery using timestamp in IMS and DB2 DR PDS
 - Earlier of two timestamps in IMS and DB2 DR PDS
 - Start IMS and DB2 (No Backouts/Undos needed during restart)

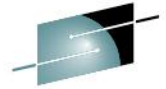
IMS Recovery Expert

Production Site



Remote Site

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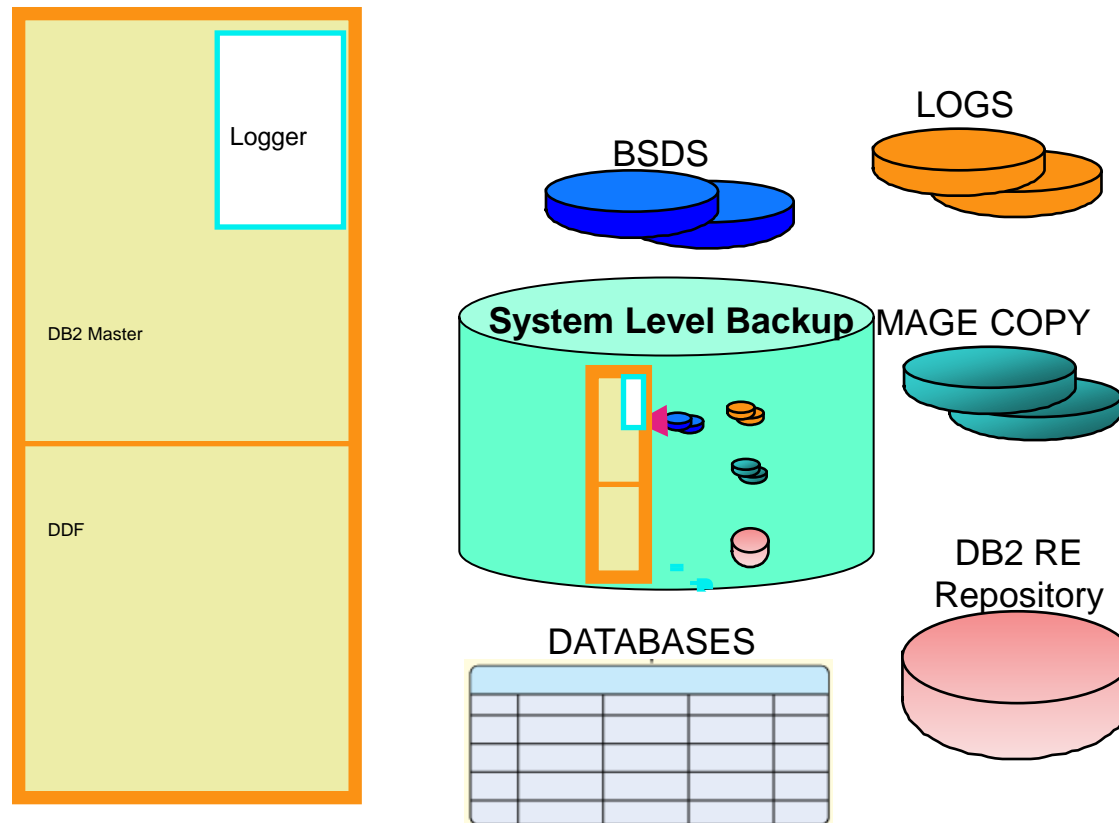


SHARE
Recovery • Connections • Results

DB2 Recovery Expert

Production Site

Remote Site

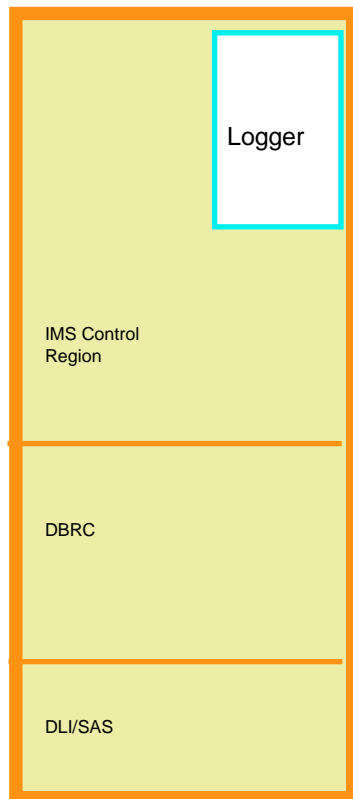


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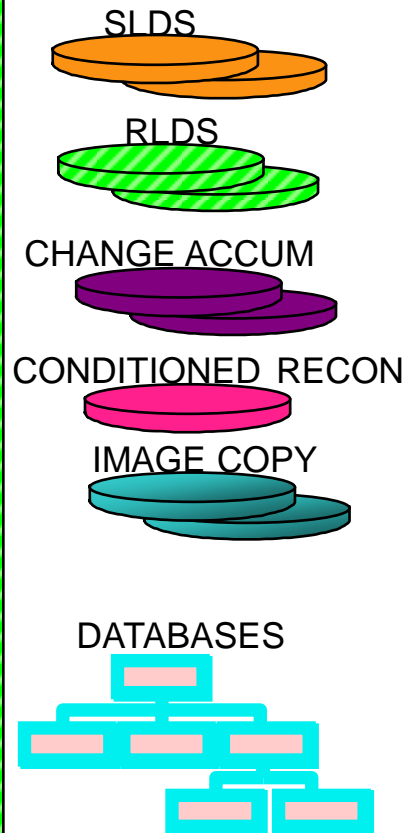
IMS Recovery Expert

Remote Site

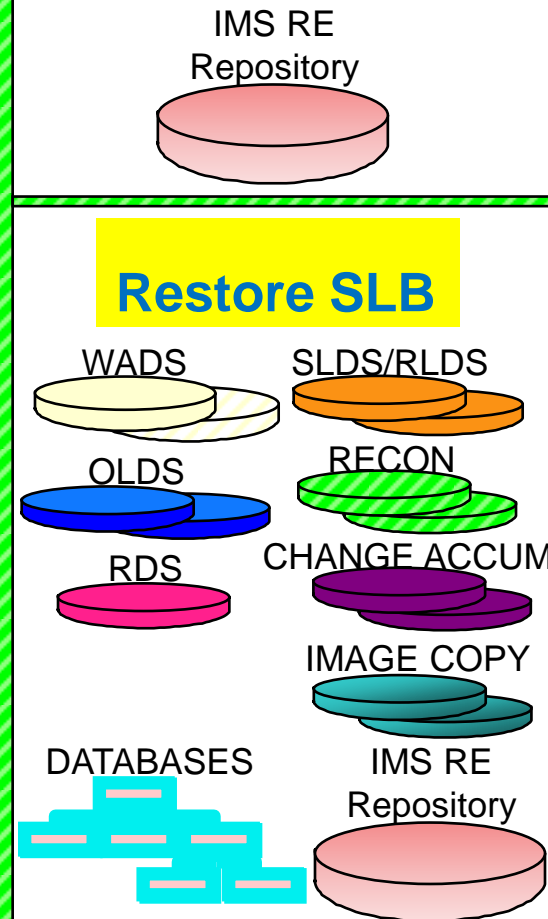
Start IMS



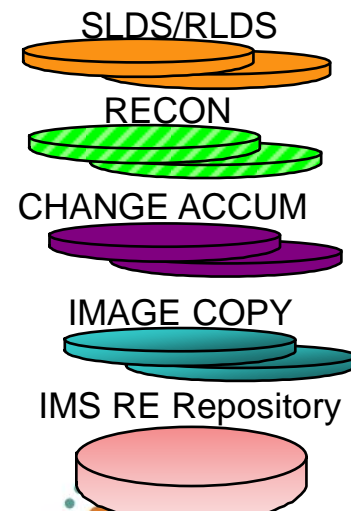
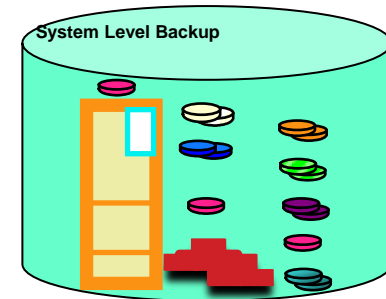
Recover DB



Find Coord RP



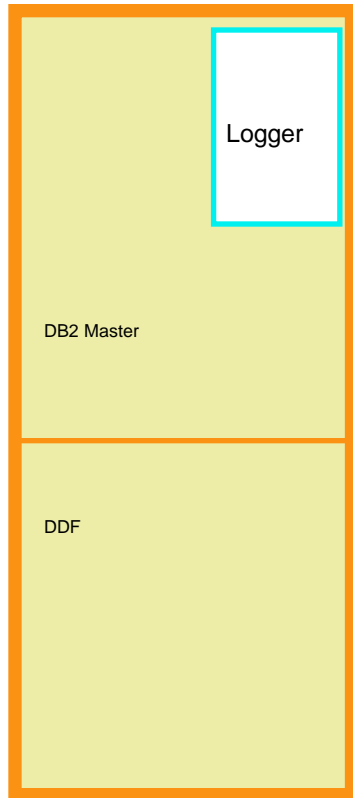
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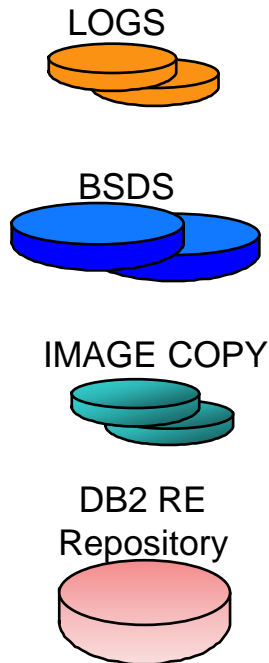
DB2 Recovery Expert

Remote Site

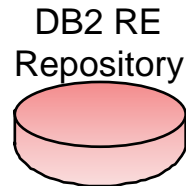
Start DB2



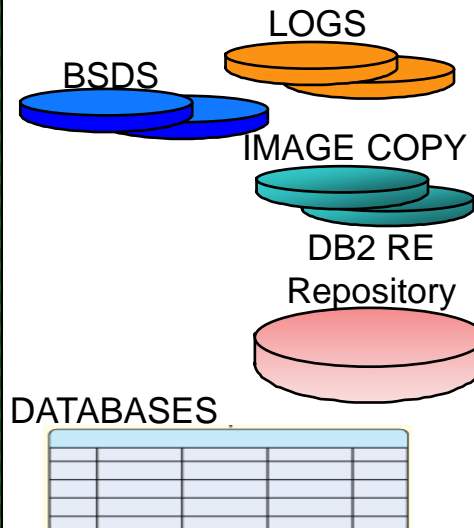
Recover DB



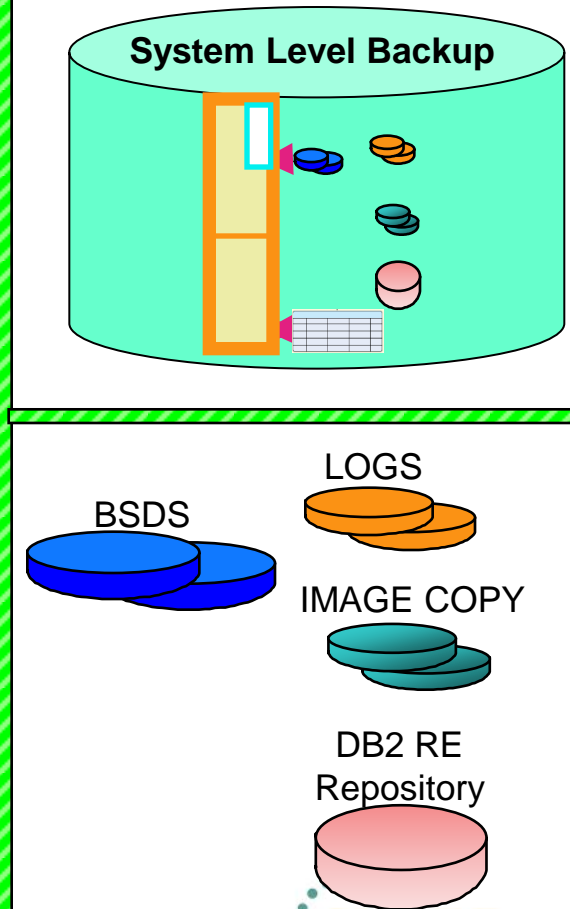
Find Coord RP



Restore SLB

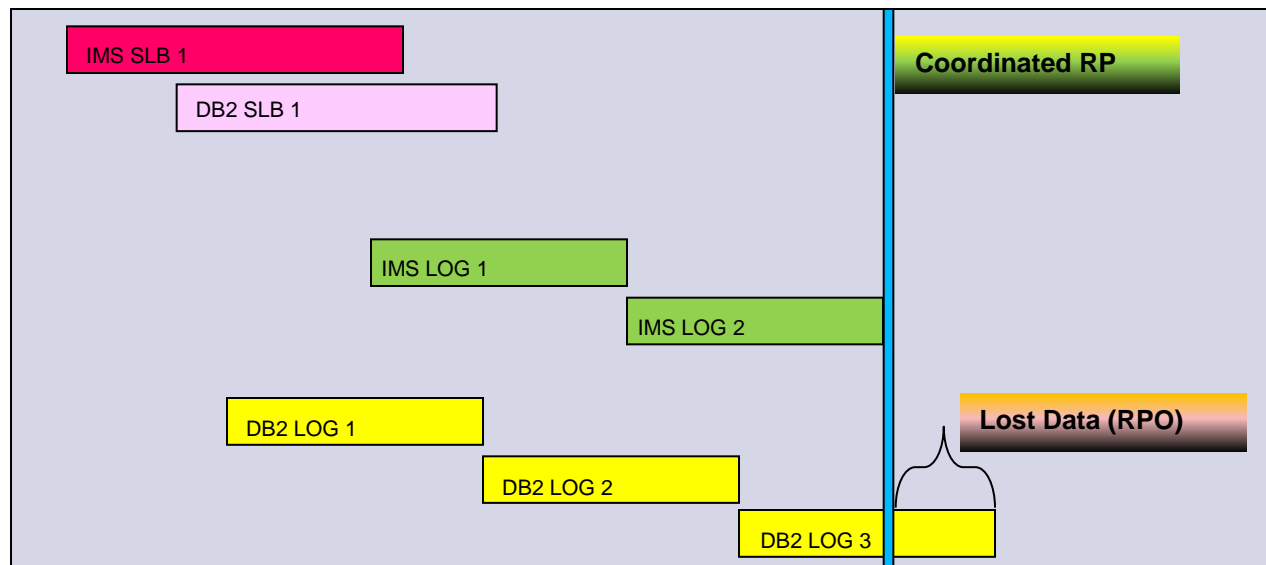


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Coordinated IMS and DB2 DR: Separate SLB

- Coordinated Recovery Point (RP)
 - RPO = Changes Past the Coordinated RP
 - Requires application and business-cycle analysis
 - Determine how all data is interconnected
 - RTO = Time to restore SLBs, recover DBs with logs, restart IMS & DB2



Coordinated IMS and DB2 DR Solutions

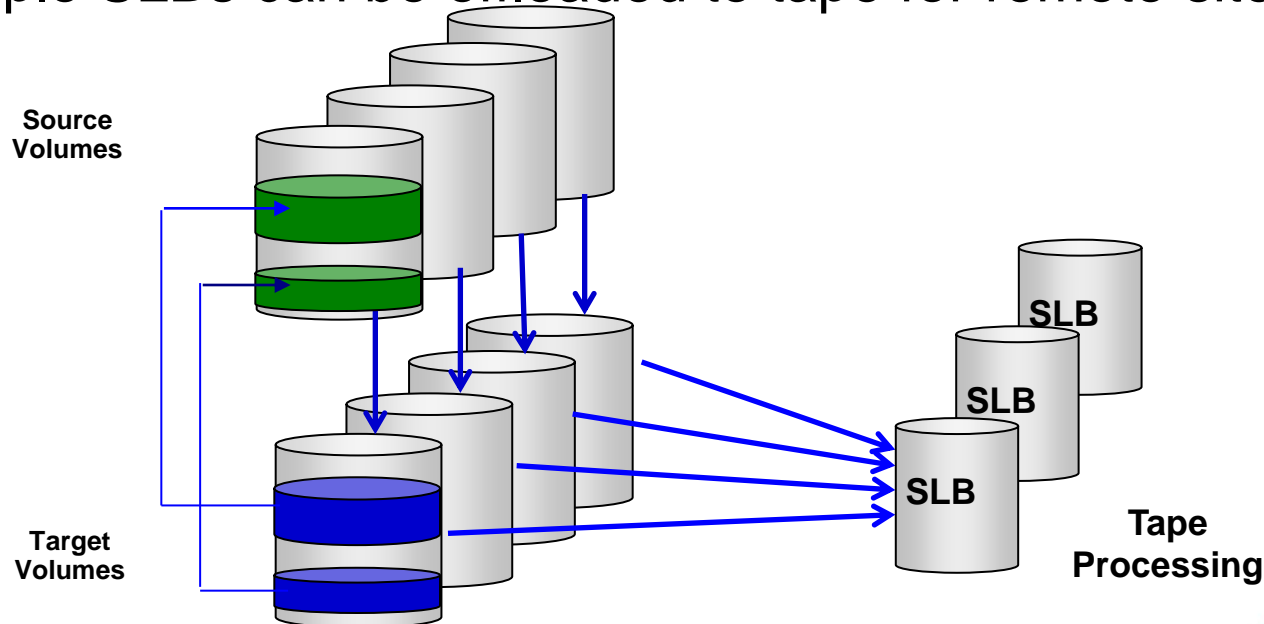
- Benefits *Coord* IMS & DB2 *Restart/Recovery* Solution
 - Same benefits as Restart solution
 - Native FlashCopy performs better than DFSMSdss
 - Validation during SLB creation
 - Offloading features
 - Repeatable process
 - Less data loss (RPO)
 - Log recovery to consistent point between IMS and DB2
 - Coordinated point in time determined by IBM Tools

IMS and DB2 Recovery Expert: SLB

- IMS and DB2 Recovery Expert features:
 - Environment discovery and configuration management
 - IMS System Level Backup includes:
 - Active and archive logs
 - RECONs
 - All IMS database data sets
 - IMS system data sets (ex. ACBLIBs, DBDLIBs, PGMLIBs, etc.)
 - All associated ICF User catalogs
 - DB2 System Level Backup includes:
 - Active and archive logs
 - Bootstrap Data Set
 - All DB2 database data sets
 - DB2 system data sets (ex. Loadlib)
 - All associated ICF User catalogs
 - IMS and DB2 volumes need to be separate from each other

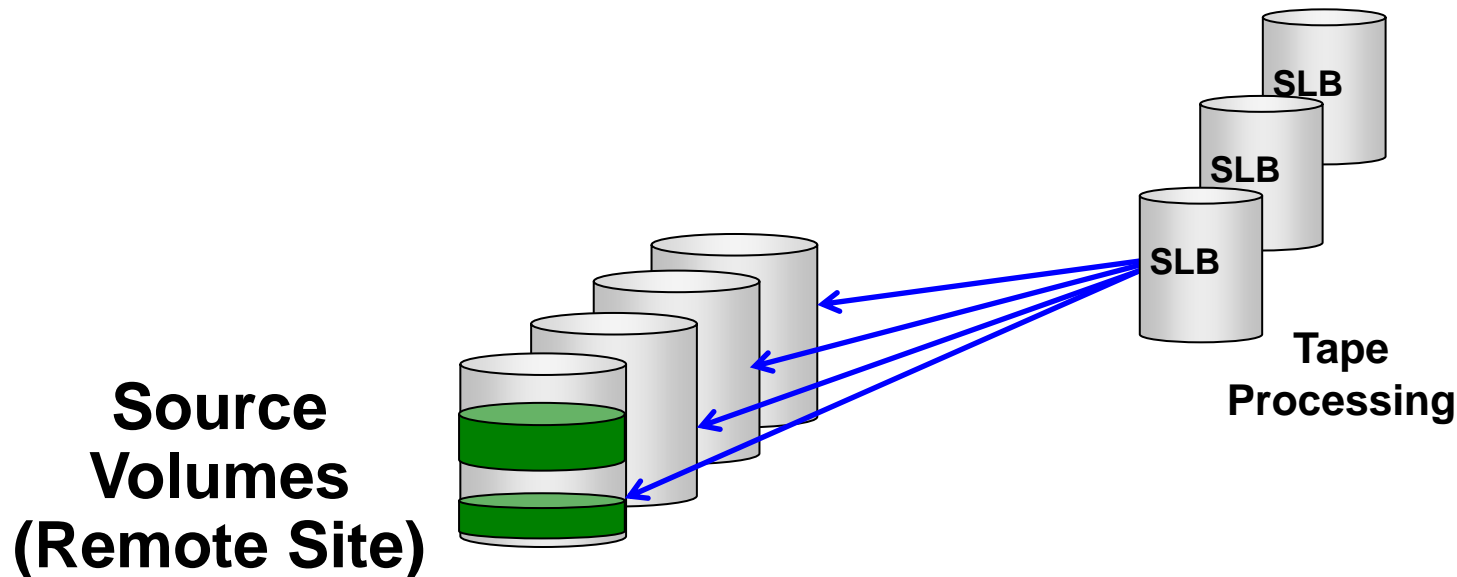
IMS and DB2 Recovery Expert: SLB

- System Level Backup (SLB)
 - Backs up entire DBMS production environment
 - Records SLB in IMS Recovery Expert Repository
 - Leverages Storage-Based Volume Fast Replication
 - Uses FlashCopy for a Consistency Group
 - Data is dependent-write consistent
 - Multiple SLBs can be offloaded to tape for remote site



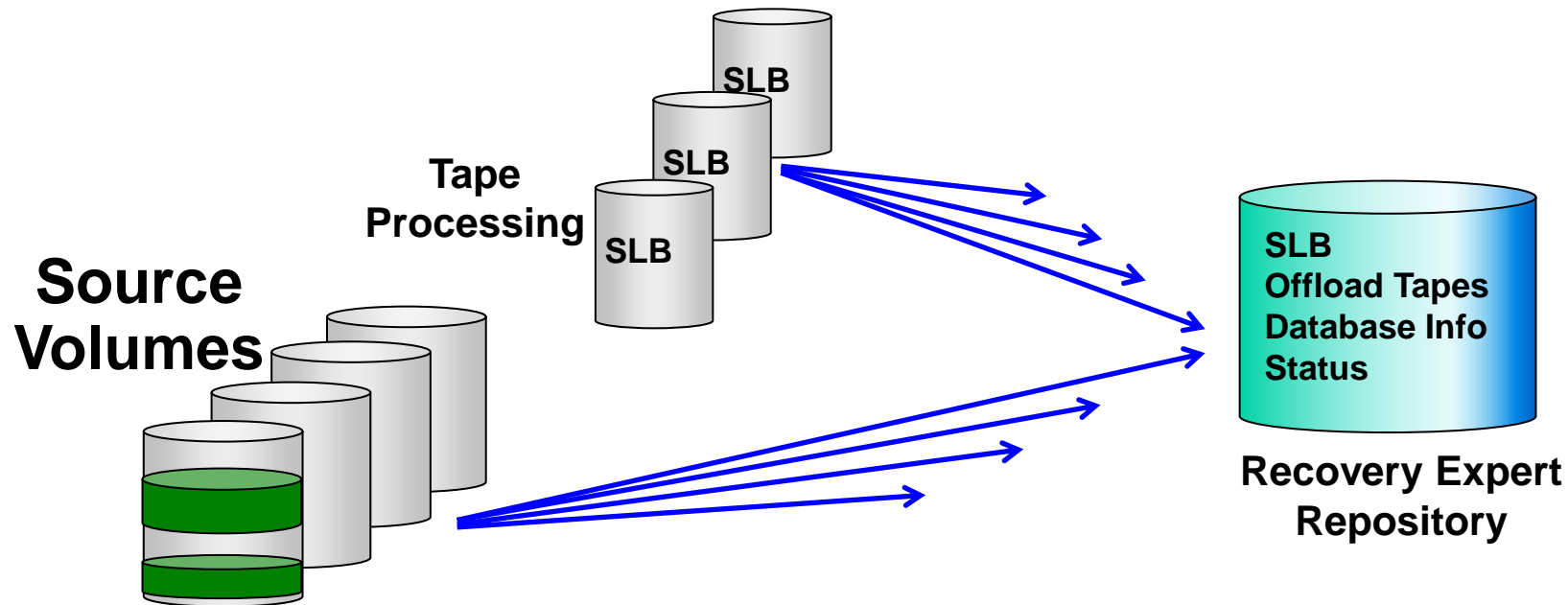
IMS and DB2 Recovery Expert: SLB Restore

- Restoring the SLB
 - System Level Backup is restored from disk or tape
 - Coordinated parallel restore operations
 - Restore is based on offload characteristics



IMS and DB2 Recovery Expert: Repository

- IMS Recovery Expert and DB2 Recovery Expert have own Repository
 - Store information on SLBs created
 - Track database characteristics and status
 - HALDB, FP EEQEs, Recovery Needed Status, Tablespaces, etc.
 - SLB and Offloading Tape information
 - Needed at remote site for restart and recovery

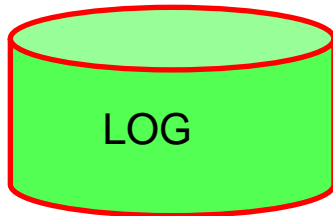


Storage-Based Consistency: Key to Coord SLB

- DBMS System
 - Provides dependent writes for database updates
- Storage-Based Flashcopy for Consistency Group
 - Provides consistency for set of volumes
- Coordinated Disaster Recovery
 - Requires DBMS to order the log and database updates
 - Requires Storage processors to ensure volume consistency

IMS Dependent Writes

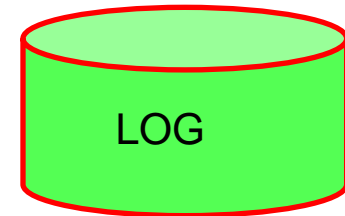
Full Function Commit and Backout Process



(1) Log "Before and After Image"
(Segment, Pointers, Freespace)



(2) Update Database

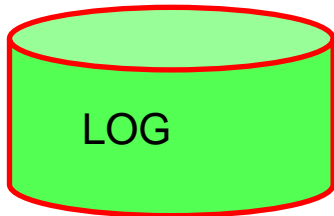


(3) Log "Commit"

Updates Completed	Dynamic Backout Required
Log (1)	Use "Before Image" from Log (1)
Log (1) + DB (2)	Use "Before Image" from Log (1)
Log (1) + DB (2) + Log (3)	No Backout, Update Committed

IMS Dependent Writes

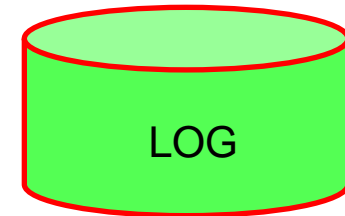
Fast Path Commit and REDO Process



(1) Log "After Image"
(2) Log "Commit"



(3) Update Database using
output thread processing

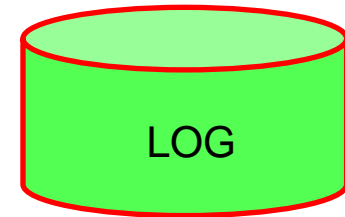
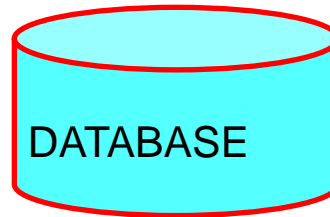
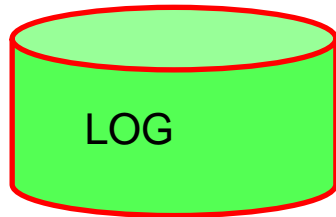


(4) Log "Output Thread Completed"

Updates Completed	Fast Path REDO Required
Log (1)	No REDO, Update not Committed
Log (1) + Log (2)	Use "After Image" to COMMIT (REDO)
Log (1) + Log (2) + DB (3)	Use "After Image" to COMMIT (REDO)
Log (1) + Log (2) + DB (3) + Log (4)	No REDO, Update was Committed

DB2 Dependent Writes

DB2 Commit and UNDO/REDO Process



(1) Log "Change Information"
(2) Log "Commit" or "Abort"

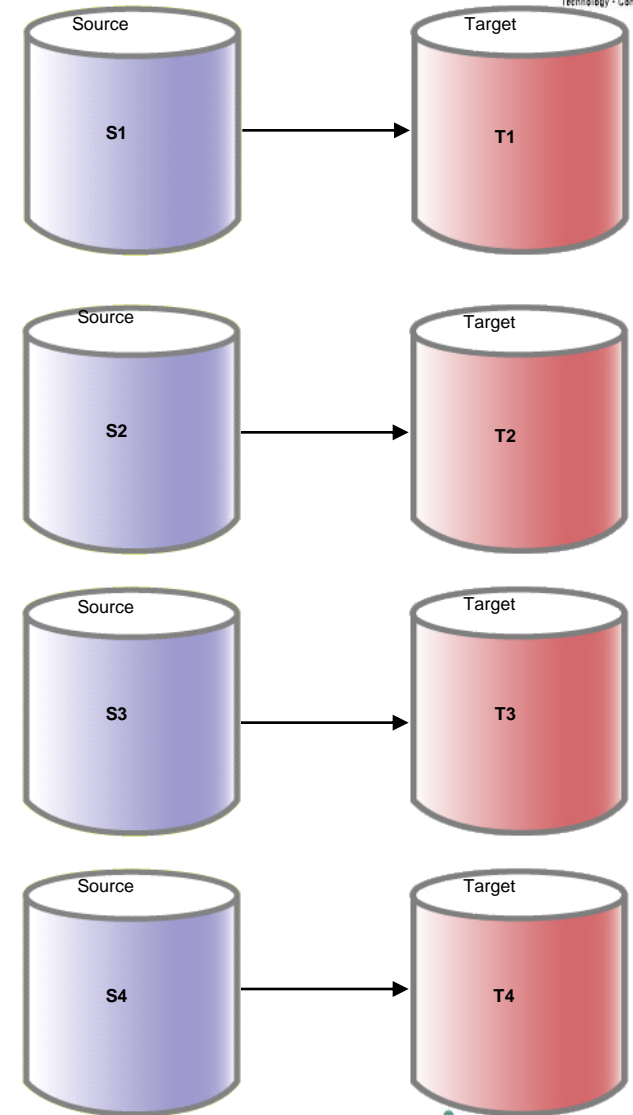
(3) Update Buffer Pool
or Database

(4) Log "Commit Completed"

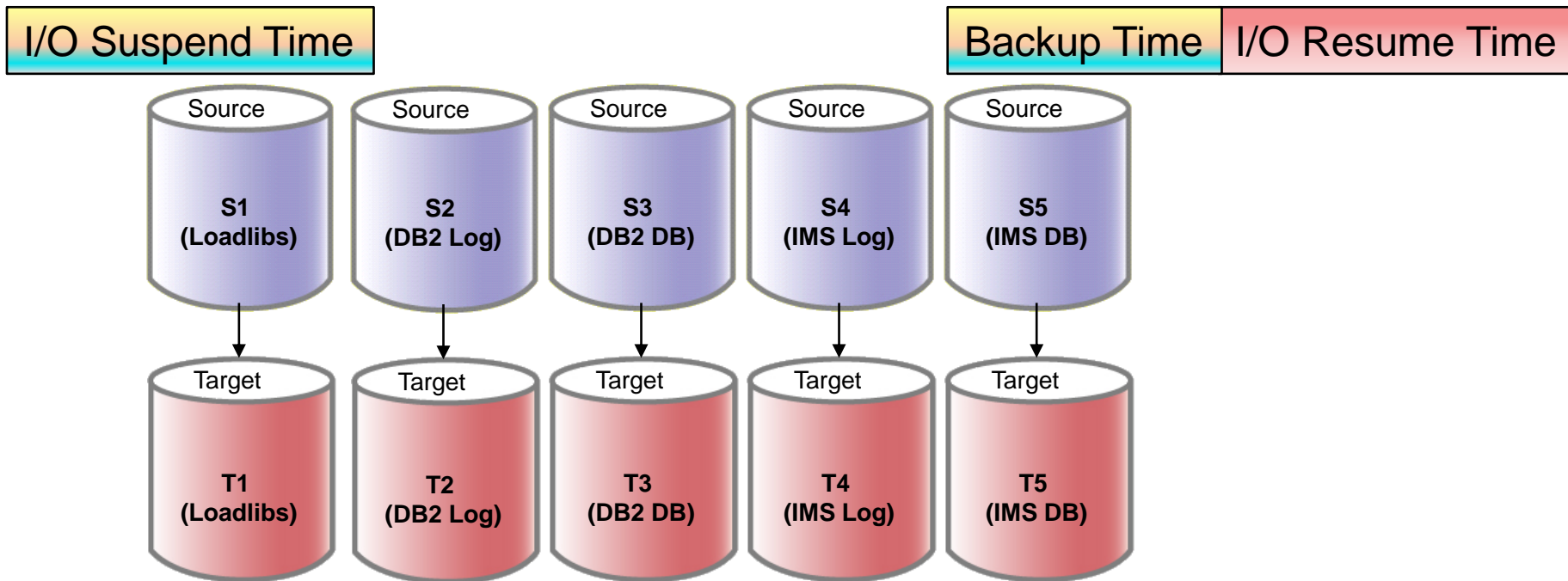
Updates Completed	DB2 UNDO/REDO Required
Log (1)	No UNDO or REDO, Update not Committed
Log (1) + Log (2)	Use "Change Information" with REDO or use "Change Information with UNDO"
Log (1) + Log (2) + DB (3)	Use "Change Information" with REDO or use "Change Information with UNDO"
Log (1) + Log (2) + DB (3) + Log (4)	No UNDO or REDO, Update was Committed

Consistency Group FlashCopy

- FlashCopy S1 to T1
 - Writes can not proceed on S1
 - Any writes occurring on S2-S4 can not be dependent writes
- FlashCopy S2 to T2
 - Writes can not proceed on S1 or S2
 - Any writes occurring on S3-S4 can not be dependent writes
- FlashCopy S3 to T3 and S4 to T4
- T1-T4 contain a consistent copy
- Unfreeze Flashcopy
 - Writes may proceed on S1-S4



System Level Backup (SLB): Key Timestamps



$$\text{I/O Resume} - \text{I/O Suspend} = \text{Backup Elapsed Time} (< 1 \text{ Sec})$$

Demo of IMS and DB2 Coordinated DR
(Onetime Setup)
(Coordinated IMS and DB2 Restart)
(Coordinated IMS and DB2 Recovery & Restart)