

IMS Disaster Recovery Overview

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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 Disaster Restart
 - Coordinated IMS and DB2 Disaster Restart
 - GDPS and Storage Mirroring
- IMS *Restart & Recovery* Solution
 - IMS system and databases are mirrored to remote site
 - Additional transmitted data allows for forward 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

1 - 4 of 4 results [Show Summaries](#) | [Hide Summaries](#) [Subscribe to search results \(RSS\)](#)

Disaster Recovery vs. Disaster Restart

- IMS Disaster *Recovery* Solutions
 - Many IMS solutions
 - IMS data is transmitted to recover databases to some point in time
 - Image copies, Change Accums, Recons, Logs
 - IMS environment data sets exist at remote site
 - Databases are restored using recovery utilities
 - Recovery to a consistent point (ex. Recovery Point)
 - Or, recovery requires backout of uncommitted updates
 - IMS is restarted with some amount of data loss
 - IMS Tools Products enhance DR solutions:
 - IMS Recovery Solution Pack (DRF, HPIC, DRF/XF, IIB) (5655-V86)
 - IMS HPPC (5655-U09)

IMS Disaster **Restart** Solutions

- IMS Disaster *Restart* Solutions
 - IMS Recovery Expert System Level Backup
 - Creates a “periodic snapshot” of IMS environment
 - Snapshot is restored at remote site
 - IMS is emergency restarted with dynamic backout
 - Coordinated DR for IMS and DB2
 - IMS Recovery Expert or DB2 Recovery Expert: System Level Backup
 - Creates a “periodic snapshot” of IMS and DB2 environment
 - Snapshot is restored at remote site
 - IMS and DB2 are restarted
 - Dynamic backout and UNDO/REDO processing
 - GDPS and Storage Mirroring
 - Data is transferred to Remote site as it changes
 - Transfer can be synchronous or asynchronous
 - IMS is emergency restarted with dynamic backout

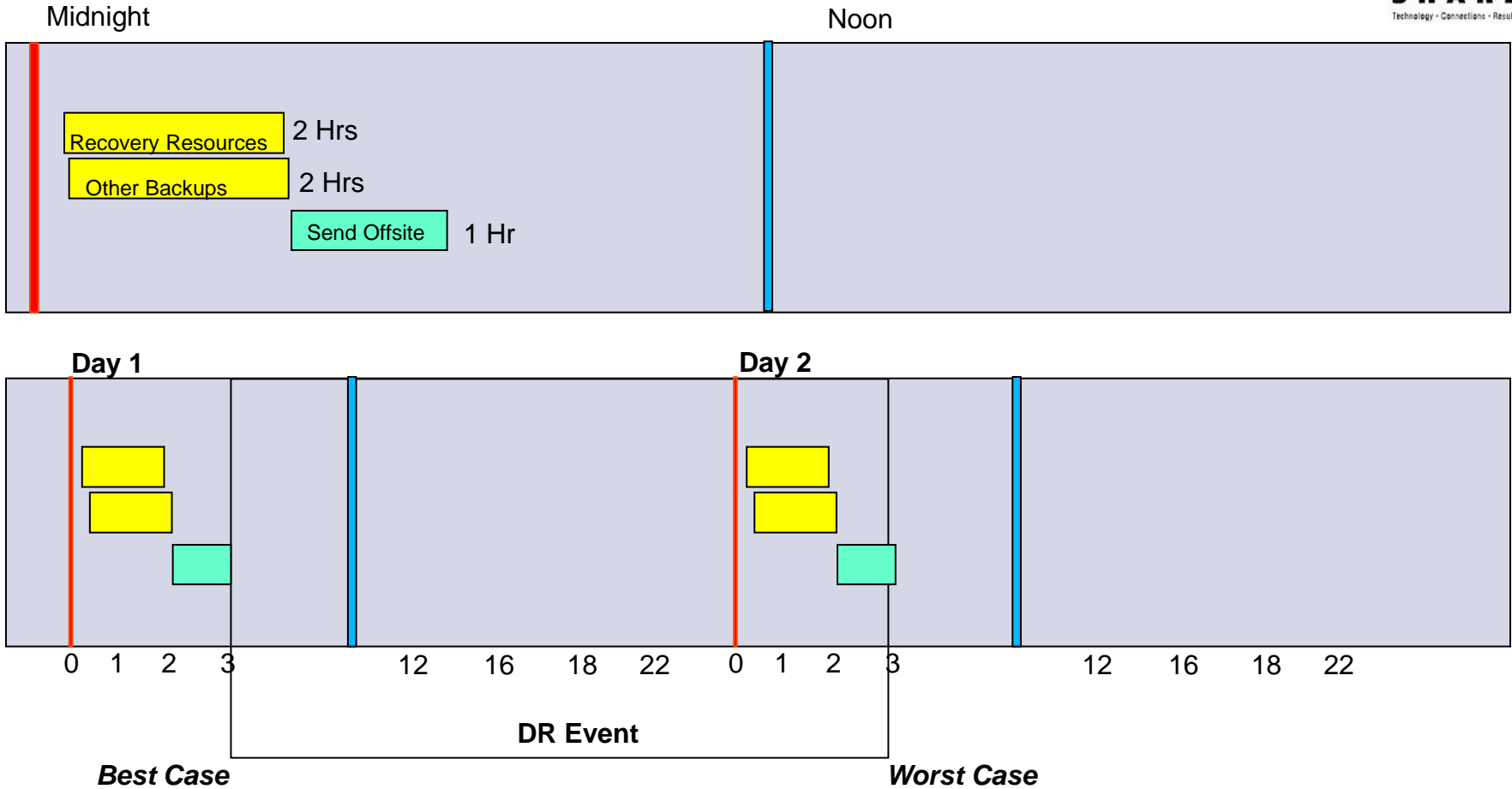
Disaster Recovery vs. Disaster Restart

- Coordinated IMS & DB2 *Restart & Recovery* Solutions
 - IMS Recovery Expert and DB2 Recovery Expert
 - System and databases in System Level Backup are restored
 - Additional Logs, Change Accumms and Recons are transmitted
 - Timestamp recovery brings state of databases forward
 - Reduction in RPO
 - IMS and DB2 are restarted

RTO vs. RPO

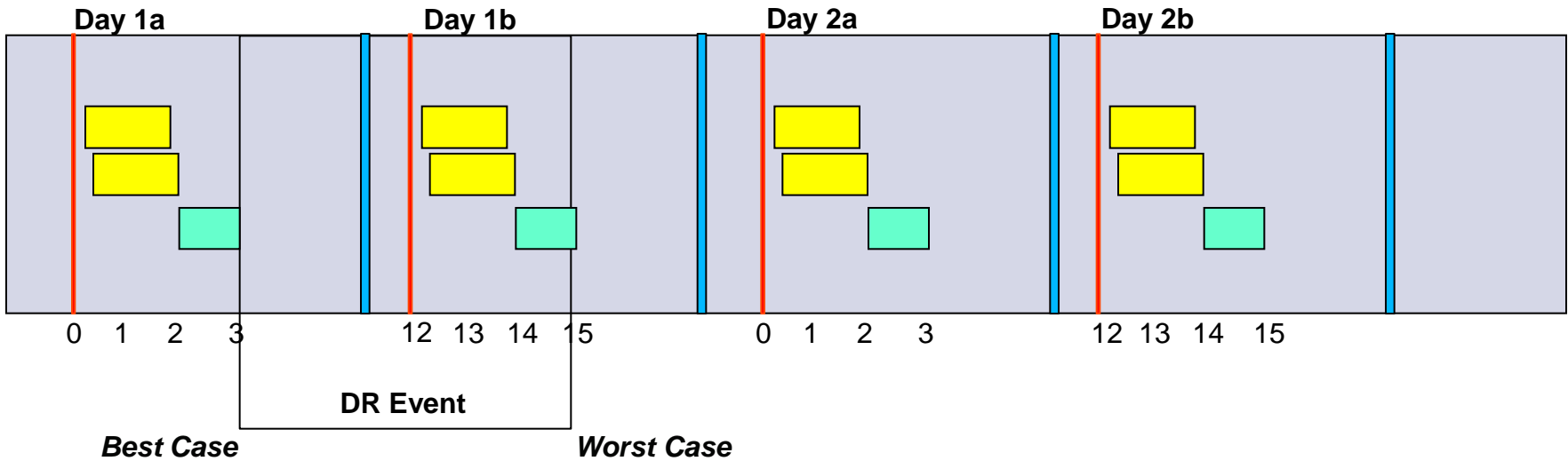
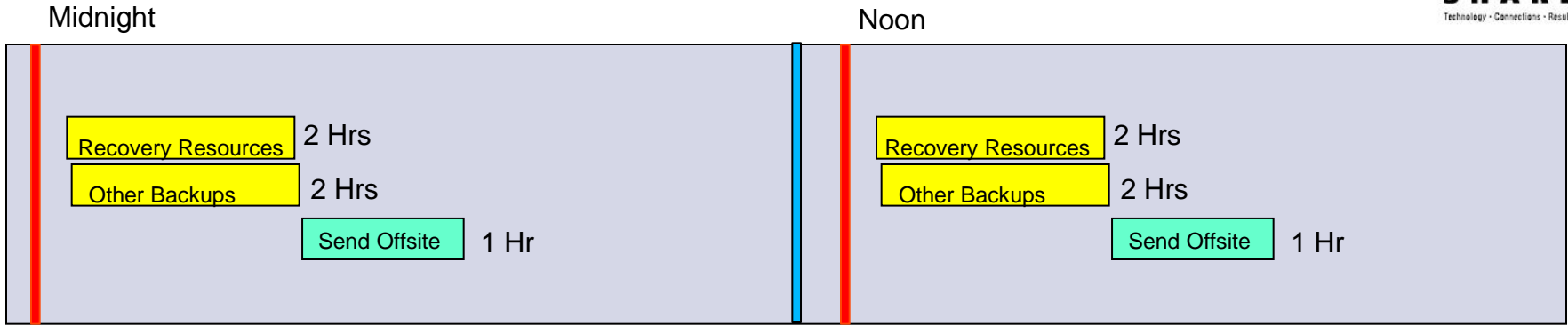
- Recovery Time Objective (RTO)
 - Time allowed to recover the applications
 - All critical operations are up and running again
 - Considerations include:
 - Recovery of databases
 - Restarting the network
- Recovery Point Objective (RPO)
 - Amount of data lost in the disaster
 - Last point-in-time when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

Defining RPO (Resources Created Once/Day)



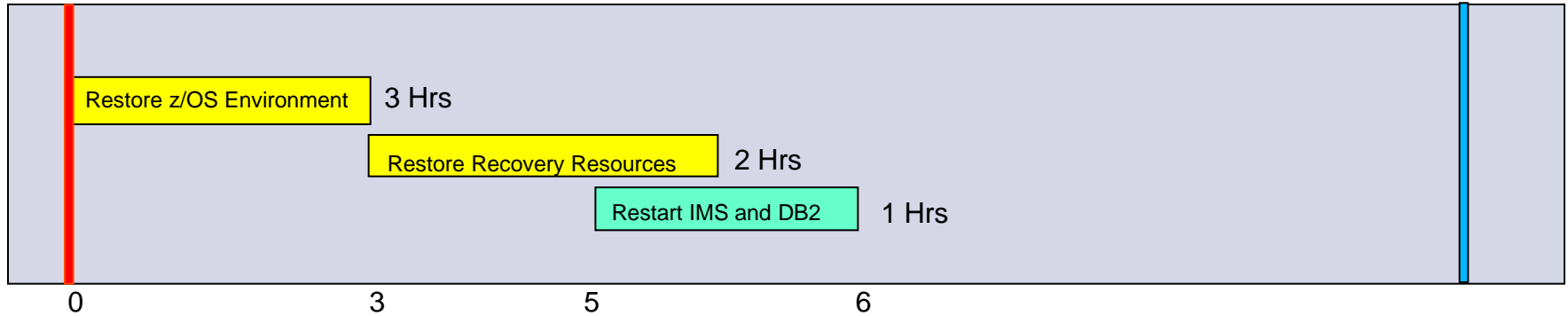
DR Event	RPO Best Case	RPO Worst Case
DR Event	Day 1 = Resources + 3 Hrs	SLB Day 2 = Resources + 27 Hrs

Defining RPO (Resources Created Twice/Day)



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

Defining RTO



Recovery at Remote Site	RTO Time
DR Event	6 Hours

IMS Disaster *Recovery* Solutions

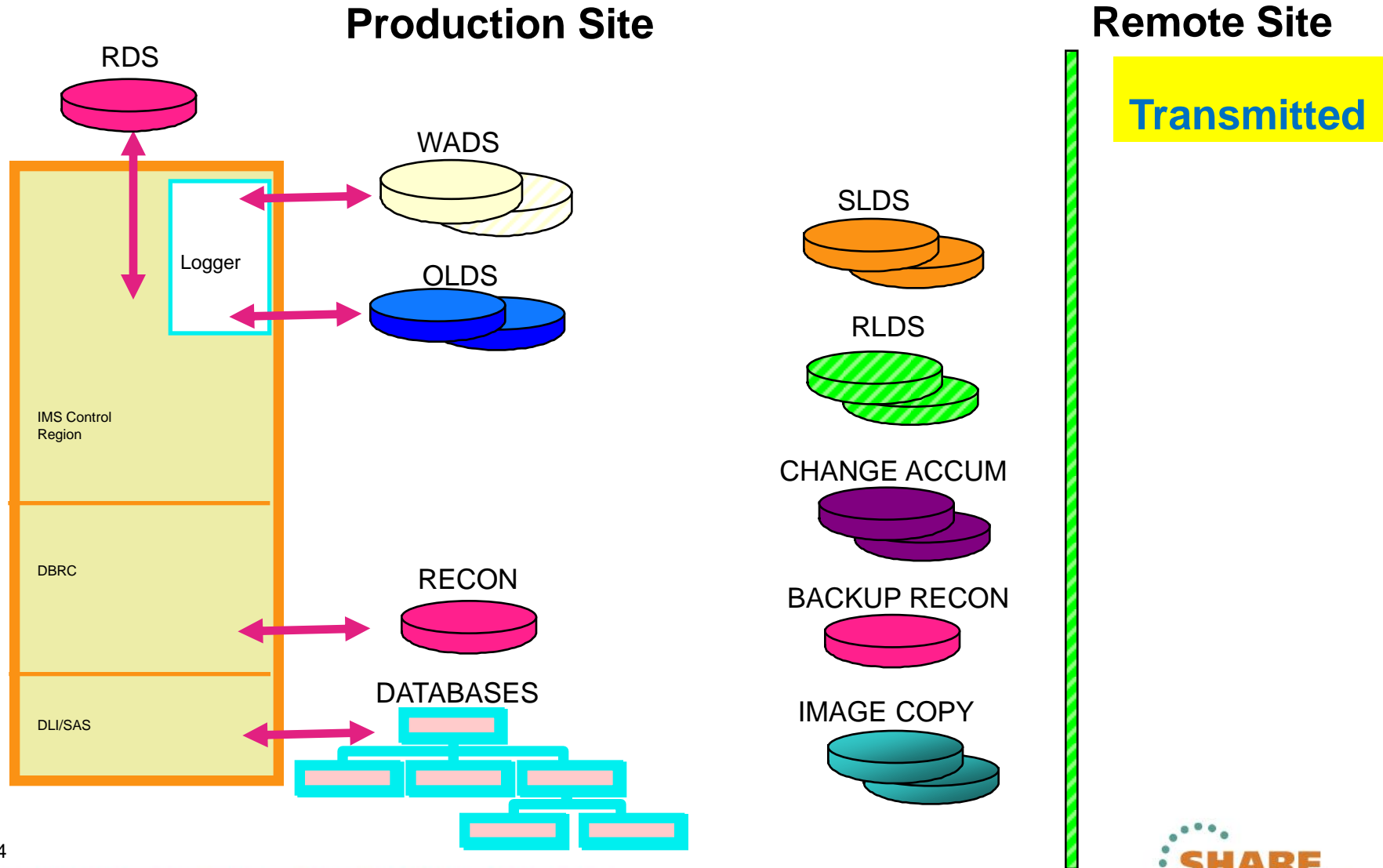
- ✓ IMS Full Database Recovery
- ✓ IMS Timestamp Recovery

IMS Disaster **Recovery** Solutions



- IMS Recovery Methodologies
 - Full Database Recovery
 - Image Copy + Logs + Change Accum + Backup Recon
 - Uncommitted updates are backed out
 - Not supported in data sharing environment
 - Timestamp Recovery
 - Two Options:
 - Image Copy + Backup Recon
 - Image Copy + Logs + Change Accum + Backup Recon
 - Recovery is to a Recovery Point
 - No uncommitted updates
 - Supported in data sharing environment

IMS Disaster Recovery Solutions



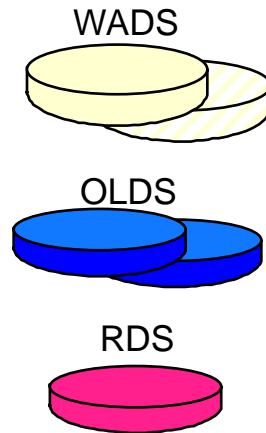
IMS Disaster *Recovery* Solutions

Remote Site

Restart IMS



Allocate New



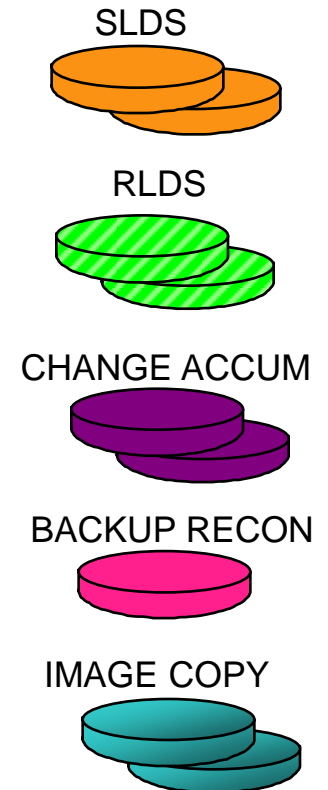
Clean Recon



Recover DB

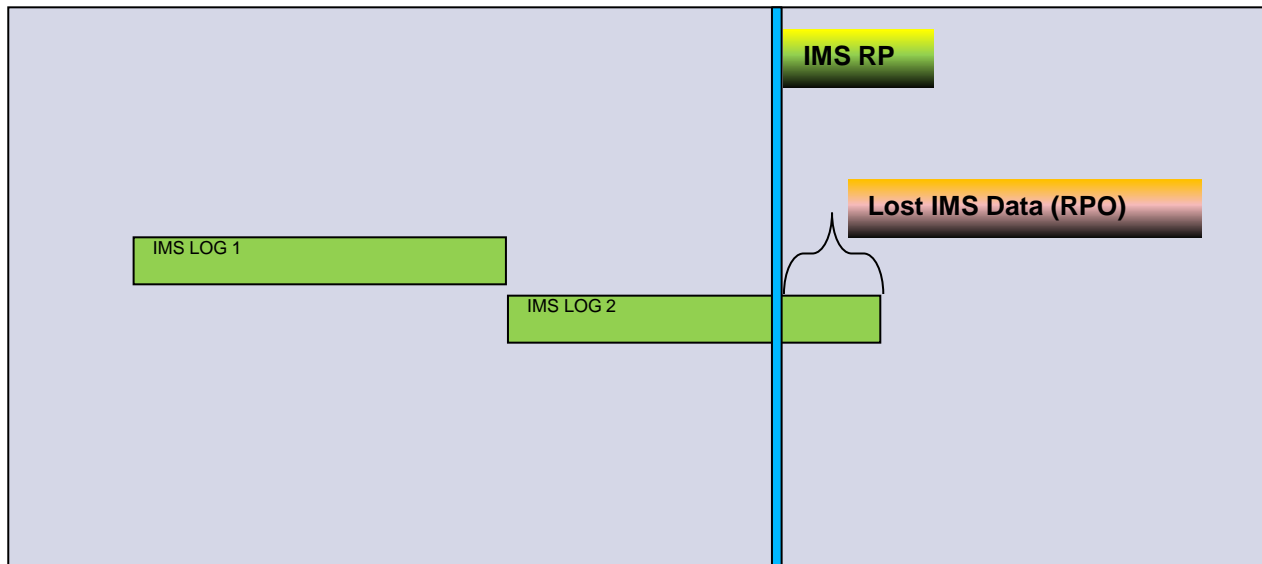


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IMS DR: Timestamp Recovery

- Recovery to an IMS Recovery Point (RP)
 - RPO = Changes Past the RP
 - RTO = Time to recover databases to RP and restart IMS



IMS Disaster **Recovery** Solutions

- Remote Site Backup Recon Cleanup
 - Backup Recon reflects all activity in production Recon
 - Must be manually cleaned for use at remote site
 - Cleanup Steps
 - Step 1: Close and archive open OLDS data set
 - Step 2: Abnormally terminate and/or delete active subsystems
 - Step 3: Flag primary image copy as invalid
 - Step 4: Change Accumulation data sets
 - Step 5: Flag DEDB AREAs for recovery

IMS Disaster **Recovery** Solutions

- Recover Databases and Restart IMS
 - Backup Recon is ready for remote site
 - GENJCL.RECOV creates recovery JCL
 - If databases are registered to DBRC
 - Full Database Recovery
 - Recovery includes uncommitted updates
 - Emergency restart with dynamic backout
 - Batch backout and Cold start
 - Timestamp Recovery
 - Image copies only or with log data sets
 - No uncommitted updates
 - Cold start IMS

IMS Disaster **Recovery** Solutions

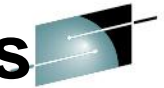


- Enhancing Recovery using IBM IMS Tools
 - IMS Recovery Solution Pack (5655-V86)
 - Recovers database in one pass of logs
 - *IBM IMS Database Recovery Facility (DRF)*
 - Automates DBRC RECON conditioning
 - *IBM IMS Database Recovery Facility Extended Function (DRF/XF)*
 - Creates Image Copy and Incremental Image Copy
 - *IBM IMS High Performance Image Copy (HPIC)*
 - Rebuilds indexes and HALDB ILE
 - *IBM IMS Index Builder (IIB)*
 - IMS High Performance Pointer Checker
 - IBM IMS High Performance Pointer Checker (HPPC) (5655-U09)

IMS Disaster *Restart* Solutions

- ✓ **IMS Recovery Expert System Level Backup**
- ✓ **Coordinated Disaster Restart for IMS and DB2**
- ✓ **GDPS and Storage Mirroring**

IMS Recovery Expert: Disaster **Restart** Solutions

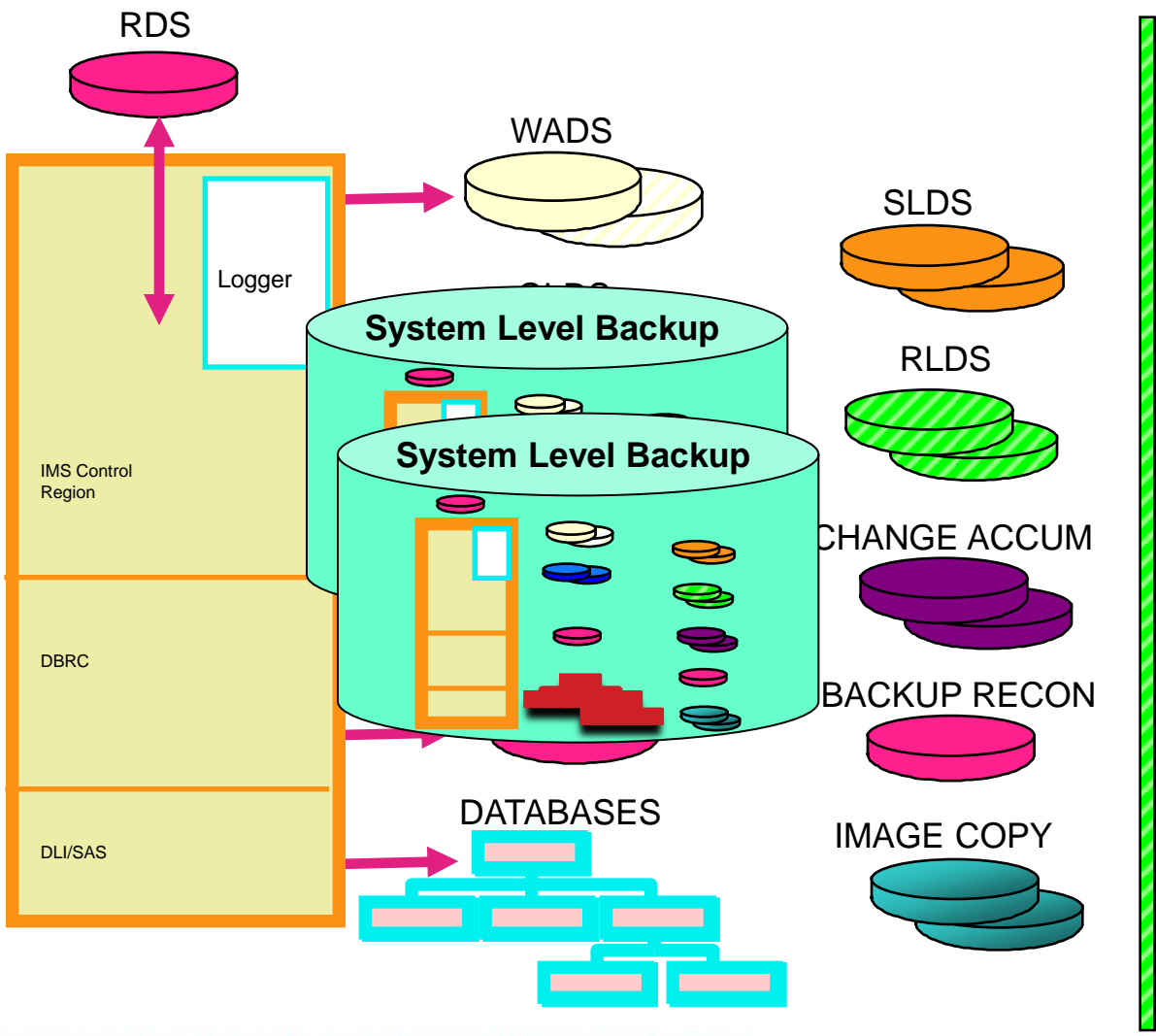


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Production Site

Remote Site

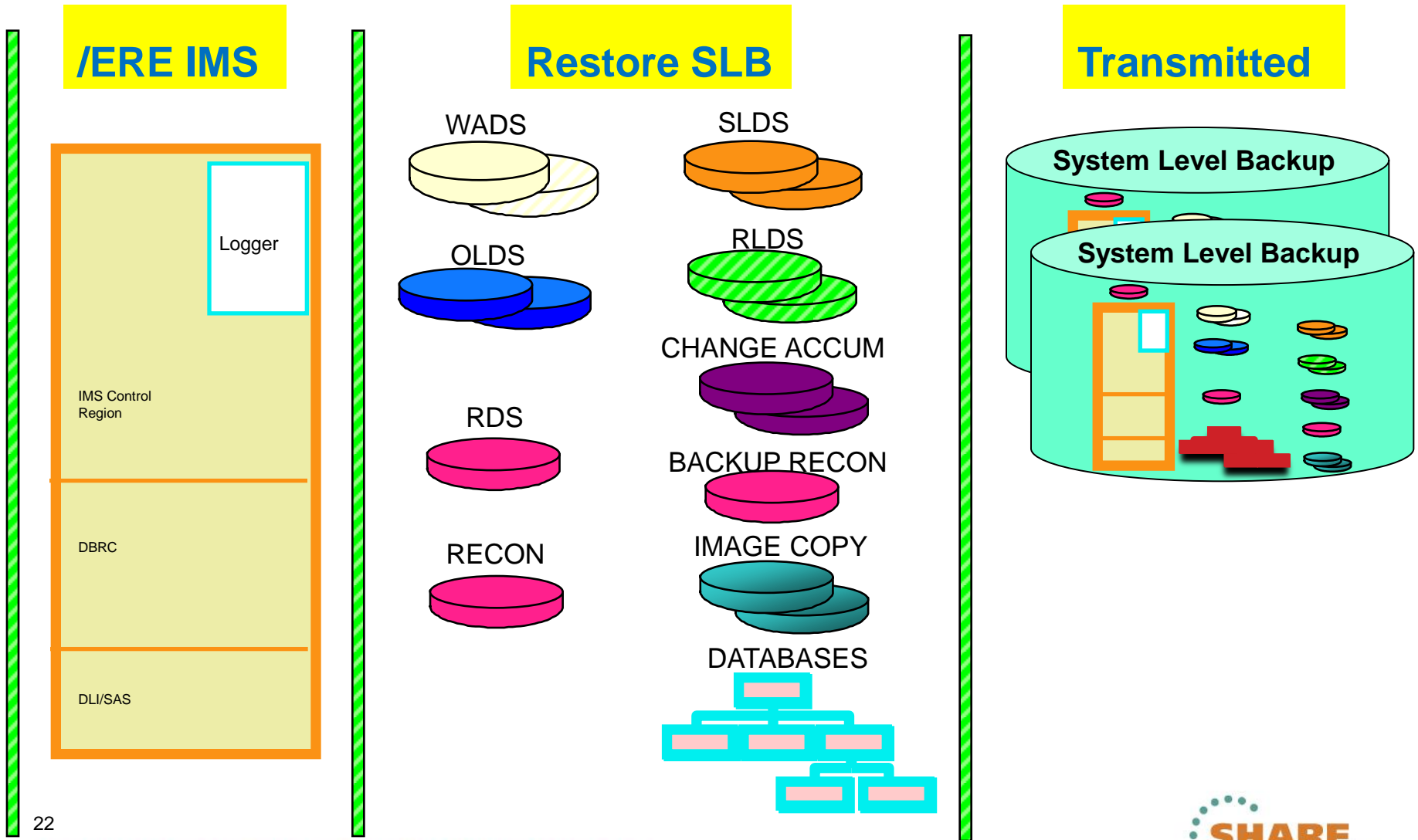
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IMS Recovery Expert: Disaster *Restart* Solutions

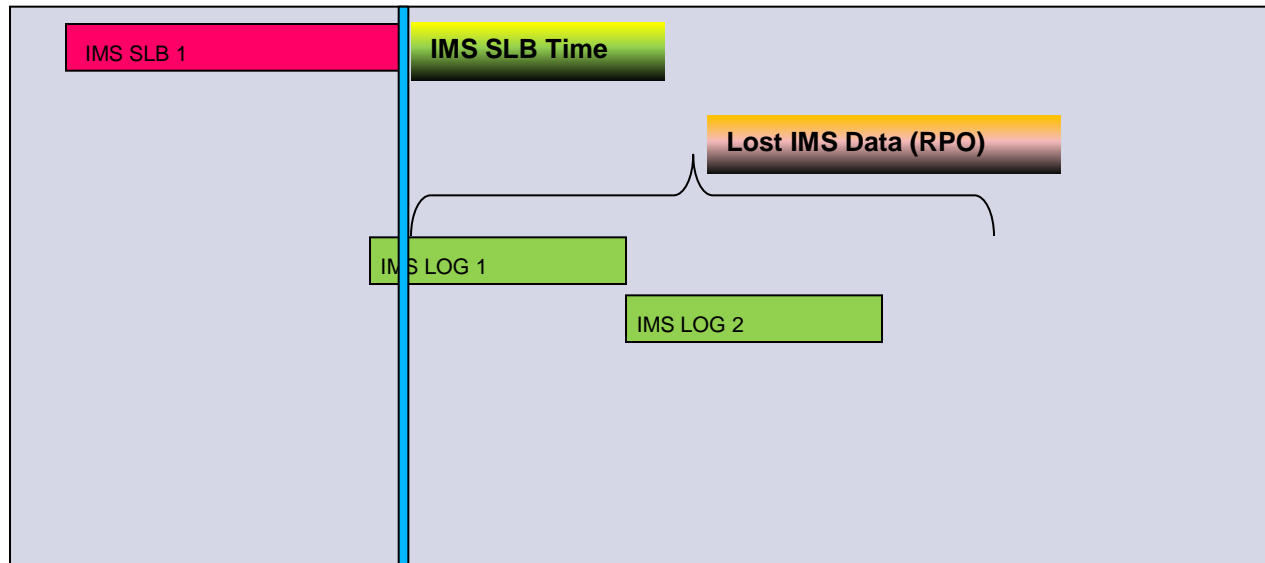


Remote Site



IMS System Level Backup (SLB)

- IMS System Level Backup (SLB) Only
 - RPO = Changes Past the Last SLB
 - RTO = Time to restore the SLB and restart IMS



IMS Recovery Expert (5655-S98) SLB



- IMS Recovery Expert features:
 - Environment discovery and configuration management
 - IMS System Level Backup (SLB) 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
 - System backup and recovery operations
 - Instantaneous backups using storage-based fast replication
 - System backup validation
 - System Level Backup is “dependent-write consistent” copy
 - Automated and encrypted tape offload management

IMS Disaster *Restart* Solutions

- ✓ **IMS Recovery Expert (5655-S98) System Level Backup**
- ✓ **Coordinated Disaster Restart for IMS and DB2**
- ✓ **GDPS and Storage Mirroring**

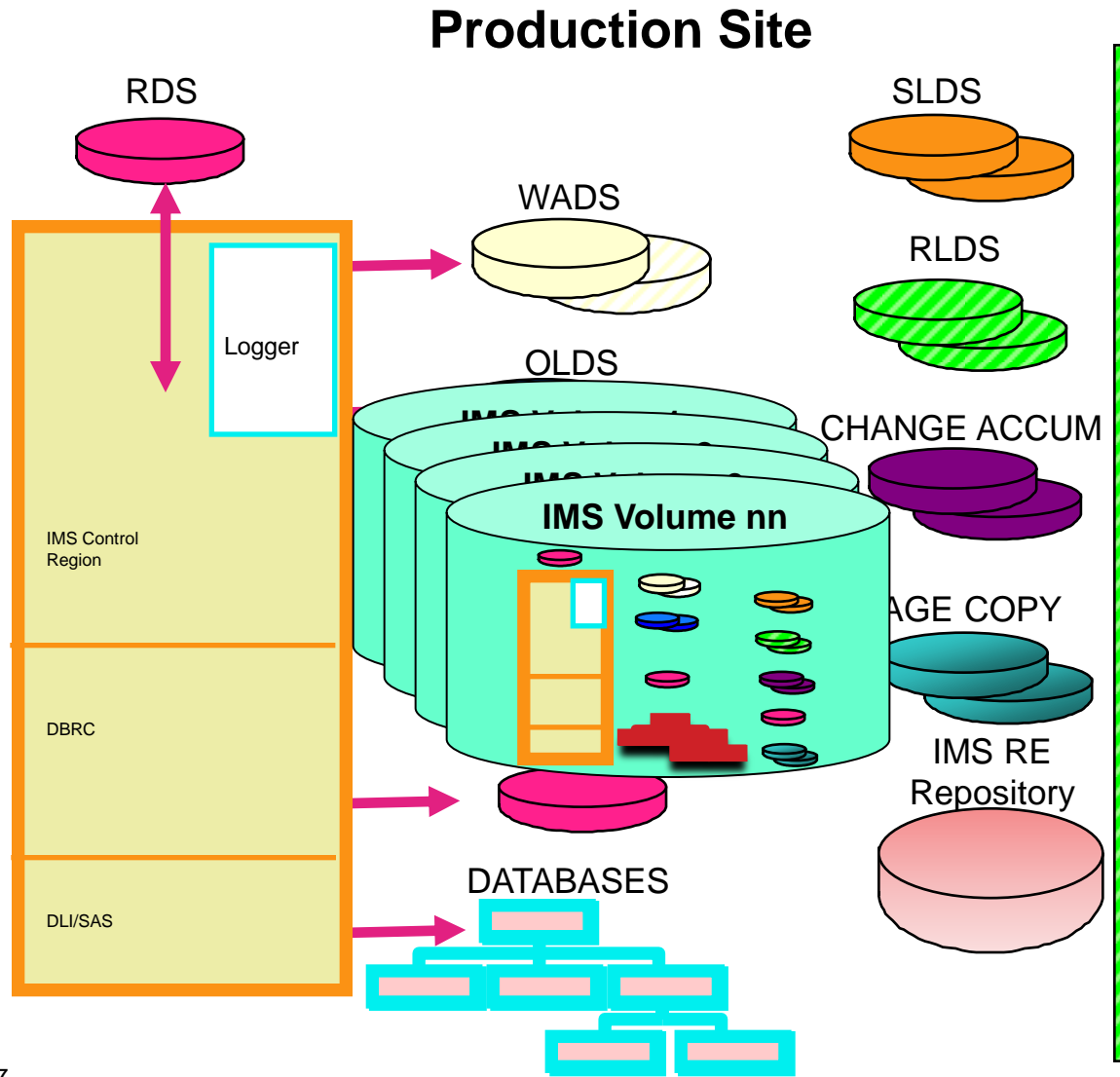
Coordinated IMS and DB2 DR Solutions



- *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

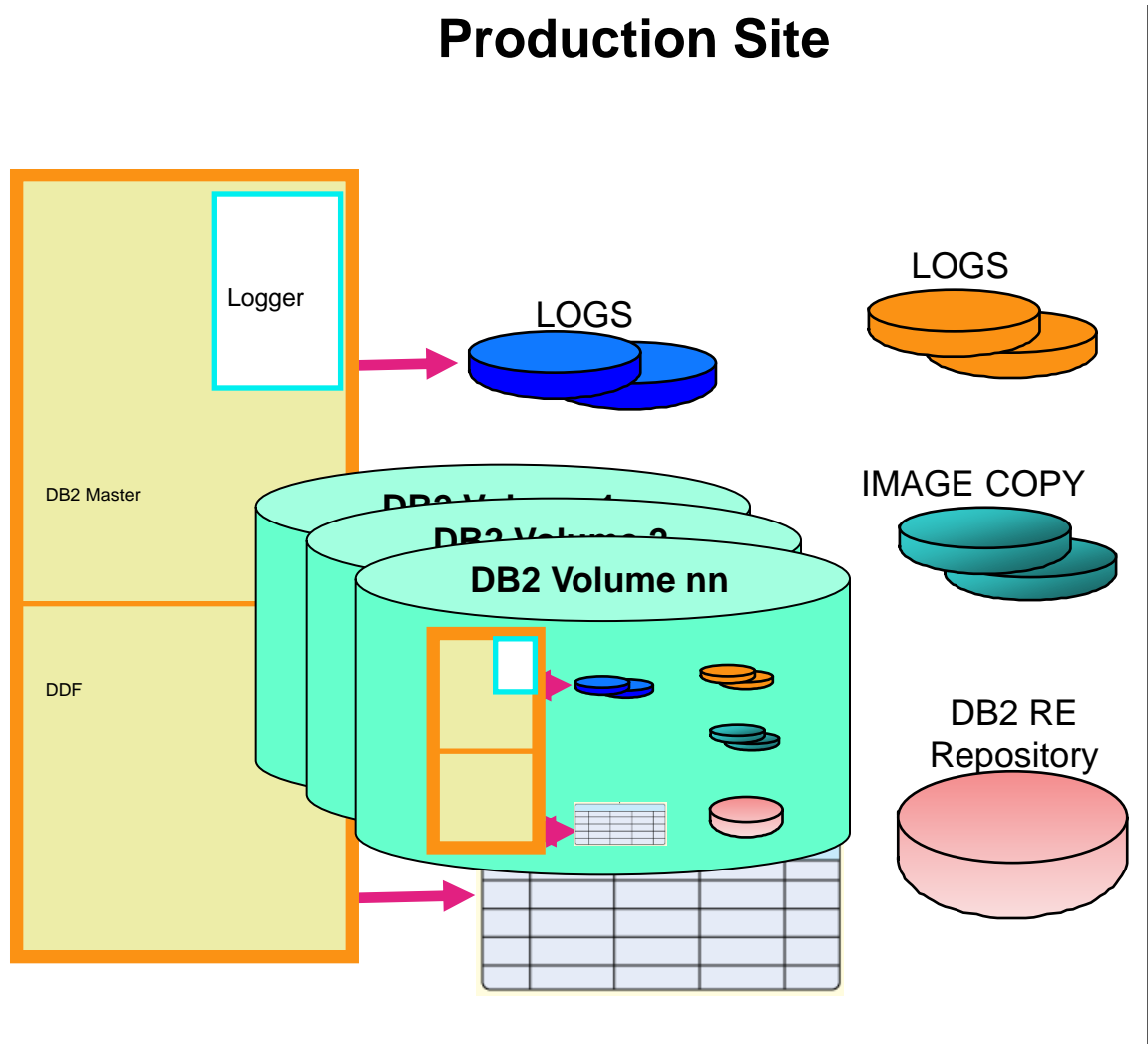
IMS System Analysis



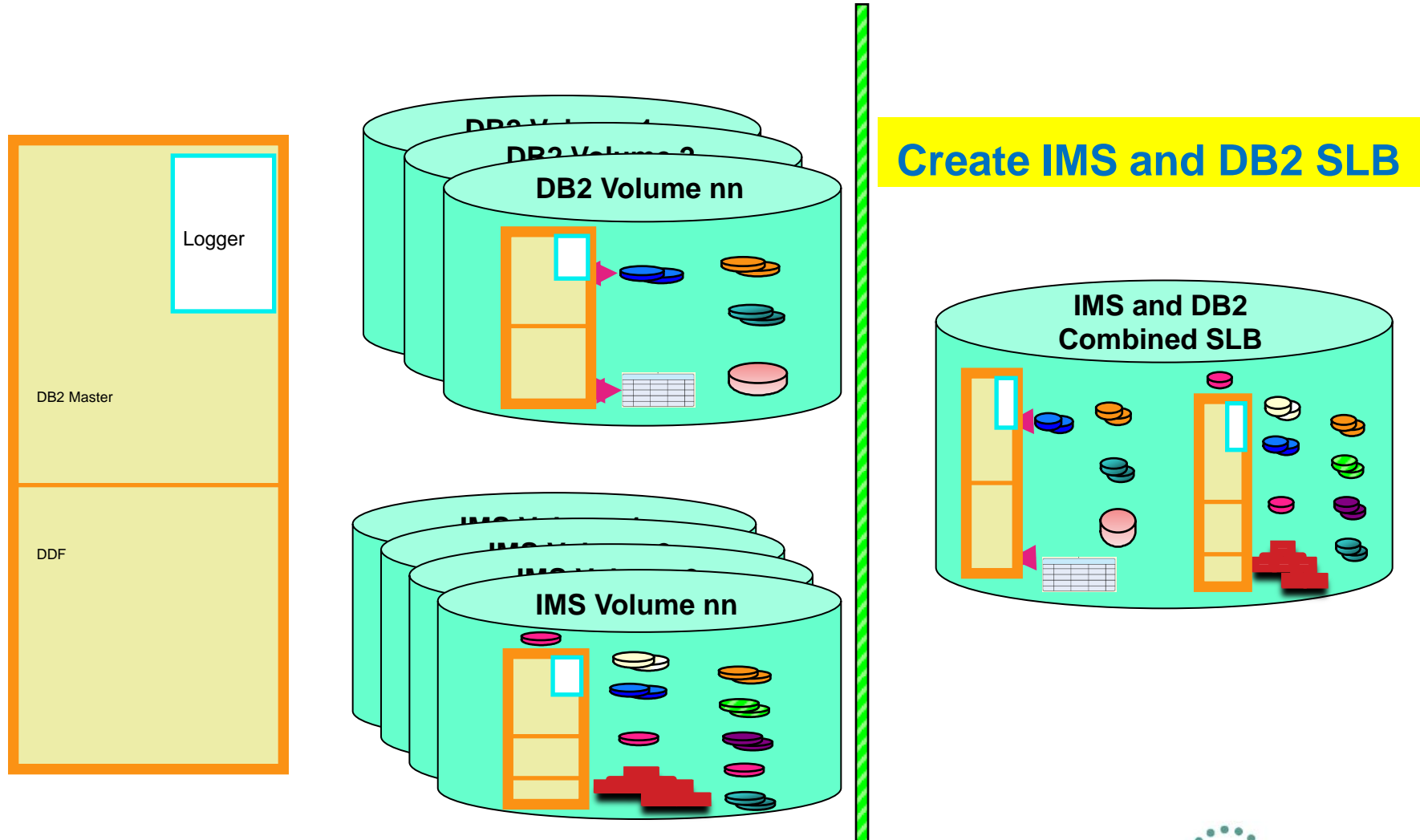
Coordinated DR - DB2 Recovery Expert

Production Site

DB2 System Analysis



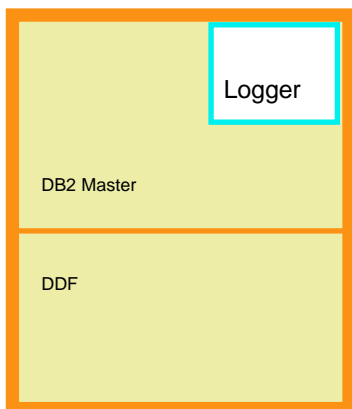
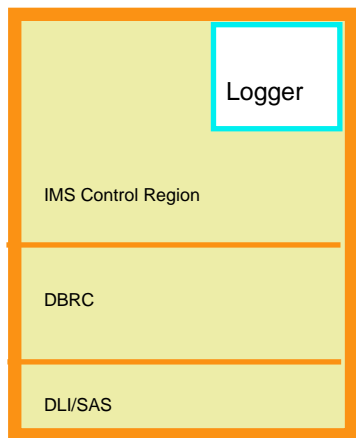
Coordinated DR - DB2 RE or IMS RE



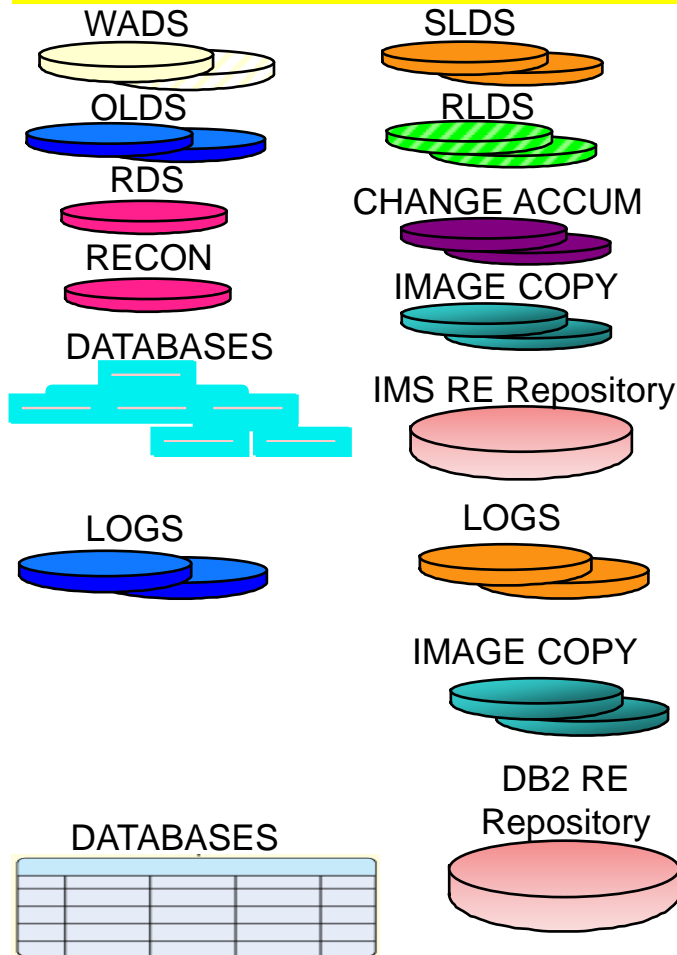
Coordinated DR - IMS and DB2 Restart

Remote Site

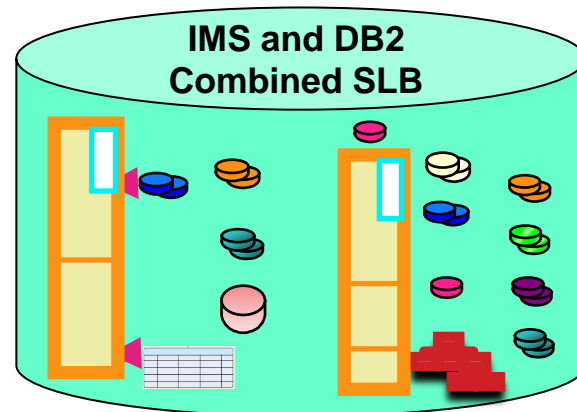
Restart IMS/DB2



Restore SLB for IMS/DB2



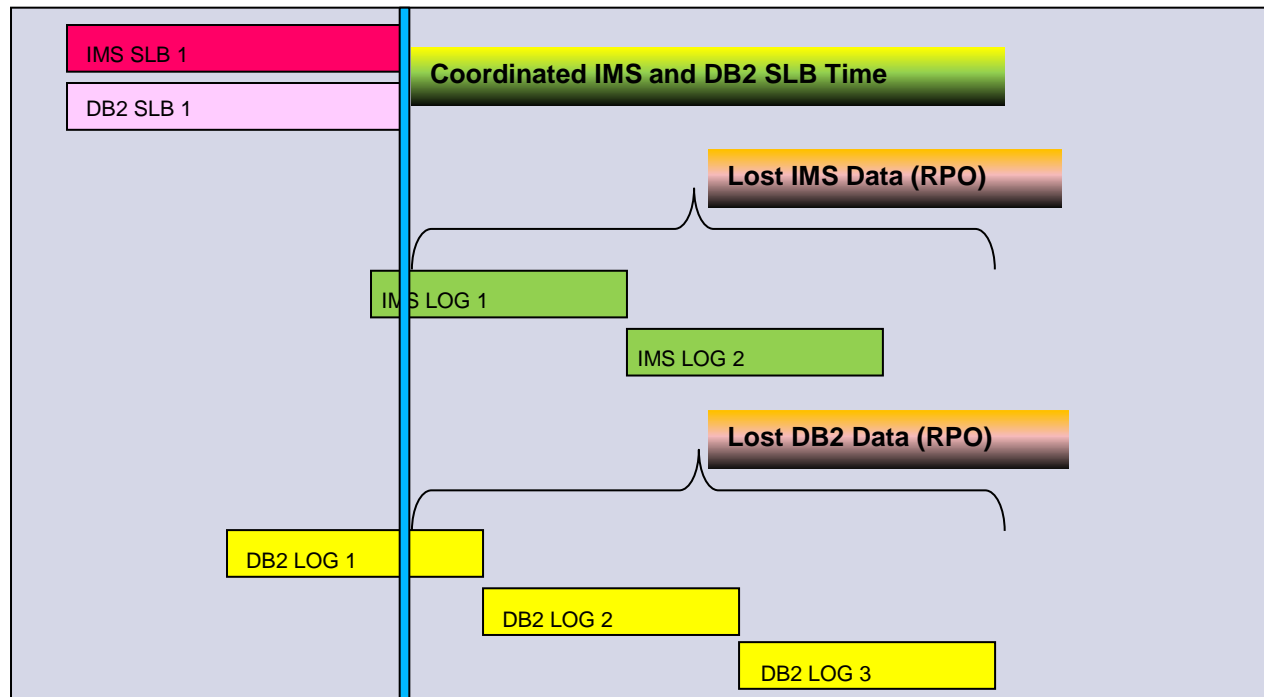
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Coordinated IMS and DB2 DR: Combined SLB



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



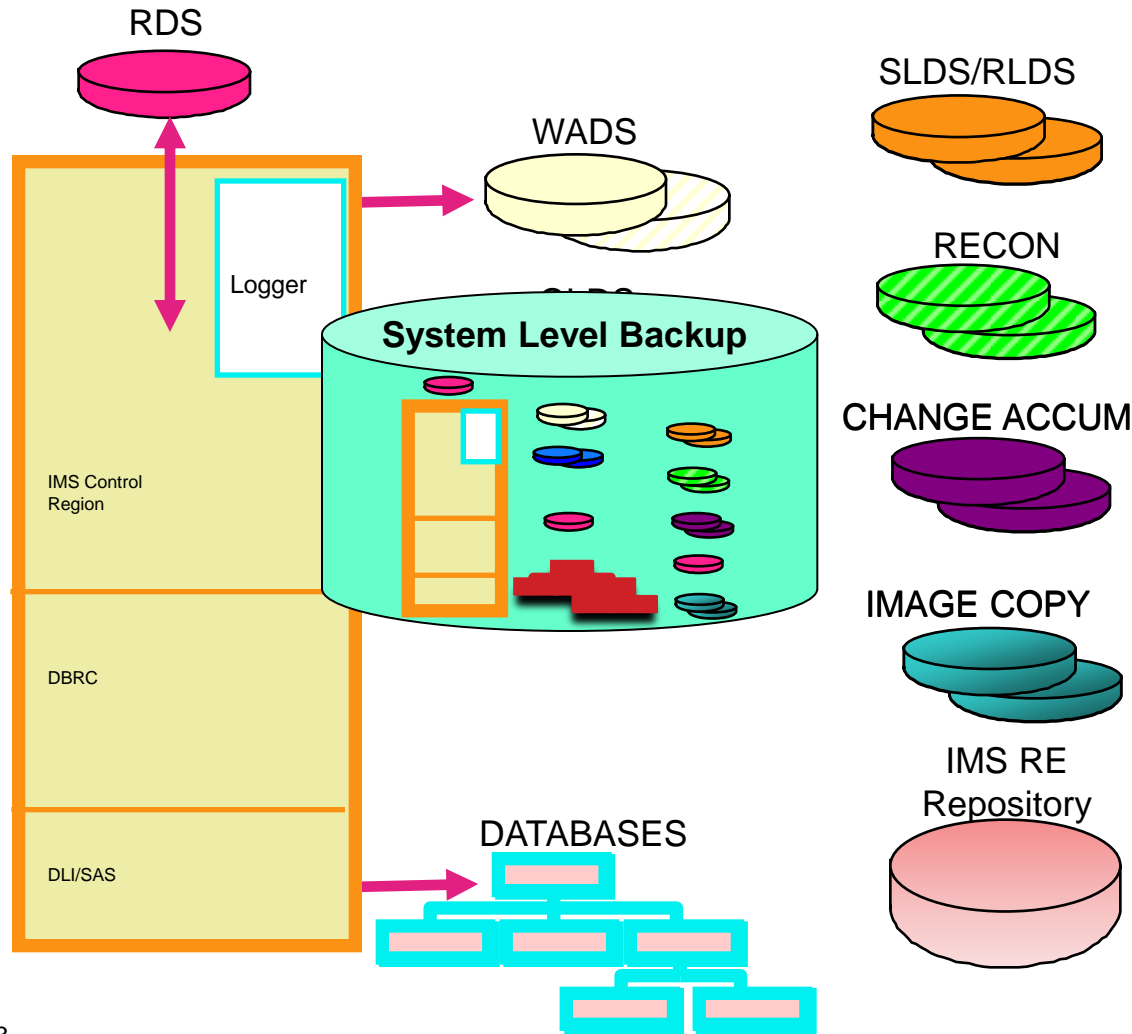
Coordinated IMS and DB2 DR Solutions



- *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)*

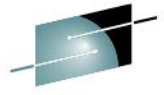
IMS Recovery Expert

Production Site



Remote Site

Transmitted



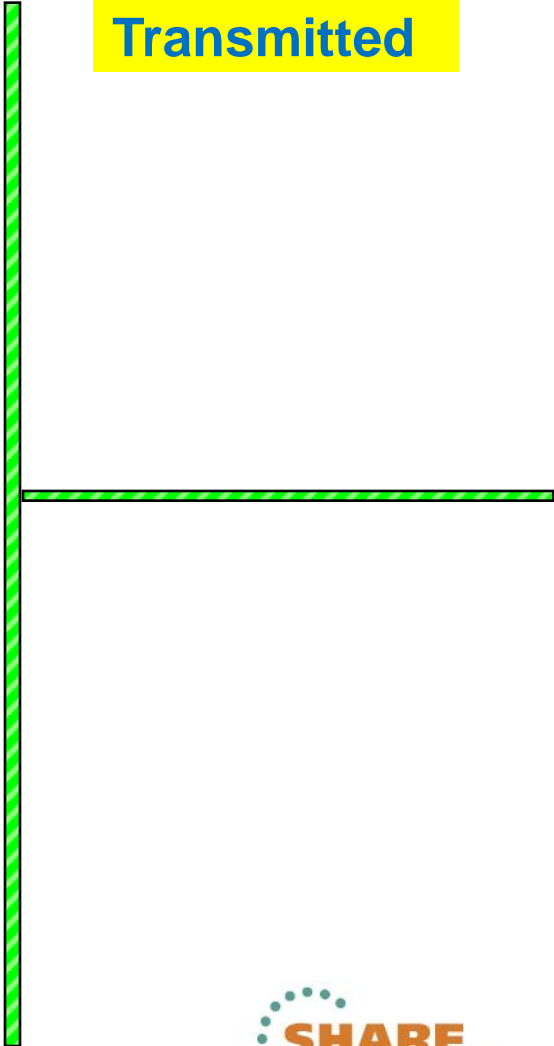
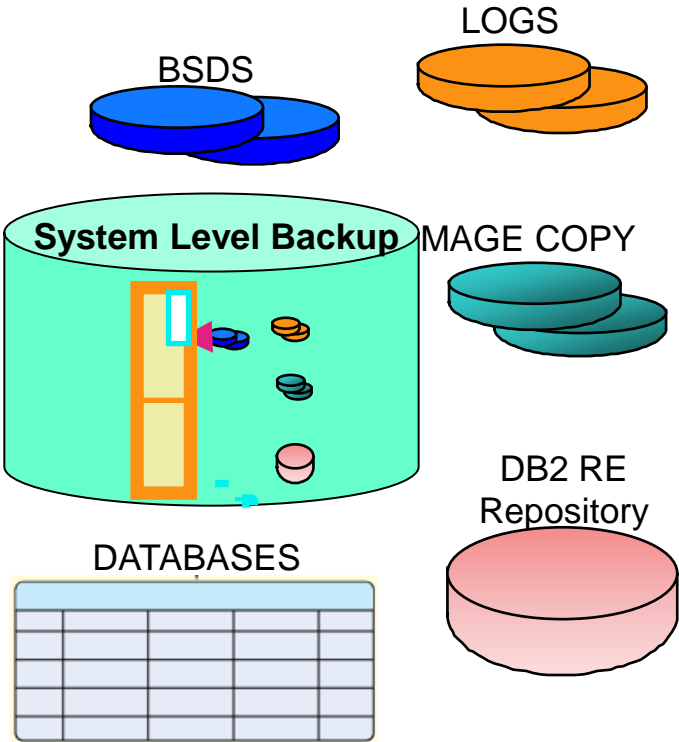
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DB2 Recovery Expert

Production Site

Remote Site

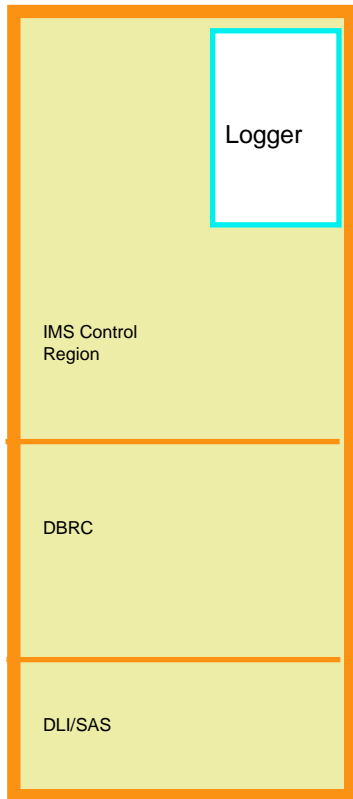
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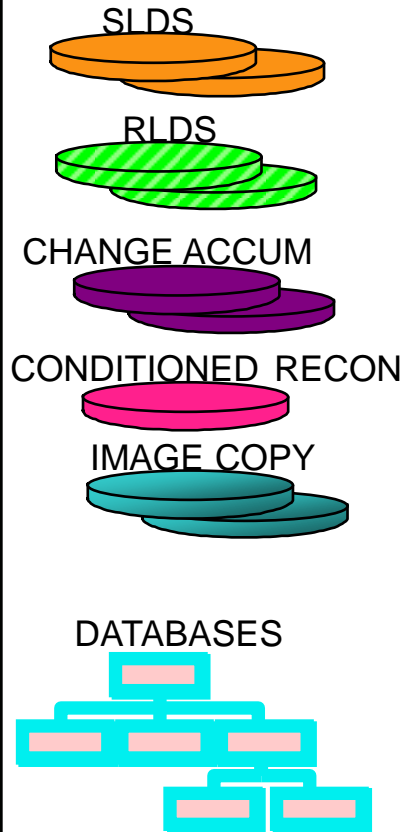
IMS Recovery Expert

Remote Site

Start IMS



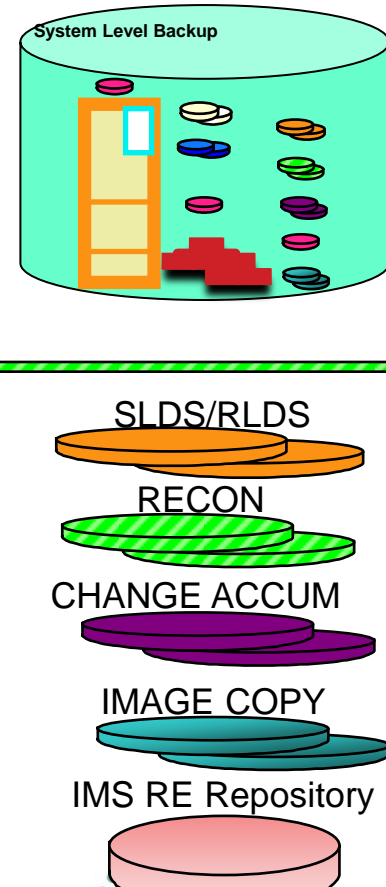
Recover DB



Find Coord RP



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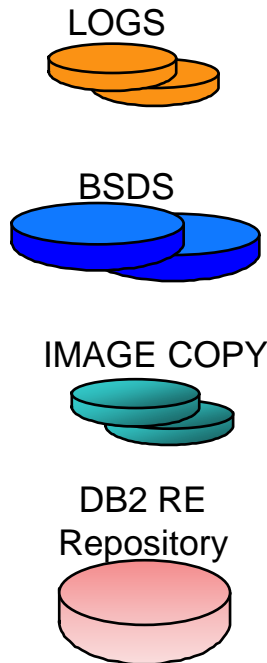
DB2 Recovery Expert

Remote Site

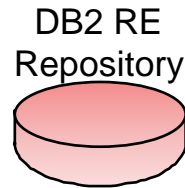
Start DB2



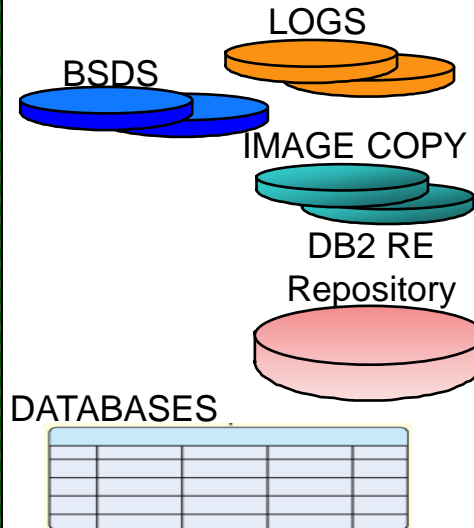
Recover DB



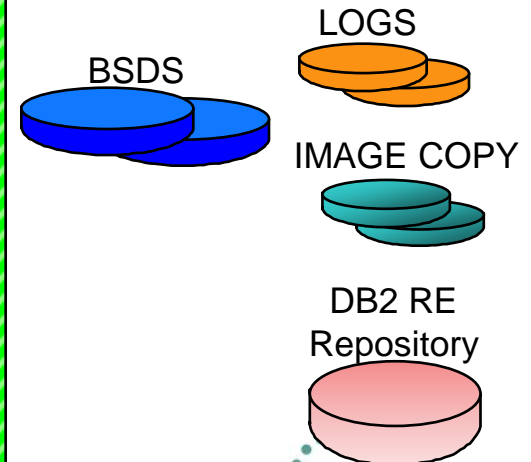
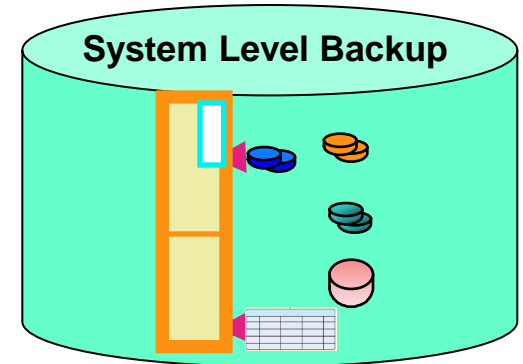
Find Coord RP



Restore SLB

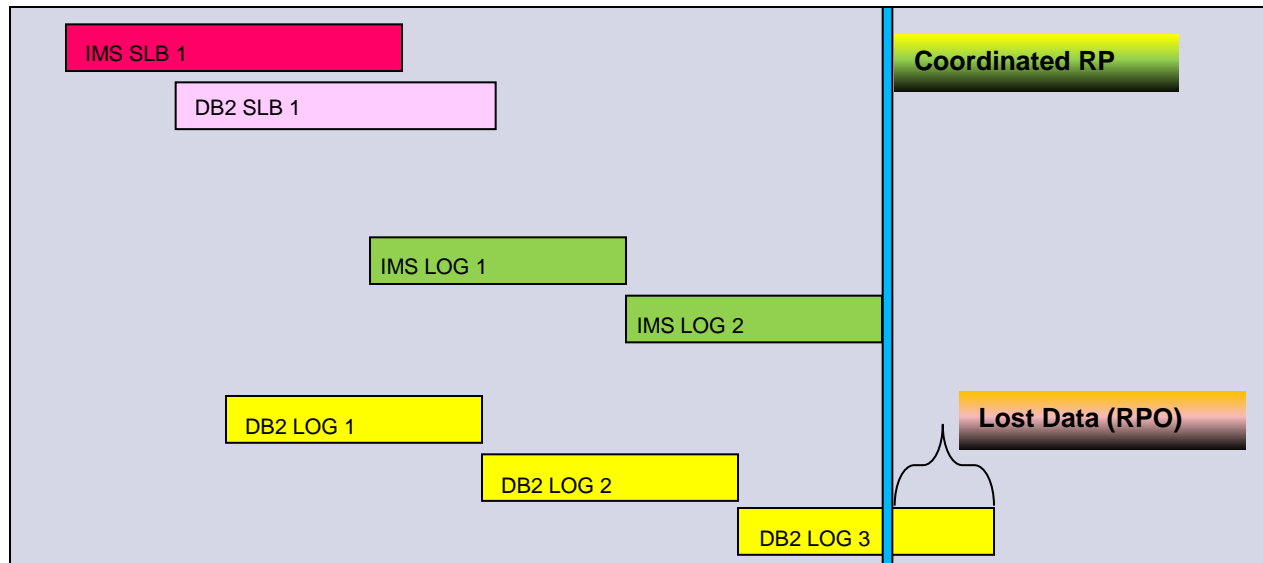


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Coordinated IMS and DB2 DR: Separate SLB

- 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

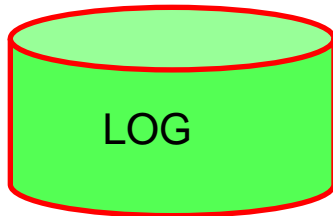


Key to Coord DR: Storage-Based Consistency

- 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

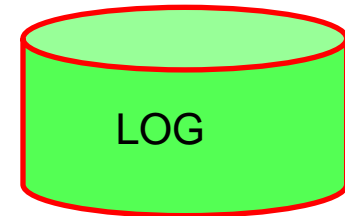
Full Function Commit and Backout Process



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



(2) Update Database

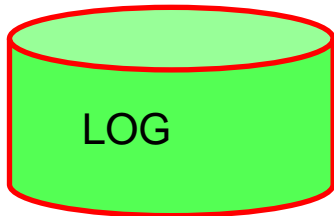


(3) Log "Commit"

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

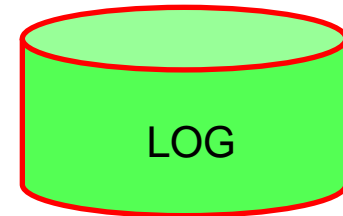
Fast Path Commit and REDO Process



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



(3) Update Database using
output thread processing

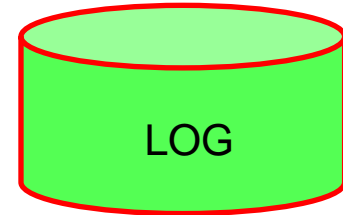
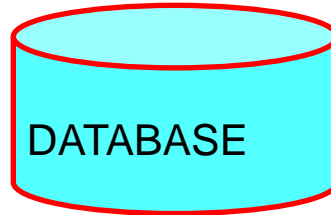
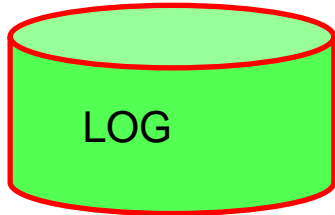


(4) Log "Output Thread Completed"

Updates Completed	Fast Path REDO Required
Log (1)	No REDO, Update <i>not</i> 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 <i>was</i> Committed

DB2 Dependent Writes

DB2 Commit and UNDO/REDO Process



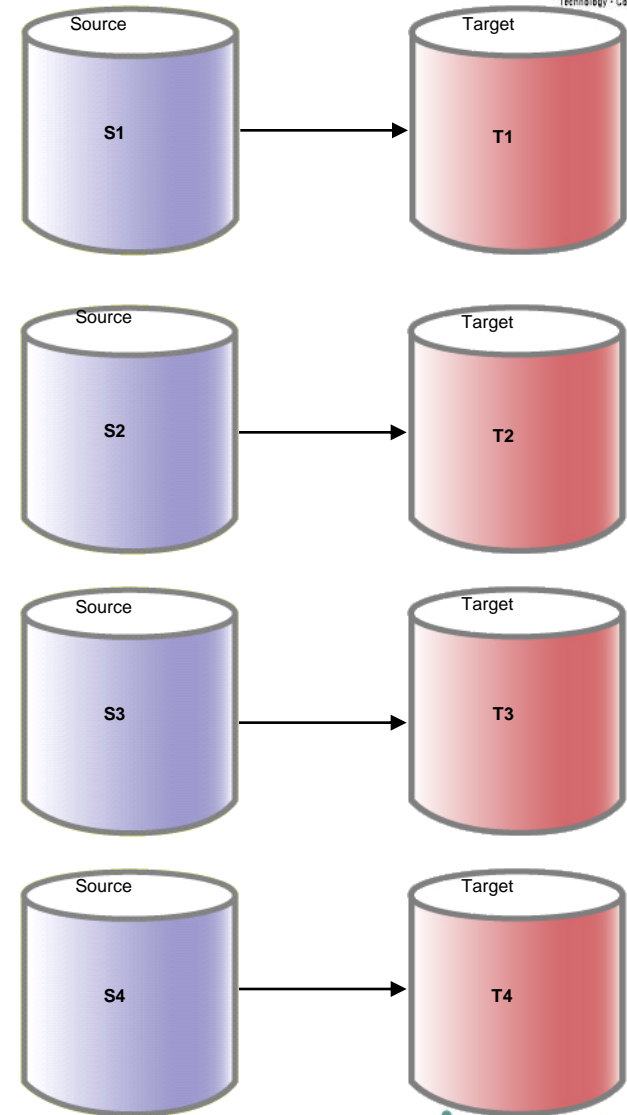
(1) Log "Change Information"
 (2) Log "Commit" or "Abort"

(3) Update Buffer Pool or Database
 (4) Log "Commit Completed"

Updates Completed	DB2 UNDO/REDO Required
Log (1)	No UNDO or REDO, Update <i>not</i> 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 <i>was</i> 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



Benchmark Example

- ✓ 13TB
- ✓ 460 volumes
- ✓ DS8300
- ✓ 2817-M80 z196
- ✓ 4,075.28 tx/sec

```
IMS Recovery Expert for z/OS
Backup Summary Report

Utility Executed:..... Backup
Profile Name:..... ROCKET1.BKUP1
IMS Subsystem:..... IMSP
IMS Version:..... 12.1
Backup Type:..... Flash Copy
Backup Contains:..... Database Data and Log Data (Mixed)
Partial Backup:..... No
Nbr of Volumes:..... 0461
Backup Date:..... 02/01/2012
Backup Time:..... 2012-02-01-17.03.20.671934
Consistency Method:..... Flash Consistency Group
Supports Database Restore: No
I/O Suspend Time:..... 2012-02-01-17.03.20.671932
I/O Resume Time:..... 2012-02-01-17.03.21.042397
Backup Elapsed:..... 00.37 Seconds
```

IMS Disaster *Restart* Solutions

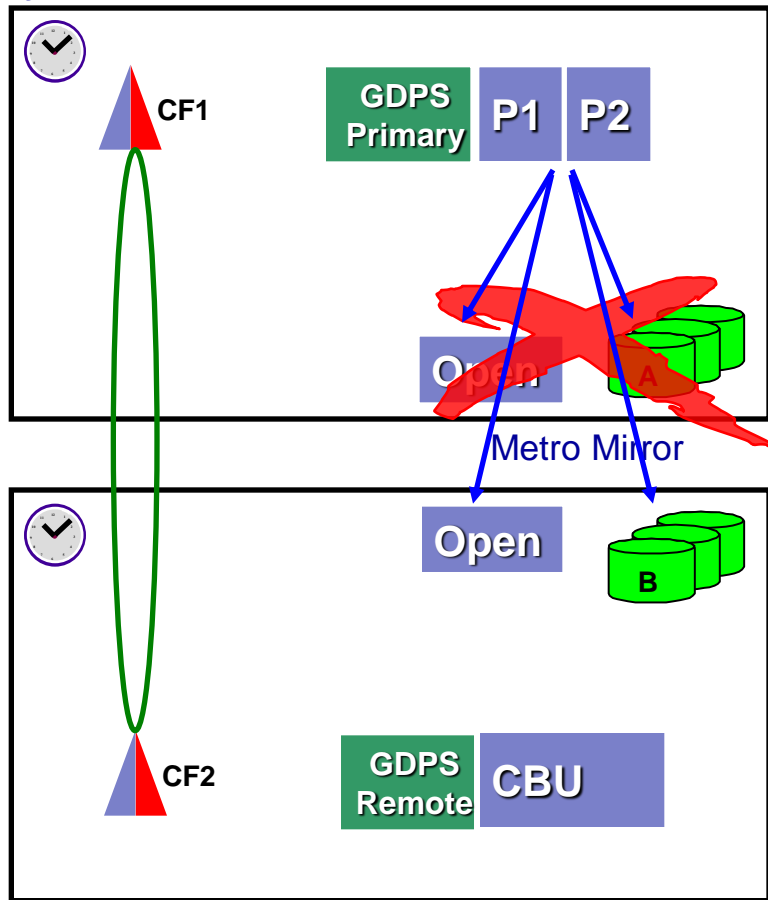
- ✓ IMS Recovery Expert (5655-S98) System Level Backup
- ✓ Coordinated Disaster Restart for IMS and DB2
- ✓ **GDPS and Storage Mirroring**

IMS Disaster **Restart** Solutions

- IBM managed storage mirroring environments
 - IBM Hyperswap Manager
 - IBM Metro Mirror (formerly PPRC)
 - IBM Global Mirror
 - IBM z/OS Global Mirror (formerly XRC)
- Geographically Dispersed Parallel Sysplex (GDPS)
 - Optional for storage mirroring
 - Provides automation for mirroring procedures

GDPS/PPRC... HyperSwap Manager

Primary Site



Remote Site

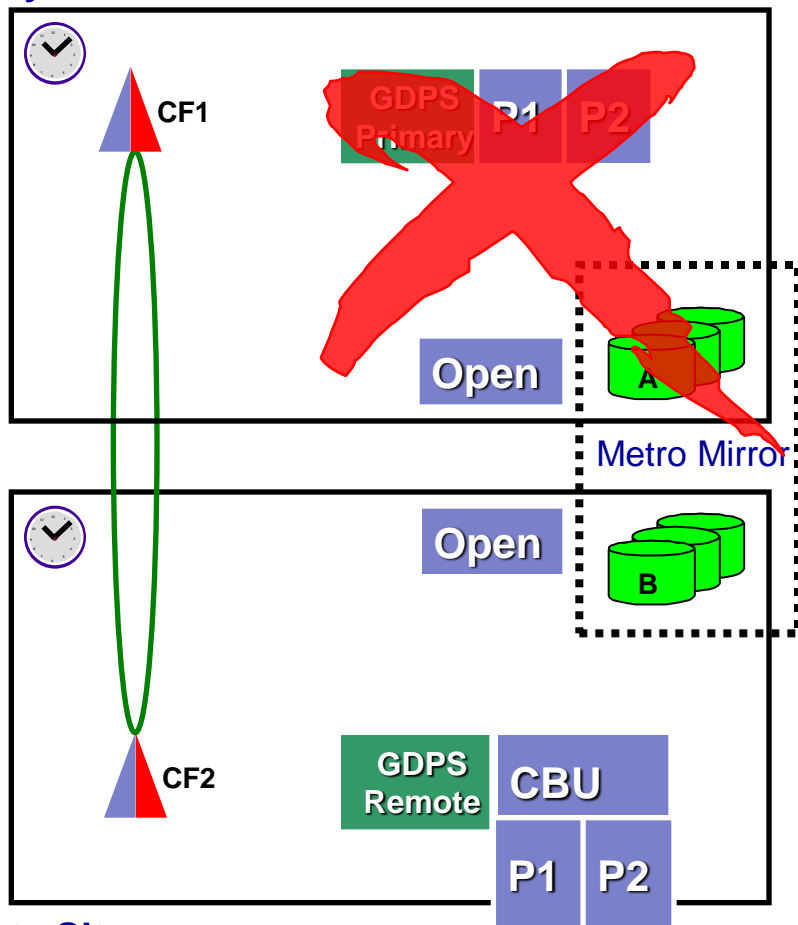
- GDPS managed MM disks
- Data is System z and Open data
 - HyperSwap for system z
 - Open data is “frozen”
- Primary disk failures (Unplanned)
 - I/O errors
 - Boxed devices
 - Control unit failures
- User initiated switch (Planned)
 - HyperSwap to switch disks

GDPS/PPRC HyperSwap Manager

- Without HyperSwap Manager (30 minutes – 2 hours)
 - Unplanned Switchover:
 1. FREEZE
 2. If decision is to Failover
 - a. *Remove systems from Sysplex*
 - b. *Restart systems at remote site*
 - Planned Switchover:
 1. Shutdown systems
 2. Remove systems from Sysplex
 3. Suspend PPRC
 4. Restart systems at remote site
- With HyperSwap Manager (Under a minute)
 1. PPRC failover
 2. Swap primary and secondary PPRC UCBs
 3. Production systems continue

GDPS/PPRC... IBM Metro Mirror

Primary Site

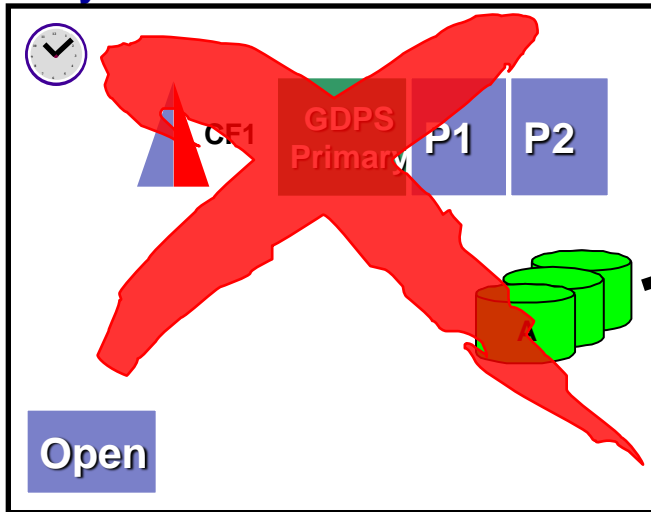


Remote Site

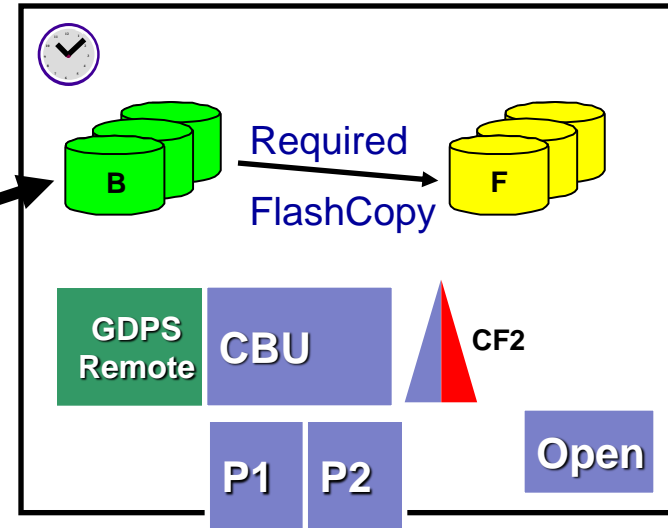
- Synchronous data transmission
 - RPO = 0
 - RTO = Restart of systems
- GDPS uses Freeze policy
- Distance is limited (about 20KM)
- After failover
 1. Stop GDPS/PPRC
 2. Start CBU
 3. IPL Systems
 4. Restart DBMS systems

GDPS/Global Mirror

Primary Site



Remote Site

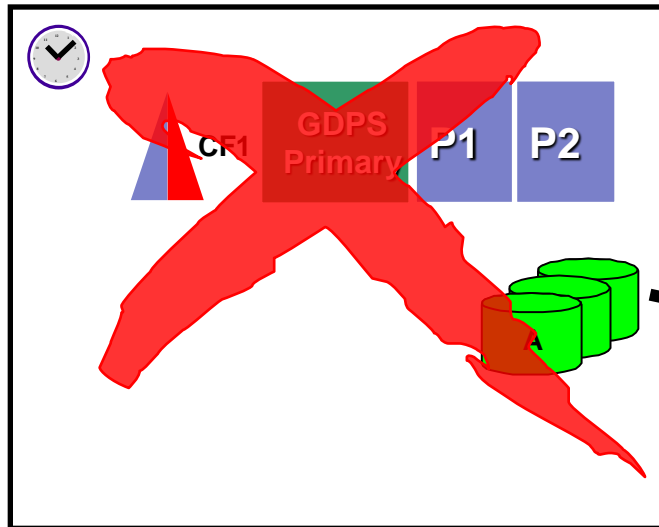


- Asynchronous data transmission
 - RPO = 3-5 seconds (bandwidth)
 - RTO = Restart of systems
- System z and Open data
- Distance is unlimited

- After failover
 - Stop GDPS/GM
 - Start CBU
 - IPL Systems
 - Restart DBMS systems

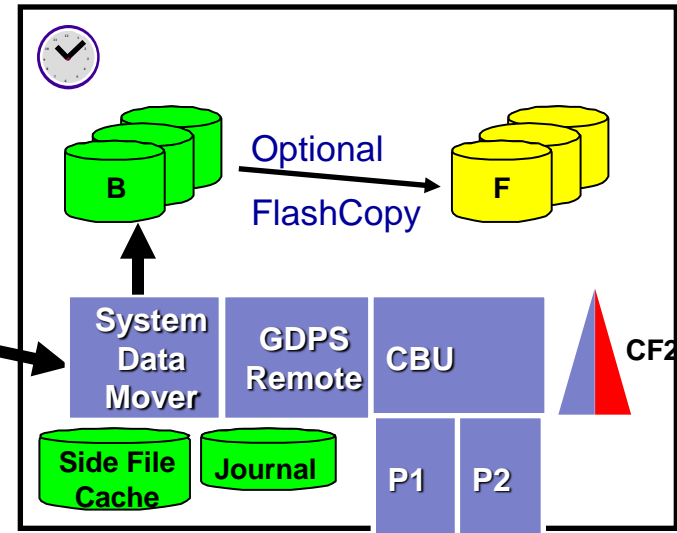
GDPS/XRC... z/OS Global Mirror

Primary Site



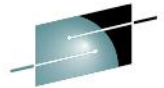
Remote Site

z/OS
Global Mirror



- Asynchronous data transmission
 - RPO = 3-5 seconds (bandwidth)
 - RTO = Restart of systems
- System z only
- Distance is unlimited

- After failover
 - Stop GDPS/XRC, SDM
 - Start CBU
 - IPL Systems
 - Restart DBMS systems

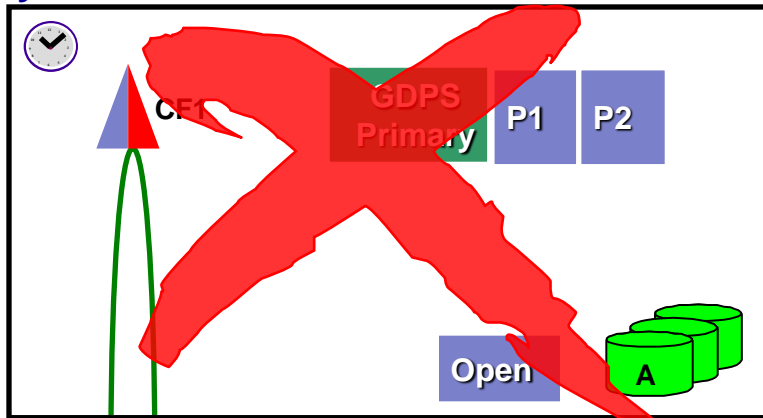


SHARE

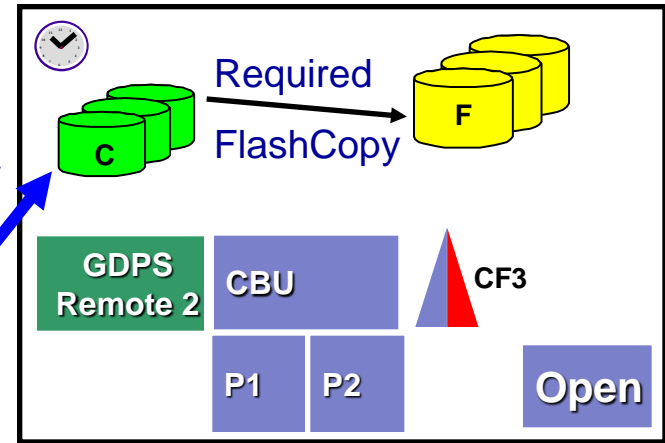
GDPS/Metro-Global Mirror

Primary Site 1

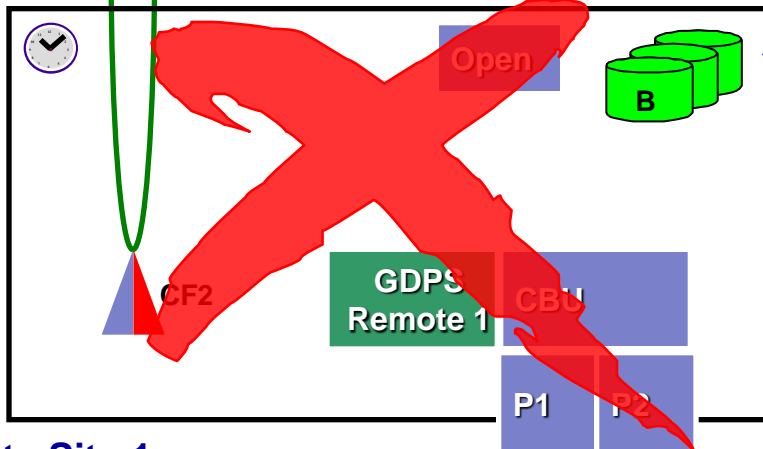
Remote Site 2



Global Mirror

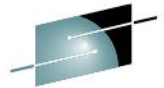


Metro Mirror



Remote Site 1

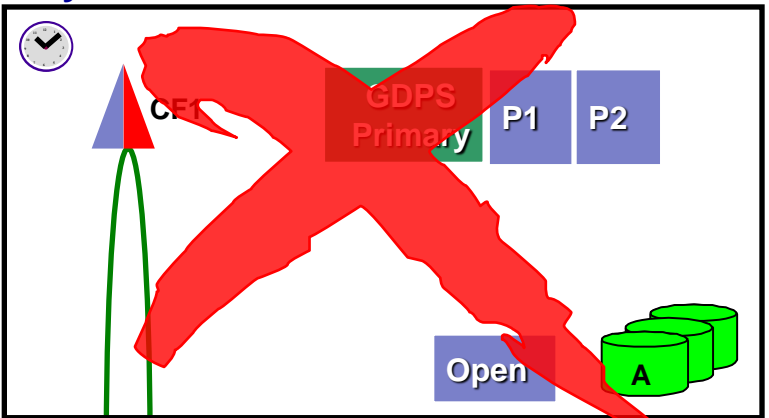
- Three-site solution
 - GDPS/PPRC = Site 1 and 2
 - RPO = 0
 - RTO = Restart of systems
 - Distance is limited
 - GDPS/GM = Site 2 and 3
 - RPO = 3-5 seconds
 - RTO = Restart of systems
 - Distance is unlimited



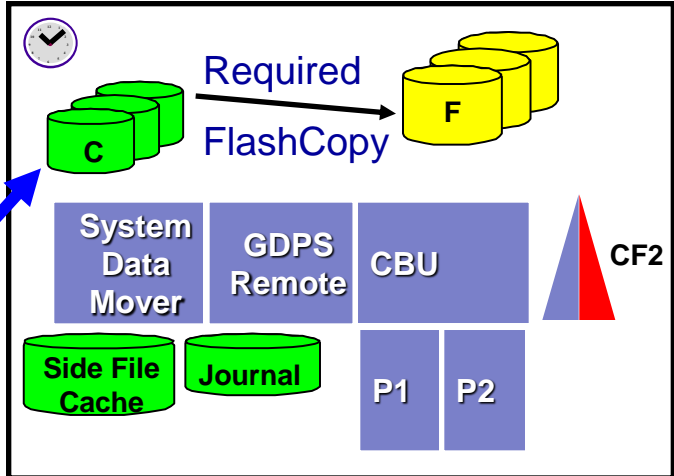
SHARE
Simplified High Availability Recovery Environment

GDPS/Metro-z/OS Global Mirror

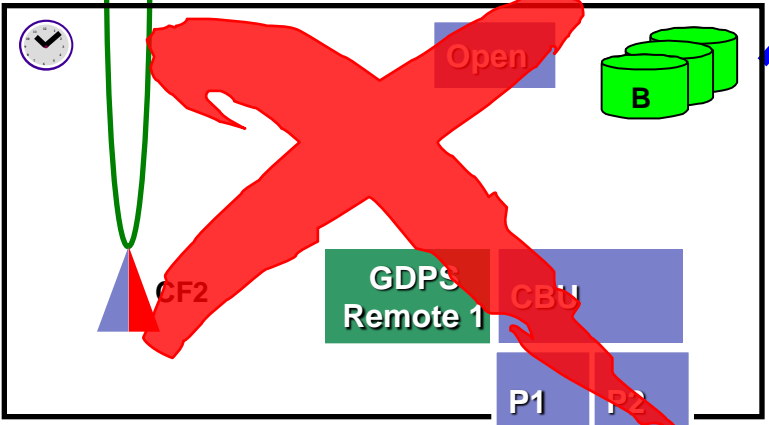
Primary Site 1



z/OS Global Mirror



Metro Mirror

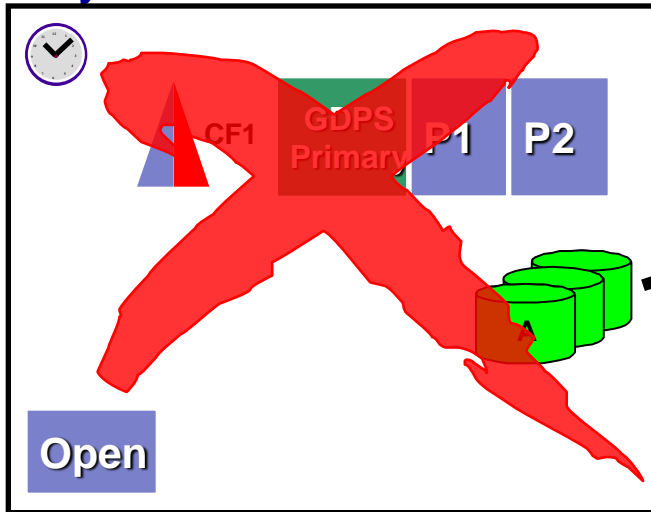


Remote Site 1

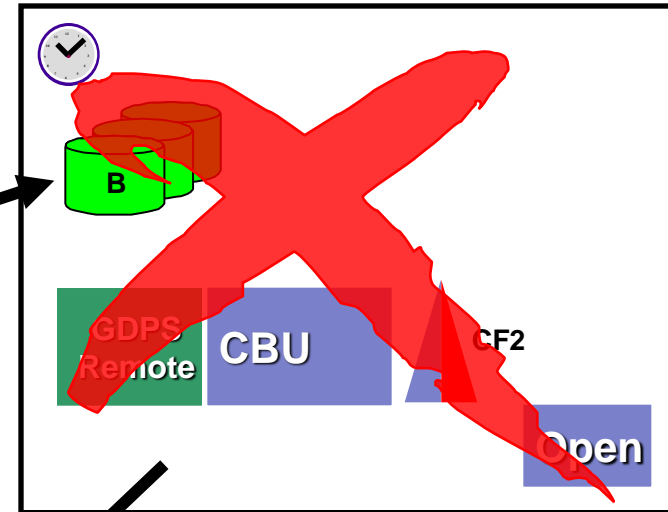
- Three-site solution
 - GDPS/PPRC = Site 1 and 2
 - RPO = 0
 - RTO = Restart of systems
 - Distance is limited
 - GDPS/XRC = Site 2 and 3
 - RPO = 3-5 seconds
 - RTO = Restart of systems
 - Distance is unlimited

Tertiary for GDPS/GM and GDPS/zGM

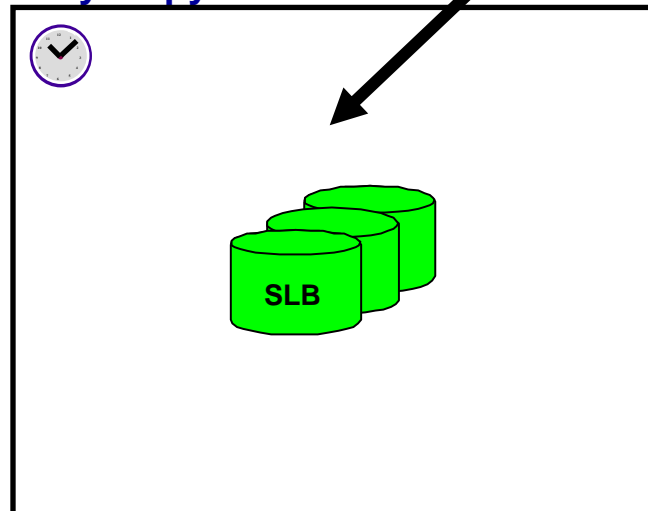
Primary Site



Remote Site



Tertiary Copy



IBM Disaster Recovery Solution - Summary



- 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 Disaster Restart
 - Coordinated IMS and DB2 Disaster Restart
 - GDPS and Storage Mirroring
- IMS *Restart & Recovery* Solution
 - IMS system and databases are mirrored to remote site
 - Additional transmitted data allows for forward recovery