Simplify and Improve IMS Administration by Leveraging Your Storage System

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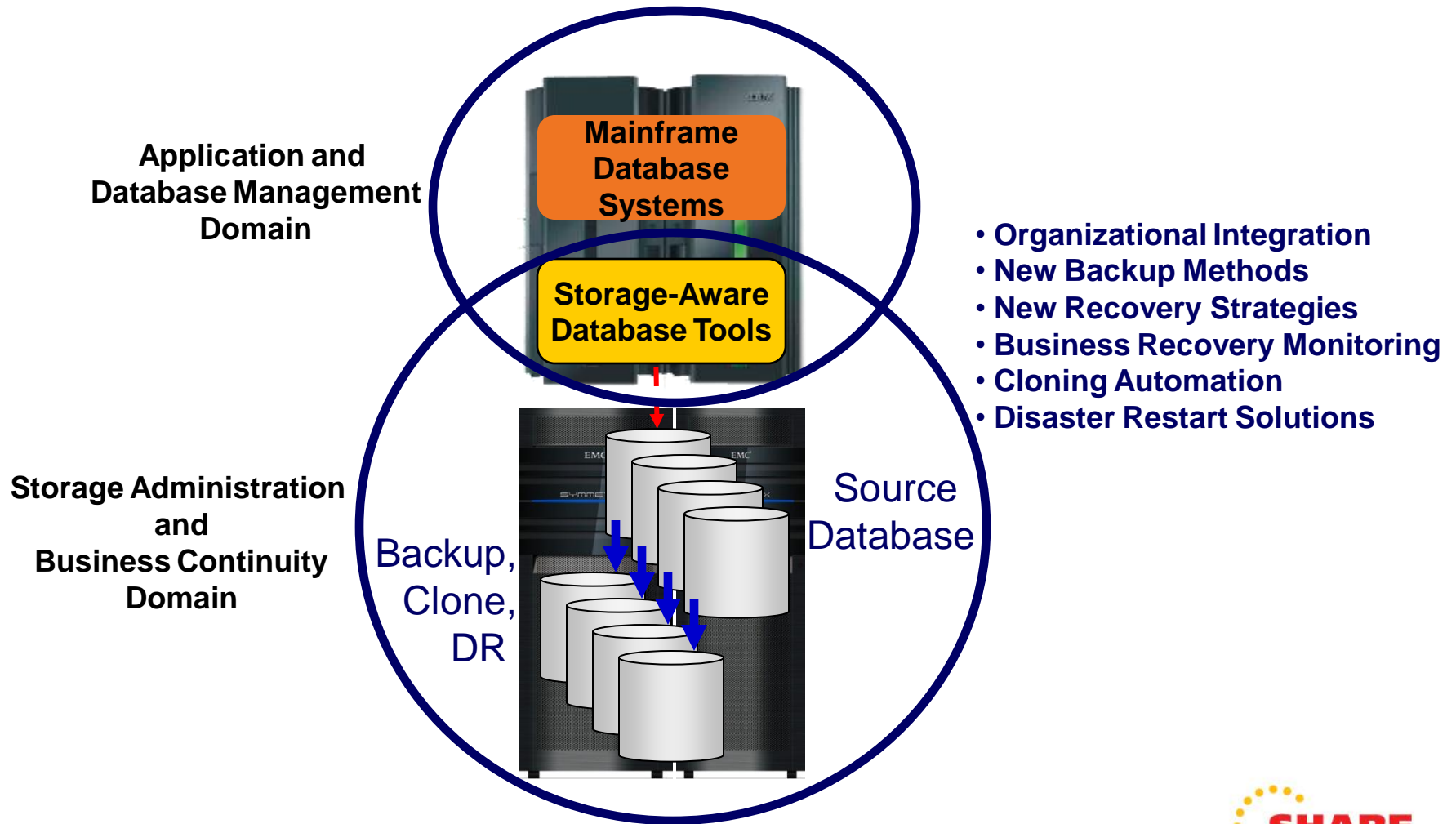August 9, 2011
Session Number: 9406

Session Agenda

- IMS Database and Storage Integration Overview
- IMS System Level Backup Methodologies and Storage System Integration
- Cloning IMS Systems Using Storage-Based Fast-replication
- Refreshing IMS Databases by Leveraging Your Storage Facilities
- IMS Storage-Aware Database Products
- Implementation Planning Considerations
- Session Summarization

Database and Storage Administration
Trends and Directions

- Large IMS systems require high availability
  - Fast and non-intrusive backup and cloning facilities are required
  - Fast recovery capabilities minimize downtime and promote high availability
  - Most backup, recovery and cloning solutions do not leverage storage-based fast-replication facilities
- Storage-based fast-replication facilities are under-utilized
  - Tend to be used by storage organizations
  - Tend not to be used by database administrators (DBAs)
- Storage-aware database products allow DBAs to use fast-replication in a safe and transparent manner
  - Provides fast and non-intrusive backup and cloning operations
  - Simplifies recovery operations and reduces recovery time
  - Simplifies disaster recovery procedures

Database and Storage Integration

Application and
Database Management
Domain

Mainframe Database Systems

Storage-Aware Database Tools

• **Organizational Integration**
• **New Backup Methods**
• **New Recovery Strategies**
• **Business Recovery Monitoring**
• **Cloning Automation**
• **Disaster Restart Solutions**

Storage Administration
and
Business Continuity
Domain

Source
Database

Backup,
Clone,
DR

Database and Storage Integration
Operational Advantages

- Reduce backup, recovery, and cloning administration costs
- Reduce host CPU and I/O resource utilization
- Perform backups and create clone copies instantly
- Reduce recovery time with fast restore and parallel recovery
- Simplify disaster recovery operations and procedures
- DBMS and storage-based fast-replication integration
  - Leverage storage processors and fast-replication investments
    - IBM, EMC, HDS, STK
  - Expose fast-replication capabilities to DBAs *safely and transparently* using "*storage-aware*" database utilities
- Provide a sophisticated infrastructure and metadata to manage the IMS and storage processor coordination

Database and Storage Integration
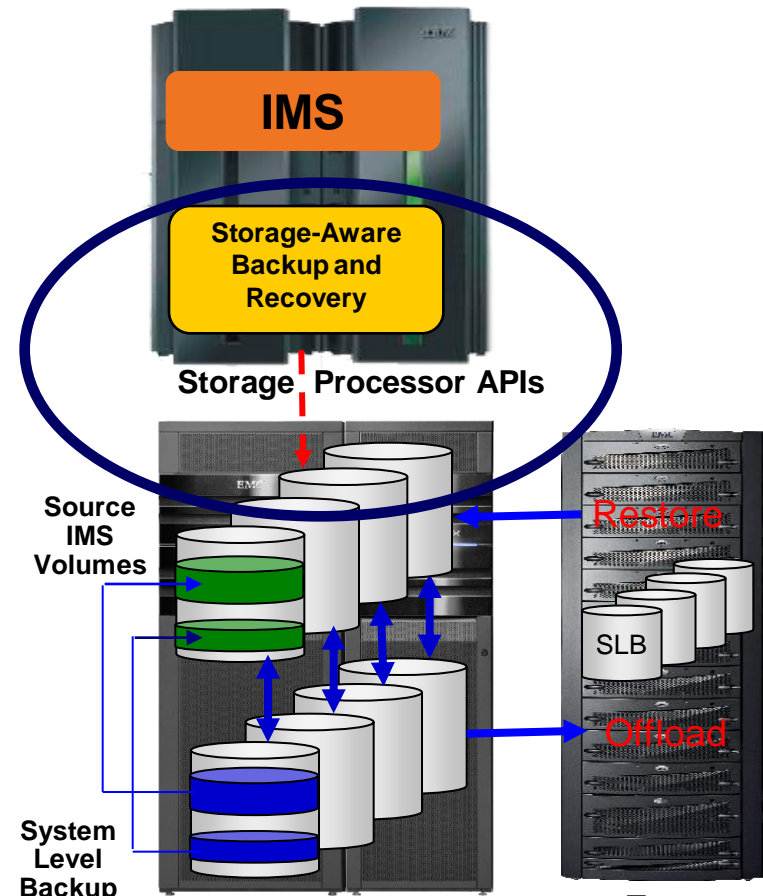## New Solutions for DBAs to Consider

- DBAs use traditional IMS backup and recovery tools
  - Hard to integrate new backup and recovery methodologies
  - Uncomfortable with new backup and recovery solutions
- Lack of IMS and storage-administration coordination
  - Storage processor fast-replication facilities are not well understood by application and DBA personnel
    - *DBAs don't trust storage technologies*
  - IMS applicability of fast-replication not well understood by storage administrators
    - *Storage groups don't trust DBAs*
- Storage-aware IMS utilities resolve these issues

IMS System Level Backup

- Backup complete IMS systems as a unit without affecting running applications
    - IMS backup components include:
        - Active and archive logs
        - RECONs
        - All IMS database data sets
        - IMS system data sets including ACBLIBs, DBDLIBs, PGMLIBs, etc.
        - All associated ICF User catalogs
    - Backups performed instantly using storage-based fast-replication
- System level backups are the foundation for federated backup and recovery solutions
- System backup and cloning methodologies are difficult to implement without sophisticated automation
    - "Split-mirror" backup methodologies pioneered in late 1990s
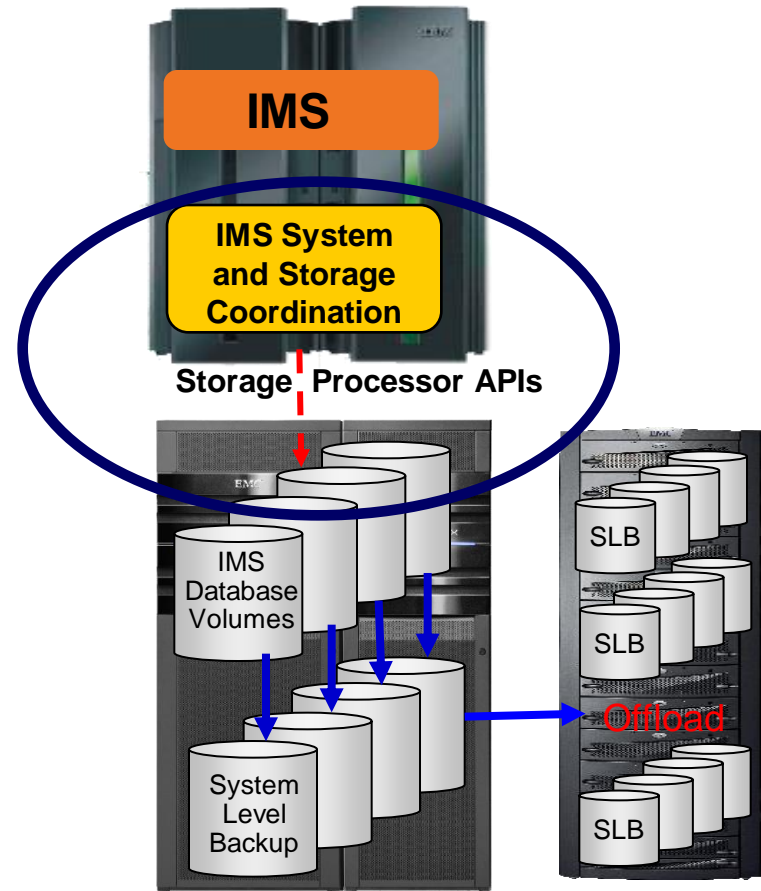   - Valuable concept but hard to implement

IMS System Level Backup
Functional Requirements

- Integrate IMS backup, restore, and recovery process with storage-based fast-replication
- Provide easy and fast backup and restore of IMS systems and applications
- Support common storage systems
    - IBM – FlashCopy (FC)
    - EMC – TimeFinder/Mirror/Clone/Snap, FC
    - HDS – Shadow Image, FC
- Feature requirements include:
    - Database system discovery and configuration management
    - Database system backup and recovery operations
    - System backup validation
    - Object and application recovery
    - Active metadata repository
    - Encrypted tape offload support
    - DR preparation and management

IMS

Storage-Aware Backup and Recovery

Storage Processor APIs

Source IMS Volumes

Restore

SLB

Offload

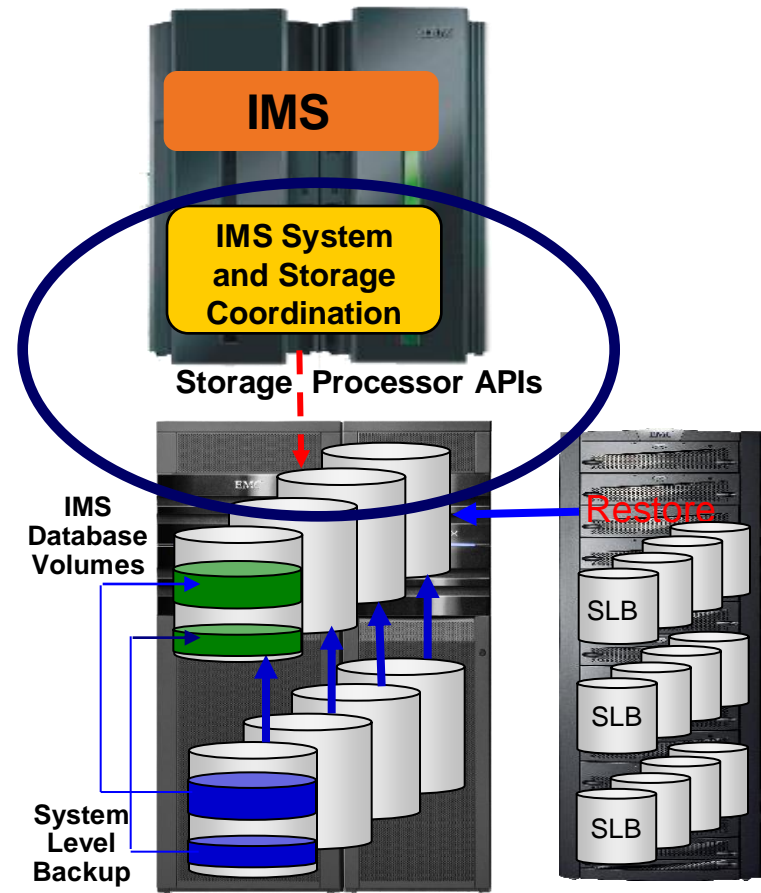System Level Backup

Tape Processing

IMS System Level Backup

- Storage-based backup reduces processing and administration costs
- Fast-replication is used to perform IMS backup and restore functions
  - Full system backups complete in seconds
  - Backup performed without host CPU or I/O
- Backup groups of databases with no application affect or down time
  - Backup windows are reduced or eliminated
  - Extend online or batch processing windows
- Data consistency ensured
  - IMS suspend process
  - Storage-based consistency functions
- Automated backup offload management

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IMS System and Storage Coordination

Storage Processor APIs

IMS Database Volumes

System Level Backup

SLB

SLB

Offload

SLB

Tape Processing

IMS System Level Backup
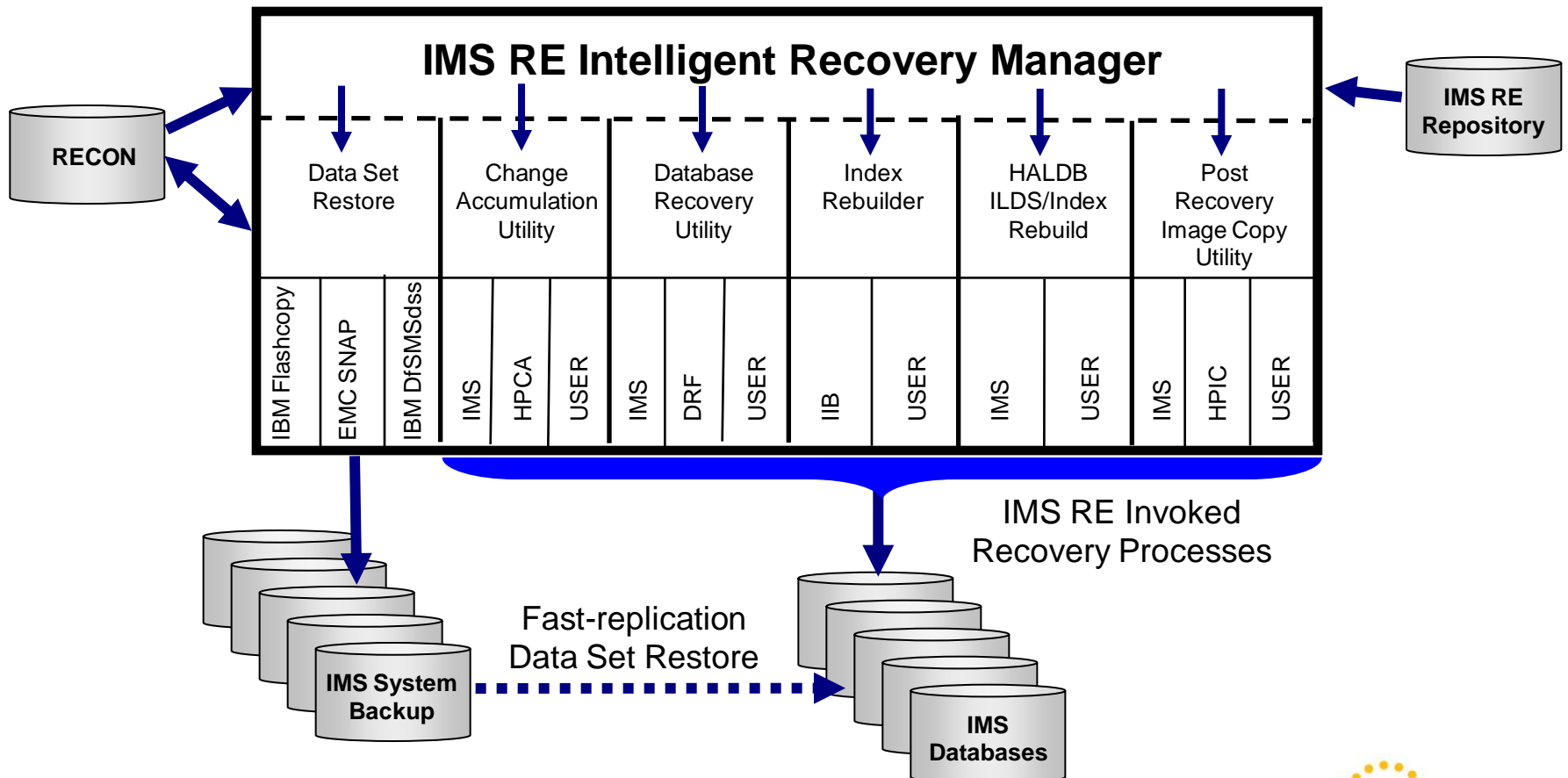## System and Application Recovery

- Recover IMS systems or databases from disk or tape automatically
- Faster recovery
  - Instantaneous system-restore process
  - Coordinated parallel restore and recovery operations minimize down time
- IMS system backup can be used for database or application recovery
  - Data sets snapped to restore data
  - Parallel log apply reduces recovery time
- One system backup used for system, application, disaster recovery

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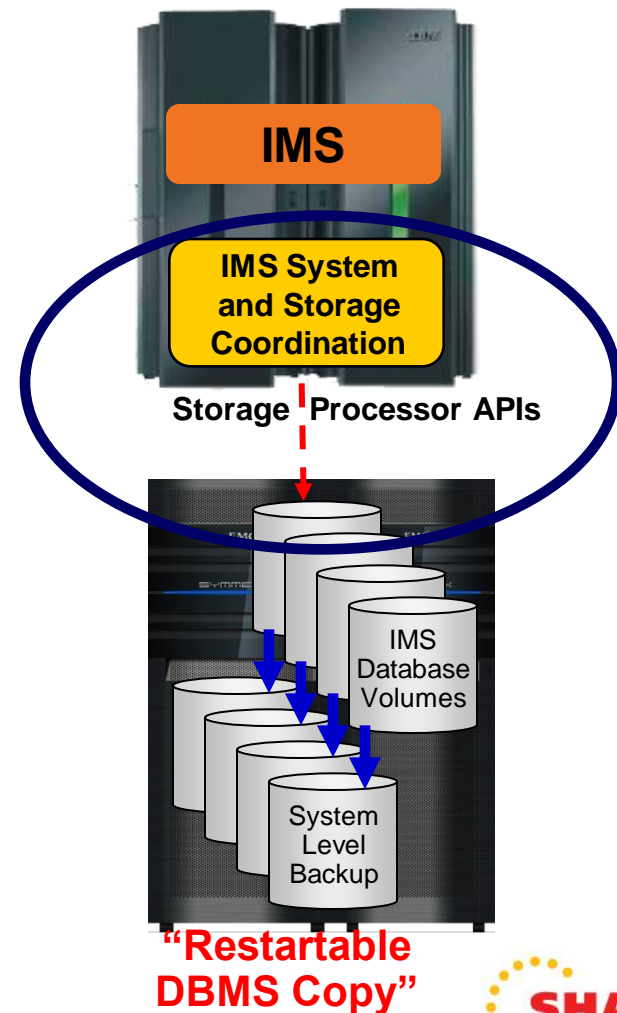**IMS System and Storage Coordination**

Storage Processor APIs

IMS Database Volumes

Restore

SLB

SLB

SLB

System Level Backup

Tape Processing

IMS Recovery Expert
Storage Integrated IMS Recovery Example

IMS RE Application Recovery

IMS RE Intelligent Recovery Manager

RECON

IMS RE Repository

Data Set Restore			Change Accumulation Utility			Database Recovery Utility			Index Rebuilder		HALDB ILDS/Index Rebuild		Post Recovery Image Copy Utility		
IBM Flashcopy	EMC SNAP	IBM DfSMSdss	IMS	HPCA	USER	IMS	DRF	USER	IIB	USER	IMS	USER	IMS	HPIC	USER

IMS RE Invoked Recovery Processes

IMS System Backup

Fast-replication Data Set Restore

IMS Databases

11

IMS System Level Backup
Disaster Recovery Benefits

- Simplifies disaster recovery operations
  - System-level backup for restart
  - System-level backup and roll forward
- System backup is "restartable"
  - Restore volumes containing the last SLB
  - Performs recovery during normal database initialization process
  - Disaster recovery is as simple as restarting from a power failure
- Reduced recovery time at a DR site
- Transforms tedious disaster recovery procedures into a tape-based disaster restart process
  - Tape-based disaster restart solutions provide similar benefits as storage-based remote replication solutions
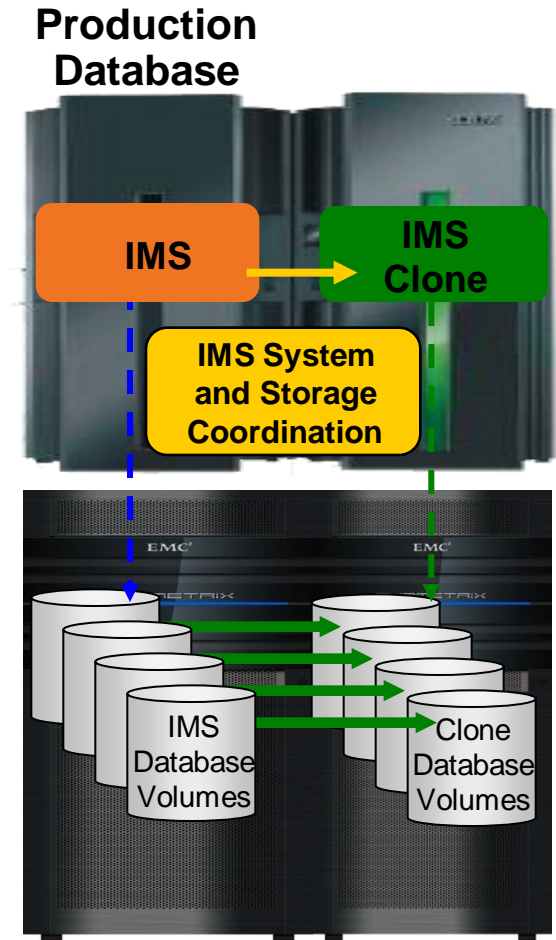
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IMS System and Storage Coordination

Storage Processor APIs

IMS Database Volumes

System Level Backup

"Restartable DBMS Copy"

IMS System Level Backup
Storage Benefits

- IMS system backup used for multiple functions
  - Saves storage and processing resources
- Leverages storage-processor and fast-replication software investments
- Expose fast copy capabilities to DBAs *safely and transparently* using "storage aware" database utilities
- Provides a sophisticated infrastructure and metadata to manage database and storage processor coordination
- Multiple storage vendor support
  - IBM – FlashCopy
  - EMC – TimeFinder/Mirror/Clone, FlashCopy
  - Hitachi – ShadowImage, FlashCopy
  - IBM RAMAC Virtual Array, STK – SnapShot

DBA Domain

IMS

Storage-Aware Database Tools

IMS Database Volumes
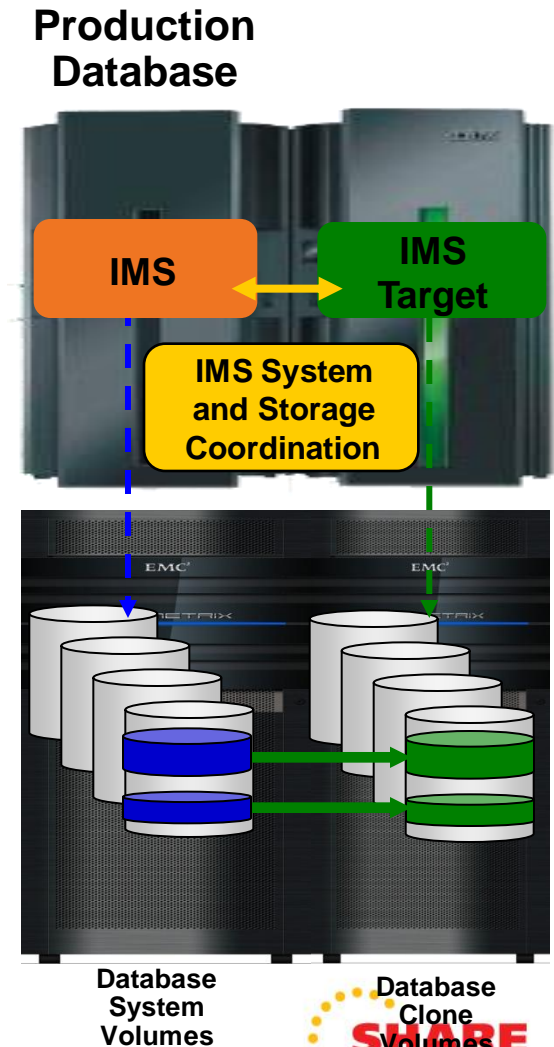
System Level Backup

Storage Domain
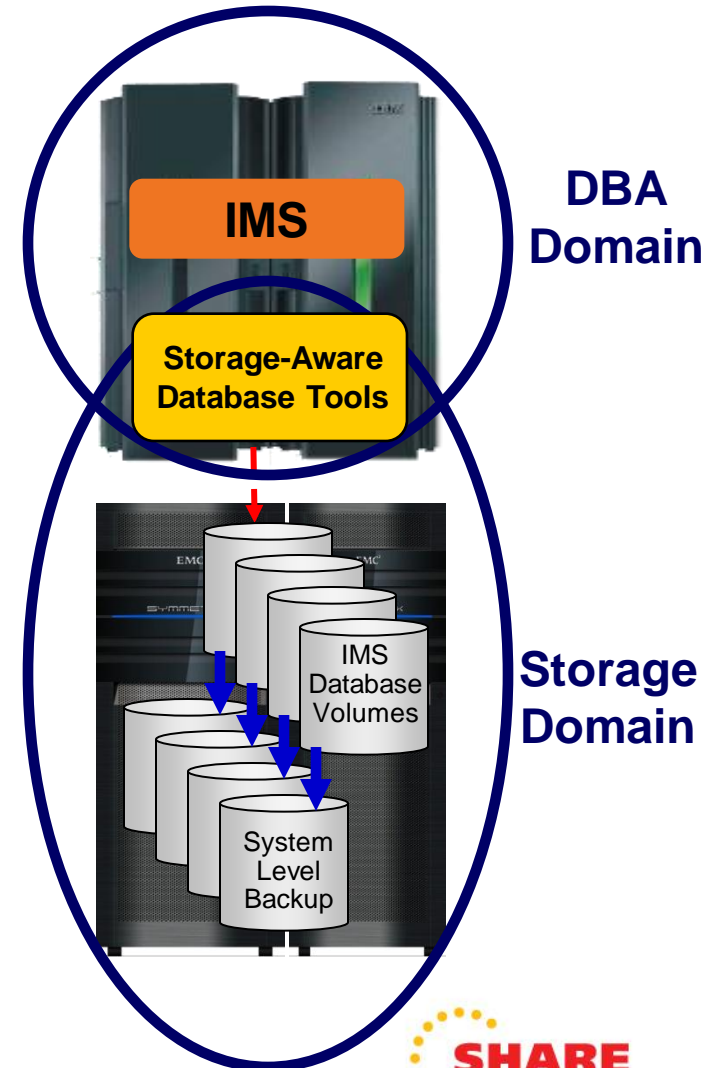
Cloning IMS Systems

- Performs IMS cloning automation
  - Simplifies IMS system cloning processes
  - Reduces cloning time and administration costs
- Leverages fast-replication facilities to clone data
  - Data can be cloned while on-line or off-line
- Performs rapid volume reconditioning and data-set renaming on cloned IMS volumes
  - Critical component of the IMS system cloning process
- Adjusts target IMS system to accommodate and accept the cloned data
  - IMS RECONs, PROCLIB, JOBS, JCL, MDA members

Production Database

IMS

IMS Clone

IMS System and Storage Coordination

IMS Database Volumes

Clone Database Volumes

Refreshing IMS Databases

- Performs automated IMS database refresh operations
  - Fast refresh of IMS databases
  - IMS DB support (FF, HALDB, DEDB)
- Verifies source and target database compatibility
- Databases copied using storage-based data set fast-replication
  - Target takes up the same amount of space as the source
- Performs target system metadata management

Production Database

IMS

IMS Target

IMS System and Storage Coordination

Database System Volumes

Database Clone Volumes

Implementation Planning Considerations

- System level backup usage
  - Determine how IMS SLB(s) will be used
- SLB type
  - Determine full, data-only, or partial SLB requirements
- Backup frequency and space utilization
  - Determine backup frequency and performance and space efficient fast-replication requirements
- Copy blade selection
  - Determine storage processor capabilities, available facilities and fast-replication preferences
- Disaster restart considerations
  - Determine offsite disaster restart resources and preferences (RTO, RPO) to define appropriate disaster recovery profiles

Implementation Planning
Partial System-Level Backup

- Partial system-level backup (PSLB)

  - Backup volumes representing a subset of the IMS system
    - PSLBs used for database or application recovery <u>only</u>
    - Data set fast replication used to restore data
    - Log and data isolation not required
    - Desired IMS databases data should be grouped on volumes as a best practice
  - PSLB <u>cannot</u> be used for system recovery
    - System recovery requires all volumes in SLB
  - PSLB usage
    - Large databases or applications having unique backup requirements
    - Reduce disk utilization
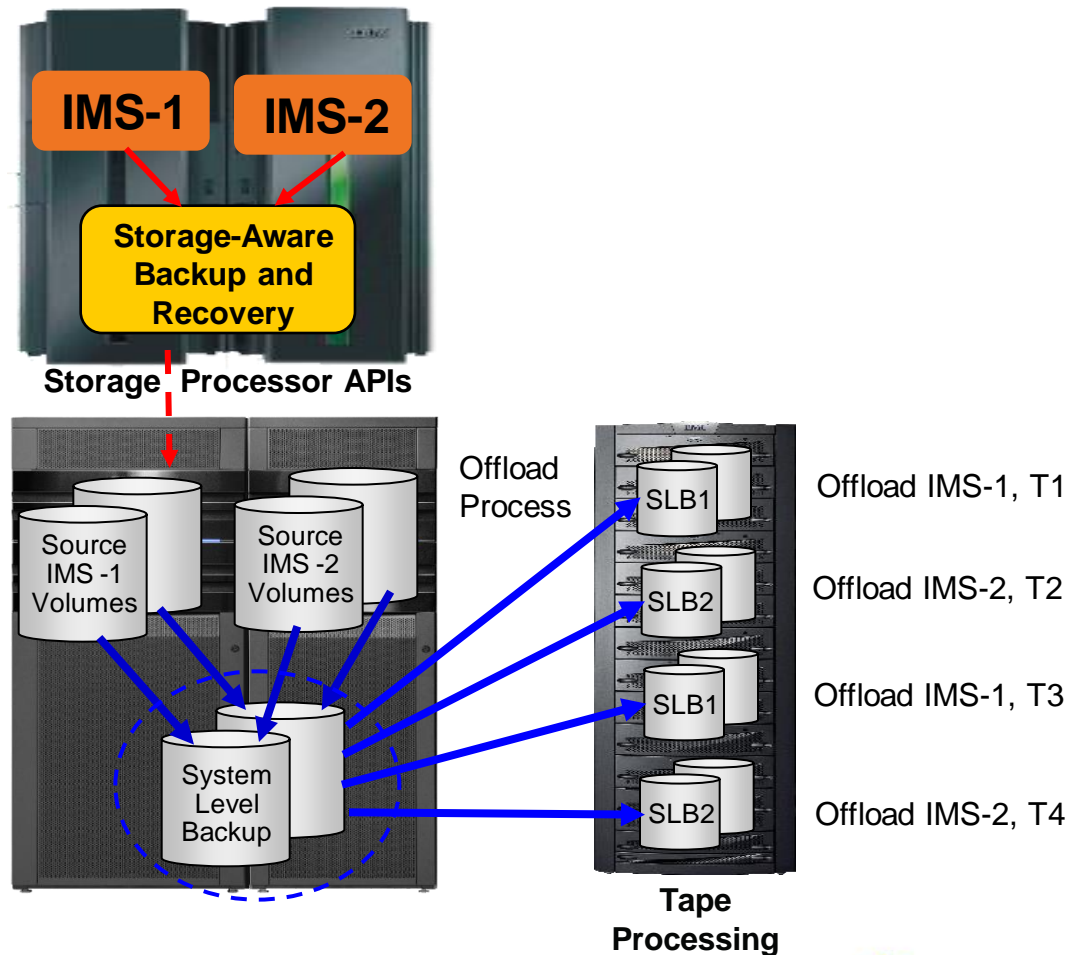   - Support more backup generations

Implementation Planning
Backup Frequency and Space Utilization

- SLB type: Full, Data only, or Partial
- Determine optimal backup frequency
- Determine number of backups to keep online (on disk)
- Establish online backup duration requirements
  - SLB or PSLB used for IC creation may be deleted after ICs complete
- Determine offline (tape) backup requirements
- Consider incremental fast-replication options to reduce background copy time and resources
- Consider using space-efficient fast-replication methods like EMC VDEVs to save space
- Consider using one set of volume targets to support multiple IMS systems
  - Saves fast-replication target volume (DASD) requirement
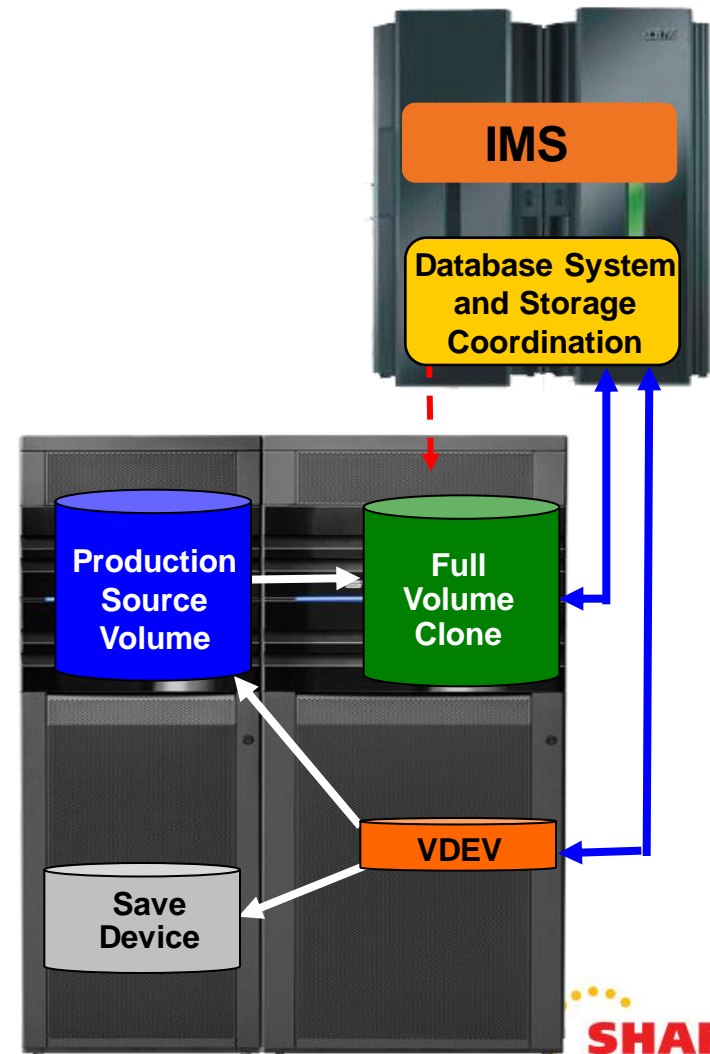- Consider cloning database systems to space efficient volumes using a SLB as the source

One Set of Backup Volumes for Multiple IMS Systems

- Backup IMS–1
  - SLB-1 created on disk
  - Archive SLB-1
  - Backup volumes are available after archive completes

- Backup IMS–2
  - SLB-2 created on disk
  - Archive SLB-2
  - Backup volumes are available after archive completes

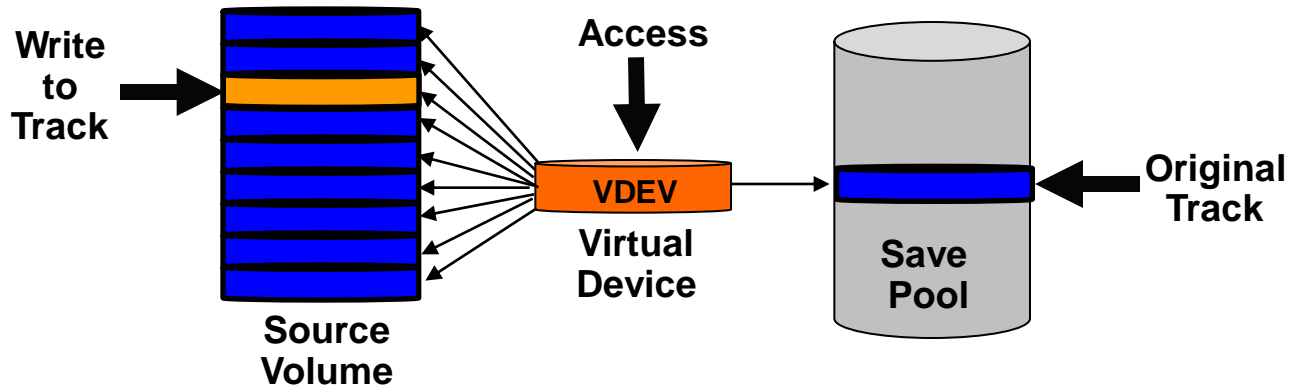- Repeat for IMS-1
- Repeat for IMS-2

IMS-1   **IMS-2**

Storage-Aware Backup and Recovery

Storage Processor APIs

Source IMS -1 Volumes

Source IMS -2 Volumes

System Level Backup

Offload Process

SLB1 — Offload IMS-1, T1

SLB2 — Offload IMS-2, T2

SLB1 — Offload IMS-1, T3

SLB2 — Offload IMS-2, T4

Tape Processing

Create SLBs and Clone IMS Systems
Full and Space Efficient Volumes

- EMC TimeFinder example
- TimeFinder/Clone
  - Full volume copy
  - Relationship can be retained with production volume
  - Allows TimeFinder/Clone incremental resynchronization
- TimeFinder/Snap Virtual Device (VDEV)
  - Space efficient copy
  - Allows TimeFinder/Snap incremental restore
  - Can have multiple TimeFinder/Snap volumes associated with production volume

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Database System and Storage Coordination

Production Source Volume

Full Volume Clone

VDEV

Save Device

TimeFinder/Snap VDEV Operation Overview

Write to Track → [Source Volume] **Access** ↓ [VDEV Virtual Device] → **Save Pool** ← **Original Track**

- The Snap target is accessible when the copy session is activated
- The first time a track on the source volume is written to:
  - Original data on the source volume is copied to a save volume (pool)
  - Pointer on the VDEV device is changed to point to the save pool
  - The host write is written onto the track of the source volume in cache
- The track on the source volume is then updated
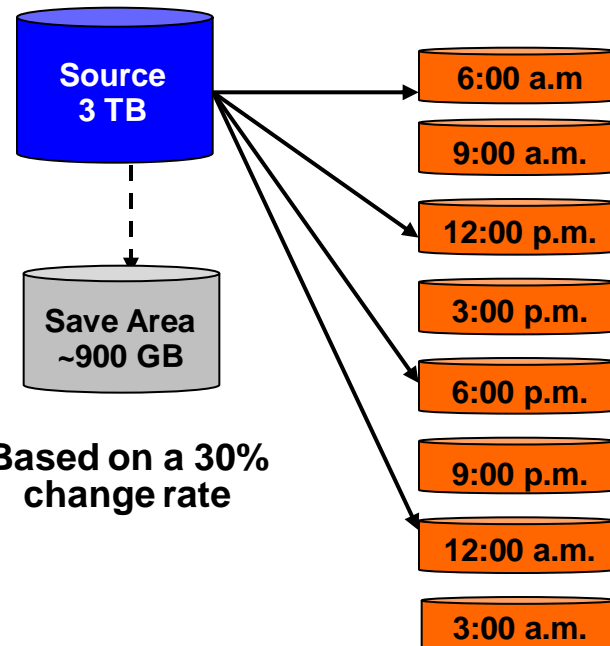- Unchanged data stays in place on the source volume

Space Efficient Usage Economics
Enable Frequent IMS SLB or Clone Copies

Full-volume SLB or clone copies

Source
3 TB

6:00 a.m.
3 TB

12:00 p.m.
3 TB

6:00 p.m.
3 TB

12:00 a.m.
3 TB
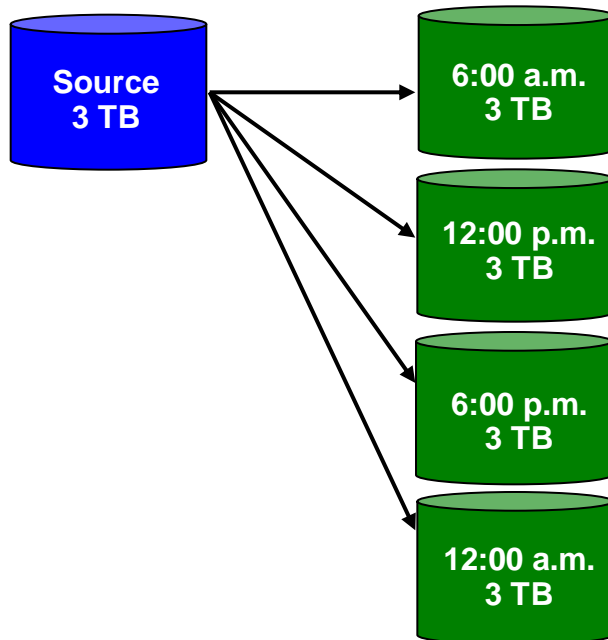
Requires <u>12 TB</u> of additional capacity

Space-efficient SLB or clone copies

Source
3 TB

Save Area
~900 GB

Based on a 30% change rate

6:00 a.m

9:00 a.m.
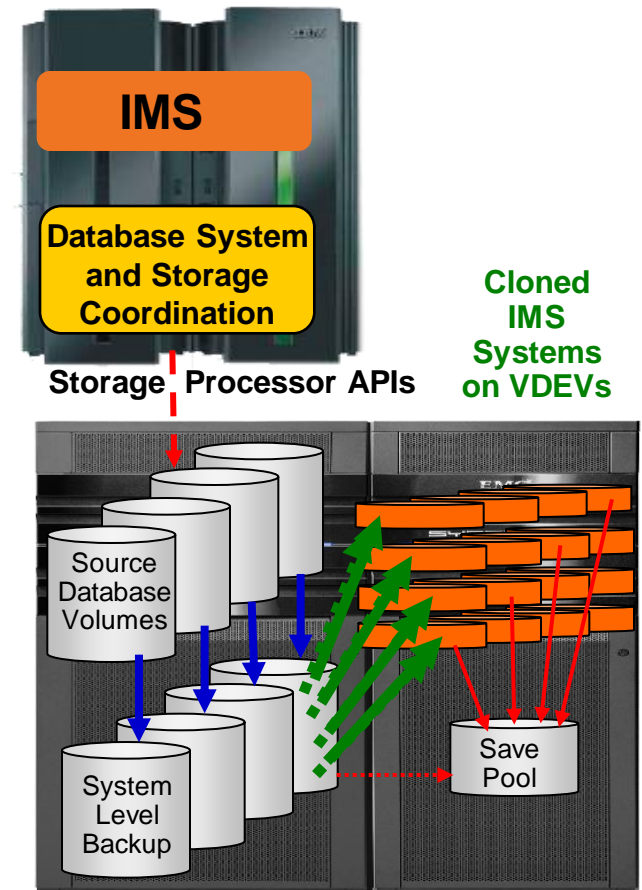
12:00 p.m.

3:00 p.m.

6:00 p.m.

9:00 p.m.

12:00 a.m.

3:00 a.m.

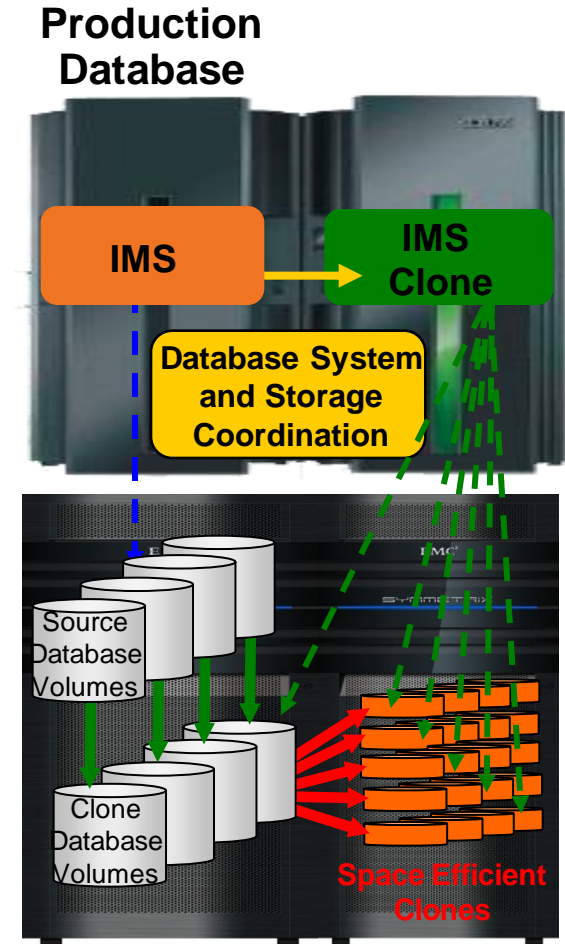Requires <u>~900 GB</u> of additional capacity

Full Volume and Space Efficient
Usage Example

- Full IMS system-level backup created using full volume fast-replication
- IMS clone operations performed using SLB backup volumes as source
- Cloned IMS systems use virtual storage devices (VDEVs)
  - IMS SLB volumes are used to service I/O for IMS clone access
  - IMS clone writes (few) go to save pool
  - IMS SLB writes (none) go to save pool
- Storage-aware database tools provides infrastructure and metadata to manage IMS and storage processor coordination

IMS

Database System and Storage Coordination

Cloned IMS Systems on VDEVs

Storage Processor APIs

Source Database Volumes

System Level Backup

Save Pool

Full Volume and Space Efficient
Usage Example (2)

- Perform full volume IMS cloning automation
  - Requires same amount of space as the source
- Perform space efficient clone operations
  - Use full volume clone as the source
  - No real space used for space efficient clones unless they are updated
- Operational automation may be required to re-instantiate space efficient clones when the full volume clone is re-instantiated

Production Database

IMS → IMS Clone

Database System and Storage Coordination

Source Database Volumes

Clone Database Volumes

Space Efficient Clones

Implementation Planning
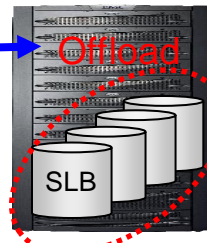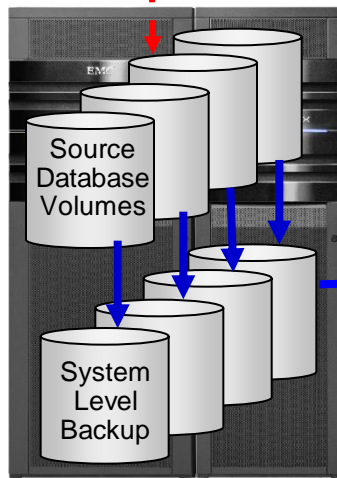## Disaster Restart Considerations

- SLB should contain IMS data only
  - Can contain other data that is restarted together
    - Recovering IMS and other data together may require using a storage based consistency function to create the SLB
    - Cannot roll forward if IMS and other data require consistency
- Use disaster recovery profiles to prepare for roll forward recovery at the DR site
  - Disaster recovery profiles specify options on how to copy log data for DR site, etc.
  - Ensure DBRs Disaster Recovery PDS is taken offsite with archive logs and image copies
  - Reduces Recovery Point Objectives (RPO)

Using IMS SLBs for a Tertiary DR Site

Primary Production Site

Secondary Production Site

IMS

Storage-Aware Backup and Recovery

Storage Processor APIs

Remote Replication
PPRC, SRDF

Primary Disaster Restart Site
(remote disk-based disaster restart)

Source Database Volumes

System Level Backup

Offload

SLB

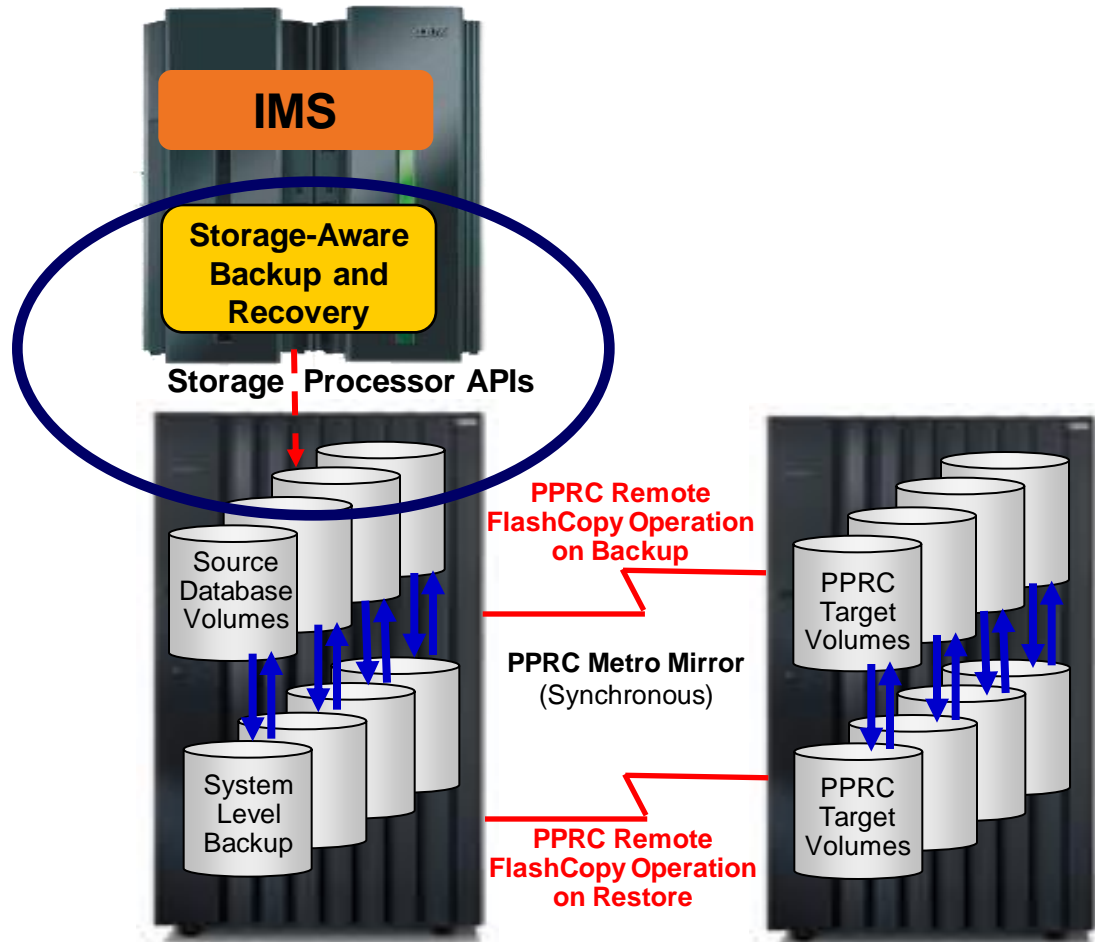**Tape Processing**

Tertiary Production Site

PTAM

Secondary Disaster Restart Site
(tape-based Disaster restart)

System Level Backup With Remote Mirror FlashCopy

- FlashCopy data is not copied over PPRC links

- SLB drives remote pair FlashCopy operation
  - Remote PPRC production volumes Flashed to remote PPRC SLB volumes

- System level restore drives remote pair FlashCopy operation
  - Remote PPRC SLB volumes Flashed to remote PPRC production volumes

- EMC Simultaneous Clone supported similar to PPRC

27

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Storage-Aware Backup and Recovery

Storage Processor APIs

Source Database Volumes

System Level Backup

PPRC Remote FlashCopy Operation on Backup

PPRC Metro Mirror (Synchronous)

PPRC Target Volumes

PPRC Target Volumes

PPRC Remote FlashCopy Operation on Restore

Implementation Planning
Copy Blade Selection

- Know your storage processing infrastructure
  - What storage processors are used (EMC, IBM, HDS)
  - What fast-replication facilities are licensed and preferred
- Determine storage blade and fast-replication facilities to use
  - DFSMSdss Blade
  - IBM FlashCopy Blade
  - EMC TimeFinder Blade
  - HDS ShadowImage Blade
- Know the type of consistency function is best for your environment
  - IMS Suspend, Storage-based consistency

Session Summarization

- IMS storage-aware database utilities provide storage integration to simplify database administration tasks
- IMS system backup solutions leverage storage-based fast-replication facilities and investments
  - Fast and non-intrusive backup operations with less administration
  - Reduces host CPU, I/O and storage utilization
  - Backups can be used for system, application, disaster restart
  - Parallel recovery reduces system and database recovery time
- IMS system cloning automaton allows production data to be leveraged easily and effectively
- IMS databases refreshed easily
- Fewer skills required to implement advanced IMS backup, recover, disaster recovery, and cloning solutions
- Implementation planning is important to optimize the benefits