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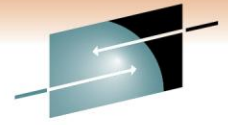
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Simplify and Improve DB2 Administration by Leveraging Your Storage System

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Rocket Software, Inc.

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Session Number 8404





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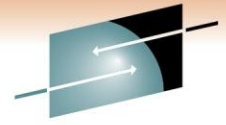
Session Agenda

- Database and Storage Integration Overview
- DB2 System-Level Backup Methodologies and Storage Integration Considerations
- Cloning DB2 Systems Using Storage-Based Fast Replication
- Refreshing DB2 Table and Index Spaces by Leveraging Your Storage Facilities
- Storage-Aware DB2 Product Examples
- Implementation Planning Considerations
- Session Summarization

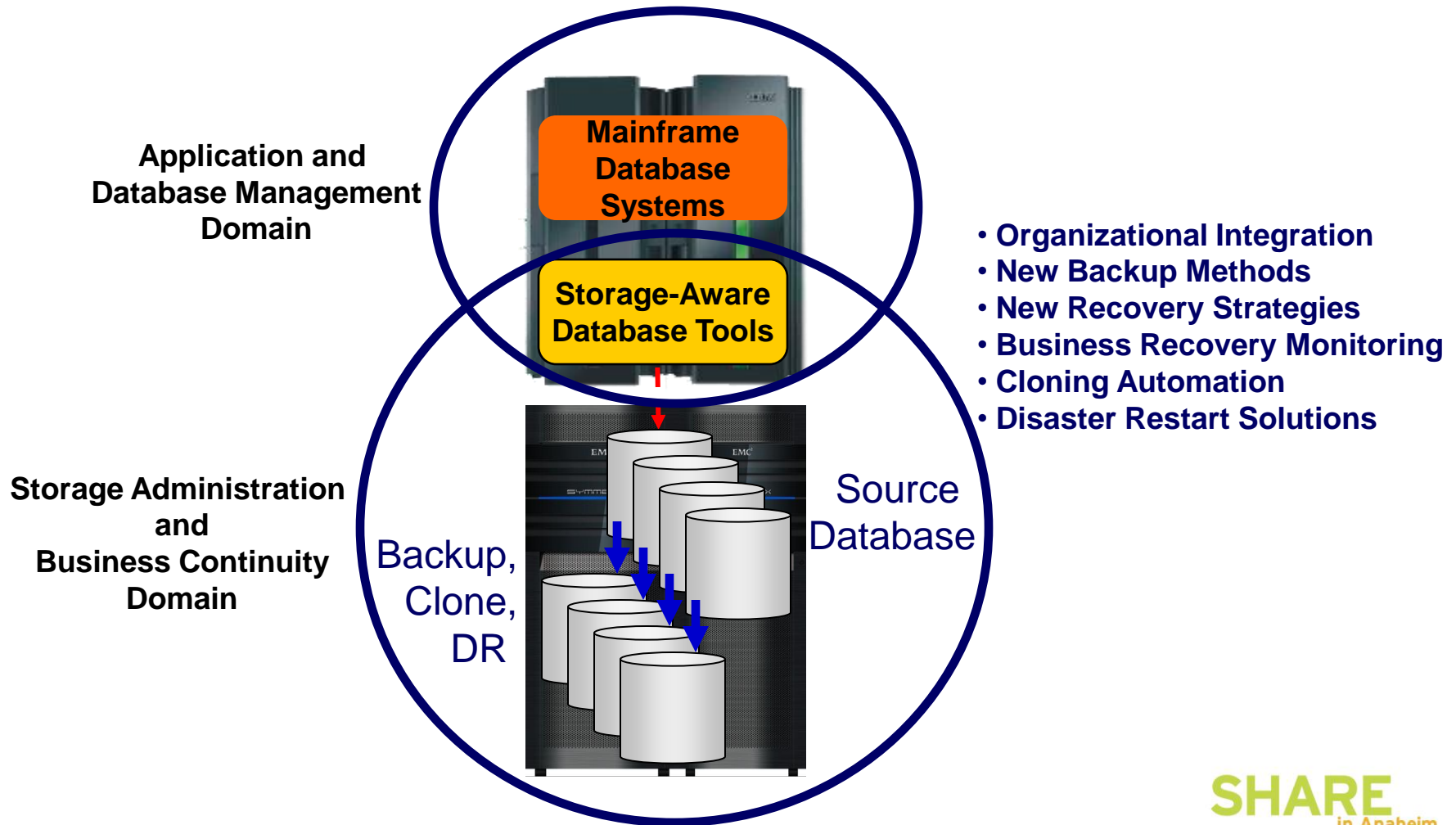
Database and Storage Administration Trends and Directions



- Large DB2 systems require high availability
 - Fast and non-intrusive backup and cloning facilities are required
 - Fast recovery capabilities are required to 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



Database and Storage Integration

Operational Advantages



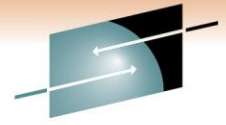
- Reduce backup, recovery, and cloning administration costs
- Reduce host CPU and I/O resource utilization
- Perform backups and create clone copies instantly
- Fast restore and parallel recovery reduces recovery time
- Simplify disaster recovery operations and procedures
- DBMS and storage-based fast-replication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

Database and Storage Integration

New Solutions for DBAs to Consider



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

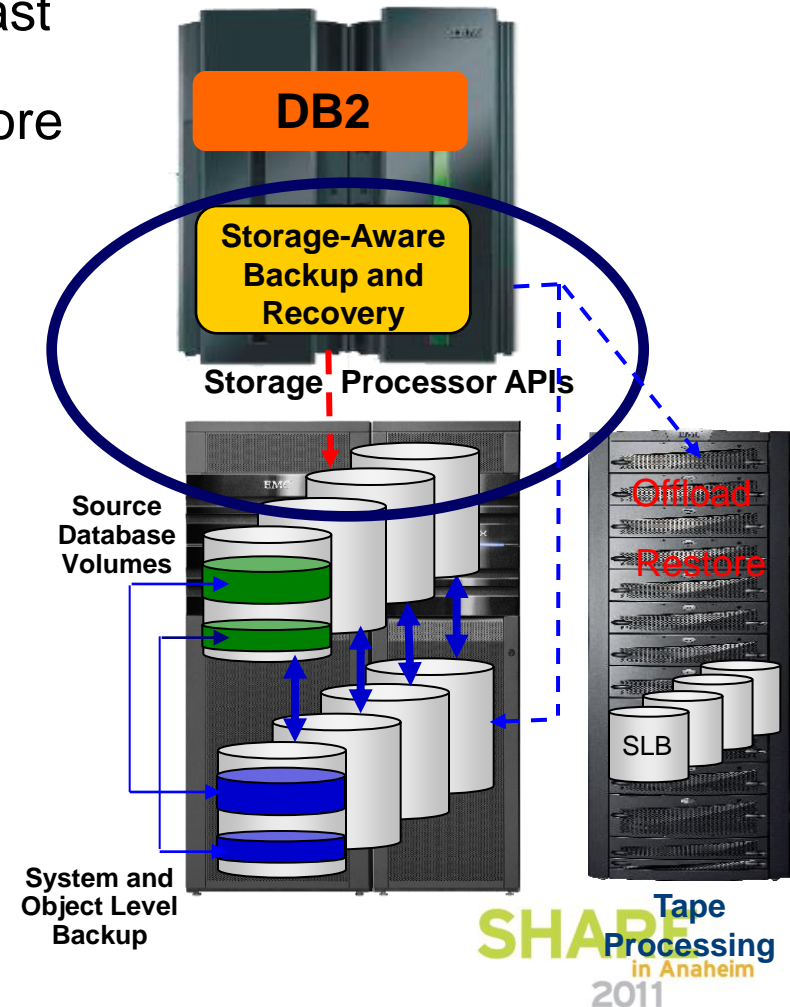


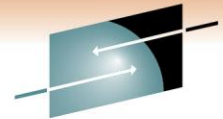
System Level Backup Methodologies

- Backup complete database systems as a unit without affecting running applications
 - Backup components include:
 - Active and archive logs
 - Recovery metadata
 - All database data sets
 - Appropriate libraries, and system data sets
 - 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

Storage-aware DB2 Backup Functional Requirements

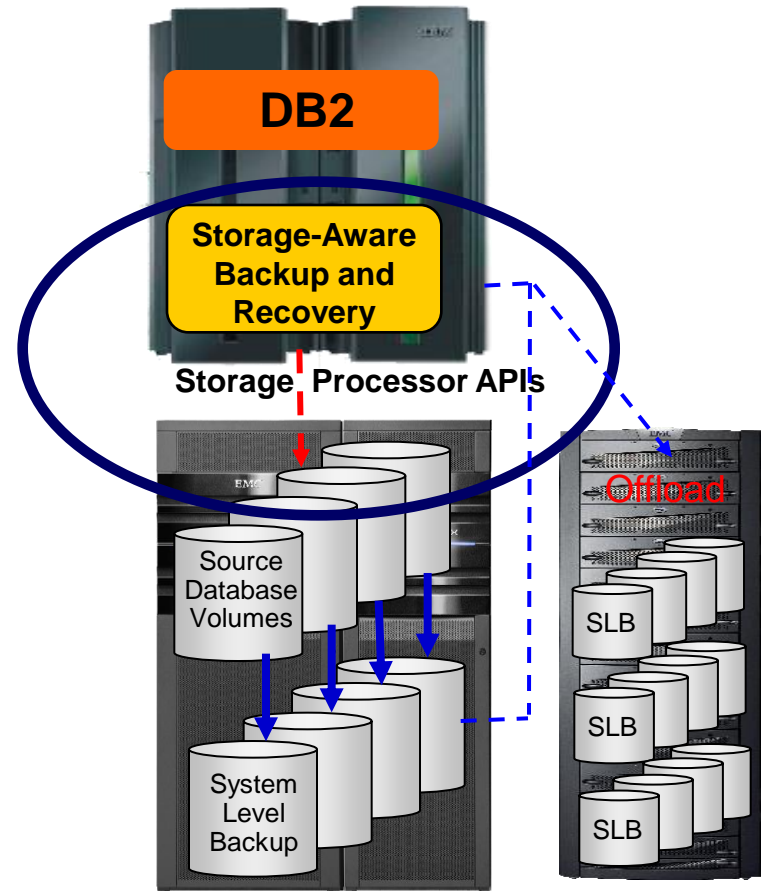
- Integrate DB2 backup, restore, and recovery process with storage-based fast replication
- Provide easy and fast backup and restore of DB2 systems and applications
- Support common storage systems
 - IBM – FlashCopy (FC)
 - EMC – TimeFinder/Mirror/Clone/Snap, FC
 - HDS – Shadow Image, FC
- Feature requirements include:
 - DB2 system discovery and configuration management
 - DB2 system backup and recovery operations
 - System backup validation
 - Application and object data set backup
 - Image copy creation
 - Object and application recovery
 - Active metadata repository
 - Encrypted tape offload support
 - DR preparation and management





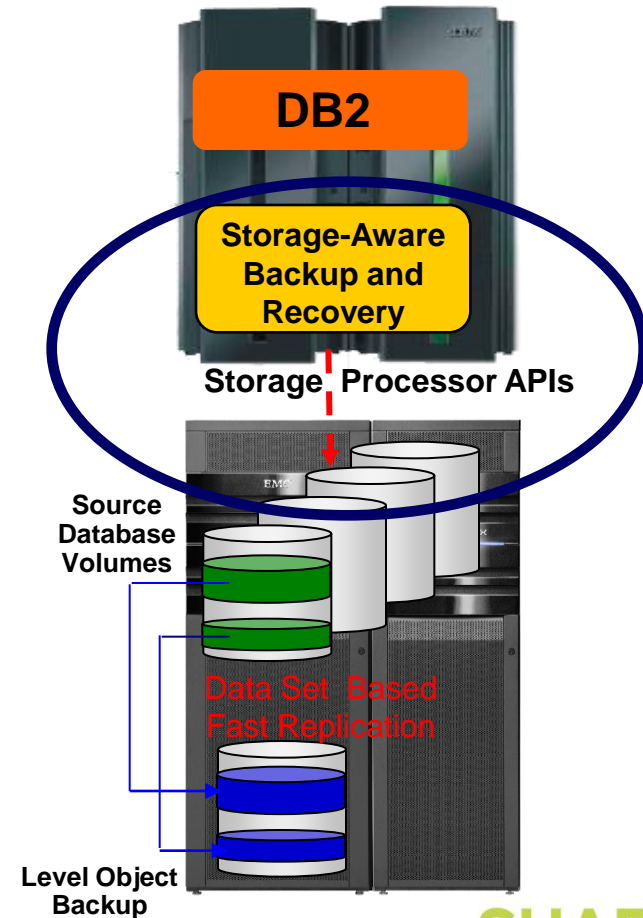
DB2 System Level Backup

- Storage-based backup reduces processing and administration costs
- Fast replication is used to perform database backup and restore functions
 - Full system backups complete in seconds
 - Backup performed without host CPU or I/O
- Back up large 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
 - Database suspend process
 - Storage-based consistency functions
 - DB2 BACKUP SYSTEM
- Automated backup offload management



DB2 Application and Object Backup Using Data Set Based Fast-Replication

- DB2 backups performed at application or object level
- Supports share levels reference and change
- Backups performed using data set fast replication facilities
- Backups can be registered in repository and used for fast restore and parallel recovery
- DB2 image copies can be created and registered

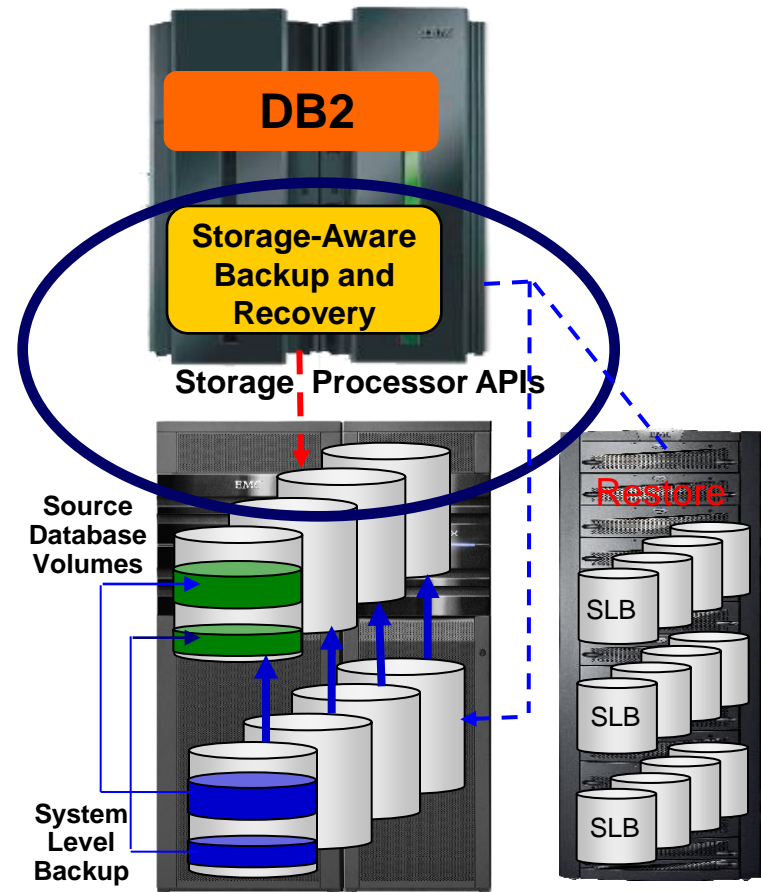


DB2 Image Copy Creation

- Image copies created from a system level backup
 - Image copies can be created and registered in DB2 syscopy
 - Eliminates I/O contention to maintain production performance
 - All image copies created at the same point in time
 - Reduces recovery time
- Image copy created from a data set fast-replication
 - Can be share level change or reference
 - Share level reference performs tablespace quiesce before data set fast-replication operations
 - Copies can be deleted after image copy creation
 - Fast-replication backups can be persistent, registered in repository, and used for restore and recovery operations

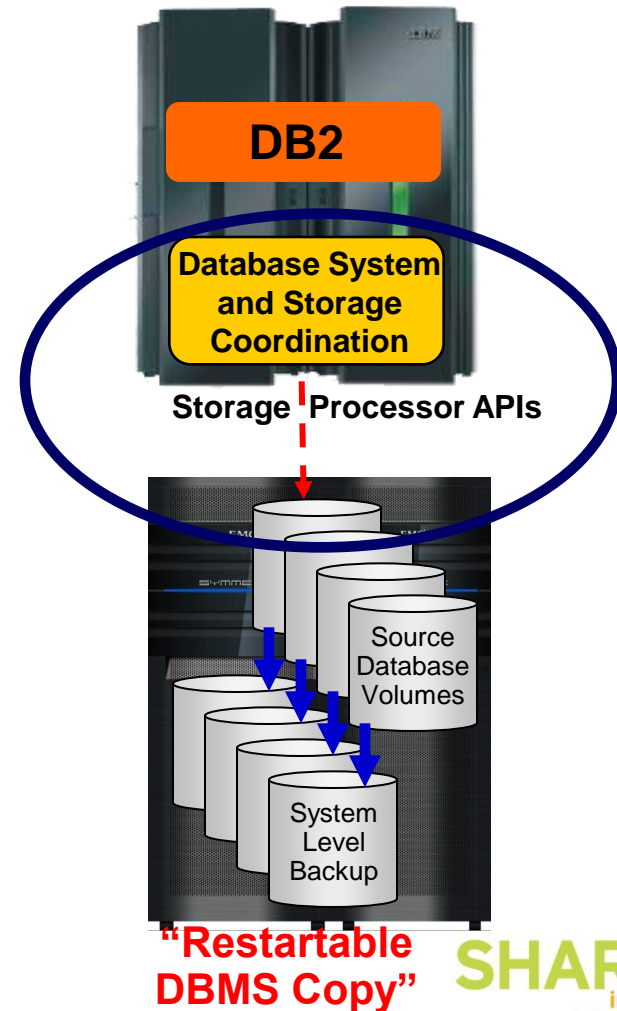
DB2 System Level Backup System and Application Recovery

- Recover DB2 systems or application objects from disk or tape automatically
- Intelligent Recovery Manager invoked to optimize recovery plans
- Faster recovery
 - Instantaneous system-restore process
 - Coordinated and parallel restore and DBMS recovery operations minimize system downtime
- DB2 system backup can be used for object or application recovery
 - Data sets snapped to restore data
 - Parallel log apply reduces recovery time
- One system backup used for system, application, and disaster recovery



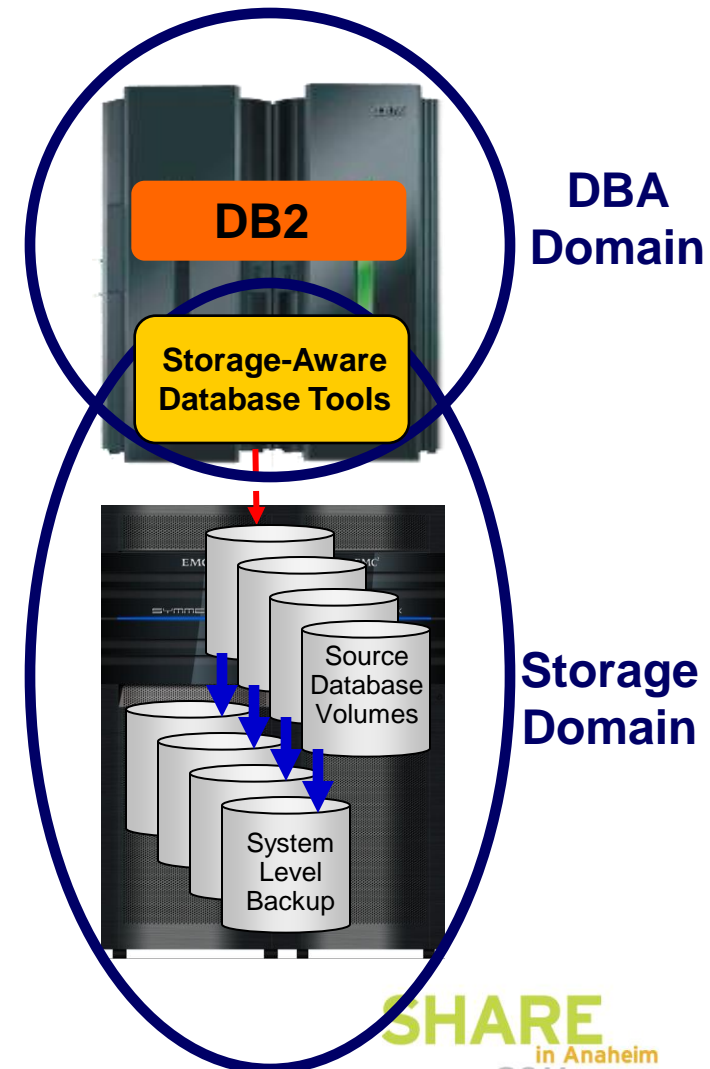
DB2 System Level Backup Disaster Recovery Benefits

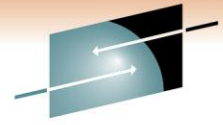
- Simplifies disaster recovery operations
 - System level backup for restart
 - System level backup and roll forward
- System backup is “restartable”
 - Restore volumes containing the last SLB
 - Performs recovery during normal database initialization process
 - Disaster recovery is as simple as restarting from a power failure
- Intelligent Disaster Recovery Manager
 - Prepares recovery assets and manages remote restore and recovery operations
- Reduced recovery time at a DR site
- Transform disaster recovery procedures into a tape-based disaster restart process
 - Similar benefits as storage-based remote replication solutions



DB2 System Level Backup Storage Benefits

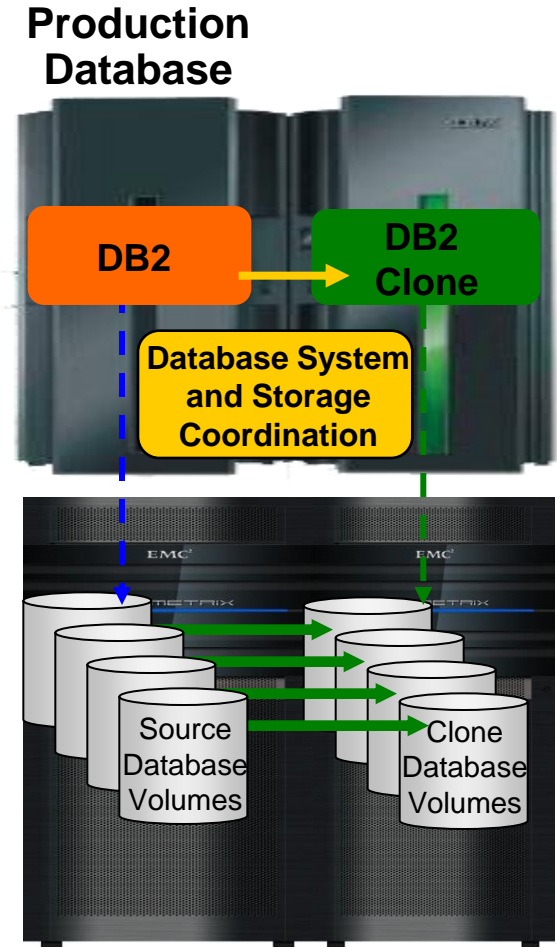
- A system backup used for multiple functions
 - Saves storage and processing resources
- Leverages storage-processor and fast-replication software investments
- Expose fast copy capabilities to the DBAs ***safely and transparently*** using “storage-aware” database utilities
- Provides a sophisticated infrastructure and metadata to manage DB2 and storage processor coordination
- Multiple storage vendor support
 - IBM - FlashCopy
 - EMC - TimeFinder/Mirror/Clone/Snap, FlashCopy
 - Hitachi – ShadowImage, FlashCopy
 - IBM RAMAC Virtual Array, STK - SnapShot

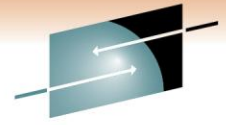




Cloning DB2 Systems

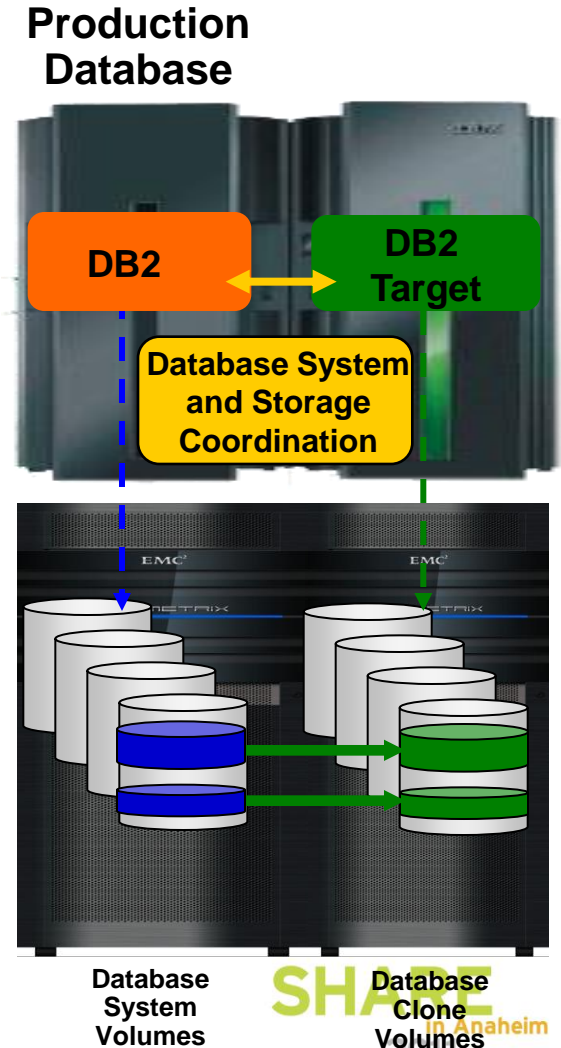
- Performs DB2 cloning automation
 - Simplifies database system cloning processes
 - Reduces cloning time and administration costs
- Leverages fast-replication facilities to clone data
 - Data can be cloned while online or offline
- Performs rapid volume reconditioning and data set renaming on cloned database volumes
 - Critical component of the database system cloning process
- Adjusts target database system to accommodate and accept the cloned data
 - DB2 catalog, directory, BSDS, active / archive log, etc.

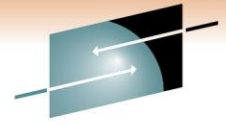




Refreshing DB2 Objects

- Performs automated DB2 table and index space refresh operations
 - Fast refresh of database objects
 - DB2 RI relationships, LOBS, and Identity columns
- Verifies source and target database compatibility
- Objects copied using storage-based data set fast replication
 - Target takes up the same amount of space as the source
- Performs object ID translations and target system metadata management





DB2 Storage-aware Products

- **IBM DB2 Recovery Expert for z/OS**
 - DB2 for z/OS backup and recovery
- **IBM DB2 Cloning Tool for z/OS**
 - DB2 system cloning and tablespace refresh
- **Mainstar Database Backup and Recovery for DB2 on z/OS**
 - DBR for DB2 – DB2 for z/OS backup and recovery
- **Mainstar Volume Clone and Rename**
 - VCR – DB2 system cloning automation
- **Mainstar Fast Tablespace Refresh**
 - FTR – DB2 tablespace refresh automation
- **EMC - Rocket Backup and Recovery for DB2 on z/OS**
 - RBR – DB2 for z/OS backup and recovery
 - EMC Select product

Implementation Planning Considerations

Examples based on DBR for DB2, VCR, EMC and IBM Storage

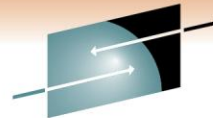


- System level backup usage
 - Determine how SLB(s) will be used
- SLB type
 - Determine full, data-only, or partial SLB requirements
- Backup frequency and space utilization
 - Determine backup frequency, performance, and space efficient fast-replication requirements
- Disaster restart considerations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

DB2 System Level Backup Usage and Data Set Layout Considerations



- DB2 SLB used for local system recovery
 - DB2 data and recovery structure isolation required
 - DB2 system isolation may be required
 - Non-database data sets will get restored when DB2 system is restored
 - User catalogs will get restored
- DB2 SLB used for application or DB2 object recovery
 - Data and recovery structure isolation is not required
- DB2 SLB used for remote disaster restart operations
 - Recovery structure isolation is not required
 - Database system isolation may be required
 - Non-database data sets will get restored when database system is restored
 - User catalogs will get restored

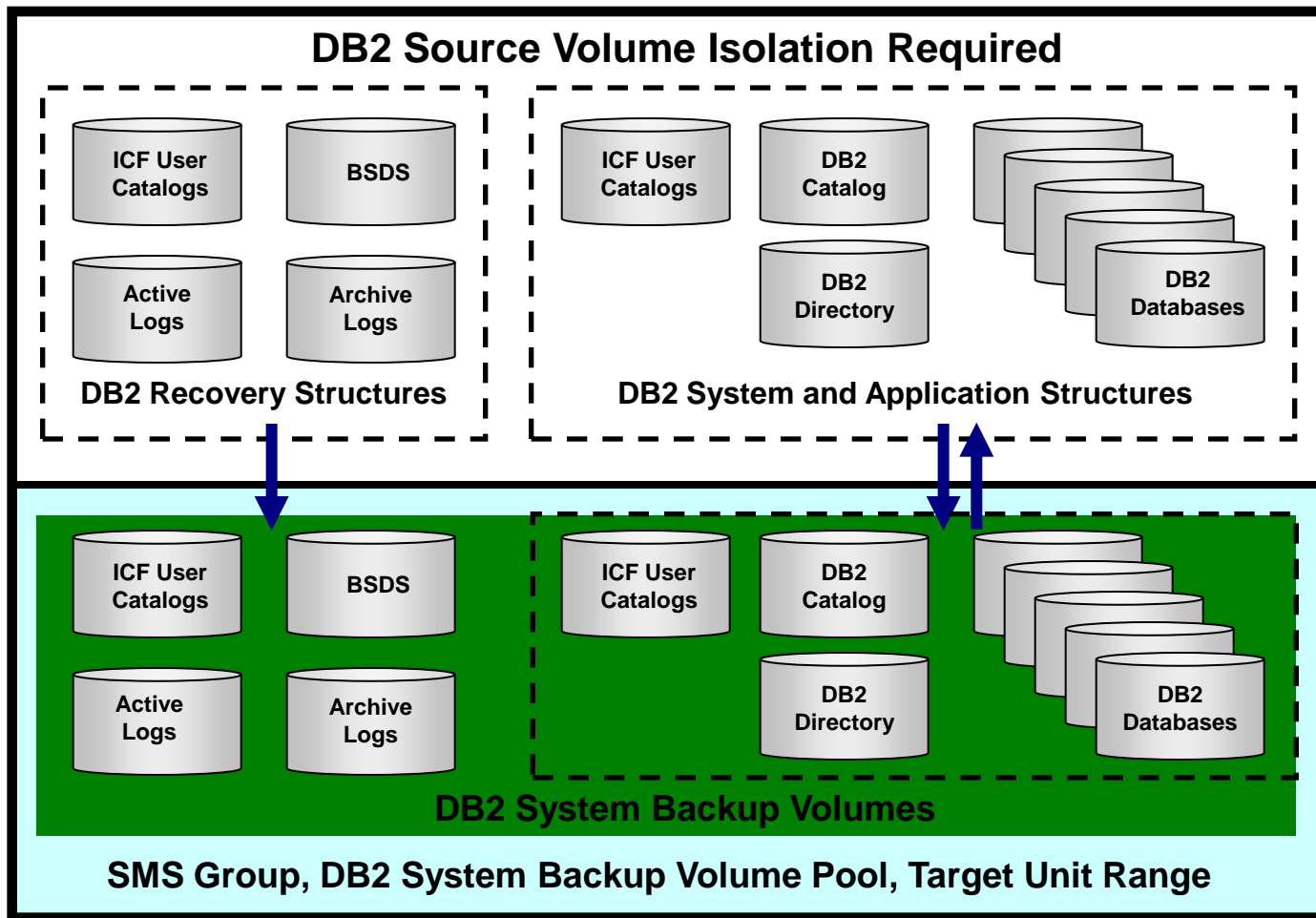


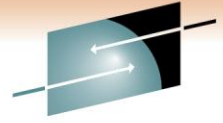
DB2 System Level Backup Usage

Data Set Layout for Full Backup / System Recovery

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DB2 on z/OS System and Database Environment



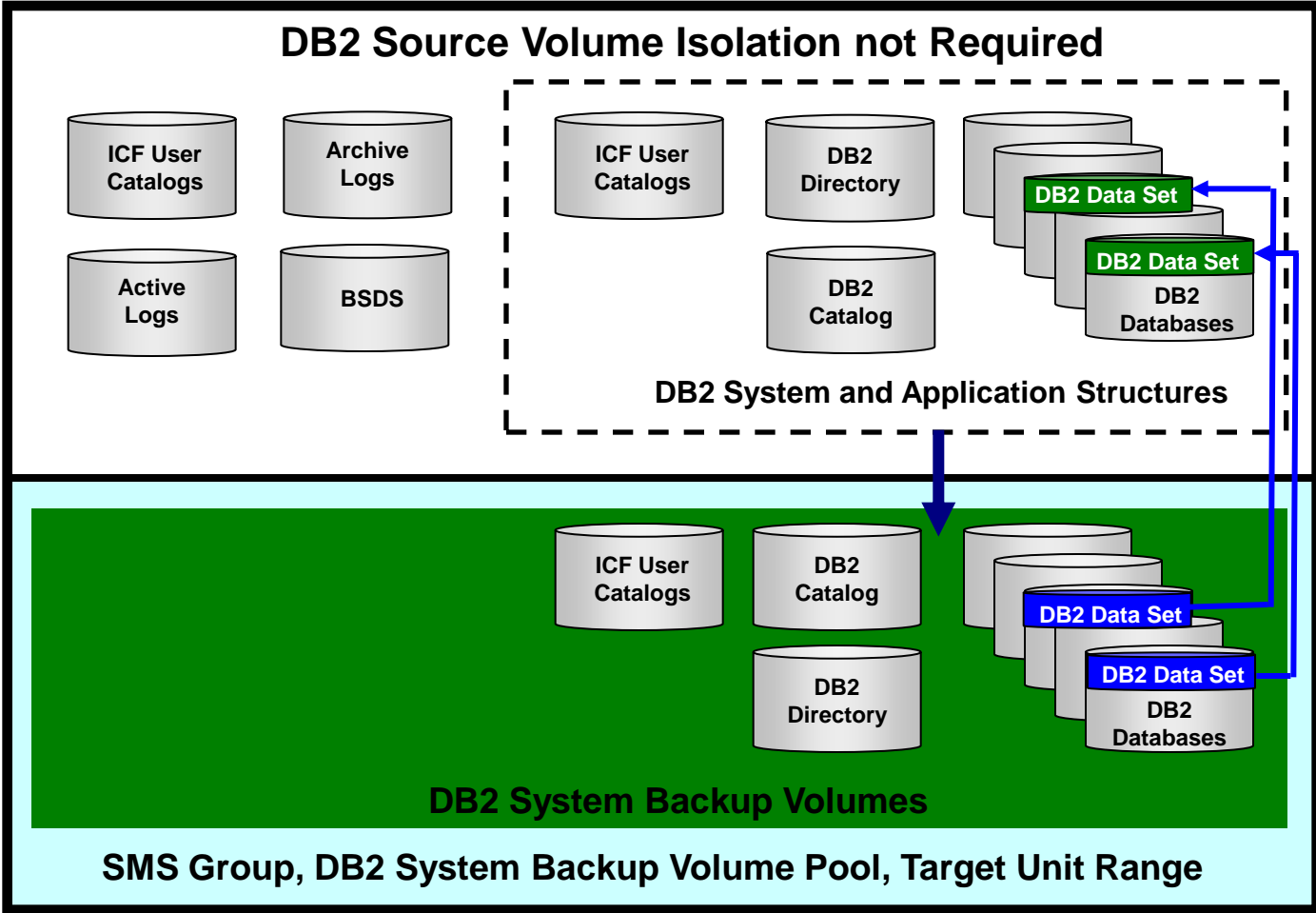


DB2 System Level Backup Usage

Data Set Layout for Data Only / Application Recovery

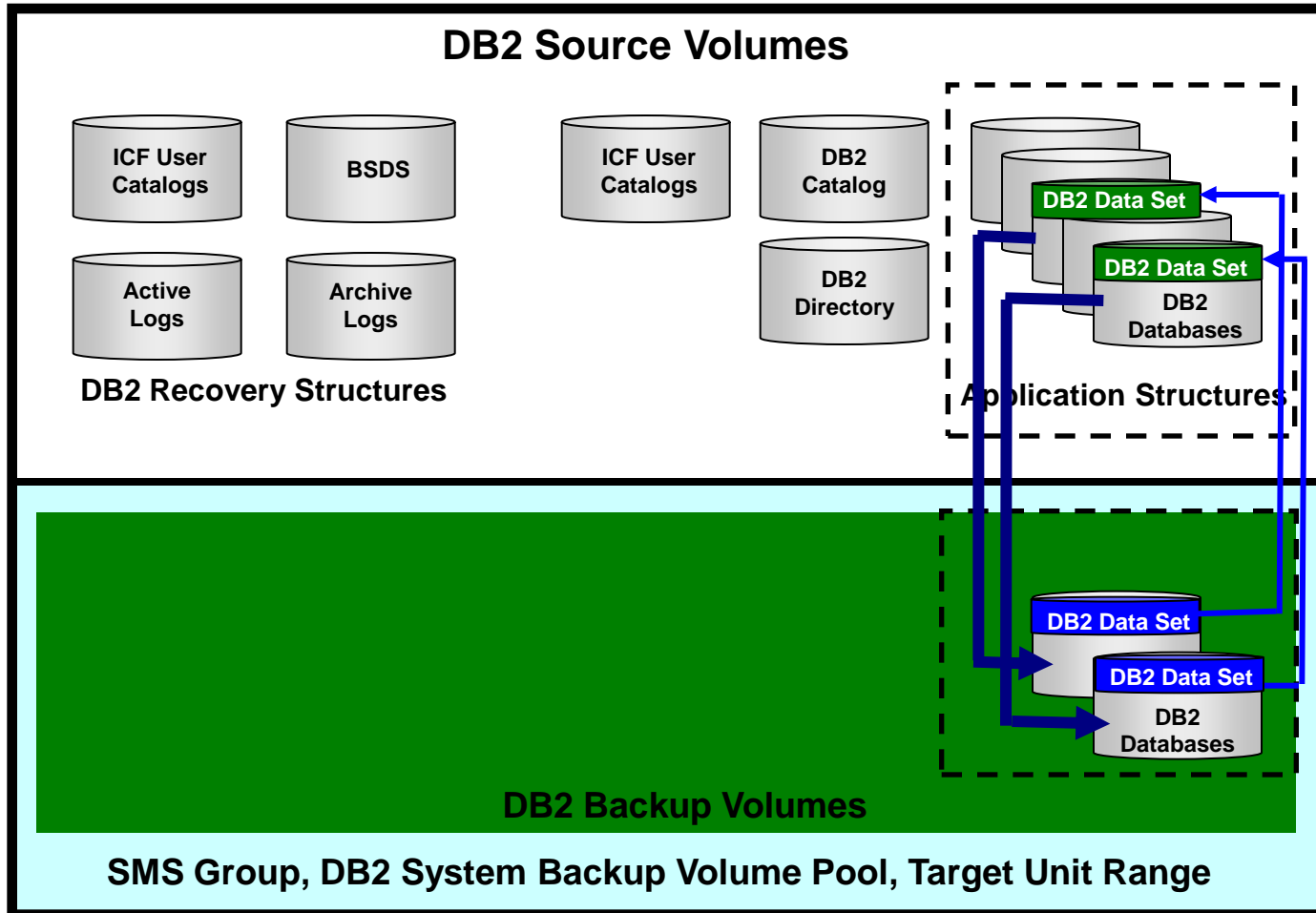
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DB2 on z/OS System and Database Environment



DB2 Partial System Level Backup Data Set Layout for Application Recovery

DB2 on z/OS System and Database Environment



DB2 Partial System Level Backup

- Partial system level backup (PSLB)
 - Backup volumes representing a subset of the DB2 system
 - PSLB's used for database or application recovery only
 - Data set fast replication used to restore data
 - Log and data isolation not required
 - Desired application database data should be grouped on volumes as a best practice
- PSLB cannot be used for system recovery
 - System recovery requires all volumes in SLB
- PSLB usage
 - Large databases or applications having unique backup requirements
 - Creating image copies from a PSLB
 - Reduce disk utilization
 - Support more backup generations

Implementation Planning

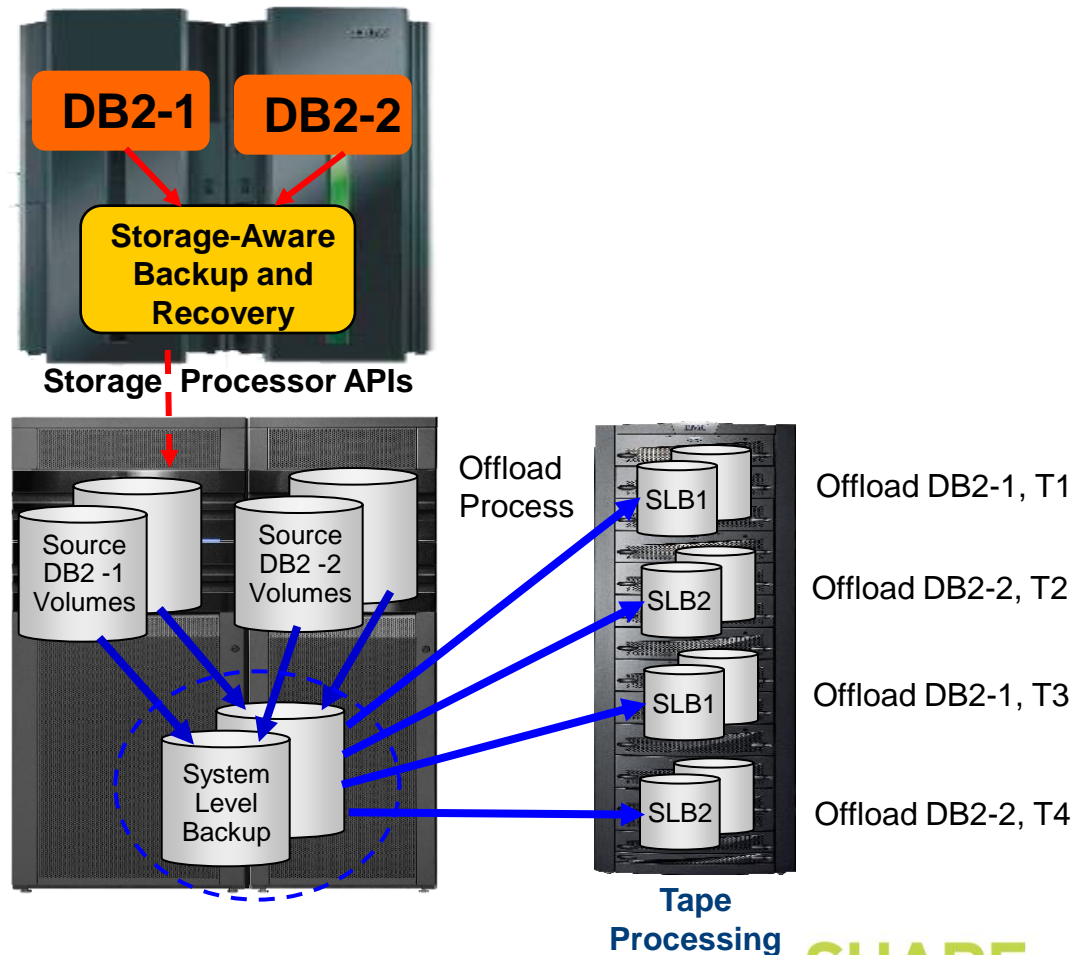
Backup Frequency, Space, and Resource Usage



- SLB type: full, data-only, or partial – shown in previous slides
- 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 one set of volume targets to support multiple database systems – next slide
 - Saves fast-replication target volume storage requirements
- Consider using space efficient fast-replication methods like EMC VDEVs to save space – later slides
- Consider cloning database systems to space efficient volumes using a full volume clone or SLB as the source – later slides

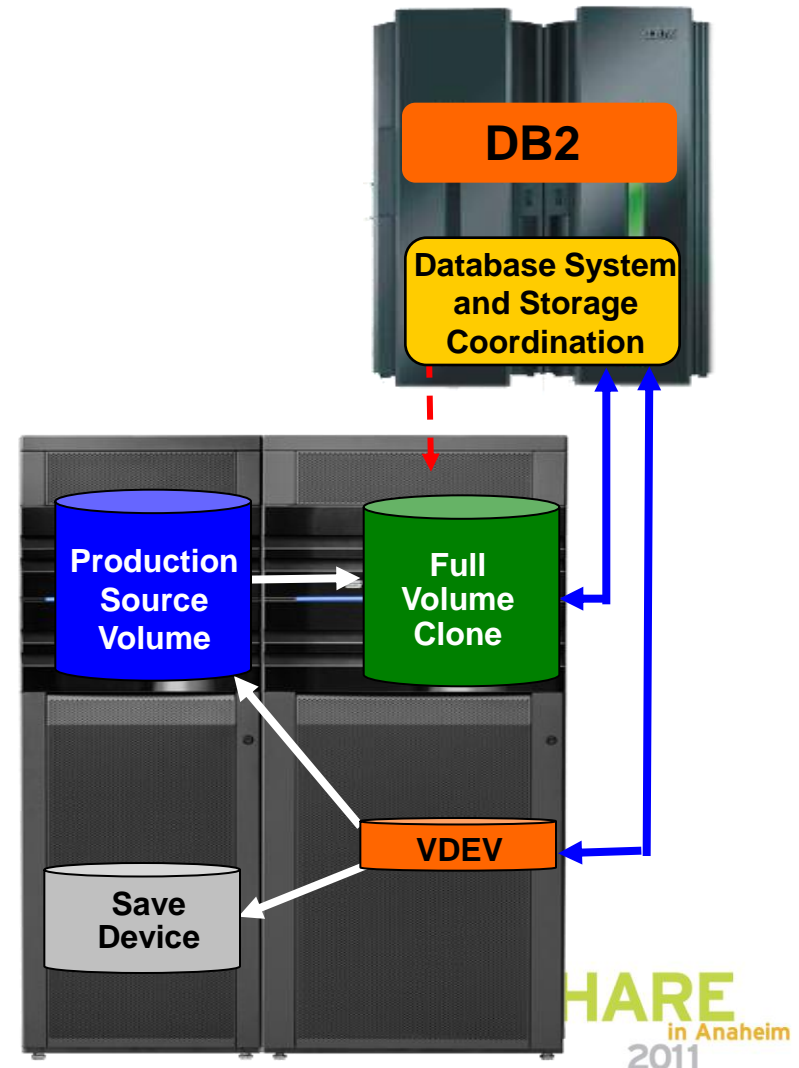
One Set of Backup Volumes for Multiple DB2 Systems

- Backup DB2-1
 - SLB-1 created on disk
 - Archive SLB-1
 - Backup volumes are available after archive completes
- Backup DB2-2
 - SLB-2 created on disk
 - Archive SLB-2
 - Backup volumes are available after archive completes
- Repeat for DB2-1
- Repeat for DB2-2

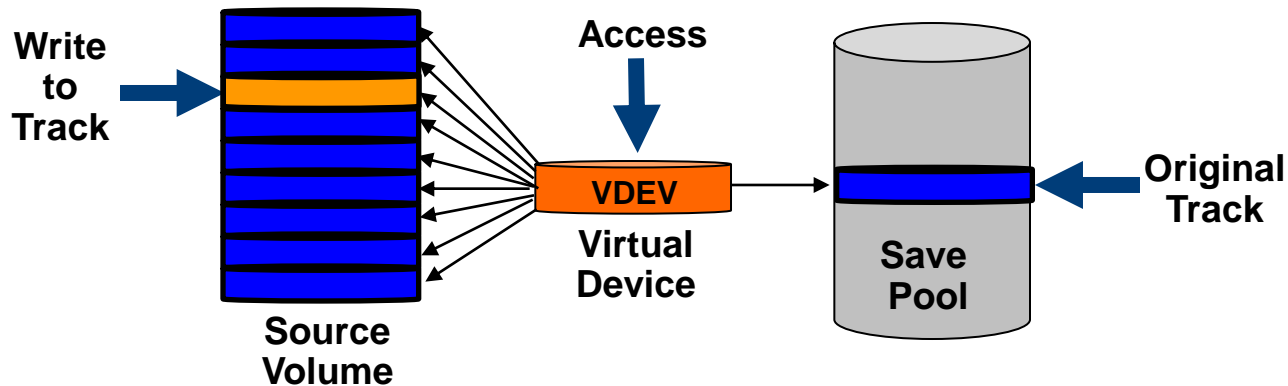


Create SLBs and Clone DB2 Systems Full and Space Efficient Volumes

- 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



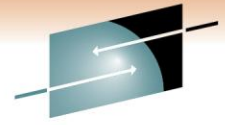
TimeFinder/Snap VDEV Operation Overview



- 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

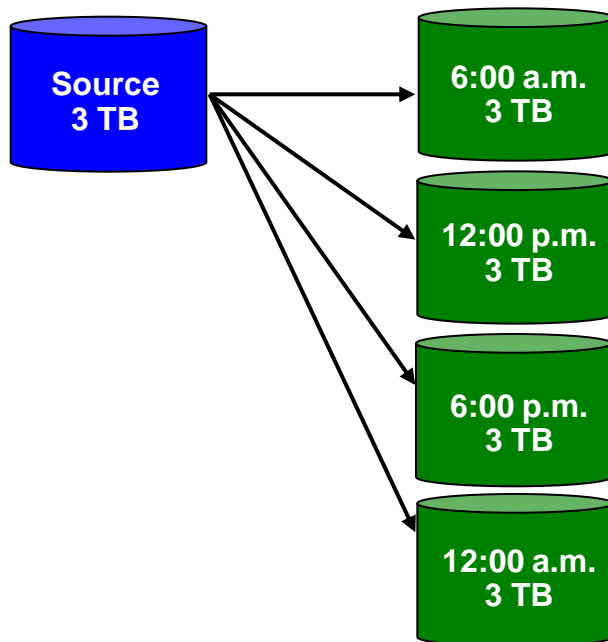
Space Efficient Usage Economics

Enable Frequent DB2 SLB or Clone Copies



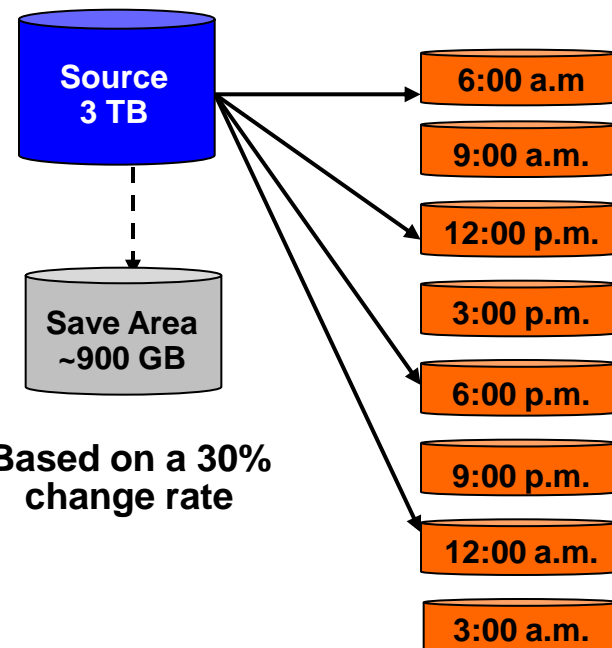
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Full-volume SLB or clone copies



Requires 12 TB of additional capacity

Space-efficient SLB or clone copies

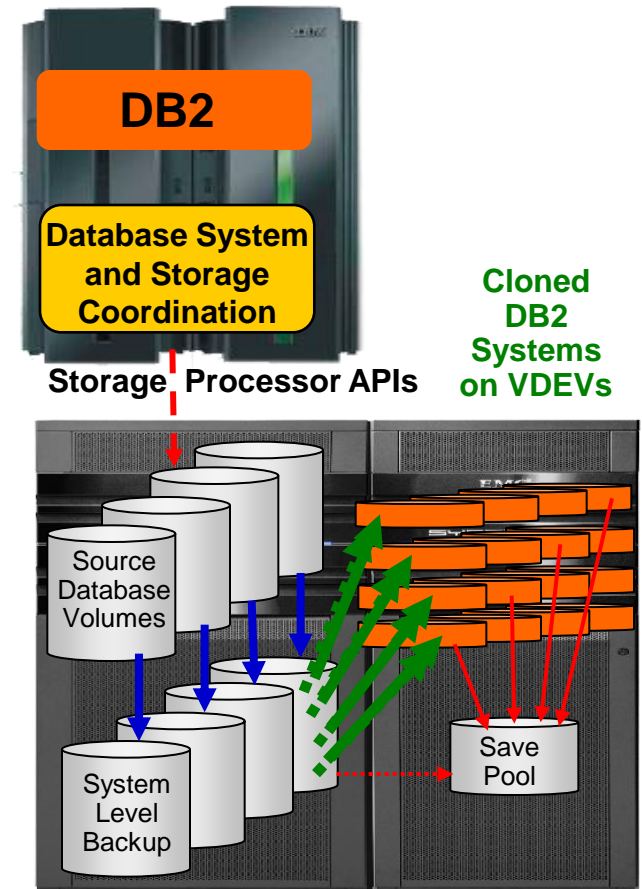


Based on a 30%
change rate

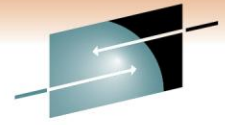
Requires ~900 GB of additional capacity

Full Volume and Space Efficient Usage Example

- Full DB2 system-level backup created using full volume fast-replication
- DB2 clone operations performed using SLB backup volumes as source
- Cloned DB2 systems use virtual storage devices (VDEVs)
 - DB2 SLB volumes are used to service I/O for DB2 clone access
 - DB2 clone writes (few) go to save pool
 - DB2 SLB writes (none) go to save pool
- Storage-aware database tools provides infrastructure and metadata to manage DB2 and storage processor coordination

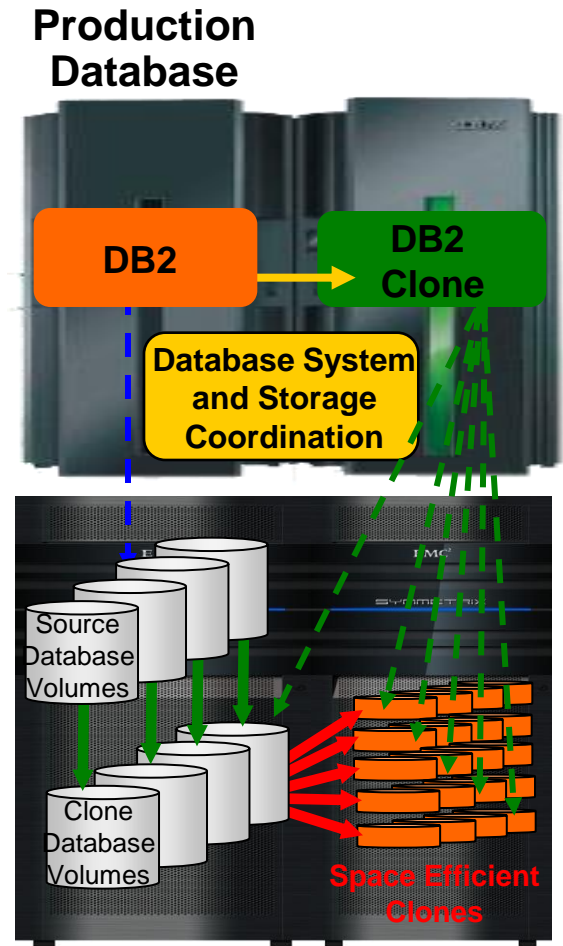


Full Volume and Space Efficient Usage Example (2)



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- Perform full volume DB2 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



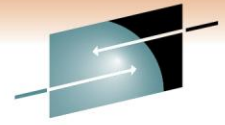
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Implementation Planning

DB2 Disaster Restart Considerations



- DB2 SLB should contain database system data only
 - Can contain other data that is restarted together
 - Recovering database and other data together may require using a storage based consistency function to create the SLB
 - Cannot roll forward if database 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 disaster recovery metadata is taken offsite with archive logs and image copies (Example DBR for DB2 DR PDS)
 - Reduces recovery point objectives (RPO)

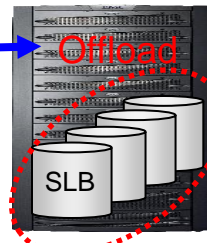
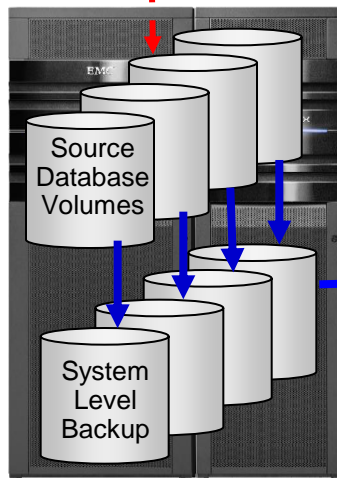


Using DB2 SLBs for a Tertiary DR Site

Primary Production Site



Storage Processor APIs



Remote Replication
PPRC, SRDF

Secondary Production Site



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

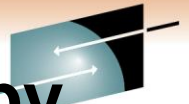
Tertiary Production Site



Secondary Disaster Restart Site
(tape-based Disaster restart)

PTAM

DB2 SLBs with PPRC Remote Pair FlashCopy

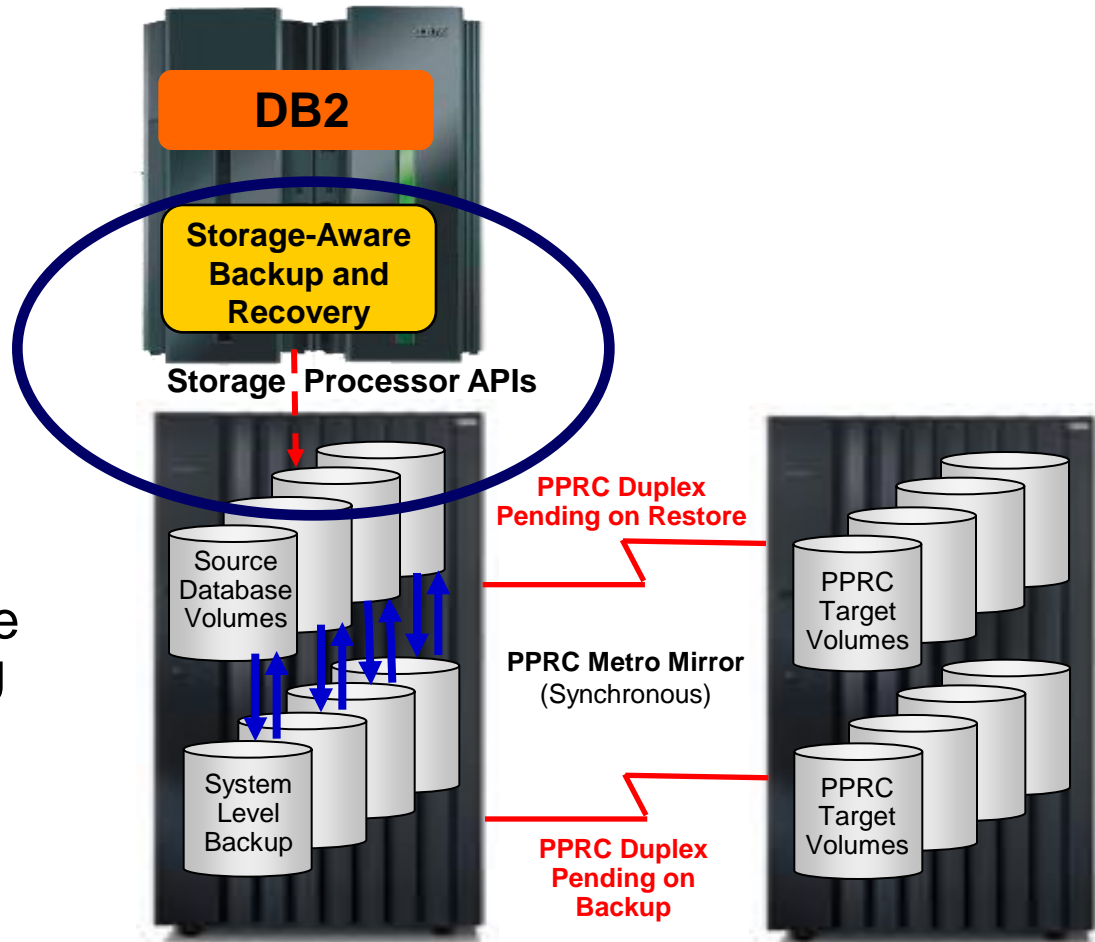


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- Storage Aware Backup/Recovery and “Remote Pair FlashCopy” Support
 - FlashCopy to PPRC Primary volume **while maintaining Full Duplex**
 - FlashCopy Metro Mirror implementations only
- Preserve Mirror support option specified in installation ParmLib (FCTOPPRCP)
 - N - Do not allow the PPRC primary to become a FlashCopy target
 - Y - The pair can go into a duplex pending state
 - P - It preferable that the pair does not go into a duplex pending state.
 - R - It is required that the pair not go into a duplex pending state
- Copy Blade Support
 - DB2 BACKUP SYSTEM blade
 - FlashCopy Blade
 - DFSMSdss copy blade

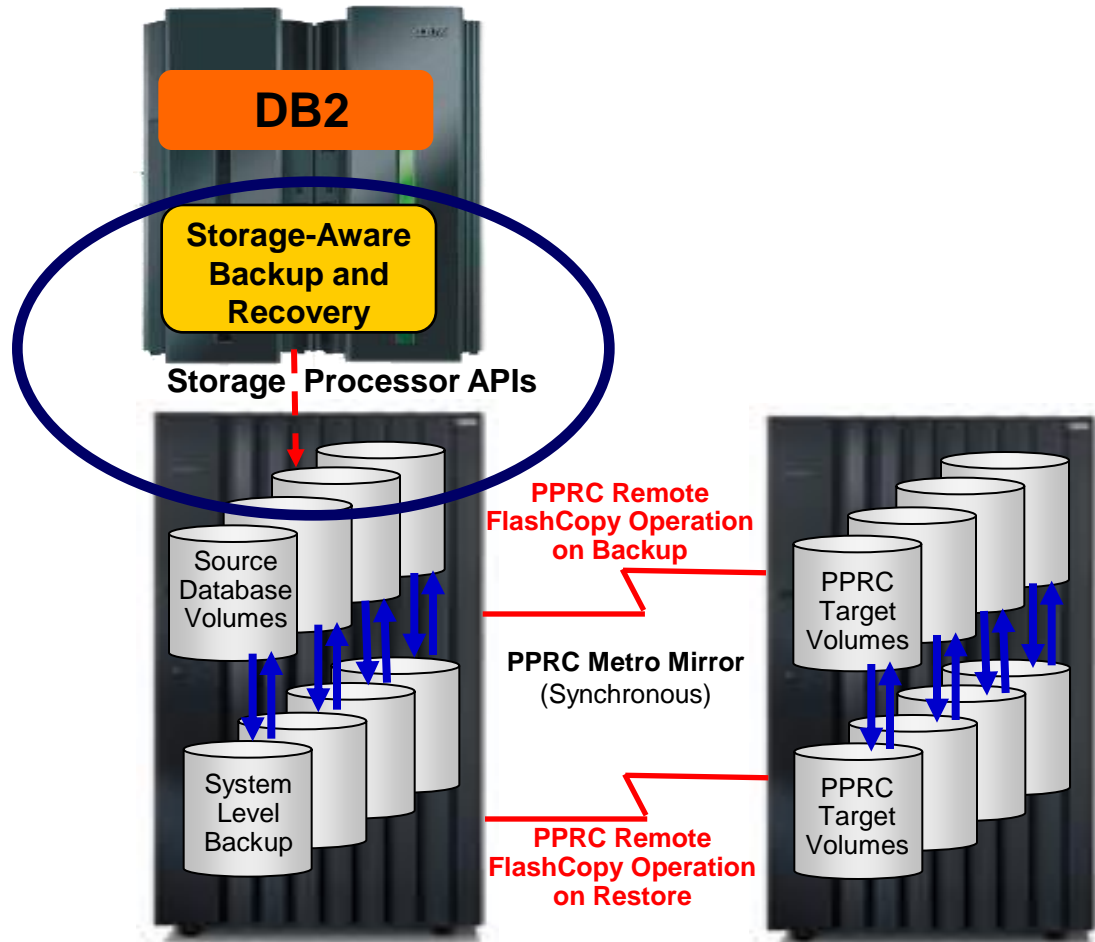
System Level Backup Without Remote Mirror FlashCopy

- SLB causes backup volume data to be copied through PPRC link
- SLB can cause PPRC duplex pending state
- SLB restore can cause PPRC duplex pending state



System Level Backup With Remote Mirror FlashCopy

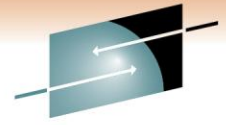
- FlashCopy data is not copied over PPRC links
- SLB drives remote pair FlashCopy operation
 - Remote PPRC production volumes Flashed to remote PPRC SLB volumes
- System level restore drives remote pair FlashCopy operation
 - Remote PPRC SLB volumes Flashed to remote PPRC production volumes



DB2 SLBs with XRC and PPRC without Remote Pair FlashCopy



- Assume DB2 volumes are primary volumes in a PPRC metro mirror or XRC relationship
- Backup target volumes must not be in a PPRC or XRC relationship
- Backup volumes cannot be used for DB2 system recovery without duplex pending state
- DB2 application and object recovery allowed
 - DBr for DB2 performs application and object recovery by copying data sets from the backup volumes to the source volumes
 - DFSMSdss used to copy data sets
 - Fast Replication Preferred option used to copy data
 - DFSMSdss uses slow copy methods as data sets cannot be Flashed to source PPRC or XRC volumes.



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
 - DB2 Backup System Blade
 - DFSMSdss Blade
 - IBM FlashCopy Blade
 - EMC TimeFinder Blade
 - HDS ShadowImage Blade
- Determine which type of consistency function is best for your environment
 - Database suspend, storage-based consistency

IBM Copy Blades

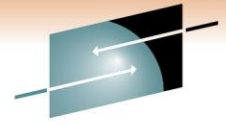
- **IBM DB2 BACKUP SYSTEM Blade**
 - Provide support for DB2 Backup System
- **IBM FlashCopy Blade**
 - Provides support for IBM FlashCopy V2
 - Data set FlashCopy support for fast object / application recovery
 - ANTRQST calls issued to drive FlashCopy volume commands (fast performance)
 - Requires Database Log Suspend
 - Supports IBM, EMC, HDS FlashCopy products
- **IBM DFSMSdss Copy Blade**
 - ADRDSSU utility invoked to perform volume copies
 - Fast replication (preferred) is used – Will support non-fast replication volumes
 - Data set FlashCopy support for fast object / database (IMS) / application recovery
 - Slower than using ANTRQST in native FlashCopy blade
 - Requires Database Log Suspend
 - Supports FlashCopy (IBM, EMC, HDS), SnapShot (STK, RAMAC Virtual Array)

EMC Copy Blades

- EMC TimeFinder Blade
 - TimeFinder/Mirror
 - TimeFinder/Clone Mainframe Snap Facility
 - TimeFinder/Snap Virtual Devices
 - Allows multiple backups with reduced storage utilization
 - Incremental copy support for all copy methods
 - EMC Consistency Technology support for all volume copy methods
 - Reduce the need for database suspend functions
 - TimeFinder Data Set Snap facility to perform fast replication application / object restores
 - DB2 Log Suspend performed on one data sharing member when backing up a data sharing group

Hitachi Data Systems Copy Blades

- ShadowImage Blade
 - Supports HDS native ShadowImage volume copy processes
 - Invoked using FlashCopy backup profile
 - Checks *shadow_image* field in backup product parameter library
 - *N – DBR for DB2 drives FlashCopy*
 - *Y – DBR for DB2 drives ShadowImage*
 - Incremental copy support
 - Requires a database log suspend operation
 - Can support database systems that span HDS and IBM storage using native methods (ShadowImage and FlashCopy)
 - HDS data set FlashCopy emulation used for fast replication object / application restores



Session Summary

- Storage-aware DB2 utilities provide storage integration to simplify DB2 administration tasks
- DB2 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 application recovery time
- DB2 system cloning automaton allows production data to be leveraged easily and effectively
- DB2 table and index spaces refreshed easily
- Less skills required to implement advanced backup, recover, disaster recovery, and cloning solutions
- Implementation planning is important to optimize the benefits

Complimentary SHARE Sessions

- Simplify and Improve IMS Administration by Leveraging Your Storage System
 - Session Number 8568
 - Thursday March 3, 2011
 - 11:00 AM – 12:00 PM
- Instant IMS and DB2 Backup and Restore – Really?!
 - Mainstar Vendor Session
 - Tuesday March 1
 - 1:30 PM
 - Room 207D.