DB2 backup and recovery that ensures business resiliency

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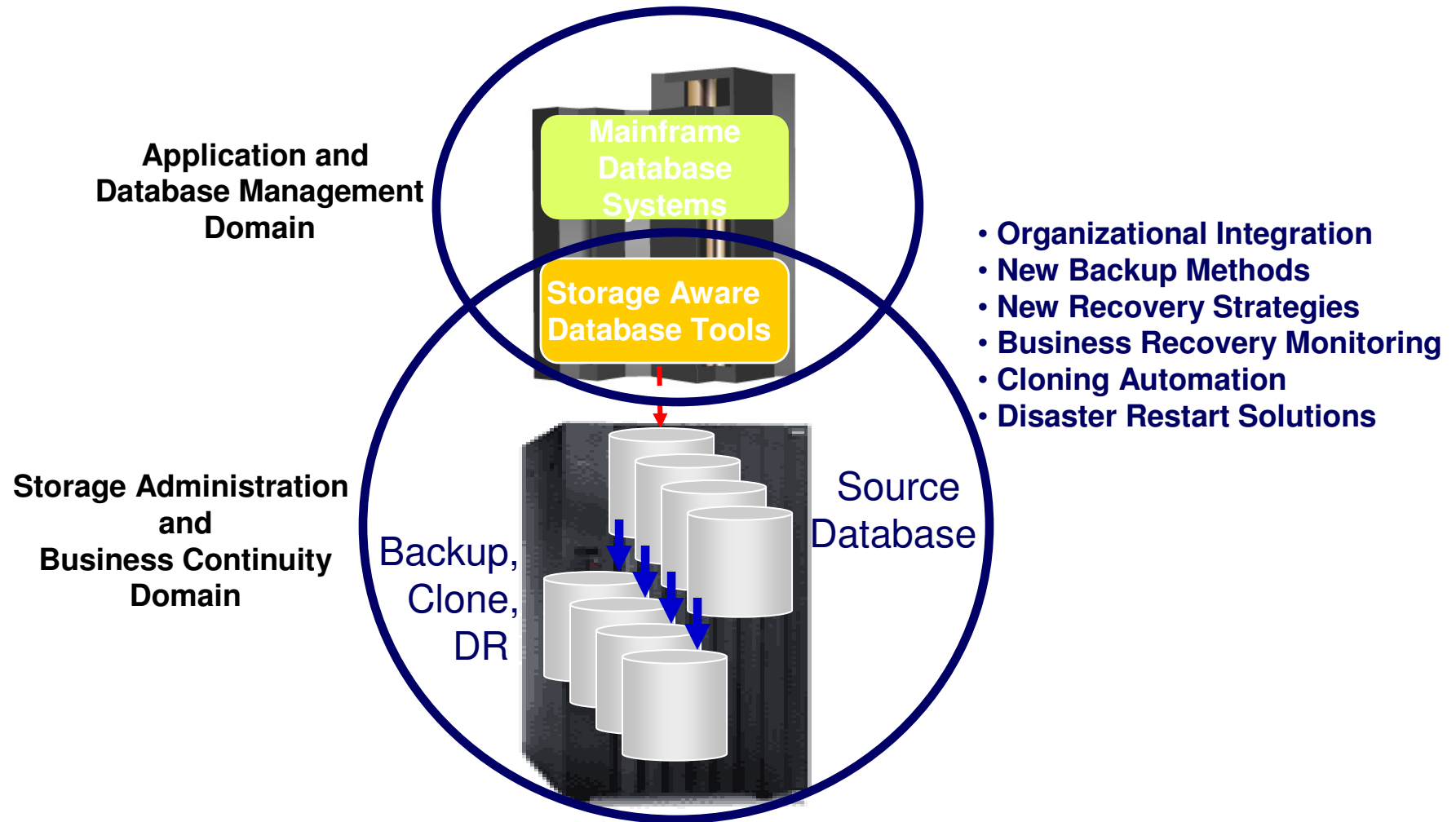Rocket Software
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Session Agenda

- DB2 System Level Backup Overview
- DB2 System Level Backup Requirements
- DB2 Recovery Expert for z/OS Introduction
- DB2 Recovery Expert Copy Blades and Storage Vendor Support
- Implementation Planning Considerations
- Session Summarization
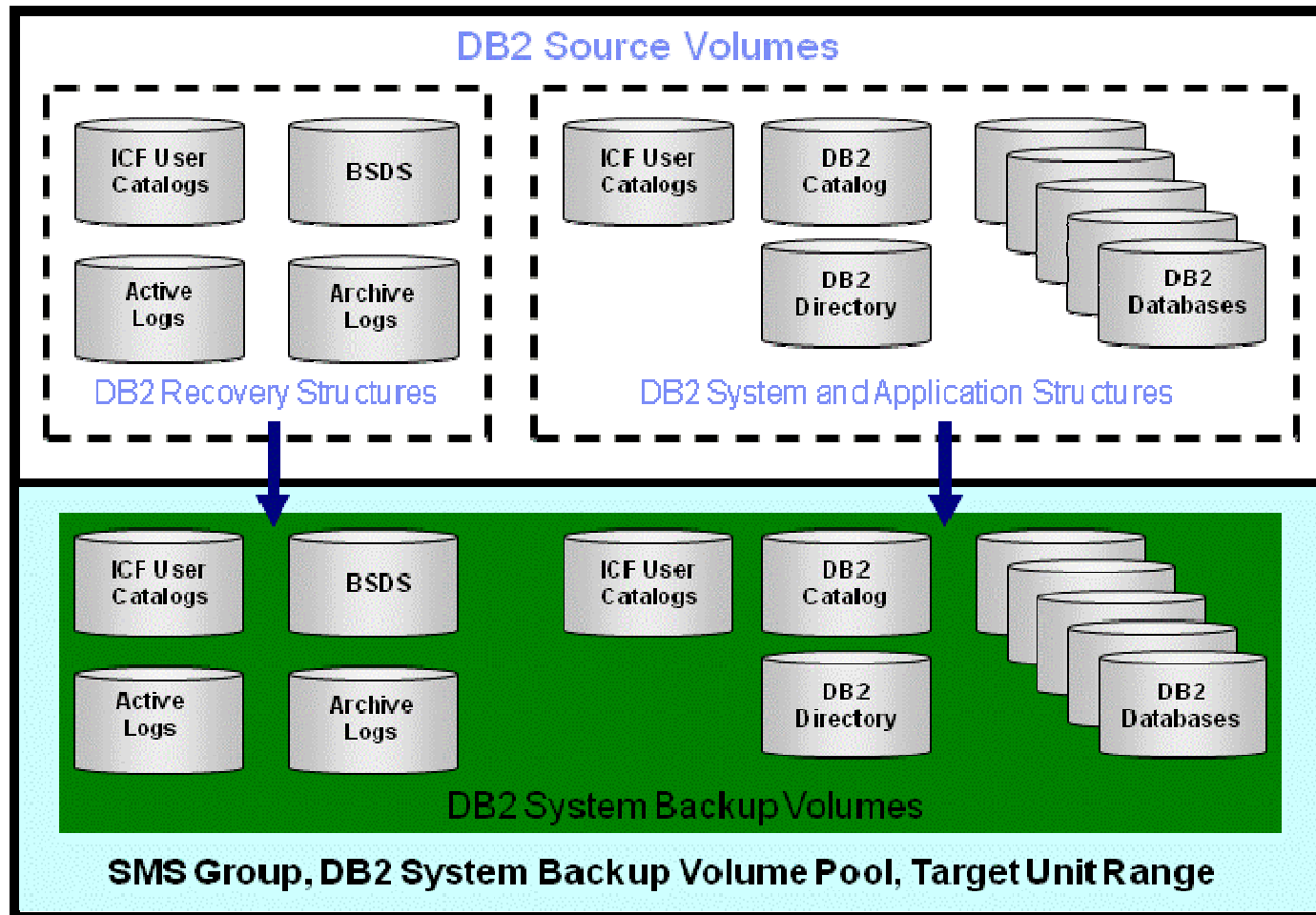
DB2 System Trends and Directions

- **Large DB2 systems require high availability**
  - Fast and non-intrusive backup facilities are required
  - Fast recovery capabilities required to minimize down time
  - 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 operations
  - Simplifies recovery operations and reduces recovery time
  - Simplifies disaster recovery procedures

DB2 System Level Backup
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**

Backup,
Clone,
DR

Source
Database

DB2 System Level Backup
Data Set Layout Considerations

DB2 on z/OS System and Database Environment

DB2 Source Volumes

DB2 Recovery Structures: ICF User Catalogs, BSDS, Active Logs, Archive Logs

DB2 System and Application Structures: ICF User Catalogs, DB2 Catalog, DB2 Directory, DB2 Databases

DB2 System Backup Volumes: ICF User Catalogs, BSDS, Active Logs, Archive Logs, ICF User Catalogs, DB2 Catalog, DB2 Directory, DB2 Databases

SMS Group, DB2 System Backup Volume Pool, Target Unit Range

# DB2 Recovery Expert Functional Requirements

- Integrate DB2 backup, restore, and recovery process with storage-based fast-replication
- Provide easy and fast backup and restore of DB2 systems, applications, or objects
- Support common storage systems
  - IBM – FlashCopy (FC)
  - EMC TimeFinder/Mirror/Clone, FC
  - HDS – Shadow Image, FC
- Feature requirements include:
  - DB2 system configuration management
  - Perform system backup and recovery
  - DB2 system backup validation
  - Perform application and object recovery
  - Full metadata repository
  - Encrypted tape offload support
  - DR preparation and management

DB2

DB2 System and Storage Coordinator

Storage Processor APIs

Source Volumes
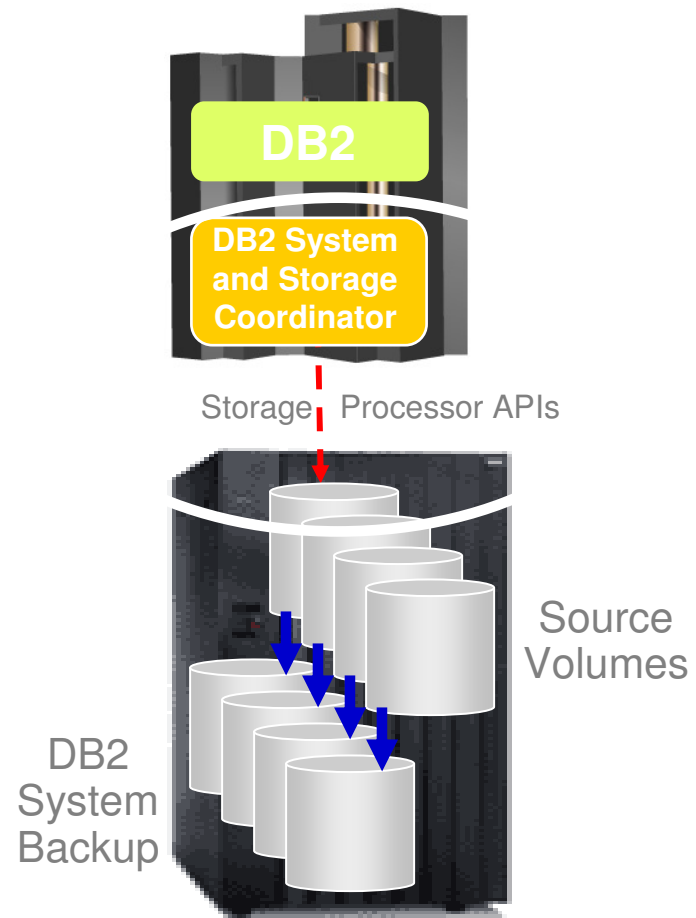
DB2 System Backup

DB2 Recovery Expert
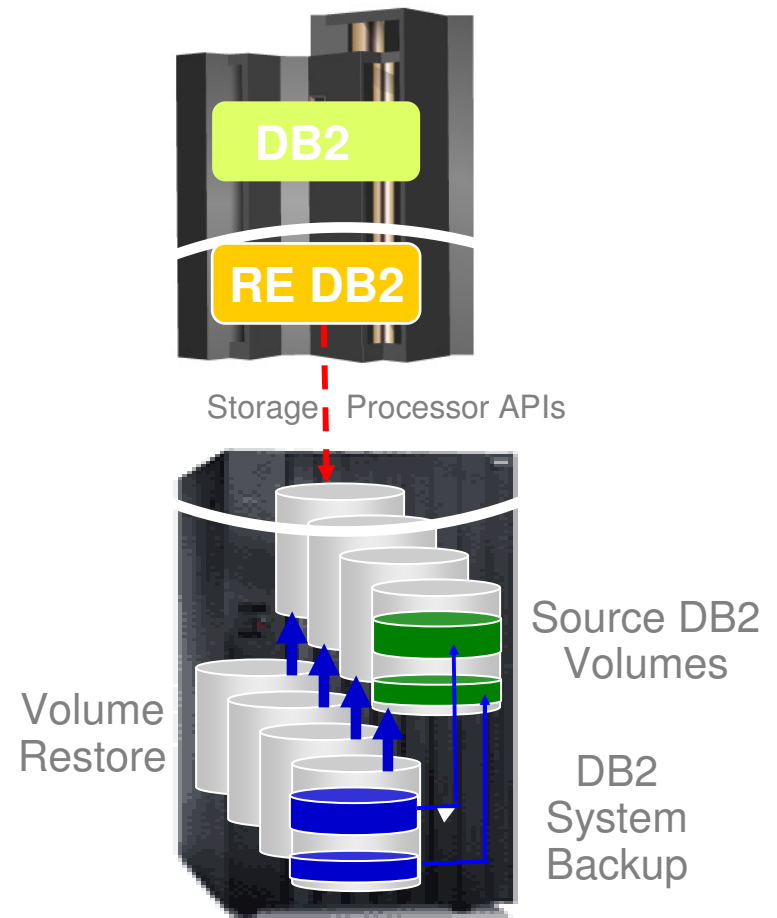# Creating a System Level Backup

- **Storage-based API drive backup process**
- **Storage-based fast-replication creates backup**
  - Full DB2 system backups in seconds
  - Does not use host CPU or I/O resources
- **Backup DB2 without affecting applications**
  - Backup windows reduced or eliminated
  - Extends processing windows
- **Data consistency ensured during backup**
  - DB2 Suspend (One data-sharing member)
  - Storage-based consistency functions
  - DB2 Backup System
- **Automated backup archival and recall**
- **One backup used for many functions**
  - Reduces backup CPU, I/O, and storage utilization

DB2

RE DB2

Storage Processor APIs

Source DB2 Volumes

Target Volumes

DB2 System Backup
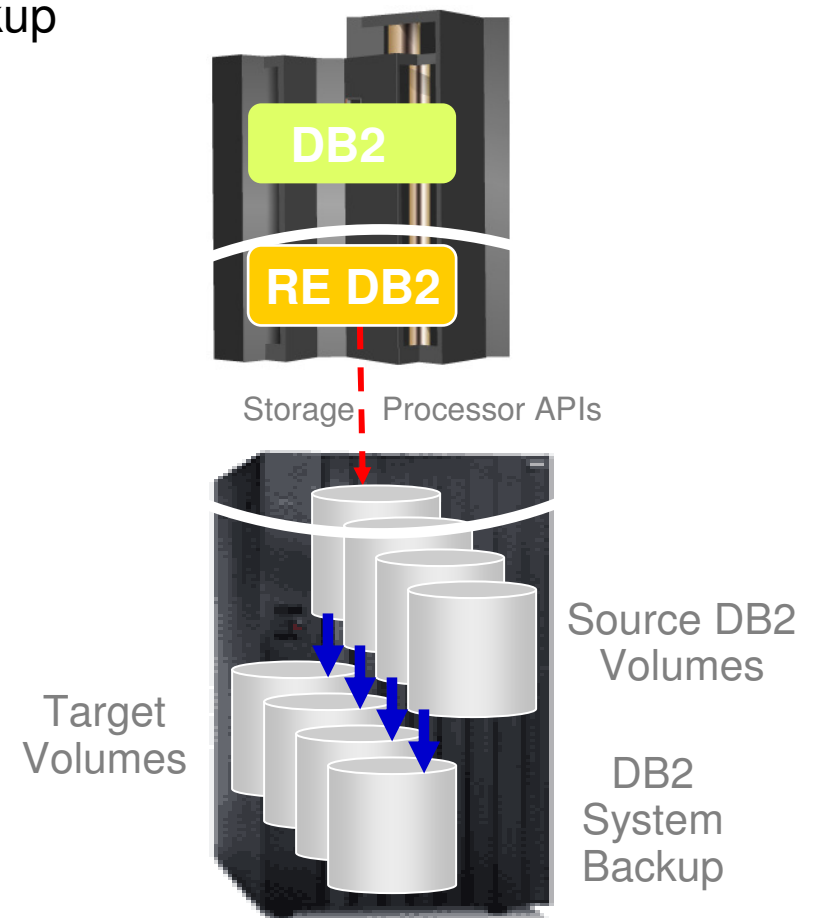
DB2 Recovery Expert
DB2 System and Application Recovery

- **DB2 Recovery Expert restores DB2 systems or application objects from disk or tape automatically**

- **Faster recovery**
  - Instantaneous data restore process
  - DB2 Recovery Expert coordinates storage-based restore and DB2 recovery functions
  - Parallel restore and recovery minimize application down time during recovery
  - Discovers and resolves objects in rebuild/recovery pending state

- **Data set snap used for application or object recovery**

- **DB2 system backup for multiple purposes**
  - DB2 system recovery
 - Application recovery
  - Disaster recovery

DB2

RE DB2

Storage Processor APIs

Source DB2 Volumes

Volume Restore

DB2 System Backup

DB2 Recovery Expert
Creating Image Copies

- **Image copies can be generated from a DB2 Recovery Expert system level backup (SLB)**
- **Image copies are registered DB2 image copies**
- **Image copies can be used for object recovery and other operational procedures**
- **All image copies are created at the same point in time**
  - No affect on the application for image copy creation
  - Reduces recovery scope for coordinated object recoveries
  - Reduces I/O contention caused by performing traditional IC processing during high transaction activity

DB2 Recovery Expert
Disaster Recovery Benefits

- **DB2 Recovery Expert simplifies DB2 disaster recovery**

  – System level backup for restart

  – System level backup and roll forward

- **DB2 system backup is "restartable"**

- **DB2 Recovery Expert offsite DB2 disaster recovery support**

  – Restores last SLB volumes

  – Optionally includes additional archive logs

  – DB2 recovery performed during normal initialization process

  – Disaster recovery is like restarting from a power failure

- **DB2 disaster recovery becomes a tape-based disaster restart process**

  – Reduced recovery time at a DR site

  – Tape-based disaster restart solutions provide similar benefits as storage-based remote replication solutions

DB2

RE DB2

Storage Processor APIs

Source DB2 Volumes

DB2 System Backup

"Restartable DB2 Copy"
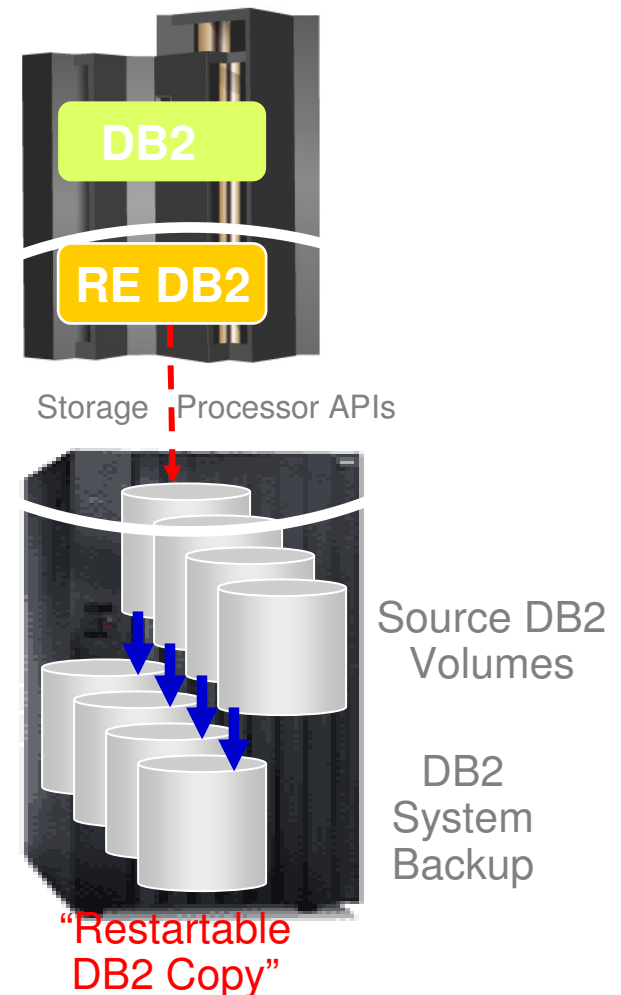
DB2 Recovery Expert
## Disaster Recovery Management

- **Local site procedures**

  – Builds and submits jobs to prepare for remote site recovery

  – Remote recovery jobs sent off site with archive logs

- **Remote site procedures**

  – Restore SLB at DR site

  – DB2 Recovery Expert adjusts the DB2 BSDS to accommodate the recovery assets at the remote site

  – DB2 Recovery Expert rolls SLB forward during DB2 restart using additional recovery assets and updated BSDS

    • Image copies
    • Archive logs

DB2 Recovery Expert
Storage Benefits

- **A system backup can be used for multiple functions saving storage and processing resources**

  – Recovery source (various forms)

- **DB2 Recovery Expert leverages fast-replication software investments for backup and restore functions**

- **Expose fast-replication to DBAs** *safely and transparently* **using "storage aware" database utilities**

- **Provides meta-data infrastructure to drive DB2 and storage processor coordination**

- **Provides multiple storage vendor support**

  – IBM - FlashCopy

  – EMC - TimeFinder/Mirror/Clone/Snap, FlashCopy

  – Hitachi – ShadowImage, FlashCopy

  – IBM RAMAC Virtual Array, STK - SnapShot
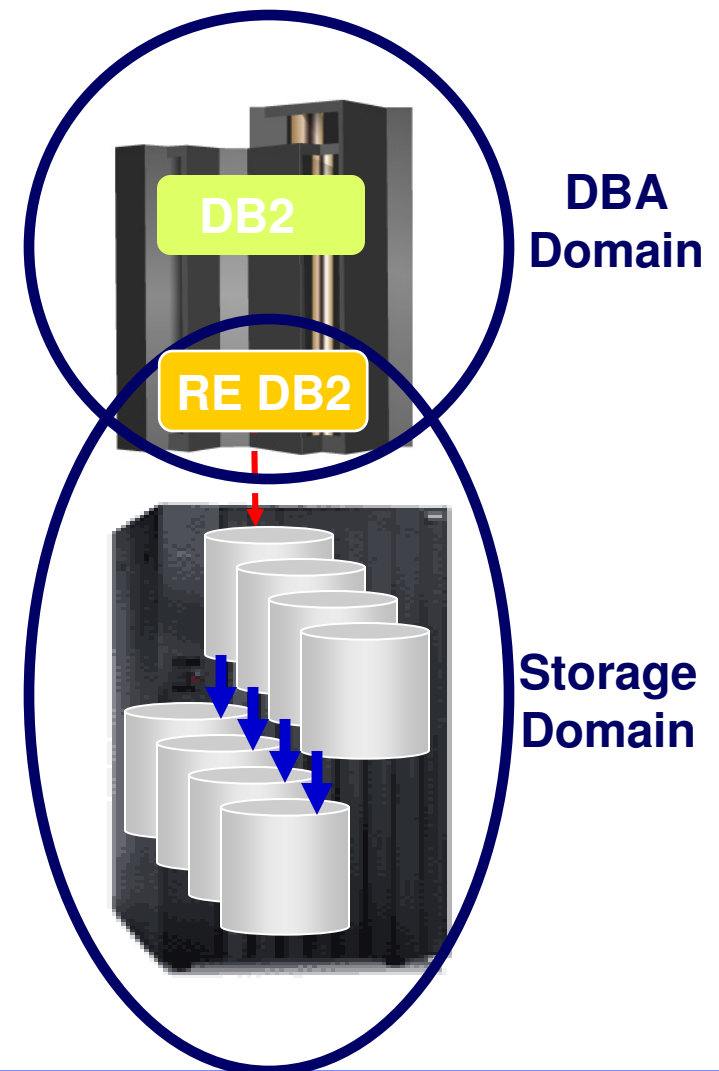
DB2 Recovery Expert Copy Blade Support

- **IBM DB2 Backup System Copy Blade**
  - Supports DB2 Backup System and drives FlashCopy V2
- **IBM FlashCopy Blade**
  - Provides support for IBM FlashCopy V2
- **IBM DFSMSdss Copy Blade**
  - Invokes ADRDSSU utility to drive FlashCopy or SnapShot
- **EMC TimeFinder Copy Blade**
  - Supports TimeFinder/BCV/Clone/Snap (Virtual Devices)
    - EMC Consistency Technology supported
- **HDS ShadowImage Copy Blade**
  - Supports HDS native ShadowImage volume copy processes
    - FlashCopy emulation used for data set fast-replication

DB2 DB2 Recovery Expert User Interfaces

- **ISPF Interface**
  - Subsystem analysis and configuration
  - Support for storage based system backups
  - Partial system backups
  - Subsystem setup
  - Recovery health check
- **GUI Interface**
  - "Expert" recovery services
  - DB2 Log Analysis services
    - undo or redo recoveries
    - Quiet point analysis
  - Drop Recovery
  - Dependency analysis
    - Optim Database Relationship Analyzer

DB2 Recovery Expert
DB2 System Analysis and Configuration

- Discovers and analyzes the DB2 system and displays an interactive report showing DASD volume usage
- Provides colored alerts and warnings when detecting anything preventing a successful system backup
- Segregates DB2 log and object data to support a system backup methodology
  - Generates JCL to move DB2 data sets to appropriate volumes
  - Provides support for moving DB2 data, logs, and BSDSs
  - Provides support for renaming DB2 objects, logs, and BSDS data sets
- Automates separating DB2 data and log datasets into their own ICF catalogs

DB2 Recovery Expert
Backup Validation Processes

- **Ensures backups are usable for a restore process**
  - All DB2 system volumes are included in the backup
  - All DB2 log volumes are included in a FULL system backup
  - User catalogs used by the DB2 system, including the log data sets, are included in backup
  - DB2 logs and object data are on separate volumes
    - FULL restore only if log structures and data are not separated
  - All source volumes are valid, online, and available
  - All target volumes are valid, offline, and available
  - Target backup volumes not in use by other backup profiles
  - All source and target volumes are the same device type

DB2 Recovery Expert System Restore
DB2 System Restore and Recover Options

- **Restore data and logs**
  - FULL restore - no recovery performed
    - Restore to copy functionality
- **Point-in-time recovery**
  - All data volumes restored
  - Recover entire DB2 system using logs
    - Recover to RBA or LRSN
    - Relative Byte Address (RBA)/Timestamp Utility
      - Creates and maintains a list of RBA to timestamp pairs
      - Provides the ability to select appropriate recovery timeframes based on the RBA values
  - Requires separation of logs and application data
  - Restore and recovery can be performed in parallel

DB2 Recovery Expert - Object Recovery

- Recovers objects from a system level backup
- Groups of objects can represent applications (Profiles)
- Profiles contain dataset restore and recovery options
  - Recovery JCL is generated for all included objects
  - Masking support to automatically include new objects when they are created
  - The most effective recovery plan is generated
    - Either standard DB2 restore from image copy, or data set restore from system level backup
- Supports object recovery to last quiesce point, last backup, to current, or to a specified RBA/LRSN
- Supports datasets that have moved since backup and datasets that do not exist at time of restore
- Optionally generate DB2 image copies from a SLB

DB2 Recovery Expert - Backup Offloading

- Automates archiving a system level backup to tape
- Robust tape naming facilities
  - All tape allocations are dynamic and handled automatically by DB2 Recovery Expert
- Tuning features for offload process; specifying number of subtasks, number of backups stacked on one tape, etc.
- DB2 systems and applications can be recovered from archive copy
  - DB2 Recovery Expert detects where the backup resides and performs the recovery
- Supported archival data movers:
  - IBM DFSMSdss
  - IBM DFSMShsm
  - Innovation FDR
  - Innovation FDRInstant

Implementation Planning Considerations

Implementation Planning
System Level Backup Usage

- **SLB used for local system recovery**
  - DB2 data and recovery structure (Log and BSDS datasets) isolation required
  - DB2 system isolation may be required
    - Non-DB2 data sets will get restored when DB2 is restored
- **SLB used for application or object recovery only**
  - Data and recovery structure isolation is not required
- **SLB used for remote disaster restart operations**
  - Recovery structure isolation is not required
  - DB2 system isolation may be required
    - Non-DB2 data sets will get restored when DB2 is restored

Implementation Planning
Partial System Level Backup

- Partial system level backup (PSLB) are used for object or application recovery <u>only</u>
  - Data set fast replication used to restore data
  - Log and data isolation not required
  - Desired application object 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 objects or applications having unique backup requirements
  - Creating image copies from a PSLB
  - 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 DB2 systems
    - Saves fast-replication target volume (DASD) requirement

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 Copy Blade
  - DFSMSdss Copy Blade
  - IBM FlashCopy Blade
  - EMC TimeFinder Copy Blade
  - HDS ShadowImage Copy Blade
- Know the type of consistency function is best for your environment
  - DB2 Suspend, DB2 Backup System, Storage-based consistency

Implementation Planning
Disaster Restart Considerations

- SLB should contain DB2 data only
  - Can contain other data that is restarted together
    - Recovering DB2 and other data together may require using a storage based consistency function to create the SLB
    - Cannot roll forward if DB2 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 RE's Disaster Recovery PDS is taken offsite with archive logs and image copies
  - Reduces Recovery Point Objectives (RPO)

IBM Copy Blades

IBM FlashCopy Blade

– Provides support for IBM FlashCopy V2

– Dataset FlashCopy support for fast object / application recovery

– ANTRQST calls issued to drive FlashCopy volume commands (fast performance)

– Requires Set 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 DASD

– Dataset FlashCopy support for fast object / application recovery

– Slower than using ANTRQST in native FlashCopy blade

– Requires Set Log Suspend

– Supports FlashCopy (IBM, EMC, HDS), SnapShot (STK, RAMAC Virtual Array)

IBM Copy Blades (Cont)

▪ IBM DB2 Backup System Copy Blade

– Executes the DB2 Backup System Utility

– Does not require DB2 Set Log Suspend

– Incremental FlashCopy support

– Uses IBM FlashCopy V2 (IBM, EMC, HDS)

– DB2 RE advantages for using DB2 System Backup Utility

  – Provides backup validation features on top of DB2 system backup
  – Manages DB2 system backup process through one ISPF interface.
  – Automates the system restore process making it less error prone.
  – Provides fail safe object recovery even if files have been moved or deleted.
  – Provides for use of system backup at DR site
  – Create image copies from the system backup
  – Produces and stores detail and summary reports on each backup.

DB2 System Level Backup
Operational Advantages

- Perform DB2 backups instantly
- Fast restore and parallel recovery reduces recovery time
- Reduce backup, recovery, and administration costs
  - Reduce host CPU and I/O resource utilization
- Simplify disaster recovery procedures
- DB2 and storage system integration used to drive fast-replication capabilities
  - 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
- Requires a sophisticated infrastructure and meta-data to manage the DB2 and storage processor coordination

Volume-level backup with DB2 BACKUP SYSTEM

- **BACKUP SYSTEM provides an easy and non-disruptive way for fast volume-level backup**
  - Use FlashCopy API to backup DB2 data and logs
  - No need to suspend the logs
  - Backup and recovery are managed by DB2 and DFSMShsm
- **Backups can be taken on DASD and/or tapes**
  - DB2 v9
- **These volume-based backups can be used for**
  - Point in time recovery of an entire subsystem or data sharing group (RESTORE SYSTEM)
  - DB2 object recovery (RECOVER)
    - DB2 v9

Prerequisites

- **Hardware**
  - DASD control units that support Flashcopy APIs
  - FlashCopy V2 is strongly recommended – Allows 'source' and 'target' to be across LSS boundary and is about 10x faster
- **Software**
  - z/OS 1.5 DFSMShsm and DB2 V8 for z/OS
    - BACKUP SYSTEM and RESTORE SYSTEM
  - z/OS 1.8 DFSMShsm and DB2 9 for z/OS
    - Ability to recover at the object level using system-level backups
    - Tape support for BACKUP SYSTEM and RESTORE SYSTEM
    - Incremental FlashCopy support (APAR PK41001)
- **People**
  - Strong collaboration between DB2 and Storage teams

Preparation of the DB2 Environment

- All volumes containing DB2 data sets must be SMS managed
  - Including the DB2 catalog/directory, logs and BSDS, and all user data
- DB2 logs and BSDS must be separated from the rest of the DB2 data sets
  - Own pool of volumes
  - Own ICF user catalog
  - Defined in a separate SMS storage group
- Special care should be taken to ensure that the ICF user catalogs stay synchronized with the data
  - Must have separate ICF user catalogs for data and logs
    - ICF user catalog(s) for data must reside in the data copy pool
    - ICF user catalog for logs must reside in the log copy pool
  - Do not share ICF user catalog with non-DB2 data

SMS Definitions

- **COPYPOOL**
  - SMS construct introduced in z/OS 1.5
  - Set of SMS storage groups – maximum 256 storage groups
  - Has a VERSIONS attribute to specify the number of copy versions to be maintained on DASD – maximum is 85
  - Each DB2 system can only have two SMS copy pools
    - Database copy pool (DSN$location_name$DB)
    - Log copy pool (DSN$location_name$LG)

SMS Definitions …

- COPYPOOL BACKUP
  - New storage group type

  - Contains the candidate target volumes for DFSMShsm fast replication requests

  - Must contain enough <u>eligible</u> target volumes to satisfy the needs of the specified number of copy pool versions

  - An <u>eligible</u> target volume must meet the following requirements:
    - Have the same track format as the source volume
    - Be the exact size of the source volume
    - For FlashCopy:
      - Not be a primary or secondary volume in an XRC volume pair
      - For FlashCopy Version 1:
        - Reside in the same LSS as the source volume
        - At the time of the backup, not be in a FlashCopy relationship

Additional Considerations

- **DFSMShsm does not support the migration of data sets within a copy pool, although it is not explicitly prevented.**
  - Recovering a copy pool or a volume within a copy pool from which data was migrated will cause data loss
  - Data set migration must be prevented in the SMS definitions

- **SMS extend or overflow storage groups**
  - Should only be utilised by storage groups containing DB2 data sets
  - Must <u>all</u> be contained within the data copy pool

EMC Copy Blades

- **EMC TimeFinder Copy Blade**
  - TimeFinder/BCV
  - TimeFinder/Clone
  - EMC Consistency Technology support
  - TimeFinder Data Set Snap facility to perform fast replication application / object restores.
  - EMC Virtual Devices
    - Allows multiple backups with reduced storage utilization
  - Incremental Copy Support
  - Set Log Suspend performed on **one** data sharing member when backing up a data sharing group.

Hitachi Data Systems Copy Blades

- **ShadowImage Copy Blade**
  - Supports HDS native ShadowImage volume copy processes
  - Invoked using FlashCopy backup profile
    - Checks *shadow_image* field in RE parm lib
      - N – RE drives FlashCopy
      - Y – RE drives ShadowImage
  - Incremental Copy Support
  - Requires DB2 Set Log Suspend
  - Can support a DB2 that is on both HDS and IBM storage using native methods (ShadowImage and FlashCopy)
  - HDS data set FlashCopy emulation used for fast replication object / application restores.

DB2 Recovery Expert
Summary of Benefits

- **Simplifies and automates a DB2 SLB methodology**
  - Leverages storage-based fast-replication
  - Fast, non-intrusive, and reduces CPU, I/O and storage utilization
- **DB2 SLBs can be used for DB2 system, application, or table and index space recovery**
  - Parallel recovery reduces system and database recovery time
- **DB2 image copies can be created from a SLB**
  - Simplifies DB2 backup and recovery strategies
- **DB2 SLBs simplify disaster recovery procedures**
  - Transforms DB2 DR procedures into a disaster restart process
- **Less skills required to implement advanced DB2 backup, recover, and disaster recovery solutions**

Q & A