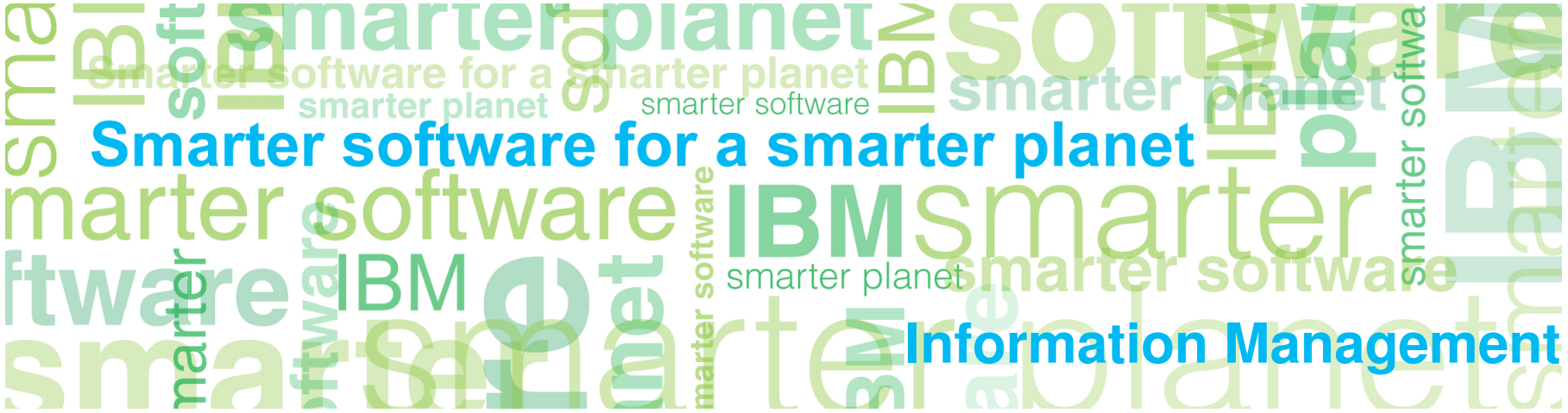
Kelly Smith

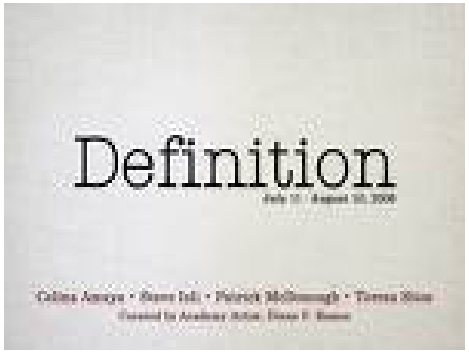
Reduce Application Recovery Time and Complexity using DB2 Recovery Expert for z/OS



Agenda

- **Definitions**
- **Trends and directions**
- **System Level Backup Overview**
- **Intelligent Recovery Manager**
  - System level backup Recovery
  - Application recovery from a system level backup
  - Dropped object recovery
  - Recovery versioning
  - Log Analysis services
  - Dependency analysis
  - Recovery plans
- **Intelligent Disaster Recovery Manager**
  - Image copy method
  - Disaster restart
- **System Level Backup Usage Considerations**

Definitions

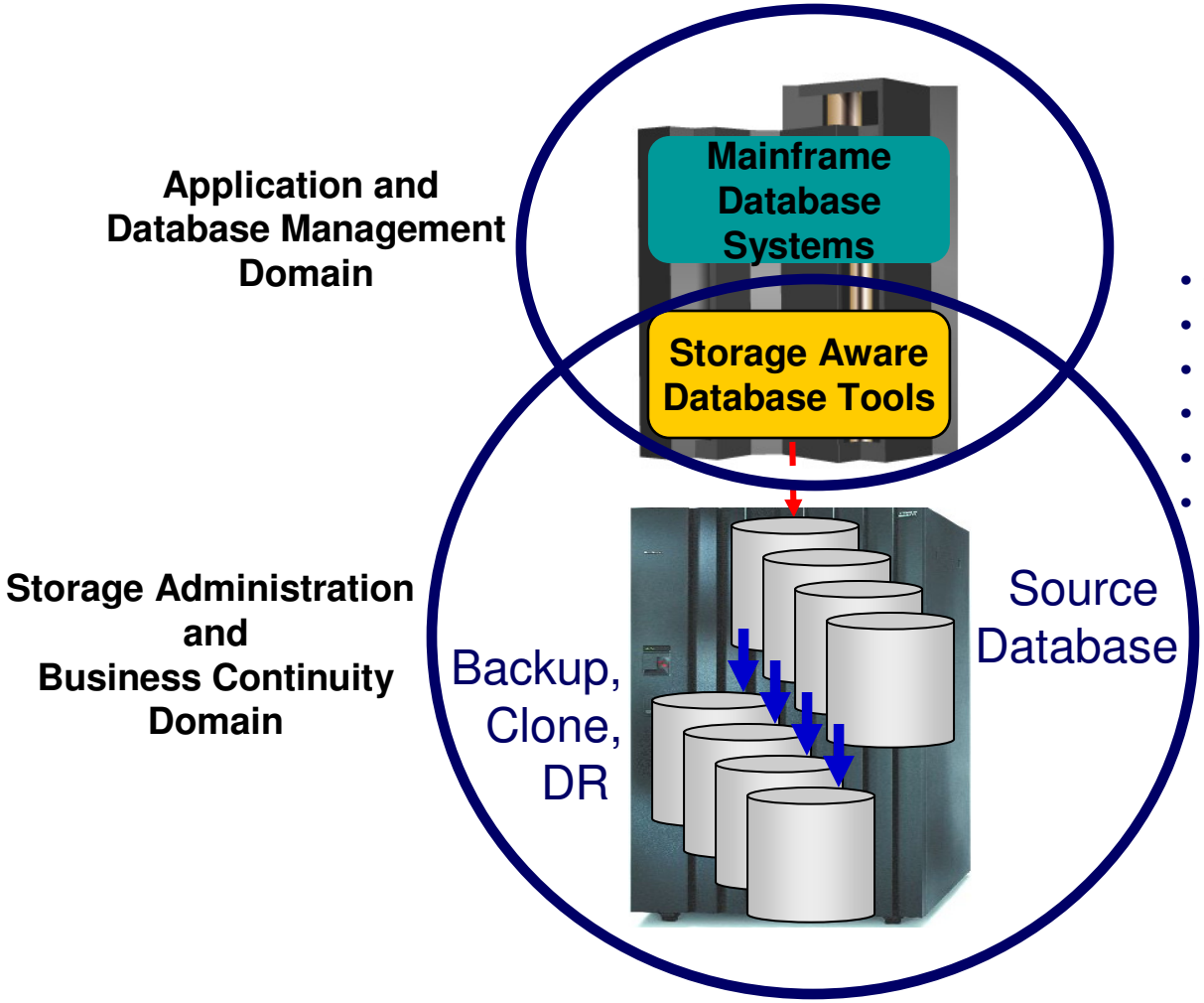


- **Restore**
  - Restoring database environment to a previous copy
    - Table space, index space, application, system
- **Recover**
  - Explicit application of database logs to a point of consistency
    - Table space, index space, application, system
- **Restart**
  - Implicit application of database logs that happens during the normal database initialization process
    - System

Database and Storage Administration - Trends and Directions

- **Large DB2 and IMS 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
  - Provide fast and non-intrusive backup and cloning operations
  - Simplify recovery operations and reduces recovery time
  - Simplify disaster recovery procedures

Database and Storage Integration



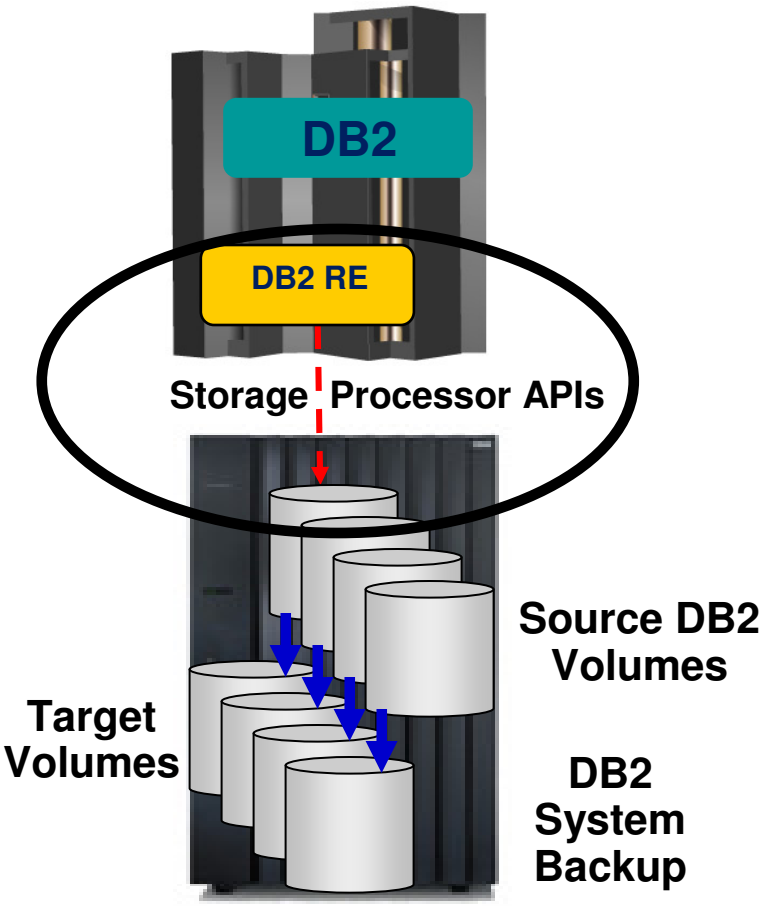
- **Organizational Integration**
- **New Backup Methods**
- **New Recovery Strategies**
- **Business Recovery Monitoring**
- **Cloning Automation**
- **Disaster Restart Solutions**

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**

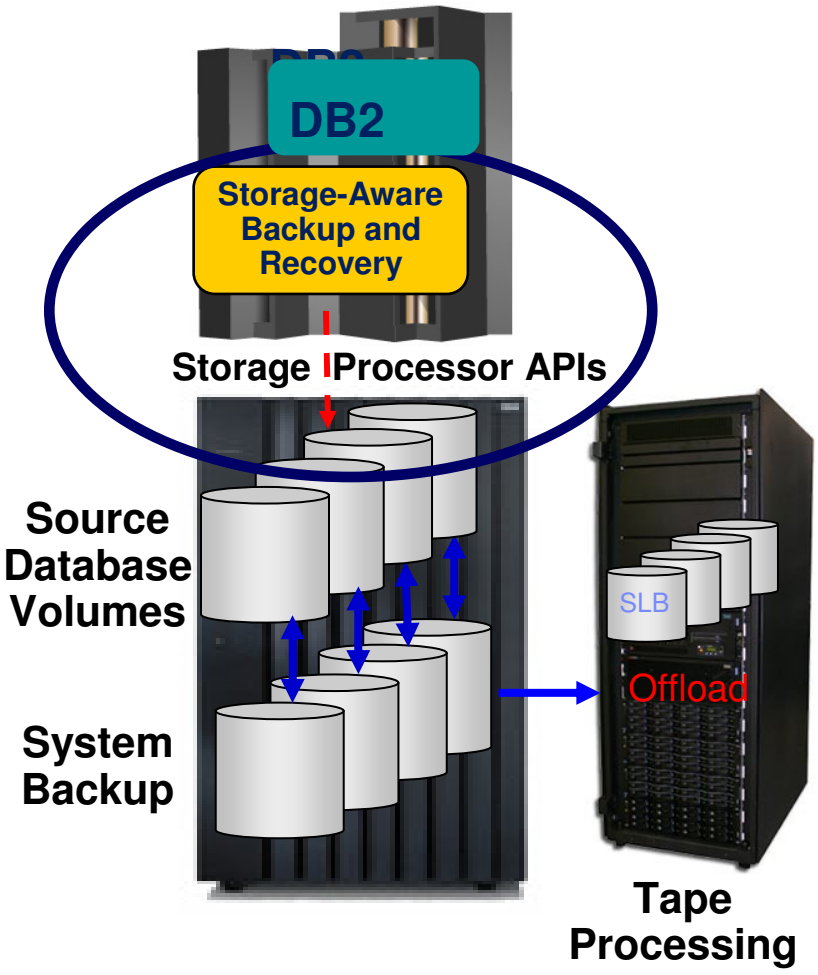
DB2 System Level Backup Overview
- System Level Backup

- **A System Level Backup is a backup of the entire DB2 environment at a point in time**
  - *Does not require* DB2 BACKUP SYSTEM or HSM
  - Recorded in DB2 Recovery Expert Meta data repository
- **Leverages storage-based fast replication to drive the volume backup**
  - Backup in seconds
  - Offloading the data copy process to the storage processor saves CPU and I/O resources
  - Faster than data set copies
- **Backup DB2 without affecting applications**
  - Backup windows reduced by replacing image copies
  - Extends processing windows
- **Data consistency ensures data is dependent-write consistent**
  - DB2 Suspend
  - Storage-based consistency functions
  - Equivalent to a power failure



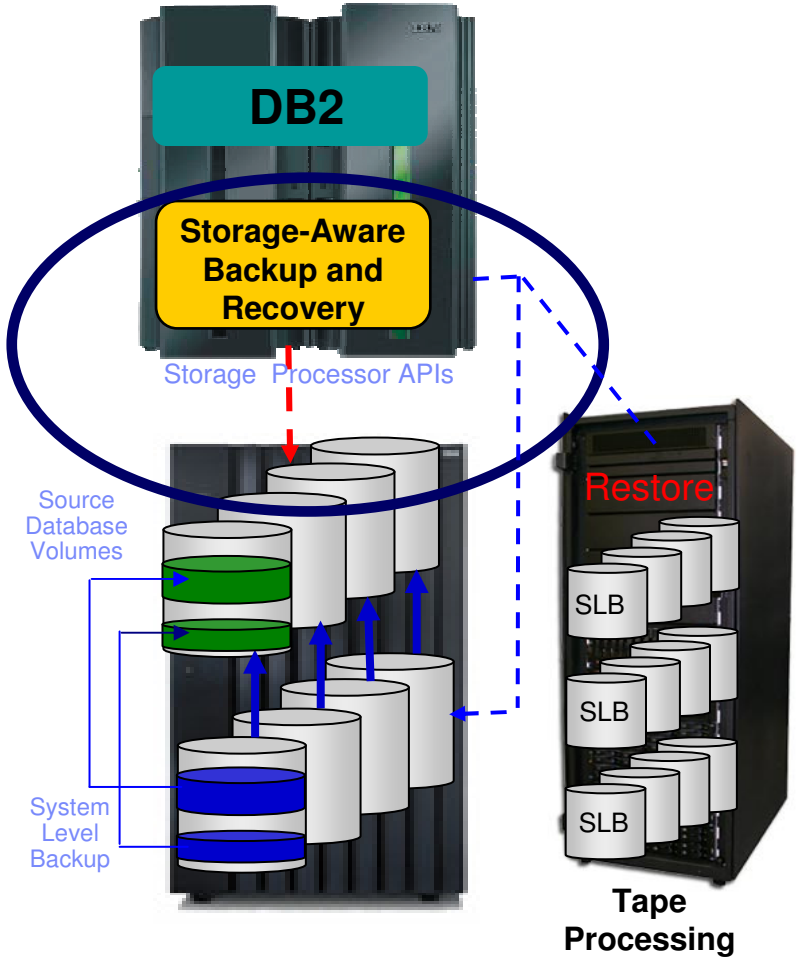
DB2 System Level Backup Overview - System Level Backup

- **Backup validation each time ensures successful recoveries**
  - Insurance that a backup is available
- **Automated backup offload (archive/recall)**
  - Copies system backup from fast replication disk to tape for use at either local or disaster site (or both)
- **Image Copies can be taken from SLB**
  - Can register Image Copies in SYSCOPY to be used by any recovery tool
  - Does not affect source application performance since image copy is made from SLB
  - All backups taken at the same time
- **Can be used in combination with other backups (image copies)**



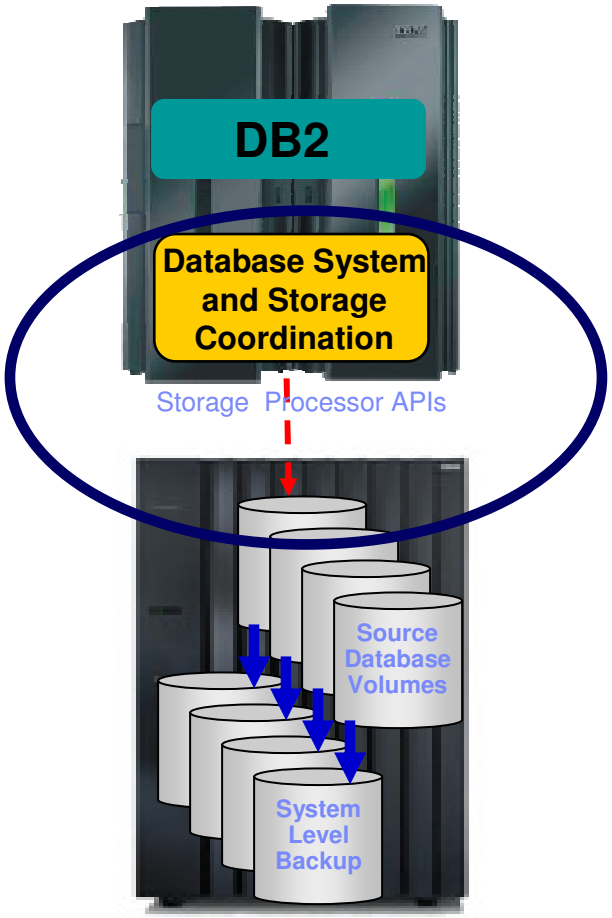
DB2 System Level Backup
- System and Application Recovery

- **Recover DB2 systems or application objects from disk or tape automatically**
- **System recovery**
  - Volume fast-replication used to restore data
  - Parallel log apply reduces recovery time
  - Automatically fixes objects in recover/rebuild pending after a System Restore
- **Object or application recovery**
  - Intelligent Recovery Manager invoked to optimize recovery
    - Integrates with traditional DB2 recovery tools
  - Data set fast-replication used to restore data
  - Parallel log apply reduces recovery time
- **Faster recovery**
  - Instantaneous system or application restore process
  - Parallel recovery minimizes downtime
- **One system backup used for system, application, and disaster restart**



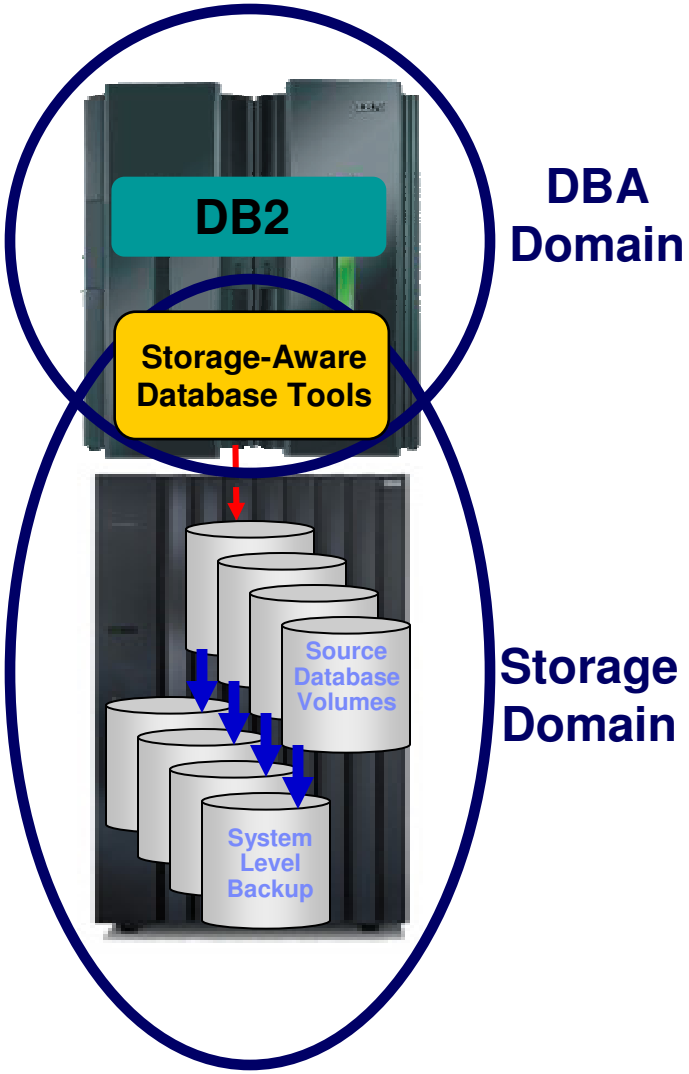
DB2 System Level Backup - Disaster Recovery

- **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
- **Possible tertiary DR site for sites using remote mirroring**



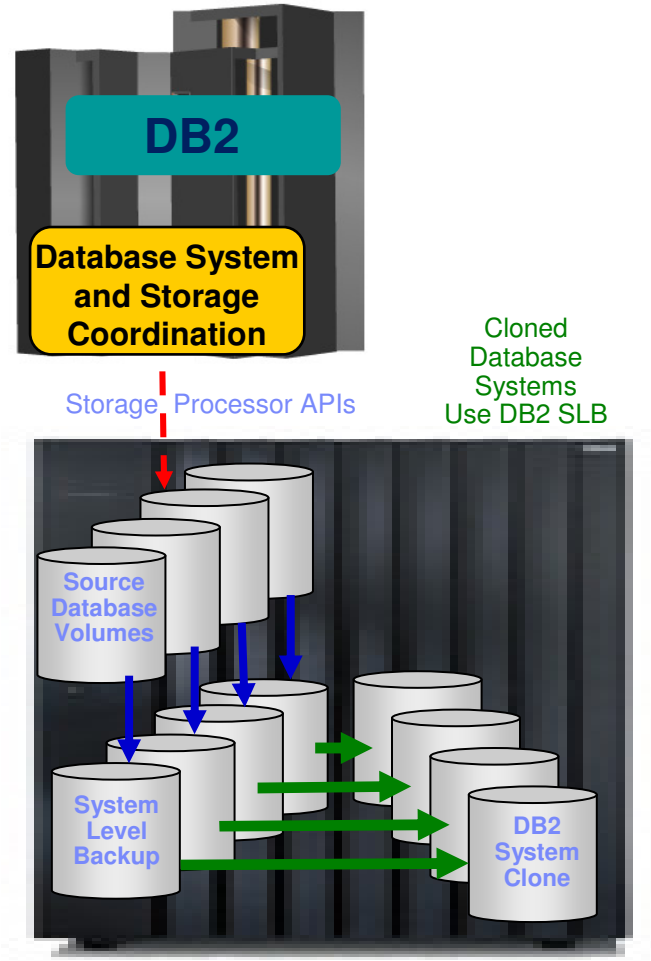
DB2 System Level Backup - Storage

- **Reduce storage and processing costs by utilizing one backup for multiple purposes**
  - Local DB2 system recovery
  - Local Application recovery
  - Disaster restart/recovery
  - Image copies from SLB
- **Leverages storage-processor and fast-replication software investments**
  - Saves CPU, I/O, and processing resources
- **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
- **Perform DB2 system cloning operations from a system level backup**



Clone from a System Level Backup

- **Full system-level backup created using full volume fast-replication**
- **Database clone operations performed using SLB volumes as source**
- **Storage-aware database tools provides infrastructure and metadata to manage database and storage processor coordination**



Intelligent Recovery Manager

Intelligent Recovery Manager

- **Performs efficient local recoveries using available recovery resources and tools**
- **IBM DB2 backup and recovery utilities look like a single product from the end-users perspective**
  - Centralizes backups
  - Only one product is needed for all recovery processes (local recovery, disaster recovery, rebuilding damaged index, dropped object recovery, application relationship analysis, etc.)
- **Simplifies and automates recovery processes:**
  - Recovery JCL built once (in advance)
  - Run-time analysis to determine recovery resources available
    - *Combination of SLB and other DB2 recovery assets*
    - *Can be directed to use DB2 recovery assets only*
  - Run-time analysis of what recovery utility to invoke and in what order
  - Spawns jobs to perform recovery tasks
  - Takes the technical knowledge out of having to create complex recovery JCL

Intelligent Recovery Manager Overview
- System Level Backup Recovery

- **Analyzes system backup and DB2 system to generate JCL that will restore/recover the system in quickest way possible**
- **Automates volume restore process from either fast replication disk or from tape copy**
- **Full DB2 Restore**
  - Restore Entire DB2 System
    - Includes DB2 active and archive logs, BSDS, ICF catalogs and z/OS control datasets
    - Can be used for disaster restart or local restart of an entire DB2 system
- **Data Only Restore/Recover**
  - Restore volumes that contain DB2 tablespaces and Indexspaces
  - Perform roll forward recovery with one pass of the log
  - Recovery of all objects to a specified point in time after the SLB
  - Detects objects that had a LOG NO event occur in recovered log range
    - Automatically generates recovery using Image Copies and rebuild indexes for those objects
  - Can be used at disaster site to replace traditional image copy recovery methods
    - SLB volumes are restored at DR site from a system backup on tape
    - Recovery is performed with one pass of the log

Intelligent Recovery Manager Overview
- Application Recovery From a System Level Backup

- **Enables recovery of an application or individual table or index spaces to a point-in-time**
  - Recover to current
  - Recover to a timestamp (timestamp utility converts to RBA)
  - Recover to an RBA/LRSN
- **Object profile created in advance**
  - Single or group of objects
  - Supports wildcards to select multiple objects
  - Saves recovery time because related applications are defined ahead of time and used when application needs recovery
- **Analyzes all objects in the profile and generates the most appropriate recovery method for each object**
  - Related objects (RI) can automatically be included
  - Generates JCL to restore objects from either IC or SLB
  - Indexes that cannot be restored are rebuilt
  - Log apply occurs in single step eliminating multiple passes of the log
  - Access to objects is automatically stopped and restarted at end of recovery
- **Storage-based fast-replication is used to perform restore (if available)**
  - Performs an instantaneous data set restore process
  - Fast replication from SLB is available even if data set has moved or was deleted or an Online Reorg occurred after SLB
  - Recovery (log apply) is performed in parallel with volume restore process if fast replication is used

Intelligent Recovery Manager Overview
- Dropped Object Recovery

- **Dropped object recovery to any version of the table**
  - Reduces downtime by eliminating the cumbersome process of figuring out what needs to be created and how to restore the data
  - Fills gap in standard DB2 recovery tools of not being able to recover dropped objects
- **Utility to save the DB2 object attributes in a DB2 Recovery Expert Schema Level Repository (SLR)**
  - Run on a scheduled basis to capture schema changes
- **Recovery point:**
  - Current, RBA/LRSN, to Copy (last full, last incremental, specific copy)
- **Overview:**
  - Display shows objects that no longer exist in DB2 catalog (dropped)
    - Users can visually see dropped objects
  - Create the DDL from the version selected
    - All related objects that have been dropped are automatically included
  - Load data from available Image Copy
    - Image copy entries are tracked in SLR
  - Apply logs to specified recovery point
    - Log apply is accomplished via building SQL statements from the log

Intelligent Recovery Manager Overview
- Recovery Versioning

- **Recovers an object or application set of objects back to a prior version**
  - Reduces downtime by eliminating the cumbersome process of figuring out what needs to be created and how to restore the data
  - If a DDL change was made that was incorrect, this allows you to recover to a prior version of the DDL
- **Utility to save the DB2 object attributes in a DB2 Recovery Expert Schema Level Repository**
  - Compares information stored in the system catalog tables against the information stored in the Schema Level Repository (SLR) repository to identify version differences
- **Overview:**
  - Drops the object definitions
  - Creates the DDL from the version specified
    - Automatically includes related objects that have changed as well
  - Loads data from available Image Copy
  - Apply the logs to specified timestamp or RBA/LRSN

Intelligent Recovery Manager Overview
- Log Analysis Services

- **Enables recovery of individual tables or groups of objects to a point-in-time to provide the most efficient recovery**
  - Recover to current
  - Recover to a timestamp (converts to RBA)
  - Recover to an RBA/LRSN
  - Reduces recovery complexity and speeds up the recovery process
- **Quiet Time Advisor**
  - Reads and analyzes the DB2 log to find quiet times or points of consistency for single or groups of objects
  - These points are saved in a DB2 table and can be selected (or generated) when a recovery is performed.
- **Undo / Redo SQL plans**
  - Undo SQL based recoveries can be generated to quickly “backout” transactions
    - This type of recovery is not supported by standard DB2 recovery tools
  - Redo SQL recoveries to quickly “roll-forward” changes
  - Generated SQL can be analyzed to identify and change errant transaction that caused issues
  - Can be used to recover just one table of a segmented tablespace
  - Includes recovering objects that contain XML or LOB columns
  - Provides recovery support not supported by standard DB2 recovery tools

Intelligent Recovery Manager Overview
- Dependency Analysis

- **All related objects that must be recovered together will automatically be included**
  - DB2 catalog referential integrity (RI)
  - User RI through an interface to Optim database relationship analyzer (DRA)
  - Related objects (RI) can automatically be included

Intelligent Recovery Manager Overview - Recovery Plans

- **GUI recovery tool that presents many different plans (or methods) of recovery**
  - Analyzes all recovery assets and methods and presents them in a list with most efficient plans presented first
  - Each plan uses a different primary recovery resource or different recovery method
  - Users can chose which method they want for a certain reason or use the recommended plan
    - SQL based recovery plans may not be the least expensive, but may be desired to view the SQL to find a bad transaction
- **Recovery plans are assigned a relative cost to indicate how quickly they will run in comparison to the other plans**
  - Users can easily identify which recovery method will get their data back the fastest
  - Cost calculation is an estimate based on the size of the data sets and the method of recovery
- **Provides intelligent assistance for performing many types of DB2 recoveries**
  - Faster, simpler recovery
    - You don't need an expert DBA
    - Provides recovery expertise to reduce downtime
- **Builds restore/recover jobs**
  - User chooses the selected plan and can review the generated JCL
- **Executes the recovery plan**
  - Can generate and execute the JCL in multiple jobs that run in parallel to execute recovery faster

Intelligent Recovery Manager Overview
- Recovery Plans

- **Supports index image copies**
  - If an index is defined as COPY YES, and an image copy of the index is available, the index will be recovered from the image copy
  - If COPY NO, the index is rebuilt
- **Improves recovery performance by executing utilities in parallel where appropriate**
  - Includes restore and recover
- **Option to generate an image copy after recovery**

Intelligent Disaster Recovery Manager

DB2 Intelligent *Disaster* Recovery Manager

- **Performs:**
  - Local site procedures to prepare for offsite disaster recovery or disaster restart
    - Image copy method
    - System level backup method
  - Remote site restore operations and appropriate recovery or restart procedures
  - Simplifies and automates disaster recovery processes
- **Disaster recovery or disaster restart creation of jobs to:**
  - Perform traditional disaster recovery process
  - Restore system level backup and restart DB2
  - Restore system level backup, restart DB2, update BSDS, apply logs to point in time
  - Restore system level backup, restart DB2, apply image copies that were sent offsite

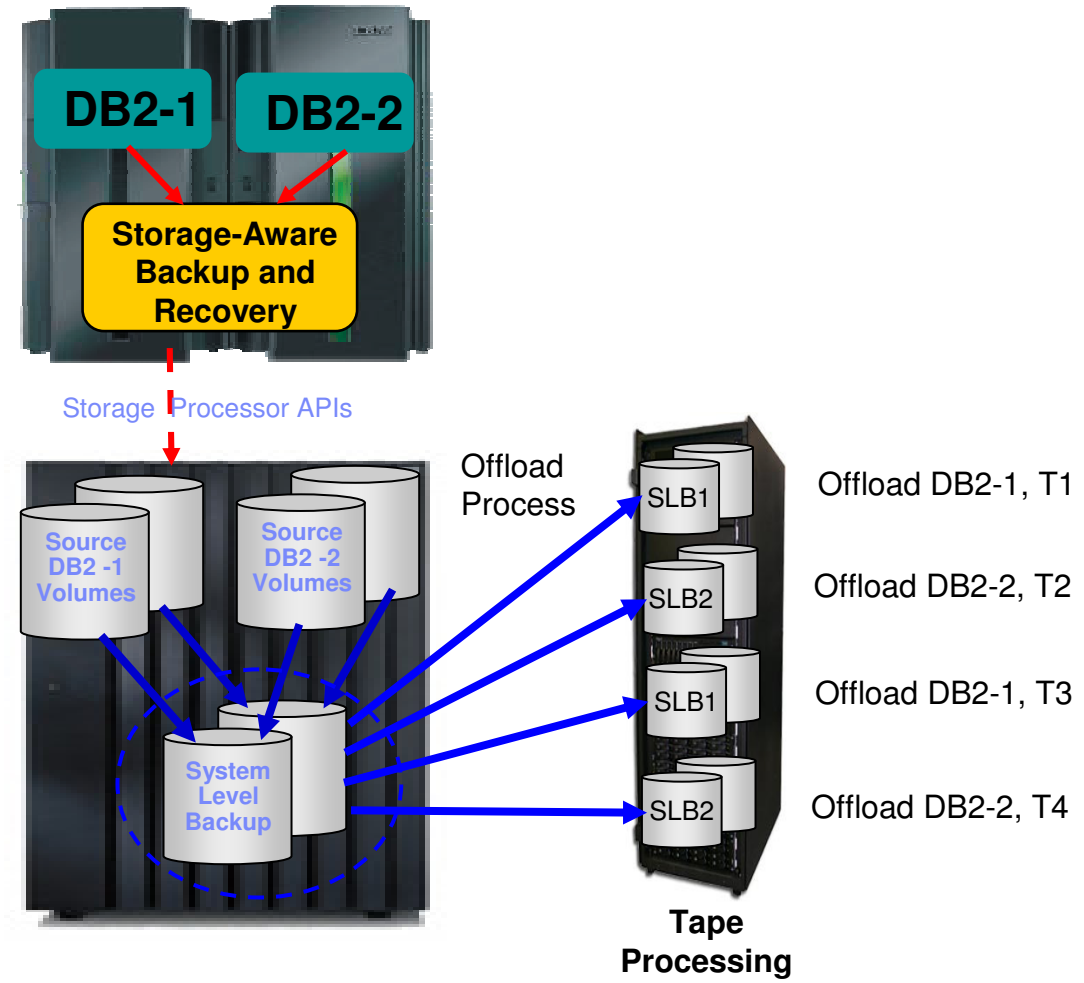
DB2 Intelligent *Disaster* Recovery Manager

- **Options to:**
  - Specify which archive logs are to be used at the disaster site
  - Copy archive logs
    - Option to force a checkpoint before archiving - DB2 Recovery Expert issues a SET LOG LOGLOAD(0) command
    - Option to force the active log to archive
  - Builds JCL to restore the DB2 catalog and directory from Image Copies
    - DB2 Recovery Expert builds recovery procedures in the right order to match DB2 release requirements
  - Finds appropriate DR image copies and stores information about them in the PDS which will be shipped to the DR site
  - Dump the DB2 Recovery Expert repository to the PDS and creates recovery JCL
  - Copy archive logs to disk at the recovery site to reduce or eliminate contention on the archive log tape during recovery
  - Catalog disaster recovery image copies in ICF catalog at DR site
  - Build the bootstrap data set(s) (BSDS)
- **Recovery JCL created each time DB2 Intelligent Disaster Recovery manager is executed at local site**
- **Jobs are pre-built and placed in a PDS to be shipped to the disaster recovery site**

Space Efficient Usage

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**

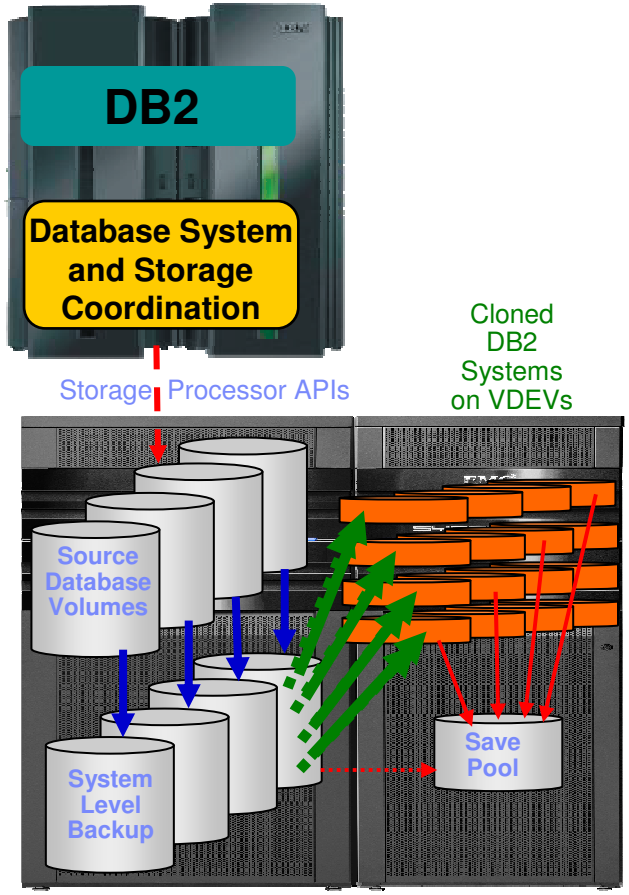


System Level Backup Implementation Considerations
- Use of Space Efficient Fast-Replication Technologies

- **Volume vs Space Efficient Operations**
- **Full volume copy**
  - Copy requires same amount of storage as the source
  - Relationship can be retained with production volume
    - Allows incremental resynchronization
  - Full volume restore used for system restore operations
  - Fast replication data set level copy used for application or object recovery from non-archived backups
- **Space Efficient Devices**
  - Requires minimal additional storage
  - Restores changed tracks
  - Can have multiple volumes associated with production volume
  - Full volume restore used for system restore operations
    - Changed tracks restored from repository in save or extent pool
    - Full volume backup needed for catastrophic loss of source volume because only changed tracks are copied back
  - DFSMSdss **host** copy methods used for application or object recovery from non-archived backups
  - *Available for EMC TimeFinder/Snap, IBM/STK SnapShot, (IBM FlashCopy coming soon)

Space Efficient Cloning Using an SLB

- **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**
- **Operational automation may be required to re-instantiate space efficient clones when the full volume clone is re-instantiated**
- ***FlashCopy SE, EMC TimeFinder/Snap, STK SnapShot**



DB2 Recovery Expert
- Summary of Benefits

- **Object or Application recovery leverages existing products (with or without SLBs)**
  - Dropped object recovery
  - Versioning recovery
  - Recovery plans
  - Implementation of an SLB and parallel recovery methodology can be done over time
- **DB2 Intelligent Disaster Recovery Manager can support image copy or disaster restart**
- **Simplifies and automates a DB2 system level backup (SLB) methodology**
  - Leverages storage-based fast-replication
  - Backup DB2 without affecting applications
  - Reduces CPU, I/O and storage utilization
  - Backup validation each time ensures successful recoveries
  - Backup windows reduced by replacing a majority of image copies
  - Extends processing windows
  - Restore in parallel with recovery
  - Image Copies can be taken from SLB
  - Utilizes one backup for multiple purposes
- **Less skills required to implement advanced DB2 backup, recover, and disaster recovery solutions**
  - Managed recovery with or without System Level Backup