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white paper

Rocket Mainstar Solutions for SAP® Systems Using IBM DB2® for IBM z/OS®

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SAP is a business critical application that is used to integrate and automate diverse business management processes. Many SAP implementations use DB2 for z/OS as the database server to manage SAP application data. Typically, DB2 for z/OS is chosen as a database server due to its robust database management capabilities, its high performance potential, its high availability characteristics, and its ability to scale to fit application requirements.

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introduction

SAP is a business critical application that is used to integrate and automate diverse business management processes. Many SAP implementations use DB2 for z/OS as the database server to manage SAP application data. Typically, DB2 for z/OS is chosen as a database server due to its robust database management capabilities, its high performance potential, its high availability characteristics, and its ability to scale to fit application requirements.

Dedicated DB2 on z/OS systems are used to support SAP applications. These DB2 systems have large numbers of correlated DB2 tables, table spaces, indexes, and index spaces that are used by the SAP application. SAP implementations can require 50,000 to 80,000 DB2 objects to be managed collectively within a given DB2 system to support SAP applications. Some DB2 objects may be dynamically created and deleted while sensitive SAP application data relationships, that are inherent in its databases, are maintained by the SAP application and by the DB2 system collectively. The dynamic interrelation of many DB2 objects requires all data to be managed as a unit and requires that the data be backed up and recovered as a unit otherwise data relationships become broken, jeopardizing the integrity of the SAP business applications.

SAP is a critical business application where high availability solutions are required to reduce the business effect caused by normal database maintenance as well as to minimize application outages caused by infrastructure failures. Fast backup, recover, and disaster recovery facilities are required to minimize business down time during normal application operations and to reduce the impact of logical errors or the impact of a catastrophic local site failure. Low impact and fast DB2 system cloning facilities are required to reduce the administration and operational impact of creating test SAP application environments.

SAP on z/OS backup and recovery challenges

Traditional DB2 for z/OS backup and recovery procedures do not work effectively for SAP systems using z/OS. The large number of integrated DB2 objects used to support SAP applications require strict backup and recovery coordination to ensure all data relationships are maintained through a recovery process. Failure to recover all related objects to exactly the same point results in comprised business data in the database server and will be reflected in the SAP business application

A DB2 system backup and recovery methodology can simplify DB2 backup and recovery procedures and ensure that dynamically-managed DB2 objects are recovered and all data relationships are preserved during a recovery process. A DB2 system backup and recovery methodology is one where the entire DB2 system is backed up as a unit and the backup can be used to recover the DB2 system as a unit. All data relationships are implicitly maintained during the recovery process, guaranteeing that data integrity is preserved for the SAP application. A DB2 system backup and recovery methodology is much faster to perform than using tradition DB2 image copy approaches and the same DB2 system backup and recovery procedures can be used for local site recovery as well as for off-site disaster recovery purposes.

Most DB2 system backup solutions use some form of storage-based fast-replication that is integrated with DB2 backup and recovery facilities. These backup and recovery solutions leverage modern storage processor capabilities and fast-replication products to perform backup and restore operations on behalf of the DB2 system. Some fast-replication products used to support a DB2 system backup approach include: IBM FlashCopy®, EMC TimeFinder/Mirror®, EMC TimeFinder/Clone®, EMC Snap®, and Hitachi ShadowImage®.

The advantages of using a DB2 system backup methodology which uses storage-based fast-replication include:

- Full DB2 system backups can be completed in seconds or less.
- There is very little or no impact to applications while the backup is performed.
- Point-in-time re-startable backup copies of an entire DB2 system are created.
- No host CPU and I/O resources are used to create the backup.
- Incremental fast-copy facilities can be used to reduce backup storage requirements and to reduce the storage processor resources used in the copy process.
- System backups can be used for multiple purposes: local site system recovery, local site object recovery, as a source for creating a backup used for offsite disaster recovery, and as a source for performing DB2 system cloning operations.
- System backups can be archived using an independent tape copy process to reduce disk storage utilization while preserving the backups created in multiple backup cycles.

The advantages of using a DB2 system backup to perform a DB2 system recovery operation include:

- The entire DB2 system can be restored from disk instantaneously when storage-based fast-replication is used to restore the data.
- Parallel recovery can be performed. That is, DB2 log apply functions can be performed in parallel to the data restoration process. Thus, reducing overall DB2 system recovery time.
- The DB2 recovery process is done by processing the DB2 log one time to recover the entire DB2 system.
- The DB2 system is recovered as a unit so all data relationships are preserved during the restore and recovery processes. Thus, ensuring the SAP application's data integrity is preserved.

The advantages of using a DB2 system backup for off-site disaster recovery include:

- A DB2 system backup can be easily copied to tape and transported to a disaster recovery site.
- Traditional DB2 disaster recovery procedures are streamlined by using a tape-based disaster restart methodology. A disaster restart methodology is one where tapes containing a system backup are loaded at a disaster recovery site and DB2 is restarted. Disaster recovery procedures are implicitly performed during the normal DB2 restart operation. Traditional DB2 disaster recovery procedures are not used. The normal DB2 restart process using a system backup transforms the system backup data-state into a transactionally-consistent data-state. The DB2 system is ready to accept new application work after the restart process is complete. A disaster restart methodology is a fast and effective way to resume SAP processing at a disaster recovery site and minimize recovery time objectives and SAP application down time.

SAP on z/OS application and data cloning challenges

SAP applications environments and their supporting data infrastructure are cloned for various application and operational reasons. Some SAP implementations that use DB2 for z/OS clone their supporting DB2 for z/OS system many times over. Some reasons to clone SAP application environments and their supporting DB2 systems include:

- Creation of SAP application test environments.
- Prototyping new SAP application functionality.
- Testing new SAP release migrations before the migrations are performed on production systems.
- Testing new DB2 for z/OS release and migration procedures.
- Testing new system management and operational procedures.

Cloning DB2 systems that support SAP application environments can take a long time when using host-based DASD volume or data set copy procedures. Further, when cloning a DB2 system in the same LPAR or in a different LPAR with shared disk, all data set names must be changed so they can be integrated into the cloned DB2 system. The data set rename process can be long when 50-80,000 data sets need to be renamed during the cloning process. Typically, cloning methodologies that use host-based volume or data sets copy procedures can take days or weeks to perform the DB2 system cloning operation. The steps required to clone a DB2 on z/OS system include:

- A data consistency mechanism must be chosen and used so that data relationships are preserved during the copy process and remain intact when the cloned DB2 system is started. Many DB2 system cloning methodologies require the SAP application to be down and its supporting DB2 stopped to get a consistent DB2 clone copy.
- All data must be in a consistent state and copied from a source DB2 system to a target DB2 system.
- Data set names must be changed during the copy process so the target data sets can be accommodated into the target DB2 system.
- The target DB2 system must be adjusted to accommodate the copied data sets and source DB2 system's recovery structures.
- Target SAP system identifiers must be adjusted to associate the cloned SAP application environment with its cloned DB2 system.

DB2 system cloning methodologies that leverage storage-based fast-replication use a storage processor to copy the data quickly. The copy process can be performed while the DB2 system is running. These cloning methodologies use a form of storage-based fast-replication to copy all volumes that make up a DB2 system to a target set of volumes. The volume copy process is fully contained and managed within the storage processor. Once the DB2 volumes are copied, then procedures are employed to condition the volumes and to rename all copied DB2 data sets so the volumes and their new data set names can be accommodated into a target DB2 system. Some fast-replication products used to support a storage-based DB2 system cloning methodology include: IBM FlashCopy, EMC TimeFinder/Mirror, EMC TimeFinder/Clone, and Hitachi ShadowImage. The advantages of using a storage-based DB2 system cloning methodology include:

- DB2 systems can be copied instantaneously and while SAP applications are running.
- There is little or no impact to the SAP application while the DB2 system is being copied.
- Application data consistency is maintained using a DB2 Set Log Suspend or a storage-processor-based consistency function to reduce or eliminate application down time.
- The DB2 system cloning process is quick and easy to perform.
- No host CPU and I/O resources are used for the data copy process.
- Volume reconditioning and fast data set renaming facilities must be employed to allow the volumes to be brought online and the data sets to be integrated into a cloned DB2 system.

Rocket Software solutions for SAP systems using DB2 on z/OS

Rocket Software offers products that simplify DB2 administration functions for SAP on z/OS environments. These products can be used independently or together to create DB2 system backup, recovery, disaster recovery, and DB2 cloning solutions on behalf of the SAP application. Mainstar offers two products that can be used to create SAP on z/OS solutions:

- Rocket® Mainstar Database Backup and Recovery for DB2 (DBR for DB2)
- Rocket® Mainstar Volume Clone and Rename (VCR) and its selectable feature Fast Table Refresh (FTR)

Database Backup and Recovery for DB2

Database Backup and Recovery for DB2 (DBR for DB2) is a DB2 for z/OS system backup and recovery solution designed specifically to simplify and speed up backup and recovery operations for SAP application environments that use the mainframe as their foundation. It is tightly integrated with storage-based fast-replication and it speeds up DB2 backup and recovery processing by using storage-based fast-replication facilities. DBR for DB2 automates the storage management functions for DBAs so they can leverage storage-based fast-replication without having to create or use storage specific commands, scripts, or JCL.

DBR for DB2 provides a fast and easy-to-use implementation of a DB2 system backup and recovery methodology. It reduces backup windows by leveraging storage-based fast-replication such that backups of multi-terabyte databases can be performed in seconds or less. It simplifies backup and recovery methodologies by allowing both full-system and object-level recoveries to be performed from a common system backup. It provides DB2 system backup and recovery support for complex applications like SAP, where all of the application's data must be backed up, restored, and recovered as a unit.

DBR for DB2 features include:

- **DB2 System Backup Configuration and Management** These facilities discover the DB2 system and recommend layout and configuration changes such that the DB2 system is set up appropriately to accommodate a system backup and recovery methodology. Optionally, DBR for DB2 will move data sets and modify the DB2 system configuration to accommodate a system backup and restore methodology.
- **DB2 System Backup and Recovery** DBR for DB2 uses profiles to define system backup and restore procedures that allow users to backup and restore DB2 systems as a unit. Object recovery profiles are used to define DB2 object and application recovery strategies using a system backup. The backup and restore procedures leverage storage-based fast-replication to perform the backup and restore functions.

- **DB2 Object Level Recovery** Object level recovery allows DBR for DB2 users to recover DB2 objects or groups of related objects that represent applications from a system backup. Object level recovery leverages storage-based data set fast-replication facilities. The use of storage-based data set fast-replication allows object recovery to be performed in parallel to the object restore process. Thus, significantly reducing the overall recovery time. Object recoveries that traditionally have taken many hours can be performed in minutes or seconds using DBR for DB2.
- **Metadata Repository** DBR for DB2 provides a comprehensive metadata repository to record backup information like backup time, backup type, log byte addresses, volumes used for the backup, etc. Reports can be generated to monitor backup methods and operations, storage volume usage, system backup volume usage, archived backups, etc.
- **Backup Validation** DBR for DB2 provides extensive backup validation to ensure the backup contains all DB2 files and catalog structures required for a successful recovery.
- **Storage-based Fast-replication Support** DBR for DB2 has extensive storage-based fast replication support. It supports IBM FlashCopy, EMC TimeFinder/Mirror, EMC TimeFinder/Clone, and Hitachi ShadowImage. Mixed vendor storage environments are supported when using IBM FlashCopy as the fast-replication method. Backups of DB2 and non-DB2 data can be accommodated by including the non-DB2 data volumes in a DB2 System Backup profile and using storage-based consistency functions to create a consistent backup.
- **Tape Offload Support** DBR for DB2 provides tape offload support to automate copying a backup from disk to tape. Backups created on disk can be copied to tape using DFSMSdss or FDR so the backup disk volume pool can be reused. A subsequent DB2 system restore operation will restore the backup from disk or tape depending on system backup availability and recovery scope. DBR for DB2 will use the most appropriate backup for object level recovery and will restore the object from disk, tape, or a previous image copy depending on which backup provides the most expedient recovery process.
- **Disaster Recovery** DBR for DB2 provides disaster recovery support by transforming traditional DB2 disaster recovery procedures into a tape-based disaster restart methodology. System backups can be tagged for offsite transport to a disaster recovery site during the offload process. The tape-based disaster restart methodology loads the system backup tapes and restarts DB2 at the disaster recovery site. The DB2 restart process transforms the system backup into transactionally consistent DB2 system that is ready to accept work. Optionally, DB2 logs generated after the system backup can be copied and subsequently applied at the disaster recovery site during the DB2 restart process. Using DBR for DB2 to implement a DB2 tape-based disaster restart methodology simplifies disaster recovery procedures and reduces recovery time objectives.
- **DB2 Version Support** DBR for DB2 supports DB2 versions 7, 8, 9, and 10 using data-sharing and non data-sharing modes of operation.

DBR for DB2 navigation is done using a sophisticated ISPF interface. The menu interface provides quick and easy access to its backup and recovery functions. Figure 1 shows the main ISPF panel for DBR for DB2.

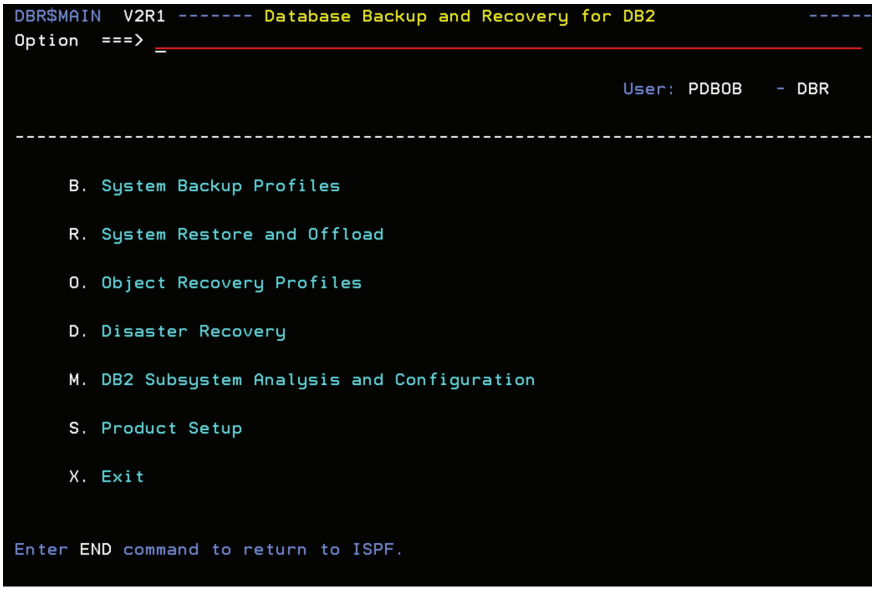


Figure 1: DBR for DB2 Main ISPF Panel Interface

A functional description of each menu option is provided below.

- **Product Setup** Allows users to establish ISPF profile defaults and to register DB2 systems they want to backup and restore. Default specifications can be provided for system backup profiles. The default specifications will be used each time a new backup profile is created. Some default backup profile specifications include: full or data only backups, the number of online and off line backup generations to maintain, the type of storage-based fast-replication method to use, and whether a storage-based consistency function or a DB2 Set Log Suspend command is used to enforce data consistency during a backup operation.
- **DB2 Subsystem Analysis and Configuration** This option invokes the DB2 system configuration discovery facilities. This facility discovers the DB2 system and displays its current DASD configuration. It also recommends DASD layout and configuration changes so that the DB2 system is set up appropriately to accommodate a DB2 system backup and restore methodology. Optionally, ISPF screens are available to assist moving data sets and modifying the DB2 system so system backup and restore functions are easily accommodated.

- **System Backup Profiles** Backup Profiles allow users to define specific backup profiles that can be executed to perform a backup of a specified DB2 system. It allows users to specify the type of backup to be performed and the association of target volumes to be used for the backup. DBR for DB2 automates the target volume selection to allow easy use of storage-based fast-replication features.
- **System Restore and Offload** System restore allows users to restore and recover the DB2 system. DB2 systems can be recovered to a specified backup, to a time stamp, or to a specified RBA value. The restore process leverages storage-based fast-replication to restore the backup, and DB2 recovery facilities are invoked to recover the DB2 system. The DBR for DB2 recovery management infrastructure coordinates the overall recovery process. System backups can be archived or offloaded to tape using this selection.
- **Object Recovery Profiles** Object recovery profiles allow users to recover objects or groups of related objects as a unit. Object recovery profiles can be used to coordinate the recovery of all objects representing a given application. DBR for DB2 will choose the most appropriate backup to restore and it will apply log records in parallel to the restoration process if possible. Recovery profiles can be created proactively to simplify and speed up application recovery scenarios.
- **Disaster Recover** Disaster recovery profiles allow users to define specific disaster recovery options into a saved profile. The profiles can be executed at the local site to ready all the necessary resources to restore a DB2 system at a remote site. Users can optionally direct DBR for DB2 to make copies of local archive logs to be shipped to the disaster recovery site. All the JCL and job cards needed to perform the DB2 restore and recovery at the remote site are generated and placed in a partitioned data set which can be written to tape or to remote DASD for transport to a disaster recovery site. Users need only submit these jobs at the disaster recovery site to perform the DB2 restore and recovery operation.
- **Exit** This option is used to exit the DBR for DB2 product.

creating a DB2 system backup

Implementing a system backup methodology requires the DB2 system and storage volume mapping to be identified and DB2 recovery structures to be isolated from DB2 catalog, directory and application data structures. ICF User Catalog placement must be coordinated with the data they represent. The DB2 discovery and system backup configuration process is done using the DB2 Subsystem Analysis and Configuration panels. Figure 2 depicts a DB2 system that is appropriately configured to use a system backup methodology.

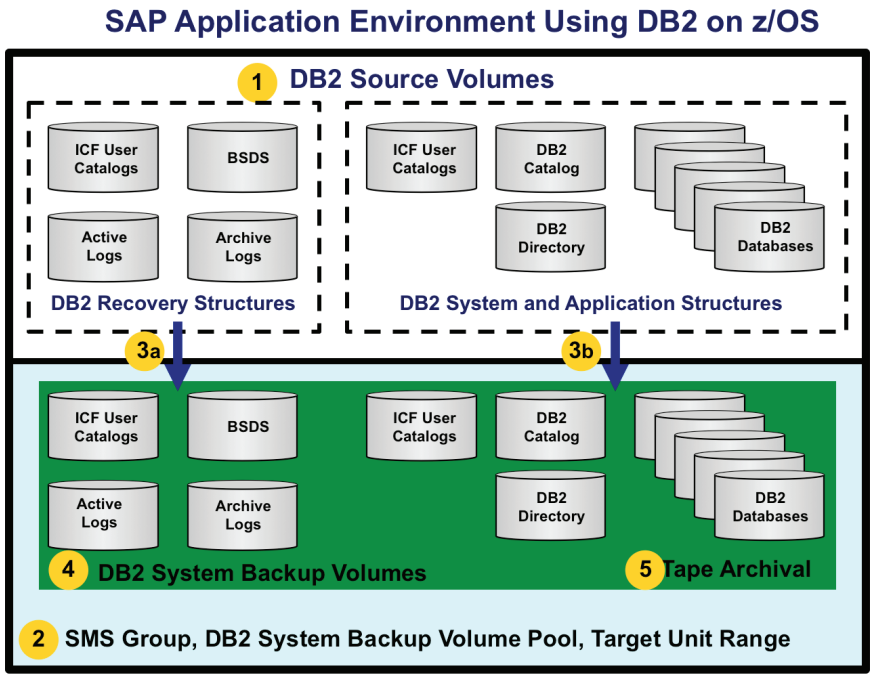


Figure 2: DB2 System Configuration for a System Backup Methodology

The following steps are performed by DBR for DB2 to implement a system backup methodology. The steps refer to Figure 2.

1. The DB2 system is discovered, analyzed, and configured to accommodate a system backup methodology.
2. A System Backup Profile is created. During the profile creation process, DASD volumes used for the system backup are selected. The target backup volumes can be selected from a range of target units, a DB2 System Backup volume pool, or an SMS Storage Group.
3. A system backup is created using the information provided in the backup profile to drive a storage-based fast replication process. Backups performed using the "full" option back up all volumes of the DB2 system (3a, 3b) while backups performed using "data only" option back up the data volumes only (3b).
4. The backup is recorded in the DBR for DB2 metadata repository. Recorded information includes: backup type, time, associated RBA values, target volumes used, and data set name mappings for use in object level recoveries.
5. Online disk volumes can be archived to tape automatically after each system backup or on demand using the System Restore and Offload ISPF menus.

Figure 3 shows DBR for DB2 creating a system backup for an SAP environment using DB2 on z/OS. DBR for DB2 performs the system backup process using information specified in System Backup Profiles and using DASD volume relationships specified in the Volumes Mapping section.

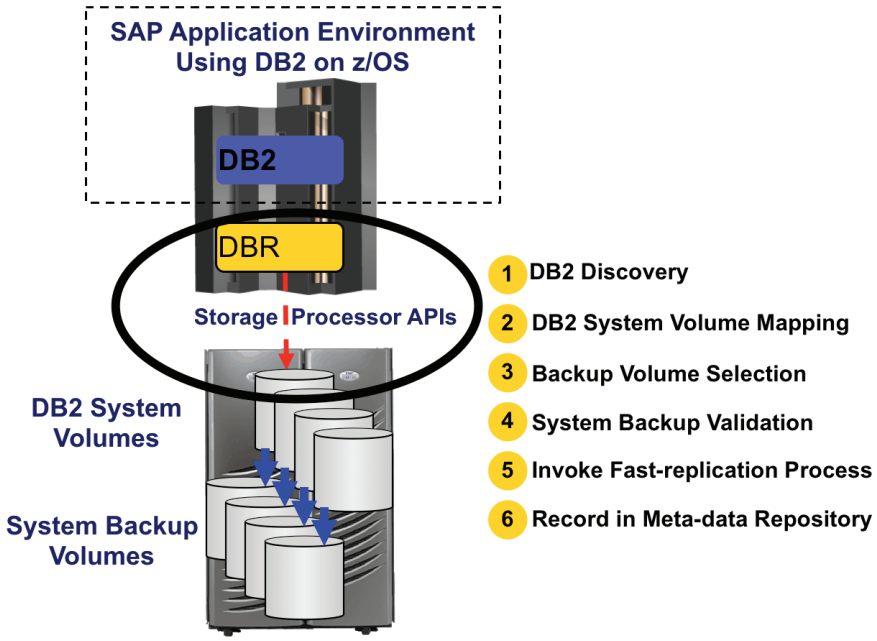


Figure 3: Creating a System Backup for an SAP Environment Using DB2 on z/OS

Processing: The steps below refer to Figure 3 and are used to perform a DB2 system backup operation using DBR for DB2:

1. The DB2 system is discovered and analyzed. Source volumes are identified and data set and catalog placement is analyzed to determine if the DB2 layout can accommodate a system backup methodology. Optionally, DBR for DB2 will move DB2 data sets and catalogs appropriately so that the DB2 system can accommodate a system backup and recovery methodology.
2. All source DB2 volumes are identified and analyzed to determine if non-DB2 data resides on the volumes. Warning messages are issued when non-DB2 data is included in a DB2 system backup.
3. Source DB2 volumes are mapped to target volumes that will contain the system backup. The source to target volume mapping is done during the backup profile creation process.
4. DBR for DB2 performs system backup validation checks before each backup to ensure the backup is complete and can be used for a successful restore operation.
5. DBR for DB2 invokes an appropriate storage-based fast-replication process. The backup is performed in the storage processor without using host CPU and I/O resources. The system backup is completed from a DB2 system and application perspective when the storage-based fast-replication command is issued. Typically, full DB2 system backups complete in seconds or less. Data consistency functions are employed to ensure the backup data state can be used for recovery purposes. Data consistency is ensured using DB2 Set Log Suspend or appropriate storage processor consistency functions.
6. When the backup is complete, information about the backup is recorded in the DBR metadata repository. The metadata information includes an inventory of where each DB2 pageset resides on the backup volumes. This information is used to restore individual data sets when performing a DB2 object recovery operation.

performing DB2 system and application recovery

DBR for DB2 automates DB2 system or object level recovery from a system backup. System recovery is performed using the System Restore and Offload ISPF panels and object recovery is performed using the Object Recovery Profiles panel interface, as seen in Figure 1.

System recovery can be a full or data only recovery. When a full system recovery is performed DBR for DB2 will restore all data and log volumes and no DB2 log apply recovery is performed on the restored volumes, as seen in Figure 2, references 3a and 3b. Performing a full systems recovery is analogous to performing a "recover to copy" when using image copies for recovery.

Data-only recovery directs DBR for DB2 to restore only the data volumes from the system backup (reference 3b, Figure 2). This leaves the DB2 log data sets unaffected and available to use for DB2's log apply phase of recovery. DBR for DB2 then executes a DB2 Restore System utility with the "LOG ONLY" keyword. This utility applies log records for the entire DB2 system with one pass (or reading) of the log files. This process can take place while the storage processor is restoring the data volumes in the background. The recovery process can use a RBA, LRSN, or a time stamp to establish the end of the recovery process. Figure 4 depicts the use of a system backup to recover an SAP application utilizing DB2 on z/OS.

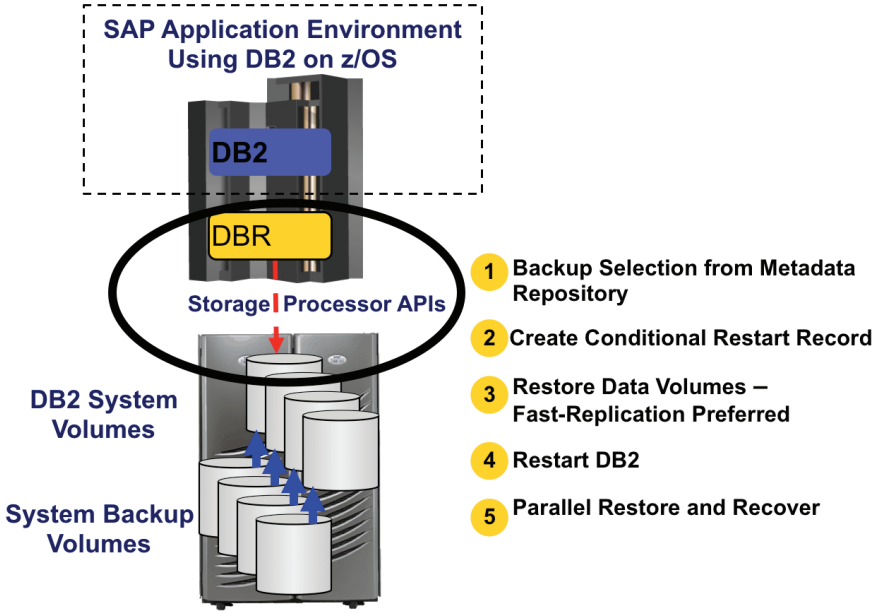


Figure 4: DBR for DB2 Used to Recover an SAP on z/OS Application Environment

The following processing steps refer to Figure 4 and describe a DB2 system recovery process using a DBR for DB2-generated system backup:

1. The appropriate system backup metadata is selected from the metadata repository using the recovery criteria specified in the Restore System Display from the System Restore and Offload panels.
2. A DB2 Conditional Restart record is created specifying at what point to stop the DB2 log apply recovery process. The information used to generate the conditional restart record is specified in the Restore Options panel.
3. DBR for DB2 invokes an appropriate, storage-based fast-replication process to perform the system restore process. The restore operation is performed in the storage processor without using host CPU and I/O resources.
4. The DB2 conditional restart and subsequent log apply process begins after the volume restore process has started. Thus, the DB2 restart and roll forward log apply process is performed in parallel with the volume restore process to minimize overall DB2 recovery time.

DB2 object-level recovery is done by creating an Object Recovery Profile. Object Recovery Profiles describe the methods and options used to recover objects or groups of related objects representing applications. Recovery profiles are created and stored in the metadata repository and can be recalled for use when an application recovery is required. The Object Recovery Profile specifies a recovery point in terms of an RBA or LRSN, last application quiesce point, last copy, to current, etc. The Object Recovery Profile also describes which recovery resources to use by specifying whether to recover from disk, an offloaded tape, an image copy, or all available resources.

System and object recoveries can restore data and perform DB2 recovery operations in parallel when recovering from a system backup that resides on disk. DBR for DB2 will invoke an appropriate data set fast-replication process in the storage processor. While the data is flowing from the backup volume to the source DB2 system to restore the data, DB2 logs are applied to roll the table or index space forward in parallel with the data restoration process. DBR for DB2's parallel restore and recovery process significantly reduces overall recovery time and increases application high availability.

implementing a tape-based DB2 disaster restart methodology

A tape-based disaster restart methodology is one where a restartable DB2 system is captured on disk and transferred to a disaster recovery site using tape as a transport mechanism. Traditional image copy based DB2 disaster recovery procedures are not used at the disaster recovery site. Instead, tapes containing a restartable DB2 system are loaded on to disk and DB2 is restarted at the disaster recovery site. The disaster recovery exercise is complete when the DB2 restart process completes.

DBR for DB2 creates a restartable DB2 system while creating a system backup. DBR for DB2 coordinates a DB2 Set Log Suspend function or a storage-based consistency function with a storage-based fast-replication procedure to create a system backup that is dependent-write-consistent. A dependent-write-consistent data state is identical to a DB2 system that has been exposed to a power failure. When a DB2 system is restarted using a system backup, the dependent-write-consistent data state that is inherent in the system backup is transformed to a transactionally-consistent data state by the DB2 restart process. Once the restart process is complete, the DB2 recovery is done.

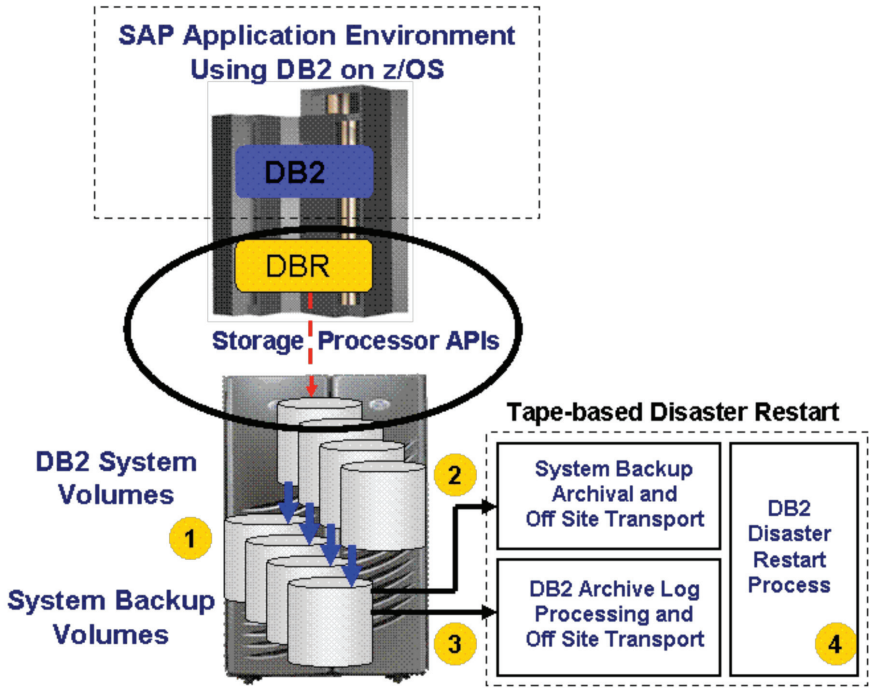


Figure 5: DBR for DB2 Used to Implement a Tape-based Disaster Restart Methodology

DBR for DB2 has facilities to pre-process archive logs as they are copied to tape for disaster recovery purposes. The pre-processing creates a partitioned data set with the information required to build a new BSDS and DB2 Conditional Restart Record at the disaster recovery site. The disaster recovery procedures exercised at the disaster site restore the DB2 system using the last off-site system backup, restore the rebuilt BSDS, replace the DB2 Conditional Restart Record, and then perform a Restore System Log Only operation. Figure 5 shows the steps required to transform traditional DB2 disaster recovery procedures into a tape-based disaster restart solution.

The following processing steps refer to Figure 5 and are used to implement a DB2 tape-based disaster restart solution:

1. DBR for DB2 creates a system backup that has a dependent-write-consistent data state.
2. The system backup is archived to tape and one of the archive tape copies is targeted to be transported to the disaster recovery site. Tape archival options and off-site specification are provided in the System Restore and Offload panels. See Figure 1.
3. DB2 archive logs are pre-processed and information is gathered and sent to the disaster recovery site to create new BSDS and DB2 Conditional Restart Record at the disaster recovery site when they are needed.
4. A disaster restart process is exercised where the last off-site system backup is restored and DB2 is restarted with a Restore System Log Only operation using the newly-created BSDS and DB2 Conditional Restart Record. The DB2 restart process transforms the dependent-write-consistent data state created in step 1 into a transactionally-consistent data state. DB2 is ready to accept new work after the restart process is complete.

creating and refreshing SAP test environments

Mainstar Volume Clone and Rename (VCR) is the foundation for cloning production SAP systems into test SAP application environments. It automates the DB2 on z/OS cloning process such that test SAP application environments can use data that is cloned from a production SAP system. VCR can use storage-based fast-replication to copy the DB2 data quickly and effectively without using host CPU or I/O resources and it performs fast and effective volume reconditioning and data set naming operations to allow the data to be used by a cloned DB2 system on the same or another shared disk LPAR. The DB2 cloning automation process can be performed while the production SAP system is stopped or running and it supports data sharing and non-data sharing DB2 environments.

Fast Table Refresh for DB2 (FTR) is a selectable feature for the VCR product. FTR provides facilities to clone or refresh table or index spaces within or across DB2 systems. It can be used to refresh DB2 table and index spaces from a production DB2 system into a test SAP environment. FTR is particularly useful when only certain DB2 objects need to be refreshed from a production SAP system into a test SAP environment. FTR can save time and processing resources by refreshing only those objects that need to be cloned instead of cloning a complete DB2 system again.

creating a test SAP application environment from a production system

Typically, test SAP application environments are created using data from a production SAP system. VCR facilitates SAP test environment creation by automating the production SAP DB2 system cloning process. The target DB2 system must be defined prior to using the system cloning automation process. Figure 6 shows the steps VCR uses to clone a production SAP application environment to create a test SAP application environment. In Figure 6, processing steps shown in a blue background are performed on the production data while processing steps shown in a green background are performed on the cloned data.

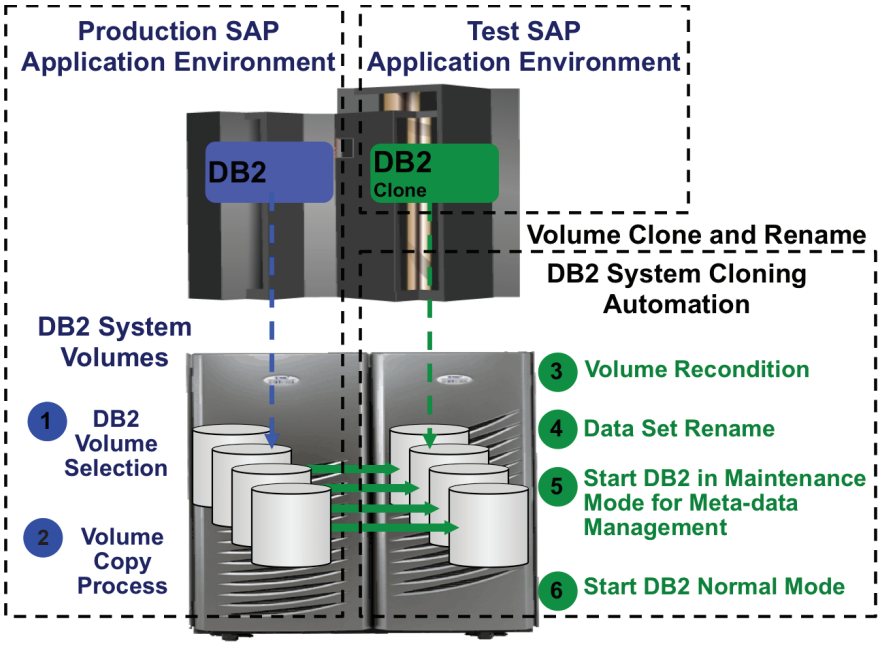


Figure 6: Creating a Test SAP Application Environment from a Production System Using Volume Clone and Rename

1. The DASD volumes that make up the production SAP DB2 system are identified by using specific VOLSER IDs, VOLSER mask, or SMS storage group.
2. VCR performs a DB2 Set Log LOAD (0) and Set Log Suspend operation on the production DB2 system and then invokes a DFSMSdss Copy to issue IBM FlashCopy or SnapShot commands to copy the data and backup up the ICF catalogs that point to the data sets being copied. Once the copy command is complete, the production DB2 system is resumed. When cloning DB2 systems that reside on EMC or Hitachi Storage Systems, an appropriate storage-based fast-replication process is performed before the VCR cloning automation is invoked and a list of copied storage volumes is passed to VCR for use in later processing steps.
3. Volume internal identifiers are re-labeled so they can be brought online to the same or different z/OS systems without volume label conflicts, if they are not already online.
4. The data sets on the cloned volumes are renamed and re-cataloged to a new high level qualifier. Data sets are renamed to eliminate duplicate data set names from a z/OS catalog perspective and to allow the new data set names to be integrated into the cloned DB2 system. The cloned DB2 data sets can then be used on the same LPAR but integrated into a different DB2 system using different data set names.
5. The cloned DB2 system is restarted in MAINTENANCE mode to allow the DB2 system catalog to be updated by the cloning automation process. When DB2 is started in MAINTENANCE mode, in-flight transactions are deferred and will not be backed out. The cloned DB2 system's directory, catalog, and BSDS are updated. The cloned data created during the copy process reflects DB2 production data and it must be changed to reflect the data in a cloned DB2 system such as the new data set names, VOLSERs, STOGRPs. Once all the metadata management processing is complete, then in-flight transactions are resolved and the cloned DB2 system is stopped.
6. The cloned DB2 system is restarted using normal ZPARM parameters and is made available to users.

creating a test SAP environment from a system backup

Test SAP environments can be created using a DBR for DB2 generated system backup as input to VCR's DB2 cloning automation process described above. When cloning DB2 from a DBR for DB2 generated system backup, VCR determines the volumes to be copied by accessing DBR for DB2's metadata repository. Once the system backup volumes are determined, they are passed to VCR to perform the DB2 cloning process described previously. Figure 7 depicts cloning a DB2 system from a DBR for DB2-generated system backup. Steps shown with a gold background color are performed by DBR for DB2. Steps shown in blue are performed by the fast-replication process and steps shown in green are performed by VCR.

1. DBR for DB2 generates a system backup using the procedures described in the section titled: Creating a DB2 System Backup.
2. VCR determines the volumes to be included in the DB2 cloning process by accessing the DBR for DB2 metadata repository. VCR uses a specific DB2 identifier and an available system backup to retrieve a data set containing corresponding source DB2 volumes and their associated backup volumes that are to be used for the cloning process. The backup volume data set is used by VCR to copy the backup volumes to target volumes, to recondition the volumes, and rename their data sets for the cloning process.
3. VCR performs the DB2 cloning automation described in the section titled: Creating a Test SAP Application Environment from a Production System.

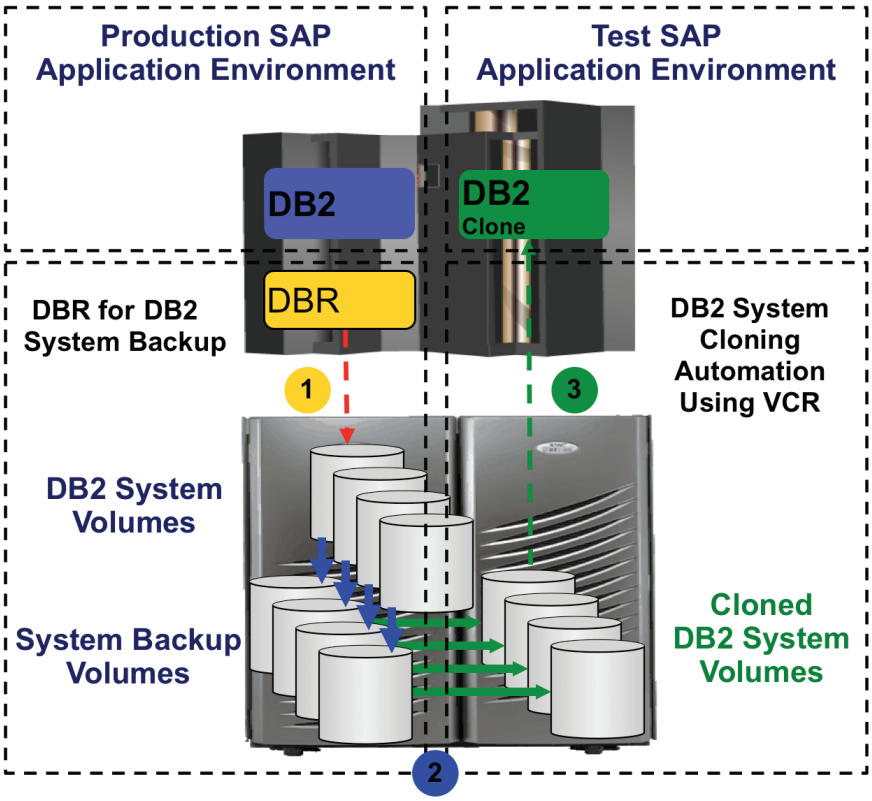


Figure 7: Cloning a DB2 System from a DBR for DB2 Generated System Backup

refreshing DB2 table and index spaces in a test SAP system

Sometimes test SAP application environments require the ability to refresh particular DB2 objects from a production SAP system. Having the ability to refresh particular objects in a test SAP environment from a production SAP system can save time and resources over having to clone a complete DB2 system.

The selectable feature in VCR, Fast Table Space Refresh (FTR) provides facilities to clone or refresh table and index spaces within or across DB2 systems. The table and index space objects can be cloned or refreshed within and across databases and the creator ID of the cloned objects can be the same or different from that of the source objects. The target DB2 table and index space objects must exist on the target DB2 system before objects can be cloned or refreshed and they can be identified by FTR using the SIMULATE command or when run for real. FTR can clone or refresh DB2 objects while they are stopped or while they are running to create fuzzy copies.

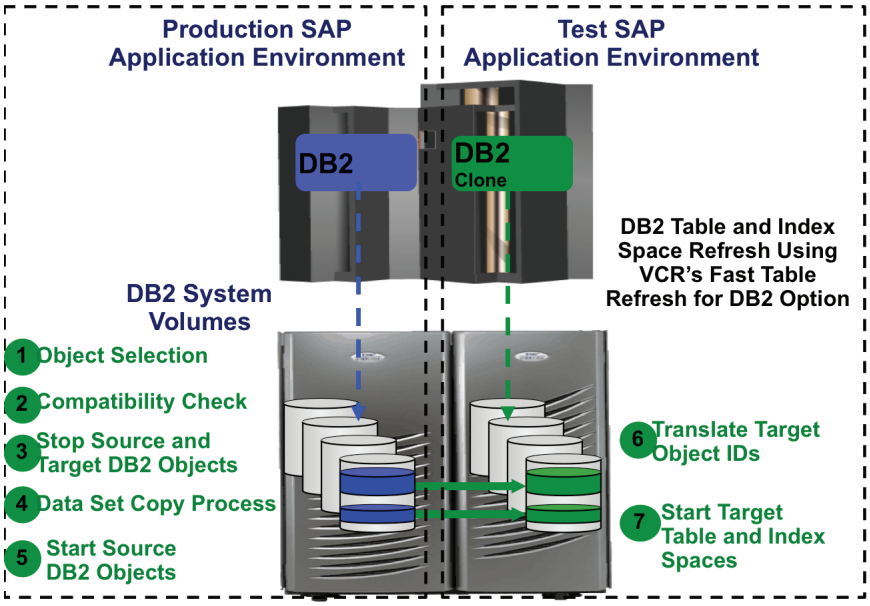


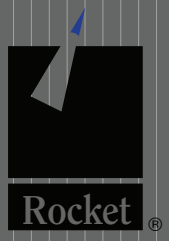
Figure 8: Refreshing DB2 Table and Index Spaces from a Production SAP System

Figure 8 depicts refreshing table and index space objects from a production SAP system to a cloned SAP environment. Steps shown with a green background color are performed by VCR's Fast Table Space Refresh for DB2 option.

1. The source table and index spaces to be refreshed or cloned are selected.
2. Checks are performed to ensure the characteristics of the source and target DB2 objects are compatible. Some characteristics that are checked include: object names and qualifiers, column attributes, objects IDs, page size, buffer pool utilization, etc.
3. The source and target table and index space objects are stopped. Optionally, the source objects can be copied while they are running to create a fuzzy copy. Care must be taken when using the fuzzy copy option as transactional integrity is not guaranteed on the cloned copy.
4. Data sets representing the cloned or refreshed objects are copied. For SAP systems using FlashCopy or SnapShot, FTR will invoke these copy facilities from the FTR process. For SAP systems using EMC TimeFinder or Hitachi ShadowImage, FTR optionally produces files describing source and target data set information along with necessary control parameters so users can create their own data set fast-replication job streams.
5. The source DB2 objects are started unless a fuzzy copy was specified in step two.
6. Object IDs are copied during the copy process in step four above. The object ID translation step changes the object's ID in the data pages to match those in the target DB2 catalog.
7. Target DB2 objects are started and made available to the SAP test environment.

lower cost, recovery time and complexity

Database Backup and Recovery for DB2 can reduce your recovery time objectives and complexity while reducing costs. It provides fast backup, recover, and disaster recovery facilities that minimize business down time. Our performance measurements show that full DB2 systems of 13 TB can be backed up in 0.4 seconds (*times will vary based on your environment). No host CPU and I/O resources are used to create the backup. System backups can be used for multiple purposes: local site system recovery, local site object recovery, as a source for creating a backup used for offsite disaster recovery, and as a source for performing DB2 system cloning operations.



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