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  - Product version (release number)
  - License number and password (trial or permanent)
- Operating system and environment information
  - Machine type
  - Operating system type, version, and service pack or other maintenance level such as PUT or PTF
  - System hardware configuration
  - Serial numbers
  - Related software (database, application, and communication) including type, version, and service pack or maintenance level
- Sequence of events leading to the problem
- Commands and options that you used
- Messages received (and the time and date that you received them)
  - Product error messages
  - Messages from the operating system
  - Messages from related software
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If you have questions about your license key or password, contact Customer Support through one of the following methods:

- Send an e-mail message to customer_support@bmc.com. (In the Subject line, enter `SupID:yourSupportContractID`, such as SupID:12345.)
- In the United States and Canada, call 1 800 537 1813. Outside the United States and Canada, contact your local support center for assistance.
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About this book

This book contains detailed information about the associated product or products. This preface explains the special conventions that the book uses, and how to access related publications.

If applicable, the preface also summarizes the major changes included in the latest release of the product.

Related publications

From the BMC Support Central website, you can use the following methods to access related publications that support your product or solution:

- **Link to the BMC Documentation Center** to browse documentation sets ([http://www.bmc.com/available/documentation-center.html](http://www.bmc.com/available/documentation-center.html) or, for secured documentation sets, [http://www.bmc.com/available/documentation-center-secure.html](http://www.bmc.com/available/documentation-center-secure.html)).

- **View Quick Course videos** (short overviews of selected product concepts, tasks, or features), which are available from the following locations:
  - Documentation Center (primary center and secured center)
  - BMC Mainframe YouTube channel ([https://www.youtube.com/user/BMCSoftwareMainframe](https://www.youtube.com/user/BMCSoftwareMainframe))

- **View individual product documents** (books and notices) within the “A – Z Supported Product List” ([https://webapps.bmc.com/support/faces/az/supportlisting.jsp](https://webapps.bmc.com/support/faces/az/supportlisting.jsp)).

Products with online interfaces also offer online Help via the **F1** key or, for graphical user interfaces (GUIs), via a **Help** button.
Tip
If you prefer hardcopy documentation, you can order it from your BMC sales representative or from Support Central. Also, from Support Central you can subscribe to receive proactive e-mail alerts when BMC issues notices.

Conventions

This document uses the following special conventions:

■ All syntax, operating system terms, and literal examples are presented in this typeface.

■ Variable text in path names, system messages, or syntax is displayed in italic text: `testsyst/instance/fileNamex`.

■ Menu sequences use a symbol to convey the sequence. For example, Actions => Create Test instructs you to choose the Create Test command from the Actions menu.

Syntax diagrams

The following figure shows the standard format for syntax diagrams:
The following example illustrates the syntax for a hypothetical DELETE statement. Because the FROM keyword, alias variable, and WHERE clause are optional, they appear below the main command line. In contrast, the tableName variable appears on the command line because the table name is required. If the statement includes a WHERE clause, the clause must contain a search condition or a CURRENT OF clause. (The searchCondition variable appears on the main line for the WHERE clause, indicating that this choice is required.)

The following guidelines provide additional information about syntax diagrams:

- Read diagrams from left to right and from top to bottom.
- A recursive (left-pointing) arrow above a stack indicates that you may choose more than one item in the stack.
- An underlined item is a default option.
- If a diagram shows punctuation marks, parentheses, or similar symbols, you must enter them as part of the syntax.
- In general, IBM commands, keywords, clauses, and data types are displayed in uppercase letters. However, if an item can be shortened, the minimum required portion might be shown in uppercase letters, with the remainder in lowercase (for example, CANcel).
- The following conventions apply to variables in syntax diagrams:
  - Variables are typically displayed in lowercase letters and are always italicized.
  - If a variable is represented by two or more words, initial capitals distinguish the second and subsequent words (for example, databaseName).

**Summary of changes**

This topic summarizes product changes and enhancements by version number and release date.
Version 12.1.00 December 2016

BMC Recovery Management for DB2 version 12.1.00 includes the following components:

**Product components**

- RECOVERY MANAGER version 12.1.00
- NGT Copy version 12.1.00
- NGT Recover version 12.1.00
- R+/CHANGE ACCUM version 12.1.00
- Log Master version 12.1.00 with High-speed Apply Engine
- SNAPSHOT UPGRADE FEATURE version 6.2 (licensed component of the EXTENDED BUFFER MANAGER for DB2 product)

**Technology components**

- BMCSORT is required for full sort support for NGT Recover.
- DB2 Component Services (DBC), used by RECOVERY MANAGER and the DB2 Product Configuration (LGC) technology, is automatically installed with the solution.
- DB2 Solution Common Code (SCC) is a set of common components used by RECOVERY MANAGER, NGT Copy, NGT Recover, and Log Master. The SCC component is automatically installed with the solution.
- Install Execution Code (AIN) is a technology that is used by the Installation System to create objects for DB2 for Recovery Management. The AIN component is automatically installed with the solution.
- Online Consistent Copy is a technology that provides the database administrator with an efficient way to make consistent copies of DB2 table spaces and indexes without having to quiesce or cause any other outage to the spaces being copied. Online Consistent Copy is automatically installed with the solution.
- DB2 Product Configuration is a technology used by RECOVERY MANAGER that provides the ability to handle option sets to set configuration options.

**Support for IBM DB2 Version 12**

This release adds support for DB2 Version 12.
This release supports:

- DB2 Version 12
- DB2 Version 11
- DB2 Version 10 in new-function mode (NFM) only

**RECOVER PLUS for DB2 name change**

Starting with this release, the name of the RECOVER PLUS for DB2 product has changed to the BMC Next Generation Technology Recover for DB2 for z/OS (or NGT Recover) product.

**COPY PLUS for DB2 name change**

Starting with this release, the name of the COPY PLUS for DB2 product has changed to the BMC Next Generation Technology Copy for DB2 for z/OS (or NGT Copy) product.

**Progress reports available for SIMULATE and INDEP OUTSPACE recoveries**

In this release, progress reports are also available for recoveries when you have specified SIMULATE YES or INDEP OUTSPACE.

**Forward recovery of indexes to a timestamp**

Starting with this release, NGT Recover can perform a forward recovery of indexes to a timestamp using the RECOVER INDEX command with OPTION RECOVERYPOINT.

**Version 11.2.00 May 2015**

BMC Recovery Management for DB2 version 11.2.00 includes the following components:

**Product components**

- RECOVERY MANAGER version 11.2
- NGT Copy version 11.2
- NGT Recover version 11.2
- R+/CHANGE ACCUM version 11.2
- Log Master version 11.2 with High-speed Apply Engine
- SNAPSHOT UPGRADE FEATURE version 6.2 (licensed component of the EXTENDED BUFFER MANAGER for DB2 product)

**Technology components**

- BMCSORT is required for full sort support for NGT Recover.

- DB2 Component Services (DBC), used by RECOVERY MANAGER and the DB2 Product Configuration (LGC) technology, is automatically installed with the solution.

- DB2 Solution Common Code (SCC) is a set of common components used by RECOVERY MANAGER, NGT Copy, NGT Recover, and Log Master. The SCC component is automatically installed with the solution.

- Install Execution Code (AIN) is a technology that is used by the Installation System to create objects for DB2 for Recovery Management. The AIN component is automatically installed with the solution.

- Online Consistent Copy is a technology that provides the database administrator with an efficient way to make consistent copies of DB2 table spaces and indexes without having to quiesce or cause any other outage to the spaces being copied. Online Consistent Copy is automatically installed with the solution.

- DB2 Product Configuration is a technology used by RECOVERY MANAGER that provides the ability to handle option sets to set configuration options.

**DB2 version support**

Recovery Management supports the following versions of DB2:

- Version 11
- Version 10


**Supports tagged copies for Outcopy migrations**

In previous releases, when EXPORT was run to identify copies for migration, it could be confusing as to which copies were exported, especially if the copies were made in multiple jobs. This release allows you to "tag" output copies to simplify selecting copies for migration. For more information about the new TAG and

Supports migration of XML spaces

This release adds support for the migration and translation of XML spaces. XML strings are now exported to allow for conversion of the XML string IDs embedded in the XML image copy pages during IMPORT. See “Moving data with a migration file” on page 177 for more information.

Improves handling of Partition by Growth (PBG) spaces

This release improves the handling of PBG spaces where the number of partitions might be different. Using the MIGRATE command, if the target space has more than 1 data set, RECOVER PLUS will automatically add the data sets to the target system.

Uses Real Time Statistics to estimate object sizes and changed page counts

Starting with this release, Real Time Statistics are used to size objects to be copied and to estimate the number of changed pages.

Adds native support for SHRLEVEL CHANGE RESET MOD YES copies

Previous releases of COPY PLUS called DSNUTILB to make SHRLEVEL CHANGE RESETMOD YES copies. Starting with this release, COPY PLUS can optionally make native SHRLEVEL CHANGE RESETMOD YES copies. See SLCHRESET in the COPY PLUS for DB2 Reference Manual.

Adds support for Online Consistent Copies of LOB objects

Starting with this release, Recovery Management supports Online Consistent Copies of LOB spaces.

Replaces NSCMAIN with CONSISTENT YES option

In previous releases, Online Consistent Copies were made by executing the program NSCMAIN. Starting with this release, Online Consistent Copies can be made by executing ACPMAIN with the COPY PLUS CONSISTENT YES option. NSCMAIN is still supported for this release for compatibility with previous releases, but it will be deprecated in the next release.

See “Using the RECOVERY MANAGER online interface” on page 200 and “Building and executing Online Consistent Copy jobs” on page 217 for more
information. See the *COPY PLUS for DB2 Reference Manual* for more information about CONSISTENT YES.

**Adds support for statistics migration**

This release adds support for migrating statistics. The new COPY PLUS STATS option allows you to carry forward existing RUNSTATS in a migration file. These RUNSTATS can then be optionally applied during a RECOVER PLUS IMPORT using the migration file. See the new STATS option in the *COPY PLUS for DB2 Reference Manual* for more information.

## Version 11.1.00 June 2013

BMC Recovery Management for DB2 version 11.1.00 includes the following components:

**Product components**

- RECOVERY MANAGER version 11.1
- NGT Copy version 11.1
- NGT Recover version 11.1
- R+/CHANGE ACCUM version 11.1
- Log Master version 11.1 with High-speed Apply Engine
- SNAPSHOT UPGRADE FEATURE version 6.1 (licensed component of the EXTENDED BUFFER MANAGER for DB2 product)

**Technology components**

- BMCORT is required for full sort support for NGT Recover.
- DB2 Component Services (DBC), used by RECOVERY MANAGER and the DB2 Product Configuration (LGC) technology, is automatically installed with the solution.
- DB2 Solution Common Code (SCC) is a set of common components used by RECOVERY MANAGER, NGT Copy, NGT Recover, and Log Master. The SCC component is automatically installed with the solution.
Install Execution Code (AIN) is a technology that is used by the Installation System to create objects for DB2 for Recovery Management. The AIN component is automatically installed with the solution.

Online Consistent Copy is a technology that provides the database administrator with an efficient way to make consistent copies of DB2 table spaces and indexes without having to quiesce or cause any other outage to the spaces being copied. Online Consistent Copy is automatically installed with the solution.

DB2 Product Configuration is a technology used by RECOVERY MANAGER that provides the ability to handle option sets to set configuration options.

**DB2 version support**

Recovery Management supports the following versions of DB2:

- Version 10
- Version 9

Recovery Management no longer supports DB2 Version 8.

**Adds data movement with a migration file**

The Recovery Management solution provides a method for transferring all types of NGT Copy and IBM copies between DB2 subsystems. The following new command syntax has been added:

- NGT Copy EXPORT command
- NGT Recover MIGRATE command
- NGT Recover IMPORT command

For complete information, see “Moving data with a migration file” on page 177.

**Adds recovery estimation improvements**

Estimation has been improved to better account for current hardware and multitasking (“NGT Recover estimation improvements” on page 143). Additionally, the following new installation options have been added to NGT Recover specifically for estimation:

- DISKIORATE is the number of megabytes per second that NGT Recover reads from disk. The default value is 100.
- **CPUMIPS** is the rate a CPU executes instructions in millions of instructions per second (MIPS). The default value is 200.

Many of the performance factors used in estimation are derived from DISKIORATE and CPUMIPS. (The descriptions for the installation options are in the *BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual*.)

For more information about estimation, see “Recovery simulation and estimation” on page 123.

### Removes TRANSFORM restrictions

The following restrictions have been removed from the High-speed Structure Chapter:

- The source table space must contain only one table.
  Multi-table table space transformations are now allowed.

- The source and target table space must have the same row format. You cannot transform a table space with basic row format (BRF) into a table space that has reordered row format (RRF), or vice versa.
  BRF to RRF and RRF to BRF transforms are now allowed.

  **Note**
  The rows are not transformed, but the DB2 catalog is changed to correctly reflect the row format from the source.

- Recovery Management is unable to handle transforms related to the MEMBER CLUSTER attribute.
  Transforms to and from MEMBER CLUSTER are now allowed.

For complete information, see “High-speed Structure Change” on page 163.

### Adds recovery to a timestamp for non-data-sharing environments

Recovery to a timestamp (using RECOVERY MANAGER TOTIMESTAMP syntax) was previously allowed only for data sharing subsystems. For this release, this type of recovery is also allowed for non-data-sharing subsystems.

This restriction has been removed in “Inflight resolution technology and timestamp recovery” on page 71. For the more information and for the syntax for TOTIMESTAMP, see the *RECOVERY MANAGER for DB2 User Guide*.
Uses RESOLVE INFLIGHTS with TOLOGMARK recovery

A TOLOGMARK recovery uses the RESOLVE INFLIGHTS syntax option. See “Inflight resolution technology and timestamp recovery” on page 71 and “Recovering to a log mark” on page 81.

Supports extended RBA/LRSN

Recovery Management supports a 10-byte RBA/LRSN.

Documentation changes

This release includes the following documentation changes:

- All messages are now available in the BMC Documentation Center, which is accessible from the BMC Support Central site (http://www.bmc.com/support). A separate messages manual is no longer available.

- Installation and configuration information is located in the following books:
  - Installation System Reference Manual
  - BMC Products and Solutions for DB2 Customization Guide

Version 10.1.00 April 2011

BMC Recovery Management for DB2 version 10.1.00 includes the following components:

Product components

- RECOVERY MANAGER version 10.1
- NGT Copy version 10.1
- NGT Recover version 10.1
- R+/CHANGE ACCUM version 10.1
- Log Master version 10.1 with High-speed Apply Engine
- SNAPSHOT UPGRADE FEATURE version 5.6 (licensed component of the EXTENDED BUFFER MANAGER for DB2 product)
Technology components

- BMCSORT is required for full sort support for NGT Recover.

- DB2 Component Services (DBC), used by RECOVERY MANAGER and the DB2 Product Configuration (LGC) technology, is automatically installed with the solution.

- DB2 Solution Common Code (SCC) is a set of common components used by RECOVERY MANAGER, NGT Copy, NGT Recover, and Log Master. The SCC component is automatically installed with the solution.

- Install Execution Code (AIN) is a technology that is used by the Installation System to create objects for DB2 for Recovery Management. The AIN component is automatically installed with the solution.

- Online Consistent Copy is a technology that provides the database administrator with an efficient way to make consistent copies of DB2 table spaces and indexes without having to quiesce or cause any other outage to the spaces being copied. Online Consistent Copy is automatically installed with the solution.

DB2 Version 10 support

This release of BMC Recovery Management for DB2 includes support for DB2 Version 10. For specific information about DB2 Version 10 support in each of the product components of the solution, see the "Summary of changes" section in the product component manuals.

Improved messaging for Online Consistent Copy

In previous releases, Online Consistent Copy with MSGLEVEL(2) issued many debugging messages. Online Consistent Copy has been changed so that MSGLEVEL(2) produces an appropriate level of messages for normal runs, and MSGLEVEL(3) now produces the debugging messages. With this change, MSGLEVEL(2) is the recommended setting for MSGLEVEL for Online Consistent Copy. ("Utility parameters on the EXEC statement" on page 219)
Overview of Recovery Management for DB2

Chapters:

- Overview of BMC Recovery Management for DB2
- Using Recovery Management for DB2
Overview of BMC Recovery Management for DB2

The BMC Recovery Management for DB2 solution provides automation and recovery optimization unmatched in the industry. Using the exclusive BMC recovery technology maximizes application availability, significantly decreases costs, and ensures the fastest and most efficient recoveries possible. The exclusive features and powerful functionality of the BMC Recovery Management for DB2 solution ensure that you will be able to meet your recovery goals. The solution includes all the features of each of its component products in addition to exclusive solution-only functionality.

Components of Recovery Management for DB2

This solution consists of the following BMC product components:
- RECOVERY MANAGER
- NGT Copy
- NGT Recover
- R+/CHANGE ACCUM
- SNAPSHOT UPGRADE FEATURE (SUF)
- Log Master with High-speed Apply Engine (formerly Apply Plus)

This solution consists of the following technology components:
- Online Consistent Copy (a technology of Recovery Management)
- BMCSORT (required for full sort support for NGT Recover and Log Master)
- DB2 Component Services (DBC) (used by RECOVERY MANAGER)
- DB2 Solution Common Code (SCC) (a set of common components that RECOVERY MANAGER, NGT Copy, NGT Recover, and Log Master use)
- Install Execution Code (AIN) (a technology that is used by RECOVERY MANAGER to create objects for DB2)

The relationship between the major components is shown in Figure 1 on page 28.

**Figure 1: BMC Recovery Management for DB2 components**

The following sections provide a brief description of each of the components and information on where to find detailed information about each one.
RECOVERY MANAGER

RECOVERY MANAGER for DB2 is the driving component of Recovery Management because it automates and simplifies the recovery planning process for the DB2 environment, regardless of the size of table spaces, complexity of structures, or frequency of backups.

You can quickly and easily create recovery planning structures that group logically-related database objects according to any criteria that you specify. Then you can perform recovery actions against these groups to simplify the process and improve the accuracy of recovery. Performing recoveries against these groups of DB2 structures can significantly decrease data loss and the amount of time spent performing recoveries.

RECOVERY MANAGER performs the following tasks:

- Automates the recovery process and eliminates time-consuming, manual, error-prone steps.
- Allows multitasking of group recovery based on workload analysis (several recovery jobs may be submitted for one group).
- Optionally uses INDEX ALL instead of explicitly including indexes in a group, reducing the elapsed time for many processes.
- Generates optimized backup and recovery JCL.
- Assists in recovery planning.
- Provides recovery simulation and estimation functions.
- Works with other Recovery Management solution components to enable recoveries to a timestamp or logpoint using inflight resolution technology.
- Provides recovery automation functions.
- Provides hardware mirroring support.
- Provides disaster recovery support.
- Recovers all DB2 objects, including the catalog and directory.
- Produces progress reports that use the group or an object pattern to display backup and recover time estimates.

For detailed information, see the RECOVERY MANAGER for DB2 User Guide.
NGT Copy

The NGT Copy component is a fast, function-rich image copy utility for table spaces and indexes. Its many advanced features make it an essential Recovery Management component that is needed to effectively prepare for a fast DB2 recovery.

NGT Copy gives you the speed you need to compensate for a shrinking batch window and growing table spaces. This enables you to make frequent image copies so you can perform a faster recovery.

NGT Copy provides a smarter way to back up your table spaces and indexes by automating much of the effort and by copying the minimum amount of necessary data, which increases data availability and performance.

NGT Copy performs the following tasks:

- Provides dynamic data set allocation and wildcarding.
- Uses multitasking to reduce elapsed time.
- Provides data integrity checking.
- Works with the SNAPSHOT UPGRADE FEATURE (SUF) to produce SHRLEVEL REFERENCE copies with an outage of only a quiesce.
- Produces full and incremental encrypted copies to disk or tape for use with NGT Recover.
- Produces specialized hardware Instant Snapshots with SUF for use with NGT Recover.
- Works with other Recovery Management solution components to produce Online Consistent Copies.
- Simplifies maintenance of the DB2 SYSCOPY and BMCXCOPY tables using the MODIFY command.
- Calculates disk size and automates tape stacking.
- Simplifies maintenance of jobs by using wildcards, lists, and the EXCLUDE option.
- Provides incremental copy features.
- Allows you to provide thresholds for full versus incremental copies of table spaces and provides specifications for automatic escalation to full copies.
- Optionally copies indexes that exceed a user-defined size threshold.
Can copy only the pages that have changed since the last copy and can produce a cumulative incremental copy by combining all changes since the last full copy.

- Provides a RUNSTATS feature that allows you to make an image copy and update table space statistics at the same time.

- Can quickly make and register local and remote site copies after the primary copy has been made and registered.

- Produces a migration file to automate data migration.

For detailed information, see the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*.

To produce Snapshot copies and Instant Snapshot copies, NGT Copy works with the SUF component. For more information about SUF, see the *EXTENDED BUFFER MANAGER and SNAPSHOT UPGRADE FEATURE User Guide*.

**NGT Recover**

The NGT Recover component provides a high-speed, function-rich recovery utility to recover table spaces and indexes. NGT Recover is a batch utility that runs outside the DB2 subsystem and provides fast execution through advanced I/O techniques and the use of alternate recovery strategies. NGT Recover ensures data integrity while maximizing the availability of business-critical data.

NGT Recover performs the following tasks:

- Allows point-in-time recovery through the exclusive BACKOUT recovery feature for table spaces and indexes, without first restoring image copies.

- Works with the SNAPSHOT UPGRADE FEATURE component of the Recovery Management solution to support Instant Snapshot copies.

- Works with the NGT Copy component of the Recovery Management solution to support encrypted copies.

- Works with other Recovery Management solution components to resolve inflight units of work to perform consistent recoveries to a user-specified timestamp or logpoint.

- Works with other Recovery Management solution components to produce Online Consistent Copies.

- Provides recovery simulation to allow the testing of recoveries by using recovery resources (copies and logs).
Works with other Recovery Management solution components to produce disaster recovery estimations.

Works with other Recovery Management solution components to collect and report on data about actual, simulated and estimated disaster recoveries.

Uses image copies and logs to recover indexes.

 Produces up to four image copies.

Allows concurrent recovery of index space and table space partitions.

Allows selection of local versus remote copies and primary versus backup copies for recovery use.

Automatically detects and accommodates stacked tapes and optimizes processing for tape-mount reduction.

Allocates subtasks and preprocesses VSAM data sets to enhance recovery performance.

Allows recovery of dropped table spaces to the point in time just prior to the drop by using object ID translation.

Creates copies without accessing table spaces.

Allows use of copies not registered in DB2 and runs without limiting the log to that indicated by SYSLGRNX.

Migrates data while keeping it online and available for updates.

Allows recovery to another DB2 subsystem and synchronizes data between subsystems.

Allows the transformation of the physical structure of a table space or index.

Utilizes the NGT Copy migration file to automate data migration.

For more information, see the *BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual*.

**R+/ CHANGE ACCUM**

The R+/CHANGE ACCUM for DB2 component offers the ability to create new recovery resources. Using these resources with NGT Recover can significantly streamline normal and disaster recovery processes. R+/CHANGE ACCUM extracts and sorts updates from the DB2 log for a designated group of spaces and stores the
updates in a file. This file, called a change accumulation file, provides an efficient alternative recovery resource for NGT Recover to use instead of DB2 log data sets.

R+/CHANGE ACCUM consists of an interactive ISPF interface and a batch utility. You can use the interface to define and create change accumulation groups. A change accumulation group can contain any number of table spaces, partitions, or data sets. Indexes cannot be included in a group, but indexes can be accumulated by specifying INDEXES YES on the SYSIN statement. Groups are stored in the R+/CHANGE ACCUM repository. You use the R+/CHANGE ACCUM batch utility to routinely generate change accumulation files, because R+/CHANGE ACCUM selects only the log record data that is needed for recovery, it can enhance the speed of recovery processes.

R+/CHANGE ACCUM performs the following:

- Reduces elapsed time required to recover table spaces (and, optionally, their associated indexes).
- Reduces the media requirements for log records.
- Limits shared resources, thereby enabling greater concurrency.
- Increases availability of DB2 data.
- Increases predictability, because recovery time depends only on the resources needed for the spaces being recovered.

For detailed information, see the R+/CHANGE ACCUM for DB2 User Guide.

Log Master with High-speed Apply Engine

The Log Master component provides sophisticated log analysis that enables you to fully and easily use information contained in the database and transaction logs to locate and correct specific transaction errors without employing time-consuming and expensive programming resources.

Log Master maintains business availability and minimizes revenue loss by ensuring fast application recoveries.

Log Master for DB2 allows you to analyze and back out problem transactions using reports and SQL statements generated from the information in your logs. You can migrate data from your production database to other databases for backup, historical use, or data warehousing. With Log Master, you can audit database activity for changes to key database structures.
High-speed Apply Engine (formerly Apply Plus) is packaged with Log Master to provide high-speed processing of SQL generated for transaction backouts.

Log Master performs the following tasks:

- Supports sophisticated auditing, refines recovery control, and increases recovery performance using a variety of reports and filtering capabilities.
- Enhances database recoveries by allowing transactions to be selectively backed out or rolled forward.
- Enhances recovery with database availability.
- Provides comprehensive problem analysis.
- Improves the effectiveness of recoveries using powerful log analysis to uncover quiet points on logs that can be used as additional recovery points.
- Supports speedy updates without disrupting online applications by providing batch migration of changes to other mainframe and distributed databases.
- Works with other Recovery Management solution components to produce Online Consistent Copies.
- Works with other Recovery Management solution components to enable recoveries to a timestamp or log point using inflight resolution technology.
- Works with NGT Recover and Online Consistent Copy to allow for a SHRLEVEL CHANGE transformation.


SNAPSHOT UPGRADE FEATURE

The SNAPSHOT UPGRADE FEATURE (SUF) for DB2 component enhances Recovery Management processing by working in conjunction with NGT Copy to enable the creation of point-in-time copies of DB2 databases, called Snapshot Copies, concurrent with business-critical batch and online activity.

You retain full read and write access to the databases critical to your business. This capability can be essential to data administrators striving to meet increasingly stringent service-level agreements with limited resources and a shrinking batch window. SUF also works with NGT Copy and NGT Recover to exploit the use of intelligent storage devices to provide hardware snapshot functionality with Instant Snapshot copies.
RECOVERY MANAGER and NGT Recover can use Snapshot Copies and Instant Snapshot copies in recovery strategies.

This interaction between SUF, NGT Copy, RECOVERY MANAGER, and NGT Recover reduces the time and costs associated with the backup and recovery of DB2 databases.

For the BMC Recovery Management for DB2 solution, SUF performs the following tasks:

- Improves DB2 application availability by minimizing outages associated with database maintenance.
- Enables the creation of point-in-time copies of DB2 databases.
- Enables the creation of hardware Instant Snapshot copies of DB2 table spaces and indexes.
- Works with other Recovery Management solution components to produce Online Consistent Copies.
- Provides mirroring support.

For more information, see the EXTENDED BUFFER MANAGER and SNAPSHOT UPGRADE FEATURE User Guide.

Online Consistent Copy

The Online Consistent Copy technology of the BMC Recovery Management for DB2 solution enables you to make consistent Instant Snapshot copies of DB2 table spaces and indexes without having to quiesce or cause any other outage to the spaces being copied.

You can then use the Online Consistent Copies to migrate data to another object or subsystem. Consistent copies have the advantage that you can recover to the copy without having to apply log records. Online consistent copies can also be used with NGT Recover to transform the physical attributes of a table space or index.

Solution-only features

The following features are available only when using the BMC Recovery Management for DB2 solution with the solution password.
## Table 1: Solution features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backout to forward recovery strategy (BACKOUT AUTO)</td>
<td>Performs backout recovery using the log to restore objects to a prior point in time (without needing to restore image copies or rebuild or restore indexes), then automatically performs a forward recovery for any objects that could not be backed out.</td>
<td>“Backout to forward recovery” on page 56</td>
</tr>
<tr>
<td></td>
<td>This strategy ensures that all objects are recovered with maximum speed without intervention from the user.</td>
<td></td>
</tr>
<tr>
<td>Cabinet copy</td>
<td>Enables you to copy all the spaces in a group into a single data set called a cabinet file Regardless of the number of objects that are copied to or recovered from the cabinet file, the cabinet file is allocated and deallocated only once, which can greatly improve performance.</td>
<td>“Cabinet copy” on page 95</td>
</tr>
<tr>
<td>Conditional restart avoidance for local full subsystem recovery</td>
<td>Shortens the time required to perform a recovery of an entire local subsystem by analyzing the system to determine whether a conditional restart can be avoided and then generating the fastest and most efficient recovery jobs possible.</td>
<td>“Full local subsystem recovery with conditional restart avoidance” on page 155</td>
</tr>
<tr>
<td>Disaster recovery data collection</td>
<td>Automatically collects and stores statistical data from all actual, simulated, and estimated disaster recoveries. The data collected can enable you to compare different recoveries, determine if you are meeting your service level agreements, and even perform a number of what-if scenarios to assist you in reducing disaster recovery time or in justifying more resources.</td>
<td>“Evaluate disaster recovery data” on page 67</td>
</tr>
<tr>
<td>Encrypted copies</td>
<td>Creates full and incremental encrypted copies to disk or tape</td>
<td>“Making encrypted copies” on page 55</td>
</tr>
<tr>
<td>Inflight resolution technology and timestamp recovery</td>
<td>Enables you to perform a consistent recovery to any timestamp or LRSN/RBA The ability to resolve inflight units of work at any point in time or to any log point completely eliminates the need to perform quiesces to establish consistent recovery points during application execution. The ability to avoid quiesces can dramatically improve the availability of your DB2 data.</td>
<td>“Inflight resolution technology and timestamp recovery” on page 58</td>
</tr>
<tr>
<td>Migration files</td>
<td>Creates migration files in NGT Copy used with the NGT Recover MIGRATE or IMPORT commands to move data</td>
<td>“Moving data with a migration file” on page 177</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td>Reference</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mirror management</td>
<td>Simplifies and automates disaster recovery processes when all or part of your DB2 subsystem is mirrored</td>
<td>“Mirroring support with the Recovery Management solution” on page 101</td>
</tr>
<tr>
<td>Online consistent copies</td>
<td>Enables you to make consistent copies of table spaces and index spaces without any outage Using the Online Consistent Copy technology, the spaces being copied are continuously available for read and write access while the copy is being made.</td>
<td>“Overview of Online Consistent Copy” on page 185</td>
</tr>
</tbody>
</table>
| Progress reports        | Produces progress reports that use the group or an object pattern to display backup and recover time estimates  
Note: Progress reports are also available for recoveries when you have specified SIMULATE YES or INDEP OUTSPACE. | RECOVERY MANAGER for DB2 User Guide                                                               |
| Recovery estimation     | Provides an estimate in hours, minutes, and seconds for the amount of time required to perform a complete disaster recovery, including both system and application resources                              | “Estimation” on page 66                                                                           |
| Recovery simulation     | Simulates all aspects of a local or disaster recovery up to, but not including, any destructive operations on the data  
Simulation verifies that all recovery resources are valid and provides a close approximation of how long an actual recovery will take. | “Simulation” on page 66                                                                           |
| SHRLEVEL CHANGE TRANSFORM | Transforms the physical structure of a table space or index with a minimal outage                                                                                                                      | “SHRLEVEL CHANGE method” on page 171                                                              |
| Online Index Rebuild    | Allows read-write application access to DB2 table space and index space objects during the rebuild process.                                                                                                   | SHRLEVEL option on the REBUILD INDEX command in the BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual |

**Multi-component features**

The following features are available when you own multiple components of the Recovery Management solution, but do not require the solution password.
### Table 2: Features available with multiple components

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated drop recovery</td>
<td>Assists in the recovery of dropped objects. This type of recovery is generally needed for an error caused by an application program or by user errors.</td>
<td>“Automated drop recovery” on page 59</td>
</tr>
<tr>
<td>Automatic index copies</td>
<td>Automatically makes an index copy when the index size threshold that you specify is reached or exceeded.</td>
<td>“Making automatic index copies” on page 53</td>
</tr>
<tr>
<td>Automatic index recovery to rebuild</td>
<td>Automatically identifies indexes that have copies and recovers them when possible. If no copy exists or the index is not recoverable, the solution automatically falls back to an index rebuild. This feature is most powerful when used in conjunction with the automatic index backup feature.</td>
<td>“Automatic index recovery to rebuild” on page 57</td>
</tr>
<tr>
<td>Incremental index copy</td>
<td>Creates incremental index copies and uses the copies as recovery resources. Having the ability to produce incremental (FULL NO) index space copies reduces the need for excessive DB2 log application for an index space recovery. In addition, incremental index space copies usually require much less disk space than full copies. Incremental index copies require both NGT Copy and NGT Recover, and are supported by RECOVERY MANAGER.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Instant Snapshots</td>
<td>Uses hardware-specific interfaces to replicate large data sets (of any size) in as little as two seconds. Instant Snapshots are physical data copies that are almost instantaneous because they require no I/O. In addition to a near-instantaneous copy process, Instant Snapshots offer a near-instant restoration phase during database recovery. Hardware support includes any device that supports Flashcopy V2, EMCSNAP, or SIBBATCH DSSNAP.</td>
<td>“Instant Snapshot recovery” on page 60</td>
</tr>
<tr>
<td>SHRLEVEL REFERENCE TRANSFORM</td>
<td>Transforms the physical structure of a table space or index while allowing read-only access.</td>
<td>“SHRLEVEL REFERENCE method” on page 166</td>
</tr>
<tr>
<td>Volume recovery</td>
<td>Supports identification and recovery of all data on a specified volume. The volumes do not need to be available at the time that you build the group, so you can perform this process after media failure occurs.</td>
<td>“Volume recovery” on page 61</td>
</tr>
</tbody>
</table>
Using Recovery Management for DB2

This chapter highlights the most useful and unique features of the BMC Recovery Management for DB2 solution and presents suggestions for using these features to meet your goals.

Note
The components of the BMC Recovery Management for DB2 solution include hundreds of features that enable you to customize your backup and recovery strategies to your needs. Review the documentation for the components to become familiar with the powerful functionality available to you.

Table 3 on page 39 lists the tasks that you perform with the BMC Recovery Management for DB2 solution to prepare for recovery and indicates where to find information about each task.

Table 3: Recovery Management tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare to Use the Recovery Management Solution</td>
<td></td>
</tr>
<tr>
<td>Install and customize the Recovery Management solution.</td>
<td>“Installing and customizing the solution” on page 41</td>
</tr>
<tr>
<td>Set subsystem-level default options using the RECOVERY MANAGER online interface.</td>
<td>“Setting subsystem-level options” on page 41</td>
</tr>
<tr>
<td>Create Groups</td>
<td></td>
</tr>
<tr>
<td>Create balanced groups of all objects in the subsystem. Use these groups for disaster recovery or full subsystem recovery.</td>
<td>“Creating subsystem groups” on page 50</td>
</tr>
<tr>
<td>Create application groups. Use these groups for local application recovery or for prioritized disaster recovery.</td>
<td>“Creating application groups” on page 51</td>
</tr>
<tr>
<td>Task</td>
<td>Reference</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Set group-level options if necessary.</td>
<td>“Setting group-level options” on page 51</td>
</tr>
<tr>
<td>Create application groups for migration of related data.</td>
<td>“Moving data with a migration file” on page 177</td>
</tr>
<tr>
<td><strong>Back Up Data for Local Recovery</strong></td>
<td></td>
</tr>
<tr>
<td>Revalidate the subsystem or application groups.</td>
<td>“Activate mirroring support” on page 52</td>
</tr>
<tr>
<td>Generate JCL to back up resources that will be required for a local application recovery.</td>
<td>“Back up resources for local recovery” on page 52</td>
</tr>
<tr>
<td>Create migration files in preparation for moving data for testing, development or data mining.</td>
<td>“Moving data with a migration file” on page 177</td>
</tr>
<tr>
<td><strong>Perform Local Recoveries</strong></td>
<td></td>
</tr>
<tr>
<td>Revalidate the application groups, specify a recovery point, and generate recovery JCL.</td>
<td>“Activate mirroring support” on page 52</td>
</tr>
<tr>
<td>Specify the backout-to-forward recovery method.</td>
<td>“Backout to forward recovery” on page 56</td>
</tr>
<tr>
<td>Specify the automatic index-recovery-to-rebuild method.</td>
<td>“Automatic index recovery to rebuild” on page 57</td>
</tr>
<tr>
<td>Specify inflight resolution recovery to a timestamp or logpoint.</td>
<td>“Inflight resolution technology and timestamp recovery” on page 58</td>
</tr>
<tr>
<td>Perform drop recoveries.</td>
<td>“Automated drop recovery” on page 59</td>
</tr>
<tr>
<td>Recover to snapshot copies.</td>
<td>“Instant Snapshot recovery” on page 60</td>
</tr>
<tr>
<td>Recover to a log mark.</td>
<td>“Recovery to a log mark” on page 60</td>
</tr>
<tr>
<td>Perform a volume recovery.</td>
<td>“Volume recovery” on page 61</td>
</tr>
<tr>
<td><strong>Prepare for Disaster Recovery</strong></td>
<td></td>
</tr>
<tr>
<td>Make copies of the subsystem or application groups that you created previously.</td>
<td>“Create copies of business applications” on page 62</td>
</tr>
<tr>
<td>Create copies of the RECOVERY MANAGER tables and repositories.</td>
<td>“Create copies of repositories” on page 63</td>
</tr>
<tr>
<td>Create copies of the DB2 catalog and directory.</td>
<td>“Create copies of the DB2 catalog and directory” on page 63</td>
</tr>
<tr>
<td>Establish a recovery point, make copies of the archive logs, and generate JCL for system resource recovery.</td>
<td>“Prepare system resources” on page 63</td>
</tr>
<tr>
<td>Task</td>
<td>Reference</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
</tr>
<tr>
<td>If time has passed since the application copies were made, revalidate the groups for recoverability.</td>
<td>“Revalidate groups” on page 64</td>
</tr>
<tr>
<td>Generate the JCL to recover all application data.</td>
<td>“Generate application recovery JCL” on page 65</td>
</tr>
<tr>
<td>Migrate data to test, development or warehouse subsystems using migration files.</td>
<td>“Moving data with a migration file” on page 177</td>
</tr>
</tbody>
</table>

Test Recovery Strategies

<table>
<thead>
<tr>
<th>Task</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform disaster recovery simulation and estimation.</td>
<td>Performing simulation and estimation on page 66</td>
</tr>
<tr>
<td>Perform local recovery simulation.</td>
<td>Simulation on page 66</td>
</tr>
<tr>
<td>Evaluate data collected during actual, simulated, and estimated disaster recovery.</td>
<td>“Evaluate disaster recovery data” on page 67</td>
</tr>
</tbody>
</table>

Miscellaneous Tasks
(Typically, you perform these tasks on an as-needed basis.)

<table>
<thead>
<tr>
<th>Task</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make Online Consistent Copies for data migration tasks</td>
<td>“Online consistent copies” on page 67</td>
</tr>
</tbody>
</table>

Installing and customizing the solution

You install the Recovery Management solution using the Installation System. While it is possible to install the components separately, the default values of options for the components are set differently if installed as part of the solution. In addition, be sure to enter the solution-level password during installation. If you attempt to use individual component passwords, you will not have access to the solution-only features such as encrypted copies, timestamp recovery, and so on.

The installation process is described in detail in the Installation System Reference Manual.

Setting subsystem-level options

You establish the optimal backup and recovery options for your environment in this task using the RECOVERY MANAGER online interface. The options that you select here affect all jobs that you generate.

The options discussed in this section are only a small percentage of those available, but they are the most likely to vastly improve the backup and recovery process.
For complete information about backup options, see the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*. For complete information about recovery options, see the *BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual*.

### NGT Copy installation options

The following table describes the NGT Copy installation options that you can customize when using the BMC Recovery Management for DB2 solution.

#### Table 4: NGT Copy installation options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max number of subtasks (MAXTASKS)</td>
<td>Specifies the maximum number of subtasks used by NGT Copy to make image copies. Valid values are 1-32. The default is 1.</td>
</tr>
<tr>
<td>Min number of pages-Incr (MINPAGES)</td>
<td>Specifies the least number of pages that must exist in a space or partition before an incremental copy can be made. If the number of pages is less than the number provided, a full copy is made. Valid values are 1 through 999999. The default is 2.</td>
</tr>
<tr>
<td>Open DB2 DSs with DBM1 ID (OPNDB2ID)</td>
<td>Instructs NGT Copy to use the DB2 RACF ID instead of the RACF ID of the user running NGT Copy when opening DB2 data sets. Specifying No tells NGT Copy to use the RACF ID of the user running NGT Copy. If No is specified, the user must have RACF authority for the DB2 data sets being copied. If your DB2 is specified in the RACF started procedures table (ICHRIN03) as a privileged or trusted task and no user ID is associated with the DB2 address space, you cannot use OPNDB2ID to allow NGT Copy to access the DB2 data sets. In this case, the user running NGT Copy must have RACF authority to access the data sets needed for recovery.</td>
</tr>
<tr>
<td>Data set name (DSNAME)</td>
<td>Specifies the default disk or tape data set name for the LPNAME, LBNAME, RPNAME, RBNAME, COPYDSN, and RECOVERYDSN installation options.</td>
</tr>
<tr>
<td>Local Site</td>
<td>The following options are used for the local site:</td>
</tr>
<tr>
<td>- Primary Copy DSN (LPNAME)—Use LPNAME to specify the default name for the local site primary copy data set. The default is the value of DSNAME.</td>
<td></td>
</tr>
<tr>
<td>- Backup Copy DSN (LBNAME)—Use LBNAME to specify the default name for the local site backup copy data set. The default is the value of DSNAME.</td>
<td></td>
</tr>
<tr>
<td>- Primary Copy device (UNIT)—Use UNIT to specify a name for the default tape or disk unit to be used for local site primary copies.</td>
<td></td>
</tr>
<tr>
<td>- Backup Copy device (UNITLB)—Use UNITLB to specify a name for the default tape or disk unit to be used for local site backup copies. The default is the value of UNIT.</td>
<td></td>
</tr>
</tbody>
</table>
Option | Description
--- | ---
Recovery Site | The following options are used for the recovery site:

- Primary Copy DSN (RPNAME)—Use RPNAME to specify the default name for the recovery site primary copy data set. The default is the value of DSNAME.
- Backup Copy DSN (RBNAME)—Use RBNAME to specify the default name for the recovery site backup copy data set. The default is the value of DSNAME.
- Primary Copy device (UNITRP)—Use UNITRP to specify a name for the default tape or disk unit to be used for recovery site primary copies. The default is the value of UNIT.
- Backup Copy device (UNITRB)—Use UNITRB to specify a name for the default tape or disk unit to be used for recovery site backup copies. The default is the value of UNIT.

---

**Log Master installation options**

The following table describes the Log Master installation options that you can customize when using the BMC Recovery Management for DB2 solution.

**Table 5: Log Master installation options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parm SMS Storage Class (PARMSTOR)</td>
<td>Designates the storage class that the product uses for dynamic allocation data sets other than sort work data sets. You can specify any storage class that is valid in DFSMS.</td>
</tr>
<tr>
<td>Parm Dynamic Alloc Unit (PARMUNIT)</td>
<td>Specifies a unit name that Log Master uses for dynamic allocation of data sets other than sort work data sets. Specify any unit name where you can allocate temporary data sets.</td>
</tr>
<tr>
<td>Work SMS Storage Class (WKSTOR)</td>
<td>Designates the DFSMS storage class that Log Master uses for dynamic allocation of large temporary files and sort work files. There is no default value for this option. Use this keyword only if you want DFSMS to manage the sort work data sets. Specify any valid DFSMS storage class.</td>
</tr>
<tr>
<td>Work Unit Name (WKUNIT)</td>
<td>Specifies the unit name that Log Master uses for dynamic allocation of sort work data sets. You can set this installation option to the name of a valid unit where you can allocate temporary DASD data sets. The default value is SYSALLDA. Do not use this keyword if you want DFSMS to manage the sort work data sets.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Memory Size-Data (KSMEMORY)                 | Specifies the amount of memory that the product uses for a temporary working storage area called a key store. If you experience large amounts of logging in your DB2 subsystem, or if you perform large log scans, allocate larger amounts of memory. This reduces the possibility of the product overflowing the temporary working storage area and using DASD storage. The KSMEMORY option requires you to specify two values. You can enter a number as bytes, kilobytes (using the suffix K) or megabytes (using the suffix M). Descriptions of these values are as follows:  
  - **KSMEMORY 1**—Specifies the amount of memory that the product uses to store internal data as it processes log records. (The default is 100M.) You may need to override this default value frequently, because the amount of memory required for efficient processing can change dramatically based on how many DB2 log data records the product is processing.  
  - **KSMEMORY 2**—Specifies a number. (The default is 10M.) The product does not currently use this value, but reserves it for future use and requires it to be present for correct syntax. You can enter a number as bytes, kilobytes (using the suffix K) or megabytes (using the suffix M). If you specify the first value without the second value, the product produces a syntax error and terminates processing with a return code of 8. |
<p>| Allocation is in (KSAALLOCU)                | Specifies how the product allocates VSAM data sets to use as overflow storage for the key store work area. The default value is CYLS. Specify cylinders with the CYLS keyword. Specify tracks with the TRKS keyword.                                                                                       |
| SMS Management Class (KSMGMT)              | Specifies a valid Data Facility Storage Management System (DFSMS) management class that Log Master uses to allocate VSAM data sets. The product allocates these data sets when it must process more log records than it can place in memory. It uses the data sets as overflow storage for the store work area. There is no default value for this option. |
| SMS Storage Class (KSSTOR)                 | Specifies a valid Data Facility Storage Management System (DFSMS) storage class that Log Master uses to allocate VSAM data sets. The product allocates these data sets when it must process more log records than it placed in memory. It uses the data sets as overflow storage for the key sort work area. There is no default value for this option. |
| SMS Data Class (KSDACLCS)                  | Specifies a valid Data Facility Storage Management System (DFSMS) data class that Log Master uses to allocate VSAM data sets. The product allocates these data sets when it must process more log records than it placed in memory. It uses the data sets as overflow storage for the key sort work area. There is no default value for this option. |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Memory Allocation percentages</strong></td>
<td>Divide the memory allocated in KSMEMORY among the following options. The total for all xxPCT options must equal 100.</td>
</tr>
<tr>
<td><strong>AN (ANPCT)</strong></td>
<td>Specifies the percentage of key store memory allocated to the anomaly (AN) key store. Enter an integer value between 0 and 98. In the AN key store, the product maintains information used to produce the Backout Integrity report. If a job does not specify a Backout Integrity report as output, the product redistributes this memory evenly to the FC and BC key stores. The default value is 20.</td>
</tr>
<tr>
<td><strong>BC (BCPCT)</strong></td>
<td>Specifies the percentage of key store memory allocated to the backward completion (BC) key store. Enter an integer value between 0 and 98. In the BC key store, the product maintains copies of complete row images that might be used for completion processing. The default value is 10.</td>
</tr>
<tr>
<td><strong>FC (FCPCT)</strong></td>
<td>Specifies the percentage of key store memory allocated to the forward completion (FC) key store. Enter an integer value between 0 and 98. In the FC key store, the product maintains copies of complete row images that might be used for row completion processing. The default value is 10.</td>
</tr>
<tr>
<td><strong>LR (LRPCT)</strong></td>
<td>Specifies the percentage of key store memory allocated to the log record (LR) key store. Enter an integer value between 0 and 98. In the LR key store, the product maintains a copy of each log record in the currently open unit of recovery, along with other log records that require row completion processing. The default value is 40.</td>
</tr>
<tr>
<td><strong>UR (URPCT)</strong></td>
<td>Specifies the percentage of key store memory allocated to the URID (UR) key store. Enter an integer value between 0 and 98. In the UR key store, the product maintains information about each unit of recovery that it encounters within the range of a log scan. The default value is 20.</td>
</tr>
</tbody>
</table>
| **Overflow Data Set Allocation for key stores (KSSPACE)** | Specifies the primary and secondary amounts of space that Log Master uses to allocate overflow data sets for key stores. This option works with the KSALLOCU option. The default values of KSSPACE are as follows:  
  - Primary = 100  
  - Secondary = 100 |
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
</table>
| Cluster Name (KSCLUST) | Establishes a prefix name that Log Master uses to derive the cluster name for a VSAM data set. The product uses this data set as overflow storage for key store work area. The prefix name is a high-level prefix entered when the product is installed (KSDATA). Values for KSCLUST are as follows:  
  - Any valid name, up to 34 characters long  
  - The symbolic &SYSUID (substitutes a TSO prefix for the prefix name) |
| Data Prefix (KSDATA) | Specifies a prefix that Log Master uses to derive the data portion name for a VSAM data set. The product uses this data set as overflow storage for the key store work area. Valid values are as follows:  
  - Any valid name, up to 34 characters long  
  - The symbolic &SYSUID (substitutes a TSO prefix for the prefix name) |
| Volumes (KSVOLS) | Specifies the volumes that Log Master uses to allocate VSAM data sets. The product uses these data sets as overflow storage for the key store work area. You can specify up to six volumes. If you specify a DFSMS storage class with the KSSTOR installation option, you do not need to specify a value for KSVOLS. The product uses the volumes that you enter in the VOLUMES parameter of a DEFINE CLUSTER command. Specify any valid VOLSER as a value for KSVOLS. |
| Use Log Range (USELGRNG) | Indicates whether Log Master uses the SYSIBM.SYSLGRNX tables to determine the ranges for a log scan. The product can use the SYSLGRNX tables to determine whether the DB2 log of a data sharing member contains information about the database structures that are included in your log. Values for USELGRNG are as follows:  
  - No—Indicates that the product will not use the SYSIBM.SYSLGRNX tables to determine valid ranges for a log scan.  
  - Yes—Indicates that the product will use the SYSIBM.SYSLGRNX tables to determine valid ranges for a log scan. |
<p>| Maximum Number of Tapes (LOGTAPES) | Specifies the maximum number of tape units or DASD data sets that Log Master allocates for reading log files. (LOGTAPES does not limit the number of physical tape drives that the product can use. It limits only the number of tape units that the product allocates for log processing at any one time.) The default value is four. The product allocates the value you specify, or a value equal to the number of members in the data sharing group, whichever value is less. |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dictionary Space (DICTSPC)</strong></td>
<td>Specifies a limit on the amount of memory that Log Master uses to store compression dictionaries. The product does not allocate any memory until it accesses a compressed table space. Adjusting this value can change the performance of log scans that read log records of compressed table spaces. The default value is 12 MB.</td>
</tr>
<tr>
<td><strong>Use Logs in order specified (USELOGS)</strong></td>
<td>Specifies the order in which the product reads active and archive log files. For all log scans, the product searches the log files in the order you enter. You can specify log keywords in any order. You can omit keywords for log copies that you do not want the product to consider. If you omit the keywords for active logs, however, the product might still read the active logs if it cannot find the required log records in the archive logs. The default order is ACT1, ACT2, ARCH1, and ARCH2.</td>
</tr>
<tr>
<td><strong>Truncation Position</strong></td>
<td>Specify which portion of a DB2 long name is truncated on a panel. The default is END. End which truncates the end of a long name. For example: The long name RMD128CHARACTERCREATOR.IC15P21L128MAXIMUMCHARACTERIXN will be truncated as follows:</td>
</tr>
<tr>
<td></td>
<td>■ Truncation Position: End, Truncation Characters: &gt;&gt; RMD128&gt;&gt;.IC15P21L128MAXIM&gt;&gt;</td>
</tr>
<tr>
<td></td>
<td>■ Truncation Position: Middle, Truncation Characters: &gt;&gt; RMD&gt;&gt;TOR.IC15P21L&gt;&gt;ACTERIXN</td>
</tr>
<tr>
<td></td>
<td>■ Truncation Position: Begin, Truncation Characters: ! !REATOR.!! IMUMCHARACTERIXN</td>
</tr>
<tr>
<td><strong>Truncation Characters</strong></td>
<td>Specify which characters are to be used as the substitution string for the truncated part of the object name. The default is &gt;&gt;.</td>
</tr>
</tbody>
</table>

**NGT Recover installation options**

The following table describes the NGT Recover installation options that you can customize when using the BMC Recovery Management for DB2 solution.

**Table 6: NGT Recover installation options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reorg Plus Execution Plan (PLANARU)</strong></td>
<td>Specifies the REORG PLUS execution plan. This is the PLANSYNC value (for example, ARUSvrmm) in the ARU$OPTS installation module for REORG PLUS. If PLANARU is specified and the DB2 plan exists, NGT Recover verifies that REORG PLUS and NGT Recover use the same BMCXCOPY table.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>NGT Copy Execution Plan (PLANACP)</td>
<td>Specifies the NGT Copy execution plan. This is the PLANCOPY value (for example, ACPCvrmm) in the ACP$OPTS module for BMC Next Generation Technology Copy for DB2 for z/OS. If PLANACP is specified and the DB2 plan exists, NGT Recover verifies that NGT Copy and NGT Recover use the same BMXCOPY table.</td>
</tr>
<tr>
<td>Use DB2 RACF ID? (OPNDB2ID)</td>
<td>Instructs NGT Recover whether to use the DB2 RACF ID instead of the RACF ID of the user running NGT Recover when opening the DB2 data sets, such as table spaces and logs. Specifying YES tells NGT Recover to use the RACFID of DB2. If NO is specified, the user must have the appropriate RACF authority. If DB2 is specified in the RACF started procedures table (ICHRIN03) as a privileged or trusted task and no user ID is associated with the DB2 address space, you cannot use OPNDB2ID. In this case, the user running NGT Recover must have RACF authority. <strong>Note:</strong> OPNDB2ID will work under data sharing only if all of the RACF IDs for the members of a group are the same. The authorizations for the BSDS and log data sets must also be the same. For any security system other than RACF, this option is ignored and the authority of the user running NGT Recover is used.</td>
</tr>
</tbody>
</table>
| Recover Index behavior (INDEXLOG) | Instructs NGT Recover what behavior RECOVER INDEX is to have, as follows:  
  - INDEXLOG=NO (the default)—indicates that RECOVER INDEX and REBUILD INDEX are synonyms and indexes are to be rebuilt from the keys extracted from the table space.  
  - INDEXLOG=YES indicates that RECOVER INDEX will recover indexes from copies, the log, or both, while REBUILD INDEX will rebuild indexes from the keys extracted from the table space.  
  - INDEXLOG=AUTO indicates that RECOVER INDEX first attempts an index recovery from image copies, the log, or both. However, if an image copy for the index does not exist, NGT Recover converts the request to a REBUILD INDEX request. |
| Index RECP Status Warning (IXRECP) | Determines whether indexes that are not rebuilt or recovered in the same run as their associated table spaces are set to RECP or RBDP status. Use this option when a point-in-time recovery of a table space is performed and it is important that any indexes on the space be recovered so that index data is synchronized with the data to which it refers. IXRECP=YES tells NGT Recover to issue a warning message for each index that has not been recovered with the table space, and to put each such index in RECP status. IXRECP=NO (the default) disables this feature. |
| Dynamic allocation unit name (WKUNIT) | Specifies the unit to use when dynamically allocating a disk file for input to a utility which NGT Recover will invoke (for example, SORT). Ensure that the unit specified is valid in your installation. |
### Adjusting for daylight savings time

You can set the values for both NGT Recover and Log Master in the RECOVERY MANAGER online interface by using option **8 Customize Options** on the main menu. These daylight savings options are used by the Recovery Management solution for the timestamp recovery feature.

See “Inflight resolution technology and timestamp recovery” on page 71 for more information about timestamp recovery.

In versions 9.2.00 and later, the TZRULE installation option replaces the FALLTS, PFALLTS, and SPRINGTS installation options. TZRULE enables you to specify the rules for when DST begins and ends. Using TZRULE, you do not need to update the value yearly, as was the case with the previous options.

The TZRULE option enables the Recovery Management solution to automatically adjust for daylight savings time when performing timestamp recoveries. While you are not required to set the daylight savings time option, this information can be important if you run a timestamp recovery after a daylight savings time change, but are recovering to a timestamp within a period before the time change. (This situation is called recovering across a daylight savings time boundary.)

#### Example

On Sunday, daylight savings time goes into effect and the clock is set forward one hour.

On Monday (after the daylight savings time change), you learn that a database needs to be recovered back to 2:00 on Saturday (before the daylight savings time change). If you supply the correct daylight savings time value for the TZRULE option, the Recovery Management solution will correctly identify the log point that corresponded to 2:00 on Saturday. If you do not specify that a daylight savings time change took place, the recovery point that the solution identifies will be 1 hour earlier than required (2:00 on Monday after the change is the equivalent of 1:00 on Saturday).

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XBM Subsystem ID (XBMID)</td>
<td>Specifies the EXTENDED BUFFER MANAGER (XBM) subsystem ID (ssid) or XBM group name (xbmGroup) to use when you restore Instant Snapshot copies. The ssid is the unique identifier that you specified when you installed XBM. If you are using XBM in a DB2 data sharing environment, you can use the xbmGroup name in place of ssid. The xbmGroup value is the name of the XBM coupling facility group defined to the XBM subsystem.</td>
</tr>
</tbody>
</table>
If your location uses daylight savings time, you should provide an appropriate value for the TZRULE option to ensure that timestamp recoveries are performed to the correct point.


## Creating groups

You create groups of DB2 objects to help manage and expedite the backup and recovery process.

You can create the following types of groups:

- Subsystem groups
- Application groups

You can also establish backup and recovery options for each group that you create.

## Creating subsystem groups

Create subsystem groups if you have decided that your disaster recovery strategy is to recover an entire DB2 subsystem without trying to prioritize applications. You can also use subsystem groups for local recovery of an entire subsystem, which is particularly useful for both test systems and systems containing a single application (such as SAP).

Create subsystem groups using either the RECOVERY MANAGER online interface or the ARMBGPS batch program. RMGR splits all objects in the subsystem into balanced groups to assist in efficient concurrent processing.

---

**Note**

You should make a full image copy of the full subsystem directly after running the ARMBGPS program. By doing so, you can make full or incremental copies of all or part of the subsystem and take advantage of the backup avoidance features (XUNCHANGED option) of the ARMBGEN batch program. For more information, see “Using backup avoidance” on page 53.
Creating application groups

You can create groups of application objects to be used both for local recoveries and for disaster recoveries (if your disaster recovery strategy dictates that some applications must be recovered before others at the remote site).

You can create groups using the RECOVERY MANAGER online interface or the ARMBGRP batch program. If you define these groups using wildcards, with dynamic grouping when you open the group, any new objects that match your definition will automatically be included in the group. The use of referential integrity checking ensures that all related objects will be backed up and recovered together. You also include the following objects when creating a group:

- All of the table spaces that are associated by LOB relationships with the objects in the group
- All of the objects that are associated by XML columns with the objects in the group
- All of the objects that are associated by a history (versioning) relationship to those specified in the group

Consider creating separate application groups for disaster recovery and local usage.

- Creating a set of RECOVERY MANAGER groups specifically for use in disaster recovery enables you to preset options that reflect the remote-site environment and to easily prioritize recovery. You may want to name these groups to reflect the sequence in which you want them to be recovered at the recovery site. For example:
  - DRGROUP1—accounts receivable
  - DRGROUP2—inventory
  - DRGROUP3—order entry

- Creating groups for use in local recoveries enables you to preset options for these groups that reflect the local environment and to take advantage of recovery methods that are only available for local recovery (for example, backout recovery).

Setting group-level options

Both subsystem groups and application groups use the subsystem-level backup and recovery options by default. However, different groups might require different options. For example, groups created specifically for disaster recovery should use options that are compatible with the remote site environment.
You can change the options for a single group using the RECOVERY MANAGER online interface. You can change the options for one or more groups simultaneously using the ARMBGRP batch program.

### Activate mirroring support

If you use hardware mirroring as part of your disaster recovery strategy, you can use the BMC Recovery Management for DB2 solution to streamline your backup and recovery processes.

Recovery Management performs the following functions in a mirrored environment:

- Identifies the volumes on which your system resources are located
- Enables you to identify mirrored application data (through the use of application groups) and identifies the volumes on which the mirrored objects are located
- Verifies that the identified volumes for both system resources and application data are being actively mirrored and reports exceptions
- Generates jobs to recover non-mirrored resources at the remote site. Objects identified as mirrored but which are not on actively-mirrored volumes are included in the recovery job.
- Optionally generates alternate jobs to recover both mirrored and non-mirrored resources at the remote site in the event of mirror failure
- Supports mirroring for full subsystem recoveries

You activate mirroring support separately for system resources and application resources using the RECOVERY MANAGER online interface. For more information, see “Mirroring support with the Recovery Management solution” on page 101.

### Backing up resources for local recovery

You can generate JCL to back up the application or subsystem groups and the system resources, including the archive logs, catalog and directory, and BSDS. You can generate backup JCL using the RECOVERY MANAGER online interface or you can use the ARMBGEN batch program.
You should make local site copies, and you should schedule the backups to run regularly. You can reduce backup costs by scheduling daily incremental copies and making full copies less frequently.

Using backup avoidance

The Recovery Management for DB2 solution exploits backup avoidance technology to reduce backup time.

This technology analyzes the log ranges to identify and exclude from the backup JCL any objects that have not changed between the last backup and the current time. This feature is particularly useful for systems with large numbers of objects that change infrequently (such as SAP).

You activate the backup avoidance feature by specifying the XUNCHANGED option of the ARMBGEN batch program.

For more information about the XUNCHANGED option, see the ARMBGEN chapter of the RECOVERY MANAGER for DB2 User Guide.

Making automatic index copies

The automatic index backup feature automatically makes an index copy when the index size threshold that you specify is reached or exceeded.

In the Recovery Management solution, automatic index backup is handled by the NGT Copy and the RECOVERY MANAGER components.

For more information, see the following documentation:
- RECOVERY MANAGER for DB2 User Guide
- BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual

Making consistent copies with minimal outage

The BMC Recovery Management for DB2 solution supports consistent (SHRLEVEL REFERENCE) copies of table spaces and indexes with minimal outages (a QUIESCE at the start of the backup).
You can request such copies by setting the following options at either the subsystem or group level:

- SHRLEVEL CONCURRENT
- RESETMOD NO

You can avoid even the QUIESCE outage by using the Online Consistent Copy technology.

Making fast copies with minimal overhead

The Instant Snapshot technology of the BMC Recovery Management for DB2 solution exploits intelligent hardware storage devices that support data set snap copies at the hardware control unit. These data set-level copies do not require the I/O needed for a standard copy and can complete in a fraction of the time.

The data sets created by Instant Snapshots are always cataloged in the ICF catalog. These data sets are VSAM linear data sets and are physical copies of the original DB2 data set. You can optionally use NGT Copy (COPY IMAGECOPY command) to make standard full image copies from Instant Snapshot copies. This feature enables you to use Instant Snapshots to make quick copies for local recoveries and as a source for standard image copies that you can use for disaster recovery or migration.

RECOVERY MANAGER generates backup JCL for NGT Copy, which utilizes SUF to create the Instant Snapshots.

You can make Instant Snapshot copies using the RECOVERY MANAGER online interface to set the DSSNAP option either at the group-level or system-level and then generate backup JCL. You can also use the ARMBGEN batch program to set the DSSNAP option. If you choose DSSNAP=AUTO (recommended), the solution makes Instant Snapshots if possible, but falls back to a standard copy if necessary (for example, XBM or the required hardware is not in place).

Set the following copy options to obtain Instant Snapshot copies:

- UNIT DISK
- FULL YES
- RESETMOD NO
- XBMID xbmId
- RESETMOD NO

See the following documentation for more information about making Instant Snapshot copies:

- BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual
Making encrypted copies

Extensive media coverage of security failures by major companies has generated increased interest in the use of encryption to secure sensitive company information.

The use of encryption protects sensitive company information and prevents security failures. The Recovery Management solution support for encryption allows users to protect image copies from unauthorized access to the sensitive information. Encrypted copies are a solution-only feature and require the solution password.

See the following documentation for more information about making Instant Snapshot copies:

- BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual
- BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual
- RECOVERY MANAGER for DB2 User Guide

Performing local recovery

The vast majority of recoveries are needed because of errors made by programs or transactions acting on the data.

In these cases, the DB2 subsystem seems to be operating normally. In other cases, a media failure might destroy data. These types of recoveries are application recoveries and they are done at the local site.

The BMC Recovery Management for DB2 solution supports a wide variety of local recovery methods, including the following methods:

- Backout to forward recovery
- Automatic index recovery
- Automatic drop recovery
- Snapshot recovery
- Transaction recovery
- Volume recovery
These methods are described in the following topics.

**Backout to forward recovery**

The backout recovery strategy of the Recovery Management solution is dramatically faster than most traditional forward recoveries.

This is shown in Figure 2 on page 57.

A backout recovery does not require image copies to perform a point-in-time recovery. Instead, it backs out the log records to undo or redo the changes that occurred between the selected point in time and the current point. This method returns the spaces and indexes to the required state without the overhead of restoring image copies, or rebuilding or restoring indexes.

When you specify the backout to forward recovery strategy (BACKOUT AUTO) RECOVERY MANAGER generates JCL for NGT Recover to perform a backout recovery for objects in the group. If the backout request fails or is invalid for any object, NGT Recover automatically goes on to perform a forward recovery for that object. BACKOUT AUTO is a feature of the Recovery Management solution and requires the solution password. When you are using a Recovery Management password and do not specify BACKOUT on the OPTIONS statement, a point-in-time recovery defaults to BACKOUT AUTO. (If you are not using a Recovery Management password, a point-in-time recovery defaults to BACKOUT NO.)

BACKOUT is not valid for:

- LOB spaces
- NOT LOGGED spaces
- Hash spaces
For more information about BACKOUT, see the *BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual*.

**Figure 2: Point-in-time recovery (forward recovery versus BACKOUT)**

**Automatic index recovery to rebuild**

Automatic index recovery to rebuild is a strategy in which the solution identifies indexes that have copies and recovers them when possible. If no copy exists or the index is not recoverable, the solution automatically falls back to an index rebuild.

The BMC Recovery Management *for DB2* solution supports this strategy through both the RECOVERY MANAGER and NGT Recover components. This feature is
most powerful when used in conjunction with the automatic index backup feature (see “Making automatic index copies” on page 53).

RECOVERY MANAGER supports the automatic index recovery-to-rebuild strategy by default. ARMBGEN generates syntax which tells NGT Recover to fall back to REBUILD for unrecoverable indexes.

For automatic backout recoveries (BACKOUT AUTO), RECOVERY MANAGER generates the INDEXLOG AUTO statement in the JCL to enable NGT Recover to automatically recover or rebuild indexes.

For more information, see the following documentation:

- BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual
- RECOVERY MANAGER for DB2 User Guide

**Inflight resolution technology and timestamp recovery**

The inflight resolution technology of the BMC Recovery Management for DB2 solution enables you to perform a consistent recovery to any timestamp or LRSN/RBA.

The ability to resolve inflight units of work at any point in time or to any log point completely eliminates the need to perform quiesces to establish consistent recovery points during application execution. The ability to avoid quiesces can dramatically improve the availability of your DB2 data.

Inflight resolution technology identifies and resolves uncommitted units of work while performing either a backout recovery or a traditional forward recovery to either a timestamp or a log point.

- In a situation in which a backout recovery is possible, the Recovery Management solution analyzes the updates within the time between current and the recovery point (as specified either by a timestamp or by an RBA/LRSN) and backs out the changes. No image copy or tape mount is required, and any uncommitted units of work are resolved.

- In a situation in which a backout recovery is not possible, the Recovery Management solution identifies and restores the most recent image copy. Recovery Management then processes log records only for committed updates, thereby removing uncommitted data from the space.

See the following documentation for more information:

- BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual
Automated drop recovery

The BMC Recovery Management for DB2 solution assists in the recovery of dropped objects. This type of recovery is generally needed for an error caused by an application program or by user errors.

Drop recovery is handled by the Log Master and NGT Recover components of the BMC Recovery Management for DB2 solution.

To perform an automated drop recovery, you first specify information about the DB2 objects that were dropped from the catalog, as follows:

- Type of objects to recover (table, table space, or database)
- Name of each object to recover
- Time frame when the objects were dropped from the catalog

Based on your input, Log Master scans the log for information relating to the dropped DB2 objects, then generates several forms of output that enable Log Master (working with NGT Recover) to recover the dropped objects. The output can include:

- DDL statements to create the dropped objects in the DB2 catalog
- NGT Recover syntax to recover a table or table space
- SQL statements for populating a recovered table with data
- DB2 commands to rebind any application plans that were invalidated when the objects were dropped
- A Drop Recovery report that provides summary information about the DB2 objects that you want to recover
  - The information includes the specific image copy that should be used for the recovery and OBID translation information.
- JCL statements to execute the different types of output in the right order to accomplish the recovery
  - You can direct Log Master to execute all or part of the generated JCL.

BMC strongly recommends that you use the Log Master online interface to define your automated drop recovery. Refer to the Log Master for DB2 Reference Manual.

Instant Snapshot recovery

The BMC Recovery Management for DB2 solution Instant Snapshot technology enables you to use intelligent storage to obtain fast backup and recovery of large spaces.

Instant Snapshot uses hardware-specific interfaces to replicate large data sets (of any size) in as little as 2 seconds. Hardware support includes any device that supports Flashcopy V2, EMCSNAP, or SIBBATCH DSSNAP.

Instant Snapshots are physical data copies that are almost instantaneous because they require no I/O. In addition to a near-instantaneous copy process, Instant Snapshots offer a near-instant restoration phase during database recovery. If an Instant Snapshot cannot be made, Recovery Management provides the capability for the copy utility to fall back automatically to a mirror-based hardware snapshot or a traditional cache-based software snapshot.

See the following documentation for more information:

- BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual
- RECOVERY MANAGER for DB2 User Guide

Recovery to a log mark

Recovery to a log mark uses features from Log Master and NGT Recover. This exclusive feature enables you to set and recover to a user-defined log mark.

The ability to create a log mark is a unique feature of Log Master. Log marks enable you to associate a name with a point on the log. When you specify a log mark, you can later refer to that point by the log mark name. You do not have to know the actual RBA/LRSN. When you define a log mark, you can optionally use the Quiesce with Mark option to set the RBA/LRSN for the log mark to the RBA/LRSN of a quiesce action that you request.

For information about creating log marks, see the Log Master for DB2 Reference Manual manual.

After setting a log mark, you can use NGT Recover to recover to that log mark:
If you performed a quiesce when you defined the log mark or set the log mark at a quiet point, you can perform a point-in-time recovery using RECOVER TOLOGPOINT LOGMARK logMarkName syntax.

If you know that the log mark is not at a quiesce point or a quiet point for the spaces or spaces that you are recovering, you should perform a timestamp recovery by using OPTIONS RECOVERYPOINT LOGMARK logMarkName.

For more information about recovering to a log mark, see the BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual.

Volume recovery

The BMC Recovery Management for DB2 solution supports volume recovery, which is needed when a media failure destroys or corrupts data.

Volume recovery is enabled by the RECOVERY MANAGER and NGT Recover components. RECOVERY MANAGER identifies the objects on a specified volume and puts them into an application group. You can then recover the group using NGT Recover as you would any other application group. The volumes do not need to be available at the time that you build the group, so you can perform this process after media failure occurs.

You can use the RECOVERY MANAGER online interface or the ARMBGRP to create the volume groups.

For more information, see the RECOVERY MANAGER for DB2 User Guide.

Using a system-level volume backup

DB2 supports the BACKUP SYSTEM command, which backs up the entire DB2 system using volume snapshots. To recover an individual space from a system-level volume backup, you can use RECOVER in the NGT Recover product and specify SB (for system backup) in the RESOURCE SELECTION for image copies. Also, COPY IMAGECOPY in the NGT Copy product can make a standard copy of the space from a system backup.

Preparing for disaster recovery

Preparing for disaster recovery is a complex process that depends on tasks both within and out of the scope of the BMC Recovery Management for DB2 solution.
These tasks are summarized in Table 7 on page 62.

Table 7: Disaster recovery preparation

<table>
<thead>
<tr>
<th>Accomplished with Recovery Management solution?</th>
<th>Task</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Create copies of business applications</td>
<td>“Create copies of business applications” on page 62</td>
</tr>
<tr>
<td>Yes</td>
<td>Create copies of repositories</td>
<td>“Create copies of repositories” on page 63</td>
</tr>
<tr>
<td>No</td>
<td>Create copies of all required libraries</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Yes</td>
<td>Create copies of the DB2 catalog and directory</td>
<td>“Create copies of the DB2 catalog and directory” on page 63</td>
</tr>
<tr>
<td>Yes</td>
<td>Prepare system resources</td>
<td>“Prepare system resources” on page 63</td>
</tr>
<tr>
<td>Yes</td>
<td>Generate application recovery JCL</td>
<td>“Generate application recovery JCL” on page 65</td>
</tr>
<tr>
<td>No</td>
<td>Create a tape management catalog backup</td>
<td>Not applicable</td>
</tr>
<tr>
<td>No</td>
<td>Create a z/OS catalog backup</td>
<td>Not applicable</td>
</tr>
<tr>
<td>No</td>
<td>Transport all copies and generated JCL to the recovery site</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**Note**
The JCL that you generate for disaster recovery processing can support hardware mirroring. The mirrored recovery JCL omits mirrored objects from the recovery because they are already available at the recovery site. You can also generate alternate JCL to recover all resources (whether mirrored or not) as a fallback strategy in the event mirroring fails. This alternate JCL is generated instead of the mirrored recovery JCL if any object cannot be verified as mirrored. For more information, see the RECOVERY MANAGER for DB2 User Guide.

Create copies of business applications

You can generate JCL to back up the application or subsystem groups using the RECOVERY MANAGER online interface or the ARMBGEN batch program.

The method for doing this is the same as described in “Backing up resources for local recovery” on page 52, with the exception that the copies should be for the remote site (RP copies).
Create copies of repositories

The RECOVERY MANAGER repository and associated tables are required at the remote site to be able to use RECOVERY MANAGER for disaster recovery.

The RECOVERY MANAGER online interface enables you to create a group containing the repository and tables. You can then use the online interface to generate NGT Copy backup JCL. You must also recover the RECOVERY MANAGER repository at the DR site to use the data collection feature.

For more information, see the RECOVERY MANAGER for DB2 User Guide.

Create copies of the DB2 catalog and directory

The RMGR online interface enables you to generate NGT Copy backup JCL for the catalog and directory.

For more information, see the RECOVERY MANAGER for DB2 User Guide.

Prepare system resources

Preparing the system resources for disaster recovery consists of the following tasks:

- Establish a recovery point
- Make copies of the archive logs
- Generate system resource recovery JCL

These tasks are described in the following topics.

Establish a recovery point

Use the RECOVERY MANAGER online interface to establish a recovery point.

You can establish any point by specifying one of the following choices:

- End of the archive log created using the ARMBLOG program
  This option generates JCL that uses the ARMBLOG program to issue an archive log command, waits until the command is completed, and use the end of that archive log as the recovery point.
- **User-specified timestamp, using the ARMBCRC program**
  This option generates JCL that uses the ARMBCRC program to convert a specified timestamp to an RBA or LRSN for use as the recovery point.

- **Last recovery point registered in the Coordinated Disaster recovery table (CRRDRPT)**
  This option is for data sharing systems and generates JCL to identify the last recovery point registered in the CRRDRPT table for use as the recovery point.

For more information, see the *RECOVERY MANAGER for DB2 User Guide*.

### Make copies of the archive logs

Make copies of the archive logs for use at the remote site, using the RECOVERY MANAGER online interface.

You can also use the ARMBARC batch program which creates a set of three data sets for each archive log data set that is copied, as follows:

- A copy of the BSDS
- A copy of the archive log data set
- A copy of the archive history file

**Note**

BMC recommends that you make both primary and backup copies.

For more information, see the *RECOVERY MANAGER for DB2 User Guide*.

### Generate system resource recovery JCL

Set options and generate JCL for the system resources.

This JCL creates jobs to recover the DB2 subsystem at the recovery site. Use the RECOVERY MANAGER online interface to generate this job. You can also use the ARMBSRR batch program.

For more information, see the *RECOVERY MANAGER for DB2 User Guide*.

### Revalidate groups

You should revalidate your subsystem and application groups to ensure that all objects within the scope of the group definition are recoverable and that they are
included in the recovery. RECOVERY MANAGER working with SUF can also revalidate and report the status of the mirrors in your environment.

--- Note ---
With the introduction of dynamic grouping in RECOVERY MANAGER version 9.2.00, revalidation no longer refers to the process of running the group definitions again to populate the group with an updated list of objects based on the current system. This type of revalidation is no longer needed with dynamic grouping. Revalidation now refers to checking the recoverability of the objects in the group. RECOVERY MANAGER does not revalidate catalog and directory resources. The recovery of the DB2 catalog and directory is reported by ARMBSRR with the optional ARMVRPT report in RECOVERY MANAGER. See the RECOVERY MANAGER for DB2 User Guide.

Revalidate using the RECOVERY MANAGER online interface. You can also revalidate the groups using the ARMBGPV batch program.

For more information about revalidating groups, see the RECOVERY MANAGER for DB2 User Guide.

For more information about revalidating mirrors, see “Mirroring support with the Recovery Management solution” on page 101.

--- Generate application recovery JCL ---
Generate JCL that you can use to recover application resources at the recovery site.

If you have created subsystem groups (see “Creating subsystem groups” on page 50) and you are using the RECOVERY MANAGER online interface, you can generate the JCL to recover those groups at the same time that you generate the JCL for the System Resources.

If you have created application groups for use at the DR site, you can generate recovery JCL either using the online interface or by using the ARMBGEN batch program.

You should specify the following options:

- RECOVER TO RESTART RBA
- SITETYPE RECOVERY
- JCLTYPE DR
- BACKOUT NO

For more information, see the RECOVERY MANAGER for DB2 User Guide.
Performing simulation and estimation

Simulation and estimation are valuable tools for preparing and fine-tuning your disaster and local-site recovery plans. You might find recovery simulation useful in reducing your disaster recovery and local site testing costs. Estimation can be useful for determining problem spaces and trying different scenarios.

Simulation

The recovery simulation feature performs all aspects of recovery up to, but not including, any destructive operations on the data.

It reads image copies and sorts and applies all log records required for recovery, discarding the output after verifying that the recovery resources are valid. You can use simulation for both disaster recovery and local group recovery. Simulation also gives you a close approximation of how long an actual recovery will take. You can use simulation for:

- Disaster recovery
- Local group recovery
- Local subsystem PIT recovery

You can use the RECOVERY MANAGER online interface to generate recovery simulation JCL for both application and system recovery, including local site recovery. You can also use the ARMBGEN batch program for application recovery simulation and the ARMBSRR batch program for system resource recovery simulation.

You can also use the NGT Recover AFRMAIN program with the SIMULATE YES option to simulate a recovery.

For more information about recovery simulation, see “Recovery simulation and estimation” on page 123.

Estimation

The recovery estimation feature can provide an estimate in hours, minutes, and seconds for the amount of time required to perform a complete disaster recovery, including both system and application resources.

It produces a list of the ten objects that would take the longest amount of time to recover. Estimation is faster than simulation because it does not perform any recovery steps.
Note

Data about the recovery operation is collected for all simulated, estimated, and actual recoveries and saved into RECOVERY MANAGER tables for comparison purposes. The ability to analyze and compare recovery statistics enables you to evaluate and improve your disaster recovery processes over time.

Evaluate disaster recovery data

The Recovery Management solution automatically collects and stores statistical data from all actual, simulated, and estimated disaster recoveries.

This data includes a list of objects that require the most recovery time, total elapsed time for recoveries, and more. The data collected can enable you to compare different recoveries, determine if you are meeting your service level agreements, and even perform a number of what-if scenarios to assist you in reducing disaster recovery time or in justifying more resources.

For more information about data collection, see “Disaster recovery data collection” on page 115.

Online consistent copies

Online Consistent Copy technology provides the database administrator with an efficient way to make consistent copies of DB2 table spaces and indexes without having to quiesce or cause any other outage to the spaces being copied.

The spaces being copied are continuously available for read and write access while the copy is being made.

One way that Online Consistent Copy does this is by making SHRLEVEL CHANGE Instant Snapshot copies. Online Consistent Copy uses the log to externalize changes to the copies for all complete transactions and to back out changes in the copies for any inflight transactions. This method is a very efficient way to make consistent copies of very large objects.

If your hardware does not support Instant Snapshots, you can still make OCCs using the SNAP VSAM option. SNAP VSAM is not as fast as using Instant Snapshot hardware, but it can make the same type of copy.

Another way that Online Consistent Copy does this is by making SHRLEVEL CHANGE standard image copies. Then Online Consistent Copy reads the standard image copies, merges them with log records to externalize changes for all complete
transactions and to back out changes for any inflight transactions, and outputs the
merged, consistent copy as a VSAM data set. In this case, Online Consistent Copy
requires the use of the OUTSIZE option on the OPTION command and the BIGDDN
option on the COPY command. These options, along with an OUTPUT command,
specify the name of the output VSAM data set that will contain the consistent copy
and work to determine when a data set is sufficiently large to merit using Instant
Snapshot copies instead of standard image copies. Only those data sets that pass a
user-specified OUTSIZE threshold are copied as Instant Snapshots. All others use
standard image copies as input to the merge process. The main advantage of this
process over Instant Snapshots or SNAP VSAM is that it may be faster if you are
copying a large number of small objects.

The advantages of Online Consistent Copy are as follows:

- Allows you to make consistent copies of production data at virtually any time,
since no outage is required
- Minimizes the impact on production applications
- Requires minimal CPU and I/O on the production system

For more information, see “Overview of Online Consistent Copy” on page 185.
Solution-only features

Chapters:

- Inflight resolution technology and timestamp recovery
- Copy encryption
- Cabinet copy
- Mirroring support with the Recovery Management solution
- Disaster recovery data collection
- Recovery simulation and estimation
- Full local subsystem recovery with conditional restart avoidance
- High-speed Structure Change
- Moving data with a migration file
Inflight resolution technology and timestamp recovery

The inflight resolution technology enables you to perform a consistent recovery to any timestamp or LRSN/RBA. The ability to resolve inflight units of work at any point in time or to any log point completely eliminates the need to perform quiesce actions to establish consistent recovery points during application execution. The ability to avoid quiesce actions can dramatically improve the availability of your DB2 data.

About inflight resolution technology and timestamp recovery

The Recovery Management solution supports the following features that use inflight resolution technology.

<table>
<thead>
<tr>
<th>Feature</th>
<th>RECOVERY MANAGER component</th>
<th>NGT Recover component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timestamp Recovery, Inflights Resolved, Data Sharing</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Timestamp Recovery, Inflights Resolved, Non-Data-Sharing</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Recovery to a Log Point, Inflights Resolved, Data-Sharing</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Recovery to a Log Point, Inflights Resolved, Non-Data-Sharing</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The timestamp recovery feature uses inflight resolution technology to perform a consistent point-in-time recovery to any user-specified timestamp. The Recovery Management solution translates the timestamp to an RBA or LRSN and resolves all inflight units of work while recovering the objects for both data sharing and non-data-sharing systems.

Recovery using inflight resolution supports both table spaces and indexes. In addition, you can recover an entire group or set of groups using this process.
Note

Timestamp recovery and inflight resolution technology use features from the RECOVERY MANAGER for DB2, BMC Next Generation Technology Recover for DB2 for z/OS, and Log Master for DB2 components of the BMC Recovery Management for DB2 solution. The Recovery Management solution password is required to use the feature.

See the BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual for more information about using NGT Recover batch syntax to perform timestamp recovery. See the following sections of this chapter for more information about using the RECOVERY MANAGER online interface to perform timestamp recoveries and use inflight resolution technology to perform recoveries to a log point.

The problem

Before inflight resolution technology, recovery to an arbitrary timestamp or log point could leave data in an inconsistent state if the target point did not correspond to a quiet point such as a quiesce.

This situation required that the system administrator choose one of the following solutions:

- Perform regular quiesces in order to provide quiet points
- Perform a conditional restart recovery of the entire subsystem

Both of these methods are unsatisfactory. Quiesces cause unwanted overhead and data outages. Conditional restart recoveries require recovery of an entire subsystem even when only a subset of objects needs to be recovered.

The solution

Inflight resolution technology identifies and resolves uncommitted units of work while performing either a backout recovery or a traditional forward recovery to either a timestamp or a log point.

See “Backout to forward recovery” on page 56 for more information about the backout to forward recovery strategy.

The following sections describe inflight resolution recovery using the two recovery strategies. See
Inflight resolution recovery using backout

In a situation in which a backout recovery is possible, the Recovery Management solution analyzes the updates within the time between current and the recovery point (as specified either by a timestamp or by an RBA/LRSN) and backs out the changes.

No image copy or tape mount is required, and any uncommitted units of work are resolved.

Example

In the sample shown in Figure 3 on page 73, a bad update was made to the EMP.PAYROLL table space at 10:00. At noon, the mistake was found and the user decided to recover to 9:00, right in the middle of the UR2 unit of recovery. No quiesce had been made.

Recovery Management backed out all changes that had been made by the payroll application from 12:00 to 9:00. In addition, it resolved inflight unit of work UR2 by backing out all its log records. The only records that needed to be altered were those that had changed during the PIT range.

Figure 3: Timestamp recovery, using backout recovery

Inflight resolution recovery using forward recovery

In a situation in which a backout recovery is not possible, the Recovery Management solution identifies and restores the most recent image copy.
Recovery Management then processes log records only for committed updates, thereby removing uncommitted data from the space.

**Example**

In the sample shown in Figure 4 on page 74, a bad update was made to the EMP.PAYROLL table space at 10:00 a.m. At 10:15, there was a mass delete on this segmented table space, which prevents a subsequent backout recovery. At noon, the mistake made at 10:00 a.m. was found and the user decided to recover to 9:00 a.m., right in the middle of the UR2 unit of recovery. No quiesce had been made.

In this case, the mass delete prevents a backout recovery. Recovery Management restored the image copy that had been made at 1:00 a.m. Recovery Management then performed a forward recovery of the committed updates to reach the log point corresponding to the 9:00 user-specified timestamp.

**Figure 4: Timestamp recovery, using forward recovery**

---

**Requirements and restrictions**

Inflight resolution recovery to a timestamp or log point has the following requirements and restrictions:

- Inflight resolution recovery requires supported versions of the following products and components:
  
  — Recovery Management with valid solution password
  
  — BMC Next Generation Technology Recover for DB2 for z/OS specified as the recover utility
Inflight resolution recovery is not valid for use with LOB table spaces, unless you are using the NGT Recover utility, version 5.2.00 or later.

Forward recovery with inflight resolution cannot use an image copy that contains updates from a transaction that was inflight at the recovery point. For this reason, consider keeping at least two image copies prior to the desired point of any forward recovery. This restriction applies only when Recovery Management is unable to perform a backout recovery.

Timestamp recovery is supported by the RECOVERY MANAGER online interface.

**Note**

RECOVERY MANAGER supports recovery to a log point with inflight resolution in both data and non-data-sharing system. In addition, NGT Recover fully supports timestamp recovery and recovery to a log point with inflight resolution for both non-data-sharing and data sharing systems. In either case, a valid Recovery Management solution password is required.

---

**How to recover to a timestamp or log point with inflight resolution**

You can perform an inflight resolution recovery to a timestamp or log point in the following ways:

- **Using RECOVERY MANAGER to generate JCL in the foreground or background**
  This method takes advantage of the automation provided by RECOVERY MANAGER and enables the use of the backout to forward recovery strategy, which can dramatically reduce the amount of time required for a recovery. See “Recovering to a timestamp or log point using RECOVERY MANAGER” on page 76.

- **Using the NGT Recover command syntax**
  See “Recovering to a timestamp or log point using NGT Recover” on page 80.
Recovering to a timestamp or log point using RECOVERY MANAGER

Use the following procedure to use the RECOVERY MANAGER online interface to generate JCL to perform a timestamp recovery or a recovery to a log point using inflight resolution technology.

Before you begin

Verify the following information prior to a timestamp recovery:

- **Daylight savings settings**
  
  If you are recovering across a daylight savings time boundary, ensure that the daylight savings options have been set appropriately for both Log Master and NGT Recover. If these options are not set correctly, the product cannot properly adjust for the time change when recovering across a boundary. See “Adjusting for daylight savings time” on page 49 for more information.

- **Authorizations**
  
  To generate recovery JCL, you need the following authorizations if you are not the creator of the group:
  
  - EXECUTE authority for the RECOVERY MANAGER DB2 plan
  - TYPE A authority if you intend to save changes to the group
  - TYPE O authority if you do not intend to save changes to the group
  - authority to update the output data set for the JCL

To generate an inflight resolution recovery job in the foreground

This procedure performs the analysis and produces JCL for an inflight resolution recovery to a timestamp or an LRSN during the active RECOVERY MANAGER TSO session.

Start this procedure at the Object List panel, which appears after you have created or retrieved a group.

1. In the Object List panel, select Option 1 **Recovery point** and press **Enter**.

   The Recovery Type Selection panel is displayed.
2 Specify the recovery point and options, as follows:

a) To recover to a log point:
   - Choose option 5. Specific RBA.
   - Enter the LRSN in the To RBA/LOGPOINT field.
   - Enter 1, Yes, in Resolve Inflights.

b) To recover to a timestamp:
   - Choose option 6. Timestamp.
   - Enter the timestamp in the To Timestamp field.

   **Note**
   Recovery to a timestamp and recovery to a log point is available for both data sharing and non-data-sharing.

   **Tip**
   BMC recommends that you accept the default Backout Auto for the recovery. A backout auto recovery is the fastest and most reliable recovery available.

3 Press Enter.

The system analyzes the object list and the Partial Recovery Verification panel appears.
4 In the Partial Recovery Verification panel, select Yes or No for each of the options shown, then press Enter.

The Object List panel is displayed again.


The system analyzes the object list and, if necessary, produces a list of objects that do not meet the criteria for inflight resolution. Press F3 to continue to the JCL Specification panel.

--- Note ---
If the Recovery Management solution cannot resolve the inflight units of work for one or more objects, it does not include those objects in the recovery JCL.

6 In the JCL Specification panel, enter a fully qualified output data set name.

Be aware of the following information:

- The output data set is used for saving the JCL and must be cataloged. If not enclosed in quotes, the output data set will be prefixed by your TSO prefix.

- The job statement must contain a symbolic variable (&#) for the job number.

7 Save the JCL data set or submit the job as required.

To generate an inflight resolution recovery job in the background

This procedure generates the JCL for a batch job that will perform the analysis and produce JCL for an inflight resolution recovery to a timestamp or an LRSN.

Start this procedure at the Object List panel, which appears after you have created or retrieved a group.

1 In the Object List panel, select 3. Gen JCL background and press Enter.
The Batch Group Recovery Point Specification and the Recovery Type Selection panels display.

2 Specify the recovery point and options, as follows:

a To recover to a log point:

- Choose option 5. Specific RBA
  - Enter the LRSN in the To RBA/LOGPOINT field
  - Enter 1, Yes, in Resolve Inflights

b To recover to a timestamp:

- Choose option 7. Timestamp
  - Enter the timestamp in the To Timestamp field

3 Press Enter.

The Batch Group JCL Generation Options panel appears.

4 Enter the SYSUT2 DD statement for batch JCL output (including //).

5 In the JCL Specification panel, enter a fully qualified output data set name.
6 Save the JCL data set or submit the job as required.

The JCL produced in the previous step runs the ARMBGEN batch program to analyze the objects in the group and to produce the recovery JCL. Run the generated JCL to perform the recovery.

---

**Note**

If the Recovery Management solution cannot resolve the inflight units of work for one or more objects, it issues messages and does not include those objects in the recovery JCL.

---

### Recovering to a timestamp or log point using NGT Recover

You perform timestamp recovery and inflight transaction recovery using the RECOVERYPOINT option of the NGT Recover OPTIONS command. The RECOVERYPOINT option specifies the recovery point and directs the utility to resolve inflight units of recovery.

You specify the RECOVER statements as if a recovery to the current point in time is specified. You can have multiple RECOVER statements in the input. The RECOVERYPOINT option effectively determines what the current recovery point is. You must not specify any point-in-time values, such as TOLOGPOINT, in the RECOVER command. The following is an example of what your syntax might look like:

```sh
//RECOVER EXEC PGM=AFRMAIN,REGION=0M,
  //PARM='DGE,TSREC.NEW/RESTART,MSGLEVEL(2)'
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
//          DD DISP=SHR,DSN=DSNLOAD
//SYSIN     DD *
OPTION BACKOUT RECOVERYPOINT TIMESTAMP 2010-11-19.11:24:12
RECOVER TABLESPACE WRPDB01.WRPTS01
RECOVER INDEX(ALL) TABLESPACE WRPDB01.WRPTS01
/*

See the *BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual* for more information about the RECOVERYPOINT option and how to use NGT Recover outside of RECOVERY MANAGER.

---

**Note**

If you are recovering across a daylight savings time boundary, ensure that the daylight savings options have been set appropriately for both Log Master and NGT Recover. If these options are not set correctly, the product cannot properly adjust for the time change when recovering across a boundary. See "Adjusting for daylight savings time" on page 49 for more information.
Recovering to a log mark

Just as you can use RECOVERY MANAGER and NGT Recover to recover to a timestamp or log point, you can use them to recover to a log mark.

In RECOVERY MANAGER in the foreground, see Figure 1 on page 76, the Recovery Type Selection panel provides the 7. Logmark selection.

Figure 5: Recovery Type Selection panel (foreground execution)

For RECOVERY MANAGER in the background, see Figure 2 on page 79, the Recovery Type Selection panel provides the 8. Logmark selection.

Figure 6: Recovery Type Selection panel (background execution)

See the RECOVERY MANAGER for DB2 User Guide for more information.

In order to invoke the inflight resolution, you should also enter 1 (Yes) for Resolve Inflights.

NGT Recover provides syntax to support log marks with relative and absolute generation numbers on the OPTIONS command with LOGPOINT LOGMARK logMarkName (logMarkGeneration) and on the RECOVER command with TOLOGPOINT LOGMARK logMarkName (logMarkGeneration). See the BMC Next
How to recover to a timestamp or log point with inflight resolution

*Generation Technology Recover for DB2 for z/OS Reference Manual* for more information.
Copy encryption

The use of encryption protects sensitive company information and prevents security failures. Recovery Management support for encryption allows you to protect image copies from unauthorized access to sensitive information. You can use Recovery Management to make full and incremental encrypted copies to disk or tape.

Recovery Management supports encryption as follows:

- BMC Next Generation Technology Copy for DB2 for z/OS provides encryption functionality and creates the encrypted copies.

- BMC Next Generation Technology Recover for DB2 for z/OS allows you to recover using full and incremental encrypted copies made by NGT Copy.

- RECOVERY MANAGER for DB2 generates JCL to create encrypted copies and to perform recoveries using encrypted copies as recovery resources.

- Log Master for DB2 can read encrypted copies to obtain dictionaries for decompression or to complete partially logged updates.

Encryption algorithms

Encryption in NGT Copy is based on standard secret key encryption algorithms.

You can select encryption based on one of three following standard algorithms:

- The ANSI Data Encryption Algorithm (DEA) with a 64-bit key (Data Encryption Algorithm, ANSI-X3.92.1981. American National Standards for Information Systems.)
  This is the default algorithm. This algorithm is also known as the U.S. National Institute of Science and Technology Data Encryption Standard (DES).

- The Triple Data Encryption Standard (TDES) with a 128-bit key

NGT Copy supports encryption of plaintext image copies or decryption of cipher text image copies. Plaintext or clear text is data in normal, readable form. (NGT Copy standard image copies are plaintext.) Encrypted text or cipher text is data that has been converted to mask its meaning from an unauthorized recipient. NGT Copy encryption involves proprietary data manipulation, in addition to the standard encryption algorithms, which is designed to make the encryption of DB2 page sets more secure.

Requirements for encryption

The following topics list the requirements to create and use encrypted copies.

NGT Copy encryption requirements

To create encrypted copies in NGT Copy, you must:

- Run NGT Copy on a processor that supports encryption
- Use the ENCIPHER option on the OUTPUT command that is used by the COPY and COPY IMAGECOPY commands
- Use the KEYDSNAM installation option to specify your key data set name
- Create and maintain the key data set ("Key data set" on page 86)
- Have the BMC Recovery Management for DB2 solution and use a valid Recovery Management password

NGT Recover encryption requirements

To recover by using encrypted copies made by NGT Copy, you must:

- Run NGT Recover on a processor that supports encryption
- Use the KEYDSNAM installation option to specify your key data set name (see the BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual)
- Create and maintain the key data set ("Key data set" on page 86)
- Have the BMC Recovery Management for DB2 solution and use a valid Recovery Management password

---

**Note**

NGT Recover finds encrypted copies registered in BMCXCOPY without the use of the syntax options. If you want to use a non-registered encrypted image copy, you must use the ENCRYPTED option and TIMESTAMP option in the INCOPY specification of the RECOVER command.

---

**RECOVERY MANAGER encryption requirements**

To generate JCL used to create and recover from encrypted copies you must:

- Ensure you have met the encryption requirements for both NGT Copy and NGT Recover ("NGT Copy encryption requirements" on page 84 and "NGT Recover encryption requirements" on page 84)

- To create encrypted copies, specify NGT Copy as the backup utility and use the Encrypt the copy option in the Output Data Set Options panel

- To recover from encrypted copies, specify NGT Recover as the recovery utility

- Have the BMC Recovery Management for DB2 solution and use a valid Recovery Management password

**Log Master encryption requirements**

To read encrypted copies made by NGT Copy, you must:

- Run Log Master on a processor that supports encryption

- Use the KEYDSNAM installation option to specify your key data set name (see the Log Master for DB2 Reference Manual)

**Restrictions for encryption**

The following restrictions apply to using NGT Copy to make encrypted copies:

- You cannot use the NGT Copy COPY command to produce encrypted Instant Snapshot copies. The options ENCIPHER YES and DSSNAP YES or AUTO cannot
both appear on an OUTPUT command. If NGT Copy finds both options on an OUTPUT command, it will issue the BMC47339 message (shown below) and end with a condition code 8.

```
BMC47339E OPTIONS DSSNAP AND ENCIPHER ARE INCOMPATIBLE
```

- NGT Copy does not support encryption of catalog or directory spaces. If encryption of these spaces is attempted, NGT Copy issues the BMC47320W message (shown below), performs the copy without encryption, and sets the condition code to 4.

```
BMC47320W OPTION IGNORED: ENCIPHER YES
```

- The NGT Copy COPY command does not support encryption for SHRLEVEL CHANGE RESETMOD YES copies. If this combination of options occurs, NGT Copy issues a BMC47320W message, performs the copy without encryption, and sets the condition code to 4.

- NGT Copy does not support encryption for a COPY command with the RESETMOD YES option unless the command also produces a plaintext image copy. If a plaintext image copy is not requested, NGT Copy issues a BMC47320W message, performs the copy without encryption, and sets the condition code to 4.

```
Note
When you specify RESETMOD YES, if you are only making RP and RB copies (no local copies), NGT Copy requires that the RP copy is plaintext.
```

- If you specify ENCIPHER YES and encryption is not supported, NGT Copy issues a BMC160637W message (shown below), sets the condition code to 4, and creates plaintext image copies.

```
BMC160637W ENCRYPTION/DECRYPTION IS NOT SUPPORTED
```

Key data set

Support for NGT Copy encryption relies on a user-created and maintained data set, called the key data set.

The key data set contains essential encryption key information. NGT Recover requires the key data set to recover encrypted copies, while Log Master might require the key data set to read encrypted image copies to obtain compression dictionaries or to complete partially logged updates.

Key data set requirements

You must perform the following tasks for the key data set:
Create the key data set.

NGT Copy requires that the key data set be a fixed or fixed block physical sequential data set with a logical record size (LRECL) of 80. NGT Copy requirements for the contents of the data set are specified in “Key data set contents” on page 87. Any variation from these requirements could prevent NGT Copy from encrypting the image copy.

Identify the key data set to NGT Copy.

The KEYDSNAM installation option specifies the key data set name. After you specify the key data set name, NGT Copy dynamically allocates the data set when it is needed. If NGT Copy attempts to encrypt an image copy and you have not specified the key data set name in the installation option module, NGT Copy issues the following warning message, sets the condition code to 4, and produces plaintext image copies.

BMC160637W KEY DATA SET IS NOT AVAILABLE

Maintain the key data set.

Periodically, you may want to change encryption keys. You cannot edit the key data set while any utility that is using the key data set is inflight. You need to schedule time to maintain the data set. You must take care when you maintain the data set because incorrect entries in the data set might prevent NGT Copy from encrypting your image copies or prevent NGT Recover from recovering using your encrypted image copies.

Provide appropriate security for the key data set to protect it from unauthorized access.

Maintain backups of your key data set either with DFSMShsm or some other facility.

Key data set contents

The key data set contains one or more rows of 80 characters per row.

NGT Copy ignores any characters in columns 72 through 80. Each row contains:

- One encryption key
- A corresponding timestamp
- An optional encryption algorithm identifier
- An optional comment

These fields are separated by one or more blank characters. The first character of the comment is an asterisk. Rows are ordered in the data set by timestamp with the most recent first.
recent timestamp first. The current key is the key in the first row. The format of the key data set row is:

<Key value>  <Timestamp>  <Encryption algorithm ID>  <Comment>

An example of the contents of a key data set follows:

<table>
<thead>
<tr>
<th>Key value</th>
<th>Timestamp</th>
<th>Encryption algorithm ID</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>X'0ABCDEF123456789FEDCBA000111111'</td>
<td>2009-11-23-12-00</td>
<td>*128 bit DES encryption</td>
<td></td>
</tr>
<tr>
<td>X'123456789ABCDEF1'</td>
<td>2009-08-23-11-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X'723DE6789000DEF1'</td>
<td>2008-12-12-16-40</td>
<td>DES *64 bit DES encryption</td>
<td></td>
</tr>
<tr>
<td>X'723DE6789000DEF1723DE6789000DEF1'</td>
<td>2008-12-12-14-00</td>
<td>AES *128 bit AES encrypt</td>
<td></td>
</tr>
<tr>
<td>X'F1F2F3F4F5F6F7F8'</td>
<td>2008-01-01-12-00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NGT Copy uses the contents of the key data set to determine a key value for encryption or decryption of image copies. The NGT Copy COPY commands such as COPY TABLESPACE and COPY INDEXSPACE use the current key or the key in the first row of the key data set to encrypt image copies. If the timestamp in the first row is in the future, NGT Copy sets the condition code to 4, issues a warning message, and creates plaintext image copies.

Encrypted image copies are registered in BMCXCOPY. As with SYSCOPY registration, BMCXCOPY registration includes a timestamp specifying when the copy was registered. The NGT Copy COPY IMAGECOPY command, as well as NGT Recover and Log Master, use this timestamp to find the correct key value in the key data set. For more information about the registration of encrypted copies, see “Registration for plaintext image copies” on page 91.

For example, if NGT Recover selected an image copy for a recovery from BMCXCOPY with a timestamp of 2009-02-12-10.00, the encryption key and DES algorithm in the third row in the example key data set above is selected.

### Key value

NGT Copy supports both 64-bit and 128-bit keys.

(See “Encryption algorithm identifier” on page 89.) The key data set can contain either or both key sizes. The key value is a clear key represented in the key data set as a string of 16 or 32 hexadecimal digits in the following format:

X'\dd...'  

The X and the quotes are required. The X must occur in the first column and be upper case.

### Timestamp

The date, hour, and minute string uses the following formats:
The values are decimal numbers and are padded on the left with a zero if necessary. The timestamp must be separated from the key value by at least one blank space.

**Encryption algorithm identifier**

An encryption algorithm identifier is optional in the key data set.

The encryption algorithm identifiers supported are:

- DES for Data Encryption Standard (for 64-bit keys)
- DES for Triple Data Encryption Standard (for 128-bit keys)
- AES for Advanced Encryption Standard (requires 128-bit keys)

The algorithm defaults to DES if no identifier is provided. If an identifier is provided, it must be separated from the timestamp by at least one blank.

Components of the Recovery Management solution distinguish between the two varieties of DES based on the length of the key (64-bit or 128-bit).

**Comments**

A comment begins with an asterisk that is separated from the preceding field by at least one blank. Comments are optional in the key data set.

**Key data set management**

The security of the encrypted NGT Copy image copies and the ability of authorized individuals to recover DB2 spaces using these image copies depends on the careful management of the key data set.

BMC recommends that you develop a simple and well-documented mechanism to manage key data sets.

BMC recommends that you maintain one key data set shared by all systems with access to the data set. Multiple distinct key data sets create difficulty with key data set management because you must ensure that the key data set that is used to encrypt an image copy is also used for recovery with that encrypted image copy.
Consider all of the following items as you manage your key data set:

- Protect the key data set on the local system and duplicates on remote systems against unauthorized access.

  Most attempts to access encrypted data occur as unauthorized access to the key data set. You should protect the key data set against unauthorized access during shipping with either a secret key or public key encryption. If key data set is not encrypted during shipping, it should never be shipped under the same cover as the encrypted image copies.

- If you plan to use encrypted image copies at your disaster recovery site, be sure that the processor at the site supports encryption.

  Remote disaster recovery sites may require a duplicate key data set for recovery purposes.

- Because the timestamps that are used for recovery are taken from the BMCXCOPY table, a change in time zones between the site where NGT Copy made the encrypted image copies and the disaster recovery site will not affect recovery.

  The possibility exists, however, that a time zone change might invalidate a key data set for creating image copies at the remote site. If this is the case, you will need a new key data set with local times for generating encrypted image copies at the remote site.

- Limit updating of the key data set to authorized individuals.

  Generating a new current key by inserting a new first row in the key data set limits the amount of data exposed if the current key is compromised. Do not modify existing rows in the key data set because image copies may exist that will require the keys for recovery. It is important that duplicate key data sets on remote systems also contain this new row, and that backups of the key data set be immediately created on all systems.

- Once image copies that are encrypted by a key are no longer referenced in the local and remote BMCXCOPY tables, the key is no longer needed by NGT Copy, NGT Recover, or Log Master and you can eliminate the key.

  Key destruction steps are:

  1. Delete backups of the current key data set on both the local and remote systems.

  2. Remove the row containing the key from the local key data set and duplicate key data sets on remote systems.

     Never remove a row from the key data set unless it is the last row in the data set.
Create backups of the new key data set on the local and remote systems.

If a key data set is lost or corrupted and not recoverable, you can gain emergency access to the current key data set with a technique called key escrow. Once you have created or updated a key data set, the contents are divided into two or more partial key data sets so that no one data set is sufficient to decrypt an image copy. Each partial key data set is sent to different trusted agent. In the event of an emergency, you can retrieve and reassemble the partial data sets.

Registration of copies

This section describes the registration of encrypted copies.

Registration for encrypted image copies

Because the encrypted image copies produced by the COPY TABLESPACE, COPY INDEXSPACE, or COPY IMAGECOPY commands are non-standard, encrypted image copies are registered in the BMCXCOPY table. An STYPE value of e indicates that the image copy is encrypted. In a recovery, you must use NGT Recover with encrypted image copies.

NGT Copy will reset copy pending when an encrypted copy is produced.

Registration for plaintext image copies

Plaintext full image copies are registered in SYSCOPY.

Instant Snapshot copies and certain index space copies are exceptions and are registered according to the rules for BMCXCOPY. (For more information, see the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual manual.)

A plaintext incremental is registered in SYSCOPY if the most recent primary full copy of the same site type is also plaintext. If the most recent primary full copy of the same site type is encrypted, the incremental is registered in BMCXCOPY.

You can use NGT Recover or the DB2 RECOVER utility to recover using plaintext copies that are registered in SYSCOPY. But you must use NGT Recover for recovery if the image copies are encrypted or the plaintext copies are registered in BMCXCOPY.
NGT Copy example syntax

To encrypt recovery site primary image copies while leaving local site primary copies in plaintext, the following syntax could be used:

```
OUTPUT LOCAL
   UNIT SYSDA
   DSNAM ACP.&TS.D&DATE.&TYPE&TIME.D&DSNUM

OUTPUT REMOTE
   UNIT TAPE
   ENCIpher YES
   DSNAM ACP.&TS.D&DATE.&TYPE&TIME.D&DSNUM

COPY TABLESPACE ACPDB04.*
   COPYDDN (LOCAL)
   RECOVERYDDN (REMOTE)
```

You can use the COPY IMAGECOPY command to encrypt plaintext image copies or to decrypt encrypted image copies. If the COPY IMAGECOPY command specifies a plaintext output with a backup type that already exists as an encrypted copy, the command creates the new plaintext copy with the same backup type. If the input copy is a primary copy and the backup does not exist, the registration of the input copy is changed to a backup copy. If the backup copy does exist, the registration of the input copy is deleted.

The following example shows how to make an encrypted copy by using any valid LP copy as input. NGT Copy can use plaintext copies, encrypted copies, or Instant Snapshots as input:

```
OUTPUT REMOTE
   UNIT SYSDA
   ENCIpher YES
   DSNAM ACP.&TS.D&DSNUM.&TYPE&TIME

COPY IMAGECOPY TABLESPACE ACPDB05.*
   RECOVERYDDN (REMOTE)
   DSNUM DATASET
   INDEXES YES
   .
   .
   .
```

The image copies produced by this command are encrypted, and their backup type is recovery primary.

Using RECOVERY MANAGER to create encrypted copies

You can use RECOVERY MANAGER to generate the JCL to create encrypted copies using NGT Copy.
Using RECOVERY MANAGER enables you to quickly and easily identify the objects that you want encrypted and then automates the JCL generation process.

You specify copy encryption for a group by setting the copy output options either in the online interface or by coding the OUTPUT_copyType_ENCIPHER option in the ARMBGRP or ARMBGEN batch programs. For more detailed information about setting options for groups and generating backup JCL, see the RECOVERY MANAGER for DB2 User Guide.

Using the RECOVERY MANAGER online interface

Use the following procedures to set options and generate backup JCL to create cabinet copies.

**To set output options for cabinet copies**

1. Display a group.
2. In the Object List Panel, select 2. Group Edit.
4. In the Utility Options Specification panel, select Update as the Action, then Backup as the Utility Type.
5. Select Output data set options, FULLDDN output data set options, or BIGDDN output data set options.
6. In the Output Data Set Options panel, set Encrypt the copy to Yes.

**To generate the backup JCL**

1. Select Gen Backup JCL foreground to generate JCL for all objects that have an acceptable status.
2. When the JCL Specification panel appears, enter a fully qualified output data set name.
3. Save the JCL data set or submit the job as required.
Using RECOVERY MANAGER batch programs

Use the OUTPUT `copyType` ENCIPHER YES syntax in the ARMBGEN program when you are generating backup JCL or in the ARMBGRP to change the utility settings for a specific group.

For more information about using these programs, see the RECOVERY MANAGER for DB2.

**Figure 7: Example ARMBGEN syntax for encryption**

```
OUTPUT COPY0001
   UNIT SYSALLDA
   ENCIPHER YES
   CATLG YES
   SPACE CYL

OUTPUT COPY0002
   UNIT SYSALLDA
   ENCIPHER YES
   CATLG YES
   SPACE CYL

OUTPUT COPY0003
   UNIT SYSALLDA
   ENCIPHER YES
   CATLG YES
   SPACE CYL
```

**Figure 8: Example ARMBGRP syntax for encryption**

```
UPDATE GROUP <name>
COPY_OPTIONS
   OUTPUT_copytype_ENCIPHER YES|NO|RESET
   FULLDDN_copytype_ENCIPHER YES|NO|RESET
   BIGDDN_copytype_ENCIPHER YES|NO|RESET
```

Recovering with encrypted copies

Encrypted copies must be recovered using NGT Recover.

When generating recovery JCL for NGT Recover using RECOVERY MANAGER, existing encrypted copies are automatically identified as potential recovery resources for the specified group. For information about recovering groups, see the RECOVERY MANAGER for DB2 User Guide.

You can also recover from an encrypted copy by using NGT Recover directly. For more information about coding recovery JCL, see the BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual.
Cabinet copy

The overhead incurred when copying a large number of small spaces can be a significant performance inhibitor. Recovery Management support for cabinet copies allows you to copy all the spaces in a group into a single data set called a cabinet file. The cabinet file is allocated and deallocated only once, regardless of the number of objects that are copied to or recovered from the cabinet file. Because file header and trailer records, including the EOF markers, are omitted from cabinet output files, performance is greatly improved. The cabinet files can be copied to either DASD or tape.

Recovery Management supports cabinet copies as follows:

- The BMC Next Generation Technology Copy for DB2 for z/OS product (NGT Copy) creates the cabinet copies.
- The BMC Next Generation Technology Recover for DB2 for z/OS product (NGT Recover) allows you to recover using the cabinet copies made by NGT Copy.
- RECOVERY MANAGER for DB2 generates JCL to create cabinet copies and to perform recoveries using cabinet copies as recovery resources.

Requirements for cabinet copies

To create and use cabinet copies, you must have:

- The Recovery Management for DB2 solution
- A valid Recovery Management password
- IBM z/OS Version 1.7 or later

Restrictions for cabinet copies

The following restrictions apply to cabinet copies:
- NGT Copy—Objects that must be copied using DSNUTILB can not be included in a cabinet file. This restriction includes compressed indexes. If the COPY command includes any special DB2 catalog spaces, the job terminates with an error.

- NGT Copy—SHRLEVEL CHANGE RESETMOD YES commands are converted to RESETMOD NO.

- RECOVERY MANAGER—Online Consistent Copy does not support cabinet copies. If you specify Online Consistent Copy as the backup utility with the STACK CABINET option, RECOVERY MANAGER issues an informational message and overrides the STACK CABINET option.

- NGT Recover—An image copy contained within a cabinet copy must have a row present in BMCXCOPY on the subsystem on which the recovery is run. The INCOPY option does not support cabinet copies. If a cabinet copy is your only source for a recovery, you must use NGT Copy to unstack the cabinet copy and register the individual image copies in the SYSCOPY table before NGT Recover can use them.

Registration of cabinet copies

Because the cabinet copies are non-standard, they are registered in the BMCXCOPY table. An ICUNIT value of C indicates the copy is a cabinet copy. A row is created for each member within the cabinet copy and each member has the same DSNAME. The DSNAME is the name of the cataloged cabinet file as indicated in the OUTPUT descriptor. The cabinet members are individually registered in BMCXCOPY as uncataloged. The cabinet file is always catalogued.

In a recovery, you must use NGT Recover with cabinet copies.

NGT Copy will reset copy pending when a cabinet copy is produced.

Using RECOVERY MANAGER to create cabinet copies

You can use RECOVERY MANAGER to generate the JCL to create cabinet copies using CHANGE MANAGER.

Using RECOVERY MANAGER enables you to quickly and easily identify the objects that you want included in your cabinet copy and then automates the JCL generation process.
You specify cabinet copies for a group by setting the copy output options either in the online interface or by coding the STACK CABINET option in the ARMBGRP or ARMBGEN batch programs. For more detailed information about setting options for groups and generating backup JCL, see the RECOVERY MANAGER for DB2 User Guide.

Using the RECOVERY MANAGER online interface

The following procedures describe how to set options and generate backup JCL to create cabinet copies.

**To set output options for cabinet copies**

1. Display a group.
2. In the Object List Panel, select 2. Group Edit.
4. In the Utility Options Specification panel, select Update as the Action, then Backup as the Utility Type.
5. Select Output data set options, FULLDDN output data set options, or BIGDDN output data set options.
6. In the Output Data Set Options panel, select Cabinet as the Stack value.
7. (optional) To set data set sizing allocations, type values in the Primary allocation and Secondary allocation fields.

**To generate the backup JCL**

1. Select Gen Backup JCL foreground to generate JCL for all objects that have an acceptable status.
2. When the JCL Specification panel appears, enter a fully qualified output data set name.
3. Save the JCL data set or submit the job as required.
Using RECOVERY MANAGER batch programs

Use the OUTPUT STACK CABINET syntax in the ARMBGEN program when you are generating backup JCL or in the ARMBGRP to change the utility settings for a specific group.

For more information about using these programs, see the RECOVERY MANAGER for DB2 User Guide.

**Figure 9: Example ARMBGEN syntax for cabinet copy**

```
OUTPUT COPY0001
  UNIT SYSALLDA
  CATLG YES
  SPACE CYL
  STACK CABINET
COPY TABLESPACE OBJECTSET "ARMQA"."CABINET"
  DSNUM 1
  COPYDDN(
    COPY0001
  )
  COPYDSN(
    &USER.CABINET.GRPX1.&TYPE.D&DATE.T&TIME
  )
  RESETMOD NO
COPY TABLESPACE OBJECTSET "ARMQA"."CABINET"
  DSNUM 2
  COPYDDN(
    COPY0001
  )
  COPYDSN(
    &USER.CABINET.GRPX1.&TYPE.D&DATE.T&TIME
  )
  RESETMOD NO
...
```

**Figure 10: Example ARMBGRP syntax for cabinet copy**

```
UPDATE GROUP <name>
RECOVER_OPTIONS
  RECOVER_OUTPUT_copytype_STACK YES|NO|CABINET|RESET
COPY_OPTIONS
  OUTPUT_copytype_STACK YES|NO|CABINET|RESET
  FULLDDN_copytype_STACK YES|NO|CABINET|RESET
  BIGDDN_copytype_STACK YES|NO|CABINET|RESET
```

Using NGT Copy to create cabinet copies

You can create a cabinet copy using NGT Copy directly. For more information about coding NGT Copy JCL, see the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual.
Note

Because there is only one data set name for the whole Cabinet file, the DSNAME parameter in the OUTPUT descriptor should be generic in nature. It should not use the &DB or &TS substitution variable parms. The &DB variable might make sense, if all copies are for the same database name.

Figure 11: Example NGT Copy syntax for cabinet copy

```
OUTPUT CABOUT
  UNIT TAPE
  STACK CABINET
  DSNNAME ACP.CABINET.PAYROLL.D&DATE.T&TIME
COPY TABLESPACE PAYROLL.*
COPYDDN ( CABOUT ) . . .
```

Recovering with cabinet copies

Objects stored in cabinet copies are recovered using NGT Recover. When generating recovery JCL for NGT Recover using NGT Recover, existing cabinet copies are automatically identified as potential recovery resources for the specified group. If you choose to create copies following a recovery, you can specify that those copies be cabinet copies. For information about recovering groups, see the RECOVERY MANAGER for DB2 User Guide.

You can also recover from a cabinet copy by using NGT Recover directly. For more information about coding recovery JCL, see the BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual.

Migration files can be used with NGT Recover or CHANGE MANAGER to migrate data stored in cabinet copies.

Working with cabinet copies

After cabinet copies are created and stored, you might need information about the relationships between individual DB2 objects and the cabinet copies that contain them.

To obtain this information, use a dynamic SQL processor (such as SPUFI or DSNTEP2) to display rows in the BMCXCOPY table. The following examples show SQL statements that you can use to retrieve the information.
To determine which DB2 objects are stored in a given cabinet copy, use an SQL statement similar to the following:

**Figure 12: Sample SQL statement to display objects in a cabinet copy**

```
SELECT DBNAME, IXNAME, FILESEQNO, INSTANCE "I", ICDATE, ICTIME, ICTYPE "IC", ICBACKUP "TP", COPY_TYPE, HEX(NOTE_VALUE) "NOTEVAL", NOTE_TYPE, DSNAME, HEX(PIT_RBA) "PITRBA", COPYPAGESF, DSVOLSER FROM BMCUTIL.CMN_BMCXCOPY WHERE DSNAME = '<your_cabinet_copy_dataset_name>' ORDER BY FILESEQNO, START_RBA DESC ;
```

To determine which cabinet copies contain a given DB2 object, use an SQL statement similar to the following:

**Figure 13: Sample SQL statement to display cabinet copies that contain an object**

```
SELECT DBNAME, IXNAME, FILESEQNO, INSTANCE "I", ICDATE, ICTIME, ICTYPE "IC", ICBACKUP "TP", COPY_TYPE, HEX(NOTE_VALUE) "NOTEVAL", NOTE_TYPE, DSNAME, HEX(PIT_RBA) "PITRBA", COPYPAGESF, DSVOLSER FROM BMCUTIL.CMN_BMCXCOPY WHERE COPY_TYPE = 'C' AND DBNAME = '<your_database_name>' AND IXNAME = '<your_object_name>' ORDER BY DSNAME ;
```

After cabinet copies are created and stored, you might need to:

- Create a non-cabinet (unstacked) image copy by using the cabinet copy as a source. To accomplish this task, use the COPY IMAGECOPY command of NGT Copy.

- Move a cabinet copy to another location. To accomplish this task, be sure that you use the COPY IMAGECOPY command, not an operating system utility. This limitation is important because NGT Copy saves the volume information about a cabinet copy in the BMCXCOPY table. If you copy the cabinet copy data set with an operating system utility, the volume information is not available and NGT Recover cannot use the copy.
Mirroring support with the Recovery Management solution

NGT Recover supports mirrored systems. The solution uses features of RECOVERY MANAGER, FEATUREEXTENDED BUFFER MANAGER, SNAPSHOT UPGRADE FEATURE (SUF), NGT Copy, and NGT Recover to simplify and automate disaster recovery processes when all or part of your DB2 subsystem is mirrored.

Note
This feature is available only with the BMC Recovery Management for DB2 solution.

The BMC Recovery Management for DB2 solution addresses the unique challenges of establishing the optimal disaster recovery strategy in a mirrored or partially-mirrored environment.

To take full advantage of mirroring, you must adjust your offsite recovery procedures to compensate for data that does not need to be recovered because it is mirrored. You must still recover nonmirrored data in a more traditional manner, and you might want to develop a fallback plan for the mirrored data in the event that mirroring fails.

Challenges in a mirrored environment

Without the right tools, performing a disaster recovery for a mirrored or partially mirrored environment is difficult and time-consuming.

Some of the challenges you face while preparing for disaster recovery are as follows:

- Determining the volumes on which mirrored data is located.
- Maintaining a list of mirrored volumes over time as objects are added and removed.
- Verifying that your resources are being actively mirrored.
Creating the most efficient disaster recovery jobs to restore both the mirrored and nonmirrored resources to the same point of consistency.

Performing a recovery if the mirrored resources are not available.

Recovery Management for DB2 solution features

The BMC Recovery Management for DB2 solution performs the following functions in a mirrored environment:

- Identifies the volumes on which your system resources are located.
- Enables you to identify mirrored application data (through the use of application groups) and identifies the volumes on which the mirrored objects are located.
- Verifies that the identified volumes for both system resources and application data are being actively mirrored and reports exceptions.
- Generates jobs to recover nonmirrored resources at the remote site. Objects identified as mirrored but which are not on actively-mirrored volumes are included in the recovery job.
- Optionally generates alternate jobs to recover both mirrored and nonmirrored resources at the remote site in the event of mirror failure.
- Supports mirroring for full subsystem recoveries.

Using mirroring support

You activate mirroring support separately for system resources and application resources using the RECOVERY MANAGER for DB2 online interface. See the following sections for more information:

<table>
<thead>
<tr>
<th>Task</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activate mirroring support for system resources</td>
<td>“Activating mirroring support for system resources” on page 103</td>
</tr>
<tr>
<td>Create groups of mirrored application objects and activate mirroring</td>
<td>“Activating mirroring support for application data” on page 106</td>
</tr>
<tr>
<td>Generate and run batch revalidation jobs to verify mirroring</td>
<td>“Revalidating mirrored groups” on page 109</td>
</tr>
</tbody>
</table>
Activating mirroring support for system resources

The Recovery Management solution defines five levels of mirroring support for system resources.

At a minimum, you must mirror both the BSDS and active logs (Level 1). The mirroring levels are as follows:

<table>
<thead>
<tr>
<th>Mirroring level</th>
<th>BSDS and active logs</th>
<th>Catalog and directory</th>
<th>RECOVERY MANAGER repository</th>
<th>Log Master repository</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Level 2</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Level 3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Level 4</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Level 5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

You activate remote mirroring support for system resources by defining your remote mirroring strategy in one of the following ways:

- Define your mirroring strategy in the RECOVERY MANAGER subsystem default recovery options. For more information, see “Defining mirroring support in the default subsystem options” on page 103.

- Define your mirroring strategy at the time that you generate the disaster recovery preparation jobs. For more information, see “Defining a mirroring strategy during DR preparation” on page 105.

Defining mirroring support in the default subsystem options

The mirroring strategy that you specify using this method becomes the default strategy for the selected subsystem.
This strategy remains in effect unless you change it at the time that you generate the DR PREP jobs. (See “Defining a mirroring strategy during DR preparation” on page 105.)

To define mirroring support in the default subsystem options

1. From the RECOVERY MANAGER Main Menu, access the Subsystem General Recovery Options, as follows:
   a. Select Option 4, Subsystem Options.
   b. On the Utility Options Specification panel, select Options 2, Update and 1, Recovery.
   c. On the Update Recover Options Utility Specification panel, select Option 1, General Recovery Options.
   d. On the Update General Recovery Options panel, press Enter to display the second General Recovery Options panel.

```
ARMROG02 ====== Browse General Recovery Options SUB SYSTEM DEDL ===============
Command ===> _________________________________________________________________
With defaults and overrides. Press Enter to continue.
```

Lv1 (S=System G=Group Blank=RMGR default)
Delete STOGROUP objs. . . 2 1. Yes 2. No (Prior to recovery)
REUSE . . . . . . . . . . 2 1. No 2. Yes 3. NOSCR (NOSCR for R+ only)
Max concurrent jobs . . . . 1
Dataset Sizing . . . . . . . 1 1. Catalog 2. Defaults 3. BMCSTATS
Always rebuild indexes . . 2 1. Yes 2. No
Use INDEX ALL recover . . 2 1. Yes 2. No
Mirror Strategy
BSDS . . . . . . . . . . . . 1. Both 2. Copy 1 3. Copy 2
Active Logs . . . . . . . . 1. Both 2. Copy 1 3. Copy 2
S Catalog and Directory . . 2 1. Yes 2. No
S Rmgr Repository . . . . 2 1. Yes 2. No
S Log Master Repository . . 2 1. Yes 2. No

2. Specify the system resources that you mirror. For more information, see Table 8 on page 104.

3. Press Enter to update the options.

Table 8: Mirroring strategy options

<table>
<thead>
<tr>
<th>Option</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSDS</td>
<td>Blank (no mirroring)</td>
<td>Indicates whether you mirror both copies of the BSDS, just Copy 1, or just Copy 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If you specify either Copy 1 or Copy 2, ARMBSRR simulates rebuilding the other copy.</td>
</tr>
</tbody>
</table>
### Option | Default | Description
--- | --- | ---
Active Logs | Blank (no mirroring) | Indicates whether you mirror both copies of the active logs, just Copy 1, or just Copy 2. If you specify either Copy 1 or Copy 2, ARMBSRR simulates rebuilding the other copy.
Catalog and Directory | Blank (no mirroring) | Indicates whether you mirror the DB2 catalog and directory.
RECOVERY MANAGER Repository | Blank (no mirroring) | Indicates whether you mirror the RECOVERY MANAGER repository. The R+/CHANGE ACCUM repository is included with the RECOVERY MANAGER repository if R+/CHANGE ACCUM is installed.
Log Master Repository | Blank (no mirroring) | Indicates whether you mirror the Log Master repository.

### Defining a mirroring strategy during DR preparation

The mirroring strategy that you specify using this method becomes the subsystem level mirroring strategy.

**To define a mirroring strategy during DR preparation**

1. From the RECOVERY MANAGER Main Menu, access the Subsystem General Recovery Options, as follows:
   
   a. Select Option 6, **Subsystem recovery**.
   
   b. Select Option 5, **Disaster recovery**.
   
   c. Select Option 3, **Prepare to Recover the DB2 Subsystem**.

   The Disaster Recovery - System Resources Recovery panel is displayed.

   ARMDR008 === Disaster Recovery - System Resources Recovery ====================

   Command ===> _______________________________________________________________

   Please type in the requested information. Then press Enter.

<table>
<thead>
<tr>
<th>Mirror Strategy</th>
<th>2</th>
<th>1. Yes</th>
<th>2. No</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSDS</td>
<td>1. Both</td>
<td>2. Copy 1</td>
<td>3. Copy 2</td>
</tr>
<tr>
<td>Active Logs</td>
<td>1. Both</td>
<td>2. Copy 1</td>
<td>3. Copy 2</td>
</tr>
<tr>
<td>Catalog and Directory</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
<tr>
<td>Rmgr Repository</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
<tr>
<td>Log Master Repository</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
</tbody>
</table>

2. Specify the system resources that you mirror.
Activating mirroring support for application data

You activate mirroring support for application data by creating groups of mirrored objects and then defining those groups as mirrored.

To activate mirroring support at the application group level, you must have activated a minimum of Level 2 mirroring support at the default subsystem level (that is, you must be mirroring at least the BSDS, the active logs, and the catalog and directory). See “Defining mirroring support in the default subsystem options” on page 103 for more information.

Creating mirrored application groups

Create groups of mirrored objects using either the online interface or the ARMBGRP batch program.

If these groups are residing on a mirrored volume at the time that ARMBGEN is run, they are excluded from the primary disaster recovery JCL that you generate. You can optionally include them in alternate JCL.

WARNING
RECOVERY MANAGER checks the mirroring status only for objects that are explicitly included in the group. If you are mirroring both table spaces and indexes, you must explicitly include the indexes as well as the table spaces in the group. Do not use the Use INDEX ALL recover option as a means of including the indexes in the group. Doing so causes the indexes to be rebuilt during recovery whether they are mirrored or not.

For more information about Use INDEX ALL, see the RECOVERY MANAGER for DB2 User Guide.

To use the online interface to create mirrored groups

1 Create one or more groups to manage your mirrored objects.

For information about creating groups, see the RECOVERY MANAGER for DB2 User Guide.
2  Access the General Recovery Options panel by performing the following steps:

a  Select Option 1, Application groups from the RECOVERY MANAGER Main Menu. Enter a group name or wildcard pattern to display one or more groups.

b  On the Group List panel, type S or SA by the group you want to select.

c  On the Object List panel, select Option 2, Group Edit.

d  In the Group Edit panel, select Option 1, Utility options and then press Enter.

e  Select Options 2, Update and 1, Recovery, and press Enter.

f  In the Update Recover Utility Options panel, select General Recovery Options and press Enter. Press Enter again to display the second panel.

```
ARMROG02 ====== Browse General Recovery Options GROUP RDAXXX BGRP1 ============
Command ===> _________________________________________________________________
With defaults and overrides. Press Enter to continue.
Lvl (S=System  G=Group  O=Object  Blank=RMGR default)
  Delete STORGROUP objs... 2 1. Yes  2. No  (Prior to recovery)
  REUSE ........................ 2 1. No  2. Yes  3. NOSCR (NOSCR for R+ only)
  Max concurrent jobs 1_ ...
  Dataset Sizing ................ 1 1. Catalog  2. Defaults  3. BMCSTATS
  Always rebuild indexes ... 2 1. Yes  2. No
  Use INDEX ALL recover ... 2 1. Yes  2. No
  Mirroring .................... 2 1. Yes  2. No
```

3 Specify Yes in the Mirroring field to indicate that objects in the current group are mirrored and save the group.

To use the batch program (ARMBGRP) to create mirrored groups

1 Create one or more groups to manage your mirrored objects in batch mode using the ARMBGRP program.

For information about creating and updating groups in batch, see the relevant chapter in the RECOVERY MANAGER for DB2 User Guide.

2 Use the following ARMBGRP syntax to specify that a group is mirrored:

```
UPDATE group RECOVER_OPTIONS MIRROR YES
```

Generating recovery JCL for mirrored groups

Use this procedure to generate recovery JCL for mirrored groups using the RECOVERY MANAGER online interface.
To generate recovery JCL for mirrored groups

1. From the main menu, select Option 1, Application groups to display the Group List panel.

2. Type a group name or wildcard pattern and press Enter to display a list of groups.

3. Type S beside a group to display the Object List Panel.

4. Specify Option 3, Gen recover JCL background and press Enter.

The Batch Group Recovery Point Specification and the Batch Group JCL Generation Options panels are displayed:

| ARMGJ02B | Batch Group JCL Generation Options
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Command:</td>
<td>Command: ____________________________</td>
</tr>
<tr>
<td>Log Only . . . . 2 1. Yes      2. No</td>
<td></td>
</tr>
<tr>
<td>Sitetype . . . . 1 1. LOCAL    2. RECOVERY</td>
<td></td>
</tr>
<tr>
<td>JCL type . . . . 1 1. LOCAL    2. DR</td>
<td></td>
</tr>
<tr>
<td>Check unchanged . 2 1. Yes      2. No (exclude unchanged from recovery)</td>
<td></td>
</tr>
<tr>
<td>ObjectSet syntax . 1. Yes      2. No (for RECOVER PLUS only)</td>
<td></td>
</tr>
<tr>
<td>Analyze. . . . . 1 1. Yes      2. No 3. Only (for RECOVER PLUS only)</td>
<td></td>
</tr>
<tr>
<td>Simulate recovery . 2 1. Yes      2. No (for RECOVER PLUS only)</td>
<td></td>
</tr>
<tr>
<td>Backout. . . . . 3 1. Yes      2. No 3. Auto (Auto for RECOVER PLUS only)</td>
<td></td>
</tr>
<tr>
<td>Recover clones only. 2 1. Yes      2. No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ARMGJ01B</th>
<th>Batch Group Recovery Point Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command:</td>
<td>Command: ____________________________</td>
</tr>
<tr>
<td>Recover to . . . . 1 1. Current 2. Image copy</td>
<td></td>
</tr>
<tr>
<td>3. Quiesce 4. Common recovery point</td>
<td></td>
</tr>
<tr>
<td>5. Specific Logpoint 6. Restart RBA</td>
<td></td>
</tr>
<tr>
<td>7. Timestamp 8. Logmark</td>
<td></td>
</tr>
</tbody>
</table>

| Full copy only . 2 1. Yes 2. No (for option 2) |
| Relative point . 0_ 0=Last to 99=99th previous (for options 2,3,4 or 8) |
| To Timestamp . . . __ - __ - __ : __ : __ : __ (Inflights resolved) |
| To Logpoint . . . __ - __ - __ - __ - __ - __ (option 5) |
| To Logmark . . . __ - __ - __ - __ - __ - __ (option 8) |
| Resolve Inflights . 1. Yes 2. No (for options 5 and 8) |

5. When you generate recovery JCL for mirrored groups online, you must set the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recover to</td>
<td>6. Restart RBA/LRSN</td>
</tr>
<tr>
<td>JCL Type</td>
<td>2. DR</td>
</tr>
<tr>
<td>Backout</td>
<td>2. No</td>
</tr>
</tbody>
</table>

6. Press Enter. The Batch Group JCL Generation panel is displayed.

7. Specify output DDs and output data sets when prompted.
Note
If the BMC Recovery Management for DB2 solution can verify that all objects in
the group are on mirrored volumes at the time that ARMBGEN runs, it generates
mirrored recovery JCL into the SYSUT2 output data set and standard,
nonmirrored recovery JCL into the alternate SYSUT4 output data set. If the
solution determines that any of the objects in the group are not on a mirrored
volume, then ARMBGEN switches to nonmirrored recovery. In this case,
ARMBGEN writes standard nonmirrored recovery JCL to the SYSUT2 data set
and ignores SYSUT4.

Revalidating mirrored groups

Before you generate disaster recovery JCL, you should revalidate groups in batch
mode either through the online interface or by running the ARMBGPV batch
revalidation program.

The online method is described in the following sections. For more information
about using ARMBGPV, see the RECOVERY MANAGER for DB2 User Guide.

Note
With the introduction of dynamic grouping in RECOVERY MANAGER version
9.2.00, revalidation no longer refers to the process of running the group definitions
again to populate the group with an updated list of objects based on the current
system. This type of revalidation is no longer needed with dynamic grouping.
Revalidation now refers to checking the recoverability of the objects in the group.
RECOVERY MANAGER does not revalidate catalog and directory resources.

The revalidation procedure automatically verifies the mirroring status of the system
resources and reports mirroring exceptions when it revalidates a group. System
resources are revalidated once per revalidation job, regardless of how many groups
are being revalidated. Before generating disaster recovery JCL, you should revalidate
mirrored groups to check the recoverability of objects and to verify mirroring status.

Note
During JCL generation for disaster recovery, when RECOVERY MANAGER
generates recovery JCL for any group that contains objects that cannot be verified as
being actively mirrored, it issues the following message:

BMC80373W creator.name NOT MIRRORED - SWITCHING TO NON-MIRRORED
RECOVERY
To revalidate mirrored groups

1. From the main menu, select Option 1, Application groups to display the Group List panel.

2. Enter a group name or wildcard pattern to display a list of groups to revalidate.

3. Type R next to a single group (or RA to report on all displayed groups).

The Batch Group Report Options panel is displayed.

4. On the Batch Group Report Options panel, set the following values and press Enter:

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report type</td>
<td>1. Revalidation</td>
</tr>
<tr>
<td>JCL Type</td>
<td>2. DR</td>
</tr>
</tbody>
</table>

Note

The Mirror System option on this panel generates the REVALIDATE MIRROR SYSTEM syntax of ARMBGPV. You do not need to specify it if you are revalidating a mirrored group because the mirrored system resources are automatically revalidated when a mirrored group is revalidated. You can use this option if you want to revalidate mirrored system resources at the same time you are revalidating a nonmirrored group or if you have no mirrored groups at all (just a mirrored subsystem).

The second Batch Group Report Options panel is displayed.
5 On the second Batch Group Report Options panel, set the following values:

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recover to</td>
<td>4. Restart RBA/LRSN</td>
</tr>
<tr>
<td>Backout</td>
<td>2. No</td>
</tr>
</tbody>
</table>

6 On the JCL specification panel, type a data set name and press **Enter** to generate the revalidation job and submit the job.

Mirroring exceptions for subsystem resources are written to the ARMXCEPT file. If mirroring exceptions are found for application data sets, information messages are written to ARMPRINT.

---

**Note**

DEFINE NO objects are identified as mirroring exceptions, but they are given a status of DEFER, which does not interfere with mirror recovery.

---

**Generating disaster recovery JCL**

After you have activated mirroring support for your system resources and groups, you can set options and generate the JCL for disaster recovery.

For a full description of the steps required for disaster recovery, see *RECOVERY MANAGER for DB2 User Guide*.

**Alternate JCL for mirrored system resources**

You can use the Recovery Management solution to optionally generate alternate JCL for disaster recovery preparations for a subsystem without omitting the mirrored resources.

You can use the alternate JCL as a fallback if the mirrored resources are unavailable at the recovery site.
Note

If the BMC Recovery Management for DB2 solution can verify that all subsystem resources identified as mirrored by your mirror strategy are on mirrored volumes at the time that ARMBSRR runs, it generates mirrored recovery JCL into the primary output GDG and standard, nonmirrored recovery JCL into the alternate output GDG. If the solution cannot verify that one or more of the subsystem resources identified as mirrored are on mirrored volumes, then ARMBSRR switches to nonmirrored recovery. In this case, ARMBSRR writes standard nonmirrored recovery JCL to the primary output GDG and ignores the alternate output GDG.

To create alternate JCL, specify an alternate output GDG base when you generate disaster recovery JCL using the System Resources Recovery (ARMDR006) panel. The solution generates the alternate job at the same time that it generates the job with mirroring support. You should transport both jobs to the remote site.

Repository recovery with different mirroring levels

Depending on the mirroring level, repository mirroring settings can override the Recover RM Repository or Recovery Log Master Repository options that you set on the System Resources Recovery (ARMDR004) panel.

Table 9 on page 113 shows whether the RECOVERY MANAGER and Log Master repositories are included in the recovery JCL for each level of mirroring when using the JCL that supports mirroring.
**Table 9: Repository included in mirroring recovery JCL**

<table>
<thead>
<tr>
<th>Option setting</th>
<th>Mirroring level 1</th>
<th>Mirroring level 2</th>
<th>Mirroring level 3</th>
<th>Mirroring level 4</th>
<th>Mirroring level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recover RM Repository YES</td>
<td>Yes</td>
<td>Yes</td>
<td>No&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes</td>
<td>No&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Recover RM Repository NO</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Recover Log Master Repository YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Recover Log Master Repository NO</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

<sup>a</sup> The mirroring level specifies the repository as mirrored. RECOVERY MANAGER therefore does not include it in the JCL even though you specified Recover RM Repository YES or Recover Log Master Repository YES. Note that the R+/CHANGE ACCUM repository is included with the RECOVERY MANAGER repository if it is installed.

**Table 10 on page 113** shows whether the RECOVERY MANAGER and Log Master repositories are included in the recovery JCL at each level of mirroring when using the alternate JCL (that is, the JCL that you can optionally generate for use in the event of mirroring failure).

**Table 10: Repository included in alternate recovery JCL**

<table>
<thead>
<tr>
<th>Option setting</th>
<th>Mirroring level 1</th>
<th>Mirroring level 2</th>
<th>Mirroring level 3</th>
<th>Mirroring level 4</th>
<th>Mirroring level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recover RM Repository YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Recover RM Repository NO</td>
<td>No</td>
<td>No</td>
<td>Yes&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No</td>
<td>Yes&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Recover Log Master Repository YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Recover Log Master Repository NO</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> The mirroring level specifies that the repository is mirrored. RECOVERY MANAGER includes it in the alternate JCL to ensure its availability in the event of a mirroring failure even though you specified Recover RM Repository NO or Recover Log Master Repository NO.
Disaster recovery data collection

The Recovery Management solution automatically collects and stores statistical data from all actual, simulated, and estimated disaster recoveries using RECOVERY MANAGER (ARMBRDC and ARMBWDC programs) and NGT Recover (AFRMAIN program).

This data includes a list of objects that require the most recovery time, total elapsed time for recoveries, and more. The data collected can enable you to compare different recoveries, determine if you are meeting your service level agreements, and even perform a number of what-if scenarios to assist you in reducing disaster recovery time or in justifying more resources.

*Note*

This functionality is available only with the BMC Recovery Management *for DB2* solution.

Automatically stored data

Historical data for actual, simulated, and estimated recoveries is collected by AFRMAIN and ARMBWDC and stored in tables in the RECOVERY MANAGER repository. Stored information includes the following data:

- Total number of objects
- Total number of jobs
- The ten objects that took the longest time to recover
- The number of bytes recovered
- Start time
- End time
- Total CPU time
Manually storing data

To record results of a test manually without using RECOVERY MANAGER, you can start by executing SQL similar to the following:

```sql
INSERT INTO BMCRMDD.Util.Run
(VERSION, SSID, DCTOKEN, NUM_TS_TO_SAVE, RUN_TYPE, START_TIMESTAMP, TOLOGPOINT)
VALUES( 1, 'DSN1', 'DRECOVER', 10, '1', '2010-11-15-12.25.33', '0');
```

Use the following values:

- **SSID** is the subsystem name (or the group attach name) of the DB2 on which you plan to store the data.
- The value of **DCTOKEN** must match the value that you specify as OPTION DCTOKEN in your NGT Recover executions.
- The value of **NUM_TS_TO_SAVE** is the number of table spaces that are stored for each job run. BMC recommends using the default value of 10.

**Note**

You can specify any value for **RUN_TYPE**, **START_TIMESTAMP**, and **TOLOGPOINT**. For example, you can enter ‘0’.

Data collection error processing

Data collection errors do not affect the job return code. This feature ensures that problems with data collection do not impact the disaster recovery. You should check the job output from the ARMD* jobs to verify that data collection from the recovery processed correctly.

Retrieving data from the DR site

Disaster recovery estimations and simulations are performed at the local site, and historical data is immediately stored in the data collection tables. Data about actual disaster recoveries is collected at the disaster recovery site and must be returned to
the local site. The disaster recovery JCL that you use at the remote site contains statements that call Log Master for DB2. Log Master generates output that you can then use to insert the information into the data collection tables at the local site.

Log Master gathers data from the recovery from the log records, then stores SQL INSERT statements in a flat file that you can use to populate the data collection tables at your local site.

By default, Log Master names the flat file \texttt{userId.BMCARMDC.D date.T time.MIGSQL}. You should take this file back to your local site and use it as input to the BMC High-speed Apply Engine (formerly Apply Plus) or to an SQL processor such as DSNTEP2. This file contains DELETE and INSERT SQL statements.

The following is a sample of the JCL used to retrieve the data from the recovery site:

```
//ARMDD013  EXEC PGM=ALPMAIN,PARM='DEBN',
//    REGION=0M,COND=(4,LT)
//STEPLIB DD DISP=SHR,DSN=SYS2.DB2V91M.DSNLOAD
//        DD DISP=SHR,DSN=SYS3.DEBN.DSNEXIT
//        DD DISP=SHR,DSN=BMCRMD.TEST.LOAD
//ALPPRINT DD SYSOUT=* 
//SQLPRINT DD SYSOUT=* 
//SYSOUT  DD SYSOUT=* 
//SYSTEM DD SYSOUT=* 
//SYSDUMP DD SYSOUT=* 
//SYSIN   DD *,DLM=##
LOGSCAN
REPORT TYPE SUMMARY
SYSPRINT
CLASS(*) NOHOLD
SYSPRINT
MIGRATE
DATASET &SYSUID..BMCARMDC.D&DATE..T&TIME..MIGSQL NEW
CYLINDERS SPACE(1,1) UNIT(SYSALLDA) RELEASE
DB2CATALOG NO
FROM RBA X'000865B1FFFF'
TO CURRENT
WHERE
TABLESPACE NAME = 'BMCARM.BMCSTM'
```

**Viewing recovery data**

Use the following procedure to view recovery data both online and in the ARMBRDC report that the ARMSRR and ARMBGEN programs generate during a disaster recovery. For more information about the ARMBRDC report, see the \textit{RECOVERY MANAGER for DB2 User Guide}.

The data that is displayed in the online reports is a small fraction of the data that is actually collected. You can use SQL statements to access the data stored in the data collection tables. For information about each of the tables, see the \textit{RECOVERY MANAGER for DB2 User Guide}.
To view recovery data

1. From the RECOVERY MANAGER Main Menu, select Option 7, **Subsystem Recovery**.

2. From the System Recovery Preparation and JCL Generation panel, select Option 7, **Recovery Reports**.

   The System Recovery Report Generation panel is displayed.

   ```plaintext
   ARMRR01 ============== System Recovery Report Generation ======================
   Command ===> _________________________________________________________________
   Select option. Then press Enter.
   _  1. Recovery History            - Display last three recoveries (all types)
   _  2. Actual Recovery History     - Display data for actual recoveries
   _  3. Simulation Recovery History - Display data for simulation recoveries
   _  4. Estimation Recovery History - Display data for estimation recoveries
   ```

3. Enter the number of the report that you want to view, and press **Enter**.

4. If you choose Option 1, **Recovery History**, you can view detailed information by entering **V** beside any recovery to display the object recovery report.

Sample online reports

This section provides samples of the reports available through the online interface.

Recovery history report

The Recovery History Report displays the three most recent recoveries of each type (actual, simulated, and estimated).

**Figure 14 on page 118** shows a sample of the recovery history report.

**Figure 14: Recovery history report**
Act

Enter V in this field to display object-level history data

Type

The recovery type:
- ACT - actual recovery
- SIM - simulation recovery
- EST - estimation recovery

Date

The date the recovery was performed

Start Time

The start time of the recovery

End Time

The end time of the recovery

Elapsed Time

The total elapsed time of the recovery

Object recovery report

The following figure shows a sample of the object recovery report.

**Figure 15: Object recovery report**

```
ARMRR03 ================ Object Recovery Report ================ Row 1 to 22 of 84
Command =>

Run Type        : SIMULATION     Run Date/Time     : 2015-01-18-09.49.30
Number of jobs  : 48             Elapsed Time      : 00:21:41
Bytes Recovered : 326646169      Estimated Elapsed : 02:31:24

<table>
<thead>
<tr>
<th>DBNAME</th>
<th>TSNAME</th>
<th>Elapsed</th>
<th>Est Elapsed</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMDDB66</td>
<td>TS66N01</td>
<td>00:04:31</td>
<td>00:00:30</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB66</td>
<td>TS66N13</td>
<td>00:03:33</td>
<td>00:00:30</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB59</td>
<td>TS59S02</td>
<td>00:01:50</td>
<td>00:02:50</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB59</td>
<td>TS59S10</td>
<td>00:01:26</td>
<td>00:02:16</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB61</td>
<td>TS61P04</td>
<td>00:01:09</td>
<td>00:00:33</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB66</td>
<td>TS66P01</td>
<td>00:00:44</td>
<td>00:00:01</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB59</td>
<td>TS59N01</td>
<td>00:00:43</td>
<td>00:00:50</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB66</td>
<td>TS66S01</td>
<td>00:00:43</td>
<td>00:00:30</td>
<td>Merge SP/IC</td>
</tr>
<tr>
<td>RMDDB59</td>
<td>TSP9BASE</td>
<td>00:00:39</td>
<td>00:00:22</td>
<td>Merge SP/IC</td>
</tr>
</tbody>
</table>
```
### Run Type

Indicates whether the recovery was an actual, simulated or estimated recovery.

### Number of jobs

The total number of jobs in the recovery.

The number of jobs is based on the number of RECOVERY MANAGER groups. Consider this number when comparing recoveries or when determining the optimal number of jobs and groups.

### Bytes Recovered

The total number of bytes recovered by all jobs.

### Run Date/Time

The beginning date and time of the recovery.

### Elapsed Time

The total elapsed time of all jobs (end time minus start time).

### Estimated Elapsed

The estimated elapsed time for all jobs (the estimate of the longest job plus the estimated system elapsed time).

### DBName

The database name of each object in the recovery.

### TSName

The table space name of each object in the recovery.

### Elapsed

The elapsed time for each object in the recovery (end time minus start time).
Est Elapsed

The estimated elapsed time for each object in the recovery

Operation

The operation performed when recovering each object

Available operations are as follows:

- merge sp/ic—Recovery from image copy
- merge sp/no ic—Recovery without image copy using log records only
- merge sp/LOGONLY—LOGONLY recovery
- snap/merge sp—Snapshot copy recovery
- backout—BACKOUT
- rebuild—REBUILD
- uk/bldix—UNLOADKEYS/BUILDINDEX function
- dsnutilb—Recovery using DSNUTILB RECOVER functions

Actual simulated and estimated recovery history reports

This report displays summary history information about all recoveries of a single type (actual, simulation, or estimation).

Figure 16 on page 121 shows a sample of an actual recovery history report. The simulation and estimation history reports use the same format.

Figure 16: Actual recovery history report

```
ARMRR04 ================== ACTUAL Recovery History ========= Row 1 to 12 of 12
Command ===> _________________________________________________________________
SLA: 00:00:00                  Projected Time to Recover: 00:21:41
(Based on history below)
Recovery Date      Start Time   Bytes    Elapsed     Difference from last recovery     Difference from SLA
2015-01-02 13.47.43          4096   N/A            N/A     N/A
2015-01-02 13.47.43          4096   N/A            N/A     N/A
2015-01-02 13.47.44          4096   23:59:59      - 137:37:4  - 12:00:01
2015-01-02 13.47.44          4096   21:59:59      - 02:00:00  - 14:00:01
2015-01-02 13.47.44          4096   20:59:59      - 01:00:00  - 15:00:01
2015-01-02 13.47.44          4096   19:59:59      - 01:00:00  - 16:00:01
```
<table>
<thead>
<tr>
<th>Date/Time</th>
<th>SLA</th>
<th>Start Time</th>
<th>Elapsed</th>
<th>Difference from SLA</th>
<th>Difference from last recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015-01-02 13.47.43</td>
<td>4096</td>
<td>18:59:59</td>
<td>- 01:00:00</td>
<td>- 17:00:01</td>
<td></td>
</tr>
<tr>
<td>2015-01-02 13.47.43</td>
<td>4096</td>
<td>16:59:59</td>
<td>- 02:00:00</td>
<td>- 19:00:01</td>
<td></td>
</tr>
<tr>
<td>2015-01-02 13.47.43</td>
<td>4096</td>
<td>12:59:59</td>
<td>- 04:00:00</td>
<td>- 23:00:01</td>
<td></td>
</tr>
<tr>
<td>2015-01-02 13.47.43</td>
<td>4096</td>
<td>10:59:59</td>
<td>- 02:00:00</td>
<td>- 25:00:01</td>
<td></td>
</tr>
<tr>
<td>2015-01-02 13.47.43</td>
<td>4096</td>
<td>08:02:03</td>
<td>- 02:57:56</td>
<td>- 27:57:57</td>
<td></td>
</tr>
<tr>
<td>2015-01-02 13.47.43</td>
<td>4096</td>
<td>06:01:01</td>
<td>- 02:01:02</td>
<td>- 29:58:59</td>
<td></td>
</tr>
</tbody>
</table>

**SLA**

The maximum amount of time in hours specified in your service level agreement for recovering the entire subsystem.

You set this value using the 4. **Subsystem Options** option on the main menu.

**Projected Time to Recover**

The amount of time in hours that it will probably take to recover the entire subsystem.

This figure is an average based on the historical recovery information shown for the listed recoveries.

**Recovery Date/Start Time**

The date and time that the recovery was started.

**Bytes Recovered**

The total number of bytes recovered by all jobs.

**Elapsed**

The total elapsed time of all jobs (end time minus start time). This value is the estimated elapsed time for estimated recoveries.

**Difference from last recovery**

The difference between the elapsed time of the current recovery and the most recent previous recovery.

**Difference from SLA**

The difference between the elapsed time and the service level agreement.
Recovery simulation and estimation

Simulation and estimation are valuable tools for preparing and fine-tuning your disaster and local-site recovery plans. This section discusses how you can use the BMC Recovery Management for DB2 solution to assist in recovery simulation, and to estimate the amount of time that will be required to perform a recovery.

You might find recovery simulation useful in reducing your disaster recovery and local site testing costs. Estimation is useful for determining problem spaces and trying different scenarios. You can collect data for simulated, estimated, and actual recoveries.

The recovery simulation feature performs all aspects of recovery up to, but not including, any destructive operations on the data. It reads image copies and sorts and applies all log records required for recovery, discarding the output after verifying that the recovery resources are valid. You can use simulation for both disaster recovery and local group recovery. Simulation also gives you a close approximation of how long an actual recovery will take. See “About simulation” on page 124 for more information.

Note

Recovery simulation uses features from both RECOVERY MANAGER for DB2 and BMC Next Generation Technology Recover for DB2 for z/OS and requires the Recovery Management solution password.

The recovery estimation feature can provide an estimate in hours, minutes, and seconds for the amount of time required to perform a complete disaster recovery, including both system and application resources. It produces a list of the ten objects that would take the longest amount of time to recover. Estimation is faster than simulation because it does not perform any recovery steps. See “About recovery estimation” on page 141 for more information.

Data about the recovery operation is collected for all simulated, estimated, and actual recoveries and saved into RECOVERY MANAGER tables for comparison purposes. The ability to analyze and compare recovery statistics enables you to evaluate and improve your disaster recovery processes over time. For more information, see “Disaster recovery data collection” on page 115.
About simulation

In the BMC Recovery Management for DB2 solution, recovery simulation is handled by the RECOVERY MANAGER and NGT Recover components.

You use the RECOVERY MANAGER online interface or batch programs to access the simulation features.

You can perform recovery simulation for the following scenarios:

- Disaster recovery scenarios (see “Disaster recovery simulation” on page 124)
- Local site recovery scenarios (see “Local site recovery simulation” on page 139)

Disaster recovery simulation

Simulation JCL is identical to that used for disaster recovery, except that it includes syntax that specifies simulation mode and syntax to bypass steps that would cause updates to the system.

For disaster recovery, simulation enables you to perform the following tasks:

- Prove that you can recover the application data in a disaster recovery environment
- Verify that needed recovery resources are valid and available and that log apply can be performed
- Work on your disaster recovery plans before you run an expensive offsite disaster recovery

By using recovery simulation, you can reduce the number of times that you need to run a full offsite disaster recovery scenario. However, while use of recovery simulation reduces the need to test your disaster recovery plans offsite, it cannot replace such tests altogether.

Note

The JCL for system recovery simulation is always generated into a data set with a .SIM suffix to ensure that it is not mistaken for actual disaster recovery JCL. Prior to generating simulation JCL, you must create a GDG data set with .SIM as the suffix. The GDG data set enables RECOVERY MANAGER to automatically append the .SIM suffix to the data set that you specify when generating recovery simulation JCL.
Disaster recovery simulation is divided into two parts:

- Simulation of DB2 system recovery (see “Disaster recovery simulation—DB2 system resources” on page 125)
- Simulation of application recovery (see “Disaster recovery simulation—Application resources” on page 136)

Disaster recovery simulation—DB2 system resources

During disaster recovery simulation, RECOVERY MANAGER generates JCL to copy the BSDS and to create the proposed conditional restart control record (CRCR) in the BSDS.

Other checks on your specifications for disaster recovery are also made. However, no actual conditional restart or recovery of the catalog and directory is performed.

**Note**

BMC recommends that you review the volume specifications (especially the VOLSERS) for data sets (such as the alternative BSDS and active logs) that are generated by ARMBSRR to verify they are appropriate for your organizational standards. For example, you might not want the simulation to run on your production volumes.

RECOVERY MANAGER performs the following tasks for system recovery simulation:

- During the recovery, the ARMBWDC program continually records data collection information. The ARMBRDC program processes the data collected during recoveries and stores the results.

- ARMBSRR creates and processes the OPTIONS SIMULATE YES syntax whether you are running with DSNUTILB or NGT Recover.

- ARMBSRR creates a dummy BSDS file. If you are using data sharing, ARMBSRR creates one dummy BSDS per data sharing member. The dummy BSDS files are named `vcat.BMCBSDS1` and `vcat.BMCBSDS2`. All JCL that is generated at this point references the dummy BSDS file. Change Log Inventory and Print Log Maps are run against the dummy BSDS.

- ARMBSRR prints a report that lists the copies and logs used for the recovery of each catalog and directory table space.
The report is produced whether or not RECOVERY MANAGER is running in simulation mode. If the ARMVRPT DD statement is present, the information for this report prints to the ARMVRPT output. If the ARMVRPT DD statement is not present, this information prints at the end of the ARMPRINT DD.

You select the simulation mode in the RECOVERY MANAGER interface to generate JCL for system recovery simulation. The tasks that you perform for system recovery simulation vary depending on your disaster recovery procedures:

- If you already have disaster recovery procedures in place, start with “Task 4: Setting options to generate simulation JCL” on page 131.

- If you do not have disaster recovery procedures in place, begin with “Task 1: (first time only) Building subsystem groups” on page 126.

The following table summarizes the tasks required for disaster recovery simulation.

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Build subsystem groups (first time only)</td>
<td>“Task 1: (first time only) Building subsystem groups” on page 126</td>
</tr>
<tr>
<td>2</td>
<td>Establish a recovery point</td>
<td>Task 2: Establishing a recovery point on page 129</td>
</tr>
<tr>
<td>3</td>
<td>Set archive log copy options</td>
<td>“Task 3: Setting archive log copy options” on page 130</td>
</tr>
<tr>
<td>4</td>
<td>Set options to generate simulation JCL</td>
<td>“Task 4: Setting options to generate simulation JCL” on page 131</td>
</tr>
<tr>
<td>5</td>
<td>Generate simulation JCL</td>
<td>“Task 5: Generating the disaster recovery simulation JCL” on page 133</td>
</tr>
<tr>
<td>6</td>
<td>Execute simulation JCL</td>
<td>“Executing system recovery simulation JCL at the local site” on page 135</td>
</tr>
</tbody>
</table>

These procedures assume that you have image copies of your business applications, the DB2 catalog and directory, the RECOVERY MANAGER repository, and the R+/CHANGE ACCUM repository (if applicable).

**Task 1: (first time only) Building subsystem groups**

Use this procedure to generate JCL to build groups for all application data within a subsystem (through the ARMBGPS program).

If this is the first time that you are building subsystem groups, perform this procedure. If you already have built subsystem groups, skip to “Task 4: Setting options to generate simulation JCL” on page 131.
To build subsystem groups

1. In the RECOVERY MANAGER Main Menu, select Option 7, **Subsystem recovery** and press **Enter**.

2. In the System Recovery Preparation and JCL Generation panel, select Option 1, **Full Recovery groups** and press **Enter**.

   The Build Recovery Groups panel is displayed.

   ```
   ARMUFS1 ==================== Build Recovery Groups ============================
   Command ===> _________________________________________________________________
   You are about to generate JCL to build RMGR recovery groups based on a sizing balance. Enter the fields and press Enter.
   Group owner . . . . . . . . . . . . . . RDAXXX__
   Group name prefix . . . . . . . . . . . ALLOBJ________
   Group description . . . . . . . . . . . _________________________
   Maximum number of groups . . . . . . . 10  (2-99)
   Build job for backup JCL generation . . 1  1. Yes  2. No
   Output data set . . RDAXXX.BMCARM_________________________________________
   Copy All Index Spaces . 2 1. Yes   2. No  3. Auto
   Index Size Threshold __________ max bytes(4294967295K,4194303M,4095G)
   Include Clones . . . . . . 2 1. Yes   2. No
   Output data set . . ______________________________________________________
   ```

3. On the panel, enter information as required and press **Enter**.

   See Table 11 on page 128 for descriptions of the fields.

4. When the JCL Specification panel appears, enter a fully qualified output data set name.

   Be aware of the following information:
   - The output data set is used for saving the JCL and must be cataloged. If not enclosed in quotes, the output data set will be prefixed by your TSO prefix.
   - The job statement must contain a symbolic variable (\#) for the job number.

5. Save the JCL data set or submit the job as required.

   **Note**
   RECOVERY MANAGER automatically adds EXCLUDE statements for the RECOVERY MANAGER and R+/CHANGE ACCUM repositories.

The subsystem groups are created and saved in the RECOVERY MANAGER repository with GENERATED BY ARMBGPS as the description. “Subsystem group creation JCL” on page 145 provides an example of the JCL that is generated.
## Table 11: Build recovery groups options

<table>
<thead>
<tr>
<th>Option</th>
<th>RECOVERY MANAGER default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group owner</td>
<td>None</td>
<td>Specifies a valid TSO user ID for RECOVERY MANAGER to use as the creatorId part of each group name. For more information about authorizations for creating groups, see the <em>RECOVERY MANAGER for DB2 User Guide</em>.</td>
</tr>
<tr>
<td>Group name prefix a</td>
<td>None</td>
<td>Specifies a character string for RECOVERY MANAGER to use as a prefix in the group part of each group name.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RECOVERY MANAGER adds a 2-digit number suffix to provide a unique name for each group. The prefix must not exceed 16 characters. The numerical suffixes that RECOVERY MANAGER adds start at 01 and continue up to the value that you provide at the <strong>Maximum number of groups</strong> prompt.</td>
</tr>
<tr>
<td>Group description</td>
<td>None</td>
<td>Specifies a description for your groups. For example, DR SIMULATION.</td>
</tr>
<tr>
<td>Maximum number of groups</td>
<td>10</td>
<td>Specifies the maximum number of groups (2-99) to create.</td>
</tr>
<tr>
<td>Build job for backup JCL</td>
<td>Yes</td>
<td>Specifies whether to build backup jobs for your applications. Important: Specify No for simulations and estimations. You should already have backups of your business applications.</td>
</tr>
<tr>
<td>generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output data set (for backup job)</td>
<td>None</td>
<td>Specifies an output data set for backup jobs. Note: Group name prefixes cannot be delimited. Important: Leave this blank. You should not be generating backup jobs during a simulation or estimation.</td>
</tr>
<tr>
<td>Option</td>
<td>RECOVERY MANAGER default</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Copy All Index Spaces</td>
<td>No</td>
<td>Specifies whether to back up eligible index spaces. This option is only available when NGT Recover version 3.5 or later is selected as the recovery utility and NGT Copy is selected as the copy utility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Yes—Back up all eligible indexes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ No—(the default) Do not back up eligible indexes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Auto—Back up indexes as large or larger than the size specified in the Index Size Threshold field.</td>
</tr>
<tr>
<td>Index Size Threshold</td>
<td></td>
<td>Specifies the size threshold at which indexes are backed up rather than rebuilt. This option is used in conjunction with Copy Index Space Auto.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enter the size as follows:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ M—Megabytes (the default). Valid range is 0-4194303.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ K—Kilobytes. Valid range is 0-4294967295.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ G—Gigabytes. Valid range is 0-4095.</td>
</tr>
</tbody>
</table>

a This task creates groups in your RECOVERY MANAGER repository. If you want to keep your simulation groups separate from your production disaster recovery groups, give them a different name.

**Task 2: Establishing a recovery point**

Use the following procedure to create log analysis JCL that you can use to establish a recovery point for a disaster recovery simulation.

If you want to recover to the end of the last archived log, you do not need to perform this task.

*Note*

If used in a data sharing environment, RECOVERY MANAGER generates the necessary JCL to establish a coordinated recovery point for all data sharing members.
To establish a recovery point

1. In the System Recovery Preparation and JCL Generation panel, select Option 5, Disaster recovery and press Enter.

2. Select Option 1, Establish a Recovery Point and press Enter.

3. On the Establish Recovery Point panel, choose the subsystem recovery point.

4. Specify whether you want to generate the JCL to establish the recovery point or wait until you have also set options for preparing the archive logs and subsystem recovery.
   - To generate the job now, select Option 6, Establish a Recovery Point (ARMBLOG or ARMBCRC) and then press Enter.
   - To generate a single job for all three disaster recovery steps, perform the following procedures:

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Set archive log copy options</td>
<td>“Task 3: Setting archive log copy options” on page 130</td>
</tr>
<tr>
<td>4</td>
<td>Set options to generate simulation JCL</td>
<td>“Task 4: Setting options to generate simulation JCL” on page 131</td>
</tr>
<tr>
<td>5</td>
<td>Generate simulation JCL</td>
<td>“Task 5: Generating the disaster recovery simulation JCL” on page 133</td>
</tr>
</tbody>
</table>

Task 3: Setting archive log copy options

Use the following procedure to set options for copying the archive logs. Set these options as you would for a production disaster recovery.

To set archive log copy options

1. In the Disaster Recovery panel, select Option 2, Copy Archive Logs.

2. Enter information about the number and types of copies that you need on the following series of panels.
   - If you chose to create more than one copy, an Offsite Copy Options panel is displayed for each copy.
3 Specify whether you want to generate the JCL to copy the archive logs now or wait to set options for generating simulation JCL.

- To generate the job now, select Option 7, Copy the Archive Logs (ARMBARC) and then press Enter.

- To generate a single job for all three disaster recovery steps, perform the following procedures:

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Set options to generate simulation JCL</td>
<td>“Task 4: Setting options to generate simulation JCL” on page 131</td>
</tr>
<tr>
<td>5</td>
<td>Generate simulation JCL</td>
<td>“Task 5: Generating the disaster recovery simulation JCL” on page 133</td>
</tr>
</tbody>
</table>

**Task 4: Setting options to generate simulation JCL**

Use the following procedure to set options for the job that simulates recovery of the full subsystem at the disaster recovery site.

**To set options to generate simulation JCL**

1 In the Disaster Recovery panel, select Option 4, Simulate DR Recovery.

The Disaster Recover (SIMULATION) - System Resources Recovery Mirror Strategy panel is displayed.

ARMDR008 === Disaster Recovery(SIMULATION) - System Resources Recovery ========

Command ===> _________________________________________________________________

Please type in the requested information. Then press Enter.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BSDS</td>
<td>1. Both</td>
<td>2. Copy 1</td>
<td>3. Copy 2</td>
</tr>
<tr>
<td>Active Logs</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
<tr>
<td>Catalog and Directory</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
<tr>
<td>Rmgr Repository</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
<tr>
<td>Chg Accum Repository</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
<tr>
<td>Log Master Repository</td>
<td>2</td>
<td>1. Yes</td>
<td>2. No</td>
</tr>
</tbody>
</table>

2 Specify the system resources that you mirror and press Enter.

For more information, see “Defining mirroring support in the default subsystem options” on page 103. The Disaster Recover (SIMULATION) - System Resources Recovery panel is displayed.

ARMDR004 === Disaster Recovery(SIMULATION) - System Resources Recovery ========

Command ===> _________________________________________________________________
Please type in the requested information. Then press Enter.

- Extend Recovery Point at DR. 1. Yes  2. No
- Recover RM Repository. 1. Yes  2. No
- Recover LogMaster Repository 1. Yes  2. No
- Archives Cataloged 1. Yes  2. No
- Restore archive copies to disk   0 (0 or 1 copy)
- Number of logs to disk   
- zIIP Redirection 2. Enabled  2. Disabled
- Initialize Active Logs 1. Yes  2. No
- Maximum log jobs per member. 1_ (1 - 10)
- Archive copy to use offsite. 1. Offsite Logs 2. Archive 2  3. Archive 1
- BSDS Log Processing Limit. __ Default: Process all logs
- Maximum catalog recovery jobs. __ (1 - 32)
- Image copy type. 1. LP  2. LB  3. RP  4. RB
- Synchronization file name.

3 Enter information as required and press Enter.

If you specify Restore archive copies to disk, the Offsite Copies Options panel is displayed. Otherwise, the Disaster Recovery (SIMULATION) - System Resources Recovery panel (job card information) is displayed (see Step 4 on page 132).

ARMDRO05 = Disaster Recovery(SIMULATION) - OffSite Copy 1 Options =============
Command ===> _________________________________________________________________
Please type in options for Copy 1
Disk unit . . . . . . SYSALLDA
Disk options (optional)
- SMS data class.
- SMS management class.
- SMS storage class.
- Unit count.
Compression . . . . . . _ 1. Yes  2. No (Yes requires PACLOG)

4 Enter information as required and press Enter.

The Disaster Recovery (SIMULATION) - System Resources Recovery panel (job card information) is displayed.

ARMDRO06 === Disaster Recovery(SIMULATION) - System Resources Recovery ========
Command ===> _________________________________________________________________
Please type in the requested information. Then press Enter.
- Job card data set. . . . . . RDAXXX.BMCARM.JCL(JCL)________
- Primary output GDG base. . . . RMD.DEBN.ARMBSRR.SIM________
- Unit. . . . . . . . . . . . SYSLDLA
- Volume. . . . . . . . . . . VOL
- Device type . . . . . . . 1. Disk  2. Tape
- Primary output model . . . . . RDAXXX.BMCARM________
- Alternate output GDG base. ______________________
- Unit. . . . . . . . . . . .
- Volume. . . . . . . . . . .
- Device type . . . . . . . 1. Disk  2. Tape
- Alternate output model . .

5 Enter information as required and press Enter.
The Disaster Recovery (SIMULATION) - System Resources Recovery (ARMBGPS Options) Panel is displayed.

```
ARMDR009 === Disaster Recovery(SIMULATION) - System Resources Recovery ==>
Command ===> _________________________________________________________________
Please type in the requested information. Then press Enter.

Options for application groups created by ARMBGPS:

<table>
<thead>
<tr>
<th>Group owner</th>
<th>RDAXXX3_</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group name prefix</td>
<td>DDD</td>
</tr>
<tr>
<td>Generate RECOVER JCL</td>
<td>2 1. Yes 2. No</td>
</tr>
<tr>
<td>LOGONLY recovery</td>
<td>2 1. Yes 2. No</td>
</tr>
<tr>
<td>Generate ObjectSet syntax</td>
<td>2 1. Yes 2. No</td>
</tr>
<tr>
<td>Primary JCL data set name</td>
<td></td>
</tr>
<tr>
<td>Alternate JCL data set name</td>
<td></td>
</tr>
</tbody>
</table>
```

**Note**

If the output JCL data set is a GDG, the product always uses SYS1.MODEL as the model data set name.

6 Enter information as required and press **Enter**.

**Note**

The ARMBGPS options are valid only when the groups in the subsystem were created automatically by RECOVERY MANAGER using the subsystem recovery online feature or ARMBGPS batch program.

The Disaster Recovery panel is displayed again.

**Task 5: Generating the disaster recovery simulation JCL**

Use this procedure to generate the JCL to execute at the local site to simulate a disaster recovery at the remote site.

The subsystem disaster recovery JCL includes the following jobs:

- **ARMBWDC**—collect recovery data (Recovery Management solution only)
- **ARMBLOG** and **ARMBCRC**—establish a recovery point
- **ARMBARC**—copy the archive logs
- **ARMBSRR**—generate system recovery simulation JCL
- **ARMBGEN**—generate application recovery JCL
- **ARMBTS**—record the recovery PIT (if a specific point in time was selected)
To generate the disaster recovery simulation JCL

1. On the Disaster Recovery panel, select Option 9, Generate ALL Disaster Recovery Jobs.

2. When the JCL Specification panel appears, enter a fully qualified output data set name.

Be aware of the following information:

- The output data set is used for saving the JCL and must be cataloged. If not enclosed in quotes, the output data set will be prefixed by your TSO prefix.
- The job statement must contain a symbolic variable (&#) for the job number.
- If you selected Simulate Yes, RECOVERY MANAGER appends to the data set name if the final node does not end in SIM or .SIM. If you are using the BMC Recovery Management for DB2 solution and you selected Estimate Yes, RECOVERY MANAGER appends .EST to the data set name if the final node does not end in EST or .EST. You must have created these GDG bases previously.

3. Submit the generated JCL.

**WARNING**

Submitting this job generates simulation JCL for system recovery and application recovery. The simulation JCL issues an -ARCHIVE LOG command. If you do not want to archive the log at the time of job submission, edit the JCL and delete the ARMBLOG step.

For more information about the simulation JCL, see the following topics:

- “Executing system recovery simulation JCL at the local site” on page 135
- “Disaster recovery simulation JCL” on page 148
- “Disaster recovery simulation—Application resources” on page 136
Executing system recovery simulation JCL at the local site

The disaster recovery simulation JCL simulates recovery of the BSDS and logs. Any steps that are disruptive to the system are commented out, and the DB2 catalog and directory are not recovered.

For more details, see “Task 5: Generating the disaster recovery simulation JCL” on page 133.

The flow of the system recovery simulation JCL is determined by the options that you specified. If more than one job is created within a phase, RECOVERY MANAGER includes job steps that synchronize job execution without requiring manual intervention.

Table 12 on page 135 shows the operations that are performed for each non-data-sharing subsystem. Whether they are performed on only one or on all members of a data sharing group is shown in parentheses. When the BSDS or logs are specified, these are work copies.

Note

If you have the Recovery Management for DB2 solution, recovery data is collected throughout the recovery and then consolidated and reported at the end.

Table 12: Functions accomplished during the Initialization Phase

<table>
<thead>
<tr>
<th>Step</th>
<th>Systems without remote hardware mirroring</th>
<th>Systems with level 1 remote hardware mirroring</th>
<th>Systems with level 2 remote hardware mirroring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Delete and define each BSDS work copy (all).</td>
<td>Delete and define each BSDS work copy (all).</td>
<td>Delete and define each BSDS work copy (all).</td>
</tr>
<tr>
<td>2</td>
<td>Delete and define each active log work copy (all).</td>
<td>REPRO new BSDS work copy from the mirrored copy (all).</td>
<td>REPRO new BSDS work copy from the mirrored copy (all).</td>
</tr>
<tr>
<td>3</td>
<td>Recover each BSDS work copy from the last archive log data set (all).</td>
<td>Delete and define each active log work copy (all).</td>
<td>Delete and define each active log work copy (all).</td>
</tr>
<tr>
<td>4</td>
<td>Use Change Log Inventory to rename the archive log data set work copies (if required) and add the last copy of the archive log data set work copy to the BSDS work copies (all).</td>
<td>REPROM new active log work copies from the mirrored copy (all).</td>
<td>REPROM new active log work copies from the mirrored copy (all).</td>
</tr>
<tr>
<td>5</td>
<td>Use Change Log Inventory to generate the CRCR (all).</td>
<td>Print log map (all).</td>
<td>Print log map (all).</td>
</tr>
<tr>
<td>Step</td>
<td>Systems without remote hardware mirroring</td>
<td>Systems with level 1 remote hardware mirroring</td>
<td>Systems with level 2 remote hardware mirroring</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>Use Change Log Inventory to add the active log work copies to the BSDS work copy. Optionally, initialize all but one of the active log data set work copies (all).</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>7</td>
<td>Print log map (all).</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

a Required only if your system is mirroring just one copy of the BSDS and active logs (HWCOPY n option).

For examples of JCL for simulated system recoveries, see “Disaster recovery simulation JCL” on page 148.

**Disaster recovery simulation—Application resources**

When ARMBGEN is run, it generates NGT Recover syntax to simulate application recovery.

The syntax includes SET OPTIONS SIMULATE YES X’logPoint’. The logPoint variable is the RESTART RBA determined by ARMBSRR.

For a recovery that uses SIMULATE YES, RECOVERY MANAGER generates all of the same steps that it would for a nonsimulation run. However, the simulation JCL has additional logic that skips the execution of any steps that have an impact on the system, such as STOP, START, COPY, CHECK, or REPAIR.

**Generating application recovery simulation JCL**

You can generate application recovery simulation JCL for a specific RECOVERY MANAGER group either online or in batch mode.

Procedures for both methods are provided. By generating and executing application recovery simulation JCL, you can verify that needed recovery resources are valid and available and that log apply can be done. (To generate application recovery simulation JCL for an entire subsystem, see “Disaster recovery simulation—DB2 system resources” on page 125.)

**Before you begin**

Before you can generate application recovery JCL for simulation purposes, you must perform the following steps:
1. Establish a RESTARTRBA in the history file by running the ARMBSRR program (see “Task 5: Generating the disaster recovery simulation JCL” on page 133 in the System Recovery Simulation section).

2. Create remote primary offsite copies for both the system and application objects.

   **Note**
   If you specify SITETYPE=RECOVERY, you must have RP or RB copies.

**To generate application simulation JCL online**

1. From the RECOVERY MANAGER Main Menu, specify Option 1, **Application Group** and type **J** or **JA** beside the group on the Group List panel.

The Batch Group Recovery Point Specification and the Batch Group JCL Generation Options panels will display.

2. On the Batch Group JCL Generation Options panel, specify the following values to use application recovery simulation:
<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recover to</td>
<td>Specify one of the following values:</td>
</tr>
<tr>
<td></td>
<td>■ Current</td>
</tr>
<tr>
<td></td>
<td>■ Common Recovery Point</td>
</tr>
<tr>
<td></td>
<td>■ Specific Logpoint</td>
</tr>
<tr>
<td></td>
<td>■ Restart RBA</td>
</tr>
<tr>
<td></td>
<td>■ Timestamp</td>
</tr>
<tr>
<td>Sitetype</td>
<td>Specify one of the following values:</td>
</tr>
<tr>
<td></td>
<td>■ RECOVERY(^{a})</td>
</tr>
<tr>
<td></td>
<td>■ LOCAL</td>
</tr>
<tr>
<td>Simulate recovery</td>
<td>Yes</td>
</tr>
<tr>
<td>Backout</td>
<td>No</td>
</tr>
</tbody>
</table>

\(^{a}\) If you specify Sitetype=Recovery, you must have RP or RB copies.

**Note**

Be aware of the following information:

- SIMULATE YES is not valid with the NGT Recover LOGSCAN YES or UNLOADKEYS/BUILDINDEX options. If you specify either of these options when using simulation, ARMBGEN issues an error message and does not generate the JCL.

- If you specify SIMULATE YES for a group that uses DB2 DSNUTILB as the recovery utility, any JCL that is generated will not execute because of the JCL logic generated by simulate mode.

3 Press **Enter** to generate JCL.

The JCL Specification panel is displayed.

4 When the JCL Specification panel appears, enter a fully qualified output data set name. Be aware of the following information:

- The output data set is used for saving the JCL and must be cataloged. If not enclosed in quotes, the output data set will be prefixed by your TSO prefix.

- The job statement must contain a symbolic variable (&#) for the job number.

- If you selected Simulate recovery, RECOVERY MANAGER appends .SIM to the data set name if the final node does not end in SIM or .SIM. If you are using the Recovery Management for DB2 solution and you selected Estimate Yes, RECOVERY MANAGER appends .EST to the data set name if the final node
does not end in EST or .EST. You must have created these GDG bases previously.

5 Submit the generated JCL. For an example of the JCL that is generated by this procedure, see “Disaster recovery simulation JCL” on page 148.

To generate application simulation JCL in batch mode

If you do not want to generate the JCL online, you can manually code the SET OPTIONS SIMULATE YES syntax for an ARMBGEN job. The ARMBGEN job generates JCL that you run on your local system to simulate recovery of the application group that you specify.

1 Use the following syntax in the ARMBGEN JCL:

```
SET OPTIONS BACKOUT NO SIMULATE YES SITETYPE RECOVERY
```

ARMBGEN control statement syntax for SET OPTIONS is shown in Figure 17 on page 139. For more information, see the RECOVERY MANAGER for DB2 User Guide.

**Figure 17: ARMBGEN control statement—SET OPTIONS**

Local site recovery simulation

You can generate JCL to simulate local site recovery of one or more groups to any of the following recovery points:

- To current
- To common recovery point
- To logpoint
- To restart RBA
- To timestamp
You can also simulate local site recovery of a full subsystem.

**Simulating local recovery of one or more groups**

Start this procedure at the Object List panel, which appears after you have created or retrieved a group.

1. Select option 1 *Recovery point* and press Enter.

   The Recovery Type Selection panel is displayed.

2. Select *Simulate Recovery* as the recovery type, then specify the other options on the series of panels. For more information about the options, see the *RECOVERY MANAGER for DB2 User Guide*.

3. Select Option 3, *Gen Recover JCL foreground* to generate simulation JCL for all objects that have an OK status. *Any object with any other status is not included in the recovery JCL.*

   **Note**
   Depending on the number of objects to be recovered, generating the JCL may take a noticeable length of time.

4. When the JCL Specification panel appears, enter a fully qualified output data set name, then save the JCL data set or submit the job as required.

**Simulating local recovery of a full subsystem**

Start this procedure at the RECOVERY MANAGER Main Menu.

1. Access the Local System Recovery panel, as follows:
   
   a. Select Option 6, *Subsystem recovery*.
   
   b. Select Option 4, *Local recovery*.

   The Local System Recovery panel is displayed.

   Generates JCL to recover active DB2 subsystems at the local site.
   Group owner ........... RDAXXX__
   Group name prefix .......... TEST____________
   Recover to time .. 2014 - 11 - 01 10 . 40 . 40 (YYYY-MM-DD HH.MM.SS)
### About recovery estimation

The recovery estimation feature can provide an estimate of the hours, minutes, and seconds required to perform a complete disaster recovery, including both system and application resources.

The complexity and unique qualities of every disaster recovery situation make accurate estimates extraordinarily difficult. Estimation is only available with the BMC Recovery Management for DB2 solution.

When using estimation, consider the following points:

- **Consistency**
  
  Estimates produced by the Recovery Management solution are calculated based on information about your subsystem. The actual hours and minutes estimated may or may not be entirely accurate, but they are consistent and can be very useful from that standpoint. For example, you might find that an actual disaster recovery took 20 hours, even though the estimate was 24 hours. The next time that your estimate is 24 hours, you can safely assume that the actual recovery will take approximately 20 hours (assuming no major changes to the system).

---

**Note**

An estimate can only be as consistent as the data on which it is based. If you change variables at the remote site, the estimate might no longer have the same correlation to the actual time. For example, an estimate of 24 hours might ordinarily correlate to a recovery of 20 hours. If you add a new processor at the remote site but do not change the options used by the estimation, an estimate of 24 hours might now correlate to a recovery of 12 hours.

2. Enter information as required and press Enter. For more information, see the Recovery Manager for DB2 User Guide.

3. On the JCL Specification panel, enter a fully qualified output data set name.

4. Save the JCL data set or submit the job as required.
Scenarios
You can use the estimate to perform what-if scenarios when you are trying to improve recovery time. Consider the following examples:

— Your initial estimate indicates that a recovery will take 24 hours. You make changes to the objects in the list of the ten longest running recoveries to see if doing so reduces the recovery time. You run the estimate again, and the recovery estimate is 20 hours.

— Your initial estimate indicates that recovery will take 20 hours. You increase the maximum concurrent jobs from 2 to 4 and run another estimate. Now the estimate indicates the recovery will take 12 hours.

These examples show how you can use estimation to improve recovery time even though you might not be certain how long the actual recovery will take.

Estimation advantages
By using recovery estimation, you can deal with problem objects and fine-tune your recovery strategy prior to running a full offsite disaster recovery scenario.

- Recovery estimation enables you to perform the following tasks:
  - Identify the objects that take the longest time to recover
  - Use different scenarios to see what changes reduce recovery time before performing a disaster recovery test
  - Work to improve your disaster recovery plans before you run an expensive offsite disaster recovery

- Estimation does not affect the status or contents of the real database objects.

- Estimation makes no I/O or system services requests.

Estimation limitations
Recovery estimation makes no registration in DB2 or BMC tables, and it cannot be restarted.
NGT Recover estimation improvements

In Recovery Management version 11.1 and later, changes for estimation in NGT Recover better account for current hardware and multitasking. The following table provides some timed results for several recovery scenarios after these improvements:

### Table 13: Estimation versus actual results

<table>
<thead>
<tr>
<th>Recovery scenario</th>
<th>AFRPLAN estimate (mm:ss)</th>
<th>AFRTIME estimate (mm:ss)</th>
<th>Actual (mm:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECOVER TABLESPACE and REBUILD INDEX</td>
<td>16:10</td>
<td>45:31</td>
<td>32:30</td>
</tr>
<tr>
<td>REBUILD INDEX ALL</td>
<td>14:21</td>
<td>40:44</td>
<td>24:59</td>
</tr>
<tr>
<td>RECOVER TABLESPACE</td>
<td>16:00</td>
<td>45:11</td>
<td>30:09</td>
</tr>
<tr>
<td>RECOVER TABLESPACE and INDEX using INCOPY</td>
<td>17:32</td>
<td>49:34</td>
<td>34:37</td>
</tr>
<tr>
<td>RECOVER TABLESPACE and INDEX using BACKOUT</td>
<td>00:55</td>
<td>01:04</td>
<td>00:59</td>
</tr>
<tr>
<td>RECOVER TABLESPACE and INDEX using OUTCOPY ONLY</td>
<td>20:36</td>
<td>58:55</td>
<td>28:44</td>
</tr>
</tbody>
</table>

Although exceptions exist, AFRPLAN values are a lower boundary, and AFRTIME values are an upper boundary. The actual value is usually between the AFRPLAN and the AFRTIME values, depending on contention, the degree of parallelism, and other conditions. The following descriptions provide some details about how AFRTIME and AFRPLAN values are calculated:

- The AFRTIME values take into account parallelism between key extraction and recovering a table space, but they do not take into account parallelism between merge phases for different partitions or different table spaces. Therefore, AFRTIME values tend to be higher than the actual values.

- The AFRPLAN values take into account parallelism between phases but may underestimate contention for resources. Therefore, AFRPLAN values tend to be lower than the actual values.

NGT Recover also provides the following installation options specifically for estimation:

- **DISKIORATE** is the number of megabytes per second that NGT Recover reads from disk. The default value is 100.

- **CPUMIPS** is the rate a CPU executes instructions in millions of instructions per second (MIPS). The default value is 200.
Many of the performance factors used in estimation are derived from DISKIORATE and CPUMIPS.

Generating a disaster recovery estimation job using RECOVERY MANAGER

Use the following procedure to set options for and run a disaster recovery estimation job.

**Before you begin**

Perform the following steps before you run an estimation job:

1. Build or revalidate your subsystem groups.
   If you have not yet built subsystem groups, perform the steps in “Task 1: (first time only) Building subsystem groups” on page 126.

2. Establish a recovery point.
   See “Task 2: Establishing a recovery point” on page 129.

3. Establish the archive log copy options.
   See “Task 3: Setting archive log copy options” on page 130.

**To generate a recovery estimation job**

1. From the RECOVERY MANAGER Main Menu, select Option 7, *Subsystem recovery*.

2. From the Subsystem General Recovery Options panel, select Option 5, *Disaster recovery*.

   The Disaster Recovery panel is displayed.


   The Mirror Strategy panel is displayed.

4. Specify your mirroring strategy as required. (See “Task 4: Setting options to generate simulation JCL” on page 131.)

   **Note**
   The mirroring strategy that you specify here remains in effect only for the current estimation job.
5 Specify the recovery options for the estimation run on the next series of panels. The panels are identical to those used for simulation. See “Task 4: Setting options to generate simulation JCL” on page 131 for more information.

**Note**
RECOVERY MANAGER appends .EST to the data set name if the final node does not end in EST or .EST. You must have created the GDG base previously.

6 To generate the job now, select Option 8, **Prepare to Recover the DB2 Subsystem (ARMBSRR)** and then press **Enter**.

7 On the JCL Specification panel, enter information and press **Enter** to display the recovery JCL.

8 Save the JCL data set, or submit the job.

---

**Sample JCL from RECOVERY MANAGER**

This section contains sample JCL from RECOVERY MANAGER for DB2 for recovery simulation and estimation.

**Subsystem group creation JCL**

The following figure contains sample JCL to generate balanced groups for the entire subsystem.

**Figure 18: Subsystem group creation JCL**

```sql
//ARMJ001 JOB PARM,'RMGR/DB2.J0001'.CLASS=A,MSGCLASS=X,
// NOTIFY=RDAXXX
//* *************************************************************** */
//* DOC:  GENERATED BY RDAXXX  ON 2015/01/03 AT 16:03 */
//* *************************************************************** */
//* *************************************************************** */
//* *************************************************************** */
//*          RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC. */
//* *************************************************************** */
//*                     BATCH GROUP CREATION */
//* *************************************************************** */
//ARMOPTS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS)
```
Sample JCL from RECOVERY MANAGER

```plaintext
//ARMPRINT DD SYSOUT=*
//ARMERROR DD SYSOUT=*
//ARMIN DD *

BUILD GROUPS RDAXXX.BGPS_1010
MAXGROUPS 10

EXCLUDE
  BMCARM.BMCARMCR
  BMCARM.BMCCESTM
  BMCARM.BMCJOBRS
  BMCASU10.BMCRSIP
  BMCASU10.BMCRTSB
  BMCASU10.BMCRSTP
  BMCASU10.BMCRSTS
  BMCMIT.BMCLGRNX
  BMCMIT.BMCSYNC
  BMCMIT.BMTRANS
  BMCMIT.BMUTIL
  BMCMIT.BMUTCOPY
  BMCMIT.BMCMAUTH
  BMCMIT.BMCROPT
  BMCMIT.BMCOBJDEF
  BMCMIT.BMCOBJSET
  BMCMIT.BMCOBJSQL
  BMCMIT.BMCPDRG
  BMCMIT.BMCCHIST
  BMCCA32.ACAREPOS
  BMCALPA1.ALPFPSP
  BMCALPA1.ALPFSSP
  BMCALPA1.ALPHISP
  BMCALPA1.ALMKSP
  BMCALPA1.ALPDLO
  BMCALPA1.ALPRCVM
  BMCALPA1.ALPRTSP
  BMCALPA1.ALPURSP
  BMCALPA1.ALPWSP
  BMCALPA1.ALMWSP
  DSNRTSDB.DSNRTSTS

DESCRIPTION 'SUBSYSTEM GROUP'

//* *************************************************************** *//
//* DOC:  GENERATED BY RDAXXX  ON 2015/01/03 AT 16:03
//* *************************************************************** *//
//* *************************************************************** *//
//*          RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC.        *//
//* *************************************************************** *//
//*             CREATE TEMP DATA SET FOR FILE TAILORING             *//
//* *************************************************************** *//

//ARMD000 EXEC PGM=IEFBR14,COND=(4,LT)
//TEMP DD DISP=(MOD,DELETE),
//  DSN=BMCRMD.QA.MAXVL17.TMPPSPF.D110103.T1603013,
//  UNIT=WORK,SPACE=(CYL,(5,5)),
//  DCB=(RECFM=FB,LRECL=3120,DSORG=PS)
//ARMD001 EXEC PGM=IEBGENER,COND=(4,LT)
//SYSPRINT DD SYSOUT=*;
//SYSIN DD DUMMY
//SYSUT1 DD DUMMY
//DCB=(RECFM=FB,LRECL=3120,DSORG=PS)
//SYSUT2 DD DISP=(NEW,CATLG,DELETE),
//  DSN=BMCRMD.QA.MAXVL17.TMPPSPF.D110103.T1603013,
//  UNIT=WORK,SPACE=(CYL,(5,5)),
```

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DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PS)
/* ******************************************************************** */
/* BATCH JCL GENERATION */
/* FOR SELECTED GROUPS */
/* ******************************************************************** */
/* ARM0002 EXEC PGM=IKJEFT1B,DYNAMNBR=250,
PARM='ISPSTART PGM(ARMBGEN) PARM(DEDL)',
REGION=4M,COND=(4,LT)
/* STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS */
/* DD DISP=SHR,DSN=DSNEXIT */
/* DD DISP=SHR,DSN=DSNLOAD */
/* ARMMSSGS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMSSGS) */
/* ARMOPTS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS) */
/* ARMPRINT DD SYSOUT=*/
/* ARMERROR DD SYSOUT=*/
/* ARMLOAD DD DISP=SHR,DSN=BMCRMD.TEST.DBLINK */
/* ARMIN DD */
SET CURRENT SQLID = RDAXXX ;
GENJCL BACKUP GROUP RDAXXX.BGPS?? :
/* ISPFILE DD DISP=(MOD,KEEP),
 DSN=BMCRMD.QA.MAXVL17.TMPISPF.D110103.T160301 */
/* ISPSLIB DD DISP=SHR,DSN=BMCRMD.TEST.DBSLIB */
/* ISPTABL DD DISP=SHR,DSN=BMCRMD.TEST.DBTLIB */
/* ISPMLIB DD DISP=SHR,DSN=BMCRMD.TEST.DBMLIB */
/* DD DISP=SHR,DSN=SYS1.PROD.ISPMLIB */
/* ISPTLIB DD DISP=(,DELETE),UNIT=WORK,SPACE=(CYL,(1,1,2)),
 DCB=BMCRMD.TEST.DBTLIB */
/* DD DISP=SHR,DSN=BMCRMD.TEST.DBTLIB */
/* DD DISP=SHR,DSN=SYS1.PROD.ISPTLIB */
/* ISPPLIB DD DISP=(NEW,DELETE),UNIT=WORK,SPACE=(TRK,(1,1,2)),
 DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PO) */
/* ISPPROF DD DISP=(,DELETE),UNIT=WORK,SPACE=(TRK,(1,1,2)),
 DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PO) */
/* ISPCTL0 DD DISP=(,DELETE),UNIT=WORK,SPACE=(CYL,(1,1)),
 DCB=(RECFM=FB,LRECL=3120,BLKSIZE=3120,DSORG=PO) */
/* ISPCTL1 DD DISP=(,DELETE),UNIT=WORK,SPACE=(CYL,(1,1)),
 DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PO) */
/* ISPLOG DD DISP=(,DELETE),UNIT=WORK,SPACE=(CYL,(1,1)),
 DCB=(RECFM=FB,LRECL=125,RECFM=VBA,BLKSIZE=3000,DSORG=PS),
 DSN=&&LOG */
/* SYSTSIN DD DUMMY */
/* SYSTSPRT DD SYSOUT=** */
/* SYSTERM DD SYSOUT=** */
/* ISPLIST DD SYSOUT=** */
/* ******************************************************************** */
/* COPY TEMP DATA SET TO TARGET DATA SET */
/* ******************************************************************** */
/* ARM0003 EXEC PGM=ARMBGKR,COND=(4,LT),REGION=4M */
/* STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS */
/* DD DISP=SHR,DSN=DSNEXIT */
/* DD DISP=SHR,DSN=DSNLOAD */
/* ARMMSSGS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMSSGS) */
/* ARMOPTS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS) */
/* ARMPRINT DD SYSOUT=** */
/* ARMERROR DD SYSOUT=** */
/* SYSUT1 DD DISP=(OLD,DELETE,KEEP),
 DSN=BMCRMD.QA.MAXVL17.TMPISPF.D110103.T160301 */
/* SYSUT2 DD DSN=RDAXXX.ARM.JCL, */
/* DISP=(NEW,CATLG,DELETE),SPACE=(CYL,(1,1)),
 UNIT=WORK, */
/* DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PS) */
Disaster recovery simulation JCL

The following figure contains sample JCL to simulate a disaster recovery of the full subsystem.

Figure 19: Disaster recovery simulation JCL

```plaintext
//ARMJ001 JOB PARM,'RMGR/DB2.J0001',CLASS=A,MSGCLASS=X,
//NOTIFY=RDAXXX

//* *************************************************************** *//
//* DOC:  GENERATED BY RDAXXX  ON 2015/01/03 AT 08:51
//* *************************************************************** *//
//* *************************************************************** *//
//* *************************************************************** *//
//* RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC. */
//* *************************************************************** *//
//* ISSUE ARCHIVE LOG COMMAND AND WAIT FOR COMPLETION */
//* DEFAULT: 5 RETRIES, 3 MINUTE WAIT BETWEEN EACH RETRY */
//* *************************************************************** *//
//* *************************************************************** *//
//ARM0001 EXEC PGM=ARMBLOG,
//PARM='DEDL,5,180',
//REGION=4M
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
//          DD DISP=SHR,DSN=DSNLOAD
//ARMMSGS   DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMSGS)
//ARMOPTS   DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS)
//ARMPRINT  DD SYSOUT=*' 
//ARMERROR  DD SYSOUT=*' 
//* *************************************************************** *//
//* *************************************************************** *//
//* RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC. */
//* *************************************************************** *//
//* ARCHIVE LOG COPY USING */
//* ARMBARC */
//* *************************************************************** *//
//* *************************************************************** *//
//ARM0002 EXEC PGM=ARMBARC,PARM='DEDL',
//REGION=4M,COND=(4,LT)
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
//          DD DISP=SHR,DSN=DSNLOAD
//ARMMSGS   DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMSGS)
//ARMOPTS   DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS)
//ARMPRINT  DD SYSOUT=*' 
//ARMERROR  DD SYSOUT=*' 
//ARMIN    DD *
//ARCHIVE3 PREFIX DD
//TAPE UNIT 22
//STACK YES
//* *************************************************************** *//
//* *************************************************************** *//
//* RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC. */
//* *************************************************************** *//
//* DISASTER RECOVERY - SYSTEM */
//* RESOURCES RECOVERY */
//* *************************************************************** *//
//* *************************************************************** *//
//ARM0003 EXEC PGM=ARMBSRR,PARM='DEDL',
//REGION=4M,COND=(4,LT)
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
```
Sample JCL from RECOVERY MANAGER
Sample JCL from RECOVERY MANAGER

```java
/* *************************************************************/
/* ARM0008 EXEC PGM=IKJEFT1B,DYNAMNBR=250,*/
/* Parm="ISPSTART PGM(ARMBGEN) Parm(DEDL)",*/
/* REGION=4M,COND=(4,LT)*/
/* STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS*/
/* DD DISP=SHR,DSN=DSNEXIT*/
/* DD DISP=SHR,DSN=DSNLOAD*/
/* ARMMGS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMGS)*/
/* ARMPNT DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS)*/
/* ARMIN DD SYOUT=*/
/* ARMBGNR DD SYOUT=*/
/* ARMLEAD DD DISP=SHR,DSN=BMCRMD.V101TEST.DBLINK*/
/* ARMIN DD */
/* SET CURRENT SQLID = RDAXX ;*/
/* SET OPTIONS SIMULATE YES ;*/
/* SET OPTIONS DCTOKEN DRECOVER ;*/
/* SET OPTIONS SITETYPE RECOVERY*/
/* BACKOUT NO */
/* JCLTYPE DR ;*/
/* GENJCL */
/* RECOVER */
/* TORESTARTBA */
/* GROUP RDAXX.BGPS?? */
/* /* */
/* /* ISPFILE DD DISP=(MOD,KEEP),*/
/* DSN=BMCRMD.QA.MAXVL17.TMPISPF.D110103.T085106 */
/* ISPSLIB DD DISP=SHR,DSN=BMCRMD.VIOITEST.DBSLIB */
/* ISPTABL DD DISP=SHR,DSN=BMCRMD.VIOITEST.DTLIB */
/* ISPLILB DD DISP=SHR,DSN=BMCRMD.VIOITEST.DMLIB */
/* DD DISP=SHR,DSN=SYS1.PROD.ISPMLIB */
/* ISPTLIB DD DISP=(DELETE),UNIT=WORK,SPACE=(CYL,(1,1,2)),*/
/* DCB=BMCRMD.VIOITEST.DTLIB */
/* DD DISP=SHR,DSN=BMCRMD.VIOITEST.DTLIB */
/* DD DISP=SHR,DSN=SYS1.PROD.ISPTLIB */
/* ISPLILB DD DISP=(NEW,DELETE),UNIT=WORK,SPACE=(TRK,(1,1,2)),*/
/* DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PO) */
/* ISPPROF DD DISP=(DELETE),UNIT=WORK,SPACE=(TRK,(1,1,2)),*/
/* DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PO) */
/* ISPCTL0 DD DISP=(DELETE),UNIT=WORK,SPACE=(CYL,(1,1)),*/
/* DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PO) */
/* ISPCTLB DD DISP=(DELETE),UNIT=WORK,SPACE=(CYL,(1,1)),*/
/* DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120,DSORG=PO) */
/* ISPLOG DD DISP=(DELETE),UNIT=WORK,SPACE=(CYL,(1,1)),*/
/* DCB=(LRECL=125,RECFM=VBA,BLKSIZE=3000,DSORG=PS),*/
/* DSN=&LOG */
/* SYSTSMN DD DUMMY */
/* SYSTSPRT DD SYOUT=** */
/* SYSTERM DD SYOUT=** */
/* ISPLST DD SYOUT=** */
/* /* */
/* /* COPY TEMP DATA SET TO TARGET DATA SET */
/* /* */
/* /* *************************************************************/
/* ARM0009 EXEC PGM=ARMBGNR,COND=(4,LT),REGION=4M*/
/* STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS*/
/* DD DISP=SHR,DSN=DSNEXIT*/
/* DD DISP=SHR,DSN=DSNLOAD*/
/* ARMMGS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMGS)*/
/* ARMPNT DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS)*/
/* ARMIN DD SYOUT=***/
/* ARMMGS DD SYOUT=***/
/* SYST1 DD DISP=(OLD,DELETE,KEEP),*/
/* DSN=BMCRMD.QA.MAXVL17.TMPISPF.D110103.T085106 */
/* SYST2 DD DISP=RDAXX.BMACRM,*/
/* DISP=OLD */
```

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Disaster recovery estimation JCL

The following figure contains sample JCL to generate an estimate for disaster recovery.

**Figure 20: Disaster recovery estimation JCL**

```plaintext
//ARMJ001 JOB PARM,'RMGR/DB2.J0001',CLASS=A,MSGCLASS=X,
     NOTIFY=RDAXXX
/** ................................................................................... */
/** DOC: GENERATED BY RDAXXX ON 2015/01/03 AT 08:56 */
/** ................................................................................... */
/** ................................................................................... */
/** ................................................................................... */
/** RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC. */
/** ................................................................................... */
/** ISSUE ARCHIVE LOG COMMAND AND WAIT FOR COMPLETION */
/** DEFAULT: 5 RETRIES, 3 MINUTE WAIT BETWEEN EACH RETRY */
/** ................................................................................... */
/** ................................................................................... */
//ARM0001 EXEC PGM=ARMBLOG, 
     PARM='DEDL,5,180', 
     REGION=4M 
//STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS 
     DD DISP=SHR,DSN=DSNEXIT 
     DD DISP=SHR,DSN=DSNLOAD 
//ARMMSGS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMSGS) 
//ARMOPTS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS) 
//ARMPRINT DD SYSOUT=* 
//ARMERROR DD SYSOUT=* 
/** ................................................................................... */
/** ................................................................................... */
/** RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC. */
/** ................................................................................... */
/** ARCHIVE LOG COPY USING */
/** ARMBARC */
/** ................................................................................... */
/** ................................................................................... */
//ARM0002 EXEC PGM=ARMBARC,PARM='DEDL', 
     REGION=4M,COND=(4,LT) 
//STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS 
     DD DISP=SHR,DSN=DSNEXIT 
     DD DISP=SHR,DSN=DSNLOAD 
//ARMMSGS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMGS) 
//ARMOPTS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARM$OPTS) 
//ARMPRINT DD SYSOUT=* 
//ARMERROR DD SYSOUT=* 
//ARMIN DD * 
ARCHIVE3 PREFIX DD 
TAPE UNIT 22 
STACK YES 
/** ................................................................................... */
/** ................................................................................... */
/** RECOVERY MANAGER - V11.2.00 - BMC SOFTWARE, INC. */
/** ................................................................................... */
/** DISASTER RECOVERY - SYSTEM */
/** RESOURCES RECOVERY */
/** ................................................................................... */
/** ................................................................................... */
//ARM0003 EXEC PGM=ARMBSRR,PARM='DEDL', 
     REGION=4M,COND=(4,LT) 
//STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS 
```

Sample JCL from RECOVERY MANAGER
Sample JCL from RECOVERY MANAGER

```plaintext
// DD DISP=SHR,DSN=DSNEXIT
// DD DISP=SHR,DSN=DSNLOAD
// ARMMGS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMMGS)
// ARMOPTS DD DISP=SHR,DSN=PRODUCT.CNTL.LIBS(ARMOPTS)
// ARMPRINT DD SYSOUT=*  
// ARMRERROR DD SYSOUT=*  
// ARMJCLDD DD DISP=SHR,DSN=RDAXXX.BMCARM.JCL(TEST01)  
// DD DISP=(NEW,CATLG),UNIT=AAA, SPACE=(CYL,(1,1)), DCB=(RDAXXX.BMCARM, 
// RECFM=FB,LRECL=80,BLKSIZE=3120)  
// ARMLOAD DD DISP=SHR,DSN=BMCRMD.V101TEST.DBLINK  
// ARMPICK DD SYSOUT=*  
// ARMVRPT DD SYSOUT=*  
// ARMIN DD *  
SET OPTIONS  
JCLTYPE DR  
RESTORE  
PACLOG NO  
ARCHIVE1 DISK UNIT SYSALLDA  
COMPRESS NO  
LIMIT LOGS 1  
RECOVER REPOSITORY  
RECOVER CHGACCUM OFFSITE NO ARCHIVE2  
MAXCATJOBS 1  
MAXLOGJOBS 1  
MISSINGCOPIES FAIL  
COPYTYPE LP  
ESTIMATE YES  
DCTOKEN DRECOVER
```
Sample JCL from RECOVERY MANAGER

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Sample JCL from RECOVERY MANAGER

```plaintext
//SYSUT2 DD DSN=RDAXXX.BMCARM, DISP=OLD
```
Full local subsystem recovery with conditional restart avoidance

In the past, full subsystem recoveries have always included a conditional restart, followed by the recovery of both application objects and the DB2 catalog and directory. This type of recovery is very time- and resource-intensive. However, unchanged objects do not need to be recovered and a conditional restart is not required if no alters, drops or creates were performed in the subsystem between the recovery point and the current time. In addition, recovery time can be further reduced if a quiet point can be used as the recovery point.

The BMC Recovery Management for DB2 solution can dramatically shorten the time required to perform a recovery of an entire local subsystem by analyzing the system for unchanged objects, DDL activity, and quiet points and then generating the fastest and most efficient recovery jobs possible.

About the analysis process

Log Master scans the log to find DDL activity (alters, drops or creates) between the specified recovery point and the current time.

It also scans for quiet points within a user-specified recovery range. The RECOVERY MANAGER programs then generate recovery JCL based on the findings, as follows:

- If no DDL activity occurred, recovery of the catalog and directory is not required and is not included in the recovery JCL.

- If catalog and directory recovery is required, RECOVERY MANAGER attempts to recover to the most recent quiet point found within the user-specified recovery range.

If a quiet point is found, Recovery Management generates JCL for a point-in-time (TOLOGPOINT) recovery.

If a quiet point is not found, Recovery Management generates JCL for a point-in-time (TOLOGPOINT) recovery.
Note
If the catalog and directory are recovered to a point-in-time, ARMBGEN converts TORESTARTTRBA to TOLOGPOINT and generates JCL to resolve inflight transactions and perform BACKOUT AUTO processing.
If the catalog and directory are recovered TOLOGPOINT, the RECOVERY MANAGER repository and the applications spaces are also recovered TOLOGPOINT.

About the CONDRESTART option

The CONDRESTART option of the ARMBSRR program controls whether a conditional restart is included in the recovery JCL.

You can optionally change this option if you want to force a different behavior.

AUTO (the default if the Recovery Management solution password is found)

This parameter instructs ARMBSRR to avoid a conditional restart if possible, but to include it if required. If quiet points are found within the specified time range, ARMBSRR generates JCL to perform the recovery to the most recent point without the conditional restart. If no quiet point is found, ARMBSRR generates JCL to perform a traditional conditional restart recovery.

YES (the default if the Recovery Management solution password is not found)

This parameter instructs ARMBSRR to generate conditional restart JCL for the recovery, regardless of whether quiet points are available within the specified time range.

NO

This parameter instructs ARMBSRR to avoid a conditional restart. If quiet points are found within the specified time range, the recovery is performed to the most recent point. If no quiet point is found, the recovery job ends with a return code 8 and message BMC80436E CATALOG AND DIRECTORY QUIET POINT NOT FOUND.

Recovering a full local subsystem

Use the following procedure to recover a full local subsystem:

1. Create the JCL to recover the DB2 subsystem.
For instructions, see “Generating the recovery JCL” on page 158. This procedure generates the jobs that you will use in the following steps.

2 Stop all activity on the subsystem.

3 Submit the JCL that you generated in Step 1 on page 156.

The steps of this job execute the following programs:

- **ARMBLOG**—Executes the appropriate DB2-ARCHIVE LOG command and waits for the archive offload to complete.

- **ARMBTSI**—Inserts the desired point in time for recovery into the RECOVERY MANAGER CRRDRPT table.

- **ARMBCRC**—Converts the point in time to an RBA or LRSN value for DB2 restart.

- **ARMBARC**—*(optional)* Updates the history file.

- **ALPMAIN**—Log Master scans the logs for DDL activity and quiet points.

- **ARMBSRR**—Creates recovery JCL for the DB2 catalog and directory and for the RECOVERY MANAGER repository.

- **ARMBLGR**—Analyzes the log ranges and updates the ARMLRNGX file.

**Note**
The final step of this job stops DB2 again.

4 Execute the JCL generated by ARMBSRR in the previous step to recover the DB2 catalog and directory (if required) and the RECOVERY MANAGER repository to the chosen point in time.

The JCL submits the first phase job(s) which execute immediately. It then submits a second job on hold. Follow the instructions in the JCL, which include starting DB2 in maintenance mode after the first phase jobs complete and then releasing the second phase jobs.

For more information about the JCL generated by ARMBSRR and about running and restarting ARMBSRR jobs, see the *RECOVERY MANAGER for DB2 User Guide*.

5 After the subsystem recovery, release the first held job to execute the ARMBGEN program.
The ARMBGEN program creates the required recovery JCL for all groups including the delta group created by ARMBGPS. ARMBGEN also reads the ARMLRNG file and excludes from recovery any table spaces that are unchanged since the last backup.

**Note**
To reduce elapsed time, try running the ARMBGEN jobs for the groups in parallel, instead of using the wild card job that is generated.

6 Submit the recovery jobs generated by ARMBGEN in the previous step.

For more information about restarting synchronized ARMBGEN jobs, see *RECOVERY MANAGER for DB2 User Guide*.

---

**Generating the recovery JCL**

This process generates JCL to recover the entire DB2 system to a prior point in time.

The JCL is generating with a default of CONDRESTART AUTO.

The process is intended for a local recovery of a DB2 system that is currently active. In addition, it generates revalidation JCL that ensures that objects created since the last execution of ARMBGPS are included in the recovery and produces a report showing objects that were included in the backup, but no longer exist.

**Before you begin**

Before you begin this procedure, make sure you have performed the following tasks:

- Build application groups for the subsystem and back them up.
  - If this task is not performed prior to the recovery point, this recovery process cannot be used. For a description of this task, see the chapter describing Full Subsystem Recovery in the *RECOVERY MANAGER for DB2 User Guide*.

- Set or verify the subsystem options for the utilities you are going to use.
  - For more information, see the section describing RECOVERY MANAGER backup and recovery options in the *RECOVERY MANAGER for DB2 User Guide*.

- Set or verify RECOVERY MANAGER control information.

- Ensure you have authority for the following:
  - EXECUTE authority for the RECOVERY MANAGER plan
— DB2 -ARCHIVE LOG command
— APF authorization for the following:
— ARMBSRR
— ARMBARC
— ALPMAIN
— ARMBT5I
— ARMBCRC
— ARMBGEN
— ARMBLGR

To generate JCL for local full subsystem recovery

Start this procedure at the RECOVERY MANAGER Main Menu.

1  Access the Local System Recovery panel, as follows:
   a  Select Subsystem recovery.
   b  Select Local recovery.

The Local System Recovery panel is displayed. Be aware that this panel has different fields if you are using the BMC Recovery Management for DB2 solution password.

<table>
<thead>
<tr>
<th>Command</th>
<th>Generates JCL to recover active DB2 subsystems at the local site.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group owner</td>
<td>RDAXXX__</td>
</tr>
<tr>
<td>Group name prefix</td>
<td>TEST</td>
</tr>
<tr>
<td>Recover start range</td>
<td>2011 - 01 - 28 14 : 48 : 13 (YYYY-MM-DD HH.MM.SS)</td>
</tr>
<tr>
<td>Recover end range</td>
<td>2011 - 01 - 28 14 : 48 : 13 (YYYY-MM-DD HH.MM.SS)</td>
</tr>
<tr>
<td>Job card data set</td>
<td>RDAXXX.BMCARM.JCL</td>
</tr>
<tr>
<td>System Resource recovery JCL output</td>
<td>BMCARM.JCL</td>
</tr>
<tr>
<td>Application data set RECOVER JCL output</td>
<td>BMCARM.JCL</td>
</tr>
<tr>
<td>Exclude Data Sharing Members</td>
<td>DXY1 DXY2 Data Sharing Only</td>
</tr>
<tr>
<td>Bypass Quiesced Data Sharing Members</td>
<td>1 1. Yes 2. No</td>
</tr>
<tr>
<td>Update history file with HISTONLY option.</td>
<td>2 1. Yes 2. No</td>
</tr>
<tr>
<td>Exclude unchanged from recovery</td>
<td>2 1. Yes 2. No</td>
</tr>
<tr>
<td>Generate ObjectSet syntax</td>
<td>2 1. Yes 2. No</td>
</tr>
<tr>
<td>Simulate recovery</td>
<td>2 1. Yes 2. No</td>
</tr>
<tr>
<td>Include Clones.</td>
<td>2 1. Yes 2. No</td>
</tr>
</tbody>
</table>

2  Enter information as required and press Enter. See Table 14 on page 160 for more information.

3  On the JCL Specification panel, enter a fully qualified output data set name. Be aware of the following information:
The output data set is used for saving the JCL and must be cataloged. If not enclosed in quotes, the output data set will be prefixed by your TSO prefix.

The job statement must contain a symbolic variable (&#) for the job number.

**Note**

If the output JCL data set is a GDG, the product always uses SYS1.MODEL as the model data set name.

4 Save the JCL data set or submit the job as required.

### Table 14: Local subsystem recovery options

<table>
<thead>
<tr>
<th>Option</th>
<th>RECOVERY MANAGER default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group owner</td>
<td>Last value used</td>
<td>Specifies a valid TSO user ID to be used by RECOVERY MANAGER as the creator_ID part of each group name. For more information about authorization for creating groups, see the <em>RECOVERY MANAGER for DB2 User Guide</em>.</td>
</tr>
<tr>
<td>Group name prefix</td>
<td>Last value used</td>
<td>Specifies a character string to be used by RECOVERY MANAGER as a prefix in the group part of each group name. <strong>Note:</strong> Delimited entries are not allowed for the group name prefix.</td>
</tr>
<tr>
<td>Recover start range</td>
<td>Current time</td>
<td>Specifies the beginning of a recovery range in the format  yyyy-mm-dd hh.mm.ss. The product searches the time range between the values that you specify in the <strong>Recover start range</strong> and the <strong>Recover end range</strong> fields for quiet points to use as a recovery point. Choose a time prior to current.</td>
</tr>
<tr>
<td>Recover end range</td>
<td>Current time</td>
<td>Specifies the end of a recovery range in the format  yyyy-mm-dd hh.mm.ss. The product searches the time range between the values that you specify in the <strong>Recover start range</strong> and the <strong>Recover end range</strong> fields for quiet points to use as a recovery point.</td>
</tr>
<tr>
<td>Option</td>
<td>RECOVERY MANAGER default</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Gen one job to convert timestamp to rba</td>
<td>Yes</td>
<td>Generates a single job stream that converts the timestamps for all members of a data sharing system in a single execution. This feature simplifies scheduling and monitoring the timestamp conversion process in a data sharing environment. Selecting No generates a separate job for each data sharing member. Each job runs on the LPAR on which the member exists. <strong>Note:</strong> This option is only available on data sharing systems.</td>
</tr>
<tr>
<td>Job card data set</td>
<td>Last value used</td>
<td>Specifies a fully-qualified name of the data set containing job card information. The job name must contain the symbolic variable $$.</td>
</tr>
<tr>
<td>System resource recovery JCL output data set name</td>
<td>Last value used</td>
<td>Specifies a fully-qualified name of a new or existing data set to be used for saving the recovery JCL for the system resources (catalog and directory).</td>
</tr>
<tr>
<td>Application data set RECOVER JCL output data set name</td>
<td>Last value used</td>
<td>Specifies a fully-qualified name of a new or existing data set to be used for saving the application data set recovery JCL.</td>
</tr>
<tr>
<td>Update history file with HISTONLY option</td>
<td>Last value used</td>
<td>Captures the copy information for the DB2 spaces DSNDB06.SYSCOPY, DSNDB01.DBD01, and DSNDB01.SYSUTILX in the RECOVERY MANAGER archive history file without copying the archive logs. RECOVERY MANAGER stores image copy registration information from the log in the archive history file so that it can optimize recovery JCL for the catalog and directory. The default is No. <strong>Note:</strong> Use this option if you made images copies of the catalog and directory within the log range of the log just archived. In this case, the history file does not yet contain a record of those copies.</td>
</tr>
<tr>
<td>Option</td>
<td>RECOVERY MANAGER default</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Simulate Recovery</td>
<td>No</td>
<td>Simulates recovery at the local site and provides a way to help you prove that you can recover the DB2 data without performing an actual recovery. You can use recovery simulation to verify that needed recovery resources are valid and available and that log apply can be done. This option is a feature of the Recovery Management solution only, and both the RECOVERY MANAGER and NGT Recover components of the Recovery Management solution are required. See the <em>Recovery Management for DB2 User Guide</em> for more information.</td>
</tr>
<tr>
<td>Include Clones</td>
<td>No</td>
<td>Specifies whether to create JCL to recover the cloned objects in the groups being created. Cloned objects are recovered separately from base objects.</td>
</tr>
<tr>
<td>Output data set (for clone groups)</td>
<td>None</td>
<td>The name of an existing data set where you want to place the recover JCL for the cloned objects. This must be a fully qualified data set name that does not contain quotes.</td>
</tr>
</tbody>
</table>

*Generating the recovery JCL*

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High-speed Structure Change

DB2 Version 9 introduced universal table spaces (UTS) that provide better performance and easier space management. Converting to this new table space definition could require a large amount of down time for your production data. The High-speed Structure Change process allows you to convert your data base objects to the new definitions with minimal outage and reduced CPU requirements.

The High-speed Structure Change process allows you to perform the following transformations:

- Simple table space to partition-by-growth (PBG) table space
- Non-large partitioned table space to large partitioned table space
- Range-partitioned table space to range-partitioned (PBR) universal table space
- Range-partitioned table space to partition-by-growth universal table space
- Multi-table table space to partition-by-growth universal table space

The High-speed Structure Change process also allows you to transform your indexes, avoiding costly sort CPU that would be required to rebuild the index.

At a more granular level, you can use the High-speed Structure Change process to:

- Change the segment size (SEGSIZE) of a table space
- Transform a non-segmented table space into a segmented one
- Change the data set size (DSSIZE or PIECESIZE) of your table space or index
- Change the compression attribute of your index
- Add or remove the MEMBER CLUSTER attribute
- Increase or decrease MAXPARTITIONS

The High-speed Structure Change process works at the page level. The process uses a VSAM image copy, such as an Online Consistent Copy or Instant Snapshot, as
input, reads each page, and transforms the page to fit the new definition. The process then moves the page to the new object. During this transformation, applications can have read-only access or concurrent (update) access to the objects. Using concurrent access reduces the length of the outage. With either type of access, you will have a brief outage at the end of the process.

Transformation without the High-speed Structure Change process

Assume, for example, that you have several non-large partitioned table spaces. You would like to improve your space management by taking advantage of range-partitioned UTSs. You can increase the data set size and convert these table spaces to large partitioned table spaces or range-partitioned UTS table spaces. These changes require that you drop and re-create objects, resulting in an outage.

Without the High-speed Structure Change process, the following steps are required to perform these transformations:

1. Start your table space in read-only access.
2. Unload the data.
3. Drop the old table space.
4. Create the new table space and indexes with the new definitions.
5. Stop your table space.
6. Load the data into the newly defined table space and rebuild all the indexes.
7. Perform RUNSTATS.
8. Re-create any auxiliary objects that were lost due to dropping the table space, such as views or triggers.
9. Rebind the programs that access this table.
10. Start the table space in read-write access.

The data is unavailable for update during Step 1 on page 164 through Step 4 on page 164. In Step 5 on page 164 through Step 9 on page 164, the data is unavailable for reading and updating. Additionally, this process requires a large amount of CPU time. The UNLOAD and LOAD must process each row in the table space and rebuild each index.
**Figure 21 on page 165** provides a hypothetical timeline that refers back to these steps for a conversion that requires you to drop and re-create objects.

**Figure 21: Timeline for typical drop-create scenario**

---

**Transformation with the High-speed Structure Change process**

The High-speed Structure Change process includes the following methods:

- **SHRLEVEL REFERENCE**
  The SHRLEVEL REFERENCE parameter enables other applications to have read-only access during the transformation.

- **SHRLEVEL CHANGE**
  The SHRLEVEL CHANGE parameter enables other applications to have read-write access during the transformation by using Online Consistent Copies, Log Master, and the High-speed Apply Engine.

---

**Note**

Because the SHRLEVEL CHANGE method uses Online Consistent Copies, you need to have access to a Recovery Management password for this method.

---

Each method provides more availability and uses less CPU resources than the steps in “Transformation without the High-speed Structure Change process” on page 164.
The transformation is done using a shadow object. This object is referred to as the target object. The object that you want to transform is referred to as the source object. The target object is identical to the source object, except for one or more of the following attributes:

**Table spaces**
- DSSIZE
- SEGSIZE
- MAXPARTITIONS
- MEMBER CLUSTER
- BUFFERPOOL (target page size must be larger than source)

**Index spaces**
- PIECESIZE
- BUFFERPOOL (target page size must be larger than source)
- COMPRESS

If the row formats are different, the target catalog is updated with the row format of the source image. Other attributes, such as PRIQTY, SECQTY, PCTFREE and FREEPAGE, may be different, but they are not honored until you perform a REORG.

The High-speed Structure Change process works at the page level and uses an Online Consistent Copy or Instant Snapshot of the source as input, reads each page, and transforms the page to fit the new definition. The High-speed Structure Change process then moves the page to the target data set.

Transforming your objects is a non-destructive process. Your source object is not touched. You can use your source object for fallback if for some reason you are not happy with the transformation. You can also create an image copy of your target table space, which eliminates the need to image copy the new table space after the transformation. The image copy is an inline image copy.

*Note*  
Recovering with this type of image copy is not as efficient as with a typical image copy. Creating a SHRLEVEL CHANGE image copy or an Online Consistent Copy after the transformation has completed might be a better strategy.

**SHRLEVEL REFERENCE method**

With the High-speed Structure Change SHRLEVEL REFERENCE method, other applications are allowed to have read-only access while the transformation is done.
To convert objects by using the SHRLEVEL REFERENCE method, follow the steps in the order shown in Table 15 on page 167.

Table 15: Steps for using the SHRLEVEL REFERENCE method

<table>
<thead>
<tr>
<th>To perform this step</th>
<th>Use this BMC solution component</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a target set of objects, using the source objects</td>
<td>BMC Database Administration for DB2 (CHANGE MANAGER for DB2 component)</td>
<td>“Creating target objects” on page 168</td>
</tr>
<tr>
<td>as a template.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issue a DB2 command to start the source table space</td>
<td>None</td>
<td>“Starting the database for read-only access” on page 168</td>
</tr>
<tr>
<td>with read-only status.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create a consistent copy of the DB2 table spaces and</td>
<td>BMC Recovery Management for DB2 (Online Consistent Copy or Instant Snapshot with SHRLEVEL</td>
<td>“Creating consistent copies of the objects” on page 169</td>
</tr>
<tr>
<td>indexes.</td>
<td>REFERENCE)</td>
<td></td>
</tr>
<tr>
<td>Create and run a job that transforms the table spaces and</td>
<td>BMC Recovery Management for DB2 (BMC Next Generation Technology Recover for DB2 for z/OS</td>
<td>“Transforming the objects” on page 169</td>
</tr>
<tr>
<td>indexes.</td>
<td>component)</td>
<td></td>
</tr>
<tr>
<td>Perform RUNSTATS.</td>
<td>None</td>
<td>“Running RUNSTATS” on page 170</td>
</tr>
<tr>
<td>Issue a DB2 command to stop the table space.</td>
<td>None</td>
<td>“Stopping the database” on page 170</td>
</tr>
<tr>
<td>Rename the objects. Re-create alias and view triggers.</td>
<td>BMC Database Administration for DB2 (CHANGE MANAGER for DB2 component)</td>
<td>“Renaming the objects” on page 170</td>
</tr>
<tr>
<td>Start the database in read-write status.</td>
<td>None</td>
<td>“Starting the database for read-only access” on page 168</td>
</tr>
<tr>
<td>Run binds.</td>
<td>None</td>
<td>“Rebinding the programs” on page 170</td>
</tr>
<tr>
<td>Modify the batch jobs that reference the source table</td>
<td>None</td>
<td>“Modifying the batch jobs” on page 171</td>
</tr>
<tr>
<td>spaces.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Creating target objects

For data migration, you can use the CHANGE MANAGER component of the Database Administration solution. With CHANGE MANAGER, you can create data structures on a DB2 subsystem from structures that already exist on the same subsystem, or on a different subsystem. You create a target set of data structures, using the source data structures as a template.

Starting the database for read-only access

Use the following procedure to start the database in read-only status:

1. Issue the DB2 command in Figure 23 on page 168.

Figure 23: Command to start the database in read-only status

```
-START DATABASE (databaseName) SPACENAM (spaceName) ACCESS(RO)
```
Creating consistent copies of the objects

Use the following procedure to create a copy of the source objects. The High-speed Structure Change process requires a consistent VSAM image copy as input. You can use an Online Consistent Copy or a SHRLEVEL REFERENCE Instant Snapshot.

1. Build an Online Consistent Copy job or a SHRLEVEL CHANGE Instant Snapshot job.

**Figure 24: Example input for an Online Consistent Copy**

//SYSIN DD *
OPTIONS
  IXRECP YES
  XBMID ssid

  RECOVER TABLESPACE targetDatabaseName.targetTableSpaceName
  TRANSFORM
  INCOPY FULL SNAPSHOT
  MODEL sourceDataSetName.A&LDSNUM.D
  OUTCOPY NO

  RECOVER INDEXSPACE targetDatabaseName.targetIndexSpaceName
  TRANSFORM
  INCOPY FULL SNAPSHOT

2. Run the Online Consistent Copy job or the SHRLEVEL REFERENCE Instant Snapshot job.

Transforming the objects

Use the following procedure to perform the transformation.

NGT Recover can reduce the elapsed time and CPU time by processing at the page level. Instead of performing an unload, drop, create, and load, you are performing a recovery into a shadow object.

1. Build a NGT Recover job by creating JCL that includes the following SYSIN DD statement.

**Figure 25: Input data set for NGT Recover**

//SYSIN DD *
OPTIONS
  IXRECP YES
  XBMID ACPN

  OUTPUT LOCALP
  DSSNAP YES

  COPY TABLESPACE databaseName.tablespaceName
    DSNUM DATASET
    COPYDDN(LOCALP)
    COPYDSN(HLQ.databaseName.&TS.P&LDSNUM)
    FULL YES
    INDEXES YES
    RESETMOD NO
    SHRLEVEL CHANGE
    GROUP YES

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2 Run the NGT Recover job as a batch job by specifying execution of the AFRMAIN module on the EXEC statement of your JCL. The target objects now contain the same data as the source objects.

Running RUNSTATS

Use the following procedure to update all statistics for the table space.

1 Use a control statement similar to the one in Figure 26 on page 170.

Figure 26: Example RUNSTATS control statement

```
RUNSTATS TABLESPACE(databaseName.tableSpaceName) TABLE INDEX
```

Stopping the database

Use the following procedure to stop the database.

1 Issue the DB2 command in Figure 27 on page 170:

Figure 27: Command to stop the database

```
-STOP DATABASE (databaseName) SPACENAM (spaceName)
```

Renaming the objects

The CHANGE MANAGER alter process enables you to rename source objects.

Using the earlier example, you will rename the source and target tables. The transform target table will now have the name of the source table.

Starting the database for read-write access

Use the following procedure to start the database in read-write status.

1 Issue the DB2 command in Figure 28 on page 170:

Figure 28: Command to start the database in read-write status

```
-START DATABASE (databaseName) SPACENAM (spaceName) ACCESS(RW)
```

Rebinding the programs

Rebind the programs that access this table.
Modifying the batch jobs

You cannot rename the table space containing the transformed table and its indexes.

You need to modify any batch jobs that refer to the source table space and index names. For example, you might need to change references in the following commands: DSN1COPY, DSN1PRINT, COPY, REORG, or RUNSTATS.

SHRLEVEL CHANGE method

In this method, you define an ongoing log scan to collect the log generated by the source table space and apply it to the target table once it has been transformed.

An ongoing log scan can run repeatedly, with each start point dependent on the end of the previous log scan. You can scan the logs multiple times, changing the range of the log scan for each run, but not changing the SYSIN DD syntax of your job step. The product keeps track of any transactions (units of recovery) that start within the current log scan, but are still open at the end point. At the start of each run, the product automatically changes the start point so that it begins at the lowest RBA/LRSN address in the set of recorded open transactions from the previous run of the log scan.

(For more information, see “Using Online Consistent Copy for transforms or data migration” on page 249.

The procedure for converting a table space with SHRLEVEL CHANGE method is similar to the procedure for using the SHRLEVEL REFERENCE method, with the following exceptions:

- You do not issue a DB2 command to start the database in read-only status before you create a consistent copy. Instead, you issue the command later in the process.
- You use logical log files to migrate data changes on an ongoing basis.

To convert objects by using the SHRLEVEL CHANGE method, follow the steps in the order shown in Table 16 on page 171.

Table 16: Steps for using the SHRLEVEL CHANGE

<table>
<thead>
<tr>
<th>To perform this step</th>
<th>Use this BMC solution component</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a target set of objects, using the source objects as a template.</td>
<td>BMC Database Administration for DB2 (CHANGE MANAGER for DB2 component)</td>
<td>“Creating target objects” on page 168</td>
</tr>
<tr>
<td>To perform this step</td>
<td>Use this BMC solution component</td>
<td>Reference</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Create an Online Consistent Copy of the DB2 table spaces and indexes and specify a WORKID.</td>
<td>BMC Recovery Management for DB2 (Online Consistent Copy technology)</td>
<td>“Using the WORKID for Online Consistent Copy” on page 173</td>
</tr>
<tr>
<td>Create and run a job that converts the table spaces and indexes.</td>
<td>BMC Recovery Management for DB2 (BMC Next Generation Technology Recover for DB2 for z/OS component)</td>
<td>“Transforming the objects” on page 169</td>
</tr>
<tr>
<td>Create the logical log files.</td>
<td>BMC Recovery Management for DB2 (Log Master for DB2 and High-speed Apply Engine components)</td>
<td>“Creating and applying logical log files” on page 173</td>
</tr>
<tr>
<td>Apply the logical log files to the target table space and indexes.</td>
<td>BMC Recovery Management for DB2 (Log Master for DB2 and High-speed Apply Engine components)</td>
<td>“Creating and applying logical log files” on page 173</td>
</tr>
<tr>
<td>Issue a DB2 command to start the source table space with read-only status.</td>
<td>None</td>
<td>“Starting the database for read-only access” on page 168</td>
</tr>
<tr>
<td>Run RUNSTATS.</td>
<td>None</td>
<td>“Running RUNSTATS” on page 170</td>
</tr>
<tr>
<td>Create the final logical log file, and apply the file to the target objects.</td>
<td>BMC Recovery Management for DB2 (Log Master for DB2 and High-speed Apply Engine components)</td>
<td>“Creating and applying logical log files” on page 173</td>
</tr>
<tr>
<td>Issue a DB2 command to stop the target table space.</td>
<td>None</td>
<td>“Stopping the database” on page 170</td>
</tr>
<tr>
<td>Rename the source and target objects. Re-create alias and view triggers.</td>
<td>BMC Database Administration for DB2 (CHANGE MANAGER for DB2 component)</td>
<td>“Renaming the objects” on page 170</td>
</tr>
<tr>
<td>Start the database in read-write status.</td>
<td>None</td>
<td>“Starting the database for read-only access” on page 168</td>
</tr>
<tr>
<td>Run binds.</td>
<td>None</td>
<td>“Rebinding the programs” on page 170</td>
</tr>
<tr>
<td>Modify the batch jobs that reference the source table spaces.</td>
<td>None</td>
<td>“Modifying the batch jobs” on page 171</td>
</tr>
</tbody>
</table>
Figure 29 on page 173 provides a hypothetical timeline that corresponds to the steps shown in Table 16 on page 171 for performing conversion using the SHRLEVEL CHANGE method.

**Figure 29: SHRLEVEL CHANGE method timeline**

---

**Using the WORKID for Online Consistent Copy**

For the Online Consistent Copy technology, you can optionally specify a Log Master WORKID in SYSIN.

For more information about WORKID, see “Building and executing Online Consistent Copy jobs” on page 217 and “Using Online Consistent Copy for transforms or data migration” on page 249.

**Creating and applying logical log files**

With the Log Master component of the Recovery Management solution, you can define an ongoing log scan (one that runs repeatedly, with each start point dependent on the end of the previous log scan).

You can scan the logs multiple times, changing the range of the log scan for each run, but not changing the SYSIN DD syntax of your job step. The product keeps track of any transactions (units of recovery) that start within the current log scan, but are still open at the end point. At the start of each run, the product automatically changes the start point so that it begins at the lowest RBA/LRSN address in the set of recorded open transactions from the previous run of the log scan.
The High-speed Apply Engine component of the Recovery Management solution accepts the Log Master logical logs as an input source and uses them to update the target tables.

To create the logical log files and apply the files to the target objects

1. Build a Log Master job by creating JCL that includes the following SYSIN DD statement.

   **Figure 30: Input SYSIN syntax for Log Master**

   ```
   //SYSIN DD *,DLM=##
   OPTION
   FILTERREL OR EXECUTION MODE CURRENT
   SORTOPTS
   FILSZ NONE
   HISTORY WRITE
   WORKID jobID.workID <=jobID - job that ran the Online Consistent Copy DESC "userID date timestamp"
   LOGSCAN
   REPORT TYPE SUMMARY
   ORDER BY TABLE NAME
   SYOUT
   CLASS(*) NOHOLD
   LLLOG
   DATASET &SYSUID..D&DATE..T&TIME..LLOGDATA NEW
   CYLINDERS SPACE(1,1) UNIT(SYSDA) RELEASE
   Control &SYSUID..D&DATE..T&TIME..LLOGCNTL NEW
   CYLINDERS SPACE(1,1) UNIT(SYSDA) RELEASE
   DATEFMT DB2I
   DB2CATALOG NO
   FROM DATE(2011-01-01) TIME(17.00.00) TO CURRENT
   WHERE
   TABLESPACE NAME IN ('databaseName.tableSpaceName'
   'databaseName.tableSpaceName')
   ONGOING HANDLE 501
   ```

2. Build a High-speed Apply Engine job by creating JCL that includes the following SYSIN DD statement.

   **Figure 31: Input SYSIN syntax for High-speed Apply Engine**

   ```
   //SYSIN DD *,DLM=##
   /STARTUP/
   FILENAME=&SYSUID..D&DATE..T&TIME..LLOGCNTL
   INPUTTYPE=LOGICALLOG
   SSID=DHA2
   /LOGICALLOG/
   SQLTYPE=MIGRATE
   INCLUDERI=NO
   INCLUDEDDL=YES
   SORT=YES
   QUALIFY=KEY
   UPDATECOLUMNS=CHANGED
   CCSIDCOMPATIBLE=NO
   /DISTRIBUTIONTUNING/
   PARTITIONCLUSTERING=NO
   RICLUSTERING=YES
   ```
3 Run the Log Master job as a batch job by specifying execution of the ALPMAIN module on the EXEC statement of your JCL.

4 Run the High-speed Apply Engine job as a batch job by specifying execution of the APTBMAIN module on the EXEC statement of your JCL.

5 Rerun the jobs as needed until the desired batch window is achieved.

Multi-table table space considerations

Multi-table table space transformations have the following requirements:

- Multi-table table spaces must be segmented.
- Each table must be processed with a separate TRANSFORM statement.
- The TRANSFORM statement must include OBIDXLAT OBID with a source OBID value. The target OBID can be defaulted. The DBID and PSID are not required.
- The target indexes must be rebuilt.

Figure 32 on page 175 provides an example of the syntax used to transform a table in a multi-table table space.

Figure 32: Example syntax for a multi-table table space transformation

RECOVER TABLESPACE PBGDB.TS1 DSNUM ALL
OBIDXLAT OBID(3,3)
TRANSFORM
INCOPY FULL SNAPSHOT
MODEL RDADMB.DSNDBD.MULTTB.MULTTS.SNAP&DSNUM
REBUILD INDEX(ALL) TABLESPACE PBGDB.TS1 DSNUM ALL

RECOVER TABLESPACE PBGDB.TS2 DSNUM ALL
OBIDXLAT OBID(7,3)
TRANSFORM
INCOPY FULL SNAPSHOT
MODEL RDADMB.DSNDBD.MULTTB.MULTTS.SNAP&DSNUM
REBUILD INDEX(ALL) TABLESPACE PBGDB.TS2 DSNUM ALL

Restrictions

Note the following restrictions when converting your table spaces:
- The source table space cannot contain tables with large object (LOB) or XML columns.

- You must rebuild (not transform) the partitioned indexes of a range-partitioned table space when you are transforming into a partition-by-growth table space.

- You must rebuild (not transform) the indexes when transforming a multi-table table space.

- If the source table space is a compressed, range-partitioned table space, you cannot transform it into a partition-by-growth table space.

- The source and target table spaces must be different, although they can be in the same database.

- You cannot transform an index without transforming its table space.

- You cannot transform a non-large index.

- You cannot transform the indexes of a versioned table space. You must rebuild indexes after you transform the table space and execute REPAIR VERSIONS.

- You cannot transform a compressed index to another compressed index with a larger page size.
  
  In order to move a compressed index to another compressed index with a larger page size, you can rebuild the index.

- You cannot change limit keys with TRANSFORM because TRANSFORM works at the page level.

- The source and target must have the same RBA/LRSN format.
Moving data with a migration file

The Recovery Management solution provides a method for transferring all types of NGT Copy and IBM copies between DB2 subsystems.

The best method to use depends on whether DASD is shared between the two subsystems. With shared DASD, you can use the MIGRATE command to merge the source image copy with log and write the new image directly to the target table space. If the target site is remote, you can use the IMPORT command to move an image copy of the source table space to the target table space.

The MIGRATE and IMPORT commands can process several objects in one execution, an OBJECTSET, or a single table space or index. The table names in the migration file are matched to the table names on the execution subsystem. If the table names do not match, you can use the CHANGE FROM...TO option in the USING specification to make them match. All other attributes of the table must be the same.

CHANGE MANAGER supports the EXPORT and IMPORT commands. For more information, see the CHANGE MANAGER user documentation.

Migration file

The Recovery Management migration file, created by the NGT Copy EXPORT command, contains information to streamline the movement of data with a minimum of user-supplied knowledge and intervention.

The migration file is a sequential file containing metadata that describes table spaces, tables, indexes, and image copies.

The migration file includes information from the following sources:

- SYSCOPY
- BMCXCOPY
- SYSTABLESPACE
- SYSTABLEPART
- SYSTABLES
This file eliminates the need to specify INCOPY, OBIDXLAT, and INDEP OUTSPACE MODEL information. Image copy names, object identifiers, and VSAM data set names will be retrieved or built with information found in the migration file. The migration file also provides a high level of error checking to make sure that the source and the target object definitions match.

The migration file supports the following registered image copy types:

- SHRLEVEL REFERENCE copy
- SHRLEVEL CHANGE copy
- OUTCOPY ONLY copy
- Online Consistent Copy
- Cabinet copy
- FlashCopy
- Snapshot copy

The migration file does not support the following:

- Incremental image copies
- Copies of the DB2 catalog
- Migrating or importing a single piece of a table space—partition or data set (The entire table space must be specified.)

**EXPORT command**

The NGT Copy EXPORT command creates the migration file.

The migration file provides a method for transferring all types of NGT Copy and IBM copies between DB2 subsystems. The migration file contains information to streamline migration or importing process with a minimum of user-supplied knowledge and intervention. The NGT Recover MIGRATE and IMPORT commands are used to complete the transfer and integration of data using the copies.

The EXPORT command migrates a *whole table space* to the target DB2 subsystem. EXPORT uses a DSNUM 0 copy or DSNUM 1 through *nnnn* copies to move all of the data for the table space. The directive option DSNUM is not used with EXPORT.
**Note**

Image copies are not required if the migration file is intended to be used with the MIGRATE option.

SYSCOPY and BMCXCOPY rows and metadata for the selected spaces are written to the designated sequential file. The metadata describes each table space with information needed to translate OBIDs on the target system and to do checks during migration and importing.

The objects named in the EXPORT command must have a current image copy available. If one or more data sets or partitions of a table space (or index, if requested) does not have a recoverable image copy, the EXPORT gives a warning that the Copy Migration file should only be used for MIGRATE. You can use the EXCLUDE keyword to eliminate unrecoverable objects.

There are no restrictions on the types of table spaces that can be exported. XML strings are exported to allow for conversion of the XML string IDs embedded in the XML image copy pages during IMPORT.

For the EXPORT command syntax, see the syntax chapter in the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*.

### IMPORT command

Before using the NGT Recover IMPORT command, the NGT Copy EXPORT command must be run on the source subsystem to collect information on the table spaces being imported.

The NGT Recover IMPORT command is then run on the target subsystem to migrate the data. The migration file contains information on the image copies and the table spaces, eliminating the need for the user to code this information on the command.

The IMPORT command will query the target DB2 catalog to ensure the target table space definitions match the definitions in the migration file.

For the MIGRATE and IMPORT command syntax, see the syntax chapter in the *BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual*.
MIGRATE command

Before using the NGT Recover MIGRATE command, the NGT Copy EXPORT command must be run on the target subsystem to collect information on the table spaces being migrated.

The NGT Recover MIGRATE command is then run on the source subsystem to optionally merge the image copy with the log and migrate the data. The migration file contains information regarding the target the table spaces, eliminating the need for the user to code this information on the command. The image copy information is obtained from the source SYSCOPY and BMCXCOPY tables and the table and table space information is retrieved from the DB2 catalog.

Since the MIGRATE command is run on the source subsystem, the target DB2 catalog cannot be queried to determine if the target definitions match the source definitions. NGT Recover will verify that the information in the image copy header page matches the information in the migration file.

For the MIGRATE and IMPORT command syntax, see the syntax chapter in the BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual.

BMCXCOPY registration

When you run the NGT Copy EXPORT command, every table space in the migration file is logged in BMCXCOPY with an ICTYPE of 'm' and COPY_TYPE of 'X'.

**DSNAME**

DSNAME contains the name of the migration file. When you run the NGT Recover IMPORT command, every table space that is imported is registered in BMCXCOPY with an ICTYPE of 'm' and COPY_TYPE of 'I'.

**EXPSSID**

EXPSSID contains the identifier or group attach name of the subsystem where the EXPORT command was run.

**EXPSLRSN**

EXPSLRSN contains last time at which the table space was updated on the source subsystem, prior to the copy being exported. EXPTLRSN contains the time at which the table space was updated on the target subsystem, prior to being imported. These two timestamps allow NGT Recover to only import data that has changed since the last execution. Alternatively, NGT Recover will MIGRATE data, regardless if the data has changed or not.
Examples

The following examples provide steps for various tasks that you can perform using this feature.

Importing a set of data

In this example, production data is migrated on a regular basis to a query-based subsystem. Because the data is never updated on the target subsystem, the import will only refresh the data that has changed on source subsystem.

1 Create the target objects (or use CHANGE MANAGER).

2 On the source subsystem, create a consistent image copy using a SHRLEVEL REFERENCE image copy or an Online Consistent Copy.

3 Run the NGT Copy EXPORT command on the source subsystem for all the table spaces with a data base name of SRC. If NGT Copy finds image copies for the associated indexes, the index information will be included in the migration file.

   OPTIONS MAXTASKS (1,1)
   OUTPUT EXPFILE UNIT WORK EXPOUT YES
   DSNNAME RADADMB.PBGMIG.EXPORT.SRC
   EXPORT TABLESPACE SRC.* EXPORTDDN(EXPFILE)

4 Run the NGT Recover IMPORT command to import the table space data. INDEXES AUTO tells NGT Recover to recover the associated indexes that have exported image copies. All other associated indexes will be rebuilt. SYNC AUTO will only import the table spaces that have changed since the last IMPORT.

   IMPORT USING RADADMB.PBGMIG.EXPORT.SRC
   CHANGE TABLE FROM SRC.TBL* TO TGT.TBL*
   INDEXES AUTO SYNC AUTO

Migrating a set of data

This is a read-only, query-based target.

1 Create the target objects (or use CHANGE MANAGER).

2 Create image copies for the target objects.

3 Run the NGT Copy EXPORT command on the target subsystem.

   OPTIONS MAXTASKS (1,1)
   OUTPUT EXPFILE UNIT WORK EXPOUT YES
   DSNNAME RADADMB.PBGMIG.EXPORT.TGT
   EXPORT TABLESPACE TGT.* EXPORTDDN(EXPFILE)

4 Quiesce or find a quiet point on the source subsystem.

5 Stop the target table spaces.
6 Run the NGT Recover MIGRATE command on the source subsystem. If there were updates between the image copy and the quiet point, log will be included in the migration.

```
MIGRATE USING RDA\DMB.PBGMIG.EXPORT.TGT
  CHANGE TABLE FROM TGT.TBL* TO SRC.TBL*
  INDEP OUTSPACE
  MODEL &VCAT.DSNDBC.&DB.&TS.I0001.&PART TOLOGPOINT LASTQUIESCE
```

7 If the associated indexes have image copies, they will be migrated, too. If there are no image copies, you will need to execute a REBUILD INDEX(ALL) on the target subsystem.

8 Start the target table spaces.

**Importing versioned data**

1 Create the target objects (or use CHANGE MANAGER).

2 On the source subsystem, create a consistent image copy using a SHRLEVEL REFERENCE image copy or an Online Consistent Copy.

3 Run the NGT Copy EXPORT command on the target subsystem.

4 Run the NGT Recover IMPORT command on the target subsystem to import the table space data. NGT Recover executes a REPAIR VERSIONS to sync the target catalog with the version found in the image copy.

```
IMPORT USING RDA\DMB.PBGMIG.EXPORT.SOURCE
  CHANGE TABLE FROM SRC.TBL* TO TGT.TBL*
  REBUILD AUTO UPDATE VERSIONS
```

5 You must rebuild any associated indexes without image copies in a separate step. Create ARM group to pick up the indexes that are in RBDP status.

6 Run REBUILD on the target subsystem.

```
Note
Data should not contain V0.
```

**Migrating versioned data**

1 Follow the steps in “Migrating a set of data” on page 181 through Step 6 on page 182.

2 Run a REPAIR VERSIONS on the target table spaces and continue with Step 7 on page 182 and Step 8 on page 182.
Online consistent copy

Chapter:

- Overview of Online Consistent Copy
- Operational considerations
- Using RECOVERY MANAGER to create consistent copies
- Syntax and options of Online Consistent Copy commands
- Building and executing Online Consistent Copy jobs
- Examples of Online Consistent Copy jobs
- Usage scenarios
Overview of Online Consistent Copy

The Online Consistent Copy technology is a component of the BMC Recovery Management for DB2 solution. This technology provides the database administrator with an efficient way to make consistent copies of DB2 table spaces and indexes without having to quiesce or cause any other outage to the spaces being copied.

Starting with this release, Online Consistent Copies can be made using the NGT Copy SHRLEVEL CHANGE CONSISTENT YES option and standard NGT Copy JCL. For more information, see the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual.

Consistent image copies

Database administrators often want to make consistent image copies of their data.

A consistent image copy is a copy that does not contain any uncommitted data. Consistent copies are usually required if you want to migrate the data to another object or subsystem. Also, consistent copies have the advantage that you can recover to the copy without having to apply log records.

The main problem with making consistent image copies is that the tools currently available must quiesce the table space, start the table space as read-only, or lock the tables in order to make a consistent copy. On busy systems, it is frequently not possible or desirable to perform any of these actions.

Online Consistent Copy allows you to make consistent copies of table spaces and index spaces without any outage. The spaces being copied are continuously available for read and write access while the copy is being made.

Online Consistent Copy does this is by making SHRLEVEL CHANGE Instant Snapshot copies. Online Consistent Copy uses the log to externalize changes to the copies for all complete transactions and to back out changes in the copies for any inflight transactions. This method is a very efficient way to make consistent copies of very large objects.
If snappable hardware is not available, a VSAM copy can be used to merge with the log. This requires the installation option SNAP=VSAM or SNAP VSAM on the OPTIONS command. A VSAM copy will be used in place of an Instant Snapshot Copy.

Using an Instant Snapshot copy to create Online Consistent Copies for smaller objects may not be as efficient as with larger objects. When you have a mix of small and large objects, you may want the product to choose the best method. In this case, to use a standard SHRLEVEL CHANGE image copy for the smaller objects, Online Consistent Copy requires the use of the OUTSIZE option on the OPTION command and the BIGDDN option on the COPY command. These options, along with an OUTPUT command, specify the name of the output VSAM data set that will contain the consistent copy and work to determine when a data set is sufficiently large to merit using Instant Snapshot copies instead of standard image copies. Only those data sets that pass a user-specified OUTSIZE threshold are copied as Instant Snapshots. All others use standard image copies as input to the merge process. This method is an efficient way to make consistent copies of a large number of objects when a relatively small percentage of the data sets involved are very large.

---

**Note**

When you use standard copies to make consistent copies, the standard copies themselves are not consistent.

---

### Advantages of Online Consistent Copy

As you depend more and more on DB2 for critical business applications, the ability to make consistent copies of your data without an outage, and without impacting the performance of your production systems, becomes crucial. Another key requirement is the ability to make these copies available to other users quickly.

### Benefits of Online Consistent Copy

By taking advantage of Instant Snapshot technology and BMC log analysis and apply technology, Online Consistent Copy can make consistent copies of even very large table spaces or indexes almost instantly and offers several substantial benefits as follows:

**Continuous availability of source objects**

No outage of the source objects is required.
Minimized performance impact on source system

Online Consistent Copy takes advantage of modern storage system technology to make Instant Snapshots, so there is minimal performance impact on the source system (CPU, I/O, or storage).

Copies available quickly

Using Instant Snapshot technology, copies are available to the target users in seconds.

Reduced costs

Because the copies are made in the storage subsystem, practically no host CPU or I/O is required to make consistent Instant Snapshots.

The ability to make standard image copies when there are a large number of objects with a relatively small number of very large data sets is another method of making consistent copies that can improve performance.

Functions and features of Online Consistent Copy

Online Consistent Copy supports almost all of the NGT Copy options used to make Instant Snapshot copies and also offers many functional enhancements. With Recovery Management version 7.3.00 and later, you can also make consistent copies without using Instant Snapshots.

Major features of Online Consistent Copy

Online Consistent Copy provides the following features:

- Supports Instant Snapshot copies in conjunction with the SNAPSHOT UPGRADE FEATURE (SUF) or EXTENDED BUFFER MANAGER (XBM) product
  Instant Snapshot copies use specialized hardware to make data-set-level copies for quick backup.

- Makes consistent Instant Snapshots without any outage of the source objects

- Supports copying a group of spaces at the same point of consistency
- Supports using standard image copies to make consistent VSAM copies, which improves performance when there are a large number of objects, a small percentage of which involve very large data sets.

- Allows the insertion of a log mark into the Log Master data base for use by the High-speed Structure change SHRLEVEL CHANGE process.

**Compatibility with other utilities**

Online Consistent Copy interacts with other utilities in the following ways:

- The DSN1COPY utility can use copies made by Online Consistent Copy.

- The UNLOAD PLUS product can unload copies made by Online Consistent Copy.

- Online Consistent Copy coordinates table space or partition status settings with BMC utilities when running on the same space.

- Online Consistent Copy supports the BMC Software BMCHIST (HISTORY) table. This table is used by other BMC utilities.

- Online Consistent Copy supports the BMC Software BMCSYNC and BMCXCOPY tables, which are used by other BMC utilities.

- Online Consistent Copy supports Instant Snapshot copies with the BMC Software SUF and XBM products. Instant Snapshot copies use specialized hardware to make data-set-level copies for quick backup.

- Online Consistent Copy supports the XBM Utility Monitor that is available with SUF and XBM. The XBM Utility Monitor allows you to view the status of your copy job as it is running.

**Ease-of-use features**

Online Consistent Copy provides the following ease-of-use features:

- Allows wildcard characters to be used in table space and index space specifications.

- Produces copies of multiple spaces at a common point of consistency in one job step with no outage to the source tables.

- Dynamically allocates image copy data sets.
- Allows you to skip a table space that is in an unacceptable status or that is migrated

**Quality and performance features**

Online Consistent Copy supports the use of intelligent storage devices to make Instant Snapshot copies without the CPU time and I/O of traditional copies.

Online Consistent Copy can also use standard image copies to make consistent copies that are VSAM data sets, which can improve performance when a large number of objects are to be copied and a small percentage of the data sets involved are very large.

If your hardware does not support Instant Snapshot copies, you can make Online Consistent Copies using the SNAP VSAM option of *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*. Using SNAP VSAM might not be as fast as Instant Snapshot hardware, but it produces the same type of copy.
Operational considerations

This chapter describes how to prepare your environment to use Online Consistent Copy to the best advantage.

The chapter introduces the following topics:

- Prerequisites and requirements you must meet before starting to use Online Consistent Copy
- Authorization necessary to run Online Consistent Copy
- How Online Consistent Copy determines the status of DB2 objects and ensures the validity of resources that can be shared during processing
- The use of Instant Snapshots to exploit intelligent storage devices

Prerequisites

This section provides information about items requiring special consideration or action before you start to use Online Consistent Copy.

Software prerequisites

Online Consistent Copy requires that you have installed the BMC Recovery Management for DB2 solution and the SNAPSHOT UPGRADE FEATURE (SUF) or the EXTENDED BUFFER MANAGER (XBM) product.

Note

SUF is a component of the Recovery Management solution.

Due to the use of the BMC dynamic bind technology, if you use the NSCMAIN program, you need to first run a regular copy to do the dynamic bind before running Online Consistent Copy for the first time. This is normally handled during
installation when the installation verification procedure (IVP) is done. (For more installation information, see the *Installation System Reference Manual*.)

### Supported hardware

Online Consistent Copy can use the following intelligent storage devices for Instant Snapshot copies:

- EMC Symmetrix hardware with TimeFinder software
- Hitachi 7700E/9900 devices with FlashCopy version 2
- IBM RAMAC Virtual Array (RVA) with a supporting version of IBM Extended Facilities Product
- IBM Enterprise Storage Subsystem (Shark) devices with FlashCopy version 2
- StorageTek (Shared Virtual Array) SVA with a supporting version of IBM Extended Facilities Product or StorageTek SVA Administrator

**Note**

Support for IBM RAMAC Virtual Array (RVA) and StorageTek Shared Virtual (SVA) products will be phased out in a future release of XBM.

### Operating environment

Online Consistent Copy requires the following operating environment:

- Any IBM-supported version of DB2
- Any IBM-supported version of z/OS

### Setting the MEMLIMIT parameter

The Online Consistent Copy technology requires above-the-bar memory and might abend if sufficient memory is not available.

In z/OS versions before 1.10, the default value for the System Management Facility (SMF) MEMLIMIT parameter is 0; a value of 0 means that no address space can use
virtual storage above the bar. In z/OS version 1.10 and later, the default value is 2 GB.

For most jobs, BMC recommends a value of at least 2 GB for the MEMLIMIT parameter. However, if you are operating on LOB or XML data, BMC recommends a value of at least 32 GB.

This value is set in member SMFPRM xx in SYS1.PARMLIB. Use any of the following methods to override the default value:

- Specify the MEMLIMIT parameter in the JCL.
- Specify REGION=0M in the JCL.
- Use the SMF IEFUSI exit.

**Installation considerations**

When you install the BMC Recovery Management *for DB2* solution, Online Consistent Copy is installed as a component of that solution. The installation process does not require any modifications to DB2.

**Authorization requirements**

To use Online Consistent Copy, you need authorization within DB2 and through your system security package. These authorizations must be sufficient to access resources and perform the tasks required during Online Consistent Copy processing.

**DB2 authority**

To use the Online Consistent Copy technology, you must have sufficient authority to execute the product's DB2 plans. Also, you must have one of the following authorizations with your primary or secondary authorization IDs:

- Installation SYSADM or SYSADM
- DBADM, DBCTRL, or DBMAINT authority for the database that contains the named space
- IMAGCOPY and DISPLAY authority for the database that contains the named space
System (RACF authority)

Because Online Consistent Copy does not run as part of the DB2 subsystem, you must have authorization to the underlying data set of a table space or index space. You must have sufficient authority to access the data set through your security system.

See one of the following manuals for more information:

- **BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual**
- **BMC Next Generation Technology Recover for DB2 for z/OS Reference Manual**
- **Log Master for DB2 Reference Manual**

Online Consistent Copy also reads the bootstrap data set (BSDS) to get information about inflight transactions. Therefore, you will need READ authorization for the BSDS.

APF authority

Online Consistent Copy must reside in an APF-authorized library. Also, all load modules that Online Consistent Copy loads must be authorized and must reside in APF-authorized libraries.

Concurrency issues

This section explains how Online Consistent Copy determines the status of DB2 objects and ensures the validity of resources that Online Consistent Copy shares during processing.

The status requirements of Online Consistent Copy are discussed in “Status considerations” on page 194. Online Consistent Copy can also coordinate the use of a space or partition with other concurrently executing BMC utilities. This coordination is discussed in “Concurrency with other BMC utilities” on page 196.

Status considerations

For Online Consistent Copy to start a copy of a space or partition, the status of the space or partition must meet certain requirements:
The space and database must have a start status of RW, RO, UT, or UTRW.

Online Consistent Copy will not run on a space that is in UTUT or UTRO status.

The space can be in any of the following statuses:
- COPY pending (COPY) status
- REORG pending (REORP) status

**Note**
Each partition in a table space can have a different initial status.

If the space is in any status other than those listed, Online Consistent Copy will not run. Online Consistent Copy will not alter the space status.

**Note**
NGT Recover can use Instant Snapshot copies made by Online Consistent Copy for normal forward recovery. If you use NGT Copy to perform a COPY IMAGECOPY of the Instant Snapshot copies made by Online Consistent Copy, the IBM RECOVER utility can use the image copies (now registered in SYSCOPY) in normal forward recovery with the following restriction. If the table space uses LOCKSIZE ROW, the IBM RECOVER utility can use the copies only for a TOCOPY recovery. This restriction does not apply to NGT Recover. For more information, see “Using Online Consistent Copy for recovery” on page 245.

Copies produced by Online Consistent Copy are also useful for data migration. See “Using Online Consistent Copy for migration” on page 241.

### Bypassing spaces that have a bad status

With the COPY command, you can use the ON ERROR BADSTATUS option to tell Online Consistent Copy what action to take if a space or partition is in an unacceptable status, or has a BMC or DB2 utility running against it:

- Use the ON ERROR BADSTATUS SKIP option to bypass the space or partition, issue a message, and continue processing.
- Use the ON ERROR BADSTATUS END option, which is the default, to tell Online Consistent Copy to terminate processing with RC=12.
Concurrency with other BMC utilities

Both the BMCUTIL and BMCSYNC tables are used by BMC utilities to coordinate access to spaces. Online Consistent Copy assumes other BMC utilities are all sharing the same BMCSYNC table. When the BMCSYNC table is shared, Online Consistent Copy can coordinate access to spaces with other BMC utilities by jointly controlling space status.

When you use Online Consistent Copy to create a copy, you should specify SHRLEVEL CHANGE. The Online Consistent Copy job can run concurrently with other BMC utilities that do not require exclusive access.

Instant Snapshot copies

Online Consistent Copy works with the BMC Software SNAPSHOT UPGRADE FEATURE (SUF) and the EXTENDED BUFFER MANAGER (XBM) products to create consistent Instant Snapshot copies.

This snapshot technology exploits intelligent hardware storage devices that support data-set-snap copies at the hardware control unit. These data-set-level copies do not require the I/O needed for a standard copy and can complete in a fraction of the time. See “Supported hardware” on page 192 for a listing of the hardware that is currently supported for Instant Snapshots. For more detailed information about Instant Snapshots, see the EXTENDED BUFFER MANAGER and SNAPSHOT UPGRADE FEATURE User Guide.

The Instant Snapshot data sets are always cataloged in the integrated catalog facility (ICF) catalog. These data sets are VSAM linear data sets and are physical copies of the original DB2 data set.

If your hardware does not support Instant Snapshots, you can also make OCCs using the SNAP VSAM option of BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual. Using SNAP VSAM may not be as fast as Instant Snapshot hardware, but it produces the same type of copy.

Note

Online Consistent Copy does not support incremental copies.

Standard image copies

Online Consistent Copy can also use standard image copies, in addition to Instant Snapshots, to make consistent copies.
Standard image copies may be the most efficient way to make consistent copies of a large number of objects, when a relatively small percentage of the data sets involved are very large. (An Instant Snapshot that takes only 3 seconds per data set is great for a 2 GB-data set, but this time is not optimal for 300 40 KB-data sets.)

Use of standard image copies can have the following advantages:

■ You are not required to have special hardware or software.
■ If you are copying a lot of small data sets, standard image copies may improve performance because Online Consistent Copy can currently do more standard copies in parallel by fully exploiting NGT Copy subtasking than Instant Snapshots. (However, for large data sets, Instant Snapshots are faster.)

Use of standard image copies can have the following disadvantages:

■ The process creates an additional copy of all small data sets.
■ The process creates issues with volume selection for new data sets.

To make VSAM consistent copies by using standard image copies, you use the OUTSIZE option ("OUTSIZE" on page 210) and BIGDDN option (described in the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual) to automatically make standard copies for small data sets and Instant Snapshots for large data sets.

The OUTSIZE option works with the BIGDDN option to determine when a data set is sufficiently large to merit a different sort of output allocation. One way to use these options is to direct very large data sets to an OUTPUT command descriptor defined with DSSNAP YES. In this way, only those data sets that pass a user-specified size threshold are copied with Instant Snapshot.

A requirement to use standard image copies in Online Consistent Copy is that the job must specify a BIGDDN value that corresponds to an OUTPUT descriptor that includes a data set name (or model) to use for the output VSAM copy.
**Note**

If a consistent copy that was made using a standard image copy is not on snappable hardware, you can recover to it using NGT Recover. The consistent copy is a VSAM data set, and NGT Recover can recover using a VSAM data set that is not on snappable disks by using the DATAMVR option.

You can use the consistent copy for recovery by renaming data sets or using DSN1COPY. See “Usage scenarios” on page 241.

You can use the UNLOAD PLUS product to unload it. (For more information, see “Example 4: Unloading consistent data without an outage” on page 232.

You can also use the COPY IMAGECOPY command in the NGT Copy product to convert the VSAM consistent copy to a standard copy, and then use the standard copy for recovery.

For example JCL, see “Example 6: Using standard image copies and Instant Snapshots” on page 238.
You can use RECOVERY MANAGER to generate JCL to create Online Consistent Copies. The Online Consistent Copy technology does not support all default options used by RECOVERY MANAGER. Therefore, during JCL generation RECOVERY MANAGER will override certain options with values appropriate for Online Consistent Copy and issue informative messages.

Be aware of the following options and overrides:

Table 17: RECOVERY MANAGER default value overrides

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Override</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOBs</td>
<td>Online Consistent Copy supports LOBS.</td>
<td>RECOVERY MANAGER switches the copy utility to NGT Copy.</td>
</tr>
<tr>
<td>SHRLEVEL</td>
<td>Online Consistent Copy always makes SHRLEVEL CHANGE copies.</td>
<td>RECOVERY MANAGER switches the specified SHRLEVEL option to CHANGE.</td>
</tr>
<tr>
<td>DSSNAP</td>
<td>The Online Consistent Copy option DSSNAP NO requires BIGDDN YES and the OUTSIZE option greater than zero.</td>
<td>RECOVERY MANAGER switches to BIGDDN YES and OUTSIZE 2500K.</td>
</tr>
<tr>
<td>Incremental copies</td>
<td>Online Consistent Copy does not support incremental copies.</td>
<td>RECOVERY MANAGER switches to FULL COPY YES.</td>
</tr>
<tr>
<td>LB, RP, or RB copies</td>
<td>Online Consistent Copy does not support LB, RP, or RB copies.</td>
<td>RECOVERY MANAGER overrides requests for those copies, which will not be made. You can use the COPY IMAGECOPY feature of NGT Copy to make standard copies from the Online Consistent Copies.</td>
</tr>
<tr>
<td>Encryption</td>
<td>Online Consistent Copy does not support encryption (the NGT Copy ENCIPHER option).</td>
<td>RECOVERY MANAGER switches to ENCIPHER NO.</td>
</tr>
</tbody>
</table>
Using RECOVERY MANAGER to create consistent copies

You can generate JCL to create consistent copies with the Online Consistent Copy technology by using either the RECOVERY MANAGER online interface or the ARMBGRP and ARMBGEN batch programs. RECOVERY MANAGER supports the RMSGROUP option, which enables Online Consistent Copy to use the RECOVERY MANAGER repository to identify the objects in the group. You do not need to regenerate the backup JCL when objects in the group change.

Using the RECOVERY MANAGER online interface

Perform the following tasks to create copies using Online Consistent Copy.

1. Retrieve a saved group or create a new group to be copied.

   For more information, see the RECOVERY MANAGER for DB2 User Guide.

2. Select BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual as the backup utility for the group, as follows:

   a. Starting at the Object List panel, which is displayed when you have retrieved or created a group, select Group Edit and press Enter.

   b. In the Group Edit panel, select Utility options and then press Enter.

   c. In the Utility Options Specification panel, select Update and Backup and press Enter.

   d. In the Update Backup Utility Options panel, select General backup options and press Enter.

   The Update General Backup Options panel is displayed.

   ARMCO001 == Update General Backup Options GROUP RDAXXX UNNAMED_GROUP =========
   Command ===> __________________________________________________________________
   Type information then press Enter.
   Lvl (S=System  G=Group  O=Object  Blank=RMGR default)
   Copy Utility. . . . . . 4 1. COPY PLUS  2. RECOVER PLUS - OUTCOPY 3. DB2 Copy
   Region Size . . . . . . __________(0-2047M) (-1 means none)
   Output Types - LP . . . 1 1. Yes 2. No (Local Site Primary)
   LB . . . 2 1. Yes 2. No (Local Site Backup)
   RP . . . 2 1. Yes 2. No (Recovery Site Primary)
   RB . . . 2 1. Yes 2. No (Recovery Site Backup)
   Quiesce Before. . . . . 2 1. Yes 2. No
   After . . . . . 2 1. Yes 2. No
Group . . . . .  2 1. Yes   2. No   (To common quiesce point)
QUIESCE WRITE . . . . 1 1. Yes   2. No
Copy Index Spaces . . . 2 1. Yes   2. No  3. Auto  (if eligible for copy)
Copy All Indexes . . . . 2 1. Yes   2. No   (COPY+ only)
Index Size Threshold __________ _ max bytes(4294967295K,4194303M,4095G)

In the Copy Utility field, select BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual NGT Copy and press Enter. The Update Backup Utility Options panel is displayed again.

3 Use the DSSNAP option to specify whether to make snapshot copies or regular copies, as follows:

a From the Update Backup Utility Options panel, select NGT Copy specific options and press Enter.

The Update NGT Copy Options panel is displayed.

b In the DSSNAP field, specify one of the following options and press Enter:

- Yes - make Instant Snapshot copies
- No - make standard copies (the default)
- Auto - make Instant Snapshot copies if possible. Otherwise make standard copies.

Note
If you specify DSSNAP Yes or Auto, you must specify Resetmod No on the second Update NGT Copy Options panel (ARMCO022).

The second Update NGT Copy Options panel is displayed.
4 Specify Shrlevel 7. Change Consistent (Online Consistent Copy).

5 You can accept the defaults for the remaining NGT Copy options and press Enter to continue.

Be aware that RECOVERY MANAGER will override some options during JCL generation. For more information, see “Using RECOVERY MANAGER to create consistent copies” on page 199.

6 Generate the backup JCL, as follows:

a In the Object List panel for the current group, select Gen Backup JCL foreground, and press Enter to generate JCL for all objects that have an acceptable status.

b When the JCL Specification panel appears, enter a fully qualified output data set name.

c Save the JCL data set or submit the job as required.

Using the ARMBGRP and ARMBGEN batch programs

You can use the ARMBGRP batch program to create a new group or modify an existing group to use Online Consistent Copy as the backup utility.

You can use the ARMBGEN batch program to generate backup JCL for the group using Online Consistent Copy.

For more information about the ARMBGRP and ARMBGEN batch programs, see the RECOVERY MANAGER for DB2 User Guide.
Using RECOVERY MANAGER to recover consistent copies

To recover using consistent copies, you must:

- Specify BMC Next Generation Technology Recover for DB2 for z/OS (formerly RECOVER PLUS) version 8.1.00 or later as the recovery utility for the group
- Use the BMC Recovery Management for DB2 solution password

When NGT Recover is set as the recovery utility, RECOVERY MANAGER displays the consistent copies as recovery resources, and enables you to use them as you would use any other recovery resource.

For information about recovering groups, see the RECOVERY MANAGER for DB2 User Guide.
Using RECOVERY MANAGER to recover consistent copies
Syntax and options of Online Consistent Copy commands

This chapter provides information about the format, syntax, and options of the COPY and OPTIONS commands provided by the Online Consistent Copy technology. This chapter also describes the OUTPUT command, which you can use in association with the COPY command. All of these commands can be present in the SYSIN data set.

Online Consistent Copy commands

The commands provided by Online Consistent Copy are a subset of the commands used by the BMC Next Generation Technology Copy for DB2 for z/OS product. They include almost all of the commands that you can use to make Instant Snapshot copies, as well as the commands to make standard image copies.

Online Consistent Copy provides the COPY command to create full table space consistent VSAM copies or full index consistent VSAM copies using Instant Snapshot technology or standard image copies. The OPTIONS command provides a runtime mechanism to modify some of the installation options. The OUTPUT command describes the parameters used to dynamically allocate one or more output data sets:

- With the COPY command you can perform the following tasks:
  - Copy by table space or partition
  - Copy by index space or partition
  - Copy spaces, partitions, or indexes using wildcards
  - Dynamically allocate output copy data sets
  - Identify alternative outputs
With the OPTIONS command, you can override installation options for the current execution of Online Consistent Copy, including the following options:

- XBM subsystem ID to be used for Instant Snapshot copies
- Maximum number of attempts to use a resource
- Time to wait between attempts to use a resource
- The threshold size for sending output to an alternative output

With the OUTPUT command, you can dynamically allocate output copy data sets by using options to perform the following tasks:

- Define disk data sets
- Make consistent Instant Snapshots by using intelligent storage devices

### Multiple commands in the SYSIN data set

You can use multiple Online Consistent Copy commands in the SYSIN data set.

All of the table spaces and index spaces copied in the same copy statement will be copied at the same consistent point. If you are using Online Consistent Copy to migrate data to another table or subsystem, you should copy all of the tables and indexes that need to be mutually consistent in the same copy statement.

You can mix COPY, OUTPUT, and OPTIONS commands in the same SYSIN data set. However, the following guidelines apply:

- Online Consistent Copy processes statements in the SYSIN data set sequentially.

- You can specify multiple OPTIONS statements. However, Online Consistent Copy uses the last specification for any OPTIONS statement in the SYSIN data set for the entire job step. BMC recommends that the OPTIONS statement appear before any other Online Consistent Copy statement.

- If you have multiple OUTPUT statements in the SYSIN data set, each OUTPUT statement must name a different descriptor.

- You can mix INDEX, INDEXSPACE, and TABLESPACE specifications within a COPY statement. If the statements are mixed, Online Consistent Copy ignores any options that apply only to a TABLESPACE for the INDEX or INDEXSPACE specification.
COPY command

This section provides information about the options available with the COPY command, including option descriptions and usage information. For a complete description of the command syntax, see the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*.

COPY rules

Online Consistent Copy supports almost all of the NGT Copy options that you use to make Instant Snapshot copies and standard image copies:

- You can use wildcards to specify the table spaces and index spaces to be copied.
- You should specify SHRLEVEL CHANGE to avoid a quiesce or other outages.
- Because Instant Snapshot does not support incremental copies, specify FULL YES.
- Instant Snapshot does not support RESETMOD YES, so you must specify RESETMOD NO.
- If you are copying partitioned table spaces or index spaces, Instant Snapshot copies them on a data-set basis, so you must specify DSNUM DATASET or DSNUM integer. For nonpartitioned, multi-data-set spaces, you must specify DSNUM DATASET to specify that you want to copy all of the data sets to separate, output data sets. For more information, see “Copying multi-data-set nonpartitioned spaces” on page 208.
- All of the table spaces and indexes copied in a single job step will be consistent to the same point in time.

Registration of consistent copies

Copies made by Online Consistent Copy are registered in the BMCXCOPY table with an ICTYPE value of F. They are not registered in the SYSIBM.SYSCOPY table because they are not in the format used by IBM DB2 utilities. The START_RBA column of the BMCXCOPY table contains either the consistent point or oldest inflight URID—whichever is the lower value. START_RBA represents the relative byte address (RBA) for non-data-sharing systems or the log record sequence number (LRSN) for data sharing systems. The consistent point is saved in the PIT_RBA column.
Copying multi-data-set nonpartitioned spaces

To copy multi-data-set, nonpartitioned table spaces or index spaces, you must follow certain naming conventions.

The copy (output) data set names must contain the data set number in the form Annn. You can accomplish this by using the &LDSNUM symbolic variable in the OUTPUT DSNAME for the COPY command. For example, you could use a DSNAME option like:

```
DSNAME DEAJCAT.&DB.&TS.A&LDSNUM.&TYPE&TIME
```

Only one name segment of the form A nnn is allowed. No other symbolic names that are related to the data set number will be used in the copy data set model.

You should also specify the DSNUM DATASET option to specify that you want to copy all of the data sets to separate output data sets. Copying individual data sets of a multi-data-set, nonpartitioned space is not allowed. For example, you cannot specify DSNUM 2 for a multi-data-set, nonpartitioned space.

OPTIONS command

The OPTIONS command allows you to override several of the installation options. Online Consistent Copy uses any overrides that you specify with the OPTIONS command for the current execution. Using the OPTIONS command does not modify any of the installation option modules that were created when Online Consistent Copy was installed.

OPTIONS syntax

This section provides information about the options that are useful for Online Consistent Copy, including option descriptions and usage information. For a complete description of the OPTIONS command syntax, see the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual.

XBMID

You can use the XBMID option to specify the XBM ssid or xbmGroup name to be used when you make an Instant Snapshot.
The ssid is the XBM subsystem ID. In a DB2 data sharing environment, you can use xbmGroup in place of ssid with the XBMID keyword. The xbmGroup is the name of the XBM coupling facility group that is defined to the XBM subsystem. See the EXTENDED BUFFER MANAGER and SNAPSHOT UPGRADE FEATURE User Guide for specific information about valid characters for XBMID and for information about the pattern-matching capabilities of XBM.

If you do not specify a value for XBMID, Online Consistent Copy uses the value of the NGT Copy XBMID installation option as the default.

**DB2NTRY**

The DB2NTRY integer option allows you to override the DB2NTRY installation option that tells Online Consistent Copy the maximum number of times to attempt to use a resource before concluding that the resource can not be obtained. The value of integer can be any integer value from 1 through 255.

If you do not specify DB2NTRY with the OPTIONS command, Online Consistent Copy uses the value of the NGT Copy DB2NTRY installation option as the default.

**DB2WAIT**

The DB2WAIT integer option allows you to override the DB2WAIT installation option that tells Online Consistent Copy the time to wait (in seconds) between attempts to use the following DB2 resources when they are not immediately available:

- DB2 system catalog
- BMCUTIL, BMCSYNC, or BMCXCOPY tables
- Table space or index space being copied

The value of integer can be any integer value from 1 through 655.

If you do not specify DB2WAIT with the OPTIONS command, Online Consistent Copy uses the value of the NGT Copy DB2WAIT installation option as the default.
OUTSIZE

OUTSIZE specifies a size threshold for making copies to an alternate DD or output descriptor. For example, you can use OUTSIZE to escalate output to Instant Snapshots rather than standard copies.

You can specify OUTSIZE as the number of 4-KB physical pages. Valid values for number of pages are 0 through 1,073,741,823. This can be specified as OUTSIZE integer or as OUTSIZE integer P.

You can also specify OUTSIZE in kilobytes, megabytes, or gigabytes as follows:

- OUTSIZE integerK, with a limit of 4,294,967,295
- OUTSIZE integerM, with a limit of 4,194,303
- OUTSIZE integerG, with a limit of 4095

If you specify a value greater than 0 and the space or partition being copied is less than the value specified with OUTSIZE, the image copy goes to the DDs as normal (using COPYDDN, RECOVERYDDN, COPYDSN, RECOVERYDSN, FULLDDN, FULLRECDDN, FULLDSN, or FULLRECDSN if specified, which are described in the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual). If threshold specified for OUTSIZE is met or exceeded, the image copy output will go to an alternate set of DDs that are specified with the following keywords, which are described in the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual.

- BIGDDN
- BIGDSN
- BIGRECDDN
- BIGRECDSN

OUTSIZE requires the use of dynamic allocation and can be used with any FULL option. The size of the copy is based on the size of a full copy.

If you do not specify OUTSIZE with the OPTIONS command, Online Consistent Copy uses the value of the NGT Copy OUTSIZE installation option as the default.

Other options

The following options are available with the OPTIONS command, but they do not apply to Online Consistent Copy:
OUTPUT command

Instant Snapshot data sets for Online Consistent Copy are always dynamically allocated. This section discusses the dynamic allocation options for copy data sets that you can code in an OUTPUT statement in the SYSIN data set. This section provides information about the options that are useful for Online Consistent Copy, including option descriptions and usage information. For a complete description of the OUTPUT command syntax, see the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*.

Default descriptor options are included in the default NGT Copy installation module, ACP$OPTS. To use the default output descriptor, use the name DEFAULT with the COPYDDN or RECOVERYDDN option in a COPY statement.

To modify the default descriptor, provide a new descriptor name in an OUTPUT statement and code the options that you want to change. Any options that are not coded use the corresponding values in the default descriptor. Also, by using the DSNAME, COPYDSN, or RECOVERYDSN option in a COPY statement, you can override the default data set names without using an OUTPUT statement.

All statements in the SYSIN data set are processed sequentially. Consequently, a new output descriptor named in an OUTPUT statement is available for all COPY statements that follow that OUTPUT statement. You can use more than one OUTPUT statement in a SYSIN data set, but each output descriptor must have a different name.

OUTPUT name

Specify the OUTPUT keyword to introduce a new output descriptor name. Online Consistent Copy creates the named descriptor and overrides the existing default
values for the options specified in the OUTPUT statement. The value for name must not exceed 8 characters.

Common options

This section describes the DSNAME and UNIT options for OUTPUT statement.

**DSNAME dataSetName**

Specify the DSNAME option and a data set name (dataSetName) to set a new default data set name.

DSNAME is the VSAM cluster name. The data component is named by the hardware implementation. The maximum length of DSNAME is 39 characters. Because V SAM data sets are cataloged in the ICF catalog, each copy data set must have a unique name.

You can construct dataSetName by using any of the symbolic variables shown in Table 18 on page 212.

**Table 18: Symbolic variables for specifying data set names**

<table>
<thead>
<tr>
<th>Symbolic variable</th>
<th>Definition</th>
<th>Length of result</th>
</tr>
</thead>
<tbody>
<tr>
<td>&amp;ATTACH</td>
<td>DB2 group attachment name or subsystem ID</td>
<td>4 bytes</td>
</tr>
<tr>
<td>&amp;DATE</td>
<td>current date (in the form YYMMDD)</td>
<td>6 bytes</td>
</tr>
<tr>
<td>&amp;DAY</td>
<td>Current day (in the form DD)</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;DB</td>
<td>Database containing the space being copied</td>
<td>8 bytes maximum</td>
</tr>
<tr>
<td>&amp;DSNUM or &amp;PART</td>
<td>Data set or partition being copied</td>
<td>2 bytes (0-99)3 bytes (100-999)4 bytes (1000-4096)</td>
</tr>
<tr>
<td>&amp;HOUR</td>
<td>Current hour (in the form HH)</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;ICTYPE</td>
<td>Type of image copy</td>
<td>1 byte</td>
</tr>
</tbody>
</table>

- F for FULL YES
- I for FULL NO
- A for FULL AUTO or CHANGELIMIT
<table>
<thead>
<tr>
<th>Symbolic variable</th>
<th>Definition</th>
<th>Length of result</th>
</tr>
</thead>
<tbody>
<tr>
<td>&amp;INST</td>
<td>Instance number, with valid values of 01 or 02</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;JDATE d e</td>
<td>Current Julian date (in the form YYDDD)</td>
<td>5 bytes</td>
</tr>
<tr>
<td>&amp;JDAY d e</td>
<td>Current Julian day (in the form DDD)</td>
<td>3 bytes</td>
</tr>
<tr>
<td>&amp;JOBNAME</td>
<td>JOB name used in the JCL</td>
<td>8 bytes maximum</td>
</tr>
<tr>
<td>&amp;LDSNUM, &amp;LPART e</td>
<td>Data set or partition being copied (long format)</td>
<td>3 bytes (000-999), 4 bytes (1000-4096)</td>
</tr>
<tr>
<td>&amp;MIN d e</td>
<td>Current minute (in the form MM)</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;MINUTE d e</td>
<td>Current minute (in the form MM)</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;MONTH d e</td>
<td>Current month (in the form MM)</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;OBNOD</td>
<td>Object node (databaseName. spaceName, where spaceName is either a table space name or an index space name)</td>
<td>17 bytes</td>
</tr>
<tr>
<td>&amp;PART or &amp;DSNUM e</td>
<td>Data set or partition being copied</td>
<td>2 bytes (0-99), 3 bytes (100-999), 4 bytes (1000-4096)</td>
</tr>
<tr>
<td>&amp;SEC d e</td>
<td>Current second (in the form SS)</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;SECOND d e</td>
<td>Current second (in the form SS)</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;SEQ g</td>
<td>Sequence number that increments with each reference. It can be used to provide unique output data set names. The sequence number restarts at 1 for each job step.</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;SSID</td>
<td>DB2 subsystem ID</td>
<td>4 bytes</td>
</tr>
<tr>
<td>&amp;STEPNAME h</td>
<td>STEP name used in the JCL</td>
<td>8 bytes maximum</td>
</tr>
<tr>
<td>&amp;TASK g</td>
<td>1- to 2-digit number corresponding to the subtask in which a copy is made. If the copy is made in the main task, the value is 0.</td>
<td>2 bytes</td>
</tr>
<tr>
<td>&amp;TIME d e</td>
<td>Current time (in the form HHMMSS)</td>
<td>6 bytes</td>
</tr>
<tr>
<td>&amp;TS i</td>
<td>Table space or index space being copied</td>
<td>8 bytes maximum</td>
</tr>
</tbody>
</table>
### Symbolic variable | Definition | Length of result
--- | --- | ---
&TYPE | Type of output being produced:  
- LP for local site primary  
- LB for local site backup  
- RP for recovery site primary  
- RB for recovery site backup | 2 bytes
&UID or &USERID | Job or TSO user ID | 7 bytes maximum
&UTIL | Utility ID | 8 bytes maximum
&VCAT | VCATNAME specified in the DB2 catalog for the space that you are copying; or, if the space is partitioned and the copy is DSNUM ALL, the VCAT name from the first partition that you are copying | 8 bytes
&YEAR | Current year (in the form YY) | 2 bytes

---

**a** Any trailing blanks in the result are removed.

**b** The maximum total length allowed for a data set name is 44 bytes, except for Instant Snapshot copies, where the maximum is 39.

**c** This is the group attachment name if one is used as a parameter; otherwise, it is the subsystem ID.

**d** The values for these variables are assigned when the output copy data set is allocated.

**e** You must prefix symbols with a numeric result by one or more alpha characters.

**f** You can override this by using the installation options ICAUTOI and ICAUTOF.

**g** For information on using this symbolic variable with cabinet copies, see the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*.

**h** PROC names are ignored.

**i** &TS for an index copy is the index space name. Using &TS is supported so that a single data set name can be specified for a group containing both table spaces and indexes.

**j** Longer utility IDs are truncated to 8 characters.

---

**UNIT**

When you use Online Consistent Copy to make Instant Snapshots, consider the following information:
If you specify any value for the UNIT option in the OUTPUT command, that value is passed to XBM or SUF as the esoteric unit.

If you do not specify the UNIT option in the OUTPUT command (thus accepting the default UNIT=SYSALLDA), no unit is passed to XBM or SUF.

BMC recommends that you not specify a value for UNIT when you are making Instant Snapshots. When you do not specify a value for UNIT, XBM or SUF determine the UNIT value, and processing is more efficient.

**Other common options**

You can also use the following options to control allocation:

- VOLCNT
- UNITCNT
- DATCLAS
- MGMTCLAS
- STORCLAS

For a complete description of these options, see the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*.

You do not need to specify the CATLG option because CATLG YES is forced for Instant Snapshots.

The MODELDCB, ENCIIPHER, and BUFNO options do not apply to Online Consistent Copy.

**Options reserved for disk data sets**

If you want to make Online Consistent Copies using Instant Snapshots, you must specify the DSSNAP YES option.

Doing so causes Online Consistent Copy to make Instant Snapshot copies with the BMC Software SUF or XBM product.

Instant Snapshots are hardware-based copies that do not require the I/O needed to make a standard copy. They are registered in the BMCXCOPY table. These copies are recognized by other BMC products that access the BMCXCOPY table.

Use the LPVOLS, LBVOLS, RPVOLS, RBVOLS, and VOLUMES options to tell Online Consistent Copy where to allocate space for Instant Snapshots or standard image copies. For a complete description of these options, see the *BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual*. The SPACE,
PCTPRIM, MAXPRIM, NBRSECD, DISKEXPD, DISKRETN, STACK CABINET, and MIGRATE options are not used for Instant Snapshots.

**Options reserved for tape data sets**

Because Online Consistent Copy works with Instant Snapshots and copies that are always stored on disk, you should not use the options reserved for tape data sets.
Building and executing Online Consistent Copy jobs

To build an Online Consistent Copy job, you need to construct SYSIN statements that contain the required Online Consistent Copy commands and options. This chapter explains how to construct these statements.

In addition, the following chapters provide more information that you might find useful in building Online Consistent Copy jobs:

- “Syntax and options of Online Consistent Copy commands” on page 205 describes the commands and options.
- “Examples of Online Consistent Copy jobs” on page 225 provides examples of Online Consistent Copy jobs and outputs.
- “Operational considerations” on page 191 provides operational considerations and Online Consistent Copy concepts.

Building a job

Building an Online Consistent Copy job involves creating JCL that includes the following statements:

- A JOB statement
- An EXEC statement that includes Online Consistent Copy parameters that specify the DB2 subsystem ID or group attachment name, the utility job ID, and so on
- Data definition (DD) statements that specify the following data sets:
  - The Online Consistent Copy and DB2 load libraries, and optionally, the DB2 exit library that you want to use
  - The SYSIN input data set that contains the COPY, OUTPUT, and OPTIONS commands
— The SYSPRINT output data set to use for Online Consistent Copy messages
— Output data sets for inflight transaction analysis ALPPRINT and SYSOUT

You can use RECOVERY MANAGER for DB2 from BMC to build Online Consistent Copy jobs. For more information about using RECOVERY MANAGER to build the jobs, see “Using RECOVERY MANAGER to create consistent copies” on page 199.

The following descriptions provide more details about building an Online Consistent Copy job. Examples of JCL are in the JCL samples provided in members of the HLQ.ACPSAMP installation data set (where HLQ represents the high-level qualifier that was used during installation).

### JOB statement

The JOB statement starts with a job name. Standard JOB statement parameters, such as accounting information and a name that identifies the run, follow the job name.

**Note**
The job name is defined as ACPEXnn (in the examples in “Examples of Online Consistent Copy jobs” on page 225).

You can include the REGION parameter on either your JOB statement or your EXEC statement. See “REGION parameter” on page 219 for recommendations.

### EXEC statement

The EXEC statement specifies the module to be executed for the Online Consistent Copy technology.

The EXEC statement also specifies Online Consistent Copy technology parameters, which are described in “Utility parameters on the EXEC statement” on page 219.

You can include the REGION parameter on either your EXEC statement or your JOB statement. See “REGION parameter” on page 219 for recommendations.

The EXEC statement has the following format:

```
//stepName EXEC PGM=ACPMAIN,REGION=0M,
  PARM='ssid,utilID,restartParm,msgLevel,logMsgLevel'
```

The PGM=ACPMAIN statement specifies the execution module for Online Consistent Copy, and PARM specifies Online Consistent Copy parameters.
The parameters are described in “Utility parameters on the EXEC statement” on page 219. The parameters are positional, and they must be specified in the order shown. If you do not specify a value for a parameter, Online Consistent Copy uses the default value (as shown in the “Utility parameters on the EXEC statement” on page 219).

The EXEC statements contained in the examples in “Examples of Online Consistent Copy jobs” on page 225 show typical parameter coding for Online Consistent Copy job EXEC statements. For a job that uses a command procedure, ensure that quotation marks, commas, and parentheses are used correctly in the EXEC statement.

See the BMC Next Generation Technology Copy for DB2 for z/OS Reference Manual for examples that use a command procedure and a partitioned data set (PDS) member to set the parameters for the utility.

REGION parameter

Include the REGION parameter on either your JOB statement or your EXEC statement to specify the region size (the amount of virtual storage used by the utility).

For the best performance, BMC recommends that you specify REGION=0M. Doing so enables the amount of virtual storage necessary to run the job to automatically be made available when the Online Consistent Copy job runs. If your data center does not permit you to specify REGION=0M, REGION=4M will usually ensure adequate storage.

Note

If you are running under DB2 Version 8 and you specify a value for REGION other than 0M, ensure that you have an appropriate value set for the MEMLIMIT parameter, either as your site’s default SMF option or on your JOB statement or EXEC statement.

BMC recommends that you have a MEMLIMIT value of at least 1 GB. For more information, see “Setting the MEMLIMIT parameter” on page 192.

Utility parameters on the EXEC statement

The Online Consistent Copy parameters in the EXEC statement include:

- A DB2 subsystem ID or group attachment name for DB2 data sharing (ssid)
- A utility ID (utilID)
- A parameter that specifies this is a new job (*restartParm*)
- An optional message-level parameter (*msgLevel*)
- An optional log message-level parameter (*logMsgLevel*)

Table 19 on page 220 describes these parameters.

### Table 19: Utility parameters for Online Consistent Copy

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB2 subsystem ID (<em>ssid</em>)</td>
<td>This parameter specifies the ID of the DB2 subsystem where the spaces to be copied reside or the group attachment name for DB2 data sharing environments.</td>
</tr>
<tr>
<td>Utility ID (<em>utilID</em>)</td>
<td>This parameter specifies the ID that uniquely names a utility execution or job step. The rules for utility ID are as follows:</td>
</tr>
<tr>
<td></td>
<td>■ The utility ID can be from 1 to 8 characters long.</td>
</tr>
<tr>
<td></td>
<td>■ The utility ID can consist of alphanumeric characters, and any of these characters: #, $, @, !, , , and €.</td>
</tr>
<tr>
<td></td>
<td>If you do not specify this parameter, the default is <em>userID. jobName</em>.</td>
</tr>
<tr>
<td></td>
<td>When you run multiple Online Consistent Copy jobs concurrently, each job must use a unique utility ID.</td>
</tr>
<tr>
<td>Restart parameter (<em>restartParm</em>)</td>
<td>This parameter specifies whether this job is a new job, a restart, or a termination. Specify NEW.</td>
</tr>
<tr>
<td>Message level parameter (<em>msgLevel</em>)</td>
<td>This parameter determines which messages Online Consistent Copy returns in the print output data set (SYSPRINT).</td>
</tr>
<tr>
<td></td>
<td>■ If you specify the default, MSGLEVEL(0), Online Consistent Copy returns normal procedural messages associated with the Online Consistent Copy job.</td>
</tr>
<tr>
<td></td>
<td>■ If you specify MSGLEVEL(1), Online Consistent Copy returns additional messages that you can use to enhance job performance.</td>
</tr>
<tr>
<td></td>
<td>■ If you specify MSGLEVEL(2), which is the recommended MSGLEVEL setting, Online Consistent Copy returns additional performance and diagnostic messages in the output. These additional messages are used for performance analysis and problem determination.</td>
</tr>
<tr>
<td></td>
<td>■ If you specify MSGLEVEL(3), Online Consistent Copy returns debugging messages.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>Log message level parameter (logMsgLevel)</td>
<td>This parameter determines which messages are returned in the ALPPRINT output data set during the log analysis phase.</td>
</tr>
<tr>
<td></td>
<td>■ If you specify the default, LOGMSGLEVEL(0), Online Consistent Copy returns normal procedural messages associated with the Online Consistent Copy job.</td>
</tr>
<tr>
<td></td>
<td>■ If you specify LOGMSGLEVEL(1), Online Consistent Copy returns additional messages that you can use to enhance job performance or identify problems.</td>
</tr>
</tbody>
</table>

**STEPLIB DD statement**

The STEPLIB DD statement identifies the Online Consistent Copy load library and the DB2 load library that you want the utility to use.

**Data set DD statements**

The following sections describe the data sets that Online Consistent Copy uses.

Each data set is specified by a data definition name (DDName). You must specify all of the data sets in the JCL.

**SYSIN data set**

SYSIN is the input data set containing one or more COPY, OUTPUT, or OPTIONS commands. Attributes for this data set must be fixed length and blocked records (RECFM=FB), and the record length must be 80 columns (LRECL=80).

**SYSPRINT data set**

SYSPRINT is the output data set for messages returned from Online Consistent Copy and from other procedures invoked during utility execution (such as NGT Copy).

You can specify the level of messages returned by using the message level parameter in the EXEC statement.

For the Online Consistent Copy messages, reason codes, and return codes that can be included in the SYSPRINT output data set. For message explanations, access the BMC Documentation Center from the BMC Support Central site. This also contains the messages returned by backup and recovery products for DB2 utilities.
Running Online Consistent Copy jobs

Running Online Consistent Copy can include the following tasks:

- Starting Online Consistent Copy as a batch job
- Displaying the status of an Online Consistent Copy job
- Restarting a failed Online Consistent Copy job
- Terminating an Online Consistent Copy job
- Cleaning up the BMCUTIL and BMCSYNC tables

To run an Online Consistent Copy job, you must have the proper authorizations. Refer to “Authorization requirements” on page 193 for details.

Starting a job

An Online Consistent Copy job runs as a batch job. You start the job by submitting it for execution. Ensure that all target spaces have an acceptable initial status before you start an Online Consistent Copy job.

Displaying the status of jobs

You can determine the status of Online Consistent Copy jobs that are currently running or that have failed by issuing an SQL SELECT statement on the BMCUTIL table.
Use the following statement as an example where BMC.BMCUTIL is the BMCUTIL table name:

```
SELECT * FROM BMC.BMCUTIL
WHERE DBNAME='databaseName' AND
SPNAME='tableSpaceName'
```

If you installed the CHANGE MANAGER for DB2 product with Online Consistent Copy, you can issue the BMCUTIL command in CATALOG MANAGER to display the status of current BMC utility jobs. Refer to the CATALOG MANAGER for DB2 User Guide for more information about the BMCUTIL command.

**Restarting a job that failed**

If an Online Consistent Copy job fails, you should clean up the BMCUTIL and BMCSYNC tables and restart the job from the beginning, if needed.

See “Cleaning up the BMCUTIL and BMCSYNC tables” on page 223 for more information.

---

**WARNING**

BMC recommends that you always clean up the BMCUTIL and BMCSYNC tables—do not ignore the failure. If no action is taken, subsequent executions of Online Consistent Copy might fail.

---

**Terminating a job during execution**

If immediate termination of Online Consistent Copy is required, cancel the job by using the MVS or TSO CANCEL command. Then, use one of the methods described in “Cleaning up the BMCUTIL and BMCSYNC tables” on page 223 to clean up the BMCUTIL and BMCSYNC tables.

**Cleaning up the BMCUTIL and BMCSYNC tables**

If an Online Consistent Copy job fails, you must clean up the BMCUTIL and BMCSYNC tables before running any more BMC utilities against the space.

You can use the following method to clean up the BMCUTIL and BMCSYNC tables:

- If you have installed CATALOG MANAGER version 3.4, fix lib 3606 or greater, you can issue the BMCUTIL TERM command from CATALOG MANAGER. Refer to the CATALOG MANAGER for DB2 User Guide for more information.
Examples of Online Consistent Copy jobs

This chapter provides examples of jobs that use Online Consistent Copy. Each example includes a brief description of the job, as well as the JCL and SYSPRINT output. Copies of the JCL for these examples are in members in the HLQ.ACPSAMP installation data set (where HLQ represents the high-level qualifier specified during installation).

Example 1: Copying a table space and index

This example illustrates how to use Online Consistent Copy to make mutually consistent copies of a sample table and its index.

Figure 33 on page 225 shows an example of the JCL necessary to perform this job.

Figure 33: Example JCL for copying a table space and index

```
//ACPEX01 JOB (0000), 'EXAMPLE 1', CLASS=A, MSGCLASS=X

// ** MAKE CONSISTENT INSTANT SNAPSHOTS OF TABLE AND INDEX

//STEP1 EXEC PGM=ACPMAIN, PARM='DEAJ, SAMPLE', REGION=0M
//STEPLIB DD DISP=SHR, DSN=PRODUCT.LOAD.LIBS
// DD DISP=SHR, DSN=DSNEXIT
// DD DISP=SHR, DSN=DSNLOAD
//SYSPRINT DD SYSOUT=* 
//SYSOUT DD DUMMY
//ALPPRINT DD DUMMY
//AFRSTMT DD DUMMY
//AFRPRINT DD DUMMY
//AFRSUMRY DD DUMMY
//AFROSUM DD DUMMY
//AFRTIME DD DUMMY
//SYSIN DD *

OPTIONS
XBMD ACPN

OUTPUT LOCALP
DSSNAP YES
DSNAME BMCNSC.&DB.&TS.D&DNUM.&TYPE&TIME
```
Example 1: Copying a table space and index

```sql
COPY TABLESPACE TGPDB.DSN8S41D
  DSNUM DATASET
  COPYDDN (LOCALP)
  INDEXSPACE TGPDB.XDEPT1
  DSNUM DATASET
  COPYDDN (LOCALP)

  FULL YES
  RESETMOD NO
  SHRLEVEL CHANGE CONSISTENT YES
```

Figure 34 on page 226 shows an example of the SYSPRINT output for the job.

Figure 34: Example SYSPRINT output from copying a table space and index

```
COPY TABLESPACE TGPDB.DSN8S41D
  DSNUM DATASET
  COPYDDN (LOCALP)
  INDEXSPACE TGPDB.XDEPT1
  DSNUM DATASET
  COPYDDN (LOCALP)

  FULL YES
  RESETMOD NO
  SHRLEVEL CHANGE CONSISTENT YES
```
Example 2: Migrating data by renaming data sets

This example illustrates the JCL necessary to use Online Consistent Copy to make a consistent copy of a sample table, and then migrate the data to another subsystem by renaming the data sets.

Figure 35: Example JCL for migrating data by renaming data sets

```//ACPEX02  JOB (0000),'EXAMPLE 2',CLASS=A,MSGCLASS=X
//*
//** MIGRATE DATA USING ONLINE CONSISTENT COPY AND
//** RENAMING DATA SETS
//**
//** MAKE A CONSISTENT INSTANT SNAPSHOT
//**
//STEP1 EXEC PGM=ACPMAIN,PARM='DEAJ,SAMPLE',REGION=0M
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
//          DD DISP=SHR,DSN=DSNLOAD
//SYSPRINT DD SYSOUT=* 
//SYSOUT DD SYSOUT=* 
//ALPPRINT DD DUMMY
//AFRSTMT DD DUMMY
//AFRPRINT DD DUMMY
//AFRSUMRY DD DUMMY
//AFROSUM DD DUMMY
//AFRTIME DD DUMMY
//SYSIN DD *
OPTIONS
XBMID ACPN
OUTPUT LOCALP
DSSNAP YES
DNAMDEARCAT.&DB.&TS.D&DSNUM.SNAPSHOT
COPY TABLESPACE TGPDB.DSN8S41D
DSNUM DATASET
COPYDDN (LOCALP)
FULL YES
RESETMOD NO
SHRLEVEL CHANGE CONSISTENT YES```
Example 2: Migrating data by renaming data sets

Figure 36 on page 228 shows an example of the SYSPRINT output for this job.

Figure 36: Example SYSPRINT output from migrating data and renaming data sets

BMC3100001 ONLINE CONSISTENT COPY FOR DB2 V11.2.00
BMC310001I COPYRIGHT BMC SOFTWARE INC. 2006-2015
BMC310304I EXECUTION STARTING 01/31/2015 11:29:19 ...
BMC310002I DB2 SUBSYSTEM ID = DEAJ.
BMC310004I Utility ID = SAMPLE.
BMC30101I COPY PLUS FOR DB2 V11.2.00
BMC30101I COPYRIGHT BMC SOFTWARE INC. 1991-2015
BMC30101I CONTACT BMC SUPPORT AT 1-800-537-1813 OR EMAIL TO SUPPORT@BMC.COM
BMC30001I Utility Execution Starting 01/31/2015 11:29:19 ...
BMC30101I OPTIONS
BMC30101I XBMID ACPN
BMC30101I DB2 Subsystem ID = DEAJ.
BMC330082I RESTART PARM = NEW/RESET
BMC30101I OPTIONS
BMC330082I DB2 Subsystem ID = DEAJ.
BMC30101I OPTIONS
BMC330082I DB2 Subsystem ID = DEAJ.
BMC330082I DB2 Subsystem ID = DEAJ.
Example 2: Migrating data by renaming data sets

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```none
BMC30101I COPY TABLESPACE TGPDB.DSN8S41D
BMC30101I DSNUM DATASET
BMC30101I COPYDDN (LOCALP)
BMC30101I FULL YES
BMC30101I RESELMOD NO
BMC30101I SHRLEVEL CHANGE
BMC30004I DB2 VERSION = 810  SITE TYPE = LOCAL
BMC30136I DB2 SECURITY EXIT NOT ACTIVE - RC = 4
BMC30101I
BMC160660I PROCESSING COMMAND COPY ON TGPDB.DSN8S41D DSNUM 1
BMC30101I
BMC47390I WILD CARD SELECTION: TABLESPACE TGPDB.DSN8S41D (001)
BMC30101I
BMC47347I BEGINNING INITIALIZATION FOR TGPDB.DSN8S41D (01), COMMAND NBR 2
BMC160625I OPTION CHECKTLEVEL IGNORED FOR INSTANT SNAPSHOT COPY
BMC160625I OPTION CHECKERROR IGNORED FOR INSTANT SNAPSHOT COPY
BMC30012I UTILINIT PHASE COMPLETE. ELAPSED TIME = 00:00:00
BMC30012I INSTANT SNAPSHOT COPY DEARCAT.TGPDB.DSN8S41D.D01.SNAPSHOT.DATA COMPLETE
BMC47322I LP COPY REGISTERED AT 01014013494C
BMC30542I DD=LOCALP, DSN=DEARCAT.TGPDB.DSN8S41D.D01.SNAPSHOT.DATA
BMC30012I COPY PHASE COMPLETE. ELAPSED TIME = 00:00:02
BMC30005I UTILTERM PHASE COMPLETE. RETURN CODE = 0
BMC310303I LOOKING FOR INFLIGHT TRANSACTIONS
BMC310303I EXTERNALIZING CHANGES
BMC310303I BACKING OUT INFLIGHT TRANSACTIONS
BMC310021I EXECUTION COMPLETE, RETURN CODE = 0
READY

DSN SYSTEM(DEAR)
DSN
-STOP DATABASE(TGPTEST) SPACENAM(DSN8S41D)
DSN9022I *DEAR DSNTDDIS 'STOP DATABASE' NORMAL COMPLETION
DSN
END
READY

END

IDCAMS SYSTEM SERVICES        TIME: 11:29:45        01/31/15 PAGE 1
ALTER DEARCAT.DSNDBC.TGPTEST.DSN8S41D.I0001.A001 -
   NEWNAME (DEARCAT.DSNDBC.TGPTEST.DSN8S41D.SAVE)
IDC0531I ENTRY DEARCAT.DSNDBC.TGPTEST.DSN8S41D.I0001.A001 ALTERED
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
ALTER DEARCAT.DSNDBD.TGPTEST.DSN8S41D.I0001.A001 -
   NEWNAME (DEARCAT.DSNDBD.TGPTEST.DSN8S41D.SAVE)
IDC0531I ENTRY DEARCAT.DSNDBD.TGPTEST.DSN8S41D.I0001.A001 ALTERED
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
IDCAMS SYSTEM SERVICES        TIME: 11:29:45        01/31/15 PAGE 1
ALTER DEARCAT.TGPDB.DSN8S41D.D01.SNAPSHOT -
   NEWNAME (DEARCAT.TGPDB.TGPTEST.DSN8S41D.D01.SNAPSHOT)
IDC0531I ENTRY DEARCAT.TGPDB.DSN8S41D.D01.SNAPSHOT.DATA ALTERED
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
ALTER DEARCAT.TGPDB.DSN8S41D.D01.SNAPSHOT.DATA -
   NEWNAME (DEARCAT.TGPDB.TGPTEST.DSN8S41D.D01.SNAPSHOT)
IDC0531I ENTRY DEARCAT.TGPDB.DSN8S41D.D01.SNAPSHOT.DATA ALTERED
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
IDC0002I IDCAMS PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
READY

DSN SYSTEM(DEAR)
DSN
-START DATABASE(TGPTEST) SPACENAM(DSN8S41D)
DSN9022I *DEAR DSNTDDIS 'START DATABASE' NORMAL COMPLETION
```
Example 3: Recovering a table space and index

This example illustrates how to use the NGT Recover product to recover to the point in time corresponding to the specified copies produced by Online Consistent Copy.

Figure 37 on page 230 shows an example of the JCL necessary to perform this job.

Figure 37: Example JCL for recovering a table space and index using Online Consistent Copy

```
//ACPEX03  JOB (0000),'EXAMPLE 3',CLASS=A,MSGCLASS=X
//*
//=== RECOVER TABLE SPACE AND INDEXES USING ONLINE
//* CONSISTENT COPIES AND BMC RECOVER PLUS
//*
//STEP1 EXEC PGM=AFRMAIN,
//      PARM='DFC1,BMCRECOVER',
//      REGION=0M
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
//          DD DISP=SHR,DSN=DSNLOAD
//SYSUDUMP DD SYSOUT=* 
//SYSPICK DD SYSOUT=* 
//SYSOUT DD SYSOUT=* 
//SYSERR DD SYSOUT=* 
//AFROSUM DD SYSOUT=* 
//SYSIN DD *
OPTION XBMID ACPB
RECOVER TABLESPACE RMDDB56.TS56N01 DSNUM 1
     INCOPY FULL SNAPSHOT
     DSNNAME DSNDFC.RMDDB56.TS56N01.LP01.T084608.DATA
     TOCOPY LASTCOPY
RECOVER INDEXSPACE RMDDB56.IC56N011 DSNUM 1
     INCOPY FULL SNAPSHOT
     DSNNAME DSNDFC.RMDDB56.IC56N011.LP01.T084608.DATA
     TOCOPY LASTCOPY
RECOVER INDEXSPACE RMDDB56.IN56N013 DSNUM 1
     INCOPY FULL SNAPSHOT
     DSNNAME DSNDFC.RMDDB56.IN56N013.LP01.T084608.DATA
     TOCOPY LASTCOPY
/*
```

Figure 38 on page 230 shows an example of the AFROSUM and AFRPRINT output for this job.

Figure 38: Example AFROSUM and AFRPRINT output

BMC40018I RECOVER PLUS FOR DB2 V11.2.00
BMC4047I COPYRIGHT BMC SOFTWARE INC. 1991-2015
BMC9617I RECOVER PLUS TECHNOLOGY IS PROTECTED BY U.S. PATENT 7,133,884
BMC4047I CONTACT BMC SUPPORT AT 1-800-537-1813 OR EMAIL TO SUPPORT@BMC.COM

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Example 3: Recovering a table space and index
Example 4: Unloading consistent data without an outage

This example illustrates how to unload consistent data without an outage.

To do so, the example uses the following utilities:

- The Online Consistent Copy technology to make a consistent Instant Snapshot of a sample table
The UNLOAD PLUS utility to unload a consistent version of the data from the Instant Snapshot.

Figure 39 on page 233 shows an example of the JCL necessary to perform this job.

Example 4: Unloading consistent data without an outage

```
//ACPEX04 JOB (0000),'EXAMPLE 4',CLASS=A,MSGCLASS=X
/**
** UNLOAD CONSISTENT DATA WITHOUT AN OUTAGE USING
** ONLINE CONSISTENT COPY AND BMC UNLOAD PLUS
/**
/**
/** MAKE A CONSISTENT INSTAN'T SNAPSHOT
/**
//STEP1 EXEC PGM=ACPMAIN,PARM='DEAJ,SAMPLE',REGION=0M
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
//          DD DISP=SHR,DSN=DSNLOAD
//SYSPRINT DD SYSOUT=*  
//SYSOUT   DD SYSOUT=*  
//ALPPRINT DD DUMMY
//AFRSTMT  DD DUMMY
//AFRPRINT DD DUMMY
//AFRSMRY  DD DUMMY
//AFRTIME  DD DUMMY
//SYSIN DD *
OPTIONS  
XBMID ACPN
OUTPUT LOCALP
DSSNAP YES
DNNAME RDATGP.&DB.&TS.D&DSNUM.SNAPSHOT
COPY  TABLESPACE TGPDB.DSN8S41D
DSNUM DATASET
COPYDDN (LOCALP)
FULL YES
RESETMOD NO
SHRLEVEL CHANGE CONSISTENT YES
/**
** UNLOAD DATA FROM THE COPY
/**
//STEP2 EXEC PGM=ADUUMAIN,REGION=0M,
//         PARM='DEAJ,ADUXM15,NEW,,MSGLEVEL(1)'
//STEPLIB  DD DISP=SHR,
//         DD DISP=ADU.V620INST.LOAD
//         DD DISP=ADU.V620INST.LOAD
//SYSIN    DD   *
* 
UNLOAD INFILE VSAMDD
   SELECT * FROM RDATGP.DEPT
*
* 
/VSAMDD  DD DISP=SHR,
//         DSN=RDATGP.TGPDB.DSN8S41D.D01.SNAPSHOT
//SYSREC  DD DSN=RDATGP.SYSREC,
//         DISP=(.,CATLG),SPACE=(TRK,(1,1)),UNIT=SYSDA
//SYSCNTL DD DSN=RDATGP.SYSCNTL,
//         DISP=(.,CATLG),SPACE=(TRK,(1,1)),UNIT=SYSDA
//UTPRINT DD SYSOUT=*  
//SYSPRINT DD SYSOUT=*  
```
Figure 40 on page 234 shows an example of the SYSPRINT output for this job.

**Figure 40: Example SYSPRINT output from unloading consistent data without an outage**

```plaintext
BMC310000I ONLINE CONSISTENT COPY FOR DB2 V11.2.00
BMC310001I COPYRIGHT BMC SOFTWARE INC. 2006-2015
BMC310304I EXECUTION STARTING 01/01/2015 09:29:01 ...
BMC310002I DB2 SUBSYSTEM ID = DEAJ.
BMC310004I UTILITY ID = SAMPLE.
BMC31011I COPY PLUS FOR DB2 V11.2.00
BMC47491I COPYRIGHT BMC SOFTWARE INC. 1991-2015
BMC47487I COPY PLUS TECHNOLOGY IS PROTECTED BY U.S. PATENT 7,133,884
BMC47492I CONTACT BMC SUPPORT AT 1-800-537-1813 OR EMAIL TO SUPPORT@BMC.COM
BMC30001I UTILITY EXECUTION STARTING 01/01/2015 09:29:01 ...
BMC30101I BMC30101I
BMC30002I UTILITY ID = SAMPLE. DB2 SUBSYSTEM ID = DEAJ.
BMC30008I RESTART PARM = NEW/RESET
BMC30101I OPTIONS
BMC30101I XBMID ACPN
BMC30101I OUTPUT LOCALP
BMC30101I DSSNAP YES
BMC30101I DSNNAME RDATGP.&DB.&TS.&DSNUM.SNAPSHOT
BMC30101I
BMC30101I COPY TABLESPACE TGPDB.DSN8S41D
BMC30101I DSNUM DATASET
BMC30101I COPYDDN (LOCALP)
BMC30101I
BMC30101I FULL YES
BMC30101I RESTMOD NO
BMC30101I SHRLEVEL CHANGE
BMC30004I DB2 VERSION = 810 SITE TYPE = LOCAL
BMC30136I DB2 SECURITY EXIT NOT ACTIVE - RC = 4
BMC30101I
BMC160660I PROCESSING COMMAND COPY ON TGPDB.DSN8S41D DSNUM 1
BMC30101I BMC30101I
BMC47390I WILD CARD SELECTION: TABLESPACE TGPDB.DSN8S41D (001)
BMC30101I
BMC47347I BEGINNING INITIALIZATION FOR TGPDB.DSN8S41D (01), COMMAND NBR 2
BMC160625I OPTION CHECKTSLEVEL IGNORED FOR INSTANT SNAPSHOT COPY
BMC160625I OPTION CHECKERROR IGNORED FOR INSTANT SNAPSHOT COPY
BMC30012I UTILINIT PHASE COMPLETE. ELAPSED TIME = 00:00:00
BMC160626I INSTANT SNAPSHOT COPY RDATGP.TGPDB.DSN8S41D.D01.SNAPSHOT.DATA COMPLETE
BMC47322I LP COPY REGISTERED AT 010170B2811D
BMC30542I DD=LOCALP, DSN=RDATGP.TGPDB.DSN8S41D.D01.SNAPSHOT.DATA
BMC30012I UTILTERM PHASE COMPLETE. ELAPSED TIME = 00:00:07
BMC30525I COPY COMMAND EXECUTION COMPLETE, RETURN CODE = 0
BMC30005I UTILITY EXECUTION COMPLETE, RETURN CODE = 0
BMC310303I LOOKING FOR INFLIGHT TRANSACTIONS
BMC310303I EXTERNALIZING CHANGES
BMC310303I BACKING OUT INFLIGHT TRANSACTIONS
BMC310021I EXECUTION COMPLETE, RETURN CODE = 0
***** **** B M C U N L O A D E R P L U S F O R D B 2 V11.2.00 *****
COPYRIGHT (C) 1991 - 2015 BMC SOFTWARE, INC. AS AN UNPUBLISHED LICENSED WORK. ALL RIGHTS RESERVED.
BMC50001I UTILITY EXECUTION STARTING 01/01/2015 9:29:30 ...
BMC50002I UTILITY ID = ADUXM15'. DB2 SUBSYSTEM ID = 'DEAJ'. OPTION MODULE = 'ADU $OPTS'.
BMC50471I MVS=SP7.0.1,PID=JBB7713,DFSMS=2.10.0,DB2=9.1.0
BMC50471I DIAG1=7AFAFA10B7C100000001C000000000000
BMC50471I DIAG2=00000000000000000000000000000000
BMC50471I SMCORE=(0K,0K)
BMC50471I SMAX=16
BMC50471I CMAX=16
BMC50471I MAXP=5
```
Example 4: Unloading consistent data without an outage

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Example 5: Migrating data with consistent copy and NGT Recover

This example illustrates how to restore the consistent copy files from one DB2 subsystem to another as a way to migrate the table space data sets.

To do so, the example uses the following utilities:

- The Online Consistent Copy technology to make the consistent copies of the table spaces
- The NGT Recover utility with its OBIDXLAT option to recover the table spaces on another SSID

You use the NGT Recover OBIDXLAT option to change the internal IDs in the DB2 table space or index space as it is recovered. You can specify the source and target IDs using the DBID, PSID, and OBID keywords. You can omit either the source or the target DBIDs and PSIDs, or you can omit the DBID or PSID keywords entirely. If you omit the target value from a DBID or PSID clause, the value defaults to the DBID or PSID of the object as reflected in the catalog of the current subsystem. When you specify the INCOPY option without the DROPRECOVERY option, the source DBID and PSID is taken from the image copy.

For a single-table table space, you can omit either the source or the target OBID, or you can omit the OBID keyword entirely. If you omit a target value from an OBID clause, the value defaults to the OBID of the object as reflected in the catalog of the current subsystem. If you specify INCOPY without DROPRECOVERY, the source OBID is taken from the image copy.

In this example, the DBID, PSID, and OBID keywords are omitted and NGT Recover automatically finds the correct values for the OBID translation.
The following are examples of the JCL necessary to perform this task. Figure 41 on page 237 shows the JCL for the Online Consistent Copy job and Figure 42 on page 237 shows the JCL for the NGT Recover job.

Figure 41: Example JCL to create the Online Consistent Copy of the table spaces

```jcl
//NSCCOPY EXEC PGM=ACPMAIN,
//    PARM='&SSID,CASE21,NEW,MSGLEVEL(1)'
//STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//    DD DISP=SHR,DSN=DSNEXIT
//    DD DISP=SHR,DSN=DSNLOAD
//SYSPRINT DD DSN=RMD.NSC.&SSID..CASE21.SYSPRINT,
//    DISP=(NEW,CATLG),UNIT=SYSALLDA,
//    SPACE=(CYL,(1,1)),
//    DCB=(RECFM=FB,LRECL=133,BLKSIZE=13300)
//SYSOUT DD SYSOUT=* 
//ALPPRINT DD SYSOUT=*
//AFRSTMT DD SYSOUT=*
//AFRPRINT DD SYSOUT=*
//AFRSUMRY DD SYSOUT=*
//AFROSUM DD SYSOUT=*
//SYSIN DD *
//OPTIONS IXDSNUM ALL
//XBMID XBMA
//OUTPUT COPY0001
//CATLG YES
//DSSNAP YES
//SPACE CYL
COPY TABLESPACE RMDCC52.TC52N01
   DSNUM DATASET
   INDEXES YES
   COPYDDN("COPY0001")
   COPYDSN("DEBHCAT.&DB.&TS.&TYPE&PART.T&TIME")
   SHRLEVEL CHANGE CONSISTENT YES
   RESETMOD NO
   GROUP YES
/*
```

Figure 42: Example JCL to recover table spaces by using NGT Recover with its OBIDXLAT option

```jcl
//***************************************************************
//* RECOVER TABLESPACES USING RECOVER PLUS AND OBIDXLAT
//***************************************************************
 ARM0001 EXEC PGM=AFRMAIN,
// PARM='DEBC,,NEW,,CHECKPT(NO),RDB2STAT(YES)',
// REGION=0M
//STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//    DD DISP=SHR,DSN=DSNEXIT
//    DD DISP=SHR,DSN=DSNLOAD
//SYSDUMP DD SYSOUT=*
//SYSPICK DD SYSOUT=*
//SYSERR DD SYSOUT=*
//AFROSUM DD SYSOUT=*
//SYSIN DD *
//OPTION XBMID XBMDB2
RECOVER TABLESPACE RMDCC52.TC52N01 DSNUM 1
   INCOPY FULL SNAPSHOT
   DSNAME DEBHCAT.RMDCC52.TC52N01.LP01.T115745.DATA
```
Example 6: Using standard image copies and Instant Snapshots

This example illustrates how to use both Instant Snapshot copies and standard image copies based on the size of the data.

Output data sets are defined for each type of copy. To do so, the example uses the following commands and options:

- OUTPUT commands that define output data sets for each type of copy—Instant Snapshots and standard image copies
- OUTSIZE option on the OPTIONS command to define the threshold at which Instant Snapshots will be made
- BIGDDN option on the COPY command to identify the output file names for the consistent copies

Figure 43 on page 238 shows an example of the JCL necessary to perform this task. For more information, see “Standard image copies” on page 196.

Figure 43: Example JCL to use standard image copies and Instant Snapshots

```
//NSCCOPY EXEC PGM=ACPMAIN,
  //     PARM='&SSID,SZC233,MSGLEVEL(1),REGION=OM
  //     INCLUDE MEMBER=NSCSTEP
  //     INCLUDE MEMBER=DB2LIBS
  //STEPLIB DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
  // DD DISP=SHR,DSN=DSNEXIT
  // DD DISP=SHR,DSN=DSNLOAD
  //SYSPRINT DD DSN=RMD.NSC.&SSID..&CASE..SYSPRINT,
  //     DISP=(NEW,CATLG),UNIT=SYSALLDA,
  //     SPACE=(CYL,(1,1)),
  //     DCB=(RECFM=FB,LRECL=133,BLKSIZE=13300)
  //SYSOUT DD SYSPUT=*
  //ALPPRINT DD SYSPUT=*
  //AFRSTMT DD SYSPUT=*
  //AFRPRINT DD SYSPUT=*
  //AFRSUMRY DD SYSPUT=*
  //AFROSUM DD SYSPUT=*
  //** SMALL DATASETS WILL USE STANDARD IMAGE COPIES
  //** LARGE DATASETS WILL USE INSTANT SNAPSHOT COPIES
  //SYSIN DD *
  //OPTIONS IXDSNUM DATASET
  XBDID XBDIDB2
  OUTSIZE 250K

OUTPUT COPY0001
```
Example 7: Recovering an Instant Snapshot using NGT Recover

This example illustrates how to use NGT Recover to recover an Instant Snapshot.

NGT Recover automatically finds the Online Consistent Copies in BMCXCOPY and performs normal recovery operations using the copies, including forward log apply if required.

Figure 44 on page 239 shows an example of the JCL necessary to perform this task. For more information, see “Recovering by using NGT Recover” on page 246.

Figure 44: Example JCL to use NGT Recover to recover Instant Snapshots

```/*
//RECOVER EXEC PGM=AFRMAIN,REGION=0M,COND=ONLY,
//               PARM='DGE,RECOVER4B,NEW/RESTART,MSGLEVEL(2)' ' 
//STEPLIB   DD DISP=SHR,DSN=PRODUCT.LOAD.LIBS
//          DD DISP=SHR,DSN=DSNEXIT
//          DD DISP=SHR,DSN=DSNLOAD
//SYSIN     DD *
RECOVER TABLESPACE BMCDBSMP.BMCTS001 TOCOPY LASTCOPY
RECOVER TABLESPACE BMCDBSMP.BMCTS002 TOCOPY LASTCOPY
RECOVER TABLESPACE BMCDBSMP.BMCTS003 TOCOPY LASTCOPY
REBUILD INDEX(ALL) TABLESPACE BMCDBSMP.BMCTS001 NOWORKDDN
REBUILD INDEX(ALL) TABLESPACE BMCDBSMP.BMCTS002 NOWORKDDN
REBUILD INDEX(ALL) TABLESPACE BMCDBSMP.BMCTS003 NOWORKDDN
*/```
Usage scenarios

This chapter provides scenarios for using Online Consistent Copy for the migration, the recovery, and the transformation of data including the following tasks.

■ You can use one of the following techniques with Online Consistent Copy to migrate data:
  — Create a consistent copy and rename the data set
  — Create a consistent copy and use NGT Recover with the INCOPY and OBIDXLAT keywords to copy the data set and reset the internal identifiers
  — Create a consistent copy and use the DSN1COPY utility to copy the data set and reset its internal identifiers
  — Unload data from a consistent copy and load it using LOADPLUS or the IBM LOAD utility

■ You can use one of the following techniques with Instant Snapshot and Online Consistent Copy to recover data:
  — Recover by using the NGT Recover product
  — Rename a consistent copy
  — Copy a consistent copy with the DSN1COPY utility
  — Create standard image copies and use the IBM RECOVER utility

■ You can use the technique in “Using Online Consistent Copy for transforms or data migration” on page 249.

Using Online Consistent Copy for migration

For the following reasons, database administrators often need to migrate data to another set of DB2 objects or to another DB2 subsystem:

■ Populating data on a reporting or analysis system.
Populating a test system.
Load balancing.
Loading a data warehouse.

The standard ways to migrate data are to use the DSN1COPY utility or to UNLOAD the data into a temporary file and then LOAD it into the target objects. It is usually best if the data is consistent. Using standard utilities to make a consistent copy of the data requires an outage on the source tables—you must quiesce the source tables and restart them in read-only status. Because of this outage, the source tables are not available for read-write access for some period of time.

Online Consistent Copy allows you to make a consistent copy without any outage on the source objects.

In addition to the examples here, you can use the EXPORT option of NGT Copy to create a migration file for OCCs and use the IMPORT option of NGT Recover to import the copies on the target system.

Renaming consistent copies to migrate objects

This scenario describes how to rename consistent copies to migrate objects. This scenario assumes that the following points are true:

- The objects on the target subsystem have the same structure and internal identifiers (DBID, PSID, OBID, ISOBID) as the objects on the source subsystem.
- You do not plan to do updates on the target objects.
- The subsystems have shared DASD.

To rename consistent copies

1 Use Online Consistent Copy to make consistent copies Instant Snapshots of the source objects.

   This process has practically no effect on the source objects, so you can do it at any time of the day. If the consistent copies are Instant Snapshots (hardware copies), it takes only a few seconds to make each Instant Snapshot, regardless of the size of the space being copied.

2 Stop the objects on the target subsystem.

3 Rename or delete the existing data sets for the spaces on the target subsystem.
4 Rename the consistent copy Instant Snapshot data sets to match the naming convention for the target subsystem.

5 Start the objects on the target subsystem.

   The data is now available on the target subsystem.

Using consistent copies with NGT Recover to migrate objects

In following scenario, NGT Recover uses Instant Snapshot technology to restore the data sets to a different subsystem. To use this method, you must have the copies and the spaces to be restored on storage devices that support data set snapshots.

To restore data sets by using NGT Recover

1 Use Online Consistent Copy to make consistent Instant Snapshots of the source objects.

   This process has practically no effect on the source objects, so you can do it at any time of the day. Because Instant Snapshots are hardware copies, it takes only a few seconds to make each Instant Snapshot, regardless of the size of the space being copied.

2 To restore the data sets to a different subsystem, run NGT Recover using the following options:

   INCOPY FULL SNAPSHOT DSNAME copyDataSetName TOCOPY LASTCOPY

3 You can use the OBIDXLAT option to translate the internal identifiers (DBID, PSID, OBID, ISOBID).

4 Start the objects on the target subsystem. The data is now available on the target subsystem.

   If you plan to update the data and you need to be able to recover those updates, you can either:

   ■ Make full image copies of the objects
   ■ Use the RECOVER command with the TOCOPY option using the same copy as above and then issue a RECOVER LOGAPPLY ONLY command statement

   For an example, see “Example 5: Migrating data with consistent copy and NGT Recover” on page 236.
Using consistent copies with DSN1COPY utility to migrate objects

This scenario describes how to use Online Consistent Copy with the DSN1COPY utility to migrate objects. You can use NGT Recover if the Instant Snapshot and the target objects are on storage devices that support Instant Snapshots. Otherwise, use DSN1COPY.

This scenario assumes that the subsystems have shared DASD and that one of the following conditions apply:

- You plan to do updates on the target objects.
- The objects on the target system have the same structure but different internal identifiers (DBID, PSID, OBID, ISOBID) than the objects on the source subsystem.

**To use consistent copies to migrate objects**

1. Use Online Consistent Copy to make consistent copies Instant Snapshots of the source objects.

   This process has practically no effect on the source objects, so you can do it at any time of the day. If the consistent copies are Instant Snapshots (hardware copies), it takes only a few seconds to make each Instant Snapshot, regardless of the size of the space being copied.

2. Stop the objects on the target subsystem.

3. Use NGT Recover or the DSN1COPY utility with the OBIDXLAT and RESET options to copy the consistent copies Instant Snapshots to the target data sets and translate the internal identifiers.

4. Start the objects on the target subsystem. The data is now available on the target subsystem.

If you plan to update the data and you need to be able to recover those updates, you can restore the data from the consistent copies Instant Snapshots by using NGT Recover or the DSN1COPY utility as described in this scenario and then perform a RECOVER LOGAPPLY ONLY or you can make full image copies of the objects on the target subsystem.
Using consistent copies with UNLOAD PLUS to migrate objects

This scenario describes how to use Online Consistent Copy with the BMC Software UNLOAD PLUS product to migrate objects. This scenario assumes that the objects on the target subsystem have a different structure than the objects on the source subsystem.

To use consistent copies with UNLOAD PLUS to migrate objects

1 Use Online Consistent Copy to make consistent copies Instant Snapshots of the source objects.

This process has practically no effect on the source objects, so you can do it at any time of the day. If the consistent copies are Instant Snapshots (hardware copies), it takes only a few seconds to make each Instant Snapshot, regardless of the size of the space being copied.

2 Use the UNLOAD PLUS product to unload the data from the consistent copies Instant Snapshots.

3 Use UNLOAD PLUS product or the IBM LOAD utility to load the target objects.

4 Clear the copy pending condition, if necessary. The data is now available on the target subsystem.

If you plan to update the data and you need to be able to recover those updates, you can reload the data by using Step 1 on page 242 through Step 4 on page 244 and then perform a RECOVER LOGAPPLY ONLY or you can make full image copies of the objects on the target subsystem.

Using Online Consistent Copy for recovery

Use one of the following methods to recover using Instant Snapshot data sets created by Online Consistent Copy:

- Use the RECOVER command available with the BMC Next Generation Technology Recover for DB2 for z/OS product. NGT Recover automatically finds the Online Consistent Copies in BMCXCOPY and perform normal recovery operations using the copies, including forward log apply if required.

Such recoveries have the advantage that you can very quickly recover one or more spaces to a previous consistent point in time without applying any log records. You might find this especially useful, for example, in some situations where you make a copy before you put a new version of an application into production and...
you want to be able to fall back to the copy quickly if there is a problem with the application.

- Rename the Instant Snapshot data sets.
- Use the DSN1COPY utility to restore the DB2 data sets from the Instant Snapshots.
- Data sets produced by Online Consistent Copy are not recognized by the IBM RECOVER utility because they are registered in BMCXCOPY. However, you can use the COPY IMAGECOPY command available with the NGT Copy product to create standard image copies that are registered in SYSCOPY. Then use the IBM RECOVER utility for normal forward recovery with the following restriction. If the table space uses LOCKSIZE ROW, the IBM RECOVER utility can use the copies only for a TOCOPY recovery. (This restriction does not apply to NGT Recover.)

### Recovering by using NGT Recover

NGT Recover automatically finds the Online Consistent Copies in BMCXCOPY and performs normal recovery operations using the copies, including forward log apply if required.

In the following scenario, NGT Recover uses Instant Snapshot technology to restore the data sets. To use this method, you must have the copies and the spaces to be recovered stored on storage devices that support data set snapshots.

**To recover Online Consistent Copies by using NGT Recover**

1. At the point in time you select as a fallback point, use Online Consistent Copy to make consistent Instant Snapshots of the source objects.

   This process has practically no effect on the source objects, so you can do it at any time of the day. Because Instant Snapshots are hardware copies, it takes only a few seconds to make each Instant Snapshot, regardless of the size of the space being copied.

2. If you need to recover to the fallback point, use the NGT Recover RECOVER command. You can specify options such as TOCOPY LASTCOPY:

   ```sql
   RECOVER...TOCOPY LASTCOPY
   ```

   **Note**

   If you want to restore a copy to a different DB2 subsystem or you want to recover to a copy that is no longer in BMCXCOPY, you would use the INCOPY option on the RECOVER statement. For more information, see “Using consistent copies with NGT Recover to migrate objects” on page 243.
For an example, see “Example 7: Recovering an Instant Snapshot using NGT Recover” on page 239.

Recovering by renaming consistent copies

Use the following procedure to recover by renaming consistent copies:

1. At the point in time you select as a fallback point, use Online Consistent Copy to make consistent Instant Snapshots of the source objects.

   This process has practically no effect on the source objects, so you can do it at any time of the day. Because Instant Snapshots are hardware copies, it only takes a few seconds to make each Instant Snapshot, regardless of the size of the space being copied.

2. If you need to recover to the fallback point, stop the objects to be recovered.

3. Rename or delete the existing data sets for the spaces to be recovered.

4. Rename the Instant Snapshot data sets to match the naming convention for the subsystem you are recovering.

5. Start the objects that you recovered.

6. If you have level ID checking enabled, you might need to reset the level ID by using the REPAIR LEVELID utility.

7. If you plan to update the data, make full image copies of the objects that you recovered.

Recovering by using the DSN1COPY utility

This scenario describes how to recover data sets by using the DSN1COPY utility to restore the DB2 data sets from Instant Snapshots. This method can be used if NGT Recover is not available or if the Instant Snapshots or the data sets to be recovered are no longer on storage devices that support Instant Snapshots.

To recover by using the DSN1COPY utility

1. At the point in time you select as a fallback point, use Online Consistent Copy to make consistent Instant Snapshots of the source objects.
This process has practically no effect on the source objects, so you can do it at any
time of the day. Because Instant Snapshots are hardware copies, it only takes a
few seconds to make each Instant Snapshot, regardless of the size of the space
being copied.

2 If you need to recover to the fallback point, stop the objects to be recovered.

3 Use the DSN1COPY utility with the RESET option to copy the Instant Snapshots
to the target data sets.

4 Start the objects that you recovered. The data is now available.

If you plan to update the data and you need to be able to recover those updates,
you can either:

- Restore the data from the Instant Snapshots using the DSN1COPY utility as
described in this scenario and then issue a RECOVER LOGAPPLY ONLY
command statement.

- Make full image copies of the objects.

**Recovering by using IBM RECOVER**

Use the following procedure to recover using IBM RECOVER.

1 Perform a COPY IMAGECOPY (using the NGT Copy product) of the Online
Consistent Copy to create a standard sequential image copy registered in
SYSCOPY.

2 Determine if the space used page-level locking or row-level locking.

You can tell if the space used row-level locking by looking at the
OCC_LOCKRULE column in BMCXCOPY. If OCC_LOCKRULE is R, the space
used row-level locking.

3 Submit a standard IBM RECOVER job.

If the space used page-level locking, all options are supported. If the space used
row-level locking, only recover TOCOPY is allowed.
Using Online Consistent Copy for transforms or data migration

Transforms are available in Recovery Management to allow you to convert a source space to a target space that has a different format by using the High-speed Structure Change process.

For more information about Online Consistent Copy and transforms, see “High-speed Structure Change” on page 163.

Like Online Consistent Copy, running a transform using the SHRLEVEL CHANGE method of the High-speed Structure Change process requires a Recovery Management password.

By specifying the Log Master WORKID, USERID, and HANDLE, you can prime standard data migration by seeding the target with an Online Consistent Copy and updating by migrating the delta with Log Master.

Specifying the Log Master WORKID and USERID

Log Master uses a WORKID statement as a unique identifier for a unit of work. The WORKID can be up to eighteen characters long.

When you make an Online Consistent Copy for use with a SHRLEVEL CHANGE transform, you should specify a WORKID. When you run the Log Master LOGSCAN statement to capture the changes after the Online Consistent Copy, you should use the same WORKID.

For Online Consistent Copy, you can optionally specify a Log Master WORKID in SYSIN.

You should not specify WORKID unless you are planning to use Log Master to apply log to the copy.

When you use WORKID, you need to specify a different WORKID for each execution of Online Consistent Copy.
When you are through applying log to a copy or copies corresponding to a WORKID, you need to delete the WORKID entries from the Log Master repository. Example JCL for this task is given in Figure 45 on page 250.

**Figure 45: Example JCL to delete WORKID entries from the Log Master repository**

```jcl
//**************************************************************
//*  CLEANUP LOGMASTER DATA                                    *
//**************************************************************
//CLEANUP EXEC PGM=ALPMAIN,
//             PARM='DXW,,MSGLEVEL(2),ALPOPTS(ALP$OPTS)',
//             REGION=0M
//      INCLUDE MEMBER=stepLibName
//      DD  DSN=DB2.DSNEXIT,DISP=SHR
//      DD  DSN=DB2.DSNLOAD,DISP=SHR
//ALPPRINT  DD SYSOUT=* 
//SQLPRINT  DD SYSOUT=* 
//ALPDUMP DD SYSOUT=* 
//SYSTERM DD SYSOUT=* 
//SQLCODES DD DUMMY
//SYSUDUMP DD SYSOUT=* 
//SYSIN DD *,DLM=##
//OPTION
//  FILTERREL AND EXECUTION MODE CURRENT
//  SORTOPTS
//  FILSZ NONE
//  HISTORY WRITE
//  LOGSCAN
//    REPOS DELETE ONGOING WORKID STEP1.EXAMPLE ALL
##
```

As part of the Log Master WORKID statement, you can also specify a USERID. The USERID represents the person or entity that started the current job. The USERID can be up to eight characters long.

Online Consistent Copy uses the Online Consistent Copy job name as the Log Master USERID. For example, if the Online Consistent Copy job name is EXAMTST, the fully qualified WORKID for the example here is EXAMTST.EXAMPLE.

The Log Master migration can be handled in a single log scan. Log Master allows multiple ongoing log scans within a WORKID and uses the Log Master HANDLE in the Log Master ALPURID table (see “Registering the Online Consistent Copy log point with Log Master” on page 251) as a unique identifier within a WORKID. When Online Consistent Copy runs to make a copy or copies for input to the transform process, all of the copies in a job step will have the same consistent point and the same inflight transactions at that point. You do not need to have multiple log scans for an Online Consistent Copy WORKID. Online Consistent Copy always uses a HANDLE of 501 when saving information in the Log Master tables.

For more information about the Log Master statements, see the *Log Master for DB2 Reference Manual*. 
Registering the Online Consistent Copy log point with Log Master

In order for Log Master to know from what point to begin capturing changes to apply to the target space, the Online Consistent Copy log point and all of the transactions that were inflight at the point of consistency need to be registered in the Log Master tables.

Log Master has the ability to:

- Capture log for an ongoing process that allows you to apply log up to a certain point with one run.
- Remember where the log apply stopped and what transactions were inflight.
- Continue log apply later in another run starting at the previous end point and picking up the transactions that were inflight.

The Log Master ALPURID table stores information about the end point of the previous run and the transactions that were inflight at that end point. Online Consistent Copy populates the ALPURID table when an Online Consistent Copy is made for input to the transform process. After the first pass of the transform process has completed, Log Master can access the information in the ALPURID table to determine what log to apply.

Because Online Consistent Copy needs to access the Log Master ALPURID table, it finds the table by loading the Log Master installation option module and reading the bind qualifier from the module. Online Consistent Copy uses the bind qualifier to construct the Log Master synonym and reads the DB2 catalog to find the corresponding table name. Online Consistent Copy then uses dynamic SQL to access the Log Master ALPURID table. The NSCSQL package is bound with DYNAMICRULES(BIND) so that the authorization ID that is used to bind the package is also used for dynamic SQL. That way, the person that runs the job does not have to have authorization for the Log Master tables, but the person that runs the bind does.

For more information about the Log Master ALPURID table, see the Log Master for DB2 Reference Manual.
Registering the Online Consistent Copy log point with Log Master
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