DB2 for z/OS and Storage Advanced Copy Services:
Creating a DB2 System Level Backup

Using FlashCopy and/or TimeFinder on EMC Hardware
Session 16796

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Topics

• Local replication technologies
  – FlashCopy
  – TimeFinder
  – Achieving ‘space efficiency’

• DB2 System Level Backup
  – Concepts / Benefits
  – Rocket Software Utilities
  – Backup to Virtual Tape
Volume Flashcopy

**FlashCopy requested**

**FlashCopy relationship is established**

**Both source and target volumes immediately available**

**Read and write to both source and target volumes possible**

**When copy is complete, relationship between source and target ends**

*Figure 2-1 FlashCopy with background copy* Source IBM Redbook: SG24-5680-04
Space Efficient FlashCopy

Source volumes

Standard FlashCopy target volumes

Space needed for FlashCopy targets

Source volumes

Repository

IBM FlashCopy SE virtual target volumes

Space needed for FlashCopy targets

Figure 11-1  Concept of FlashCopy SE

Source: IBMREDP-4368-00

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EMC TimeFinder Features

- **TimeFinder/Clone**
  - Up to 16 high-performance physical copies
  - Full-volume (w/ precopy) and dataset level
  - Incremental resync (dataset and multi-volume)
  - Consistency Group support *(dataset and volume!)*

- **TimeFinder/Snap**
  - Space-saving volume snapshot images (up to 128)
  - Uses Virtual Devices (VDEVs)
  - Typically requires less than 30% additional capacity
  - Async COFW, Dynamic SAVEPOOL expansion
  - Incremental resync
  - Consistency Group support
TimeFinder/Snap – Pointer-Based SNAPs

Source Device

Virtual Devices (VDEVs)

10 A.M.

12 Noon

2 P.M.

4 P.M.

Save Devices

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Virtual Provisioning on EMC VMAX

- Storage capacity is structured in pools defined by RAID protection, drive technology, rotational speed
- Thin devices are logical volumes that are provisioned to hosts
- Workload is spread across many disks in 12 track chunks

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TimeFinder/Clone to Thin Devices

- Create
- Activate (NOCOPY)
TimeFinder/Clone and Virtual Provisioning: COPY vs NOCOPY

- TF/CLONE NOCOPY to THIN target results in space efficient copy
- Target can be in shared or dedicated VP pool (repository-like) that can be over-provisioned

**TF/Clone COPY**

- THIN SOURCE
- 5GB

**THIN TARGET**

- 5GB

Upon establish all tracks are background copied into pool or copied on first write.

**TF/Clone NOCOPY**

- THIN SOURCE
- 5GB

- THIN TARGET

Copy only made on write to source or write to target

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Achieving Space Efficient FlashCopy with EMC VMAX

- Use of Symmetrix Virtual Provisioning provides equivalent functionality to Space Efficient FlashCopy

- FlashCopy parameter ‘SETGTOK’ allows, but does not require, the target volume to be an SE volume
  - Symmetrix devices do not present as Space Efficient devices

- However, using a Symmetrix thin device as a FlashCopy target and specifying NOCOPY, results in a space efficient copy
FlashCopy on VMAX with Virtual Provisioning: Copy vs NoCopy

- FlashCopy NOCOPY to THIN target results in space efficient copy.
- Target can be in shared or dedicated VP pool (repository-like) that can be over-provisioned.

Upon establish all tracks are background copied into pool or copied on first write.

Copy only made on write to source or write to target.
## Space Efficient FlashCopy Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Space Efficient FC devices</th>
<th>EMC thin devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert to full copy</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Incremental possible</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Special devices required</td>
<td>Yes</td>
<td>Thin</td>
</tr>
<tr>
<td>Repository resizable</td>
<td>No</td>
<td>Yes (thin pool)</td>
</tr>
<tr>
<td>Standard FC possible</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
SE Flashcopy ‘equivalence’ using VMAX thin devices: Consideration

• Devices do not present as SE FlashCopy devices
  – No reporting of SE devices in
    ▪ TSO FC QUERY
    ▪ ICKDSF FC QUERY RELATIONS
DB2 System Level Backup
Preparing the Configuration

• SMS managed DB2 volumes are required
• Two types of Storage Groups required
  – System Level Data Sets
    • BSDS, Logs (Active and Archive)
    • Dedicated ICF catalog for these data sets
  – Application Level Data Sets
    • DB2 Catalog, Tablespaces/Indexspaces
    • Dedicated ICF catalog for these data sets
• ONLY DB2 data sets on these volumes
SMS Storage Groups

- Target devices may be in HSM Copy Pools
- Target devices may be in ordinary Storage Groups
- When using the “BACKUP SYSTEM” and “RESTORE SYSTEM” DB2 commands Copy Pools are required.
- Recovery Expert allows either
DB2 Full Volume Cloning

Source Devices

- 1000: BSDS
- 1001: Archive Logs
- 1002: ICF User Catalog
- 1003: Active Logs

Recovery Structures

Target Devices

- 4000: BSDS
- 4001: Archive Logs
- 4002: ICF User Catalog
- 4003: Active Logs

Recovery Structures

- 1004: ICF User Catalog
- 1005: DB2 Catalog
- 1006: Table Spaces
- 1007: DB2 Directory

Data Structures

VMAX
Source Devices

• May be Thick or Thin
• May be R1 or R2 (Primary or Secondary)
• Consistency across all DB2 volumes is required
  – VMAX can use Enginuity Consistency Assist feature with volumes in a Consistency Group
  – DB2 commands allow for consistency
    • Set Log Suspend before Clone/FlashCopy
    • Set Log Resume after Clone/FlashCopy
Target Devices

- May be Thick, Thin (TDEV) or Virtual Device (VDEV)
- May be R1 or R2 (Primary or Secondary)
- Must be in the same array as the source
- Must be equal number of volumes as the source
- Must be the same geometry as the source
FlashCopy Backup

1. Initiate
   Establish FlashCopy
   - Recovery Structures
   - Application Data
   - Logs
   - System Data
   - FC Device

2. DBMS Restartable Copy
   - Full Volume Backup To DLm
   - FDR or DFDSS

3. Restore/Recover
   - Update Transaction
   - RECOVER TS
   - Restore System
   - Host

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Clone Backup

1. Initiate
   - Activate Clone

2. Update Transaction
   - RECOVER TS
   - Restore System

3. Restore/Recover

DBMS Restartable Copy

Full Volume Backup To DLm

VMAX

DB2

Host

4100 4101
Recovery Structures  Application Data

4102 4103
Logs  System Data

4120 4121
Thin Device  Thin Device

4122 4123
Thin Device  Thin Device

FDR or DFDSS

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DB2 System Backup With Thin Devices

- Use thin devices in SMS backup copy pools
- Specify VERSIONS=0 on copy pool backup definition
  - Generates a NOCOPY parameter on the FlashCopy
- Changed tracks are stored in the thin pool
- Withdraw operation occurs after HSM dumps the volume
Rocket Software Products

• Rocket Backup and Recovery for DB2
• Fully integrates with both FlashCopy and TimeFinder/Clone and TimeFinder/Snap backups with DB2
• Supports thin and thick devices as backup targets
• Resold by IBM as a part of DB2 Recovery Expert
Profile Specifications for Rocket

MAINSTAR  V2R2 ------- Source Stogroup Selection ------- 2015/02/11  15:49:13
Option ===>  Scroll ===> PAGE

Line Commands: I - Enter  D - Delete

Creator: TMOULD1    Name: DB0P                             SSID: DBS1
Share Option: U  (Upd,View,No)    Description: PRODUCTION PROFILE

------------------- Enter Storage Groups  -------------------
Row 1 of 3

Cmd  Stogroup

DBSDSG
DBSLSG

Storage Groups that are not Copy Pools

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Profile Choices for Snapshot

+------------------- Enter New Backup Profile Options -------------------+

| Creator         | TMOULD1            |
| Profile Name    |                   |
| Description     |                   |
| DB2 SSID        | DBS1 (for system list) |
| Backup Method   | S (Bcv/Snap/Flash/Db2/dfsmsdss(L)) |
| Source/Target Mapping | M (Auto discover/pool mapping, Stogroup discover/pool mapping, Manual) |
| Update Option   | U (Update, View only, No access) |

Chosen at Profile creation and can’t be changed afterwards
## Automatic Mapping

<table>
<thead>
<tr>
<th>&lt;----DB2 Volume----&gt;</th>
<th>&lt;---Target--&gt;</th>
<th>&lt;--------Data Types--------&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volser Ucb# Devtyp</td>
<td>Volser Ucb#</td>
<td>Obj</td>
</tr>
<tr>
<td>---- ---- ----</td>
<td>---- ---- ----</td>
<td>----</td>
</tr>
<tr>
<td>DBS001 4500 3390-9</td>
<td>BKP025 4528</td>
<td>No</td>
</tr>
<tr>
<td>DBS002 4501 3390-9</td>
<td>BKP026 4529</td>
<td>No</td>
</tr>
<tr>
<td>DBS003 4502 3390-9</td>
<td>BKP027 452A</td>
<td>No</td>
</tr>
<tr>
<td>DBS004 4503 3390-9</td>
<td>BKP028 452B</td>
<td>No</td>
</tr>
<tr>
<td>DBS005 4504 3390-9</td>
<td>BKP013 451C</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS006 4505 3390-9</td>
<td>BKP014 451D</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS007 4506 3390-9</td>
<td>BKP015 451E</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS008 4507 3390-9</td>
<td>BKP016 451F</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS009 4508 3390-9</td>
<td>BKP017 4520</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS010 4509 3390-9</td>
<td>BKP018 4521</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS011 450A 3390-9</td>
<td>BKP019 4522</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS012 450B 3390-9</td>
<td>BKP020 4523</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS013 450C 3390-9</td>
<td>BKP021 4524</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS014 450D 3390-9</td>
<td>BKP022 4525</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS015 450E 3390-9</td>
<td>BKP023 4526</td>
<td>Yes</td>
</tr>
<tr>
<td>DBS016 450F 3390-9</td>
<td>BKP024 4527</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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Time Required for Flash

Utility Executed: Backup
Profile Name: TMOULD1.DB0P
DB2 Subsystem: DBS1
DB2 Version: 1010
Backup Type: Flash Copy
Backup Contains: Object Data and Log Data
Partial Backup: No
Nbr of Volumes: 0016
Backup RBA: 000001619270
Last Checkpoint RBA: 000001614346
HPGRBLP RBA: 000001616DC0
Backup Date: 11/17/2014
Consistency Method: Flash Consistency Group
Supports Object Restore: Yes

Backup Elapsed: 00.10 Seconds
To Log Suspend or Not That is the Question

• Log Suspend in DB2?
  – Disk Hardware (FlashCopy Consistency Group or TF/Clone Consistency function) provides a “Dependent Write Consistent” (aka power failure consistent) restartable image of the DB2 subsystem
  – What could go wrong?
  – Got Referential Integrity?
    • DB2 performs separate writes for Parent/Child Updates
    • I have seen the DASD Hardware hold writes from the host in between the Parent and Child updates
    • After a subsystem was restored with no logs applied the Parent and Child were inconsistent
  – If you do not perform a Log Suspend, then plan on applying all logs.
To Image Copy or Not

• With DB2 V10 an SLB supports recovery of individual objects
• Savings if Image Copies were suspended
  – If you use Virtual Tapes, the capacity requirements are minimized
  – If you use Physical Tape, you need fewer tapes
  – If you use Disk, the capacity requirements are minimized
    • If you replicate the disk pool to another site, network capacity requirements are minimized
Offload to a EMC Disk Library for mainframe (DLm)

- Define the DLm tape devices as 3590-1
- In Recovery Expert choose number of tasks based on tape devices available for use
- Choose Local and Remote Options (LP/RP)
- Choose Data Set Name options and Unit Names to direct output to the desired Volsers
- Choose Generations to determine retention
- Choose to Delete aged generations
Enter the Offload options to associate with this Backup profile:

- Local Primary: N (Yes/No/Update)
- Local Backup: N (Yes/No/Update)
- Recovery Site Primary: N (Yes/No/Update)
- Recovery Site Backup: N (Yes/No/Update)
- Offload Generations: 01 (1 - 99)
- Delete Aged Backup files: Y (Yes/No)
- Compress Data: N (Yes/No)
- Data Mover: D (Dfsmsdss, Fdr, or fdrInstant)
- Encrypt Data: N (Yes/No/Update)
- Number of Tasks: 02 (1 - 99)
Offload Example

• The following example used these options
  – Number of Tasks = 2
    • One for Local Backup Copy
    • One for Remote Backup Copy
  – Controls the use of Volsers
    • Higher the number uses more Volsers takes less time
    • Lower the number uses less Volsers takes more time
Offload to DLm Example

JES2 JOB LOG -- SYSTEM TST1 --

12.27.13 JOB02654 ---- WEDNESDAY, 09 OCT 2013 ----
12.27.13 JOB02654 IRR010I USERID ******** IS ASSIGNED TO THIS JOB.
12.27.14 JOB02654 ICH70001I ******** LAST ACCESS AT 12:17:57 ON WEDNESDAY, OCT
12.27.14 JOB02654 $HASP373 DBRBACK STARTED - INIT A - CLASS A - SYS TST2

12.28.32 JOB02654 *IEC501A M A400,PRIVAT,SL,COMP,DRBBACK,DBRJOFFL,DBRTDS.LP.TES
12.28.32 JOB02654 IEC705I TAPE ON A400,T00059,SL,COMP,DBRBACK,DBRJOFFL,DBRTDS.
12.28.32 JOB02654 *IEC501A M A440,PRIVAT,SL,COMP,DRBBACK,DBRJOFFL,DBRTDS.RP.TES
12.28.32 JOB02654 IEC705I TAPE ON A440,B00032,SL,COMP,DRBBACK,DBRJOFFL,DBRTDS.

13.00.01 JOB02654 -DBRREBU1 00 638 153 .01 .00
13.00.01 JOB02654 IEF404I DBRBACK - ENDED - TIME=13.00.01
13.00.01 JOB02654 -DBRBACK ENDED. NAME=************************** TOTAL TCB CPU TI
13.00.01 JOB02654 $HASP395 DBRBACK ENDED

JES2 JOB STATISTICS
- 09 OCT 2013 JOB EXECUTION DATE
- 134 CARDS READ
- 1,379 SYSOUT PRINT RECORDS
- 0 SYSOUT PUNCH RECORDS
- 89 SYSOUT SPOOL KBYTES
- 32.79 MINUTES EXECUTION TIME

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### Offload to DLm Example

**Database Backup and Recovery for DB2**

**Volume Offload Detail Report**

<table>
<thead>
<tr>
<th>Volser</th>
<th>Ucb#</th>
<th>Type</th>
<th>Offloaded to Filename</th>
<th>FileSeq</th>
<th>Volser</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBTV01</td>
<td>5B16</td>
<td>LP</td>
<td>DBRTDS.LP.TEST.D2013282.T122832.DBTV01</td>
<td>001</td>
<td>T00059</td>
</tr>
<tr>
<td>RP</td>
<td>DBRTDS.RP.TEST.D2013282.T122834.DBTV01</td>
<td>001</td>
<td>B00032</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1PAGE 0001 5695-DF175 DFSMSDSS V1R13.0 DATA SET SERVICES 2013.282 12:28

- **Dump Full** -
  - INDDNAME( DSDBTV01 ) -
  - OUTDDNAME( SYS00023 , SYS00024 ) -
  - OPTIMIZE( 4 ) -
  - ALLEXCP ALLDATA(*)

ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'DUMP '
ADR109I (R/I)-RI01 (01), 2013.282 12:28:32 INITIAL SCAN OF USER CONTROL STATEME
ADR050I (001)-PRIME(01), DFSMSDSS INVOKED VIA APPLICATION INTERFACE
ADR016I (001)-PRIME(01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
0ADR006I (001)-STEND(01), 2013.282 12:28:32 EXECUTION BEGINS
0ADR006I (001)-STEND(02), 2013.282 12:28:54 EXECUTION ENDS
0ADR013I (001)-CLTSK(01), 2013.282 12:28:54 TASK COMPLETED WITH RETURN CODE 0000

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Native DB2 Utilities

- DB2 searches the EDT for any UNIT specification
- DLm UNIT names should be in the EDT or these utilities will fail
Summary

- DB2 System Level Backup is completely supported on EMC Hardware using either FlashCopy or TimeFinder
- VMAX has options for reducing capacity requirements for target devices using both FlashCopy and TimeFinder
- Rocket Software utilities exploit both Flashcopy and TimeFinder to produce DB2 System Level Backups
- EMC DLm provides for all requirements when offloading the target devices to tape volsers