IBM Tivoli Storage FlashCopy Manager
best practices in an IBM DB2 HADR environment

Version 1.1

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January 2014
# Table of contents

Abstract ....................................................................................................................................... 3  
Storage hardware and software products overview ................................................................. 4  
Scope of this Best Practices paper ......................................................................................... 5  
FlashCopy functions in a DB2 HADR environment ................................................................. 6  
Hardware and software setup ................................................................................................. 6  
Conceptual background .......................................................................................................... 8  
  FlashCopy Manager backup process flow ............................................................................. 8  
  FlashCopy Manager restore and database recovery .............................................................. 8  
  FlashCopy Manager backup of a DB2 standby database ....................................................... 9  
Tivoli Storage Manager configuration .................................................................................... 9  
  TSM Server .......................................................................................................................... 9  
  TSM Client ........................................................................................................................ 12  
TSM for ERP Systems configuration ....................................................................................... 13  
FlashCopy Manager configuration ......................................................................................... 14  
  The ASNODENAME parameter .......................................................................................... 14  
  FCM profiles ....................................................................................................................... 14  
  FlashCopy Manager backup server setup ......................................................................... 19  
  Specification of the FlashCopy target volumes ................................................................. 19  
Backup and restore command examples ............................................................................... 21  
Some troubleshooting hints .................................................................................................... 23  
A SAN Volume Controller FlashCopy view ......................................................................... 24  
Trademarks and special notices ............................................................................................ 26  

## Change control:

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<td>01/21/2014</td>
<td>First release</td>
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<td>1.1</td>
<td>04/01/2014</td>
<td>Updated FCM profile merge description</td>
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Abstract

Backups of SAP® systems are normally performed within a window during batch processing because the impact of the backup load on a database or application can be best tolerated. Compressing all backup activities into this backup window causes an extremely high peak workload for the system infrastructure (network, servers, tape drives). Because of growing database volumes and the business need for 24-by-7 application availability, the backup window can become a key obstacle in meeting service-level requirements.

Tivoli Storage FlashCopy Manager provides the operational flexibility necessary for today’s IT infrastructure. Zero impact FlashCopy backups can be started any time during the daily operation of an application system, because the FlashCopy technique minimizes the impact on the application (server-processor load, database-backup window). Fast FlashCopy restores can minimize the downtime required for data restore.

FlashCopy Manager supports manifold combinations of operating systems, database applications and storage systems.

This Best Practices paper describes a FlashCopy Manager setup in a highly available IBM DB2 database environment using DB2 HADR on IBM Power System and IBM SAN Volume Controller.
Storage hardware and software products overview

IBM SAN Volume Controller
(abbr.: SVC)
The IBM System Storage SAN Volume Controller® is a storage virtualization system. It enables a single point of control for storage resources to improve business application availability and resource usage. SVC helps increase available storage capacity to host applications. By pooling capacity from multiple disk systems in the storage area network (SAN), storage administrators can reach beyond traditional islands of SAN storage.

See www.ibm.com/systems/storage/software/virtualization/svc/index.html

SVC FlashCopy
The FlashCopy function creates an almost instant copy of active data for backup and cloning. SVC supports incremental FlashCopy operations that copy only the portions of the source or target virtual disk updated since the last FlashCopy function, and also backs up cascaded operations where the target of one FlashCopy relationship is further copied. These abilities can help maintain and update a test environment based on production data.


IBM Tivoli Storage Manager
(abbr.: TSM)
IBM Tivoli Storage Manager is IBM’s data protection platform that gives enterprises a single point of control and administration for data backup and restore and other storage management needs. The TSM family of products provides backup and restore functionality for a wide range of applications (including databases and mail).

See: www.ibm.com/software/tivoli/csi/backup-recovery/

IBM Tivoli Storage FlashCopy Manager
(also: FlashCopy Manager, FCM)
In today’s IT world, where application servers are operational 24 hours a day, the data on these servers must be fully protected. With the rapid increase in the amount of data on these servers, their critical business needs and the shrinking backup windows, traditional backup and restore methods can be reaching their limits in meeting these challenging requirements. Snapshot operations can help minimize the impact caused by backups and provide near-instant restore capabilities. Because a snapshot operation typically takes much less time than the time for a tape backup, the window during which the data...
is being backed up can be reduced. This helps with more frequent backups and increases the flexibility of backup scheduling and administration because the time spent for forward recovery through transaction logs after a restore is minimized.

IBM Tivoli Storage FlashCopy Manager uses the copy-services capabilities of intelligent storage subsystems to create point-in-time copies. These are application-aware copies (FlashCopy or snapshot) of the production data. A copy is then retained on disk as a backup, allowing for a fast restore operation (flashback). FlashCopy Manager also allows mounting the copy on an auxiliary server (backup server) as a logical copy. This copy (instead of the original production-server data) is made accessible for further processing. This processing includes creating a backup to Tivoli Storage Manager (disk or tape) or doing backup verification functions (for example, the Database Verify Utility). Fast FlashCopy restores can minimize the downtime required for data restore.

In addition the FlashCopy technology is ideally suited for database cloning, especially for large and intensively used databases, because it is fast (short time to recover and access the copy) and can be used in an ad hoc manner (database online, no load on production).

FlashCopy Manager supports manifold combinations of operating systems, database applications and storage systems. Check the system requirements on the Tivoli Storage FlashCopy Manager product website for a complete list of supported environments: www.ibm.com/software/tivoli/products/storage-flashcopy-mgr/

**Scope of this Best Practices paper**

This Best Practices paper describes a FlashCopy Manager setup in an IBM DB2 HADR environment on IBM Power System and IBM SAN Volume Controller. FlashCopy Manager creates FlashCopy backups on SVC and integrates with Tivoli Storage Manager software to create a permanent backup: the FCM offload feature transfers the data from the FlashCopy target volumes to a TSM server.

The paper does not provide introductions to Tivoli Storage Manager or FlashCopy Manager.

The reader should particularly be familiar with the FlashCopy Manager configuration tasks on UNIX and Linux system. The following web pages provide technical information about FlashCopy Manager:


www.ibm.com/support/techdocs/atsmastr.nsf/Web/Techdocs

Search for: FlashCopy AND Manager

The paper does also not describe the integration of an application such as SAP. A smooth reconnection to the DB2 database after a DB2 HADR takeover operation requires the availability of service IP addresses and other failover capabilities. On AIX operation system high availability solutions such as Tivoli Systems Automation (TSA) or PowerHA provide these functions.

**FlashCopy functions in a DB2 HADR environment**

In a highly available DB2 environment the integration of FlashCopy Manager and TSM enables a flexible database backup and restore scenario:

- Online / offline backups of the active DB2 database with TSM
- Online / offline FlashCopy backups of the active and the standby database with FCM
- Offload of the FlashCopy backups to TSM for the active and the standby DB2 database
- Instant restores of the active and the standby DB2 database with FCM
- TSM restores of active and the standby databases

The scenario remains operational after a DB2 HADR takeover without manual intervention!

**Hardware and software setup**

Figure 1 illustrates a highly available DB2 environment that is backed up with FlashCopy Manager and TSM. It includes the following hardware products:

- IBM POWER® systems with logical partitions (LPARs) running Virtual I/O Server (VIOS) and AIX operating system
- IBM SAN Volume Controllers (SVC) 6.3
- IBM DS8000® Storage System had been chosen as SVC backend storage. Any SVC-supported storage systems can be used.
Figure 1 Setup overview

The list of software products includes:

- SAP NetWeaver 7.3
- AIX 7.1 operating system
- DB2 9.7.5 database server
- Tivoli Storage Manager Client 6.3.0
- TSM for ERP Systems (Data Protection for SAP) 6.3.0
- Tivoli Storage FlashCopy(R) Manager 3.2.0.1

For software version 3.2 this minimum fix level is strongly recommended.
Conceptual background

FCM does not only create FlashCopies of the logical volumes that host the database. It also performs multiple operations to keep database and file system consistency. The following illustrations describe the FCM backup and restore process flows in DB2 environments:

FlashCopy Manager backup process flow

1. Set database into backup mode / quiesce database I/O
2. Perform file system sync
3. Optionally perform a file system freeze operation *
4. Create Storage Flash Copy
5. Optionally perform a file system thaw (unfreeze) operation
6. Set database to backup complete / resume database I/O

For offload to TSM server:
7. Mount the file systems on the FlashCopy target volumes at secondary server
8. Transfer data to a TSM server / third party backup system

Note: If a file system does not support freeze/thaw operations, a file system check will be required before mounting the file systems on the FlashCopy target volumes.

FlashCopy Manager restore and database recovery

- Cleanup production system resources
  - unmount file systems
  - export Volume Groups
- Perform reverse FlashCopy
- Import production system resources
  - Import Volume Groups and mount file systems
- Recover database depending of backup type (additional step outside FCM)
FlashCopy Manager backup of a DB2 standby database

In a DB2 database environment FlashCopy Manager integrates with the DB2 backup/restore system. DB2 backup and restore commands with the *use snapshot* option initiate the FlashCopy Manager operations. The DB2 backup history recognizes a FlashCopy backup with FCM as a regular DB2 backup.

DB2 does not allow DB2 backup and restore operations on a standby database. As a consequence – while *FlashCopy Manager for DB2* is used for the active database – *FCM for Custom Applications* is used on the standby site. In other words: the FlashCopy of the standby database comprehends a file system backup and not a database backup as on the active site.

FCM can use scripts to stop HADR before and start it after the FlashCopy creation. The software package includes two sample scripts in which only the database name must be customized.

Tivoli Storage Manager configuration

This section describes the TSM configuration on the TSM server and on each TSM client.

**TSM Server**

On the TSM Server the creation of multiple nodes enables the differentiation between different server data types:

- One TSM node per Power Systems LPAR (with: node name = hostname). In this setup TSM password handling uses these nodes.
- One node to backup the DB2 HADR primary instance
- One node to backup the DB2 HADR standby instance

All „hostname nodes“ act as proxy agents for the „database nodes“ (proxy targets).
Example:

```
crem: TSMSEL1> query node domain=DO_FAU

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Platform</th>
<th>Policy Domain Name</th>
<th>Days Since Last Access #</th>
<th>Days Since Password Set</th>
<th>Locked?</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAPT1C</td>
<td>TDF R3</td>
<td>DO_FAU</td>
<td>7</td>
<td>29</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>AIX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAPT1P</td>
<td>TDF R3</td>
<td>DO_FAU</td>
<td>&lt;1</td>
<td>21</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>AIX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAPT1SBY</td>
<td>TDF R3</td>
<td>DO_FAU</td>
<td>2</td>
<td>21</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>AIX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAPT2C</td>
<td>TDF R3</td>
<td>DO_FAU</td>
<td>7</td>
<td>21</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>AIX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1P</td>
<td>TDF R3</td>
<td>DO_FAU</td>
<td>&lt;1</td>
<td>29</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>AIX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1PSBY</td>
<td>??</td>
<td>DO_FAU</td>
<td>7</td>
<td>29</td>
<td>No</td>
</tr>
</tbody>
</table>
```

```
crem: TSMSEL1> query proxy target=T1P

<table>
<thead>
<tr>
<th>Target Node</th>
<th>Agent Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1P</td>
<td>SAPT1C</td>
</tr>
<tr>
<td></td>
<td>SAPT2C</td>
</tr>
<tr>
<td></td>
<td>SAPT1P</td>
</tr>
<tr>
<td></td>
<td>SAPT1SBY</td>
</tr>
<tr>
<td>T1PSBY</td>
<td>SAPT1C</td>
</tr>
<tr>
<td></td>
<td>SAPT2C</td>
</tr>
<tr>
<td></td>
<td>SAPT1P</td>
</tr>
<tr>
<td></td>
<td>SAPT1SBY</td>
</tr>
</tbody>
</table>
```

Multiple storage pools on disk and tape storage exist to separate the different kinds of backup and archive data:

- Pools for database backup to disk and tape
- Pools for database log file backup (two copies, also disk and tape pools for each copy)
- Pools for file system backup to disk and tape
- One copy storage pool on tape (to be used for all primary pools)
The following Management Classes have been created:

- MFS: file system backup to disk (with backup and archive copy groups)
- MDB: database backup to disk (archive copy group only)
- MDBT: database backup to tape (archive copy group only)
- MLOG1: database log file archive (LOG1) to disk (archive copy group only)
- MLOG2: database log file archive (LOG2) to disk (archive copy group only)

```
```

Note that the TSM for ERP Systems software writes to a TSM archive set for a database backup.
TSM Client

If the TSM offload feature is used, we recommend using two TSM client configurations in parallel in a FCM for SAP/DB2 environment. The Backup/Archive client can be used to backup and restore non-database data, for example database and application software and configuration files. The API client is called by TSM for ERP Systems to backup and restore the database itself.

The default installation paths of the backup/archive and API clients on AIX operating system are: /usr/tivoli/tsm/client/ba/bin64 and /usr/tivoli/tsm/client/api/bin64

B/A client configuration:

The TSM server stanza in the dsm.sys includes the TSM Server address, the TSM node name and the passwordaccess generate statement for automated password handling between TSM server and client. With specific TSM node names for the four AIX hosts the TSM server maintains separate backup sets for the servers.

Example:

```
Servername tsm2
nodename sapT1P
COMMMethod TCPip
TCPPort 9091
TCPServeraddress 9.155.50.201
ERRORLOGNAME /tmp/tsmerrorlog2
passwordaccess generate
```

API configuration:

TSM for ERP Systems and thus the FCM offload feature use the TSM client API to backup and restore the database. Adding the asnode statement in the dsm.sys file of all four AIX servers the database backup can be written to and read from one TSM archive set – no matter on which server a database backup or restore is started.

Example:

```
Servername tsm2
nodename sapT1P
asnode T1P
COMMMethod TCPip
TCPPort 9091
TCPServeraddress 9.155.50.201
ERRORLOGNAME /tmp/tsmerrorlog2
passwordaccess generate
```
TSM for ERP Systems configuration

TSM for ERP Systems is IBM's data protection solution for SAP systems with a DB2 or Oracle database and is a FCM requirement for SAP database instances. Install TSM for ERP Systems on all AIX hosts: DB2 server, DB2 standby server, FCM backup servers.

The software installation procedure asks for some configuration data including the name of the database name to backup and the TSM management classes for backup and archive operations. It then creates the init<SID>.utl configuration file including a stanza that describes the TSM environment. The default directory path of this configuration file is /db2/<SID>/tdp_r3.

In addition, the TSM for ERP Systems installation procedure requests the method of database log file handling. Selecting “2- LOGARCHMETH1” will cause a DB2 database configuration setting that can be checked later with a DB2 command.

sapt1p:db2t1p> db2 get db cfg for T1P|grep -i logarch

First log archive method (LOGARCHMETH1) = VENDOR:/usr/tivoli/tsm/tdp_r3/db264/libtdpdb264.a

Options for logarchmeth1 (LOGARCHOPT1) = /db2/T1P/tdp_r3/vendor.env

Second log archive method (LOGARCHMETH2) = OFF

Options for logarchmeth2 (LOGARCHOPT2) =

As a result of this DB2 setting, DB2 will decide when log archiving is required and delegate the log archiving task to TSM for ERP Systems.

After this initial software configuration manually set the PASSWORDREQUIRED parameter to NO in the TSM for ERP Systems configuration file init<SID>.utl. This setting disables password handling by TSM for ERP Systems and thus enables automated password handling by TSM. In addition comment or delete the ADSMNODE statement.

Example:

<table>
<thead>
<tr>
<th>SERVER</th>
<th>tsm2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SESSIONS</td>
<td>2</td>
</tr>
<tr>
<td># Maximum number of sessions</td>
<td></td>
</tr>
<tr>
<td># to server_a</td>
<td></td>
</tr>
<tr>
<td>PASSWORDREQUIRED</td>
<td>NO</td>
</tr>
<tr>
<td># Use a password?</td>
<td></td>
</tr>
<tr>
<td># No, because of passwordaccess generate</td>
<td></td>
</tr>
<tr>
<td># ADSMNODE</td>
<td>T1P</td>
</tr>
<tr>
<td># BPBACKUPMGTCLASS</td>
<td>MDB</td>
</tr>
<tr>
<td># BRBACKUPMGTCLASS</td>
<td>MDB</td>
</tr>
<tr>
<td># BRARCHIVEMGTCLASS</td>
<td>MLOG1 MLOG2</td>
</tr>
<tr>
<td># TCP_ADDRESS</td>
<td>192.168.1.1</td>
</tr>
<tr>
<td># IP address of network interface</td>
<td></td>
</tr>
<tr>
<td># on server_a</td>
<td></td>
</tr>
<tr>
<td># Overrides IP address of dsm.sys</td>
<td></td>
</tr>
<tr>
<td># USE_AT</td>
<td>0 1 2 3 4 5 6</td>
</tr>
<tr>
<td># Days when server_a is used for</td>
<td></td>
</tr>
<tr>
<td># backup</td>
<td></td>
</tr>
</tbody>
</table>

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Although TSM for ERP Systems delegates password handling to TSM the initial TSM node password must be specified to TSM for ERP Systems using the backom utility. Login as DB2 administrator (with username dbs<sid>) and configure the TSM client password:

```bash
# /usr/tivoli/tsm/tdp_r3/db264/backom -c password
```

### FlashCopy Manager configuration

In a DB2 HADR environment FlashCopy Manager must be installed and configured on multiple servers: the DB2 active and the DB2 standby database server and the associated FlashCopy Manager backup servers that run the TSM offload function. We recommend the following step by step process for the FlashCopy Manager configuration:

- On the active DB2 server create a FlashCopy Manager configuration (profile) for DB2 – ignoring the HADR environment.
- On the standby server create a FlashCopy Manager configuration (profile) for a DB2 standby server.
- Merge the two profiles to one in order to use almost identical configuration files on the active and standby server.
- Copy the FCM software from each of the DB2 servers to the related FCM backup system using the FCM setup script menu “manage backup systems”. This setup process step includes the creation of a FCM profile for a new FCM backup server.

These steps are described in detail in the following subsections.

The described technique enables a functional FCM environment after a DB2 HADR takeover without manual intervention. Other approaches may also meet this target.

### The ASNODENAME parameter

Just as for the offload of the database backup the offload of the standby database backup uses a proxy to write to TSM. While TSM for ERP Systems and the TSM Client handle the offload of the database backup, FCM initiates the offload function in case of the standby database. Consequentially this feature is configured with the ASNODENAME parameter of the FCM profile.
**FCM profiles**

After the installation of FlashCopy Manager the script ./setup_db2.sh supports the initial software configuration on the database servers as well as the software and configuration file copy to the backup servers.

The setup script is located in the database instance-specific directory that you specified during the FCM installation, for example: `/db2/db2t1p/sqlib/acs`. It requests input parameters that describe the application environment and finally creates a FlashCopy Manager instance-specific subdirectory named acs and a basic FCM configuration file (filename: profile).

The setup script suggests using the parameter values of an existing profile (which can be the original profile of FCM software package or a customized one) as default values. This facilitates the step-by-step enhancement of an FCM profile. Select “modify the profile” to use this configuration feature.

**FCM setup script excerpt:**

```
Found profile /db2/db2t1p/sqlib/acs/profile
Do you want to:
   (c)reate a new profile
   (r)euse the profile unchanged
   (m)odify the profile
```

The following configuration file examples show the FlashCopy Manager profiles created on the active DB2 server, the DB2 standby server and the merged profile.

**FCM profile of the active database server**

```plaintext
>>> GLOBAL
# ACS_DIR /db2/db2t1p/sqlib/acs
ACSD sap1tp 57328
TRACE NO
<<<

>>> ACSD
ACS_REPOSITORY /db2/db2t1p/acs/acsrepository
# ADMIN_ASSISTANT NO
# REPOSITORY_LABEL TSM
<<<

>>> CLIENT
# BACKUPIDPREFIX DB2___
APPLICATION_TYPE SAP
# PARTITION_GROUP
TSM_BACKUP LATEST
# MAX_VERSIONS ADAPTIVE
# LVM_FREEZE_THAW AUTO
# NEGATIVE_LIST NO_CHECK
# TIMEOUT_FLASH 120
```
# GLOBAL_SYSTEM_IDENTIFIER

DEVICE_CLASS BACKUP_LOCAL

>>> OFFLOAD

BACKUP_METHOD DB2
# OPTIONS
# DB2_OPTIONS
# PARALLELISM AUTO
# NUM_SESSIONS 1
# NUM_BUFFERS AUTO
# BUFFER_SIZE AUTO
# NUMBER_BACKUPS_IN_PARALLEL 0
# DATABASE_MEMORY 0

<<<

>>> DEVICE_CLASS BACKUP_LOCAL

COPYSERVICES_HARDWARE_TYPE SVC

COPYSERVICES_PRIMARY_SERVERNAME 9.155.66.107
# COPYSERVICES_USERNAME superuser
# CLONE_DATABASE NO
SVC_COPY_RATE 90
# SVC_CLEAN_RATE 50
# SVC_GRAIN_SIZE 256
COPYSERVICES_REMOTE NO
# COPYSERVICES_COMMPROTOCOL HTTPS
# COPYSERVICES_CERTIFICATEFILE NO_CERTIFICATE
# COPYSERVICES_SERVERPORT 5989
FLASHCOPY_TYPE NOCOPY
# COPYSERVICES_TIMEOUT 6
# RESTORE_FORCE NO
# STORAGE_SYSTEM_ID
# RECON_INTERVAL 12
# BACKUP_HOST_NAME PREASSIGNED_VOLUMES
TARGET_SETS VOLUMES_FILE
VOLUMES_FILE /db2/db2t1p/sqllib/acs/volumesSVC.txt

<<<

FCM profile of the standby database server

>>> GLOBAL

# ACS_DIR /db2/db2t1p/sqllib/acs

ACSD saptlsby 57328

TRACE YES

<<<

>>> ACSD

ACS_REPOSITORY /db2/db2t1p/acs/acsrepository
# ADMIN_ASSISTANT NO
# REPOSITORY_LABEL TSM

<<<

>>> CLIENT

# BACKUPIDPREFIX DB2___
APPLICATION_TYPE SAP___
# PARTITION_GROUP
TSM BACKUP LATEST
# MAX_VERSIONS ADAPTIVE
# LVM_FREEZE_THAW AUTO
# NEGATIVE_LIST NO_CHECK

Best practices for SAP applications on IBM XIV Storage Systems

16
# TIMEOUT_FLASH 120
# GLOBAL_SYSTEM_IDENTIFIER
DEVICE_CLASS BACKUP_SBY

>>> DB2STANDBY
DB2 PRODUCTIVE_SERVER sapt1p sapdb2T1P
DB2_ALIAS T1P
PRE_FLASH_CMD /db2/db2t1p/sqllib/acs/pre_flash_cmd.sh
POST_FLASH_CMD /db2/db2t1p/sqllib/acs/post_flash_cmd.sh
# DB2 USERNAME db2t1p
# DB2 AUTH_TYPE SERVER ENCRYPT
TSM BACKUP LATEST
# MAX VERSIONS ADAPTIVE
DEVICE_CLASS BACKUP_SBY

>>> OFFLOAD_DB2STANDBY
BACKUP_METHOD TSM_CLIENT
# MODE FULL
ASNODENAME T1Psby
DSM_DIR /usr/tivoli/tsm/client/ba/bin64
DSM_CONFIG /usr/tivoli/tsm/client/ba/bin64/dsm.opt
# VIRTUALFSNAME fcm

>>> OFFLOAD
BACKUP_METHOD DB2
# OPTIONS
# DB2 OPTIONS
# PARALLELISIM AUTO
NUM_SESSIONS 1
# NUM BUFFERS AUTO
# BUFFER_SIZE AUTO
# NUMBER BACKUPS IN PARALLEL 0
# DATABASE MEMORY 0

>>> DEVICE_CLASS BACKUP_SBY
COPYSERVICES_HARDWARE_TYPE SVC
COPYSERVICES_PRIMARY_SERVERNAME 9.155.66.107
# COPYSERVICES USERNAME superuser
# CLONE_DATABASE NO
SVC_COPY_RATE 90
# SVC CLEAN RATE 50
# SVC GRAIN SIZE 256
COPYSERVICES_REMOTE NO
# COPYSERVICES COMMPROTOCOL HTTPS
# COPYSERVICES CERTIFICATEFILE NO CERTIFICATE
# COPYSERVICES SERVERPORT 5989
FLASHCOPY TYPE NOCOPY
# COPYSERVICES TIMEOUT 6
# RESTORE FORCE NO
# STORAGE SYSTEM ID
# RECON INTERVAL 12
# BACKUP HOST NAME PREASSIGNED VOLUMES
TARGET SETS VOLUMES_FILE
VOLUMES_FILE /db2/db2t1p/sqllib/volumesSVC.txt
Best practices for SAP applications on IBM XIV Storage Systems

18
>>> OFFLOAD
BACKUP_METHOD DB2
# OPTIONS
# DB2_OPTIONS
# PARALLELISM AUTO
# NUM_SESSIONS 1
# NUM_BUFFERS AUTO
# BUFFER_SIZE AUTO
# NUMBER_BACKUPS_IN_PARALLEL 0
# DATABASE_MEMORY 0
<<<

>>> DEVICE_CLASS BACKUP_LOCAL
COPYSERVICES_HARDWARE_TYPE SVC
COPYSERVICES_PRIMARY_SERVERNAME 9.155.66.107
# COPYSERVICES_USERNAME superuser
# CLONE_DATABASE NO
SVC_COPY_RATE 90
# SVC_CLEAN_RATE 50
# SVC_GRAIN_SIZE 256
COPYSERVICES_REMOTE NO
# COPYSERVICES_COMMPROTOCOL HTTPS
# COPYSERVICES_CERTIFICATEFILE NO_CERTIFICATE
# COPYSERVICES_SERVERPORT 5989
FLASHCOPY_TYPE NOCOPY
# COPYSERVICES_TIMEOUT 6
# RESTORE_FORCE NO
# STORAGE_SYSTEM_ID
# RECON_INTERVAL 12
# BACKUP_HOST_NAME PREASSIGNED_VOLUMES
TARGET_SETS VOLUMES_FILE
VOLUMES_FILE /db2/db2t1p/sqllib/acs/volumesSVC.txt
<<<

**FlashCopy Manager backup server setup**

With the Secure Shell (SSH) protocol the FCM setup scripts can copy FCM software and configuration files from the DB2 servers to their backup server peers. If customer policies prohibit SSH use, FCM must be explicitly installed and configured on the backup systems.

FCM setup script excerpt:

Select (1) manage backup systems
and      (n) configure a new backup system

Enter the hostname of the backup system: sapt2c

**Specification of the FlashCopy target volumes**
While FlashCopy Manager automatically detects the source volumes of a FlashCopy backup or clone, the target volumes must be specified. The target volumes are either listed in a FlashCopy Manager configuration file or specified by the use of naming rules, for example:

```
TARGET_SETS 01 02 03 04 05 06 07
TARGET_NAMING %SOURCE_T%TARGETSET
```

If the source volume name was SAPDATA, FlashCopy Manager would check for the following target volumes on the storage system: SAPDATA_T01, SAPDATA_T02 etc.

If a volumes list is used, the FlashCopy Manager profile parameter VOLUMES_FILE must point to the volumes list filename, for example:

In DEVICE_CLASS section “DEVICE_CLASS BACKUP_LOCAL”:

```
VOLUMES_FILE /db2/db2t1p/sqlib/acs/volumesSVC.txt
```

```
saptlp:db2t1p 33> cat volumesSVC.txt
>>> TARGET_SET vol_set_1
TARGET_VOLUME SAP_T1P_SED01
TARGET_VOLUME SAP_T1P_SED02
TARGET_VOLUME SAP_T1P_SEL01
TARGET_VOLUME SAP_T1P_db2t1p_bkup1
<<< vol_set_1
>>> TARGET_SET vol_set_2
TARGET_VOLUME SAP_T1P_SED03
TARGET_VOLUME SAP_T1P_SED04
TARGET_VOLUME SAP_T1P_SEL02
TARGET_VOLUME SAP_T1P_db2t1p_bkup2
<<< vol_set_2
```

Whichever method is used, FlashCopy Manager expects that the target volumes exist on the SAN Volume Controller.

DB2 HADR does not require an identical storage layout for the active and the standby database. Our setup made use of this flexibility. Therefore the FlashCopy target volumes configuration file looked different on the DB2 standby server.

```
saptisby:db2t1p 8> cat volumesSVC.txt
>>> TARGET_SET vol_set_1
```

FlashCopy Manager requires target volume predefinition and specification for IBM SAN Volume Controller, Storwize V7000 and DS8000. It does not require target volume specification for IBM N Series and XIV because these storage systems do not request the preallocation of Snapshot target volumes. IBM N Series and XIV create Snapshots “on the fly.”
With this configuration after a DB2 takeover a new FlashCopy backup of the now active database will overwrite the previous FlashCopy backups of the standby database and vice versa. With separate FlashCopy Manager device classes for the active and standby database it would be possible to keep the old backups. However a restore from these backups would not be available before a new takeover operation. We knowingly created this “limitation” because we did not expect daily database takeover operations and after two takeover operations the FlashCopy backups could have been too old to use them in a restore. Yet we recommend performing new FlashCopy backups directly after a database takeover with such a setup.

**Backup and restore command examples**

After a successful configuration daily usage of FlashCopy Manager bases upon a few DB2 and FlashCopy Manager commands:

Create a FlashCopy (or disk-only) backup of the active DB2 database:

```
db2 backup db T1P online use snapshot
```

```
db2 backup db T1P online use snapshot exclude logs
```

**Note:** Check the IBM DB2 command reference for details about the use of the exclude logs and include logs option with snapshot backups.

Create a FlashCopy backup of the standby database:

```
./fcmcli -f backup_db2standby
```

Show available backups:
Delete an existing backup from the FCM repository:

```
db2acsutil delete snapshot taken at <timestamp>
```

```
./fcmcli -f delete -B <backup_ID> [-F]
./fcmcli -f delete_db2standby -B A0HPA4LELF
```

Restore and recover the active database from an available backup:

```
db2 restore db T1P use snapshot
```

```
db2 restore db T1P use snapshot logtarget exclude
```

**Note:** Stop the database before starting a full database restore.

Restore and recover the active database from an available backup:

```
./fcmcli -f restore_db2standby
```

**Note:** Stop DB2 HADR before starting this restore.

Recover/ roll forward the database after a successful restore:

```
db2 rollforward db T1P to end of logs and complete
```

Test DB2 database connection (optional):

```
db2 connect to T1P
```

After changing the FlashCopy Manager profile it can be necessary to stop and start the FlashCopy Manager daemons:

```
./setup_db2.sh -a stop -d /db2/db2t1p/sqlib
./setup_db2.sh -a start -d /db2/db2t1p/sqlib
```

**Note:** The DB2 and FCM manuals include additional command options.

Figure 2 shows an operation sequence in a FCM / DB2 HADR environment.
### AIX Server: sap1tp

<table>
<thead>
<tr>
<th>sapt1p: active database</th>
<th>AIX Server: sap1tsby</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check HADR status: db2pd -db T1P -hadr</td>
<td>ditto</td>
</tr>
<tr>
<td>Database FlashCopy backup: db2 backup db T1P online use snapshot</td>
<td>File system FlashCopy backup: fcmpcl -f backup_db2standby</td>
</tr>
<tr>
<td>Show backup status: fcmpcl -f inquire_detail</td>
<td>Show backup status: fcmpcl -f inquire_detail -no2standby</td>
</tr>
<tr>
<td>Offload to TSM: fcmpcl -f tape_backup</td>
<td>Offload to TSM: fcmpcl -f tape_backup</td>
</tr>
<tr>
<td>This offload to TSM operation starts TSM4ERP</td>
<td>This offload to TSM operation starts the TSM client, for example: dsmc backup group -fileslist -tmpfCMP-TakUb-asmnodename=T1Ptsby -groupname=FCM_T1P -virtualname=fcmp -mode=full</td>
</tr>
</tbody>
</table>

### AIX Server: sap1tsby

<table>
<thead>
<tr>
<th>sapt1tsby: standby database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check HADR status: db2pd -db T1P -hadr</td>
</tr>
<tr>
<td>DB2 failover; db2 takeover hadr on database T1P</td>
</tr>
</tbody>
</table>

### sap1tp: standby database

<table>
<thead>
<tr>
<th>sapt1tp: standby database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database and file system FlashCopy backups and offloads to TSM. Same as above with roles reversed.</td>
</tr>
<tr>
<td>Deactivate the database and stop HADR: db2 shutdown db T1P</td>
</tr>
<tr>
<td>Database FlashCopy restore: fcmpcl -f restore_db2standby</td>
</tr>
<tr>
<td>Restart standby database: db2 start hadr on db T1P as standby</td>
</tr>
<tr>
<td>Stop HADR and database; perform a database FlashCopy restore and rollforward: db2 start hadr on db T1P</td>
</tr>
<tr>
<td>dbstop</td>
</tr>
<tr>
<td>db2 start db mgr</td>
</tr>
<tr>
<td>db2 restore db T1P use snapshot logtarget exclude</td>
</tr>
<tr>
<td>db2 rollforward db T1P to end of logs and complete</td>
</tr>
<tr>
<td>db2 start hadr on db T1P as primary</td>
</tr>
<tr>
<td>Check HADR status: db2pd -db T1P -hadr</td>
</tr>
<tr>
<td>DB2 failover; db2 takeover hadr on database T1P</td>
</tr>
</tbody>
</table>

### sap1tsby: active database

<table>
<thead>
<tr>
<th>sapt1tsby: active database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restore from TSM with sample application SAP: Stop HADR</td>
</tr>
<tr>
<td>Stop SAP and DB</td>
</tr>
<tr>
<td>Start DB Manager: db2 start db manager</td>
</tr>
<tr>
<td>Restore database: db2 restore db T1P load</td>
</tr>
<tr>
<td>fasmkCheckpoint_r3\db264\lib\pre264.a</td>
</tr>
<tr>
<td>Rollforward database: db2 rollforward db T1P to end of logs and complete</td>
</tr>
<tr>
<td>Start SAP</td>
</tr>
</tbody>
</table>

---

**Figure 2 FCM operation sequence**

---

**Some troubleshooting hints**

Parallel FlashCopy backups
In a combined FCM/TSM environment parallel FlashCopy backups on the active and standby nodes are not possible. Running the following two commands in parallel will cause errors:
> db2 backup db T1P online use snapshot
> fcmcli -f backup_db2standby

FCM will display error messages such as:
FMM6827E Tablespace 'T1P#USER1D' is in state 'Backup in progress'. Snapshot backup is not possible.

Error cause: FlashCopy Manager on the standby node tries to communicate with the active database. Communication fails while the database is in backup state!

**Wrong DB2 HADR parameters after a restore**

After a DB2 takeover and a subsequent restore of the standby database with TSM HADR does not start.

If the TSM backup was taken on the other DB2 HADR node, check the HADR parameters of the DB2 configuration. The file system backup of the standby database includes node-specific parameters which could have been restored by TSM.

**Example:**
The host named sapt1p is the current DB2 standby server and on this host the restore was performed. The offload of the DB2 standby server however was taken on host sapt1sby before the HADR takeover.

```
sapt1p:db2t1p 1> db2 get db cfg for T1P | grep -i hadr
HADR database role = STANDBY
HADR local host name (HADR_LOCAL_HOST) = sapt1sby
HADR local service name (HADR_LOCAL_SVC) = hadr_service2
HADR remote host name (HADR_REMOTE_HOST) = sapt1p
HADR remote service name (HADR_REMOTE_SVC) = hadr_service1
HADR instance name of remote server (HADR_REMOTE_INST) = db2t1p
HADR timeout value (HADR_TIMEOUT) = 120
HADR log write synchronization mode (HADR_SYNCMODE) = NEARSYNC
HADR peer window duration (seconds) (HADR_PEER_WINDOW) = 0
```

```
db2 update db cfg for MZS using HADR_LOCAL_HOST sapt1p
db2 update db cfg for MZS using HADR_LOCAL_SVC hadr_service2
```

**Note:** On the active DB2 server a comparable error situation should not occur. A DB2 restore handles this situation.

**A SAN Volume Controller FlashCopy view**

FlashCopy Manager leverages the FlashCopy or Snapshot features of IBM Storage Systems. Thus a view of the FlashCopy Consistency Groups completes this technical paper. See Figure 3
Figure 3 SVC Consistency Groups
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