IBM Replication Solutions for Business Continuity Part 1 of 2
TotalStorage Productivity Center for Replication (TPC-R)

FlashCopy Manager/PPRC Manager

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Business Continuity

Business Continuity is not simply IT Disaster Recovery... it is a management process that relies on each component in the business chain to sustain operations at all times.

- **Effective Business Continuity depends on ability to:**
  - **Reduce the risk of a business interruption**
  - **Stay in business when an interruption occurs**
  - **Respond to customers**
  - **Maintain public confidence**
  - **Comply with requirements:**
    - **Audit**
    - **Regulator/Legislative**
    - **Insurance**
    - **Health and Safety**

People   Facilities   Business Processes   Infrastructure   Applications

... An end-to-end Business Continuity program is only as strong as its weakest link

The Drivers for Replication and Replication Management

- Need for High Availability
  - Provide for continuous application processing in the event of an unplanned outage, such as server failure.
- Need to recover from disasters
  - Ranging from nature, to deliberate attacks, to human error

- Recovery times must be repeatable and reliable

- Solution must be scalable

- Testing must be affordable and nearly continuous

Storage Replication Management Status Today

- **Current state of managing replication services**
  - Many manual procedures
  - Home grown hard-to-maintain scripts
  - These manual procedures and scripts are very error prone and provide no view of a customer's overall copy environment status
- **Replication management is complicated**
  - Initial setup and ongoing management of large copy services environments is complex and error prone – especially in three site environments
  - Difficult to monitor progress and status of copy services tasks
- **Solution complexity increases with size of enterprise**

- **Inconsistent management GUI's between different storage servers**

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TPC for Replication Family Value

▸ TPC for Replication is software running on a server that manages IBM disk based replication functions, i.e.:

- ▸ FlashCopy
- ▸ Metro Mirror
- ▸ Global Mirror
- ▸ Metro Global Mirror

▸ TPC for Replication

- ▸ Provides central control of your replication environment
- ▸ Helps simplify and automate complex replication tasks
- ▸ Allows testing of D/R at any time using Practice Volumes
- ▸ Provides end to end management and tracking of the copy services
- ▸ Provides management of planned and unplanned disaster recovery procedures
- ▸ Manage your replication from the server of your choice, z/OS or open systems servers, z/OS or open data

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IBM Copy Services Terminologies

FlashCopy

Point in time copy

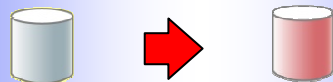**Within the same Storage System**
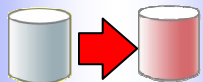
Metro Mirror

Synchronous mirroring

Primary Site A **Metro distance <300km Site B**
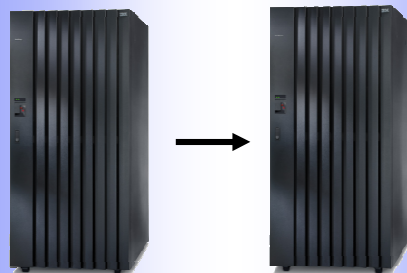
Global Mirror

Asynchronous mirroring

Primary Site A **Out of Region Site B**

Metro / Global Mirror

Three site synchronous & asynchronous mirroring

Primary Site A **Metro Site B** **Out of Region Site C**
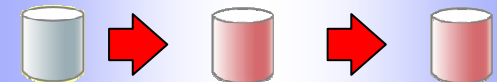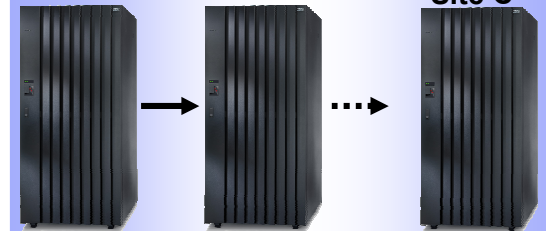
Aspects of Availability

High Availability

Fault-tolerant, failure-resistant Infrastructure supporting contiuous application processing

TPC-R for managing HyperSwap and OpenSwap

Continuous Operations

Non-disruptive backups and system maintenance coupled with continuous availability of application

TPC-R Practice Volumes

Disaster Recovery

Protection against unplanned outages such as disasters through reliable, predictable recovery

TPC-R management, automation and simplification

TPC for Replication Overview

- Replication management solution
  - Simplified replication management & monitoring
  - Powerful commands and logic

- Multiple Storage subsystems
  - DS8000, DS6000, ESS800, SVC

- Multiple logical volume types
  - Open systems (FB) LUNs
  - z/OS (CKD) volumes

- Multiple replication types
  - FlashCopy
  - Metro Mirror
  - Global Mirror
  - Metro/Global Mirror

- High performance and scalability

TPC for Replication – Common Tasks

- **Common Tasks**

  - Monitor overall health of the Replication Environment

  - List all sessions and important status information

  - Take actions on sessions

  - Add and Remove Storage Subsystems

  - Add and Remove Paths

  - Create and Remove Sessions

  - Add and Remove Copy Sets, Monitor Sessions

  - Modify Storage Subsystem connection parameters

  - Create FlashCopy, Metro Mirror, Global Mirror and Met[...] Global Mirror sessions

  - Define a stand-by server

  - Review Diagnostics

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Using the DS Hardware Commands

1. Determine where to place Master GM session given the PPRC paths.

2. Establish PPRC links between Master and Subordinate DS8000's.

3. Establish PPRC paths between A and B volumes

4. Establish Subordinate sessions on the A volumes of the DS8000's

5. Establish a GC relationship between A and B

6. Query A to determine first pass complete

7. Establish Flash Copy between B and C with incremental

8. Add A to the Subordinate Global Mirror session

9. If first A volume on this DS8000 then start the Global Mirror Master with new configuration

▪ Monitor the Global Mirror Master with 051 queries and calculate RPO.

▪ Monitor for failures and fatal conditions

Using TPC-R Commands

1. START

Recover a Global Mirror Copy

Using the DS Hardware Commands

1. Establish PPRC B to A Failover

2. Query all B to C Flash Copy relationships and determine if they are revertible and have the same sequence number

3. If the sequence numbers are all the same AND at least one relationship is not revertible issue a "*withdraw Flash Copy with commit*" to all of the revertible relationships

4. If all of the Flash Copy relationships are Revertible, issue a "withdraw Flashcopy with revert" to all Flashcopy relationships.

5. Issue "establish Flashcopy C to D" with Fast Reverse Restore

Using TPC-R Commands

1. RECOVER

Tivoli Storage Productivity for Replication – Task Savings

Tivoli Storage Productivity Center for Replication drastically enhances the efficiency of your copy services tasks by reducing the time it takes to execute replication jobs

Task	DSxxxx Command Line Interface	TPC for Replication
Set up Global Mirror	5 steps	1 command (START)
Global Mirror Recovery	4 steps	1 command (RECOVER)
Set up Metro Global Mirror	8-25 steps	1 command (START)
Make a practice copy	5 steps	1 command (FLASH)
Task	SVC Command Line Interface	TPC for Replication
Set up Metro Mirror	4 steps	1 command (START)
Clean up a consistency group	3 steps	1 command (TERMINATE)
Make a practice copy	5 steps	1 command (FLASH)

Replication Configurations

DS8000, DS6000 and ESS800 2-site

FlashCopy

Metro Mirror * / Global Copy

Metro Mirror w/Practice

Global Mirror

Global Mirror w/Practice

Global Mirror Both Directions w/Practice

DS8000 3-Site

Metro Global Mirror*

Metro Global Mirror w/Practice

SVC 2-Site

FlashCopy

Metro Mirror and Global Mirror

Metro Mirror and Global Mirror

Note: No Journal Volume for SVC
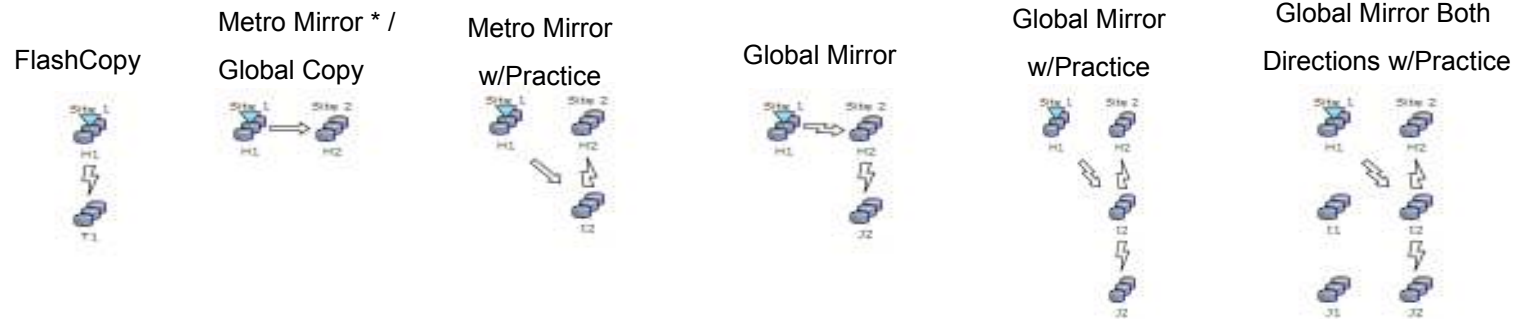
- 'H' volumes are the Host connected volumes
- Volumes on the same site are in the same storage system

* Running on zOS provides the ability to enable the session for Hyperswap capabilities

Practice Volumes Sessions

- Practice Volumes are an important function in Disaster Recovery (DR) management

- Practice Volumes allow IT managers to:

  - Test their DR environment without interfering with daily DR operations

  - Provides an additional set of consistent data that could be used for testing or data mining without interfering with daily DR operations

  - Provides an additional set of recoverable data to help protect against a disaster during a resynchronization

  - Provides a way to practice their DR op disaster.

TPC for Replication Stand-By server options

- Two Site Server Standby option allows you to manage copy services at the production site while maintaining recovery capabilities at the Disaster Recover site.

- Two Site option requires two servers for a high availability configuration

  - One Active and one Stand-by server

  - Changes to Primary are propagated to Stand-by server(s)

  - Managed as part of the entire Copy Services Environment

  - Managed via Graphical User Interface
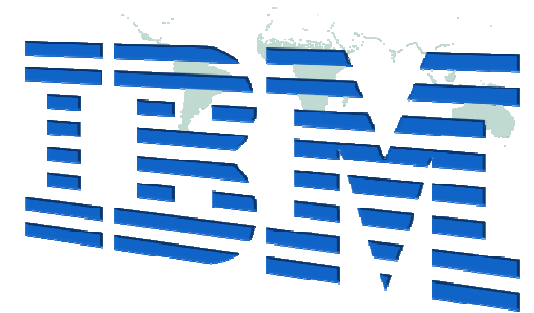
Tivoli Storage Productivity Center (TPC) 4.1

IBM Tivoli Storage Productivity Center (TPC)

TPC Standard Edition (SE)
Now contains TPC for Fabric functions

TPC For Data

TPC For Disk

Basic Edition (included in all SSPC's)

TPC For Replication
Includes Two Site BC
Optional priced Three Site
BC product

TPC For Replication for System z (2 site BC & Optionally priced 3 site BC feature)
TPC-R for System z Basic Edition (for HyperSwap)

Tivoli Storage Productivity Center for Replication family

There are four products within the replication family:

TPC for Replication Two Site BC
- Administration and Operations management for Advanced Copy Services
- Disaster Recovery management between two sites including failback features
- Includes support for: FlashCopy, Metro Mirror & Global Mirror

TPC for Replication Three Site BC
- Administration and Operations management for Advanced Copy Services
- Disaster Recovery management between three sites including failback features
- Includes support for FlashCopy, Metro Mirror, Global Mirror, & Metro Global Mirror

TPC for Replication Basic Edition for System z
- No charge product that provides basic support for the HyperSwap function within a System z environment

TPC for Replication for System z
- Administration and Operations management for Advanced Copy Services
- Disaster Recovery management between two sites including failback features
- The optional Three Site BC feature supports Metro Global Mirror environments

Tivoli Storage Productivity Center is not a prerequisite of Tivoli Storage Productivity Center for Replication

TPC-R and TPC Integration

- Installation

- Information shared between TPC-R and TPC
  - Storage subsystems connection information
  - Volumes defined to replication sessions
  - Storage subsystems defined to replication sessions
  - The storage subsystems and volumes that are still in replication sessions cannot be deleted from TPC

- TPC-R sends all defined SNMP events as alerts to TPC

- Launch TPC-R GUI from Tivoli Integration Portal (TIP) and TPC GUI
  - Single sign-on

Comparing TPC for Replication and Tivoli Storage FlashCopy Manager

- The IBM Tivoli Storage Productivity Center (TPC) for Replication family helps to manage the advanced copy services provided by the IBM System Storage DS8000®, IBM System Storage SAN Volume Controller (SVC), IBM® Storwize® V7000 and the IBM Enterprise Storage Server® (ESS) Model 800

- IBM Tivoli® Storage FlashCopy® Manager software provides fast application-aware backups and restores leveraging advanced snapshot technologies in IBM storage systems. Performs near-instant application-aware snapshot backups, with minimal performance impact for IBM DB2, Oracle, SAP, Microsoft SQL Server and Exchange. In addition, FCM provides support for custom applications on Unix and Linux which provides for support of all data stored on the supported devices.

TPC for Replication and Tivoli Storage FlashCopy Manager

	TPC for Replication	FlashCopy Manager
Purpose	Disk and File Replication Mgt	Application & File System Backup/Restore and DB Cloning
Hardware Copy Function used	FlashCopy, Metro Mirror, Global Mirror, Metro Global Mirror, HyperSwap and OpenSwap (AIX)	FlashCopy
Hardware Supported	DS8000, SVC, Storwize V7000	Unix – DS8000, XIV, SVC and Storwize V7000 Windows – VSS supported disk (only IBM disks have been tested)
Data Supported	All data on supported hardware	Unix – DB2, Oracle, SAP plus all data via custom App support (If backing up to TSM additional TDP software is required) Windows – VSS supported Apps (i.e. Exchange & SQL)
Servers Supported	Windows, AIX, Linux, z/OS	Windows, AIX, Linux, Solaris

TPC for Replication and FlashCopy Manager Synergy

- For the DS8000 - TPC for Replication can manage the process of sending FCM created backups to remote locations (using synchronous or asynchronous replication)

- FCM can be used to Flash a local copy of data that is being remote copied to a secondary site using TPC-R – creating local snapshots of the source mirror

- TPC-R can be used to provide disaster recovery for applications by establishing metro or global mirroring for the application data volumes while FCM can provide snapshot backup and recovery for the same application by exploiting FlashCopy of the application data volumes being mirrored.

Summary

Tivoli Storage Productivity Center for Replication

- Provides central control of your replication environment

- Helps simplify and automate complex replication tasks

- Provides end to end management and tracking of the copy services

- Allows testing of D/R at any time using Practice Volumes

- Provides management of planned and unplanned disaster recovery procedures

- Manage your replication from the server of your choice, z/OS or open systems servers for both z/OS and open data

PPRC Manager and FlashCopy Manager Introduction

- PPRC Manager FlashCopy Manager are two IBM software products that are designed to allow the user to exploit the underlying IBM technology without requiring a understanding of the details involved in using the technology.
  - z/OS based
  - ISPF based for configuration processes
  - Operates on full volumes

- There are two parts to the use of PPRC or and Flash Copy technology
  - Defining the Configuration and building JOBs – ISPF panel based functions
  - Manipulating the configuration – Batch JOB based functions

- Batch JOB based manipulations allow the user to execute the operations individually or to imbed the JOBs into a more complex business application

- Scope of applications – single DS8100 thru very large configurations

PPRC Manager and FlashCopy Manager Prerequisites

- z/OS 1.7(and up) with ISPF
- REXX library or the REXX alternate Run Time library
  - The REXX Alternate Run Time Library is included with z/OS 1.9
- Appropriate microcode licenses for the IBM Storage subsystem hardware
  - IBM 1750, IBM 2105-F20, IBM 2105-800 or IBM 2107

- Both products are priced
  - One time charge (site license)
  - Subscription and Support option is available

- Can be ordered via Shop zSeries
  - Catalog reference information
    - Package type: z/OS –CBPDO or ServerPac
    - Group: MVS –Miscellaneous/Other

  - PPRC Manager - 5635-PPM
  - FlashCopy Manager – 5635-FCN

- z/OS 1.7(and up) with ISPF

Design Objectives

- Use technologies that systems programmers and storage administrators use daily (ISPF, ISMF etc.).

- Use a Batch Job based methodology to allow the manipulation tasks to be easily integrated into a more complex business solution job stream.

- Minimize the level of understanding of the details of the underlying PPRC or FlashCopy process for both configuration development and manipulation of the environment.

- For FlashCopy, eliminate SYSGEN dependencies & duplicate label problems with IPLs.

Applications – PPRC Manager

Sample Business applications:

- Migrate from older technology to newer technology

- Migrate data to new data center (old to old or old to newer technology)

- Create a consistent Point in Time Copy of all the data on production SYSPLEXes for transfer to tape for DR – Boeing

- Create a synchronous PPRC DR environment for DR purposes
  Seven z/OS SYSPLEXes and a VM Plex, about 100TB of production data

- Create an Extended distance PPRC environment for Disaster recovery purposes

# Applications – FlashCopy Manager

Sample Business applications:

- Create a consistent copy of production data that will be transferred to tape for Disaster Recovery use.

- Create a consistent copy of production Database data for improved recovery from software database corruption.

- Create a consistent copy of production Database data for use in application development/Quality Assurance testing…Medco.

Advanced applications

- Cascading PPRC
- PPRC followed by FlashCopy
- FlashCopy with PPRC
- FlashCopy followed by PPRC
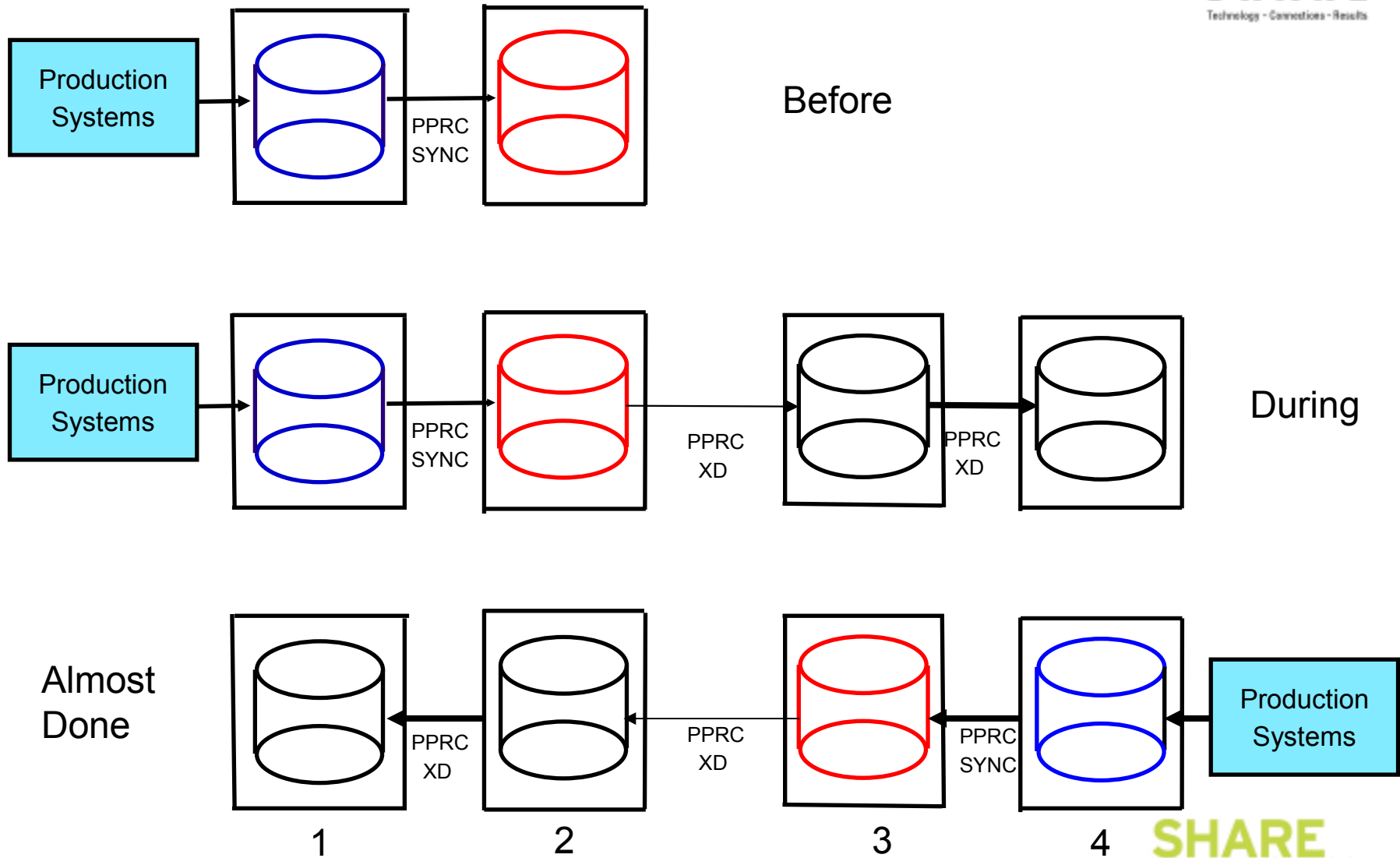- FlashCopy followed by PPRC followed by FlashCopy
- Global Mirror

Cascading PPRC

Production Systems → (blue disk) → **PPRC XD or SYNC** → (red disk) → **PPRC XD** → (black disk)
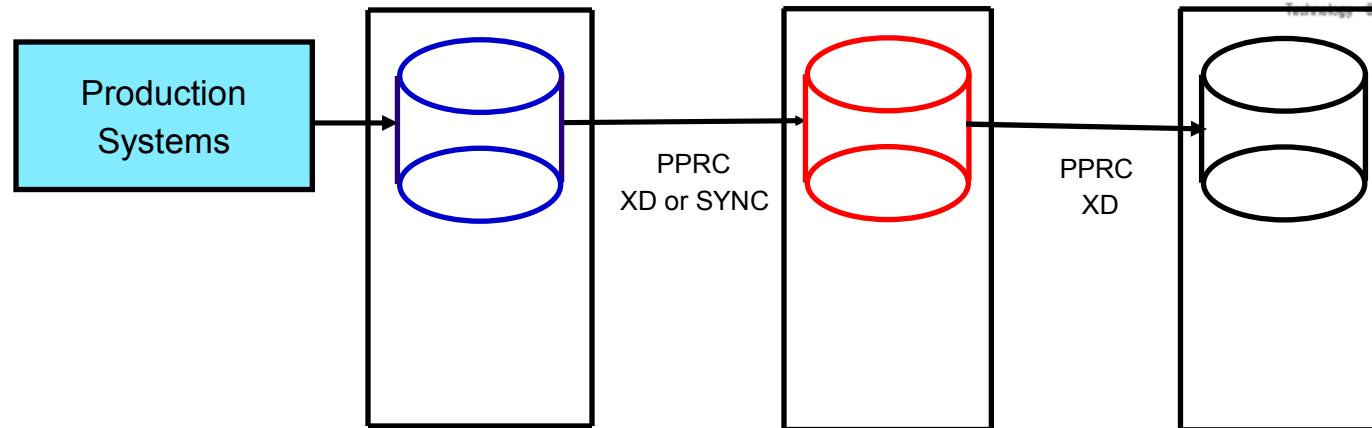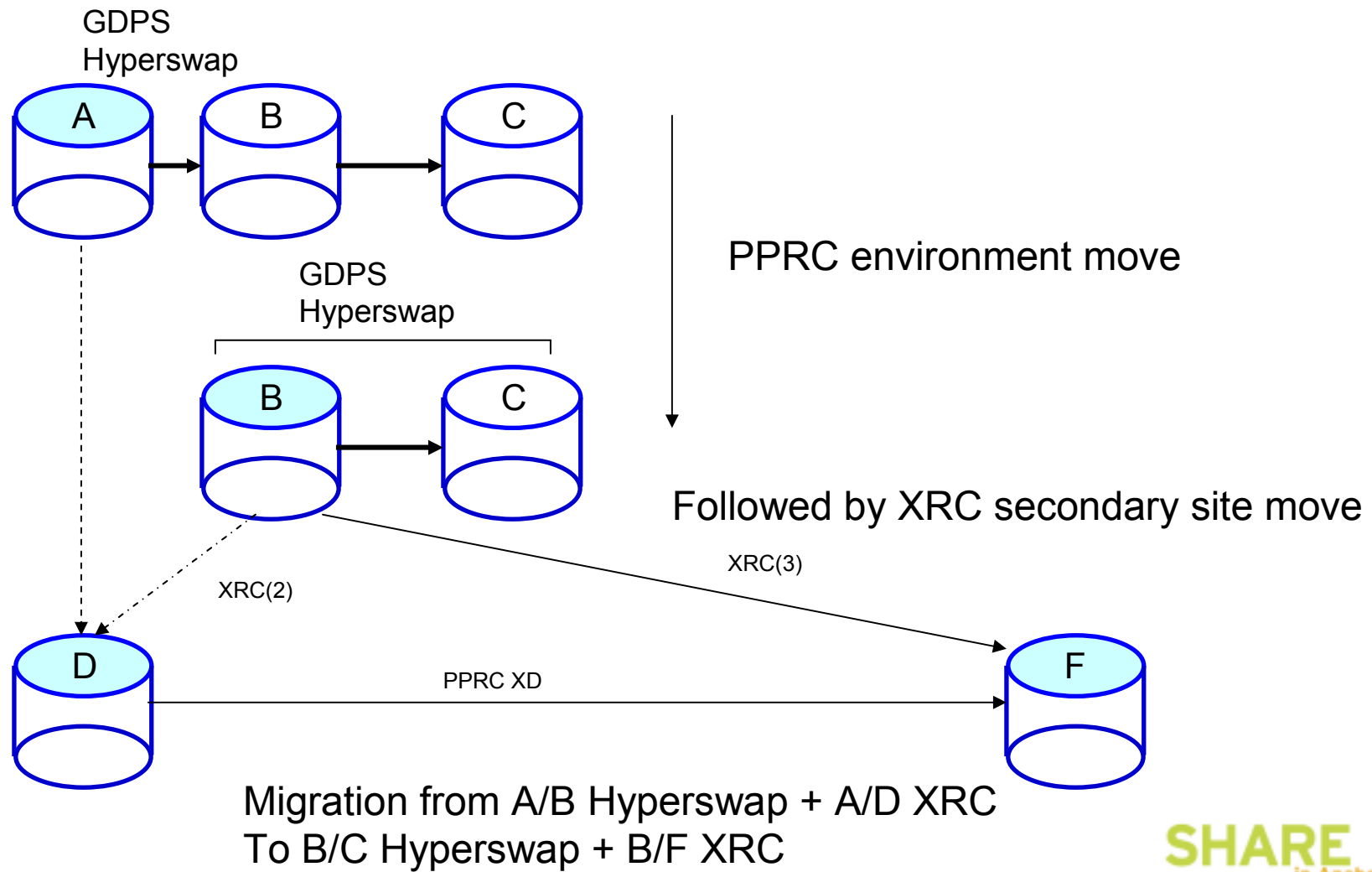
Applications

- Data Center Migrations PPRC-XD to PPRC-XD
- Technology Migrations   PPRC-Sync to PPRC-XD
        ESS800 -> DS8300 -> DS8300
- Create common test environment for multiple production environments
    - First PPRC pair is PPRC Sync for DR application
    - Second PPRC pair creates copy of production data in common
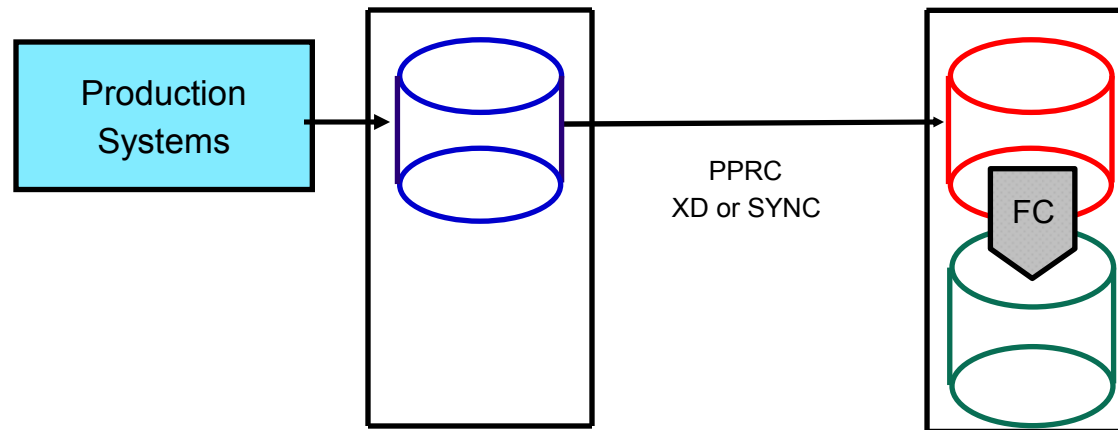   test center or is used for PIT disk to tape

Paired data center Migration(4 sites)

Before

During

Almost
Done

| 1 | 2 | 3 | 4 |

Multiple moves

GDPS
Hyperswap

A → B → C

PPRC environment move

GDPS
Hyperswap

B → C

Followed by XRC secondary site move

XRC(3)

XRC(2)

D — PPRC XD → F

Migration from A/B Hyperswap + A/D XRC
To B/C Hyperswap + B/F XRC

PPRC followed by FlashCopy

Applications

- Data Center Migration
    - PPRC-XD to PPRC-sync, FlashCopy and then back to PPRC-XD
    - Final production switch is to the FlashCopy targets
- Consistent copy of data for Disk to tape based DR process
    - PPRC sync required for Point in Time FlashCopy
- FlashCopy targets used for application testing
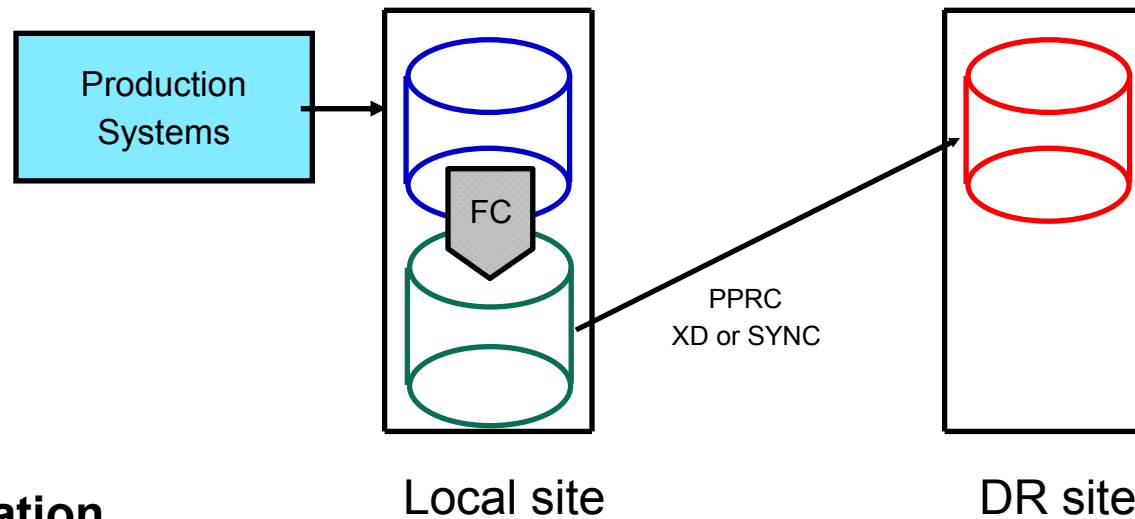- Obtain Point in time copies of DB2 data from GDPS Metro Mirror secondaries

FlashCopy with PPRC

Production Systems

FC
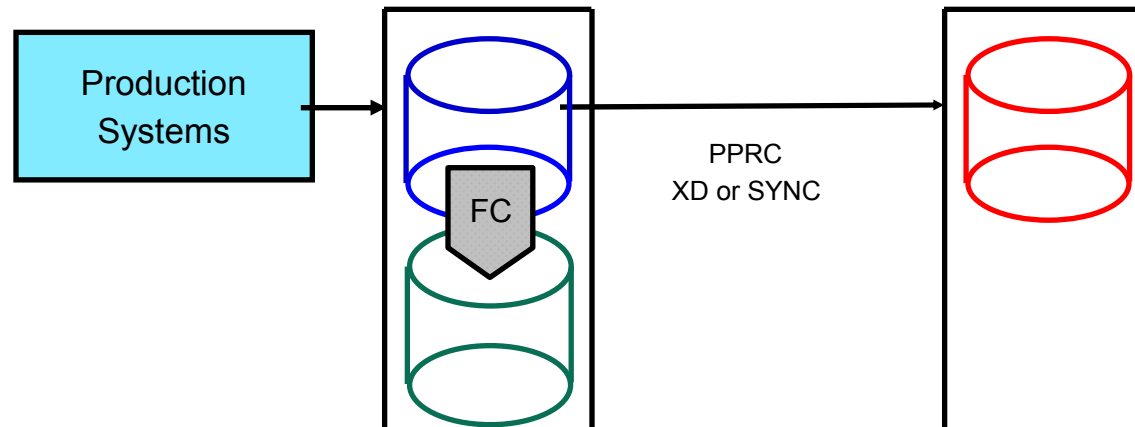
PPRC
XD or SYNC

Application

• PPRC for Disaster Recovery - AND
• FlashCopy target data available for local recovery from software data corruption

FlashCopy followed by PPRC

Local site   DR site
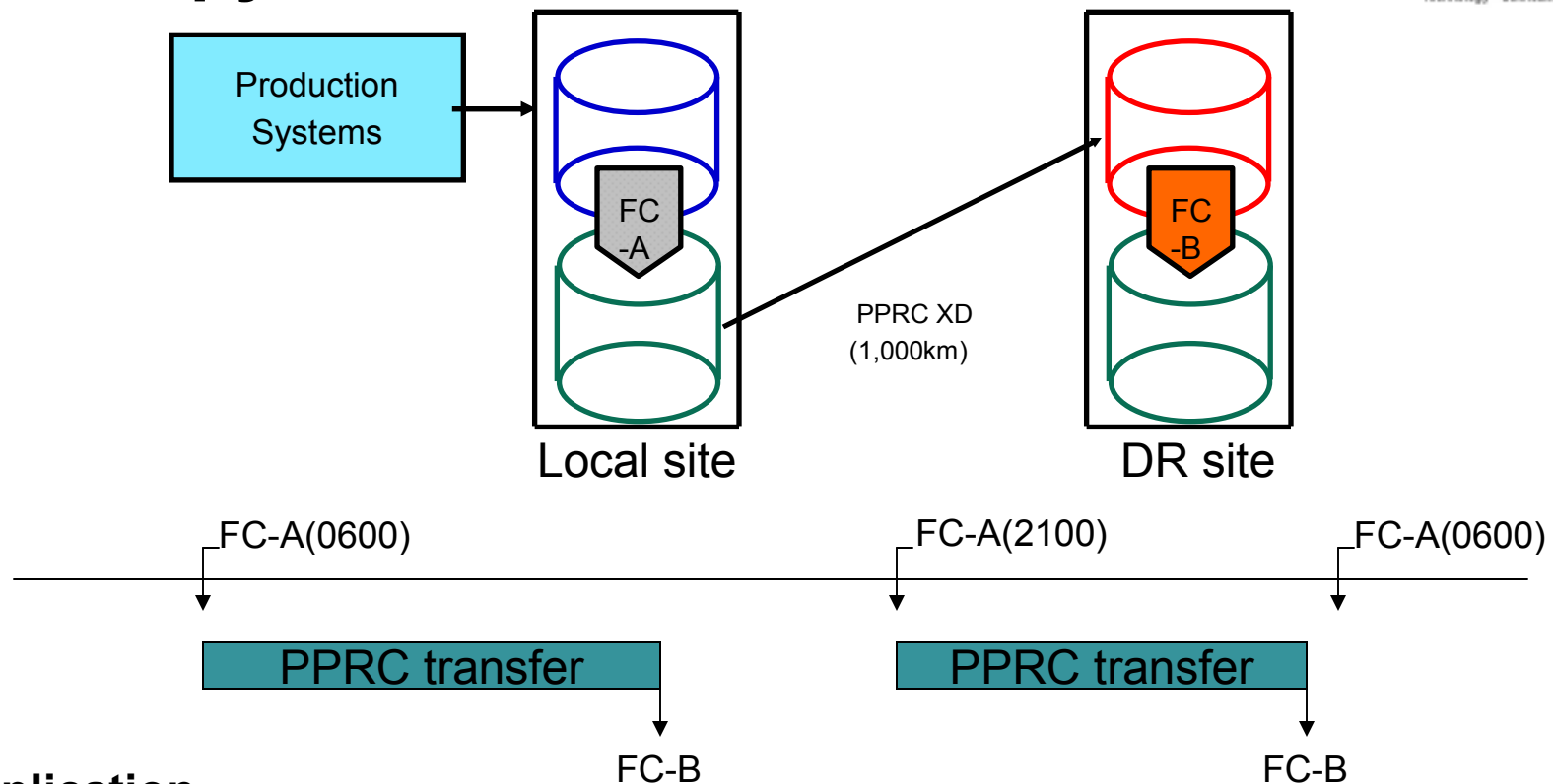
Application

- Create a set of FlashCopy volumes with data spaced 24 hours apart
  - 20 January, FC production to volume set A, PPRC A to DR set 1
  - 21 January, FC production to volume set B, PPRC B to DR set 2
  - 22 January, FC production to volume set C, PPRC C to DR set 3
  - 23 January, FC production to volume set A, PPRC A to DR set 4

Net:
  - 3 copies for local recovery from database corruption
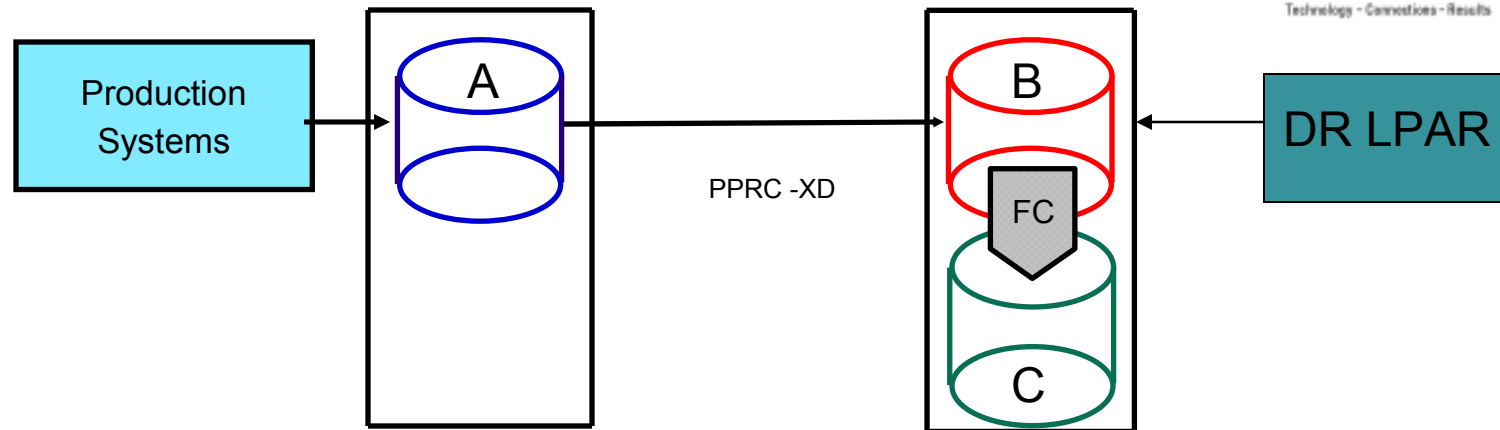 - 3+ copies of data at DR site

FlashCopy followed by PPRC followed by FlashCopy

Application

- Create a local set of FlashCopy data twice per day with copies at the DR site

Global Mirror

GM – From Production
1. PPRC-XD normally(A->B)
2. Incremental FlashCopy(B->C)
3. Activate Global Mirror
   - `A@DEFSES`
   - `B@PSESS`
   - `C@SACOPY`

4. Deactivate Global Mirror
   - `E@TACOPY`
   - `F@DPSESS`
   - `G@CLSESS`

GM – From DR
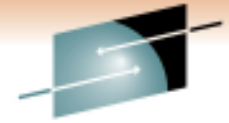Global Mirror Recovery actions(run 4 jobs)

1. Failover(`XF@1OVER`)
   (B becomes a suspended PPRC primary)
2. Analysis/Revert/Commit(`GM$1FREC`)
3. Fast Revert Restore(`GM$2FRR`)
4. FlashCopy(`GM$3FEST`)

IPL from B volumes

Reference Materials

- Introduction to FlashCopy Manager for z/OS. IBM Storage and Networking Symposium, New Orleans, LA, USA. July 25-29, 2005

- SHARE : Session 3084 Medco Clones DB2 Environments Using IBM FlashCopy and Mainstar's VCR. Boston, MA, USA. August 22, 2005

- Publications:
  - PPRC Manager
    - User's Guide and Reference – G325-2633
    - Program Directory – GI11-2905
  - FlashCopy Manager
    - User's Guide and Reference – G325-2632
    - Program Directory – GI11-2904

- Redbooks Redpaper
  - REDP-4065-01: IBM System Storage FlashCopy Manager and PPRC Manager Overview

Questions?