

Preserve System Integrity for Your Business With IBM Replication Solutions for Business Continuity

Part 1 of 2

TotalStorage Productivity Center for Replication (TPC-R)
DFSMS Copy Services
Session # 9947

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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

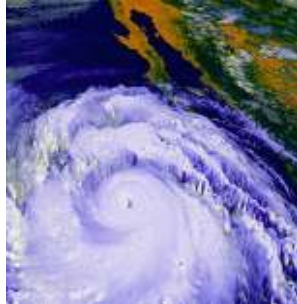
Infrastructure

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**



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

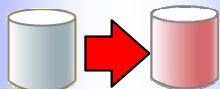


IBM Copy Services Terminologies

FlashCopy

Point in time copy

Within the same Storage System

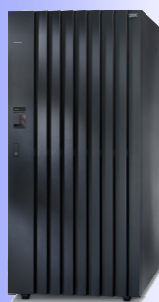


Metro Mirror

Synchronous mirroring

Primary Site A

Metro distance
<300km
Site B

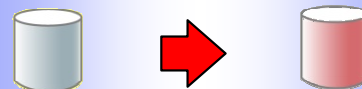


Global Mirror

Asynchronous mirroring

Primary Site A

Out of Region Site B



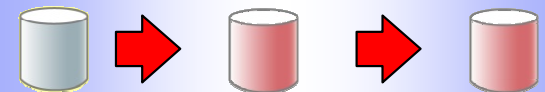
Metro / Global Mirror

Three site
synchronous & asynchronous
mirroring

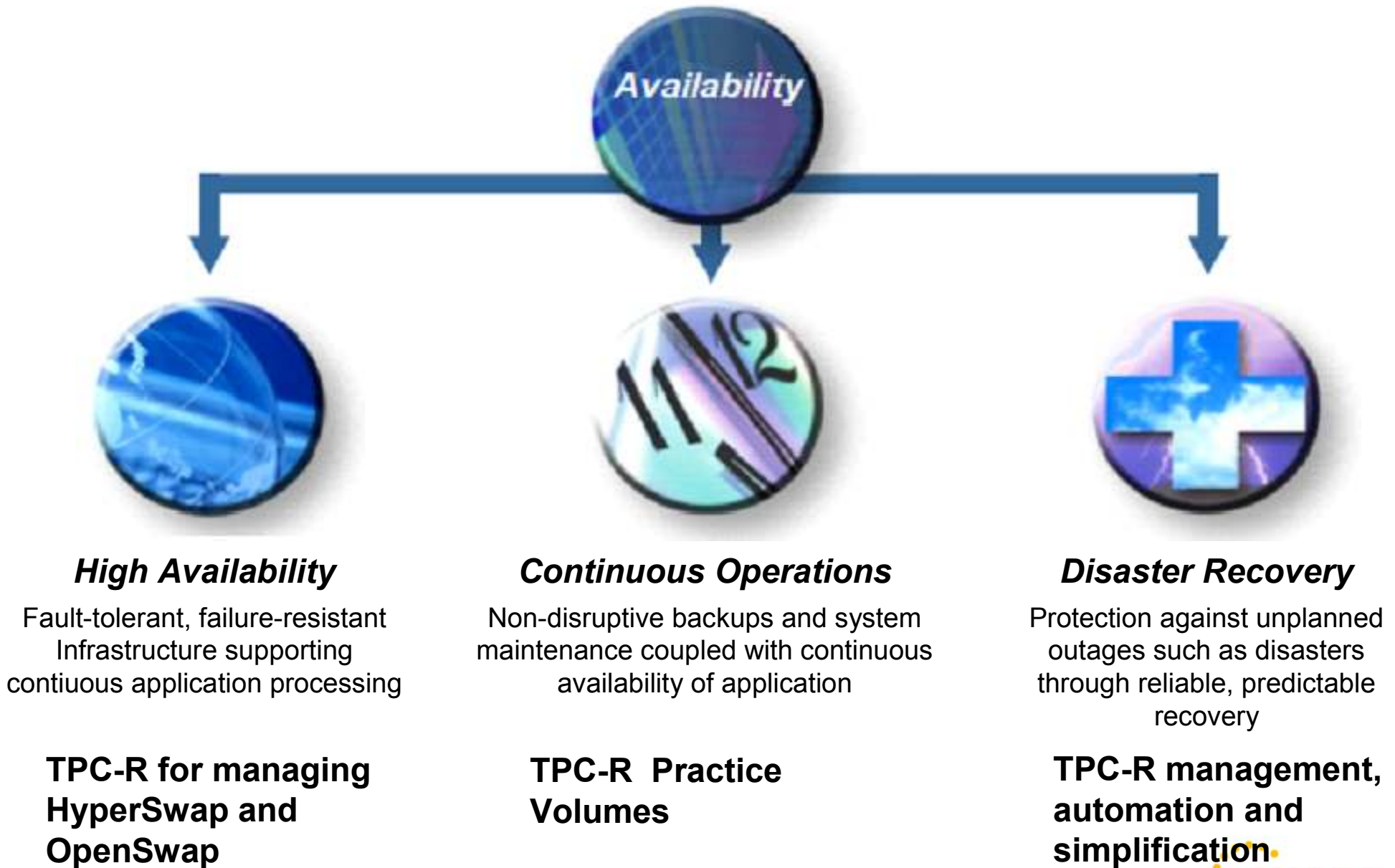
Primary Site A

Metro Site B

Out of Region Site C



Aspects of Availability



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 Metro Global Mirror sessions
- Define a stand-by server
- Review Diagnostics



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 B” with Fast Reverse Restore

Using TPC-R Commands

1. RECOVER

Tivoli Storage Productivity for Replication – Task Savings

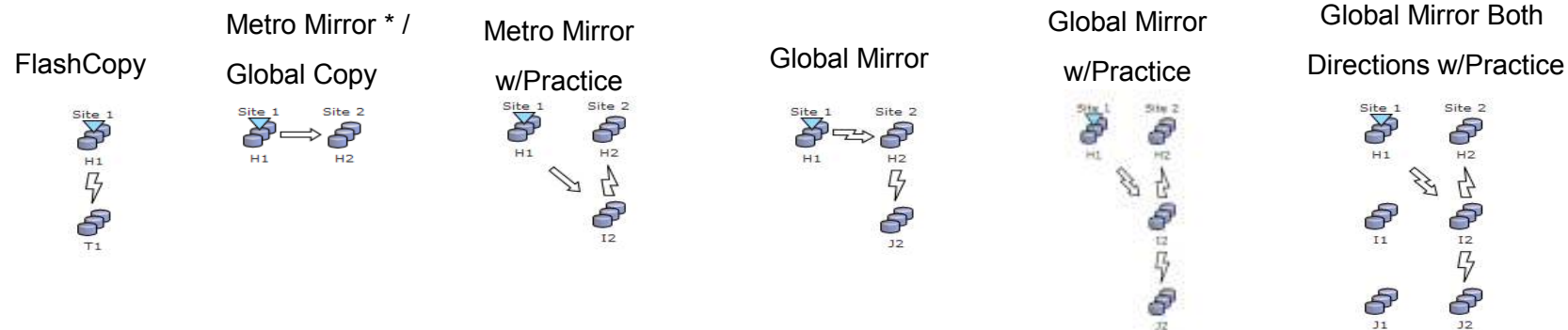
Tivoli Storage Productivity Center for Replication drastically enhances the efficiency of your copy services tasks by reducing the time it takes to execute replication jobs

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)

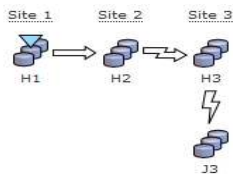
Replication Configurations

DS8000, DS6000 and ESS800 2-site

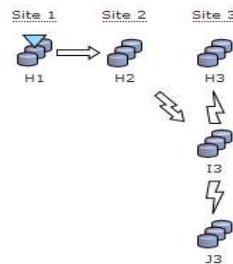


DS8000 3-Site

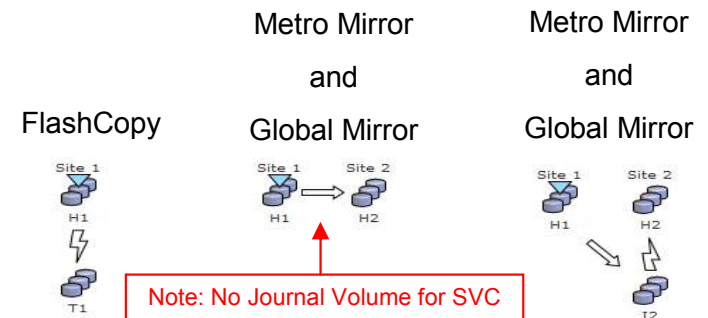
Metro Global Mirror*



Metro Global Mirror w/Practice



SVC 2-Site



- '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

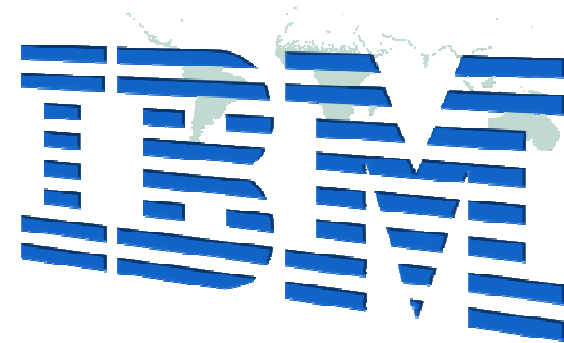
Practice Volumes Sessions

- 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 operations like they would in a real 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.

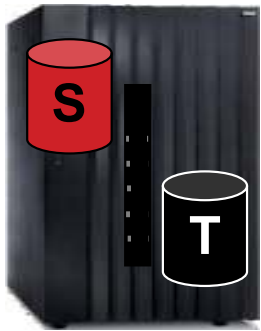
Summary



Tivoli Storage Productivity Center for Replication

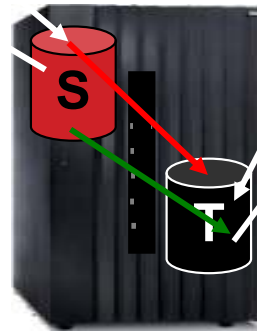
- Provides central control of your replication environment
- Helps simplify and automate complex replication tasks
- Provides end to end management and tracking of the copy services
- Allows testing of D/R at any time using Practice Volumes
- Provides management of planned and unplanned disaster recovery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

FlashCopy overview



PiT copy technology on the disk subsystem
When a FlashCopy is issued the copy is available immediately
A bitmap tracks the relationship between source and target tracks

Read and write activity are possible on both the source and target devices



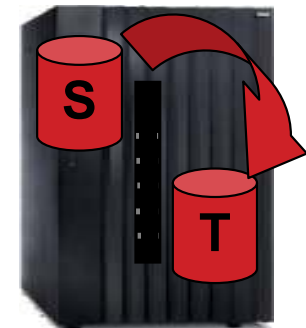
Writes to the source may cause a copy on write if the track has not been copied to the target

Reads of tracks on the target that have not been copied from the source will be redirected to the source

Several options available for FlashCopy including

- Incremental FlashCopy
- Consistent FlashCopy
- Multiple FlashCopy relationships
- Dataset level FlashCopy
- Space Efficient FlashCopy
- Remote Pair FlashCopy

An optional background copy process will copy all tracks from the source to the target which will end the relationship

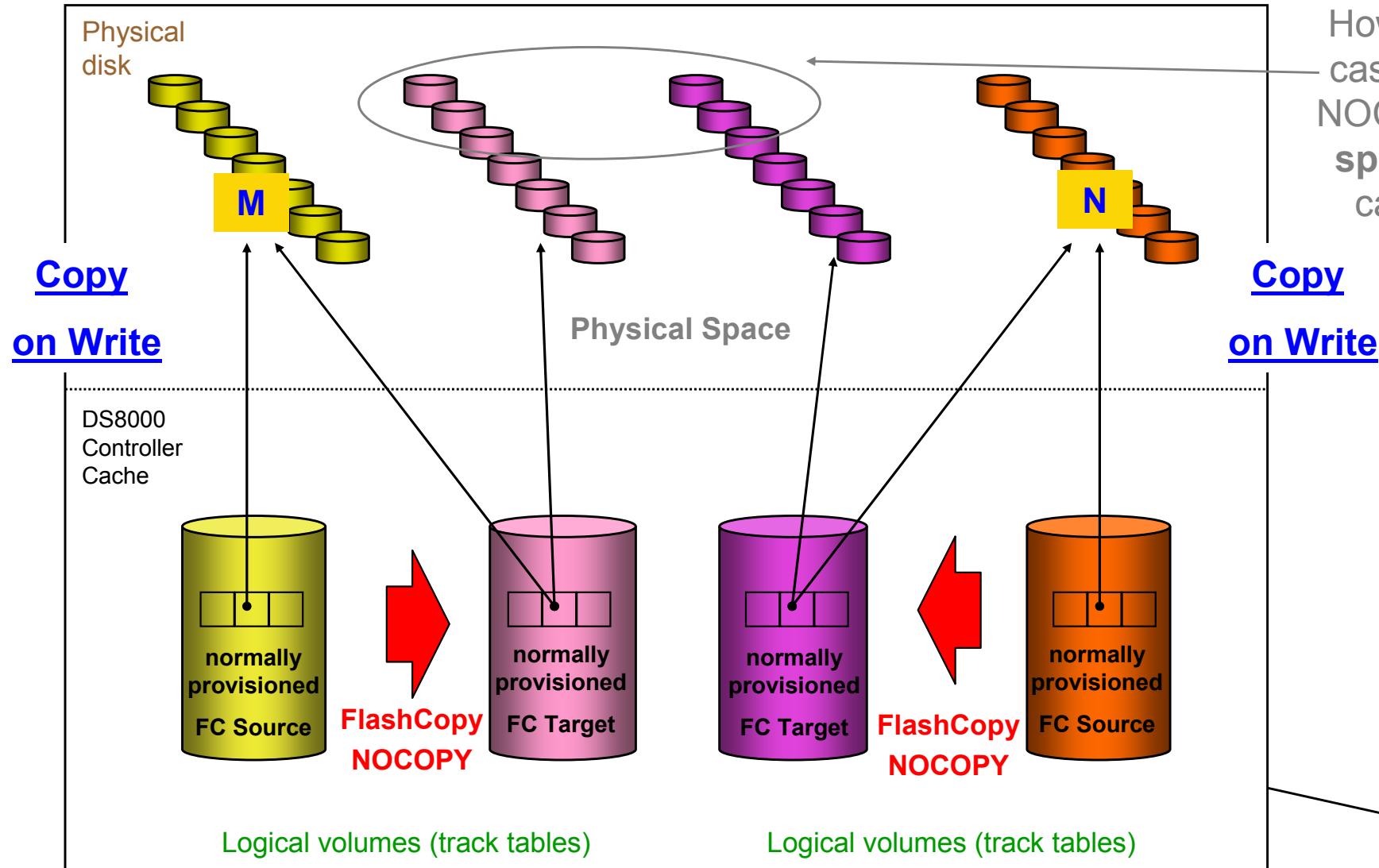


List of DS8000 FlashCopy Functionalities

- Full Volume FlashCopy
 - **Background Copy or NOCOPY**
- Dataset FlashCopy (System z)
- Persistent FlashCopy
 - **FlashCopy relationship continues to exist until explicitly withdrawn**
- Full Volume Incremental FlashCopy
 - **Minimizes physical background copy**
 - **One target only, bidirectional**
- Inband FlashCopy
 - **Send FlashCopy command to remote PPRC volume**
 - **Commands use Fibre Channel disk mirroring paths to remote site**
- Fast Reverse Restore
 - **FlashCopy NOCOPY - fast restore target back to source**
- FlashCopy NOCOPY to COPY
 - **Tell system to change a NOCOPY to a COPY**
 - **Use to delay cloning operation to accommodate heavy production workloads**
- Consistency Group FlashCopy
 - **Write freeze volume groups to maintain write dependent consistency**
- Multiple Relationships
 - **One source may have up to 12 targets**
- Flexible target volume selection
 - **Any volume equal/larger in disk system**

Review: FlashCopy NOCOPY

However, in many cases, FlashCopy NOCOPY **physical space** for targets can go unused

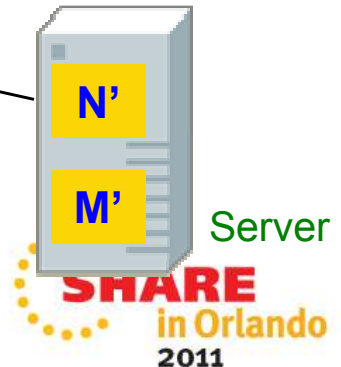
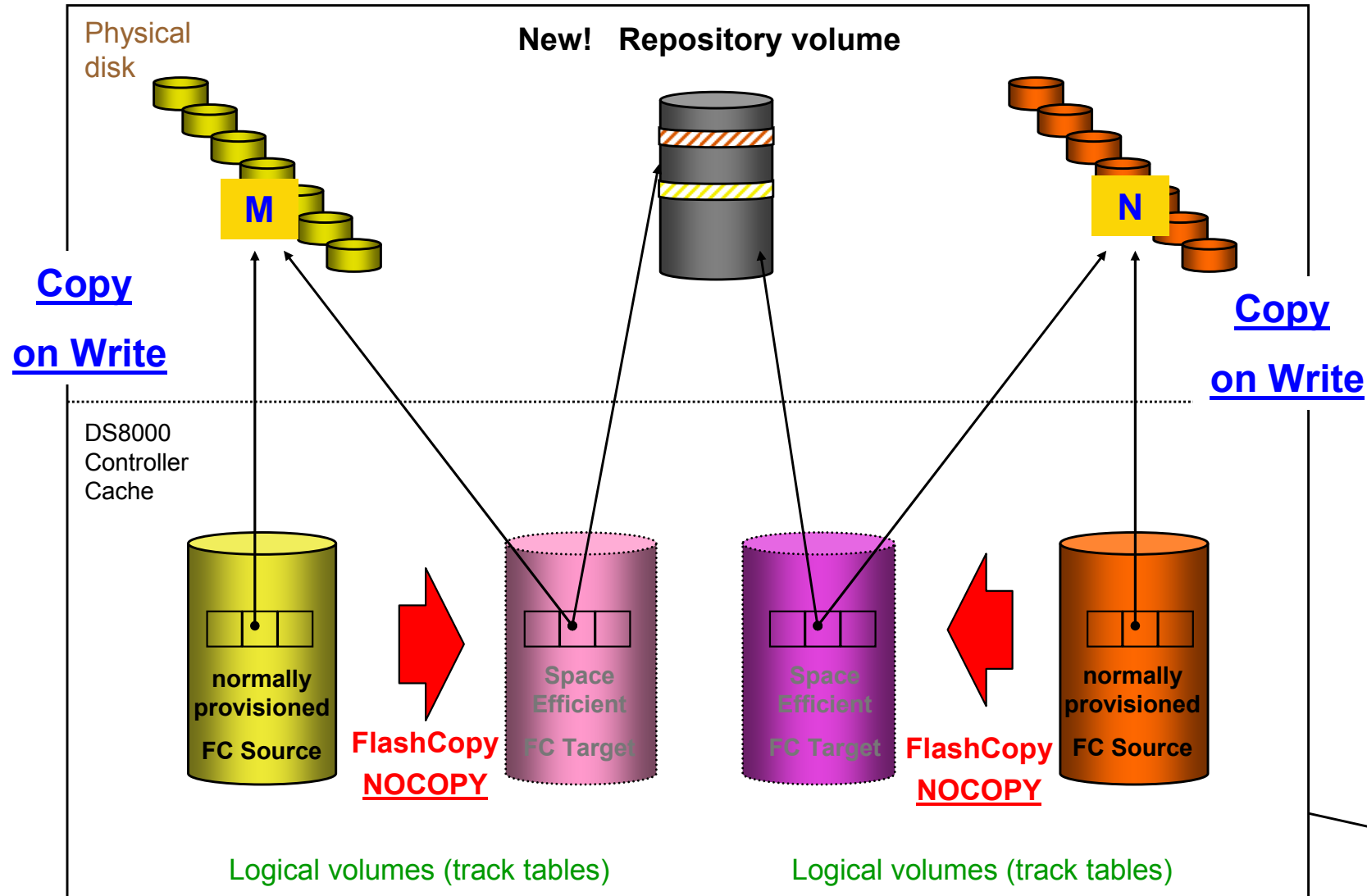


FlashCopy SE to Space Efficient volumes

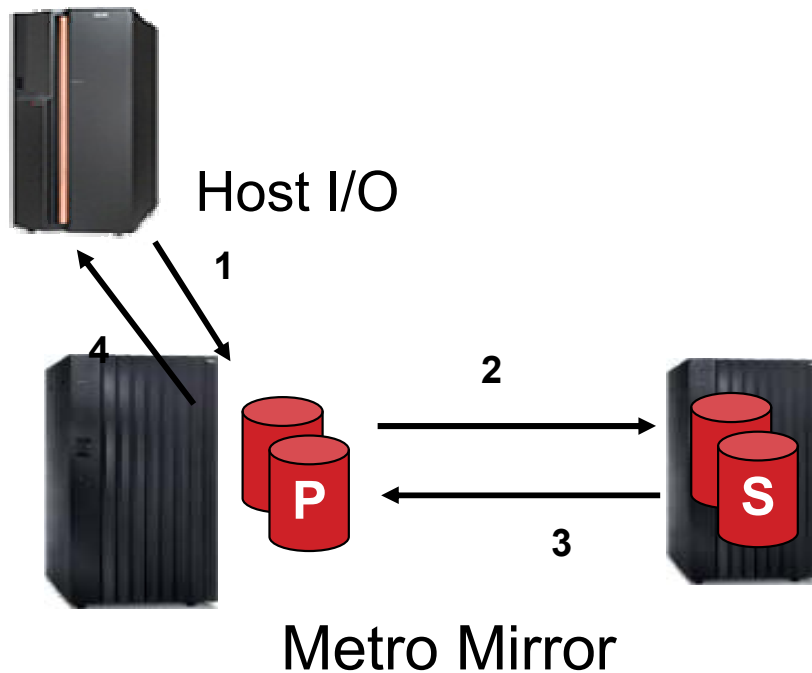


Goal:
SHARE
Smaller amount of
total physical GB for
Repository

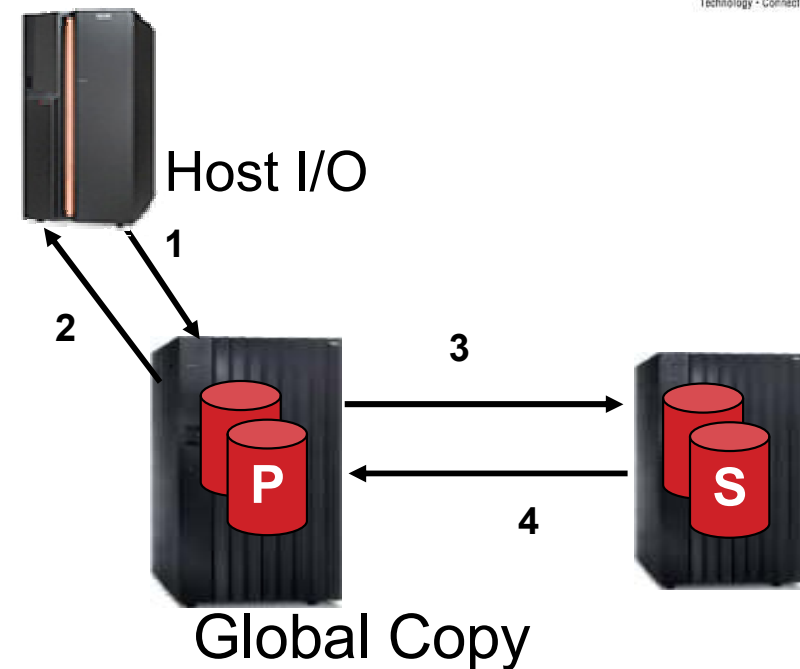
Note: Repository
has a defined
1) Physical Size
2) Logical Size



Metro Mirror and Global Copy



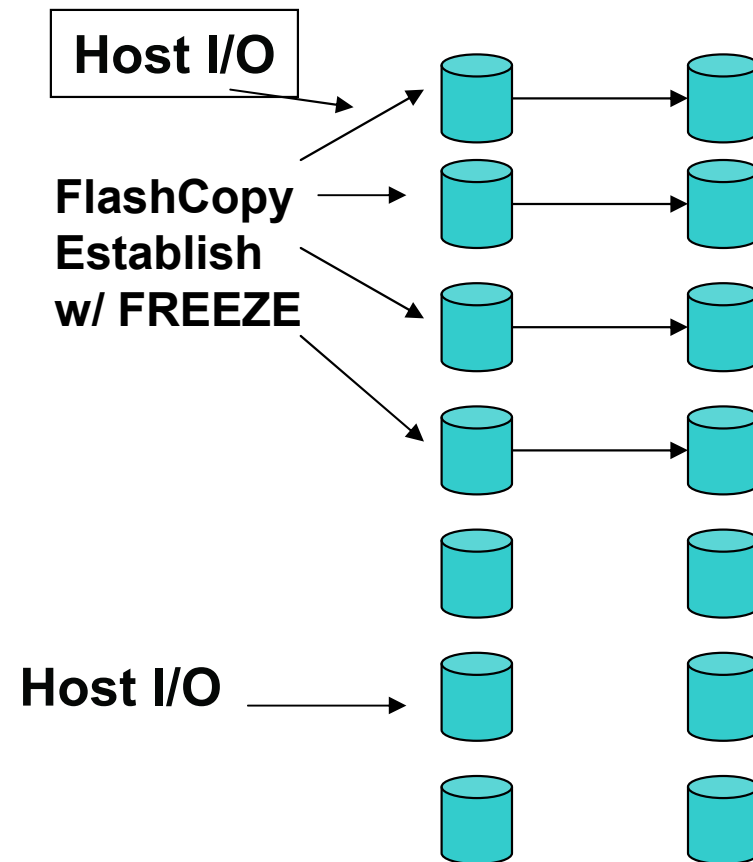
- Write to primary volume.
- The primary disk subsystem initiates an I/O to the secondary disk subsystem to transfer the data.
- Secondary indicates to the primary that the write is complete.
- Primary acknowledges to the application system that the write is complete.



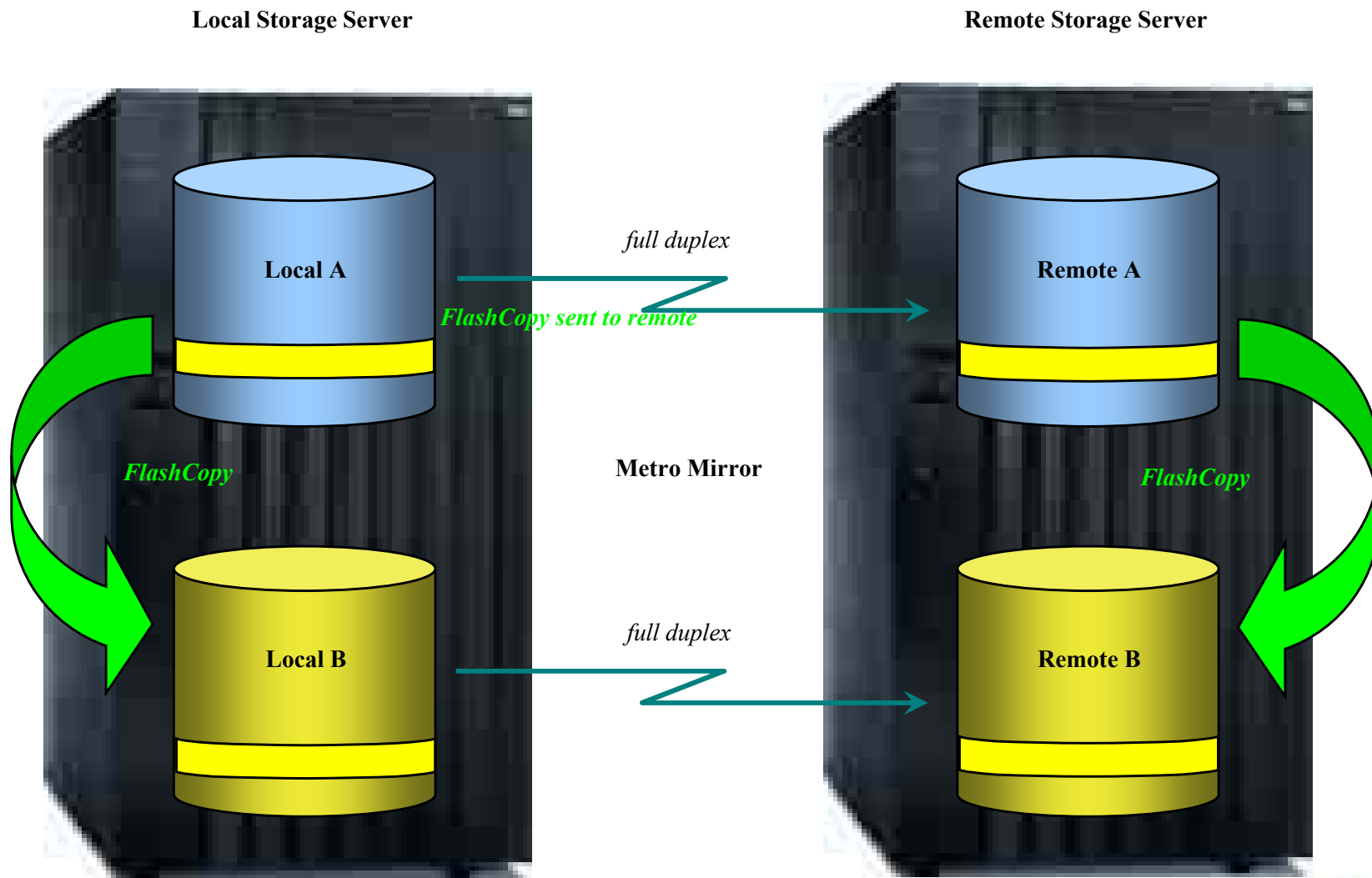
- Write to primary volume.
 - Primary acknowledges to the application system that the write is complete.
- At some later time:
- The primary disk subsystem initiates an I/O to the secondary disk subsystem to transfer the data.
- Secondary indicates to the primary that the write is complete.
 - Primary resets indication of modified track.

FlashCopy Consistency Groups

- Data consistent copies across boundaries
- Reduce or eliminate need to quiesce applications
- Long busy on establish with FREEZE
- LSS thawed with ACTION=THAW or 2 minute timer expired
- Application must be aware of data dependency



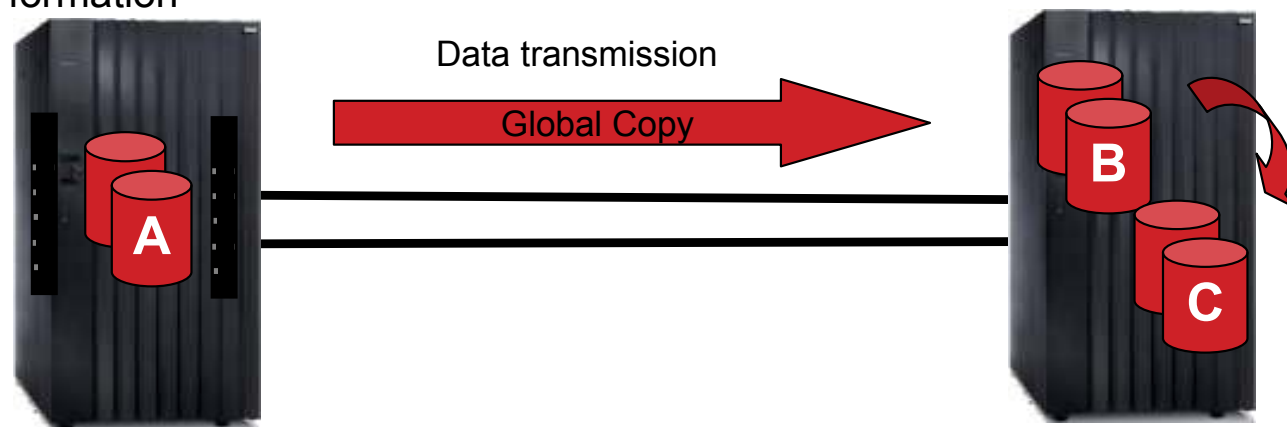
FlashCopy to PPRC Primary using Preserve Mirror



Global Mirror architecture

- Bitmaps used to hold consistency group information on primary disk subsystem
- PPRC paths used for disk subsystem to co-ordinate consistency groups among multiple disk subsystem
- Global Copy used to transmit consistency group between primary and secondary
- FlashCopy used to save consistency groups on secondary disk subsystem

Consistency group
Co-ordination and formation



Consistency group save

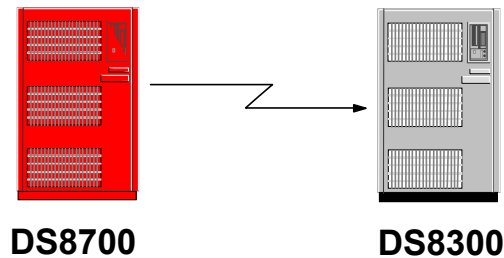
Multiple Global Mirror

- Allows for finer granularity of management and recovery
 - Separate workloads with different RPO requirements
 - Ability to failover only failing servers or applications
- Can now have one or more test session along with one or more production sessions on the same control unit(s)
- Builds upon the existing Global Mirror technology and microcode
- 32 active sessions per control unit
- Works with 3-site Metro Global Mirror (MGM)
- One session per LSS
 - This must be taken into consideration when planning how to divide up volumes into separate Global Mirror sessions
- Multiple session supported on DS8700 only
 - DS8300/DS8100 can only support a single active session
- Intermix of DS8700 and DS8300/DS8100 supported
 - DS8300/DS8100 can be a subordinate for a single or target for many
 - If used as a target, multiple sessions cannot be run bi-directionally

Multiple Global Mirror

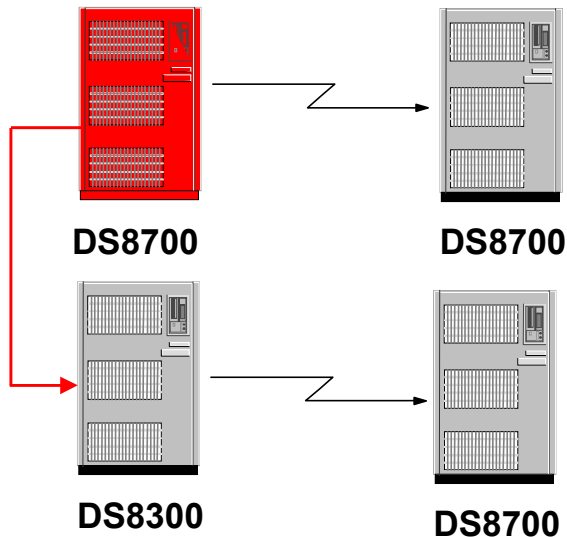
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- OA30618 (SDM)

Examples of Intermix



DS8300/DS8100 as a GM target

- Multiple sessions can active but only in one direction (DS8700 to DS8300)

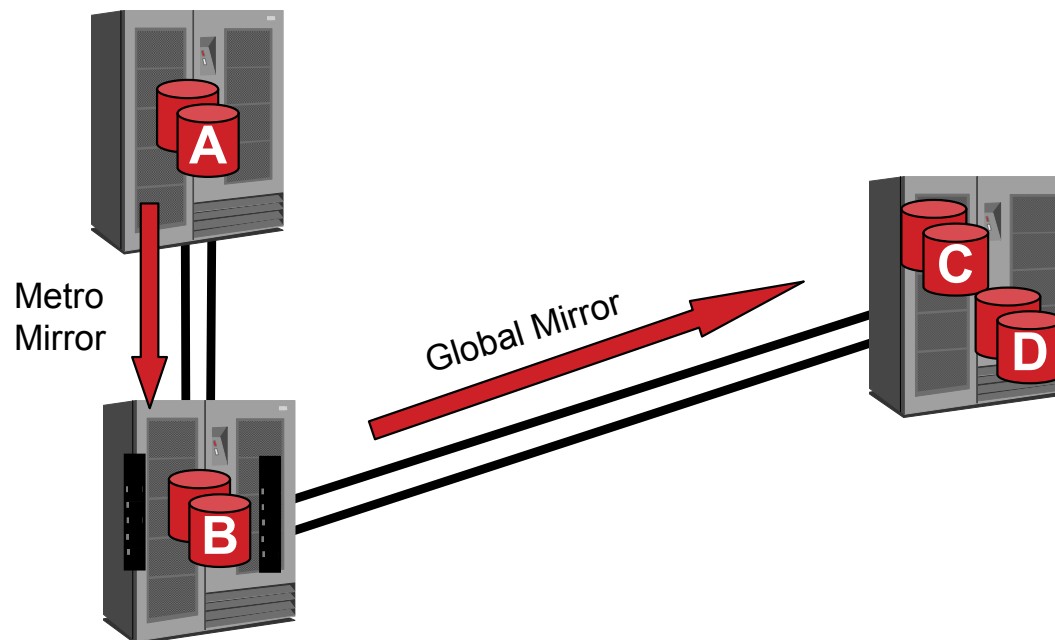


DS8300/DS8100 as a GM subordinate

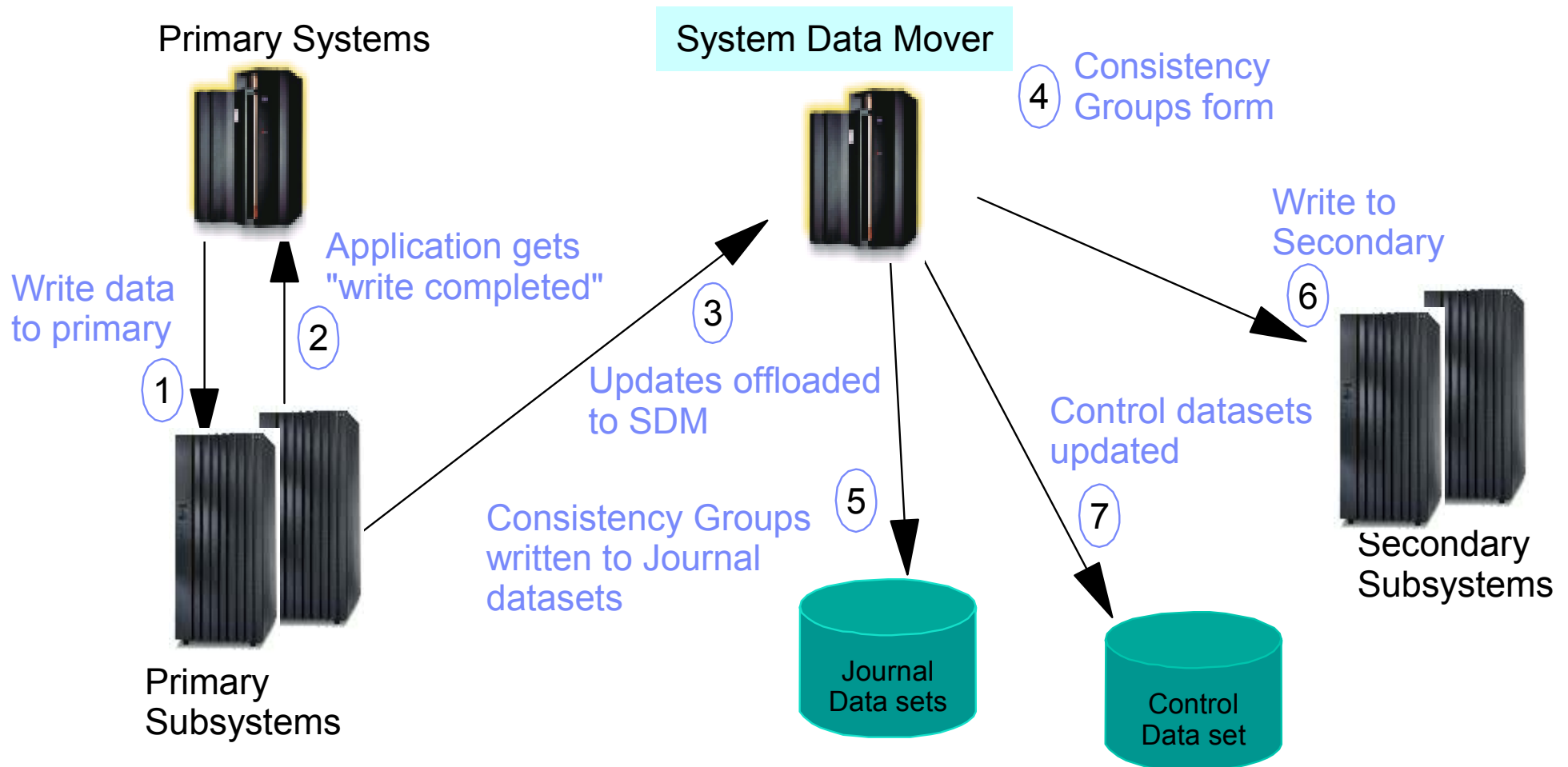
- The DS8700 can run multiple sessions but can only use the DS8300 as a subordinate for one session

Metro Global Mirror

- Combines synchronous and asynchronous PPRC
 - Allows for local continuous availability and out of region disaster recovery
- RPO of 0 for “A” site failure
 - Can recover to either B or D
 - Zero RPO implies automation to ensure no production updates if mirroring stops
- Potential RPO of seconds for “A” and “B” twin site failure
 - Depends on workload and bandwidth between B and C



z/OS Global Mirror (XRC) Concepts



XRC enabled for zIIP

- XRC processing eligible to be dispatched on zIIP
 - Approximately 97% of XRC processing is eligible (under lab conditions)
 - Actual amount of offload depends on amount of CPU consumed, number of ordinary CPs, zIIPs, and CEC level limitations on CP/zIIP ratio
- Enabled via the zIIPENABLE(YES) setting in XRC PARMLIB
- Available with:
 - z/OS V1.10 and above
 - IBM System Storage DS8000, or any storage controller supporting DFSMS SDM

DFSMS Copy Services Interfaces

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
- 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.



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



ICKDSF FLASHCPY and PPRCOPY

- ICKDSF FLASHCPY
 - First implemented to be only used within the scope of Async PPRC, but restriction has since been lifted.
 - May only be invoked via batch JCL
 - Only supports full volume
 - Provide volume serialization, if online
 - Users are able to establish, query, and withdraw relations
 - Issues withdraw during INIT
- ICKDSF PPRCOPY
 - Supports all functions to setup and run PPRC, for both SYNC and ASYNC (ie Metro Mirror, Global Mirror)
 - Provides volume serialization, if online
- Supports multiple Operating Systems
 - MVS, CMS (CKD only), VSE/ESA (CKD only), Stand-Alone

System Data Mover

- DFSMS SDM provides primitives that are used by IBM products and can be used by ISV programs (or built into CLISTs or REXX execs)
- ANTMAIN/ANTAS000 address spaces must be active
- SDM does not provide data management services (allocation, catalog, serialization)
 - Datasets to be accessed from target volume need user intervention or use of interface like DFSMSdss
- TSO commands
 - All FlashCopy and PPRC functions supported
- Application Programming Interface
 - ANTRQST macro
- REXX Interface
 - Formally Supported in z/OS V1R12

System Data Mover

- **Point-in-time Products**

- FlashCopy
- Concurrent Copy
- Virtual Concurrent Copy (IBM) / Snapshot (OEM)

- **Continuously Mirrored Products**

- PPRC
 - Metro Mirror for ESS, aka (synchronous) Peer-to-Peer Remote Copy (PPRC)
 - Global Mirror for ESS, aka (asynchronous) Peer-to-Peer Remote Copy
 - Global Copy for ESS, aka PPRC-Extended distance (PPRC-XD)
 - Metro/Global Copy for ESS, aka synchronous PPRC combined with PPRC-XD
 - Metro/Global Mirror, aka synchronous PPRC combined with Global Mirror
- XRC
 - Global Mirror for zSeries, aka Extended Remote Copy (XRC)

DFSMSdss FlashCopy

- **Functions that exploit FlashCopy**
 - COPY
 - Full volume
 - *DUMPCONDITIONING available to provide online volume clone to be used for backup purposes*
 - Data Set level
 - *Logical or Physical*
 - *Physical allows copying back a set of files using FC on a volume basis*
 - *DataSet DUMPCONDITIONING*
 - *Can Rename data sets to a temporary name at COPY time, and at DUMP time have the ability to rename them back to its original name*
 - DEFRAG and CONSOLIDATE
 - Default is to use FlashCopy if possible, can revert to using CC,VCC, and traditional I/O
 - Updates catalog and performs serializations
 - Volume and data set level

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
 - DFSMS Advanced Copy Services - SC35-0428:
- Redbooks Redpaper
 - REDP-4065-01: IBM System Storage FlashCopy Manager and PPRC Manager Overview
 - SG245680: IBM TotalStorage Enterprise Storage Server Implementing ESS Copy Services with IBM eServer zSeries
 - SC26-7445: IBM TotalStorage Enterprise Storage Server User's Guide



Questions?