zGM, XRC, PPRC, GM, GC, MM, FC, CC, VCC:
Introduction to the Alphabet Soup of Copy Services

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Agenda

- Disaster Recovery Considerations
- Copy Services Decoder Ring
- Understanding the Technology
  - Point in Time Copy
  - PPRC
  - z/OS Global Mirror (XRC)
- Copy Services Topologies / Solutions
Disaster Recovery Considerations

- Business Objectives for Disaster Recovery
  - **Recovery Time Objective (RTO)**
    - How long can you afford to be without your systems
  - **Recovery Point Objective (RPO)**
    - When it is recovered, how much data can you afford to lose
  - Network Recovery Objective
    - How much of the network must be restored
- Business Considerations for Disaster Recovery
  - Recovery requirements dependent upon people and automation
    - Striking the correct balance
  - Capacity (MIPs and gigs) at recovery site
    - sized for production that will run there
  - Distance between data centers
  - Disasters may cause multiple companies to recover, putting stress on the commercial business recovery services
  - These Objectives and Considerations must be established selecting right technology
Tiers of Disaster Recovery

Best D/R practice is blend tiers of solutions in order to maximize application coverage at lowest possible cost. One size, one technology, or one methodology does not fit all applications.

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IBM Copy Services Decoder Ring

- IBM Copy Services Terminologies
  - **High Availability**
    - data availability for production
  
  - **Disaster Recovery**
    - data availability or recoverability in the event of a disaster
  
  - **Metro** – local distances
  
  - **Global** – extended distances
  
  - **Mirror** – consistency of data at secondary
    - Can be synchronous or asynchronous
  
  - **Copy** – data is copied, consistency not always ensured
    - In PPRC is continuous
    - **Mirror is consistent, copy is not**
    - Also 'Point in Time' (PiT) copy mechanisms (FlashCopy, Snapshot, Concurrent Copy, Virtual Concurrent Copy)
IBM Copy Services Decoder Ring

- Geographies Terminologies
  - **2-Site**
    - Can be single region/geography or two regions/geographies
      - 2-site / Single region with HA
      - 2-site / Two regions for D/R
  
- **3-Site**
  - Typically Two regions
    - 2-site at production region with HA
    - Third site out of region for D/R

- **4-Site**
  - Typically Two geographies
    - 2-site at one region with HA
    - 2-site at second region with HA
    - Asynchronous mirror between geographies for D/R or site switch
    - Also used for Active/Active
Understanding the Technology

- Point in Time Copy
  - FlashCopy
  - Concurrent Copy
  - Virtual Concurrent Copy
- PPRC
  - Metro Mirror (Synchronous PPRC)
  - Global Mirror (Asynchronous PPRC Mirror)
  - Global Copy (PPRC Extended Distance Copy)
- XRC
  - z/OS Global Mirror (XRC, zGM)
  - z/OS Metro/Global Mirror (XRC and Synchronous PPRC)
    - Also z/OS Global Mirror Incremental Resync (with GDPS)
IBM Disk Storage Advanced Copy Services

Extended Remote Copy

Peer to Peer Remote Copy

FlashCopy

Concurrent Copy

Data Mover

Cache
FlashCopy

- Point in Time copy
- Establishes logical copy in seconds
- Source and target quickly available for full read/write

Options
- Full volume FlashCopy
- Dataset FlashCopy (z/OS only)
- FlashCopy consistency groups
- Incremental FlashCopy
- Inband FlashCopy
- Space Efficient FlashCopy
- Fast Reverse Restore
- Remote Pair FlashCopy

Uses
- Online backup
- Tape backup
- Moving datasets
- Practice Copy
- Safety Copy

Establishes logical copy in seconds
Source and target quickly available for full read/write

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FlashCopy

PiT copy technology on the ESS
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

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

- All dataset types
- Source and Target may be the same volume
- Any track can be the source of up to 12 target relationships
- Any track can only be a source OR a target
Miscellaneous FlashCopy Options

- Incremental FlashCopy
- Space Efficient FlashCopy
- Remote Pair FlashCopy for PPRC
  - Allows FlashCopy between Metro Mirror primaries, FlashCopy is mirrored and performed between secondaries
- No Background Copy
- NOCOPY to COPY conversion
  - Allows FlashCopy to be established with NOCOPY, and converted to a COPY when there would be less impact
  - Starts background copy for existing NOCOPY relationship
- Deleted Dataset Withdraw (DDSW)
  - Initiates background copy for source relationships, withdraws target relationships
Concurrent Copy

- Point in time copy
- Generate copy/dump while dataset is being updated
- Volume and dataset level
Virtual Concurrent Copy

- Point in time copy
- Generate copy/dump while dataset is being updated
- Volume and dataset level
- User identifies Working Space Datasets (WSDSs) for the Data Mover to use
- WSDSs allocated on FlashCopy eligible devices
- FlashCopy used to virtually move data faster
Concurrent Copy Phases

- CC session initialization
- Copying the data
- Intercepting writes
- CC session termination

Concurrent Copy Considerations

- Appropriate time to start backup
- Many jobs can cause auxiliary storage shortage
- 16 sessions per devices
- 64 sessions per LSS
PPRC
Peer to Peer Remote Copy (PPRC)

- Metro Mirror
- Global Copy
- Global Mirror
PPRC (Metro Mirror and Global Copy)

- Writes are performed synchronously
  1) Write to primary volume.
  2) The primary disk subsystem initiates an I/O to the secondary disk subsystem to transfer the data.
  3) Secondary indicates to the primary that the write is complete.
  4) Primary acknowledges to the application system that the write is complete.

- Writes are performed asynchronously
  1) Write to primary volume.
  2) Primary acknowledges to the application system that the write is complete.
  At some later time:
  3) The primary disk subsystem initiates an I/O to the secondary disk subsystem to transfer the data.
  4) Secondary indicates to the primary that the write is complete.
  5) Primary resets indication of modified track.
PPRC-XD data transmission

- Each LSS has one or more tasks sending data that needs to be copied.
- The tasks run through the devices in sequence sending any tracks that need to be copied.
- The number of tasks are influenced by the number of DAs and numbers of PPRC links.
PPRC communication

- A primary LSS may be related with up to 4 secondary LSS.
- Bidirectional PPRC paths are supported.
- A secondary LSS may have paths to as many primary LSS as physical connections allow.
Failover / failback

PPRC suspends due to planned or unplanned event

OR of both bitmaps will be used for subsequent resynchronisation

Failover command issued to allow access to secondary devices and placed them in primary suspended state.

Failback command can be using in either direction to resynchronise the PPRC relationship

Resynchronisation
1. Establish PPRC paths

2. Establish PPRC control paths between Master to Subordinate

3. Establish PPRC-XD Pairs

4. Establish FlashCopy Relationships

5. Create PPRC global mirror sessions and add primary volumes

6. Start Asynchronous PPRC with Start command to master-Commit Writes

5. Define session to LSSes that will participate in session

6. Join volumes to session

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z/OS Global Mirror (XRC)
XRC Operation

Primary System

Secondary Subsystem

System Data Mover

1. Write data to primary

2. Application gets "write completed"

3. Updates offloaded to SDM

4. Consistency Groups form

5. Consistency Groups written to Journal D/S

6. Write to Secondary

7. Control D/S updated

Journal Data sets
IBM Copy Services Topologies
IBM Copy Services Solution Topologies

- **FlashCopy**
  - Point in time copy
  - Within the same Storage System

- **Metro Mirror**
  - Synchronous mirroring
  - Metro distance <200km
  - Primary Site A
  - Out of Region 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
IBM Copy Services Solution Topologies

**zGlobal Mirror (XRC)**
Asynchronous mirroring
Host Driven

SDM Systems

**Metro/zGlobal Mirror (XRC)**
Three site synchronous & asynchronous mirroring
CU and Host Driven

XRC Primaries
XRC Secondaries/Journals

SDM Systems
4-site topology with Metro Global Mirror

Global Copy from Global Mirror secondary devices already used for datacentre migrations

Global Copy in secondary site converted to Metro Mirror in case of disaster or planned site switch
DFSMS Interfaces

• DFSMS SDM provides primitives that are used by IBM products and can be used by ISV programs (or built into CLISTs or REXX execs)
  • Application Programming Interfaces
    • ANTRQST API
    • ANTTREXX
  • TSO Commands
• ICKDSF provides primitives that are used by IBM products and can be built into CLISTs for z/OS and z/VM devices
• DFSMS DSS provides Fast Replication exploitation via JCL and Panel interfaces to perform dataset services, including FlashCopy
• DFSMS HSM provides Fast Replication exploitation in their Copy Pool function
  • Part of DB2 CDP
Summary

- Disaster Recovery Considerations
- Copy Services Terminologies
- Copy Services Technologies
  - Point in Time Copy
    - FlashCopy
    - Concurrent Copy
  - PPRC
    - Metro Mirror
    - Global Copy
    - Global Mirror
  - z/OS Global Mirror (XRC)
- Copy Services Topologies
- Questions?
Reference Materials

- Publications:
  - SC35-0428: DFSMS Advanced Copy Services
  - SC35-0423: DFSMSdss Storage Administration
- Redbooks
  - SG245680: IBM TotalStorage Enterprise Storage Server Implementing ESS Copy Services with IBM eServer zSeries