Coordinated IMS and DB2 Disaster Recovery
Session Number #10806

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IBM
IBM Disaster Recovery Solutions

- **IMS Recovery Solutions**
  - IMS databases are recovered using image copies and/or logs
    - IMS Full Database recovery or IMS Timestamp recovery

- **IMS Restart Solutions**
  - IMS system and databases are mirrored to remote site
    - IMS Recovery Expert product: System Level Backup
    - GDPS and Storage Mirroring

- **IMS Restart & Recovery Solution**
  - IMS system and databases are mirrored to remote site
  - Additional transmitted data allows for forward recovery

- **Coordinated IMS and DB2 Restart & Recovery Solution**
  - Approach 1: SLB contains both IMS and DB2 volumes
  - Approach 2: Separate SLBs for IMS and DB2 (PITR log recovery)
RTO vs. RPO

• Recovery Time Objective (RTO)
  • Time allowed to recover the applications
  • All critical operations are up and running again
  • Considerations include:
    • Recovery of databases and network
• Recovery Point Objective (RPO)
  • Amount of data lost in the disaster
  • Last point-in-time when all data was consistent
  • Considerations include:
    • Frequency of creating recovery points
    • Frequency of transfer of data to remote site
Recovery vs. Restart: Comparison

• *Coordinated* IMS and DB2 *DR* Solutions
  • RTO is low based on:
    • Performance of Storage-Based Fast Replication
    • Volumes are restored from the SLB at the remote site
    • Databases are recovered in parallel in one pass of logs
  • RPO is medium based on:
    • Frequency of SLB creation and Log transmission
    • Method of data transmission (ex. Virtual Tape)
  • Operational complexity is low
    • Automation provided by IBM Tools
Coordinated IMS and DB2 DR Solutions

- **Coordinated IMS and DB2 Restart Solution**
  - Combined SLB created from IMS and DB2 volumes
    - Separate analysis is performed on IMS and DB2
      - *Volumes combined under one Recovery Expert product*
    - At Primary site, one SLB is created
      - *One Flashcopy for all volumes (IMS & DB2)*
    - At Remote site, after SLB is restored
      - *IMS and DB2 are restarted individually*
      - *Restart with Dynamic Backout and Undo/Redo processing occur*
IMS Recovery Expert

Production Site

IMS System Analysis

IMS Control Region

DBRC

DLI/SAS

IMS Volume nn

DATABASES

IMS Volume 1

IMS Volume 2

IMS Volume 3

IMS Volume nn

Logger

RDS

WADS

OLDS

CHANGE ACCUM

IMAGE COPY

IMS RE Repository

SLDS

RLDS

IMS Volume 1

IMS Volume 2

IMS Volume 3

IMS Volume nn
DB2 Recovery Expert

Production Site

DB2 System Analysis
DB2 Recovery Expert or IMS Recovery Expert

Create IMS and DB2 SLB

Logger

DB2 Master

DDF

DB2 Volume nn

IMS and DB2 Combined SLB

IMS Volume nn
DB2 Recovery Expert

Remote Site

Start DB2

Restore SLB

Transmitted

IMS and DB2 Combined SLB

DB2 Master

Logger

DDF

LOGS

IMAGE COPY

DATABASES

DB2 RE Repository
Coordinated IMS and DB2 DR: Combined SLB

- Coordinated Recovery Point (RP)
  - RPO = Changes Past the Last SLB
Coordinated IMS and DB2 DR Solutions

• Benefits from *Coordinated IMS & DB2 Restart* Solution
  • Native FlashCopy performs better than DFSMSdss
    • Shorter IMS and DB2 unavailability time
  • Validation during SLB creation
    • Identifies and maps missing volumes
  • Offloading features
    • Encryption
    • Compression
    • Volume stacking on tapes to reduce number of tapes
    • Parallel offloading of volumes to tape
  • Repeatable process
Coordinated IMS and DB2 DR Solutions

- **Coordinated IMS and DB2 Recovery & Restart Solution**
  - Separate SLBs created for IMS and DB2 volumes
  - Separate analysis is performed on IMS and DB2
  - At Primary site:
    - Separate SLB is created for IMS and for DB2
      - Two Flashcopies for each set of volumes (IMS & DB2)
      - Archived logs are transmitted to remote site
        - Log Timestamps are recorded in DR PDS
  - At Remote site:
    - IMS and DB2 SLBs are restored
    - Point In Time Recovery using timestamp in IMS and DB2 DR PDS
      - Earlier of two timestamps in IMS and DB2 DR PDS
    - Start IMS and DB2 (No Backouts/Undos needed during restart)
IMS Recovery Expert
Production Site

Remote Site

Transmitted

IMS Control Region
DBRC
DLI/SAS

RDS
Logger

WADS
SLDS
RLDS
CHANGE ACCUM
IMAGE COPY
IMS RE Repository

System Level Backup

DATABASES

RECON
IMS RE Repository

TRANSMITTED

IMAGE COPY

RLDS
SLDS

IMS Recovery Expert
Production Site
DB2 Recovery Expert

Production Site

Remote Site

DB2 Master

DDF

Logger

System Level Backup

LOGS

LOGS

MAGE COPY

DATABASES

DB2 RE Repository

Transmitted
IMS Recovery Expert

Remote Site

Start IMS

Recover DB

Restore SLB

Transmitted

System Level Backup

Logger

IMS Control Region

DBRC

DLI/SAS

SLDS

RLDS

CHANGE ACCUM

CONDITIONED RECON

IMAGE COPY

DATABASES

WADS

SLDS

OLDS

RDS

RECON

CHANGE ACCUM

IMAGE COPY

DATABASES

IMS RE Repository

IMS RE Repository

SLDS

RLDS

CHANGE ACCUM

IMAGE COPY
DB2 Recovery Expert

Remote Site

Start DB2

Recover DB

Restore SLB

Transmitted

DB2 Master

DDF

Logger

LOGS

IMAGE COPY

DB2 RE Repository

LOGS

IMAGE COPY

DB2 RE Repository

System Level Backup

LOGS

IMAGE COPY

DB2 RE Repository

DATABASES

SHARE in Atlanta 2012
Coordinated IMS and DB2 DR: Separate SLB

- Coordinated Recovery Point (RP)
  - RPO = Changes Past the Coordinated RP
  - Requires application and business-cycle analysis
    - Determine how all data is interconnected and when batch jobs are run
  - Potential to add additional Recovery Points in future
Coordinated IMS and DB2 DR Solutions

- *Coordinated IMS & DB2 Restart/Recovery* Solution
  - Same benefits as Restart solution
    - Native FlashCopy performs better than DFSMSdss
    - Validation during SLB creation
    - Offloading features
    - Repeatable process
  - Less data loss (RPO)
    - Log recovery to consistent point between IMS and DB2
    - Coordinated point in time determined by IBM Tools
IMS and DB2 Recovery Expert: SLB

- IMS and DB2 Recovery Expert features:
  - Environment discovery and configuration management
    - **IMS System Level Backup includes:**
      - Active and archive logs
      - RECONs
      - All IMS database data sets
      - IMS system data sets (ex. ACBLIBs, DBDLIBs, PGMLIBs, etc.)
      - All associated ICF User catalogs
    - **DB2 System Level Backup includes:**
      - Active and archive logs
      - Bootstrap Data Set
      - All DB2 database data sets
      - DB2 system data sets (ex. Loadlib)
      - All associated ICF User catalogs
IMS and DB2 Recovery Expert: SLB

- System Level Backup (SLB)
  - Backs up entire DBMS production environment
  - Leverages Storage-Based Volume Fast Replication
    - Uses FlashCopy for a Consistency Group
    - Data is dependent-write consistent
  - Multiple SLBs can be offloaded to tape for remote site
IMS and DB2 Recovery Expert: SLB Restore

- Restoring the SLB
  - System Level Backup is restored from disk or tape
  - Coordinated parallel restore operations
IMS and DB2 Recovery Expert: Repository

- IMS and DB2 Recovery Expert have their own Repository
  - Store information on SLBs created
  - Track database characteristics and status
    - HALDB, Fast Path EEQEs, Recovery Status, Tablespaces, etc.
  - SLB and Offloading Tape information
  - Sent to remote site for restart and recovery
Storage-Based Consistency: Key to SLB

• DBMS System
  • Provides dependent writes for database updates

• Storage-Based Flashcopy for Consistency Group
  • Provides consistency for set of volumes

• Coordinated Disaster Recovery
  • Requires DBMS to order the log and database updates
  • Requires Storage processors to ensure volume consistency
IMS Dependent Writes

Full Function Commit and Backout Process

1. Log “Before and After Image” (Segment, Pointers, Freespace)
2. Update Database
3. Log "Commit"

<table>
<thead>
<tr>
<th>Updates Completed</th>
<th>Dynamic Backout Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (1)</td>
<td>Use “Before Image” from Log (1)</td>
</tr>
<tr>
<td>Log (1) + DB (2)</td>
<td>Use “Before Image” from Log (1)</td>
</tr>
<tr>
<td>Log (1) + DB (2) + Log (3)</td>
<td>No Backout, Update Committed</td>
</tr>
</tbody>
</table>
IMS Dependent Writes

Fast Path Commit and REDO Process

(1) Log “After Image”
(2) Log “Commit”
(3) Update Database using output thread processing
(4) Log ”Output Thread Completed”

<table>
<thead>
<tr>
<th>Updates Completed</th>
<th>Fast Path REDO Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (1)</td>
<td>No REDO, Update <em>not</em> Committed</td>
</tr>
<tr>
<td>Log (1) + Log (2)</td>
<td>Use “After Image” to COMMIT (REDO)</td>
</tr>
<tr>
<td>Log (1) + Log (2) + DB (3)</td>
<td>Use “After Image” to COMMIT (REDO)</td>
</tr>
<tr>
<td>Log (1) + Log (2) + DB (3) + Log (4)</td>
<td>No REDO, Update <em>was</em> Committed</td>
</tr>
</tbody>
</table>
DB2 Dependent Writes

DB2 Commit and UNDO/REDO Process

(1) Log “Change Information”
(2) Log “Commit” or “Abort”
(3) Update Buffer Pool or Database
(4) Log ”Commit Completed”

<table>
<thead>
<tr>
<th>Updates Completed</th>
<th>DB2 UNDO/REDO Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (1)</td>
<td>No UNDO or REDO, Update <em>not</em> Committed</td>
</tr>
<tr>
<td>Log (1) + Log (2)</td>
<td>Use “Change Information” with REDO or use “Change Information with UNDO</td>
</tr>
<tr>
<td>Log (1) + Log (2) + DB (3)</td>
<td>Use “Change Information” with REDO or use “Change Information with UNDO</td>
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<td>Log (1) + Log (2) + DB (3) + Log (4)</td>
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</table>
Consistency Group FlashCopy

- **FlashCopy S1 to T1**
  - Writes are frozen on S1
  - Writes continue on S2-S4
- **FlashCopy S2 to T2**
  - Writes are frozen on S1, S2
  - Writes continue on S3-S4
- **FlashCopy S3 to T3**
  - Writes are frozen on S1, S2, S3
  - Writes continue on S4
- **FlashCopy S4 to T4**
  - Writes are frozen on S1-S4
- **T1-T4 contain a consistent copy**
- **Thaw S1 – S4**
  - Writes proceed on S1-S4
System Level Backup (SLB): Key Timestamps

**I/O Suspend Time**
- Source S1 (Loadlibs)
- Target T1 (Loadlibs)
- Source S2 (DB2 Log)
- Target T2 (DB2 Log)
- Source S3 (DB2 DB)
- Target T3 (DB2 DB)
- Source S4 (IMS Log)
- Target T4 (IMS Log)
- Source S5 (IMS DB)
- Target T5 (IMS DB)

**Backup Time**

**I/O Resume Time**

I/O Resume – I/O Suspend = Backup Elapsed Time (< 1 Sec)
Demonstrations

- **Product Configuration**
  - IMS Recovery Expert only
- **Onetime Setup**
  - IMS Recovery Expert driven demo
  - DB2 Recovery Expert driven demo
- **Coordinated DR for IMS and DB2**
  - IMS Recovery Expert driven demo (SLB Only)
  - IMS and DB2 Recovery Expert
    - PITR Recovery to Coordinated Timestamp
IMS and DB2 Recovery Expert: IMS Onetime Setup

**Primary Site**

### Step 1
IMS Recovery Expert
- Register IMS
- Include/Exclude Datasets

### Step 2
IMS Recovery Expert
- Analyze IMS Configuration

### Step 3
DB2 Recovery Expert
- Register DB2
- Analyze DB2 Configuration

### Step 4
IMS Recovery Expert
- Create Backup Profile
- Include DB2 Volumes
- Update Target Pool
- Update Offload Options

### Step 5
IMS Recovery Expert
- Create Profile for DR Site
- Build Restart JCL
IMS and DB2 Recovery Expert: DB2 Onetime Setup

**Primary Site**

**Step 1**
DB2 Recovery Expert
Register DB2

**Step 2**
DB2 Recovery Expert
Analyze DB2 Configuration

**Step 3**
IMS Recovery Expert
Register IMS
Analyze IMS Configuration

**Step 4**
DB2 Recovery Expert
Create Backup Profile
Include IMS Volumes
Update Target Pool
Update Offload Options

**Step 5**
DB2 Recovery Expert
Create Profile for DR Site
Build Restart JCL
IMS and DB2 Coordinated Restart DR (SLB Only)

Primary Site

Cold Start
Start
BMP (No
BMPs
Complete
IMS or DB2
Recovery Expert
Run DRESTART
(Create Restart PDS)

Remote Site

 IMS or DB2
Recovery Expert
Execute Restart JCL
(Restore SLB)

Emergency Restart IMS
Start DB2
(Show Dynamic Backout)

Show Updated Database
IMS Recovery Expert: Onetime Setup

**Primary Site**

**Step 1**
- IMS Recovery Expert
- Register IMS
- Include/Exclude Datasets

**Step 2**
- IMS Recovery Expert
- Analyze IMS Configuration

**Step 3**
- IMS Recovery Expert
- Create Backup Profile
- Update Target Pool
- Update Offload Options

**Step 4**
- IMS Recovery Expert
- Create Profile for DR Site
- Build Recovery JCL
DB2 Recovery Expert: Onetime Setup

Primary Site

Step 1
DB2 Recovery Expert
Register DB2

Step 2
DB2 Recovery Expert
Analyze DB2 Configuration

Step 3
DB2 Recovery Expert
Create Backup Profile
Update Target Pool
Update Offload Options

Step 4
DB2 Recovery Expert
Create Profile for DR Site
Build Recovery JCL
IMS and DB2 Coordinated Recovery & Restart DR

Primary Site
- Cold Start IMS
- Start DB2
- BMP (No Commit)
- BMP (Suspend)

Remote Site
- Execute IMS Restart JCL
- Execute DB2 Restart JCL (Restore SLB)

SLB, Remote PDS
- Create IMS SLB
- Create DB2 SLB

IMS
- IMS DB Recover
- IMS DRESTART (Create Restart PDS)
- Execute IMS Restart JCL
- Emergency Restart IMS (Show Dynamic Backout)

DB2
- DB2 DB Recover
- DB2 DRESTART
- Execute DB2 Restart JCL
- Show Database Updates
- Start DB2

Remote Site
- BMP
- BMP (Suspend)
Demo of IMS and DB2 Coordinated DR
(Onetime Setup)
(Coordinated IMS and DB2 Restart)
(Coordinated IMS and DB2 Recovery & Restart)