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# E35

# DL/I Batch to BMP Conversion

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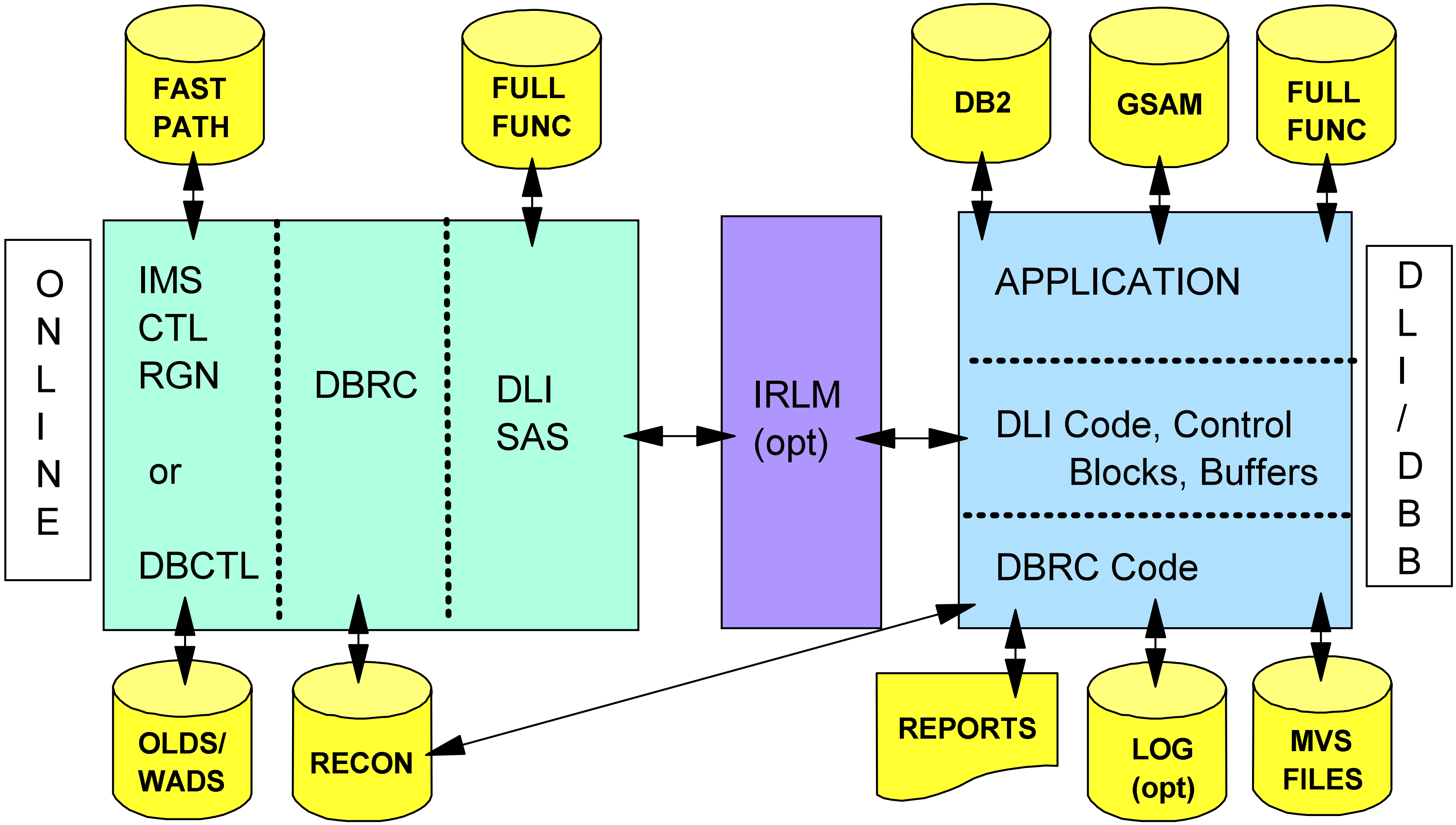
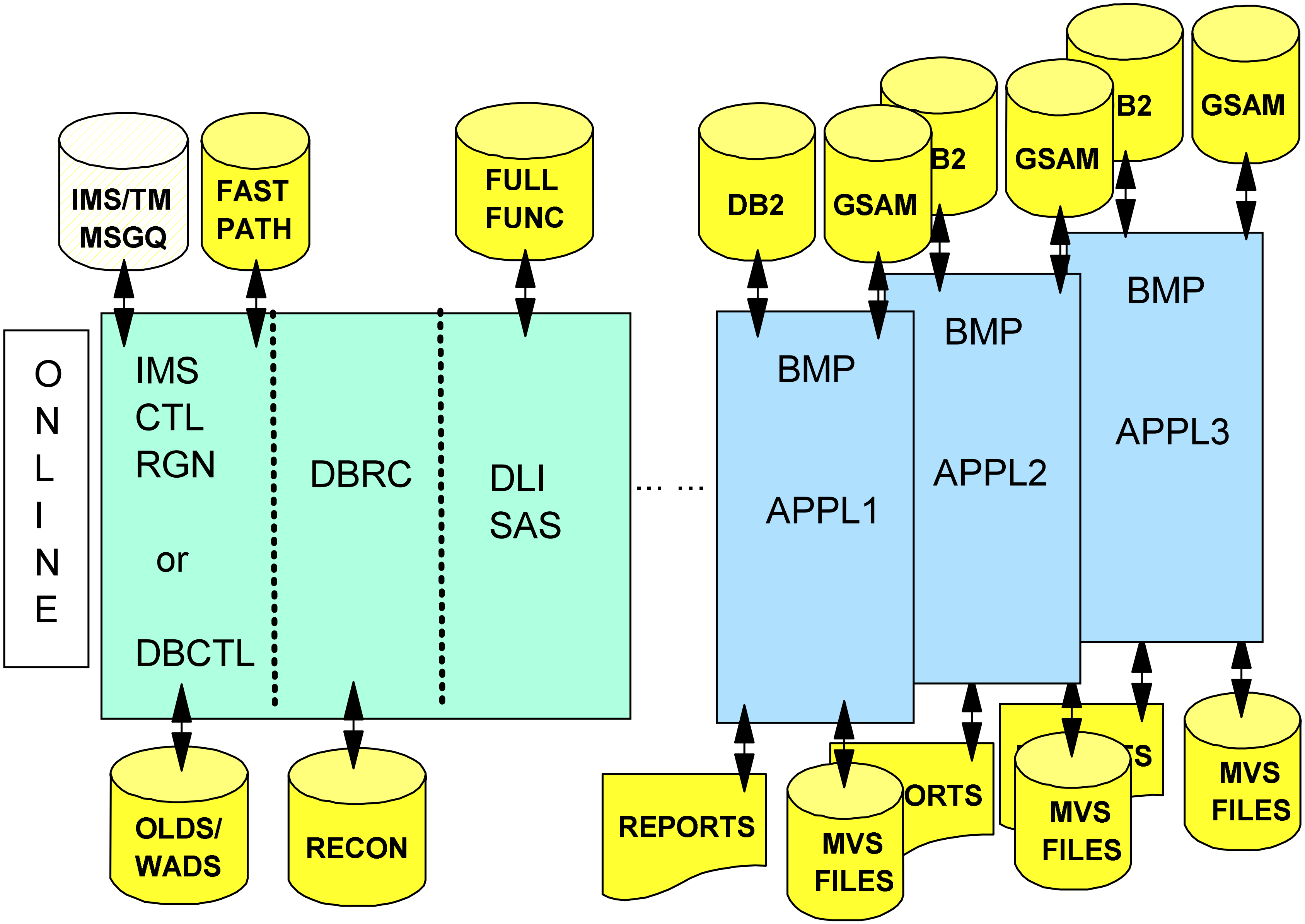
# Agenda

- DLI Batch versus BMP
- BMP Implementation
- Checkpoint/Restart
- Performance
- Summary
- Appendix:  Sample Checkpoint Program Logic

# Topic 1: DLI Batch Address Space



# BMP Address Space



# DLI Batch Versus BMP

| | BATCH | BMP |
|---|---|---|
| Online required for execution | N | Y |
| Requires sufficient batch window | Y | N |
| DLI and DBRC services in same address space as application | Y | N |
| Authorization/Unauthorization at each step | Y | N |
| Open/Close at each step | Y | N |
| Own database buffering | Y | N |
| Own log data set | Y | N |
| Can use HSSR | Y | N |
| Database resources locked until sync point | N | Y |
| Batch Backout required after application abend | Y | N |
| Access to IMS Message Queue | N | Y |

# DLI Batch Versus BMP . . .

| | BATCH | BMP |
|---|---|---|
| Define in IMSGEN | N | Y |
| Scheduled by MVS, not IMS | Y | Y |
| May experience deadlocks | N | Y |
| OSAM Sequential Buffering available | Y | Y |
| Block level data sharing required to concurrently update online databases | Y | N |
| CFNAMES,CFVSAM=..,CFOSAM=..,CFIRLM=.. required in DFSVSAMP for Block level data sharing | Y | N |
| Should include CHKP / XRST capability | N* | Y |
| Access to IMS Full Function Databases | Y | Y |
| Access to Fast Path Databases | N | Y |
| Access to MVS Files | Y | Y |
| Access to GSAM | Y | Y |
| Access to DB2 | Y | Y |

# TOPIC 2:  BMP IMPLEMENTATION

- Adding an IOPCB
- Including Checkpoint/Restart logic
- Setting up the IMSBATCH procedure
- Using GSAM
- Including the BMP in the online system
- Allocating a JES Initiator
- Operating Considerations for the BMP

# The IOPCB

- Required by a BMP
- Acquired as 1st PCB in PSB at scheduling time
  - Need PCB Mask
  - Need linkage
- Used for 'CHKP'/'XRST' calls
- For testing in DLI Batch
  - PSBGEN . . .,COMPAT=YES

# Checkpoint/Restart

- BMP concerned with concurrency of access as well as restartability
- All BMPs should have regular commit points
  - GU IOPCB
  - CHKP call
  - SYNC call
  - ROLL, ROLB, ROLS calls
- Resources Locked until commit
  - Span of data locked
    - Number of DB records (HDAM locks on RAP)
    - Control records
    - Twin chains
  - Lock enqueue space (PI or IRLM)
  - Deadlock possibility

# Checkpoint/Restart ... ...

- Affect on Operations
  - Cannot change DB status (/STO,  /STA, /DBR, /DBD ... )
  - Cannot shut down online system
- Frequency depends on mode
  - MD-BMP ... MODE=SNGL recommended
  - 'GC' status code for DEDB with PROCOPT=P | H
  - User Interval
    - Elapsed time
    - Number of DB records read (not 'read' calls)
    - Number of DB records updated (not 'update' calls)
    - Use "master" for controlling interval
    - One DB or file read or updated once per iteration thru program

# Batch to BMP without CHKPs

- Add IOPCB
- Implement IMSBATCH procedure
- Add PSB to online IMS (APPLCTN)
- Use PROCOPT=E
  - Avoids locking overhead, unless data sharing
  - Prevents others in this IMS from scheduling
- Use PROCOPT=GON | GOT
  - Avoids locking overhead
  - Avoids data sharing requirements
  - Allows other online users to be scheduled in this and other IMSs

# IMSBATCH Procedure PARM='

- BMP (region type)
- MBR=
  - application program name
- PSB=
  - psbname if different for program name
- NBA=
  - fast path database buffers
- OBA=
  - fast path overflow buffers
- IN=
  - input transaction code
  - IMS/TM only - Message Driven (MD) BMP
  - OUT= ignored
    - Replies go to IOPCB
    - May use ALT-PCBs

# IMSBATCH Procedure PARM= ...

- OUT=
  - output transaction code or LTERM name
  - IMS/TM only - non-Message Driven (NMD) BMP
  - For sending output messages via the IOPCB
  - Not for reading input messages from the input Qs
- CKPTID=
  - null:  no restart
  - 'LAST':  restart from the last checkpoint issued
  - 8 byte checkpoint id created by application
  - 14 byte checkpoint id from DFS0540I or DFS681I messages
    - (IIIIDDDHHMMSST) where IIII is region ID
  - NOMSG681* to suppress DFS681I messages
  - NOMSG540* to suppress DFS0540I messages
  - NOMSG* to suppress both DFS681I and DFS0540I messages

# IMSBATCH Procedure PARM= ...

- LOCKMAX=
  - value between 1 - 32767 (in units of 1000)
  - When exceeded, BMP will 3301 abend
- CPUTIME=
  - value between 1 - 1440 (minutes)
  - When exceeded, BMP will U0240 abend after DLI call completes
  - Use instead of MVS TIME= parameter to avoid U113 abend of IMS online
- IMSID=
  - 1-4 character ID of IMS online system where the BMP will run

# IMSBATCH Procedure PARM= ...

- PARDLI=0 | 1
  - 0:  DLI processing under control of BMP TCB
    - Best for performance
    - Use for production
    - Advantages:
      - Page fault isolation to BMP's TCB
      - Multi-CPU exploitation
      - Priority dispatching
    - Disadvantage:  Sx22 abend may cause IMS U113 abend
  - 1:  DLI processing under IMS Control Region TCB
    - Use for test
    - Eliminates IMS U113 abend which may occur when Sx22 abend occurs in the BMP region
      - S122 - operator cancel with dump
      - S222 - operator cancel
      - S322 - timeout
      - S522 - timeout due to 'wait'
      - S722 - output limit exceeded
    - Disadvantage:  Bad for performance

# Using GSAM

- What is it?
  - ►OS files under control of DLI
  - ►BSAM or VSAM(ESDS)
  - ►F | FB | V | VB | U
- Used to ease restart - IMS automatically repositions
- Problems with GSAM
  - ►Backout does not remove updates
  - ►Out of space conditions
  - ►JES sysouts
- ACBLIB not used - IMSBATCH must contain DD statements for:
  - ►DBDLIB
  - ►PSBLIB

# Define BMP to IMS

```
APPLCTN    FPATH=NO,PGMTYPE=BATCH,PSB=xxxxxxxx,
           SCHDTYP=SERIAL | PARALLEL
```

- FPATH=YES is invalid
- PGMTYPE=BATCH:  BMP [and CICS Transaction]
- SCHDTYP=
  - SERIAL:
    - Single scheduling of PSB only
    - Processing limited to one dependent region/thread
  - PARALLEL:
    - Multiple scheduling of PSB for multiple transact codes
    - Processing limited to MAXREGN parameter

# Define Transaction for MD-BMP to IMS/TM

- TRANSACT CODE=(aaaaaaaa,bbbbbbbb, . . .),DCLWA=YES,
  MODE=SNGL|MULT,SERIAL=YES|NO,[WFI]
- DCLWA=YES:
  - Write input/output messages to log prior to enqueuing
- MODE=SNGL:
  - Commit at each GU IOPCB
  - Performance option
  - Faster response to end-user
  - Forced for WFI
- SERIAL=NO:
  - Input does not need to be processed in FIFO sequence
- WFI:
  - Wait-for-Input - do not terminate BMP if there are no messages for it
- PRTY: Normal and Limit priorities are set to 0
- PROCLIM: ignored
- PARLIM: not supported

# Starting the BMP

- JES INITIATORS:
  - Set up JES initiator(s) for BMP job classes
  - Use initiators to control when BMPs run
    - Start fewer initiators during peak transaction processing
    - Start more initiators during slow times
- BMP Started By:
  - JES job submission
  - JES START command
  - IMS command:  /START REGION membername

# Stopping the BMP

- /STOP REGION | THREAD nn (normal case)
- /STO REG | THREAD nn ABDUMP
  - Software cancel - BMP issues own abend
  - Application looping or in wait state
- /STO REG | THREAD nn CANCEL
  - Only if /STO REG nn ABDUMP fails to work
  - Abends active TCB of BMP
  - May cause U113 abend of IMS if PARDLI=0
- Cannot use:
  - MVS or JES STOP | CANCEL (IMS traps and prevents)
  - MVS MODIFY

# Restarting the BMP

- If BMP does not issue CHKPs/XRST
  - Resubmit entire job
- If BMP issues CHKP/XRST
  - Specify CKPTID='LAST' and resubmit
    - Do NOT change jobname, psbname or program name
    - Last CHKP log record (X'18') must be on OLDS
  - Last CHKP (X'18') not on OLDS
    - Include //IMSLOGR DD
    - Supply checkpoint id from DFS0540I or DFS681I msgs in JOBLOG
  - Checkpoint ID not known
    - Resubmit job - U102 abend results with DFS0540I msg
    - Scan console log (or JOBLOG) for most recent DFS681I msg

# Topic 3:  Checkpoint / Restart

- Checkpoint Call
- Restart Call
- Synchronization Point Call
- ROLL, ROLB, ROLS Calls

# Checkpoint Call

- Applies to Batch DLI and BMP
  - Commits all changes made
  - Establishes a restart point
  - Used for recovery purposes
- Basic Checkpoint - restart dependent on application logic
  - CALL 'xxxTDLI' USING CHKP, IOPCB | AIB, IOAREA
  - EXEC DLI CHKP ID('literal') | ID(areaname)
- Symbolic Checkpoint - requires use of Restart (XRST)
  - CALL 'xxxTDLI' USING CHKP, IOPCB | AIB, IOAREALN, IOAREA,
    AREA1LN, AREA1, . . .
    AREA7LN, AREA7
  - EXEC DLI SYMCHKP ID('literal') | ID(areaname)
    AREA1(area1) LENGTH1(expression1) . . .
    AREA7(area7) LENGTH7(expression7)

# Checkpoint Events

- Database updates committed
  - ► Before/After images written to system log
  - ► Modified segments written to database
  - ► Locks on modified segments released
- Checkpoint information written to log (X'18')
  - ► Checkpoint ID
  - ► All IMS database positions, including GSAM
  - ► Up to 7 user data areas
- Checkpoint ID sent to IMS master & MVS console
  - ► (DFS0540I & DFS681I)
- Database position lost except:
  - ► GSAM,
  - ► DEDB PROCOPT=P | H if 'GC'
- [Output messages enqueued for sending after logging]
- [Input messages dequeued - next input message returned]

# Checkpoint Program Flow

- Database driven program ('GN' processing)
  - ► Save database position
  - ► Issue CHKP call
  - ► Re-establish database position
  - ► Resume processing
- File driven program ('GU' processing)
  - ► Issue CHKP call
  - ► Read file
  - ► GU to re-establish database position
  - ► Resume processing

# Restart Call

- Restart a BMP that
  - abended
  - was terminated due to operator command
    - /CHE FREEZE
    - /STO REG | THREAD xx [ABDUMP | CANCEL]
  - abended due to an IMS abend
- Restart should be first program call (after GU IOPCB if MD-BMP)
- Restart must precede first checkpoint call
  - CALL 'xxxTDLI' USING XRST, IOPCB | AIB, IOAREALN, IOAREA,
    AREA1LN, AREA1, . . .
    AREA7LN, AREA7
  - EXEC DLI XRST MAXLENGTH(expression) ID('literal') | ID(areaname)
    AREA1(area1) LENGTH1(expression1) . . .
    AREA7(area7) LENGTH7(expression7)

# Restart Events

- GSAM repositioned by IMS
  - do not change blocksize
  - DISP=MOD positions to end with PROCOPT=L
- IMS Full Function databases repositioned, if possible, by IMS
  - identical position not guaranteed if
    - segments added or deleted
    - non-unique keys
    - no keys
  - check status code of each database PCB
  - if not blanks, reposition if necessary
- Fast Path databases not repositioned, user responsibility if necessary
- User areas restored

# Synchronization Point (SYNC) Call

- Usable only by NMD-BMPs
- Application must be SELF RESTARTING if restart required
- Not used in conjunction with CHKP
- No WTO
- No log data
- Releases resources that IMS has locked for the application
- CALL 'xxxTDLI' USING SYNC IOPCB | AIB
- No EXEC DLI equivalent

# ROLL, ROLB, ROLS Calls

- ROLL: Backout full function (FF) to last commit
  - ►CALL 'xxxTDLI' USING ROLL
  - ►EXEC DLI ROLL
  - ►Program abends with U778
- ROLB:  Backout FF to last commit
  - ►CALL 'xxxTDLI' USING ROLB, IOPCB | AIB [,IOAREA]
  - ►EXEC DLI ROLB
  - ►Returns control to program
  - ►[returns first message segment into IOAREA]
- ROLS:  Backout FF to earlier processing set point (SETS | SETU)
  - ►CALL 'xxxTDLI USING ROLS, IOPCB | AIB | DB-PCB, [IOAREA, TOKEN]
  - ►EXEC DLI ROLS TOKEN(token1) AREA(data-area)
  - ►Returns control to program or
  - ►DB-PCB:  Can result in U3303 abend if DB2 or DEDB | MSDB in PSB

# Topic 4:  Performance

- Monitors:
  - BMP - IMS Monitor:  BMP tuning more difficult
  - Batch - DB Monitor:  Batch tuning easier
- DLI & DBB may be swappable in non-data sharing environment
  - SWAP=Y | N (default is Y)
- Parallel DLI
  - PARDLI=0 :  Best for Performance
  - PARDLI=1 :  Best for testing where U113s are a problem
- BMP Initiators
  - 4 - 10 reasonable
- Start when online processing volumes are low

# Performance . . .   . . .

- Page fixing OSAM and VSAM control blocks and buffer pools
- Buffer Isolation - separate subpools to
  - Minimize buffer steals
  - Minimize buffer contention
- VSAM
  - Optimize buffer hit ratio
  - Minimize buffer steals
  - Use Hiperspace for high read:reread ratio
- OSAM
  - Use OSAM Sequential Buffering when applicable
  - Minimize read requests
  - Minimize buffer steals

# Performance . . .    . . .

- OSAM Sequential Buffering
  - Optional
  - One pool of sequential buffers for each per DB PCB/DSG
    - 4 buffer sets by default
    - 10 buffers per buffer set
    - long-term page fixed
    - no lookaside between dependent regions
  - Activation
    - SBONLINE control statement in DFSVSMxx requests SB for IMS DB/DC or DBCTL
    - PCB   ...,SB=COND requests SB for the BMP
    - //DFSCTL DD with control statement in IMSBATCH JCL
      - SBPARM used to override SB and default number of buffer sets by PCB in PSB
    - SB Initialization  User Exit routine - optional
      - Request conditional activation
      - Change default number of buffer sets
      - Disallow usage of SB for this execution

# Performance . . .    . . .

- DEDB High Speed Sequential Processing (HSSP)
  - Optional
    - Reduces elapsed time
    - Optionally can concurrently image copy - requires DBRC registration
  - Three buffer sets equal to UOW size long-term page-fixed
    - Will be dynamically increased to six buffer sets if necessary
    - 4 buffer sets to 7 buffer sets if ASIC
  - Activation
    - PCB ...,PROCOPT=H to activate HSSP for the NMD-BMP only
      - Appl must 'CHKP' at 'GC' (UOW boundary crossed)
    - //DFSCTL DD control statements in IMSBATCH JCL
      - SETO can turn off HSSP request in PCB
      - SETO can request Asynchronous Image Copy (ASIC)
      - SETO can request No Read Ahead (NORDAH)
      - SETR can specify which areas are to be processed and in what order

# Topic 5:  Summary

- BMP Limitations
- XRF Considerations
- BMP Advantages

# BMP Limitations

- Can only backout to LAST checkpoint
  - Batch DLI can backout to any checkpoint if not block level data sharing
- Cannot recover to beginning of BMP and re-run
- HSSR won't work with BMPs
  - OSAM Sequential Buffering is a good alternative
- No IMS commands from BMP regions in DBCTL environment

# XRF Considerations

- When ACTIVE IMS fails, BMP fails:
  - dynamically backed out to last CHKP
  - manually restart BMP on alternate (new active)
- Use initiators / job classes to control execution CPU
  - Stop initiators on old active
  - Start initiators on new active
  - Don't use system affinity
    - JES2:  /*JOBPARM SYSAFF= . . .
    - JES3:  //*MAIN SYSTEM=...

# BMP Advantages - Better Operational Environment

- Uses IMS Online Logs:
  - Simplified database recovery
  - Simplified operations
  - Central log control
  - Dynamic backout for all failures
- Avoids data sharing within a single MVS image
- Protection from inadvertent operator cancels
- U828 (ISRT duplicate index entry) eliminated
- No 'batch window' constraints

# BMP Advantages: Application Architecture

- Access to Fast Path DEDBs (data entry data bases)
  - alternative to user partitioning (240 AREAs) of databases
  - alternative to DB Partitioning (only 32 partitions permitted - pre-V7)
  - operations at AREA level
  - utilities executed against AREA
  - utilities run online while AREA is in use
  - High Speed Sequential Processing (HSSP)
  - Asynchronous Image Copy (ASIC) concurrent with HSSP
- IMS/TM: Access to message queues

# BMP Advantages: Performance

- Databases already OPEN'd by online
- Databases already AUTHORIZEd by online (less RECON access)
- WFI (wait-for-input) processing: IMS/TM only
- High performance LWA (log write ahead) to WADS

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# DL/I Batch to BMP Conversion

## Thank you for your evaluation

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# Appendix:  Sample Checkpoint Program Logic

- Uses program specified UNIQUE checkpoint IDs
  - Must be unique, else from where to restart?
  - IMS generated not known to application, hard to use in automated process
  - Minimize JCL changes - just resubmit with necessary logs
  - Eliminate recompile for frequency changes
- Components
  - Checkpoint database - HDAM root only
    - Program name is KEY
    - JES Job number
    - Counter
    - Good place to store CHKP frequency information
      - To alter frequency, change value in database
      - No need to recompile program
  - Generalized checkpoint code copied into program
  - PCB for Checkpoint database

# Sample Checkpoint Program Logic . . .

- At program START
  - GU CHKP-DB-PCB using KEY = PGMNAME
  - If input record blanks, then normal execution
  - If input record contains chkp-id, restart indicated
- Issue XRST call
  - If normal execution, use blanks in IOAREA
  - If restart, use CHKP-ID from CHKP-DB in IOAREA
    - Saved program areas restored
    - GSAM databases repositioned by IMS
    - IMS databases repositioned if possible by IMS

# Sample Checkpoint Program Logic . . .

- If restarting
  - Check status code of all database PCBs for blanks
    - If not blank, reposition database if necessary
  - Update CHKP-DB with new JES job number
  - Issue initial CHKP call
- Normal processing
  - Obtain checkpoint frequency from CHKP-DB
  - Increment and test CHKP counter
    - elapsed time
    - # DB records updated
    - # DB records read

# Sample Checkpoint Program Logic . . .

- When CHKP to be taken
  - Update user areas to be CHKP'd
  - Update CHKP-ID counter
  - REPL root in CHKP-DB
  - Issue CHKP with new CHKP-ID and up to 7 user areas
  - Reset CHKP-ID counter
  - Reposition databases if necessary (not needed for GSAM or DEDB with 'GC')
- At normal completion
  - REPL CHKP record with blanks in CHKP-ID field so next execution is normal start
  - Terminate program

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