

E08



# Using IMS and DB2 Together

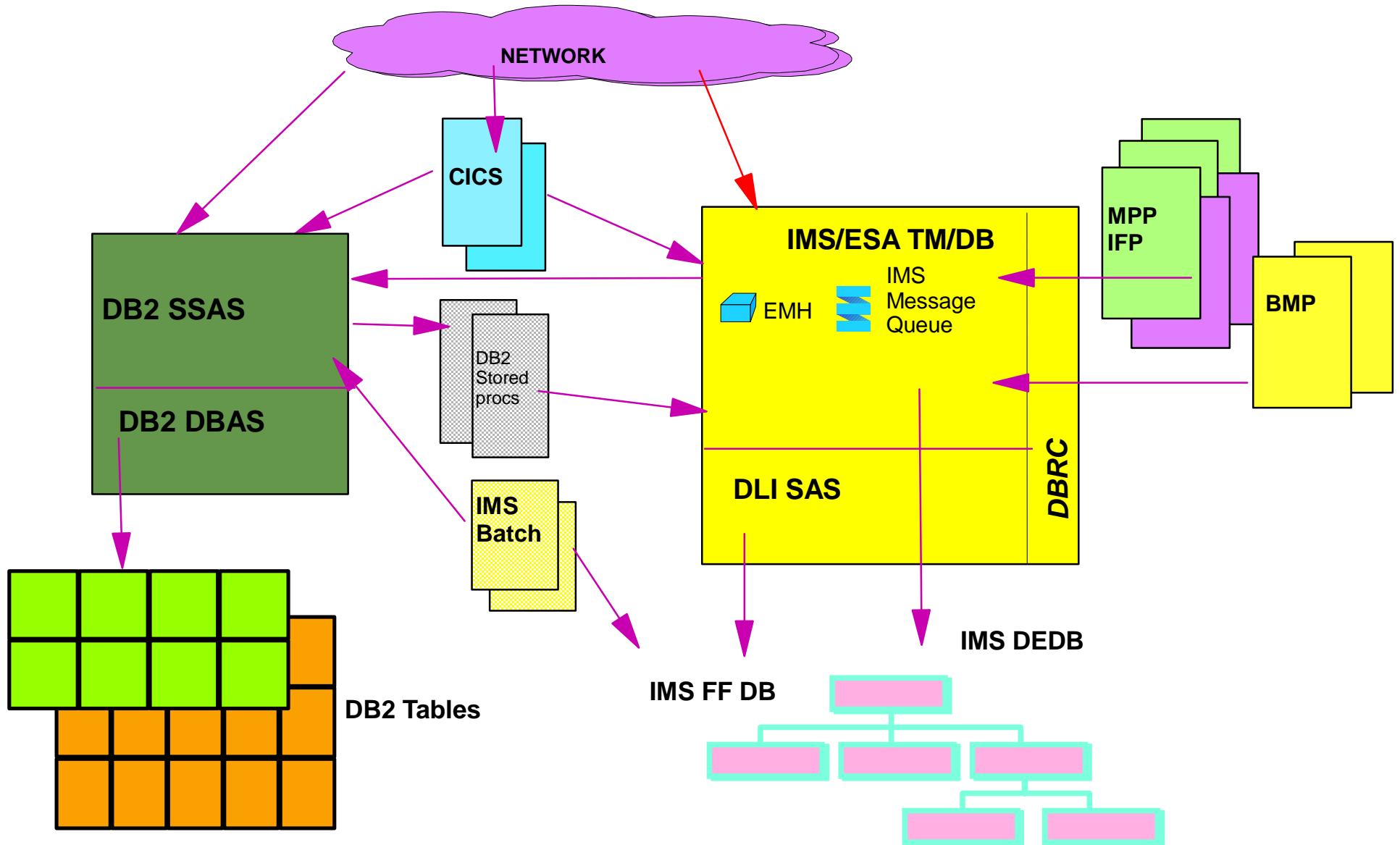
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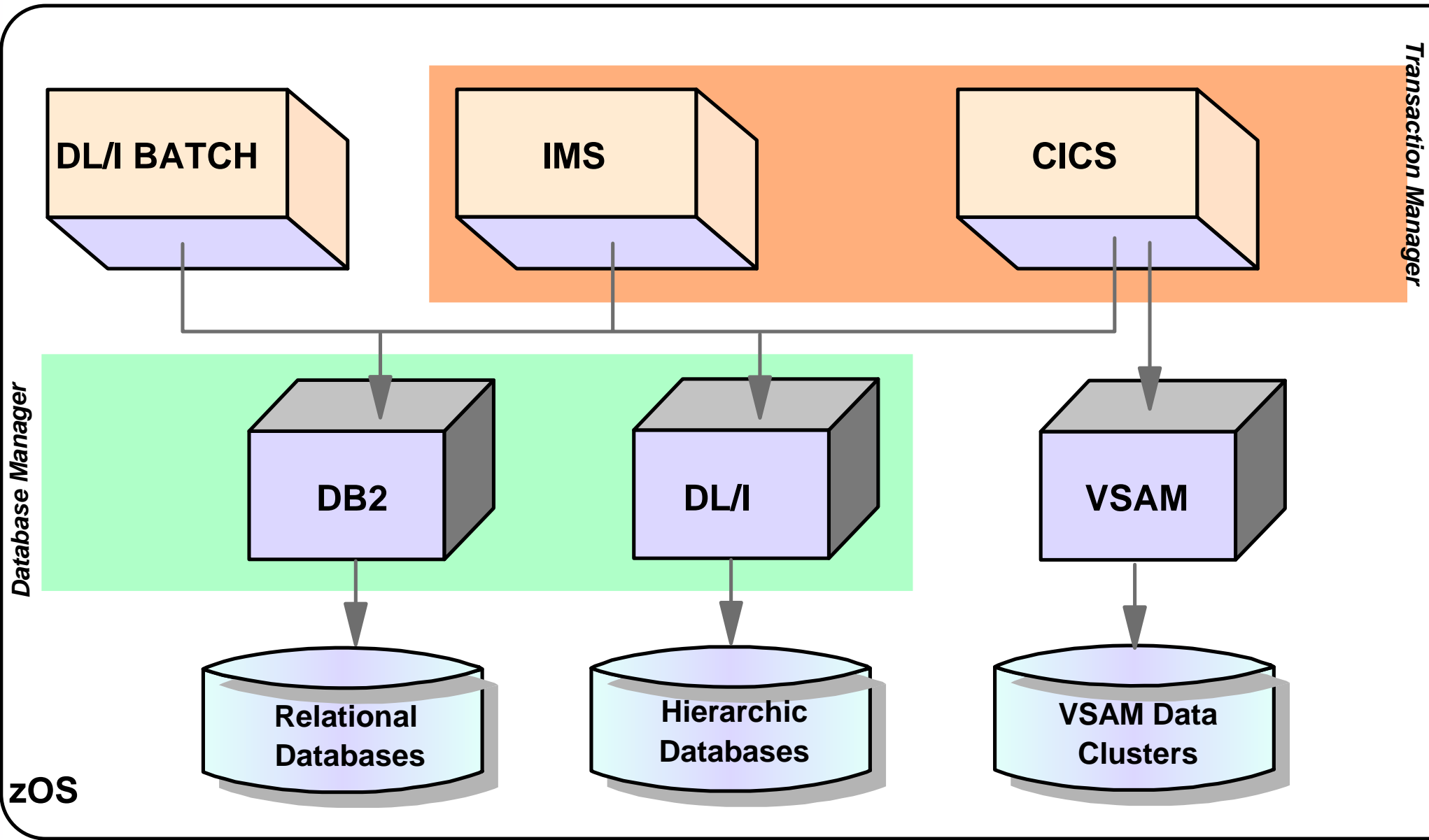
**St. Louis, MO**

**Sept. 30 - Oct. 3, 2002**

# z/OS Transaction and Database Managers



# *z/OS Transaction and Database Managers ...*

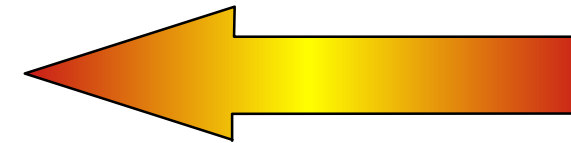


zOS

# Agenda



- ▲ **Access to DB2 from an IMS application**
  - External Subsystem Attach Facility (ESAF)
- ▲ **Access to IMS DB from a DB2 stored procedure**
  - ODBA since IMS V6
  - JDBC support with IMS Java in IMS V7
- ▲ **Propagation between the DB2 and IMS database managers**
  - IBM Data Refresher
  - IMS Data Propagator
- ▲ **The IBM Data Management Tools**



*This session will discuss the many ways IMS and DB2 have of interacting and working together to provide a complete data management solution.*

*The IMS Transaction Manager (IMS TM) can execute application programs which access DB2 tables (as well as IMS DB data), providing the ultra high performance/availability environment required in this rapidly changing world.*

*We explain how the External Subsystem Attach Facility (ESAF) works for this and how IMS TM, IMS DB and DB2 can work together.*

*The IMS Database Manager can be accessed by DB2 Stored Procedures as well as other environments using the JDBC interface. We'll look at those capabilities now possible with IMS V7 and the Open Database Access (ODBA) facility. It is time to learn that new access to IMS databases are now available!*

*In addition, customers need to be able to propagate data between the DB2 and IMS database managers. This session will highlight how the IMS Data Propagation (DPROP) product works for integrated data handling. New and existing applications and data can run alongside of each other without data migration.*



# *Access to DB2 from an IMS Application*

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## ▲ **The need**

- Take benefit of IMS TM strengths to access DB2 data
  - High system availability of IMS architecture
- Use all the network connection capabilities of IMS to access DB2 data
- No impact on IMS users
- Allow access to both IMS DB and DB2
- Access from IMS transactions, IMS BMP region and IMS Batch

## ▲ **IMS Attachment Facility**

- Allows access to DB2 from an IMS environment
  - DB2 provides database services for IMS MPP, BMP, IFP and IMS batch.
- Receives and interprets requests for access to DB2 databases
  - Uses exits provided by IMS subsystems
- Allows coordinated recovery of both DB2 and IMS data

# IMS DB2 Subsystem Attachment Facility



## ▲ Usage of the IMS External Subsystem Attach Facility

- Also used by MQSeries for OS/390

## ▲ Connection between IMS Subsystems and one or more DB2 Subsystems

## ▲ Communication between IMS Users and DB2

- Command Thread
- Transaction Threads

## ▲ Application Programming Interface

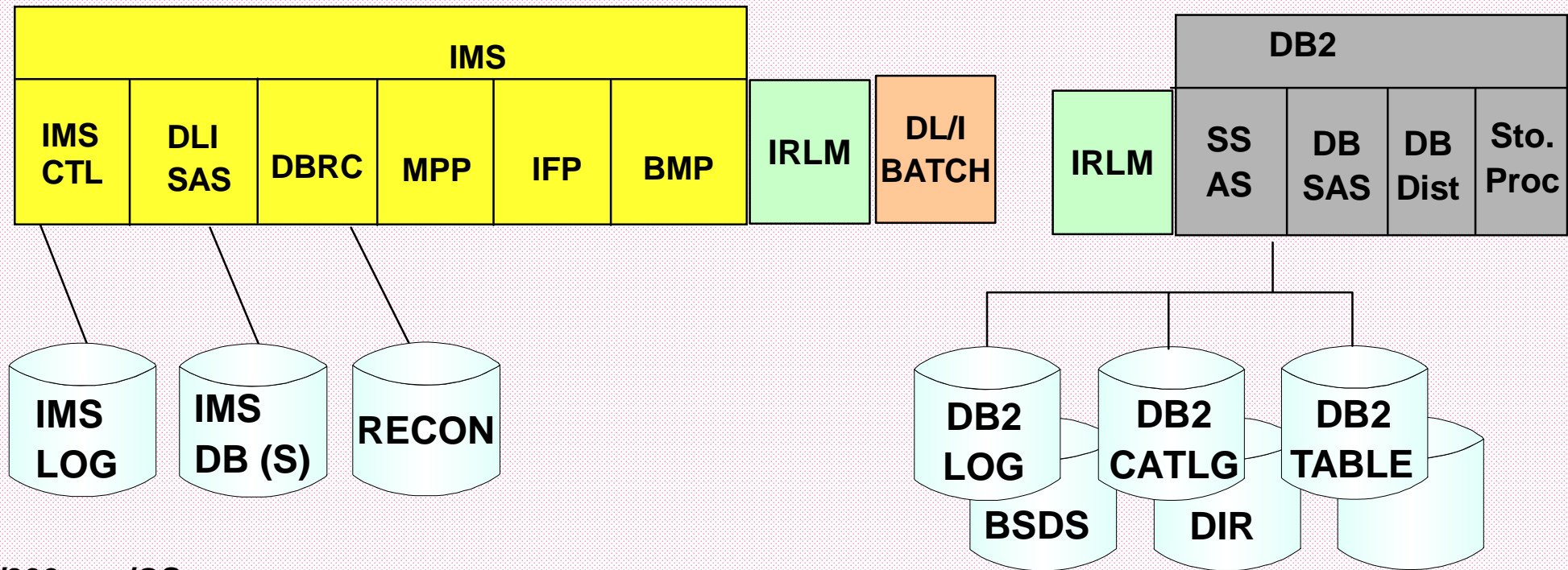
- DB2 Precompiler
- Language Interface

An application talks to a single DB2 subsystem  
*depending on the DFSLIxxx module which is link-edited with.*

## ▲ Coordinated Recovery/Restart

- Unit of Work/Unit of Recovery
- Two-Phase Commit Protocol
- Indoubt Thread Resolution

# IMS DB2 Subsystem Attachment Facility ...



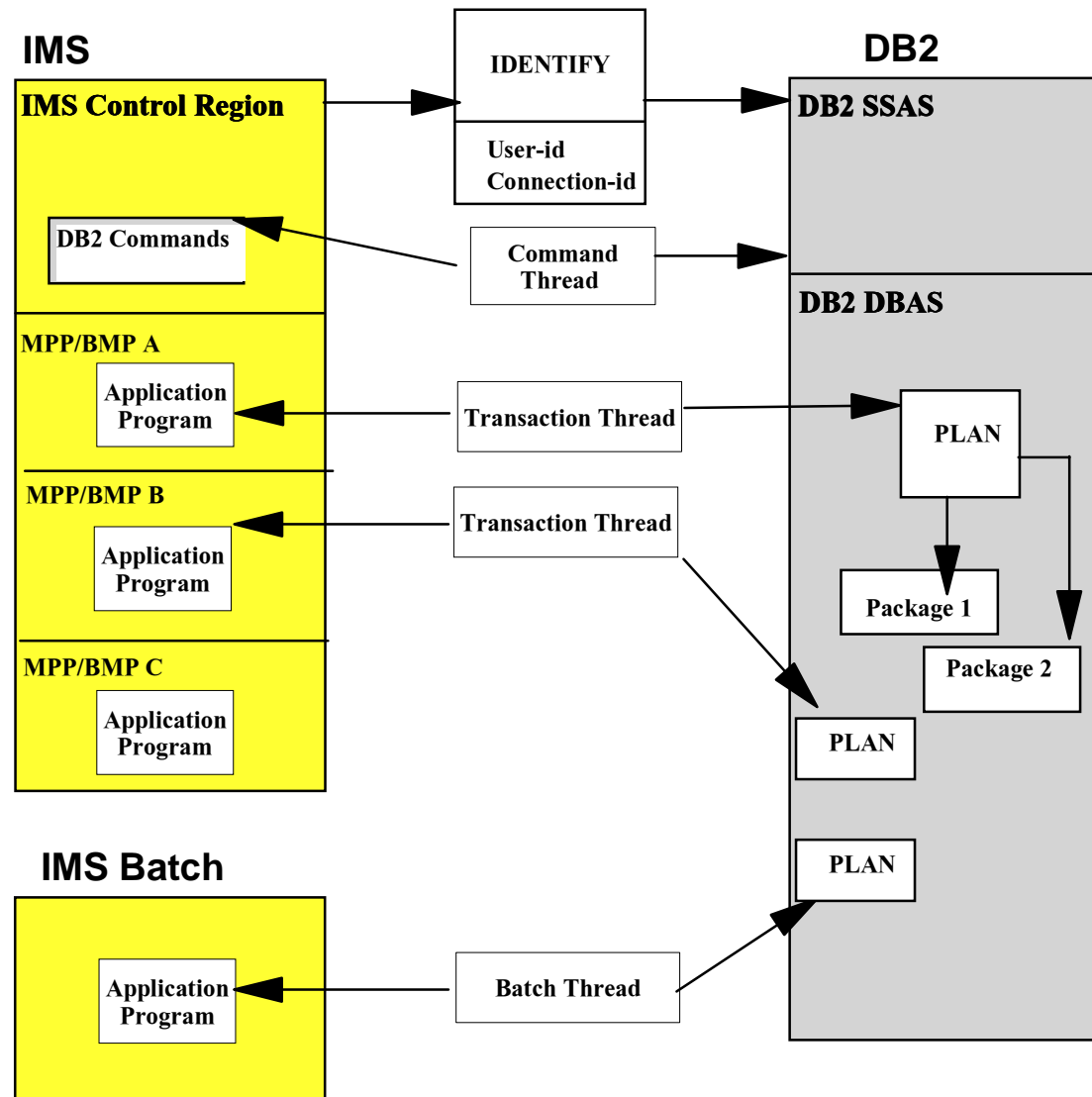
OS/390 or z/OS

- ▲ IMS and DB2 must be on same OS/390 image
- ▲ One DB2 Subsystem can be connected to multiple IMSs
- ▲ One IMS Subsystem can connect to multiple DB2s
- ▲ One IMS dependent region can connect to multiple DB2s
- ▲ One application program can access only one DB2 per schedule

# IMS DB2 Subsystem Attachment Facility ...

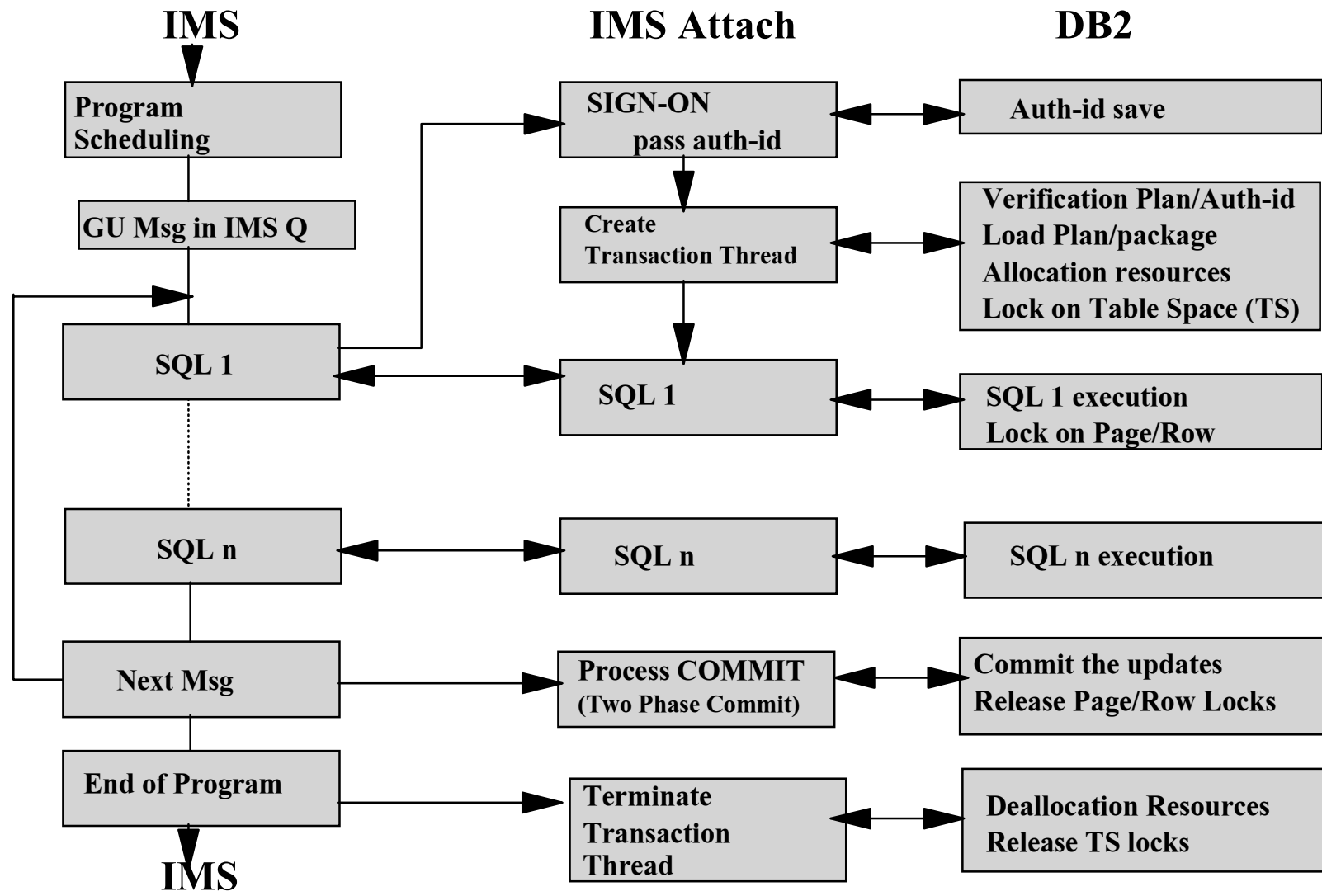


- ▲ **IMS Attach**
  - Defined by a subsystem member
- ▲ **IMS Control Region**
  - Command thread
  - One per DB2
- ▲ **IMS MPP/BMP**
  - Transaction thread
  - One per active connection
- ▲ **IMS Batch**
  - Batch thread
  - No DB2 command processing





# IMS DB2 Subsystem Attachment Facility ...



# IMS and DB2 in a Parallel Sysplex Environment



## MultiSystem Management and Data Sharing

VTAM or TCP/IP

*Single Image*

Transaction Manager	
CICS	IMS TM

***Dynamic Workload Balancing***

Appl	Appl	.	.	.	.
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***Unchanged Applications***

IMS DB	DB2	VSAM
Data Managers		

***Data Sharing***

MVS/ESA		
XCF	JES2	RACF

*Base Services*



# IMS DB2 Subsystem Definition

- ▲ **No specific IMS SYSGEN requirement**
- ▲ **No specific DB2 installation requirement**
- ▲ **IMS Control or Dependent Region JCL**
  - SSM = mmmm
  - PROCLIB member name = IMSidmmmm
- ▲ **PROCLIB Subsystem member**
  - Subsystem identifier  
SSN= subsystem name
  - Language Interface Token (LIT)  
LIT= xxxx to choose the adequate DFSLI module  
SYS1 for DFSLI000  
DFSLI macro to create other DFSLIxxx
  - External subsystem module table  
ESMT= DSNMIN10 for DB2
  - Resource Translation Table (RTT)  
if plan name different from the PSB name
  - Region error options (ERR)  
When DB2 services not available  
R (return code), Q (pseudo-abend and requeue)  
or A (abend)
  - Command Recognition Character (CRC)  
Routing commands to DB2

```
DB2A, SYS1, DSNMIN10, , R, -  
DB2B, SYS2, DSNMIN10, , R, &
```

- **ESAF Group Attach (IMS V7)**  
SSN=DB2 group name  
SST=DB2 specified (or defaulted to)

# IMS DB2 Subsystem Definition ...



## IMS.PROCLIB

SSMI member:

DSNP, SYS1,..

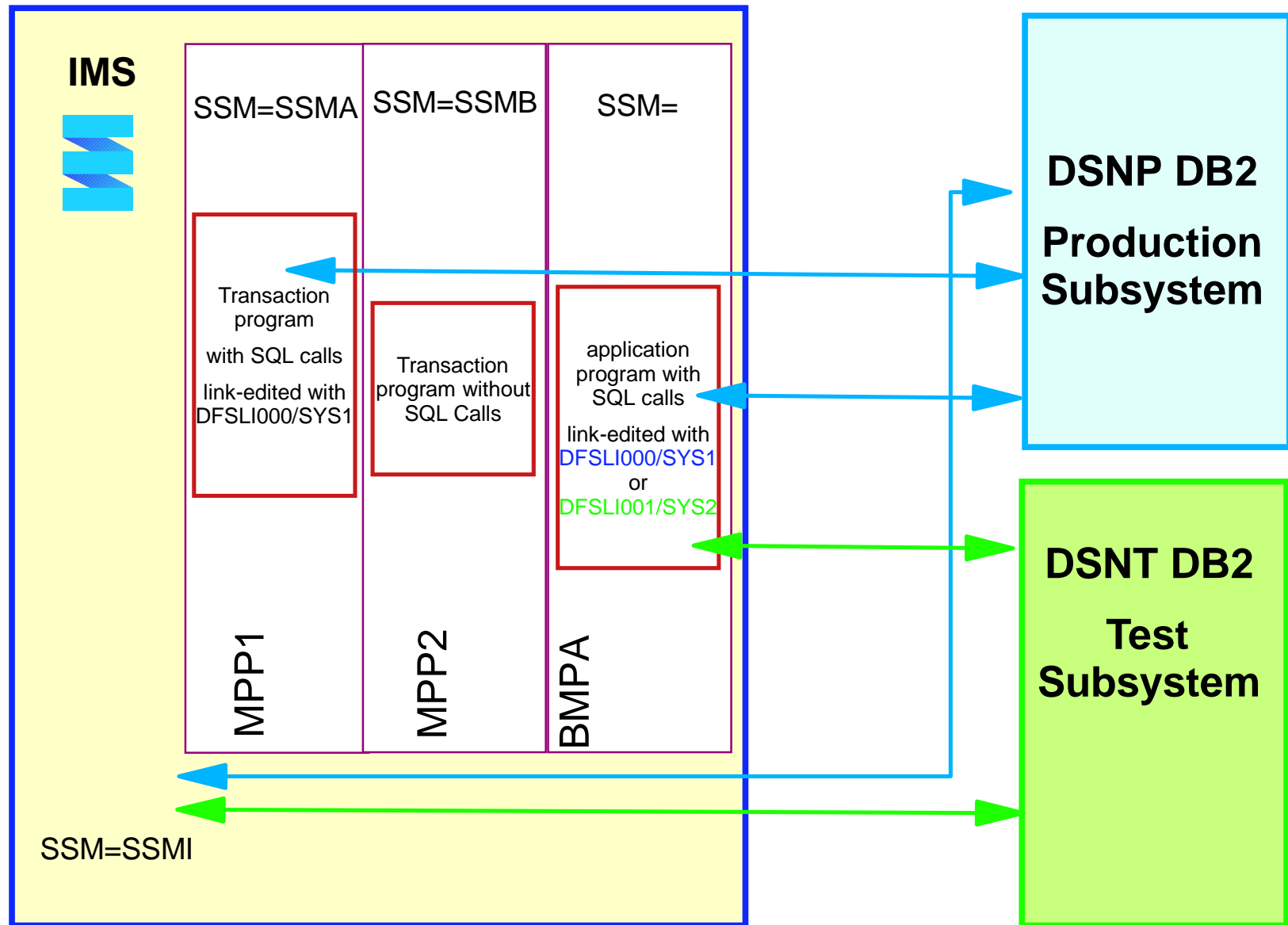
DSNT, SYS2,..

SSMA member:

DSNP, SYS1,..

SSMB member:

empty member



# IMS DB2 Recovery Restart



- ▲ **Two Phase Commit protocol**
- ▲ **IMS as "Coordinator Control System"**
  - Establish a unit of work
    - Begins at PSB scheduling time or at previous commit
    - Includes IMS TM, IMS DB, DEDB, and DB2 activity
    - Ends when all the activities are committed or aborted
  - Coordinates the commit/abort decisions
  - Coordinates the restart activities following failures
- ▲ **DB2 as "Participant"**
  - Establish a unit of recovery
    - Begins when the 1st SQL update is executed
    - Ends when DB2 is told by IMS to commit/abort

*Multiple  
resources being  
managed by  
multiple resource  
managers*

# IMS DB2 Operations



## ▲ IMS DB2 Attach Startup

- Started when IMS starts if DB2 is active
- By /START SUBSYS xxxx command  
xxxx = DB2 subsystem name

## ▲ IMS DB2 Attach Stop

- When DB2 stops
- When IMS stops
- With /STOP SUBSYS xxxx command
- When abnormal termination of IMS or DB2

## ▲ How to operate

- To control and display the status of the IMS connections to DB2
  - /START SUBSYS                      Connects the IMS control region to a DB2 subsystem
  - /TRACE                                      Controls the IMS trace
  - /DISPLAY SUBSYS                      Displays connection status and thread activity
  - /DISPLAY OASN SUBSYS              Displays outstanding units of recovery
  - /CHANGE SUBSYS                      Deletes an indoubt unit of recovery from IMS
  - /STOP SUBSYS                              Disconnects IMS from a DB2 subsystem
- To send DB2 commands from an IMS terminal/application program to DB2
  - /SSR (subsystem request command)

# Locking Considerations



## ▲ **IMS Lock Manager**

- **IMS Program Isolation**
  - Local locking
  - 4 locking states used
- **IRLM**
  - Global Locking
  - 4 locking states used

## ▲ **DB2 Lock Manager**

- **IRLM**
  - 6 locking states used

## ▲ **IRLM**

- **External lock manager**
  - Same product
  - Use one for IMS, one for DB2
- **Mandatory in IMS or DB2 data sharing**
- **Functions**
  - Lock request handling
  - Deadlock detection
    - No deadlock detection between IMS and DB2 resources.*
  - Trace
  - Communication between IRLMs
    - Associated to the same sub-system type*

# Security Considerations



- ▲ **Using RACF or any equivalent product**
- ▲ **Database datasets protection**
- ▲ **Subsystem connections verification**
  - DB2 subsystem defined in a RACF class
- ▲ **User authorization**
  - Userid/password validation
    - in IMS at user signon
    - in OTMA client for OTMA access
    - in APPC/MVS for LU6.2 access
- ▲ **Transaction authorization**
  - Userid/transaction validation
- ▲ **DB2 security**
  - Userid/DB2 resource validation
    - Primary authorization ID
    - RACF connected group name
  - DB2 Signon exit
    - To use/change secondary authorization ID
- ▲ **Command security**
  - In IMS and in DB2



# Performance Considerations



## ▲ No need to worry about

- Number of Threads
  - Each IMS dependent region has one
- DB2 dispatching priority
  - DB2 requests performed under IMS region TCB
- IMS Sysgen
- PSB generation if not using IMS DB or GSAM
  - Automatic generation
- IMS application scheduling
  - Business as usual
  - For better thread utilization and high volume transactions
    - WFI region*
    - Pseudo WFI transaction*
  - High priority transactions assigned to high priority regions

*Redbook : IMS Version 7 Performance Monitoring and Tuning Update  
(SG24-6404-00)*

# Application Considerations



## ▲ IMS considerations

- Standard IMS transaction programming techniques
  - Initialization
  - Get the input message
  - Validate input
  - Execute processing logic
    - Access to DB2 resources*
  - Send output message
  - Get the next message
  - Terminate
- Usage of the IMS API
  - Simple and Consistent
- DB2 Precompile step
- GSAM
  - IMS interface to MVS sequential files
    - Available in BMP and IMS Batch*
  - IMS allows repositioning.

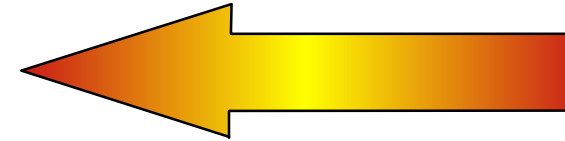
## ▲ DB2 Considerations

- Requirements of the application in the DB2 application plan
  - Same name as the APPLCTN name defined in the IMS sysgen
  - Or RTT usage
- DB2 resources allocated at 1st SQL call
  - All SQL statements are allowed except COMMIT and ROLLBACK.
- At IMS checkpoint
  - Cursor closed
  - DB position lost

# Agenda

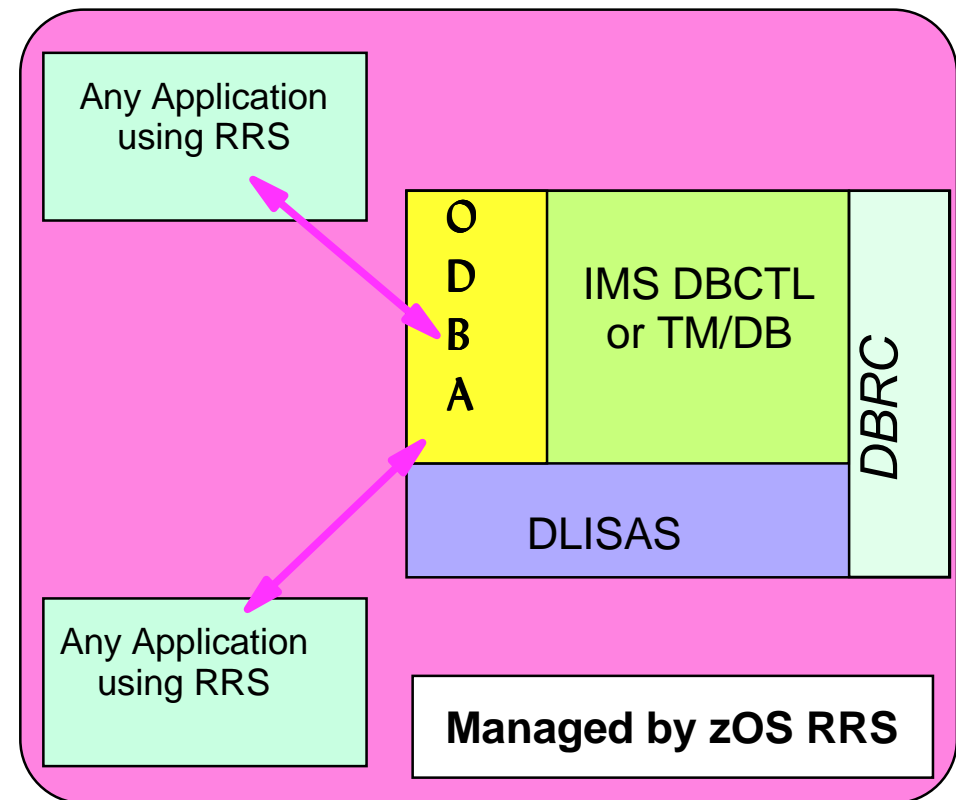


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# Open Database Access (ODBA) - Objectives

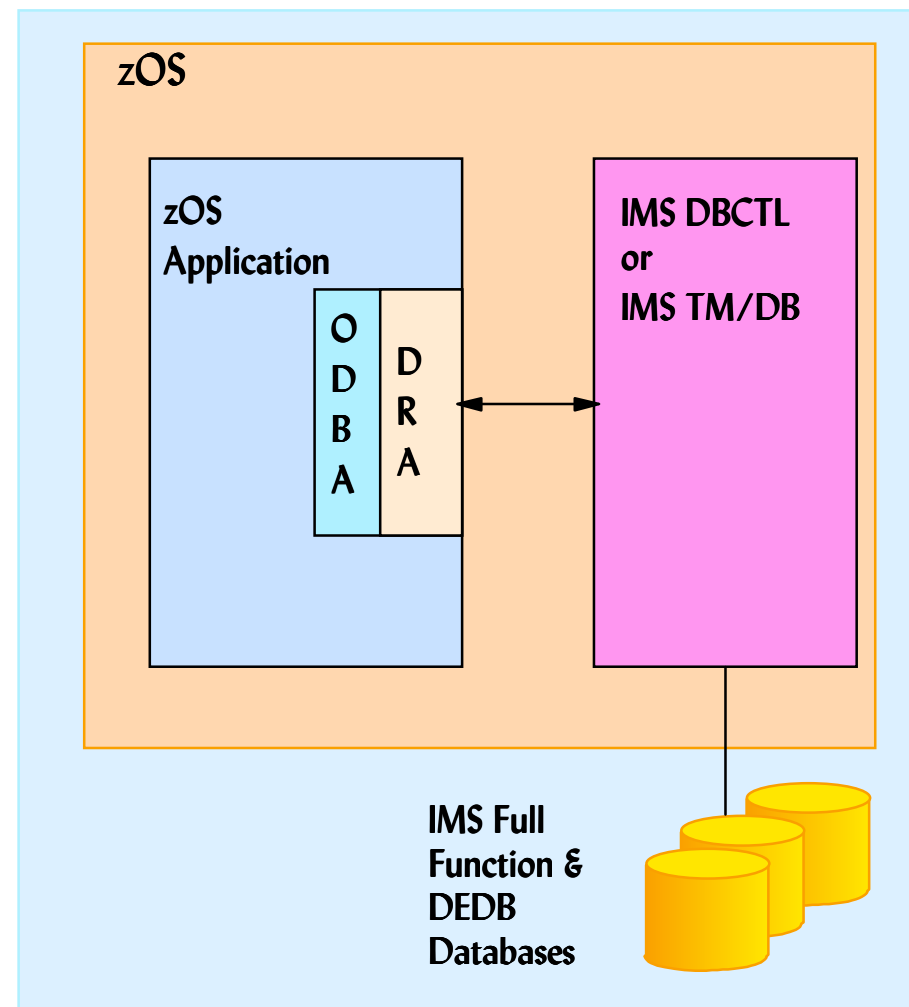
- ▲ **Provides a callable interface to IMS databases from any OS/390 programs that are not managed by IMS**
  - DB2 Stored Procedures
  - or Any OS/390 applications that use OS/390 Resource Recovery Services (RRS) to manage their syncpoint processing
- ▲ **Connection to IMS TM or DBCTL**
  - Uses the Database Resource Adapter (DRA)
  - DL/I calls are issued using the Application Interface Block (AIB) interface



# ODBA - Database Resource Adapter (DRA)

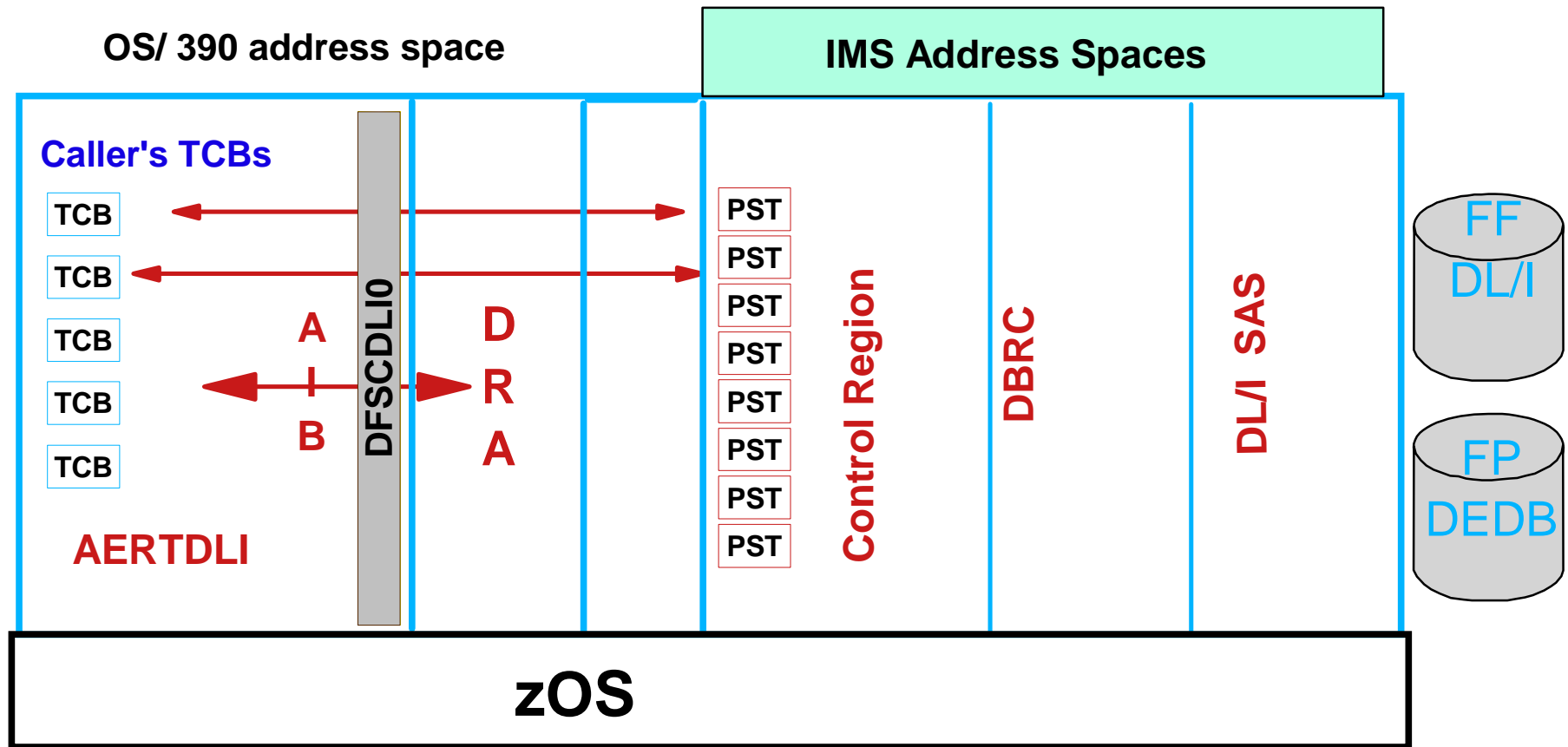


- ▲ **The OS/390 application gains access to IMS Full Function & DEDB databases through the Database Resource Adapter**
  - Similar to CCTL's usage of the DRA
  - ODBA uses the AERTDLI interface rather than PAPL parameter list to communicate its requests to the DRA
- ▲ **The DRA is initialized as a result of a CIMS INIT or APSB call**
- ▲ **The DRA can process multiple threads at a time**
  - Through the MINTHRD & MAXTHRD parameters in the DRA Startup Table
  - Maximum number of threads & dependent regions supported by an IMS DB instance at one time is 999



ODBA's Use of the DRA

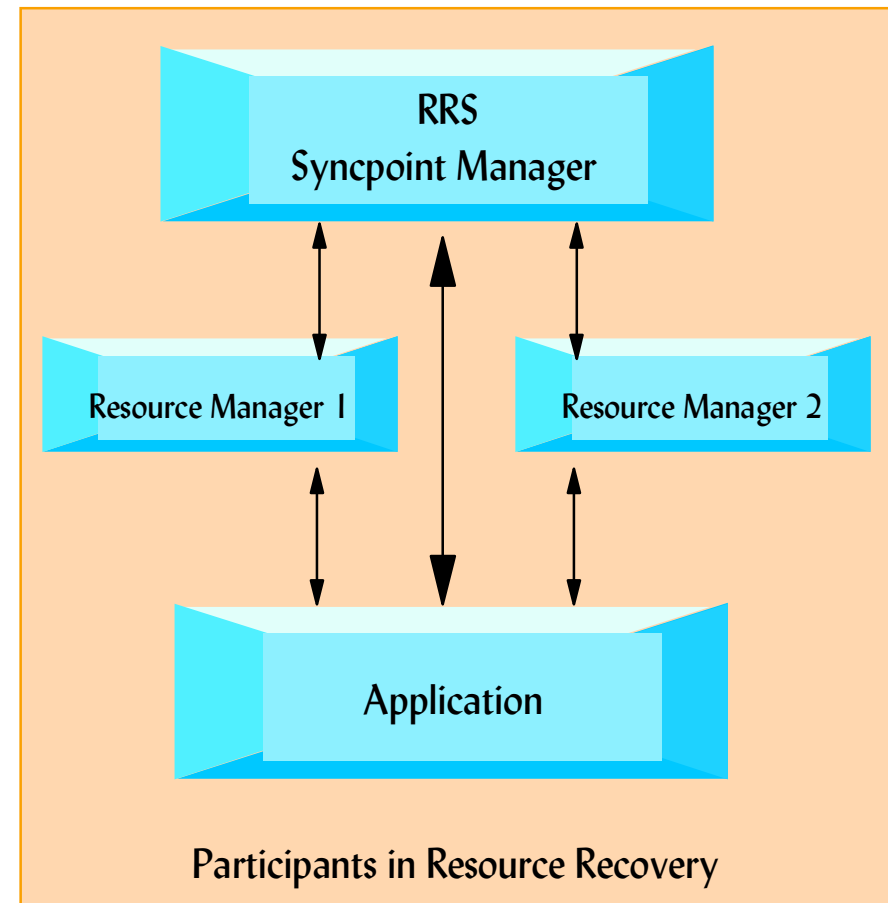
# ODBA - Database Resource Adapter (DRA) ...



- ▲ There is one DRA TCB attached per IMS DB connection
- ▲ One DRA Thread TCB is attached per specified number of threads
- ▲ When the APSB call is processed, a context is established & tied to the TCB
  - At commit time all contexts for this TCB are committed or aborted by RRS

# zOS Resource Recovery Services

- ▲ **Resource Recovery Services is required**
  - Prereqs OS/390 Release 3
- ▲ **RRS is the syncpoint manager and coordinates the two-phase commit process**
- ▲ **RRS implements SAA Commit and Backout callable services for use by application programs**
- ▲ **RRS provides services for Resource Managers to:**
  - Register & participate in two-phase commit process
  - Express interest in an application instance & be informed of commit & backout requests
  - Obtain system data to restore their resources to a consistent state



# ODBA Utilization - Program Flow



## ▲ Connect to IMS DB

### ➤ CIMS call

Initialize & terminate ODBA interface in your OS/390 application

## ▲ Allocate a PSB

### ➤ APSB call

Allocate a PSB for the zOS application region  
*The PSB must exist & security checking must be successful before the call can succeed*  
*A CIMS INIT call must have been successful*  
*RRS must be active when the APSB call is made*

```
CIMS INIT call for IMSA
```

```
APSB call for PSBX
```

```
Database calls
```

```
CALL AERTDLI (GU, AIB, IOAREA, ...)  
...
```

```
SRRCMIT
```

```
DPSB call
```

```
CIMS TALL call
```



# ODBA Utilization - Program Flow ...



## ▲ Perform DB Calls

### ➤ DL/I Calls Supported by ODBA

APSB <span>Extended</span>	DPSB <span>Extended</span>	GNP/GHN P	INQY (FIND;DBQUERY; ENVIRON)	RCMD	SNAP
<b>CIMS</b> <span>NEW</span>	FLD	GMSG	ISRT	REPL	STAT
DEQ	GU/GHU	ICMD	LOG	ROLS	OPEN
DLET	GN/GHN	INIT	POS	SETS/SETU	CLSE

### ➤ DL/I Calls not Supported by ODBA

CHKP	PCB	ROLL	SYNC	INQY (AIBSFUNC=PROGRAM)
GSCD	XRST	ROLB	TERM	

- GU/GN/ISRT calls to the I/O PCB are not supported  
No access is provided to the IMS message queues
- Alternate destination PCBs cannot be used

# ODBA Utilization - Program Flow ...



## ▲ Commit the changes

- Synchronization is performed by issuing the distributed commit calls
  - Commit unit of work  
*SRRCMIT/ATRCMIT*
  - Backout unit of work  
*SRRBACK/ATRBACK*

## ▲ Deallocate the PSB

- DPSB call
  - Used when the work unit is complete
  - A commit call must be issued prior to the DPSB

## ▲ Terminate the connection

- CIMS Call
  - "TERM" subfunction to terminate one & only one IMS connection
    - The ODBA environment will remain in tact in the zOS address space on call completion.*
  - "TALL" subfunction to terminate all connections to IMS and terminates the ODBA environment in the application address space

# ODBA Setup Process



## ▲ Create the ODBA DRA startup table

- Generate your own table by using the DFSPRP macro

```
TITLE 'DATABASE RESOURCE ADAPTER STARTUP PARAMETER TABLE'
DFSIMSP0 CSECT
EJECT
DFSPRP DSECT=NO
END
```

Characters 1-3 = DFS  
Characters 4-7 = specified 4-byte ID  
(recommended use IMSID of system to which you will connect)  
Characters 8 = 0

**You would have one Startup Table for each IMS DB connection**

## ▲ ODBA & DRA modules in the STEP/JOBLIB of the zOS application region

- DFSCDLI0 : Linked or loaded by an application program. Contains the ALIAS name AERTDLI
- DFSAERGO : Loaded by DFSCDLI0
- DFSAERM0
- DFSAERA0
- DFSnnnn0 (Startup Table )

## ▲ Link the ODBA application programs with DFSCDLI0 (AERTDLI)

## ▲ Set up security

# DB2 Stored Procedures



## ▲ DB2 Stored Procedures

- Enables users to "bundle" multiple SQL statements into a single unit
- A "stored procedure" resides on the mainframe
- Clients can then execute these statements by issuing one network call

## ▲ DB2 - established Stored Procedures

- Introduced in DB2 V4R1
- One address space, multiple tasks
- Limited function -- will not be enhanced
- Must use DSNALI (call attach)

## ▲ WLM - established Stored Procedures

- With DB2 V5 and OS/390 R3
- Multiple "environments"
- Multiple address spaces for each environment
- Each address space can have multiple tasks
- Must use DSNRLI (RRS attach)
- Dynamically started by OS/390 Workload Manager if in GOAL mode

*Stored Procedures are blocks of code that contain SQL statements and reside on a server platform.*

# DB2 Stored Procedures ...



## ▲ New Stored Procedure languages since DB2 V5

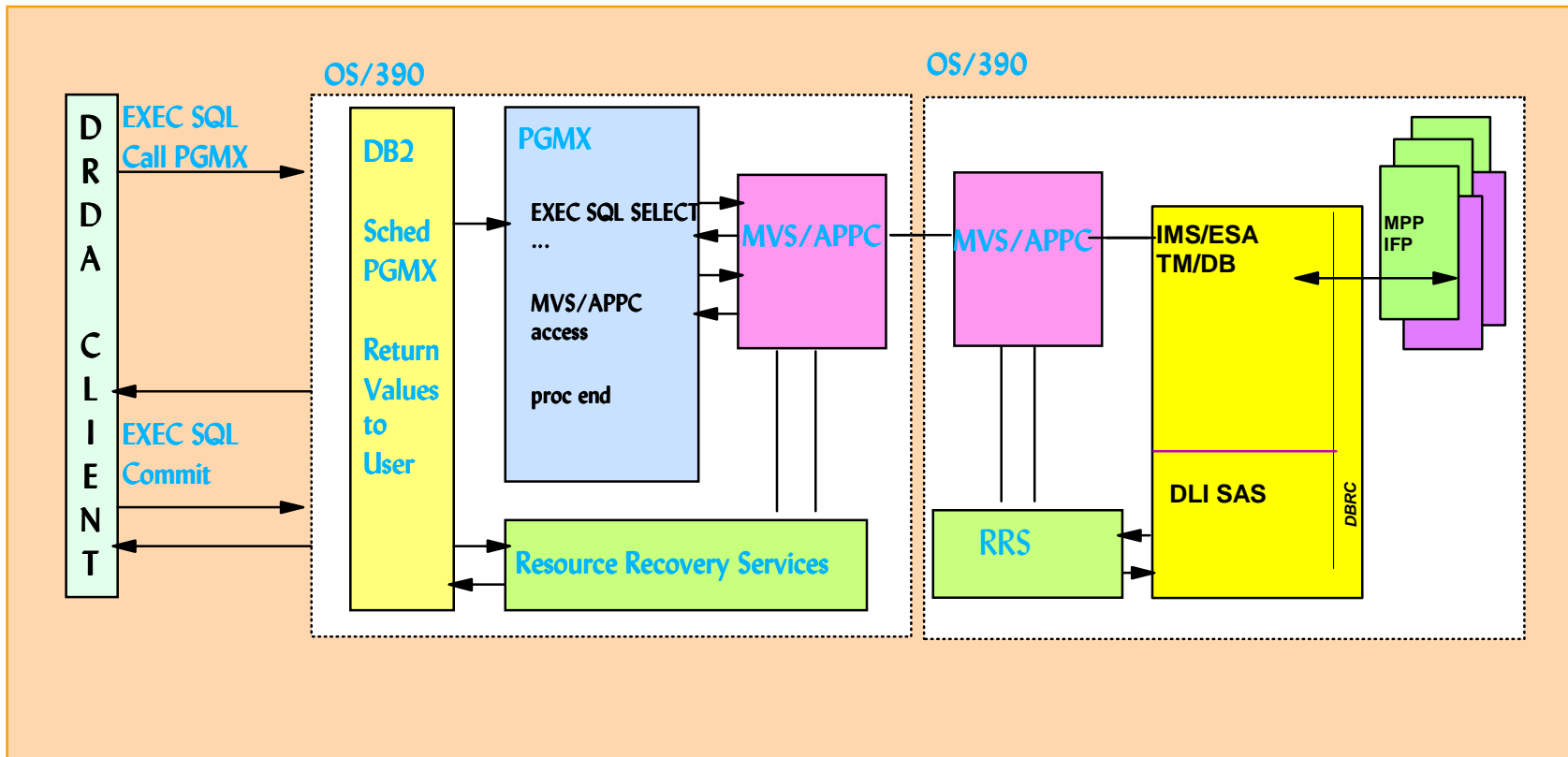
- REXX
  - REXX SQL support
- SQL (also known as PSM)
  - More like other DB vendors
- Java
  - JDBC and SQLJ
  - Compiled Java in V5/V6
  - Interpreted via JAR files in V7

## ▲ Stored Procedure builder

- Building new (LANGUAGE SQL)
- Executing existing (any language)

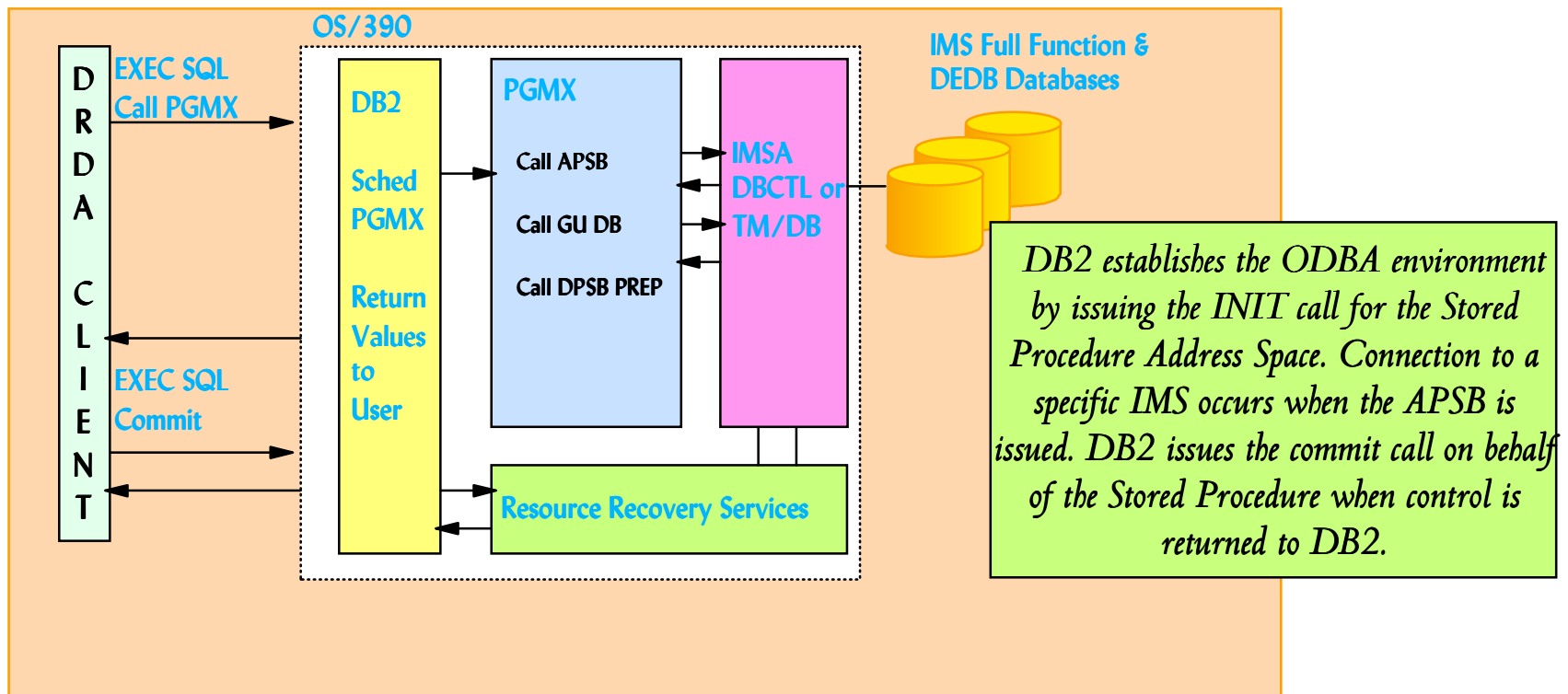
# Access to IMS Transactions using APPC

- ▲ **DB2 Stored Procedures Address Space uses MVS/APPC calls to access IMS TM Subsystem**
  - On same OS/390 or on different OS/390
- ▲ **DB2 notifies RRS about Commit/abord decisions**
- ▲ **RRS passes decision to other resources manager**
  - Allows 2-phase commit with MVS/APPC applications (e.g. an IMS Transaction)



# Access to IMS Databases using call DLI (ODBA)

- ▲ **DB2 Stored Procedures Address Space access to an IMS DB Subsystem**
- ▲ **DL/I data can be presented through an SQL interface either**
  - locally to this DB2 or
  - to DRDA connected DB2s
- ▲ **RRS coordinates the commit between DB2 and IMS**



# DB2 Stored Procedures & ODBA



- ▲ **DB2 Stored Procedures provides clients the ability to work transparently with multiple server facilities such as**
  - IMS data, DB2 data, VSAM, MQ Series messages
- ▲ **Results of IMS work can be passed to the client using multiple result sets**
- ▲ **Desktop tools such as Visual Basic, PowerBuilder, VisualAge can handle multi-row query result sets**
- ▲ **IMS & zOS applications can be developed, installed & maintained independently of one another**
- ▲ **Failure isolation**
- ▲ **Client is not exposed to any DL/I calls or other APIs!**
- ▲ **Prereqs**
  - RRS required
  - Workload Manager Established Address Space required
    - Therefore DB2 Version 5 or higher is needed*
  - Only the PREP subfunction of the DPSB call should be issued by the Stored Procedures



# Java and IMS



## ▲ IMS Java application support

- Development and runtime support
- Access to IMS resources

## ▲ Web Access to IMS Transactions

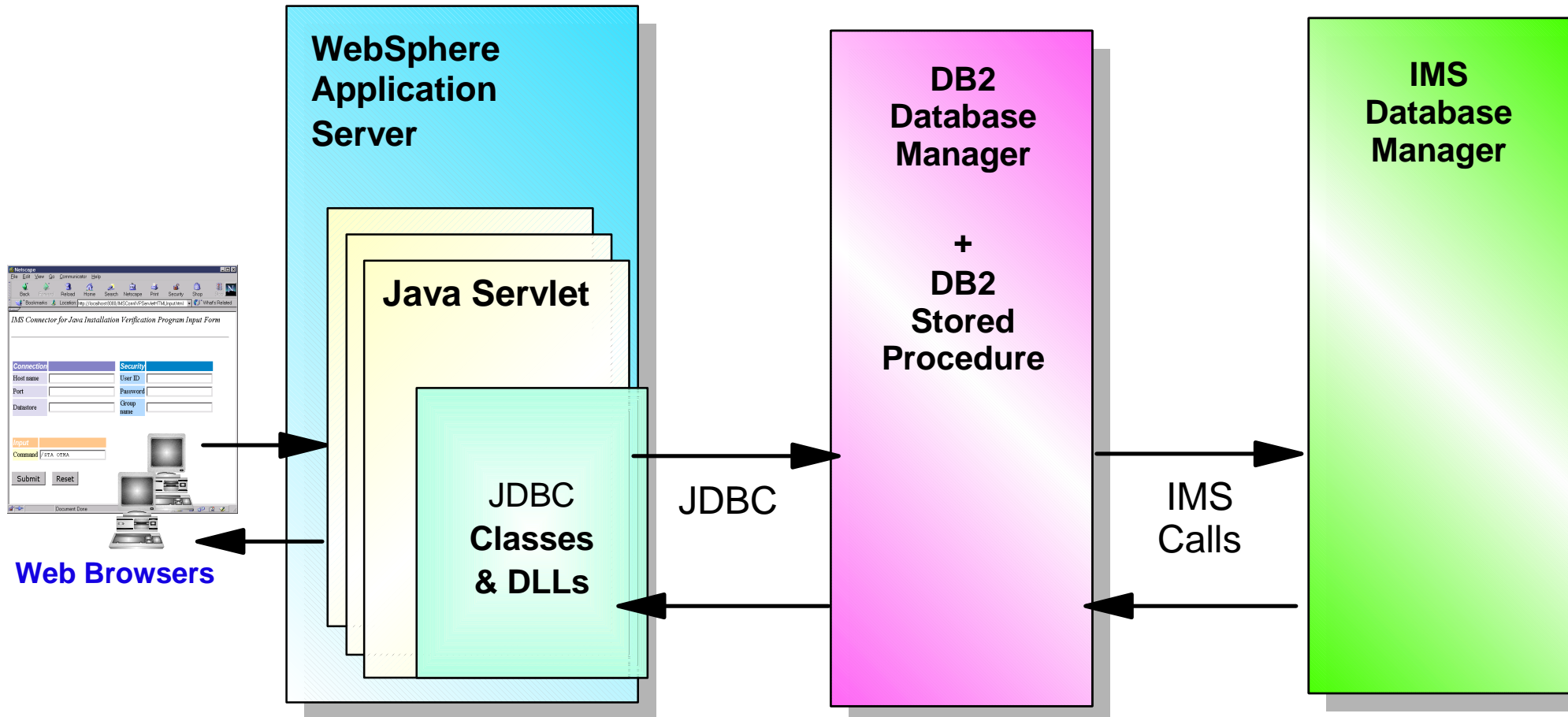
- IMS Connect
- IMS Connector for Java
- XML

## ▲ JDBC access to IMS Databases

- On OS/390: CICS, DB2 Stored Procedures, Websphere
- On any platform: using a DB2 Stored Procedure gateway

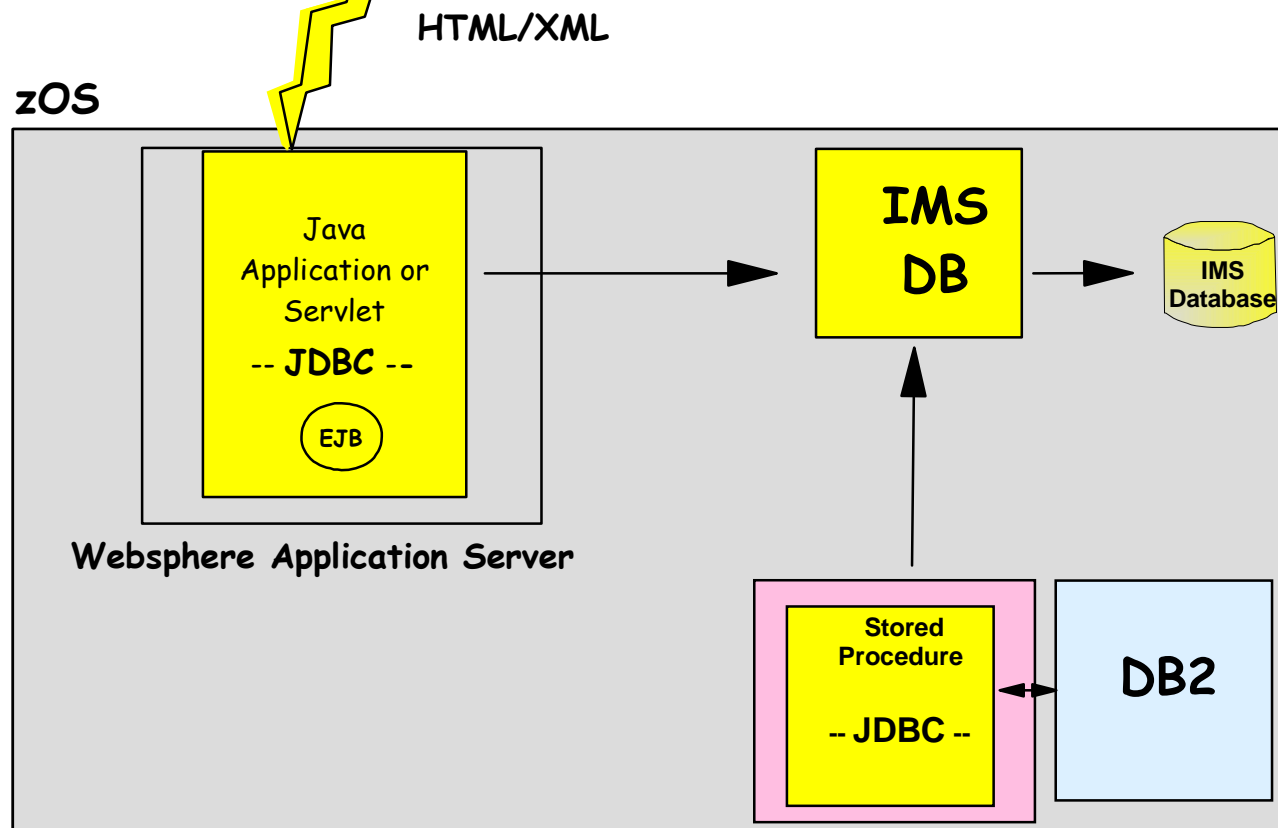


# JDBC to DB2, DB2 to IMS



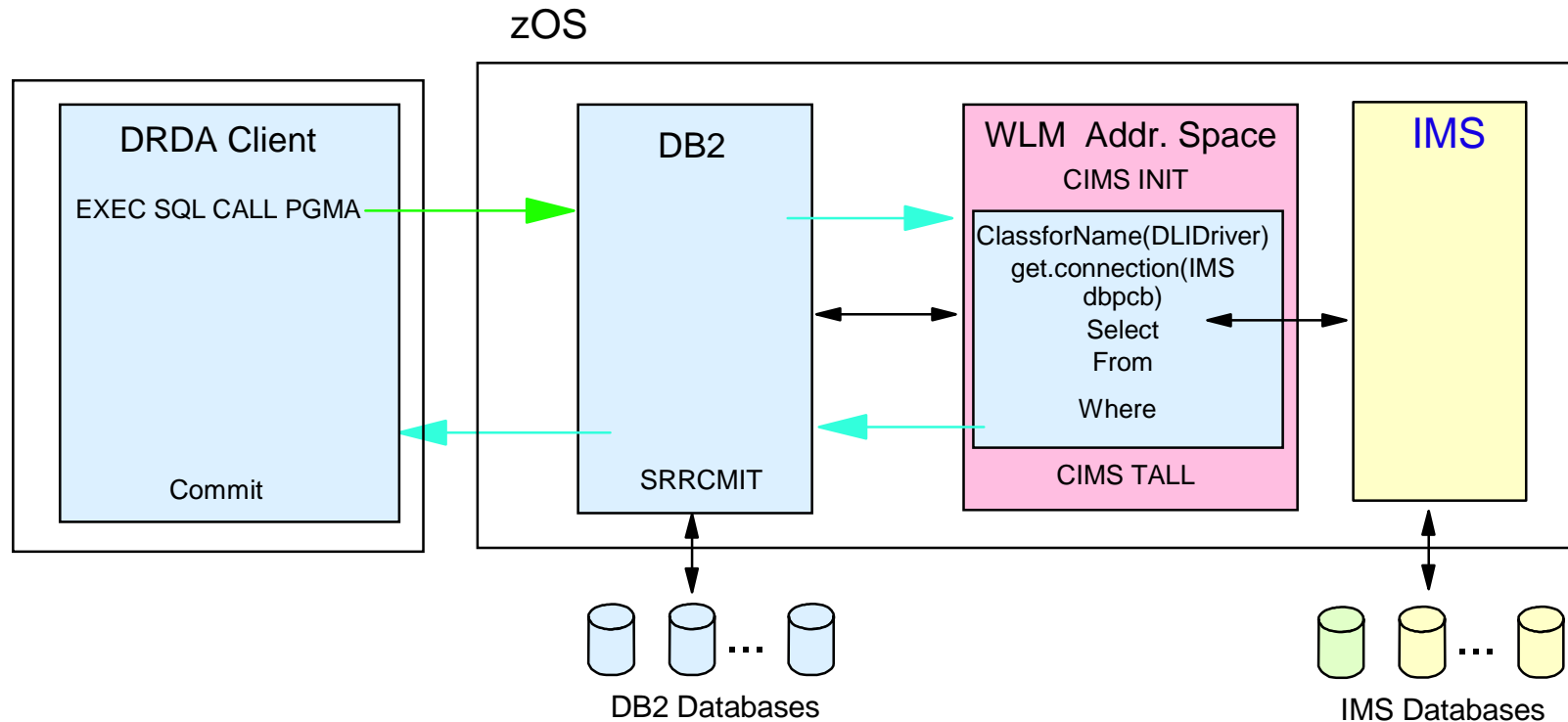


- JDBC access to IMS data from
  - Websphere
  - CICS
  - DB2 Stored Procedures



# DB2 Stored Procedure Example

Using IMS V7 Java Classes JDBC interface



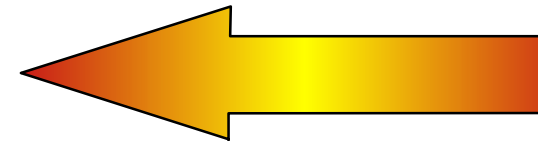
## DB2 Java stored procedure example

- IMS Java Classes can be used to access IMS DB

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# IMS Data Propagation - The Basics



## ▲ Program Number

- License Product ID: 5655-E52
- Subscription and Support Product ID: 5655-E53

## ▲ Replacement for IMS Data Propagator V2R2

- Product: 5696-705
- End of Service: 30/04/2003

## ▲ Current Version 3

- Available 05/10/2001

## ▲ IMS Versions Supported

- V6, V7, V8

## ▲ IMS DataPropagator for z/OS Concepts

- SC27-1544

### The IBM Replication Suite

#### *IBM Data Refresher*

(5696-703)

MLC Product

#### *IMS Data Propagator*

(5655-E52)

#### *DB2 Data Propagator*



# IMS Data Propagator - Functions at a glance

- ▲ **Renamed from DPROPNR**
  - Data Propagator Non Relational
  
- ▲ **Maintains consistency between two copies of the same data, where one copy of the data is stored in an IMS Database Manager (IMS DB) database and the other is stored in a DB2 database on OS/390**
  
- ▲ **Types of Propagation**
  - Synchronous propagation
    - At the time of update
    - Within the same unit of work (UOW)
  
  - Asynchronous propagation
    - At some time after the update
    - Independent of the update
    - Guaranteed delivery of update

V1 R1	1991	■ IMS → DB2 (Synchronous)
V1 R2	1993	■ IMS ← DB2 (Synchronous)
V2 R1	1995	■ IMS → DB2 (Asynchronous)
V2 R2	1997	■ MVS Sysplex Support ■ IMS & DB2 Data Sharing ■ IMS V6 and V7 Support
V3 R1	2001	■ IMS → DB2 with MQSeries
Future		■ <i>IMS → IMS with MQSeries</i> ■ <i>CICS DBCTL Support</i>

# IMS Data Propagator Uses

## ▲ Data Middleware

- User access to stable data
- Propagate only the data of interest
- Exploit relational technology for query

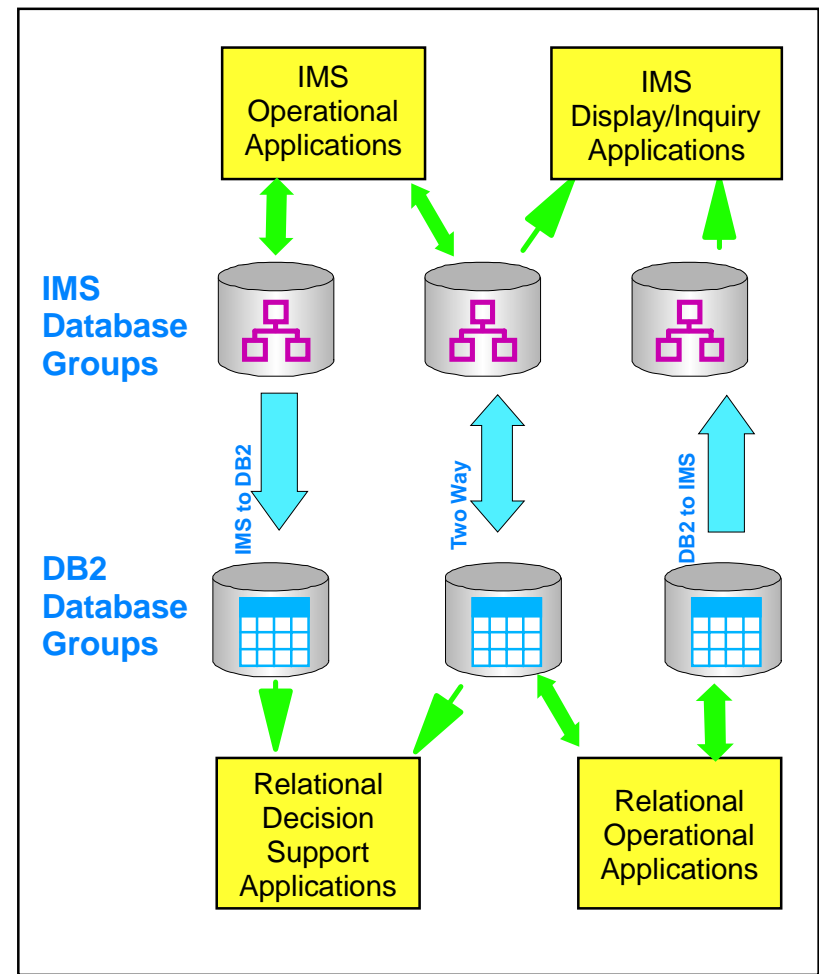
## ▲ Application co-existence

- Two masters
- Data in both systems synchronized

## ▲ Application Migration

- Gradual, orderly migration
- Minimal risk

**No Change to Existing Applications**





# Example: Building the Relational Base

## ▲ Making IMS operational data available in a relational environment

### ➤ Copying data to the DB2 Tables

Point in time copies of IMS application data

*Using an application program*

*Using IBM Data refresher*

Conversion/setup for propagation of changed data

### ➤ Capturing changed data

Capturing changes to IMS application data

Data transformation

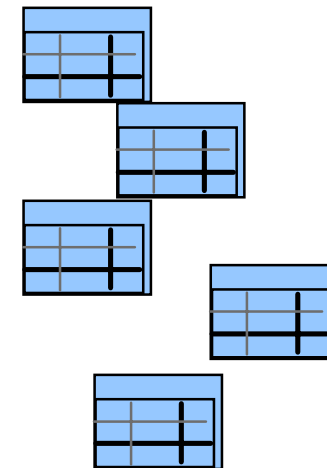
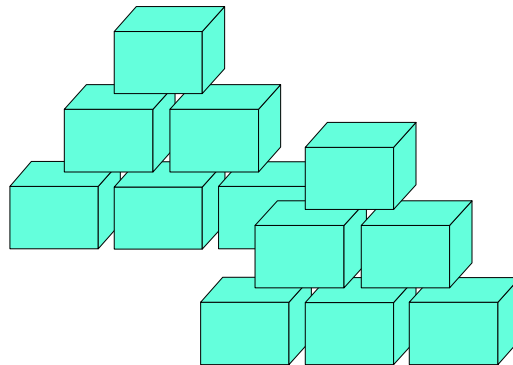
*mapping*

*data types*

Moving to relational environment

### Operational Data

Application Oriented  
Limited Integration  
Constantly Updated  
Current Values Only  
Supports Daily Operations



### Informational Data

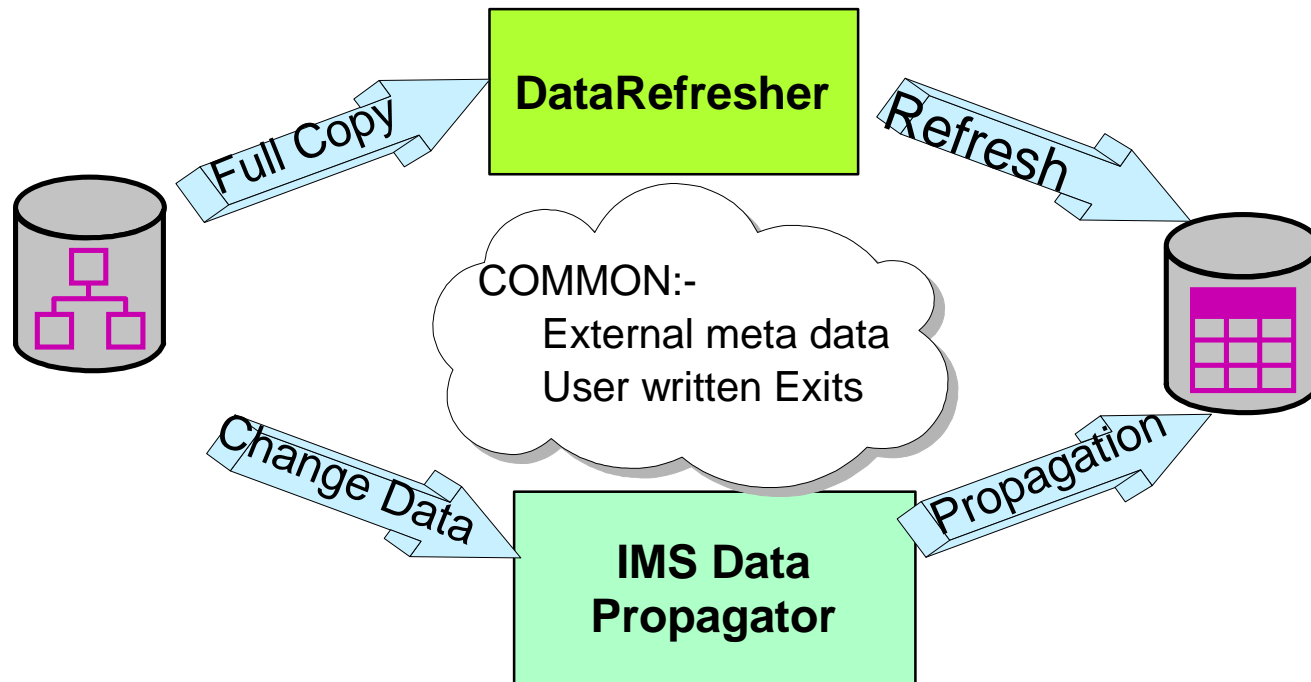
Subject Oriented  
Integrated  
Non-volatile  
Values Over Time  
Supports Decision Making

# Example: Building the Relational Base ...



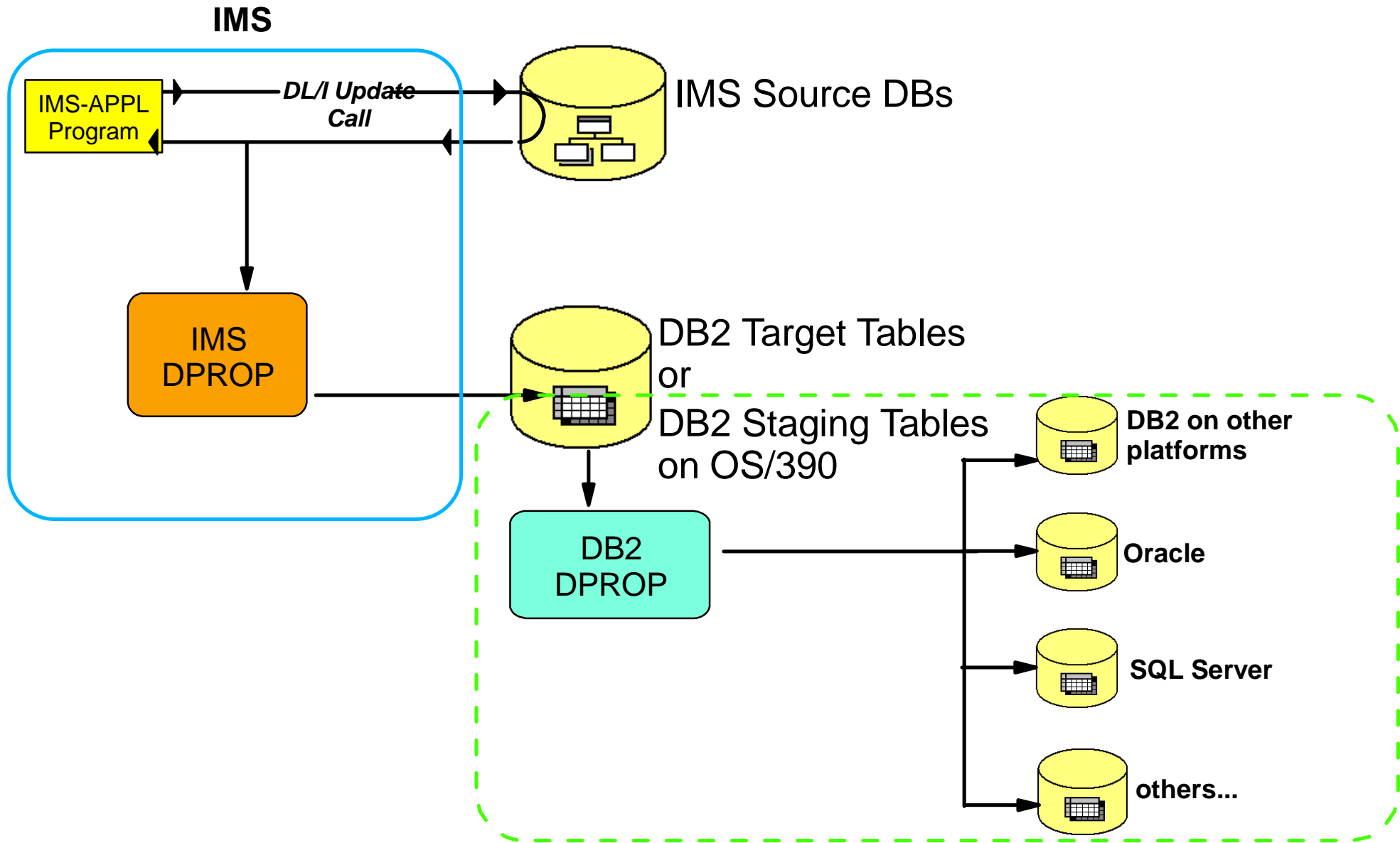
## ▲ IBM Data Refresher

- Build informational databases on the DB2 family
  - From any data source on OS/390
- Heterogeneous join across sources
- Eliminate extract application development and maintenance
- Data enhancement





# Example: Building the Relational Base ...

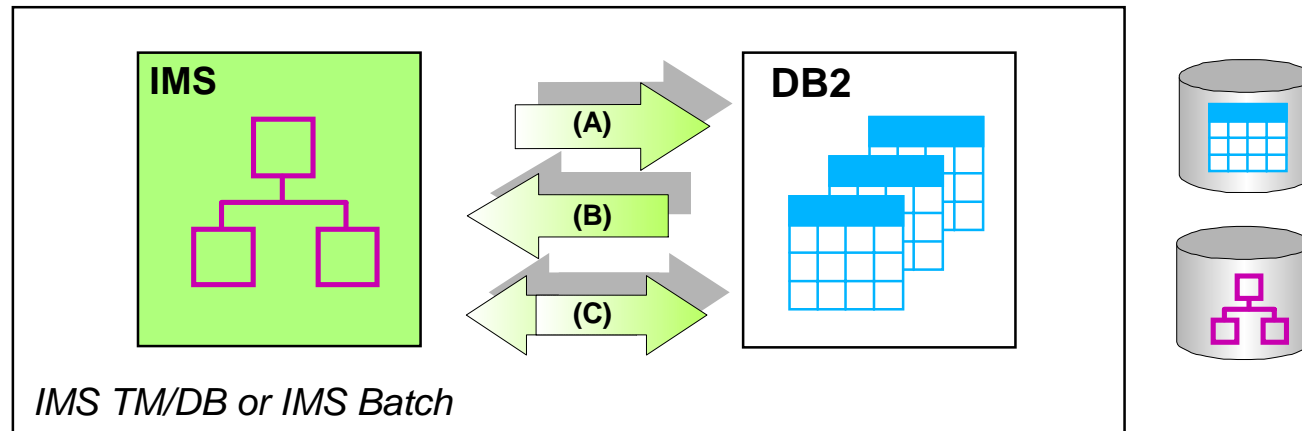


# Synchronous Propagation Mode



## ▲ Updates from

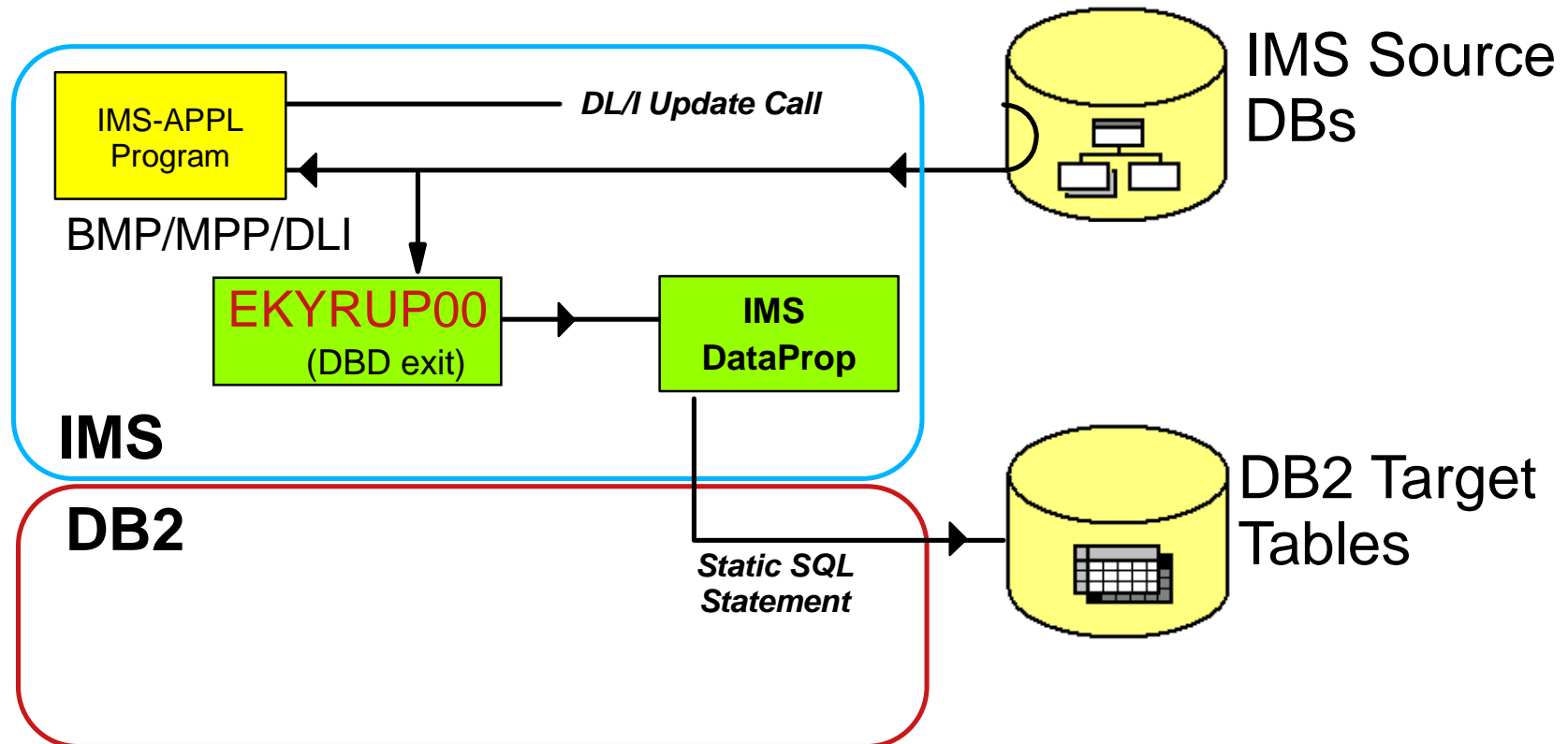
- IMS TM  
MPP, IFP or BMP
- IMS Batch
- No DBCTL support yet



## ▲ Source updates propagated to target copy within commit scope of updating application

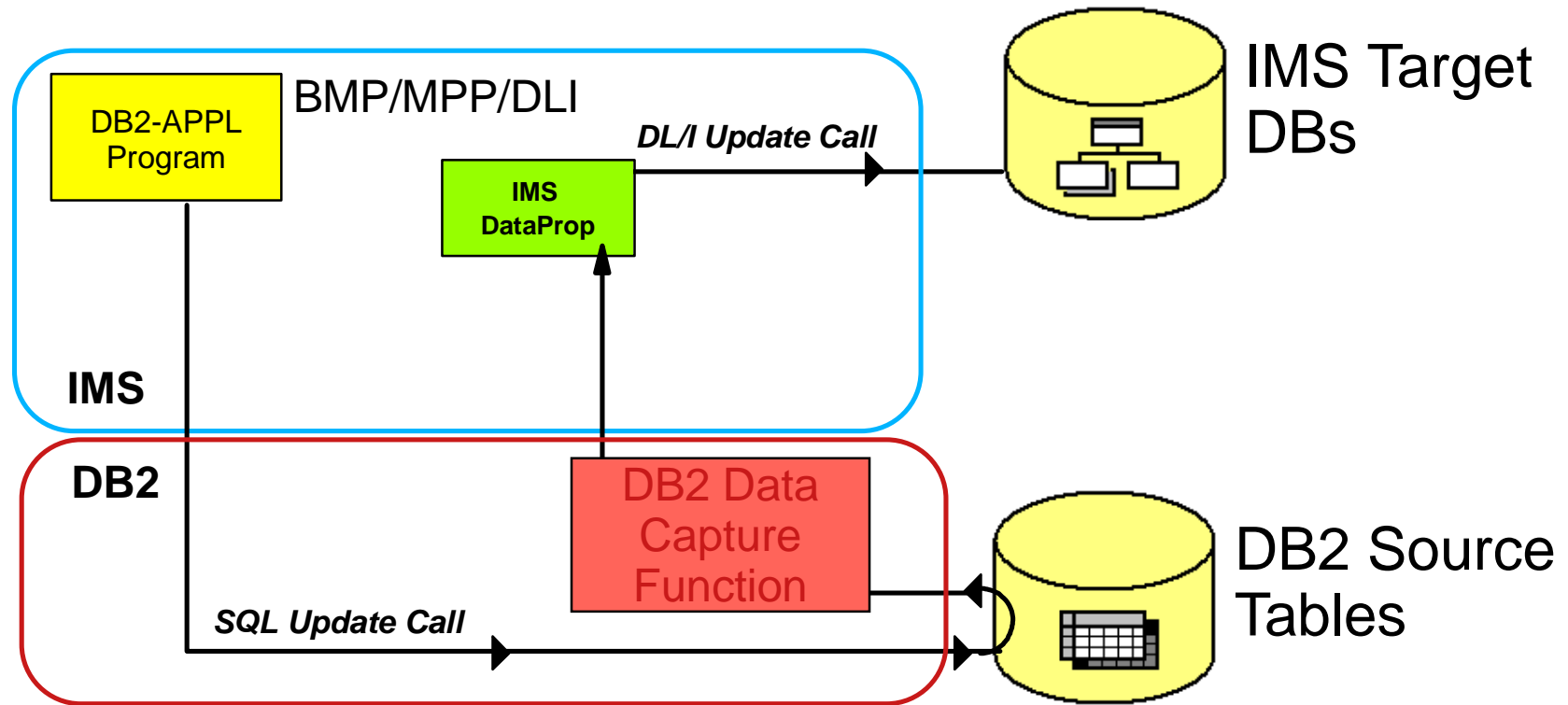
- IMS and DB2 must reside on same OS/390 image
- Consistent copy of source data  
Failure of one update, "backs out the other"
- Updates available in real-time  
DLI updates waits on the DB2 update to process before returning to application program
- Additional system overhead at peak times

# Synchronous Propagation Mode - IMS to DB2



```
DBD NAME=IVPDBASE, ACCESS=(HDAM,OSAM),  
RMNAME=(DFSHDC40,5,4),  
EXIT=EKYRUP00, VERSION=DPROPIVP
```

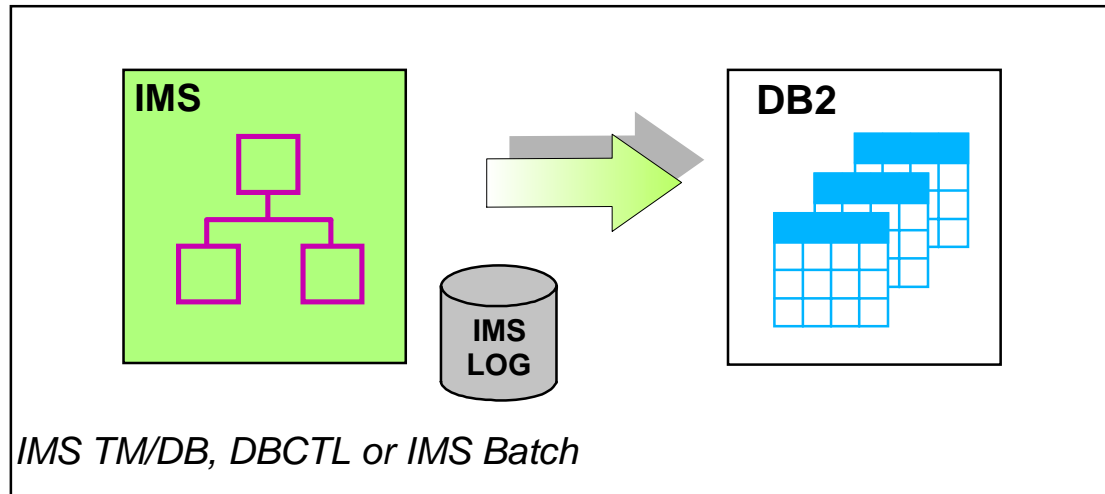
# Synchronous Propagation Mode - DB2 to IMS



# Asynchronous Propagation Mode

## ▲ Updates from

- IMS TM  
MPP, IFP or BMP
- IMS Batch
- CICS/DBCTL



## ▲ Source updates propagated to target copy at a later point in time

- IMS and DB2 on same or different z/OS image
- Segment updates selected from IMS Log
- Point-in-time consistency between source and target
- Updates selected and applied to target under installation control

# *Asynchronous Propagation Mode ...*

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## **▲ Capture changes made to data in IMS database segments**

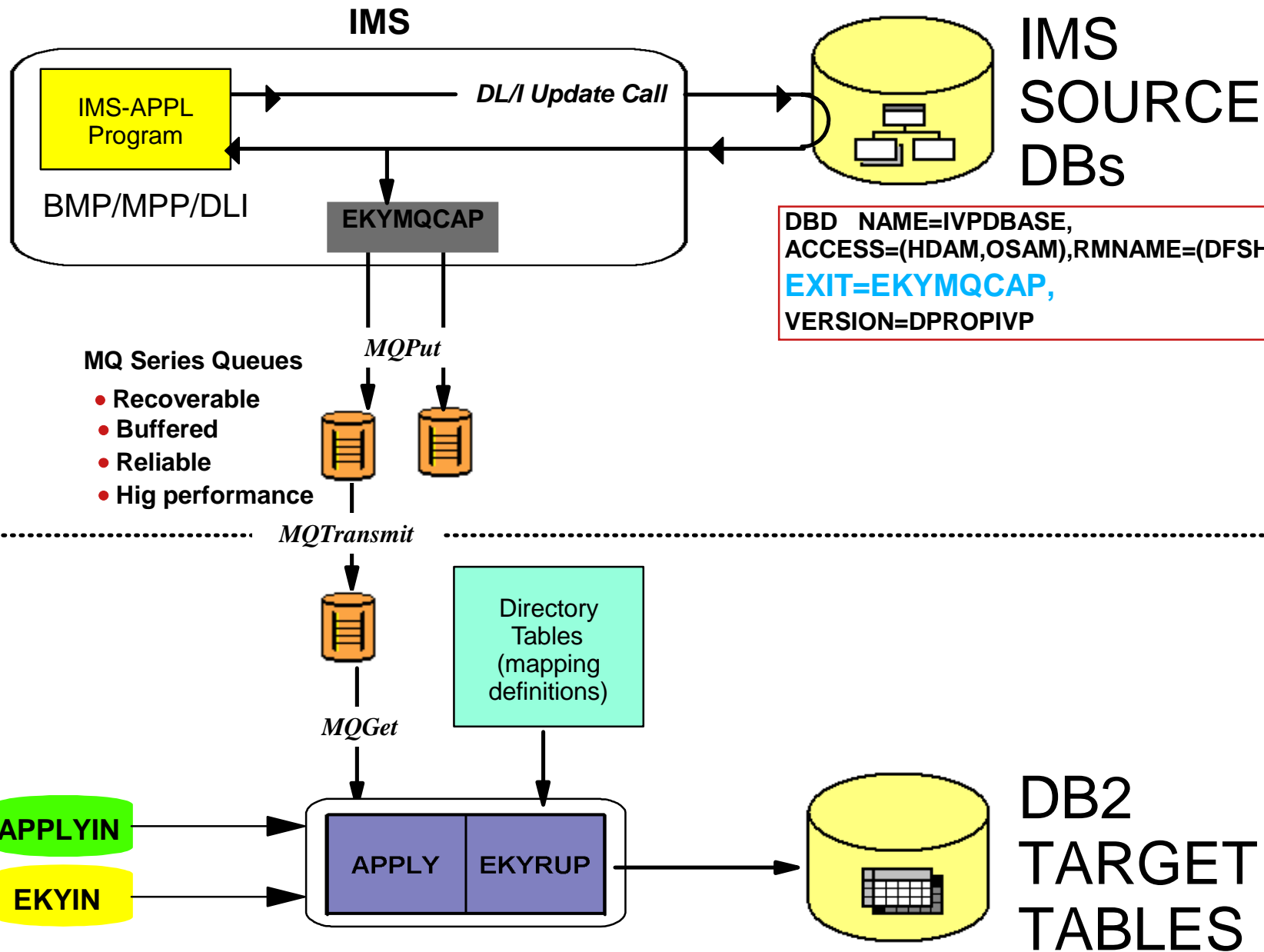
- only application data changes
  - No IMS prefix changes
- BMP, MPP or DLI address spaces
- CICS support if Log asynchronous propagation

## **▲ Selectively process those changes**

- At some time after the update
- Independent of the update
- Guaranteed delivery of update
- Transform them to DB2 format
- Apply to DB2 tables
  - Application tables
  - Staging tables



# Asynchronous, near-real-time, MQSeries based propagation



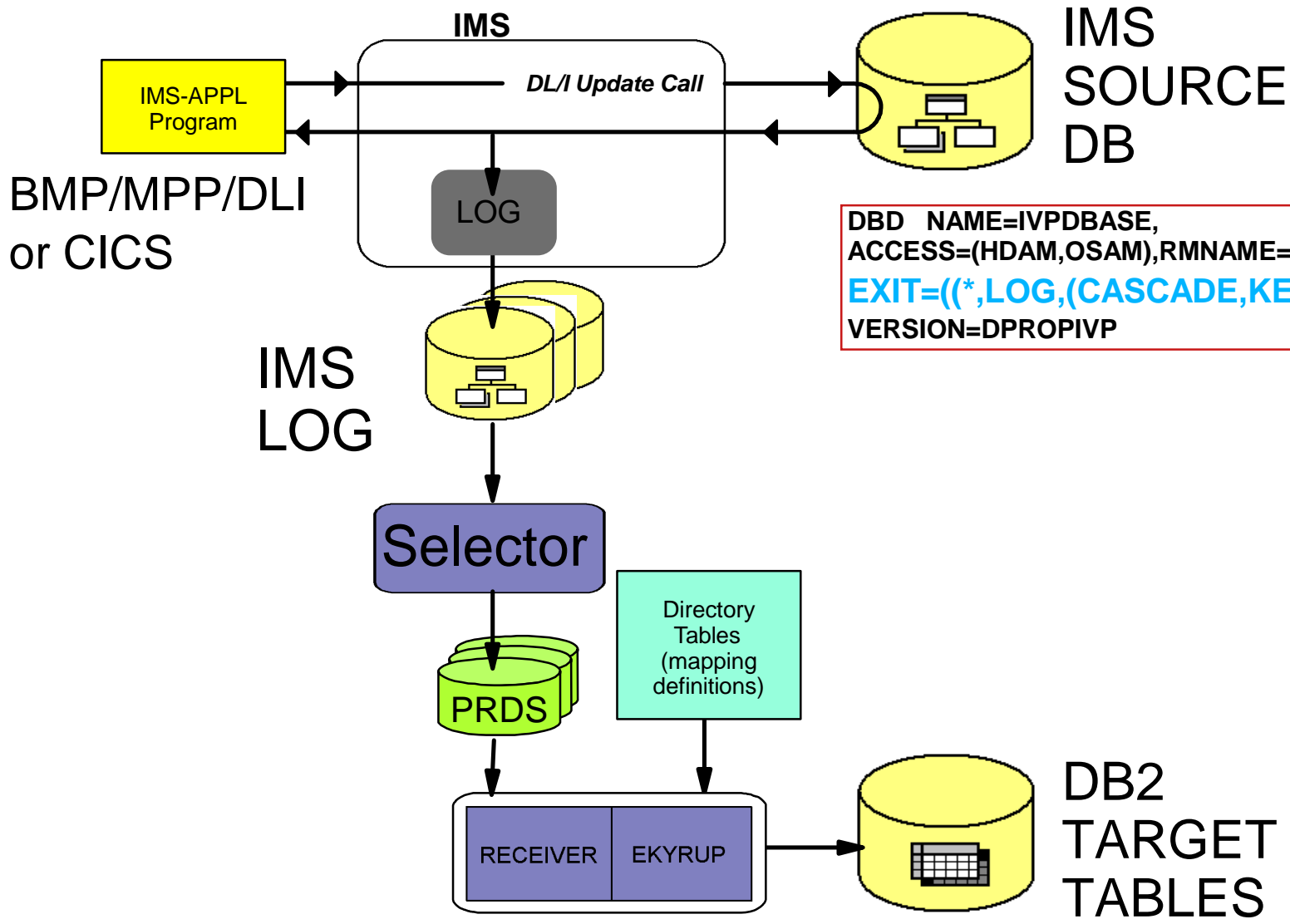
# *Asynchronous, near-real-time, MQSeries based propagation*



## ▲ **Advantages of MQ-ASYNCH**

- Supports "near real time" propagation  
short delay between update of source DBs by application programs and update of target DBs
- Supports (like Log-Asynch) a point-in-time propagation
- Simpler for the the customer to operate and administer  
No more a large number of file processing and file transmission  
No more a plethora of esoteric utilities
- Designed for high performance, high quality and robustness
- Uses IMS commit coordination on MQSeries resources  
The MQ Messages written by EKYMQCAP are part of the same UOW as the DB-updates of applications  
MQ messages are kept on source system queue until commit of the application  
After the commit, messages made available  
MQSeries can transmit the messages to their destination  
Messages readable on this MQSeries system

# Asynchronous, log-based propagation



```

DBD NAME=IVPDBASE,
ACCESS=(HDAM,OSAM),RMNAME=(DFSHDC40,5,4),
EXIT=((*,LOG,(CASCADE,KEY,DATA,NOPATH))),
VERSION=DPROPIVP
    
```



# Asynchronous, log-based propagation

## ▲ Features of LOG-ASYNCH

- Supports Propagation from all IMS environments
  - IMS MPP, BMP and DLIBATCH processing
  - CICS updates supported
  - Supports updates in all data sharing environments
- Merges all required log files into time sequence
  - Change Accumulation not required
  - Different timing available for databases or applications
    - priority sequencing of critical data*
    - "End of business day" or continuous propagation*
- Batches updates
  - Only processes SLDS data sets (batch or archived OLDS)
  - Typically at least an hour behind application updates
    - frequency of OLDS archive*
    - amount of data to propagate*



## ▲ Mapping and Design

- Identify the propagated data to IMS DPROP
  - IMS data for IMS-to-DB2 propagation
    - DBD changes*
  - DB2 data for DB2-to-IMS propagation
    - DB2 ALTER TABLE*
- Specify the mapping
  - Using the Map Capture Exit (MCE) - Data refresher exit provided by IMS DPROP
  - Using the Mapping Verification and Generation (MVG) utility provided by IMS DPROP
    - IMS DPROP or any DB2 application updates the MVG DB2 **input** tables.*
    - Output** of MVG utility is a Propagation Request stored in the IMS DPROP directory*

## ▲ Setup

- Adjust IMS and DB2 systems
- Extract and load the data for the first time
  - Consistent starting point for propagation

## ▲ Propagation

## ▲ Maintenance and control

- Optional tasks
  - Consistency Check Utility (CCU)
  - Audit trail and trace analysis

# IMS DPROP Phases - Mapping and Design



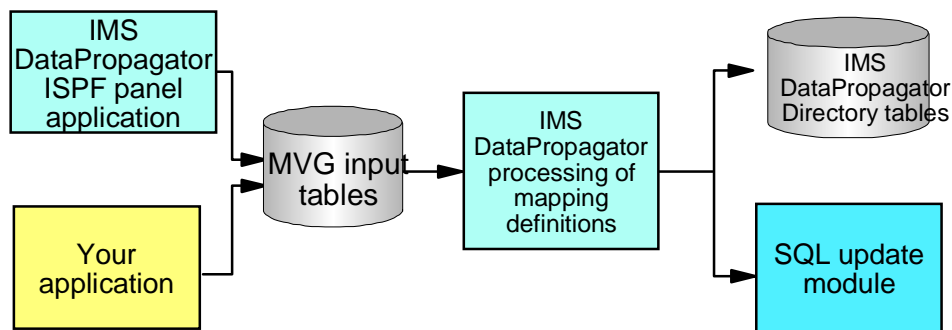
## Specify the mapping

- Using the Map Capture Exit (MCE) - Data refresher exit provided by IMS DPROP
- Using the Mapping Verification and Generation (MVG) utility provided by IMS DPROP  
IMS DPROP or any DB2 application updates the MVG DB2 *input* tables.  
**Output** of MVG utility is a Propagation Request stored in the IMS DPROP directory tables in DB2 for zOS

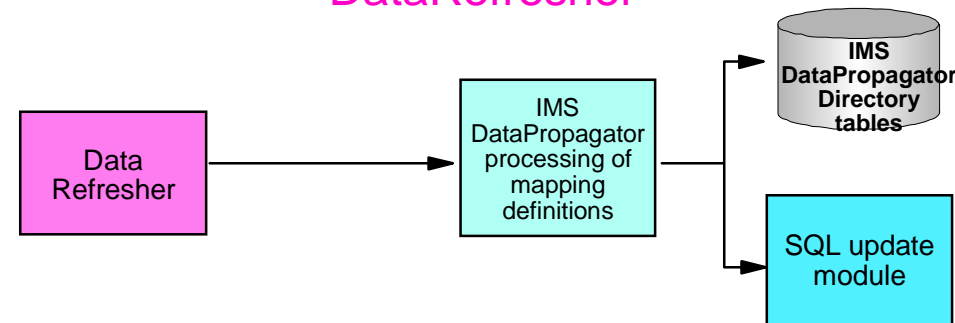
## A propagation request specifies how a segment is to be propagated

- including transformation

### Defining the mapping using IMS DataPropagator



### Defining the mapping using DataRefresher



# Data Mapping



## ▲ Propagated data must be mapped from IMS to DB2 format

- IMS DBDs and DB2 tables must exist prior to mapping definition

## ▲ Need to define

- Key fields, columns identifiers
- Data fields, columns subset
- Mapping parameters structure conditions

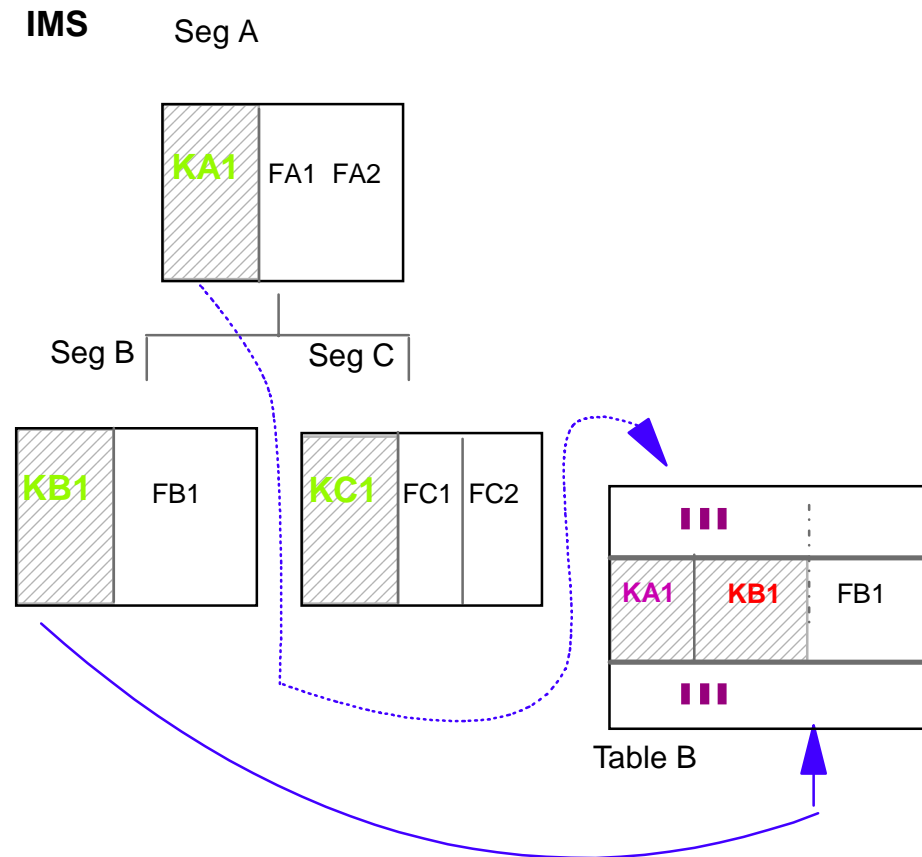
IMS	DB2
Segment	Table
Field	Column
Segment Occurrence	Row
Parent/Child Relationship	RIR

# Data Mapping - Mapping Case 1

▲ Data is mapped from a single hierarchical path down to a particular segment

- This segment is called the "entity segment"
- The following fields can be mapped
  - All key fields from the entity segment up to the root segment
  - All nonkey fields from the entity segment

## IMS DProp Mapping Case 1



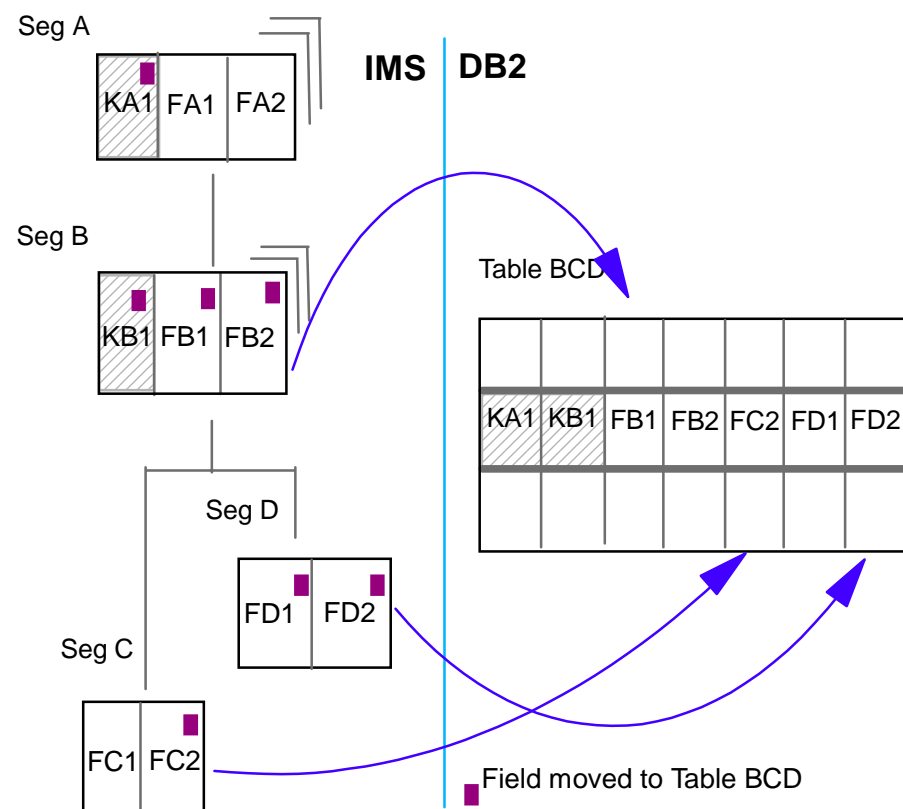


# Data Mapping - Mapping Case 2

▲ Data is mapped from a single hierarchical path down to a particular segment and from any immediate subordinate segment

- This subordinate segment is called the "extension segment"
- The extension segment may have zero or one occurrence per entity segment
- The following fields can be mapped
  - All key fields from the entity segment up to the root segment
  - All nonkey fields from the entity segment
  - Any fields from one or more extension segments

## IMS DProp Mapping Case2



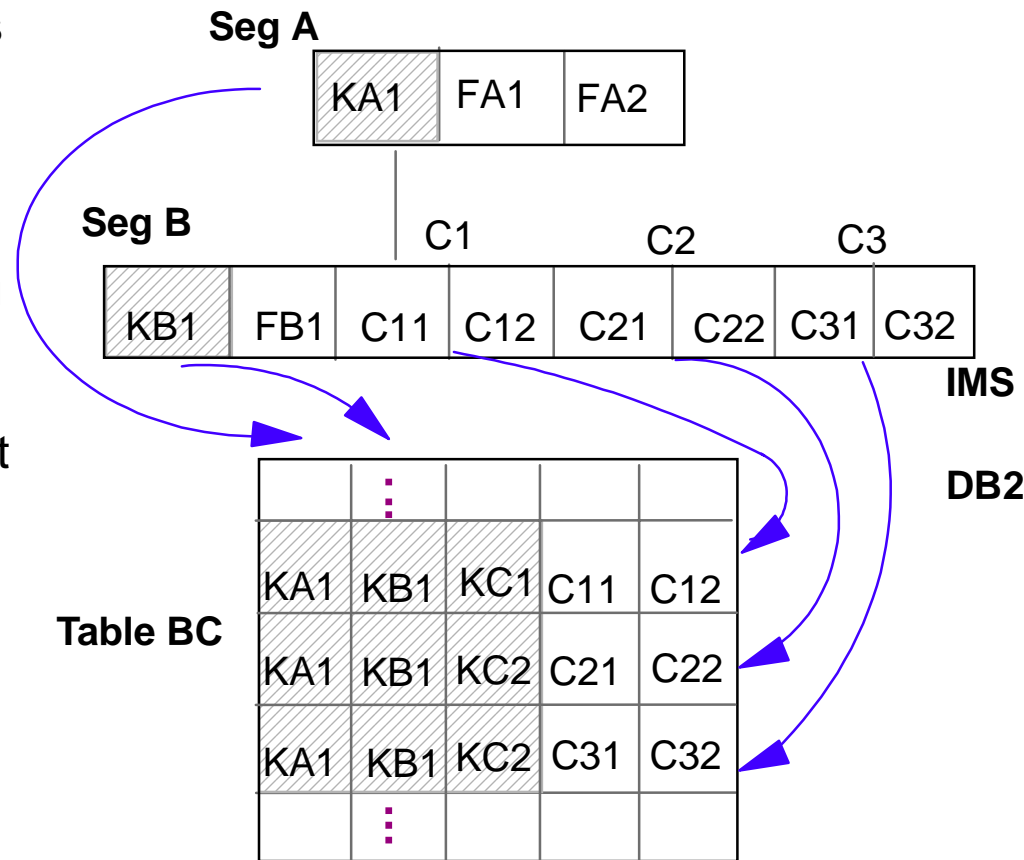
# Data Mapping - Mapping Case 3



▲ Embedded structures are mapped from a single hierarchical path down to a particular segment

- An embedded structure is a group of fields
- A structure may occur more than once within a segment
- These structures are called internal segments
- The IMS segment is called the **containing segment**
- The following fields can be mapped
  - All key fields from the containing segment up to the root segment
  - Any fields from the internal segment

## IMS DProp Mapping Case 3



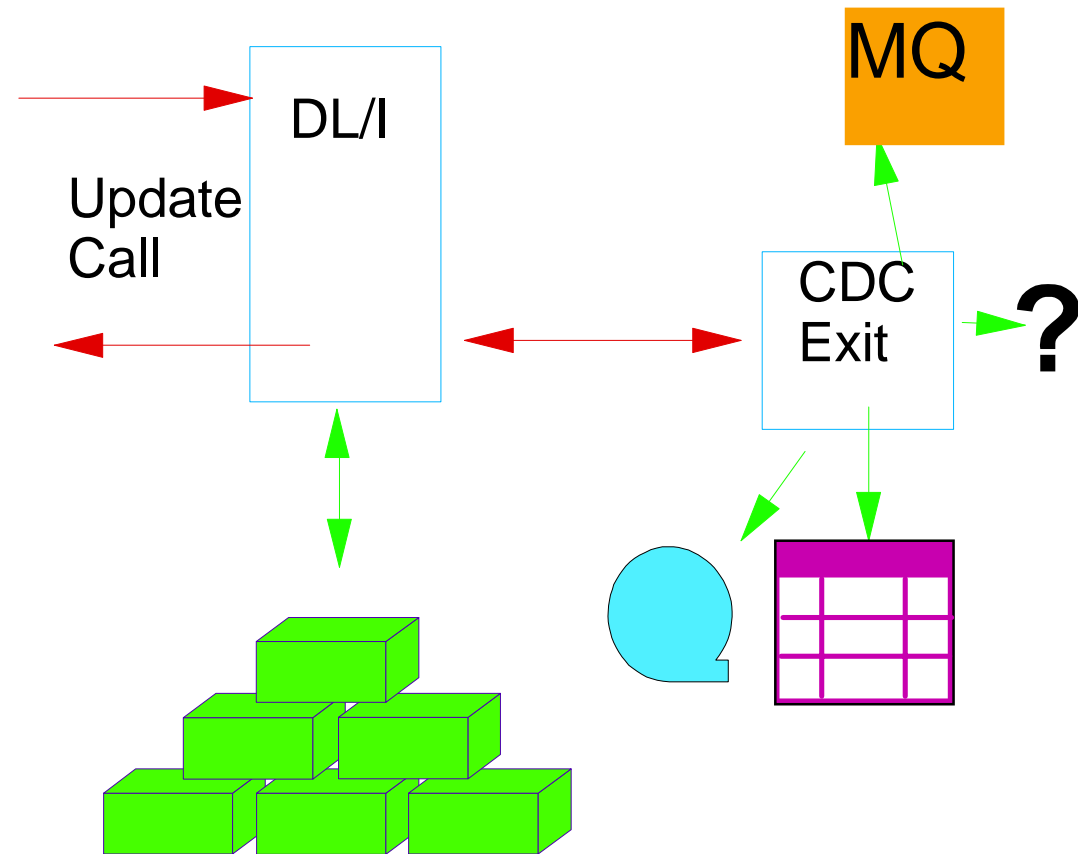
# IMS Changed Data Capture Exit

## ▲ DBD Changes

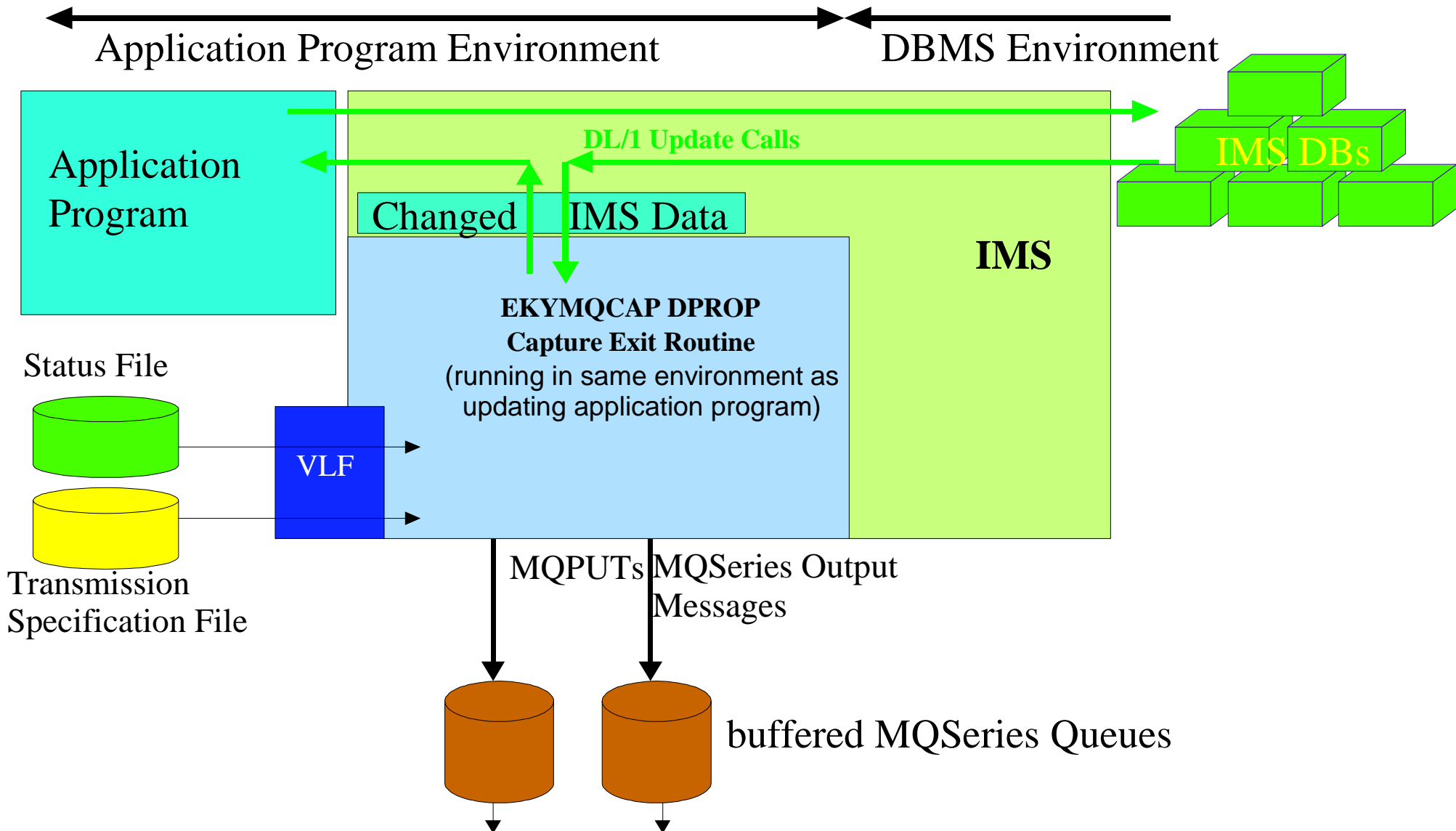
- EXIT=xxxxx
- At DATABASE or SEMENT level

## ▲ Where go the Changes?

- X'9904' records on IMS Log  
Asynchronous propagation
- IMS DataPropagator applies changes  
Synchronous propagation
- MQSeries Change Data Capture exit  
MQ-ASync propagation
- User-written exit  
????



# MQSeries Propagation - Change Data Capture Exit



# MQSeries Propagation - Change Data Capture Exit



## ▲ Application program must be in an IMS address space

- BMP
- MPP
- DLIBATCH (RRS used)

## ▲ EKYMQCAP runs in same address space

- transparent to updating application programs
- operates in the same environment
- same Unit-of-Work as the updating application programs

## ▲ Main input to capture exit routine

- Changed IMS data and segment information
- Status file
- DBA-provided transmission specifications
- Usual DPROP option file - //EKYIN DD statement  
PROP OFF or PROP LOAD  
*activation or deactivation of propagation*  
TRACE  
TRDEST

## ▲ Main output from capture exit routine

- MQSeries messages containing the changed IMS data



# MQSeries Propagation - Apply program

## ▲ Inputs

- Each Apply processes one MQ input queue.
- Each MQ input queue is processed by only one Apply Program.  
This is to preserve the FIFO sequence of the source DB updates
- Apply uses the MQSeries 'signal option'  
When trying to read a message and the input queue is empty  
*Apply will go into wait*  
*Will be posted by MQ when a message arrives.*  
*Maximal wait time: n seconds.*

## ▲ Outputs

- Updated DB2/390 Target Tables
- Error Table  
DB containing changes that could not be applied (e.g. a 'Replace' of non-existing row)
- Event Marker Table
- Statistics
- Traces

# MQSeries Propagation - Apply program



## ▲ Event Markers/ Point-In-Time propagation

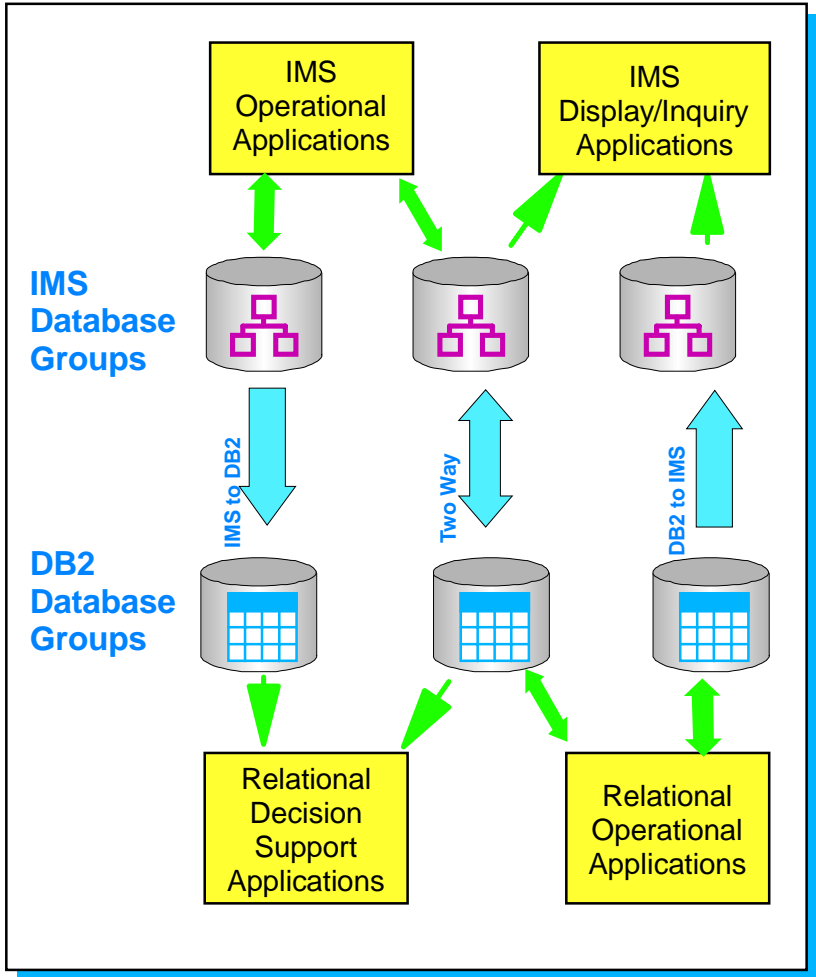
- To identify to MQ-ASYNCH a source-system 'event'
  - Logical end of a business day
  - Completion of a monthly jobstream
  - Execute the CUT on the source system, at the time where the event happens
  - With CUT CTL statements, the user assigns an 'Event Marker ID' to the event.
  
- The CUT will create a MQSeries message that will be transmitted in First-In First-Out sequence to the Apply together with all other MQSeries messages
  
- The Apply program can be instructed
  - Via CTL Statements
  - To stop its processing when reading a MQSeries message containing an 'Event Marker' with a specific 'Event Marker ID'
  - After stopping, the content of the target tables will reflect the content of the source IMS DBs at the Point-in-Time of the identified event.

# IMS Data Propagator



- ▲ **Business Intelligence on IMS Production Data**
- ▲ **Application co-existence**
- ▲ **Application Migration**

**No Change to Existing Applications**  
**Synchronous or Asynchronous**  
**One way or Two way**

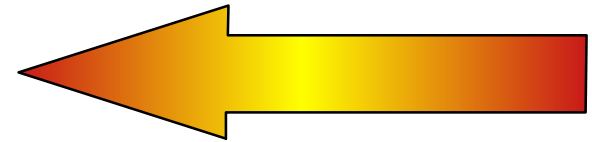




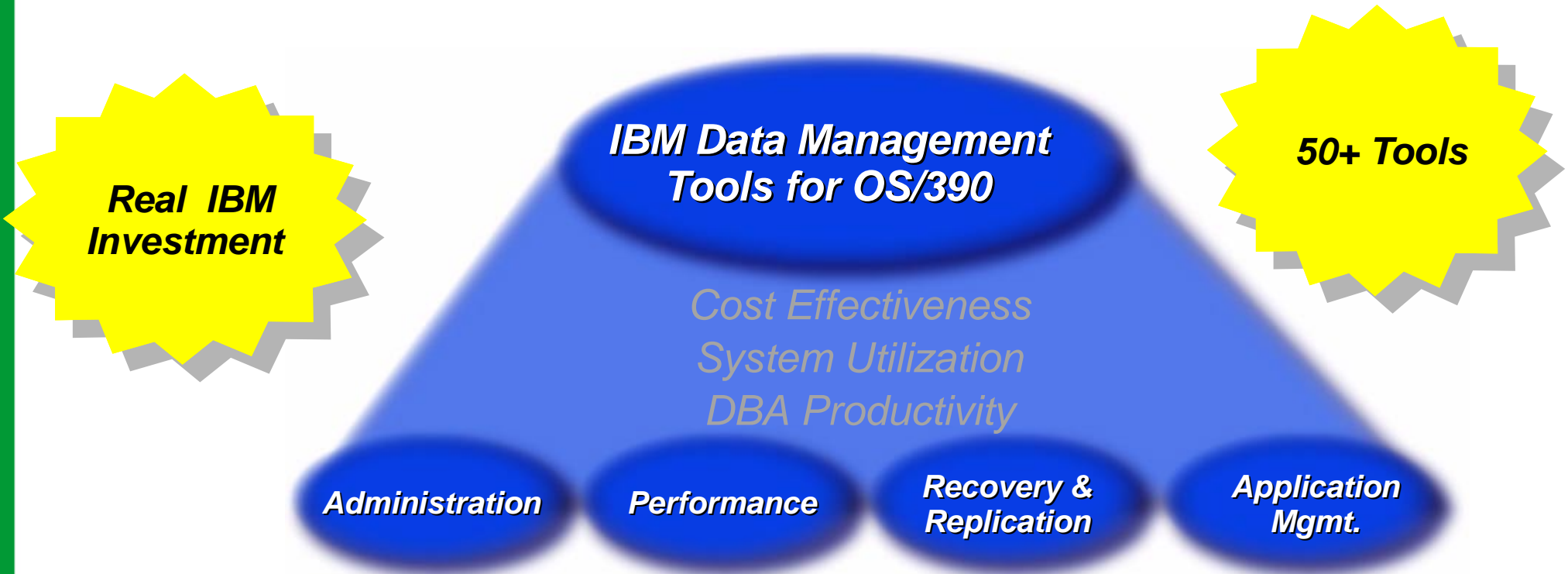
# Agenda



- ▲ **Access to DB2 from an IMS application**
  - External Subsystem Attach Facility (ESAF)
- ▲ **Access to IMS DB from a DB2 stored procedure**
  - ODBA since IMS V6
  - JDBC support with IMS Java in IMS V7
- ▲ **Propagation between the DB2 and IMS database managers**
  - IBM Data Refresher
  - IMS Data Propagator
- ▲ **The IBM Data Management Tools**



# IBM Data Management Tools



- ▲ **Significant IBM investments targeted at the growing tools market**
  - Development, marketing, sales, & support
- ▲ **New and enhanced suite of products**
  - Comprehensive capabilities
  - Affordable
- ▲ **Migration incentives, support and tailored financing offerings**

# IBM Data Management Tools ...



## ▲ Database Administration

- Increase DBA productivity
- Easily accomplish the tasks necessary to define and maintain database operations...
- With
  - DB2 Administration Tool
  - DB2 Forms
  - DB2 High Performance Unload
  
- IMS Fast Path Basic & Online Tools
- IMS High Performance Load, Unload
- IMS High Performance Change Accum.
- IMS Parallel Reorg

...and more

## ▲ IMS TM administration

- Efficient IMS TM system management
- With
  - IMS Queue Control Facility
  - ETO Support
  - Network Compression Facility

## ▲ Performance

- Bottleneck breaking insight
- Keep the subsystem environment operating at peak performance to maximize system utilization...
- With
  - DB2 Performance Monitor
  - DB2 Query Monitor
  - DB2 SQL Performance Analyzer
  
- IMS Performance Analyzer
  
- ...and more

## ▲ IMS System Administration

- Efficient IMS System management
- With
  - IMS High Performance Sysgen
  - IMS Command Control Facility
  
- ... and more

# IBM Data Management Tools ...



## ▲ Recovery and Replication

- Fast, easy recovery & improved availability
  - Make information available to support global audiences operating round the clock...
  - With
    - DB2 DataPropagator,
    - DB2 Recovery Manager,
    - DB2 Row Archive Manager
  
    - IMS DataPropagator,
    - IMS Online Recovery Services,
    - IMS DEDB Fast Recovery,
    - IMS Image Copy Extensions,
- ...and more

## ▲ Application

- Efficient application control
  - Easily synchronize the application and database environments to manage changing applications...
  - With
    - DB2 Bind Manager,
    - DB2 Web Query Tool
  
    - IMS Program Restart Facility,
    - IMS Connect,
- ...and more

# Providing IMS and DB2 Information on the Web



## ▲ DB2

➤ <http://www.ibm.com/software/data/db2>

## ▲ IMS

➤ <http://www.ibm.com/software/data/ims>

## ▲ IBM Database Tools for z/OS and OS/390

➤ <http://www.ibm.com/software/data/db2imstools>

## ▲ IMS Redbooks

➤ <http://www.redbooks.ibm.com/redbooks>

## ▲ S/390 Books

➤ <http://www.s390.ibm.com/bookmgr-cgi/bookmgr.cmd>

