



E09

Using IMS and DB2 Together

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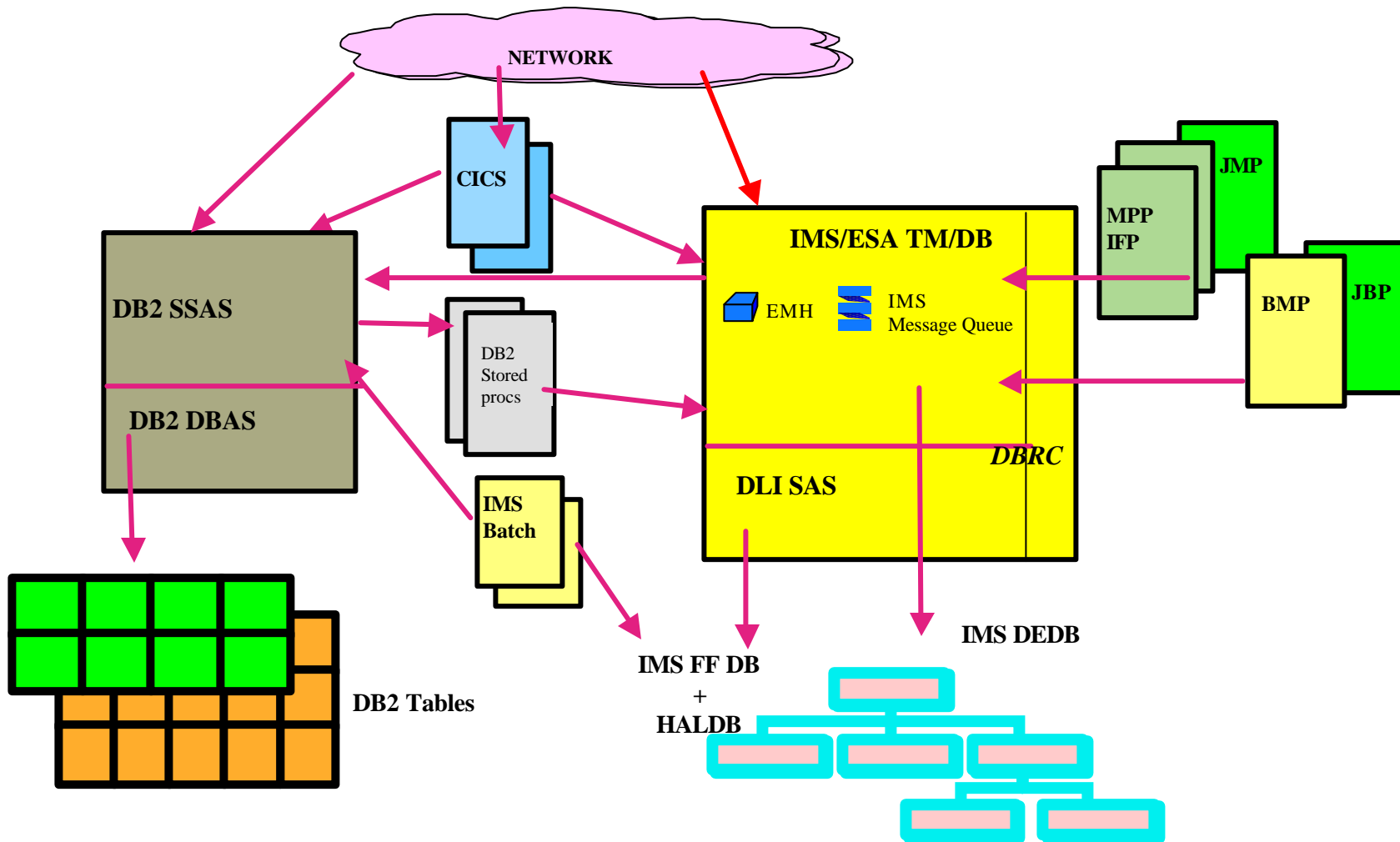


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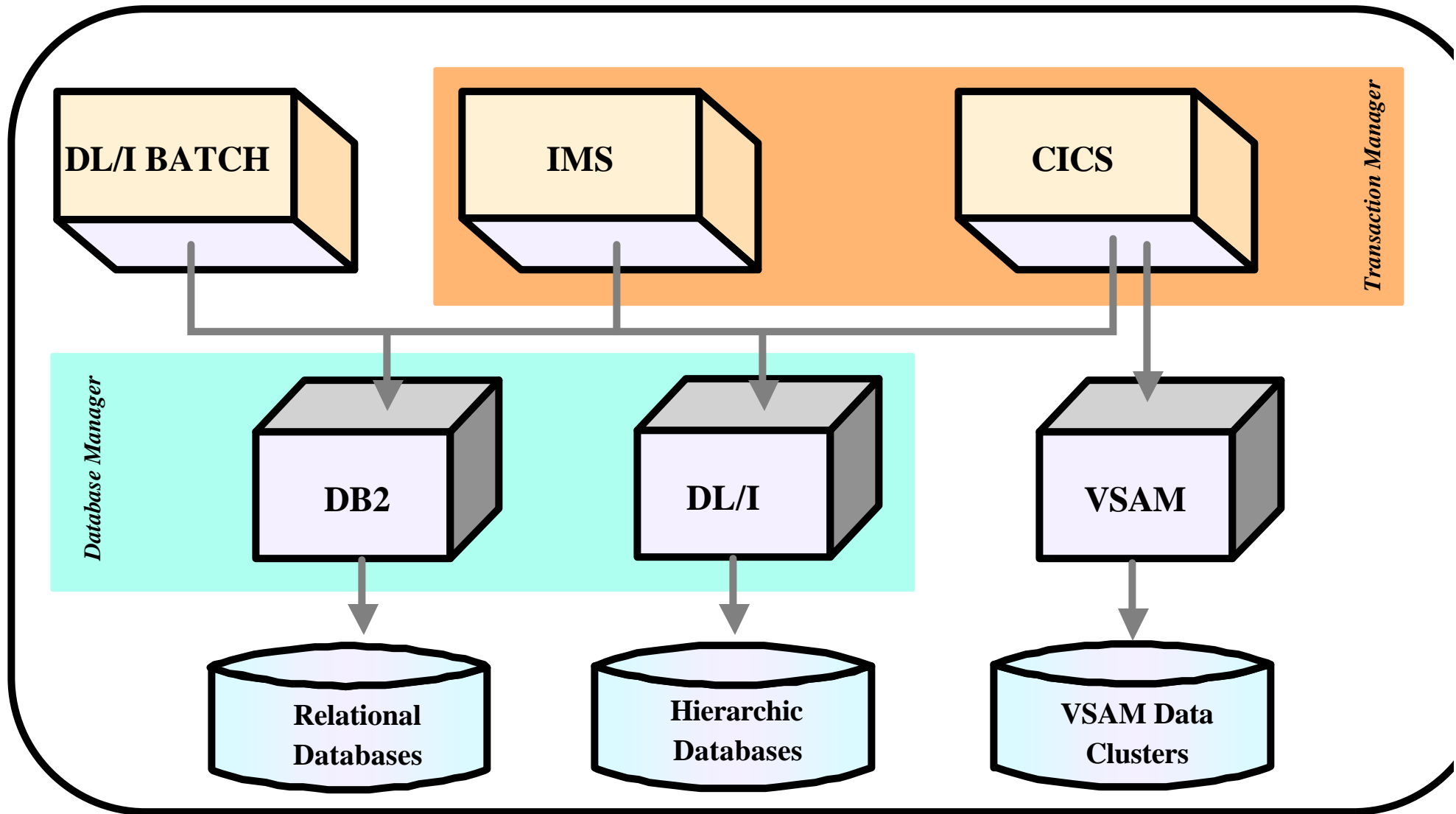


z/OS Transaction and Database Managers





z/OS Transaction and Database Managers ...



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
- DB2 Control Center as IMS V8 SPOC
- The IBM Data Management Tools



This session discuss how IMS and DB2 interacts together to provide a complete data management solution. The IMS Transaction Manager can execute application programs, which access DB2 tables (as well as IMS data), providing the ultra high performance/availability environment required in this rapidly changing world. We explain how the ESAF works. Using the JDBC interface the IMS Database can be accessed by DB2 Stored Procedures and other environments. We'll look at those capabilities based on the Open Database Access (ODBA) facility. It is time to learn this new access to IMS databases. This session will also highlight how the IMS Data Propagation (DPROP) 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

■ 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



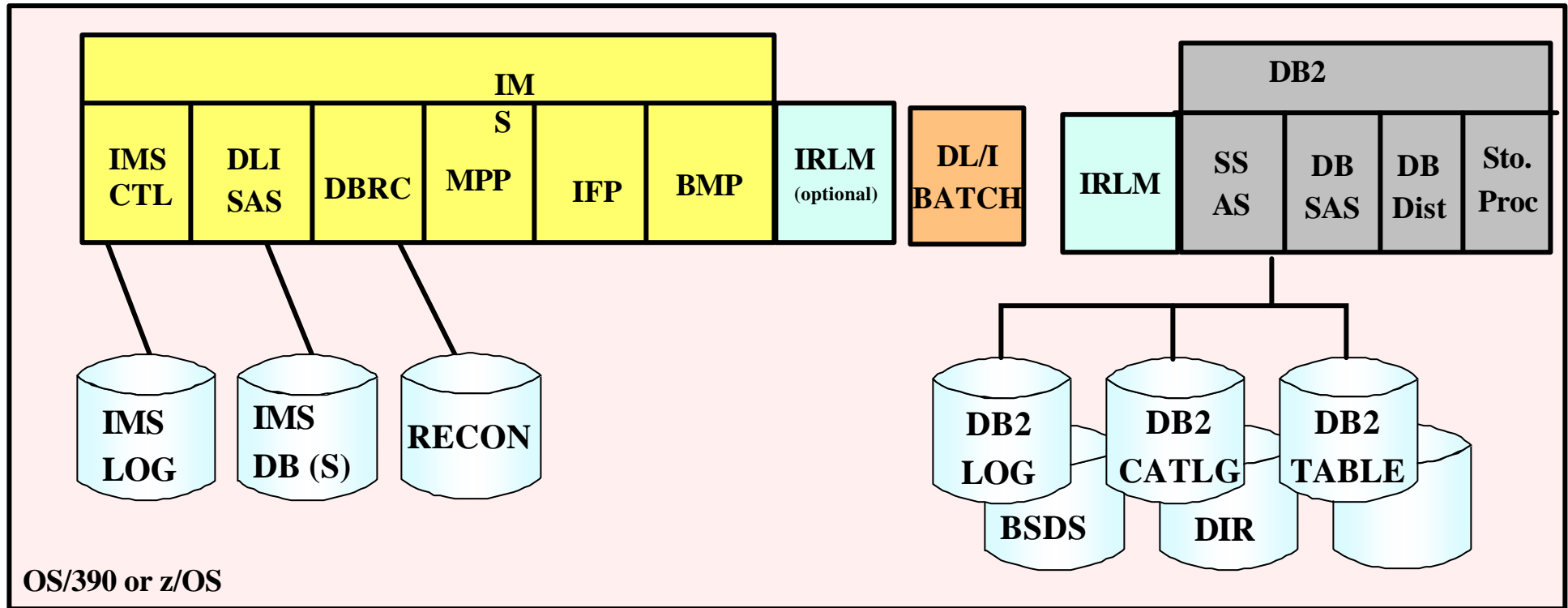


IMS DB2 Subsystem Attachment Facility

- 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



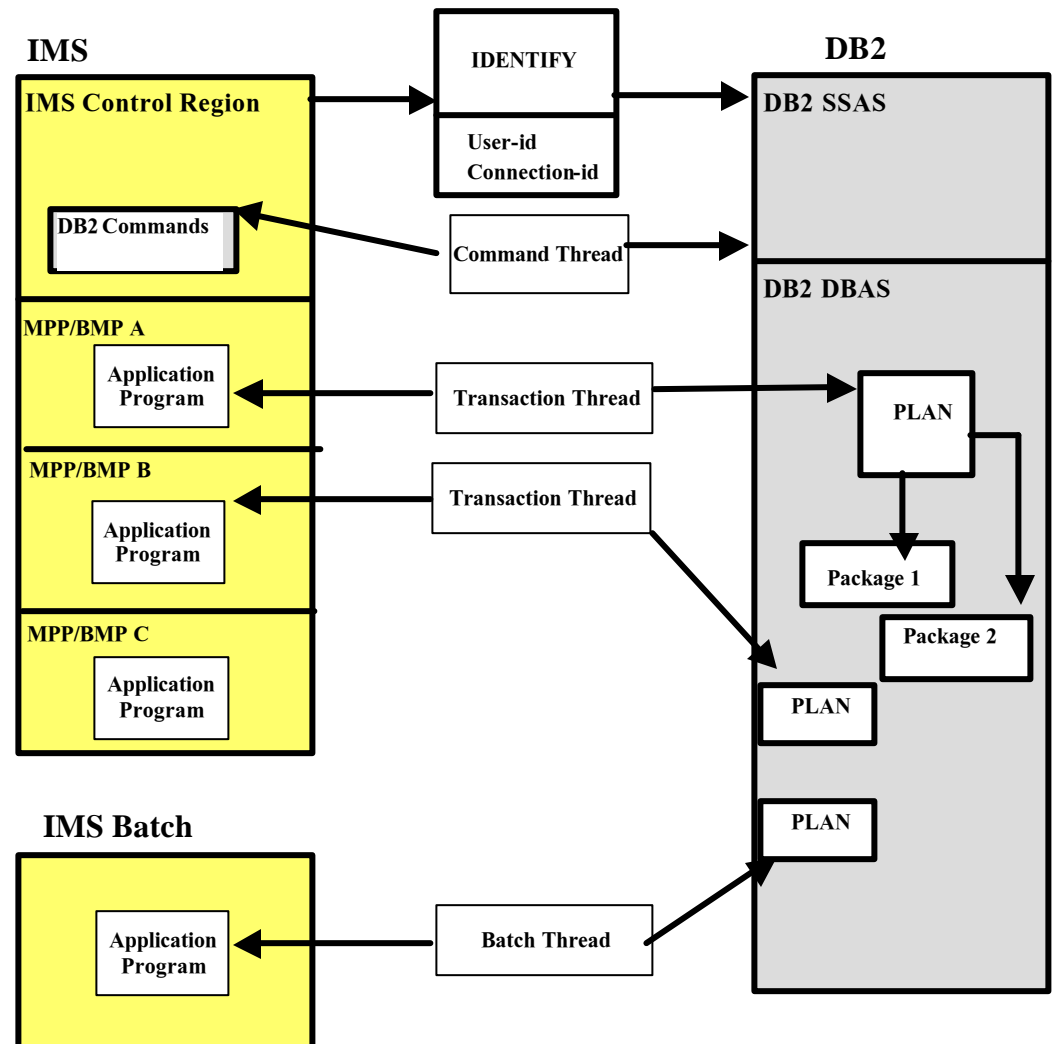
IMS DB2 Subsystem Attachment Facility ...



- IMS and DB2 must be on same zOS 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

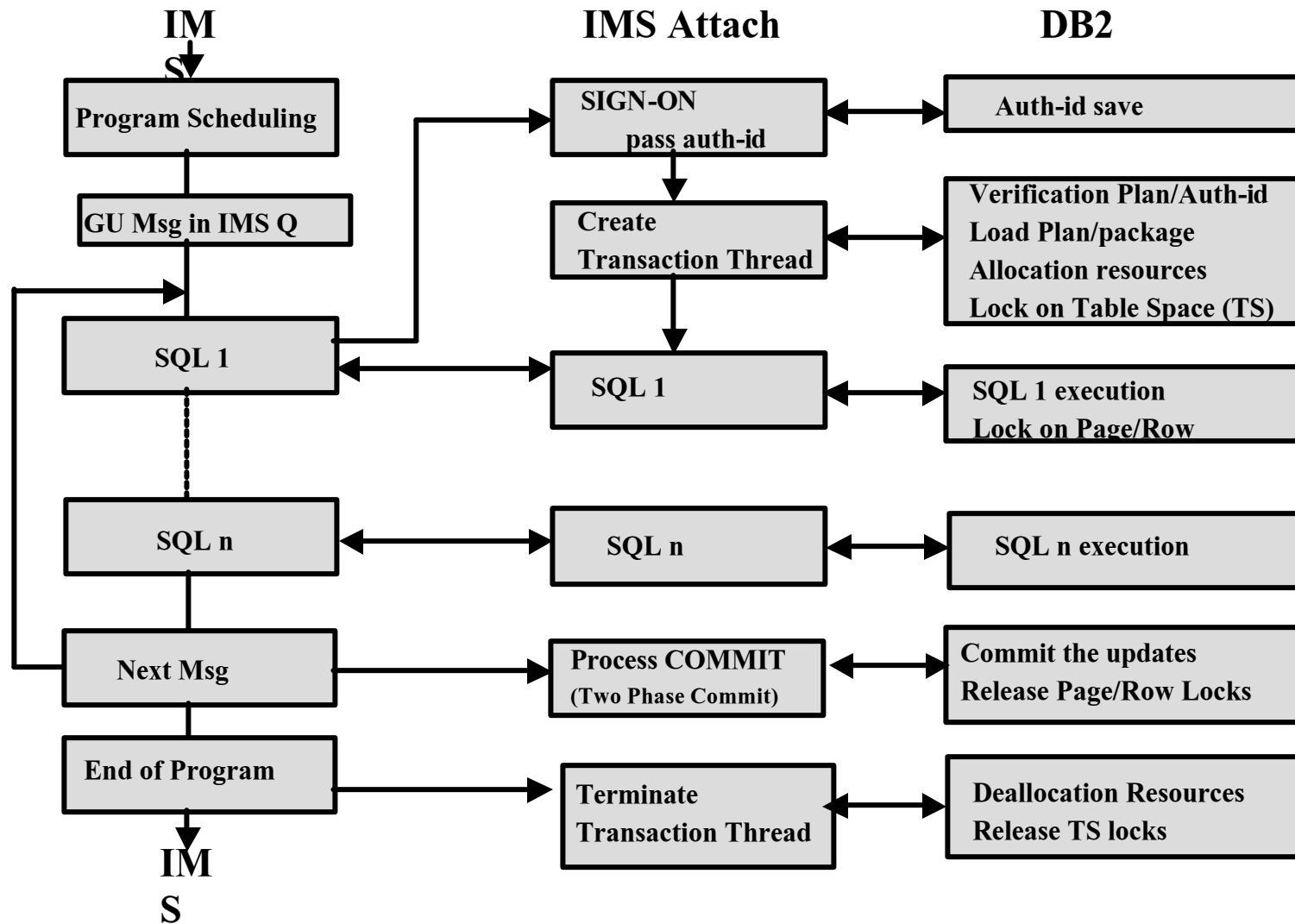
IMS DB2 Subsystem Attachment Facility ...

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





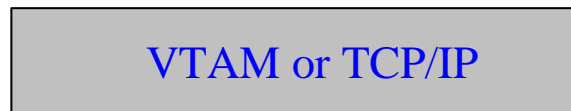
IMS DB2 Subsystem Attachment Facility ...





IMS and DB2 in a Parallel Sysplex Environment

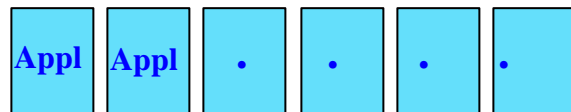
MultiSystem Management and Data Sharing



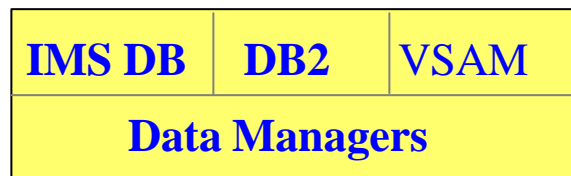
Single Image



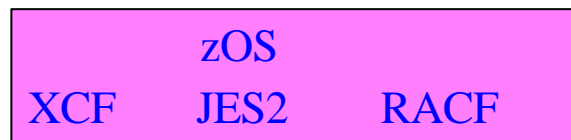
Dynamic Workload Balancing



Unchanged Applications



Data Sharing



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

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

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

- 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





IMS DB2 Subsystem Definition ...

IMS.PROCLIB

SSMI member:

DSND, SYS1,..

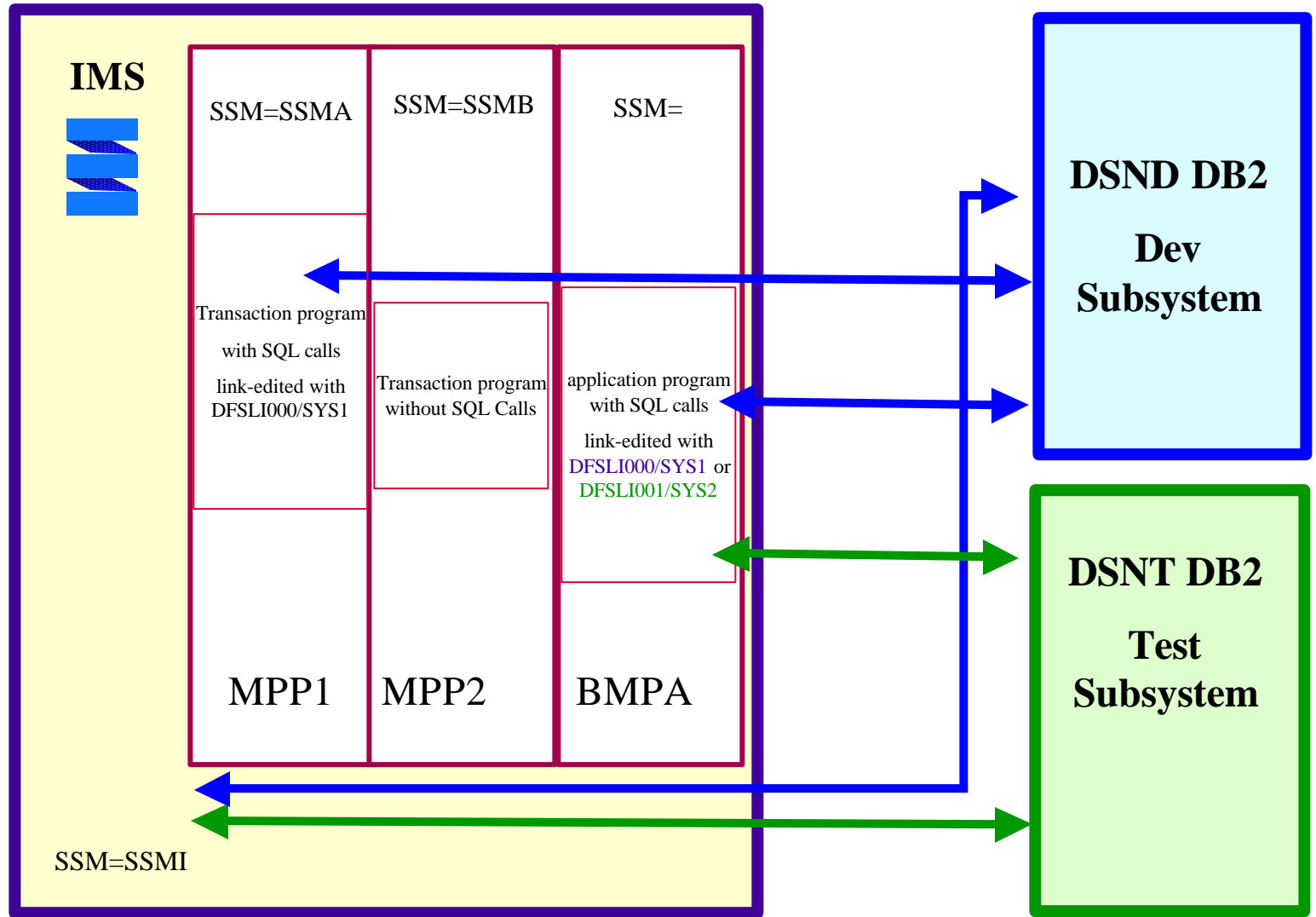
DSNT, SYS2,..

SSMA member:

DSND, 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
 - ▶ For IMS database datasets
 - ▶ For DB2 database datasets
- 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
- Command security
 - ▶ In IMS and in DB2

Control Access
to IMS and DB2 Subsystem
to IMS and DB2 Objects
to IMS and DB2 Data-sets



Security Considerations

■ DB2 Security Identifiers

- ▶ Primary authorization IDs
- ▶ Secondary authorization IDs
- ▶ SQL IDs

■ DB2 Connection Security - IDENTIFY

- ▶ RACF control with the initial DB2 primary ID on
 - The DB2 resource class (CLASS=DSNR)
 - The DB2 subsystem (SUBSYS=ssnm)
 - The connection type requested
- ▶ DB2 Connection exit routine
 - Needed to use DB2 secondary IDs
 - RACF group names used as DB2 secondary IDs when using the IBM-supplied sample routine

■ DB2 Signon Security

▶ DB2 Sign-on exit routine

Needed to use DB2 secondary IDs

When using the IBM-supplied default sign-on exit routine:

- The initial primary authorization ID remains the primary ID.
- The current SQL ID is set equal to the primary ID.
- No secondary IDs exist.

■ DB2 Authorization for IMS Userids

▶ DB2 internal security

GRANT

▶ RACF control using access control authorization exit (DSNX@XAC)

Not supported with IMS because DB2 does not pass the ACEE address for DB2 commands or IMS transactions.





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)**

IMS Performance Analyzer (IMS PA) can be used for response-time analysis and tracking all IMS-generated requests to DB2.





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

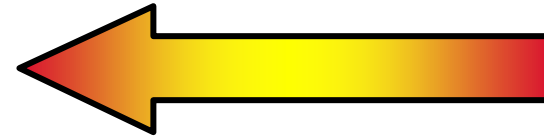
Cursor closed

DB position lost



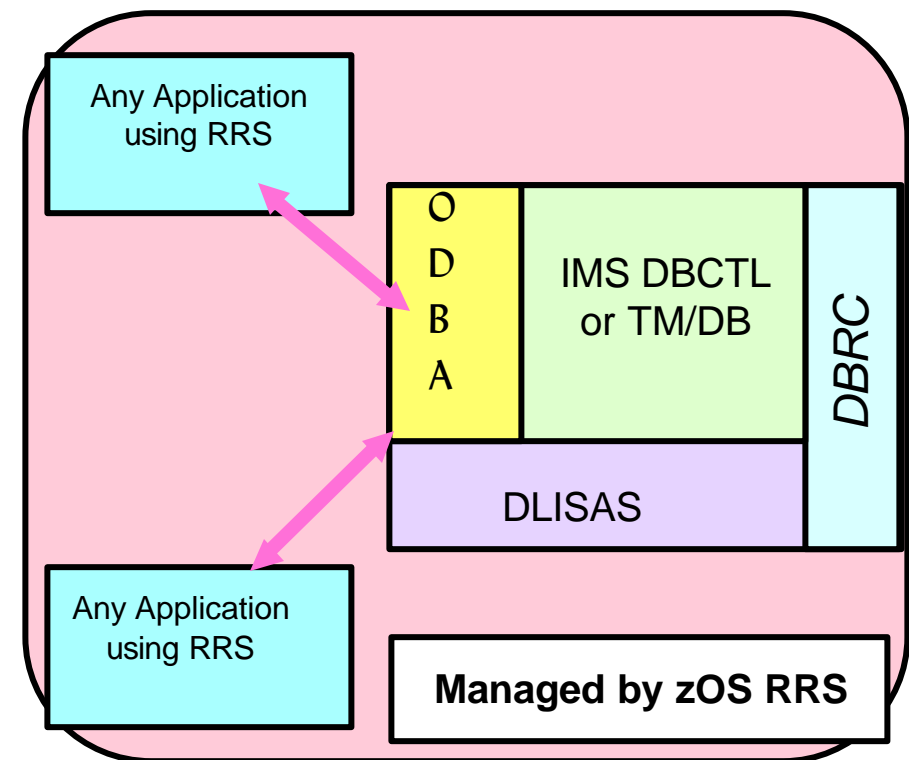
Agenda

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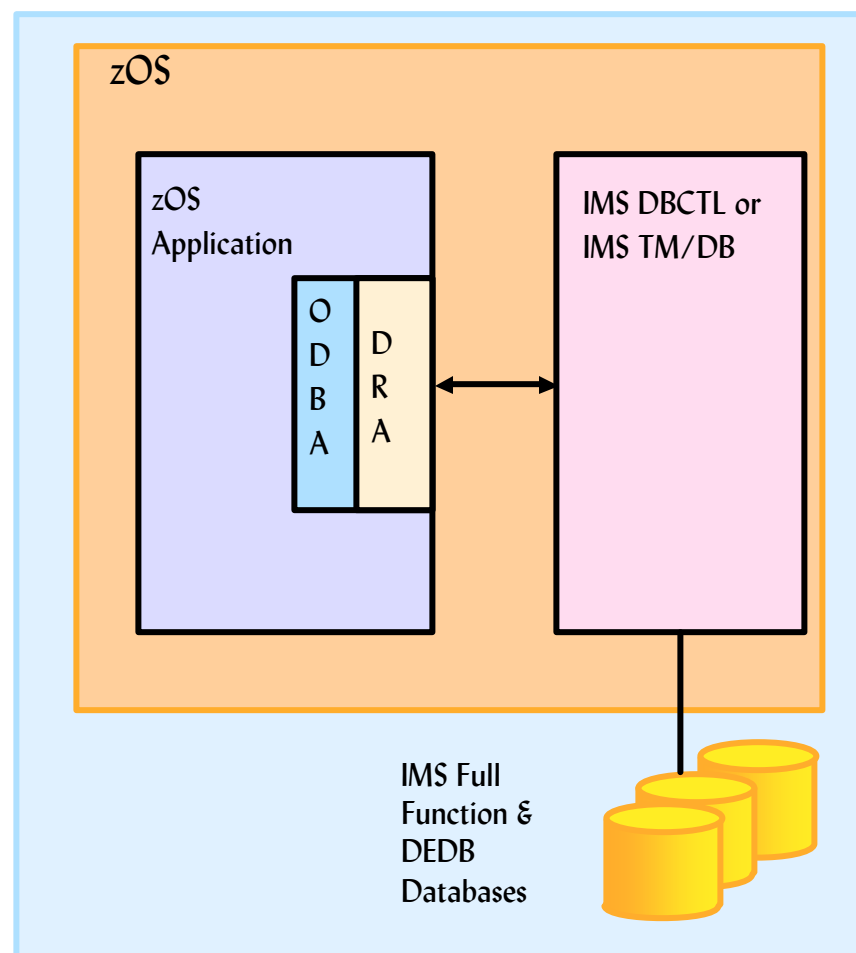
Open Database Access (ODBA) - Objectives

- Provides a callable interface to IMS databases from any zOS programs that are not managed by IMS
 - ▶ DB2 Stored Procedures
 - ▶ or Any applications that use zOS 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



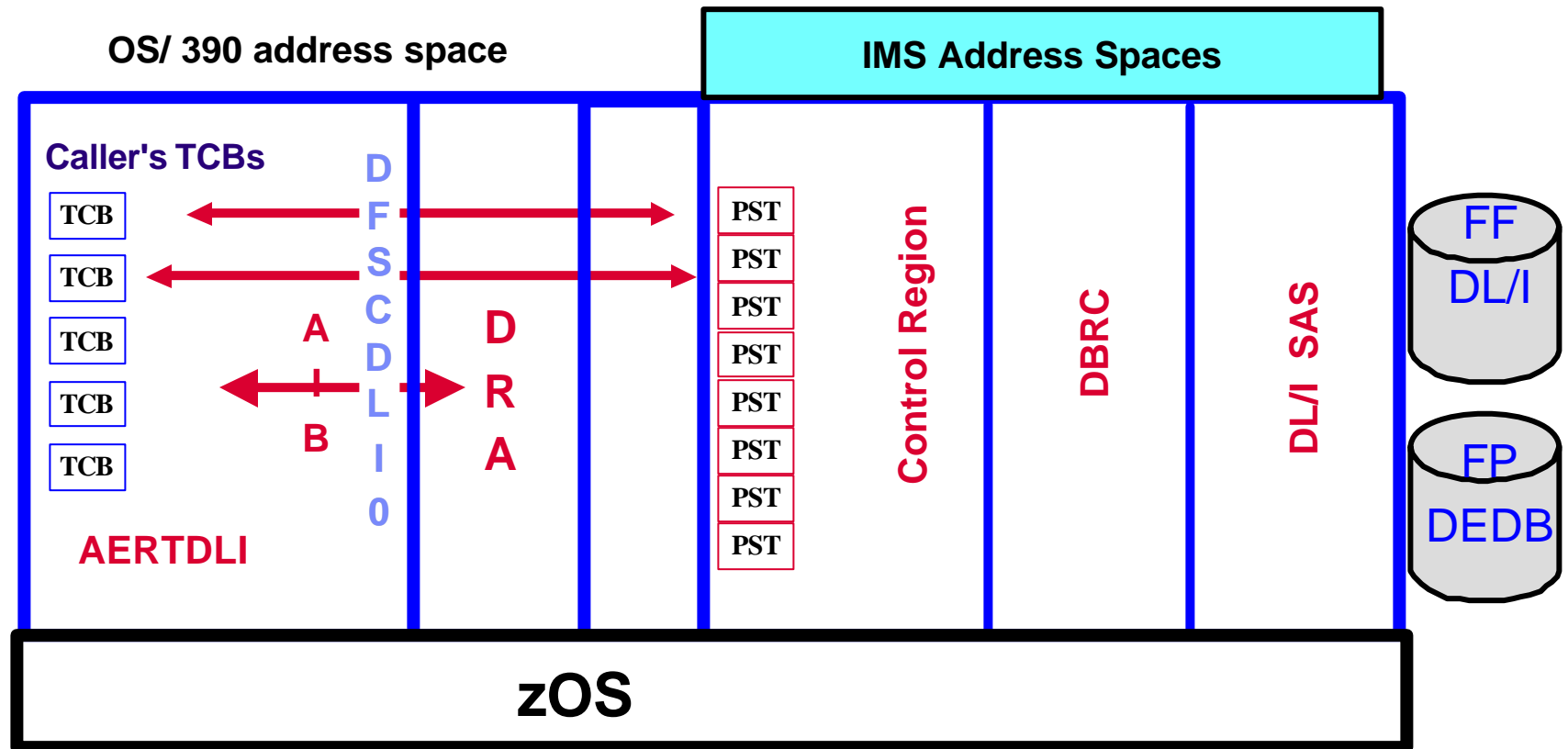
ODBA - Database Resource Adapter (DRA)

- The zOS 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

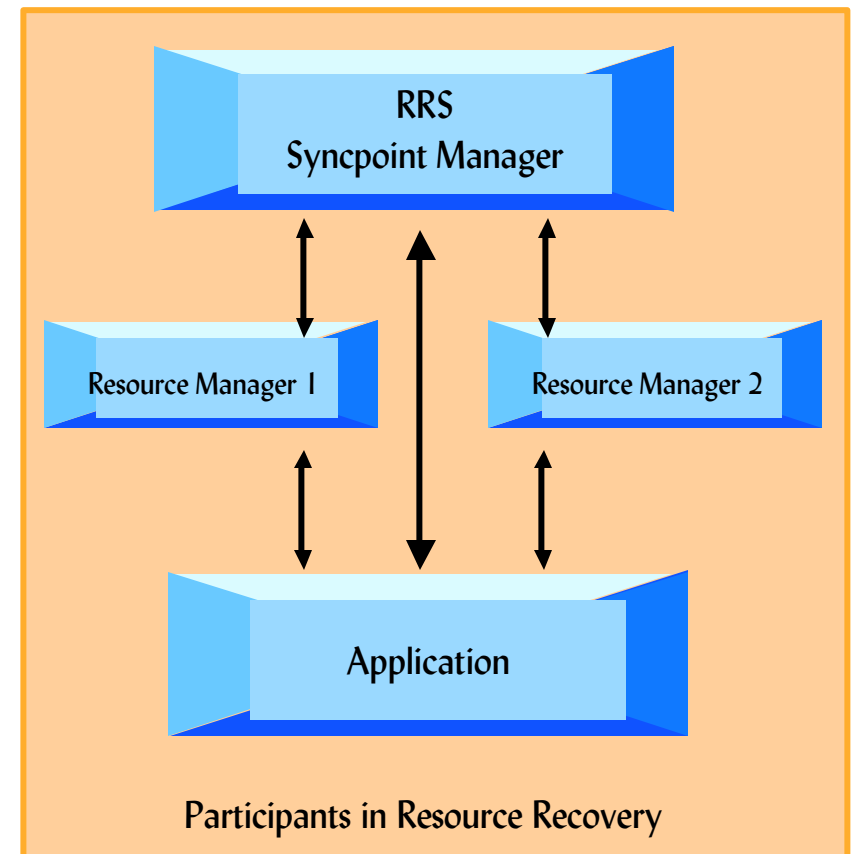
ODBA - Database Resource Adapter (DRA) ...



- 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	Extended	DPSB	Extended	GNP/GHNP	INQY (FIND;DBQUERY;ENVIRON)	RCMD	SNAP
CIMS	NEW	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 ...

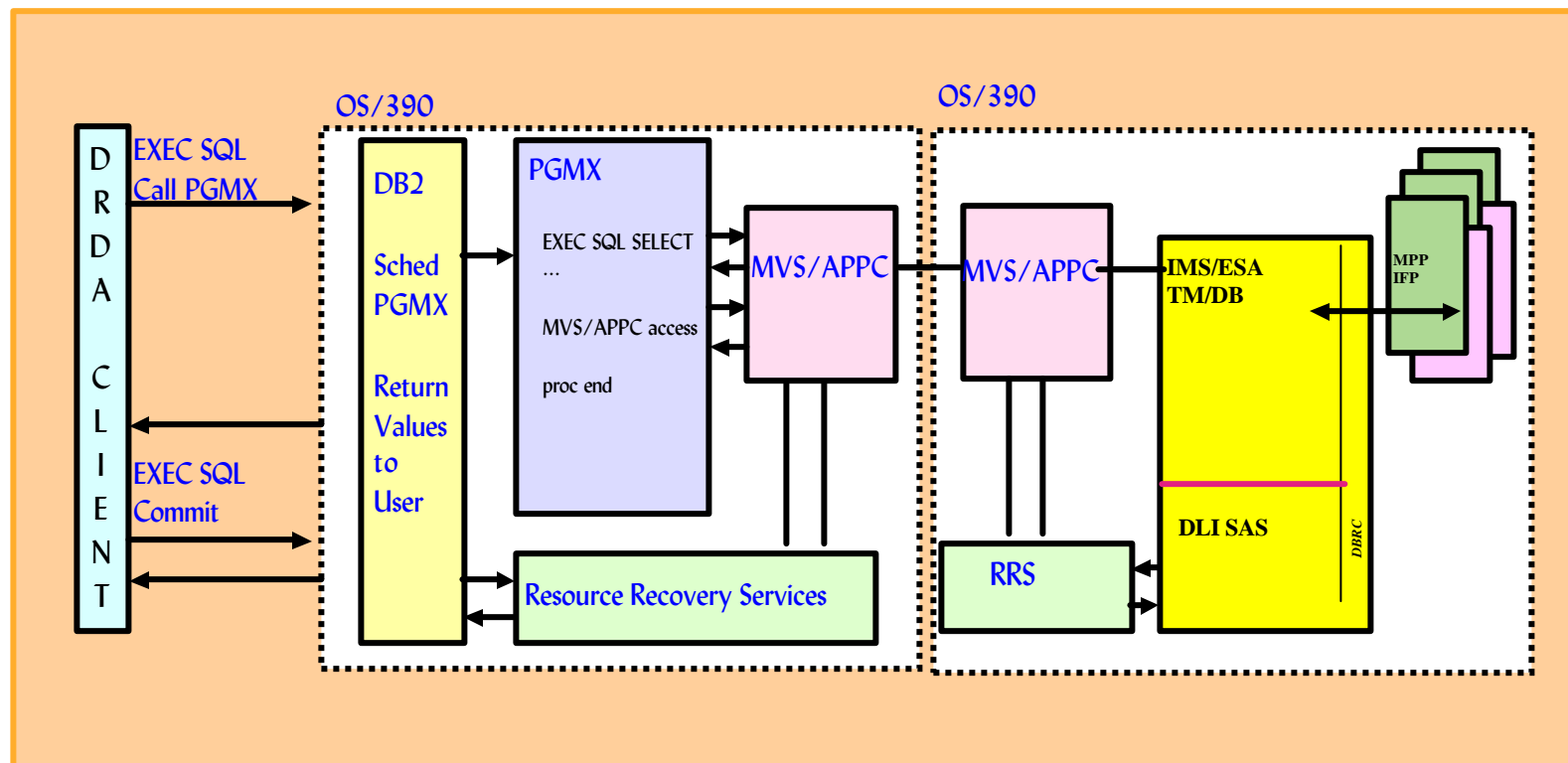
- New Stored Procedure languages since DB2 V5
 - ▶ REXX
 - REXX SQL support
 - ▶ SQL (also known as PSM)
 - More like other DB vendors
 - ▶ Java
 - JDBC and SQLJ
 - Compiled Java in V5/V6
 - Interpreted via JAR files in V7

- Stored Procedure builder
 - ▶ Building new (LANGUAGE SQL)
 - ▶ Executing existing (any language)



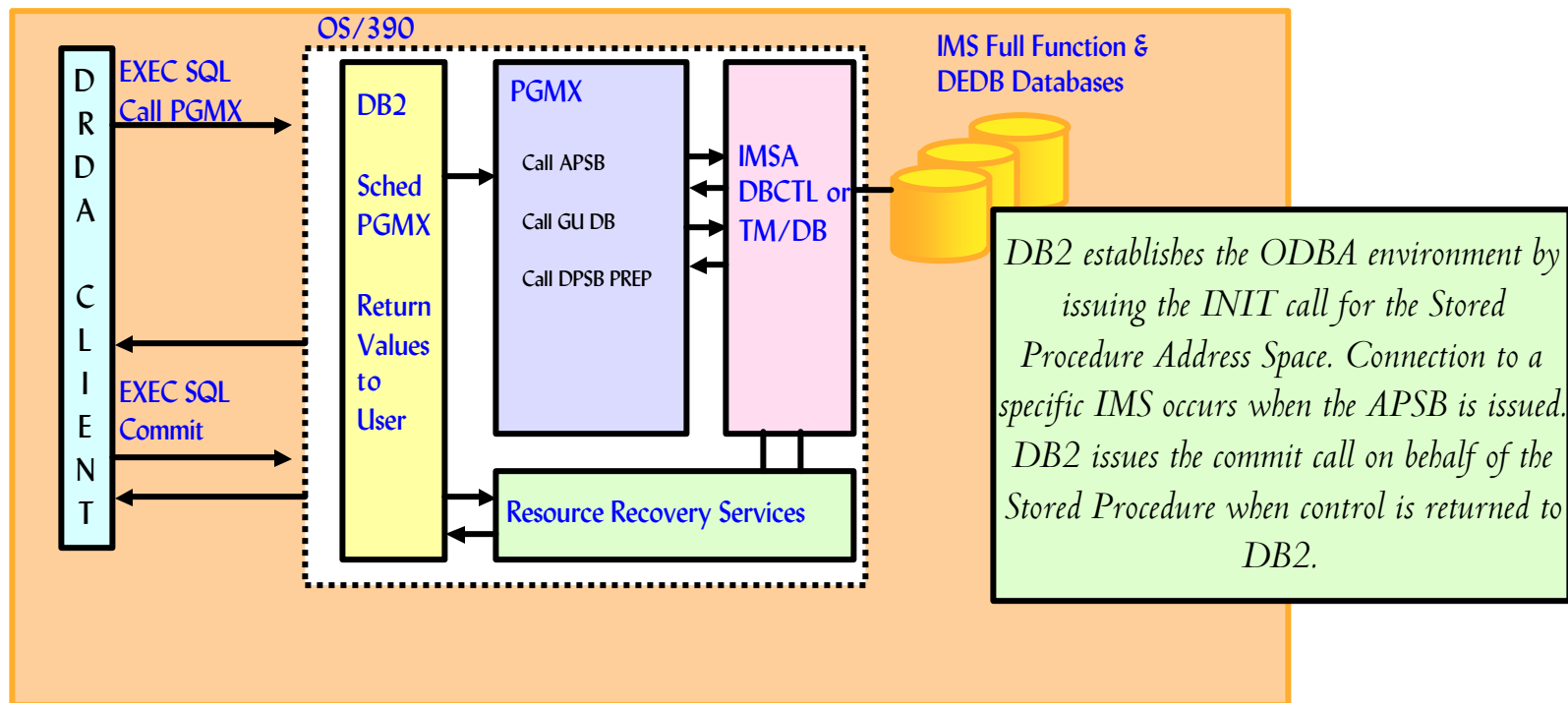
Access to IMS Transactions using APPC

- 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/abond 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

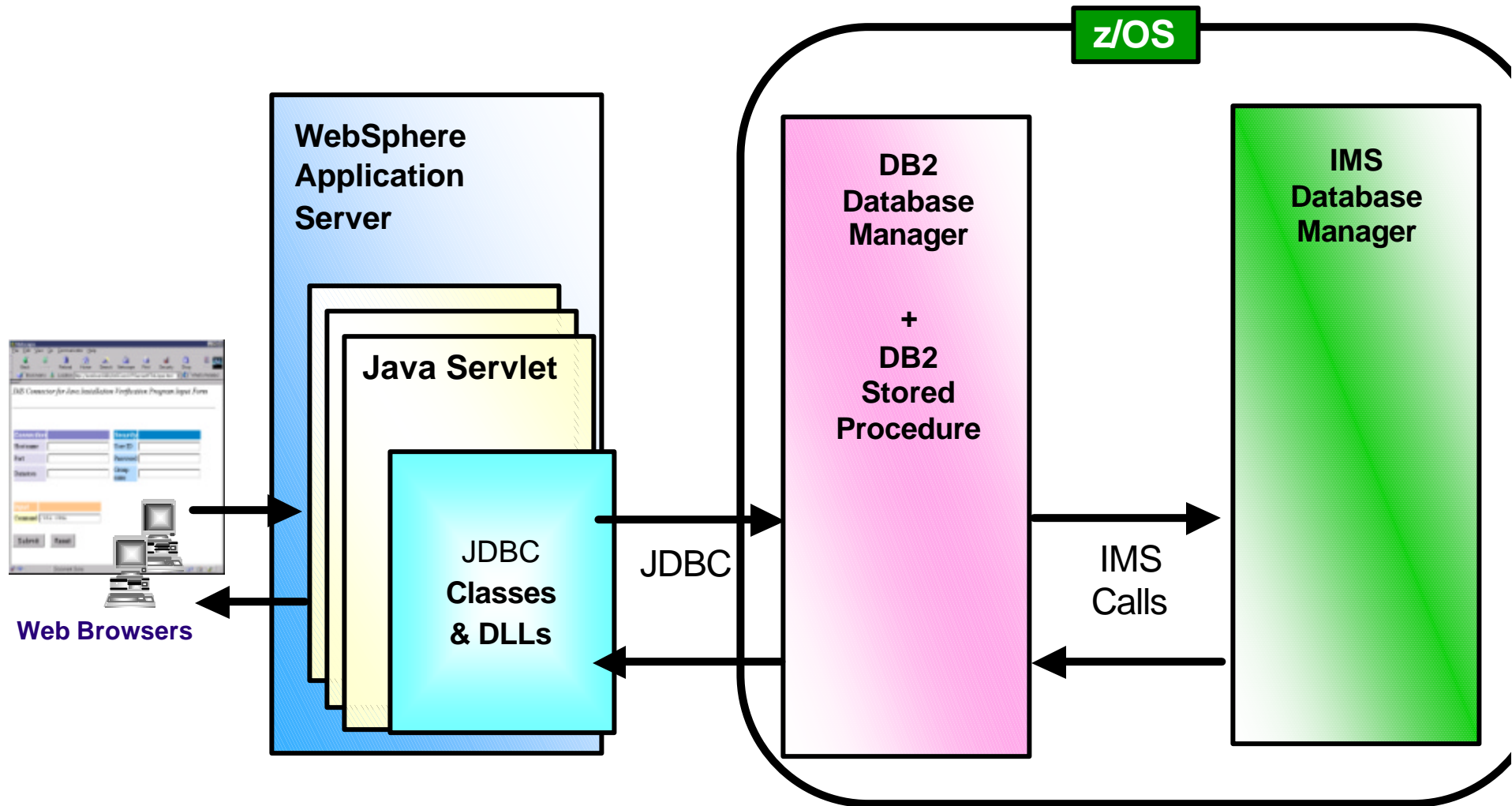
- Web Access to IMS Transactions
 - ▶ IMS Connect
 - ▶ IMS Connector for Java
 - ▶ XML
 - ▶ Web Services

- JDBC access to IMS Databases
 - ▶ On zOS: IMS, CICS, DB2 Stored Procedures, Websphere
 - ▶ On any platform: using a DB2 Stored Procedure gateway



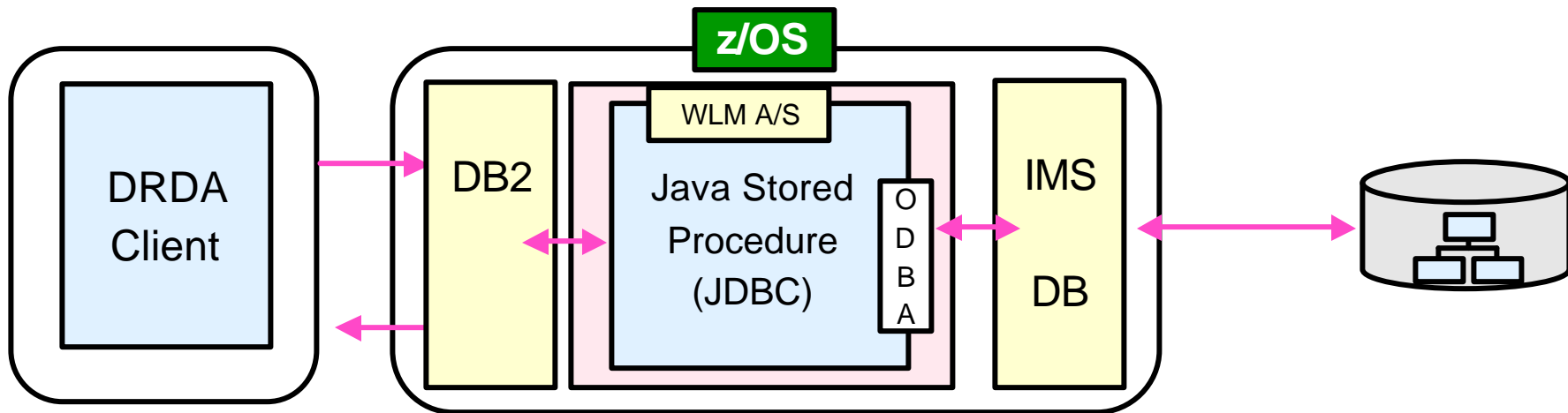


JDBC to DB2, DB2 to IMS



DB2 Stored Procedure Support

- Applications run as
 - ▶ Java Stored Procedures
 - ▶ Return DB2 Result Sets
 - Populate temporary table
- To commit or rollback resources
 - ▶ DB2 activates
 - ▶ RRS manages syncpoint processing
- IMS DB access through ODBA





IMS Java

- Write, compile, and run IMS programs written in Java

- ▶ Development environment

- IMS Java Class Library

- Set of packages that contain groups of classes

- IMS Java classes are pre-written reusable code that can be invoked by Java program to ...

- Access IMS message queues and databases

- Support APIs familiar to Java programmers

- ▶ Runtime environment supports new dependent region types

- JMP and JBP (V7 APAR PQ53944)

- *Persistent reusable Java Virtual Machine*

- Benefit

- ▶ Incorporates Java programming model into IMS environment

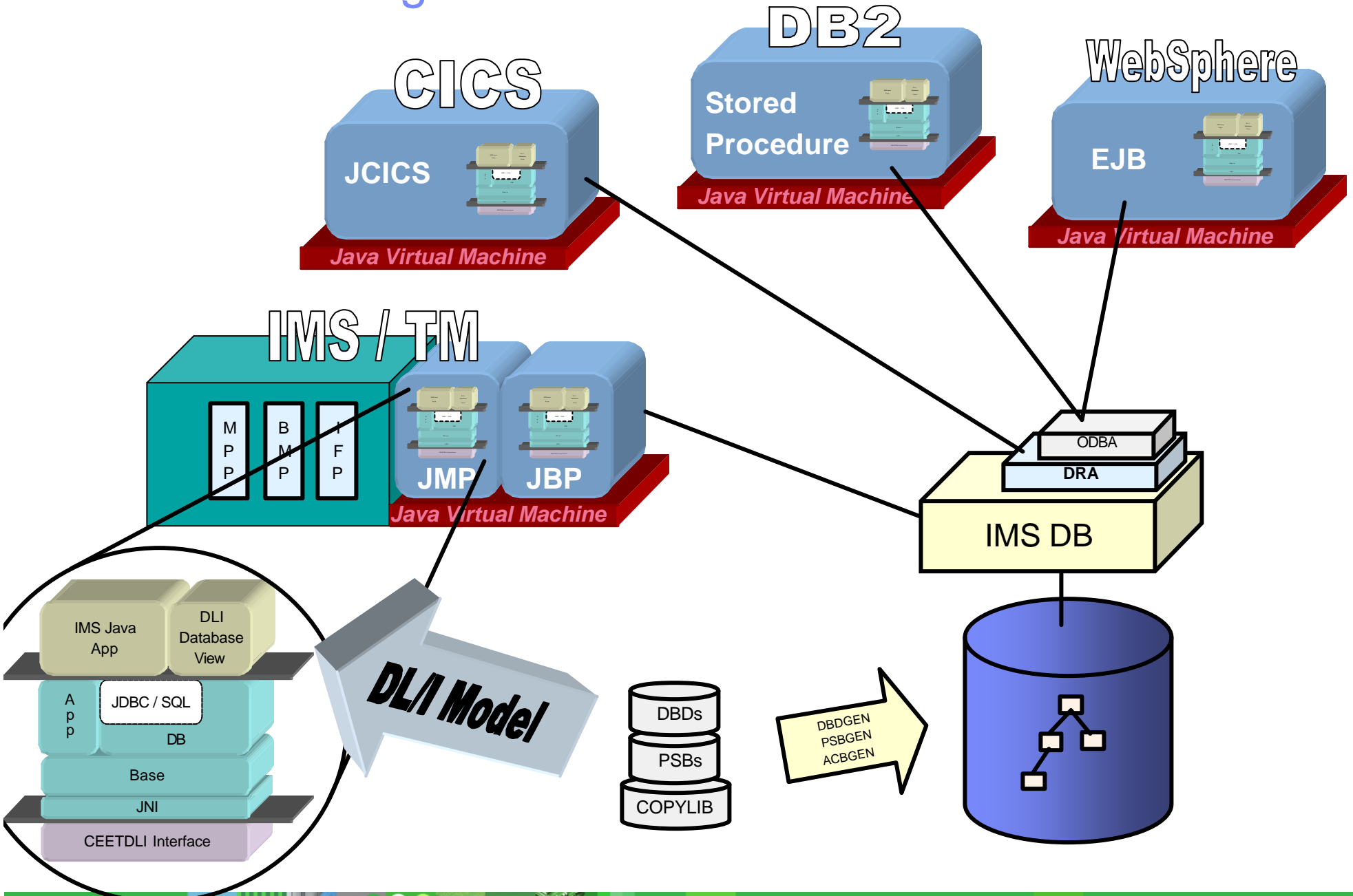
- ▶ Allows Java programmers to code IMS applications

- Requires only basic IMS knowledge

- Supports all major IMS capabilities



MS Java - The Big Picture



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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 DPROP NR
 - ▶ 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

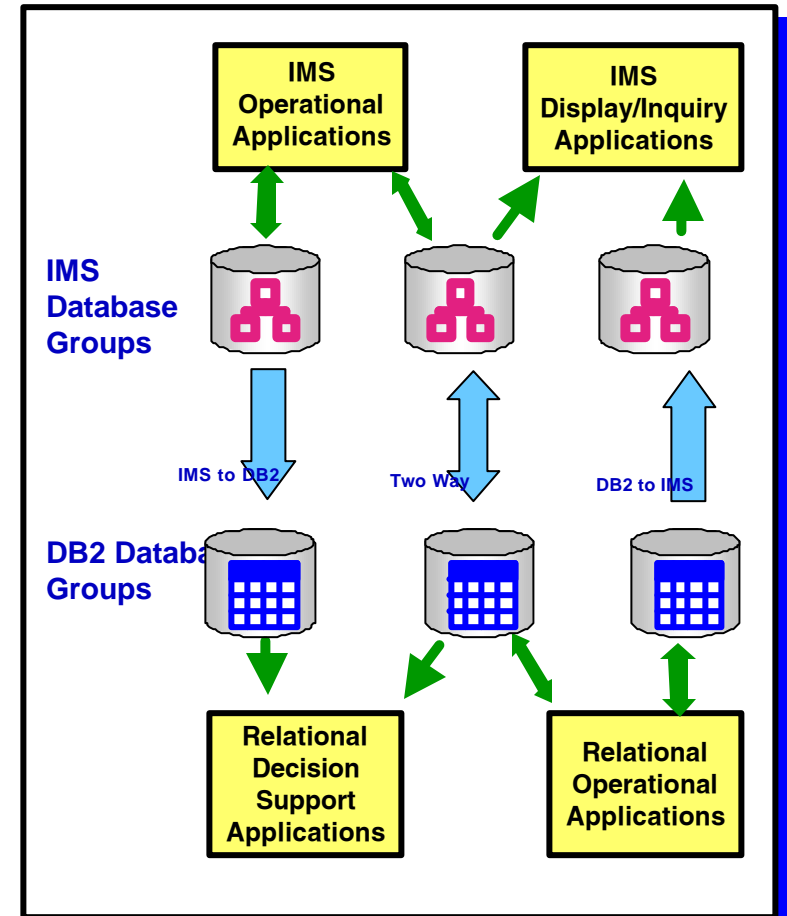
V1 R1	1991	■ IMS → DB2 (Synchronous)
V1 R2	1993	■ IMS ← DB2 (Synchronous)
V2 R1	1995	■ IMS → DB2 (Asynchronous)
V2 R2	1997	■ MVS Sysplex Support ■ IMS & DB2 Data Sharing ■ IMS V6 and V7 Support
V3 R1	2001	■ IMS → DB2 with MQSeries
Future		■ IMS → IMS with MQSeries ■ CICS DBCTL Support



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

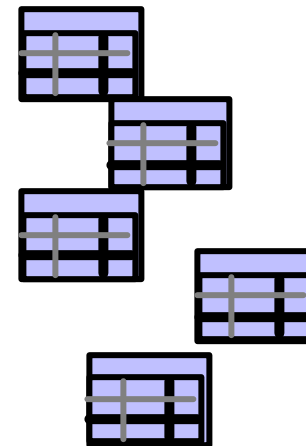
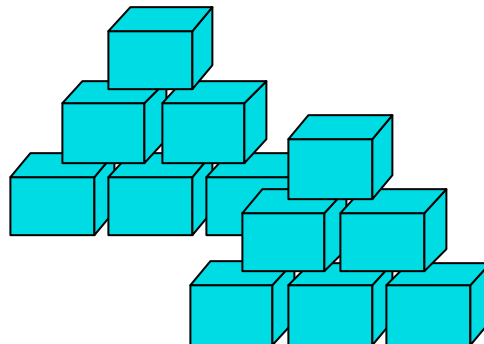
Data transformation

- 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

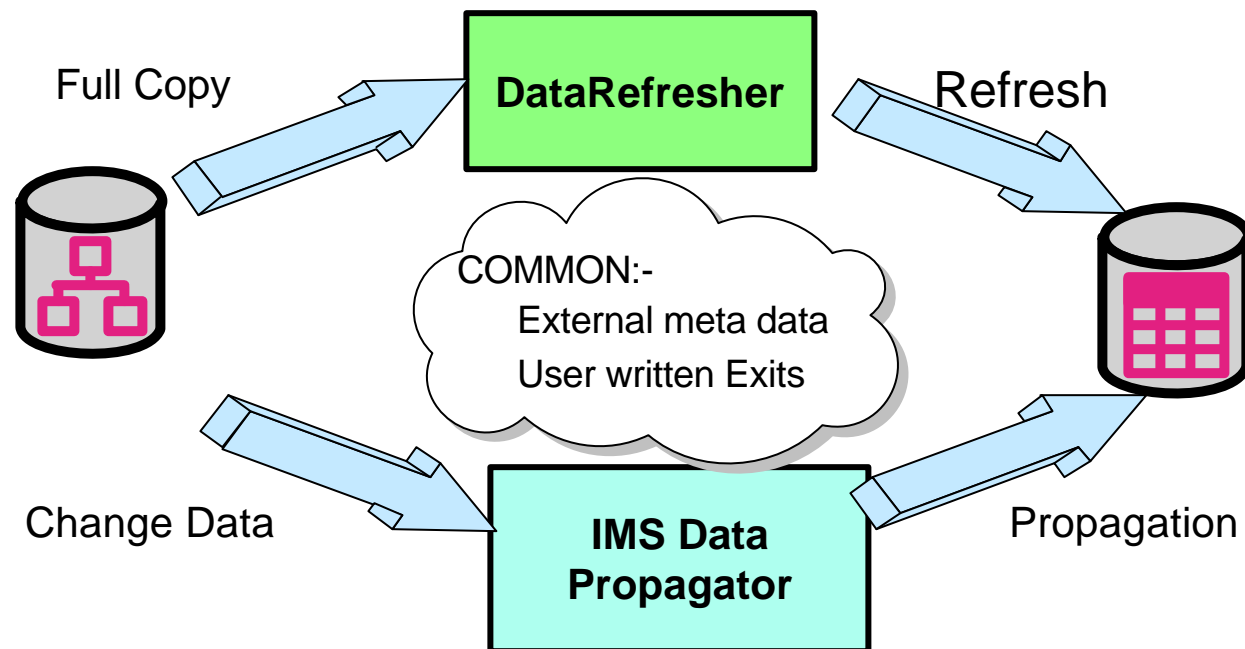


Example: Building the Relational Base ...

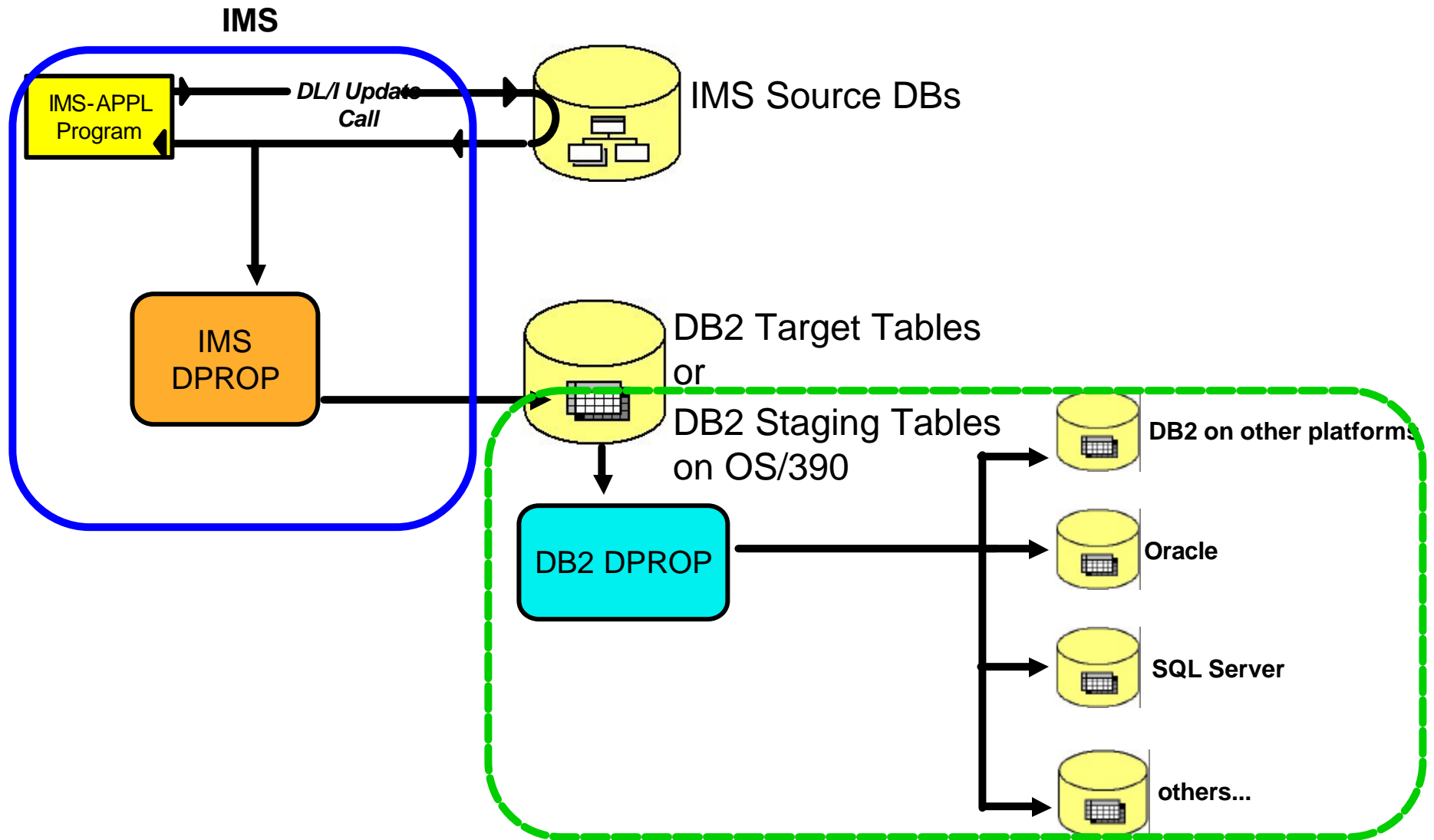


■ IBM Data Refresher

- ▶ 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

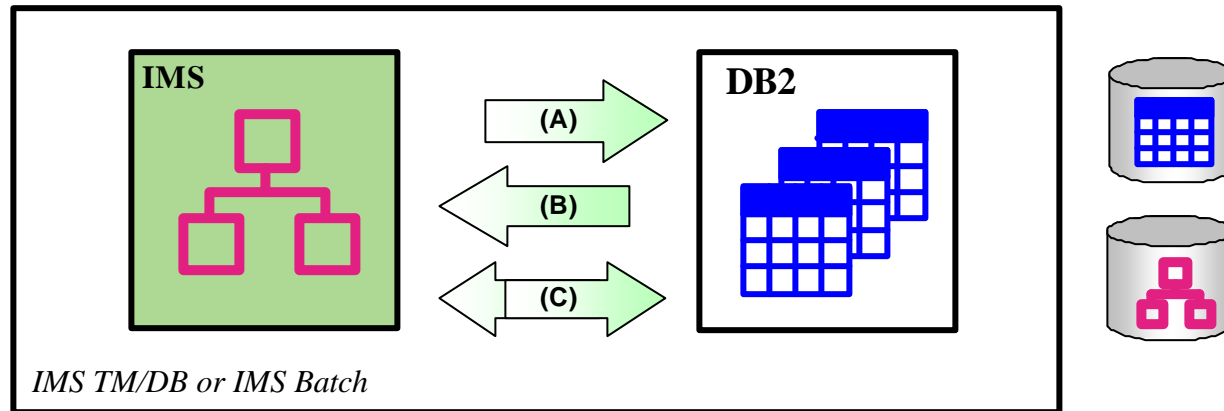


Example: Building the Relational Base ...



Synchronous Propagation Mode

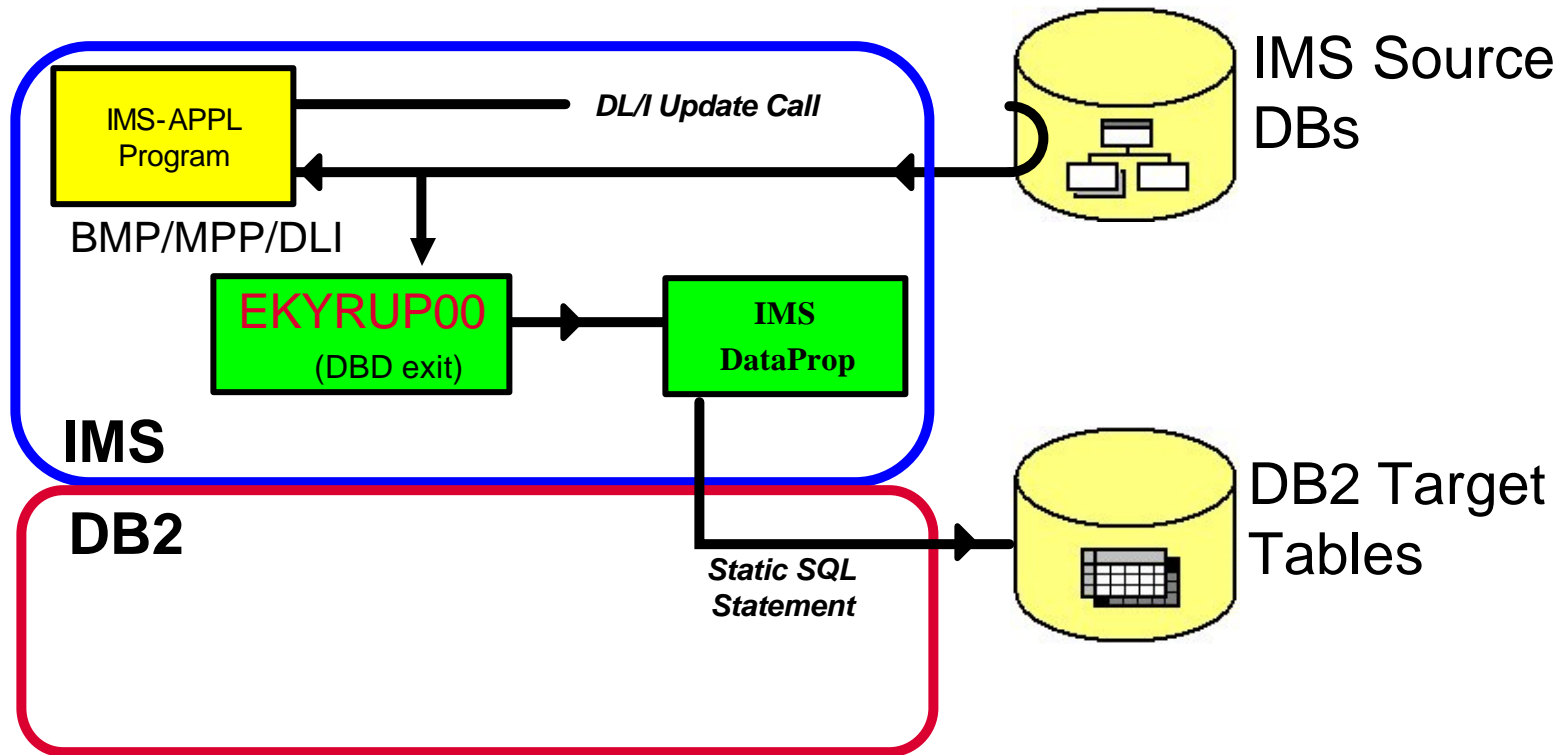
- Updates from
 - ▶ IMS TM
 - MPP, IFP or BMP
 - ▶ IMS Batch
 - ▶ No DBCTL support yet



- 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



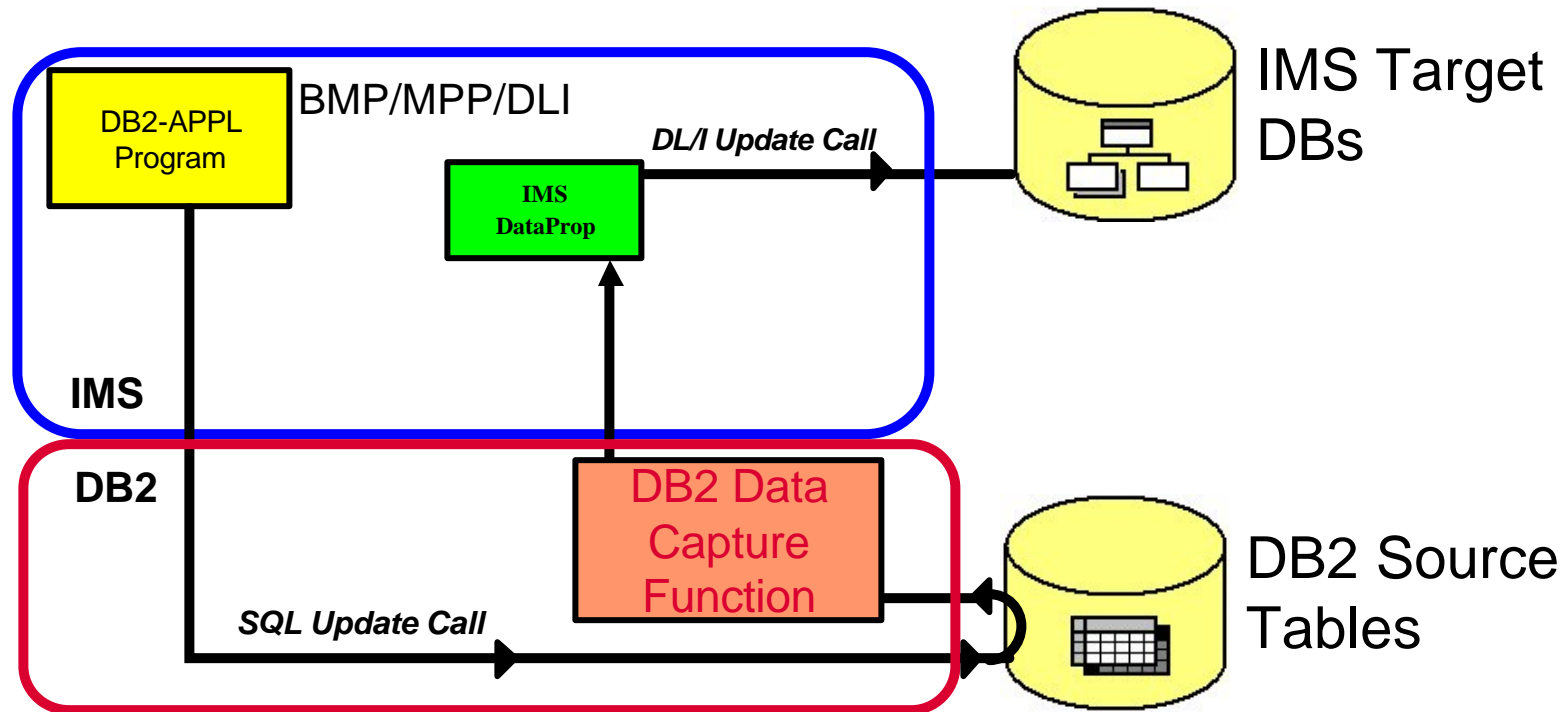
Synchronous Propagation Mode - IMS to DB2



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



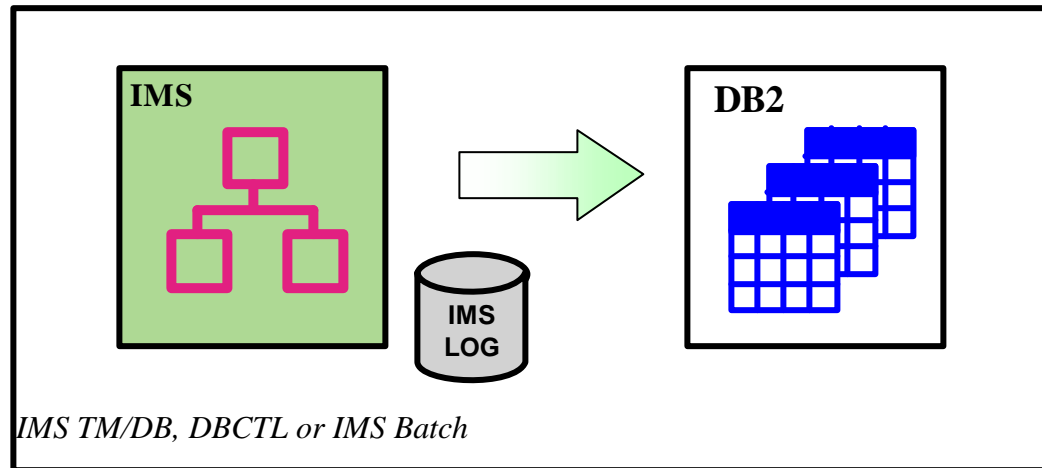
Synchronous Propagation Mode - DB2 to IMS



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

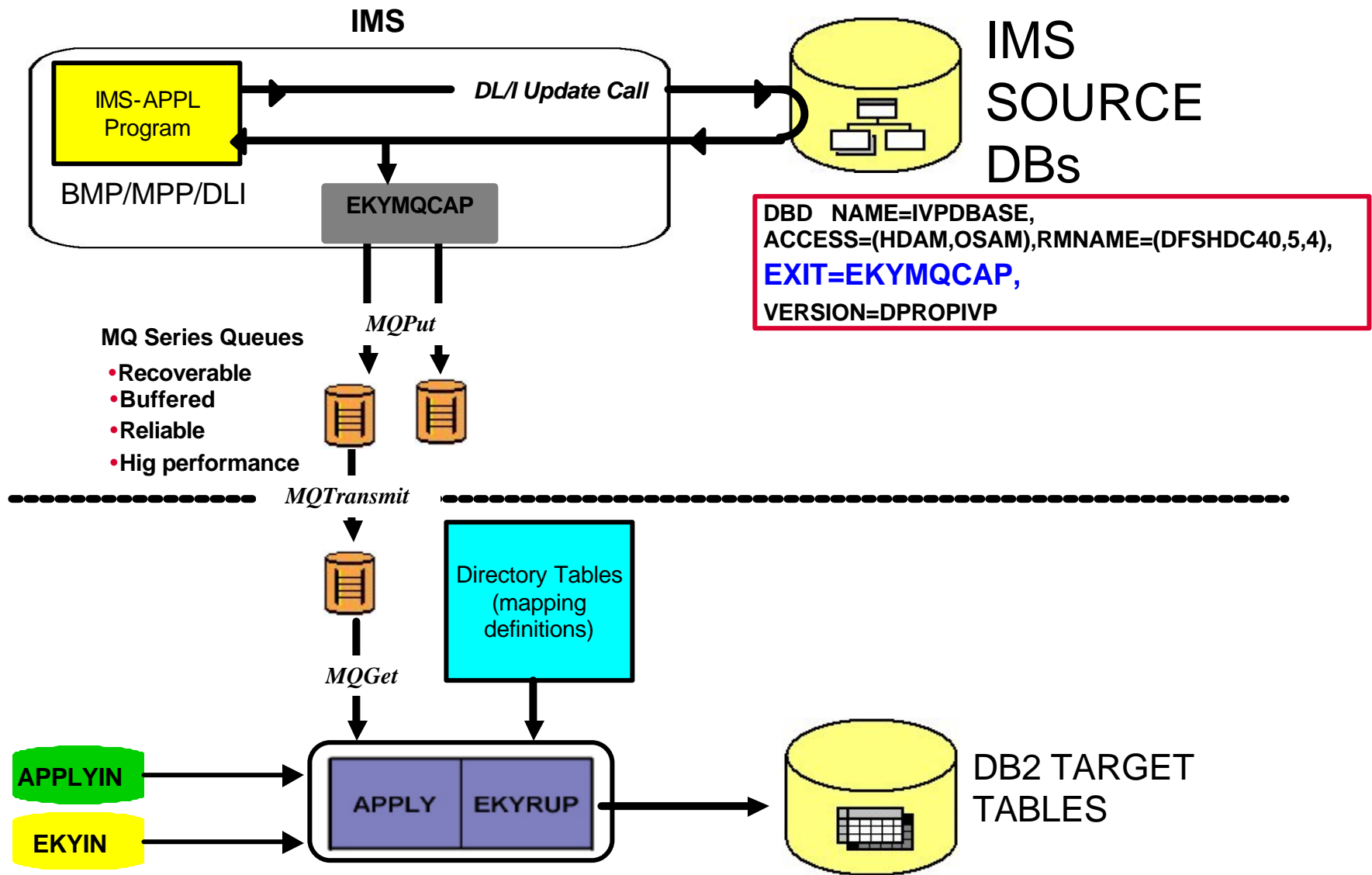
Asynchronous Propagation Mode ...

- Capture changes made to data in IMS database segments
 - ▶ Only application data changes
 - No IMS prefix changes
 - ▶ BMP, MPP, Java Region 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

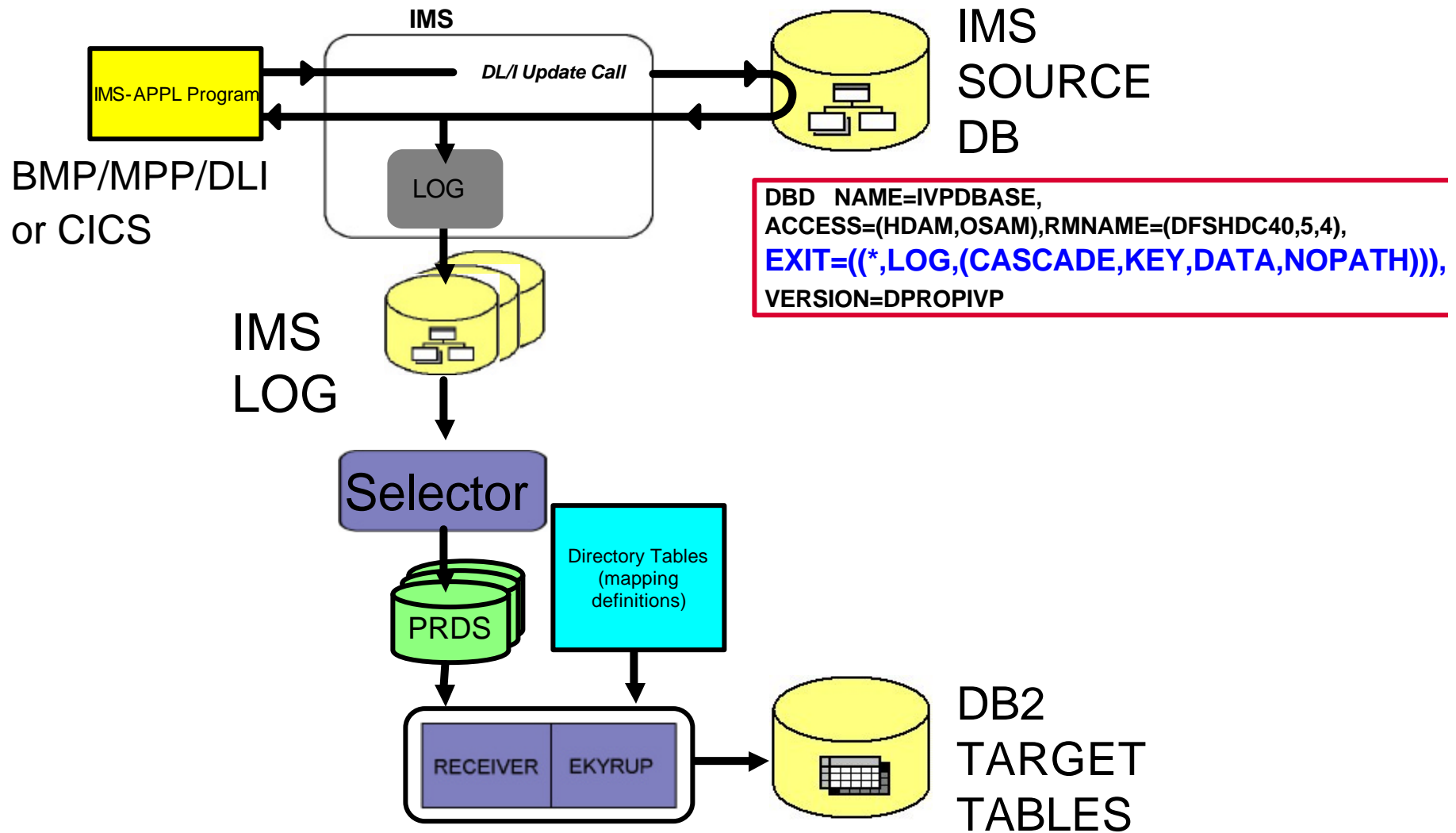
After the commit, messages made available

MQSeries can transmit the messages to their destination

Messages readable on this MQSeries system



Asynchronous, log-based propagation





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





IMS DPROP Phases

■ 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)

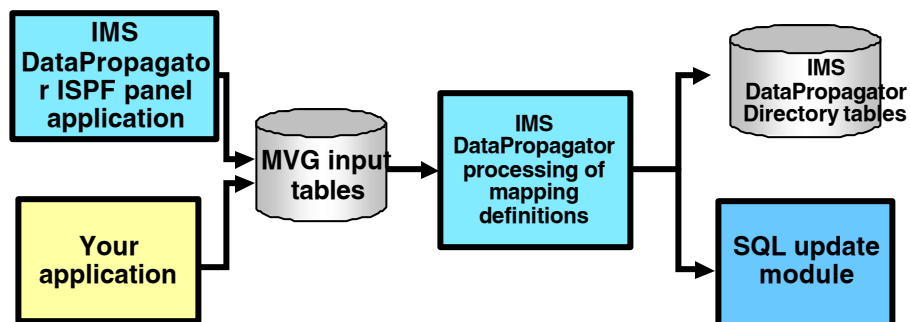
Audit trail and trace analysis



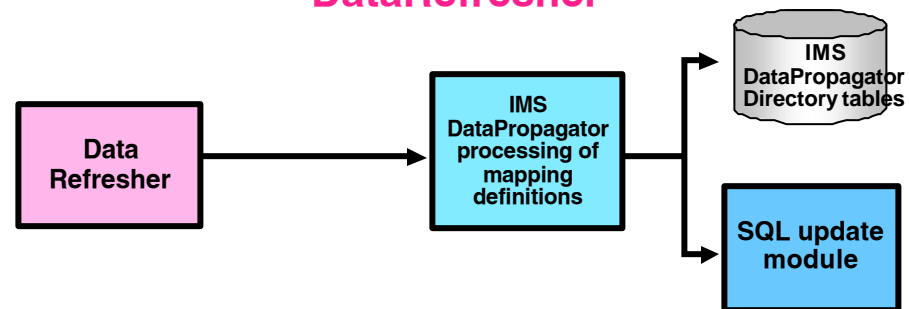
IMS DPROR Phases - Mapping and Design

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

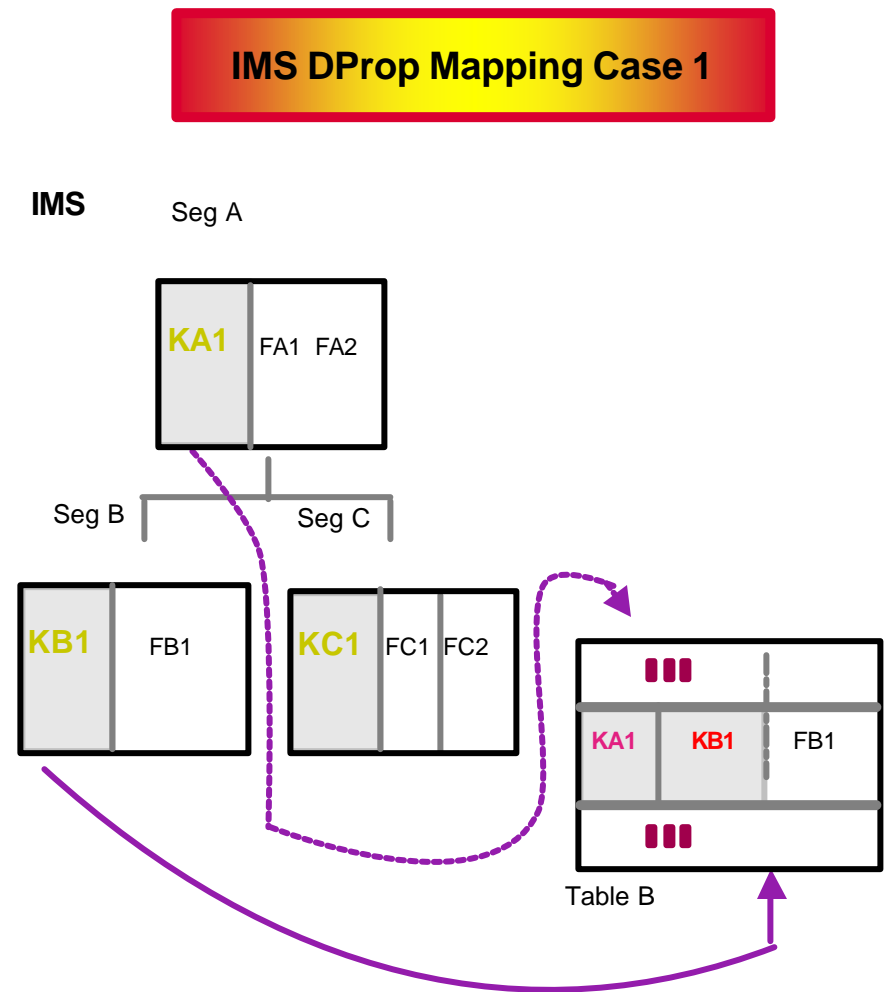
- Need to define
 - ▶ Key fields, columns
identifiers
 - ▶ Data fields, columns
subset
 - ▶ Mapping parameters
structure
conditions

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



Data Mapping - Mapping Case 1

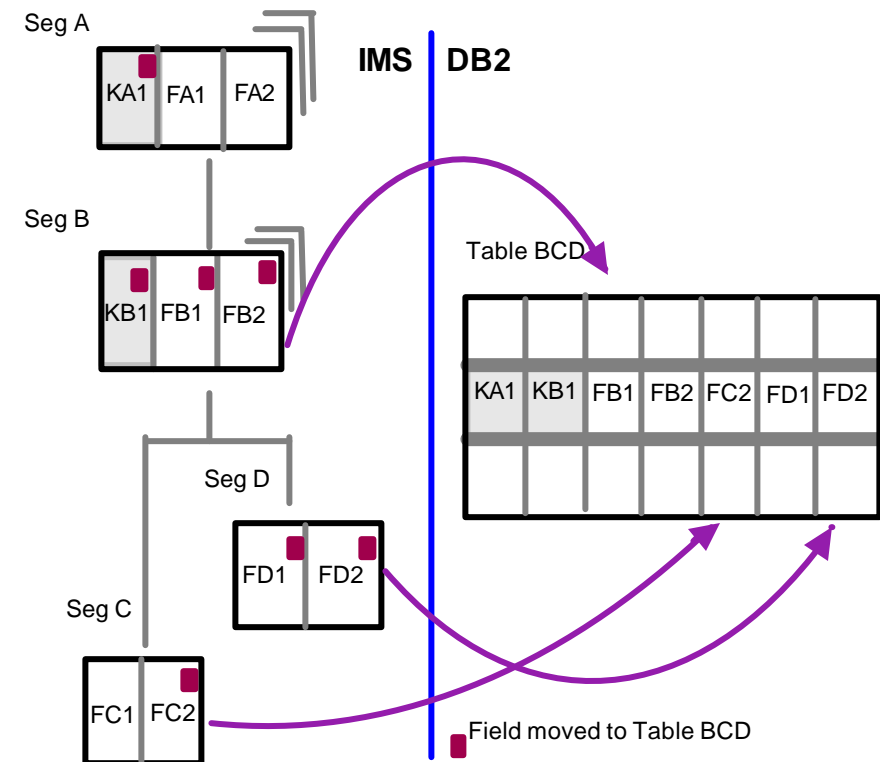
- Data is mapped from a single hierarchical path down to a particular segment
 - ▶ This segment is called the "entity segment"
 - ▶ The following fields can be mapped
 - All key fields from the entity segment up to the root segment
 - All nonkey fields from the entity segment



Data Mapping - Mapping Case 2

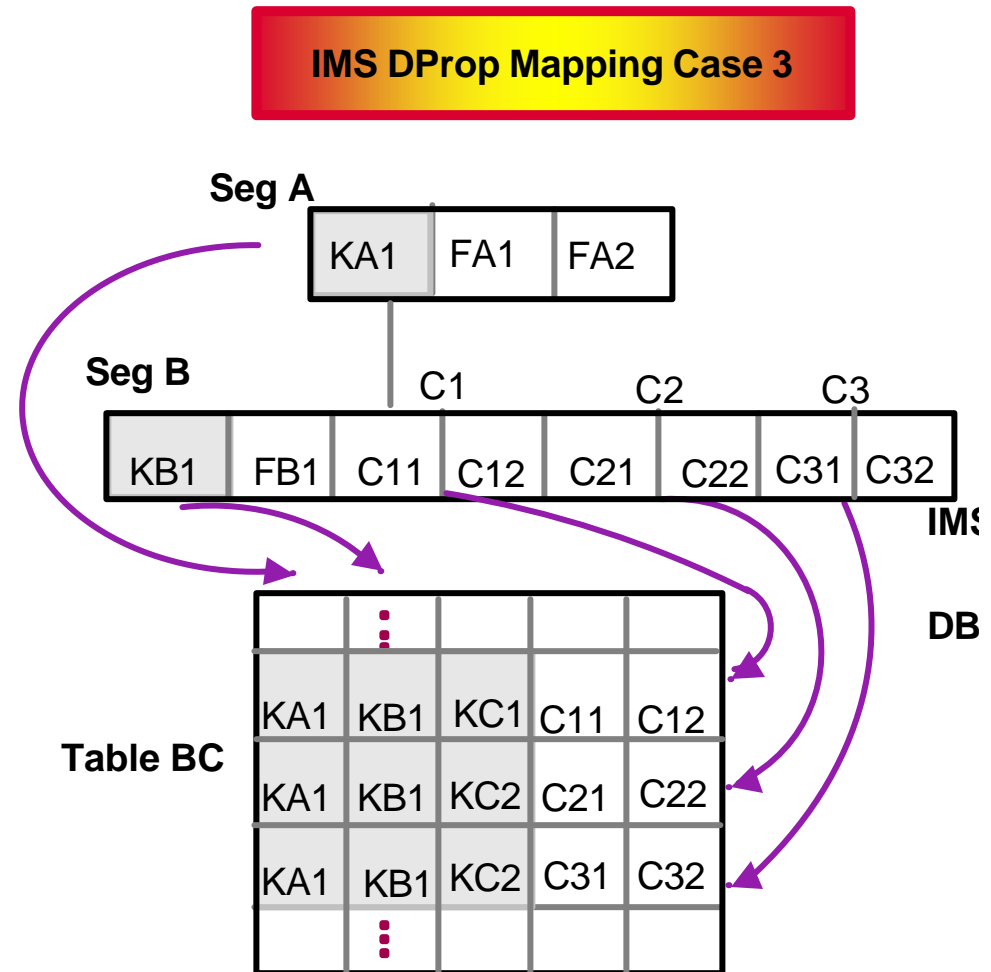
- Data is mapped from a single hierarchical path down to a particular segment and from any immediate subordinate segment
 - ▶ This subordinate segment is called the "extension segment"
 - ▶ The extension segment may have zero or one occurrence per entity segment
 - ▶ The following fields can be mapped
 - 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



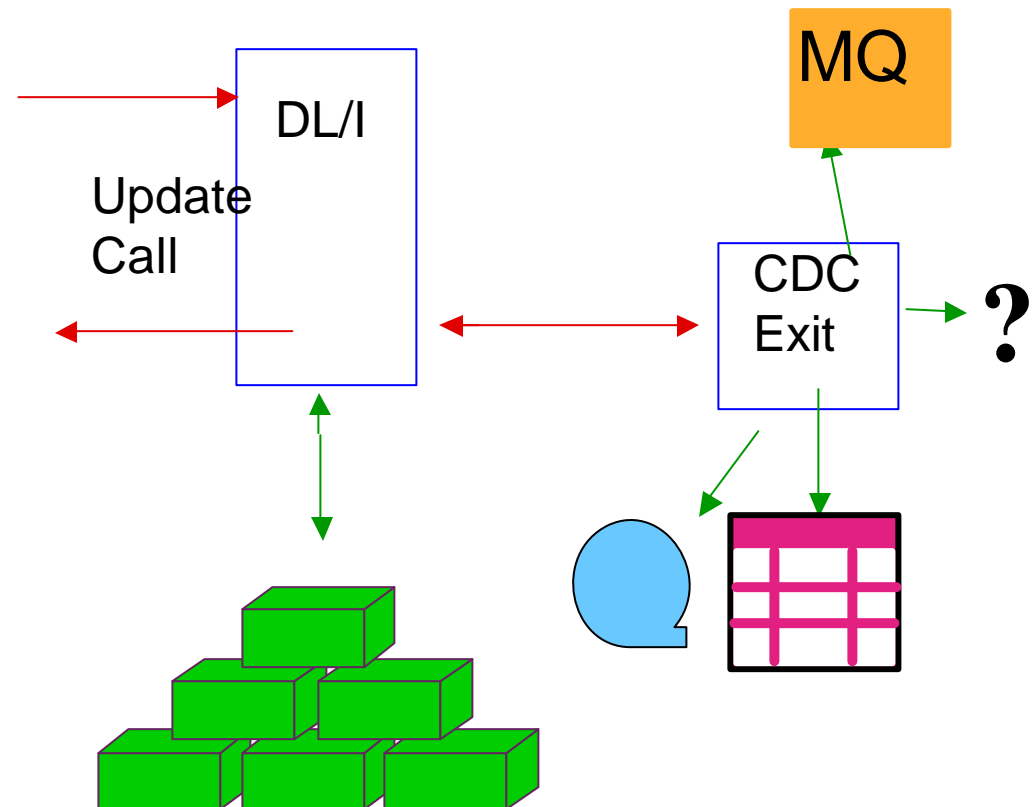
Data Mapping - Mapping Case 3

- **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



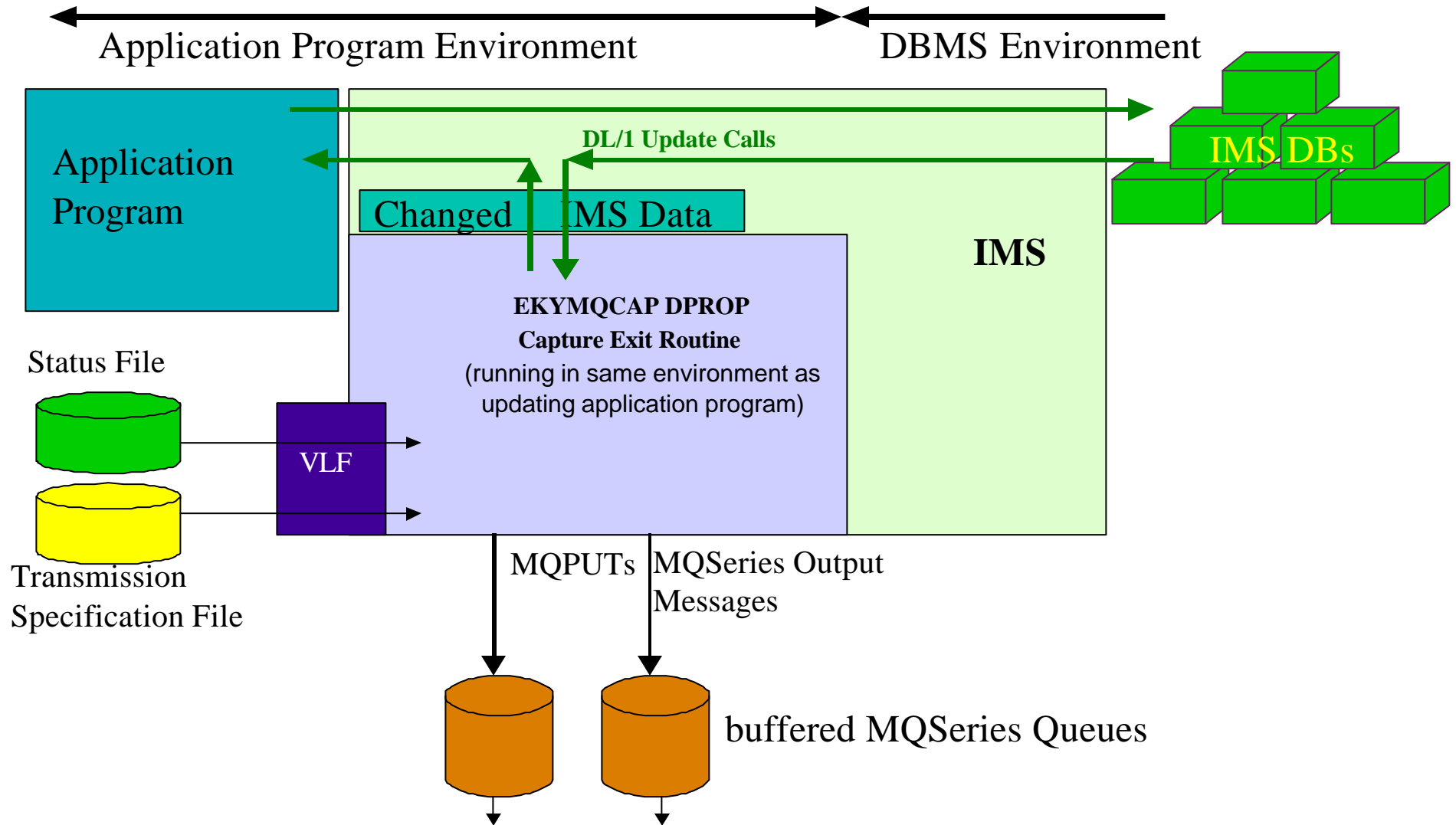
IMS Changed Data Capture Exit

- DBD Changes
 - ▶ EXIT=xxxxx
 - ▶ At DATABASE or SEGMENT 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 DPRDP option file - //EKYIN DD statement
- 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'

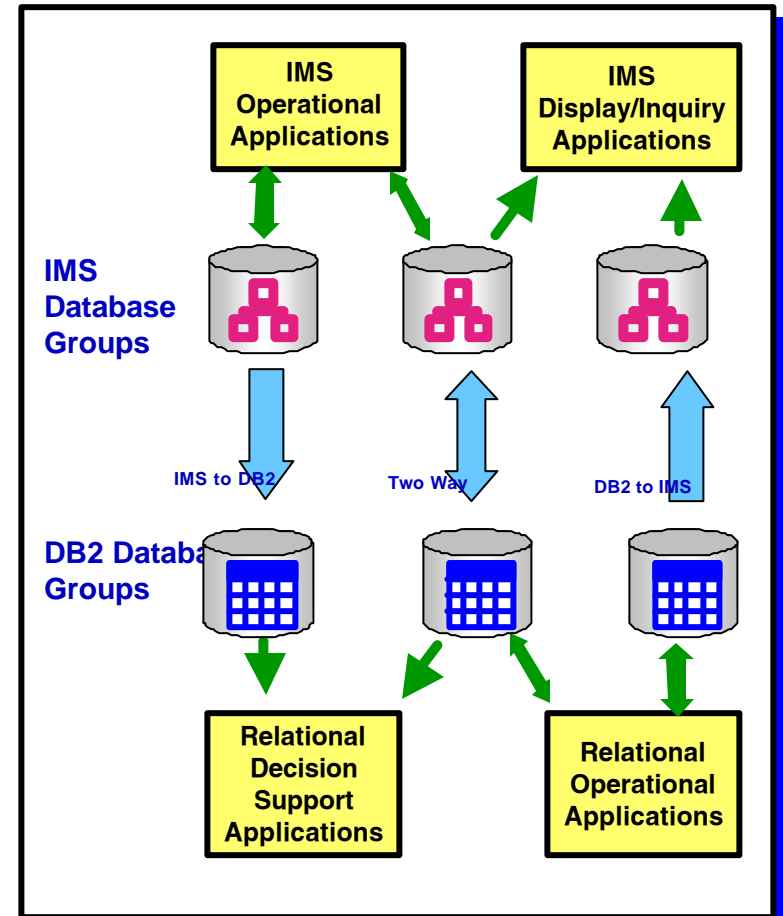
After stopping, the content of the target tables will reflect the content of the source IMS DBs at the Point-in-Time of the identified event.



IMS Data Propagator

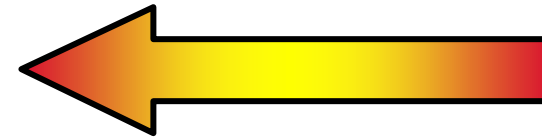
- Business Intelligence on IMS Production Data
- Application co-existence
- Application Migration

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



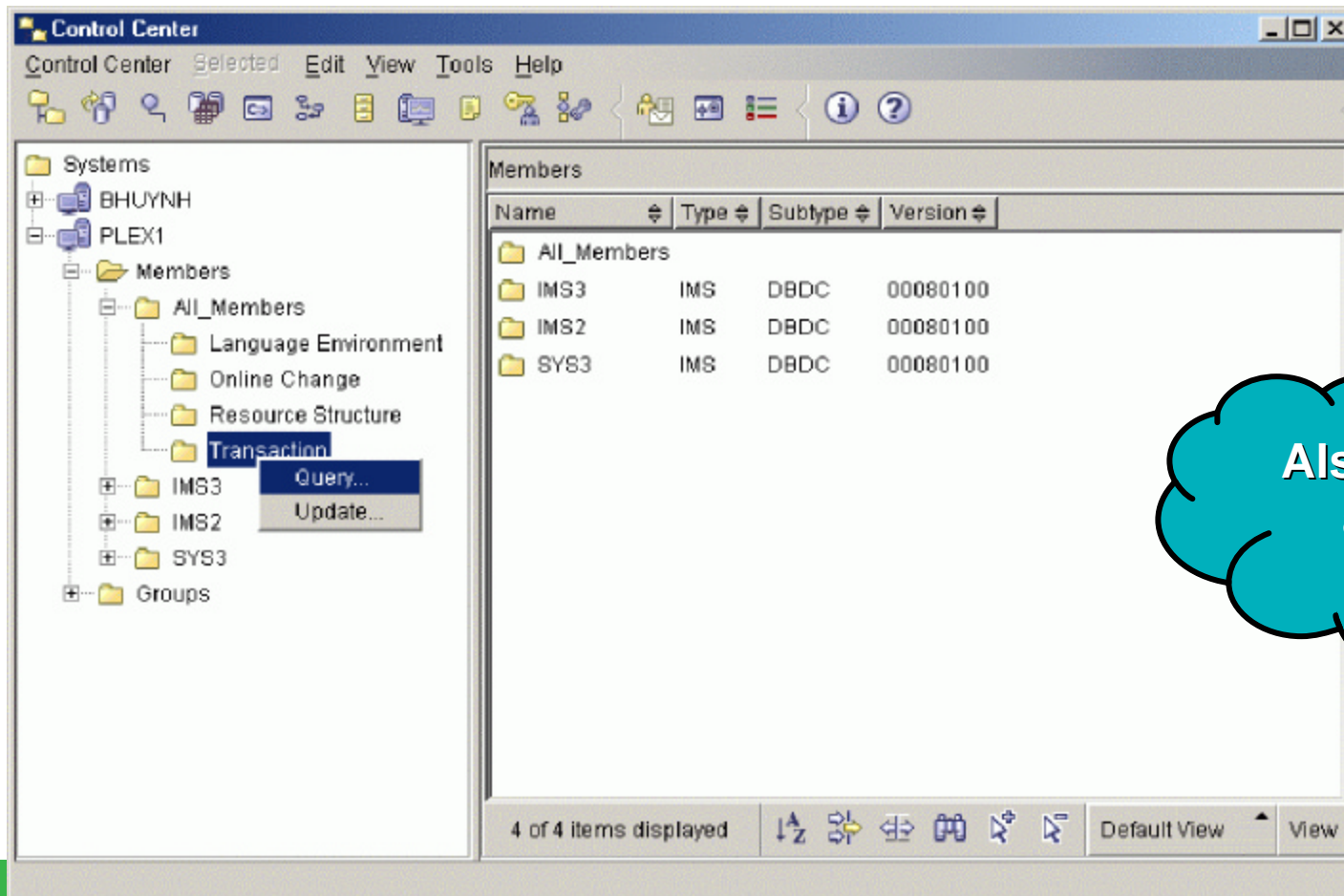
Agenda

- 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
- DB2 Control Center as IMS V8 SPOC
- The IBM Data Management Tools



IMS Control Center

- A work-station SPOC is also available
 - ▶ the Control Center (shipped with DB2)
- Requires IMS Connect as the interface between the Control Center (SPOC) and the Operations Manager



Also supports
a DBCTL
System



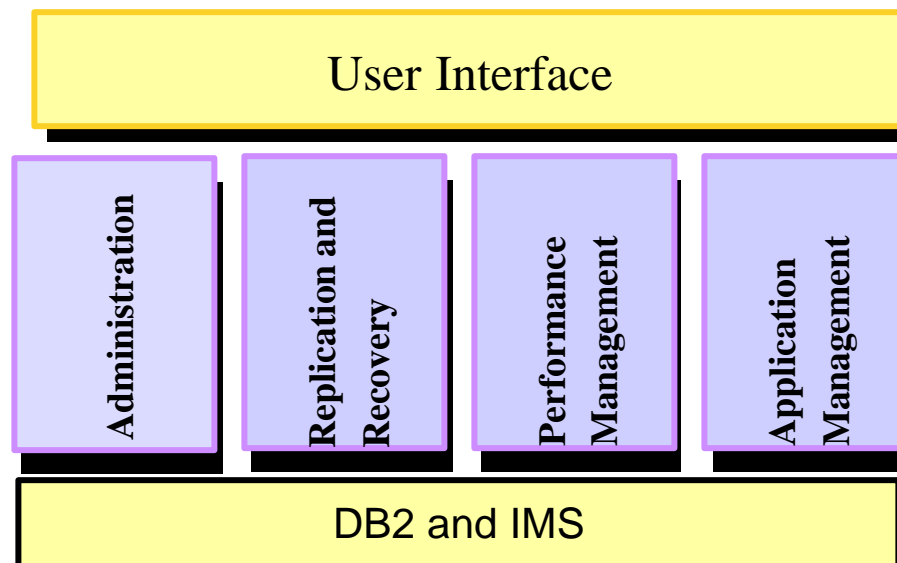
Agenda

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- The IBM Data Management Tools



zSeries Data Management Tools Strategy

- Significant IBM investments targeted at the growing tools market
 - ▶ Development, marketing, sales, & support
- New and enhanced suite of products
 - ▶ Comprehensive capabilities
 - ▶ Competitive and affordable
- Available for multiple releases of IMS and DB2



***March and
September
announcements,
and more***

***More than 70
Tools***



IMS Tools Product Portfolio + April 2003+ June 2003 Ann.

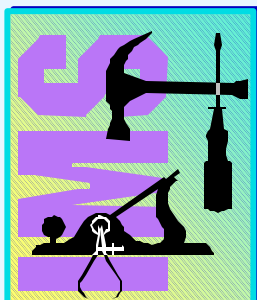
Administration

IMS TM Administration

- ▶ *IMS Queue Control Facility 5697-E99*
- ▶ *ETO Support 5655-E12*
- ▶ *IMS Workload Router V2.3 5697-B87 (PSLC)*

IMS System Administration

- ▶ *IMS IMS High Performance Sysgen Tools 5655-F43*
- ▶ *IMS Command Control Facility 5655-F40*



IMS DB Administration

- ▶ *IMS High Performance Unload 5655-E06*
- ▶ *IMS High Performance Load 5655-E07*
- ▶ *IMS High Performance Prefix Resolution 5655-I15*
- ▶ *IMS Index Builder V2.3 5655-E24*
- ▶ *IMS Parallel Reorganization V2 5655-F74*
- ▶ *IMS Online Reorganization Facility for z/OS (beta program)*
- ▶ *IMS High Performance Pointer Checker V2 5655-K53*
- ▶ *IMS Data Base Repair Facility 5655-E03*
- ▶ *IMS Library Integrity Utilities 5655-I42*
- ▶ *IMS Sequential Randomizer Generator 5655-E11*
- ▶ *IMS Compression - Extended 5655-E02*
- ▶ *IMS Data Base Control Suite V2R2 5655-F76*
- ▶ *IMS Fast Path Basic Tools 5655-E30*
- ▶ *IMS Fast Path Online Tools V1 5655-E31 (V2 5655-F78)*
- ▶ *HALDB Conversion and Maintenance Aid 5655-K47*
- ▶ *Data Encryption for IMS & DB2 Databases V1 5799-GWD*

Performance Management

- ▶ *IMS Performance Analyzer V3.2 5655-E15*
- ▶ *IMS Network Compression Facility 5655-E41*
- ▶ *IMS Buffer Pool Analyzer 5697-H77*
- ▶ *IMS Problem Investigator for z/OS (5655-K50)*
- ▶ *IMS Performance Monitor for z/OS (beta program)*

Recovery / Replication

- ▶ *IMS High Performance Change Accumulation 5655-F59*
- ▶ *IMS Image Copy Extensions V2R1 5655-J56*
- ▶ *IMS DEDB Fast Recovery V2R2 5655-E32*
- ▶ *Application Recovery Tool for DB2 and IMS V1R2 5697-F56*
- ▶ *Online Recovery Service (ORS) 5655-E50*
- ▶ *IMS Database Recovery Facility for z/OS, V2.1 (5655-I44)*
- ▶ *IMS Data Propagation 5655-E52*

Application Management

- ▶ *IMS Connect V2 5655-K52*
- ▶ *IMS Message Format Services Reversal Utilities 5655-F45*
- ▶ *IMS Program Restart Facility 5655-E14*
- ▶ *IMS Batch Backout Manager 5697-H75*
- ▶ *Batch Terminal Simulator V3 5655-A14*
- ▶ *IMS Multi-Dialog Manager for z/OS (5697-H91)*



DB2 Utilities & Tools Portfolio

Administration

Object Management

- ▶ DB2 Administration Tool V4.2 5655-I23
- ▶ DB2 Object Comparison Tool V2.1 5655-I20
- ▶ Data Encryption for IMS & DB2 Databases V1 5799-GWD

Utility Management

- ▶ DB2 V7 Utilities Suite 5697-E98
 - DB2 V7 Operational Utilities 5655-E63
 - DB2 V7 Diagnostic & Recovery 5655-E62
- ▶ High Performance Unload V2.1 5655-I19
- ▶ DB2 Automation Tool V1.3 5655-G63

Recovery & Replication

Recovery Management

- ▶ DB2 Object Restore V1.3 5655-E72
- ▶ DB2 Log Analysis Tool V1.3 5655-E66
- ▶ DB2 Change Accumulation Tool V1.2 5655-F55
- ▶ DB2 Application Recovery for IMS & DB2 V1.2 5697-F56
- ▶ DB2 Archive Log Compression V1.1 5655-F54
- ▶ DB2 Archive Log Accelerator for z/OS, V2 (5697-I73)
- ▶ DB2 Row Archive Manager V1.1 5655-E65
- ▶ DB2 Batch Thread Cancel V1.1 5799-GWE

Replication Management

- ▶ DB2 DataPropagator V8.1 5655-I60
- ▶ DB2 Replidata V3.1 5799-GKW

Perf.

Performance Management

- ▶ DB2 Performance Expert V1.1 5655-I21
- ▶ DB2 Performance Monitor V7.2 5655-E61
- ▶ DB2 Query Monitor V1.2 5655-E67
- ▶ DB2 SQL Performance Analyzer V2.1 5655-I22
- ▶ DB2 Buffer Pool Analyzer V1.2 5655-E54

Application Management

- ▶ DB2 Bind Manager V2.1 5655-E43
- ▶ DB2 Path Checker V1.2 5655-E39
- ▶ DB2 Table Editor V4.3 5655-G65
- ▶ DB2 Data Export Facility V1.1 5655-E46
- ▶ DB2 Web Query Tool V1.1 5655-E71

Appli.
Mgt



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/>
- zSeries Books
 - ▶ http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/LIBRARY

