

A35

Using IMS and DB2 Together

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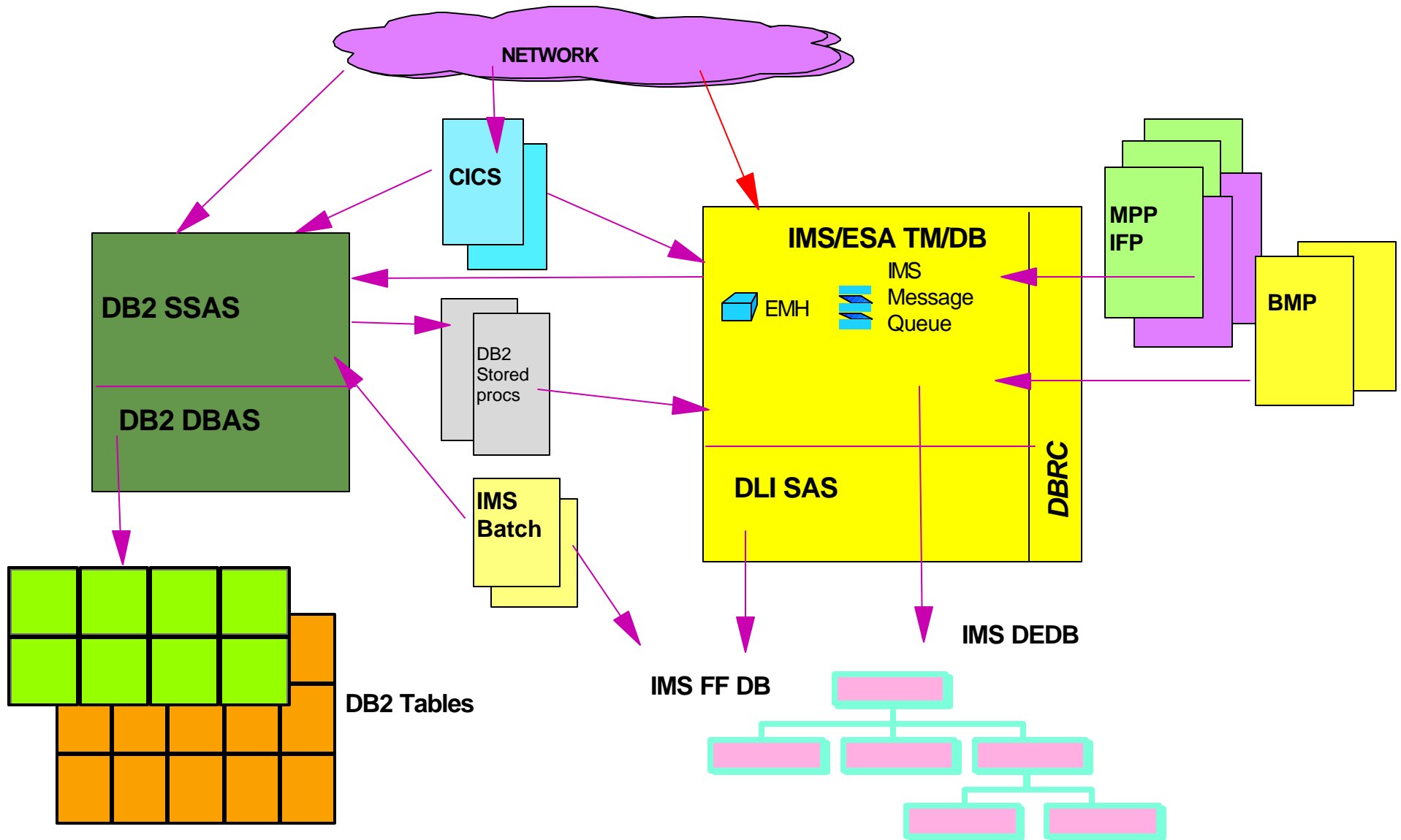


Miami Beach, FL

October 22-25, 2001

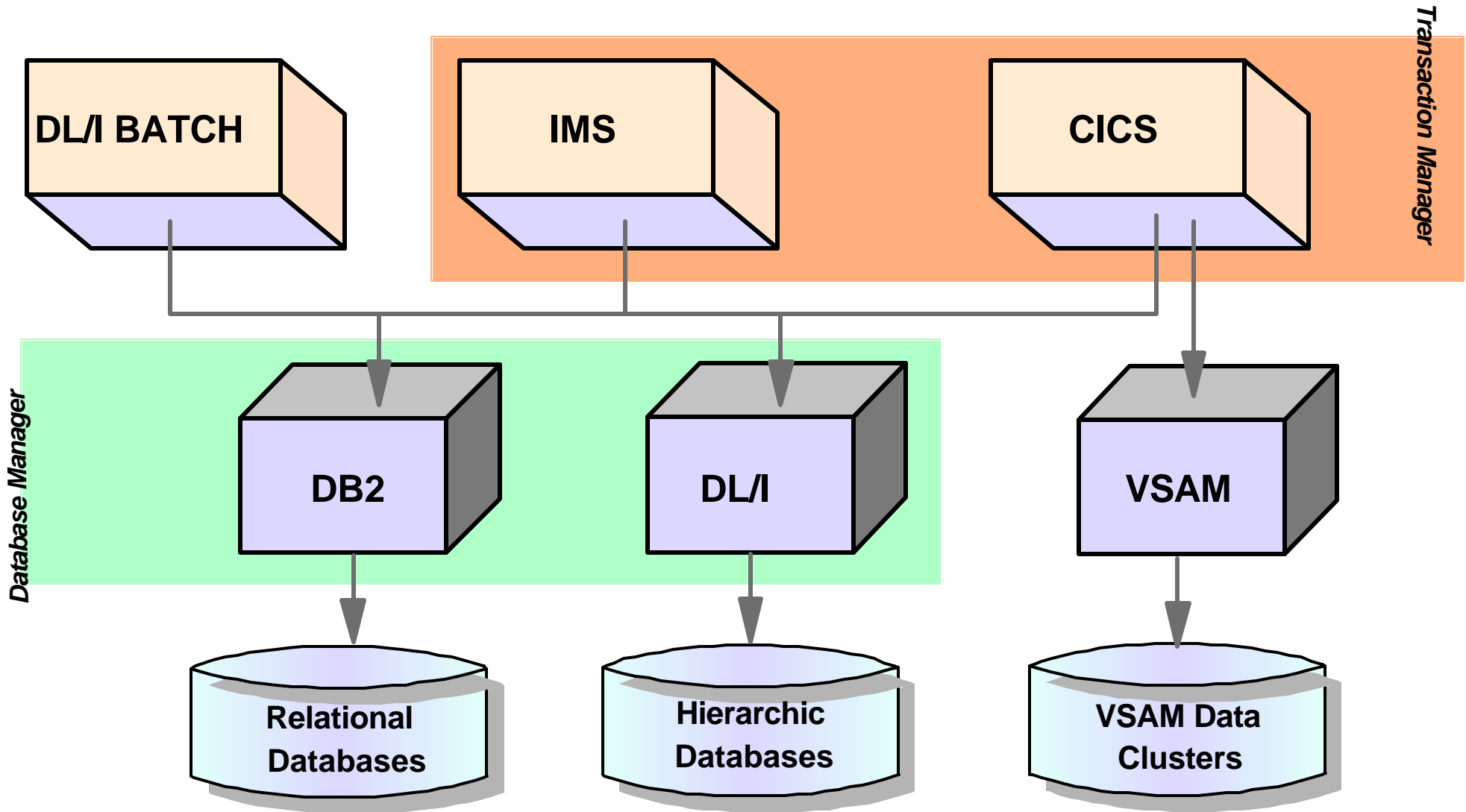


z/OS Transaction and Database Managers





IMS and DB2 - Multiple 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 from IMS DB data to DB2 data**
 - Data Refresher
 - IMS Data Propagator
- ▲ **The IBM Data Management Tools**

IMS as a transaction manager can execute application programs which access IMS databases as well as DB2 tables. This session explains how the External Subsystem Attach Facility (ESAF) works and how IMS and DB2 can work together.



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

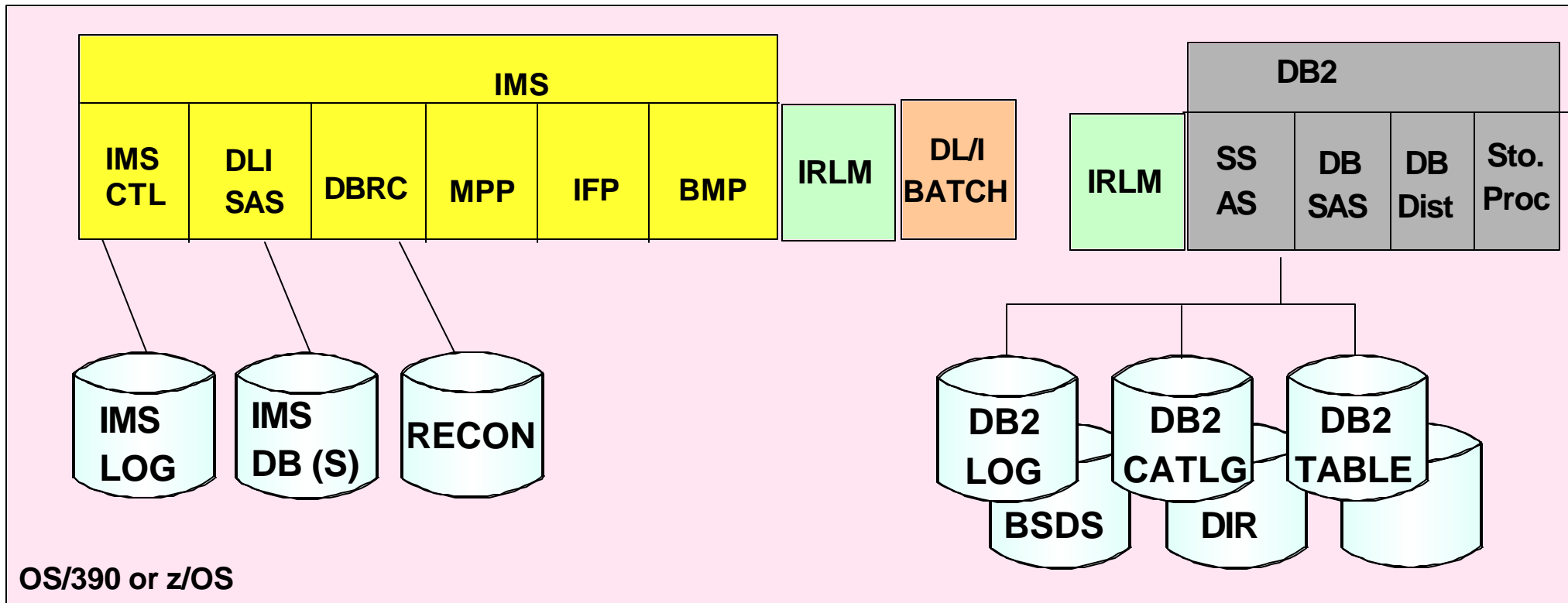
depending on the DFSLIxxx module which is link-edited with.

▲ Coordinated Recovery/Restart

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



IMS DB2 Subsystem Attachment Facility ...

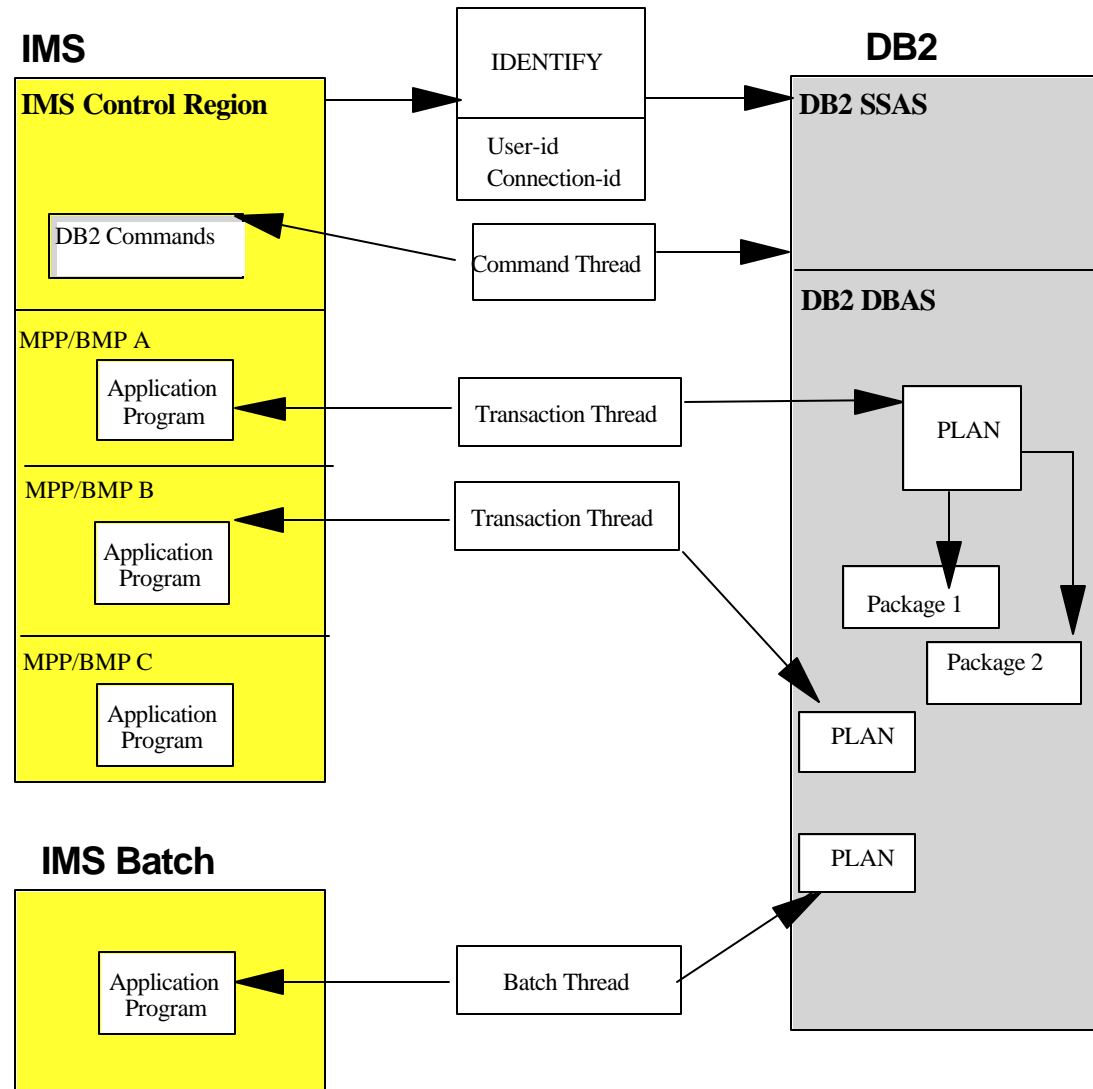


- ▲ IMS and DB2 must be on same OS/390 image
- ▲ One DB2 Subsystem can be connected to multiple IMSs
- ▲ One IMS Subsystem can connect to multiple DB2s
- ▲ One IMS dependent region can connect to multiple DB2s
- ▲ One application program can access only one DB2 per schedule



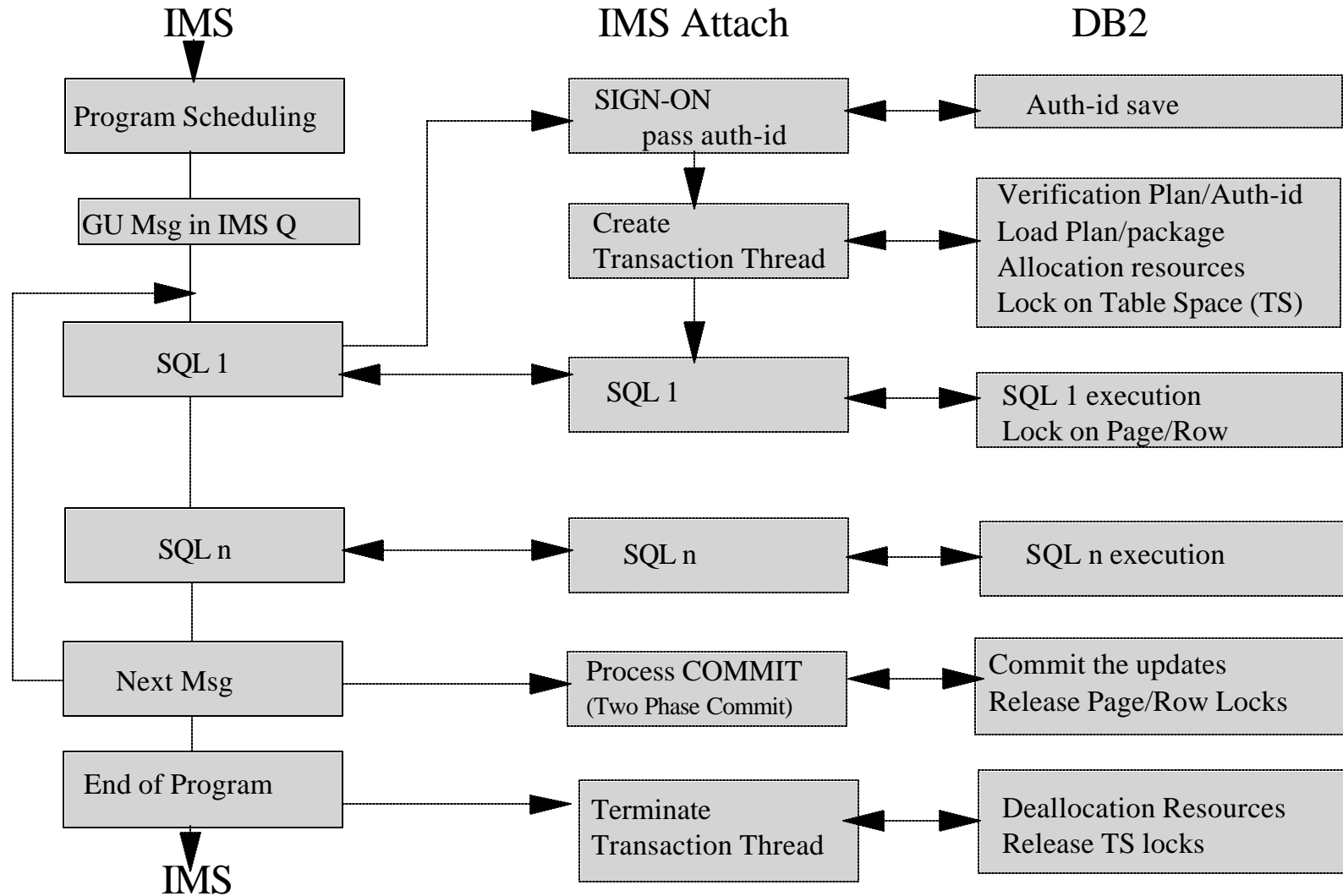
IMS DB2 Subsystem Attachment Facility ...

- ▲ **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
------	------	---	---	---	---

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

```
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 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



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



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DB2 Stored Procedures

▲ DB2 Version 4 introduced stored procedure support

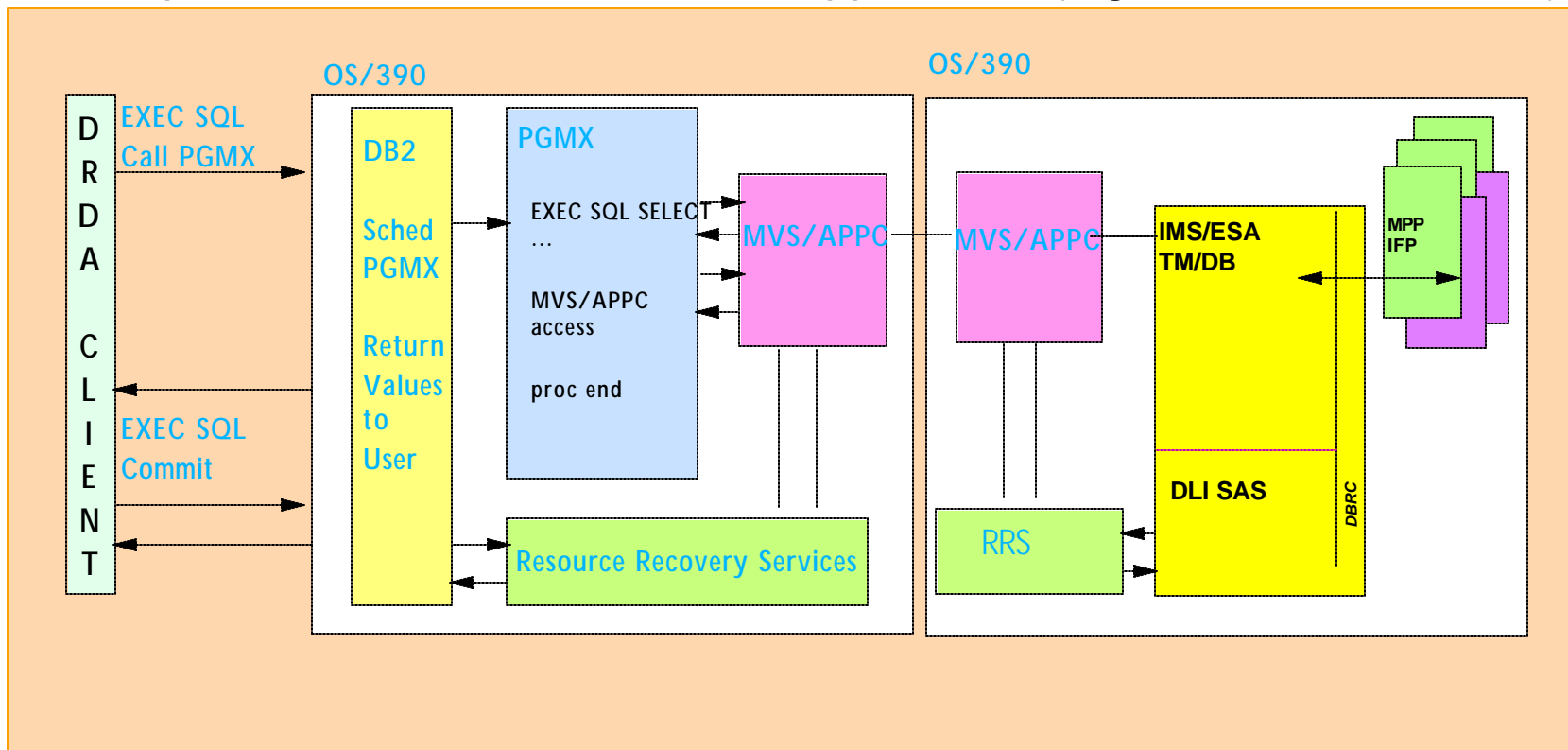
- Enables users to "bundle" multiple SQL statements into a single unit
- A "stored procedure" residing on the mainframe
- Clients can then execute these statements by issuing one network call

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



Access to IMS Transactions using APPC

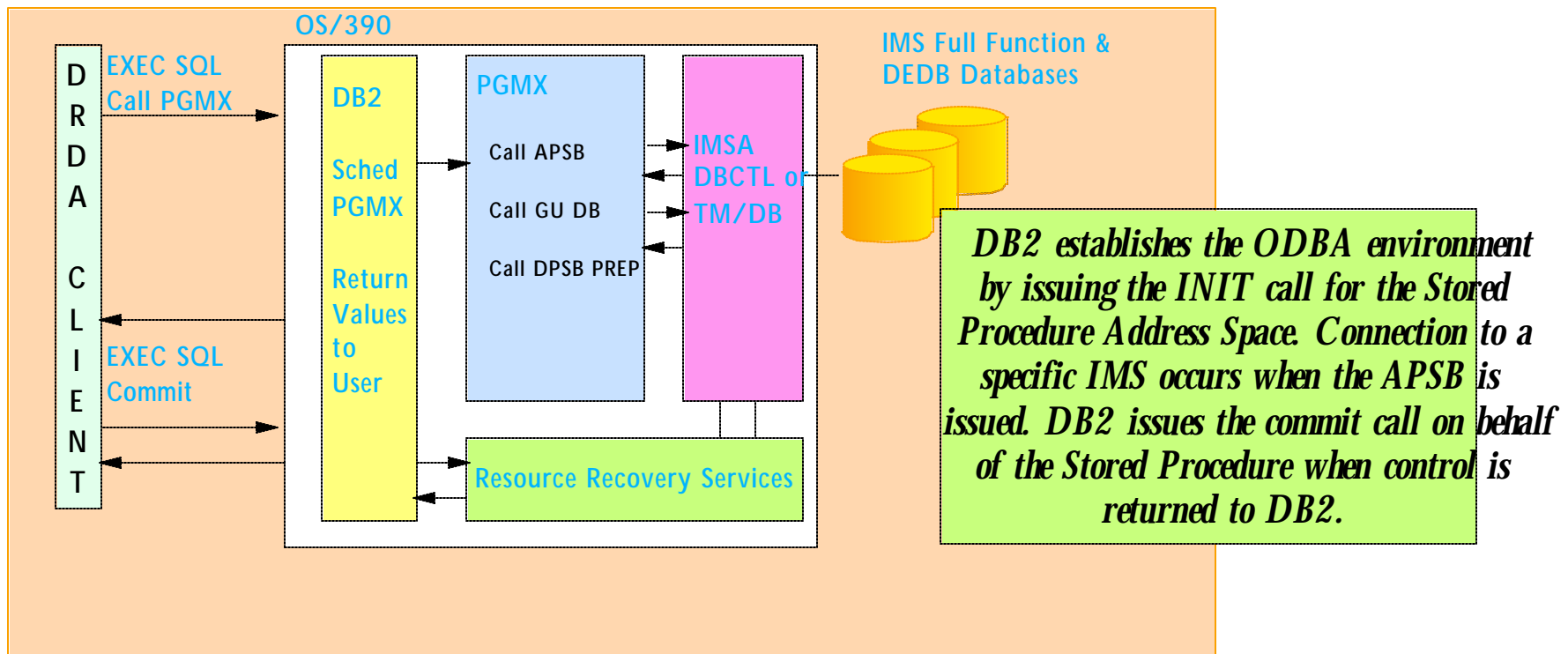
- ▲ **DB2 Stored Procedures Address Space uses MVS/APPC calls to access IMS TM Subsystem**
 - On same OS/390 or on different OS/390
- ▲ **DB2 notifies RRS about Commit/abond decisions**
- ▲ **RRS passes decision to other resources manager**
 - Allows 2-phase commit with MVS/APPC applications (e.g. an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





Access to IMS Databases using call DLI (ODBA)

- ▲ **DB2 Stored Procedures Address Space access to an IMS DB Subsystem**
- ▲ **DLI 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 Proc Requirements

▲ To use ODBA with DB2 Stored Procedures:

- OS/390 RRS is required
- Workload Manager Established Address Space is required
- Therefore DB2 Version 5 or higher is needed
- Only the PREP subfunction of the DPSB call should be issued by the Stored Procedures

▲ You can code the Stored Procedure in any language supported by the Stored Procedure



IMS V7 Java

- ▲ **Support included in IMS V7**
- ▲ **Provides applications to be written in Java and run in IMS TM as MPPs, BMPs, IFPs**
 - Supports conversational and non-conversational transactions
 - Provides Class libraries for input-output message handling
 - Supports Message Format Services
- ▲ **Using JDBC for data access to IMS DB and/or DB2**
 - Provides JDBC 1.0 access to IMS DB
 - Will support JDBC/SQLJ 1.0 access to DB2
- ▲ **Using Host and VisualAge tools for development**
 - Compile using High Performance Java Compiler
 - Create VisualAge projects and do Remote Build
 - Edit using VisualAge editor
 - Remote debugging using VAJava Remote Debug tool
 - Performance Tracing
 - Usable from VisualAge for Java's ET/390





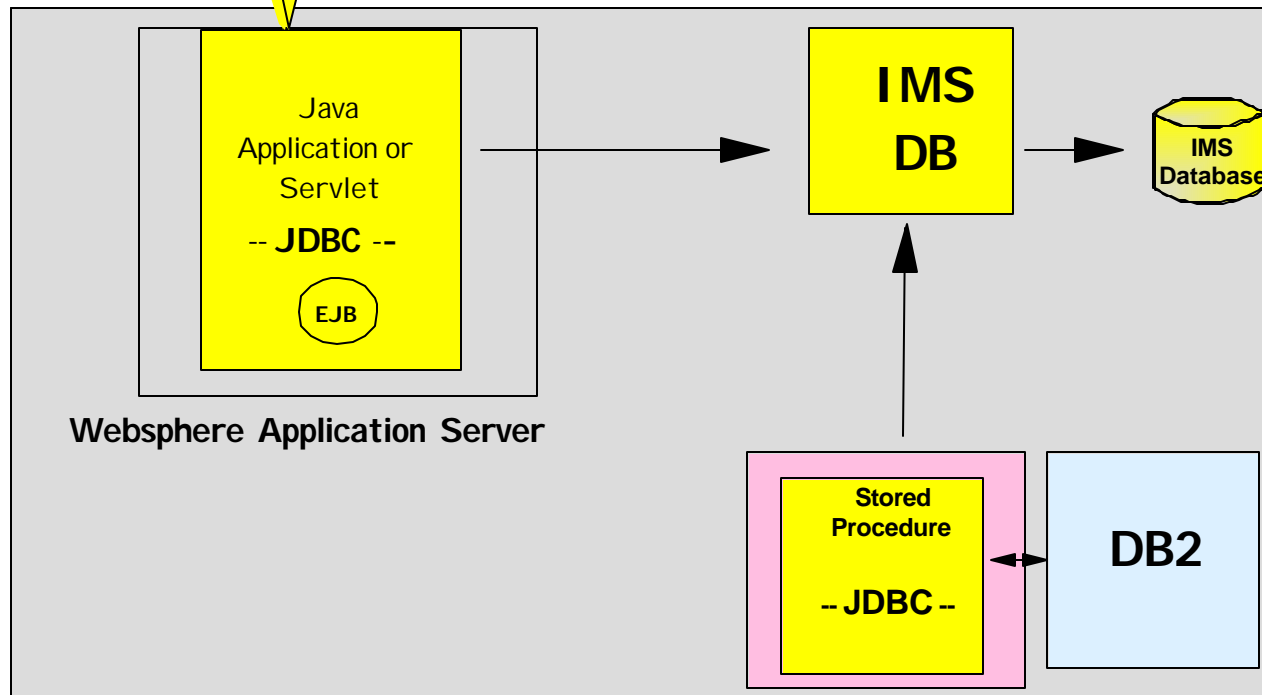
IMS V7 Java ...



OS/390

HTML/XML

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





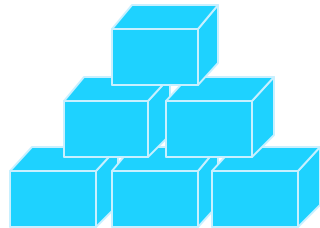
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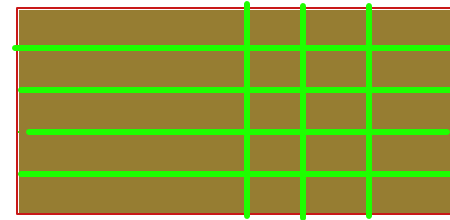
Data Characteristics

Operational Data



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

Informational Data

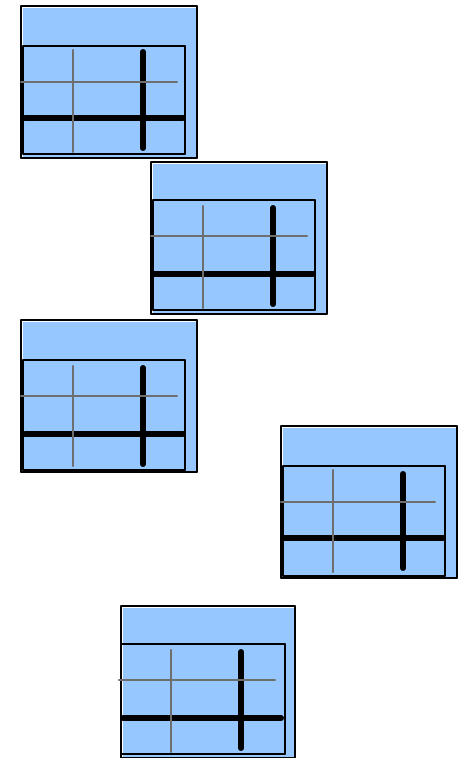
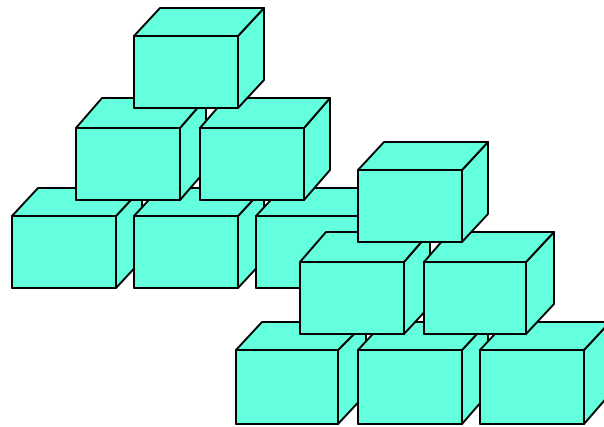


Subject Oriented
Integrated
Non-volatile
Values Over Time
Supports Decision Making

Operational and Informational Data are Fundamentally Different



Building the Warehouse



Copy to the Warehouse

- Decode, cleanse, summarise, enhance data
- Time series values
- Isolate from Operational System
- Cyclic Update - reproducible results

How?

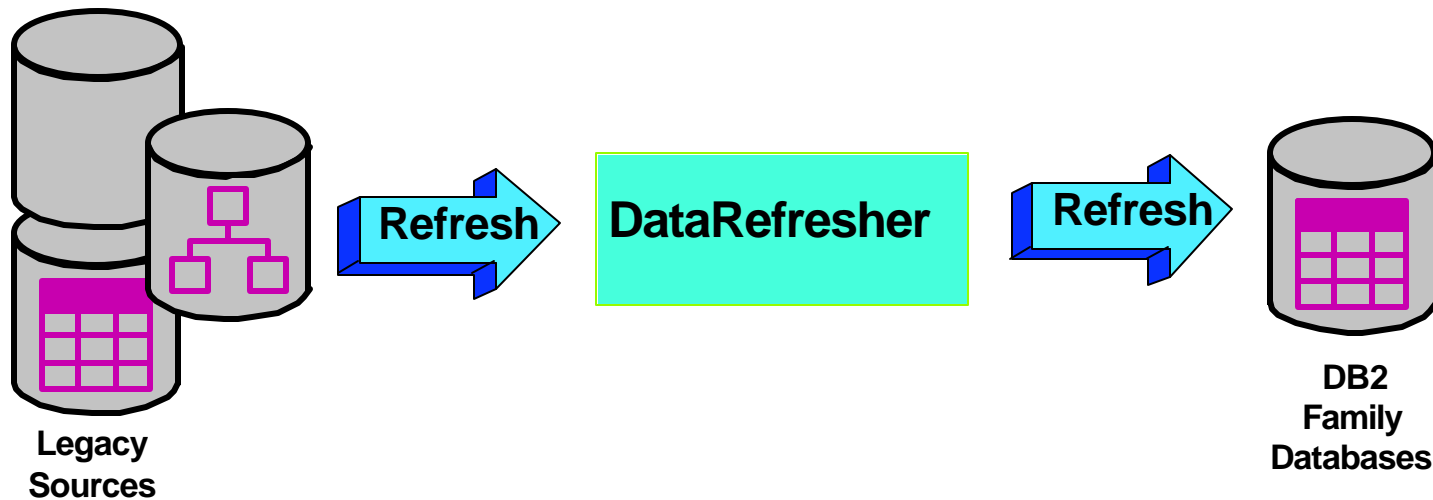
- DataRefresher for mass extract
- IMS DataPropagator for changes



Mass Extract - DataRefresher

▲ Build informational databases on the DB2 family

- From any data source on MVS and from DB2/VM
- Heterogeneous join across sources
- Eliminate extract application development and maintenance
- Data enhancement
- Client/Server implementations

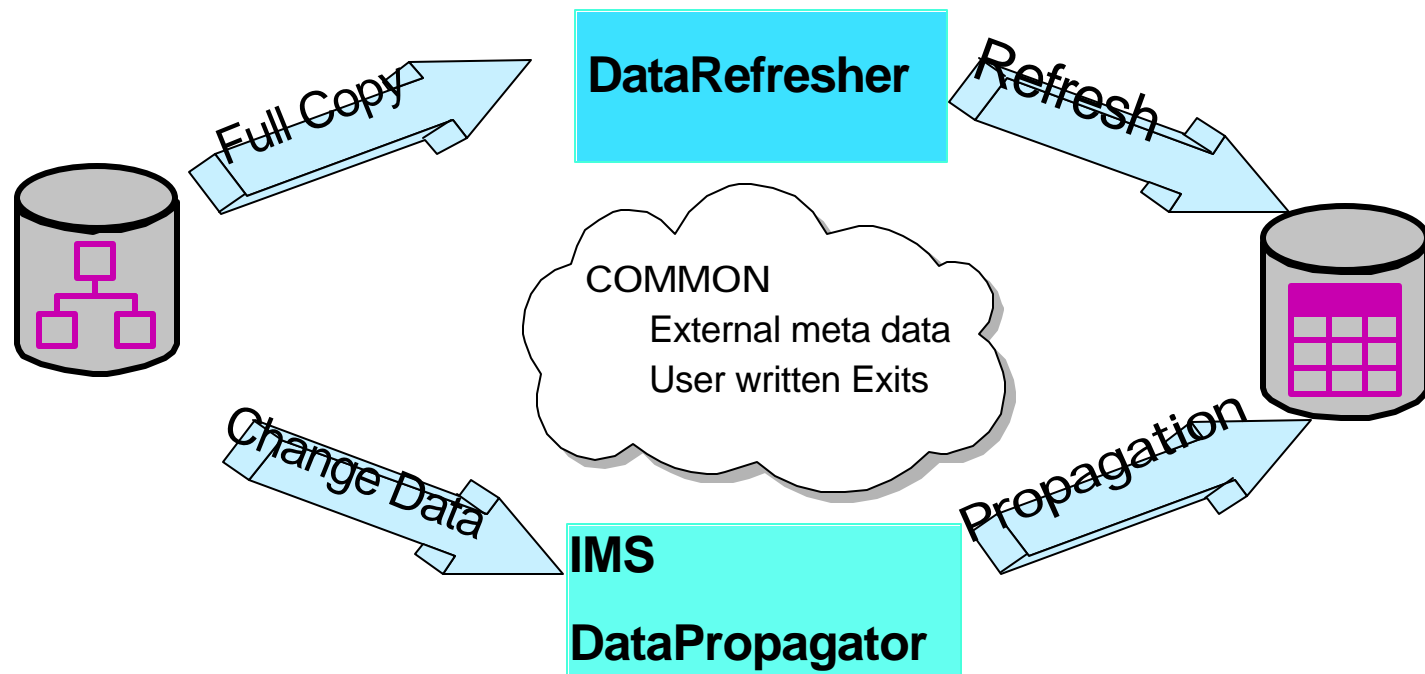




Capturing Changes - DR and IMS DataPropagator

▲ Build informational databases on the DB2 family

- From any data source on MVS
- Heterogeneous join across sources
- Eliminate extract application development and maintenance
- Data enhancement
- Client/Server implementations





IMS Data Propagator - Functions at a glance

- ▲ Renamed from DPROPNR
- ▲ 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

V1 R1		■ IMS → DB2 (Synchronous)
V1 R2	Added	■ IMS ← DB2 (Synchronous)
V2 R1	Added	■ IMS → DB2 (Asynchronous)
V2 R2	Added	■ MVS Sysplex Support ■ IMS & DB2 Data Sharing ■ IMS V6 and V7 Support
V3	Added	■ <i>IMS → DB2 with MQSeries</i>



IMS DataPropagator Uses

Decision Support

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

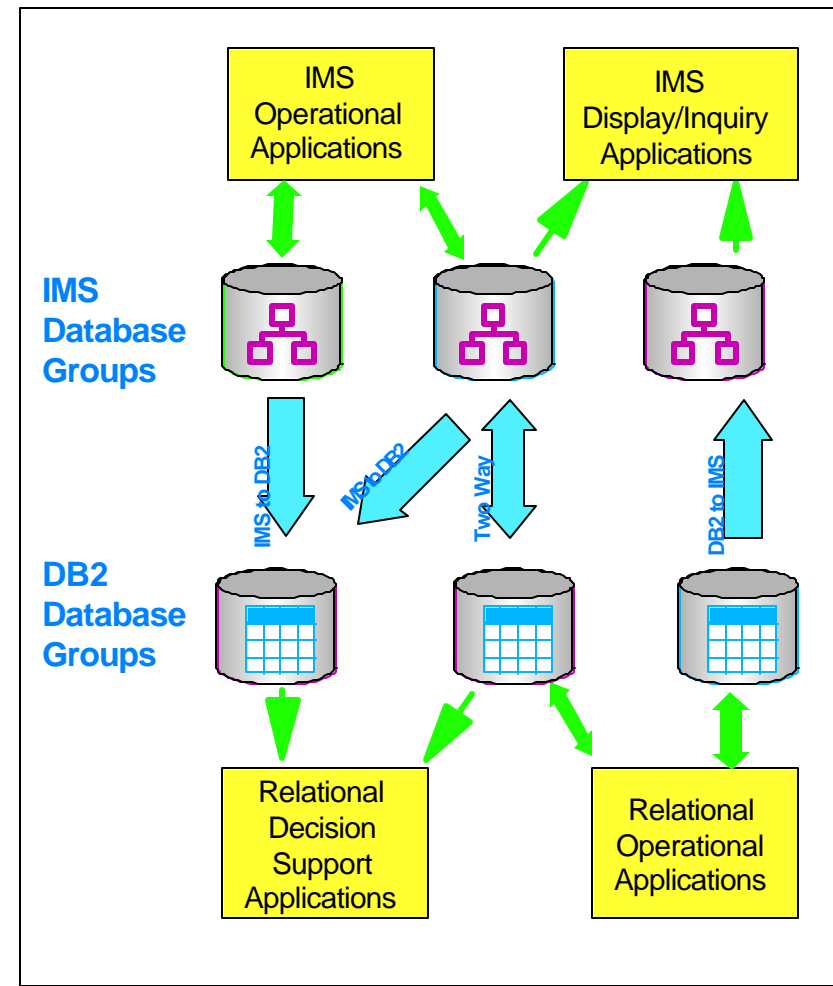
Application co-existence

- Two masters
- Data in both systems synchronized

Application Migration

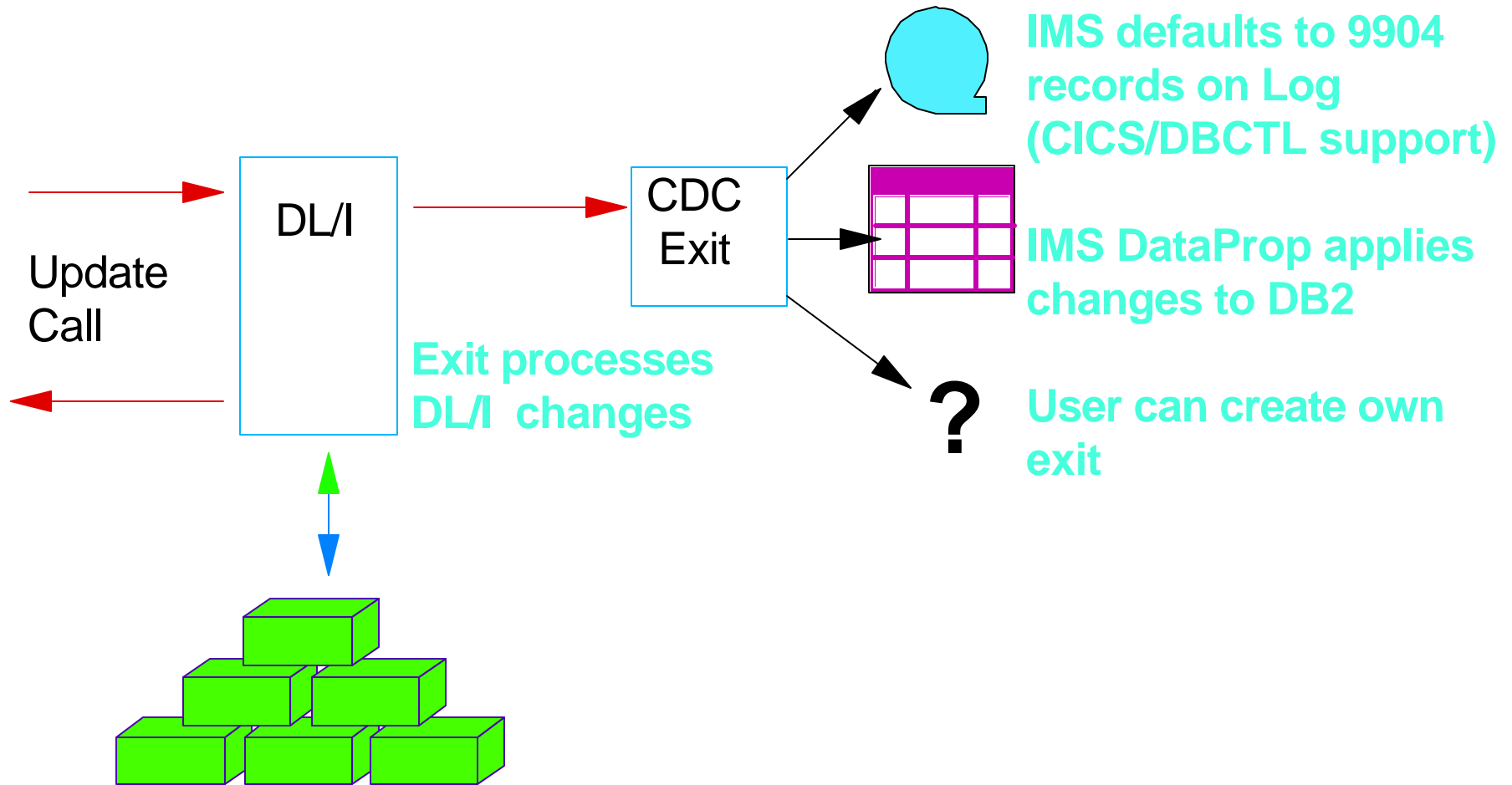
- Gradual, orderly migration
- Minimal risk

No Change to Existing Applications





IMS Change Data Capture

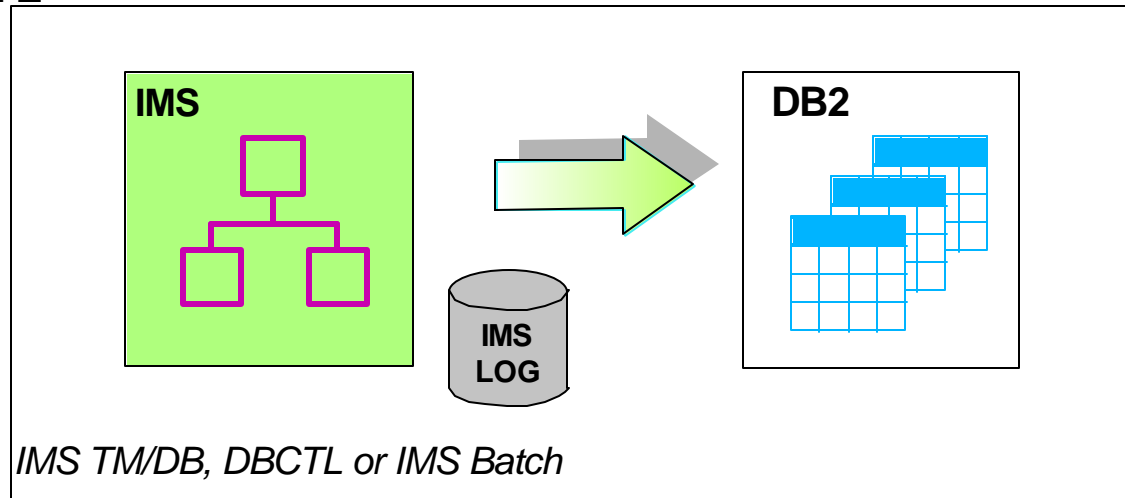




Asynchronous Propagation Mode

▲ Updates from

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



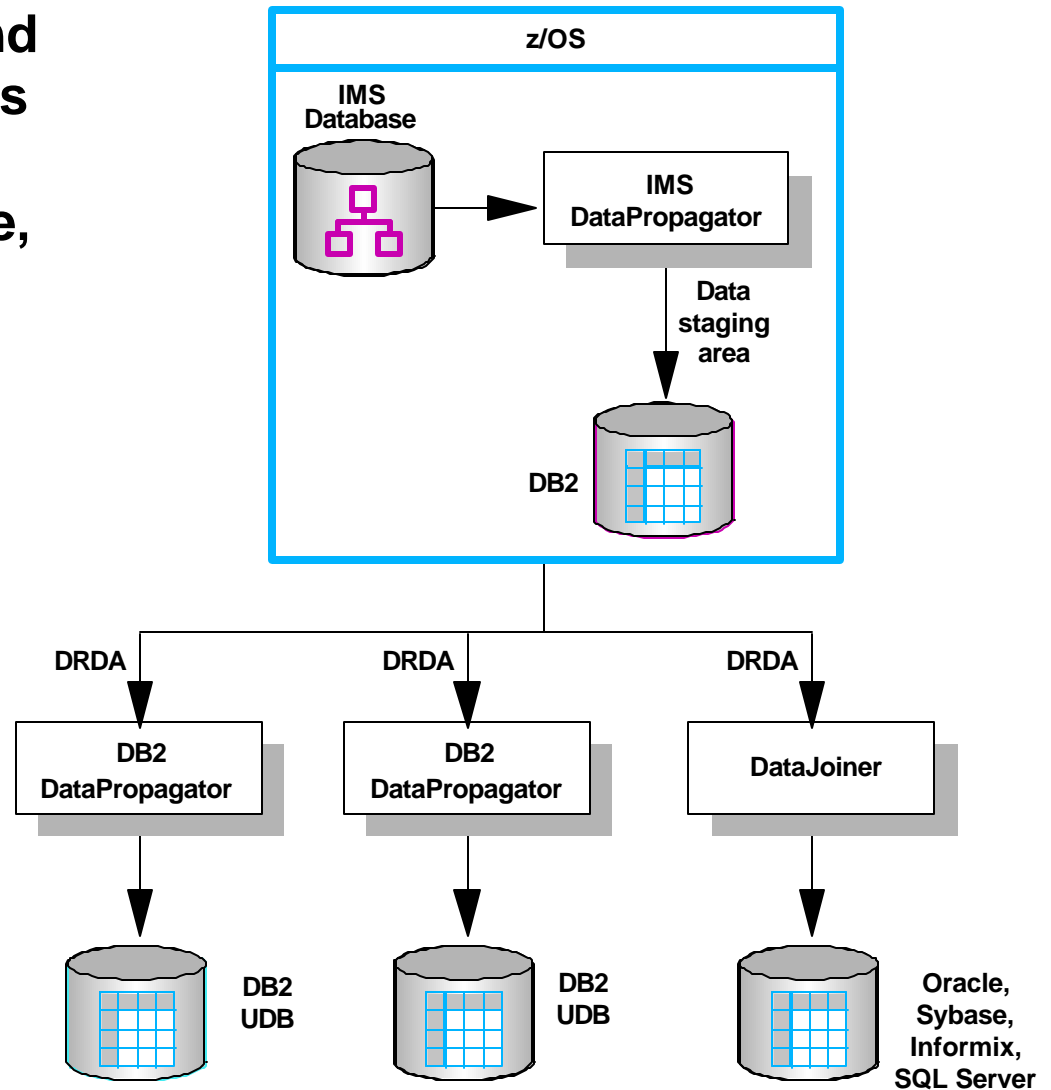
▲ Source updates propagated to target copy at a later point in time

- 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 Beyond DB2 on z/OS

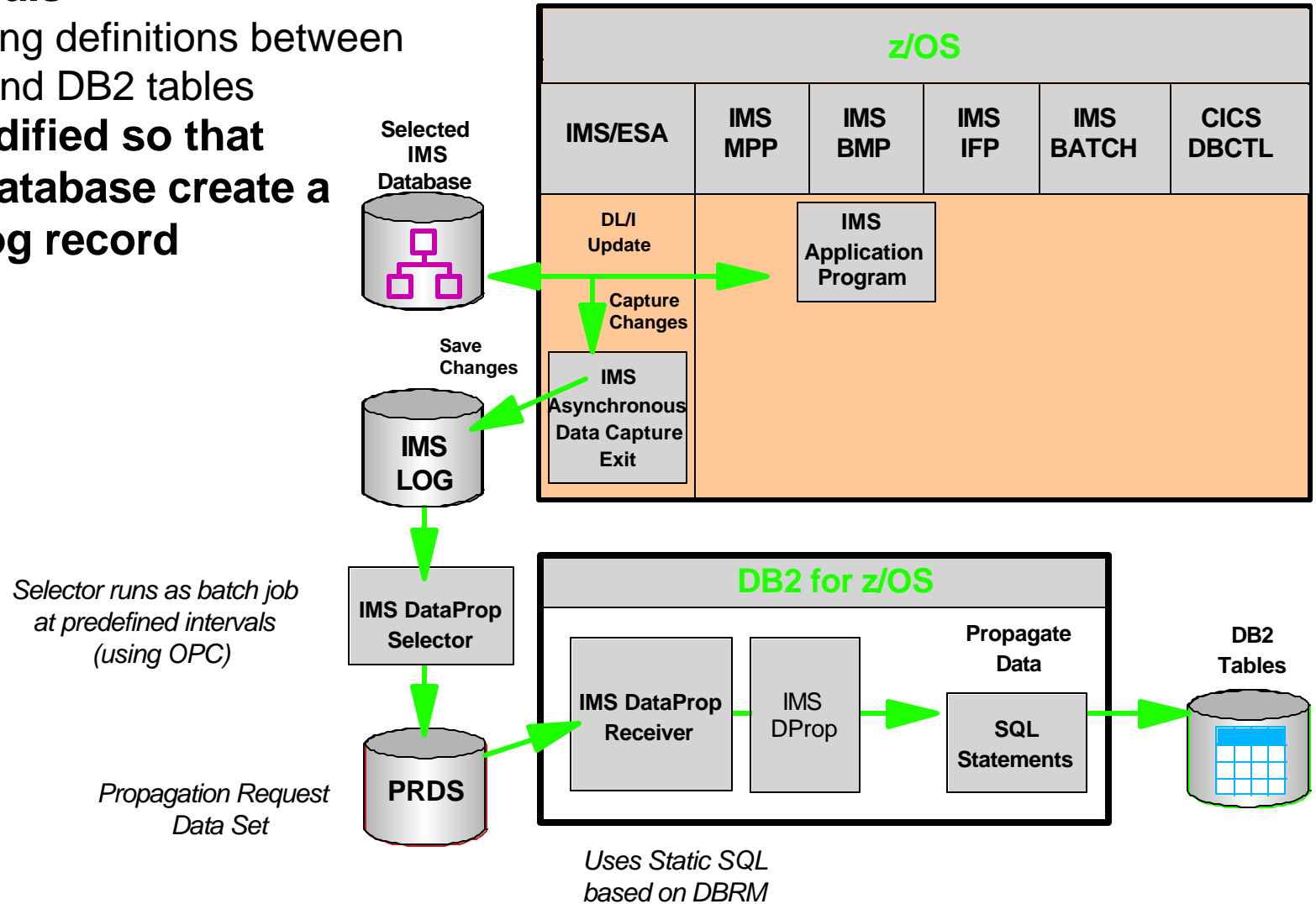
- ▲ **IMS DataProp & DB2 DataProp extend IMS data to DB2 UDB on all platforms**
- ▲ **IMS DataProp, DB2 DataProp & DataJoiner extend IMS data to Oracle, Sybase, Informix, Microsoft SQL Server, etc.**





Asynchronous Propagation Environment

- ▲ Updates applied at installation determined intervals
 - Based on mapping definitions between DL/I segments and DB2 tables
- ▲ DBD must be modified so that changes to IMS database create a specific type of log record

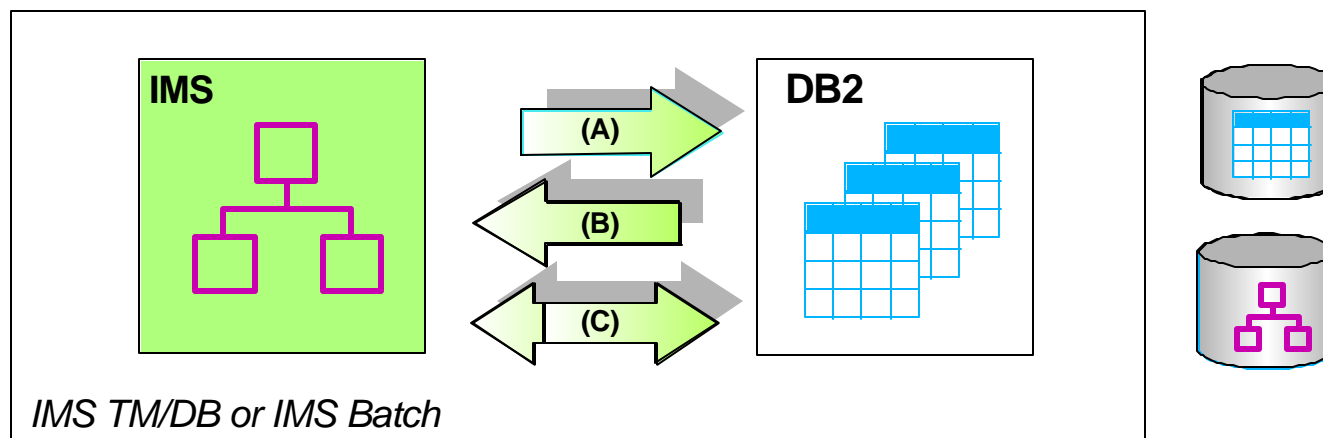




Synchronous Propagation Mode

▲ Updates from

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



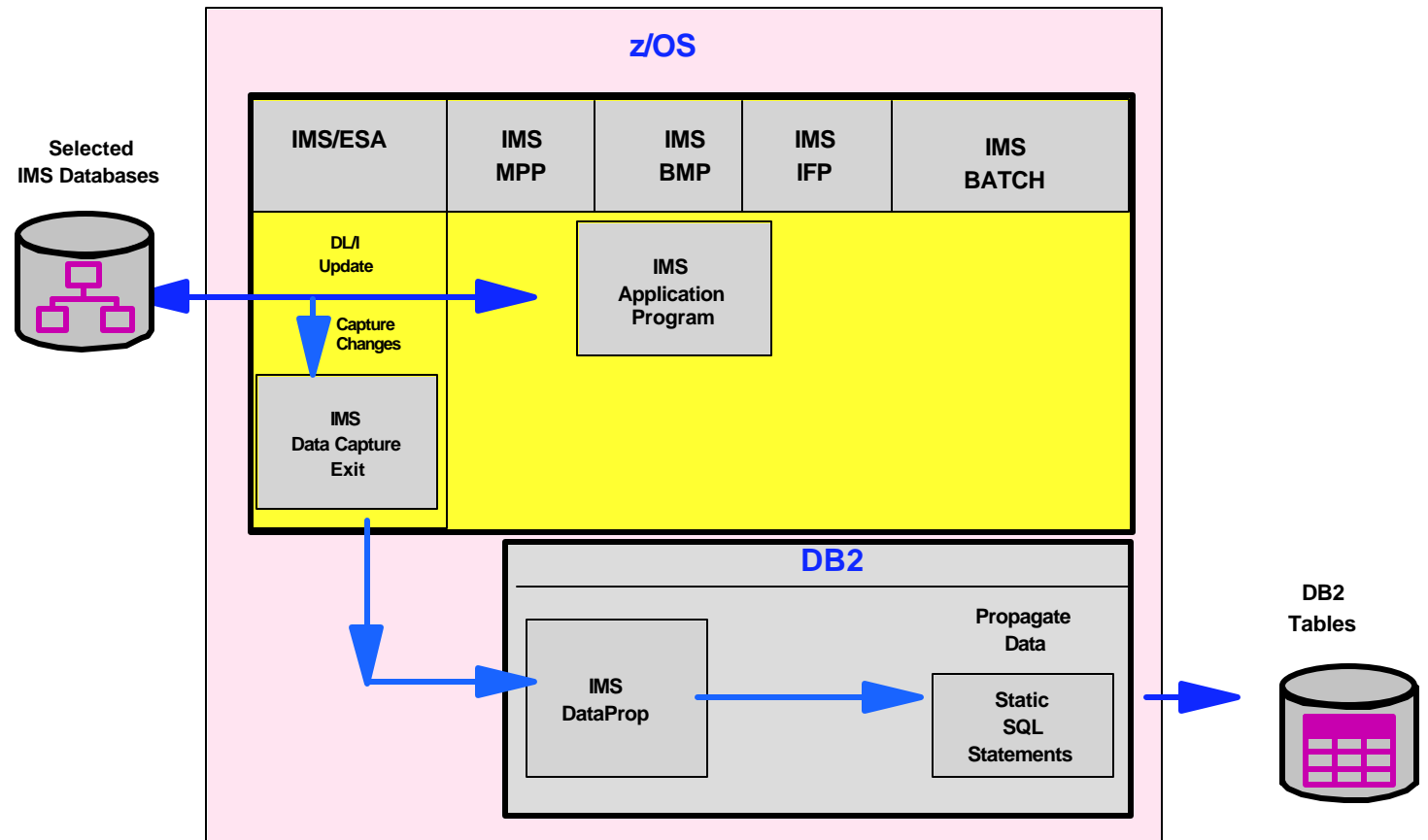
▲ Source updates propagated to target copy within commit scope of updating application

- IMS and DB2 must reside on same OS/390 image
- Consistent copy of source data
- Updates available in real-time
- Additional system overhead at peak times



Synchronous Propagation - IMS to DB2

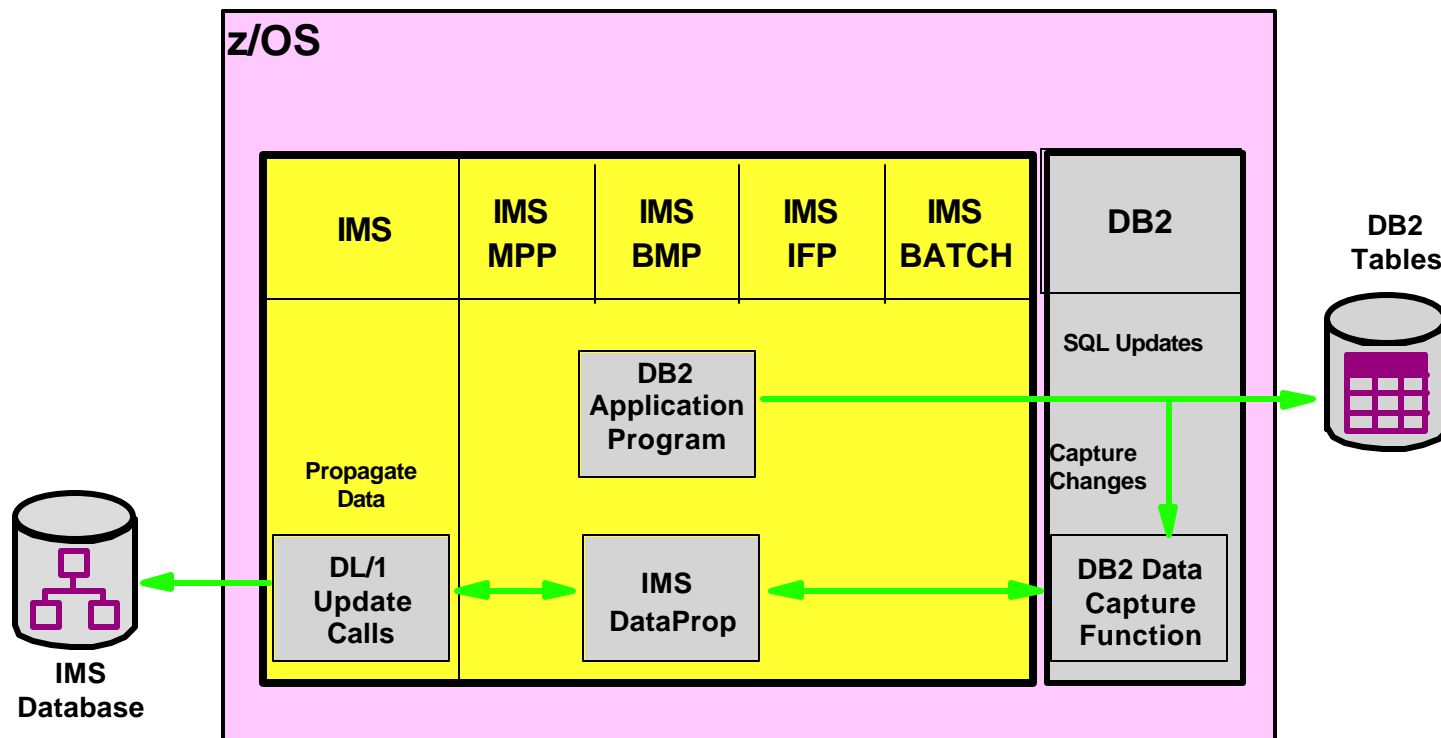
- ▲ Changes propagated in the same unit of work
- ▲ Data integrity and consistency
- ▲ IMS master, DB2 read only copy





Synchronous Propagation - DB2 to IMS

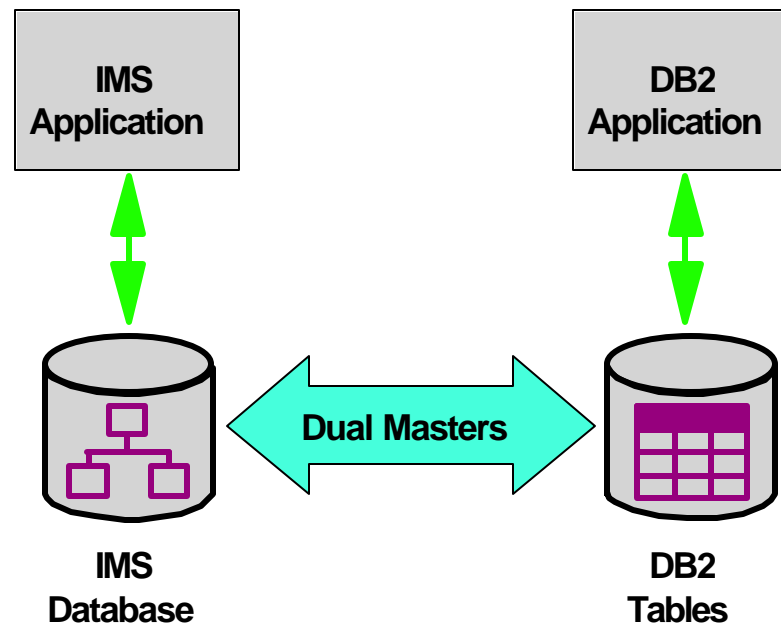
- ▲ Changes propagated in the same unit of work
- ▲ Uses DB2 Data Capture exit
- ▲ Data integrity and consistency
- ▲ DB2 master, IMS read only copy





Synchronous Propagation - Two Way

- ▲ New applications can use either data store
- ▲ Data integrity and consistency
- ▲ Both master copies can be updated





IMS Data Mapping & Selection

- ▲ A mapping definition establishes a correspondence between the source and the target data

IMS	DB2
Segment	Table
Field	Column
Segment Occurrence	Row
Parent/Child Relationship	RIR (Referential Integrity Relationships)

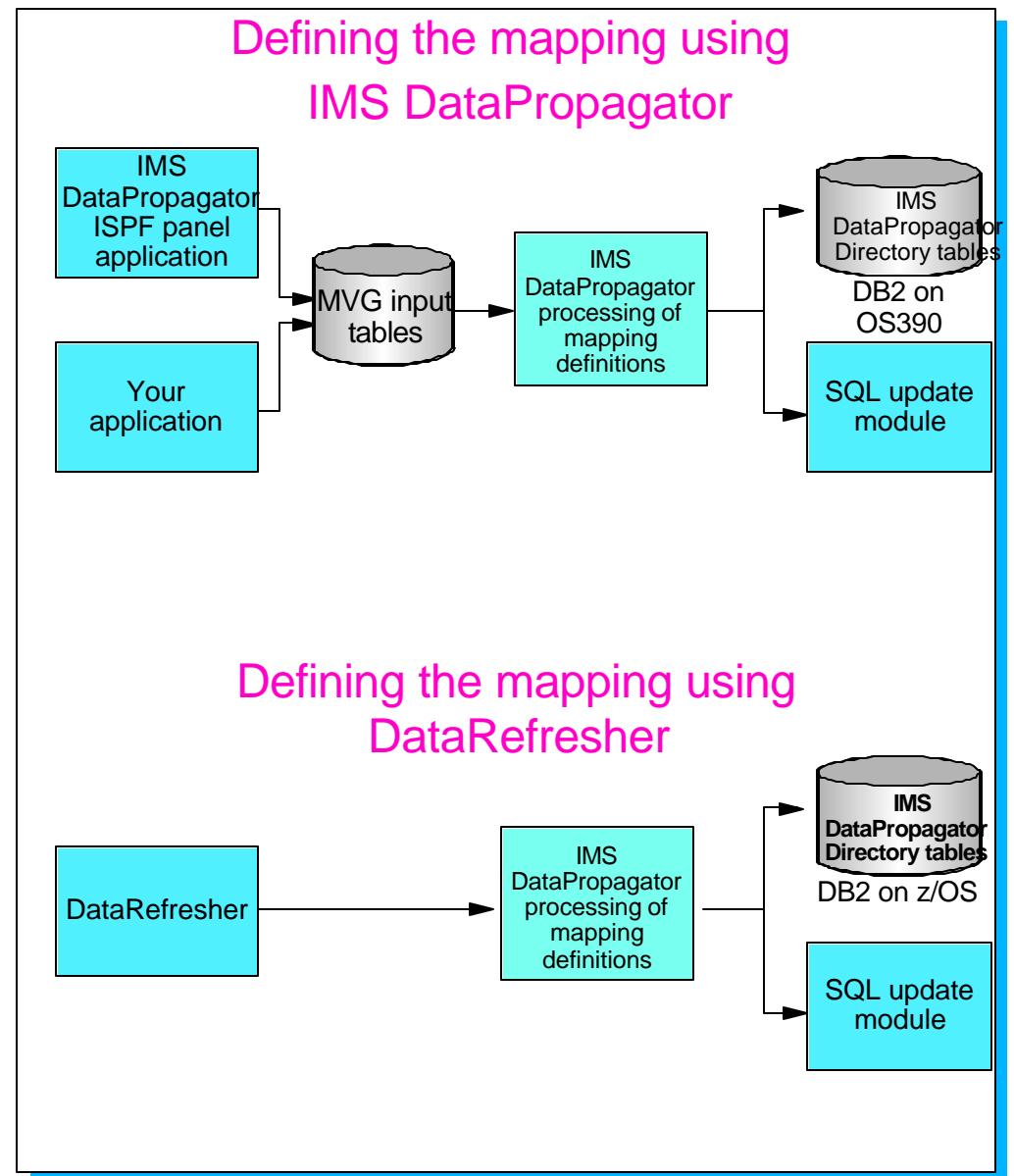
- ▲ **IMS Data Propagator supports**

- Mapping of multiple IMS DB segments to a single DB2 table
- Mapping of complex segment with embedded structures to multiple DB2 tables
- SQL-style WHERE clause for selection of propagated data



IMS Propagation Request (PR)

- ▲ A propagation request specifies how a segment is to be propagated (including transformation)
 - PR (Propagation Request) stored in IMS DataProp Directory tables in DB2 on z/OS
 - PR created by IMS Data Prop Directly via MVG (Mapping Verification Generation) input tables (ISPF, SPUFI) Indirectly via DataRefresher



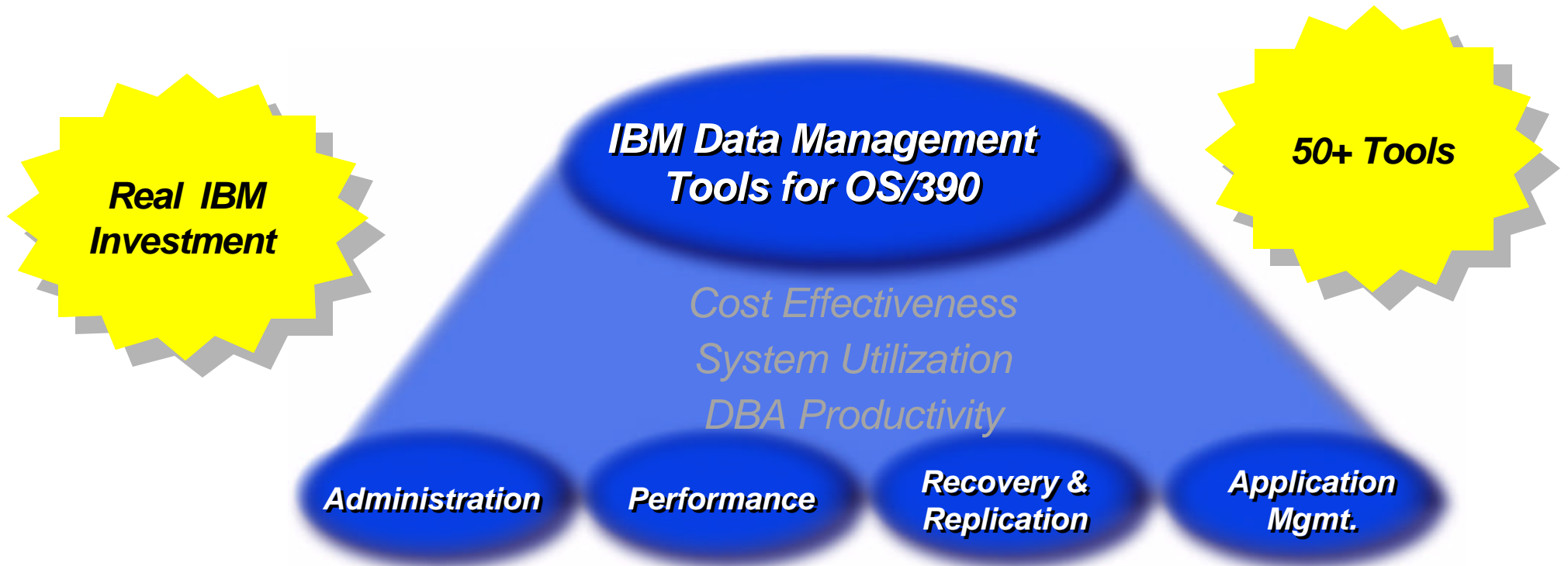


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IBM Data Management Tools



- ▲ **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>

▲ **Tools Information**

➤ tools@us.ibm.com

▲ **Additional IMS Information Thru**

➤ imsmkt@us.ibm.com

