A31

Access to IMS Databases using different APIs: DL/I, SQL, JDBC

Hélène Lyon - IBM France - hlyon@fr.ibm.com

Miami Beach, FL October 22-25, 2001

RETURN TO INDEX

Agenda

- **Direct Access to IMS DB using IMS calls**
  - The standard way!
  - But also a new way using ODBA
- **Direct Access to IMS DB using JDBC**
  - IMS JAVA with IMS V7
- **Direct Access to IMS DB using SQL calls**
  - Classic Connect, Data Joiner
- **Business Intelligence from IMS DB Data**
  - Terminology
  - Data Propagation and Replication

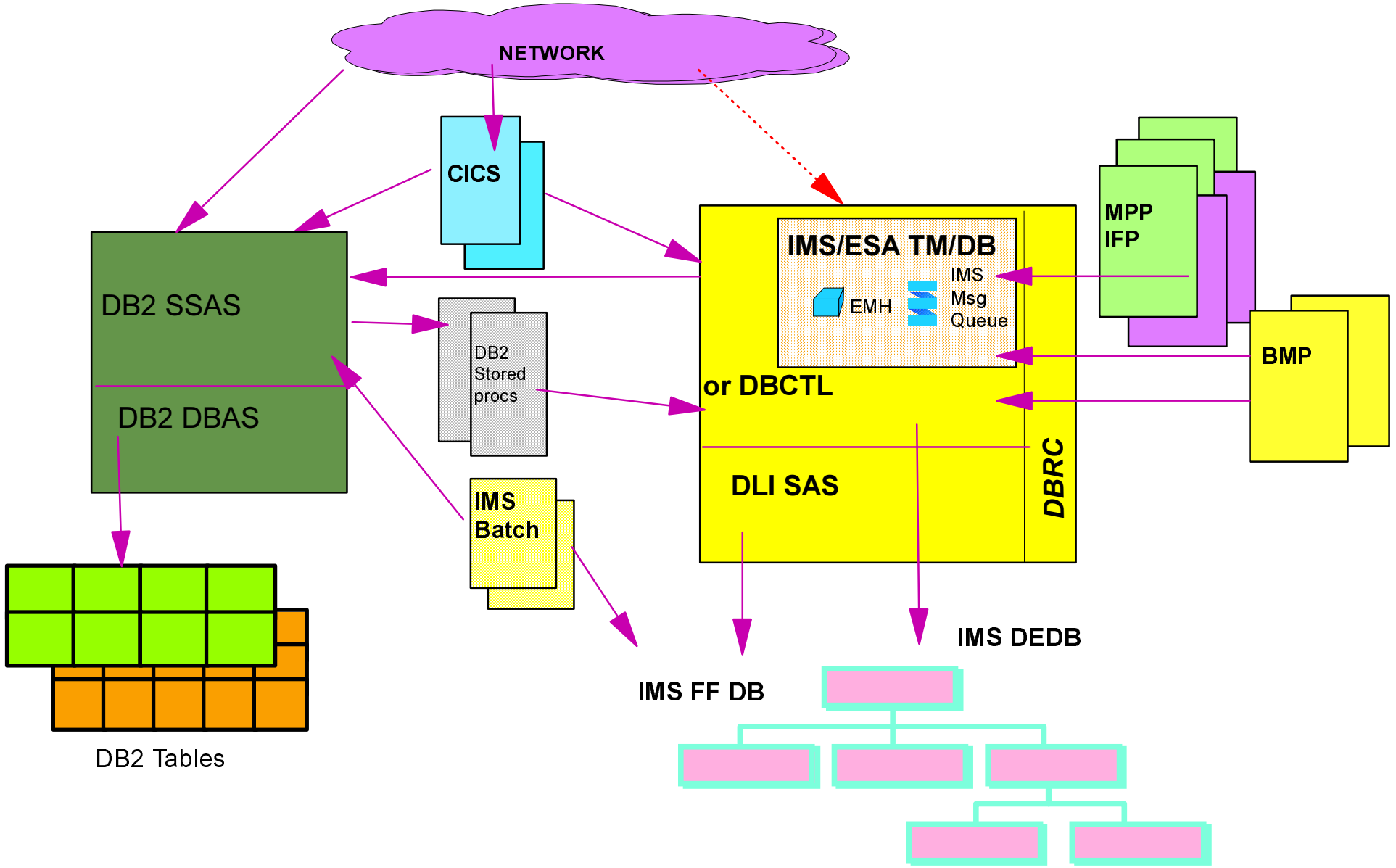
You probably know how to access IMS databases from a CICS transaction, an IMS transaction or a batch-oriented process. It is time to learn that new access to IMS databases are now available.

This session discusses the different solutions including the old ones and the new ones like JDBC!

Direct Access to IMS Databases using DL/I Calls

- **With IMS Transaction Manager**
  - MPP
  - IFP
  - BMP Message Driven or Non Message Driven
  - Open Database Access (ODBA) since IMS/ESA Version 6
- **With IMS Database Manager (DBCTL)**
  - BMP Non Message Driven
  - Open Database Access (ODBA) since IMS/ESA Version 6
- **With CICS Transaction Server**
  - CICS connected to DBCTL
- **With IMS Batch**
  - MVS Batch
  - Only for Full Function IMS databases
  - Can be converted to BMP in an IMS TM or DBCTL environment

IMS TM/DB Architecture



IMS Transaction Manager

- **Communication Manager**
  - Device Dependent Modules for SNA LU0, LU1, LU2, LU6.1
  - APPC/IMS to support SNA LU6.2
    - Using APPC/MVS
  - OTMA to provide direct access to any MVS client
    - MQI access thru MQSeries for MVS/ESA
    - TCP/IP socket access thru IMS Connect
- **Transaction Manager**
  - With IMS Message Queue - IMS Full Function TM
  - Without IMS Q - IMS Fast Path TM
- **Application Program Manager**
  - Message Scheduling
  - IMS Message processing region (MPP)
  - IMS Batch Message Processing Region (BMP)
    - BMP Message Driven
    - BMP Non-Message Driven
  - IMS Fast Path (IFP)
    - Using Expedited Message Handler
    - For IMS Fast Path TM only

IMS Transaction Manager ...

- **Lock Manager**
  - Program Isolation for internal locking
  - IRLM for global locking
    - Mandatory in a parallel sysplex environment
- **Syncpoint Manager**
  - Coordination of the Two Phase Commit
  - Resource managers involved: IMS TM, IMS DB, DB2, MQI
- **Resource Manager**
  - Participant in the Two Phase Commit when OS/390 Resource Recovery Services (RRS) is Syncpoint manager
  - APPC distributed syncpoint for transaction access
  - ODBA for database access
- **Security**
  - Using RACF or any equivalent product
  - Using IMS exits
    - Signon exit
    - Transaction Authorization exit and Command Authorization exit
    - Security Reverification exit

IMS Database Manager

- **Same architecture than IMS TM/DB**
  - DBCTL to access IMS DB (FF and FP)
    IMS Batch still exist outside of IMS DBCTL scope.
  - No communication manager
  - No transaction manager
    No message queue
  - No message driven region (MPP, BMP MD, IFP)
- **Lock Manager**
- **Syncpoint Manager**
  - DBCTL to coordinate the Two Phase Commit protocol
    Access to IMS DB, DB2, MQI in the same unit of work
- **Resource Manager**
  - Participant in the Two Phase Commit
  - With CICS as Syncpoint Manager
  - With RRS as Syncpoint Manager
    ODBA for database access
- **Security**

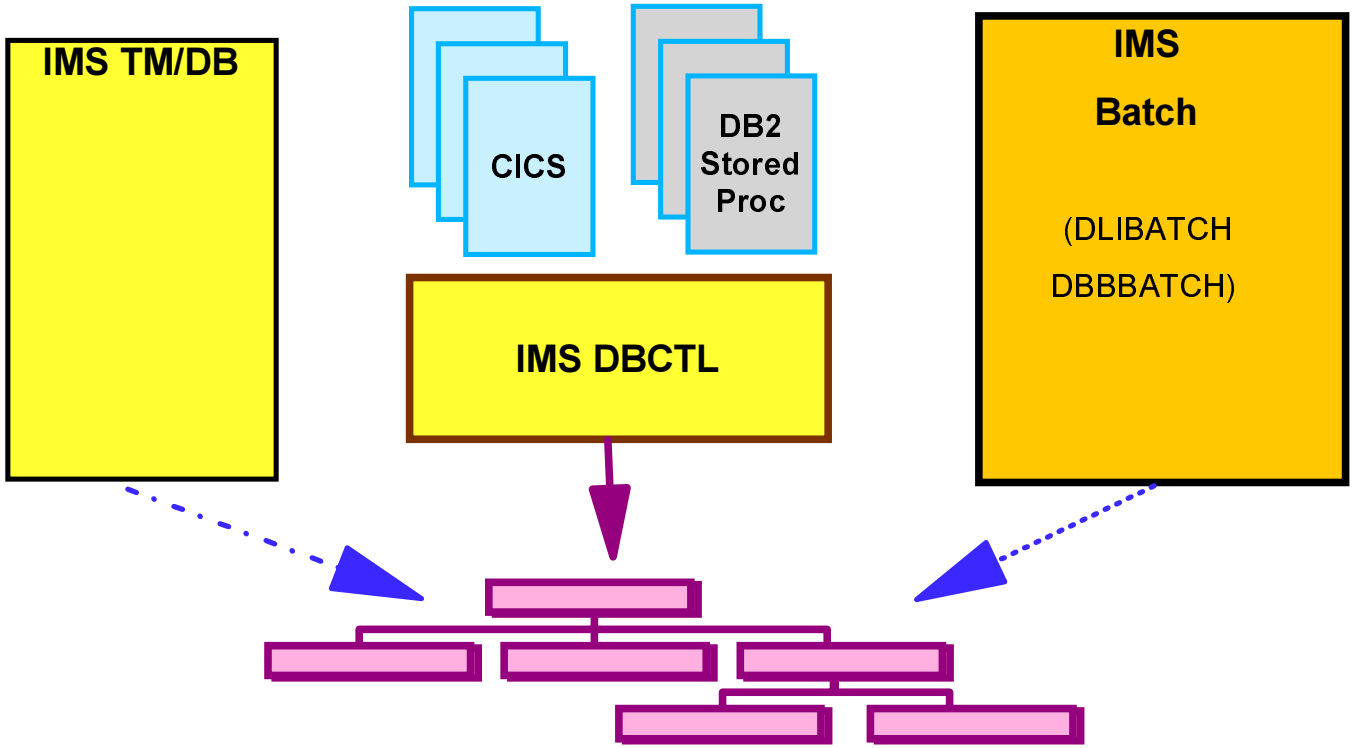
IMS Batch

- **An IMS Subsystem**
  - Separate IMS Logs
  - DBRC as an option
  - Access to IMS DB and DB2 data
    Internal two-phase commit protocol
  - Access to IMS FF DB and GSAM DB

- **BMPs as a replacement ...**
  - Reduction in the number of IMS subsystems to manage
  - Performance
    - *DBCTL fast and centralized logging*
    - *Large Bufferpools can prevent DASD I/O*
    - *OSAM Sequential Buffering and parallel I/O*
  - Dynamic Backout in case of an abend
    - *To the last checkpoint only*
  - Concurrent access
    - *Parallelism without data sharing implementation*
    - *Lock management with Program Isolation*
  - Automated Operations in IMS applications
  - Access to DEDBs
- **But Checkpoint/Restart Logic should be added!**

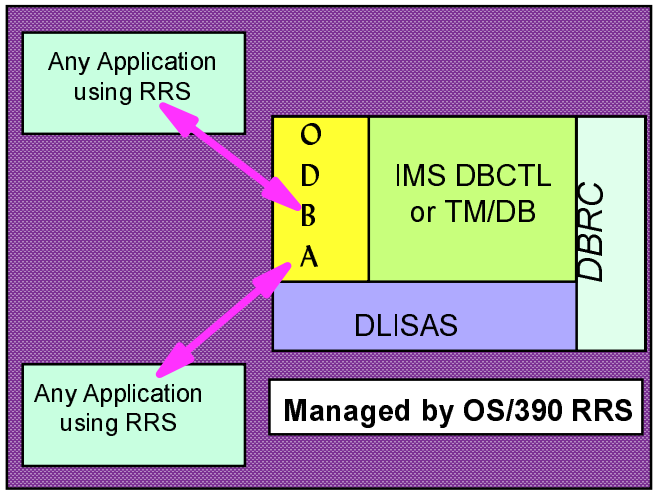
IMS DB Sharing

- **Data Sharing Support**
  - Data Base Level Sharing with DBRC
    1 Updater and n Reader-without-integrity
  - Sysplex Data Sharing with DBRC, and IRLM as global lock manager
    n Updaters
- **Between IMS Subsystems**
  - IMS TM/DB
  - IMS DBCTL
  - IMS Batch



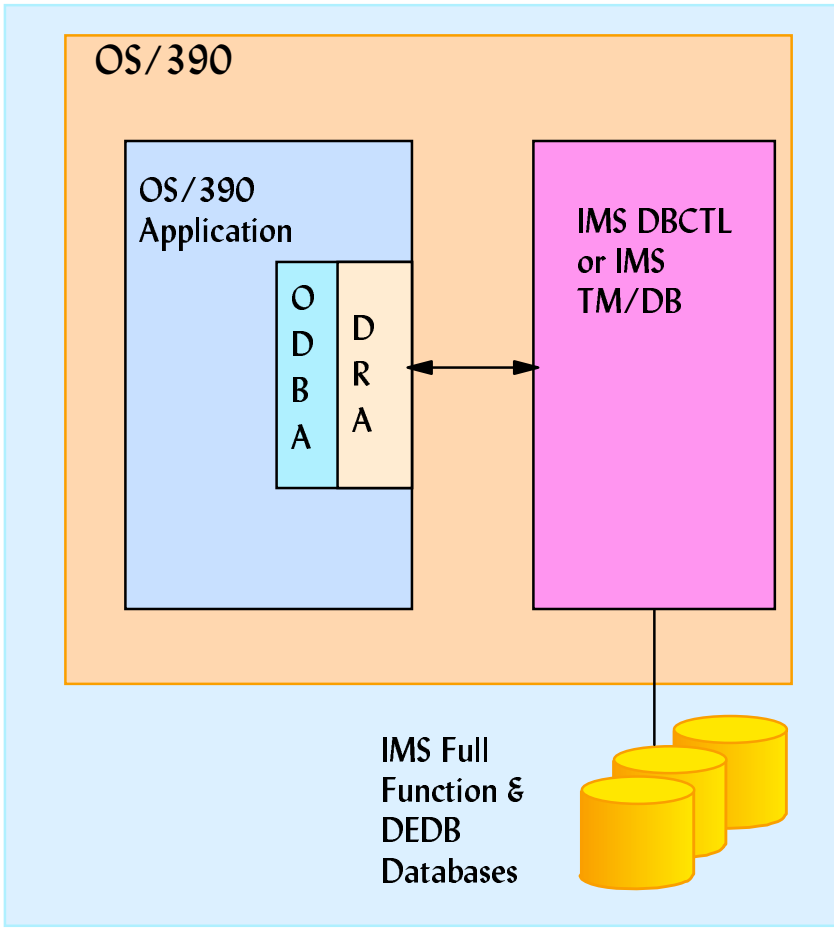
Open Database Access Objectives

- **Provides a callable interface to IMS databases from any OS/390 programs that are not managed by IMS**
  - DB2 Stored Procedures
  - Websphere Application Server
  - 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



Database Resource Adapter (DRA)

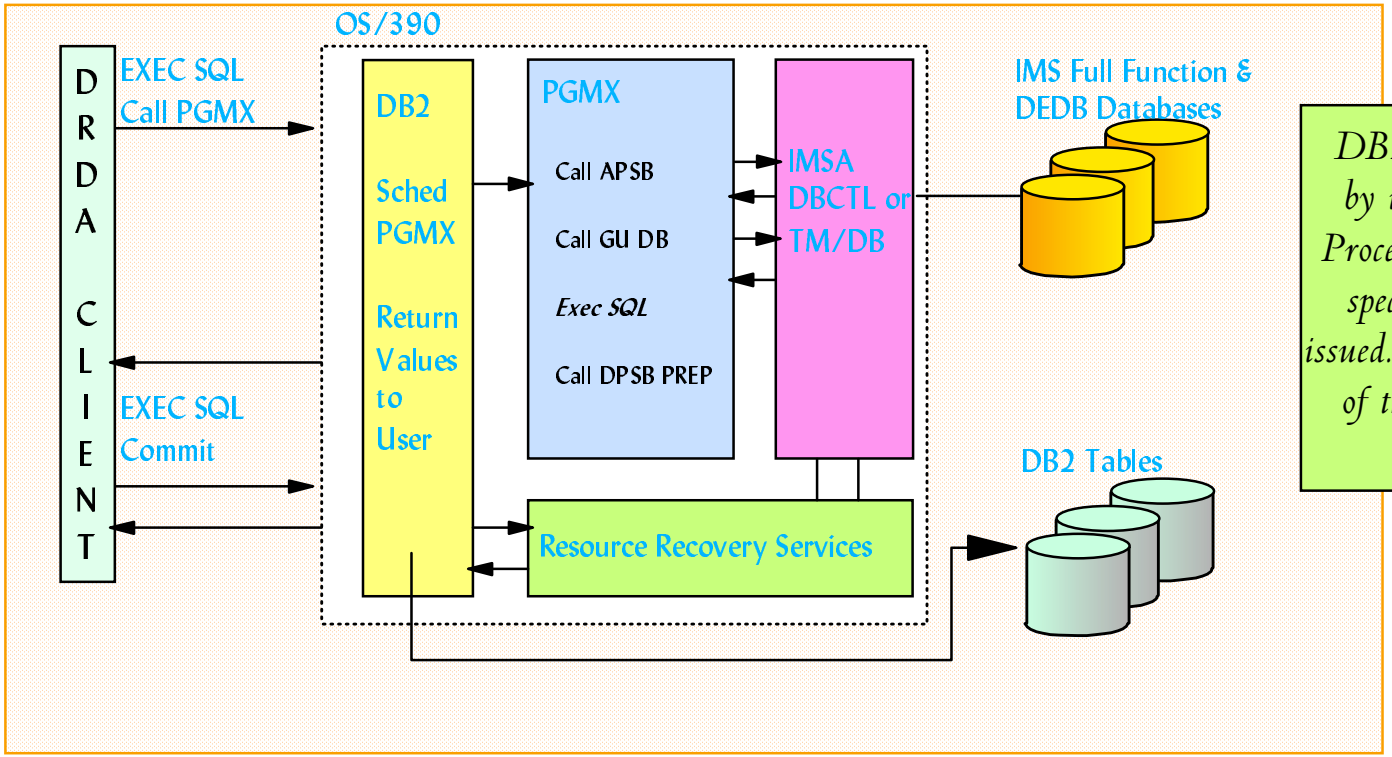
- **The OS/390 application gains access to IMS Full Function & DEDB databases through the Database Resource Adapter**
  - Similar to CCTL's usage of the DRA
  - ODBA uses the AERTDLI interface rather than PAPL parameter list to communicate its requests to the DRA
- **The DRA is initialized as a result 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

DB2 Stored Procs & ODBA

- **DB2 Stored Procedures Address Space access to an IMS DB Subsystem**
  - Access to DB2 tables and IMS databases in the same unit of work
- **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 establishes the ODBA environment by issuing the INIT call for the Stored Procedure Address Space. Connection to a specific IMS occurs when the APSB is issued. DB2 issues the commit call on behalf of the Stored Procedure when control is returned to DB2.

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 Procedure
- **Stored Procedure written in any language supported by the DB2 Subsystem**
- **IMS and DB2 subsystem in the same OS/390 image (LPAR)**

Agenda

- **Direct Access to IMS DB using IMS calls**
  - The standard way!
  - But also a new way using ODBA
- **Direct Access to IMS DB using JDBC**
  - IMS JAVA with IMS V7
- **Direct Access to IMS DB using SQL calls**
  - Classic Connect, Data Joiner
- **Business Intelligence from IMS DB Data**
  - Terminology
  - Data Propagation and Replication

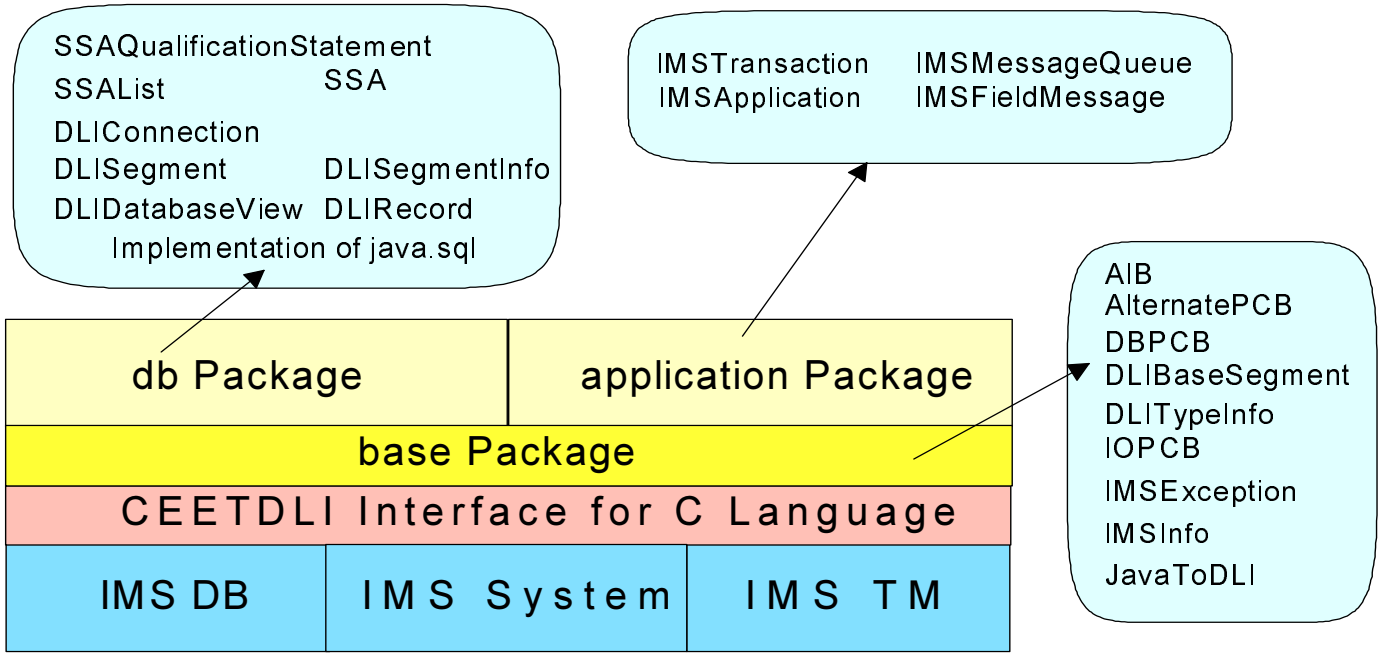
IMS V7 Java

- **Support included in IMS V7 Transaction Manager**
- **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 using Type 2 driver
  - 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 Class Library

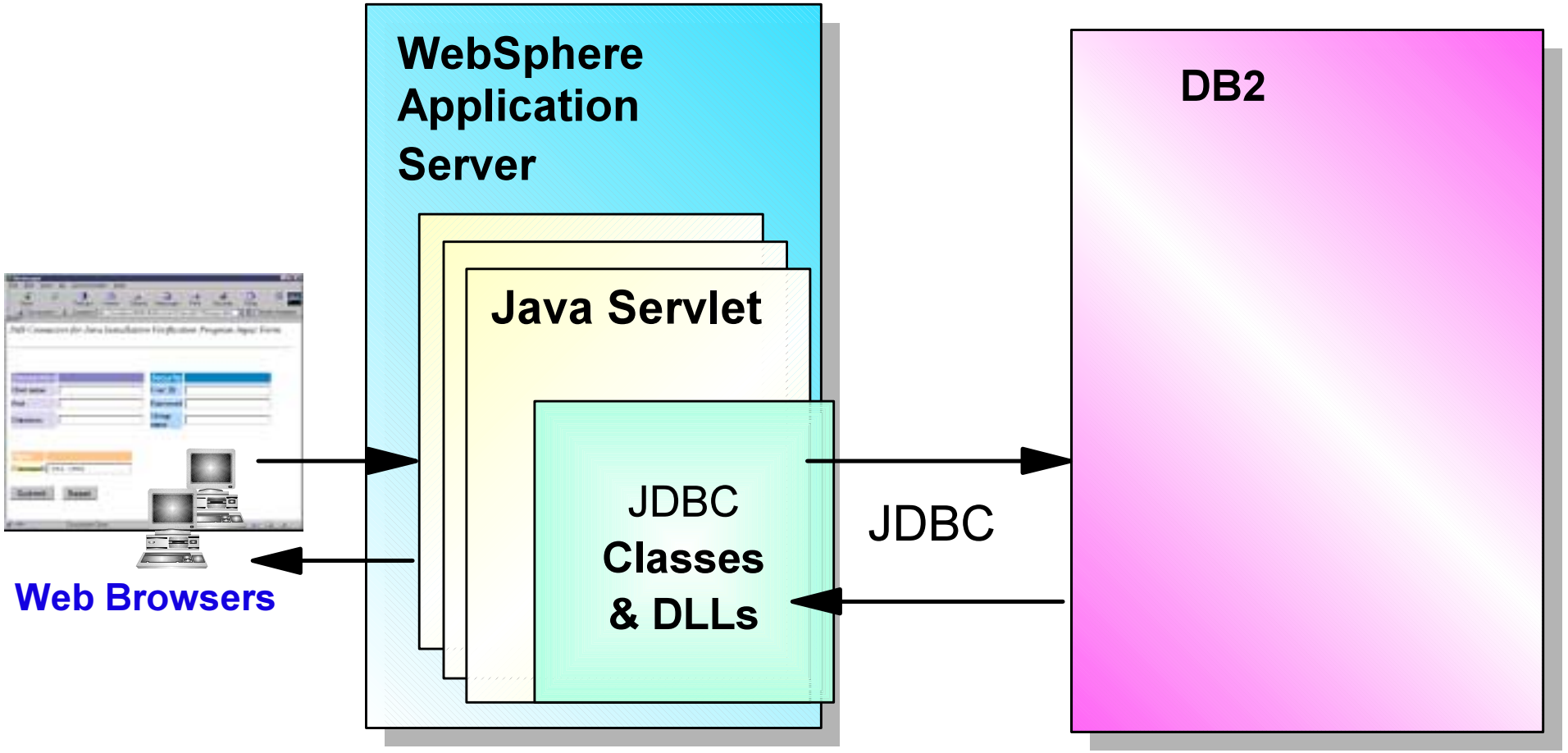
- **Objective: To provide a Java class library that:**
  - is easy-to-use by experienced Java programmers, requiring only basic IMS knowledge
  - provides the infrastructure for automated tool support and integration with VisualAge for Java and the Application Framework for e-business
  - robustly supports all major IMS capabilities
  - provides best-possible Java performance
    With High Performance Java Compiler

Java in IMS packages

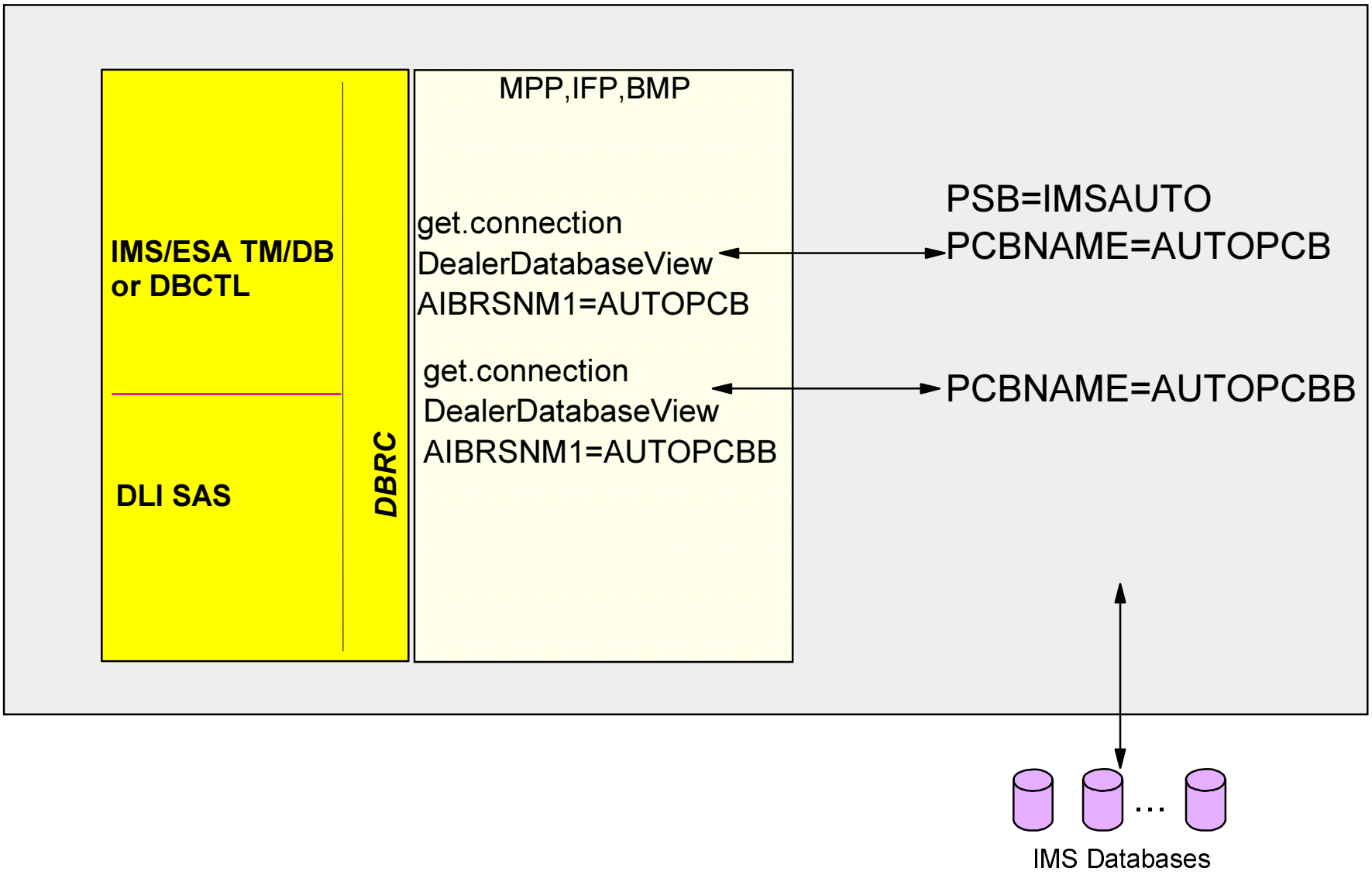


- **Java program uses the APIs that are provided**
  - Application package classes
    - To initialize/begin the program
    - To get/put the message from/to the message queue
    - To commit
  - JDBC interface or db Package classes to access IMS data

JDBC to DB2

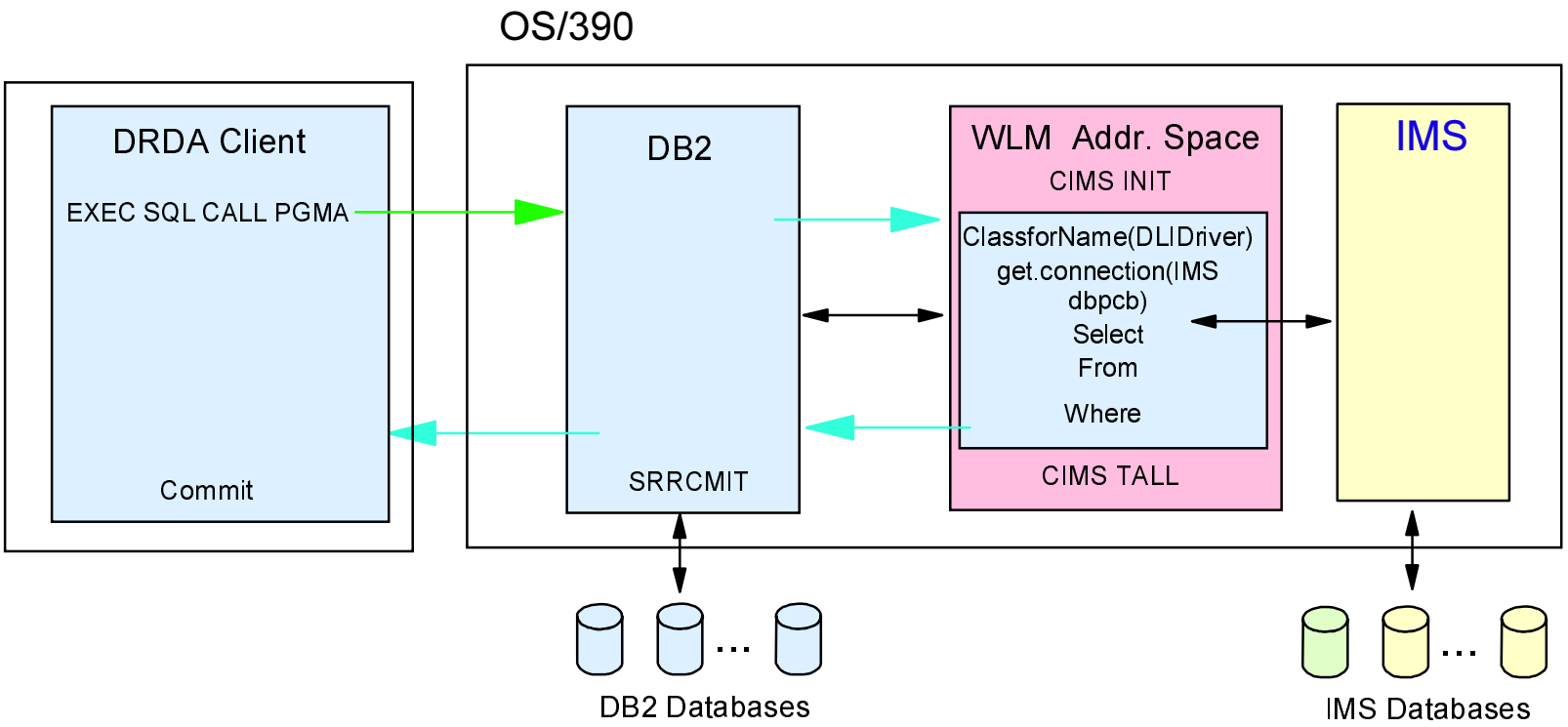


JDBC Connection to IMS DB PCB



DB2 Stored Procedure Example

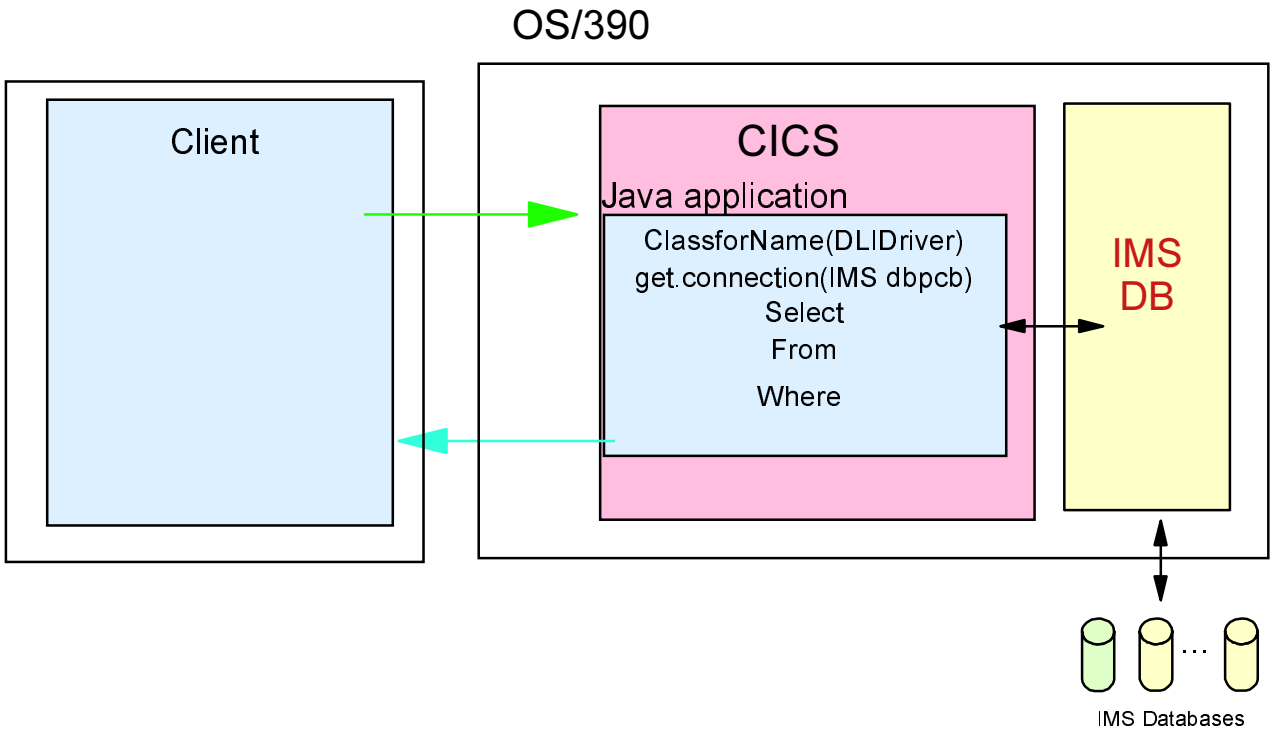
Using IMS V7 Java Classes JDBC interface



- **DB2 Java stored procedure example**
  - IMS Java Classes can be used to access IMS DB

CICS Example

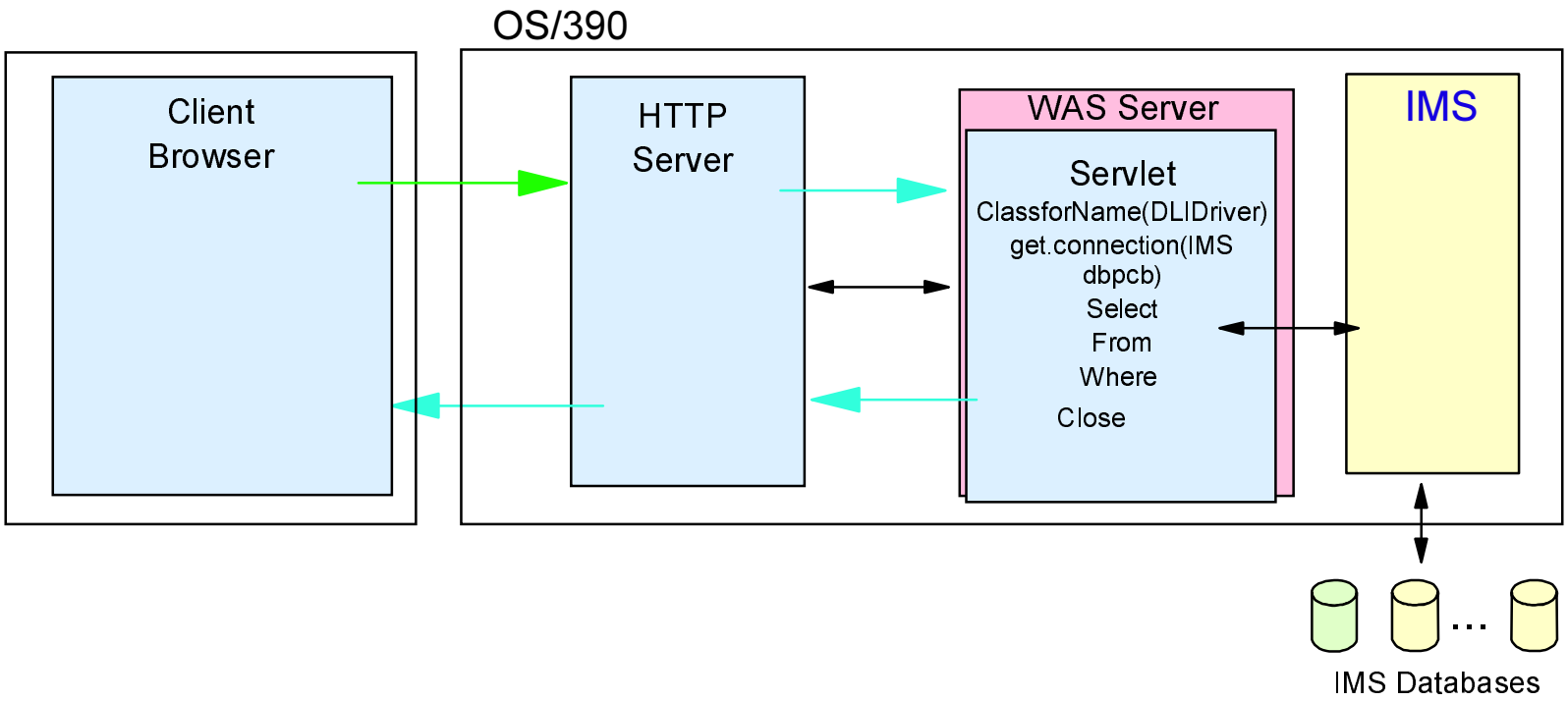
Using IMS V7 Java Classes JDBC interface



- **CICS Java Application example**
  - IMS Java Classes can be used to access IMS DB

OS/390 WebSphere Application Server

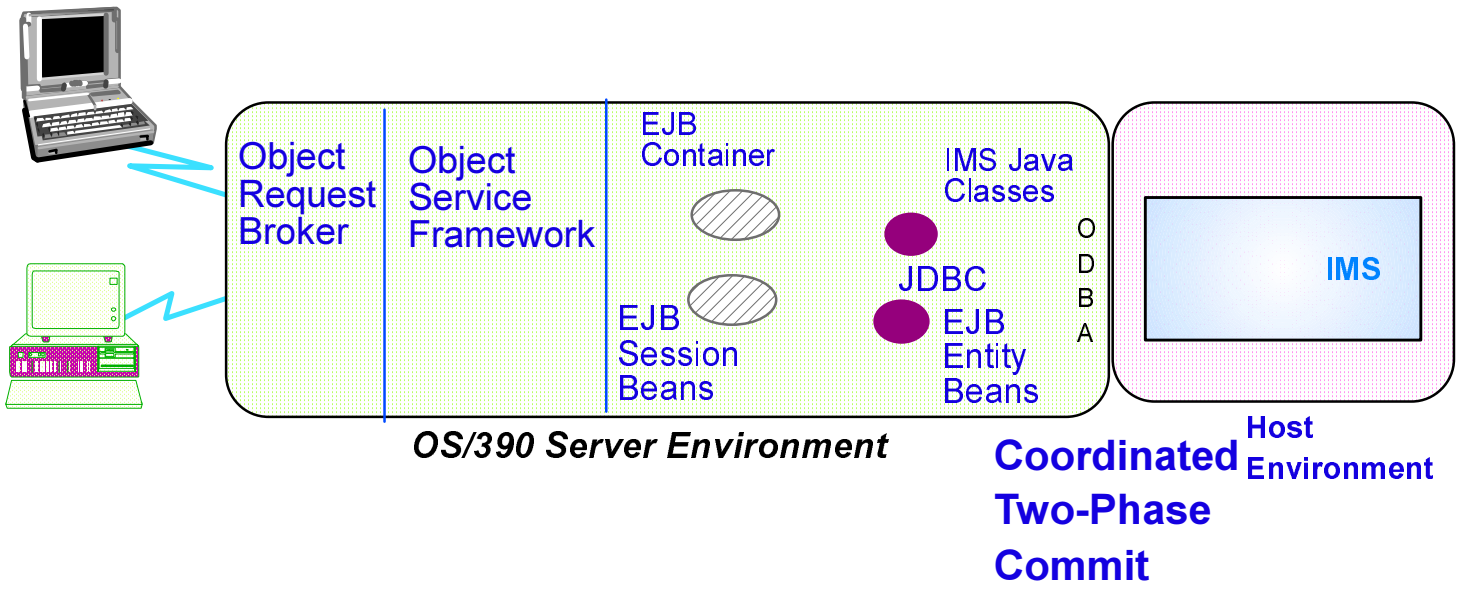
Using IMS V7 Java Classes JDBC interface



- ***Requirement: To provide OS/390 WebSphere Application Server JDBC access to IMS DB***

OS/390 WebSphere Application Server

Using IMS V7 Java Classes EJB/JDBC access to IMS DB



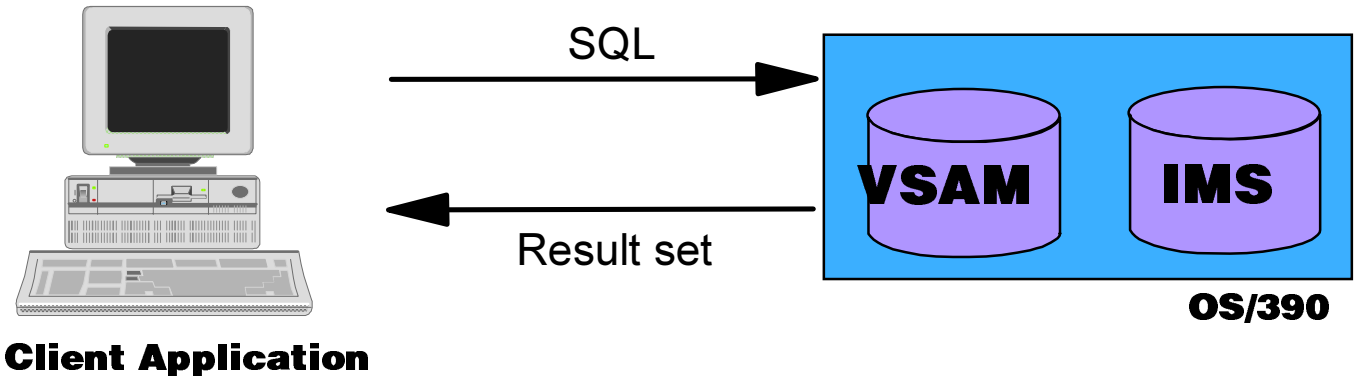
- **Requirement: To provide OS/390 WebSphere Application Server Entity Bean access to IMS DB data**

Agenda

- **Direct Access to IMS DB using IMS calls**
  - The standard way!
  - But also a new way using ODBA
- **Direct Access to IMS DB using JDBC**
  - IMS JAVA with IMS V7
- **Direct Access to IMS DB using SQL calls**
  - Classic Connect, Data Joiner
- **Business Intelligence from IMS DB Data**
  - Terminology
  - Data Propagation and Replication

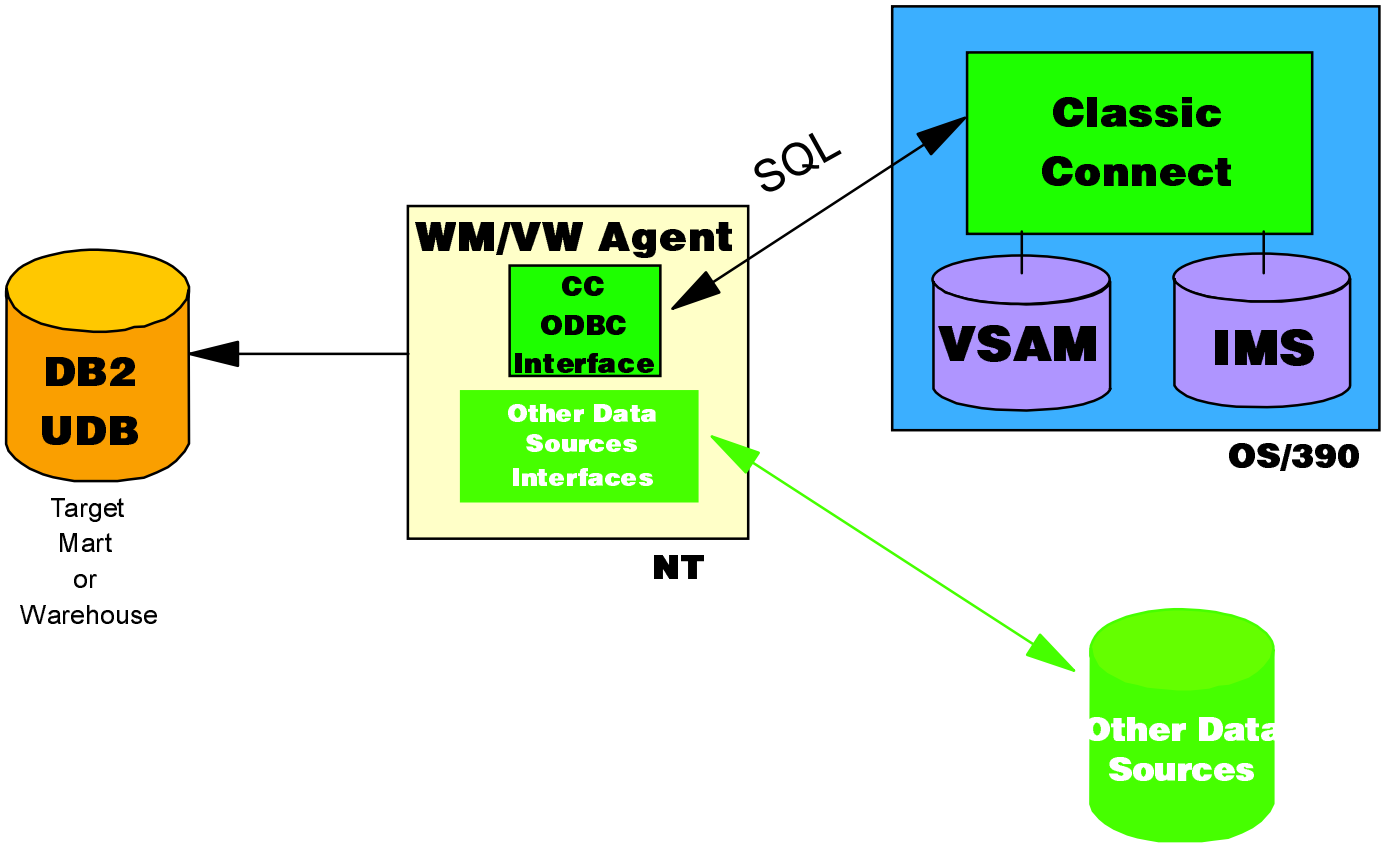
Classic Connect - What is it?

- **Problem:**
  - Need for read access of IMS and VSAM data and other relational and non-relational data from same applications/tools used to access relational data
- **Solution: IBM Classic Connect**
  - Classic Connect provides relational access via standard SQL to non-relational data stored in IMS and/or VSAM.
  - Gain additional value from data stored in IMS and/or VSAM
    - IMS and VSAM data available to relational tools
      - *easily move legacy data to DB2 mart/warehouse via SQL*
      - *integrate operational data with the Internet*
      - *deliver OS/390 data to desktop data analysis tools*
    - Simulates DB2 catalogs and functions



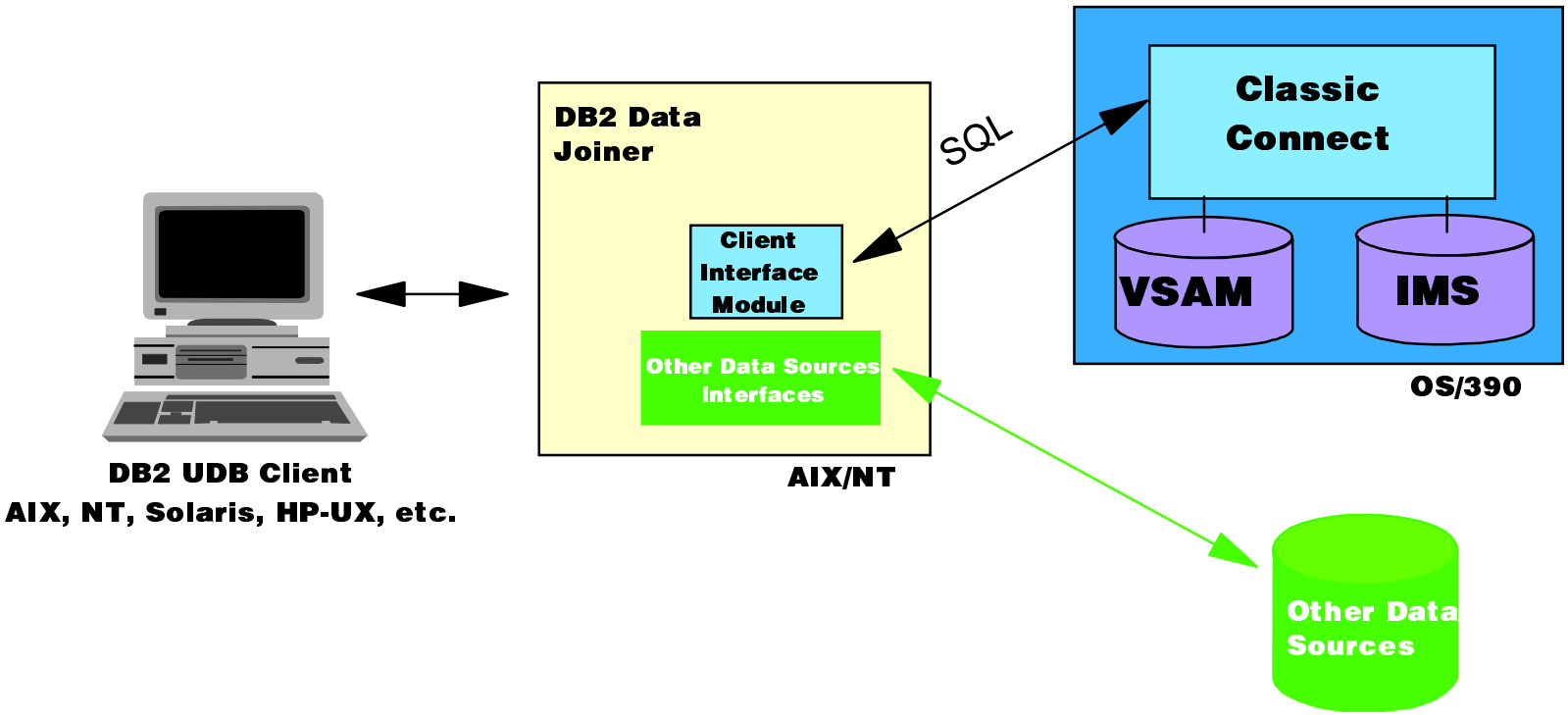
Classic Connect - DB2 Warehouse Manager/Visual Warehouse

- Allows DB2 WM/VW to schedule extracts from IMS and VSAM data sources, and populate DB2 marts and/or warehouses

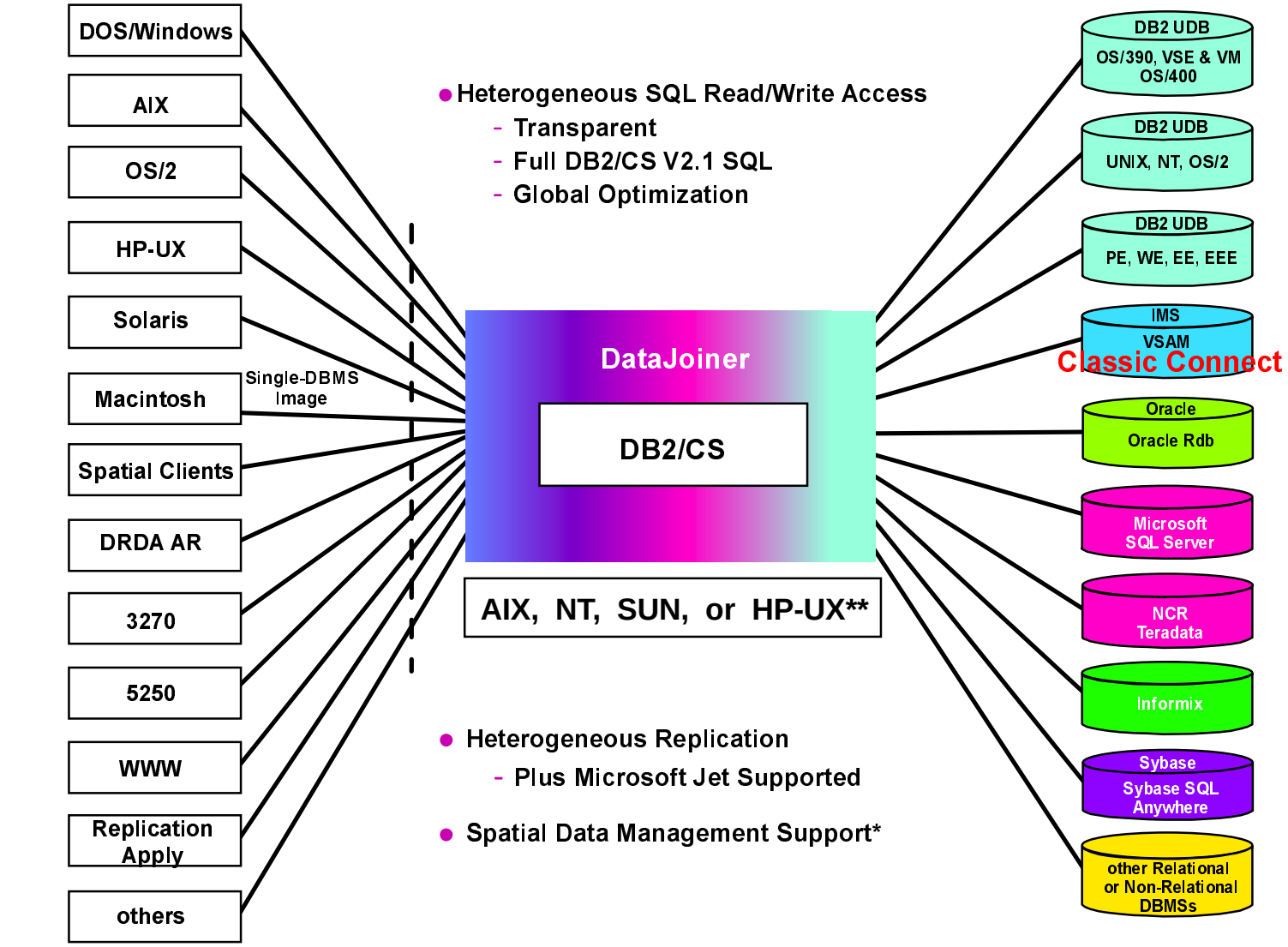


Classic Connect - DataJoiner Usage

- **Allows DataJoiner clients SQL access to IMS and VSAM data sources and IMS/VSAM data to be joined with other relational data.**
- **DataJoiner is a multi-database server**
  - Provides users and applications access to data -- IBM and non-IBM, relational and non-relational, local and remote -- as though it were a single relational database

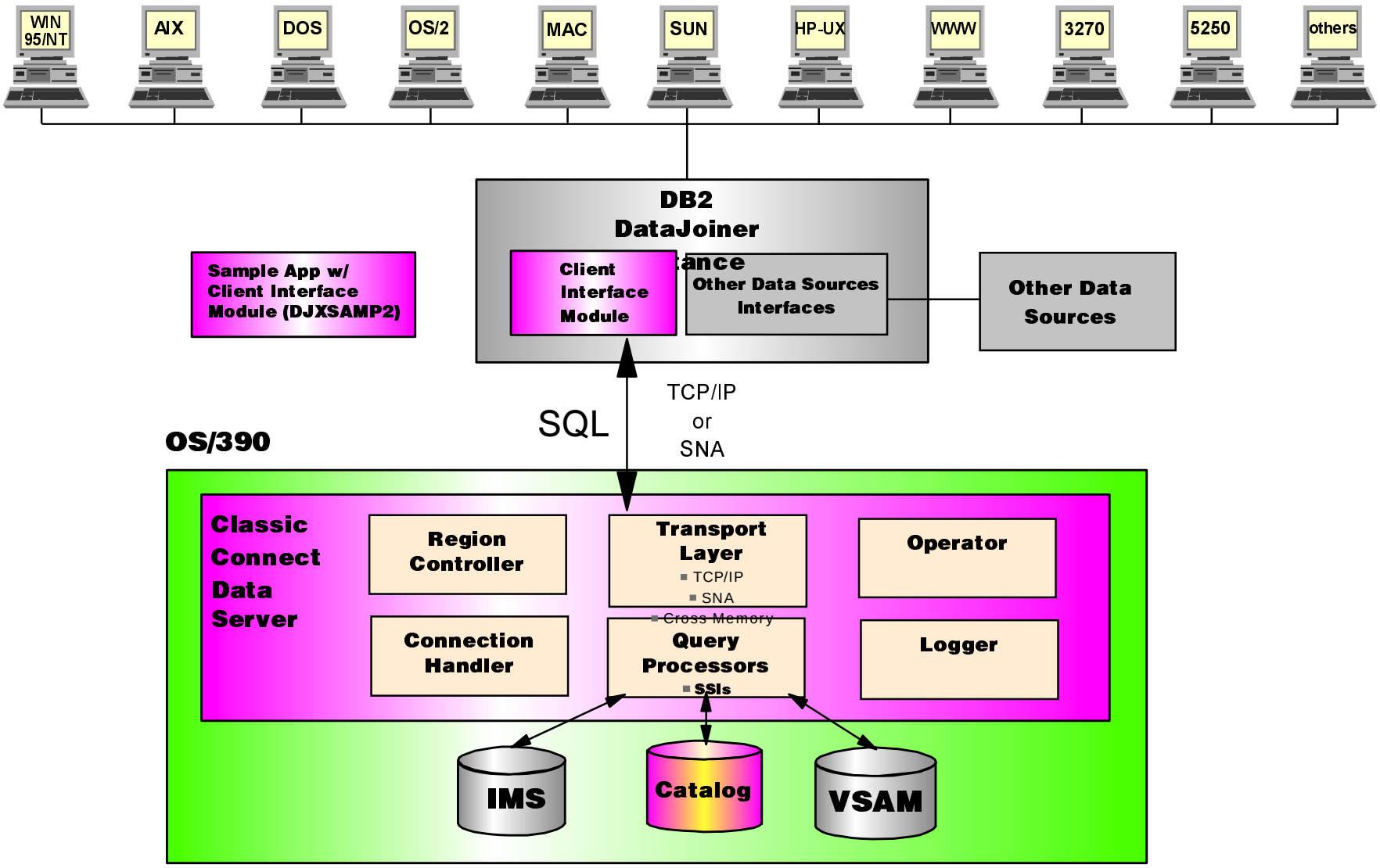


DataJoiner Version 2.1.1 - Overview



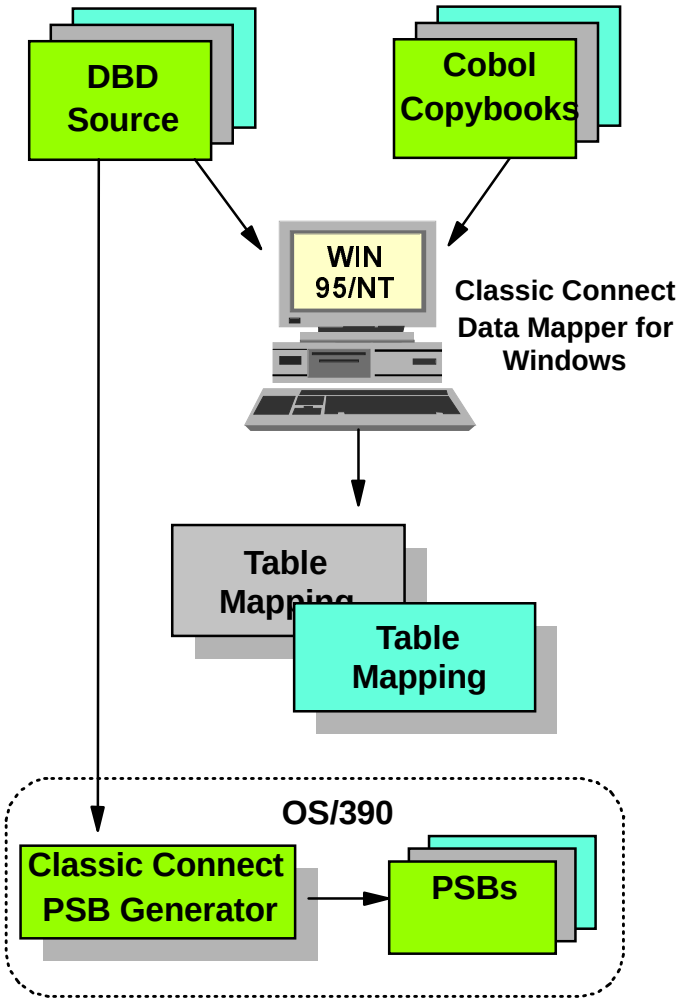
* Available on AIX and NT Only
** Available on DataJoiner V1.1 Base Only

Classic Connect V2 - Architecture



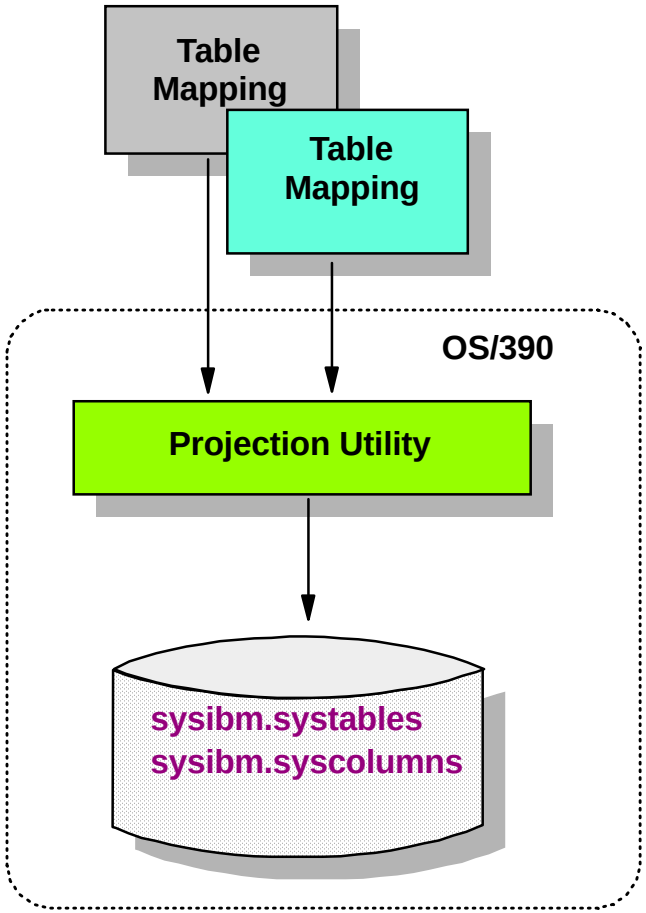
Two Tools to Simplify the Task

- **Data mapper**
  - Inputs
    - IMS DBDs
    - IMS segment copybooks
  - User builds table mappings by selecting fields, data types, etc, through a point-and-click environment.
- **PSB Generator**
  - Inputs
    - IMS DBDs
    - Classic Connect EXTRACT PSB statements
  - The tool builds PSBs and PCBs for use with the table mappings.



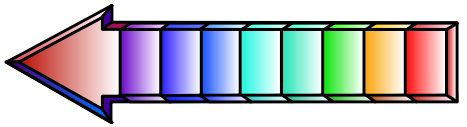
Building the Virtual Relational Database

- Tables mappings for a given virtual database are moved to the host.
- The mappings are processed by the Classic Connect Projection Utility
- The result is a DB2-like database, complete with catalog tables, that can be accessed from DataJoiner.



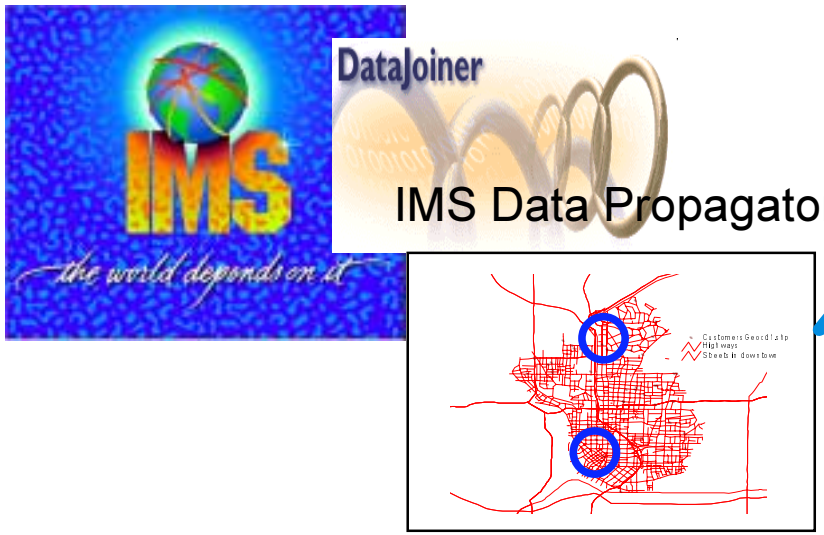
Agenda

- **Direct Access to IMS DB using IMS calls**
  - The standard way!
  - But also a new way using ODBA
- **Direct Access to IMS DB using JDBC**
  - IMS JAVA with IMS V7
- **Direct Access to IMS DB using SQL calls**
  - Classic Connect, Data Joiner
- **Business Intelligence from IMS DB Data**
  - Terminology
  - Data Propagation and Replication



IMS Business Intelligence

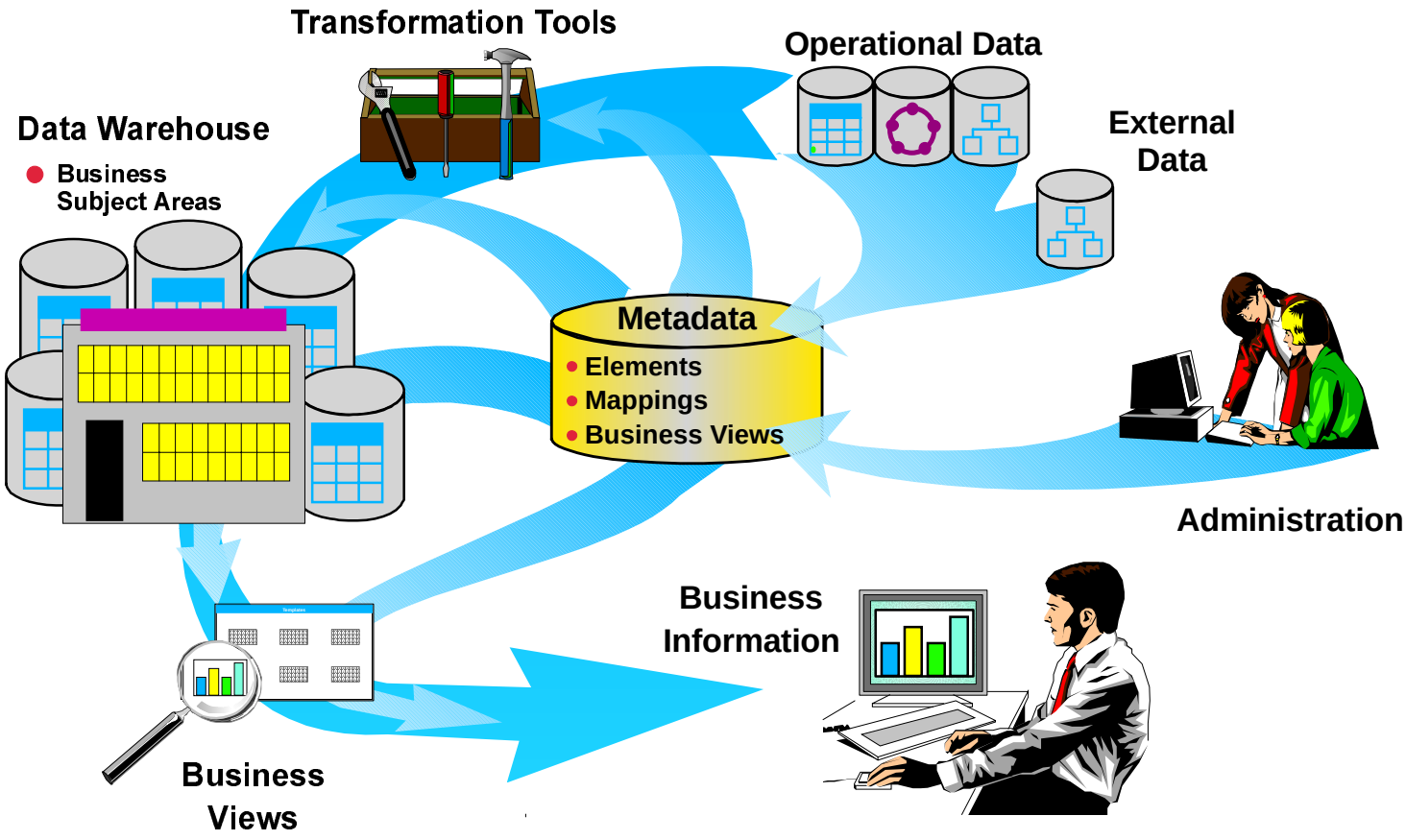
Extend the reach and value of your IMS data!



IMS data includes "implicit" spatial information

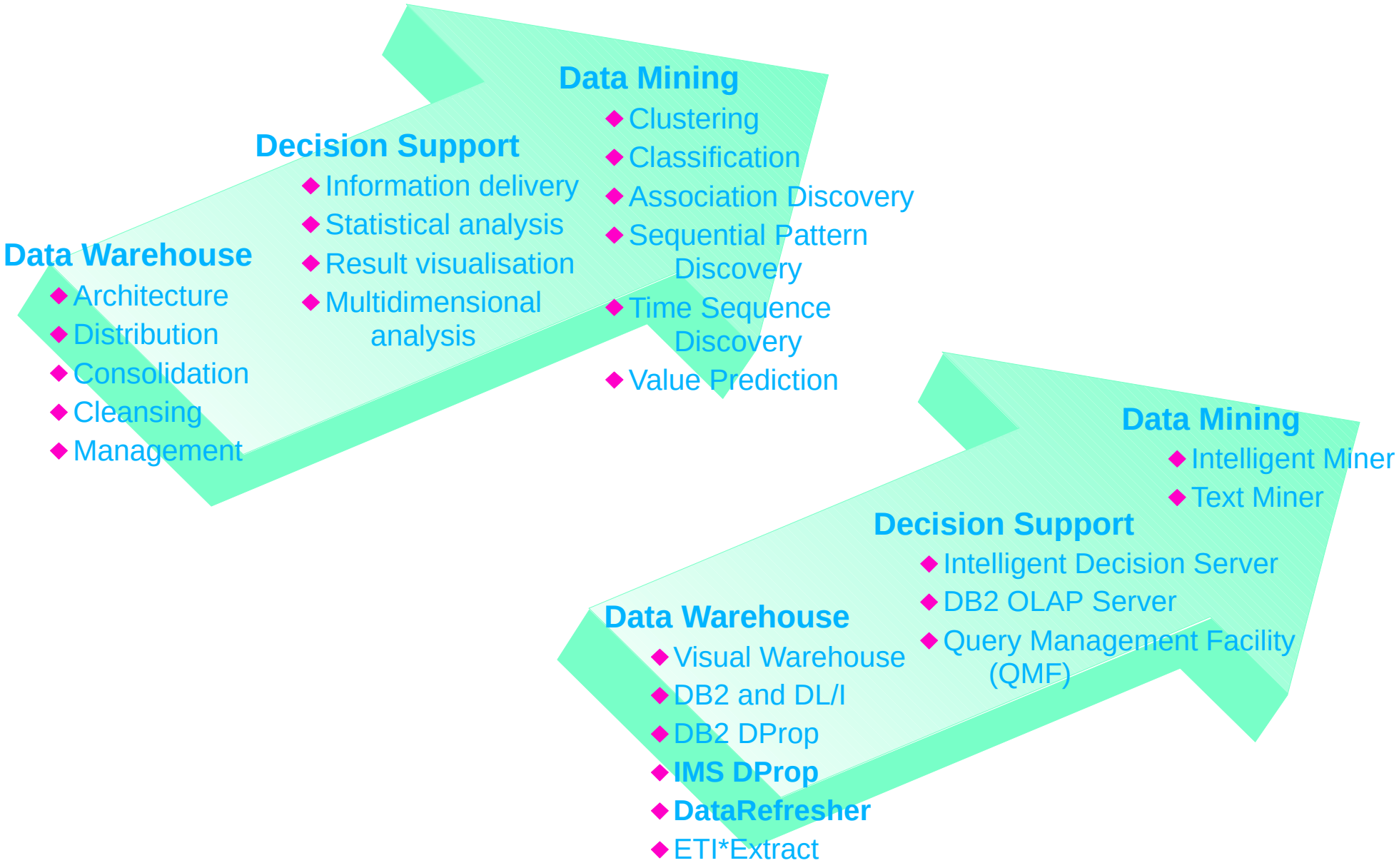
- **Challenge:**
  - Provide IMS customers with advanced data integration and analysis capabilities leveraging existing IMS data assets
- **Solution:**
  - DataJoiner, Classic Connect, DB2 Spatial Extender, DataPropagator technologies
  - ODBA, JDBC access
- **Benefit:**
  - New forms of analysis utilizing IMS databases
  - Easily integrate IMS data with other business data in the enterprise

Data - to - Information Process



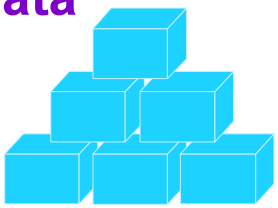
Torture the data until it confesses!

Business Intelligence Components and Products



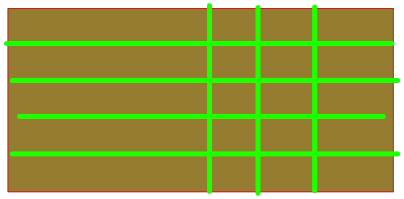
Data Characteristics

Operational Data



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

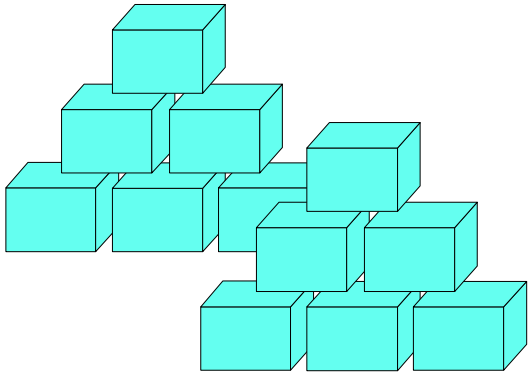
Informational Data

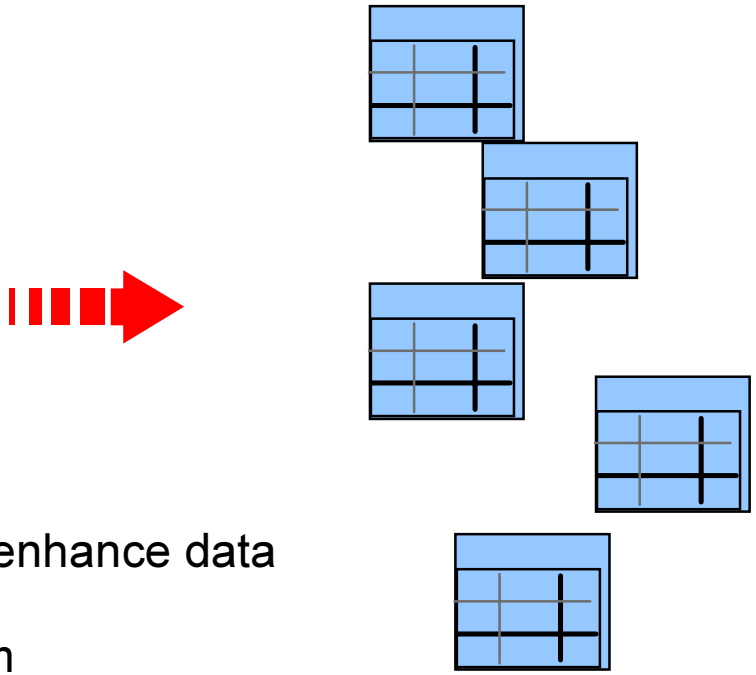


Subject Oriented
Integrated
Non-volatile
Values Over Time
Supports Decision Making

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

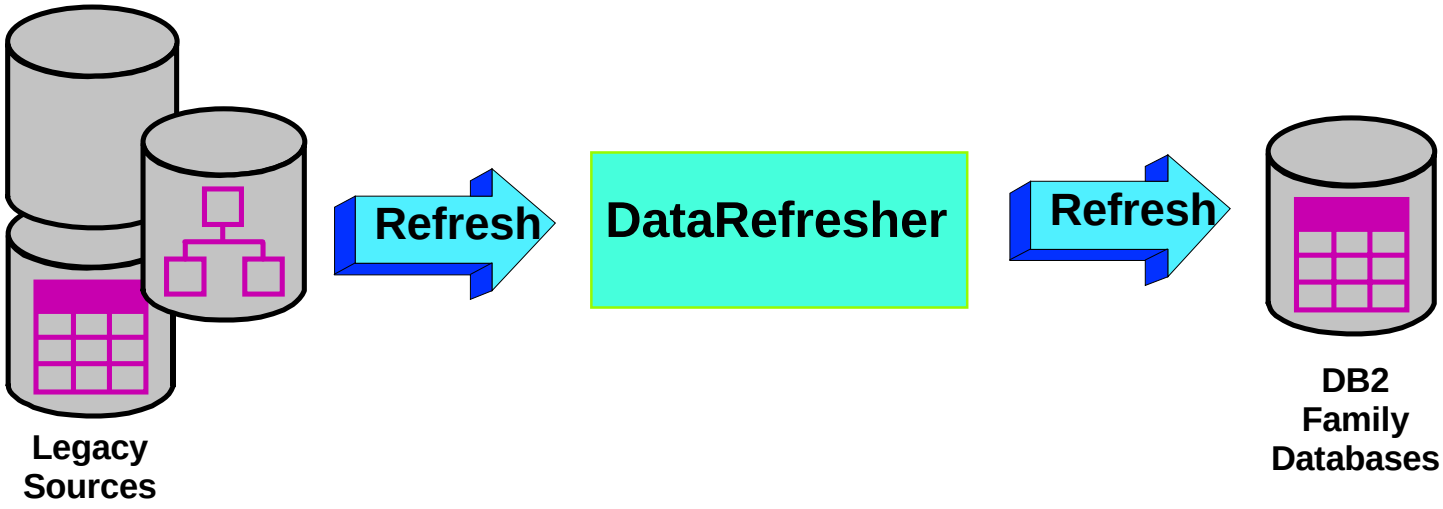
How?

DataRefresher or ETI*Extract - mass extract

IMS DataPropagator - for changes

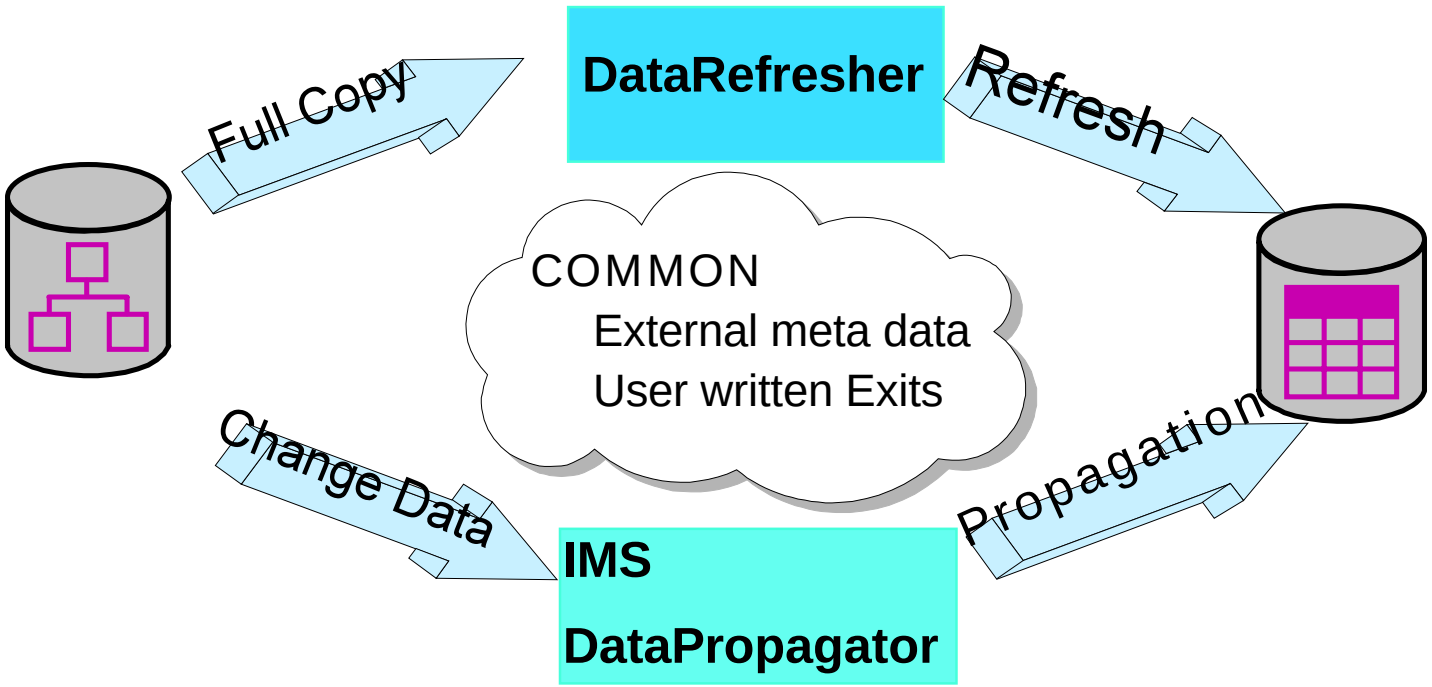
Mass Extract - DataRefresher

- **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

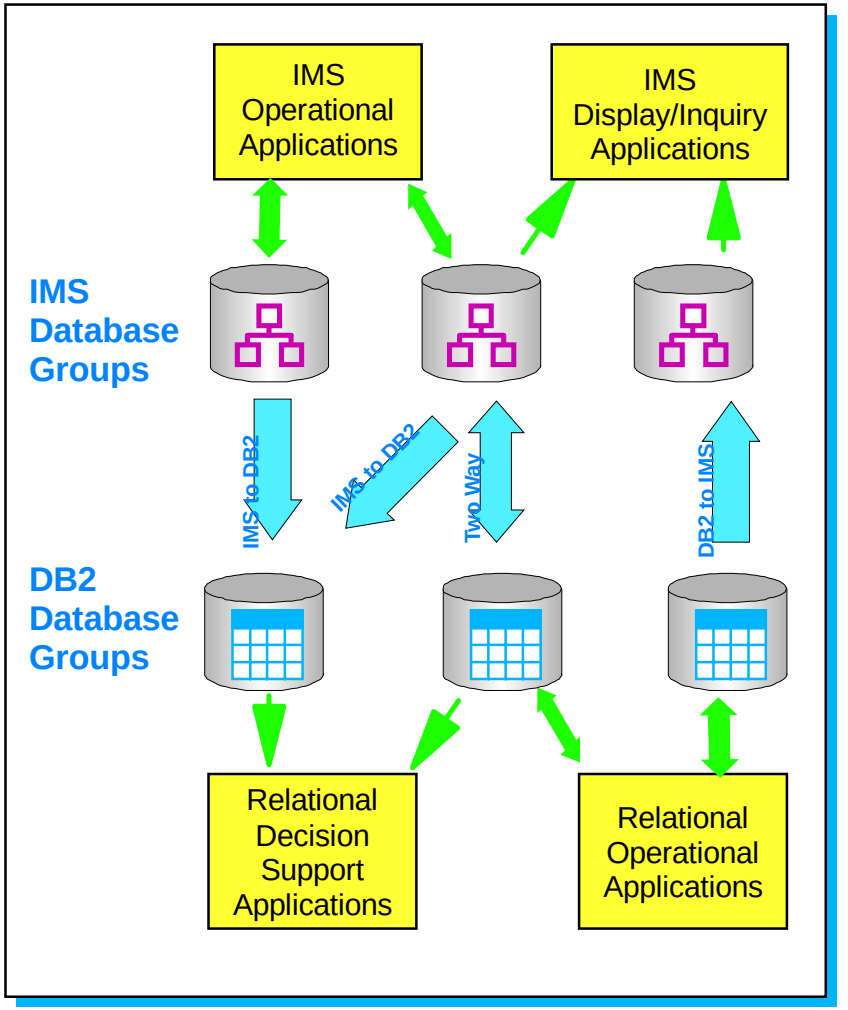
- **Renamed from DPROPNR**
- **Maintains consistency between two copies of the same data, where one copy of the data is stored in an IMS Database Manager (IMS DB) database and the other is stored in a DB2 database on OS/390**

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	▪ *IMS → DB2 with MQSeries*

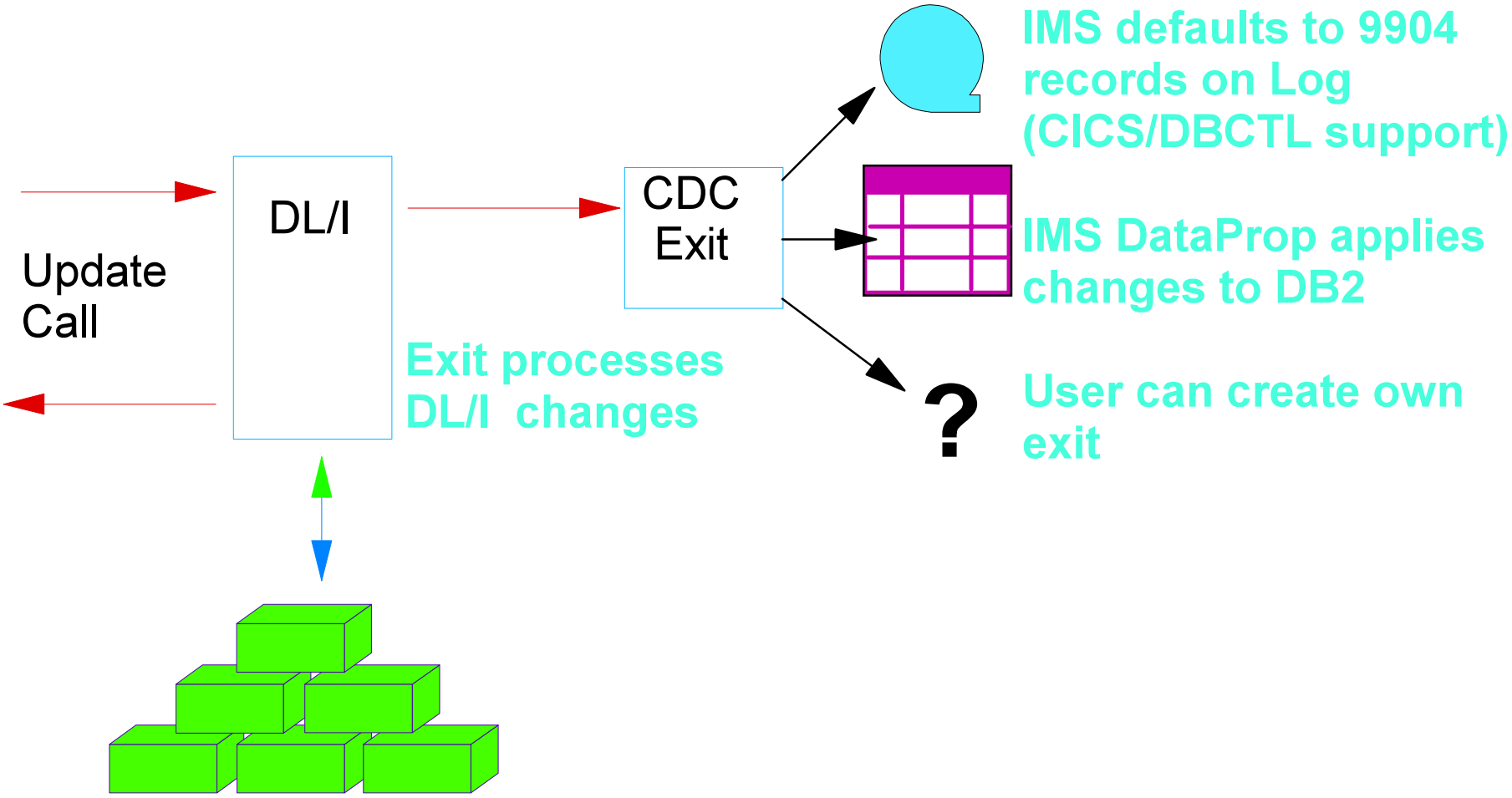
IMS DataPropagator Uses

- **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

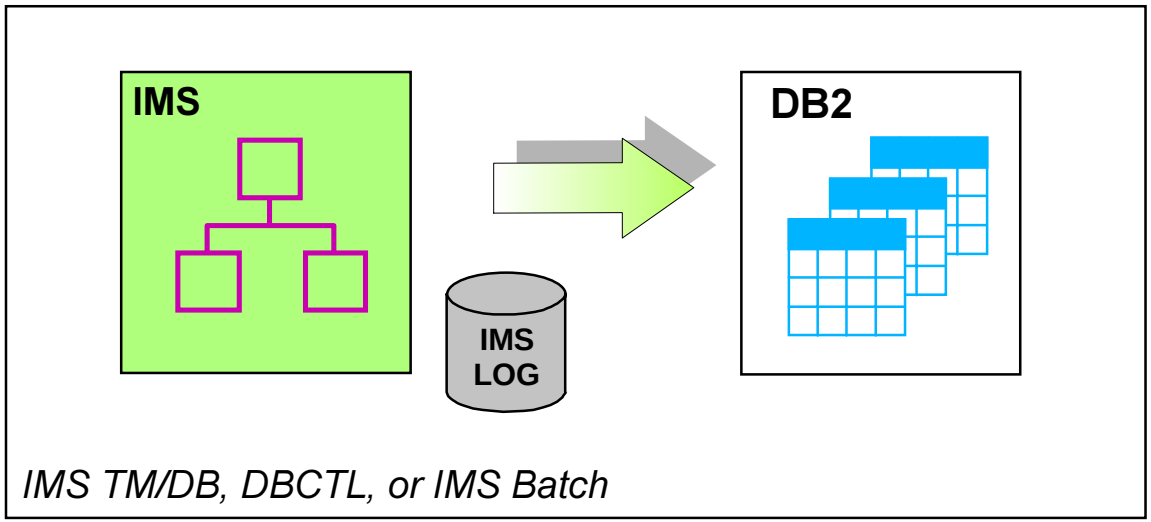


IMS Change Data Capture



Asynchronous Propagation Mode

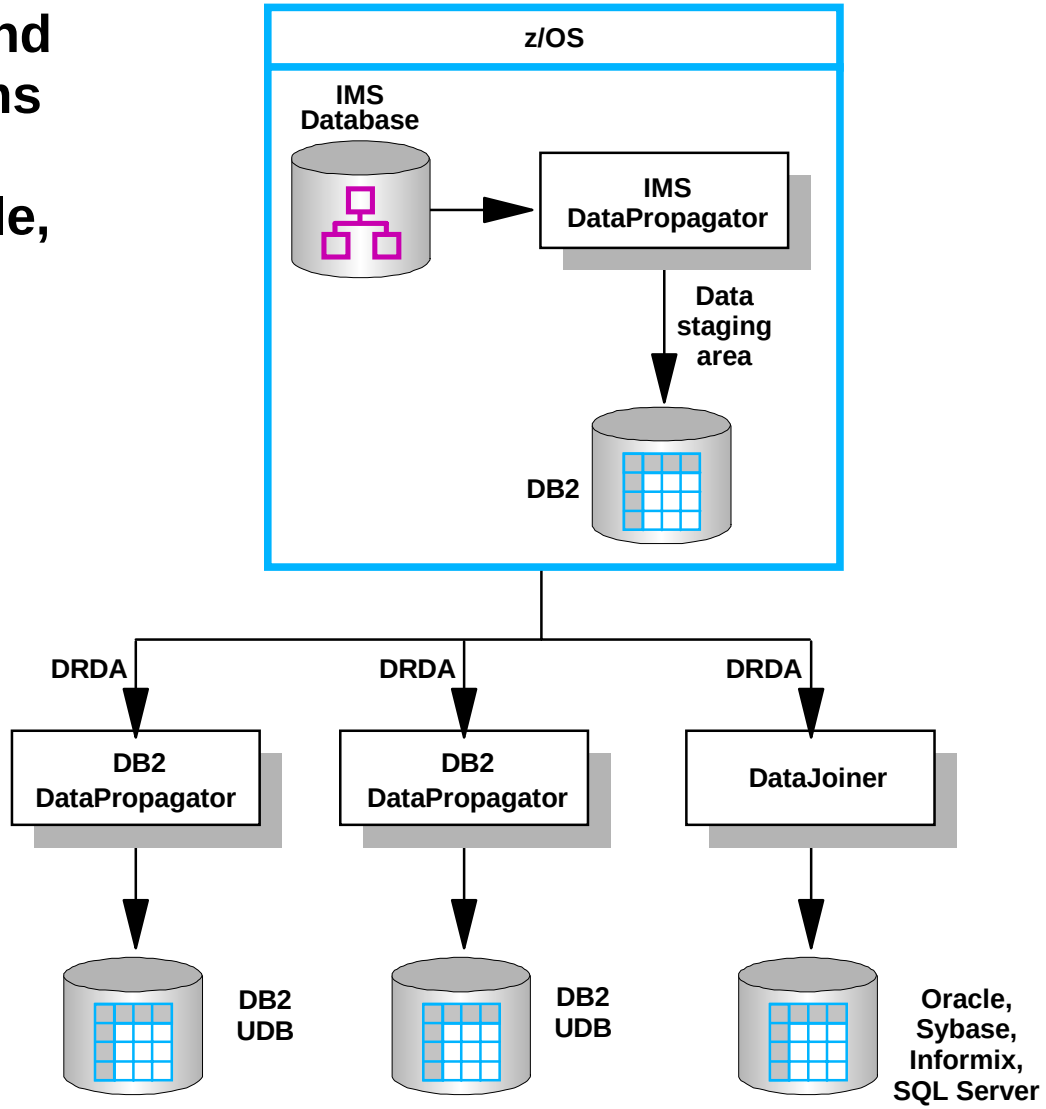
- **Updates from**
  - IMS TM
    MPP, IFP or BMP
  - IMS Batch
  - CICS/DBCTL



- **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

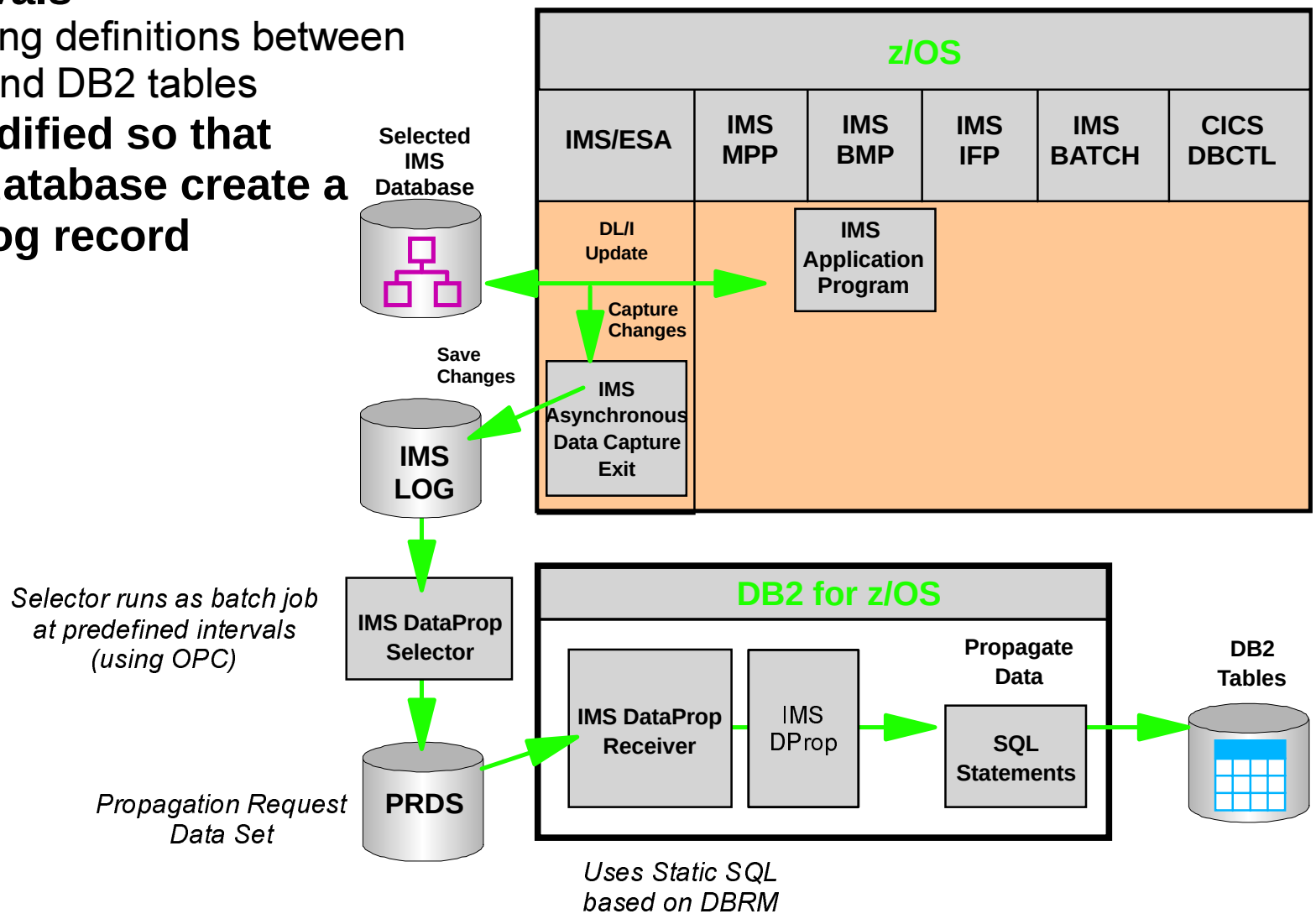
Asynchronous Propagation Beyond DB2 on z/OS

- 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.



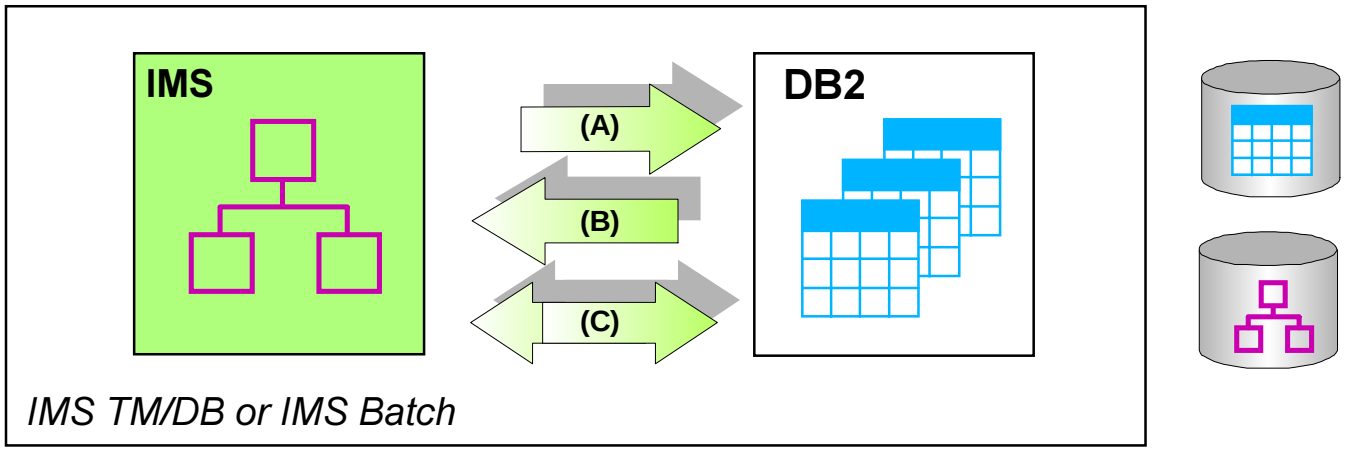
Asynchronous Propagation Environment

- **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

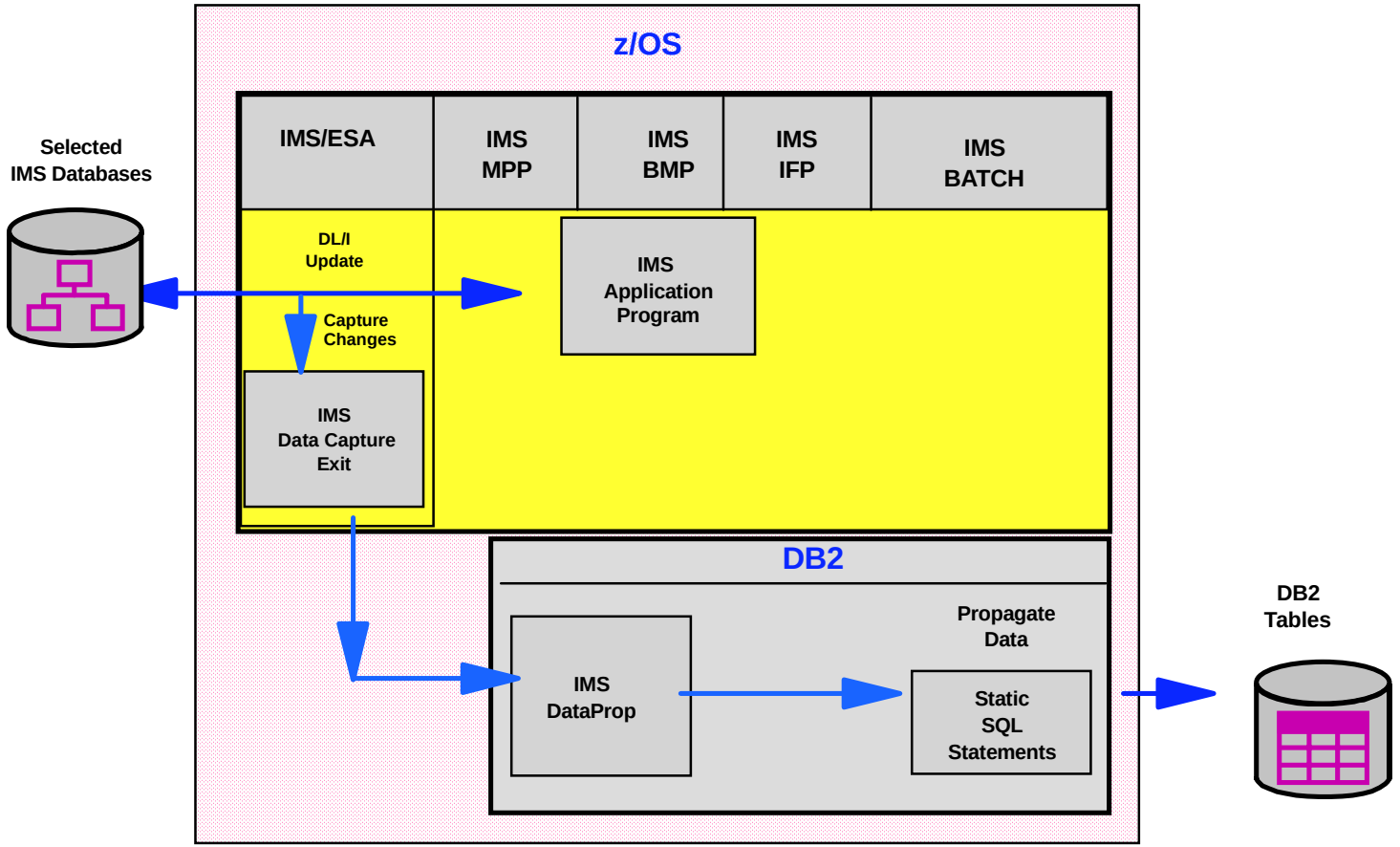
- **Updates from**
  - IMS TM
    MPP, IFP or BMP
  - IMS Batch
  - No DBCTL support yet



- **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

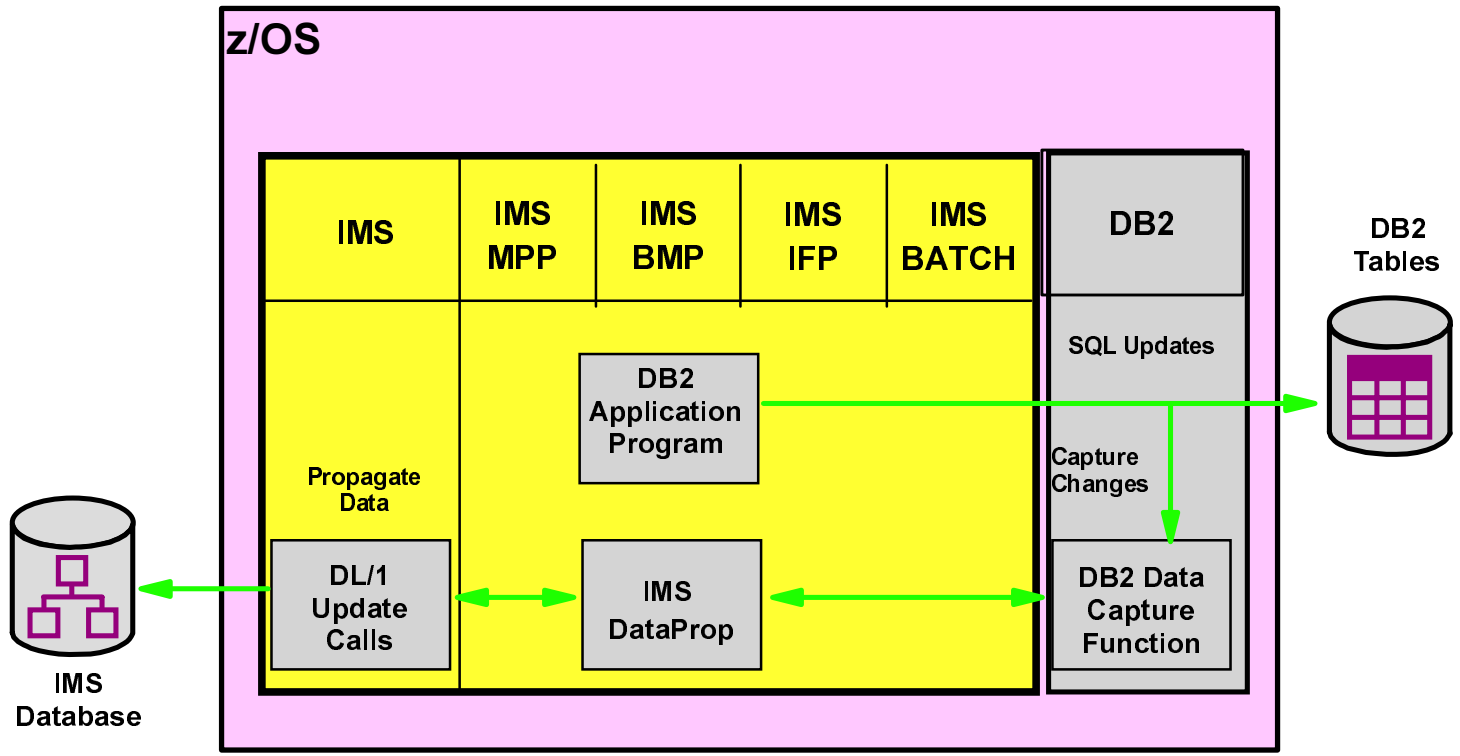
Synchronous Propagation - IMS to DB2

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



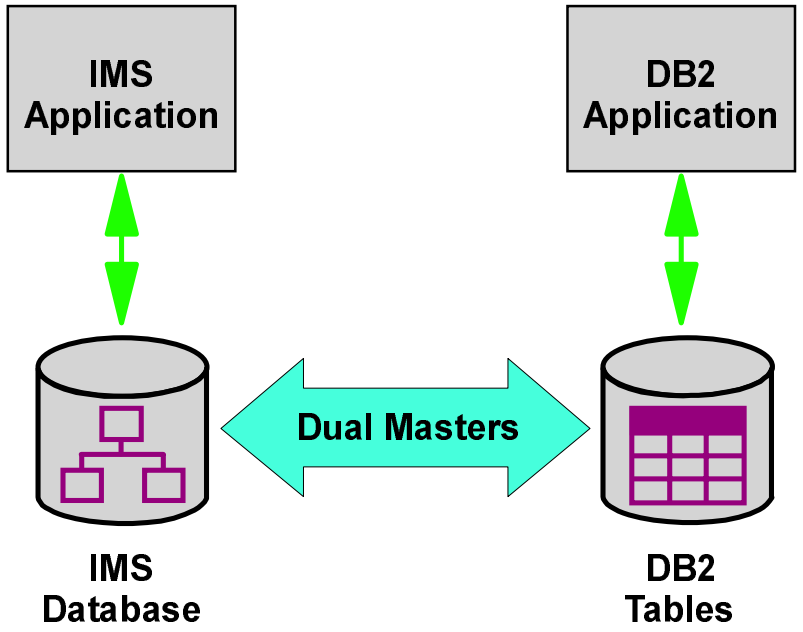
Synchronous Propagation - DB2 to IMS

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

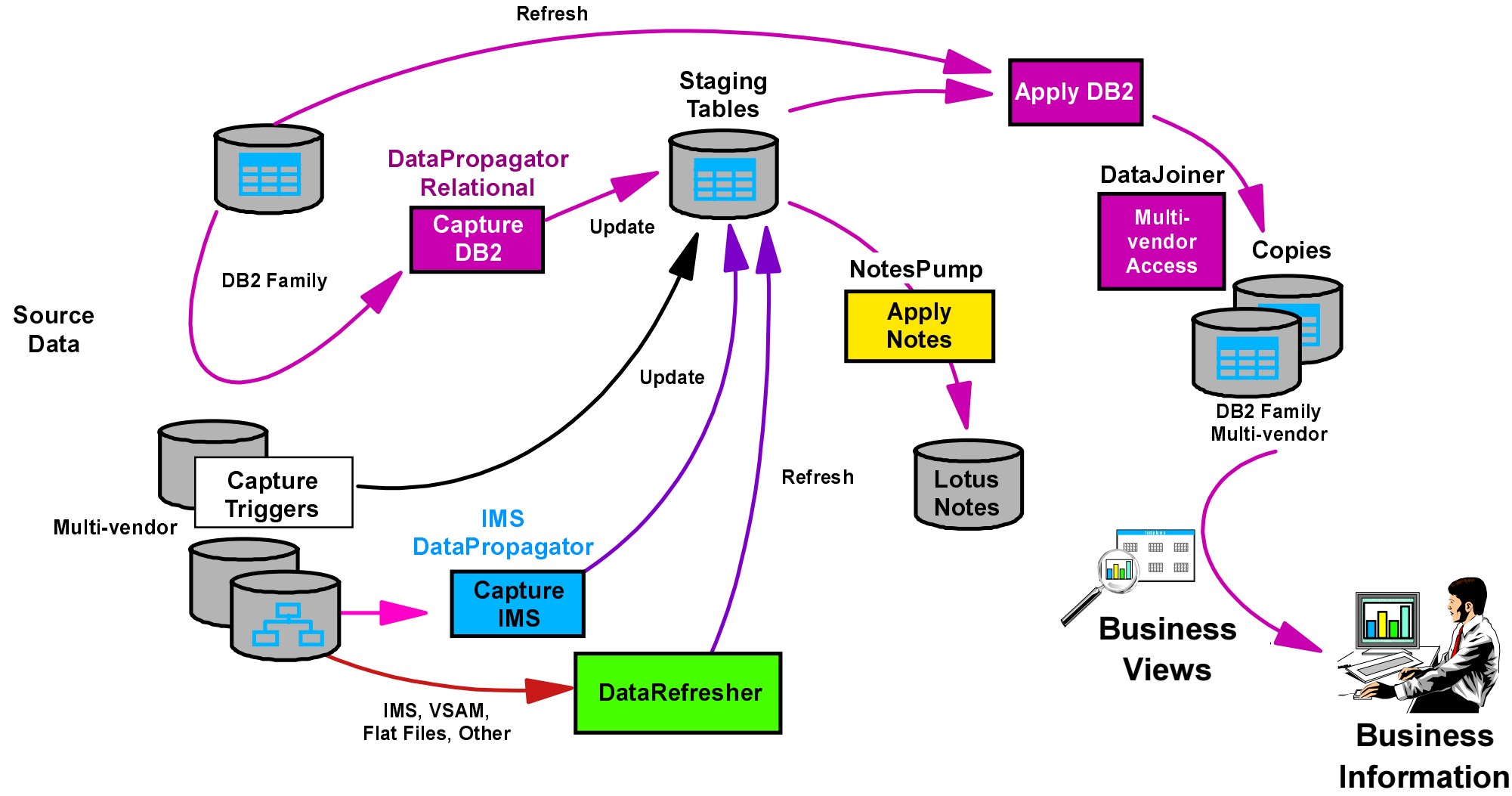


Synchronous Propagation - Two Way

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



Building the Warehouse - Summary



Summary

- **IMS data can be accessed and updated using DLI call**
  - from an IMS application
  - from a CICS application
  - from an IMS batch program
  - ..... and from any OS/390 address space using RRS and ODBA
  - ..... in many programming language including Java
- **IMS data can be accessed and updated using JDBC**
  - On OS/390
    - from an IMS application using JDBC
    - from a CICS application using JDBC
    - from a DB2 stored procedure using JDBC
    - And soon, from WAS using JDBC
- **IMS data can be accessed and updated using SQL call**
  - From any DRDA platform
  - Thru a DB2 stored procedure and ODBA
- **IMS data can be read using SQL call***
  - On NT/UNIX
    - using Classic Connect in conjonction with Data Joiner or DB2 DW
- **IMS data can be copied/updated in a DB2 warehouse**
  - using Data Refresher
  - using IMS Data Propagator

RETURN TO INDEX