IBM Advanced Technical Support
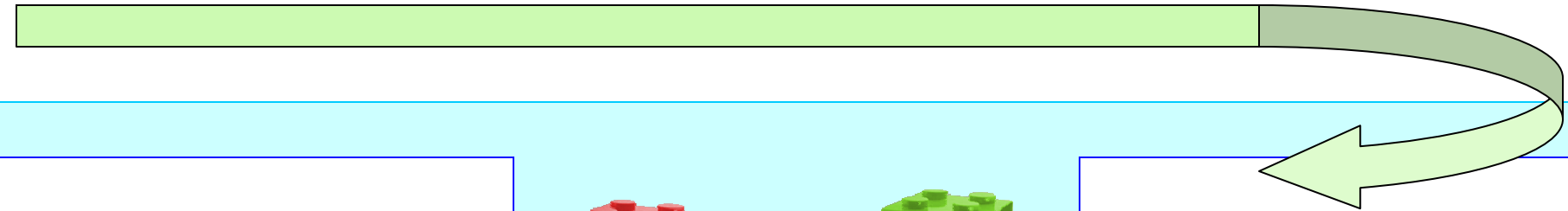
Architecting Access to IMS

The e-business Evolution

Access	Enterprise Integration	On Demand
"Get on the Net"	"Buying, not browsing Working, not surfing"	Optimize operations... dynamically respond to the needs of customers, employees, partners.

| Access | Publish | Transact | **Integrate** Internally | **Integrate** Externally | Adopt Dynamically |
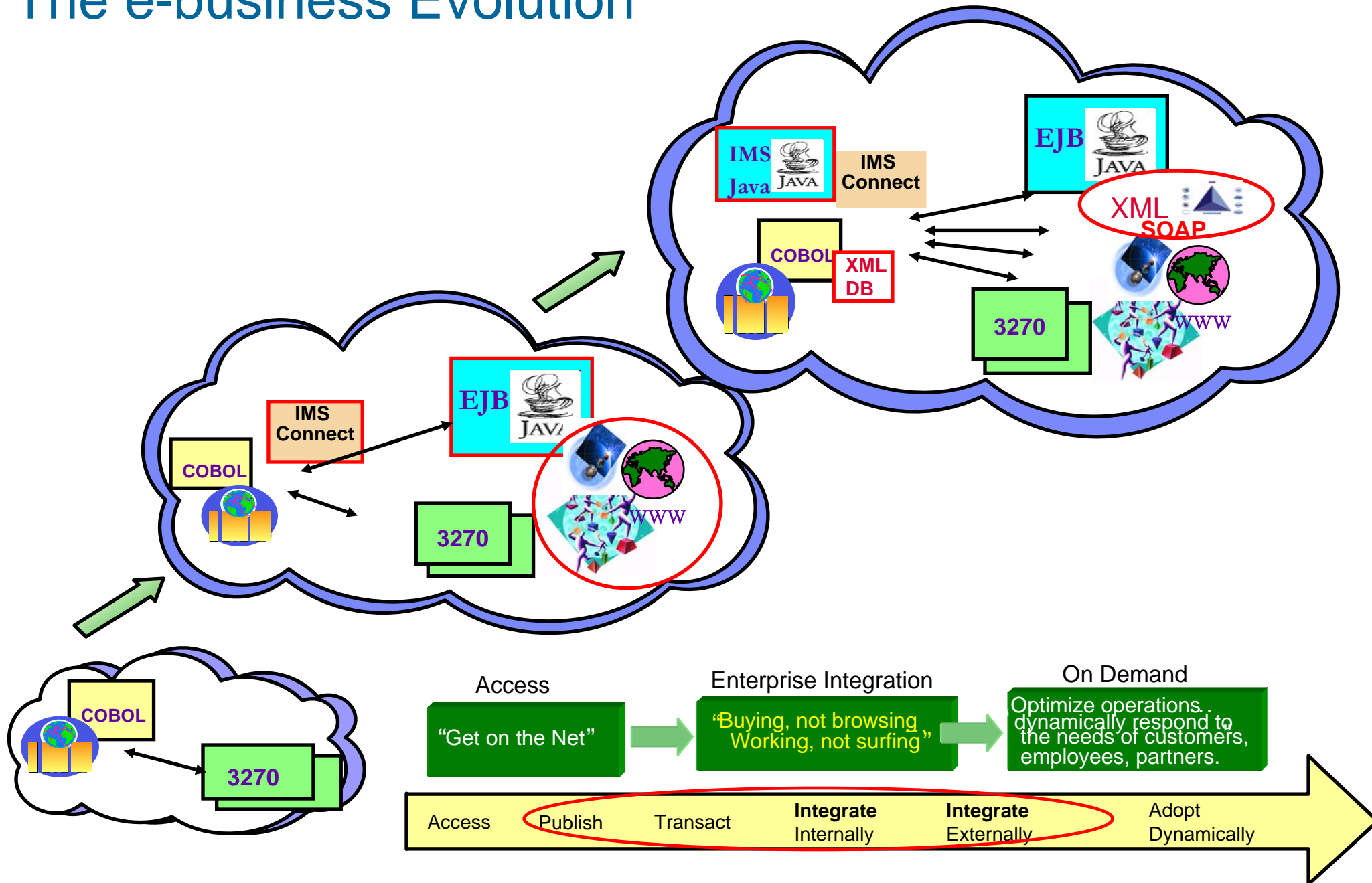
Service Oriented Architecture (SOA)

… a service?

A **repeatable business task**
  e.g., open new account,
      view balance, etc.

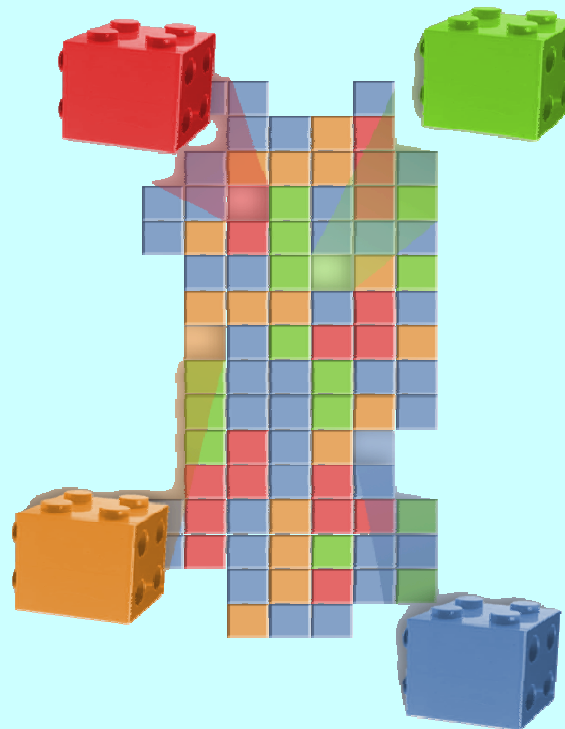### … service orientation ?

A way of integrating your
business as linked services
and results of accessing them

… service oriented architecture?

An **IT architectural style**
that supports service
orientation

… a composite application?

A set of **related and integrated**
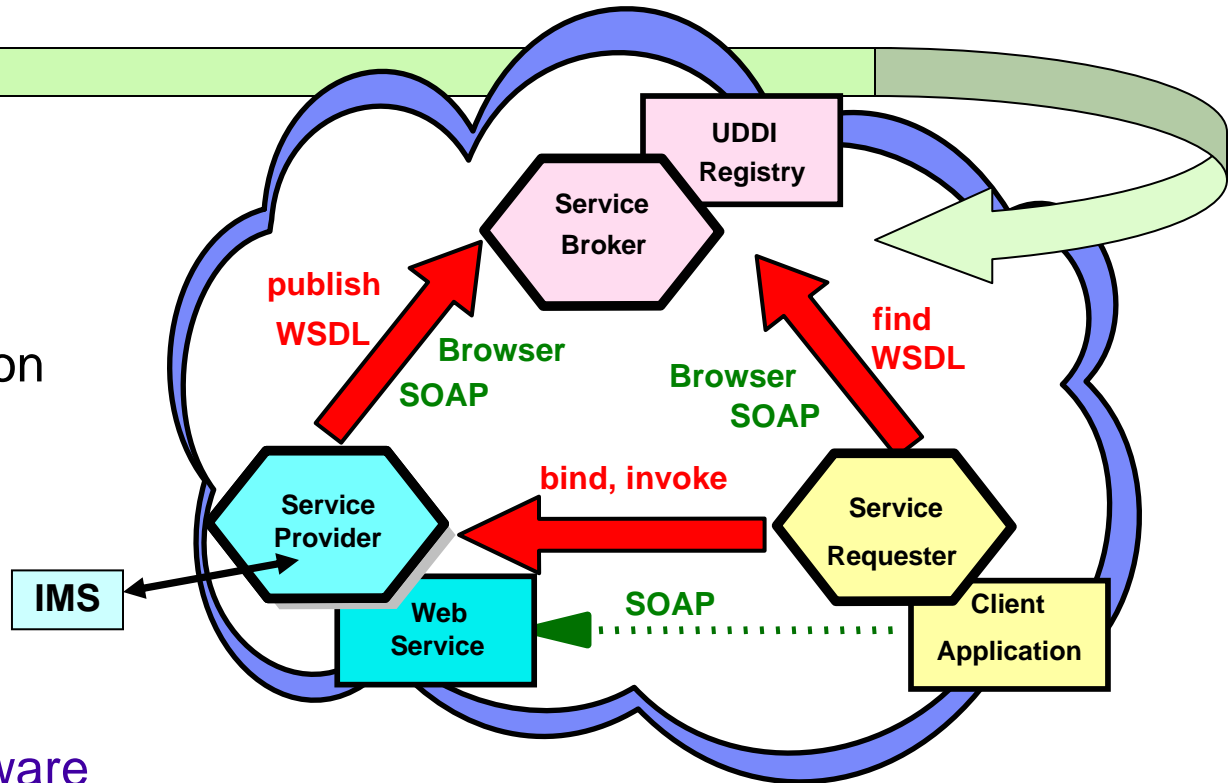services that support a business
process built on SOA

What is a Web Service ?

- Architecture for

  ▸ Application to application

    - Communication

    - Interoperation

- Definition:

  ▸ Web Services are software components described via WSDL(Web Services Description Language) that are capable of being accessed via standard network protocols such as SOAP over HTTP

The entire industry is agreeing on one set of standards !!
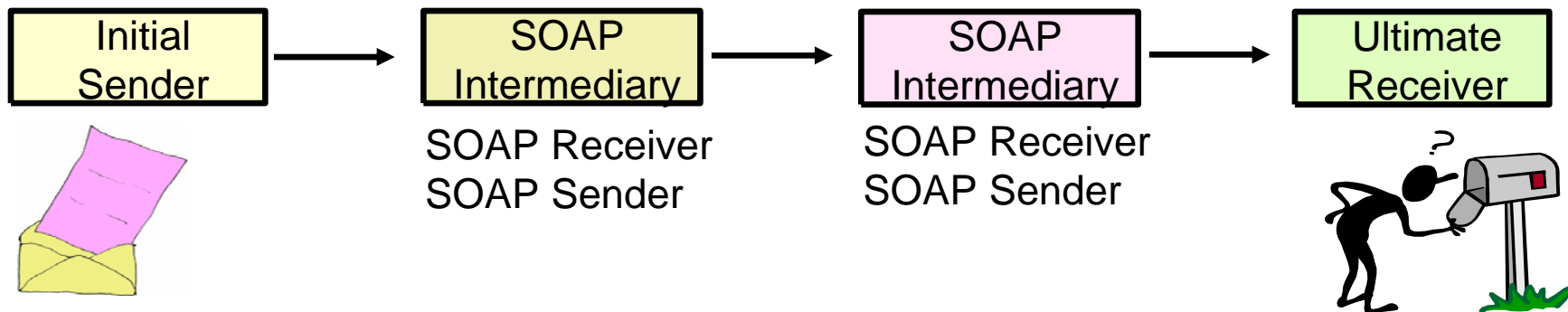
SOAP

- **What is SOAP?**
  - ▸ An XML-based protocol for exchange of information
  - ▸ An open standard whose main goal is to facilitate interoperability
  - ▸ A protocol which is not tied to any operating system, transport protocol, programming language, or component technology

- **What type of HTTP request does SOAP use?**
  - ▸ HTTP POST method

- **What do the letters stand for?**
  - ▸ Simple Object Access Protocol (SOAP 1.1)
  - ▸ Nothing (SOAP 1.2)

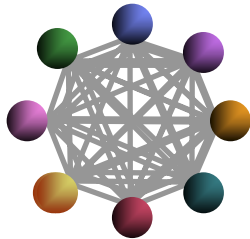| Initial Sender	→	SOAP Intermediary	→	SOAP Intermediary	→	Ultimate Receiver
		SOAP Receiver SOAP Sender		SOAP Receiver SOAP Sender		

WSDL

- **WSDL – Web Services Description Language**
  - ▶ Open Standard
  - ▶ XML resume describing what a Web Service can do, where it resides, and how to invoke it
  - ▶ Machine readable, generated, used by IDEs
  - ▶ Similar in purpose to IDL, but in XML form

- **One or multiple XML documents**
  - ▶ Service Interface – input and output parameters, operations and methods
  - ▶ Service binding – protocol binding
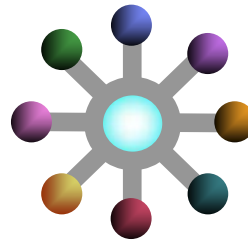 - ▶ Service implementation – location of service

Service

Bindings

Port Types

Operations
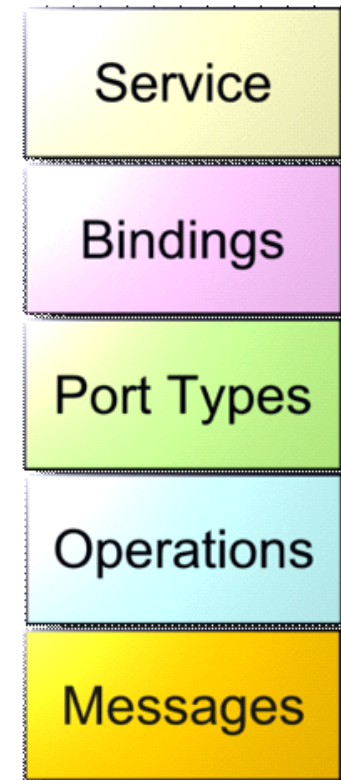
Messages

SOA Supports Flexibility and Reuse

Service Orientated Integration

Enterprise Application Integration (EAI)

Messaging Backbone
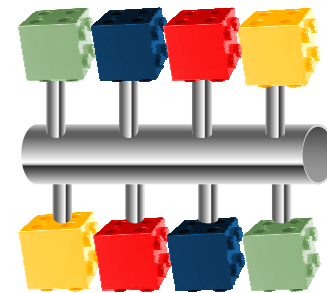
- Integration and choreography of services through an Enterprise Service Bus
- Flexible connections with well defined, standards-based interfaces

- EAI connects applications via a centralized hub
- Easier to manage larger number of connections

- Point-to-Point connection between applications
- Simple, basic connectivity

Flexibility

## *As Patterns Have Evolved, So Has IBM*

And so has IMS

- IMS provides architected capabilities and solutions that allow IMS to continue to be a premier server in the SOA world
  - ▶ Supporting qualities of service that can only be found in z/Series
    - Very high Performance, scalability, reliability, integrity

      – **Needed now more than ever in the Web world**

- **New interfaces and products provide access to/from IMS transactions and data**
  - ▶ Distributed environments can "easily" incorporate IMS access
    - Interfaces, tooling, products – from IMS, IBM and many vendors

      – **IMS becomes another server in an integrated environment**

protecting your business
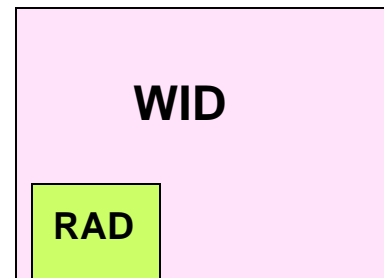
Business Continuity on zSeries

The Challenge

- **Figuring out how to access IMS**
  - ▶ "Exposing" the IMS resources as web services
- **Deciding how to create the web service**

IMS

?

Service Provider
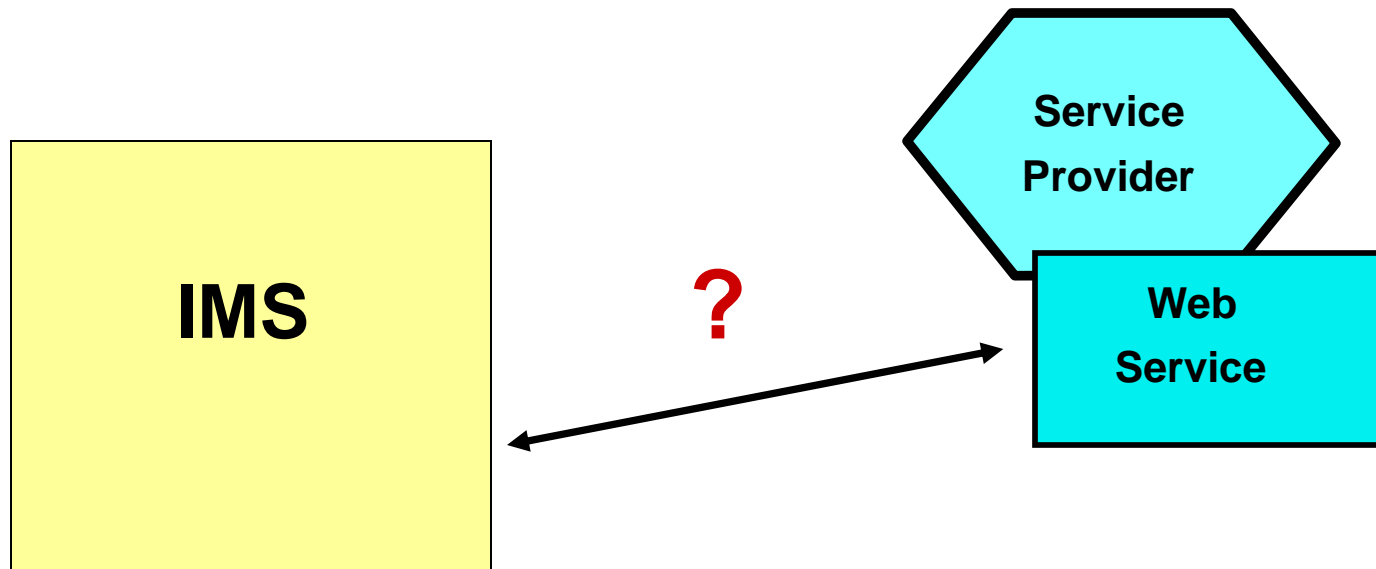
Web Service

IBM Solutions

Toolkits that generate web services, EJBs, JSP, etc. for IMS, CICS, DB2

WSAD-IE	→	RAD

WebSphere Studio
Application Developer
Integration Edition

Rational Application
Developer

(both include the IMS Connector for Java)

Service
Provider

Web
Service

IMS

WID

RAD
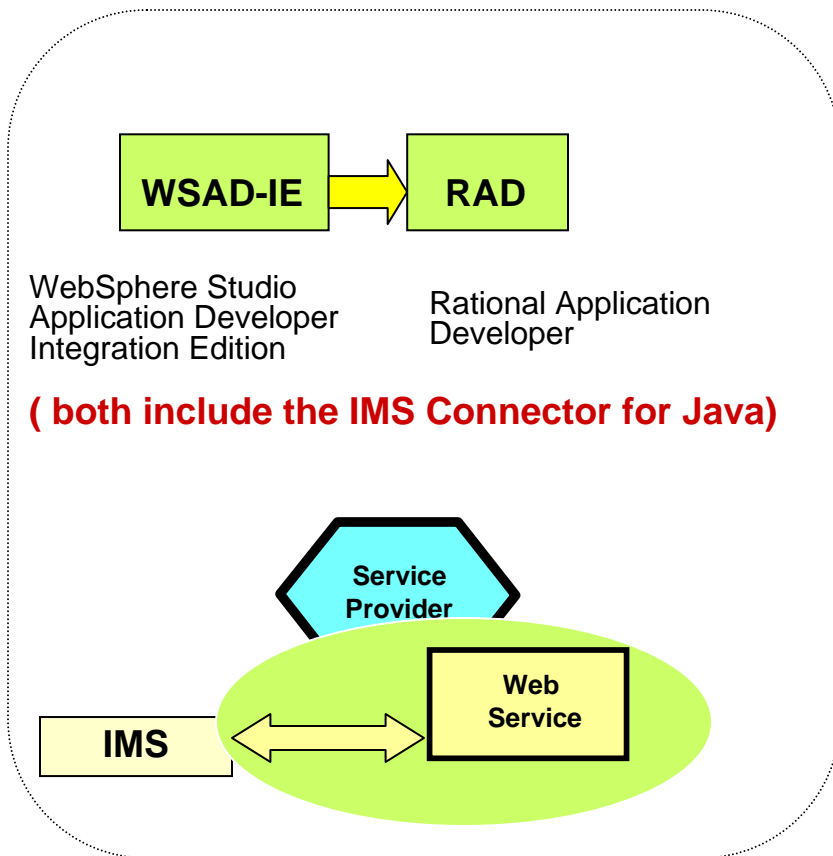
WebSphere® Integration Developer: Eclipse technology-based tooling that enables rapid assembly of business solutions based on a composite application-development framework

WDz

RAD
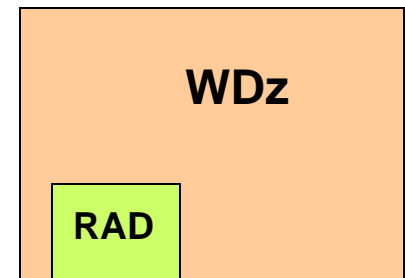
WebSphere Developer for zSeries: Common workbench and an integrated set of tools that supports end-to-end, model-based application development

What are your requirements?

- **The Environment**
  - ▶ Network requirements - **SNA or TCP/IP**

- **Application requirements**
  - ▶ **Access to IMS transactions**
    - ▪ *Direct connection model*
    - ▪ *Messaging and Queuing model*
  - ▶ **Access to IMS data**
    - ▪ ODBA
    - ▪ *Inquiry (read-only) or Update*
  - ▶ **Access from IMS applications**
  - ▶ **Replicating IMS data**

- **Development requirements**
  - ▶ Programming language
  - ▶ Skill vs. Cost - Build versus Buy and Modify
    - ▪ *Toolkits*

There are a variety of solutions

First define your requirements

To Make a Choice - Understand the Building Blocks
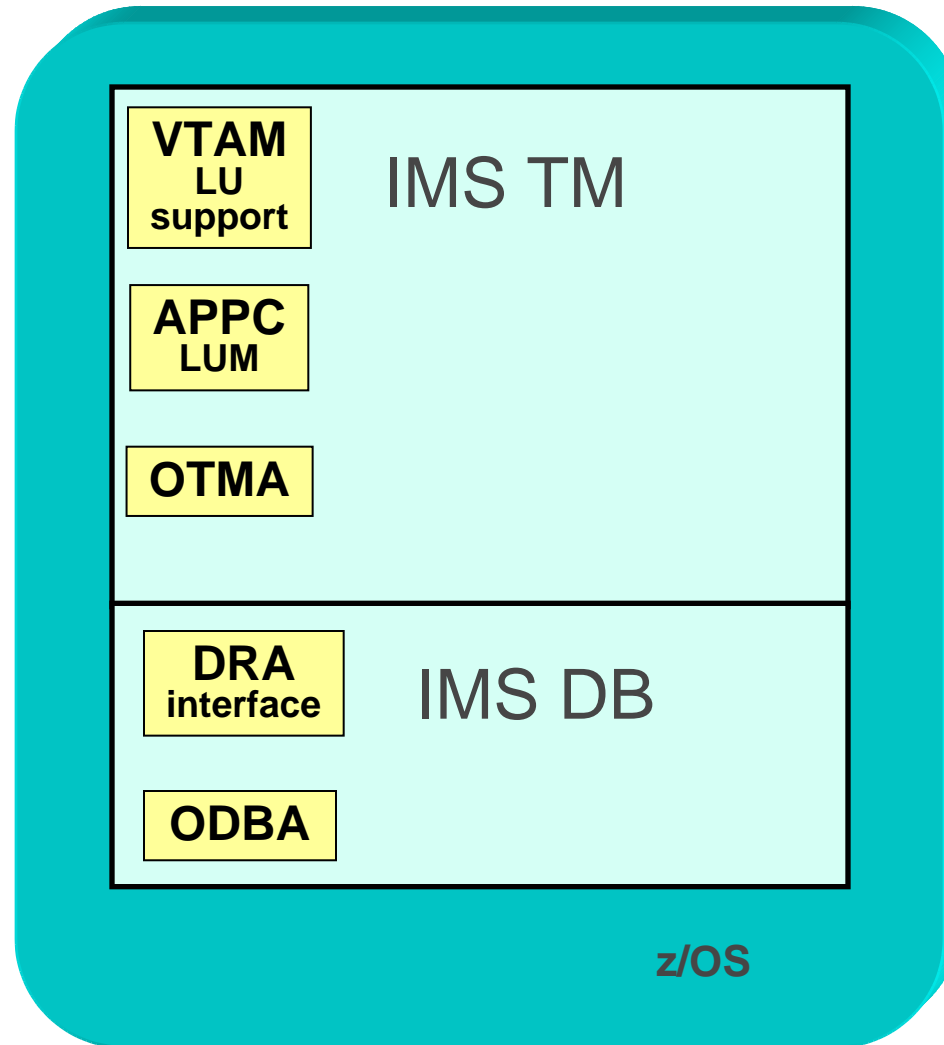
IMS Architecture Foundations

IMS Architecture Foundations …. The Usage

IBM or other vendor solutions

Servlet
Web server API,
CGI program
…
Socket calls or
APPC calls or
MQ calls or
Other

SQL call

ODBC call

JDBC call

VTAM

APPC/MVS

LU…

MQSERIES MVS

Telnet

TCP/IP

IMS Connect

WebSphere
Socket calls or
APPC calls or
MQ calls or
Other

OTMA CI

ODBA

IICF

DB2 stored proc

DB2

IMS TM

IMS DB

C I C S

z/OS

13
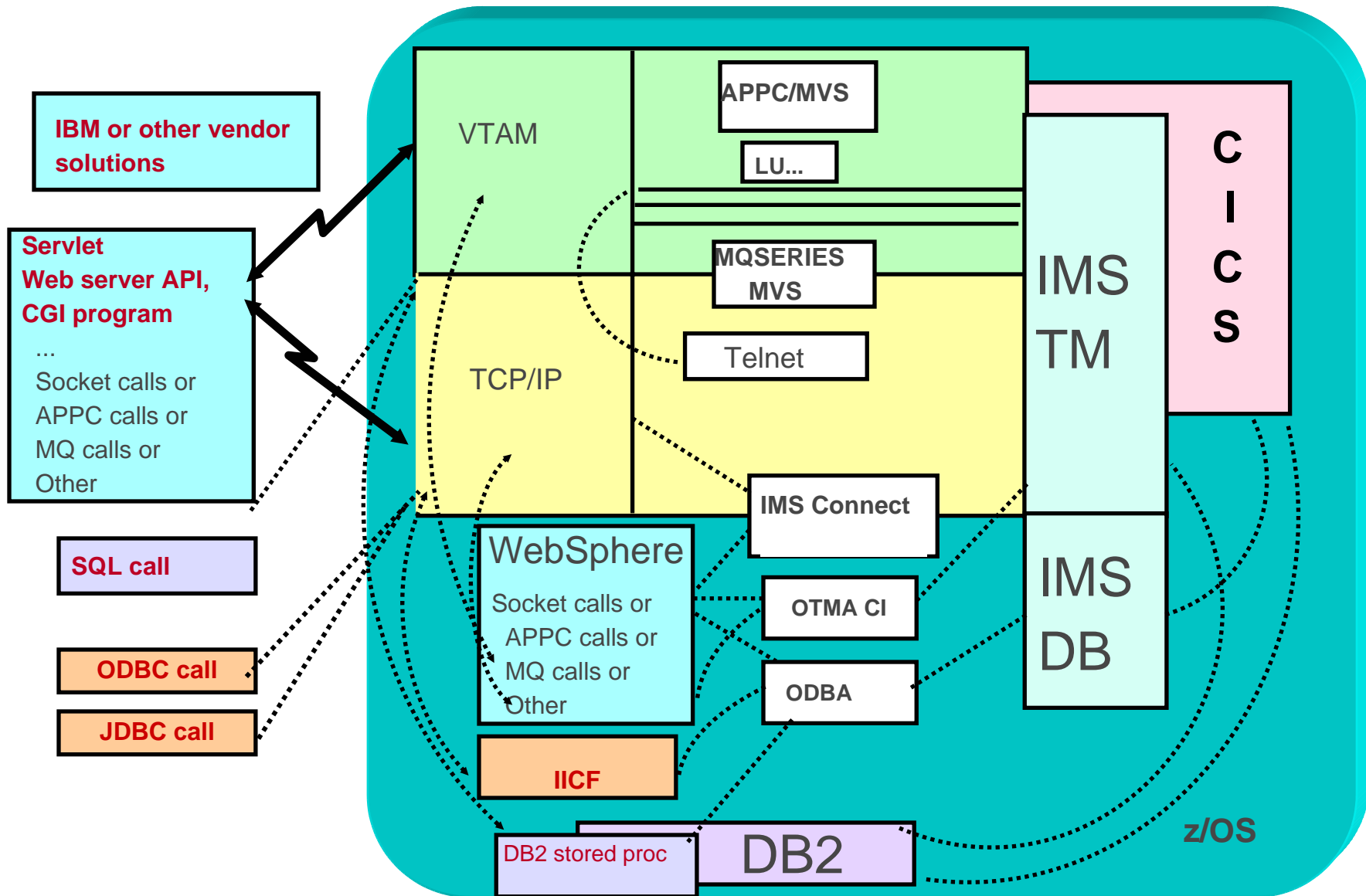
Access to IMS transactions

Application Requirement – Direct Connection Model

Direct Connection Model (transactions)

▶ Characteristics

- Processing begins only if connections can be established
- Immediate notification of problems
  - Error indicators sent in the case of failures

▶ Most popular types of support :

- 3270 emulation - Traditional interface
  - SNA=EHLLAPI, TCP/IP=TN3270
- Program-to-Program support
  - SNA=APPC, TCP/IP=Sockets
  - Interactive processing
  - Output messages can be sent before/after IMS syncpoint
  - Remote programs can affect whether or not commit occurs

Direct Connection Model - 3270 emulation

- *Benefits and value*
  - ▶ Straightforward and simple
    - IMS is unaware that the access is from the Web
      - Traditional IMS communication model
  - ▶ Leverages standard TCP/IP Telnet (TN3270) capabilities

- IBM's Host Integration Solution
  - ▶ Host On-Demand - Host Access Transformation Server (HATS)
    - HATS Studio uses Host On-Demand to provide connection support from HATS applications to 3270 applications using Telnet protocols
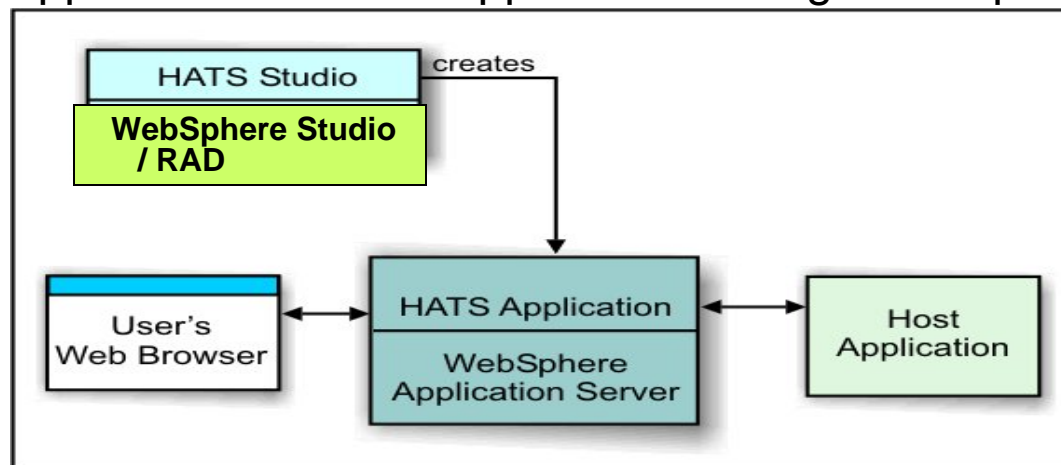
Direct Connection Model - 3270 emulation ...

- **Vendors that provide a variety of solutions:**

  This is a sample list that does not attempt to include all possible vendors

  ▶ Crossplex e3270 Emulation - SofTouch Systems Inc.
    - *http://www.softouch.com/cpx_prod/index.html#*
  ▶ HOBLink TE
    - *https://webshop.hob.de/scripts/produkte.php*
  ▶ Host Access Transformation Services – IBM
    - *http://www.ibm.com/software/webservers/hats/*
  ▶ Jacada
    - *http://www.jacada.com*
  ▶ Resqnet
    - *http://www.resqnet.com*
  ▶ Web 390 for OS/390 and MVS - Information Builders
    - *http://www.informationbuilders.com/products/web390/pdf/web390.pdf*
  ▶ *...*

Direct Connection – TCPIP: IMS Connect

- **A capability that provides connectivity support between TCP/IP applications and IMS – Integrated into IMS V9**
  - ▶ Configured on a z/OS server

- *Benefits and Value*
  - ▶ Supports TCP/IP sockets access to IMS transactions and commands
  - ▶ Provides a general purpose and structured interface
  - ▶ Provides a strategic base for new connection technologies
    - Operations Manager – IMS Control Center
    - IMS SOAP Gateway

Web Server program
COMTI   Cobol
Visual Basic   Assembler
PowerBuilder   C/C++
...   Java

Java Applet

BROWSER

Web Server
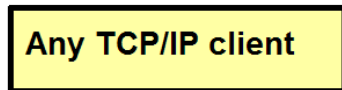
TCP/IP

VTAM

IMS Connect

Websphere

IMSB

IMSA
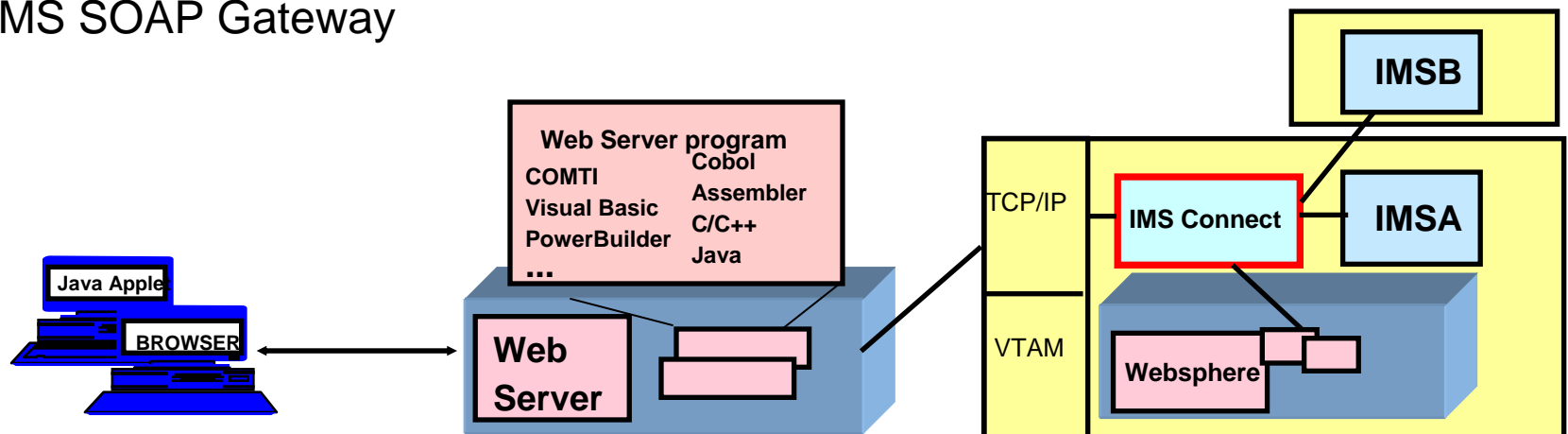
IMS Connect - Architecture

IMS Control Center
-Requires
    IMS Connect
    DB2 UDB Admin. Client V8.1
- Does not require DB2 UDB

Structured Call Interface — SCI

Operations Manager (OM) — SCI

IMS Control Region — SCI

enhanced commands

IMS Control Center

Web server pgms

IMS Connector for Java

Any TCP/IP client

SOCKET calls   ...   SCI   XCF

IMS Connect

transactions and commands

Comm. Analyzer (DDMs)   SCI

APPC LU Manager

XCF OTMA

Solid IMS -based Architecture

BPE

Environments

Command Component (CMD)

Call Interface

TCP/IP Driver (socket calls)

TCP/IP client Communic. component (CCC)

Datastore Communic. component (DCC)

OTMA Driver (XCF services)

TCP/IP clients

19

IMS Connect – Architecture and Socket Design

CLIENT

Socket()

| Establish environment and create Socket_S |

Connect()

| Connect socket S to IMS Host (Port) |

Write()
Read()
.....

| Data exchange on Socket S |

Close()

| Close Socket S and terminate |

IMS Connect

| Establish environment and create socket S | Socket() |

| Bind socket S to a local address (Port) | Bind() |

| Alert TCP/IP of the ability to accept connection requests | Listen() |

| Accept connection and receive second Socket NS | Accept() |

| Data exchange on Socket NS - process data | Read() |

| Close Socket NS | Write() |

| Close Socket S and terminate |

- Receive msg from TCP/IP
-Prepare and send msg to IMS in OTMA format
-Receive msg from IMS
-Prepare msg in client format

IMS with OTMA

Receive the OTMA message
....
process
...
Send the OTMA output reply

clients use SOCKETS API:
- *Input message:*
  • Formatted message header to communicate with IMS Connect
  • Client message (can include OTMA headers)
- *Output message* can consist of one or more predefined structures

User Exits: HWSIMSO0, HWSSMPL0, HWSJAVA0, ...

Optionally perform:
- Translation ASCII / EBCDIC
-Conversion between client msg format and OTMA msg format
- Prepare output message format

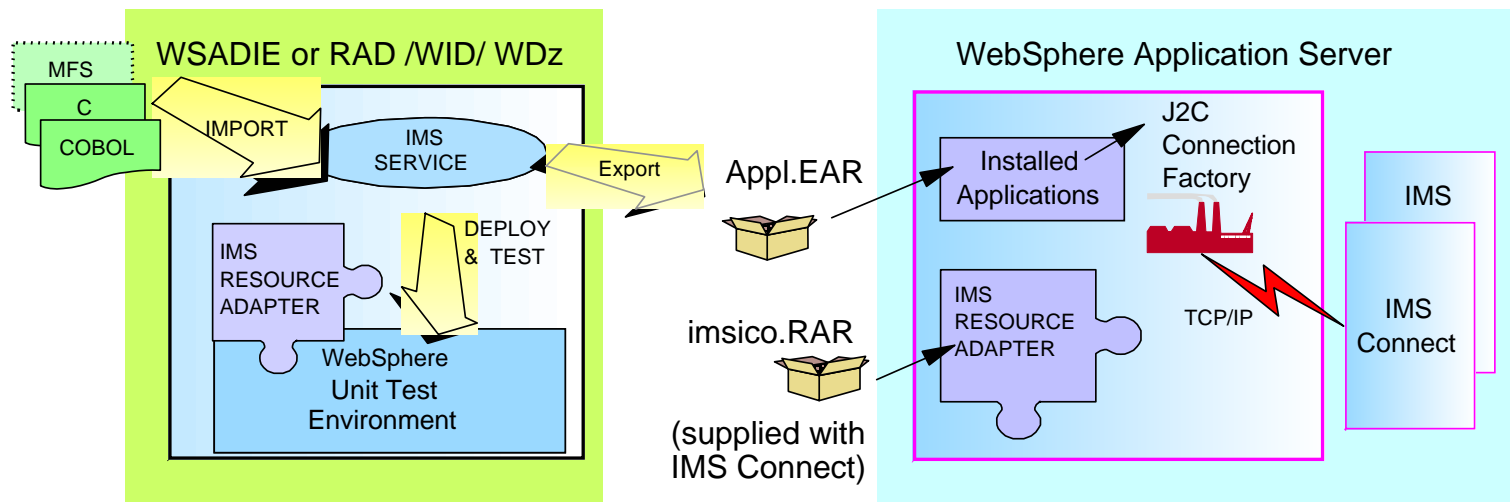# IMS Connect Solutions

- ## IMS Connector for Java
  - ▸ Supports rapid development/deployment of Java applications to access IMS
    - *Development component*
      - – Delivered with WebSphere Studio Application Developer Integration Edition (WSAD-IE) or Rational Application Developer (RAD), WID, WDz
    - *Runtime component*
      - – Must be installed into an application server, e.g., WebSphere

IMS Connector for Java = IMS Resource Adapter = WebSphere Adapter for IMS
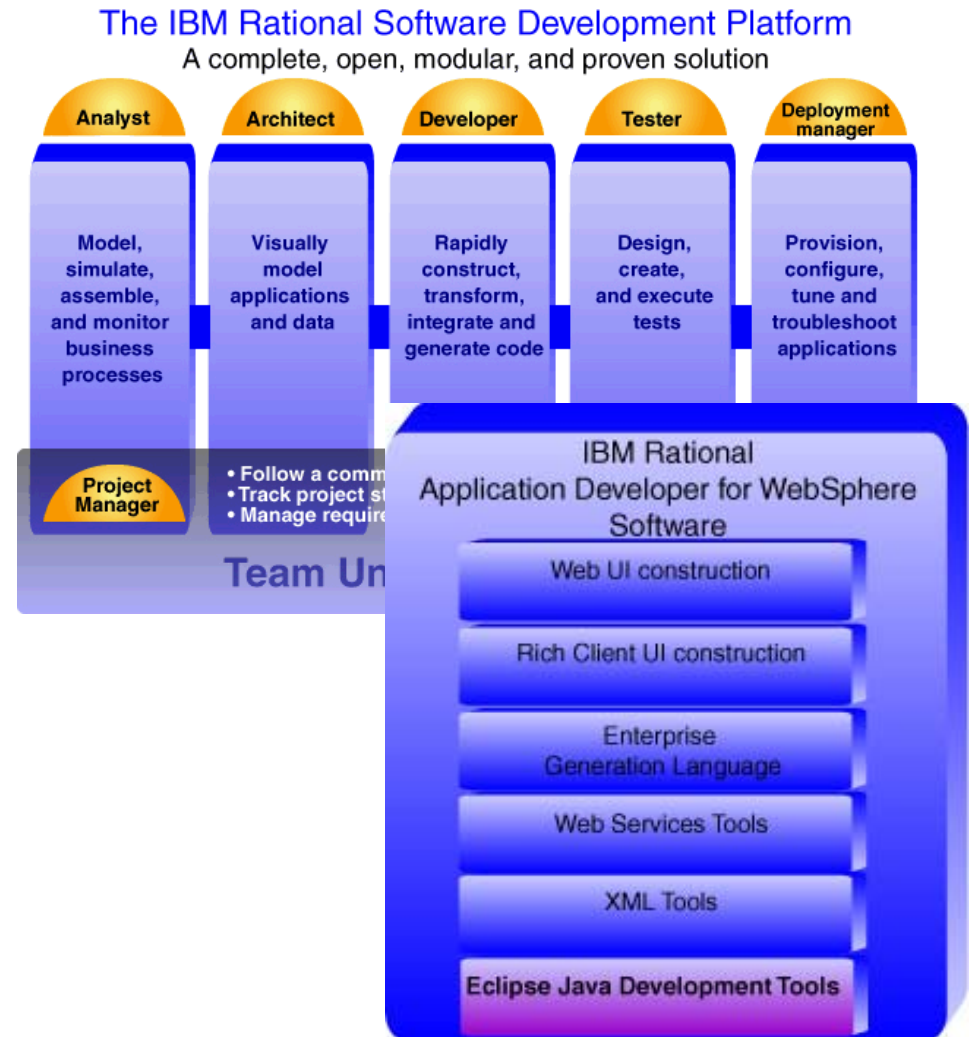
IBM Development Toolkits – WSAD-IE, RAD, WID, WDz
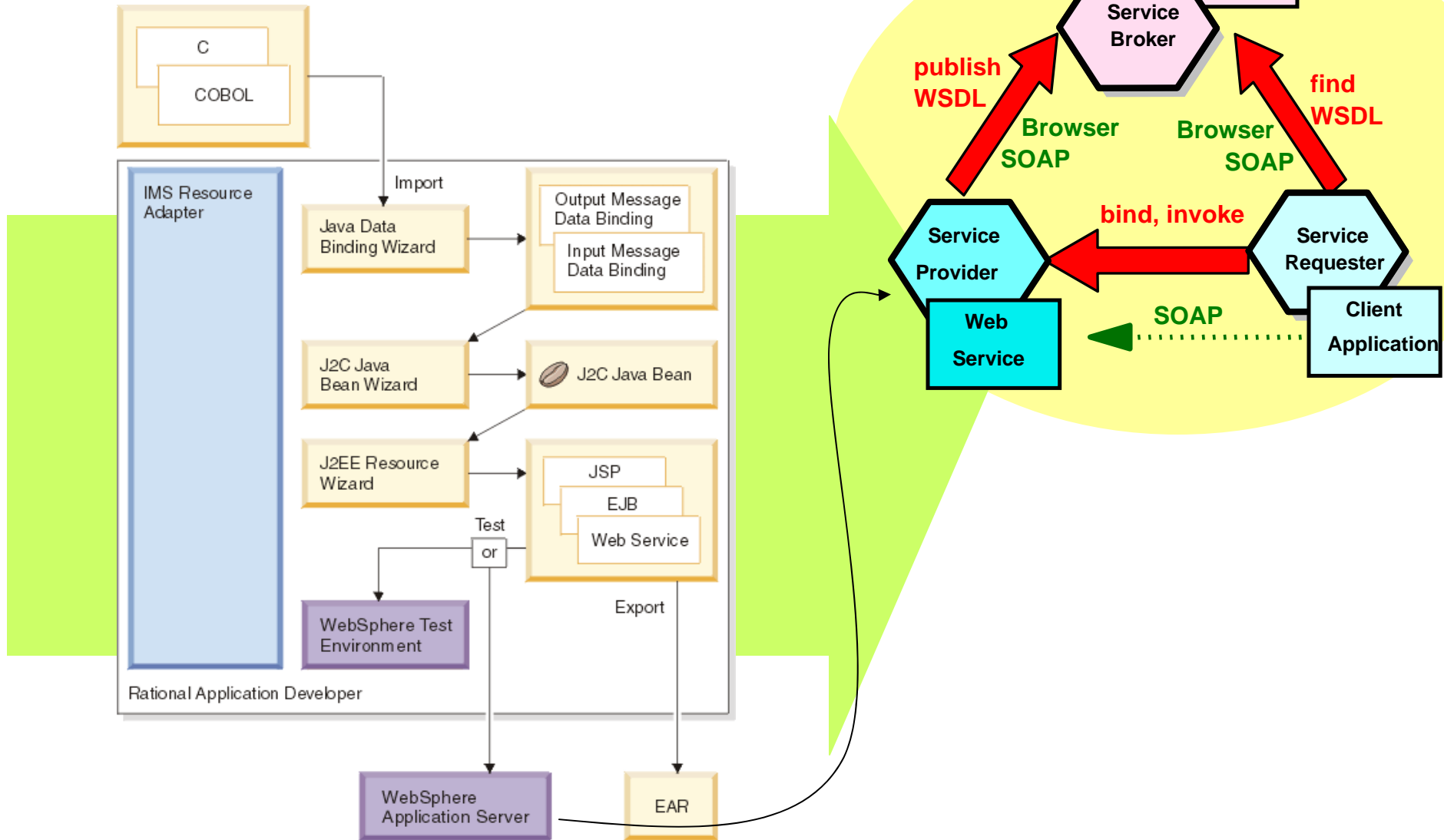
- **Open, modular solutions**
  - ▸ Assist in building, integrate, extending, modernizing and deploying software and software-based systems.
  - ▸ Combine integrated development tools with proven best practices and processes guidelines

- **For IMS environments**
  - ▸ Incorporates the IMS Connector for Java
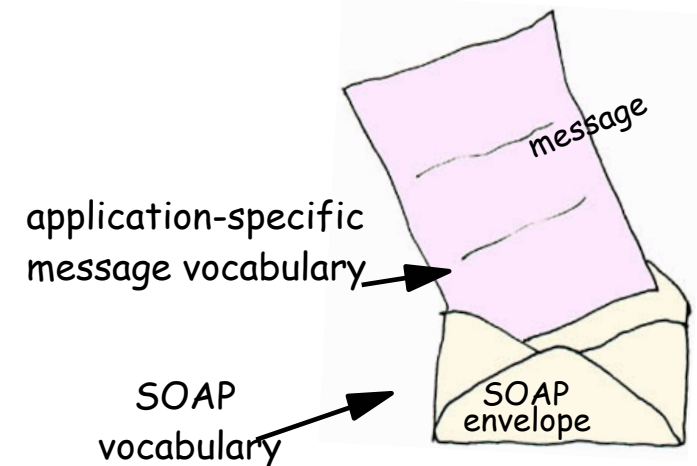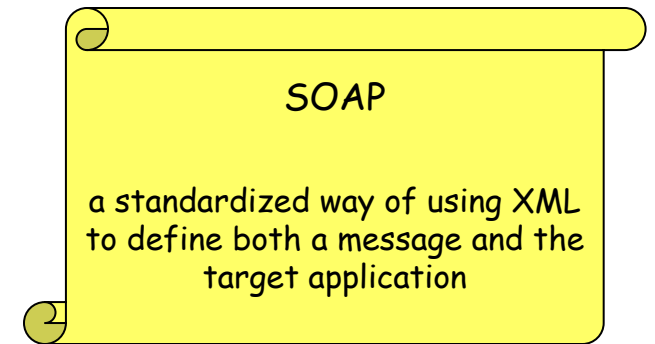 - ▸ Exposes IMS transactions for web access

The IBM Rational Software Development Platform
A complete, open, modular, and proven solution

Analyst — Model, simulate, assemble, and monitor business processes

Architect — Visually model applications and data

Developer — Rapidly construct, transform, integrate and generate code

Tester — Design, create, and execute tests

Deployment manager — Provision, configure, tune and troubleshoot applications

Project Manager
• Follow a comm
• Track project st
• Manage requir

Team Un

IBM Rational Application Developer for WebSphere Software
- Web UI construction
- Rich Client UI construction
- Enterprise Generation Language
- Web Services Tools
- XML Tools
- Eclipse Java Development Tools

WSAD-IE, RAD, WID, WDz

IMS Connect Solutions …

- **IMS Connect Extensions**

  ▶ http://www-306.ibm.com/software/data/db2imstools/imstools/imsconnectext.html

  ▶ Simplifies problem determination
  ▶ Streamlines performance tuning and customization
 ▶ Improves the availability and security of IMS Connect.

Using IMS Connect – IMS SOAP Gateway

- **Uses SOAP messages to support end-to-end integration between IMS transactions and**
  - ▸ Microsoft .Net & Java applications
  - ▸ Any third party applications, e.g. SAP XI
  - ▸ RYO applications

- **Provides HTTP/SOAP transport and processing**
  - ▸ SOAP envelope and headers handled by the gateway

- **Utilizes WebSphere Developer for z/Series tooling to create converters for transforming XML messages to COBOL data and vice versa**
  - ▸ No need to change existing IMS application code

- **Runs on any Java supported platform**

SOAP

a standardized way of using XML to define both a message and the target application

message

application-specific message vocabulary

SOAP vocabulary

SOAP envelope

Using IMS Connect – IMS SOAP Gateway ...

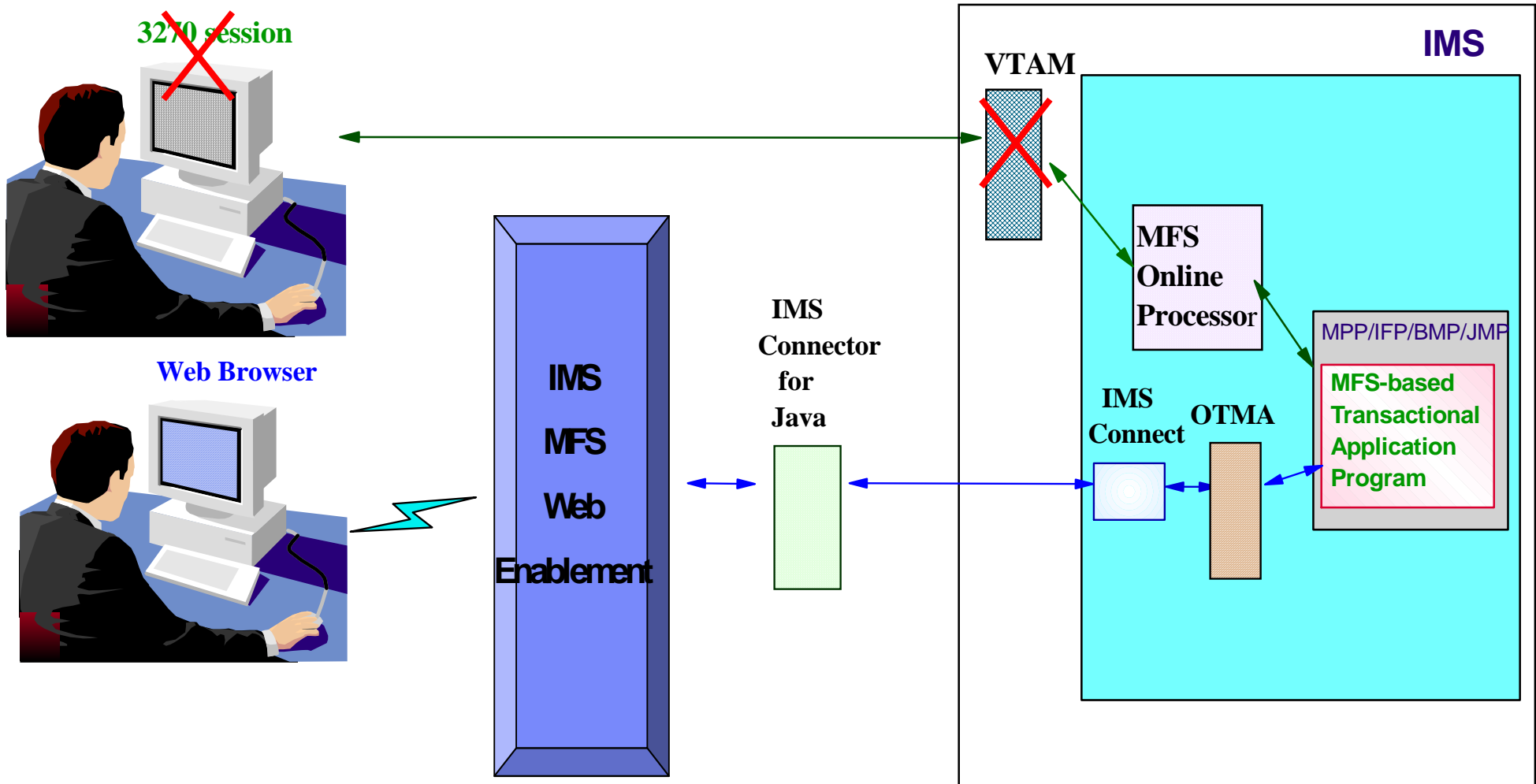Java/ .NET client invokes IMS COBOL application as a Web Service
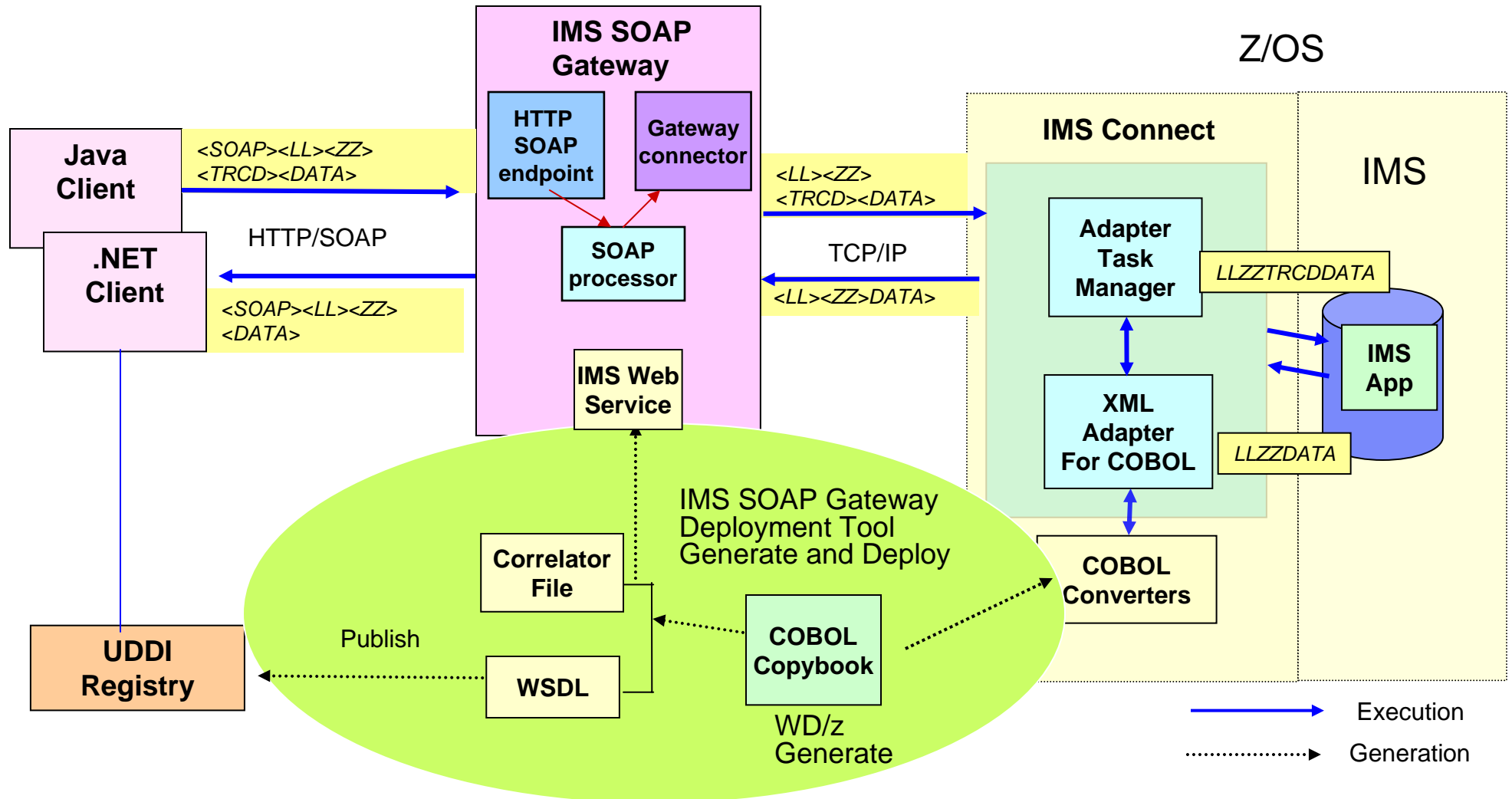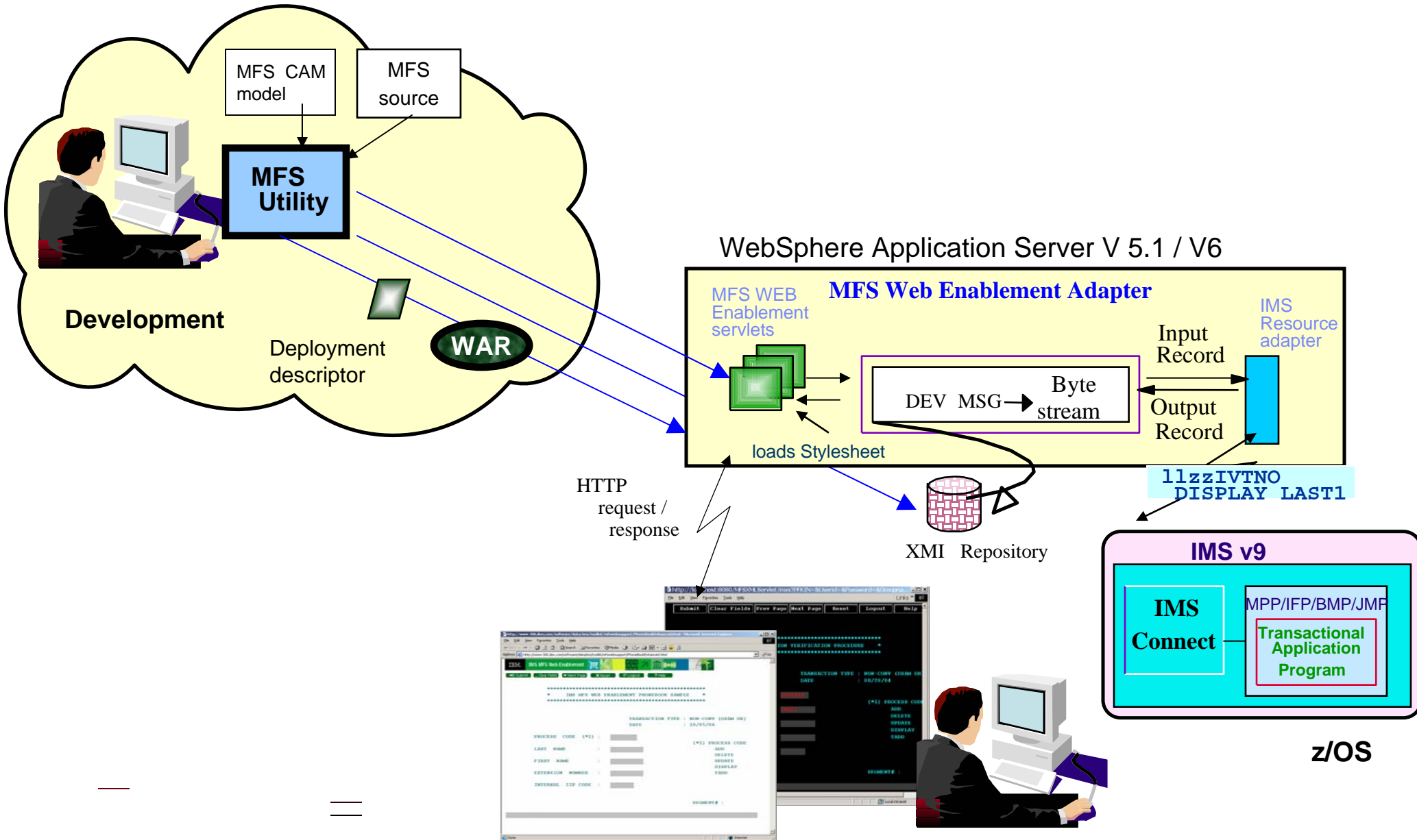
Using IMS Connect – MFS Web Enablement

Reuse existing MFS-based IMS business logic

Eliminate 3270 emulators and VTAM => reduce total cost of ownership!

z/OS

3270 session

IMS

VTAM

Web Browser

IMS

MFS

Web

Enablement

IMS Connector for Java

MFS Online Processor

IMS Connect

OTMA

MPP/IFP/BMP/JMP

MFS-based Transactional Application Program

Using IMS Connect – MFS Web Enablement ...

IMS Connect Solutions …

- **Product solutions that leverage IMS Connect:**

  - Attachmate - Synapta Services Builder for IMS
    - *http://www.attachmate.com/NR/rdonlyres/2FFC7D0A-9744-4996-95CE-18AFCEC0B4F7/0/tp_ssb_transactionaccess.pdf*
  - Comporsys Connector for IBM IMS
    - *http://www.comporsys.de/pdf/connector,ims,datasheet(en*).pdf
  - Microfocus Mainframe Express (MFE) IMS Connect interface
    - *http://www.microfocus.com/mfnewsletter/20040601_004.asp*
  - MicroSoft Transaction Integrator
    - *http://msdn.microsoft.com/library/default.asp?url=/library/en-us/his_2004main/htm/his_planning_for_transaction_integrator_node_gphi.asp*
  - NetManage OnWeb Connectors
    - *http://www.ftp.com/products/pdf/datasheets/OnWeb_Connectors2_3-05.pdf*
    - SeeBeyond e*Way Intelligent Adapter for IMS
    - *http://goldstar.seebeyond.com/support/support/docs/4.5.4/eWay_Intelligent_Adapters/IMS_eWay_Monk.pdf*

IMS Connect Solutions …

- **Product solutions that leverage IMS Connect…**

  This is a sample list that does not attempt to include all possible vendors

  - IONA Mainframe Integrator for IMS
    - *http://www.iona.com*
  - iWay Adapter for IMS/TM
    - http://www.egeneration.com/iwaydocs/iway55/5.5.001/iw55_ims.pdf
  - Sybase XJS 390 Enterprise Integrator 3.8
    - *http://www.sybase.com/detail?id=1018620*
  - webMethods 6 Mainframe Integration
    - *http://www.webmethods.com*

  - *…*

- **Products that enhance IMS Connect:**
  - BMC Energizer for IMS Connect
    - *http://www.bmc.com/*
  - IMS Connect Extensions
    - *http://www.fundi.com.au/pr_ims_ce.html*

Application Requirement – Messaging and Queuing

- **Messaging and Queuing Model (transactions)**
  - ▶ Characteristics
    - Processing occurs whether or not a connection is made
      - Assured delivery of messages (inbound/outbound) when components and/or network are available
  - ▶ Support
    - WebSphere MQ (MQSeries)
      - Remote program is not sensitive to the network type
        - MQ provides its own high-level standard API
        - Same applications can be deployed on TCP/IP or SNA
      - Supports the use of MQ API
      - Supports the use of JMS (Java Message Service) API
        - Messaging standard that allows application components based on J2EE to create, send, receive, and read messages
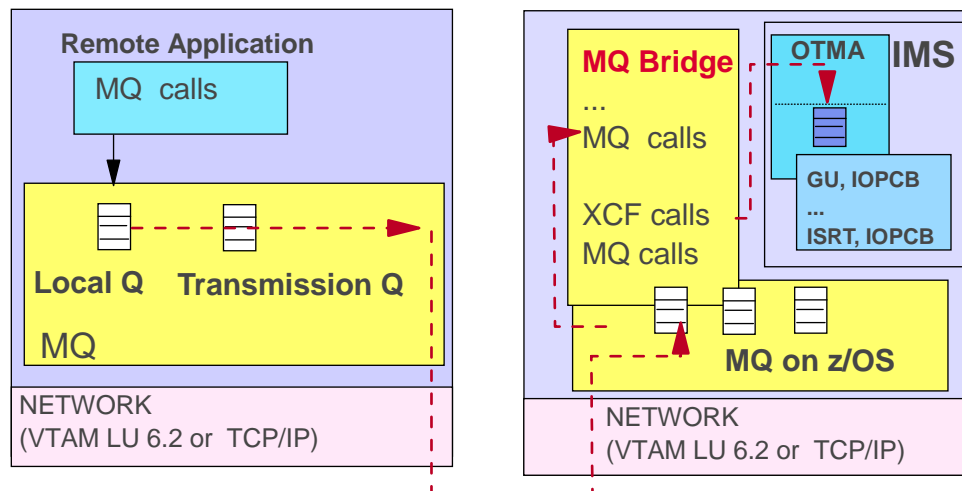
WebSphere MQ Family

- *Benefits*
  - ▸ Provides a programming interface that can be deployed across multiple platforms on different types of networks

- **IMS Support**
  - ▸ Adapter – uses the IMS External Subsystem interface
    - ▪ *Supports the use of explicit MQ calls in the IMS application*
  - ▸ Bridge – uses the OTMA interface
    - ▪ *Takes advantage of the DL/I call interface in the IMS application*

Messaging and Queuing – WebSphere MQ Family…

- **Websphere Business Integration (WBI) Message Broker**
  - ▸ Content-based solution
    - E.g., takes XML and converts the message to/from MQ interface for delivery to IMS
  - ▸ Extends the messaging capabilities of WebSphere MQ
    - Adds message brokering, routing and aggregation of several information requests driven by enterprise business rules
    - Provides additional intelligence to transform messages
      - – Topic-based or content-based filtering
    - Supports a framework for extending the functionality with plug-ins to user-written or third-party solutions for specific requirements
- **History**
  - ▸ MQSeries Integrator (MQSI) → WebSphere MQ Integrator (WMQI) → WebSphere Business Integration Message Broker (WBI MB)

Comparing Solution Types – IMS Connect vs MQ

⚠ Direction Connection

- Natively synchronous (connection-oriented), supports asynchronous (connectionless)
- Direct correlation between input and output
- Potential issues with program-to-program switches when spawning multiple transactions
- Easily supports IMS conversational transactions (relatively transaparent)
- Designing for failure:
  - ► If connection can not be made, try later
  - ► Decide what to do when the connection breaks - understand IMS actions

⚠ Messaging and Queuing

- Natively asynchronous (connectionless), simulates synchronous (connection-oriented)
- Need to consider how to correlate output to input
- Easily supports program-to-program switches even when spawning multiple transactions
- Requires keeping track of the conversation id to continue an IMS conversation
- Designing for failure:
  - ► No knowledge of whether entire connection path is available
  - ► Handle Late reply messages and the dead letter queue

Access to IMS data

Application Requirement – Access to Data

▪ **Direct Connection (database)**

▸ Characteristics

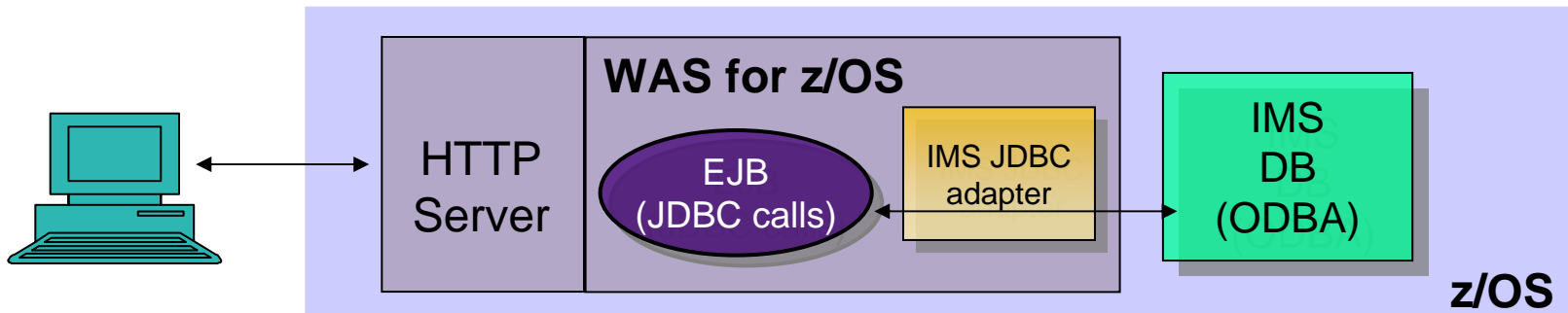 ▪ Access to data without invoking an IMS transaction

▸ ODBA interface (Open DataBase Access)

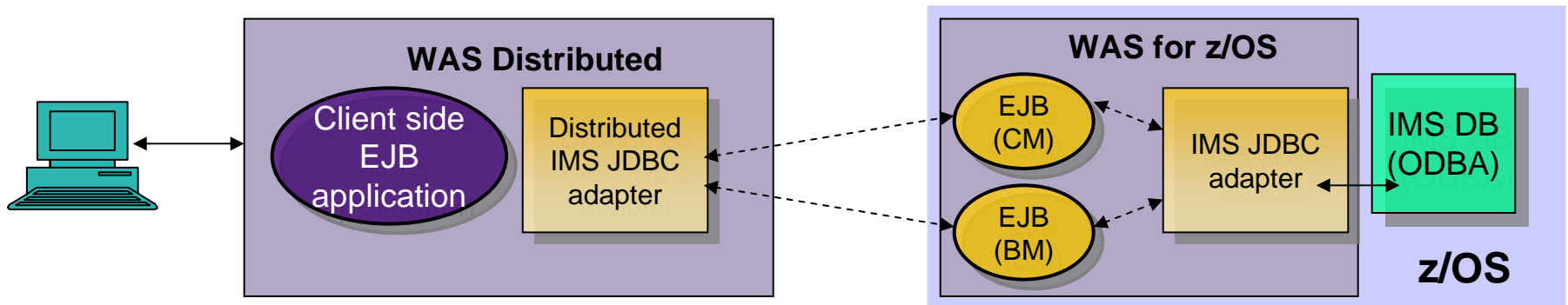 ▪ Programs that issue database calls must reside on the same MVS as IMS

IMS Solutions

- **JDBC access to IMS DB (delivered by IMS)**

  ▶ Currently supported on WebSphere z/OS and IMS Java support

  ▶ Support with IMS V9 – IMS Java Remote Data Services

  CM: container managed (supports global transaction semantics)
 BM: bean managed (supports local transaction semantics)

WebSphere Solutions

- **Websphere Information Integrator Classic Federation (WSIICF)**

  - ▸ Integrates access to a variety of resources
    - ODBC, JDBC access to IMS data
      - – Support for access to IMS resources includes:
        - • Read and update access to IMS DB using JDBC and ODBC
    - IMS access using SQL SELECT, INSERT, UPDATE, DELETE & stored procedure call
      - – Multi-threaded with native DBCTL/DRA and ODBA IMS drivers for scalable, multi-user performance
    - IMS transactions
      - – Suite of stored procedures that use APPC to access IMS
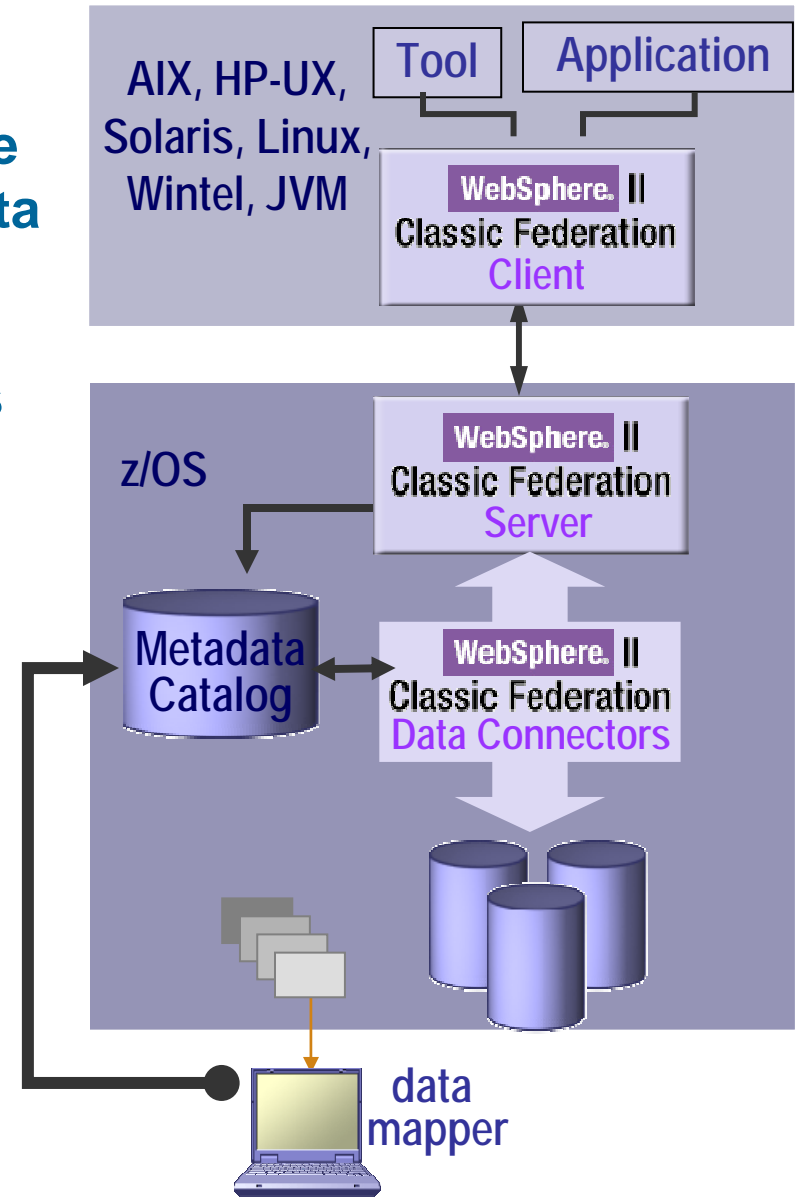
WebSphere Solutions …

- **WebSphere Information Integrator *Classic Federation* (WSIICF) …**
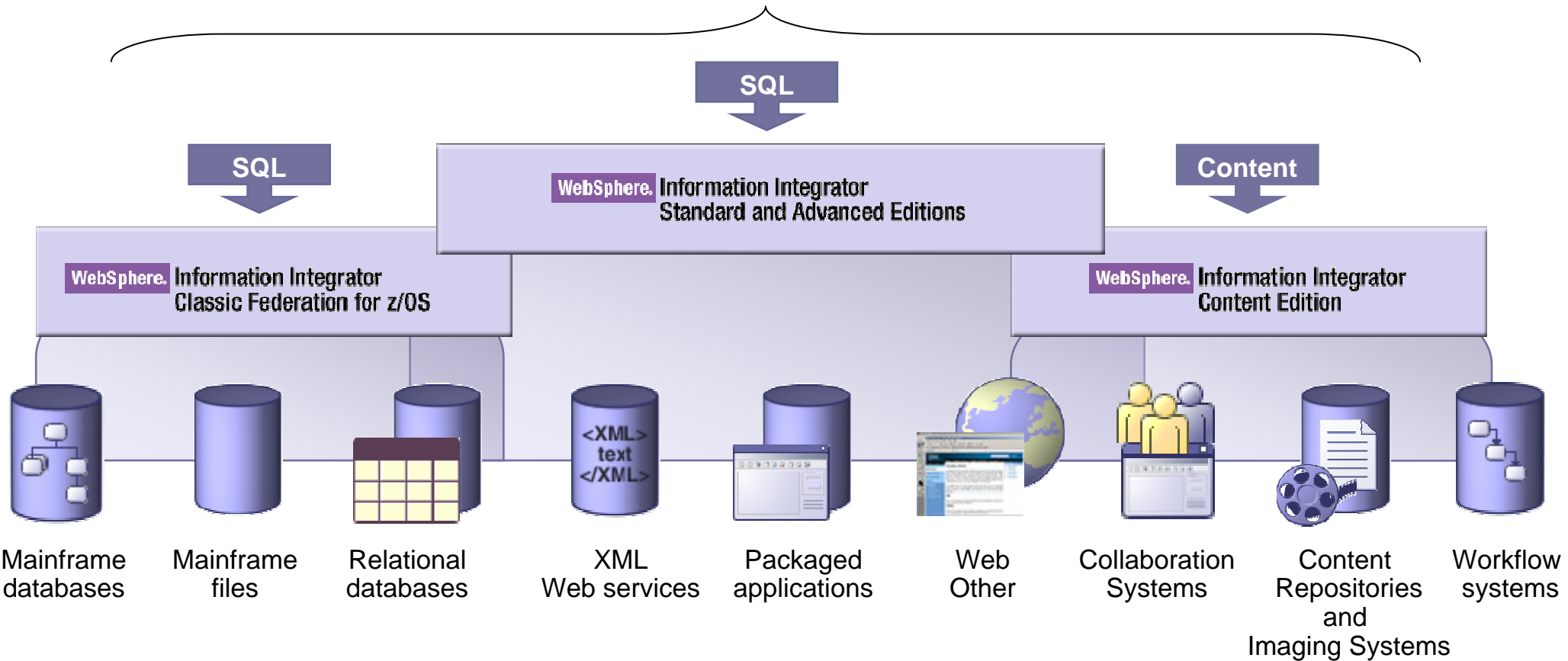 - ▸ *http://www-306.ibm.com/software/data/integration/iicf/support.html*
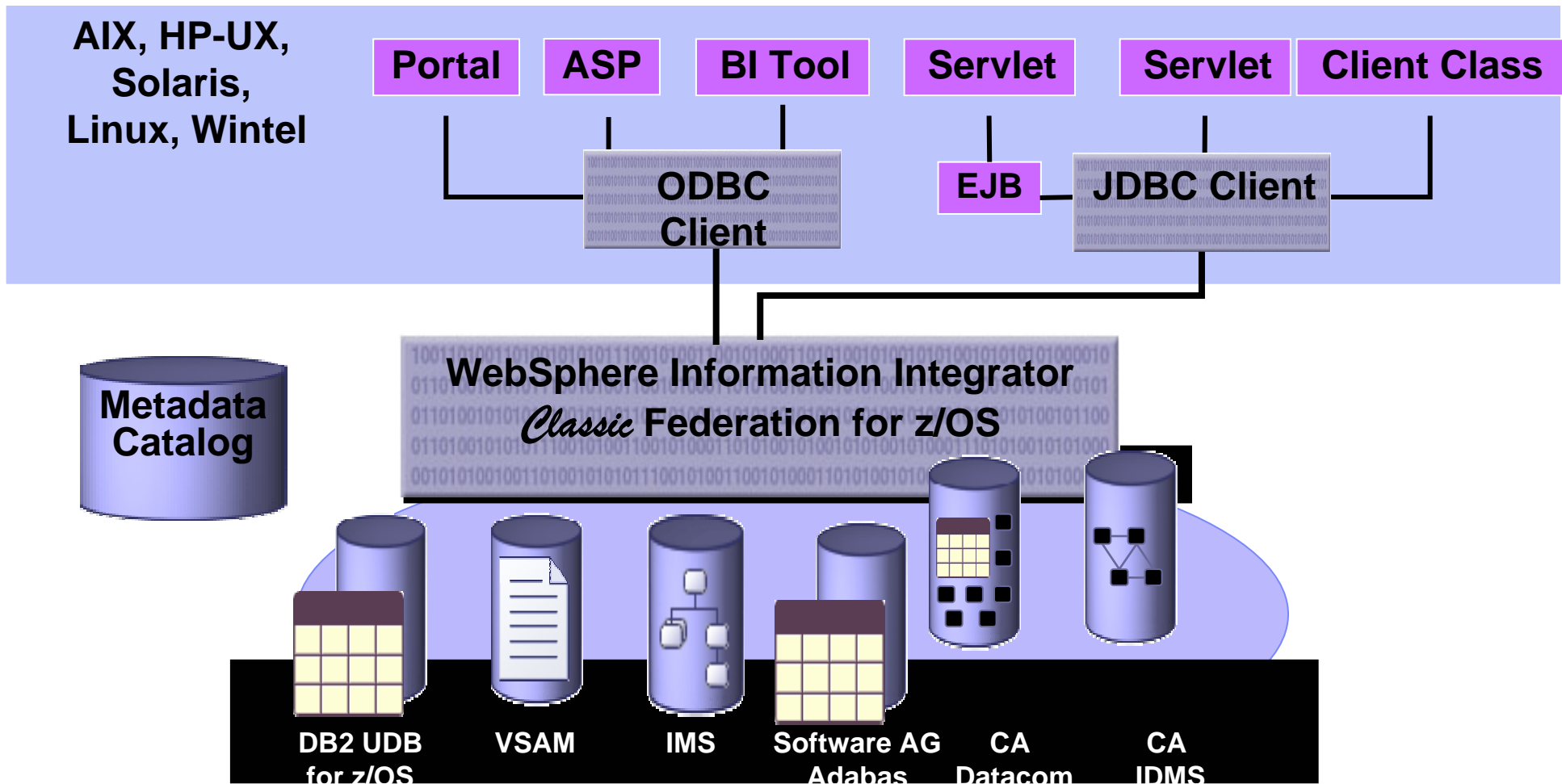
WebSphere II Classic Federation Implementation

- **Create relational description of mainframe data sources by mapping the physical data definitions to logical tables and views**

- **Mainframe Server and components act as a relational database engine**

- **JDBC and/or ODBC drivers provide standardized interface for tools and applications**

Standard SQL Access
Leverage enterprise data

| Understand | Cleanse | Transform |

SQL

SQL

Content

WebSphere. **Information Integrator**
Standard and Advanced Editions

WebSphere. **Information Integrator**
Classic Federation for z/OS

WebSphere. **Information Integrator**
Content Edition

| Mainframe databases | Mainframe files | Relational databases | XML Web services | Packaged applications | Web Other | Collaboration Systems | Content Repositories and Imaging Systems | Workflow systems |

41

Outbound Access

Accessing Other Environments

- **IMS applications can "explicitly" code communication interface calls**
  - ▶ TCP/IP sockets support
    - Standard sockets api - C, Java
    - Extended sockets api - Assembler, Cobol, PL/I
  - ▶ APPC calls
    - CPIC interface
    - MVS interface

- **IMS Java application capabilities**
  - ▶ Standard Java classes
    - HTTP, etc.?

- **Enterprise Cobol For z/OS V3.2 or later**
  - ▶ Interoperability with IMS Java

Pushing Data Out

- **IBM solutions**

  ▸ IMS Architecture capability – Data Capture Exit

    - Supports

      – Extension to the IMS application as an exit routine (no change to application)
        • Synchronous – ISRTs ALTPCB, db calls, etc.

      – Data Capture Log records – x'99'

Pushing Data Out … WS II Classic Event Publisher

▸ WebSphere Information Integrator Classic Event Publisher for IMS (5655-M38)

- *http://www-306.ibm.com/software/data/integration/iicep/edition_ims.html*

- *Leverages the IMS Data Capture architecture*
  - Captures changes made to IMS files using an IMS logger exit
    - Captured changes are reformatted into a relational data format
  - The relational format data is packaged as a self-describing XML message
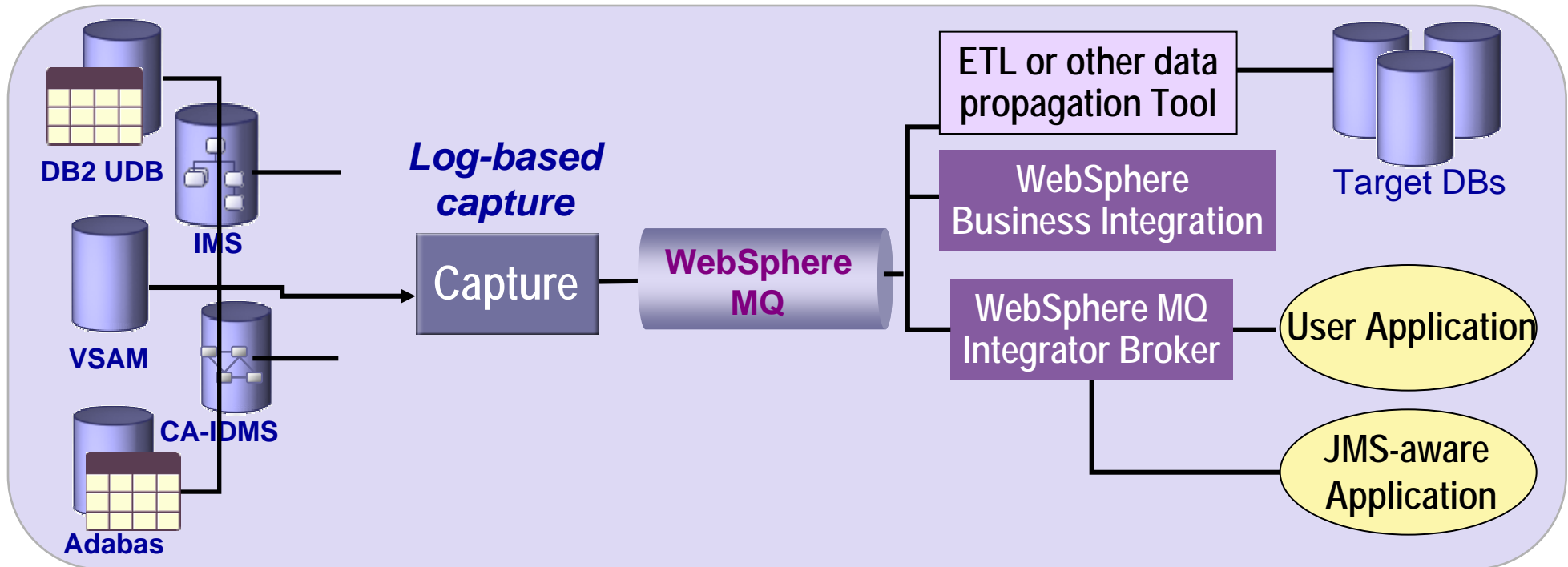 - The XML messages are published to WebSphere MQ

Pushing Data Out … WS II Classic Event Publisher …

Function

- **Capture data events in real time**
- **Publish these data events:**
  - ▸ to a message queue for widespread delivery
 - ▸ in XML format for widespread use

Usage

- **Application to application messaging**
- **Event streaming**
- **Change-only data distribution**

46

WebSphere II Event Publishers for z/OS

- **Real-time &/or background capture and publishing of data changes made to:**
  - ▸ DB2 UDB
  - ▸ VSAM through CICS
  - ▸ IMS database
  - ▸ CA-IDMS database
  - ▸ Software AG Adabas database

- **Two Event Publisher infrastructures:**
  - ▸ DB2 Universal Database for z/OS
    -- based on WebSphere II Replication
  - ▸ IMS, VSAM, CA-IDMS and Adabas
    -- based on WebSphere II Classic
       Federation

WebSphere MQ changes

WebSphere II
Classic
Event Publisher

IMS
changes

47
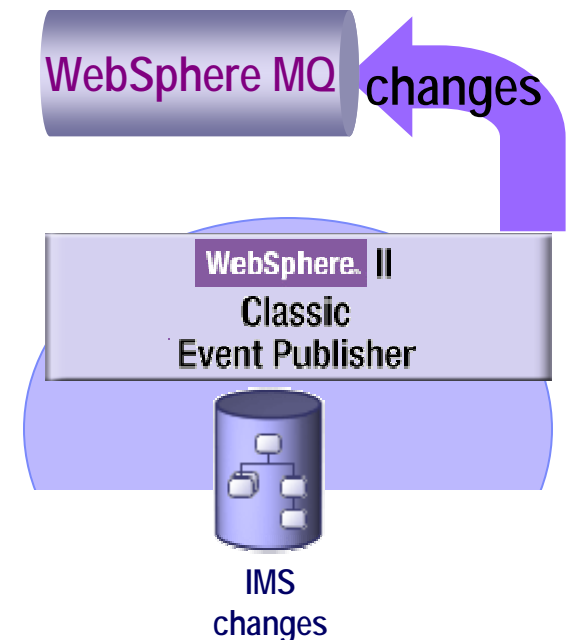
WebSphere II Event Publishers for z/OS ...

- **Log-based & recoverable:**
  - ▸ Log exits for active processing
  - ▸ Log files and spills for BOTH recovery processing and non-real time implementations

- **XML message output:**
  - ▸ Self-describing XML message format for easy integration
  - ▸ Consistent format across all publishing solutions regardless of source

- **WebSphere MQ publishing:**
  - ▸ Common delivery mechanism
  - ▸ Guaranteed delivery that spans broadest choice of platforms
  - ▸ Dominant mainframe messaging infrastructure
  - ▸ Broad set of IBM & 3rd party solutions can "read" WebSphere MQ queues
  - ▸ Publish once – read any number of times
  - ▸ High performance

Accessing Data

- **Accessing Data outside IMS**

  ▸ DB2
    - SQL, JDBC, SQLJ

  ▸ Other data
    - ISV products
      – E.g., ORACLE Access Manager for IMS – allows IMS applications to access Oracle data
      – *…*

    - ???

Futures

- Callout support from an IMS application
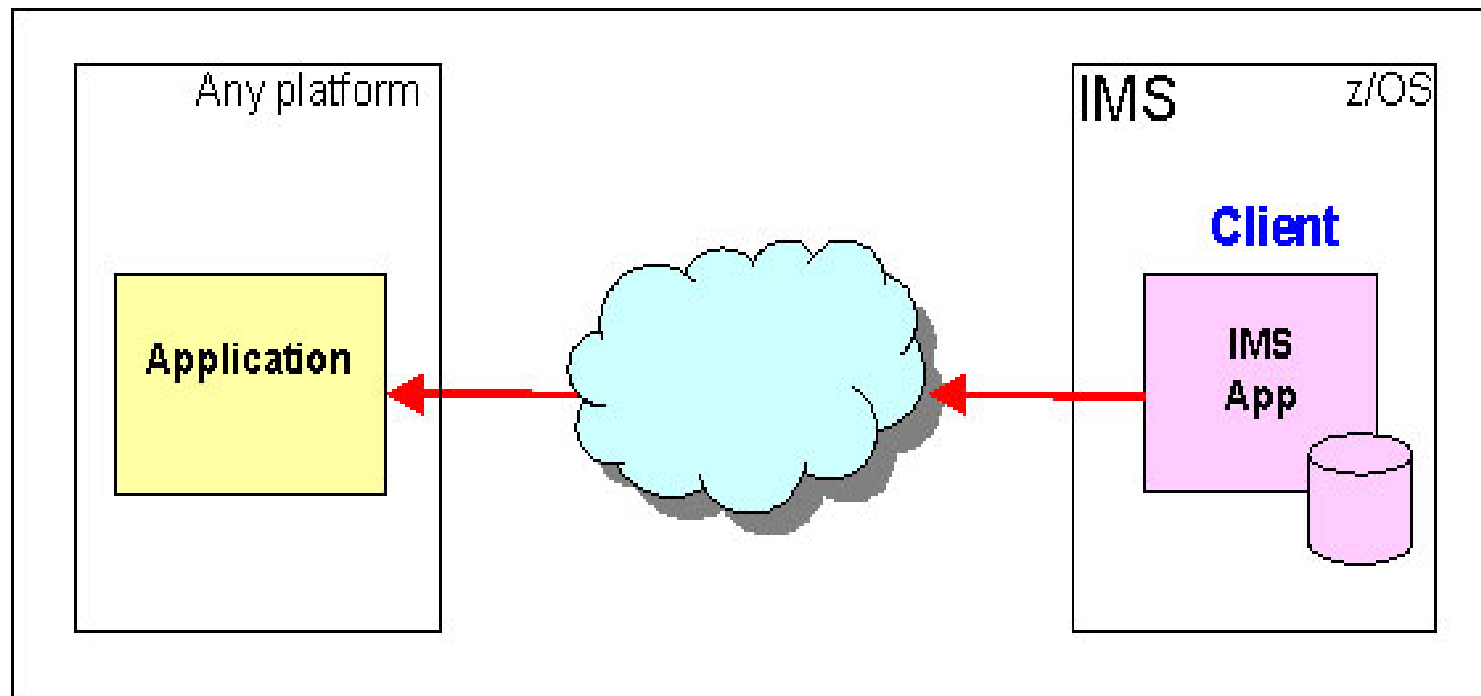
- What would this mean to you?
  - ▶ **Please respond to a survey at:**
    - *http://www-950.ibm.com/survey/oid/wsb.dll/studies/imscallout.htm*

Summary

- Once again, the message:

- **IMS continues to be a premier server**
  - ▸ Architected interfaces support standard access from the web

- **New interfaces, products and tools from a variety of vendors provide access to IMS transactions and data**