Dynamic e-Business: Trends in Web Services

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About the Speaker

Dr. C. Mohan joined the IBM Almaden Research Center as a Research Staff Member in 1981. In 1997, he was named an IBM Fellow for being recognized worldwide as a leading innovator in transaction management. He received the ACM SIGMOD Innovations Award in 1996 in recognition of his innovative contributions to the development and use of database systems. At VLDB99, he was honored with the 10 Year Best Paper Award for the impact of his work on the ARIES family of algorithms. In 1992, he was elected to the IBM Academy of Technology. Mohan is a core member of IBM's Application Integration Middleware (AIM) Architecture Board. Currently, he is working on data caching and next generation messaging in the context of WebSphere and DB2. He was the founding leader of the Dominotes project which resulted in the enhancement of Domino/Notes's scalability by the introduction of transactional recovery in R5. Prior to that, Mohan led the Exotica project which was focussed on the workflow product FlowMark (now called MQSeries Workflow), the messaging product MQSeries and the groupware product Lotus Notes. Mohan was a designer/implementer of the R* distributed DBMS, the Starburst extensible DBMS and DB2. He is the primary inventor of the ARIES family of recovery and locking methods, and the Presumed Abort commit protocol. He has had major impact on numerous IBM and non-IBM prototypes and products. Mohan's research results and designs have been incorporated in the IBM products DB2, MQSeries, S/390 Parallel Sysplex Coupling Facility, ADSM (now called Tivoli Storage Manager), SQL/DS and VM Shared File System, in Microsoft's SQLServer, in the IBM prototypes R*, Starburst and QuickSilver, and in IBM's SNA LU6.2 and DRDA. Mohan is a consultant to IBM's database, transaction, messaging and workflow product groups.

Mohan is the recipient of several IBM awards: an IBM Corporate Award for his contributions to database support for the S/390 parallel sysplex; an IBM Outstanding Innovation Award (OIA) for his coinvention of the ARIES recovery method which is being used in numerous IBM and non-IBM products and prototypes; an OIA for his inventions (ARIES, ARIES/IM, Commit_LSN) and major contributions to performance, availability and concurrency in DB2/MVS V4; three OIAs for his algorithmic and hardware architectural coinventions for supporting the shared disks transaction environment in S/390 and DB2/MVS; an Outstanding Technical Achievement Award (OTAA) for enhancements to Lotus Domino to provide log-based recovery; an OIA for his coinvention of the Hybrid Join method which is implemented in DB2/MVS; an OIA for his coinvention of the Presumed Abort commit protocol which has been widely adopted in the industry and which is now part of the JTS, ISO-OSI, X/Open and DRDA distributed transaction processing standards; an IBM Research Division Award (RDA) for his work on transaction management in R*; an RDA for his contributions to WDSF/VM; 10th Plateau IBM Invention Achievement Award for his patent activities (30 issued and 3 pending). Mohan was named a leading software inventor of IBM for 1994 and 1995, and a Master Inventor in 1997.

Mohan was the Americas PC Chair for the 1996 International Conference on Very Large Data Bases, a PC Vice-Chair for the 1994 International Conference on Data Engineering (ICDE) and the PC Chair for the 1987 International Workshop on High Performance Transaction Systems. He is the Industrial PC Co-Chair for ICDE2003. He has been an Editor of the VLDB Journal, and Distributed and Parallel Databases - An International Journal. Mohan received a PhD in computer science from the University of Texas at Austin in 1981 and a BTech in chemical engineering from the Indian Institute of Technology, Madras in 1977.
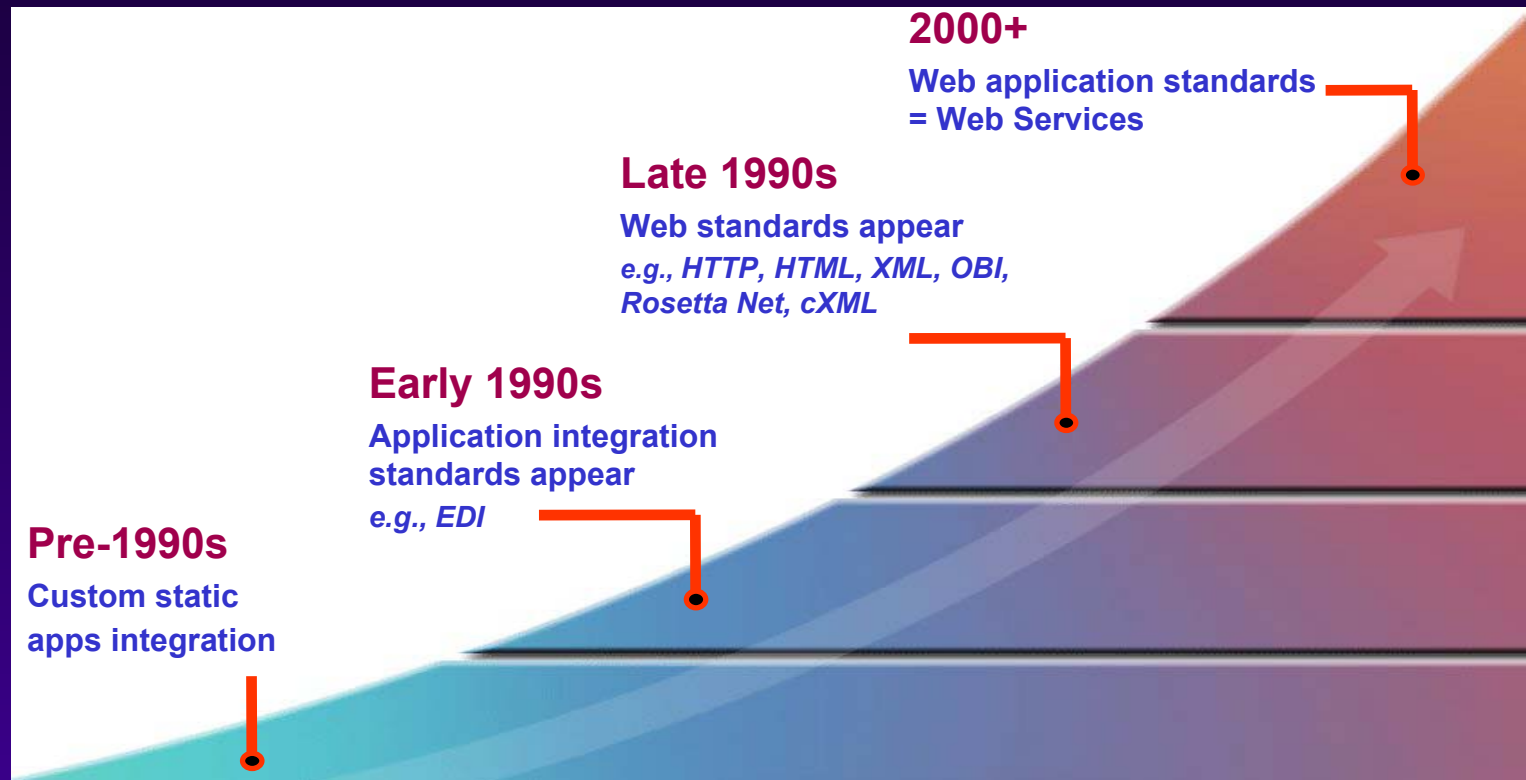
Overview

- Introduction

- J2EE and .NET

- In-Progress WS Activities

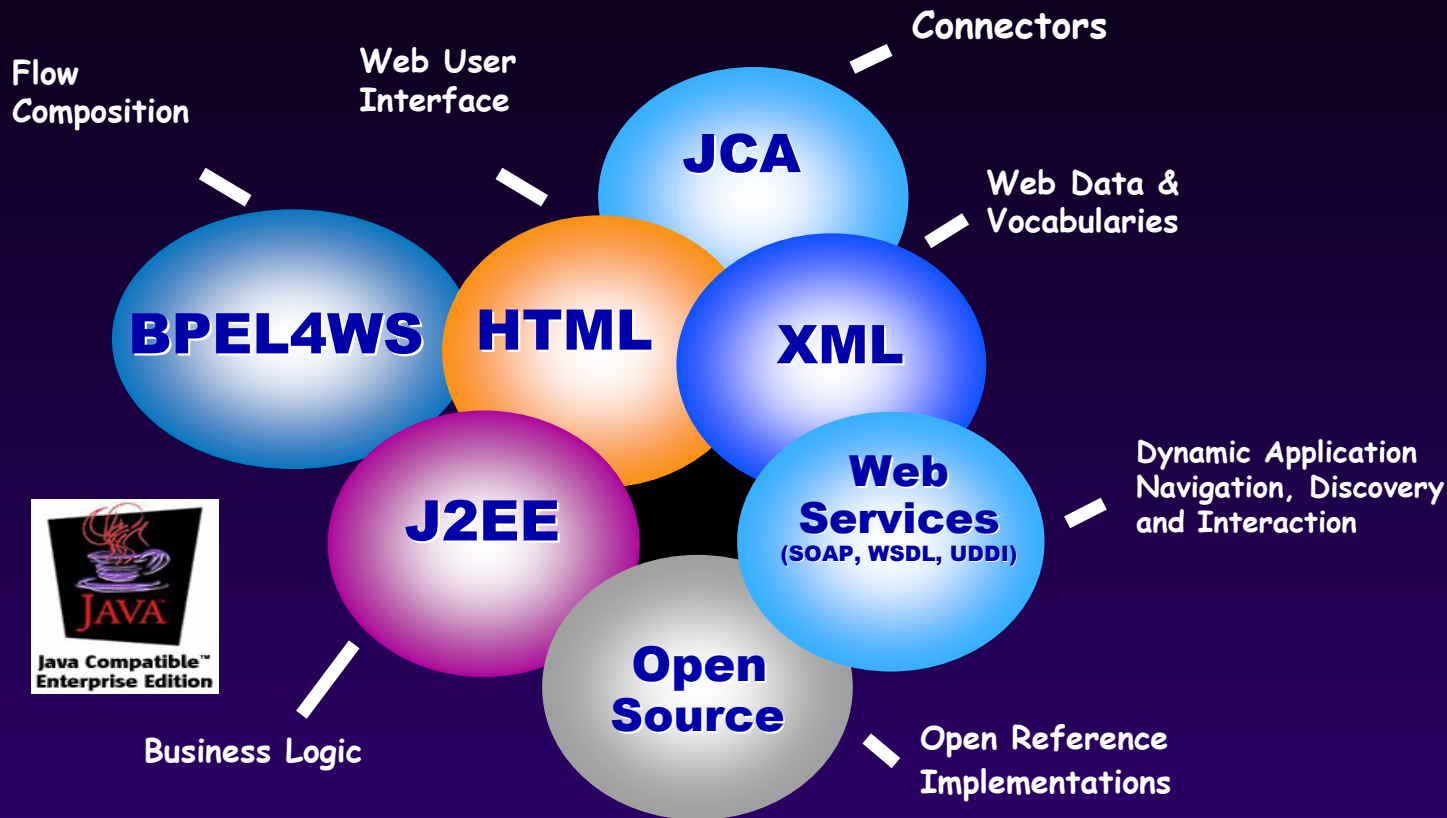- Business Process Management

- Summary and Outlook

.NET		XML
J2EE	WS	SOAP
BPEL4WS		UDDI
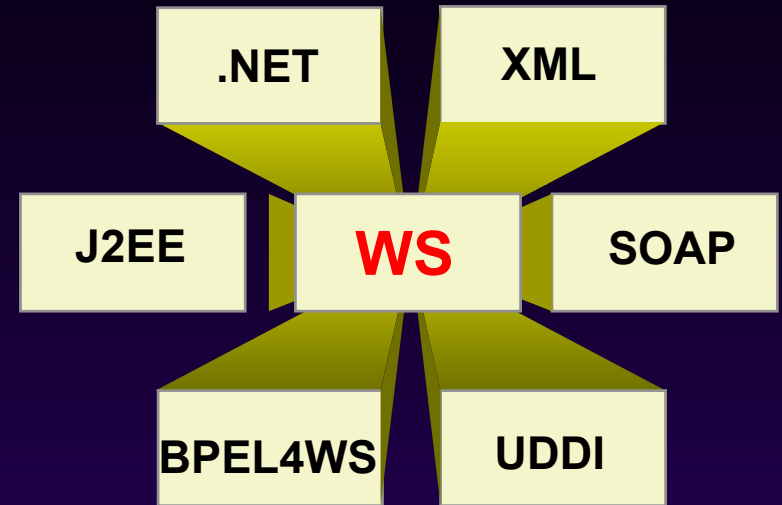
Web Application Integration Evolution

Applications which interact with each other using Web standards

2000+

Web application standards = Web Services

Late 1990s

Web standards appear
e.g., HTTP, HTML, XML, OBI, Rosetta Net, cXML

Early 1990s

Application integration standards appear
e.g., EDI

Pre-1990s

Custom static apps integration

Application Servers

- Modern equivalents of traditional TP monitors
- Except Microsoft, all based on Java 2, Enterprise Edition (J2EE)
- **Commercial:** BEA WebLogic, IBM WebSphere, Oracle9i Application Server, Sun ONE (iPlanet), Sybase EAServer, HP, Iona, ATG, Allaire, SilverStream, Brokat, Borland, Pramati, Fujitsu Interstage, SAS, Macromedia, Trifork, Hitachi, NEC, Computer Associates, ..., Microsoft .NET
- **Open Source:** JBoss, JOnAS
- Some representative quotes:
  - ▶ "J2EE is to Java what SQL was to databases"
  - ▶ "Without J2EE, it is not an application server"
- Vendor differentiation based on scalability, high availability, reliability, ease of use, legacy data & app integration, complementary products (e.g., for personalization, commerce, workflow) and extensions

Open Standards

Flow
Composition

Web User
Interface

Connectors

JCA

Web Data &
Vocabularies

BPEL4WS **HTML** **XML**

J2EE **Web Services**
(SOAP, WSDL, UDDI)

Dynamic Application
Navigation, Discovery
and Interaction

Open Source

Java Compatible™
Enterprise Edition

Business Logic

Open Reference
Implementations

Trusted Internet Networking Services

Linux   Windows   AIX   Solaris   HP/UX   OS/400   OS/390   zOS

Java 2 Platform, Enterprise Edition (J2EE)

Application Server Platform for Java (latest: 1.3, 7/2001)

- Java Servlets & Java Server Pages (JSP)
- Enterprise Java Beans (EJB)
- Java Transaction API (JTA)
- Java Transaction Service (JTS)
- Java API for XML Parsing (JAXP)
- Java Messaging Service (JMS)
- Message Driven Beans (MDB)
- Remote Method Invocation (RMI)
- Java Database Connection 2 (JDBC2)
- Java Connector Architecture (JCA)
- Java Naming and Directory Interface (JNDI)
- JavaBeans Activation Framework (JAF)

http://java.sun.com/j2ee/sdk_1.3/index.html

For excellent news, views, etc., visit http://www.theserverside.com/
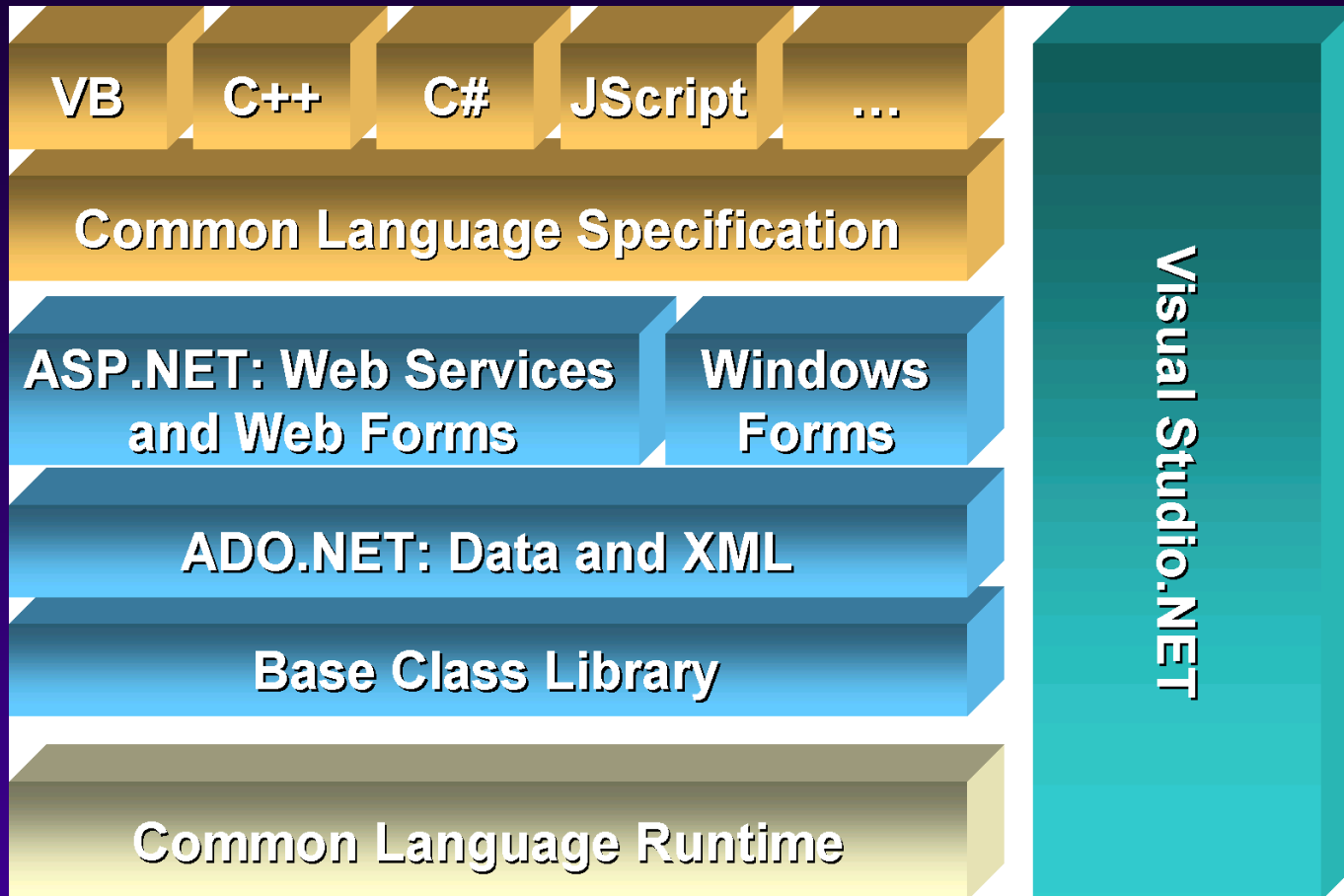
Multi-Tier J2EE-Based Architecture
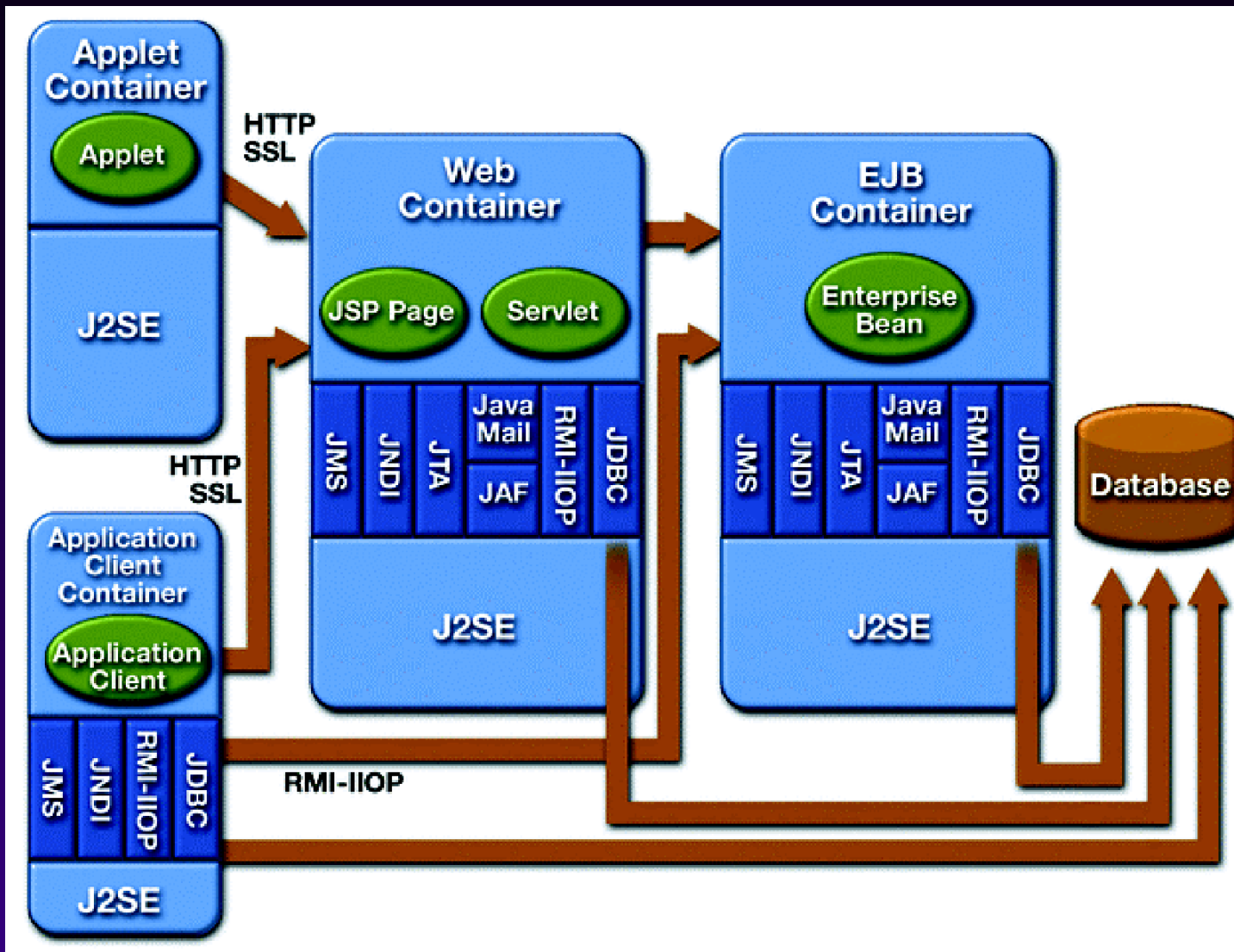
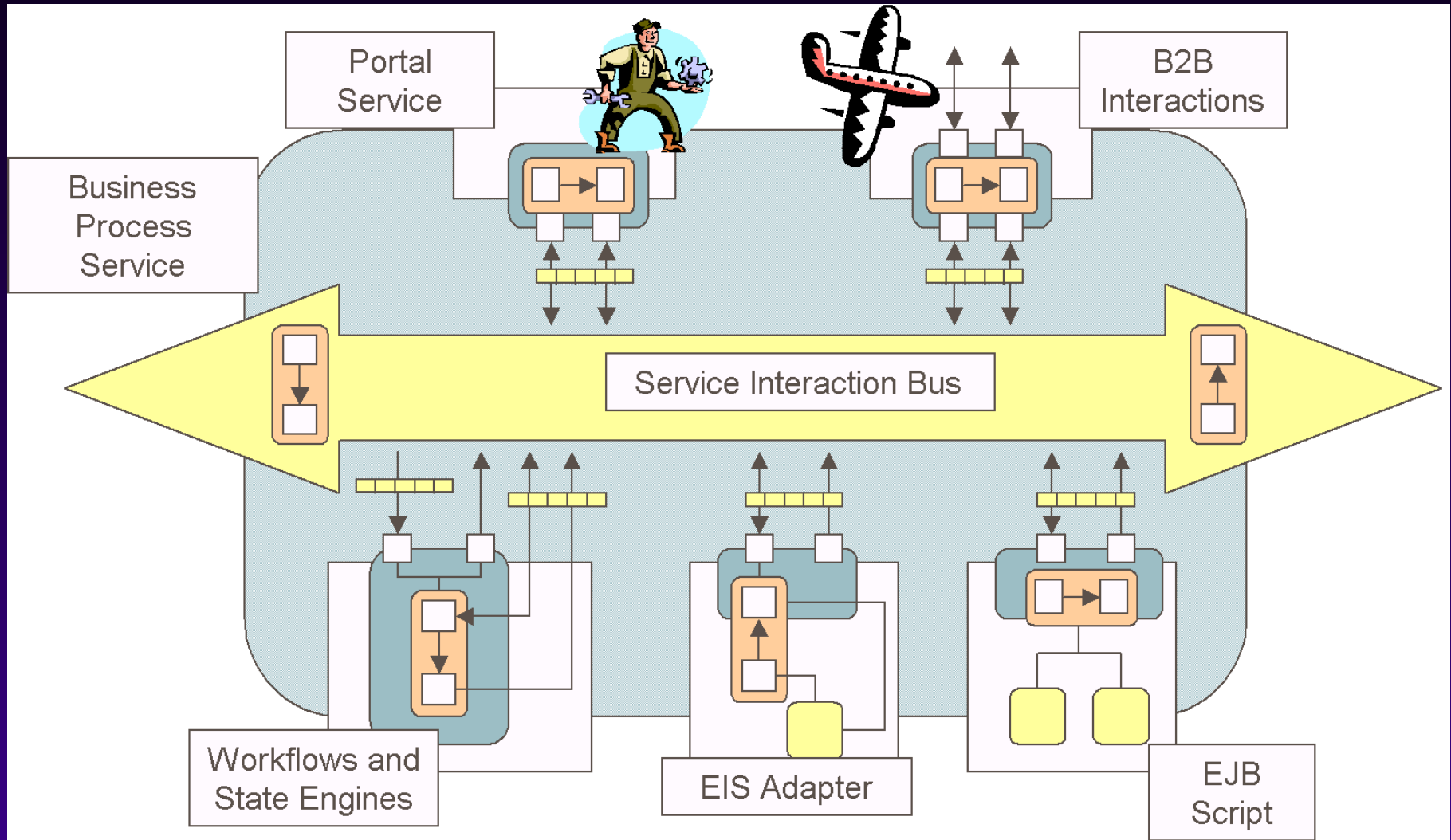A J2EE app with all its modules delivered in an Enterprise ARchive (EAR) file = WARs + JARs

Microsoft's .NET

- Make resources, applications and information, available any time, any place and on any device
- Relies on UDDI, SOAP, WSDL and software-as-a-service model
- Emphasis on multiple languages and access devices
- Common Language Specification & Runtime (CLS & CLR)

VB	C++	C#	JScript	...

Common Language Specification

ASP.NET: Web Services and Web Forms | **Windows Forms**

ADO.NET: Data and XML

Base Class Library

Common Language Runtime

Visual Studio.NET

Services-Oriented Architecture

Standards Efforts

Many formal and informal standardization groups

- World Wide Web Consortium (W3C)

- Web Services Interoperability Organization (WS-I.org)

- OASIS Web Services for Interactive Applications (WSIA)

- Java Community Process (JCP)

Web Services

- UDDI (Universal Description, Discovery and Integration) for discovering services
- SOAP (Simple Object Access Protocol) for using services
- WSDL (Web Services Description Language) for describing services
- A service = a set of port types
- Set of XML Schema definitions
- Set of message definitions
- Set of operations
- Bindings provide implementation or usage details for services, port types, etc.
- App servers provide message handlers (for intercepting incoming and outgoing messages) and serializers (for mapping complex data types between Java and XML)

For survey see
http://www.almaden.ibm.com/u/mohan/WebServices_TES2002.pdf

| Prolog |
| Types |
| Messages |
| Operations |
| Bindings |
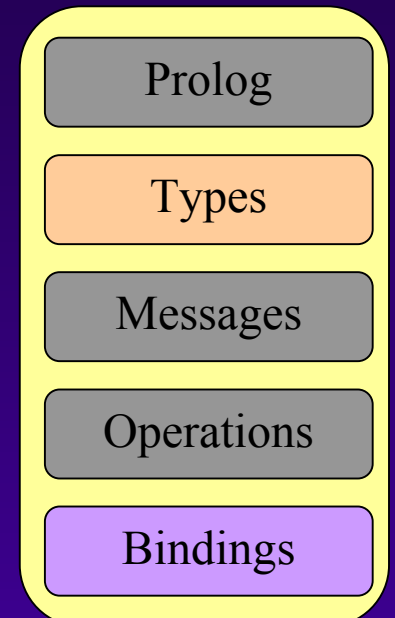
SOAP

- A more flexible alternative to traditional methods of program-to-program communication mechanisms like RPC, RMI, MQSeries API, …

- Intended to be able to tunnel through firewalls

- Originally based on HTTP and XML

- Now support for various other transport protocols being designed: SMTP, JMS, …

- More efficient ways to handle binary data is needed: SOAP with Attachments

- For list of SOAP implementations see
  http://www.soapware.org

Databases and Web Services

- Support in WebSphere tooling (WSAD) to easily turn DB2 stored procedures into WS

- Can invoke in DB2 SQL query web services as if they are like table functions

- Beta version of Web Services Object Runtime Framework (WORD) available – lets DB2 XML Extender support WS

- Research project at INRIA allows embedding of WS invocations in XML documents (*a la* QUEL as a data type in Postgres) thereby supporting concept of Active XML

Web Services Invocation Framework (WSIF)

IBM developed WS Invocation Framework (WSIF)

- Provides a level of abstraction and supports late binding of actual transport mechanism

- Lets services be developed without worrying about transport protocols or locations of services

- Source code donated by IBM to Apache XML project (Axis)

UDDI

- Public UDDI registries are not being used that much

- Rating system needed for trustworthiness and QoS of listed companies in public directories

- Private UDDI is becoming popular

  - Used to catalog software developed by various groups in a company

  - Track info on partner companies and the services that they provide

JAX RPC

- Java API for XML-RPC

- Essentially Java RMI over SOAP, similar to RMI-IIOP

- Can be used from session, entity and message-driven beans

- Foundation for new endpoint interface, allowing stateless session bean to be invokable as a web service
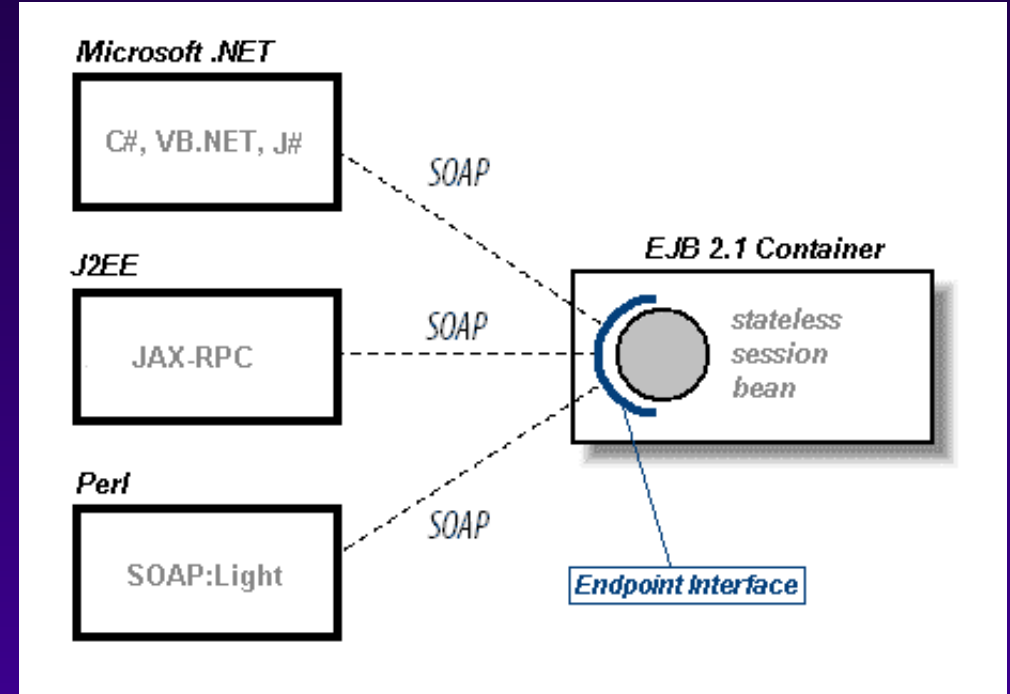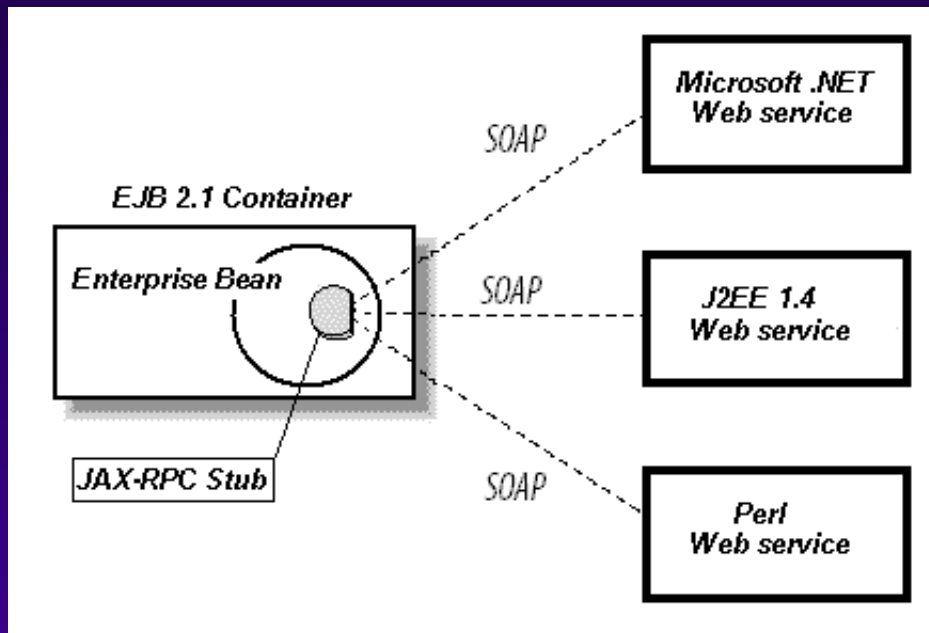
JAXM

- Java API for XML messaging

- SOAP messaging similar to JMS

- Sending/receiving messages via web services

- Document oriented - SOAP messages exchanged as XML documents

- JAXM clients assemble, receive and manipulate SOAP messages using SAAJ (SOAP with Attachments API for Java)

WS-Security

- Proposal from IBM, Microsoft and VeriSign

- Addresses message integrity, message confidentiality and single message authentication

- Can accommodate a variety of security models and encryption technologies

- Can encode binary security tokens like X.509 certificates, Kerberos tickets, opaque encrypted keys

- Extensibility mechanisms for describing characteristics of included credentials

WS-Routing

- Asynchronous routing protocol for SOAP messages over HTTP, TCP and UDP

- SOAP envelope can describe entire route for a message, including a return route

- Supports one-way and two-way messaging, and long-running dialogs

- No retransmission or reliability policies specified

A Common Programming Model
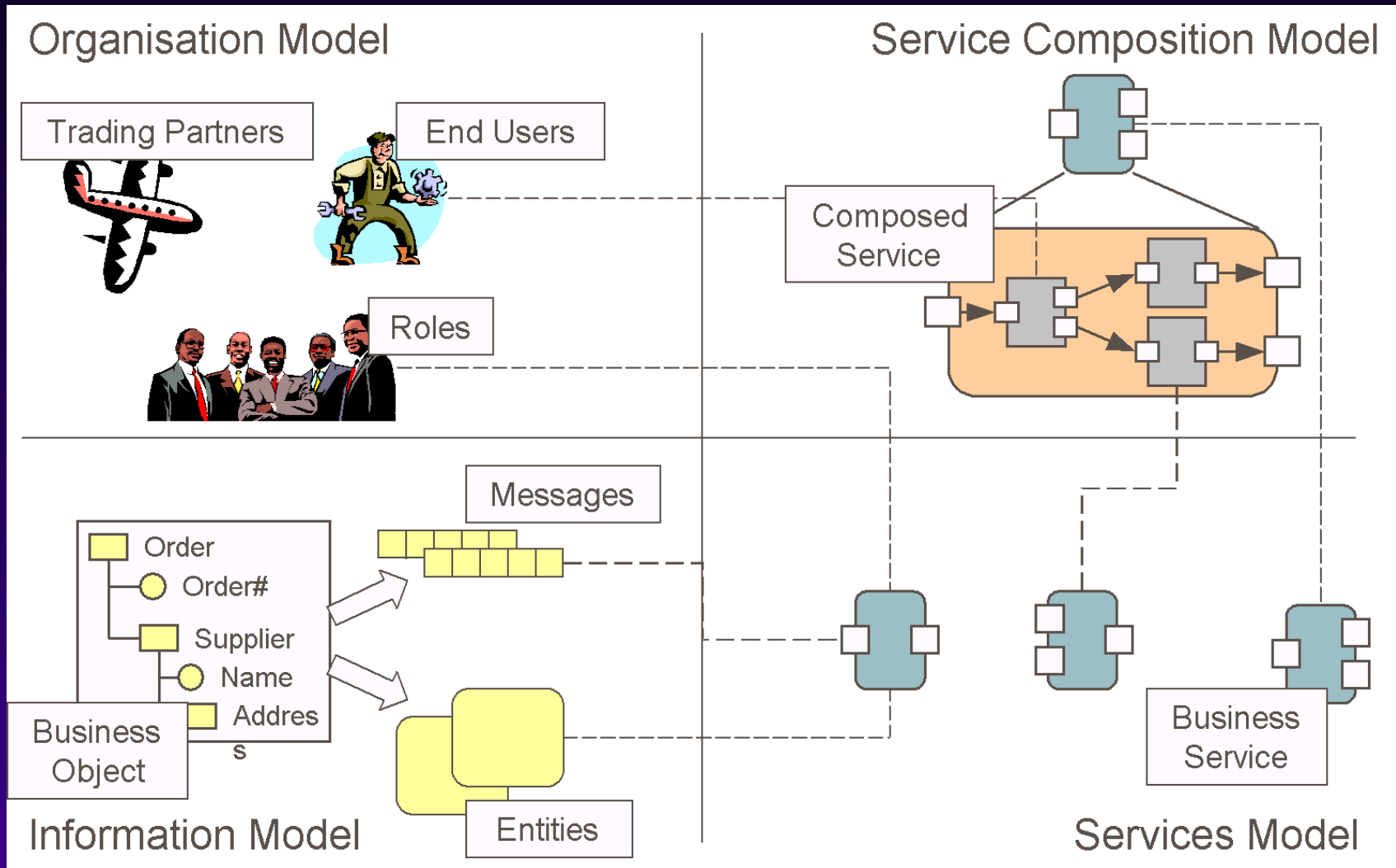
WS-Transaction (WS-TX)

- Defines Atomic Transaction and Business Activity
- Essentially X/Open XA for the WS environment + compensating transactions
- Provides two-phase commit coordination for atomic transaction executions
- Makes use of WS-Coordination coordination protocols

Figure BA2: BusinessAgreement Protocol State Diagram
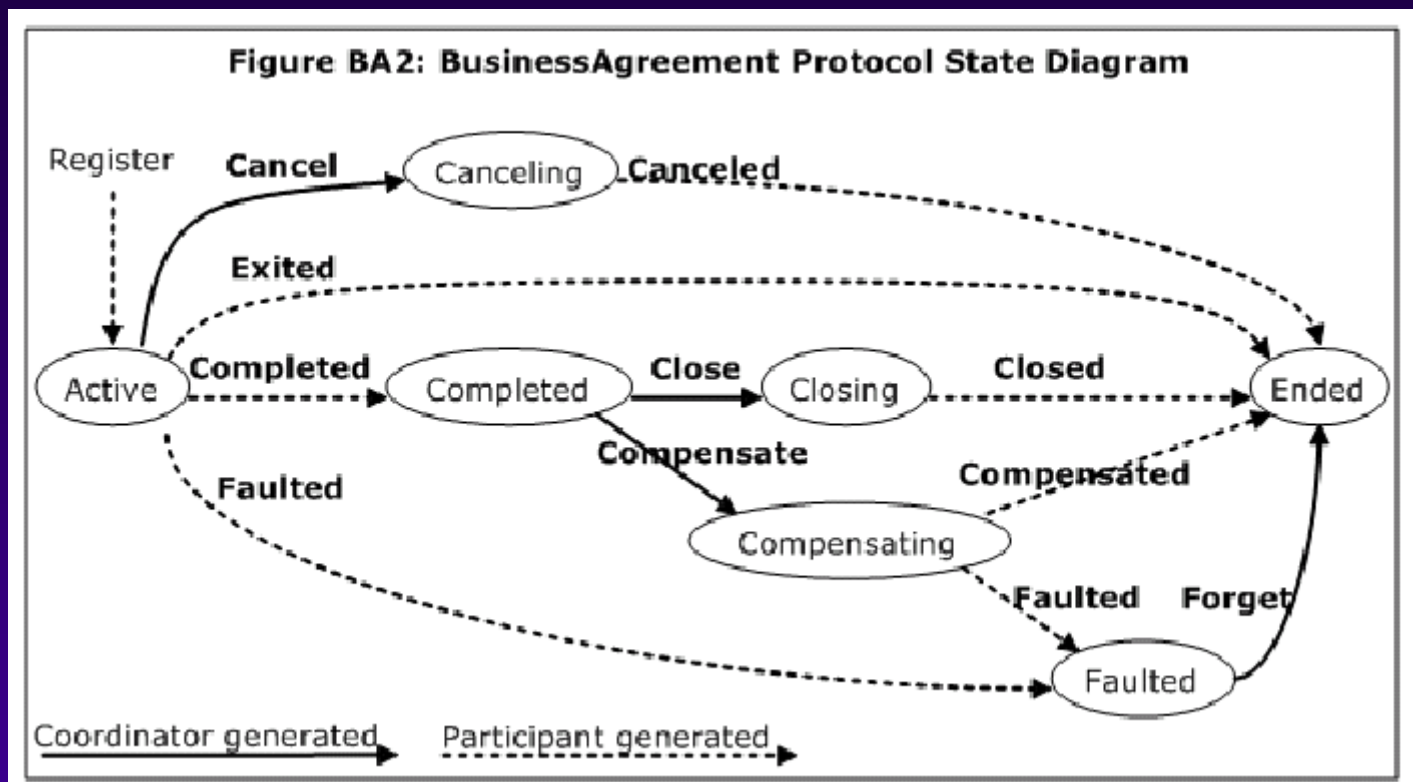
WS-Coordination

- Defines an extensible framework for coordinating activities using a coordinator and set of coordination protocols
- Allows participants to reach consistent agreement on outcome of distributed activities
- Includes short-lived operations and long-running business activities
- Defines activation service, coordination context and registration service

Figure 1: A Coordinator
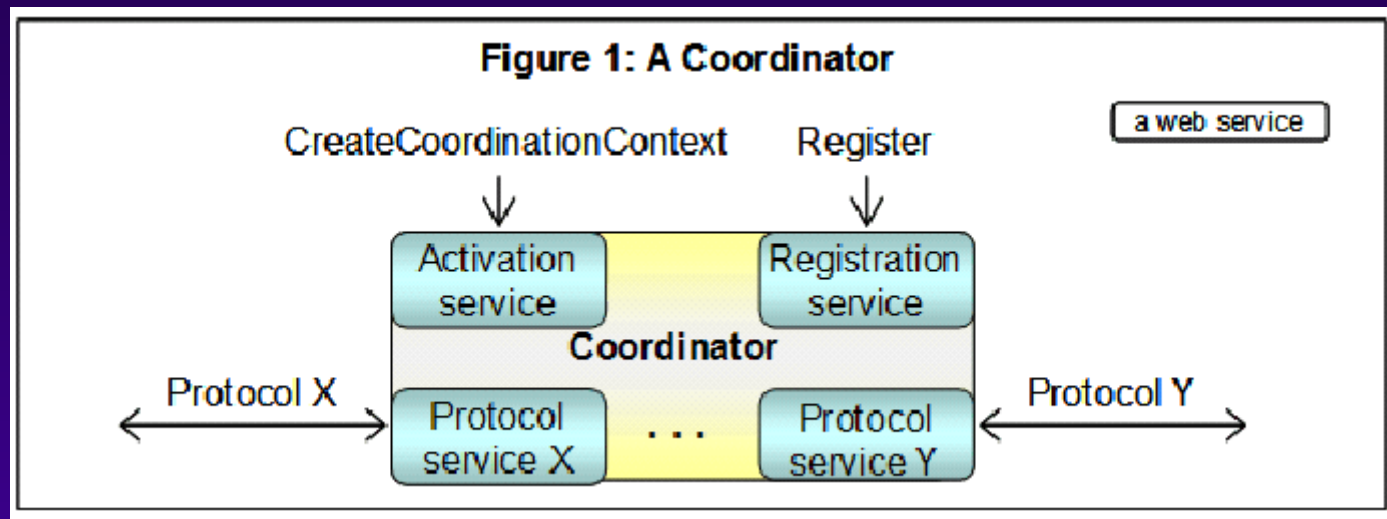
BPEL4WS

Business Process Execution Language for Web Services

- Describe business processes involving many WS

- Standardize message exchanges internally to a company and between business partners

- Combines ideas from IBM's Web Services Flow Language (WSFL) and Microsoft BizTalk Server's XLANG

- A number of related proposals from various other groups of companies: ebXML's BPSS, BPMI.org's BPML, HP's WSCL, …

Summary and Outlook

- J2EE has become wildly successful and J2EE 1.4 focused on web services
- Microsoft attempting to fight J2EE with .NET
- WS to be bridge between J2EE and .NET worlds
- WS becoming popular, even for intranet usage – vendors are furiously adding support for WS in their products
- XML parsing overhead too high – big issue for fine-grained web services
- Amazon & Google have their exposed functionality via WS
- Private UDDI becoming more popular than public UDDI
- Compensating transaction support begins to appear finally
- Work in progress to improve WS performance and availability via caching
- Database researchers and practitioners should pay more attention and influence work in web services area!

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