The Java™ 2 Platform

Optional Packages

Java 2 Enterprise Edition (J2EE)

Optional Packages

Java 2 Standard Edition (J2SE)

Java 2 Platform Micro Edition (J2ME™)

Personal Basis Profile

Personal Profile

Foundation Profile

MIDP

CDC

CLDC

Java Card APIs

JVM

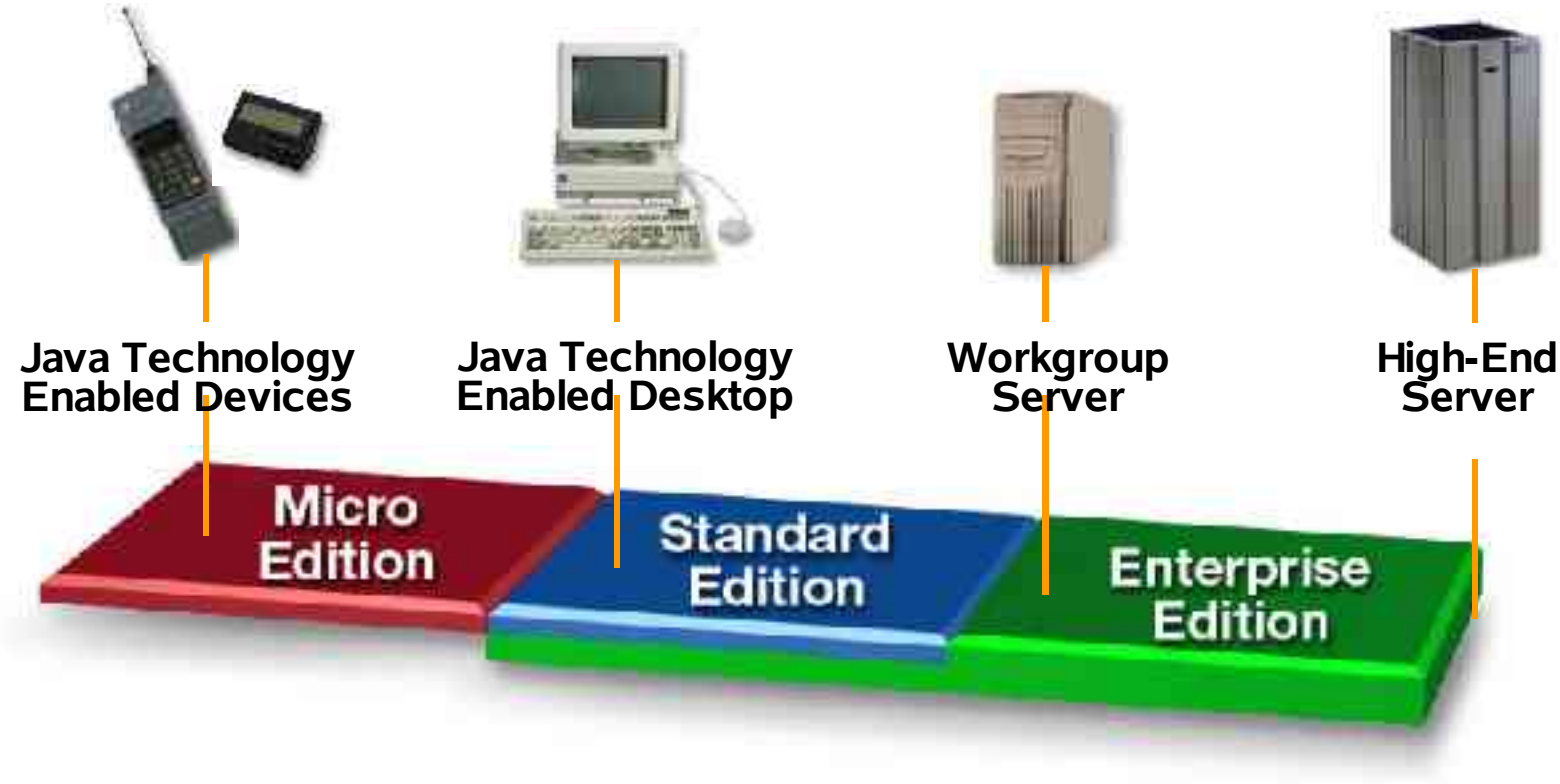
KVM

CardVM

Java Technology Overview

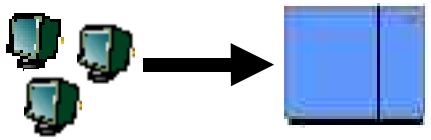
- Java 2 Standard Edition (J2SE)
  - Compiler, tools, runtime and APIs for Java application development
- Java 2 Enterprise Edition (J2EE)
  - APIs for development, deployment and management of server-based, distributed, multi-tier and component-based applications
- Java 2 Micro Edition (J2ME)
  - Highly optimized version for resource-limited consumer device software development

The Java™ 2 Platform



Evolution of Enterprise Applications

- Single-Tier
  - monolithic, direct connection
- Two-Tier
  - fat clients
- Three-Tier
  - Browser, Web Server, DB
  - Remote Procedure Calls (RPC-based)
  - Component-based (CORBA, RMI, DCOM)



Trends in Enterprise Applications

- Transition from single-tier/two-tier to multi-tier applications
- Transition from monolithic applications to object-based applications
- Transition from application "fat client" to a web browser client

Problems

- The "Middle Tier" is complex
- Each application must duplicate the same basic system services:
  - concurrent access to resources
  - transactional access to resources
  - load-balancing among resources
  - securing access to resources
  - managing resources
  - managing persistence of data

Solution - J2EE

J2EE provides

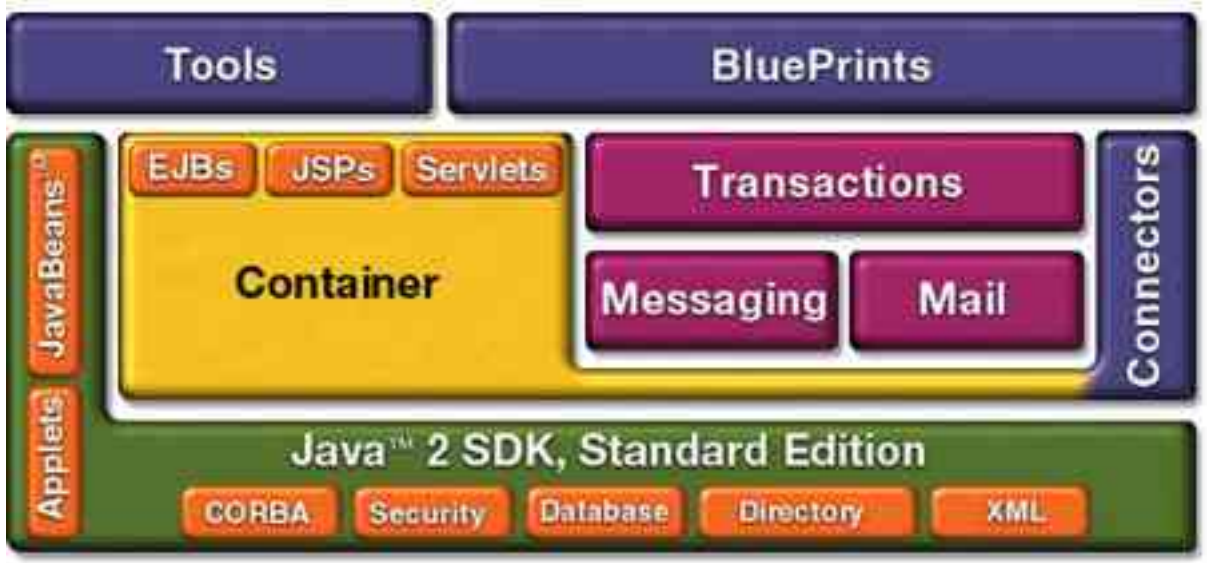
- a standard set of Application Programming Interfaces (APIs), and
- a component-based architecture, and
- the idea of a container to provide standarized system services to all applications,

to reduce the complexity of "Middle Tier" programming

J2EE Contents

- Platform Specification
  - Defines the standard APIs
- Reference Implementation and SDK
  - Implements the complete specification as an operational definition of J2EE
- Compatability Test Suite
  - Tests compliance with the standard, guarantees portability
- Blueprints
  - Architecture and design guidelines

J2EE Platform Architecture



J2EE Core Concepts

- Open, published Specification
- Distributed Applications
- Component-Based
- Containers
- Packaging / Assembly
- Deployment
- Roles

J2EE Core Concepts (1)

- J2EE is an open, formal Specification
  - What must be supported, but not how
  - Agree on standard and compete on implementation
  - Sun Microsystems participates but does not control the standard
- Applications are distributed
  - Application components can run on different devices connected by a network

J2EE Core Concepts (2)

- Applications are based on components
  - A component is an application-level unit of code
  - Supported components:
    - JavaBeans (from J2SE)
    - Java Applets (client side)
    - Java Application Clients (client side)
    - Enterprise Java Beans (server side)
    - Web Components (server side)
    - Resource Adapter Components (server side)
  - A component is responsible for:
    - Presentation logic
    - Business logic

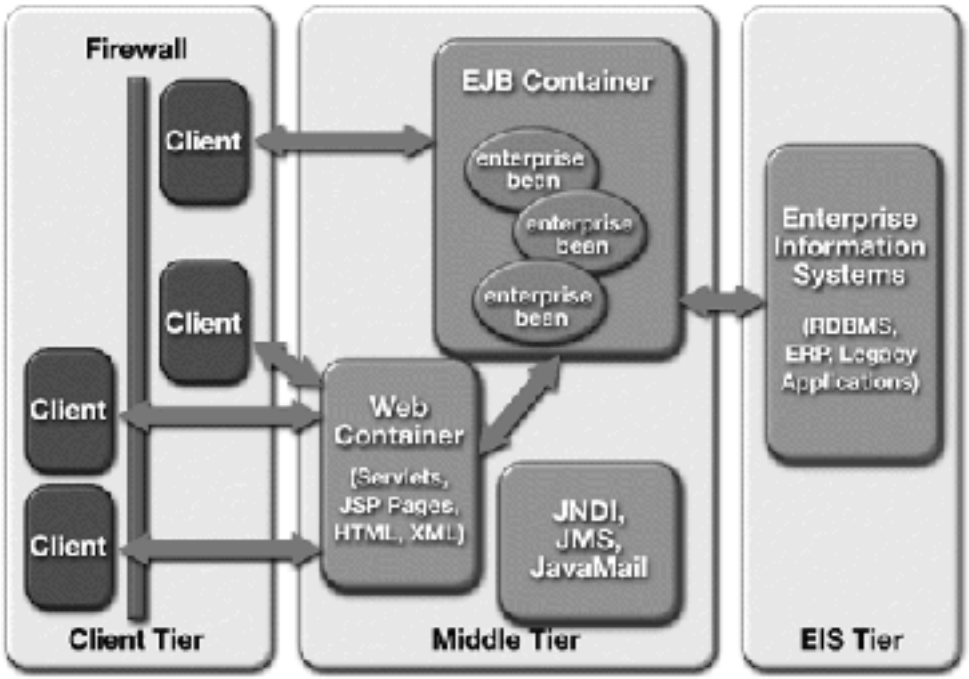
J2EE Core Concepts (3)

- Applications run in containers providing:
  - Services to components (transaction management, object distribution, concurrent access, security, persistence, resource management, life-cycle management)
  - Standardized access methods to Enterprise Information Systems (EIS), such as SAP
  - Control over application behaviour at assembly and deployment time, as well as at run time (in the code)

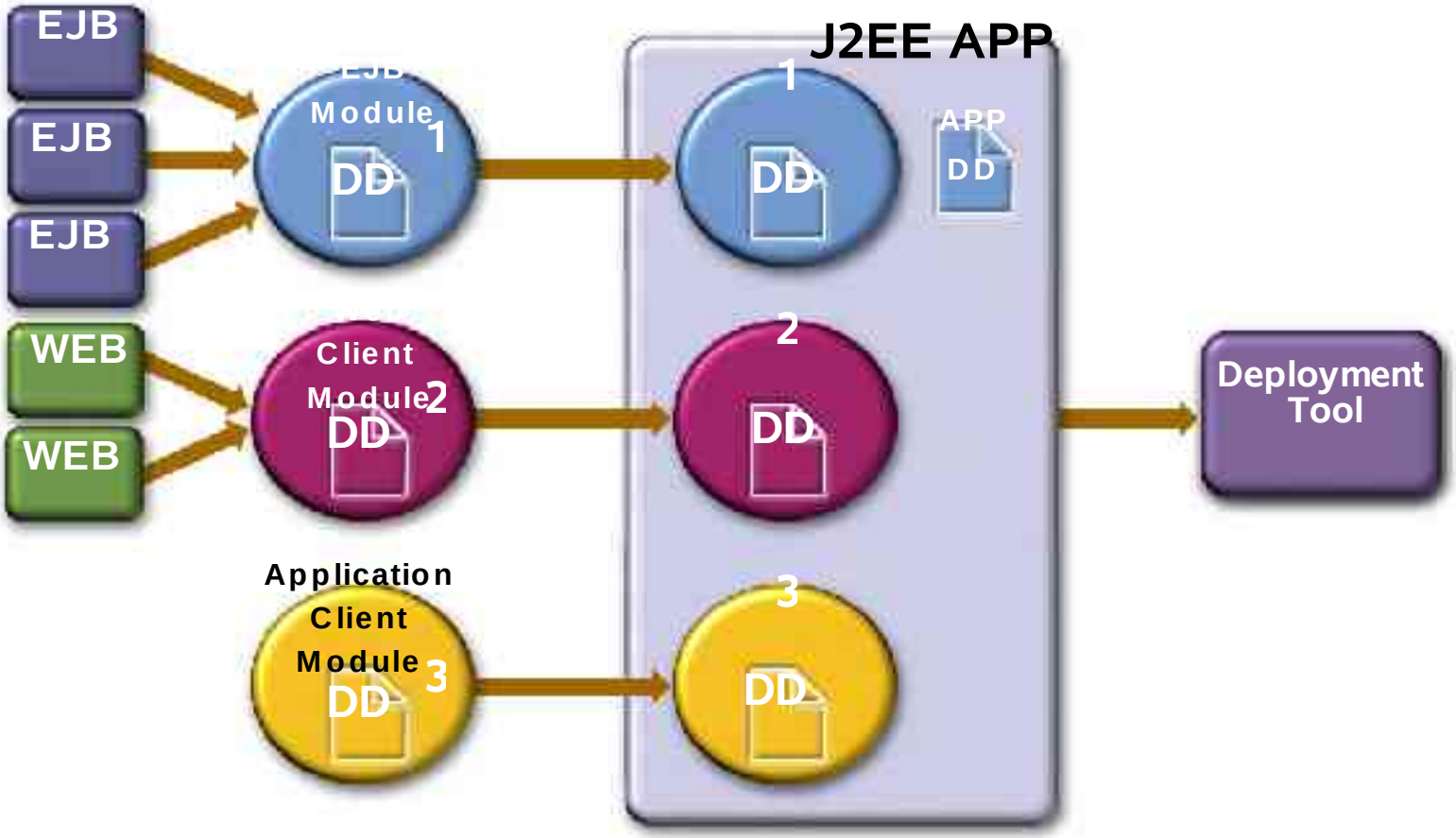
Components and Containers
Responsibilities

- Containers handle:
  - Concurrency
  - Security
  - Availability
  - Scaleability
  - Persistence
  - Transactions
  - Life-cycle Management
- Components handle:
  - Presentation logic
  - Business logic

A Typical J2EE Environment



J2EE Core Concepts (4)
Packaging / Assembly

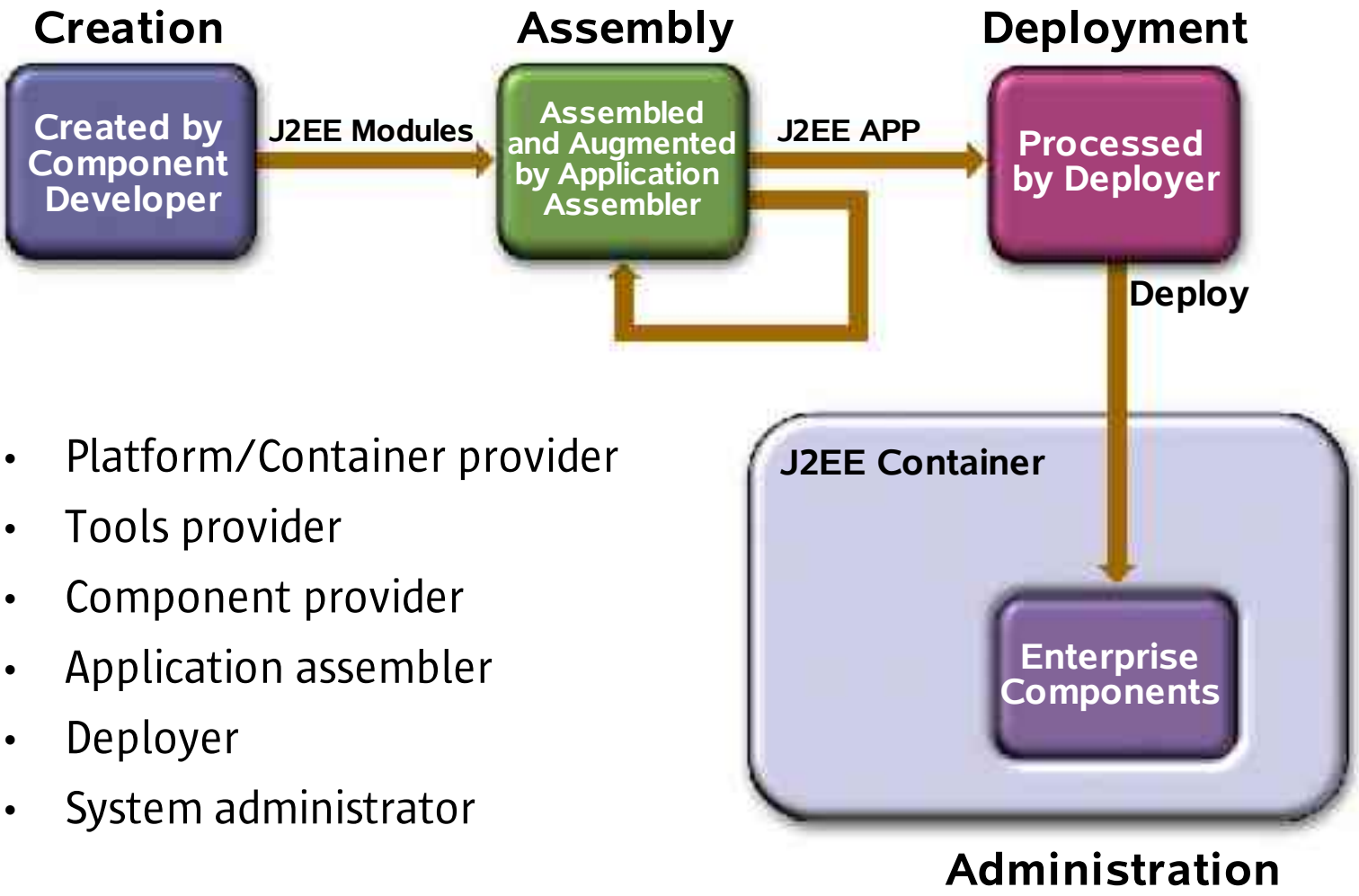


J2EE Core Concepts (5)

- Deployment
  - Applications are configurable at packaging/assemby AND deployment time via deployment descriptors
  - Changes can be made without programming:
    - Transactional behaviour
    - Security characteristics (user/group, role assignments)
    - External resource references (databases, EIS)
    - Container-specific features (load-balancing, clustering)

J2EE Core Concepts (6)

Roles

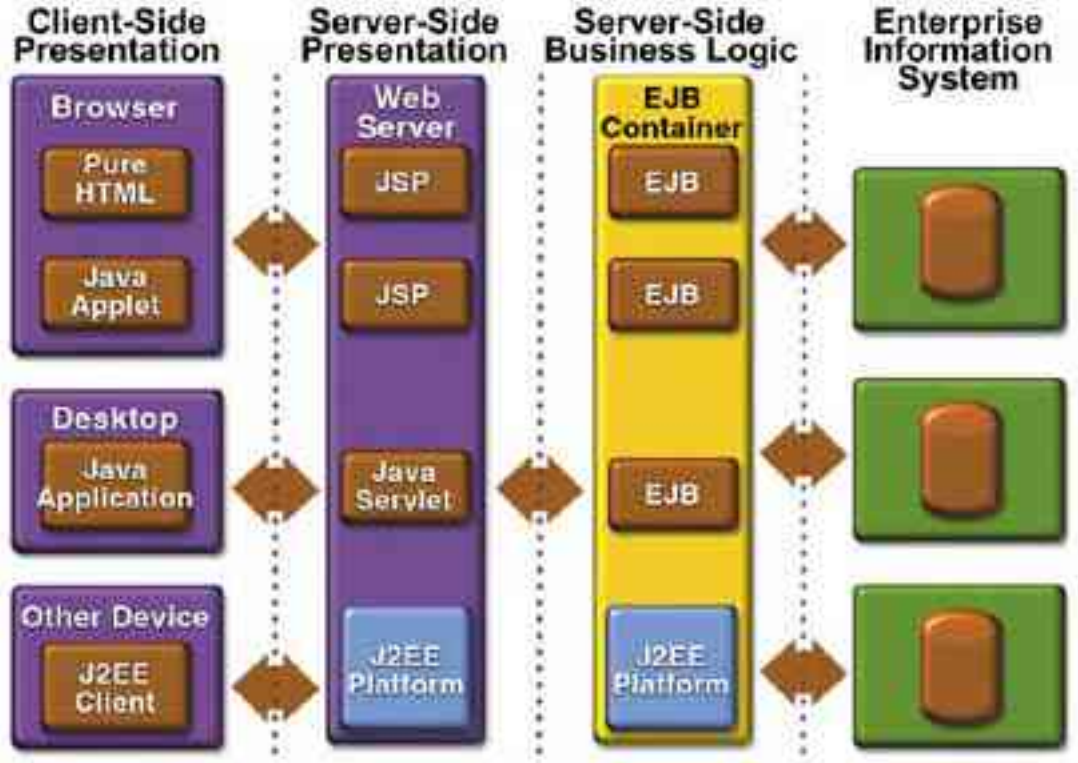


- Platform/Container provider
- Tools provider
- Component provider
- Application assembler
- Deployer
- System administrator

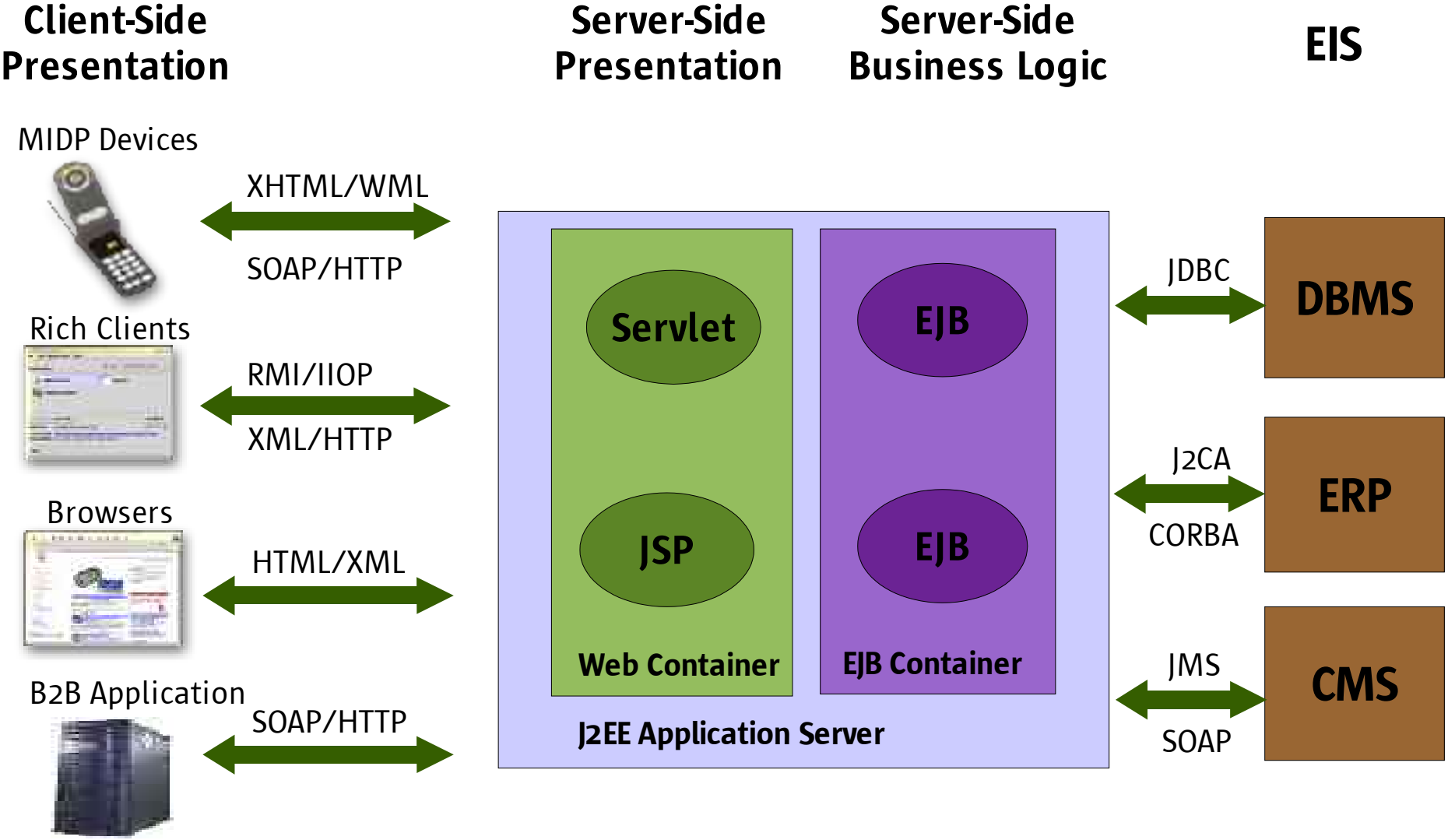
J2EE Application Architecture

- The J2EE Application Architecture defines - but does not require - these tiers:
  - Client tier (the user interface)
    - Browser-based clients
    - Standalone application clients, including J2ME clients
    - Non-Java clients; eg, VB making HTTP requests
    - Standards on the client tier - HTTP, HTML, XML
  - Middle tier (one or more, client services and business logic)
    - Web containers for Servlets and JSPs
    - EJB containers for Enterprise Java Beans
  - Back-end tier (data management)
    - Oracle Database or EIS such as SAP

J2EE Application Architecture
Full Multi-Tier Example



J2EE End-to-End Architecture



Best Practices/Design Patterns

- Java BluePrint for J2EE
  - Guidelines, patterns and code examples
  - http://java.sun.com/blueprints/enterprise
- J2EE Patterns
  - Best practices and design strategies (common solutions to common problems)
  - J2EE Pattern Catalog from the Sun Java Center

Benefits for Developers

- Containers provide common services
- Freedom on choice for servers, tools and components
- Comprehensive resources available
- Integration methods for existing information systems
- Configurable security model

Benefits for IT Managers

- Applications are portable
- No vendor lock-in
- Large marketplace, many vendors to choose from

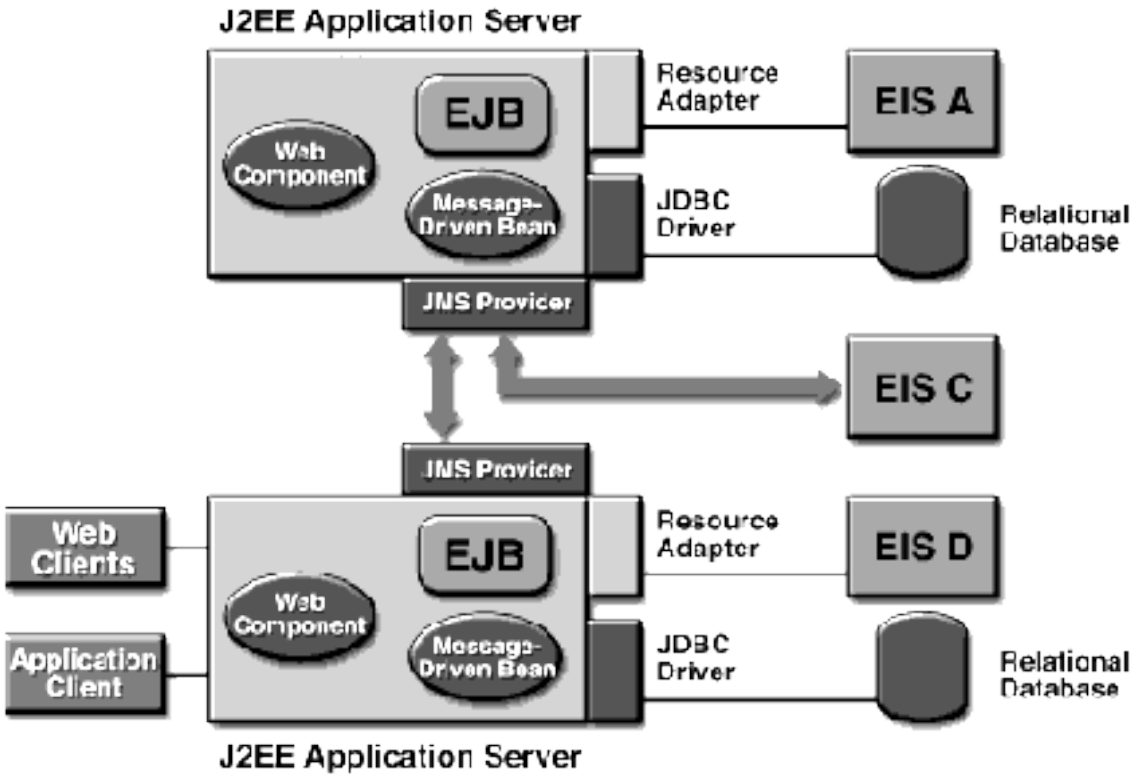
J2EE APIs and Technologies

- JDBC (Java Database Connectivity)
- Java IDL (Interface Definition Language for CORBA)
- EJB (Enterprise Java Beans)
- Java Servlets
- JSP (Java Server Pages)
- JMS (Java Message Service)
- JNDI (Java Naming and Directory Interface)
- XML APIs (JAXP, JAXR, JAX-RPC)
- JavaMail
- J2EE Connector Architecture (JCA)
- Transactions (JTA / JTS)

J2EE/EIS Integration APIs

- J2EE Technologies used in EIS integration:
  - J2EE Connector Architecture (JCA)
    - For Enterprise Information Systems (EIS); for example, SAP
  - JDBC
    - For Databases; for example, ORACLE
  - Java Message Service (JMS)
    - For Message-Oriented-Middleware; for example, SunONE Message Queue or IBM MQ Series
  - Java Naming and Directory Interface (JNDI)
    - For Directory Services; for example, LDAP Directories
  - JavaMail
    - For E-Mail Systems

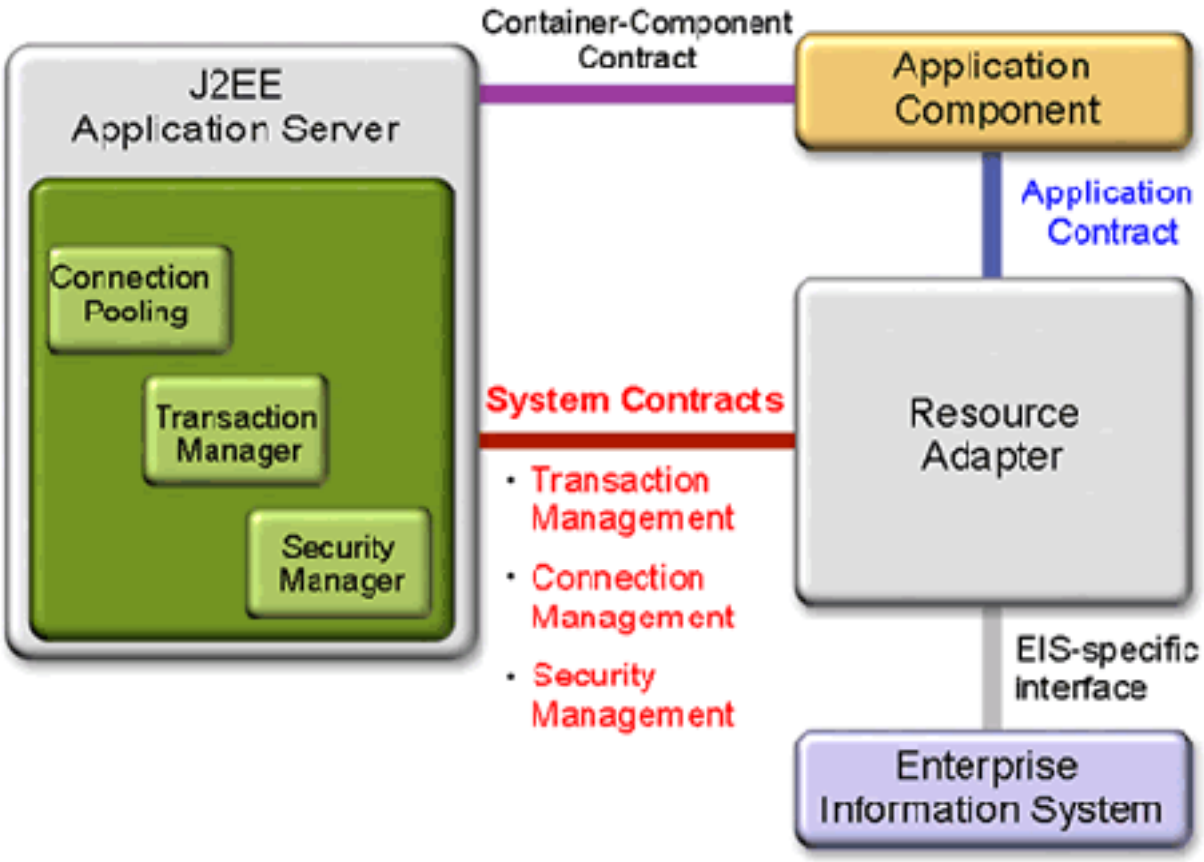
J2EE Integration Architecture



JCA Overview

- Process
  - EIS provides a JCA-compliant adapter
  - J2EE Application Server supports JCA
  - EIS Adapter plugs into Application Server
  - J2EE Applications running in Application Server access EIS via the Adapter
- EIS Vendors provide only one Adapter for all Application Servers
- EIS accessed in a standard way in all Application Servers

JCA Components



J2EE/SAP Integration Methods

- SAP Web Application Server (mySAP)
  - "Fully J2EE Compatible"
  - Java and/or ABAP Application runs in server
  - Application --> Integration Engine --> SAP
  - Adapters allow SAP Exchange Infrastructure to use Java to talk to external systems
- SAP Java Connector (JCo)
  - SAP-specific Java adapter (deprecated in favour of JCA Adapter)
- SAP J2EE Connector Architecture (JCA) Adapter
  - J2EE Application Server supports JCA
  - SAP JCA Adapter supports JCA
  - J2EE Application Server application calls SAP via the SAP Adapter

J2EE Releases

- J2EE 1.4:
  - New APIs for core Web Services protocols
  - New management and deployment APIs
  - New versions of JSPs, EJBs, Connector APIs
- J2EE 1.5
  - Simplification of J2EE Application Development
  - Enhance the influence of J2EE in the entire Java Development Community
  - XML Standards (XMLdsig, XML Encryption, WS-Security
  - APIs (Portlets, Java Server Faces, JAXB)

Resources

- Starter Kit
  - J2SE, J2EE and J2ME JDK software
  - Java training and code samples
  - Development tools, including Studio 5 IDE
  - Web Services Tutorial and Building Services on the J2EE Platform
  - J2EE Middleware

Resources continued

- http://java.sun.com/blueprints/enterprise/
  - Blueprint - "Designing Enterprise Applications with the J2EE Platform, 2nd Edition"
- http://java.sun.com/j2ee
  - Software, tutorials and documentation
- http://java.net
  - Java Developer Portal
- http://wwws.sun.com/software/products/appsrvr/home_
  - Sun Application Server product web site
- **http://wwws.sun.com/software/sundev/index.html**
  - **Sun Studio product web site**

J2EE APIs and Technologies

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JDBC

- Standard API for accessing tabular data
  - Connect to a database or tabular data source (including spreadsheets and flat files)
  - Send SQL statements
  - Process the results
- Packages:
  - java.sql
  - javax.sql
- http://java.sun.com/products/jdbc/index.html

Java IDL

- Adds CORBA capability
- Enables invocation of remote network services using OMG IDL and IIOP
- Includes an ORB for distributed computing using IIOP
- J2SE 1.3 includes the IDL-to-Java compiler
- http://java.sun.com/products/jdk/idl/index.html

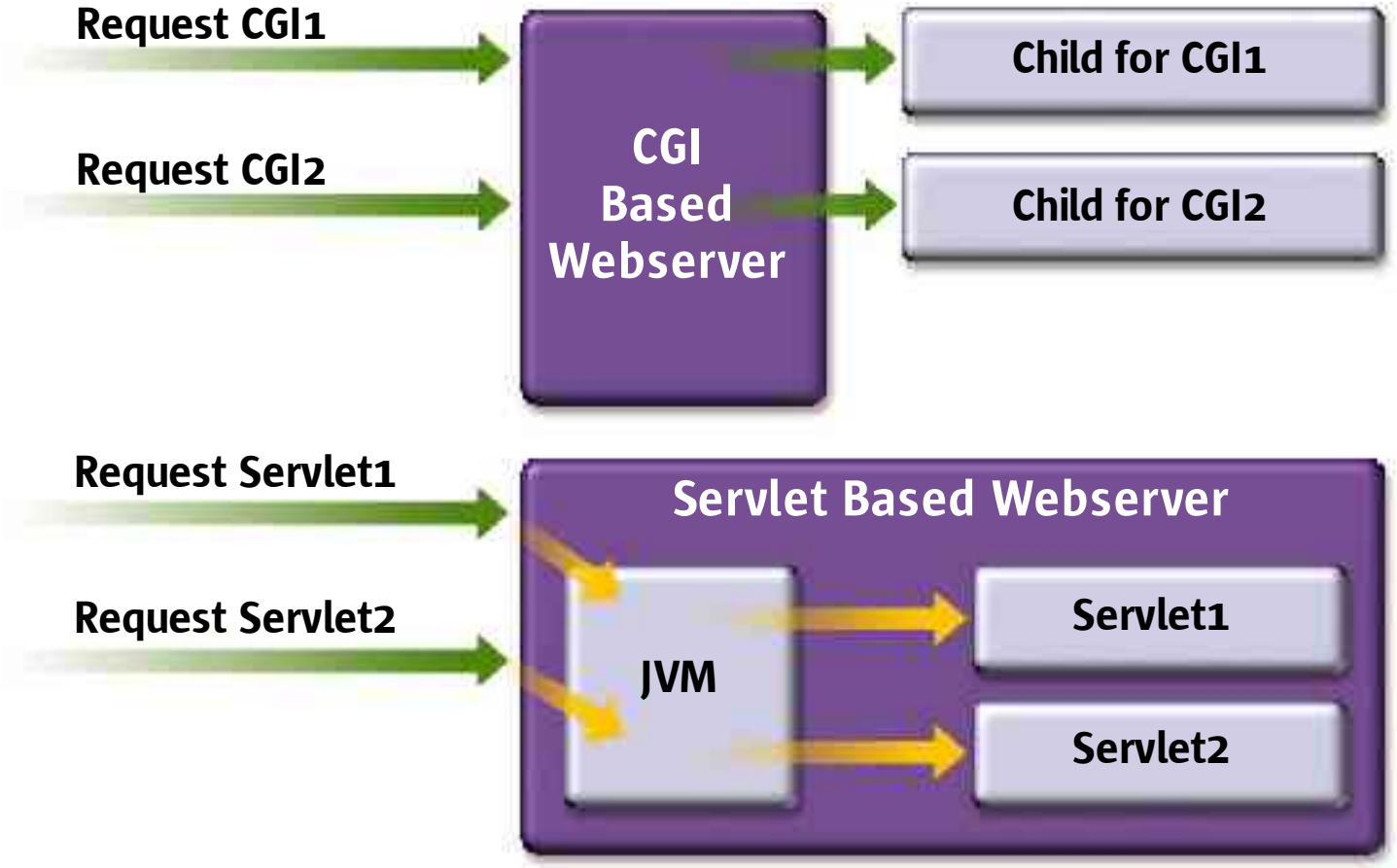
Enterprise Java Beans

- Standard server-side component
- Session Beans
  - Process and task management
- Entity Beans
  - Persistent objects in a database
- Message-Driven Beans
  - Send/receive asynchronous JMS messages
- http://java.sun.com/products/ejb/index.html

Java Servlets

- Component-based, platform-independent method for building web-based applications
- An applet that runs on the server side
- Generates dynamic content
- Packages:
  - javax.servlet
  - javax.servlet.http
- http://java.sun.com/products/servlet

Java Servlets vs. CGI



Java Server Pages

- Extension of Java Servlets
- Separates the user interface from content generation
  - Presentation in HTML or XML/XSLT
  - Business logic in JavaBeans or Custom Tags
  - Easier to maintain
- Packages:
  - javax.servlet.jsp
  - javax.servlet.jsp.tagext
- http://java.sun.com/products/jsp

Java Message Service

- Access to Enterprise Messaging, or Message Oriented Middleware, via standard API
- Requires a Message Provider (Sun Message Queue is built into Sun Application Server)
- Package javax.jms
- http://java.sun.com/products/jms

Java Naming and Directory Interface

- Standard extension to the Java Platform
- Unified interface to naming and directory services
- Class libraries and service providers for:
  - LDAP, DNS, NIS/NIS+, CORBA COS Naming, RMI Registry, file system
- http://java.sun.com/products/jndi

XML APIs

- JAXP (Java API for XML Processing)
  - Processing of XML documents using DOM, SAX and XSLT
- JAXR (Java API for XML Registries)
  - Bindings for Web Services Registries - ebXML Registry and UDDI Registry v2.0
- JAX-RPC (Java API for XML-Based RPC)
  - Core API for web services development/deployment
  - Builds SOAP-based web services

JavaMail

- Platform-independent and protocol-independent API to build mail and messaging applications
- Requires JavaBeans Activation Framework extension (javax.activation package)
- http://java.sun.com/products/javamail/index.html

J2EE Connector Architecture

- Standard architecture for connecting the J2EE platform to heterogenous Enterprise Information Systems (EIS) - such as SAP
- EIS vendor provides a standard resource adapter for its EIS
- Adapter plugs into the Application Server, providing connectivity between the EIS and the enterprise application
- http://java.sun.com/j2ee/connector

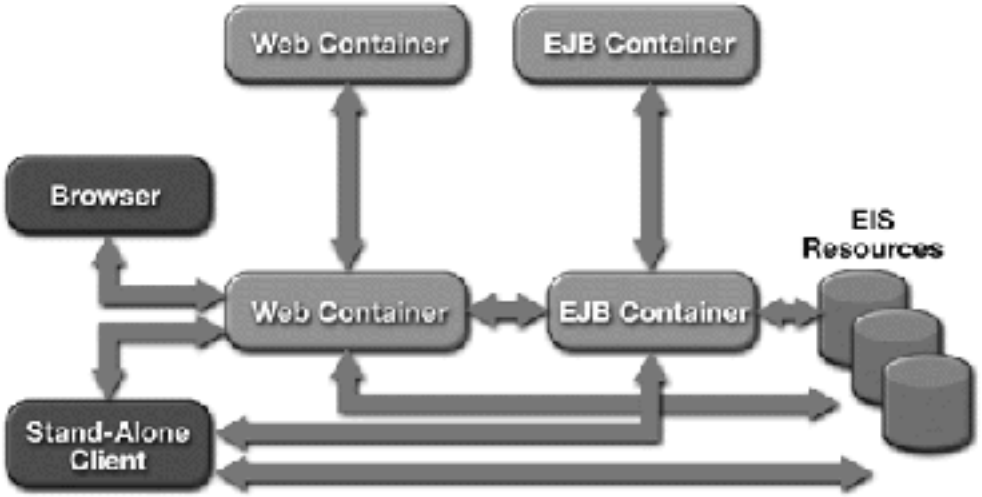
Transactions

- Supports distributed transaction management
- JTA (Java Transaction API)
  - high-level, implementation-independent, protocol-independent API allowing access to transactions
- JTS (Java Transaction Service)
  - Implementation of a Transaction Manager supporting JTA
  - Implementation of Java mapping to OMG Object Transaction Service (OTS) 1.1
- http://java.sun.com/j2ee/transactions.html

J2EE Flexibility

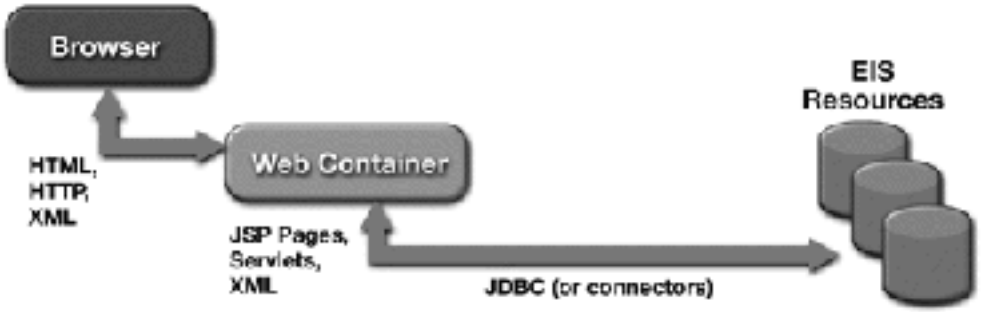
- J2EE specifies, but does not require, multi-tier architectures
- Both the Web and EJB Containers are optional
- There is no bias or preference for one architecture over another; however, there can be preferred ways of doing things

Possible Architectures



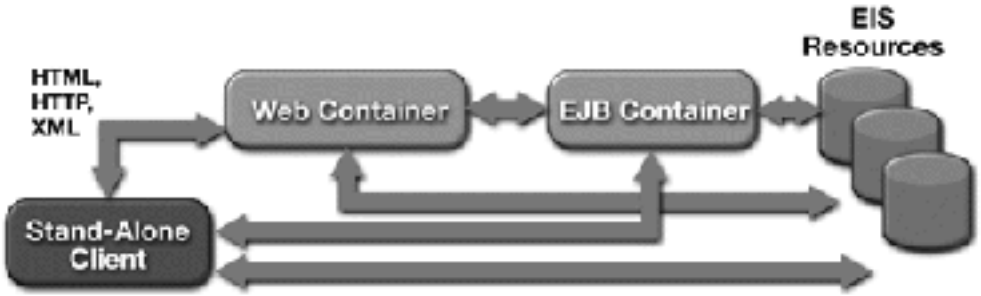
- Following are just three possibilities:
  - Web-Oriented application
  - Standalone-Client application
  - Multi-Tier application

Web-Oriented



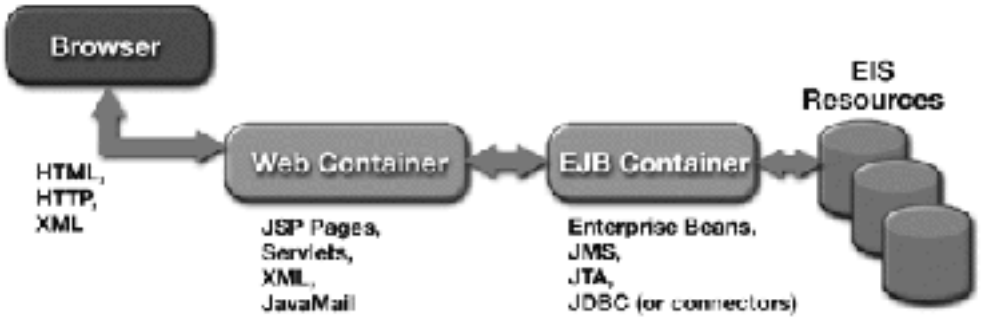
- Cases where EJB Container components would be overkill and deliver poor performance
- Web Container hosts presentation logic (JSP) and business logic (Java Servlets)
- Web Container components use JDBC, JMS and JCA to access EIS Resources

Standalone-Client



- Client accesses EJB Container components directly
  - EJB Container components access EIS Resources via JDBC, JMS and JCA
- Client accesses content provided by Web Container components
  - Client handles display logic
  - Web container components handle business logic, may use EJB Container components for EIS access, or may access directly
- Client access EIS directly using JDBC, JMS and JCA
  - Client handles all logic

Multi-Tier



- Client is a Web Browser
- Presentation and business logic provided by Web Container components
  - Java Servlets recommended for request processing and application control
  - JSPs recommended for user interface/display logic
- EJB Container components manage access to EIS resources using JDBC, JMS and JCA

Logical View

- Tries to use existing security services
- Role-based Security Implementation
  - Role - Application Developer
    - Declarative Security (deployment descriptors)
    - Programmatic Security (Java code)
  - Role - Application Deployer
    - Configures Security Policy
  - Role - Application Container (J2EE Container)
    - Enforces Security Policy

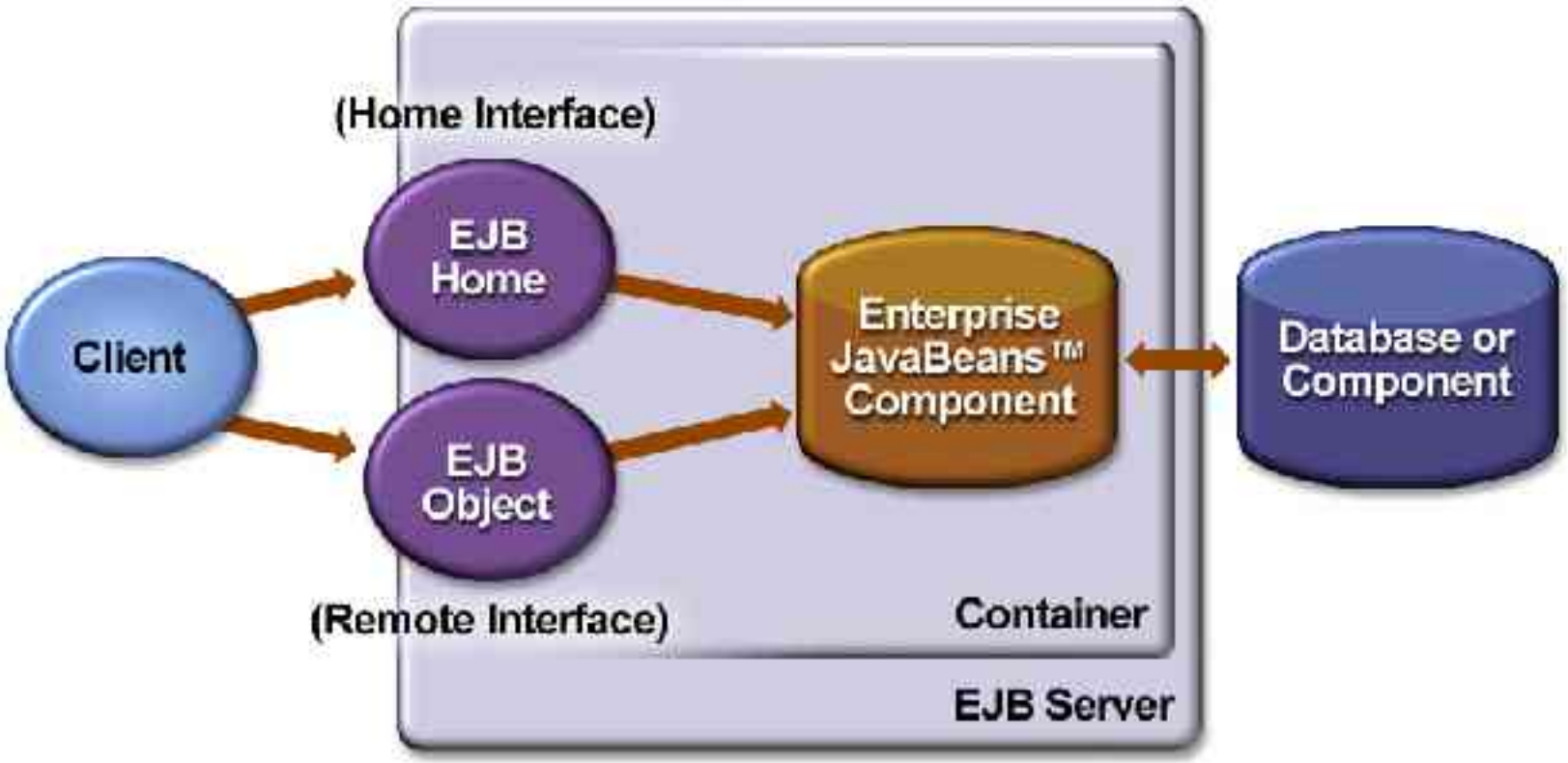
Mechanisms

- Authentication
  - Web-Tier Authentication
  - EJB-Tier Authentication
  - EIS-Tier Authentication
- Authorisation
  - Declarative and Programmatic
  - Provider and User of component
- Signing
- Encryption
  - Integrity and Confidentiality
- Auditing

Why Use EJBs

- Takes advantages of the server-side component model; that is, container services
- Separates business logic from system code
- Enables component portability across J2EE Servers and Operating Systems
- Enables configuration at deployment time as well as at development time

EJB Architecture



EJB Component Types

- Session Bean
  - Implementation of Workflows or Services
  - Stateless (no session state from request to request)
  - Statefull (session state persists across requests)
- Entity Bean
  - Represents state and behaviour of an actual Object
  - State is persistent across requests and clients
  - Container-Managed Persistence
    - EJB Container manages database interaction
  - Bean-Managed Persistence
    - Programmer codes SQL statements to manage database interaction
- Message Driven Bean
  - Allows the sending and receiving of JMS Messages within an EJB Container

J2EE and .NET Development

- J2EE
  - One language (Java)
  - Many platforms (Solaris, Windows, Linux...)
- .NET
  - One platform (Windows)
    - Mono effort in progress (Linux and UNIX)
  - Many languages (C#, Managed C++, VB.NET...)