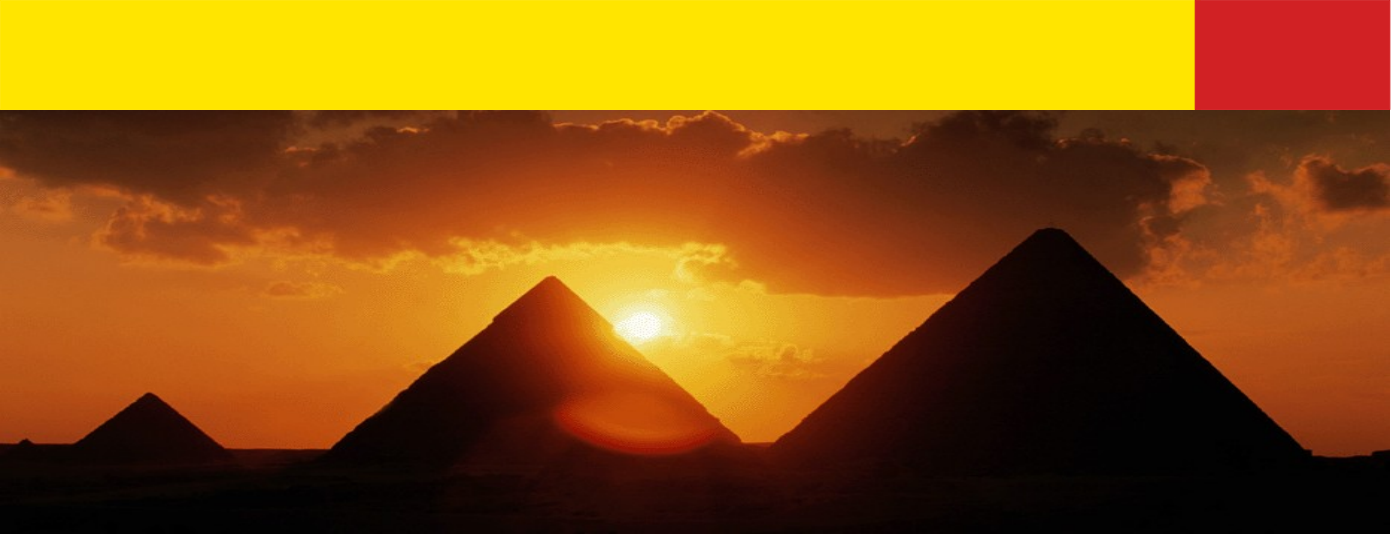
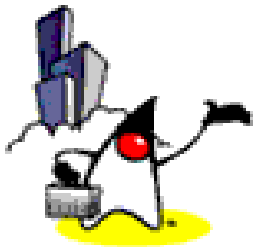


Introduction to Java EE (J2EE)

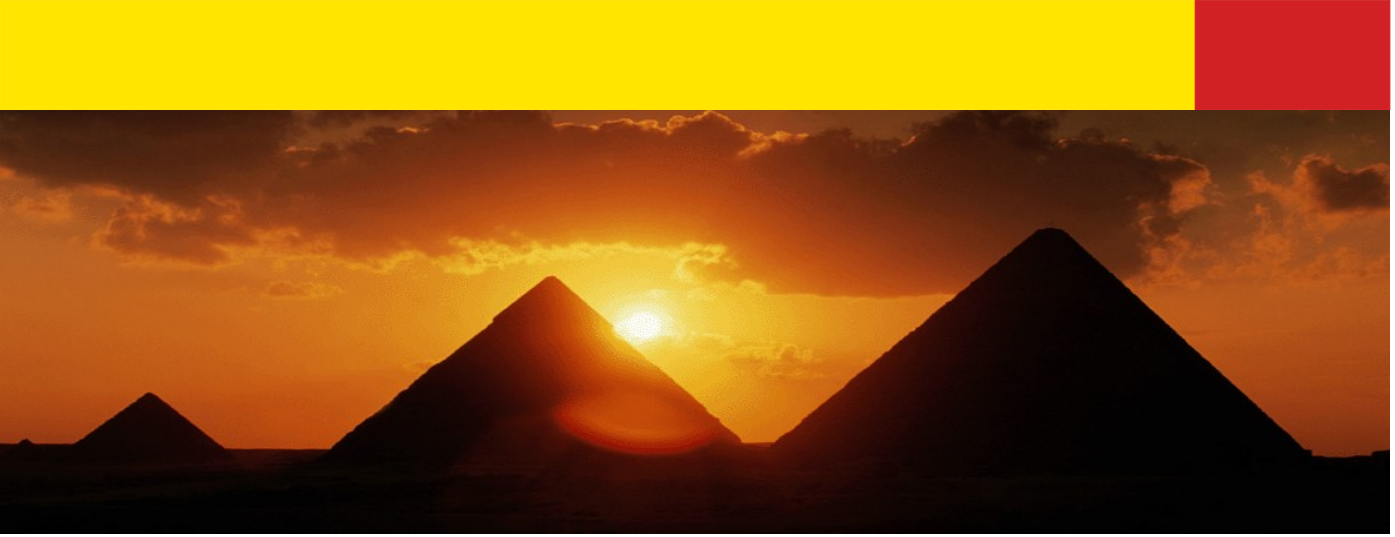


Session Objectives

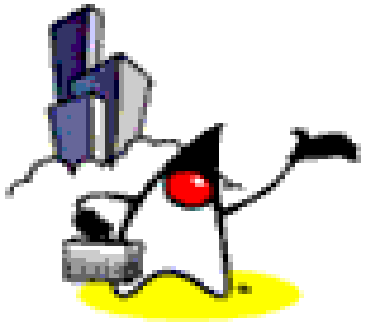
- Understanding the value propositions of J2EE
- Getting a big picture of J2EE architecture and platform
- Getting high-level exposure of APIs and Technologies that constitute J2EE
  - You don't have to understand the details
- Understanding why J2EE is a great platform for development and deployment of web services

Agenda

- What is J2EE?
- Evolution of Enterprise Application Development Frameworks
- Why J2EE?
- J2EE Platform Architecture
- J2EE APIs and Technologies
- Standard Impl (J2EE 1.4), Compatibility Test Suite (CTS)
- BluePrints
- J2EE and Web Services
- How to get started



What is J2EE?



Enterprise Computing

Challenges

- Portability
- Diverse Environments
- Time-to-market
- Core Competence
- Assembly
- Integration

Key Technologies

- J2SE™
- J2EE™
  - JMS
  - Servlet
  - JSP
  - Connector
- XML
  - Data Binding
  - XSLT

Products

- App Servers
- Web Servers
- Components
- Databases
- Object to DB tools

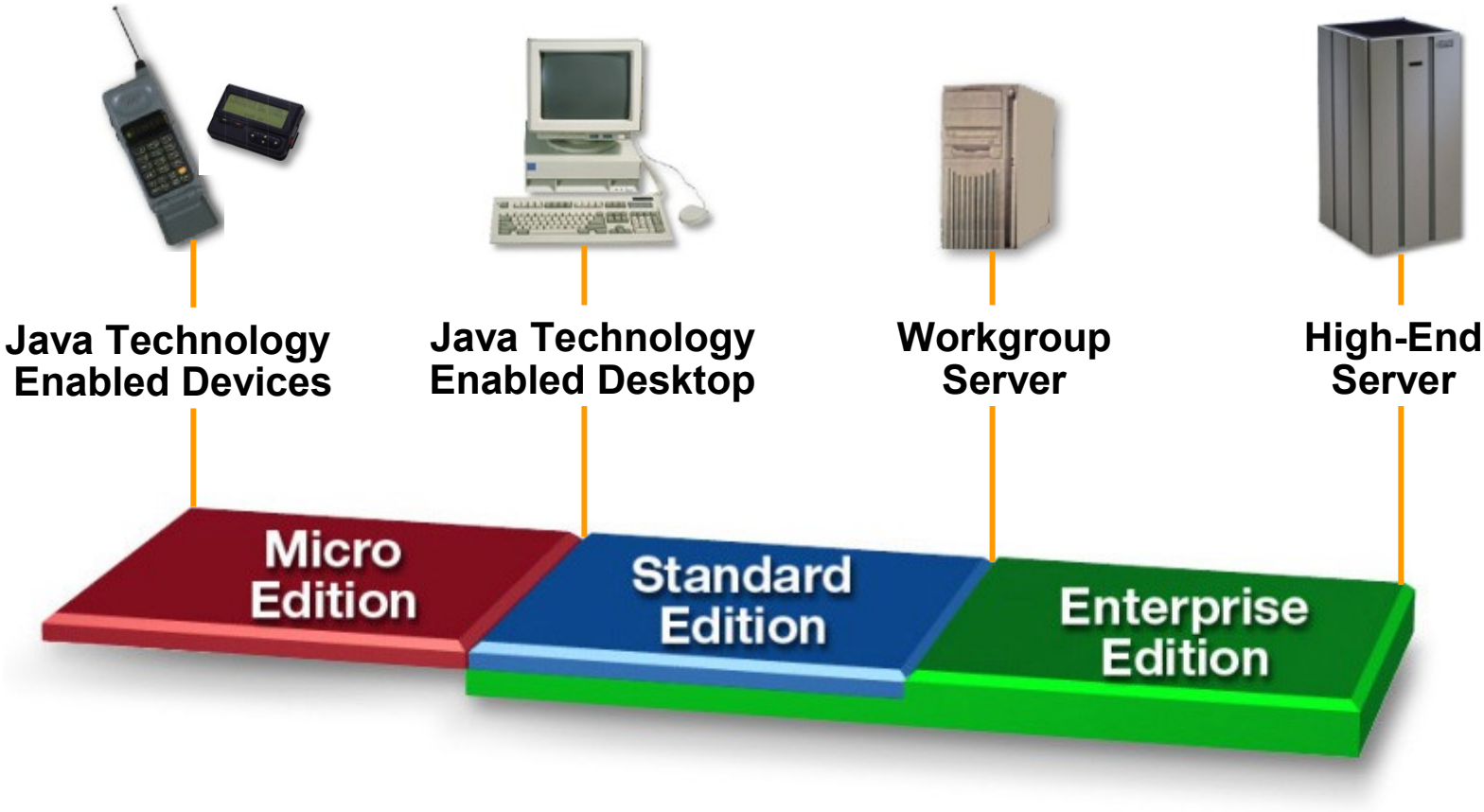
Legacy Systems

- Databases
- TP Monitors
- EIS Systems

What Is the J2EE?

- Open and standard based platform for
- developing, deploying and managing
- n-tier, Web-enabled, server-centric, and component-based enterprise applications

The Java™ Platform



The Java™ Platform

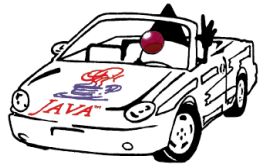
Optional Packages

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

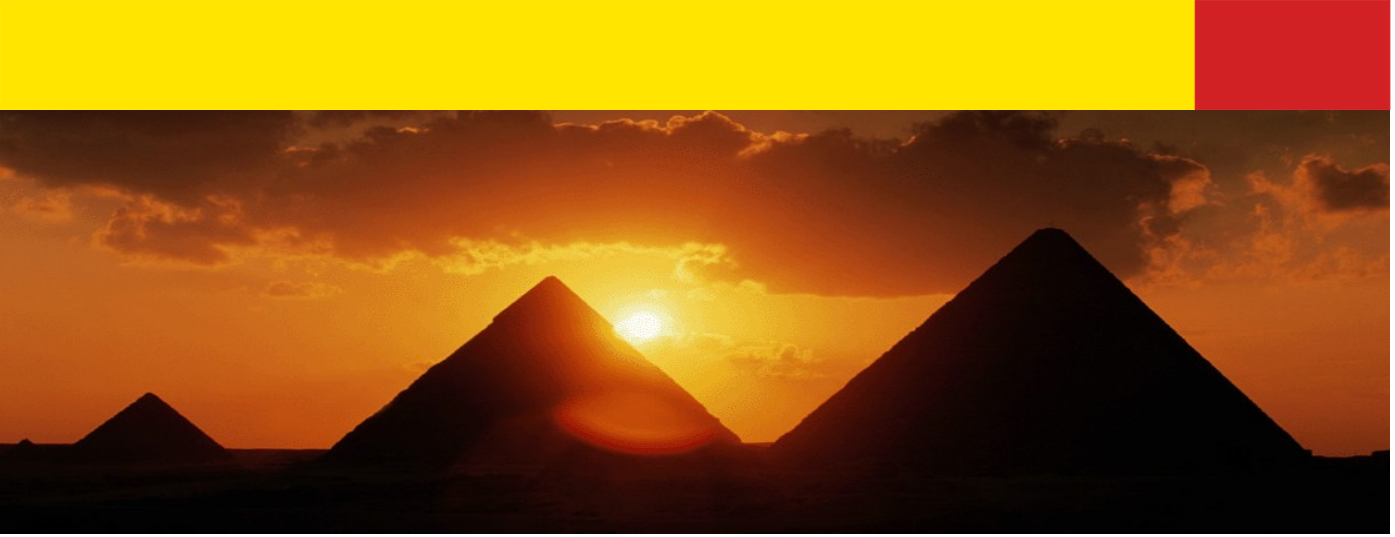
JVM

KVM

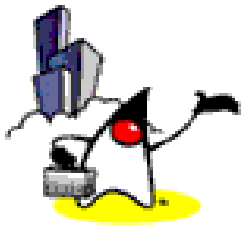
CardVM

What Makes Up J2EE?

- API and Technology specifications
- Development and Deployment Platform
- Standard and production-quality implementation
- Compatibility Test Suite (CTS)
- J2EE brand
- J2EE Blueprints
- Sample codes



Evolution of Enterprise Application Frameworks



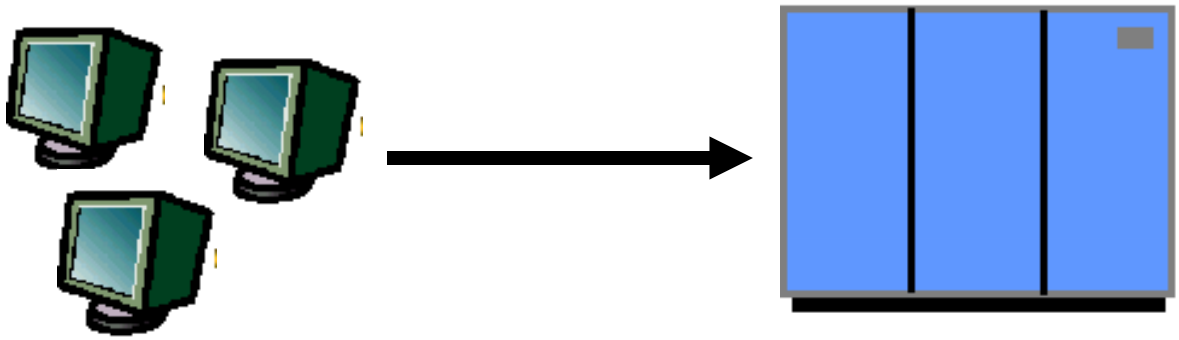
Evolution of Enterprise Application Framework

- Single tier
- Two tier
- Three tier
  - RPC based
  - Remote object based
- Three tier (HTML browser and Web server)
- Proprietary application server
- Standard application server

About Enterprise Applications

- Things that make up an enterprise application
  - Presentation logic
  - Business logic
  - Data access logic (and data model)
  - System services
- The evolution of enterprise application framework reflects
  - How flexibly you want to make changes
  - Where the system services are coming from

Single Tier (Mainframe-based)

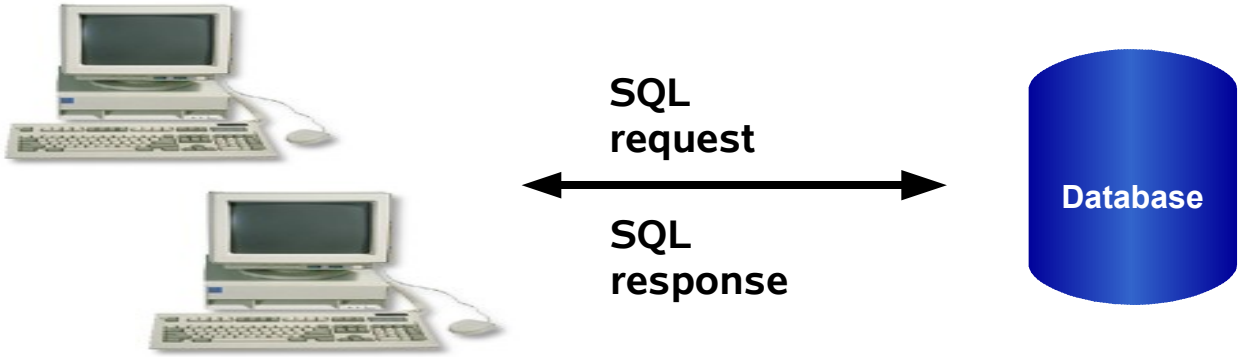


- Dumb terminals are directly connected to mainframe
- Centralized model (as opposed distributed model)
- Presentation, business logic, and data access are intertwined in one monolithic mainframe application

Single-Tier: Pros & Cons

- Pros:
  - No client side management is required
  - Data consistency is easy to achieve
- Cons:
  - Functionality (presentation, data model, business logic) intertwined, difficult for updates and maintenance and code reuse

Two-Tier



- Fat clients talking to back end database
  - SQL queries sent, raw data returned
- Presentation,Business logic and Data Model processing logic in client application

Two-Tier

- Pro:
  - DB product independence (compared to single-tier model)
- Cons:
  - Presentation, data model, business logic are intertwined (at client side), difficult for updates and maintenance
  - Data Model is “tightly coupled” to every client: If DB Schema changes, all clients break
  - Updates have to be deployed to all clients making System maintenance nightmare
  - DB connection for every client, thus difficult to scale
  - Raw data transferred to client for processing causes high network traffic

Three-Tier (RPC based)

- Thinner client: business & data model separated from presentation
  - Business logic and data access logic reside in middle tier server while client handles presentation
- Middle tier server is now required to handle system services
  - Concurrency control, threading, transaction, security, persistence, multiplexing, performance, etc.

Three-tier (RPC based): Pros & Cons

- Pro:
  - Business logic can change more flexibly than 2-tier model
    - Most business logic reside in the middle-tier server
- Cons:
  - Complexity is introduced in the middle-tier server
  - Client and middle-tier server is more tightly-coupled (than the three-tier object based model)
  - Code is not really reusable (compared to object model based)

Three-Tier (Remote Object based)

- Business logic and data model captured in objects
  - Business logic and data model are now described in "abstraction" (interface language)
- Object models used: CORBA, RMI, DCOM
  - Interface language in CORBA is IDL
  - Interface language in RMI is Java interface

Three-tier (Remote Object based): Pros & Cons

- Pro:
  - More loosely coupled than RPC model
  - Code could be more reusable
- Cons:
  - Complexity in the middle-tier still need to be addressed

Three-Tier (Web Server)

- Browser handles presentation logic
- Browser talks Web server via HTTP protocol
- Business logic and data model are handled by "dynamic contents generation" technologies (CGI, Servlet/JSP, ASP)

Three-tier (Web Server based): Pros & Cons

- Pro:
  - Ubiquitous client types
  - Zero client management
  - Support various client devices
    - J2ME-enabled cell-phones
- Cons:
  - Complexity in the middle-tier still need to be addressed

Trends

- Moving from single-tier or two-tier to multi-tier architecture
- Moving from monolithic model to object-based application model
- Moving from application-based client to HTML-based client

Single-tier vs. Multi-tier

Single tier

- No separation among presentation, business logic, database
- Hard to maintain

Multi-tier

- Separation among presentation, business logic, database
- More flexible to change, i.e. presentation can change without affecting other tiers

Monolithic vs. Object-based

Monolithic

- 1 Binary file
- Recompiled, relinked, redeployed every time there is a change

Object-based

- Pluggable parts
- Reusable
- Enables better design
- Easier update
- Implementation can be separated from interface
- Only interface is published

Outstanding Issues & Solution

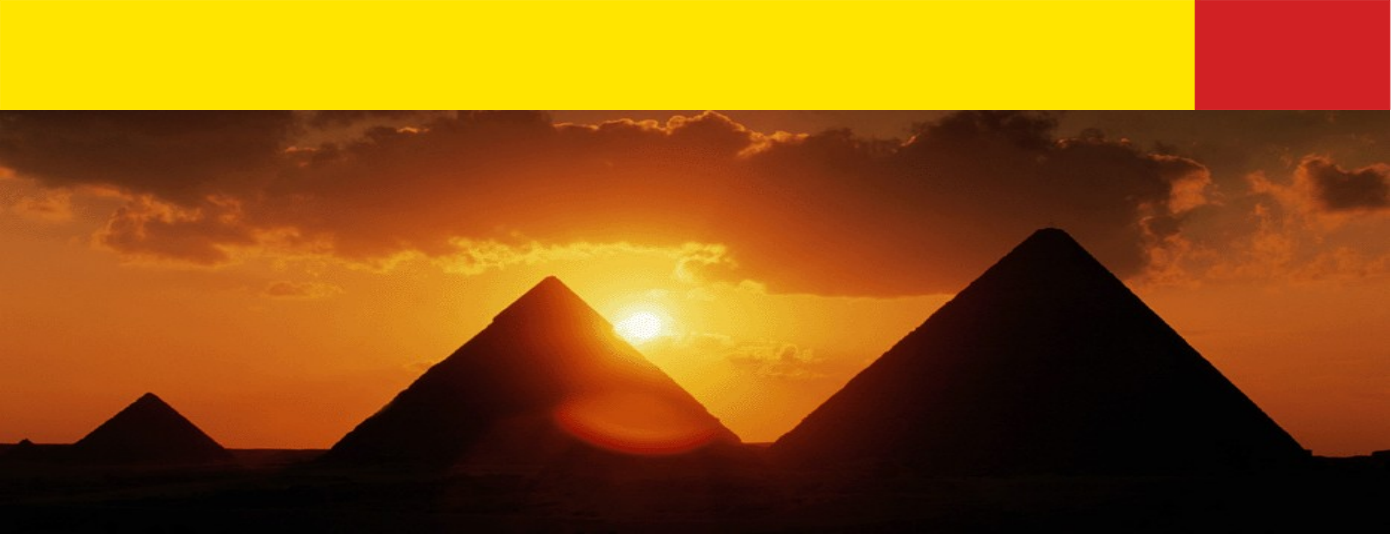
- Complexity at the middle tier server still remains
- Duplicate system services still need to be provided for the majority of enterprise applications
  - Concurrency control, Transactions
  - Load-balancing, Security
  - Resource management, Connection pooling
- How to solve this problem?
  - Commonly shared container that handles the above system services
  - Proprietary versus Open-standard based

Proprietary Solution

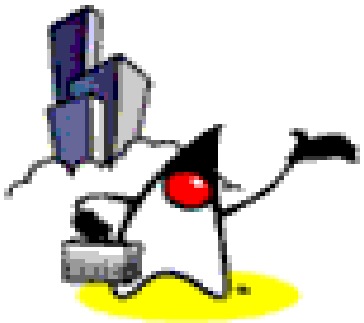
- Use "component and container" model
  - Components captures business logic
  - Container provides system services
- The contract between components and container is defined in a well-defined but with proprietary manner
- Problem of proprietary solution: Vendor lock-in
- Example: Tuxedo, .NET

Open and Standard Solution

- Use "component and container" model in which container provides system services in a well-defined and as industry standard
- J2EE is that standard that also provides portability of code because it is based on Java technology and standard-based Java programming APIs



Why J2EE?



Platform Value to Developers

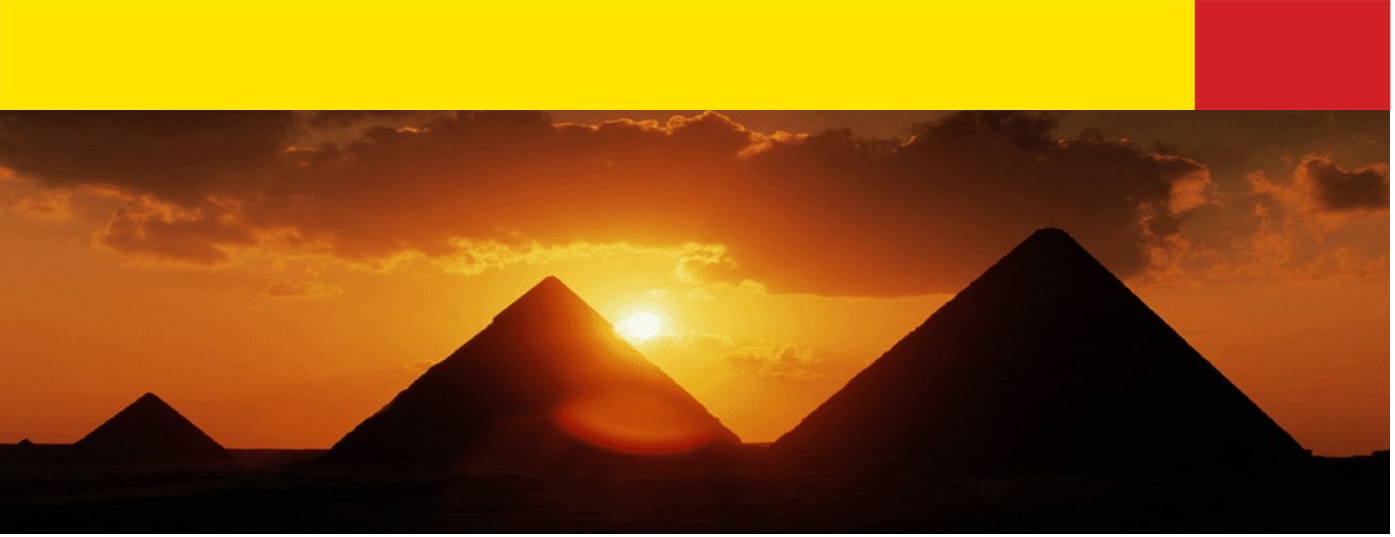
- Can use any J2EE implementation for development and deployment
  - Use production-quality standard implementation which is free for development/deployment
  - Use high-end commercial J2EE products for scalability and fault-tolerance
- Vast amount of J2EE community resources
  - Many J2EE related books, articles, tutorials, quality code you can use, best practice guidelines, design patterns etc.
- Can use off-the-shelf 3rd-party business components

Platform Value to Vendors

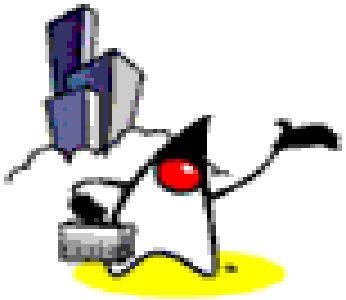
- Vendors work together on specifications and then compete in implementations
  - In the areas of Scalability, Performance, Reliability, Availability, Management and development tools, and so on
- Freedom to innovate while maintaining the portability of applications
- Do not have create/maintain their own proprietary APIs

Platform Value to Business Customers

- Application portability
- Many implementation choices are possible based on various requirements
  - Price (free to high-end), scalability (single CPU to clustered model), reliability, performance, tools, and more
  - Best of breed of applications and platforms
- Large developer pool



J2EE APIs & Technologies

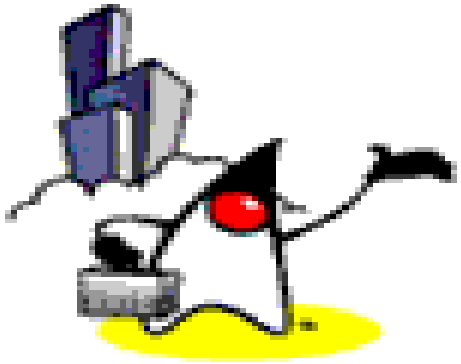


J2EE 1.4 APIs and Technologies

- J2SE 1.4 (improved)
- JAX-RPC (new)
- Web Service for J2EE
- J2EE Management
- J2EE Deployment
- JMX 1.1
- JMS 1.1
- JTA 1.0
- Servlet 2.4
- JSP 2.0
- EJB 2.1
- JAXR
- Connector 1.5
- JACC
- JAXP 1.2
- JavaMail 1.3
- JAF 1.0

Java EE 5

- JAX-WS 2.0 & JSR 181
- Java Persistence
- EJB 3.0
- JAXB 2.0
- JavaSever Faces 1.2 – new to Platform
- JSP 2.1 – Unification w/ JSF 1.2
- StAX – Pull Parser – new to Platform

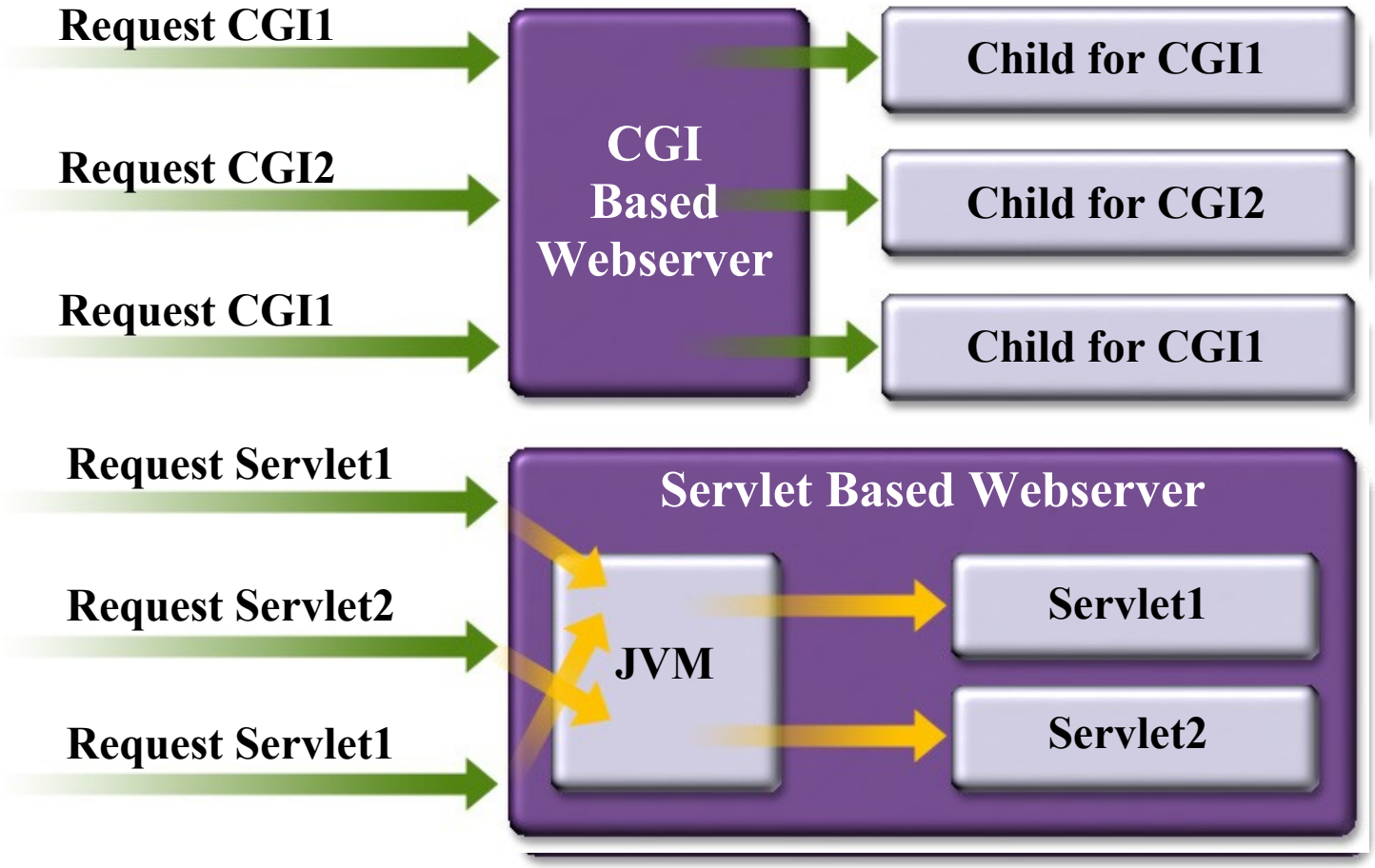


Servlet & JSP (JavaServer Pages)

What is a Servlet?

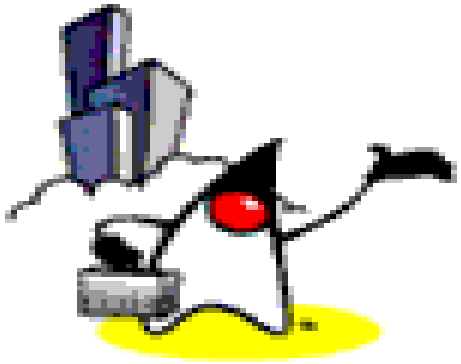
- Java™ objects which extend the functionality of a HTTP server
- Dynamic contents generation
- Better alternative to CGI, NSAPI, ISAPI, etc.
  - Efficient
  - Platform and server independent
  - Session management
  - Java-based

Servlet vs. CGI



What is JSP Technology?

- Enables separation of business logic from presentation
  - Presentation is in the form of HTML or XML/XSLT
  - Business logic is implemented as Java Beans or custom tags
  - Better maintainability, reusability
- Extensible via custom tags
- Builds on Servlet technology



EJB (Enterprise Java Beans)

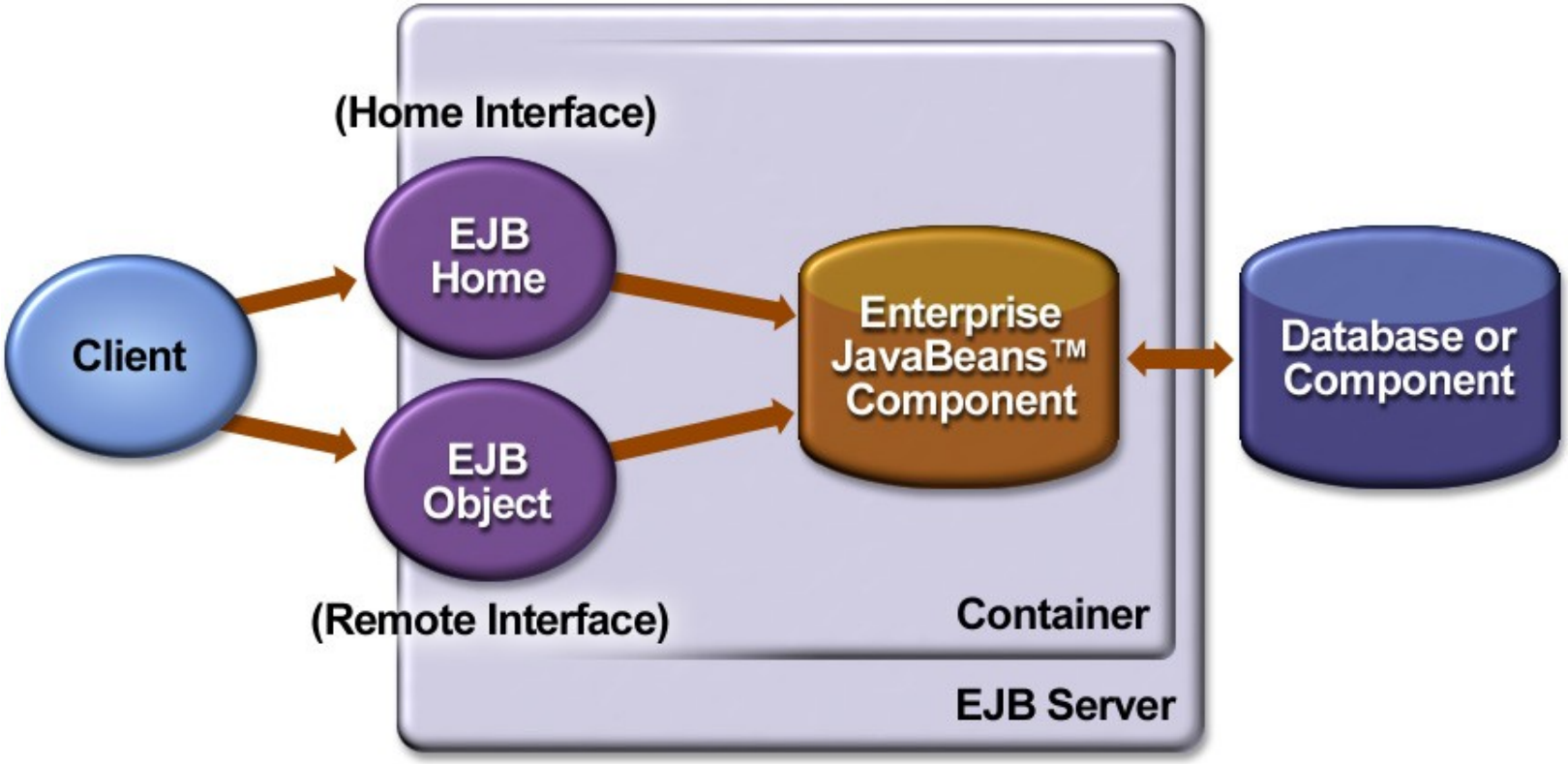
What is EJB Technology?

- A server-side component technology
- Easy development and deployment of Java technology-based application that are:
  - Transactional, distributed, multi-tier, portable, scalable, secure, …

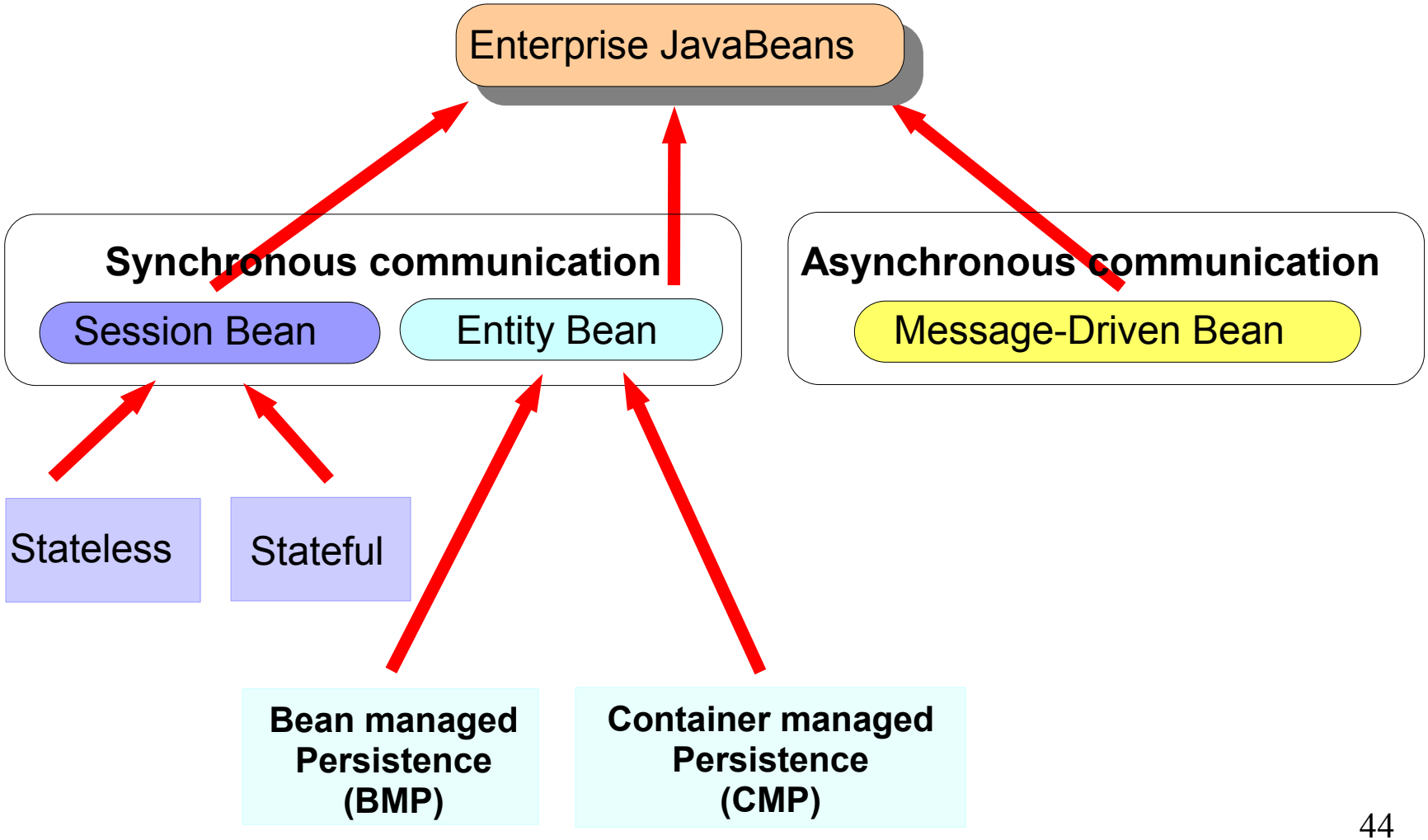
Why EJB Technology?

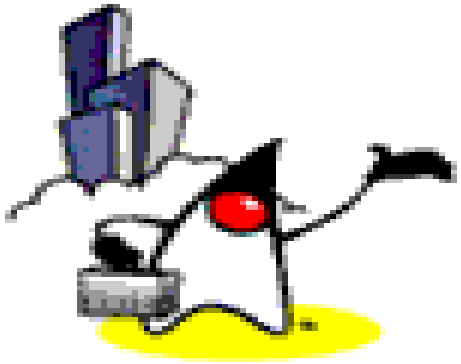
- Leverages the benefits of component-model on the server side
- Separates business logic from system code
  - Container provides system services
- Provides framework for portable components
  - Over different J2EE-compliant servers
  - Over different operational environments
- Enables deployment-time configuration
  - Deployment descriptor

EJB Architecture



Enterprise JavaBeans

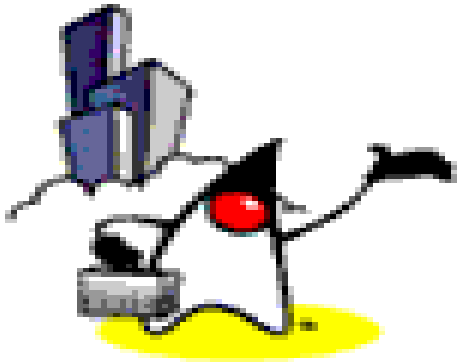




JMS (Java Message Service)

Java Message Service (JMS)

- Messaging systems (MOM) provide
  - De-coupled communication
  - Asynchronous communication
  - Plays a role of centralized post office
- Benefits of Messaging systems
  - Flexible, Reliable, Scalable communication systems
- Point-to-Point, Publish and Subscribe
- JMS defines standard Java APIs to messaging systems

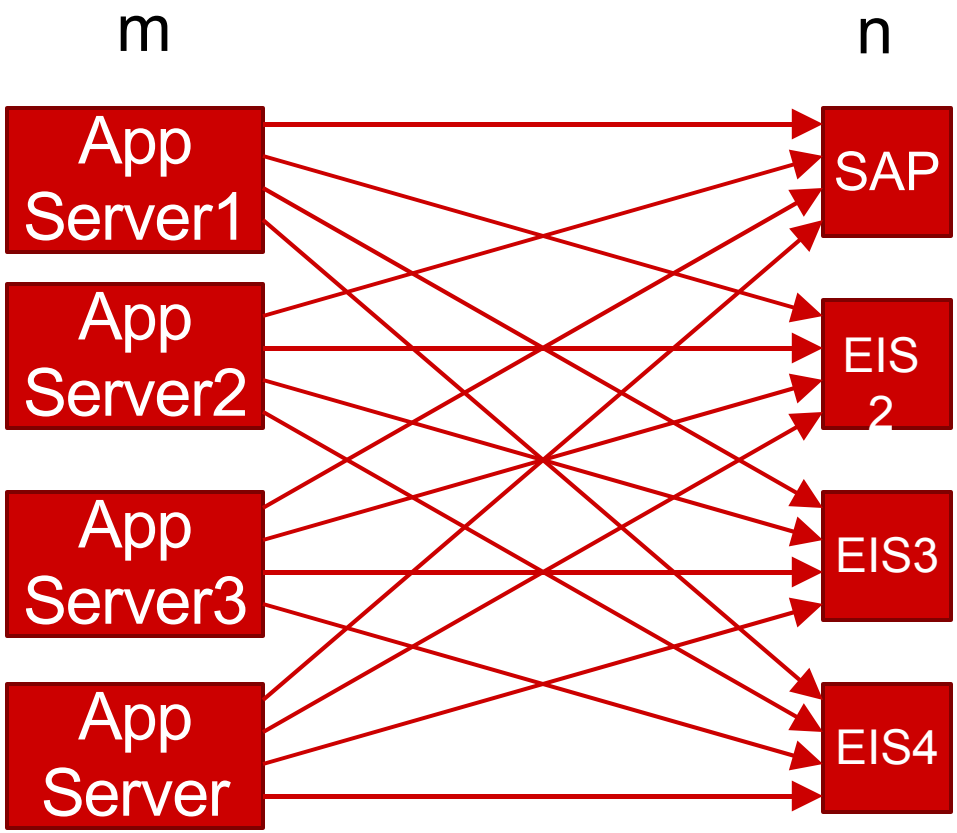


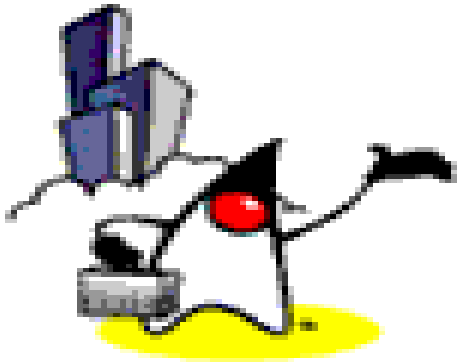
Connector Architecture

Connector Architecture

- Defines standard API for integrating J2EE technology with EIS systems
  - CICS, SAP, PeopleSoft, etc.
- Before Connector architecture, each App server has to provide an proprietary adaptor for each EIS system
  - m (# of App servers) x n (# of EIS's) Adaptors
- With Connector architecture, same adaptor works with all J2EE compliant containers
  - 1 (common to all App servers) x n (# of EIS's) Adaptors

m x n Problem Before Connector Architecture



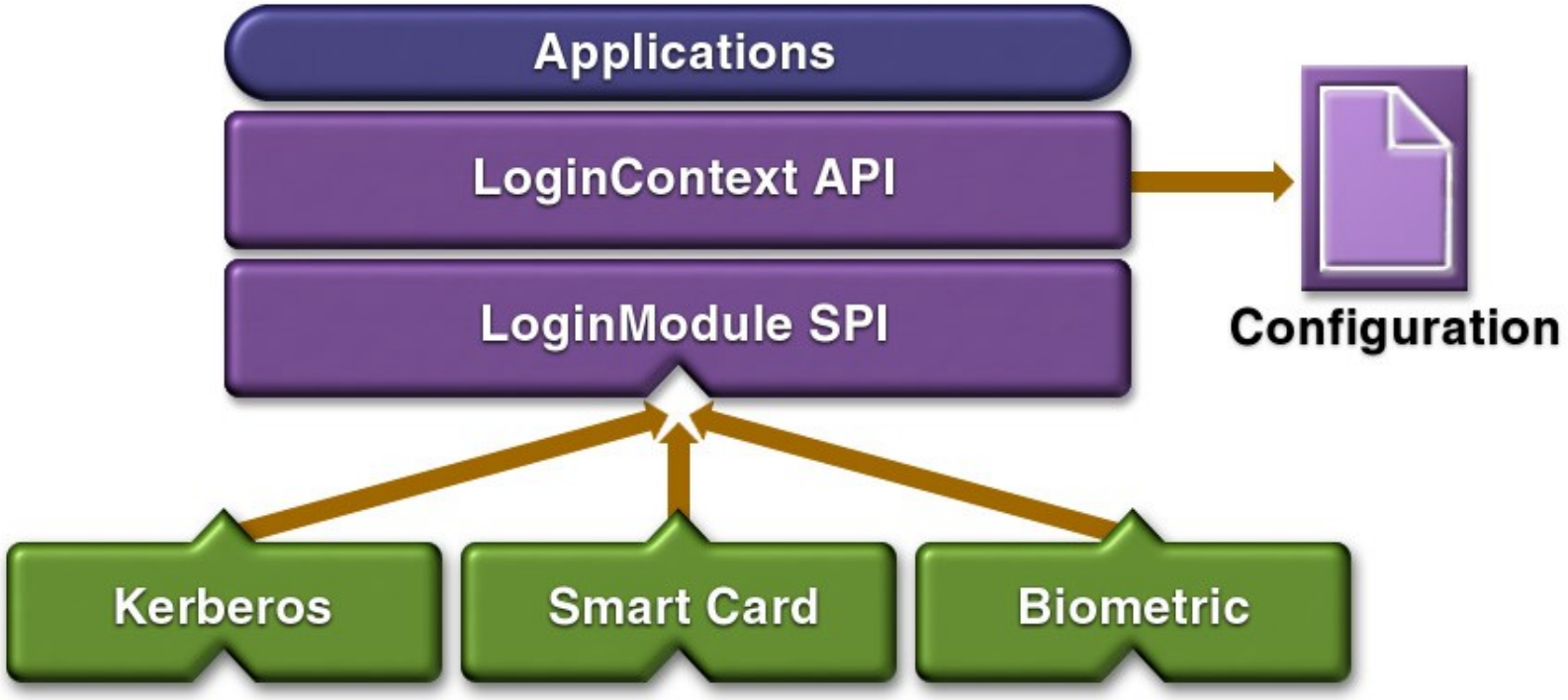


JAAS (Part of J2SE 1.4) (Java Authentication & Authorization Service)

JAAS: Authentication

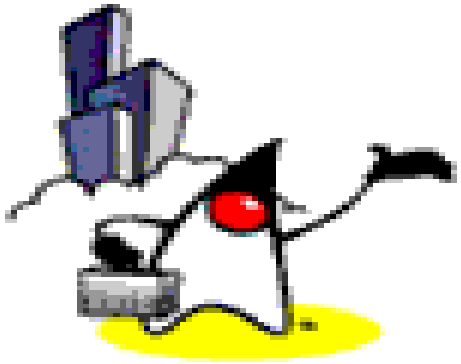
- Pluggable authentication framework
  - Userid/password
  - Smartcard
  - Kerberos
  - Biometric
- Application portability regardless of authentication schemes underneath
  - JAAS provides authentication scheme independent API
  - Authentication schemes are specified Login configuration file, which will be read by JAAS

JAAS Pluggable Authentication



JAAS: Authorization

- Without JAAS, Java platform security are based on
  - Where the code originated
  - Who signed the code
- The JAAS API augments this with
  - Who's running the code
- User-based authorization is now possible



Other J2EE APIs & Technologies

JNDI

- Java Naming and Directory Interface
- Utilized by J2EE applications to locate resources and objects in portable fashion
  - Applications use symbolic names to find object references to resources via JNDI
  - The symbolic names and object references have to be configured by system administrator when the application is deployed.

JDBC

- Provides standard Java programming API to relational database
  - Uses SQL
- Vendors provide JDBC compliant driver which can be invoked via standard Java programming API

J2EE Management (JSR-77)

- Management applications should be able to discover and interpret the managed data of any J2EE platform
- Single management platform can manage multiple J2EE servers from different vendors
- Management protocol specifications ensure a uniform view by SNMP and WBEM management stations
- Leverages JMX

J2EE Deployment (JSR-88) - J2EE 1.4

Tools

IDEs

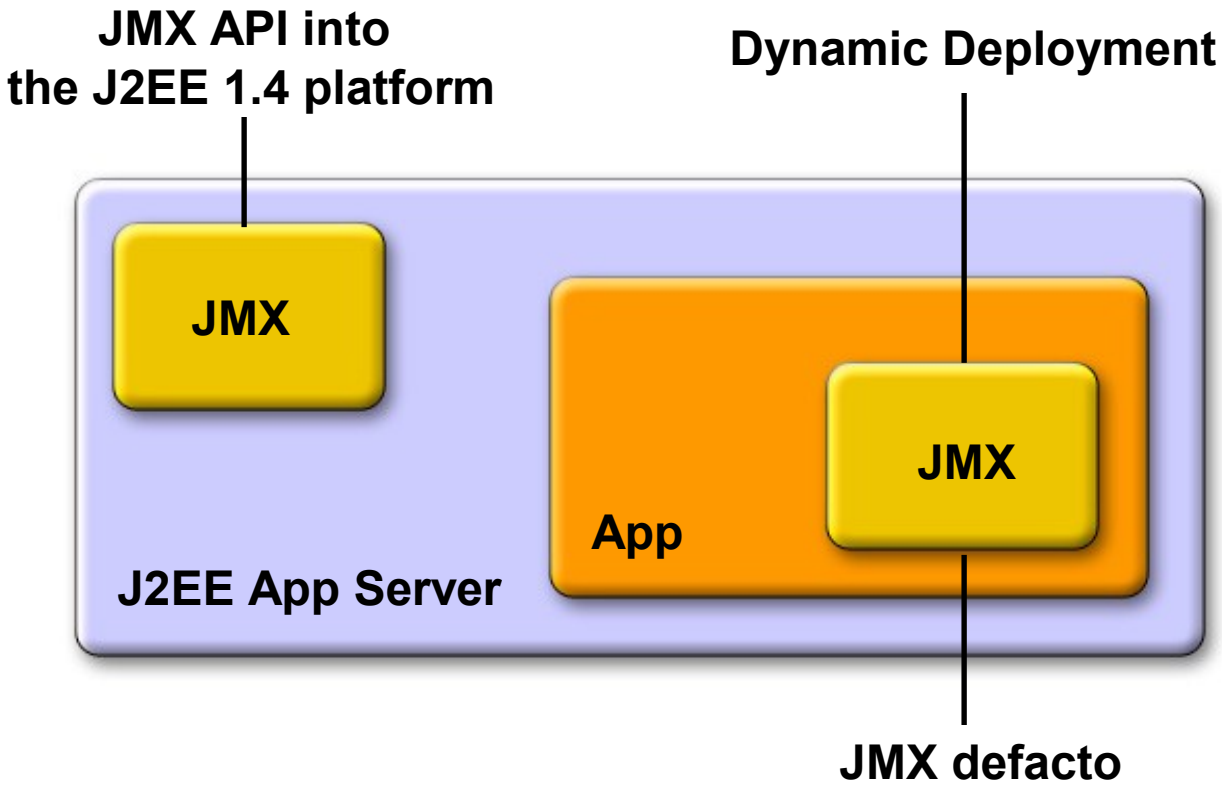
Vendor Deploy Tools

Management Tools

Standard Deployment API (Universal Remote)

J2EE Platforms

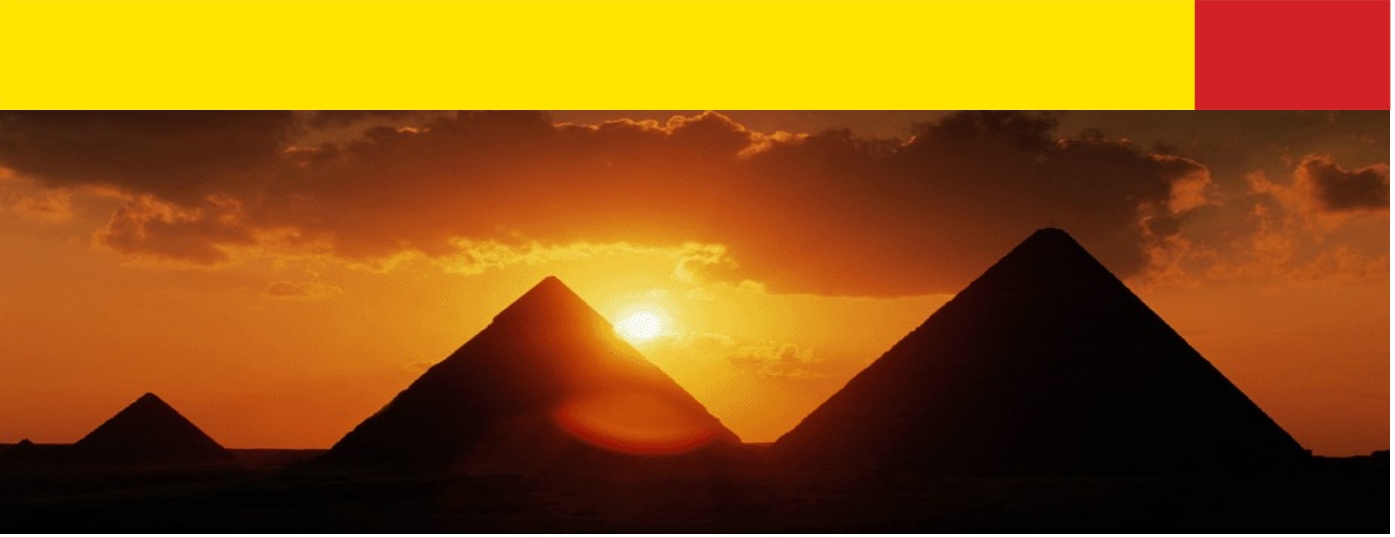
JMX



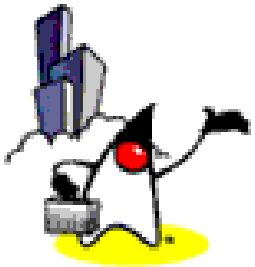
A single technology for the J2EE platform

JACC (Java Authorization Contract for Containers) - J2EE 1.4

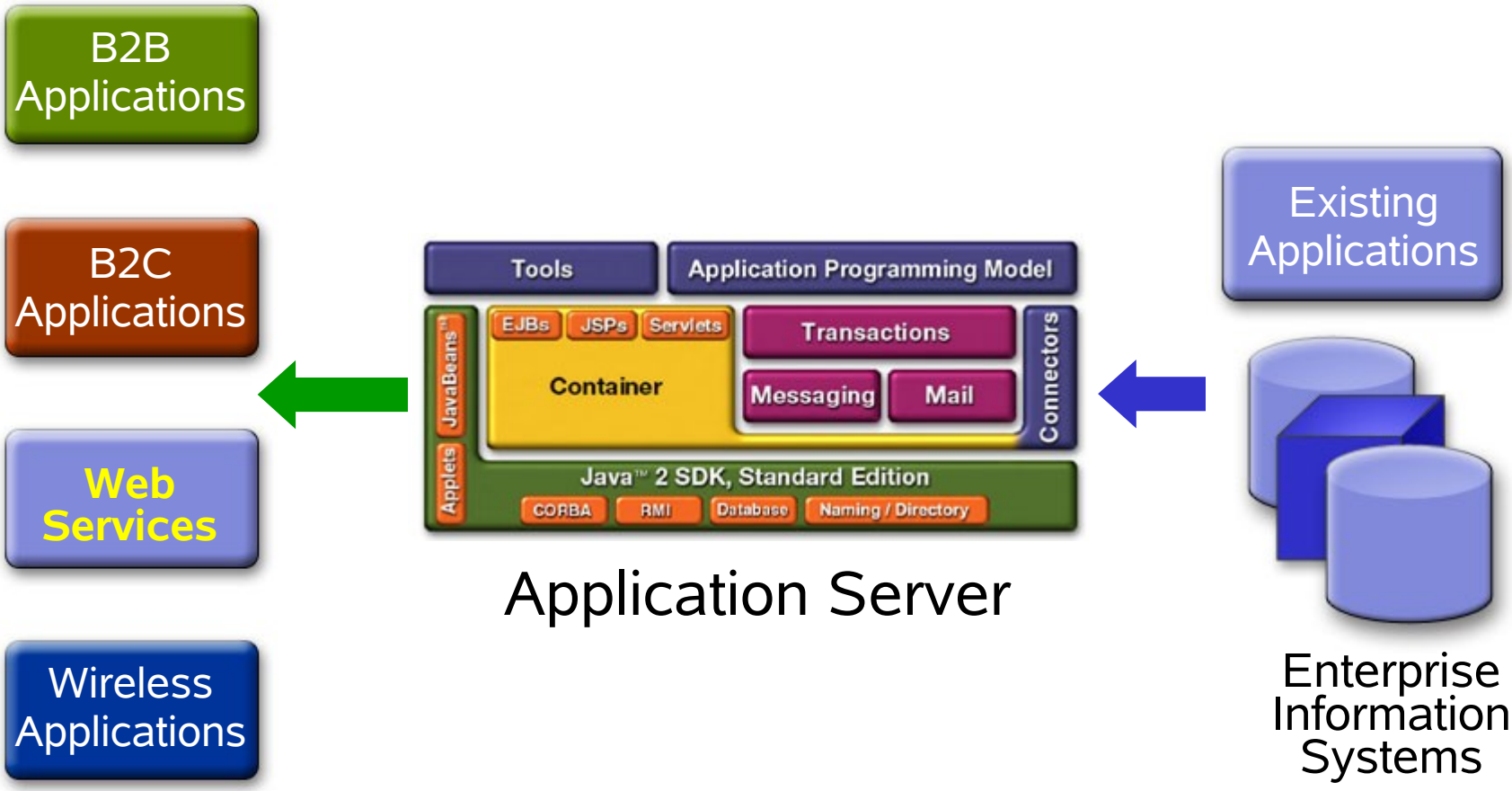
- Defines contract between J2EE containers and authorization policy modules
  - Provider configuration subcontract
  - Policy configuration subcontract
  - Policy enforcement subcontract
- Enable application servers to integrate with enterprise user registries and authorization policy infrastructure



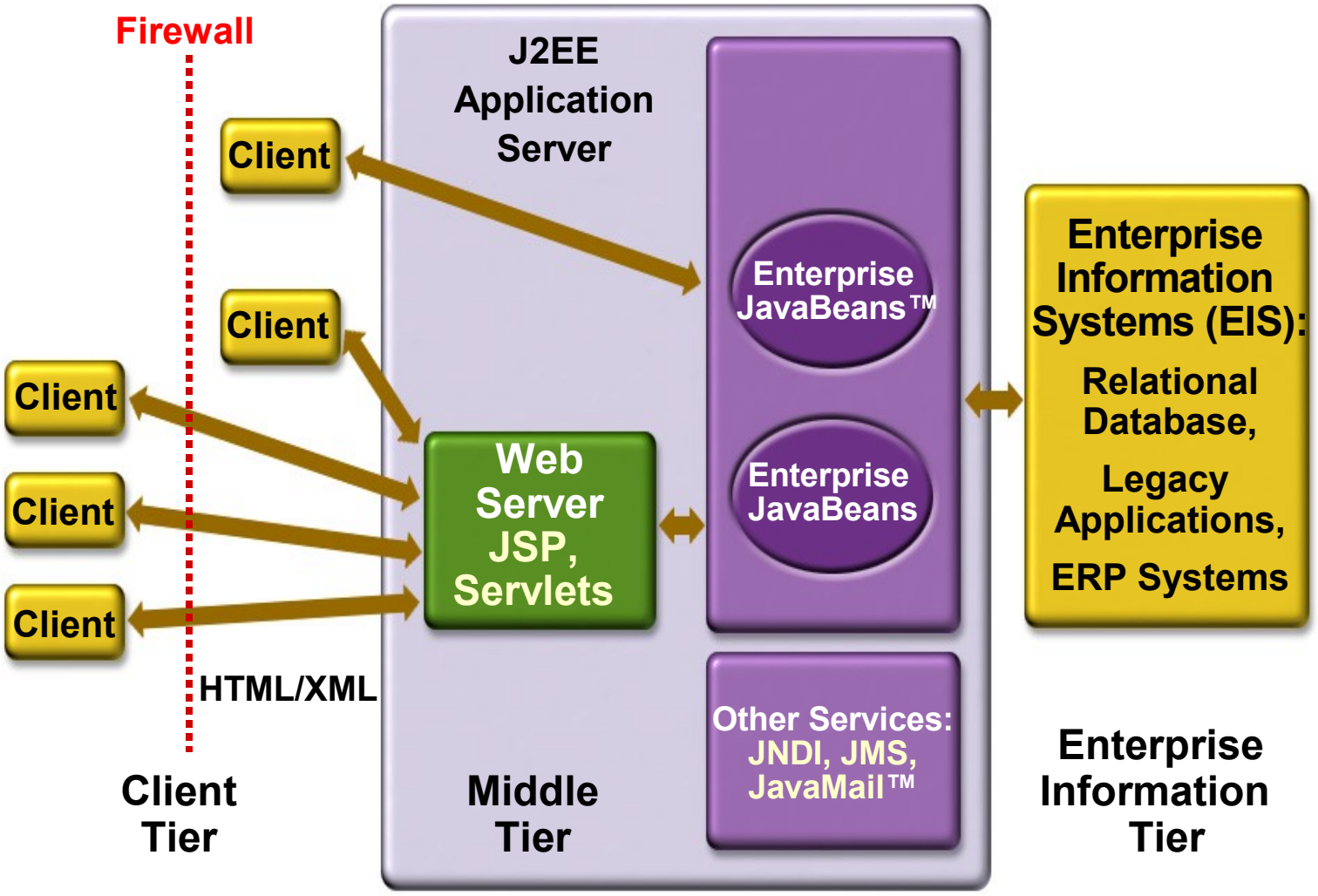
J2EE is an End-to-End Architecture



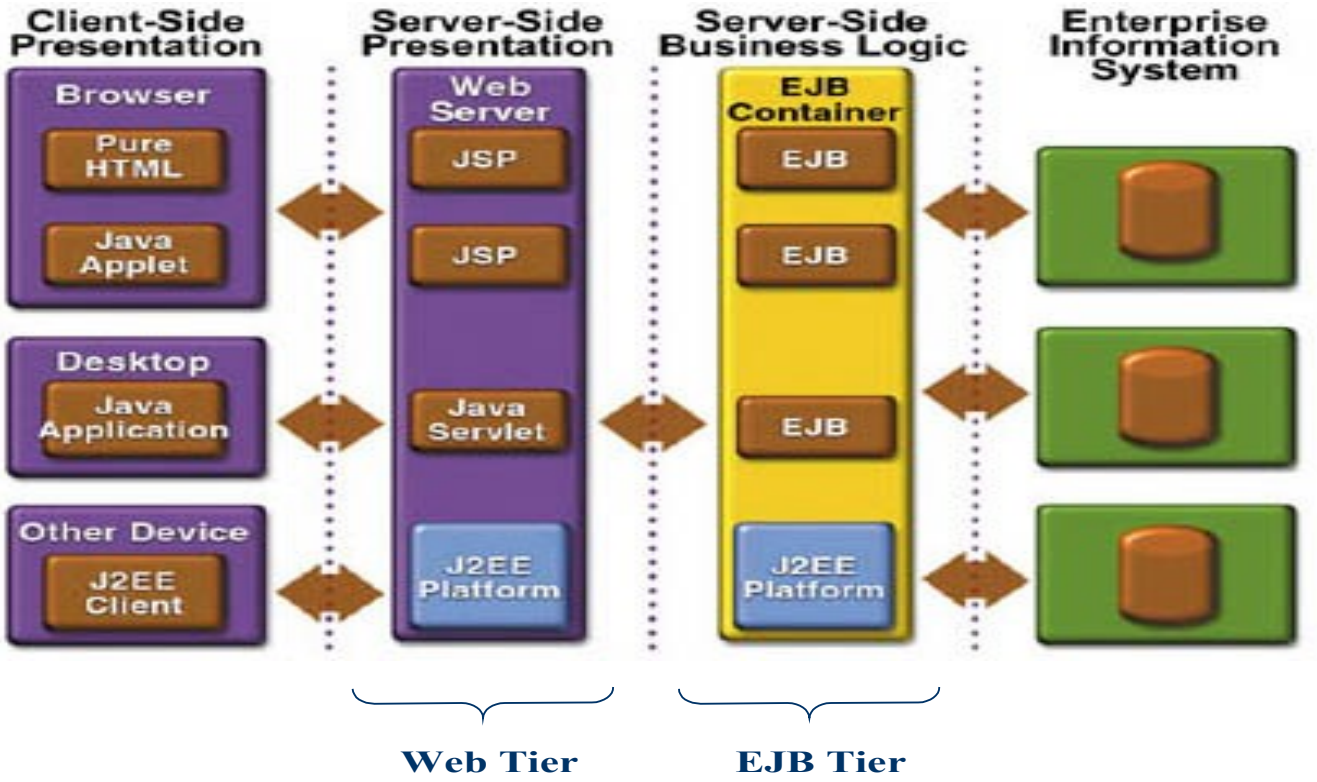
The J2EE Platform Architecture

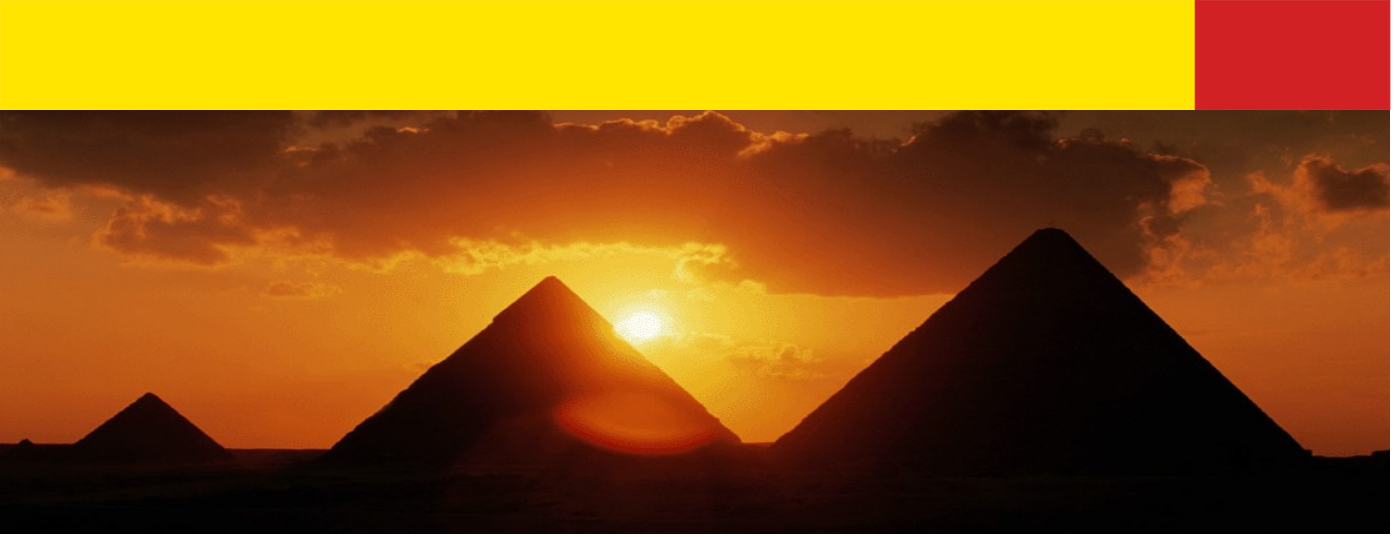


J2EE is End-to-End Solution

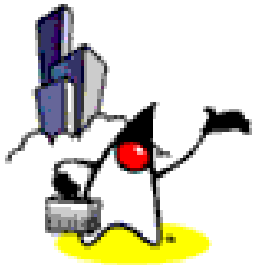


N-tier J2EE Architecture

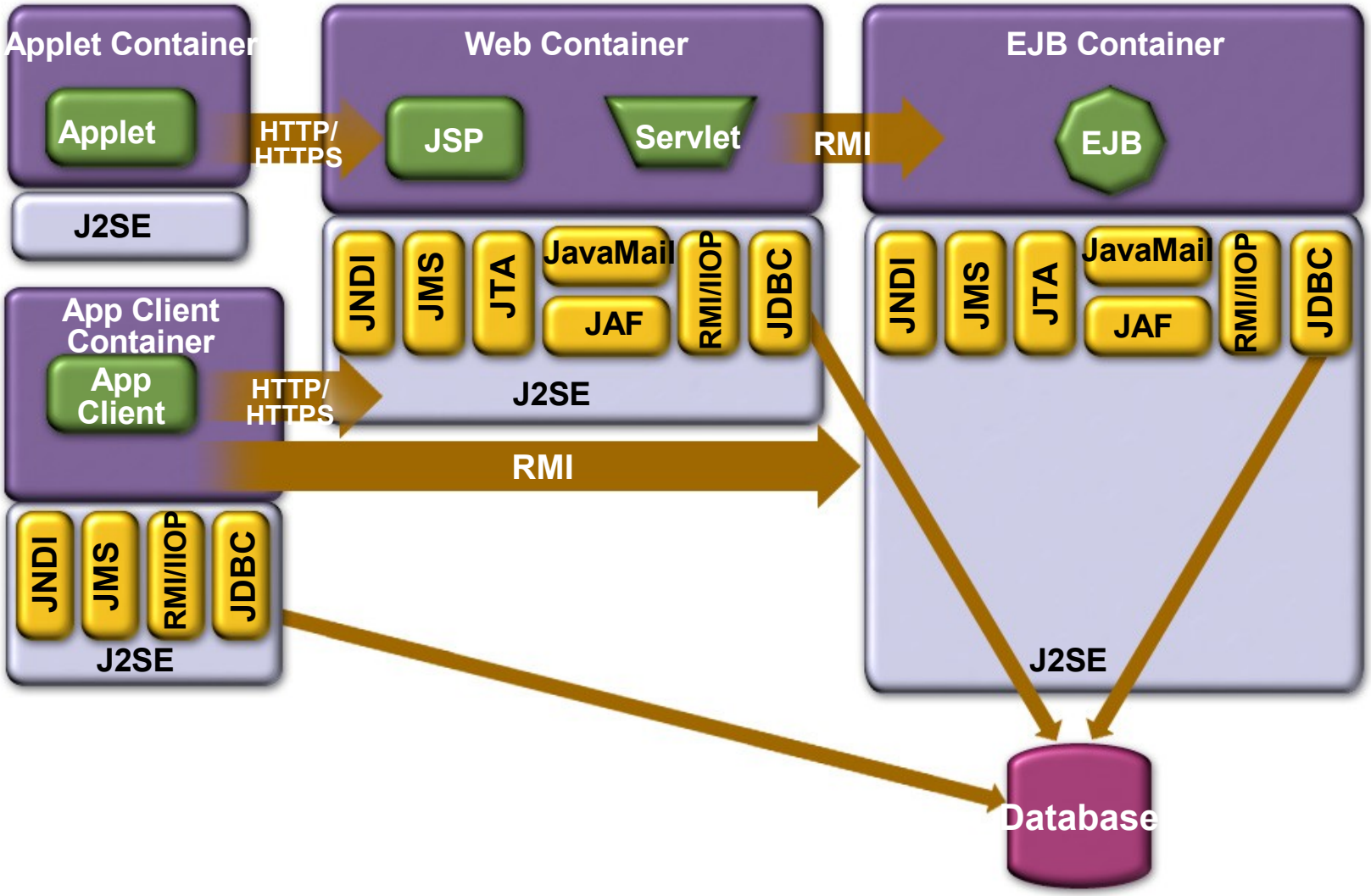




J2EE Component & Container Architecture



J2EE Containers & Components



Containers and Components

Containers Handle

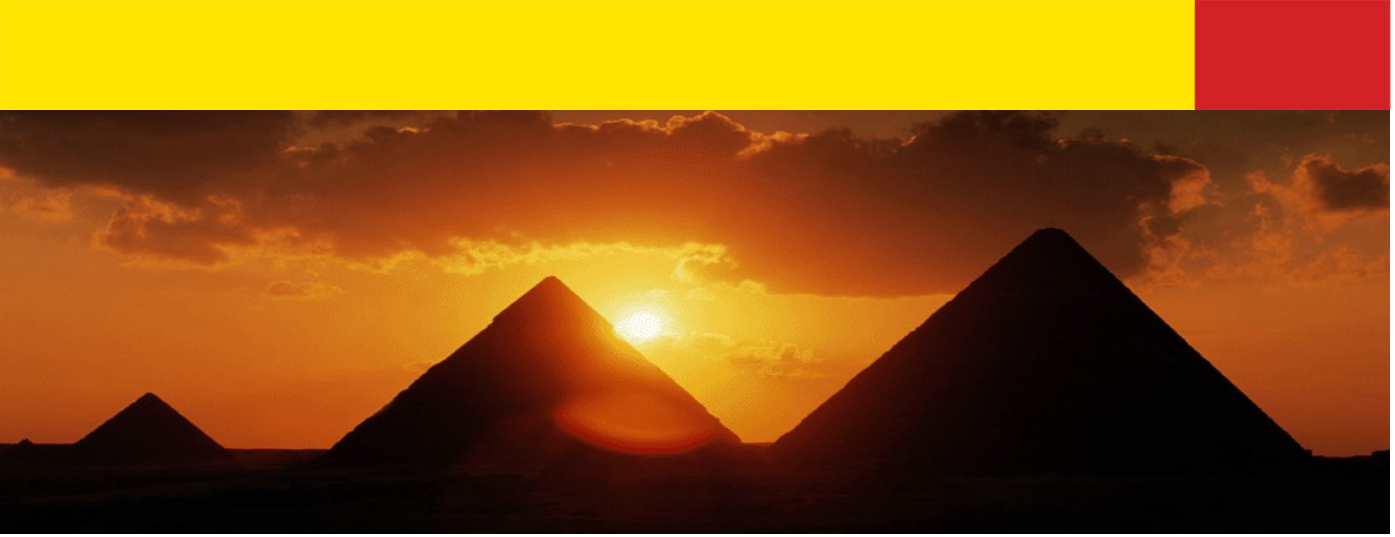
- Concurrency
- Security
- Availability
- Scalability
- Persistence
- Transaction
- Life-cycle management
- Management

Components Handle

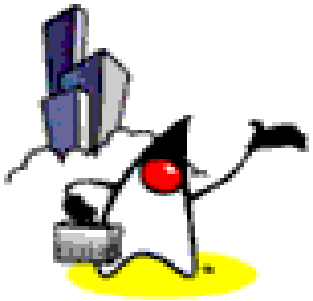
- Presentation
- Business Logic

Containers & Components

- Containers do their work invisibly
  - No complicated APIs
  - They control by interposition
- Containers implement J2EE
  - Look the same to components
  - Vendors making the containers have great freedom to innovate



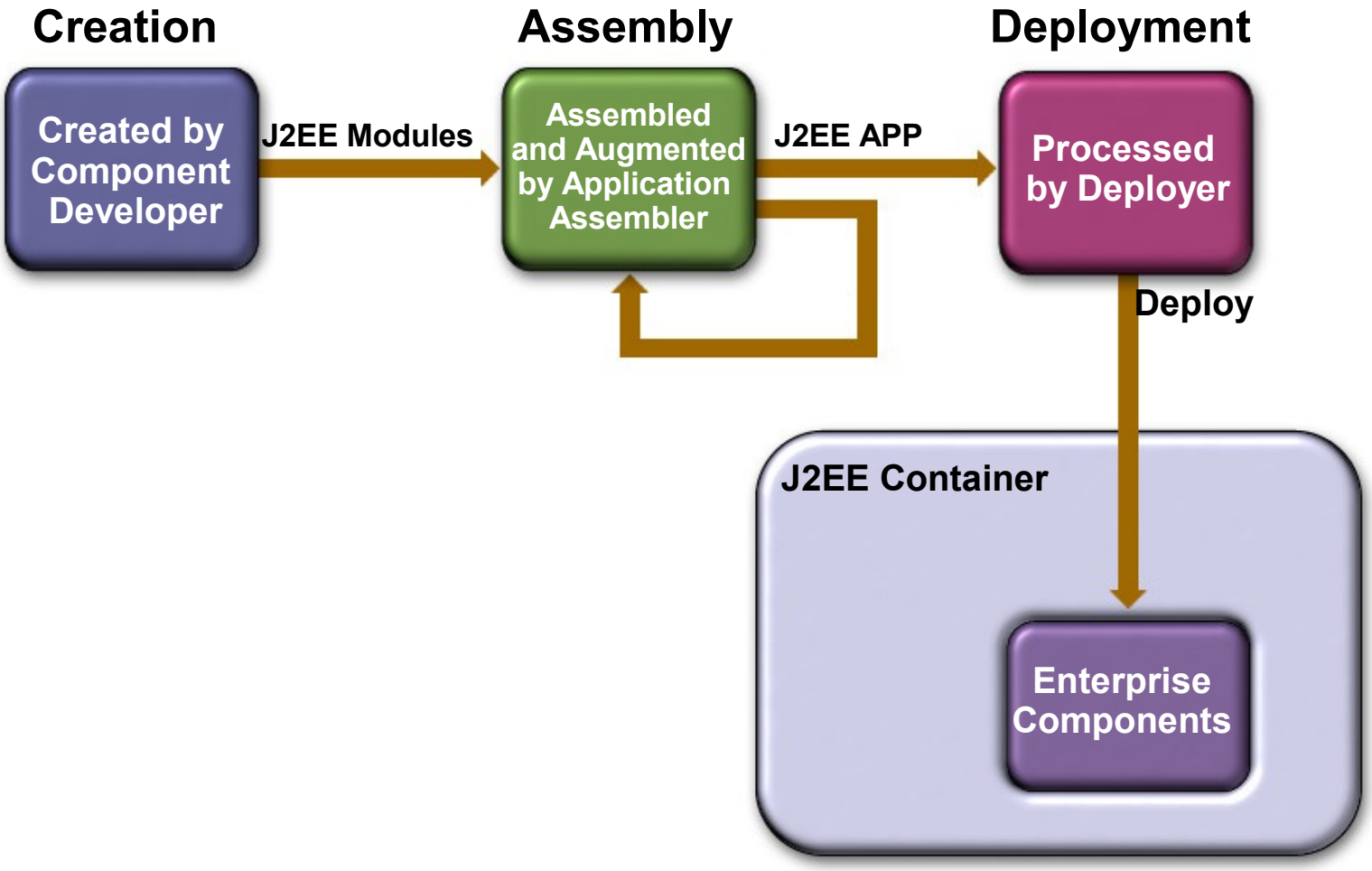
J2EE Application Development & Deployment Life Cycle



J2EE Application Development Lifecycle

- Write and compile component code
  - Servlet, JSP, EJB
- Write deployment descriptors for components
  - From Java EE 5, you can use annotations
- Assemble components into ready-to-deployable package
- Deploy the package on a server

Life-cycle Illustration

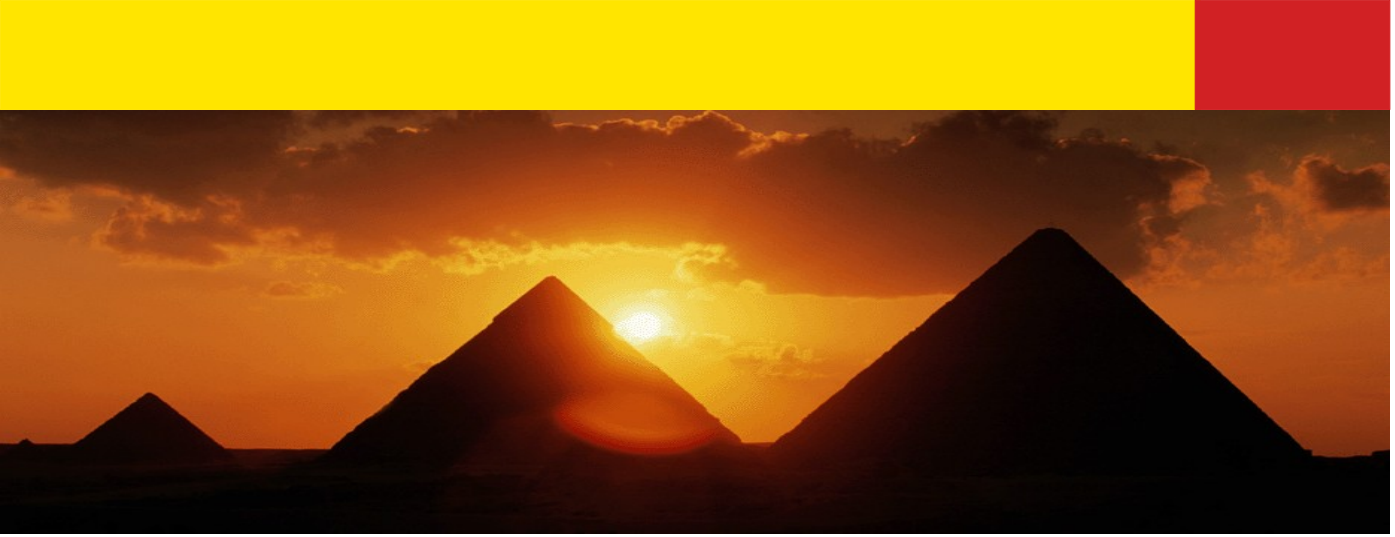


J2EE Development Roles

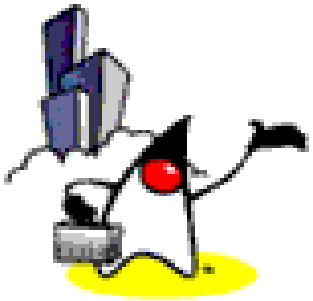
- Component provider
  - Bean provider
- Application assembler
- Deployer
- Platform provider
  - Container provider
- Tools provider
- System administrator

The Deployment Descriptor

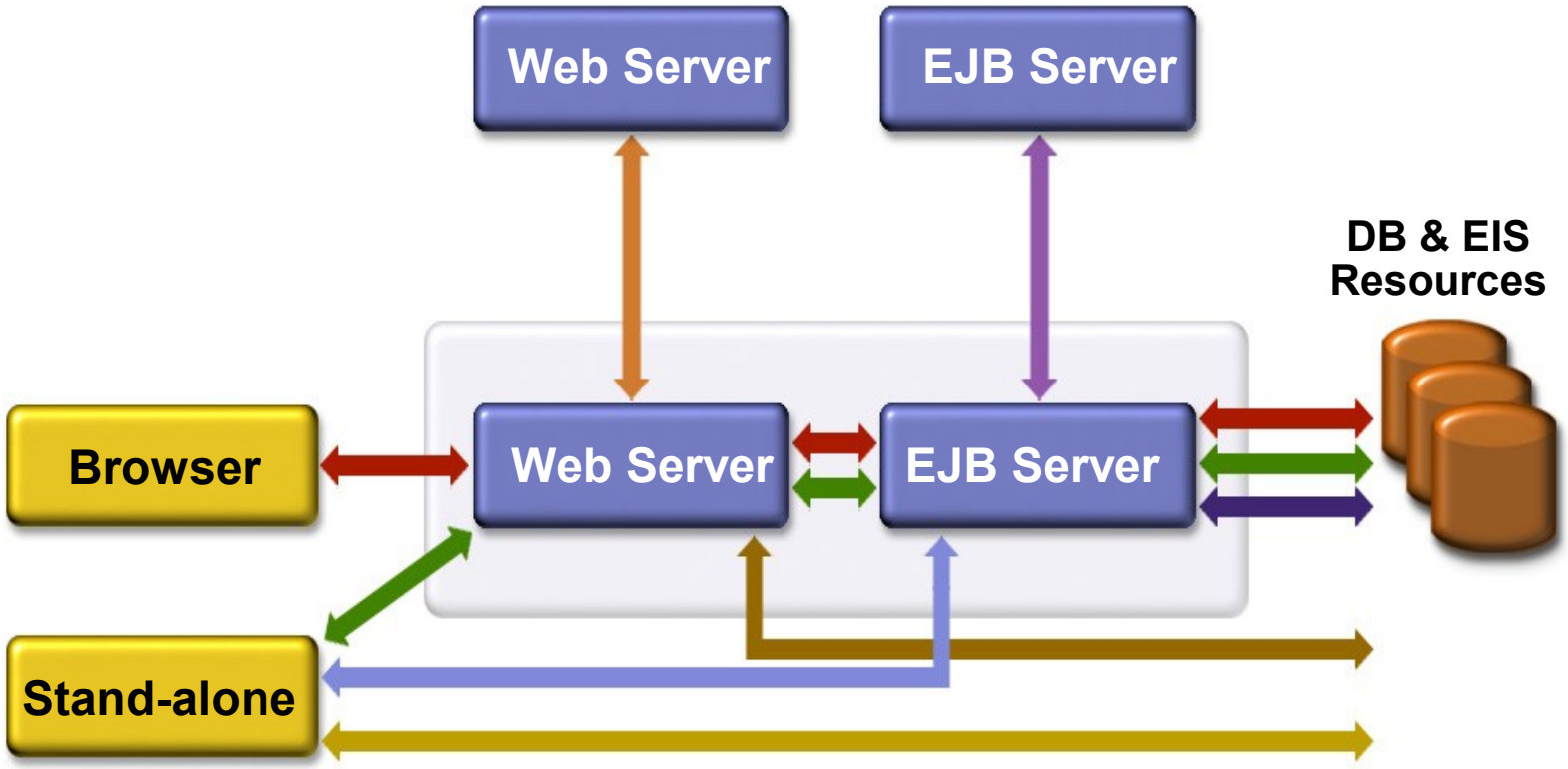
- Gives the container instructions on how to manage and control behaviors of the J2EE components
  - Transaction
  - Security
  - Persistence
- Allows declarative customization (as opposed to programming customization)
  - XML file
- Enables portability of code



J2EE Application Anatomies



Possible J2EE Application Anatomies

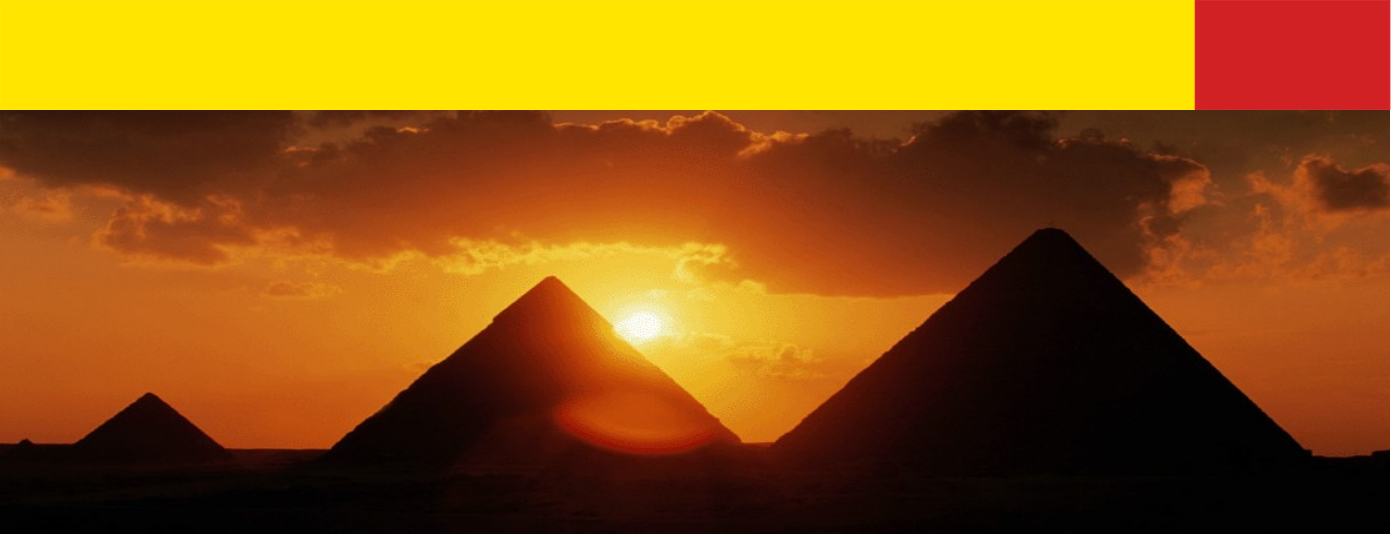


J2EE Application Anatomies

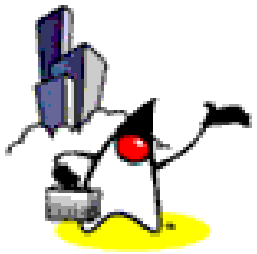
- 4-tier J2EE applications
  - HTML client, JSP/Servlets, EJB, JDBC/Connector
- 3-tier J2EE applications
  - HTML client, JSP/Servlets, JDBC
- 3-tier J2EE applications
  - EJB standalone applications, EJB, JDBC/Connector
- B2B Enterprise applications
  - J2EE platform to J2EE platform through the exchange of JMS or XML-based messages

Which One to Use?

- Depends on several factors
  - Requirements of applications
  - Availability of EJB tier
  - Availability of developer resource



J2EE 1.4 Standard Implementation, Compatibility Suite, Brand



Standard Implementation

- Under J2EE 1.4 SDK, it is Sun Java Application Server Platform Edition 8
- Production-quality J2EE 1.4 compliant app server
- Free to develop and free to deploy
- Seamless upgrade path to Sun Java Application Server Enterprise Edition

Compatibility Test Suite (CTS)

- Ultimate Java™ technology mission:
  - Write Once, Run Anywhere™
  - My Java-based application runs on any compatible Java virtual machines
  - My J2EE based technology-based application will run on any J2EE based Compatible platforms

J2EE Application Verification Kit (J2EE AVK)

- How can I test my J2EE application portability?
  - Obtain the J2EE RI 1.3.1 and the J2EE Application Verification Kit (J2EE AVK)
- Self verification of application
  - Static verification
  - Dynamic verification
- Obtain the tests results, verify that all criteria are met

Compatible Products for the J2EE Platform (Brand)

ATG
Bea Systems
Borland
Computer Associates
Fujitsu
Hitachi
HP
IBM
IONA
iPlanet
Macromedia
NEC
Oracle
Pramati
SilverStream
Sybase
Talarian
Trifork

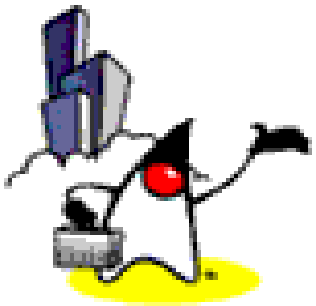
The J2EE Platform "Ecosystem," Application Servers and…

- Tools
  - IDE's: Borland JBuilder Enterprise, WebGain Visual Cafe', IBM Visual Age for Java™, Forte™ for Java™, Oracle JDeveloper, Macromedia Kawa
  - Modeling, Performance, Testing, etc.
- Enterprise Integration: Connectors, Java Message Service (JMS) API, XML
- Components
- Frameworks
- Applications

Major Investment in Compatibility by the Industry

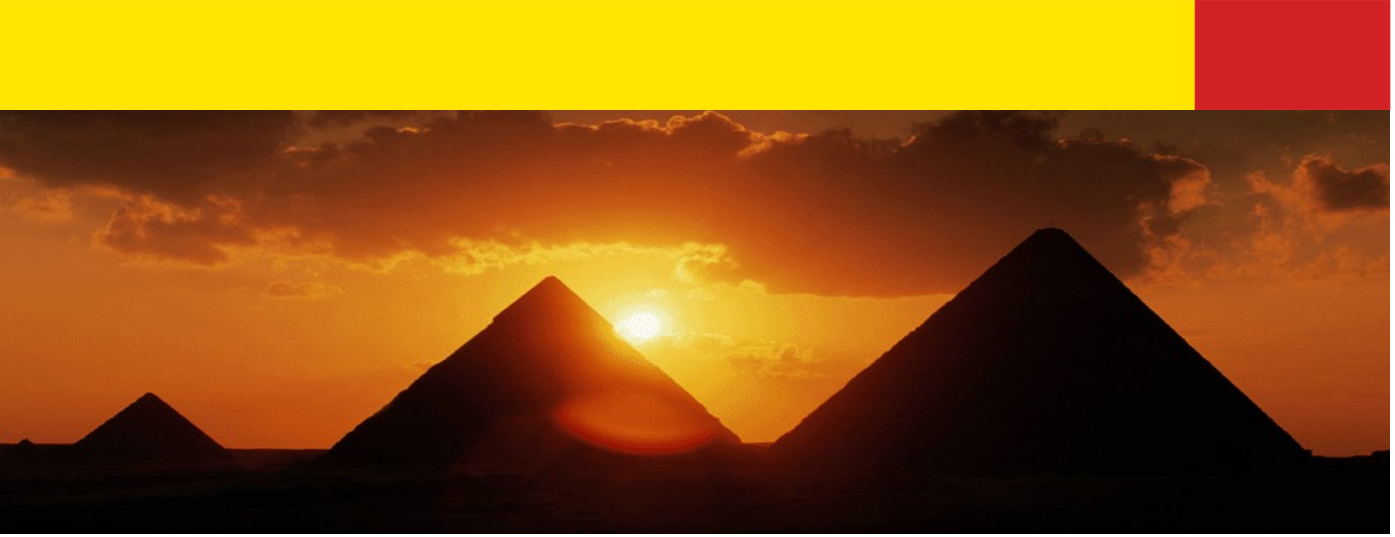
- Sun has spent scores of engineer years developing tests
- Licensees have spent scores of engineer years passing the tests
- Testing investment on top of specification investment, implementation investment, business investments
- In total, tens of millions of dollars invested in J2EE platform compatibility by the industry

J2EE Blueprint & Pet Store Application

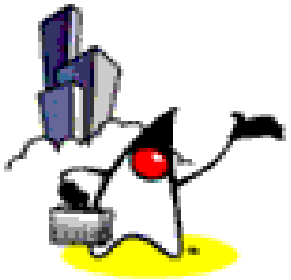


J2EE Blueprint

- Best practice guidelines, design patterns and design principles
  - MVC pattern
- Covers all tiers
  - Client tier
  - Web tier
  - Business logic (EJB) tier
  - Database access tier
- Sample codes come with J2EE 1.4 SDK
  - Java Pet Store, Adventure builder



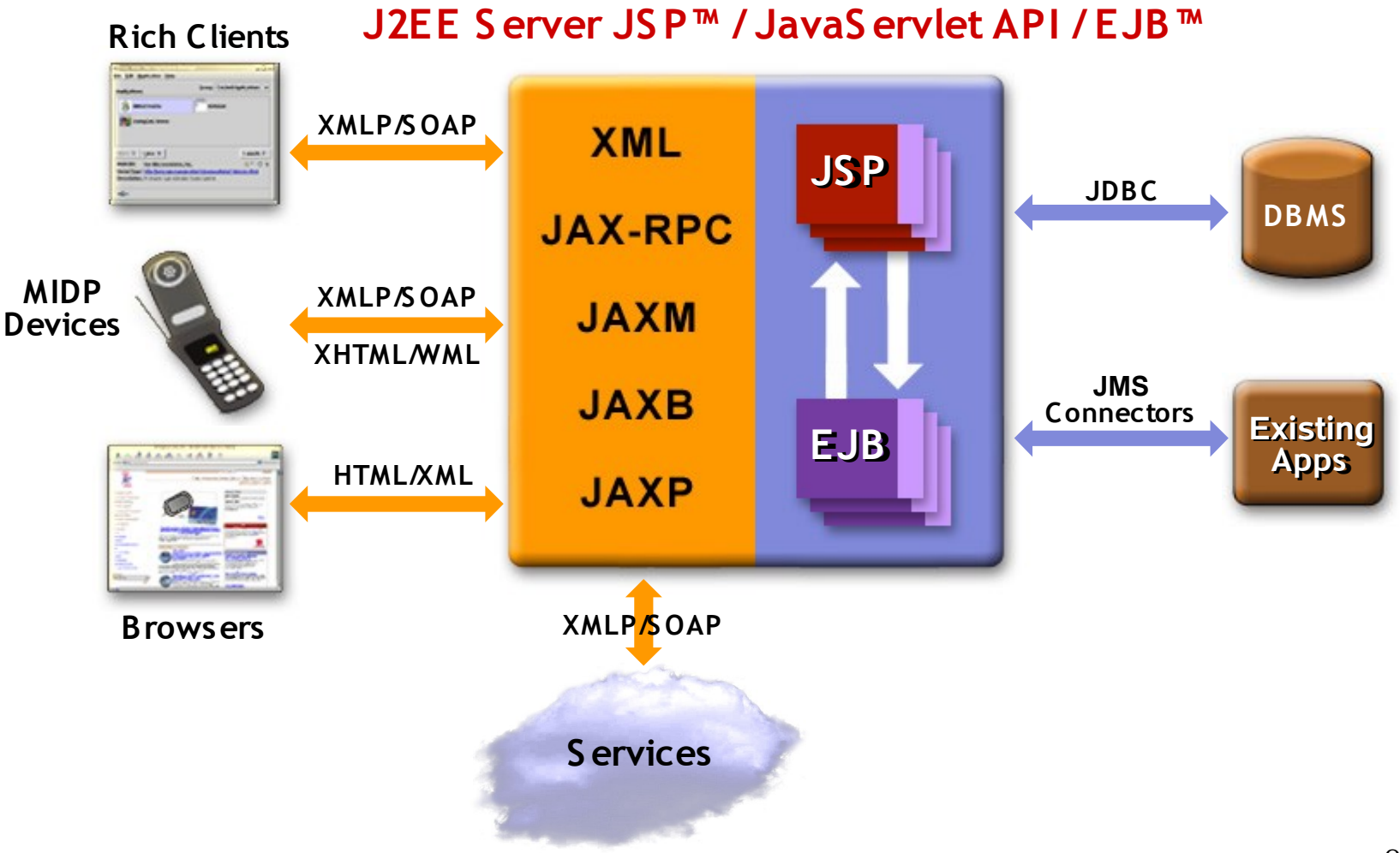
Why J2EE for Web Services?



Why J2EE for Web Services?

- Web services is just one of many service delivery channels of J2EE
  - No architectural change is required
  - Existing J2EE components can be easily exposed as Web services
- Many benefits of J2EE are preserved for Web services
  - Portability, Scalability, Reliability
  - No single-vendor lock-in

Web Services Model Over J2EE



Where Are We Now?

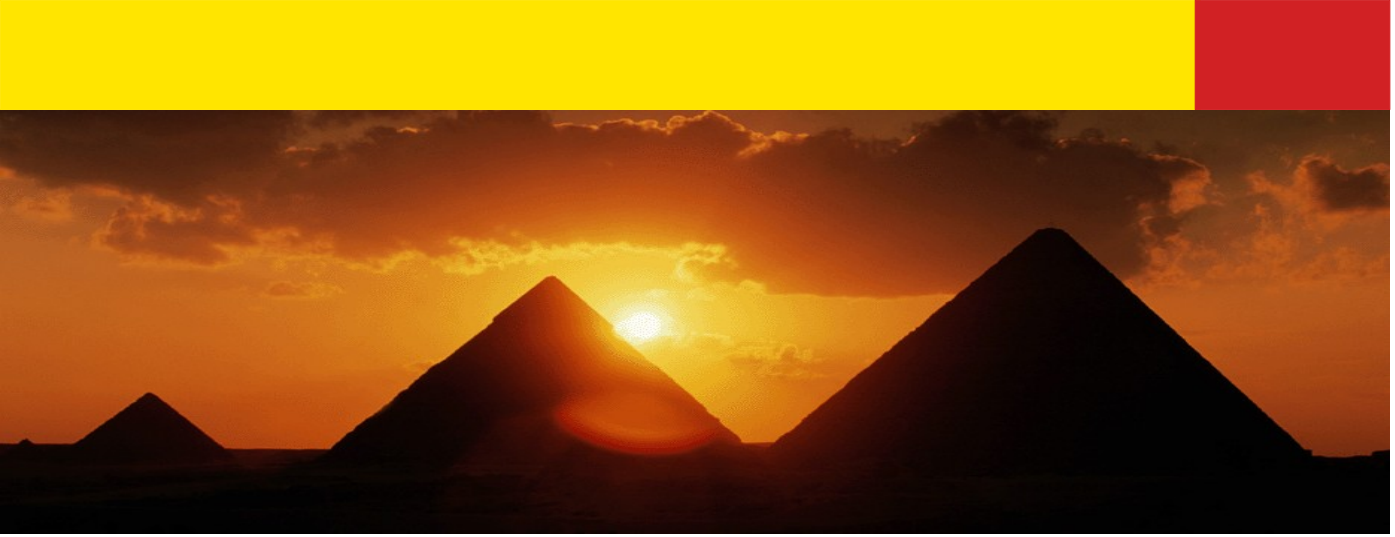
- Java APIs for Web Services are being developed very rapidly
  - Web services support on WUST (WSDL, UDDI, SOAP) ready now
  - Next layer Web services work in progress
- Tools are available now for exposing existing J2EE components as Web services
- J2EE community has defined overall framework for Web Services (J2EE 1.4, Web services for J2EE)

Design Goals J2EE 1.4 Web Services Framework

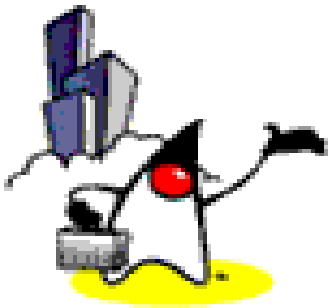
- Portability of Web services component
  - Over different vendor platform
  - Over different operational environment
- Leveraging existing J2EE programming models for service implementation
- Easy to program and deploy
  - High-level Java APIs
  - Use existing deployment model

J2EE 1.4 Web Services Framework

- J2EE 1.4 (JSR 151)
- Web services for J2EE (JSR 109)
- JAX-RPC (JSR 101)
- JAXR (Java API for XML Registries)
- SAAJ (SOAP with Attachments API for Java)
- EJB 2.1



How to Get Started



Step1: For Beginners and Intermediate J2EE Programmers

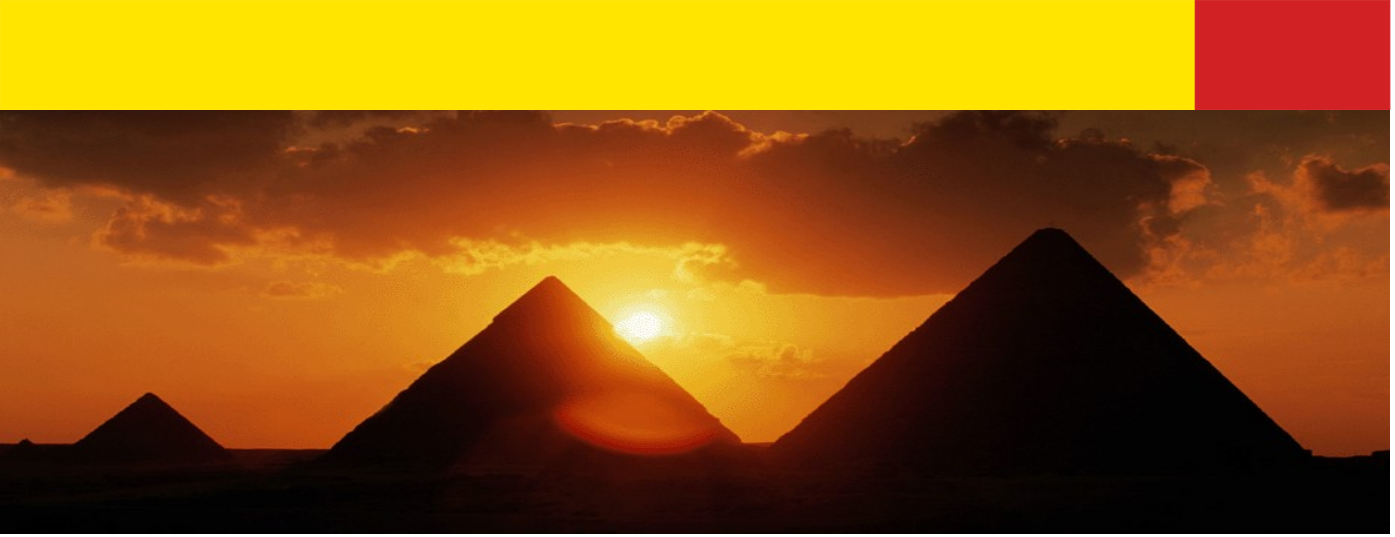
- Follow along with this course
- Start using J2EE IDE of your choice
- Try open source IDE's
  - NetBeans IDE 5.0 (netbeans.org)
    - Excellent out of the box J2EE support
    - We will use NetBeans IDE 5.0 or NetBeans IDE 5.5 as our default IDE in this course
    - Lots of tutorials
  - Eclipse

Step2: Next Step (For Advanced J2EE Programmers)

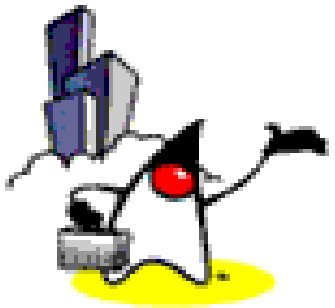
- Learn practical open-source solutions
  - Spring framework (for light-weight framework)
  - Hibernate (for O/R mapping)
  - JDO (for transparent persistence)
  - Struts, WebWork, Tapestry (for Web-tier frameworks)
  - JUnit (for unit testing)
  - Log4j (for logging)
  - Many more

Step3: Next Step (For Advanced J2EE Programmers)

- There is no shortage of quality J2EE online resources
  - java.sun.com/j2ee
  - www.theserverside.com
  - www.javapassion.com/j2ee/J2EEresources.html#J2EEResourceSites



Summary & Resources



Summary

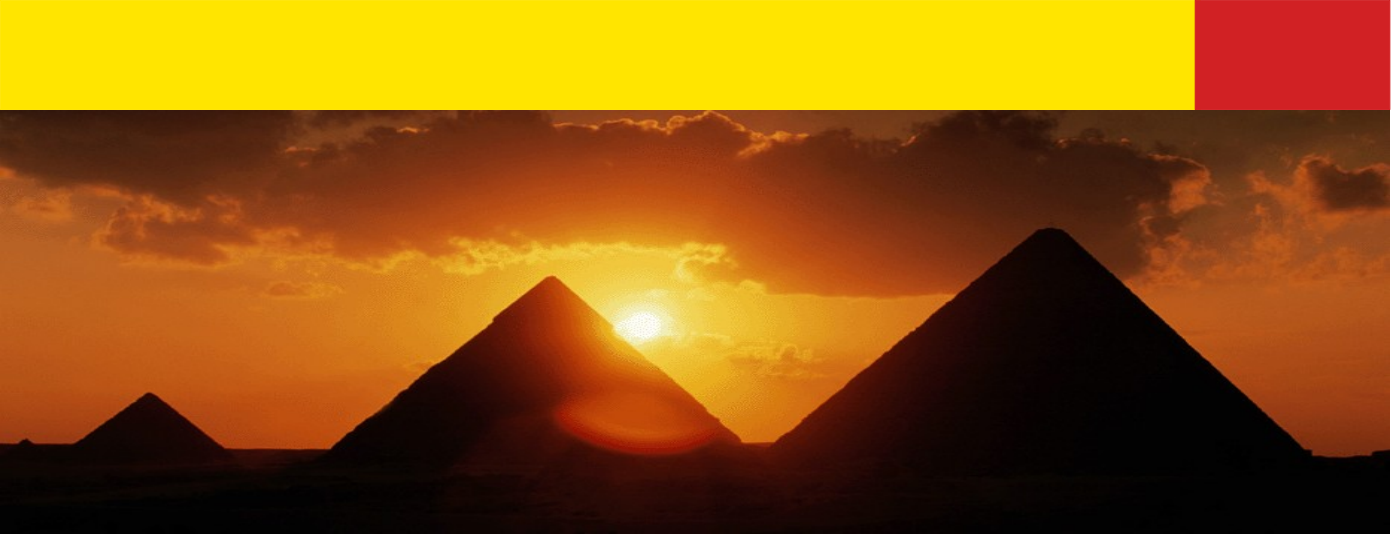
- J2EE is the platform of choice for development and deployment of n-tier, web-based, transactional, component-based enterprise applications
- J2EE is standard-based architecture
- J2EE is all about community
- J2EE evolves according to the needs of the industry

Resources

- J2EE Home page
  - java.sun.com/j2ee
- J2EE 1.4 SDK
  - java.sun.com/j2ee/1.4/download.html#appserv
- J2EE 1.4 Tutorial
  - java.sun.com/j2ee/1.4/download.html#appserv
- J2EE Blueprints
  - java.sun.com/blueprints/enterprise/index.html

NetBeans Resources

- NetBeans IDE Homesite
  - http://www.netbeans.org
- NetBeans IDE Tutorials/Articles Master index
  - http://www.javapassion.com/netbeans/masterindex.html



Passion!