

Java™ 2 Platform, Enterprise Edition (J2EE™)

Overview for Web Application Development

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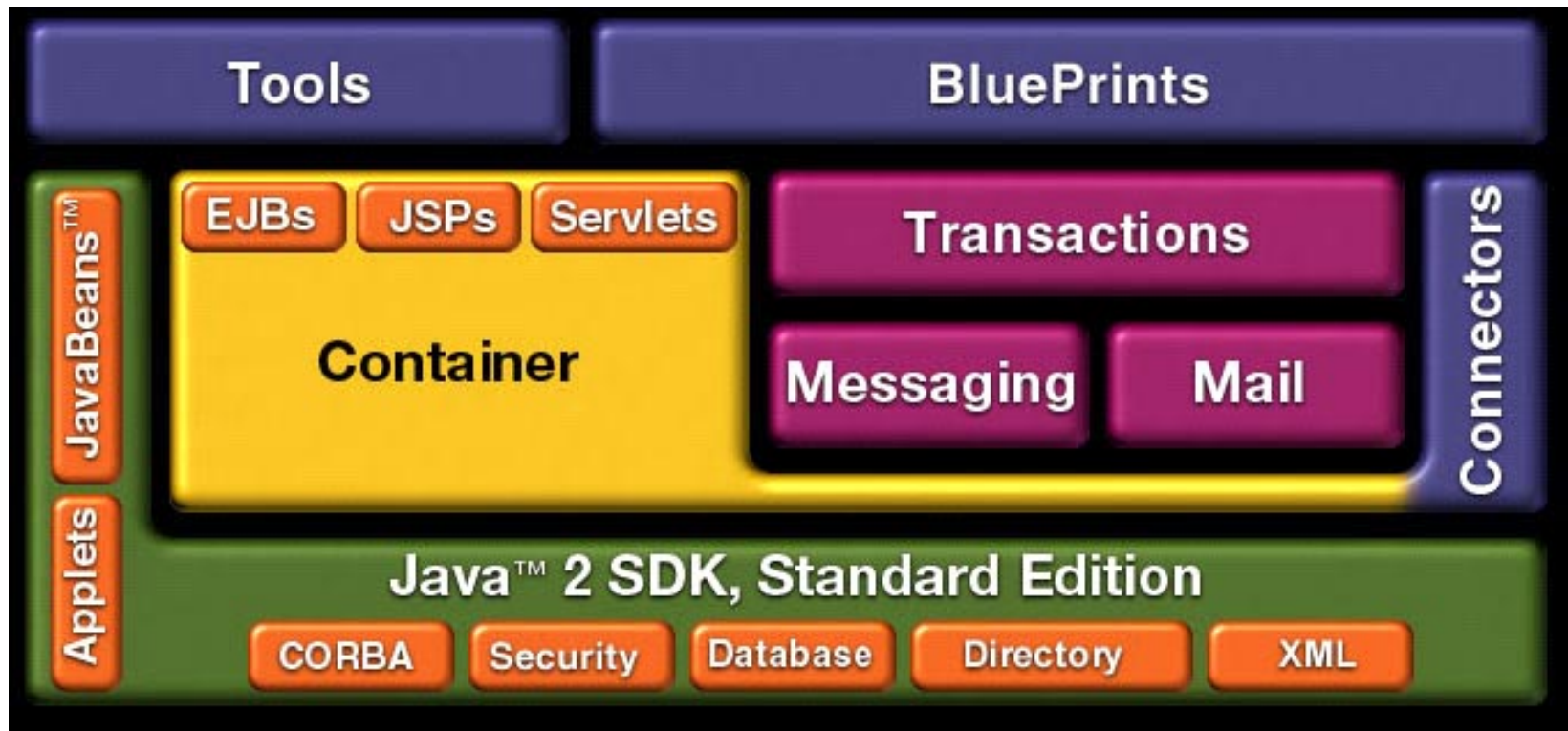
Agenda

- Introduction, Java Platforms
- J2EE Community and Future Directions
- Web Application Development in the J2EE World

Java: J2SE – J2ME – J2EE

- J2SE: WORA, new generation language
 - Additional APIs (AWT, SWING)
 - Core Language APIs
 - JVM
- J2ME: small JVM profiles
 - MIDP
 - CLDC
- J2EE: System Services, Middleware
 - Components
 - Containers
 - Services

J2EE Architecture



Good Overview of J2EE Architecture:

Designing Enterprise Applications with the J2EE Platform, 2nd Edition,
Inderjeet Singh, Beth Stearns, Mark Johnson, Enterprise Team, 2002

Strength of Java™ Community

- 2.5 Million of registrations at Sun's Java™ Developer Connection
- 652 Java Community ProcessSM members
 - 554 companies
 - 98 individuals
- 227 JSRs
 - 60% are led by Java™ partner companies
 - 40% are led by Sun

J2EE Success: Credit Suisse

- Implemented SECOR Monitor, a monitoring tool for the bank's order routing system
 - Checks accuracy of trades
 - Expected to make 10% cost saving and improve efficiency
- Web Services based solution from Ergon Informatik
- Developed on J2EE™ Platform on the Server and J2SE™ Platform on the Client
- Credit Suisse Group employes 80,000 staff with \$1.3 Trillion CHF under management

J2EE at Sun Microsystems

- <http://java.sun.com/j2ee>

The screenshot shows the Java 2 Platform, Enterprise Edition (J2EE) website. The address bar displays <http://java.sun.com/j2ee/>. The page header includes the Java logo and the text "java.sun.com". An "Advanced Search" box is located in the top right corner. The main content area is titled "Java 2 Platform, Enterprise Edition (J2EE)" and features three tabs: "J2EE Technologies", "J2EE Downloads", and "J2EE Documentation". The "Introduction" section describes the J2EE platform and its component-based model. The "Hot Topics" section highlights the availability of J2EE 1.4 Platform Beta 2. The right sidebar contains "Hot Downloads" and "Demand Compatibility" sections.

Technologies
Downloads
Documentation
Industry News
Developer Services
Java BluePrints

J2EE Main
- APIs
- Compatibility
- Licensees
- Java Verification
- New to Java
- Tools
- 日本語版
- Русский

Printable Page

Java 2 Platform, Enterprise Edition (J2EE)

J2EE Technologies | **J2EE Downloads** | J2EE Documentation

Introduction
J2EE technology and its component based model simplifies enterprise development and deployment. The J2EE platform manages the infrastructure and supports the Web services to enable development of secure, robust and interoperable business applications. The J2EE platform is the foundation technology of the Sun ONE platform and Sun's Web services strategy.
[Overview](#) | [List of Technologies](#) | [Sun ONE Developer](#)

Hot Topics
[J2EE 1.4 Platform Beta 2 Now Available](#) NEW
The Java 2 Platform, Enterprise Edition (J2EE) defines the standard for developing multi-tier enterprise applications. The J2EE 1.4 platform introduces new APIs which implement core Web services protocols stack. It also introduces new Management and Deployment APIs, new versions of the JavaServer Pages, Enterprise JavaBeans, and Connector APIs, along with other features which establish J2EE 1.4 technology as a premier Web services and enterprise application intergration platform.
[Java Application Verification Kit \(AVK\) for the Enterprise 1.4 Early Access](#) NEW

Hot Downloads
[Java VM](#)
[Sun ONE Studio, Enterprise Edition](#)
[Sun ONE Application Server](#)
[J2SE 1.4.2 SDK](#)
[Java Web Services Developer Pack](#)

Demand Compatibility

Java
COMPATIBLE
ENTERPRISE EDITION
Preserve Your Freedom to Choose

J2EE at BEA

- <http://dev2dev.bea.com>

J2EE at Oracle

- <http://otn.oracle.com/tech/java>

The screenshot shows a web browser window with the address bar containing <http://otn.oracle.com/tech/java/content.html>. The page features a navigation menu with links for Home, Technology Centers, Resources, and Services. A breadcrumb trail indicates the current location: Oracle Technology Network > Technology Centers > Java Center >. On the left, there is a sidebar with a 'Need Assistance? Ask the Oracle Concierge' button and a list of OTN categories including Products, Technologies, Documentation, Software Downloads, Sample Code, Security Alerts, Discussion Forums, Events, User Groups, Skills Marketplace, Hosted Development, Oracle University, Consulting, and Support. The main content area is titled 'Java Technology Center' and is updated as of August 5, 2003. It features three featured articles: 1. 'New Tutorial: Managing Component Relationships' with a Java logo icon, describing a tutorial on managing relationships between components in the Virtual Shopping Mall application. 2. 'From Java Pro Magazine: Deploy a Web Application with OC4J' with a diagram icon, overviewing the use of Oracle9iAS Containers for J2EE (OC4J). 3. 'Build Your Ideal J2EE Environment' with a Java logo icon, discussing the combination of Oracle9iJDeveloper and the... On the right side, there is a 'Oracle Developer Days Register now!' banner, a 'Resources' section with links for Application Development, Java in the Database, and Deployment/Administration Architect, a 'Quick Picks' dropdown menu, a 'New to Java on Oracle?' link, and a 'Top Content' section listing several tutorial series and evaluation copies.

J2EE Development Tools

- Borland: <http://www.borland.com/jbuilder/>
 - JBuilder Personal (free)
 - JBuilder Developer, Enterprise (90 days eval)
- Sun: <http://www.sun.com/software/sundev/>
 - SunONE Studio
- BEA: <http://www.bea.com/>
 - Workshop 8.1 (12 months free development)
- Oracle: <http://www.oracle.com/ip/develop/ids/>
 - JDeveloper (free development license, OTN)

J2EE Development Runtime

- Borland: <http://www.borland.com/besappserver/>
 - Borland App Server (90 days eval)
- Sun: http://www.sun.com/software/products/appsrvr_pe/home_appsrvr_pe.html
 - SunONE App Server 7 PE (free)
- BEA: <http://www.bea.com/>
 - WebLogic 8.1 (12 months free development)
- Oracle: <http://www.oracle.com/ip/develop/ias/>
 - Oracle 9iAS (free development license, OTN)

J2EE Deployment Runtime

- Sun: http://www.sun.com/software/products/appsrvr_pe/home_appsrvr_pe.html
 - SunONE App Server 7 PE (free)
- Sun: <http://java.sun.com/webservices/webservicespack.html>
 - Java Web Services Developer Pack 1.2 (free)
- Apache: <http://jakarta.apache.org/tomcat/>
 - Apache Tomcat 4.1 (free)
 - Apache Tomcat 5.0 (free)

Additional J2EE Links

- Java Community Process
 - <http://www.jcp.org/>
- J2EE Community/News
 - <http://www.theserverside.com/>
- J2EE hardcore Opensource
 - <http://www.apache.org/foundation/maillinglists.html>
- J2EE Technology Journal
 - <http://www.sys-con.com/java/>
- J2EE EJB Reference
 - Applying Enterprise JavaBeans 2.1:
Development for the J2EE Platform (2nd edition)
by Vlada Matena, Sanjeev Krishnan, Beth Sterns, Linda Demichiel
(May 27, 2003)

J2EE and Microsoft

- J2EE is winning against .NET in the Enterprise (for now)
- J2EE interoperates with .NET
 - J2EE will support WS-I Basic Profile 1.0
- Allows to annotate fields, methods and classes with attribute-value pairs
 - JVM maps to CLR
 - Java maps to C#
 - J2EE maps to .NET
- J2EE provides a “safe harbor” against MSFT for software startups

J2EE Web Services in J2EE 1.4

- JAX-RPC 1.1
 - Implements WS-I Basic Profile 1.0
 - SOAP and WSDL based interoperability
 - Implements WSDL to Java mapping
 - Servlet based endpoint
 - Stateless session bean endpoint
- JAXR 1.0
 - Implements UDDI Registry protocol
- JSR 109 (Web Services for J2EE)
 - Deployment descriptors

Ease-of-Development in J2EE

- Main thrust for J2EE Platform going forward:
Ease-of-Development
- J2EE Platform is designed to serve the needs of every developer:
 - Enterprise Developer
 - Corporate (Workgroup) Developer
 - Content (Web) Developer
- J2EE is becoming a ubiquitous platform for every type of application
 - Not just the Enterprise

Example: EJB Creation

Currently, to create an EJB:

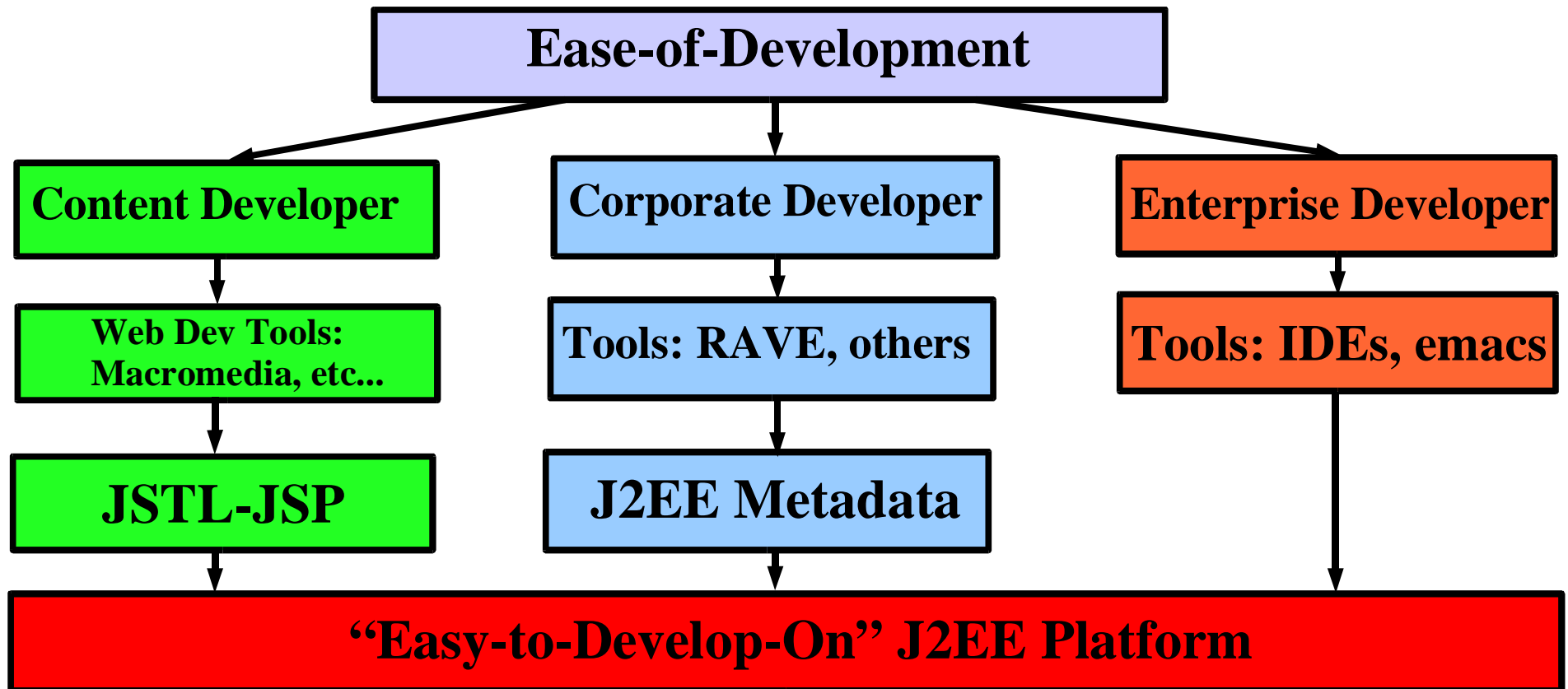
```
Context initial = new InitialContext();
Object objref = initial.lookup("java:comp/env/ejb/SimpleFoo");
FooHome home = (FooHome)
    PortableRemoteObject.narrow(objref, FooHome.class);
Foo myFoo = home.create();
```

Wouldn't It be Nice, instead:

```
private @create Foo myFoo;
```

What is the Ease-of-Development?

- Tools are important, but...
- Code should be easy to write, understand and maintain as well

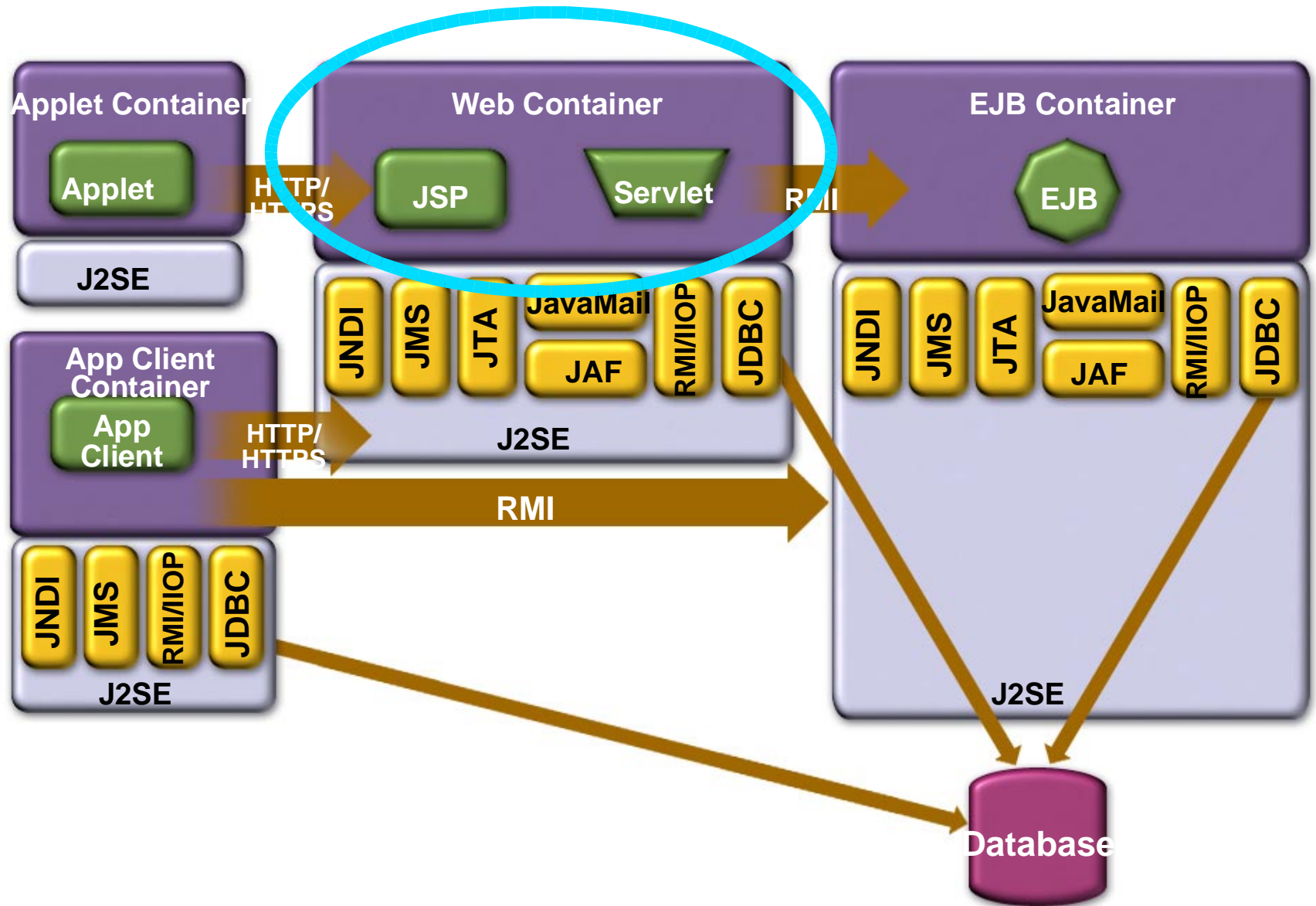


Web Application Development in the J2EE World

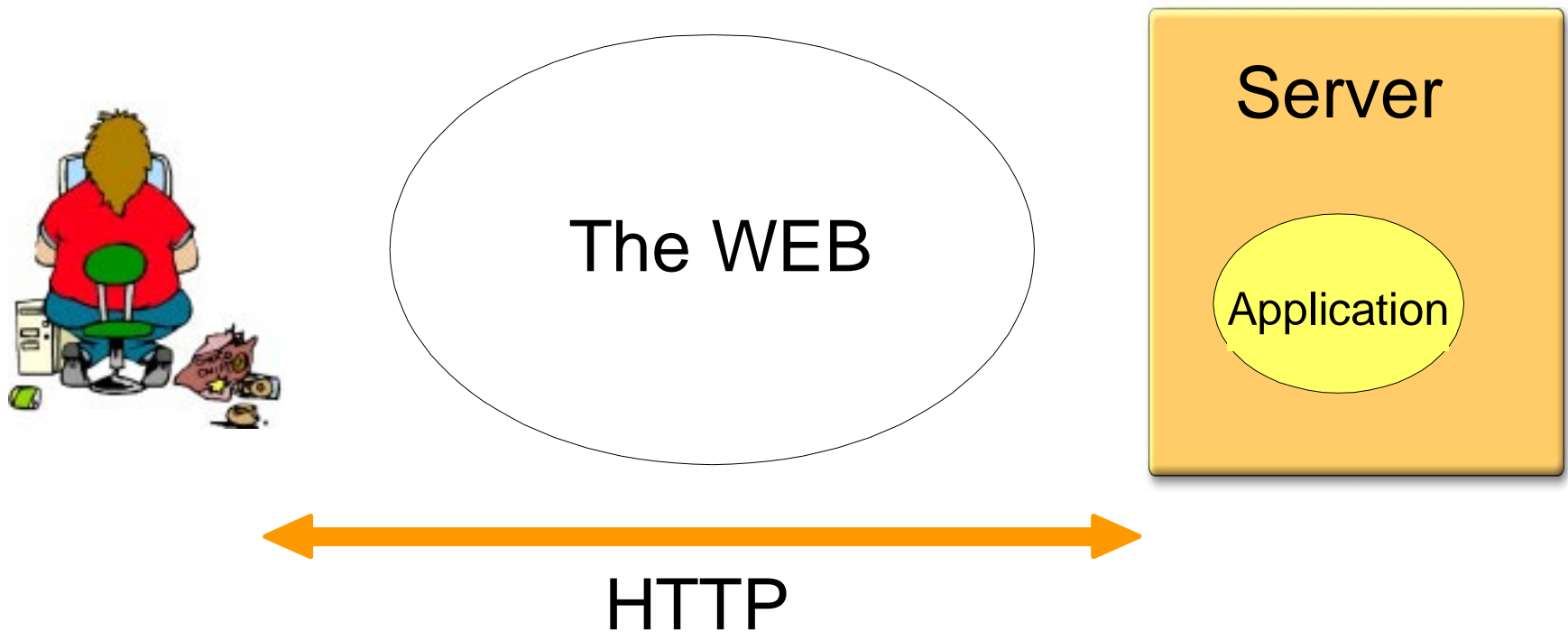
A large, faint watermark of the Java logo is visible in the background. It features a stylized coffee cup with steam rising from it, and the word "JAVA" in a serif font below it, with a small "TM" trademark symbol to the right.

JAVA™

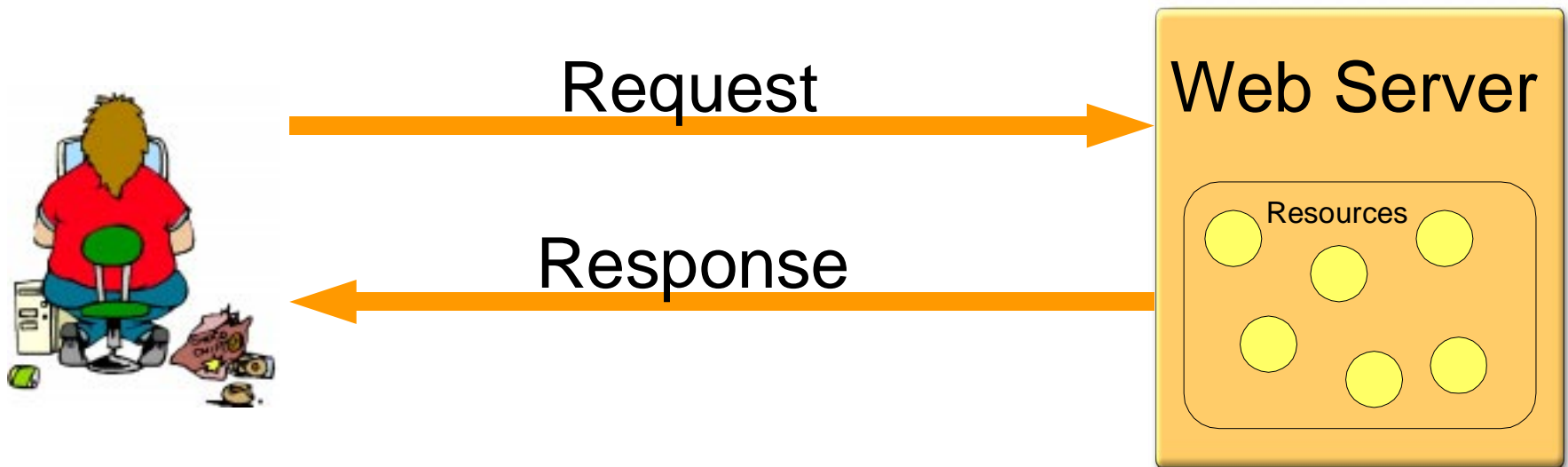
The Web Tier



What is a Web Application?



HTTP Communication Model



- Stateless
- No immediate feedback
- No details on how request is made

HTTP Request

GET /index.html HTTP/1.1 *request line*

Host: java.sun.com *request headers*

User-Agent: Mozilla/4.5 [en]

Accept: image/gif, image/jpeg, image/pjpeg, */*

Accept-Language: en

Accept-Charset: iso-8859-1,*,utf-8

optional request body

HTTP Response

```
HTTP/1.1 200 OK
```

status line

```
Last-Modified: Mon, Aug 4 2003 22:10:40 GMT
```

```
Date: Wed, Aug 8 2003 14:23:35 GMT
```

```
Status: 200
```

```
Content-Type: text/html
```

```
Content-Length: 59
```

response headers

```
<html>
```

optional response body

```
  <body>
```

```
    <h1>Hello World!</h1>
```

```
  </body>
```

```
</html>
```


Request Parameters

- Request can also contain additional info in the form of parameters
 - In the URI itself as a query string
 - As part of the request body

<http://acme.com/register?name=Paul+Smith&state=CA>

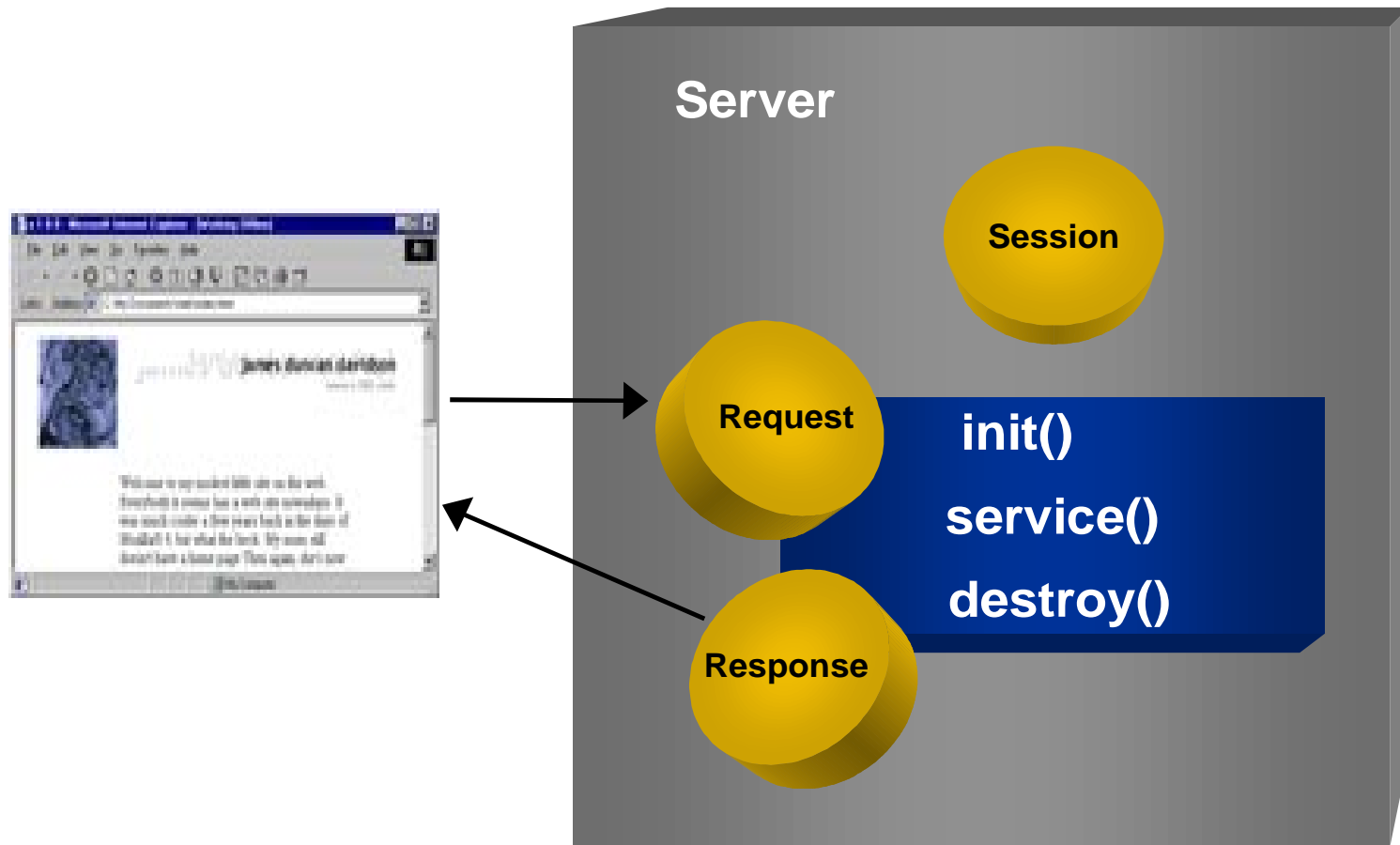
Servlets



What is a “Java Servlet”?

- Extension mechanism for dynamic content generation over HTTP, based on the Java™ Servlet API
- Simple architecture where the servlet container manages the lifecycle of servlets
- Extremely powerful
 - The full Java platform available to your web application

Servlet Invocation



Simple HTML example

```
public class HelloServlet extends HttpServlet {
    public void doGet(HttpServletRequest request,
                      HttpServletResponse response)
    {
        response.setContentType("text/plain");
        PrintWriter out = response.getWriter();
        out.println("Hello World!");
    }
}
```

Longer HTML Example

```
public class HelloServlet extends HttpServlet {
    public void doGet(HttpServletRequest request,
                      HttpServletResponse response)
    {
        response.setContentType("text/html");
        PrintWriter out = response.getWriter();
        out.println("<html>");
        out.println("Hello World!");
        out.println("<br>");
        JspCalendar clock = new JspCalendar();
        out.println("Today is");
        out.println("<ul>");
        out.println("<li>Day of month: ");
        out.println("clock.getDayOfMonth());
        out.println("</ul>");
        out.println("</html>");
    }
}
```

Servlets are great, but...

- Processing code and HTML elements are lumped together → BAD
 - Need to know Java to design HTML pages
 - Need to update servlet code to update L&F and support new types of clients
 - Hard to take advantage of web-page development tools when designing application interface

JavaServer Pages™

JAVA™

Servlet

```
public class HelloServlet extends HttpServlet {
    public void doGet(HttpServletRequest request,
                      HttpServletResponse response)
    {
        response.setContentType("text/plain");
        PrintWriter out = response.getWriter();
        out.println("<html>");
        out.println("Hello World!");
        out.println("<br>");
        JspCalendar clock = new JspCalendar();
        out.println("Today is");
        out.println("<ul>");
        out.println("<li>Day of month: ");
        out.println("clock.getDayOfMonth());
        out.println("</ul>");
        out.println("</html>");
    }
}
```

JSP

```
<jsp:useBean  
    id="clock" class="calendar.JspCalendar" />  
  
<html>  
    Hello World!<br>  
    Today is  
    <ul>  
        <li>Day of month: <%= clock.getDayOfMonth()%>  
        <li>Year: <%= clock.getYear()%>  
    </ul>  
</html>
```

How does it work?

- JSP page
 - A textual document describing how to create a *response* from a *request*
 - Mixture of template data and dynamic content
 - “Inside-Out” Servlet
- JSP engine
 - Compiles JSP page to Servlet
 - Executes servlet's `service()` method
- JSP page is
 - Compiled once
 - Executed many times

Key JSP concepts

- Directives
 - `<%@ directive %>`
- Scripting elements
 - `<%! declaration %>`
 - `<% scriptlet %>`
 - `<%= expression %>`
- Implicit objects
 - request, response, session, application, out, page, pageContext...
- Standard Actions
 - `<jsp:useBean>`, `<jsp:getProperty>`,
`<jsp:setProperty>`
 - `<jsp:include>`, `<jsp:forward>`,

Example: Output Shopping Cart

```
<jsp:useBean id="cart" class="acme.com.bean.Cart"
             scope="request" />
```

```
<html>
  <body>
    <table>
      <%
        for (int i=0; i<cart.size(); i++) {
          CartItem item = cart.getItem(i);
        %>
      <tr>
        <td><%= item.getName() %></td>
        <td><%= item.getPrice() %></td>
      </tr>
      <% } %>
    </table>
  </body>
</html>
```

Very nice, but who's the target audience?



Mike

Hard-core developer.
Handles all business logic and
back-end matters.
Expert in Java, XML,
databases, etc.



Ernie

Jack of all trades.
Not an expert in anything,
but will eventually get
the job done...



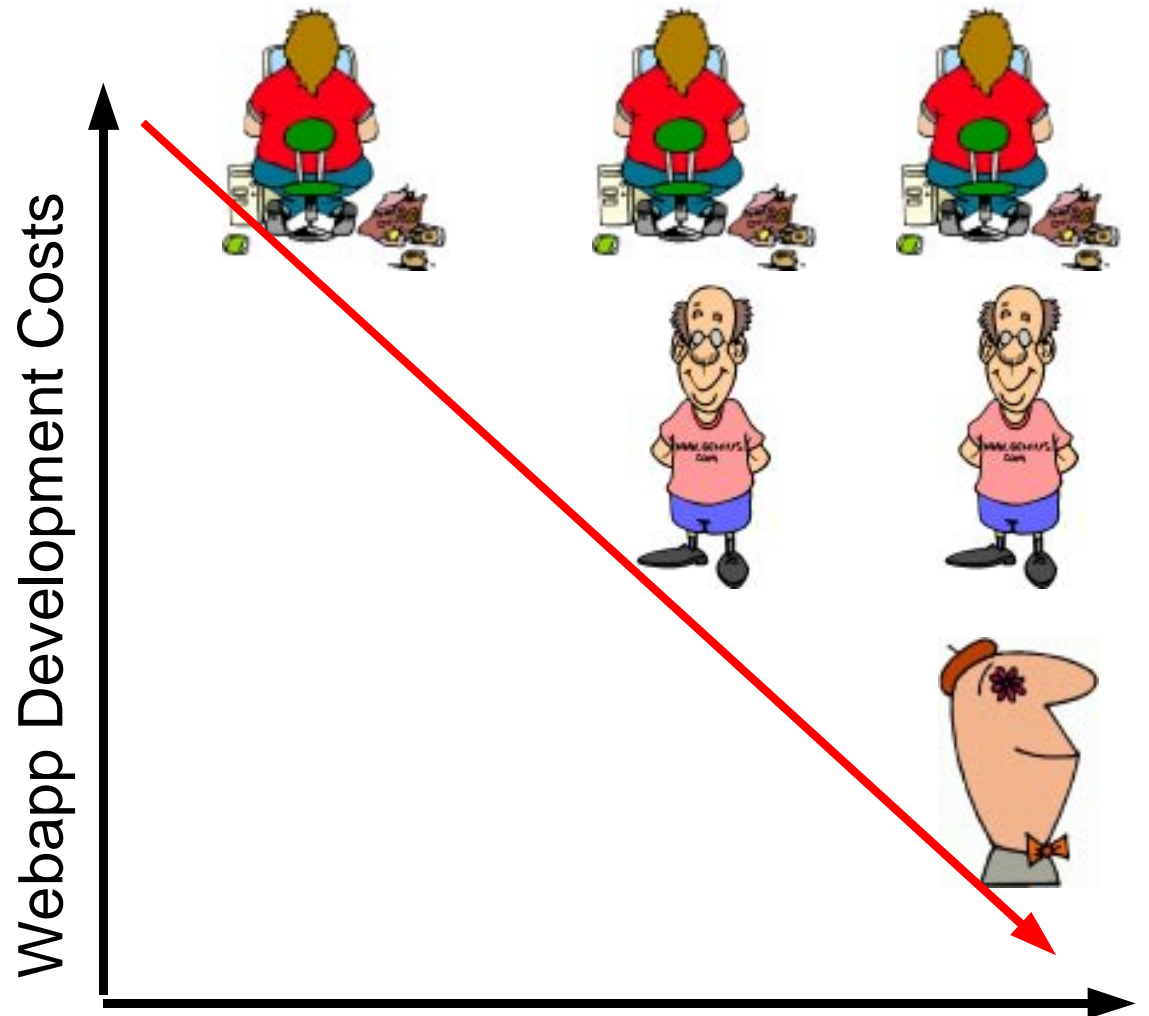
Philippe

Web site designer.
Knows how to make a
website look really cool!
HTML/JavaScript expert

Cost rules...

Higher levels of abstraction make it easier to develop with JSPs:

- Less skills required
- Faster time to market



**How should the
technology evolve
to reduce the cost of
developping
sophisticated web
applications?**

JAVA™

Custom Actions

- Design your own tags - Extremely powerful!
- Java code is executed when tag is encountered
- Easy to use by page authors
 - Look like HTML
- Encapsulate functionality
 - Reusable, maintainable
 - Keep Java Code off the JSP page
- Organizations can build a rich repository of tag libraries

Much easier...

```
<html>
  <body>
    <table>
      <acme:cart id="item">
        <tr>
          <td><%= item.getName() %></td>
          <td><%= item.getPrice() %></td>
        </tr>
      </acme:cart>
    </table>
  </body>
</html>
```

But...

Still need to refine...

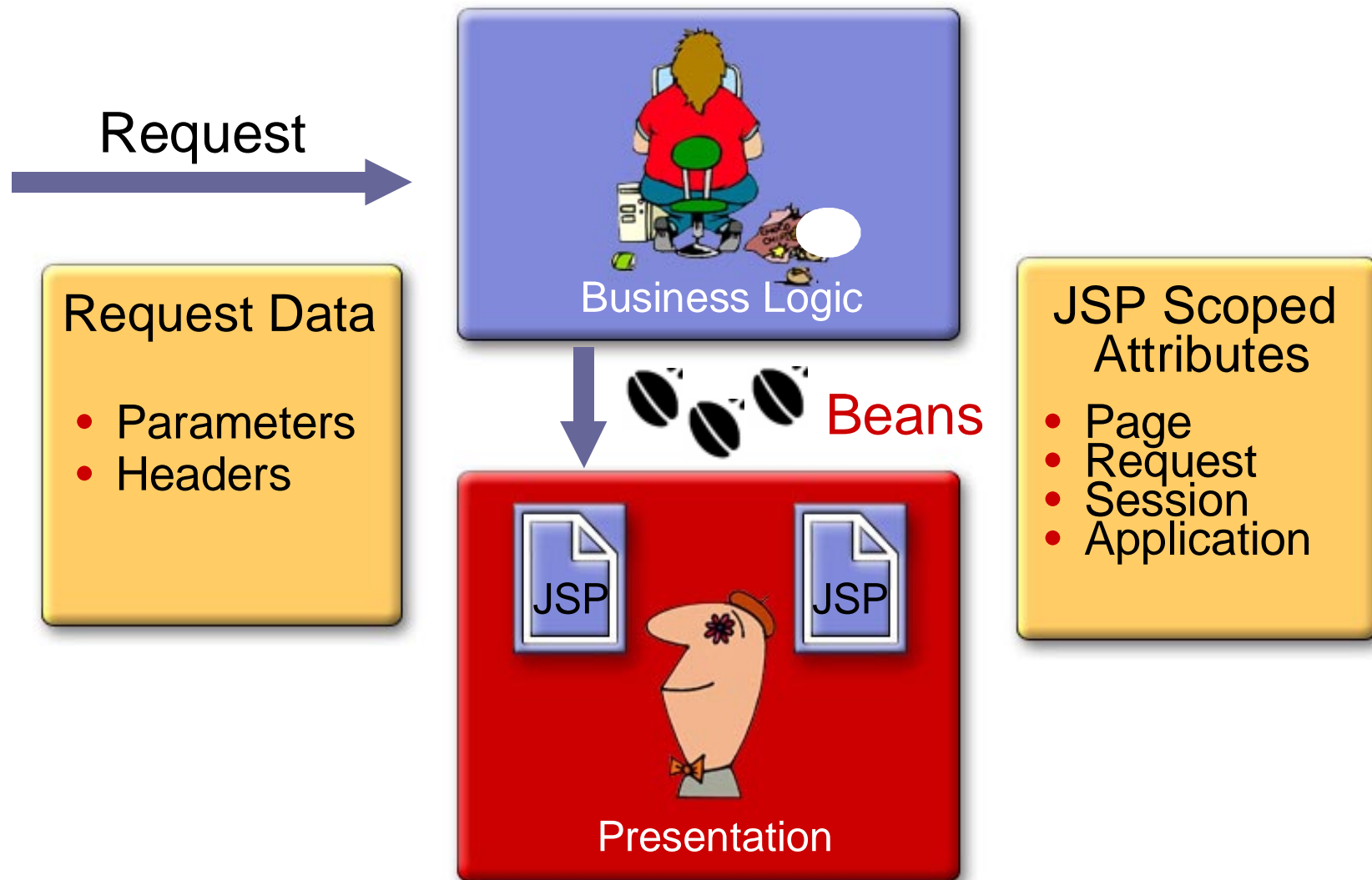
- Tag Libraries
 - Should everyone reinvent the wheel?
 - Standard tag libraries → JSTL
- Java as the scripting language in JSP scares many people (e.g. Philippe)... can we simplify?
 - Expression Language: A language adapted for the web developer

Expression Language

JAVA™

A large, faint watermark of the Java logo is visible in the background. It features a stylized coffee cup with steam rising from it, and the word "JAVA" in a serif font below it, with a trademark symbol (TM) to the right.

Easy Access/Manipulation of Application Data



Before...

1. Must declare

2. Must know type

```
<jsp:useBean id="product"  
  type="acme.com.Product" scope="request"/>  
...  
Product Name: <%= product.getName() %>  
...  
<% if (product.getManufacturer().equals("ACME")) { %>  
  ...  
<% } %>
```

3. Awkward syntax

4. Knowledge of scripting language required even for simple manipulations

After

1. Direct access

2. Easier syntax

```
Product Name: ${product.name}
```

```
...
```

```
<c:if test="${product.manufacturer == param.manufacturer}">  
  ${product.name}  
</c:if>
```

3. All app data easily accessible

4. Better adapted expression language

Expression Language

1. Syntax

`#{expression}`

`value="product_#{name}.#{type}"`

Expression Language

2. Application data directly accessible

```
#{foo} -> pageContext.findAttribute("foo")
```

Implicit objects:

- `{page|request|session|application}Scope`
- `param/paramValues, initParam`
- `header/headerValues, cookie`
- `pageContext`

Expression Language

3. Beans and collections rule

```
${user.address.city}
```

```
${products[product.id]}
```

```
${products["DCR-PC100"]}
```

Expression Language

4. Operators

relational:

`==, !=, <, >, <=, >=`

arithmetic:

`+, -, *, /, %`

binary:

`and, or, not`

Expression Language

5. Automatic type conversions

`int` ← `Integer`

```
begin="${request.beginValue}"
```

Expression Language

6. Default values

```
<c:set var="city"  
      value="{user.address.city}"  
      default="N/A" />
```

Expression Language

7. Extensibility through functions

*truncate name to 30 chars and display it
in uppercase*

```
 $\{$ fn:toUpperCase(fn:substring(name, 0, 30)) $\}$ 
```

EL Support Actions

- `<c:out>` – Display EL expression

```
<c:out value="\${customer.address.city}"
      default="unknown" />
```

- `<c:set>` – Set scoped variable

```
<acme:foo>
  <acme:bar>
    <x:atag>...</x:atag/>
  </acme:bar>
</acme:foo>

<c:set var="bar">
  <x:atag>...</x:atag/>
</c:set>
<acme:foo bar="\${bar}" />
```

- `<c:remove>` – Remove scoped variable

Conditional Actions

- Simple conditional execution

```
<c:if test="\${user.visitCount == 1}">  
    This is your first visit!  
</c:if>
```

- Mutually exclusive conditional execution

```
<c:choose>  
    <c:when test="\${verbosityLevel == 'short'}">  
        ${product.shortDescription}  
    </c:when>  
    <c:otherwise>  
        ${product.longDescription}  
    </c:otherwise>  
</c:choose>
```


Iteration Actions

1. All J2SE collection types supported

```
<table>
  <c:forEach items="{customers}"
            var="customer"
            varStatus="status">
    <tr>
      <td>${status.count}</td>
      <td>${customer}</td>
    </tr>
  </c:forEach>
</table>
```

2. Current item

3. Iteration status

- begin, end, step
- `<c:forTokens delims="...">`

**Standard Actions
for Common Needs**

URL related Actions

The Java logo watermark is a large, light blue, stylized graphic of a coffee cup with steam rising from it, positioned in the background of the slide. Below the graphic, the word "JAVA" is written in a large, blue, serif font, with a small "TM" trademark symbol to the right of the "A".

JAVA™

Hypertext Links

URL rewriting

```
<c:url url="/exec/add"  
      var="myUrl">  
  <c:param name="name" value="{param.name}"/>  
  <c:param name="country" value="{param.country}"/>  
</c:url>
```

```
<a href="{myUrl}">Add Member</a>
```

Parameter name and value
automatically URL encoded

<jsp:include> — Webapp Centric

Web Application

Same Context

Relative URL

`/foo/bar.jsp`

`bar.jsp`

<jsp:include>

<c:import> —URL Centric

Internet Resources

Absolute URL

```
http://acme.com/foo  
ftp://xyz.org/README
```

Web Application Same Context

Relative URL

```
/foo/bar.jsp  
bar.jsp
```

Web Application Foreign Context

Relative URL

```
context="/global"  
/copyright.html
```

```
<c:import url="...">
```

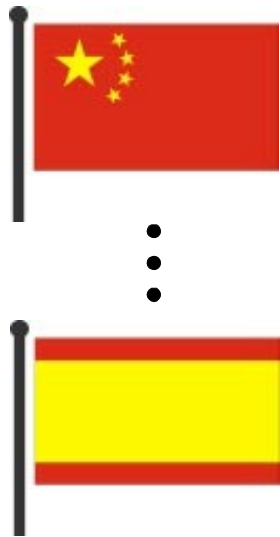
**Standard Actions
for Common Needs**

**Internationalization
and
Text Formatting**

JAVA™

Webapp for Global Markets

Worldwide Users

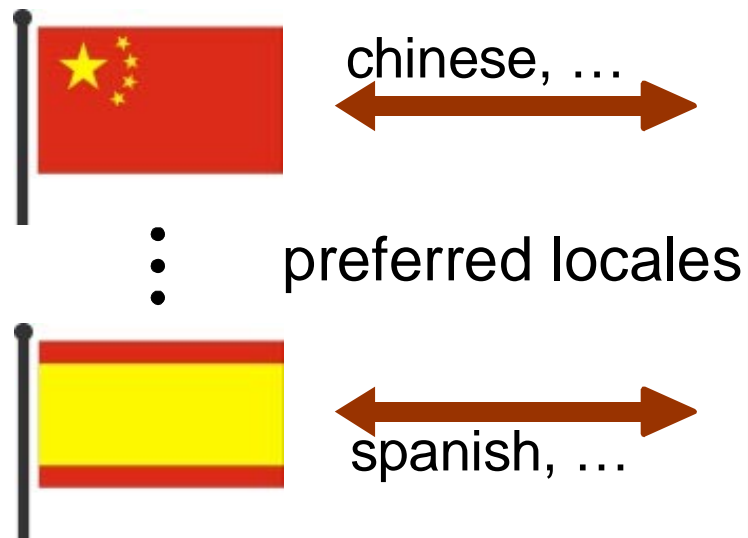


Web Application

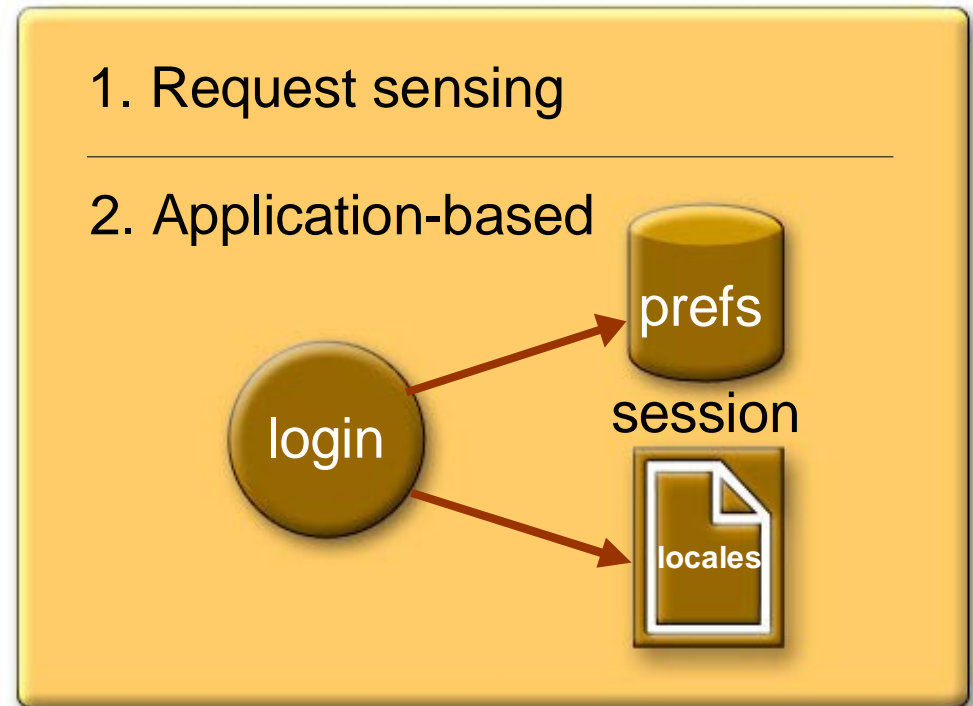


Locale

Worldwide Users

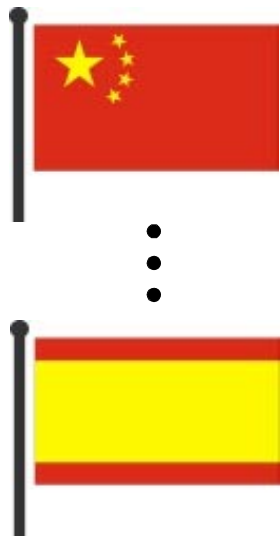


Web Application



I18N Architecture

Worldwide Users



Web Application

1. One page per locale

controller

JSP
ch

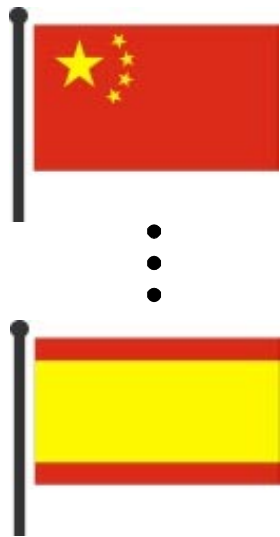


JSP
es

<fmt:formatNumber>
<fmt:parseNumber>
<fmt:formatDate>
<fmt:parseDate>

I18N Architecture

Worldwide Users



Web Application

2. One page for all locales

Resource Bundles



`<fmt:message key="...">`

How Easy to I18N a Webapp?

```
<fmt:message key="welcome" />
```

How Easy to I18N a Webapp?

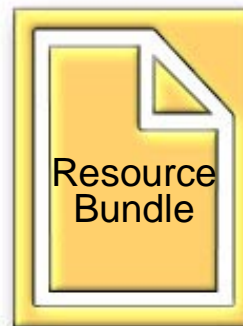
Uses Default Localization Context



1. Client's Locale preferences

2. Resource bundle basename

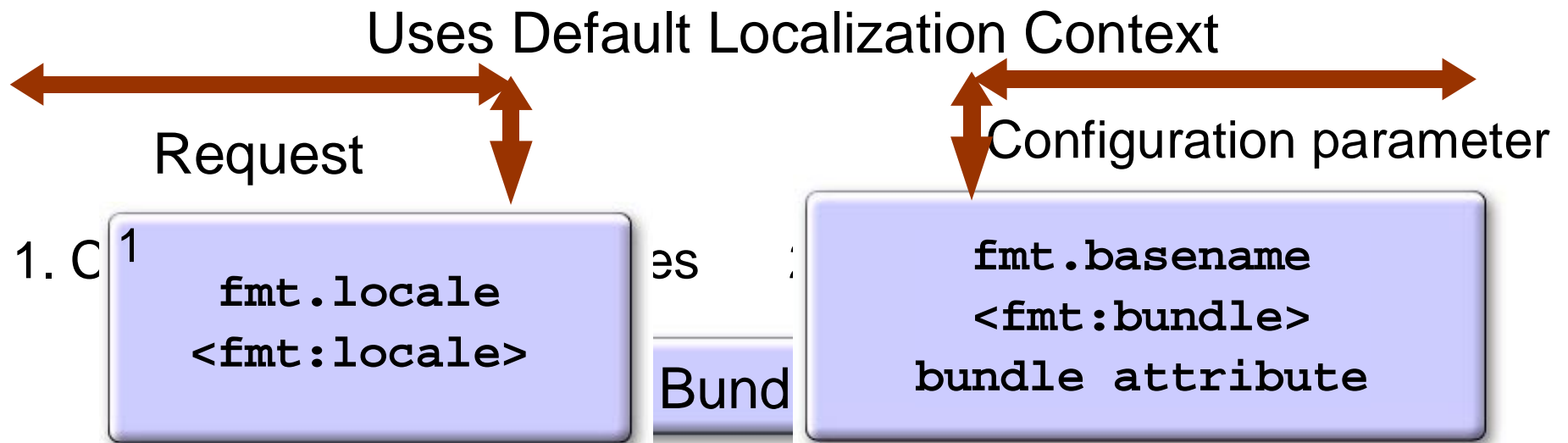
J2SE Resource Bundle Selection Algorithm



```
<fmt:message key="welcome" />
```

3. Fallback Locale

I18N Flexibility



```
<fmt:message key="welcome">  
  <fmt:messageArg value="$visitCount"/>  
</fmt:message/>
```

```
<fmt:message key="welcome" />
```

3. Fallback Locale

**Standard Actions
for Common Needs**

Database Access



Database Access



MVC Architecture



RAD/Prototyping/Simple Apps



SQL



SQL Actions



Query the database

```
<sql:query>
```

Easy access to
result set

```
Result
```

```
ResultSupport
```

Update the database

```
<sql:update>
```

```
<sql:transaction>
```



DataSource

- All DB actions operate on a DataSource
- Different ways to access a DataSource
 - Transparent collaboration
 - via configuration parameter `sql.dataSource`
`<db:query query="..." />`
 - Explicit collaboration
 - Object provided by application logic
 - Object provided by `<sql:dataSource>` action
`<sql:dataSource var="dataSource"
 driver="org.gjt.mm.mysql.Driver"
 url="jdbc:..." />`
`<sql:query dataSource="{dataSource}" .../>`

Querying a Database

```
<sql:query var="customers" dataSource="${dataSource}">
    SELECT * FROM customers
    WHERE country = 'China'
    ORDER BY lastname
</sql:query>
```

```
<table>
<c:forEach var="row" items="${customers.rows}">
    <tr>
        <td><c:out value="${row.lastName}" /></td>
        <td><c:out value="${row.firstName}" /></td>
        <td><c:out value="${row.address}" /></td>
    </tr>
</c:forEach>
</table>
```

Updating a Database

```
<sql:transaction dataSource="{dataSource}">
  <sql:update>
    UPDATE account
    SET Balance = Balance - ?
    WHERE accountNo = ?
    <sql:param value="{transferAmount}">
    <sql:param value="{accountFrom}">
  </sql:update>
  <sql:update>
    UPDATE account
    SET Balance = Balance + ?
    WHERE accountNo = ?
    <sql:param value="{transferAmount}">
    <sql:param value="{accountTo}">
  </sql:update>
</sql:transaction>
```

Standard Actions for Common Needs

XML



JAVA™

XML Everywhere



...



...



1. Easy Access to XML Data



...



...



XPath

```
$doc/employee[@name=$param:name]
```

XPath variable bindings

1. Easy Access to XML Data



...



...



XPath – expression language for XML actions

<x:out>

<x:set>

<x:if>

<x:choose>

<x:forEach>

select attribute to specify XPath expression

2. Get the XML Data



...



...



```
<x:parse>  
in    xmlUrl,xmlText,body content  
out   var, varDom  
perf  filter (org.xml.sax.XMLFilter)
```

3. XSLT Transformation



...



...



```
<x:transform>
```

```
in    xmlUrl,xmlText,body content
```

```
in    xsltUrl,xsltText
```

```
out   var,result,page
```

```
perf transparent caching of Transformer objects possible
```

Demo / Q&A

JAVA™

Resources

- JSP home page
<http://java.sun.com/jsp>
- JSTL home page
<http://java.sun.com/jstl>
- Java Web Services Developer Pack
<http://java.sun.com/xml>
- Books
 - JavaServer Pages, Hans Bergsten, O'Reilly
 - JSTL in Action, Shawn Bayern, Manning