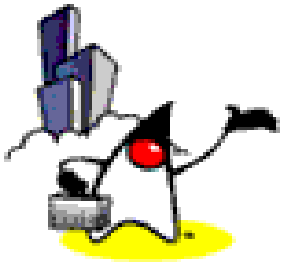
Spring Framework Basics (Dependency Injection)

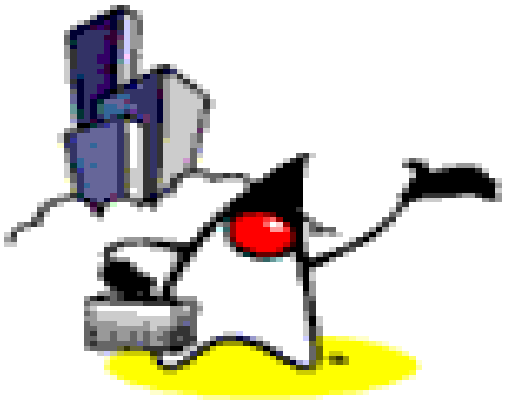


Topics

- What is Spring framework?
- Why Spring framework?
- Spring framework architecture
- Usage scenario
- Dependency Injection (DI)
  - Basic concept
  - DI support in Spring framework
  - Injection parameter types
  - Bean naming
  - Autowiring

Topics covered in other presentations

- Refactoring HelloWorld application using Spring framework
- Spring framework and hibernate (persistence)
- Spring framework and JPA (Java Persistence API)
- Spring MVC
- Spring WebFlow
- Spring AOP (Aspect-Oriented Programming)



What is Spring Framework?

What is Spring Framework?

- Light-weight yet comprehensive framework for building Java SE and Java EE applications

Key Features - DI

- JavaBeans-based configuration management, applying Inversion-of-Control principles, specifically using the Dependency Injection (DI) technique
  - This aims to eliminate manual wiring of components
- A core bean factory, which is usable globally

Key Features - Persistence

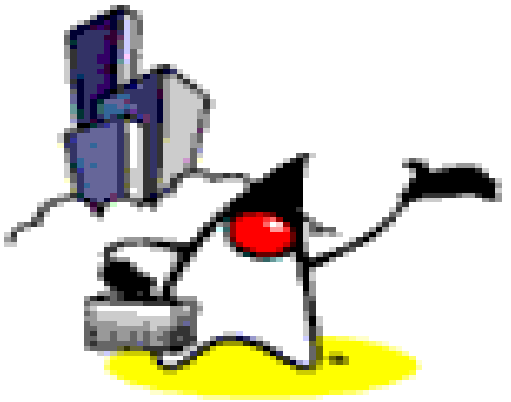
- Generic abstraction layer for database transaction management
- Built-in generic strategies for JTA and a single JDBC DataSource
  - This removes the dependency on a Java EE environment for transaction support.
- Integration with persistence frameworks Hibernate, JDO and iBATIS, and JPA.

Key Features - Web-Tier

- MVC web application framework, built on core Spring functionality, supporting many technologies for generating views, including JSP, FreeMarker, Velocity, Tiles, iText, and POI(Java API to Access Microsoft Format files).
- Web Flow - fine-grained navigation

Key Features - AOP

- Extensive aspect-oriented programming (AOP) framework to provide services such as transaction management
  - As with the Inversion-of-Control parts of the system, this aims to improve the modularity of systems created using the framework.



Why Use Spring Framework?

Why Use Spring?

- Wiring components (JavaBeans) through Dependency Injection
  - Promotes de-coupling among the parts that make up an application
- Design to interfaces
  - Insulates a user of a functionality from implementation details
- Test-Driven Development (TDD)
  - POJO classes can be tested without being tied up with the framework

Why Use Spring? (Continued)

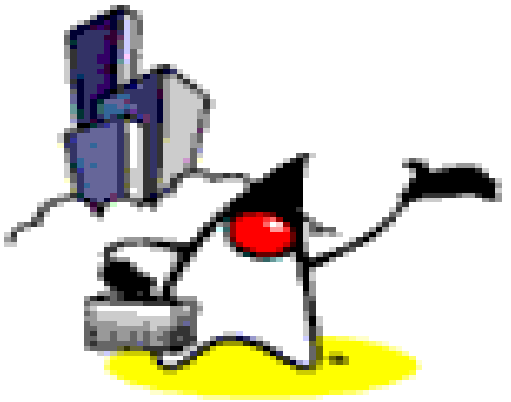
- Declarative programming through AOP
  - Easily configured aspects, esp. transaction support
- Simplify use of popular technologies
  - Abstractions insulate application from specifics, eliminate redundant code
  - Handle common error conditions
  - Underlying technology specifics still accessible

Why Use Spring? (Continued)

- Conversion of checked exceptions to unchecked
  - (Or is this a reason not to use it?)
- Not an all-or-nothing solution
  - Extremely modular and flexible
- Well designed
  - Easy to extend
  - Many reusable classes

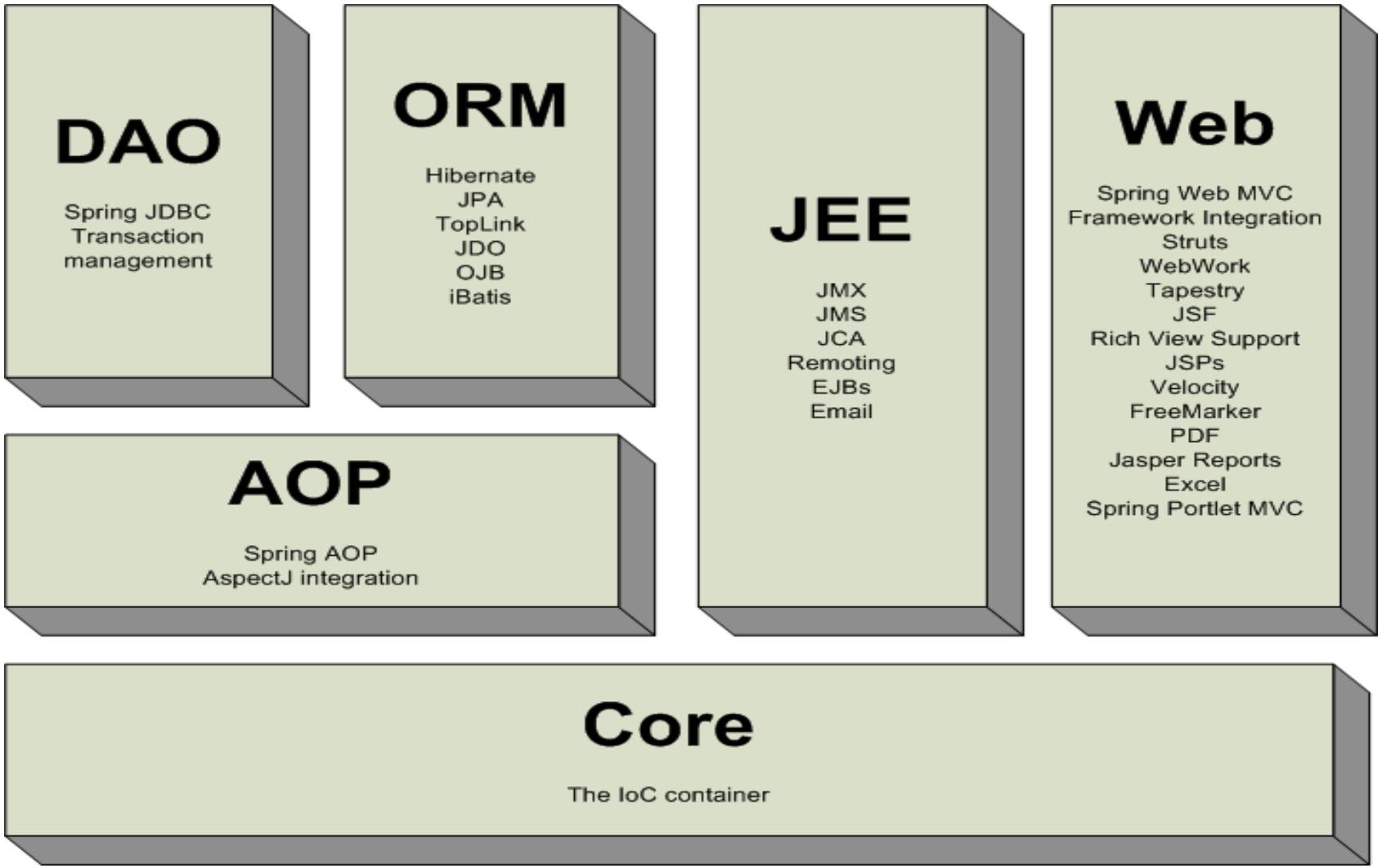
Why Use Spring? (Continued)

- Integration with other technologies
  - EJB for J2EE
  - Hibernate, iBates, JDBC (for data access)
  - Velocity (for presentation)
  - Struts and WebWork (For web)
  - Java Persistence API (JPA)



Spring Framework Architecture

Spring Framework Architecture



Core Package

- Core package is the most fundamental part of the framework and provides the Dependency Injection container
- The basic concept here is the BeanFactory, which provides a sophisticated implementation of the factory pattern which removes the need for programmatic singletons and allows you to decouple the configuration and specification of dependencies from your actual program logic

DAO Package

- The DAO package provides a JDBC-abstraction layer that removes the need to do tedious JDBC coding and parsing of database-vendor specific error codes
- The JDBC package provides a way to do programmatic as well as declarative transaction management, not only for classes implementing special interfaces, but for all your POJOs (plain old Java objects)

ORM Package

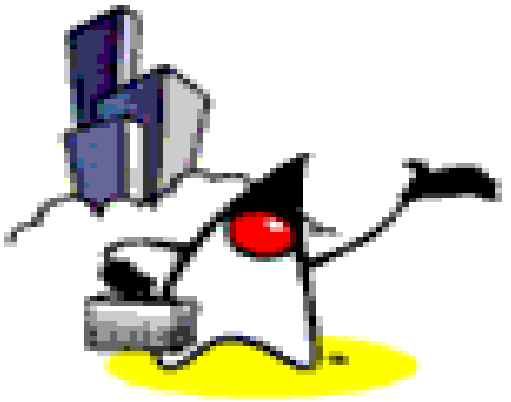
- The ORM package provides integration layers for popular object-relational mapping APIs, including JPA, JDO, Hibernate, iBatis, and JPA.
- Using the ORM package you can use all those O/R-mappers in combination with all the other features Spring offers, such as the simple declarative transaction management feature mentioned previously

AOP Package

- Spring's AOP package provides an AOP Alliance-compliant aspect-oriented programming implementation allowing you to define, for example, method-interceptors and pointcuts to cleanly decouple code implementing functionality that should logically speaking be separated
- Using source-level metadata functionality you can also incorporate all kinds of behavioral information into your code

MVC Package

- Spring's MVC package provides a Model-View-Controller (MVC) implementation for web-applications
- Spring's MVC framework is not just any old implementation; it provides a clean separation between domain model code and web forms, and allows you to use all the other features of the Spring Framework.

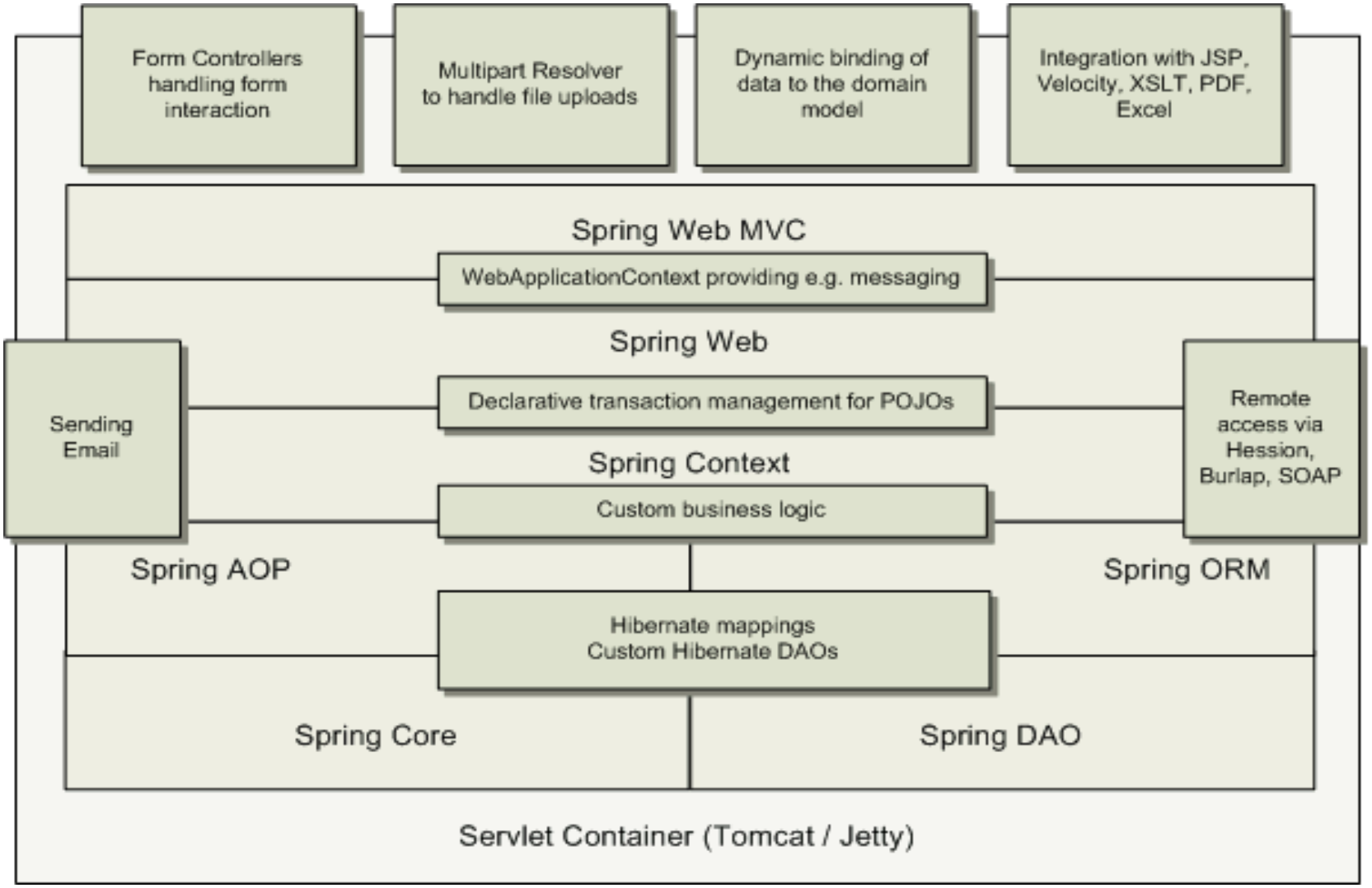


Usage Scenarios

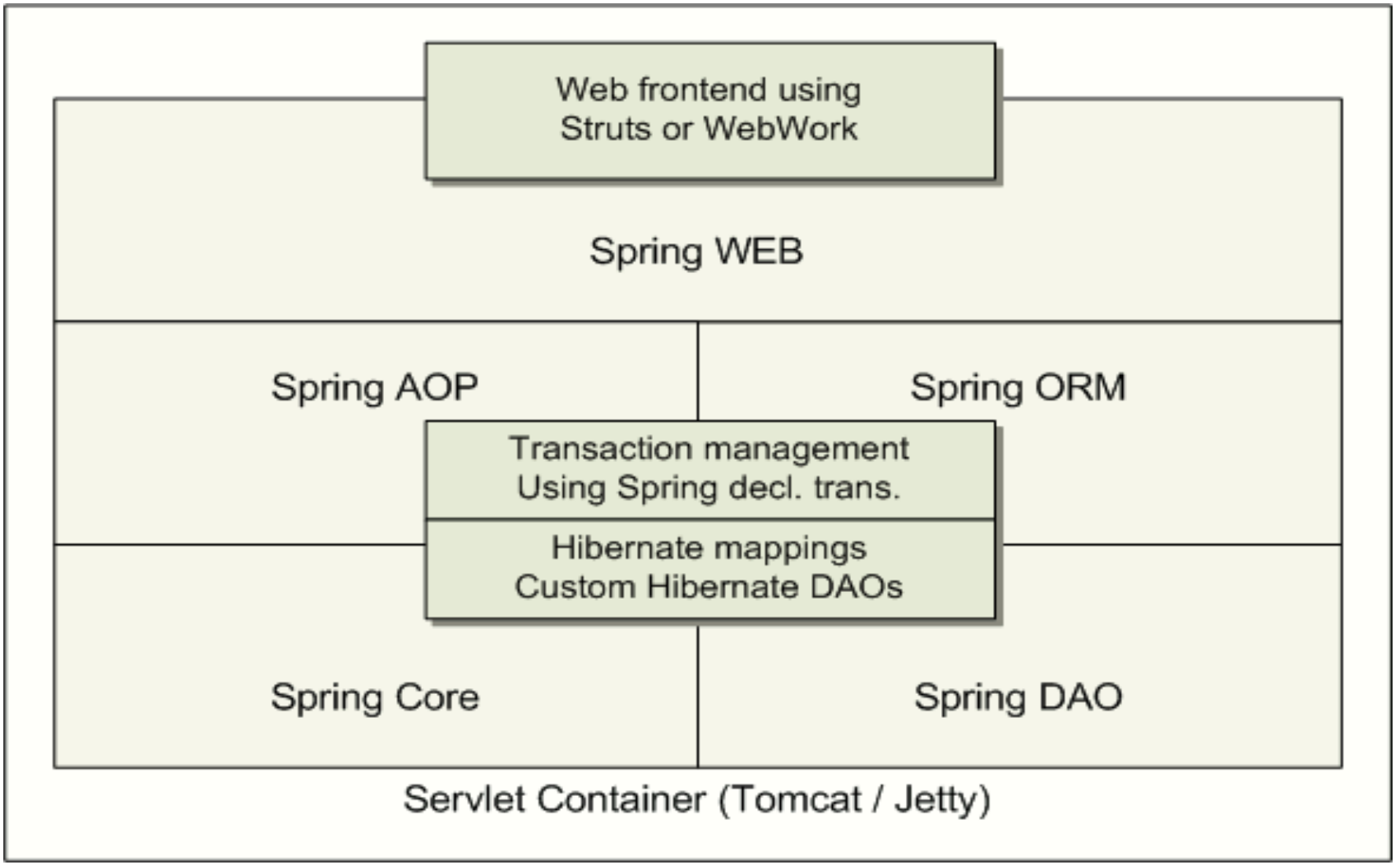
Usage Scenarios

- You can use Spring in all sorts of scenarios, from applets up to fully-fledged enterprise applications using Spring's transaction management functionality and web framework integration

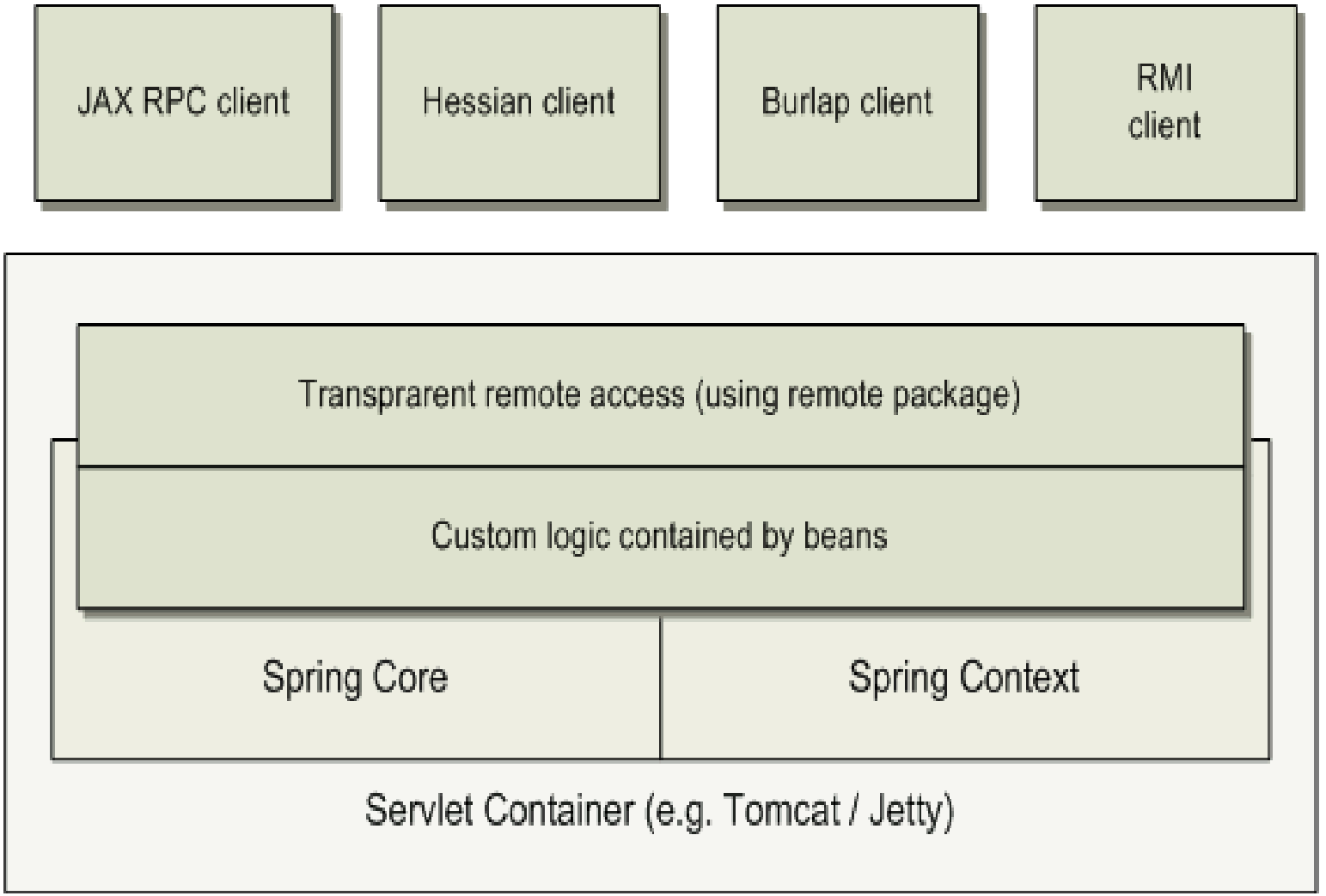
Typical Full-fledged Spring Web Application



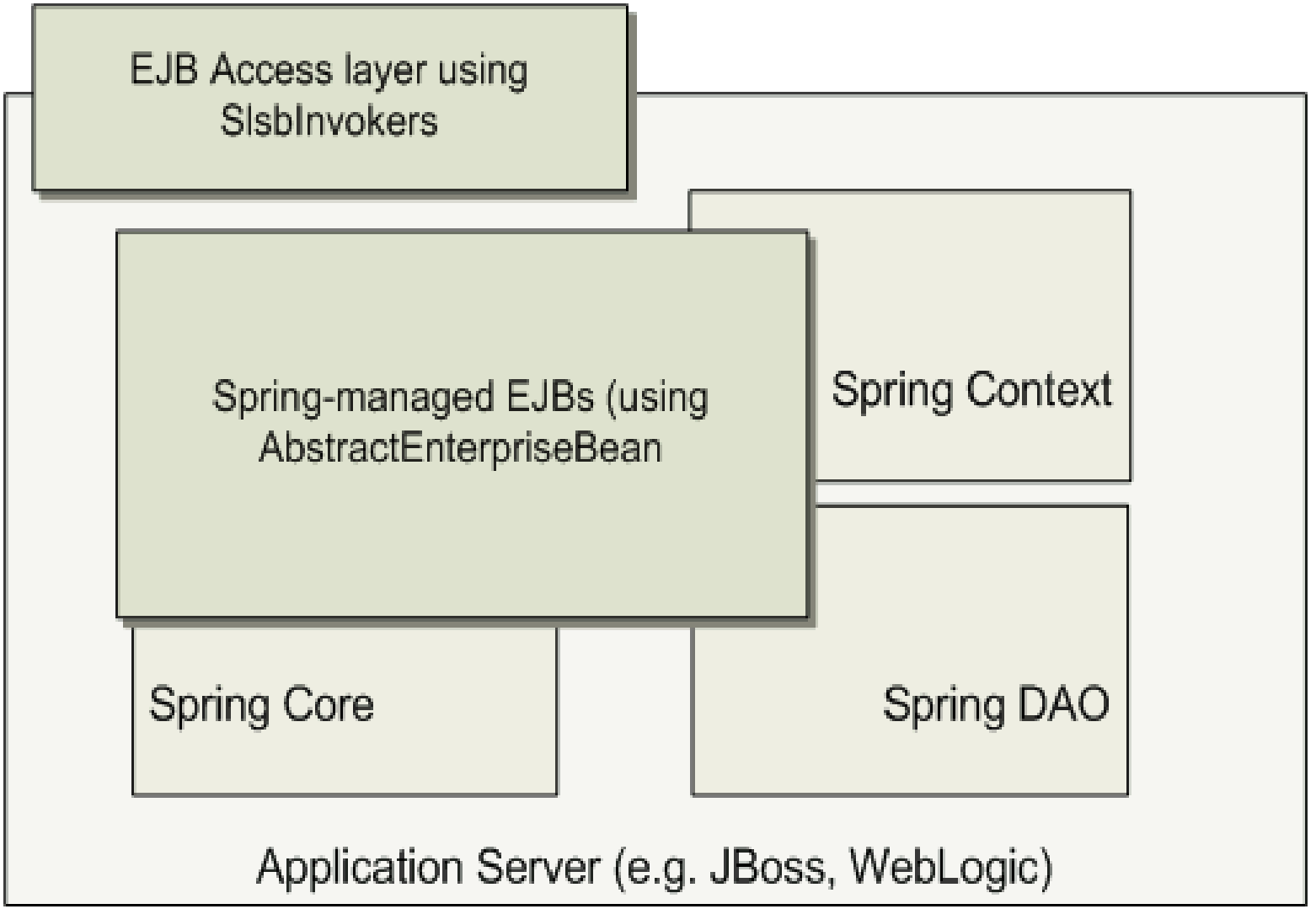
Spring Middle-tier Using 3rd party Web Framework

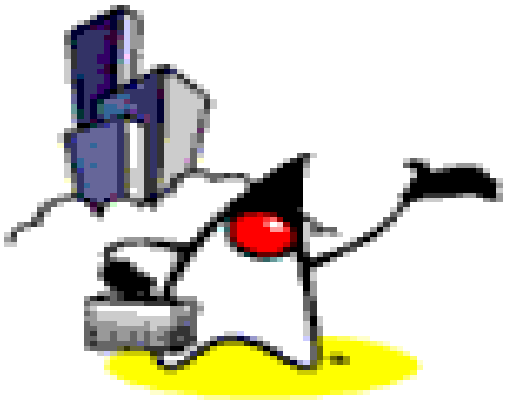


Remoting Usage Scenario



EJBs – Wrapping Existing POJOs





Dependency Injection (DI): Basic concept

Spring Dependency Injection

- A kind of Inversion of Control (IoC)
- “Hollywood Principle”
  - Don't call me, I'll call you
- “Container” resolves (injects) dependencies of components by setting implementation object (push)
- As opposed to component instantiating or Service Locator pattern where component locates implementation (pull)
- Martin Fowler calls it Dependency Injection

Benefits of Dependency Injection

- Flexible
  - Avoid adding bokup code in business bgic
- Testable
  - No need to depend on external resources or containers for testing
  - Automatic testing (as part of nightly build process)
- Maintainable
  - Allows reuse in different application environments by changing configuration files instead of code
  - Promotes a consistent approach across all applications and teams

Two Dependency Injection Variants

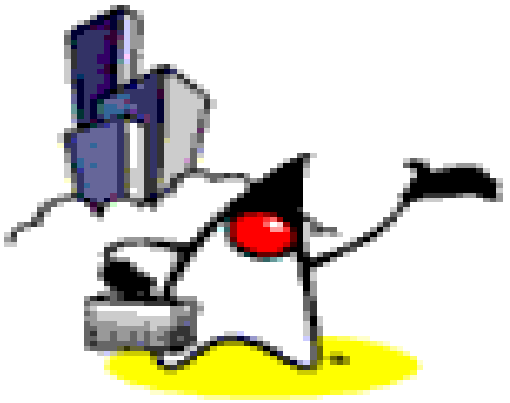
- Constructor dependency Injection
  - Dependencies are provided through the constructors of the component
- Setter dependency injection
  - Dependencies are provided through the JavaBean-style setter methods of the component
  - More popular than Constructor dependency injection

Constructor Dependency Injection

```
public class ConstructorInjection {

    private Dependency dep;

    public ConstructorInjection(Dependency dep) {
        this.dep = dep;
    }
}
```

Setter Dependency Injection

```
public class SetterInjection {

    private Dependency dep;

    public void setMyDependency(Dependency dep) {
        this.dep = dep;
    }
}
```



Dependency Injection (DI): DI Support in Spring

Sub-topics

- *BeanFactory* interface
- *XmlBeanFactory* implementation
- Bean configuration file
  - Setter dependency injection
  - Constructor dependency injection
- Beans
- Injection parameters

BeanFactory

- *BeanFactory* object is responsible for managing beans and their dependencies
- Your application interacts with Spring's DI container through *BeanFactory* interface
  - *BeanFactory* object has to be created by the application typically in the form of *XmlBeanFactory*
  - *BeanFactory* object, when it gets created, read bean configuration file and performs the wiring
  - Once created, the application can access the beans via *BeanFactory* interface

BeanFactory Implementations

- *XmlBeanFactory*
  - Convenience extension of *DefaultListableBeanFactory* that reads bean definitions from an XML document

Reading XML Configuration File via XmlBeanFactory class

```
import org.springframework.beans.factory.xml.XmlBeanFactory;
import org.springframework.core.io.FileSystemResource;

public class XmlConfigWithBeanFactory {

    public static void main(String[] args) {
        XmlBeanFactory factory =
            new XmlBeanFactory(new FileSystemResource("beans.xml"));
       SomeBeanInterface b =
            (SomeBeanInterface) factory.getBean(“nameOftheBean”);
    }
}
```

Bean Configuration File

- Each bean is defined using *<bean>* tag under the root of the <beans> tag
- The *id* attribute is used to give the bean its default name
- The *class* attribute specifies the type of the bean (class of the bean)

Bean Configuration File Example: Setter DI

```
<!DOCTYPE beans PUBLIC "-//SPRING//DTD BEAN//EN"
   "http://www.springframework.org/dtd/spring-beans.dtd">
<beans>
   <bean id="renderer" class="StandardOutMessageRenderer">
      <property name="messageProvider">
         <ref local="provider"/>
      </property>
   </bean>
   <bean id="provider" class="HelloWorldMessageProvider"/>
</beans>
```

Bean Configuration File Example: Constructor DI

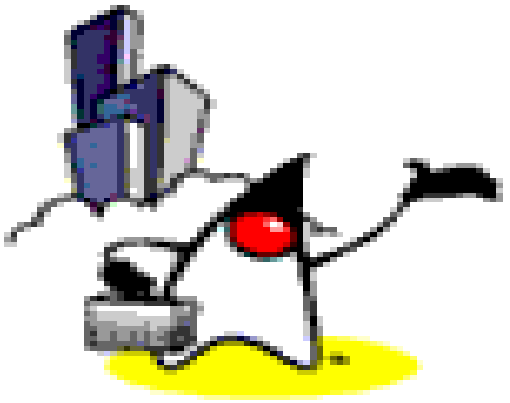
```
<!DOCTYPE beans PUBLIC "-//SPRING//DTD BEAN//EN"
   "http://www.springframework.org/dtd/spring-beans.dtd">
<beans>
   <bean id="renderer" class="StandardOutMessageRenderer">
      <property name="messageProvider">
         <ref local="provider"/>
      </property>
   </bean>
   <bean id="provider" class="ConfigurableMessageProvider">
      <constructor-arg>
         <value>This is a configurable message</value>
      </constructor-arg>
   </bean>
</beans>
```

Bean Example: Constructor DI

```
public class ConfigurableMessageProvider implements
    MessageProvider {

    private String message;

    public ConfigurableMessageProvider(String message) {
        this.message = message;
    }

    public String getMessage() {
        return message;
    }

}
```

Beans

- The term “bean” is used to refer any component managed by the *BeanFactory*
- The “beans” are in the form of JavaBeans (in most cases)
  - no arg constructor
  - getter and setter methods for the properties
- Beans are singletons by default
- Properties the beans may be simple values or references to other beans
- Beans can have multiple names



Dependency Injection (DI): Injection Parameter Types

Injection Parameter Types

- Spring supports various kinds of injection parameters
  1. Simple values
  2. Beans in the same factory
  3. Beans in another factory
  4. Collections
  5. Externally defined properties
- You can use these types for both setter or constructor injections

1. Injecting Simple Values

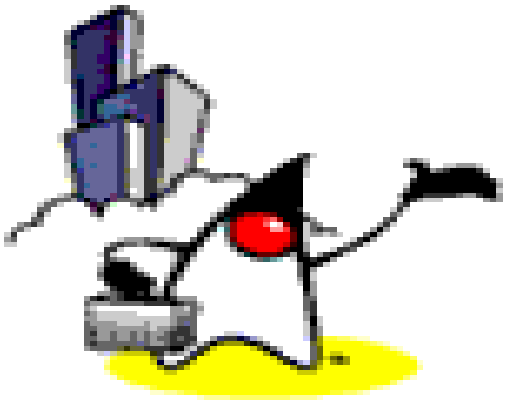
```
<beans>

    <!-- injecting built-in vals sample -->
    <bean id="injectSimple" class="InjectSimple">
        <property name="name">
            <value>John Smith</value>
        </property>
        <property name="age">
            <value>35</value>
        </property>
        <property name="height">
            <value>1.78</value>
        </property>
        <property name="isProgrammer">
            <value>true</value>
        </property>
        <property name="ageInSeconds">
            <value>1103760000</value>
        </property>
    </bean>

</beans>
```

2. Injecting Beans in the same Factory

- Used when you need to inject one bean into another (target bean)
- Configure both beans first
- Configure an injection using <ref> tag in the target bean's <property> or <constructor-arg>
- The type being injected does not have to be the exact type defined on the target
  - if the type defined on the target is an interface, the type being injected must be an implementation of it
  - if the type defined on the target is a class, the type being injected can be the same type or sub-type

2. Injecting Beans in the same Factory

```
<beans>

    <!-- oracle bean used for a few examples -->
    <bean id="oracle" name="wiseworm" class="BookwormOracle"/>

    <!-- injecting reference sample (using id) -->
    <bean id="injectRef" class="InjectRef">
        <property name="oracle">
            <ref local="oracle"/>
        </property>
    </bean>

</beans>
```



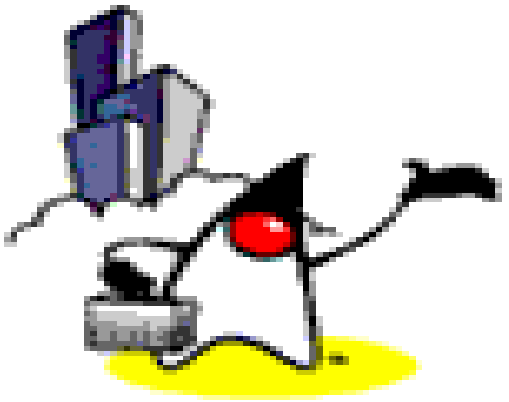
Dependency Injection (DI): Bean Naming

Bean Naming

- Each bean must have at least one name that is unique within the containing BeanFactory
- Name resolution procedure
  - If a <*bean*> tag has an *id* attribute, the value of the *id* attribute is used as the name
  - If there is no *id* attribute, Spring looks for *name* attribute
  - If neither *id* nor *name* attribute are defined, Spring use the class name as the name
- A bean can have multiple names
  - Specify comma or semicolon-separated list of names in the name attribute

Bean Naming Example

```
<bean id="mybeanid" class="mypackage.MyClass"/>
<bean name="mybeanname" class="mypackage.MyClass"/>
<bean class="mypackage.MyClass"/>
<bean id="mybeanid" name="name1,name2,name3"
   class="mypackage.MyClass"/>
```



Dependency Injection: Autowiring

What is Autowiring?

- Spring can autowire dependencies through introspection of the bean classes so that you do not have to explicitly specify the bean properties or constructor arguments.
  - Instead of using <ref>
- Bean properties can be autowired either by property names or matching types.
- Constructor arguments can be autowired by matching types.
- Autowiring can potentially save some typing and reduce clutter. However, you should use it with caution in real-world projects because it might sacrifices the explicitness

Autowiring Properties

- *autowire="name"*
  - The property names of target bean (actually set<Property-name>() methods of the target bean) are used to search beans
- *autowire="type"*
  - The property types of target bean - actually argument types of set<Property-name>(ArgumentType arg) - are used to match a bean instance in the container
- *autowire="constructor"*
  - Match constructor argument types
  - The argument types of Constructor(ArgumentType arg) - are used to match a bean instance in the container
- *autowire="autodetect"*
  - If default constructor exists, do autowiring using "type", otherwise use "*constructor*"

Spring Framework Basics (Dependency Injection)