In Pieces

Breaking down monolithic applications with Spring-DM and OSGi

Agenda

- The problem: Lack of modularity
- OSGi Basics
- OSGi without Spring-DM
- Introducing Spring-DM
- Spring-DM and the web
- Blueprint Services
- So what?
- Moving to OSGi

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The Problem

Modularity is...

- High cohesion
  - Modules are focused in purpose
- Low coupling
  - Modules have minimal/no direct dependency on each other
- Not a new idea...

> "A well-defined segmentation of the project effort ensures system modularity. Each task forms a separate, distinct program module. At implementation time each module and its inputs and outputs are well-defined, there is no confusion in the intended interface with other system modules. At checkout time the integrity of the module is tested independently; there are few scheduling problems in synchronizing the completion of several tasks before checkout can begin. Finally, the system is maintained in modular fashion; system errors and deficiencies can be traced to specific system modules, thus limiting the scope of detailed error searching."
>
> *Designing Systems Programs*, Richard Gauthier and Stephen Pont, **1970**.

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Modularity promotes...

- Testability
- Comprehensibility
- Flexibility
- Reusability
- Plugability

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Modularity in Java?

- Java lacks some essential features to support modular development
  - Classes encapsulate data and functionality
    - They're too fine-grained for practical modularity
  - Packages only contain classes
    - They're only an organizational mechanism
  - JAR files only contain packages/classes
    - Their boundaries dissolve when placed on the classpath

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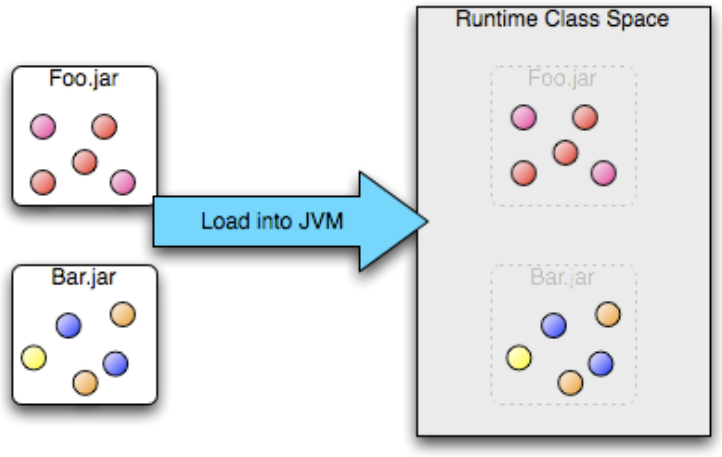
A false sense of modularity



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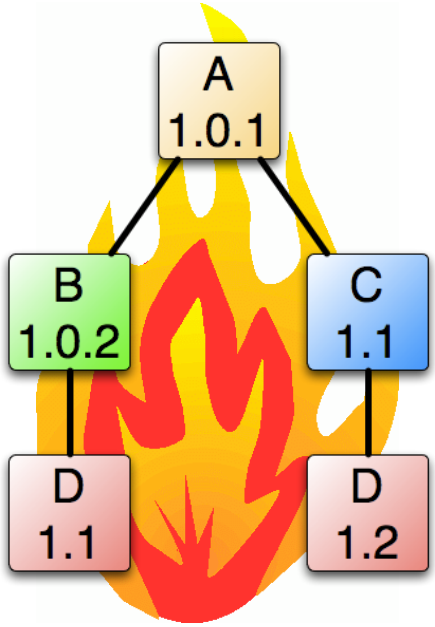
JAR Hell



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The solution...OSGi

- Modular framework for the OSGi platform
- Classpath++
- POJO-oriented
- Dynamic Runtime
  - Modules can be installed, started, stopped, updated, and uninstalled...in a live program
- Ends JAR Hell
  - Multiple versions of a class can reside in OSGi simultaneously

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You think you're modular?

Then why do you deploy your web applications as a single large WAR file?

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Yeah, but...

Isn't OSGi hard?

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OSGi Basics

Bundles

- Just JAR files
- Contain special metadata in MANIFEST.MF
- All content is private by default
  - May export packages to be imported by other bundles
  - May publish services
- May be versioned

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Fragments

- Just JAR files, like bundles, but...
- Must be hosted by another bundle
- Physically separate, logically united
- Used to add content (classes, resources, etc) to a hosting bundle

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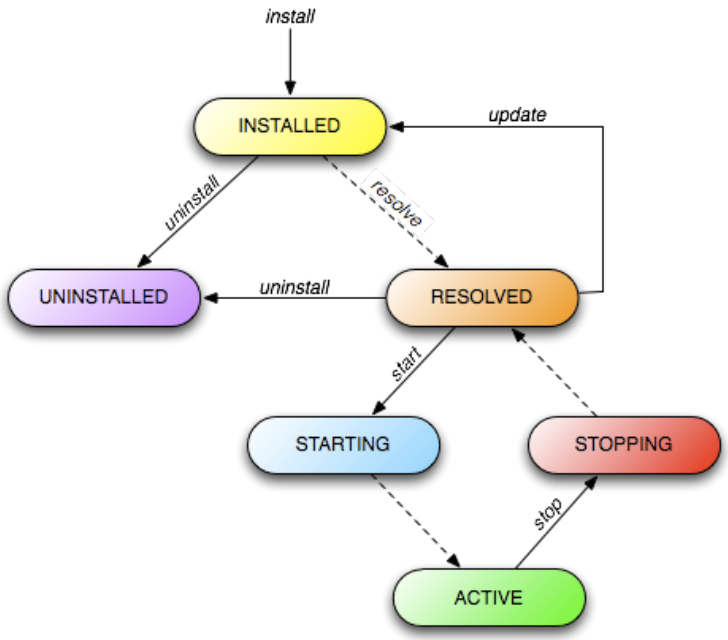
Bundle Lifecycle



OSGi Manifest

- Defines the content of a bundle

```
Manifest-Version: 1.0
Built-By: wallsc
Created-By: Apache Maven Bundle Plugin
Bundle-Activator: com.osgiknowhow.hello.consumer.internal.HelloConsumerActivator
Import-Package: com.osgiknowhow.hello.service;version="1.0.0.SNAPSHOT",
 org.osgi.framework,org.osgi.util.tracker
Bnd-LastModified: 1236686261405
Bundle-Version: 1.0.0.SNAPSHOT
Ignore-Package: com.osgiknowhow.hello.consumer.internal
Bundle-Name: com.osgiknowhow.hello.consumer
Bundle-Description: Generated using Pax-Construct
Build-Jdk: 1.5.0_16
Private-Package: com.osgiknowhow.hello.consumer.internal
Bundle-ManifestVersion: 2
Bundle-SymbolicName: com.osgiknowhow.hello.consumer
Tool: Bnd-0.0.255
```

- Don't ever write this file yourself
  - Generate it

Activators

- Perform some functionality when a bundle is started and stopped
- Typically used to publish and/or consume services
- Should be quick...or else they'll hold up the starting/stopping of a bundle

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Versioning

- Bundles and packages can be versioned
  - Can even be versioned independent from each other
- Multiple versions can be available simultaneously
- Packages can be imported by specifying a specific version, a version range, or no version at all (implying an infinite version range)

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Services

- Bundle functionality encapsulated behind services
- Bundles can publish/consume services
  - Identified by their interface(s) and optional parameters
  - Publish programatically using bundle context
  - Consume programatically using bundle context and service tracker
- Can be published/consumed declaratively
  - Declarative Services, iPOJO, Spring-DM

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OSGi without Spring-DM

Publishing services

- Done from an activator, via the bundle context:

```
public final class HelloServiceActivator implements BundleActivator
{
    public void start( BundleContext bc )
        throws Exception
    {
        Dictionary props = new Properties();
        bc.registerService(HelloService.class.getName(),
            new HelloServiceImpl(), props );
    }

    public void stop( BundleContext bc )
        throws Exception
    {
    }
}
```

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Consuming services

- Done through an activator, via the bundle context and service activator:

```
public final class HelloConsumerActivator implements BundleActivator {
    private ServiceTracker serviceTracker;

    public void start( BundleContext bc ) throws Exception {
        serviceTracker = new ServiceTracker(bc,
                HelloService.class.getName(), null);
        serviceTracker.open();

        HelloService service =
            (HelloService) serviceTracker.waitForService(10000);
...
    }

...
}
```

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Yeah, but...

- We had to write an activator class
- We had to import org.osgi.*
- We had to work with the OSGi API directly
- There's a lot of boilerplate code

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Wouldn't it be great if...

- ...we could eliminate the boilerplate?
- ...we could declare services for publication and consumption?

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Introducing Spring-DM

What Spring-DM offers...

- Declarative service model for OSGi
- The full facilities of the Spring framework
- Simplified OSGi web development
  - with easy Spring MVC integration
- OSGi API...optional

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Not the only game in town

- OSGi Declarative Services
- Apache Felix iPOJO
- DynamicJava's ServiceBindingUtils
- Peaberry

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The Spring-DM Extender

- "Allows other bundles to extend the functionality in a specific domain"
- Watches for bundles to be installed in OSGi
- Creates a Spring application context for Spring-enabled bundles
  - By default, looks in META-INF/spring/*.xml
  - Can be configured with Spring-Context: header
- Publishes Spring context as a service
  - Can be disabled with ";public-context:=false"

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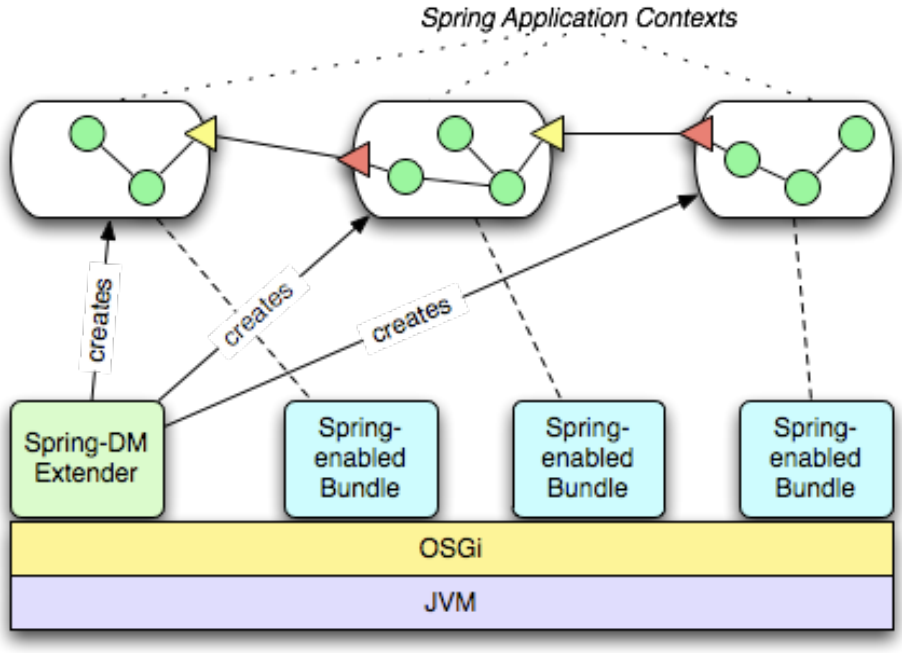
Spring-DM Extender



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Adding Spring-DM

- Your code typically doesn't depend on Spring-DM
- Only need the Spring-DM extender bundle and a few Spring bundles
- Add them all with Pax Construct:

```
% pax-import-bundle -g org.springframework.osgi \
?     -a spring-osgi-extender -v 1.2.0 \
?     -- -DimportTransitive -DwidenScope
```


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Spring-DM context XML

- Best kept separate from non-OSGi XML
  - Supports OSGi-free testing of beans
- Best used as default namespace

```
<beans:beans xmlns="http://www.springframework.org/schema/osgi"
       xmlns:beans="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.springframework.org/schema/osgi
            http://www.springframework.org/schema/osgi/spring-osgi.xsd
            http://www.springframework.org/schema/beans
       http://www.springframework.org/schema/beans/spring-beans-2.5.xsd">

...

</beans:beans>
```


Registering services

- Simplest form:

```
<service ref="helloBean" interface="com.osgiknowhow.beans.HelloService" />
```

- Publish under multiple interfaces:

```
<service ref="helloBean">
  <interfaces>
    <beans:value>com.osgiknowhow.beans.HelloService</beans:value>
    <beans:value>com.osgiknowhow.beans.GoodbyeService</beans:value>
  </interfaces>
</service>
```

- With service properties

```
<service ref="helloBean" interface="com.osgiknowhow.beans.HelloService" >
  <service-properties>
    <beans:entry key="mode" value="test" />
  </service-properties>
</service>
```

Consuming services

- Simplest form:

```
<reference id="helloBean"
        interface="com.osgiknowhow.beans.HelloService" />
```

- Optional service reference:

```
<reference id="helloBean"
        interface="com.osgiknowhow.beans.HelloService"
        cardinality="0..1" />
```

- Specifying a filter:

```
<reference id="helloBean"
        interface="com.osgiknowhow.beans.HelloService"
        filter="(mode=testing)" />
```

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Spring-DM and the web

Web Bundles

- Just WAR files
  - With an OSGi manifest
  - Should be thin...no/few JARs in WEB-INF/lib
  - And Bundle-ClassPath: header

```
Bundle-ClassPath: .,WEB-INF/classes,WEB-INF/lib/hello.jar
```

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Web Extenders

- Pax Web Extender
  - Parses web.xml file
  - Automatically registers servlets/filters/etc with HttpService
- Spring-DM Web Extender
  - Doesn't parse web.xml file
  - Hands web bundle over to Tomcat/Jetty to deploy

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A tale of two Spring contexts

- Spring-DM extender will create a web context for the web bundle
- Spring MVC will create another web context for the DispatcherServlet
- The controllers in the Spring MVC context won't be able to see the service references in the DM-created context
- Unless...

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OsgiBundleXmlWebApplicationContext

```
<web-app>
  <context-param>
    <param-name>contextClass</param-name>
    <param-value>
    org.springframework.osgi.web.context.support.OsgiBundleXmlWebApplicationContext
    </param-value>
  </context-param>

  <context-param>
    <param-name>contextConfigLocation</param-name>
    <param-value>/WEB-INF/dude-osgi.xml</param-value>
  </context-param>

  <listener>
    <listener-class>org.springframework.web.context.ContextLoaderListener</listener-class>
  </listener>

  <servlet>
    <servlet-name>dude</servlet-name>
    <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
    <init-param>
      <param-name>contextClass</param-name>
      <param-value>
    org.springframework.osgi.web.context.support.OsgiBundleXmlWebApplicationContext
      </param-value>
    </init-param>
  </servlet>
</web-app>
```

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You'll need a few more bundles

- You'll need the Spring-DM web extender and Spring MVC
- Using Pax Construct:

```
pax-import-bundle -g org.springframework.osgi -a spring-osgi-web-extender
                  -v 1.2.0
pax-import-bundle -g org.springframework.osgi -a spring-osgi-web -v 1.2.0
pax-import-bundle -g org.springframework -a spring-web -v 2.5.6
```


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Blueprint Services

OSGi 4.2's Blueprints

- AKA RFC-124: A component model for OSGi
- Suspiciously similar to Spring-DM
- Spring-DM 2.0.0 is the reference implementation
  - Also available outside of Spring

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Blueprint Example

```
<?xml version="1.0" encoding="UTF-8"?>

<blueprint xmlns="http://www.osgi.org/xmlns/blueprint/v1.0.0"
           xmlns:ext="http://geronimo.apache.org/blueprint/xmlns/blueprint-ext/v1.0.0"
           default-activation="lazy">

   <bean id="numberService"
            class="com.habuma.numbers.internal.NumberToEnglishServiceImpl" />

   <service ref="numberService"
            interface="com.habuma.numbers.NumberToEnglishService" />

</blueprint>
```

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So what?

What did OSGi buy us?

Each module can be...

- Developed independently
- Tested independently
- Understood independently
- Updated independently
- Swapped out for alternate implementations

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Moving to OSGi

Or...what do I do with this WAR file I already have?

Strategy

1. Convert full app into one large bundle
   a. Embed JARs (Use Bundle-ClassPath)
   b. Add Bundle-SymbolicName
2. Peel off dependencies one-by-one
   a. Start with 3rd party libraries
   b. Pull out proprietary modules

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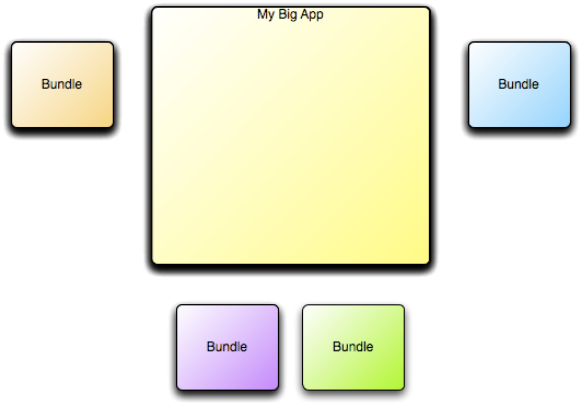
Converting Big Apps



Dealing with Legacy JARs

- BND
- Pax Construct:
  - pax-wrap-jar or pax-embed-jar
- Find them in a bundle repository
  - OBR
    - http://www.osgi.org/Repository
  - SpringSource Enterprise Bundle Repository
    - http://www.springsource.com/repository