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Best Practices for (Enterprise) OSGi applications

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Who is Tim Ward?
- @TimothyWard

- **Java Consultant**
- **5 years at IBM developing WebSphere Application Server**
- **PMC member of the Apache Aries project**
  - Particularly interested in Bytecode weaving/generation, JPA, EJBs, Blueprint Dependency injection, Declarative qualities of service (e.g. transactions)
- **Regular conference speaker**
  - JAX London, EclipseCon, Devoxx, Jazoon, OSGi Community Event
- **Author of Enterprise OSGi in Action**
  - Early access available at http://www.manning.com/cummins
  - All chapters complete
    - See the Manning booth for discounts on this and many other books

Agenda

What is “Enterprise OSGi” and why do I need it?

How can I use OSGi in my Applications?

How *should* I use OSGi in my Applications?

Where can I learn more about OSGi?

What is “Enterprise OSGi” and why do I need it?

- **OSGi is a mature technology with a broad range of adoption**
  - Eclipse!
  - Embedded systems
  - Home automation
  - Java EE Application Servers

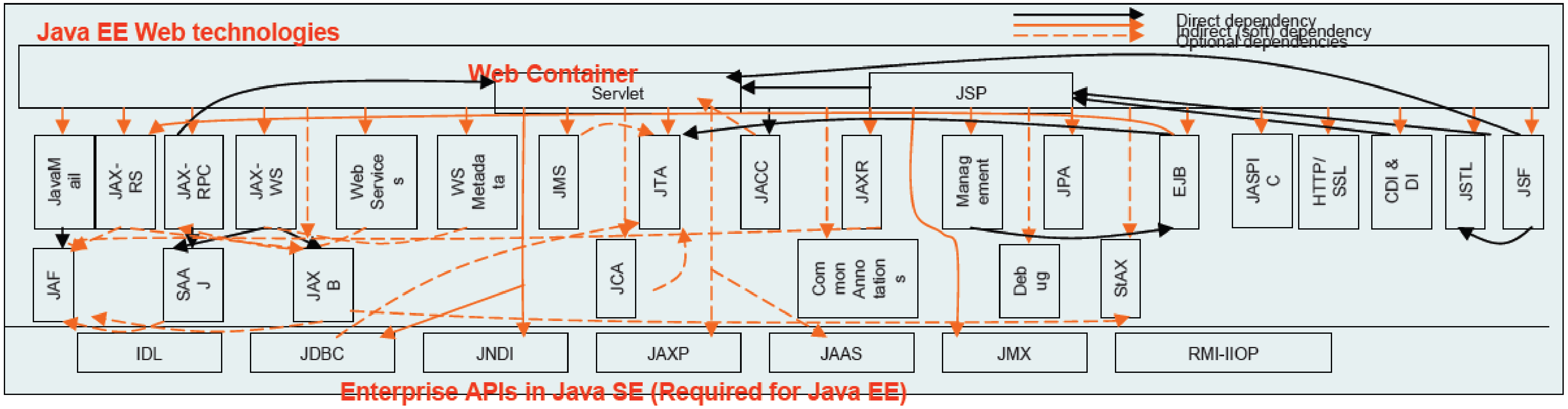
- **Enterprise OSGi is much newer (First release 2010)**
  - Primary focus to improve OSGi’s support for enterprise tools
  - Widely available in Open Source and Commercial servers

What is “Enterprise OSGi” and why do I need it? (2)

- **So simply put Enterprise OSGi is just OSGi applied to “Enterprise” Applications**
    - OSGi Web applications
    - Using databases from an OSGi framework
    - Managed Transactions for OSGi bundles
    - Remoting Services…
- **But isn’t this what Java EE is for?**
    - Why is OSGi helpful?

What is "~~Enterprise~~ OSGi" and why do I need it? (3)

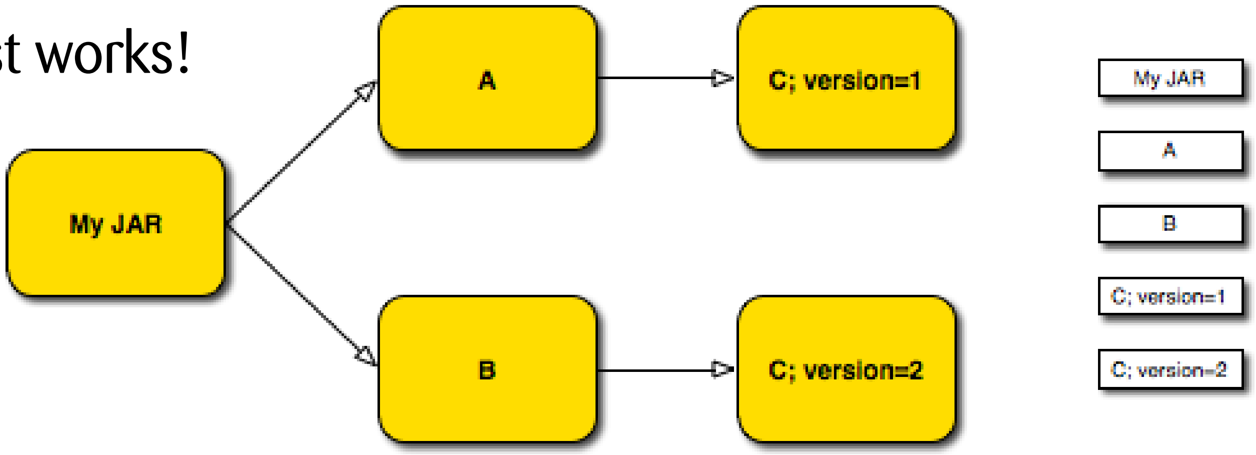
- **OSGi is used for many reasons, but a primary motivation is modularity**
  - Big systems are hard to maintain and understand because of the relationships between components:



- **Big applications are just as complicated as servers (and usually have more external dependencies!)**

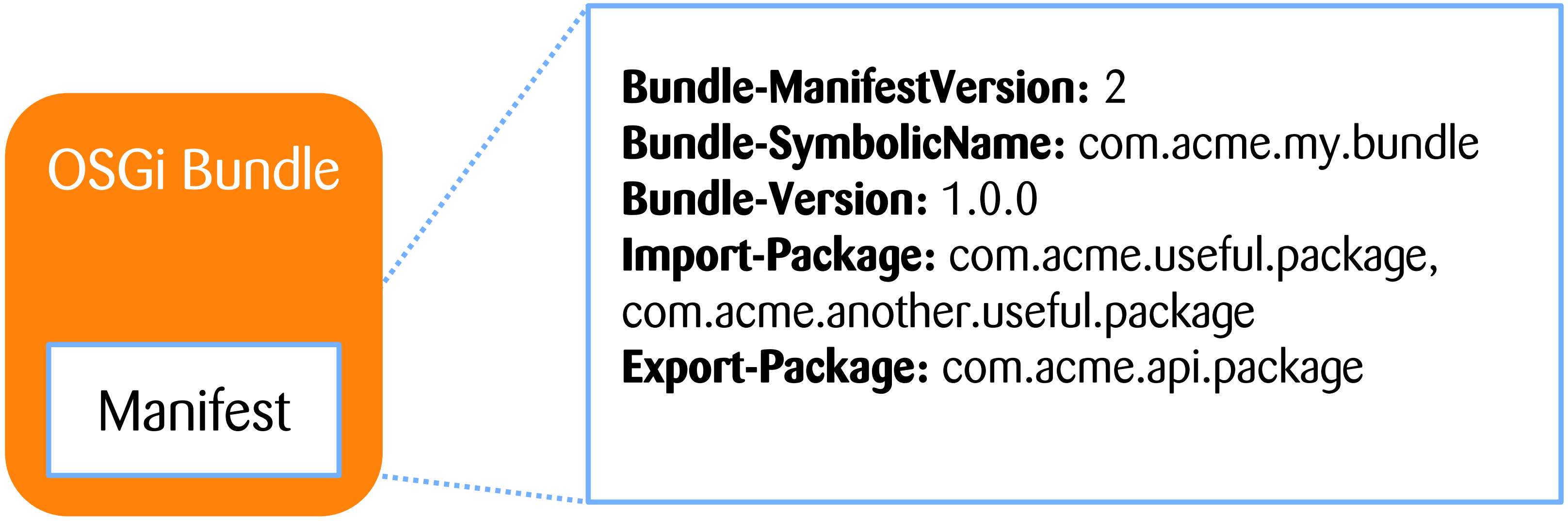
Why else do I need OSGi?

- **Have you ever found that you need to use a library class, but it depends on another version of a library you were already using?**
  - Java has a flat classpath, so you can only have one version of the class
  - If you can't change the code you can be forced into using brittle combinations of point releases
- **OSGi has a classloader graph:**
  - It all just works!



How can I use OSGi in my Applications?

- **Lots of Application runtimes offer some support for OSGi applications**
  - WebSphere, Glassfish, Jboss, Geronimo, Karaf, Virgo, Aries…
- **Most require little more than packaging your application as OSGi bundles**



Bundle-ManifestVersion: 2
Bundle-SymbolicName: com.acme.my.bundle
Bundle-Version: 1.0.0
Import-Package: com.acme.useful.package, com.acme.another.useful.package
Export-Package: com.acme.api.package

How can I use OSGi in my Applications? (2)

- **In terms of scope OSGi bundles are like JARs with better isolation**
  - This is good, but how many Enterprise Applications are built as a single JAR?
- **The Java EE EAR exists to support multi-module applications**
  - Even WAR files have built in support for library JARs
- **For a long time OSGi had no scope beyond the bundle**
  - Parallel solutions exist in Eclipse, Apache and several commercial servers
  - A unified model is offered by OSGi Subsystems

How *should* I use OSGi in my Applications?

Best practices for all OSGi applications

How *should* I use OSGi in my Applications?
1. Bundle Hygiene

- **Well designed Object Oriented code exhibits good modular properties**
  - Simple reuse and ability to switch implementation
- **These properties rely on classes being Cohesive and loosely coupled**
- **From a modularity perspective OSGi bundles very similar**
  - To work well an OSGi Bundle should be cohesive and loosely coupled
- **The bundle manifest is an excellent guide to how well designed the bundle actually is**

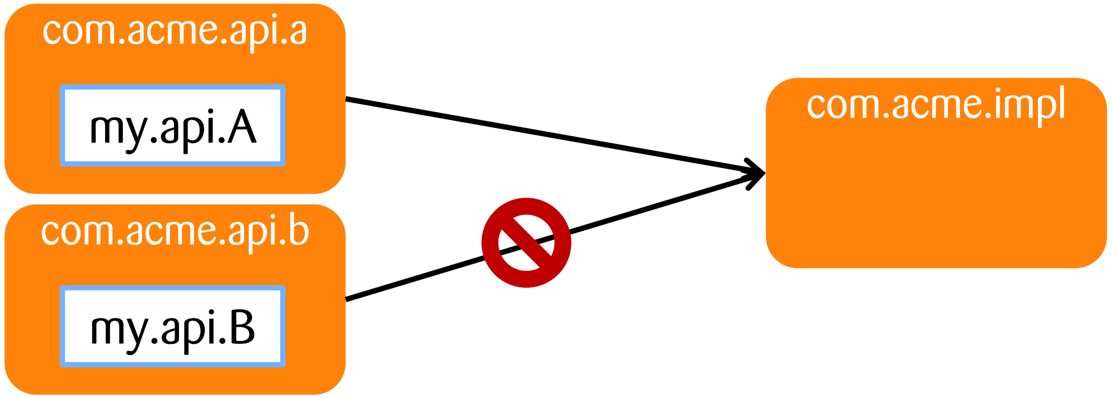
How *should* I use OSGi in my Applications?
1 a) Avoid Tight Coupling

- **Java developers learn to recognise tightly coupled code**
  - Casting to implementation
  - Relying on side-effects and leftover state
- **OSGi has similar warning signs**
  - We saw how code can be imported by **Import-Package**
  - OSGi also offers **Require-Bundle**
- **Require-Bundle is a bit like casting to an implementation type**
  - You don’t just care about API, but also where it comes from!

How *should* I use OSGi in my Applications? 1 b) Do enough to be Cohesive

- **Splitting behaviour across multiple Objects makes an API hard to use**
  - The same is true of packages in OSGi

- **A split package is one that exists two or more bundles but contains different classes in each**
  - The OSGi classloader allows packages to come from exactly one bundle



The implementation might get A or B, but never both

How *should* I use OSGi in my Applications?
1 c) Don’t do too much in your bundle

- **Doing too much in a class is as bad as doing too little**
  - It’s hard to use an API with too many methods and arguments
  - It adds overhead and hurts performance
  - It’s hard to maintain
- **Bundles can suffer from the same problem**
  - Huge numbers of dependencies (Import-Package or Require-Bundle)
  - Lots of exported packages (which one do I use?!?)
- **If a manifest can be measured in megabytes you’re doing it wrong!**

How *should* I use OSGi in my Applications?
2. Version *Everything*

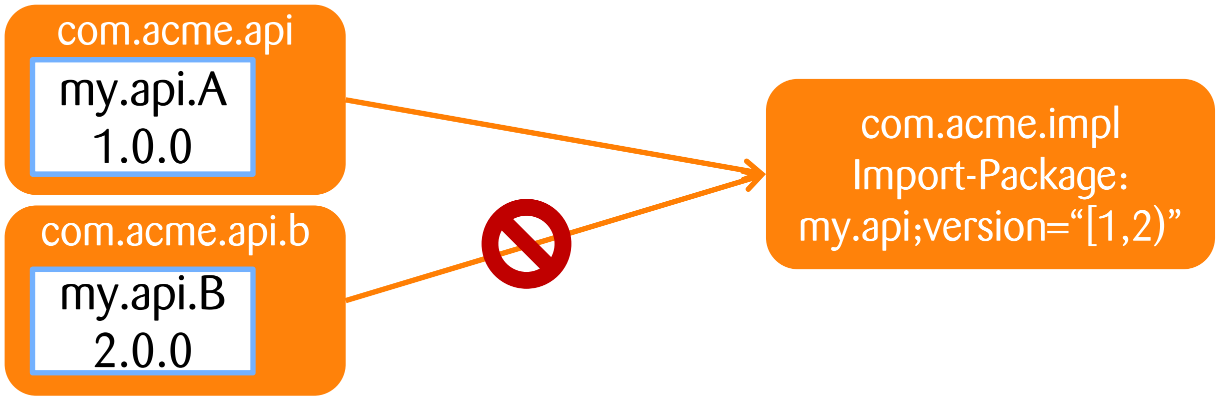
- **You've seen that bundles can have a version**
  - Package Exports can be versioned too
  - Imports can declare a range of accepted versions

- **Versioning properly makes bundles less brittle and easier to reuse**
  - Semantic versioning of packages allows clients to declare what function they require
    - Major version changes indicate that clients might be broken
    - Minor version changes indicate backward compatible updates
    - Micro version changes are for bug fixes

- **Unversioned packages are like a box of chocolates…**

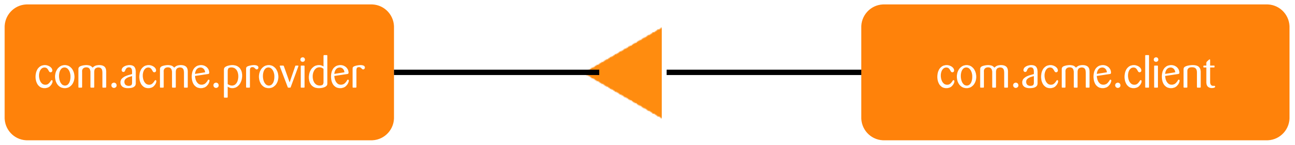
How *should* I use OSGi in my Applications? 2. Version *Everything* (2)

- **We saw how split packages can break client bundles**
  - If they are versioned properly then the client can make a choice



How *should* I use OSGi in my Applications?
3 a) Use Services for looser coupling

- **Java lacks a satisfactory way to get implementation Objects**
  - Using new introduces tight coupling
  - Using a factory is better, but still couples you to the factory!
- **OSGi has a service registry that bundles can use to collaborate**
  - Services are registered using their API, so clients don't need to construct them!

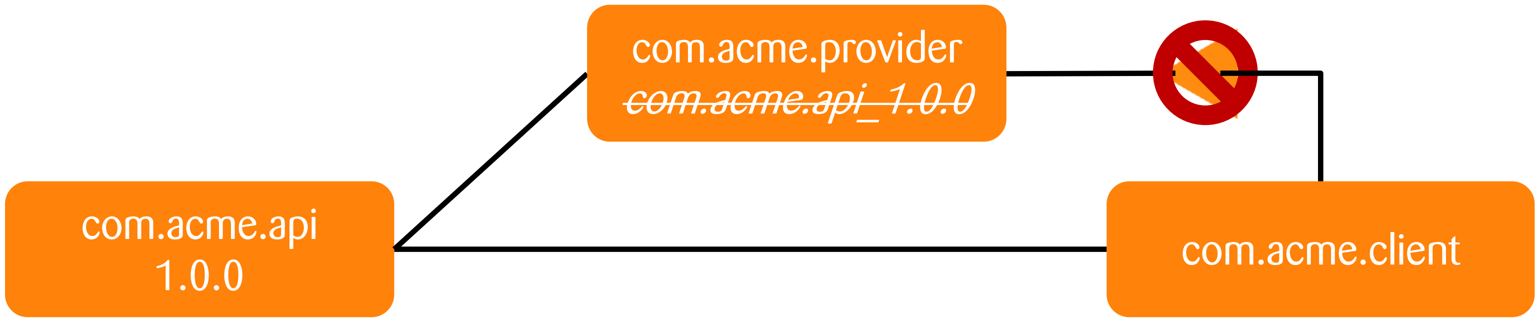


- **Using services makes it much easier to reuse and swap bundles**

How *should* I use OSGi in my Applications?
3 b) Make services substitutable

- **Sharing services relies on your bundles using the same version of the API**
  - In fact it relies on you both getting the API from the same bundle!

- **If the same API is available from multiple bundles then the client might see a different one to the service provider…**



- **API works best when it is substitutable**
  - Bundles that export API should import it too – this allows more sharing

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How *should* I use OSGi in my Applications?

Best practices for ***Enterprise*** OSGi applications

How *should* I use OSGi in my Applications? 4. Don't do it all yourself!

- **OSGi is a very powerful environment, but it can be hard to use**
  - Many constructs are very low level
  - This is great for embedded systems, but not always for enterprise apps!
- **The Enterprise Specifications offer a number of helpful tools**
  - Dependency injection frameworks
  - Data Access Services…
- **Make sure you use them!**

How *should* I use OSGi in my Applications? 4 a) Accessing services

- Using an OSGi service *properly* is hard because they are dynamic

```
private BundleContext ctx;

private AtomicReference<LogService> ls = new
AtomicReference<LogService>();
private AtomicReference<ServiceReference> lr = new
AtomicReference<ServiceReference>();

public void start(BundleContext ctx) throws InvalidSyntaxException
{
this.ctx = ctx;
ctx.addServiceListener(this, "(objectClass=org.osgi.service.log.LogService)");
ServiceReference ref = ctx.getServiceReference(LogService.class.getName());
if (ref != null) {
        ls.set((LogService) ctx.getService(ref));
        lr.set(ref);
}
}
```

```
@Override
public void serviceChanged(ServiceEvent event)
{
ServiceReference ref = event.getServiceReference();

if (ls.get() == null && event.getType() == ServiceEvent.REGISTERED) {
        ls.set((LogService) ctx.getService(ref));
} else if (ls.get() != null && event.getType() == ServiceEvent.UNREGISTERING
        &&
        ref == lr.get()) {
        ref = ctx.getServiceReference(LogService.class.getName());
        if (ref != null) {
              ls.set((LogService) ctx.getService(ref));
              lr.set(ref);
        }
}
}
```

How *should* I use OSGi in my Applications?
4 a) Accessing services (2)

- **There are several OSGi dependency injection containers that make using services *much easier***
  - Blueprint and Declarative Services are both OSGi standards
- **Declarative Services is very lightweight**
  - Great for systems with simple wirings
  - No damping of services (A good and bad thing!)
- **Blueprint offers a Spring-like programming model**
  - Easy to set up and manage large injection graphs
  - Service damping means beans are protected from the service lifecycle

How *should* I use OSGi in my Applications? 4 a) Accessing services (3)

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Sample blueprint consuming a service:

```
<blueprint>
  <bean id="myBean" class="org.acme.impl.MyBean">
    <property name="logService" ref="logService" />
  </bean>
  <reference id="logService"
      interface="org.osgi.service.log.LogService" />
</blueprint>
```

Sample Declarative Services consuming a service:

```
<component name="myBean">
  <implementation class="org.acme.impl.MyBean" />
  <reference bind="setLogService" cardinality="1..1"
      interface="org.osgi.service.log.LogService"
      policy="static" unbind="unsetLogService"
      name="logService" />
</component>
```

How *should* I use OSGi in my Applications?
4 b) Accessing data

- **JDBC and JPA are commonly used to access data**
  - Both rely on static factories and Classpath visibility to work
- **Trying to use traditional access patterns leads to unpleasant hacks**
  - There are Standard ways to get hold of these things in OSGi
- **The JDBC service uses DataSourceFactory services to create DataSources**
  - Your server may register managed DataSource sservices too
- **The JPA service also uses the service registry to provide EntityManagerFactory Objects**

How *should* I use OSGi in my Applications? 4 c) Enterprise OSGi Web Applications

- **Traditionally OSGi applications use the HttpService to register Servlets**
  - This is good if you have one or two servlets, but not for big web apps
- **The Enterprise Specification defines Web Application Bundles**
  - Essentially they are WARs with OSGi metadata
- **WABs allow you to reuse tools and expertise when moving to OSGi**
  - Many web frameworks are OSGi enabled too
  - A very easy way to begin migrating to OSGi

Summary

Things to remember

- **OSGi isn't as hard as you've been led to believe!**
  - But it isn't magic either, you need to use what it gives you

1. **Keep your bundles tidy and well defined**
   i. Spaghetti bundles are just as bad as spaghetti code!
2. **Use semantic versioning to keep control of your dependencies**
3. **Use the service registry to communicate between bundles in a simple, decoupled way**
4. **Use the Enterprise specifications to avoid writing huge amounts of boilerplate in your applications**

Useful Resources

- The OSGi specifications are available at http://www.osgi.org
- Apache Aries for implementations http://aries.apache.org/
- Manning have several good OSGi books
  - **Enterprise OSGi in Action** – Get up and running with Web Apps, Transactions, JPA, Remoting, IDEs and build tools
  - **OSGi in Action** – Great examples and coverage of core OSGi and compendium services
  - **OSGi in Depth** – Detailed coverage of architectural patterns for OSGi
- If you go to the Manning stand there are big EclipseCon discounts

- OSGi Articles available at http://www.developerworks.com