Felix Goes to Tuscany

Applying OSGi modularity after the fact

Luciano Resende

lresende@apache.org

Graham Charters

charters@uk.ibm.com

About Apache Tuscany

- Tuscany provides a component based programming model which simplifies development, assembly and deployment and management of composite applications in SOA.
- Apache Tuscany implements SCA standards defined by the OASIS OpenCSA and also provides extensions based on real user feedback.

About Apache Felix

- Apache licensed open source implementation of OSGi R4
  - Framework (in progress, stable and functional)
    - Version 1.2.1 currently available
- Implements additional services
  - OSGi Bundle Repository (OBR)
  - IPOJO - POJO-based component model
  - Maven Bundle Plugin
  - ...

Tuscany Environment before OSGi

- Modularization inspired in OSGi
  - 150+ Modules
- Multiple Extensions with different levels of dependencies
  - 120+ 3rd Party Dependencies
- Maven based build

Motivation for OSGi

- Better class loading mechanism for our modules
- Create clean boundaries between sub-systems
- Facilitate embedding Tuscany in OSGi based environment
- Without OSGi Java modularity is broken
  - OO modularity too fine-grained
  - Severely limited package modularity
  - Jars have no modularity characteristics
  - Classpath ordering defines which class you get

OSGi & SCA

- Support OSGi as a packaging mechanism for SCA application artifacts (contributions)
  - SCA specification already mentions OSGi as package skin
  - Leverage OSGi import/export to import java artifacts from different SCA application artifacts (contributions)
- Support OSGi as an SCA Component Implementation Type
  - Use SCA to assemble OSGi Bundles with other implementation technologies

Constraints

- No free-reign to drive through the changes
- Community Concerns:
  – Must not cease non-OSGi support
  – Must not significantly increase distribution footprint
  – Must not significantly increase build time
  – Must not significantly increase runtime costs
  – Must not overburden non-OSGi community
- These constraints influence speed of and approach to OSGi adoption

Supporting Tools

- We have found various tools available
  - Dependency analyze tools
    - BND
  - Bundle dependency visualization
    - <coderthoughts /> - GMF
    - <coderthoughts /> - ManyEyes
  - Maven related tools
    - Various maven plugins
- Our experience
  - In general, most of the tools have particular issues that didn't allow us to have a fully OSGi experience

Dependency Analysis Tools

- BND
  - Tool for creating Bundles
  - Analyzes code to determine dependencies
  - Supports directives to tailor OSGi Manifest
  - Supports many build options
    - Command Line
    - Ant
    - Maven
    - Eclipse

http://www.aqute.biz/Code/Bnd

Apache Felix Maven Bundle Plugin

- The 'glue' between Maven and BND

```
...
<plugin>
    <groupId>org.apache.felix</groupId>
    <artifactId>maven-bundle-plugin</artifactId>
    <configuration>
        <instructions>
            <!-- Bundle versioned from Tuscany version -->
            <Bundle-Version>${tuscany.version}</Bundle-Version>
            <!-- Bundle Symbolic name -->
            <Bundle-SymbolicName>org.apache.tuscany.sca.api</Bundle-SymbolicName>
            <!-- Bundle description from pom description -->
            <Bundle-Description>${pom.description}</Bundle-Description>
            <!-- Export org.osoa.sca and all sub-packages -->
            <Export-Package>org.osoa.sca*</Export-Package>
            <!-- No Import-Package so calculate imports from code dependencies -->
        </instructions>
    </configuration>
</plugin>
...
```

http://felix.apache.org/site/apache-felix-maven-bundle-plugin-bnd.html

Apache Felix Maven Bundle Plugin - Caveats

- Test dependencies are ignored during calculation of imported packages
  - Issues when tests have references to external packages
- Current solution
  - Created maven plugin that consider test dependencies and properly find import packages and mark them as optional

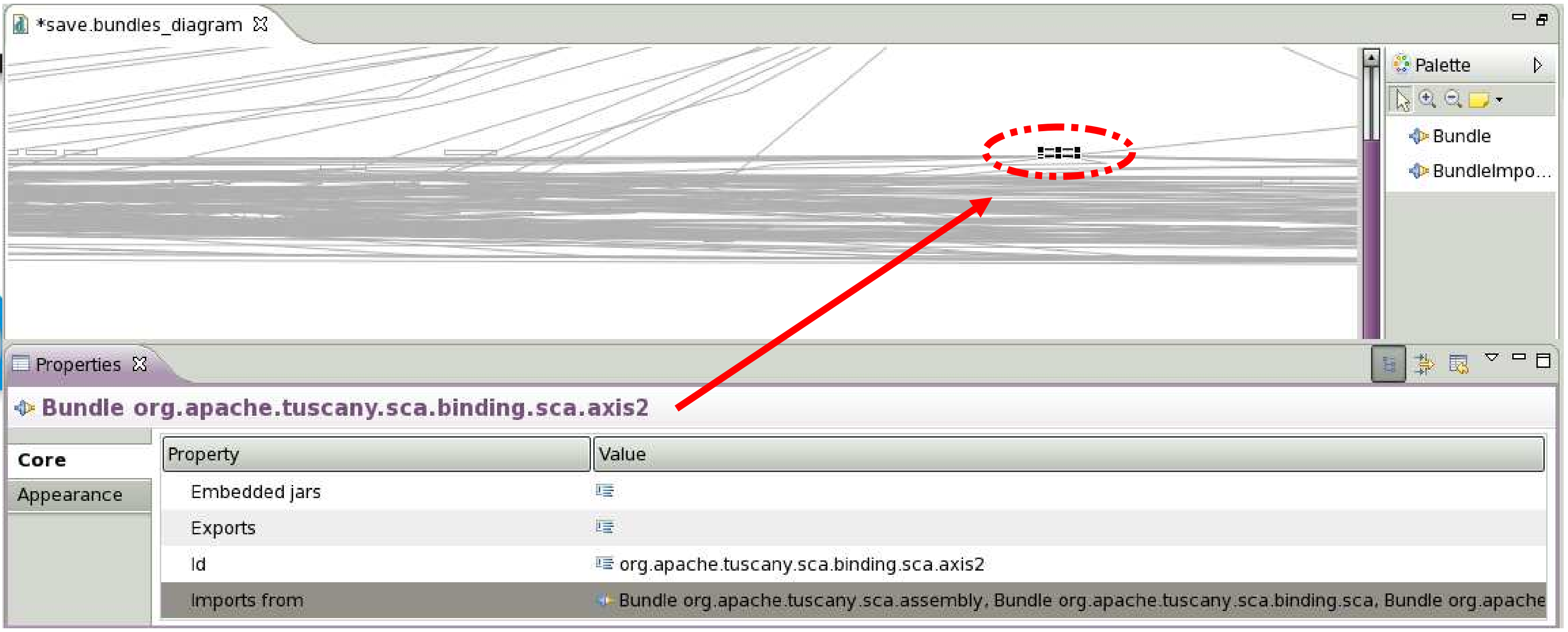
Bundle dependency visualization

- <coderthoughts /> + GMF
  - ASL2 licensed output from a blog by <coderthoughts />
  - Uses EMF to model and save Bundle runtime dependency resolution
  - Introspector bundle analyzes and saves dependencies from a running system
  - Uses GMF for Visualization

http://coderthoughts.blogspot.com/2008/04/osgi-bundle-dependency-visualizer-in.html

<coderthoughts /> + GMF

- Dependency analysis works very well
- GMF visualization does not scale!



Bundle org.apache.tuscany.sca.binding.sca.axis2

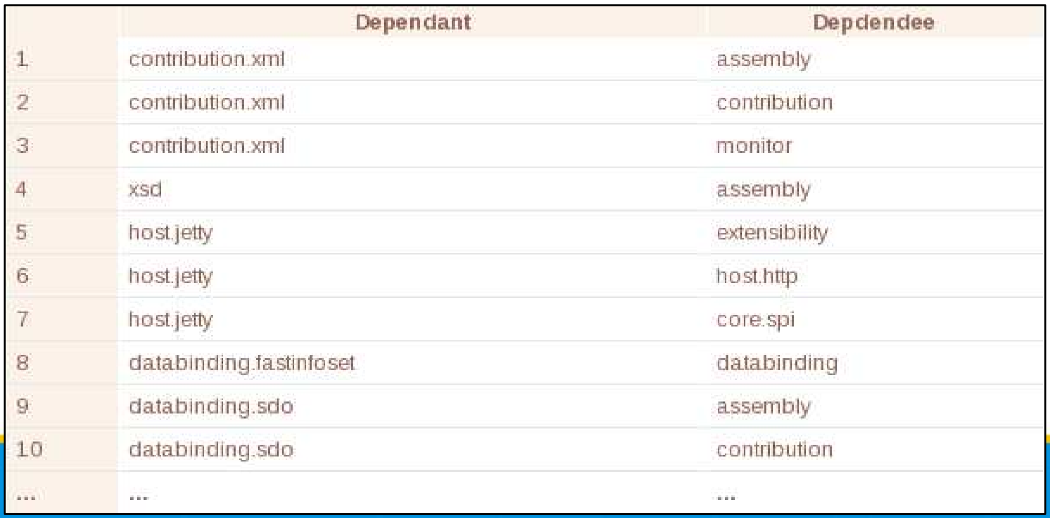
Core

Appearance

Property	Value
Embedded jars	
Exports	
Id	org.apache.tuscany.sca.binding.sca.axis2
Imports from	Bundle org.apache.tuscany.sca.assembly, Bundle org.apache.tuscany.sca.binding.sca, Bundle org.apache

ManyEyes

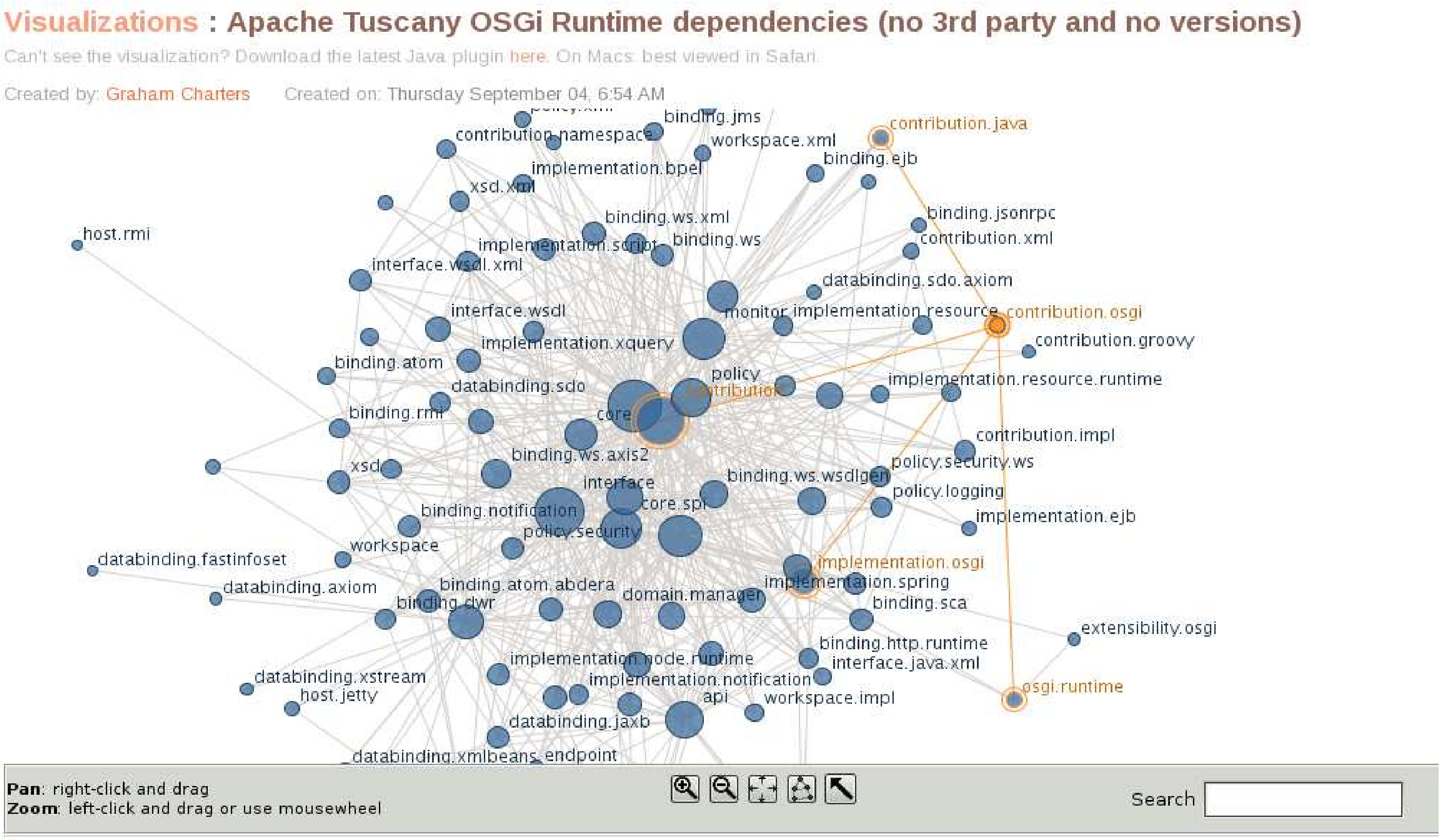
- IBM AlphaWorks shared data visualization service
- Visualization options include
  - Maps, Line Charts, Pie Charts, Tree Maps, Network Diagrams, and many more
- Used Network Diagram to visualize dependencies
- DataSet is simple table of dependant to dependee
  - Can use 'cat', 'grep' and 'sed' to slice-n-dice the data and experiment with combining Bundles
- <coderthoughts /> dependency analysis used to create DataSet



	Dependant	Depdendee
1	contribution.xml	assembly
2	contribution.xml	contribution
3	contribution.xml	monitor
4	xsd	assembly
5	host.jetty	extensibility
6	host.jetty	host.http
7	host.jetty	core.spi
8	databinding.fastinfoset	databinding
9	databinding.sdo	assembly
10	databinding.sdo	contribution
...	...	...

http://services.alphaworks.ibm.com/manyeyes/home

<coderthoughts /> + ManyEyes


Visualizations : Apache Tuscany OSGi Runtime dependencies (no 3rd party and no versions)

Can't see the visualization? Download the latest Java plugin here. On Macs best viewed in Safari.

Created by: Graham Charters Created on: Thursday September 04, 6:54 AM

Pan: right-click and drag
Zoom: left-click and drag or use mousewheel

Search

http://services.alphaworks.ibm.com/manyeyes/view/SWhH8QsOtha6MtkkFzD9Q2~

Maven builds and OSGi

- Maven 2.0.9+
  - Fixes for MNG-3396 and MNG-3410
    - Fixes that allow definition of specific dependency version when dependency range was defined.

Maven builds and OSGi - Caveats

- Version ranges have different meanings in Maven and OSGi
  - OSGi
    - x.y.z.q > x.y.z
    - 3.3.0 < 3.3.0-v20070606-0010
    - 3.3.0-v20070606-0010 **is** in [3.3,4.0)
  - Maven
    - x.y.z.q < x.y.z
    - x.y.z-q < x.y.z
    - 3.3.0-v20070606-0010 < 3.3.0
    - 3.3.0-v20070606-0010 is **not** in [3.3,4.0)

    - 1.0.0-SNAPSHOT = work in progress towards 1.0.0
- Workaround
  - use <dependencyManagement> to explicitly define the version to be used
  - Requires maven 2.0.9+

Maven Eclipse Plugin

- Used to generate Eclipse IDE Files for given maven projects
  - *.classpath
  - *.wtpmodules
  - .settings folder
  - etc

Maven Eclipse Plugin - Caveats

- Eclipse plugin add dependency jars directly in the project classpath in addition to the “eclipse bundle class path container”
- Current solution
  - Created maven plugin to properly configure project classpath to use the “eclipse bundle class path container” and avoid adding the dependency jars directly to the classpath

Maven eclipse compiler

- The Sun compiler is not aware of OSGi Import/Export
- The maven-eclipse-compiler plugin allows us to directly use the Eclipse compiler that have better support for OSGi bundles

Maven eclipse compiler - Caveats

- We found various issues with the eclipse compiler plugin
  - Warnings would cause plugin to hang
- In progress solution
  - Using a forked version of the maven-eclipse-compiler plugin
  - Bring-up plugin to working stage
  - Enhancing to enforce OSGi Import/Export

Applying OSGi to Tuscany

One Big Bundle of Joy

- Recommended practice when moving to OSGi*
  - Create one big bundle containing application and dependent libraries
  - Get it working in OSGi
  - Gradually replace dependent libraries with Bundles
  - Keep it working!
- This is how we started...
  - 1 Bundle ~ 60MB made from 200+ jars

*http://developers.sun.com/learning/javaoneonline/2008/pdf/TS-5122.pdf

Decomposition First Attempt

- Identified five categories of jars and created corresponding Bundles

– `org.apache.tuscany.sca.api.jar`	18,701
– `org.apache.tuscany.spi.jar`	430,563
– `org.apache.tuscany.runtime.jar`	538,660
– `org.apache.tuscany.extensions.jar`	1,374,045
– `org.apache.tuscany.depends.jar`	57,872,558

- Issues:
  - Too coarse-grained to be of real value
  - No opportunity for sub-setting
  - Not modular

Re-using Existing Decomposition

- Tuscany already decomposed into many Maven modules
- Benefits:
  - Maven Bundle Plugin makes it easy to create Bundles
  - Matches community's existing understanding
  - Same bundles can be used outside OSGi
  - Easily sub-set as Tuscany intended
- Issues:
  - Lots of classloader issues
    - Assumed single classloader
  - Difficult to consume (200+ bundles)

Granularity

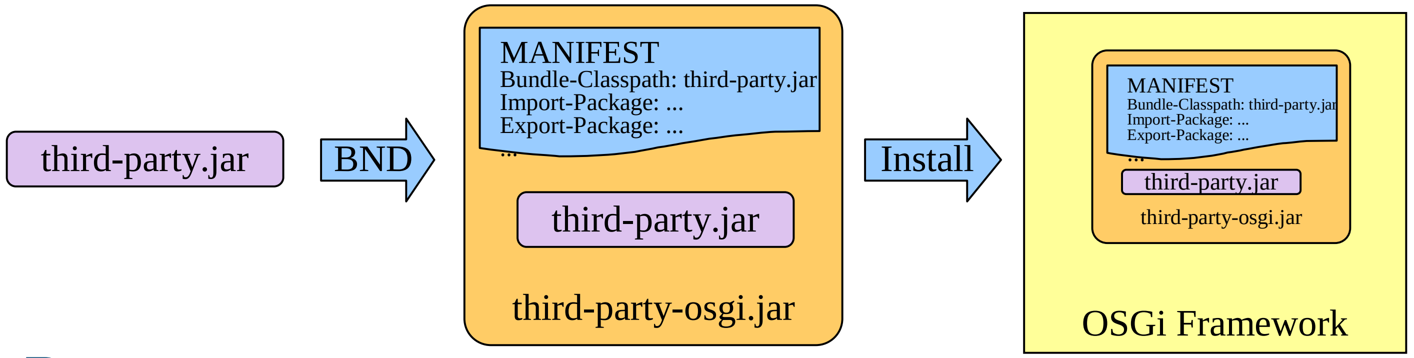
- 200+ bundles cumbersome
- Multiple bundles required to enable one capability
- Much debate about right level of granularity
- Conclusion
  - Fine-grained bundles suitable for developer view
  - Features used to aggregate bundles to provide a user view
    - Inspired by Eclipse Features

Third-party Libraries

- Many third-party libraries not enabled for OSGi
- Repositories are emerging
  - OSGi Bundle Repository (OBR)
  - Apache Felix Commons
  - Eclipse Orbit
  - SpringSource Bundle Repository
- Tuscany has ~120 pre-requisite third-party libraries
- Version and footprint constraints influence choice of approach
  - Project not comfortable to go with repository choice

Third-party Library: wrap

- Wrap the Jar in a Bundle
  - Bundle-Classpath: third-party.jar

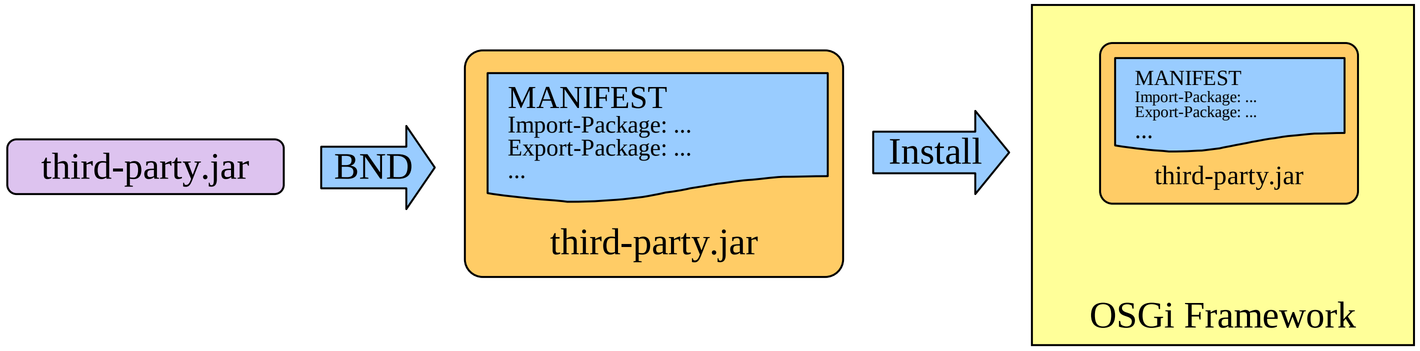


- Pros
  - Works for signed Jars
  - Can aggregate multiple Jars
- Cons
  - Jar no longer works in non-OSGi environment (doubles the build footprint)

Leading the Wave of Open Source

Third-party Library: convert

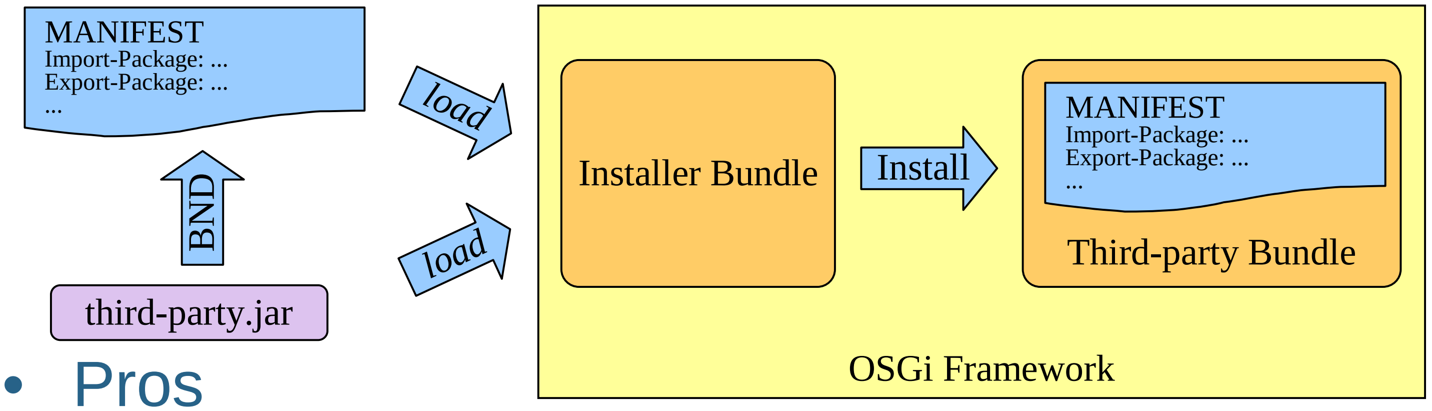
- Convert the Jar to a Bundle



- Pros
  - Jar works in non-OSGi environment (no footprint issue)
- Cons
  - Doesn't work for signed Jars
  - May affect library licensing
  - Can't aggregate multiple Jars

Third-party Library: virtual bundle

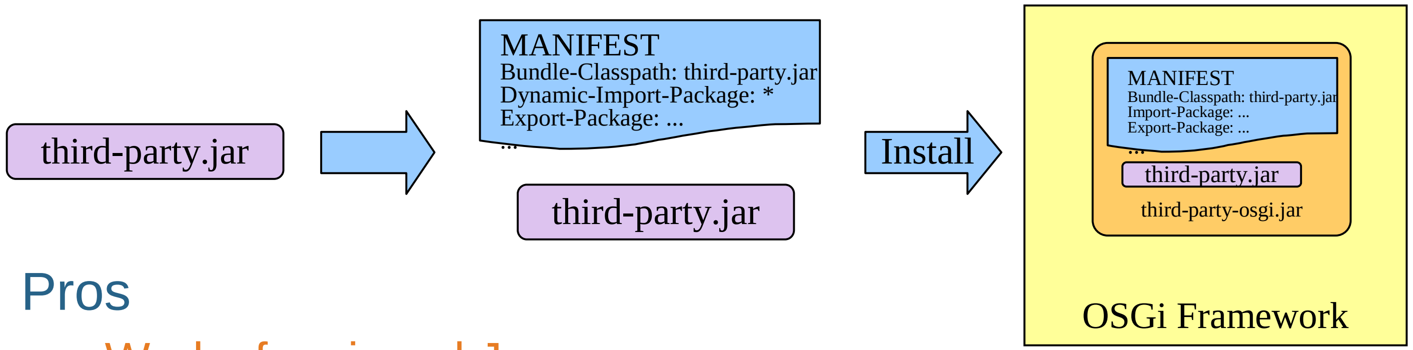
- Convert Jar to a Bundle at runtime
  - Manifest pre-generated or created on-the-fly



- Pros
  - Jars completely unchanged
  - Works for signed Jars
- Cons
  - No 'real' bundle to work with during development
  - Messy – two artefacts to manage

Third-party Library: Unpacked wrap

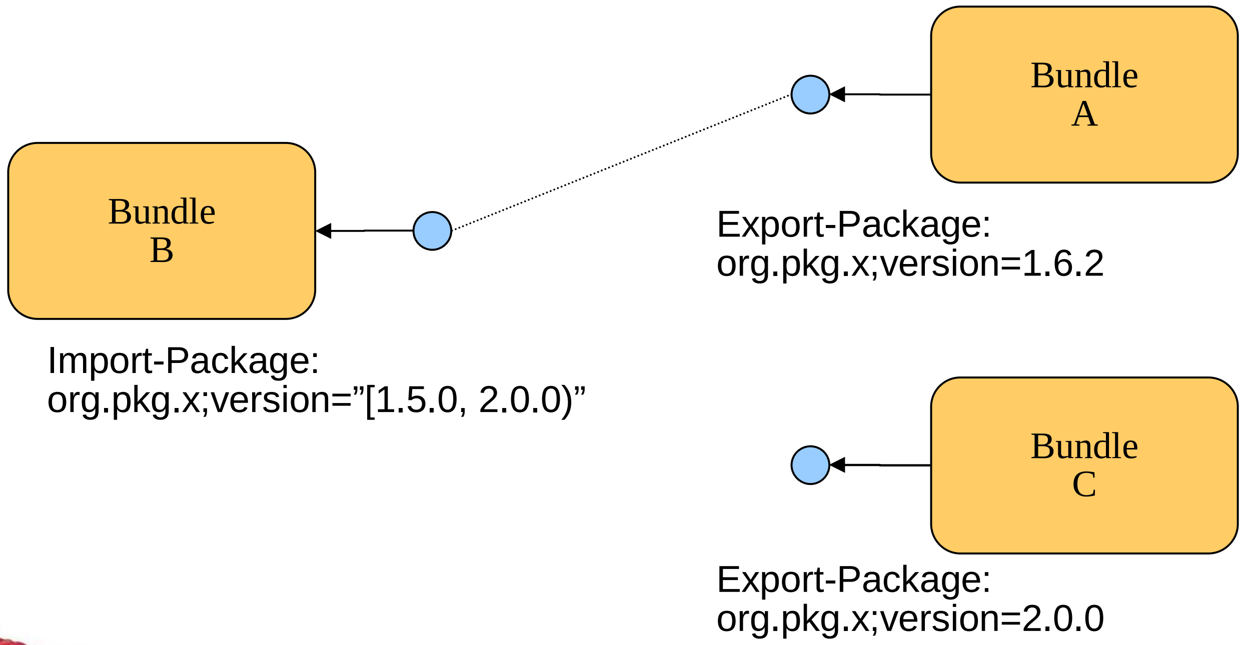
- Unpacked wrap style bundle
  - Bundle-Classpath: third-party.jar



- Pros
  - Works for signed Jars
  - Can aggregate multiple Jars
- Cons
  - Dynamic resolving might have performance implications
    - Working on enhancing the tools to use BND logic to calculate import packages

OSGi Versioning

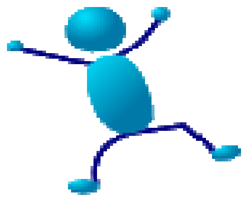
- Package exports can specify a version
- Package imports can specify a version range
- The OSGi resolver 'wires' imports to exports

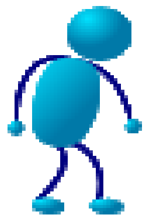

Bundle A
Export-Package: org.pkg.x;version=1.6.2
Bundle B
Import-Package: org.pkg.x;version=”[1.5.0, 2.0.0)”
Bundle C
Export-Package: org.pkg.x;version=2.0.0

Versioning

“Apache Commons has guidelines, we should trust them to do the right thing.”

“Without the testing, we can't be sure of anything.”





The Idealist

- Version range [1.5.0, 2.0.0)
- Flexible
- Relies on others to do the right thing
- Risky
- Makes an untested support statement

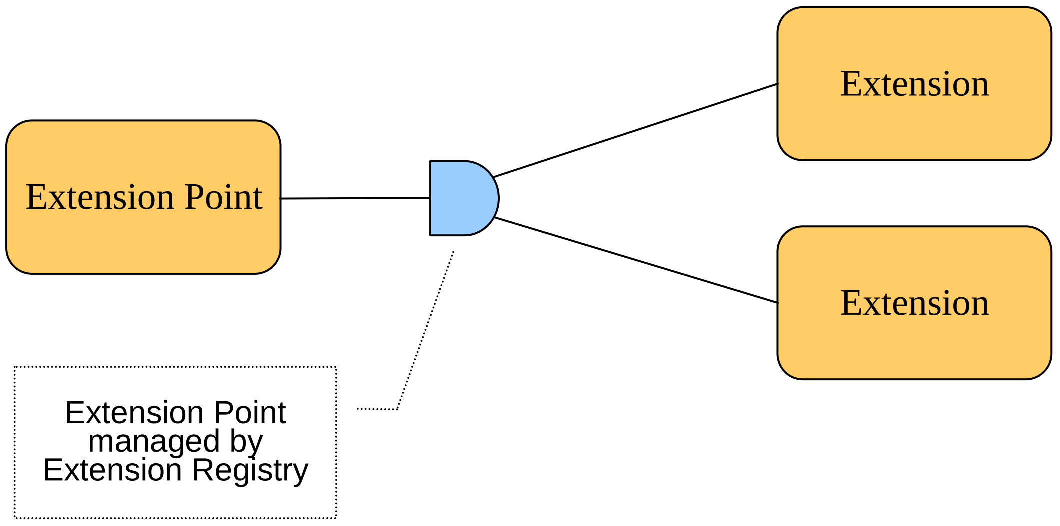
The Realist (paranoid)

- Fixed version [1.5.0, 1.5.0]
- Inflexible
- Will get the version you tested against
- Safe
- Inhibits bundle updates

Tuscany community chose to start with fixed versions with a view to introducing ranges through experience

Extension Registry Pattern

- Module declares extension point
- Modules contribute extensions which implementation extension points
- Extension Registry manages extension point and extension matching
- Used extensively in Eclipse (not standard OSGi and not part of Felix)



http://www.eclipsezone.com/articles/extensions-vs-services/

Tuscany Extensibility

- OSGi optional so Tuscany needed its own thing
  - inspired by Extension Registry
- Tuscany SPI defines extension points
- Extension Modules contribute
  - Bindings (REST, json-rpc, SOAP, ...)
  - Implementation Types (POJO, BPEL, OSGi, ...)
  - Interface Types (Java, WSDL)

Summary

- It is indeed possible !
  - OSGi effort is making good progress
- Current Approach
  - Tuscany Modules → OSGi Modules
  - 3rd Party Libraries → OSGi Modules
    - Using Unpacked wrap style bundle
  - Bundle Manifests available in source repository and tweaked for optional test dependencies
  - Tools are still an issue
    - Have already created several toolings
    - Looking for a maven-eclipse-compiler that would enforce OSGi import/export

Useful Links

- Apache Tuscany
  - http://tuscany.apache.org
- Apache Felix
  - http://felix.apache.org
- Eclipse Equinox
  - http://www.eclipse.org/equinox/
- OSGi Alliance
  - http://www.osgi.org
- OSGi Best Practices
  - http://developers.sun.com/learning/javaoneonline/2007/pdf/TS-1419.pdf
- Converting (Large) Applications to OSGi
  - http://developers.sun.com/learning/javaoneonline/2008/pdf/TS-5122.pdf