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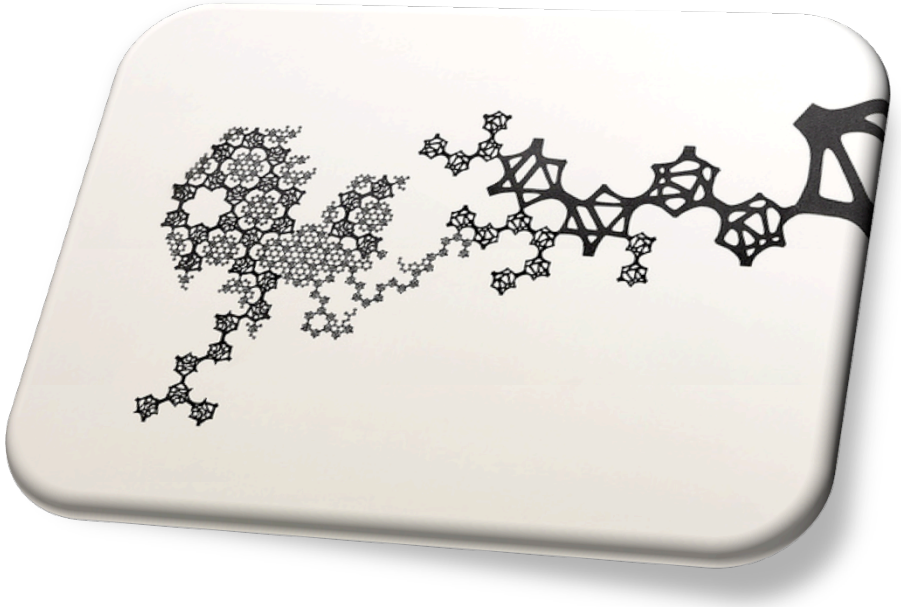

iPOJO

A Tale about Simplicity

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What about me ?

- Solution Architect in the Modular and Mobile CC
- Apache Software Foundation
  - PMC Apache Felix, Apache Ace
  - Apache Felix iPOJO project leader
- OW2
  - Chameleon project leader

The Apache Software Foundation
http://www.apache.org/

OW2 Consortium

APACHE felix

iPOJO

chameleon

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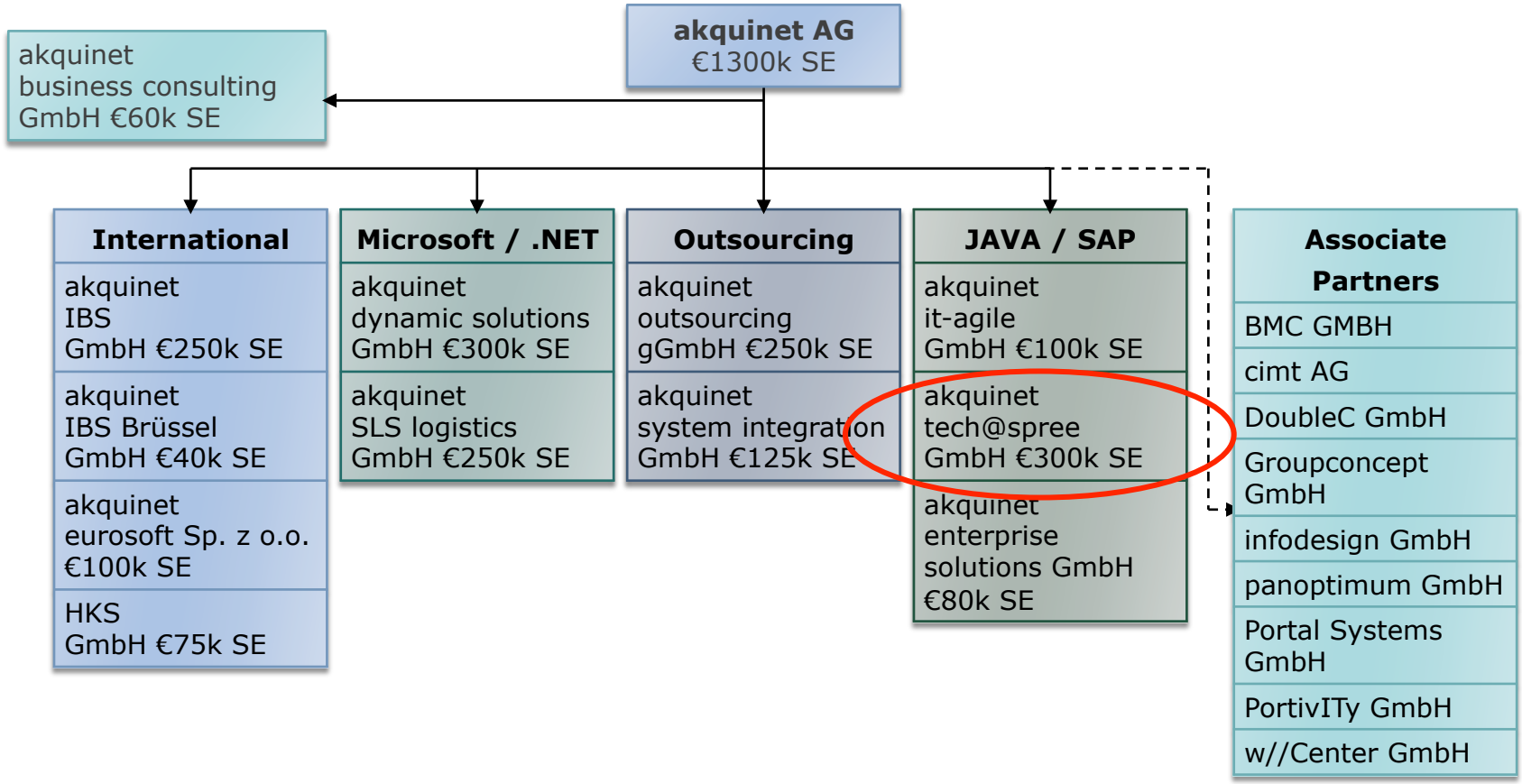
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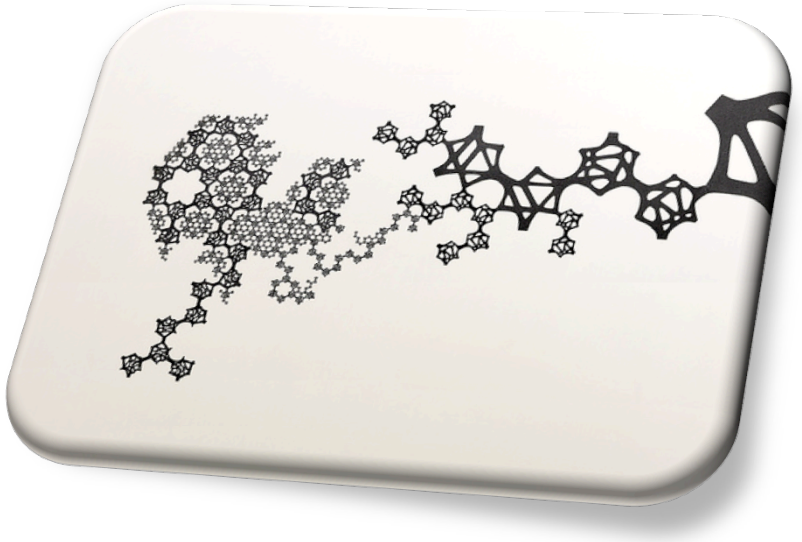
Modular and Mobile Solutions

- Competence Center focusing on
  - Modular Systems
    - Modularization expertise
    - OSGi-based
    - Sophisticated, Large scale, Distributed systems
  - Mobile Solutions
    - *In the large*
      - Mobile devices, Interactions middleware, Server-side …
      - M2M, B2B
- Open Technologies
  - OSGi (Apache Felix, Apace Ace, OW2 Chameleon, Apache Sling…)
  - Android
  - Java EE (JBOSS, OW2 JOnAS)



Modularity

The Graal Quest ?

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Time Travel

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.

At checkout time the integrity of the module is tested **independently**.

Finally, the system is maintained in **modular fashion**.

R. Gauthier and S. Pont, Designing Systems Programs, 1970.

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Time Travel

The major advancement in the area of modular programming has been the development of coding techniques and assemblers which

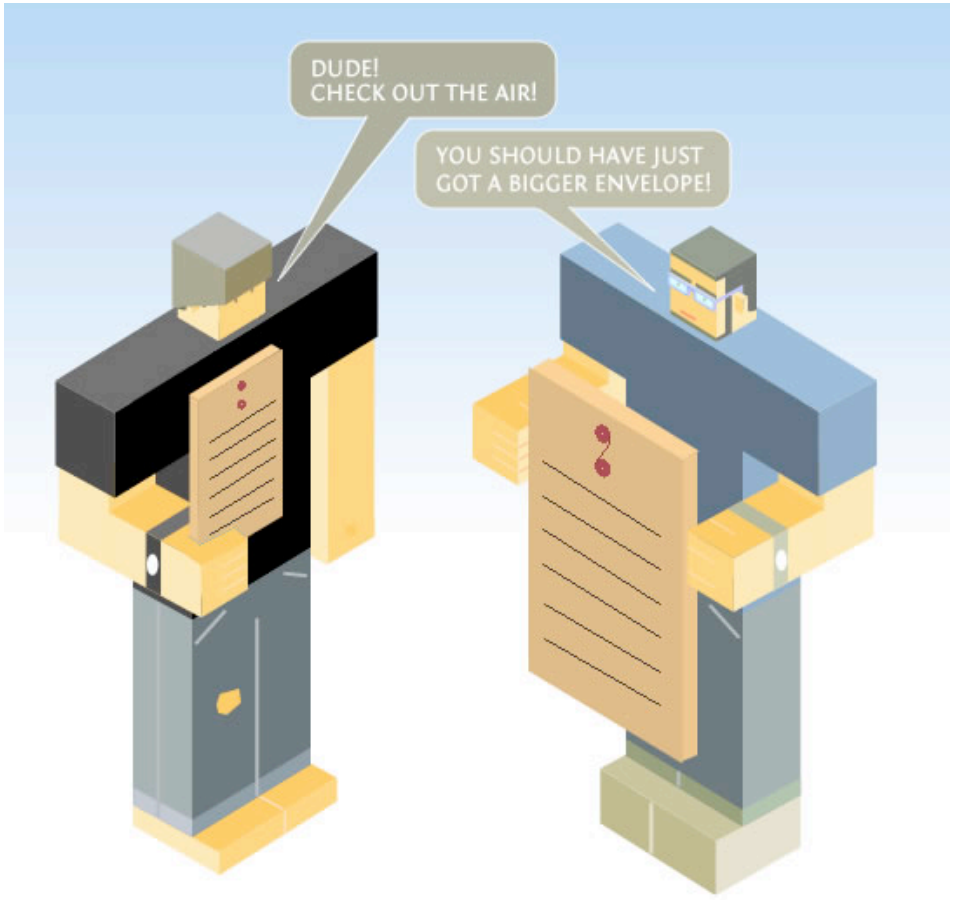
(l) allow one module to be written with **little knowledge** of the code in another module, and

(2) allow modules to be **reassembled** and **replaced** without reassembly of the **whole system**.

D. Parnas, On the Criteria to Be Used in Decomposing Systems into Modules, 1972

My software is bigger than yours !

- A DVD player can contain 1 Million lines of code (space shuttle <0.5 million lines)
- A BMW car can contain up to 50 networked computerized devices
- Eclipse contains 3.5 million lines of code
- @ 10 lines a day …
- Libraries are a necessity, but …



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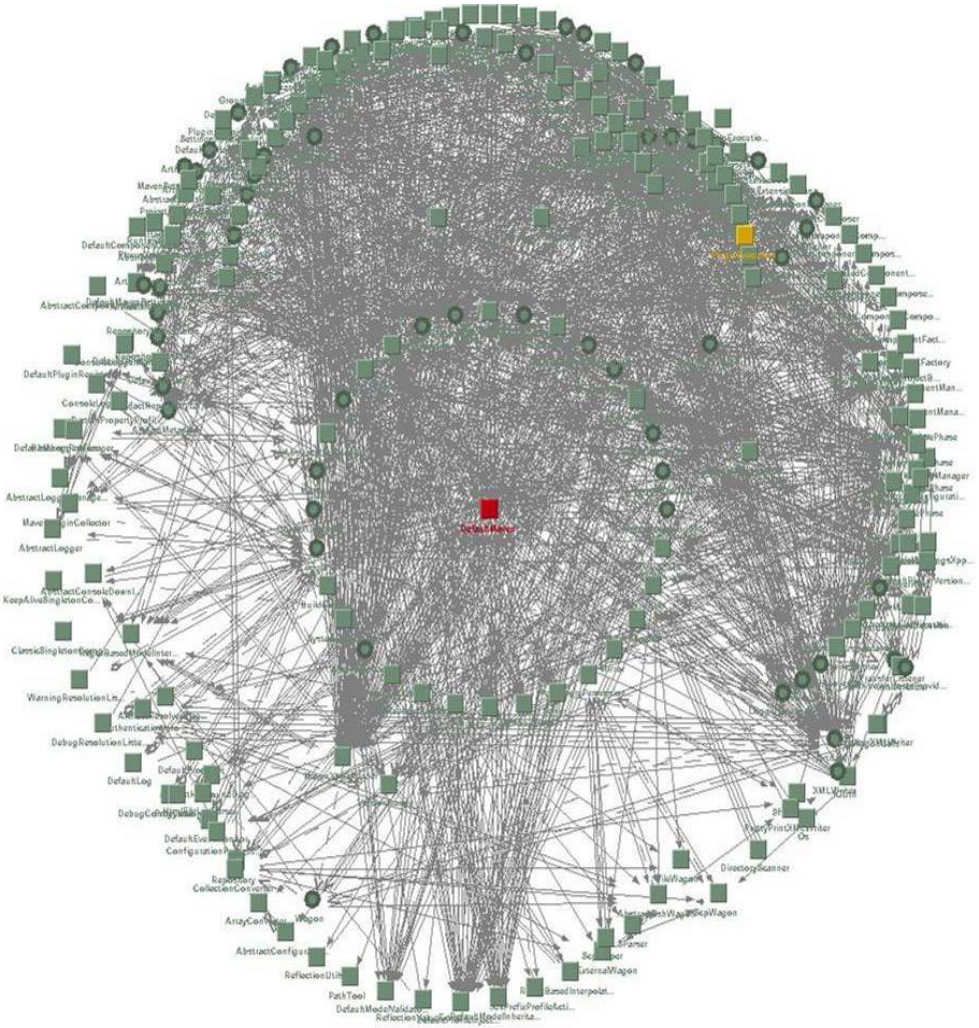
Limits of OOP

- Coupling severely limits reusability
  - Using a generic object, can drag in a large number of other objects
- Creates overly large systems after a certain complexity is reached
- Flexibility must be built in by the programmer
  - Plugin architectures
  - Factories, Dependency Injection



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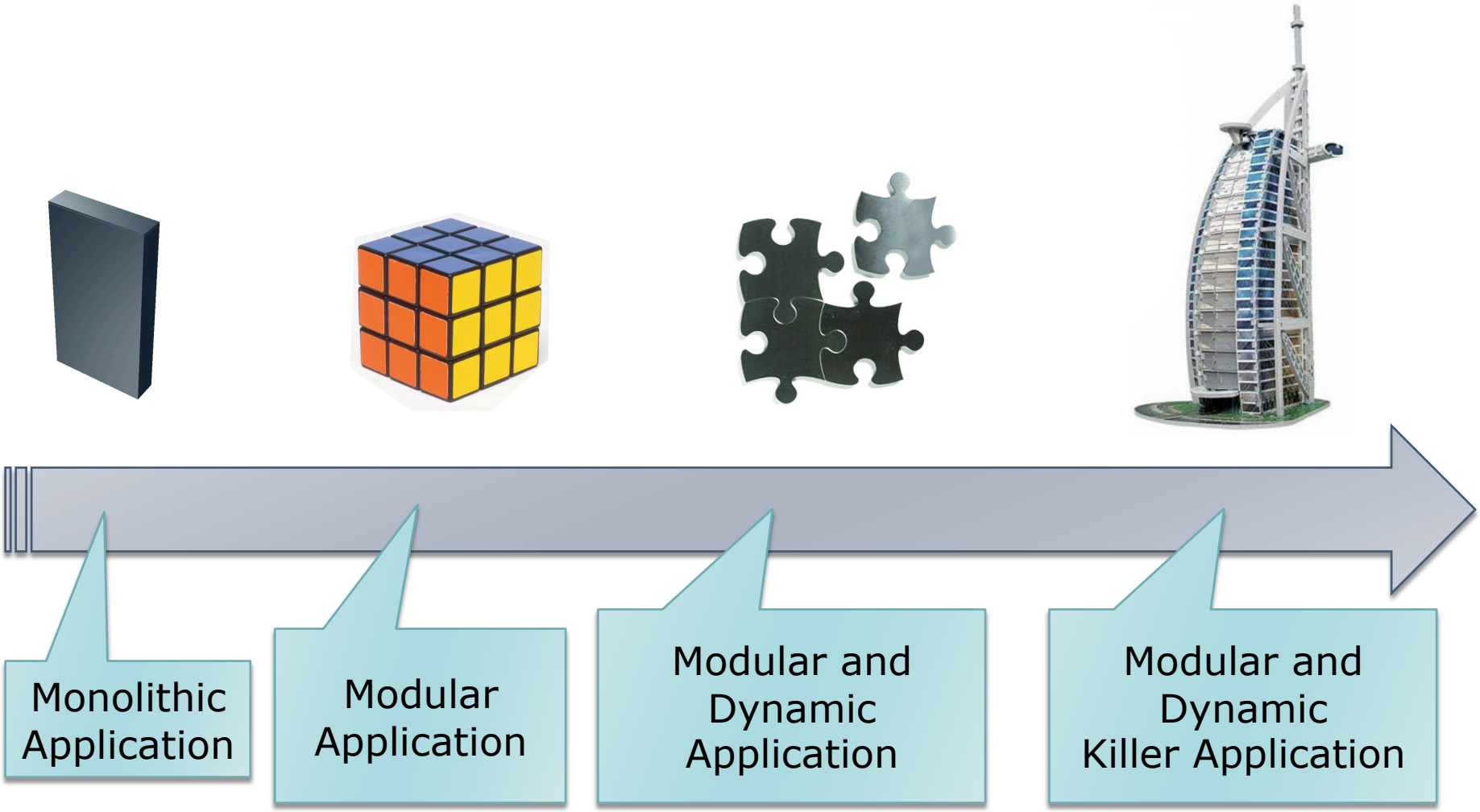
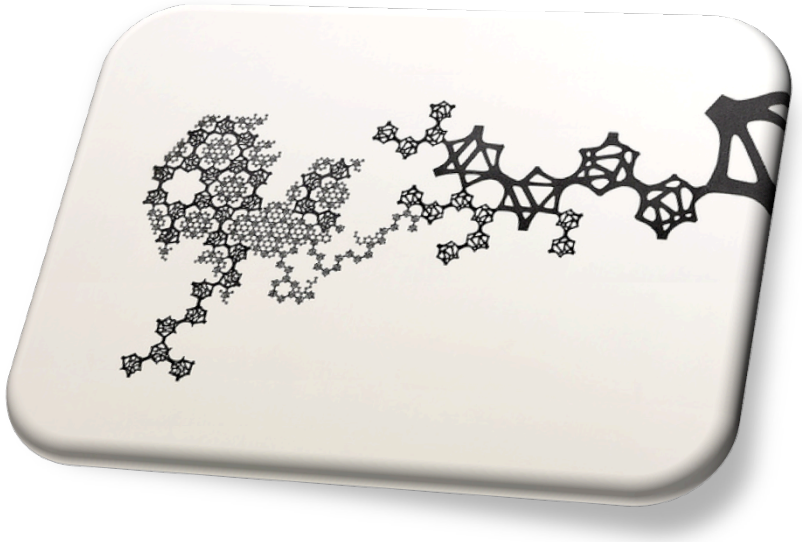
Modularize !





OSGi

The Graal ?

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Why OSGi ?

- Need simpler ways to construct software systems
  - OSGi is about software construction: building systems out of smaller components …
  - OSGi is about components that work together …
  - OSGi is about managing components …
  - OSGi is about "Universal Middleware"

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OSGi to build modular systems

- OSGi
  - Module layer on the top of Java
  - Define
    - A module layer
      - Bundle
      - Relation between bundles (import / export packages)
    - A lifecycle layer
      - Define bundle lifecycle
      - Continuous deployment
    - A service layer
      - Dynamic, loose-coupled interactions between bundles
      - Promotes substitution

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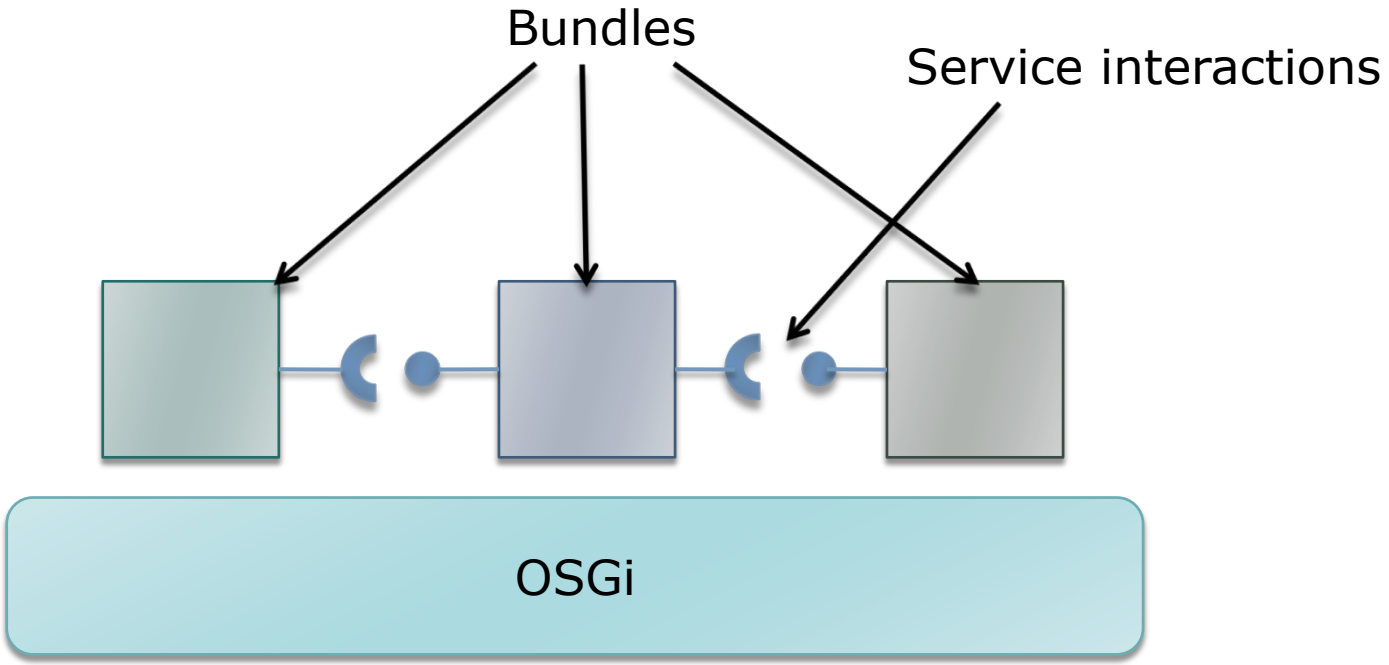
OSGi to build modular systems

- Modular system with OSGi
  - Define the bundles and the interactions
  - Deploy
  - Update



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Does it work ?

- For (very) small system :
  - Yes
- For complex system
  - It's a Nightmare
  - *Classloaders on steroids*
    - Classloader hell
    - Systems were not design to follow these rules
      - How to integrate legacy ?
  - OSGi API is complex
  - **Dynamism is challenging**

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Does it work ?

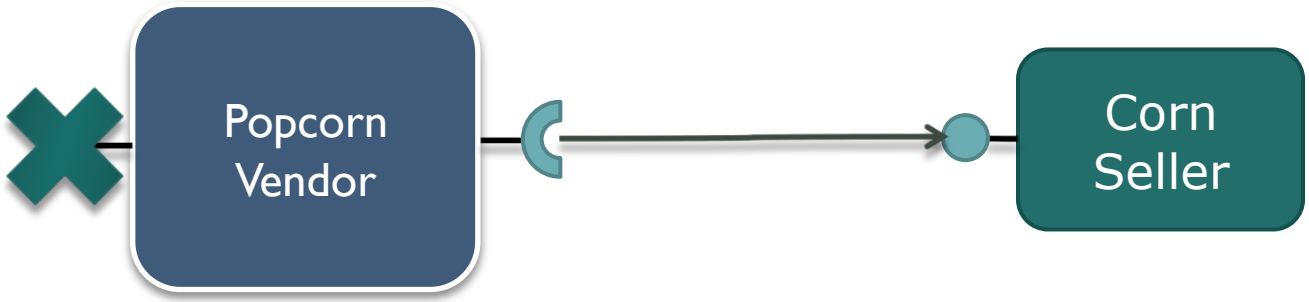
- With the OSGi momentum, more and more systems are OSGi powered
  - Linkedin
    - completely hides OSGi, is it really modular ?
  - Module Fusion
    - OSGi enterprise distribution
    - Goes a little further, but a lot of issues are still there
      - Try to change your JPA entity classes…
  - Eclipse
    - Why I have to reboot ?
    - Why I can’t install the plugin P version X ?

OSGi is not enough – recipe errata

- Before building sophisticated modular applications on the top of OSGi, we need:
  - An OSGi framework (R4.2 compliant)
  - A set of technical / common services
    - Compatible
    - Flexible
  - **A component model flexible and extensible**
    - Dynamism pain reliever
    - Integrating technical services in the application
  - Tools
    - Deployment
    - Management
  - Design Guideline

Practical Explaination

- OSGi™ Snack Bar
  - Pop Corn Vendor



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Popcorn Vendor service listener

```
public synchronized void serviceChanged(ServiceEvent event) {
        if (event.getType() == ServiceEvent.REGISTERED) { // If a  seller was registered, see if we need one. If
                                                          // so, get a reference to it.
                if (m_ref == null) { // Get a reference to the service object.
                        m_ref = event.getServiceReference();
                        m_seller = (Vendor) m_context.getService(m_ref);
                        m_sr = m_context.register(Vendor.class.getName(), this, null);
                }
        }
        // If a seller was unregistered, see if it was the one we were using. If so, unget the service and try to query
        // to get another one.
        else if (event.getType() == ServiceEvent.UNREGISTERING) {
                if (event.getServiceReference() == m_ref) { // Unget service object and null references.
                   m_context.ungetService(m_ref);
                   m_ref = null;
                   m_seller = null;
                   // Query to see if we can get another service.
                   ServiceReference[] refs = m_context.getServiceReferences(Vendor.class.getName(), "(type=corn)");
                   if (refs != null) {
                        m_ref = refs[0]; // Get a reference to the first service object.
                        m_seller = (Vendor) m_context.getService(m_ref);
                   } else { // No more provider.
                        m_sr.unregister();
                    }
        }
}
```

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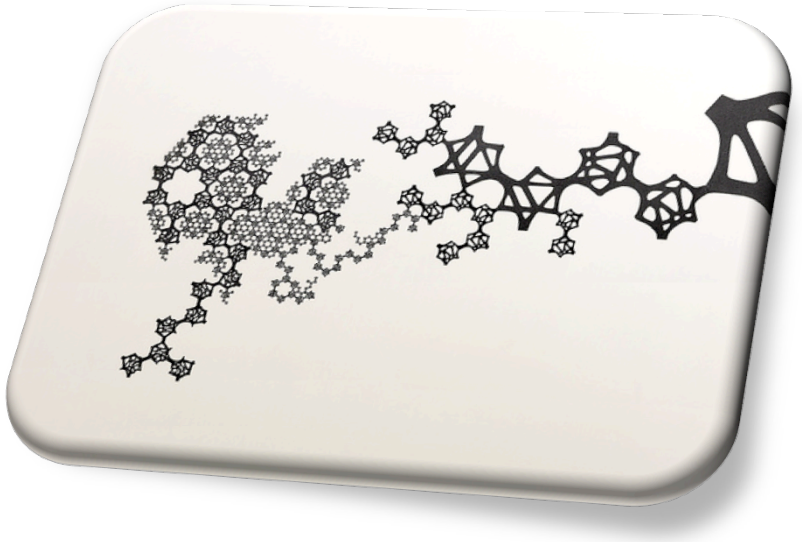
Do you see a problem ?

- A little complex, isn't it ?
  - Listeners are difficult to implement correctly
  - Do not forget to release used services
  - Mix dynamism management and business logic

- Question ?
  - How to ease OSGi™ application development
    - Development
    - Design



(Service) Component Model

The Graal Trail ?

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Component Models

- Objectives:
  - Beyong object programming …
  - Separation of concerns / Abstraction
    - Persistance, Security, Bindings
  - Avoid monolithic applications
    - Application compozed by components
    - An assembler select components and bind them
  - Hierarchical composition
    - Component can contain other components …

Component Models : Principles

Objects

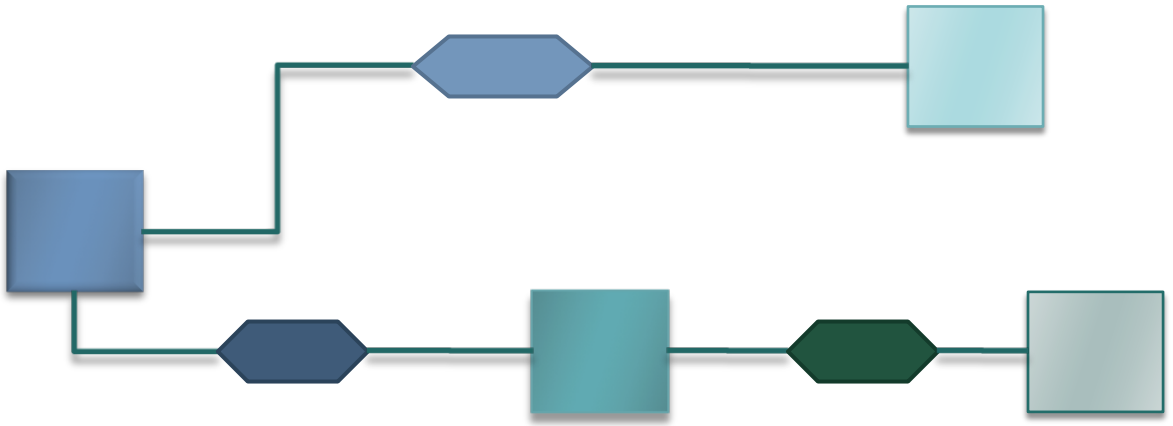
- Class : Object type
  - Code unit
  - Encapsulation
- Instance : Object

Components

- Component type
  - Unit of code or composition
  - Non-functional concerns description
  - Provided & Required services
- Component Instance
  - One content
  - One container

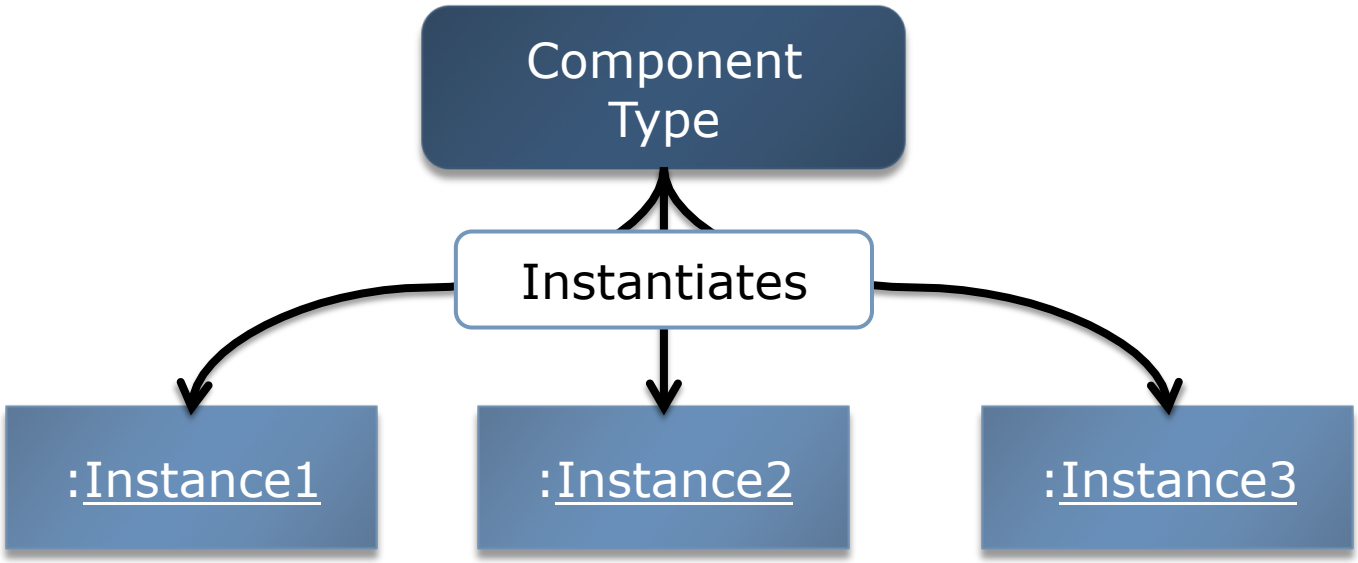
Component Models : Principles

- Architecture Description Language
  - How to describe an application
    - Selection of component & binding (configuration)
  - Static checking
    - Matching between provided and required interfaces

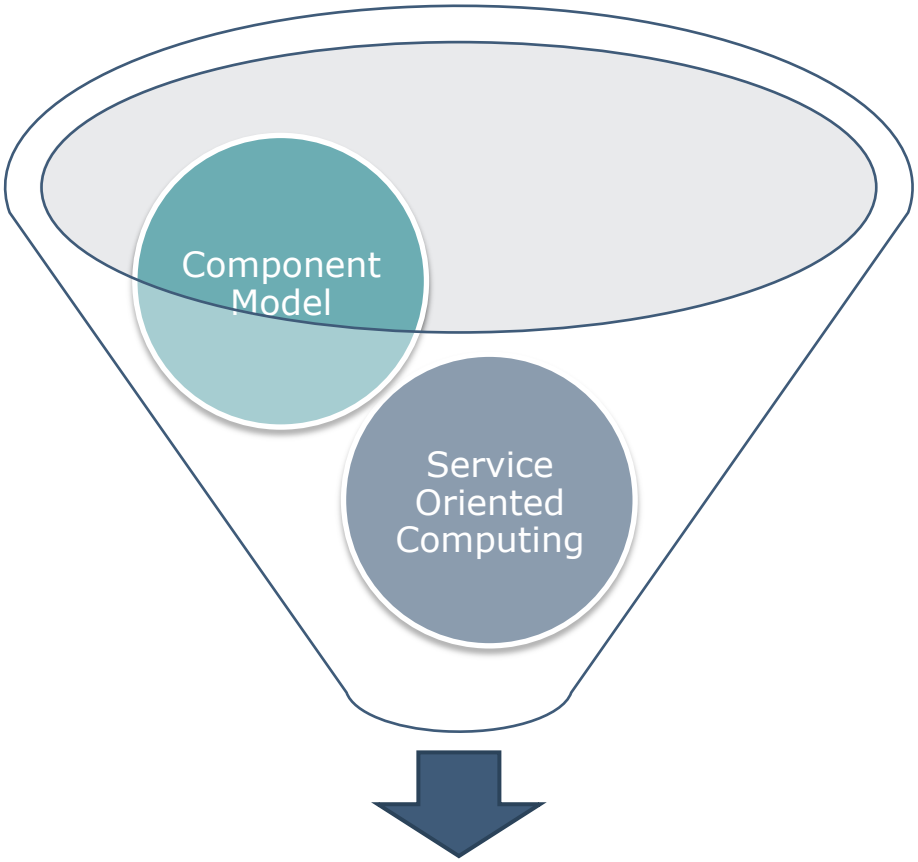


Component Models : Factories

- Factories
  - There is no « new » on component
    - Instantiation of the container and of the content
  - Principles of factories
    - Allow component instances creation



Service Component Model (SOCM)



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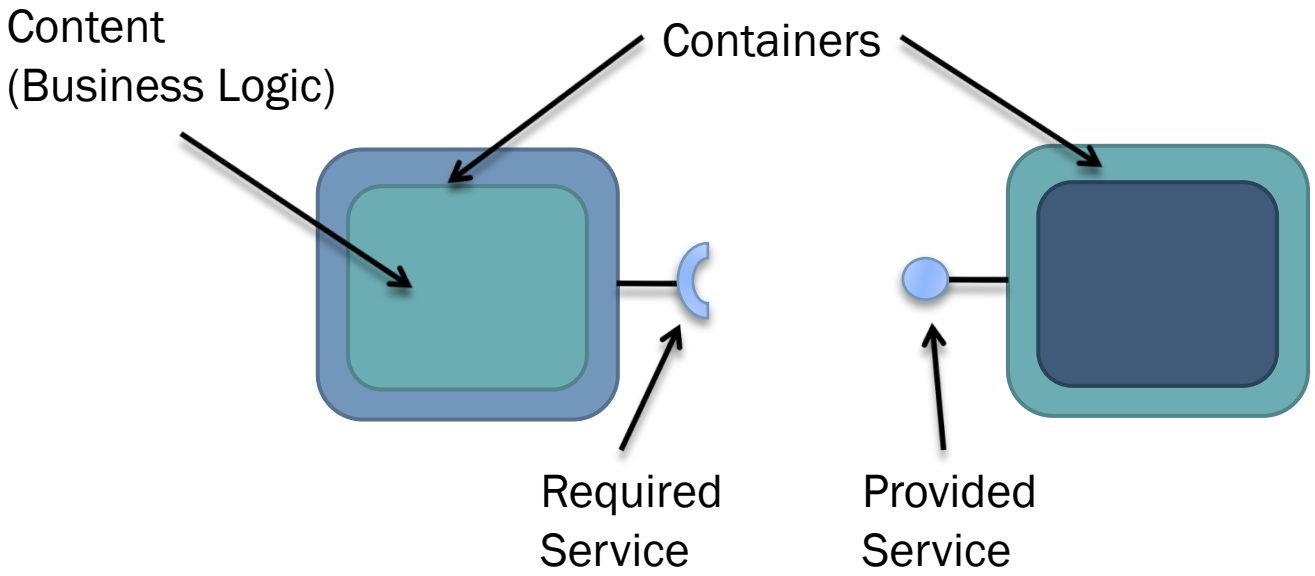
SOCM : Principles

- An instance
  - Provides services
  - Requires and uses services
- Service dependencies are resolved at runtime by following service-oriented computing paradigm
- Composition in term of service specifications

SOCM

- Basically, SOCM containers manage
  - Required services (discovery, selection, binding, tracking)
  - Provided services (publication, withdrawal, service object creation …)



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Existing SOCM for OSGi™

- Service Binder / Declarative Service :
  - OSGi™ R4 (Compendium)
  - Define de component model managing service dependency and providing
    - Required services are injected via “bind” and “unbind” methods
    - Instance lifecycle is managed by the container
- Dependency Manager
  - API to develop component
  - Managing service providing and service requirements
  - Allow to add dynamically new dependencies

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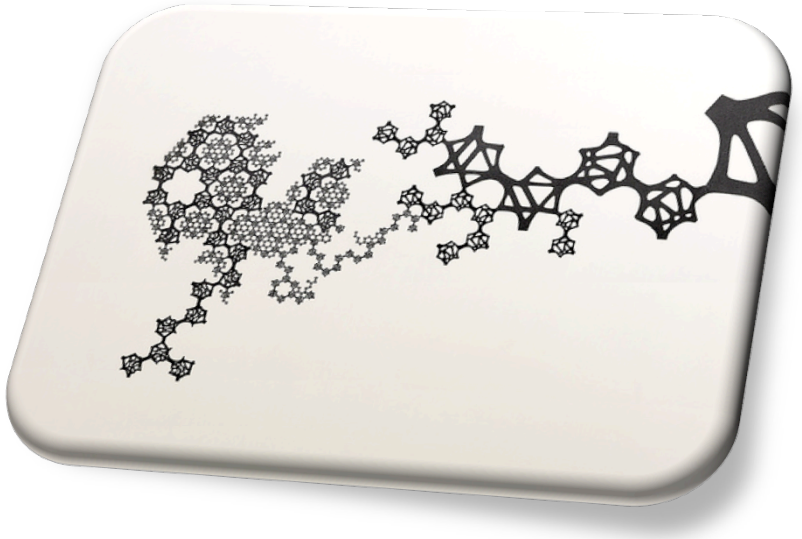
Existing SOCM for OSGi™

- Blueprint
  - Spring framework on the top of OSGi™
  - Injection of OSGi™ services
  - Manage others non-functional concerns (persistence, transaction, configuration …) [not-standardized]

- iPOJO
  - Extensible component model
  - Supports annotations, XML and API descriptions
  - Real separation type / instance
  - Manages service dependencies and service providing ….
  - Allow to add others non-functional properties (JMX, persistence, security …)
  - Provide an ADL to build service based applications

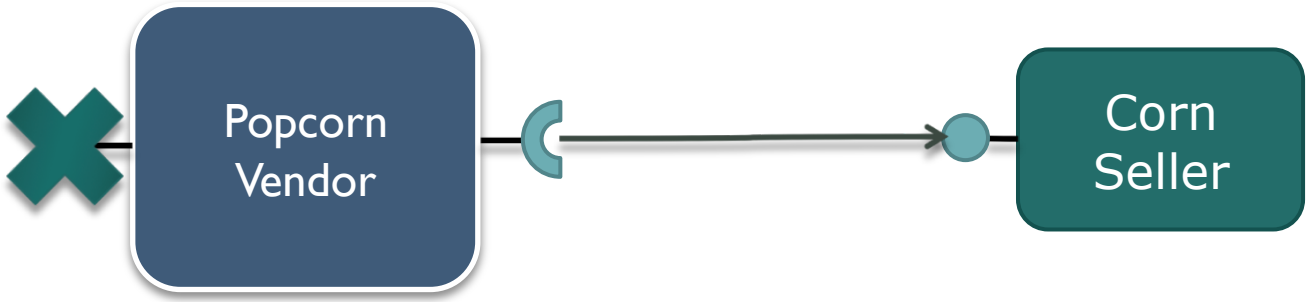


iPOJO

The fastest path ?

Snark Bar Reloaded

- OSGi™ Snack Bar
  - Pop Corn Vendor



Implementation using iPOJO

```
@Component(name="popcorn-provider")
@Provides
public class PopcornVendor implements Vendor {
    @Requires
    private Reseller m_vendor;

    public  String getName() { return "Popcorn from Paris"; }
    public String buy() {
            m_vendor.buy();
            return "popcorn";
    }
}
```

```
<ipojo>
        <instance component="popcorn-provider"/>
</ipojo>
```

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Implementation using next iPOJO version

```
@Component(name="popcorn-provider")
@Instantiates
@Provides
public class PopcornVendor implements Vendor {
    @Requires
   private Reseller m_vendor;

   public  String getName() { return "Popcorn from Paris"; }
   public String buy() {
          m_vendor.buy();
          return "popcorn";
   }
}
```

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iPOJO

- Apache Felix sub-project
- iPOJO provides
  - A very simple development model (POJO)
  - The automation of service based interactions
    - Publication, Service Properties, Service discovery, Service tracking, Service binding
  - An extensible infrastructure
    - To manage other non functional features

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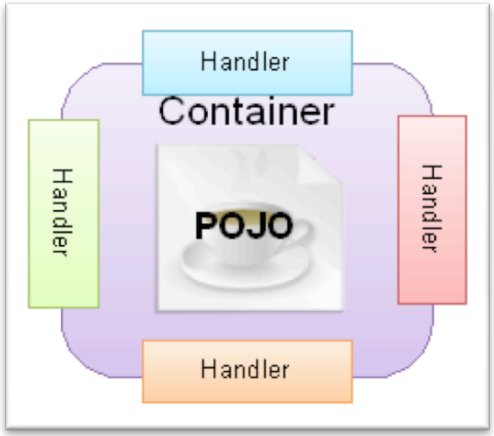
iPOJO overview

- Differentiation between
  - Component types (<component>)
    - Describe non-functional requirement
  - Instances (<instance>)
    - You can create several instances from the same component types
    - Will really provide services, required services…
- Injection mechanism
  - Container can interact with the POJO by
    - Invoking methods on the POJO (Container => POJO)
    - Injecting value inside fields (Container => POJO)
    - Be notified of POJO change on field (POJO => Container)

Mechanism & Container

- Bytecode weaving
  - Aspect-like mechanisms
- Metatada format agnosticism
  - XML, Annotation, API
- Highly Extensible
  - Handlers



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Component Type

- @Component
  - Declares a component type
  - Target class definition

```
@Component
public class MyClass {…}
```

- Attributes
  - Name : factory name
  - Immediate : is the instance immediately activated (boolean)
  - Propagation : enables / disables configuration propagation
  - …

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Service Providing

- @Provides
  - All implemented interfaces will be published
  - Target class definition

```
@Component
@Provides
public class MyClass implements MyService {…}
```

- Attributes
  - Specifications: set the published interfaces (class [])
  - Factory: Service Object creation
    - {SINGLETON|FACTORY|INSTANCE|…}

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Service Properties

- @ServiceProperty

```
@Component(immediate=true)
@Provides
public class Circle implements SimpleShape {

  @ServiceProperty(name=SimpleShape.NAME_PROPERTY)
  private String m_name = "Circle";

  @ServiceProperty(name=SimpleShape.ICON_PROPERTY)
  private ImageIcon m_icon =
    new ImageIcon(this.getClass().getResource("circle.png"));

  public void draw(Graphics2D g2, Point p) {
    ...
  }
}
```

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Requiring a service

- iPOJO Service requirement
  - Field injection and Method injection
  - Optional or Mandatory
  - Scalar or Aggregate
  - Filter
  - Binding policy : static, dynamic, dynamic priority

Method Injection of Services

- @Bind and @Unbind

```
@Bind(filter="(name=main)")
protected void bindWindow(Window window) {
  m_log.log(LogService.LOG_INFO, "Bind window");
  window.addWindowListener(this);
}

@Unbind
protected void unbindWindow(Window window) {
  m_log.log(LogService.LOG_INFO, "Unbind window");
  window.removeWindowListener(this);
}
```

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Method Injection of Services

- Attributes
  - Aggregate, Filter, Optional

```
@Bind(aggregate=true)
public void bindShape(SimpleShape shape, Map attrs) {
  final DefaultShape delegate = new DefaultShape(shape);
  final String name = (String) attrs.get(SimpleShape.NAME_PROPERTY);
  final Icon icon = (Icon) attrs.get(SimpleShape.ICON_PROPERTY);
  m_shapes.put(name, delegate);
  SwingUtils.invokeAndWait(new Runnable() {
    public void run() {
      ...
    }
  });
}
```

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Field injection of Services

- @Requires
  - Manage synchronization for you

```
@Requires(optional=true)
private LogService m_log;
To access the log service, we just use the field, like this:
@Override
public void windowClosed(WindowEvent evt) {
  try {
    m_log.log(LogService.LOG_INFO, "Window closed");
    m_context.getBundle(0).stop();
  } catch (BundleException e) {
  }
}
```

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Field injection of Services

- Optional management
  - Nullable
  - Default-Implementation
  - Disabled with nullable=false

```
@Requires(optional=true)
private LogService m_log;
To access the log service, we just use the field, like this:
@Override
public void windowClosed(WindowEvent evt) {
  try {
    m_log.log(LogService.LOG_INFO, "Window closed");
    m_context.getBundle(0).stop();
  } catch (BundleException e) {
  }
}
```

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Field injection of Services

- Synchronization management

```
@Requires Foo m_foo;
public void statelessAccess() {
m_foo.doA()
m_foo.doB()
m_foo.doC()
}
```

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Lifecycle

- iPOJO Instance state
  - INVALID | VALID

```
@Validate
protected void activate() {
  SwingUtils.invokeAndWait(new Runnable() {
    public void run() {  setVisible(true); }
  });
}

@Invalidate
protected void deactivate() {
SwingUtils.invokeLater(new Runnable() {
        public void run() { setVisible(false); dispose(); }
        });
}
```

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Configuration

- Component type declare Property
  - @Property
  - Method: setX(value)
  - Field
- Component Instance receive configurations
  - Instance configuration (XML)
  - 'Factory' configuration (API)
  - Configuration Admin
- @Instantiates does not allow configurations

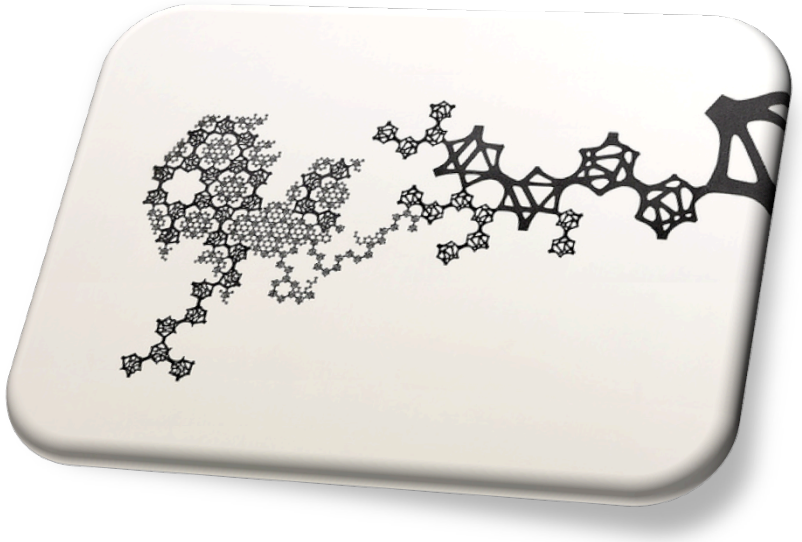
Instance Configuration

- @Component => Component type
- <Instance> => Instance
  - metadata.xml
    - Not necessary in the same bundle
  - Supports configuration

```
<instance component=”foo”/>

<instance component="buns_and_wieners">
    <property name="buns" value="9"/>
    <property name="wieners" value="8"/>
</instance>
```

- Cfg files
  - Java properties file



Conclusion

How are you ?

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Modularity, OSGi, SOCM

- The objectives
  - Dynamic, modular applications
- The trail
  - OSGi
- The easiest way
  - SOCM

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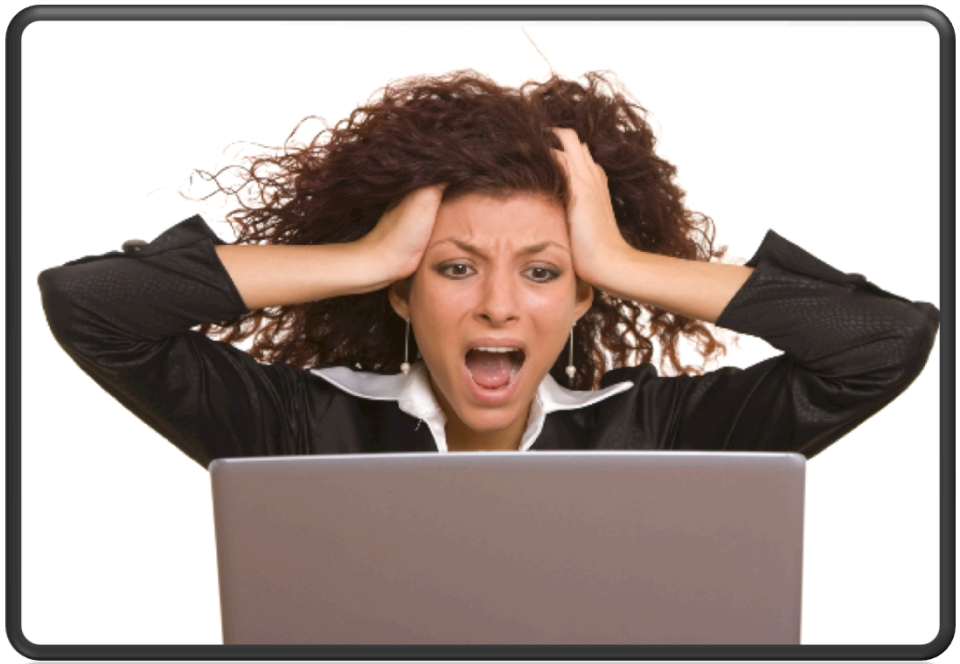
iPOJO

- Apache Felix sub-project
  - 5 years of development
  - Used in numerous projects
    - Application server
    - Gateway
    - Mobile phone
- It’s the most advanced component model for OSGi

Questions ?



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