Smart Use of Annotation Processing - APT

@gdigugli

@dbaeli

Speakers

@dbaeli - Dimitri BAELI

- Java developer since 1999
- R&D Team Mentor at

LesFurets.com Comparez futé

- Coder, DevOps, Agile Coach
  - From idea to production
- eXo Platform
  - VP Quality

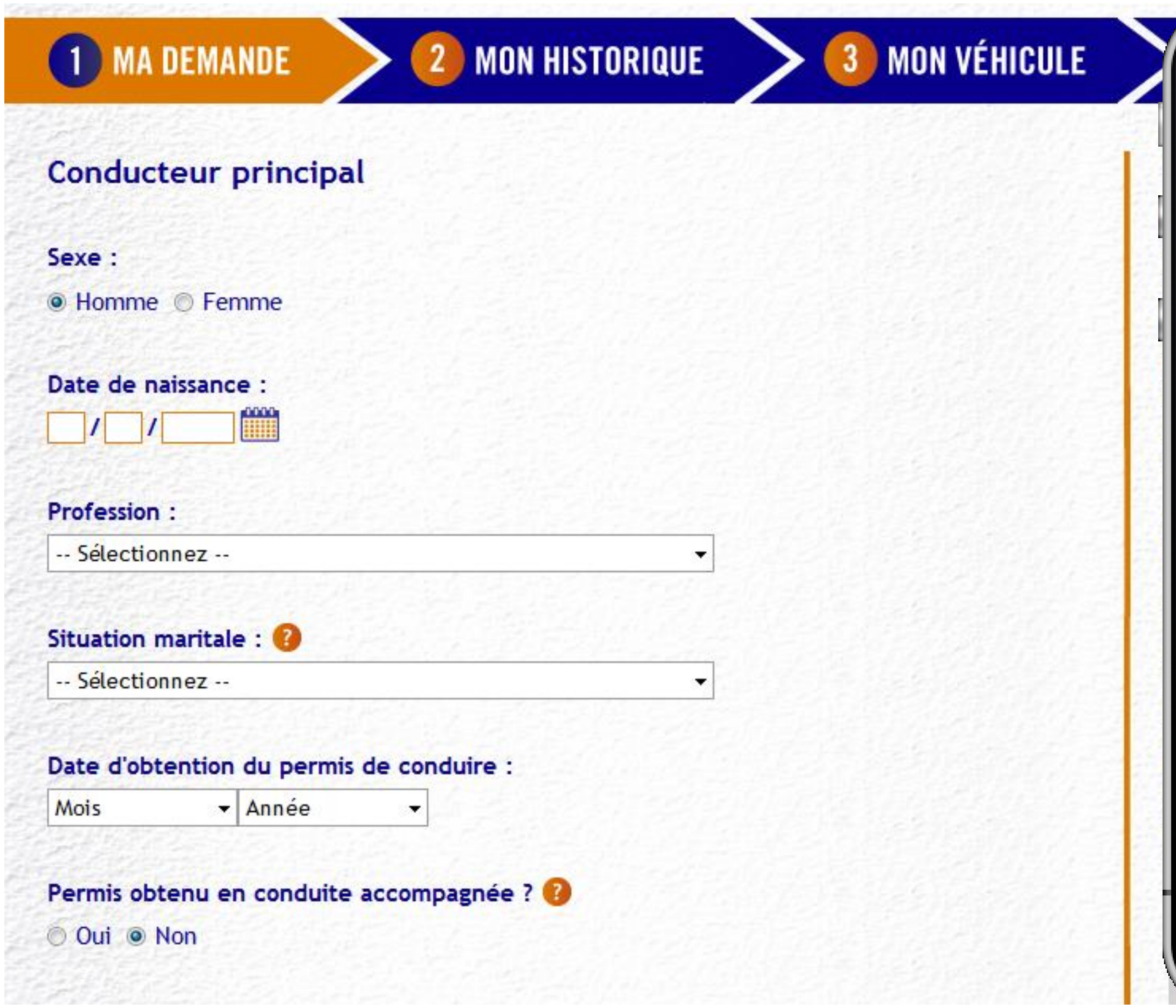
@gdigugli - Gilles Di Guglielmo

- Java developer since 1999
- Software architect at

LesFurets.com Comparez futé

- ILOG - IBM
  - ✓ 2D graphic toolkit
  - ✓ Rule engine
- Prima-Solutions
  - ✓ Services platform for J2EE
  - ✓ Domain models code generators

Content Display Management



1 MA DEMANDE | 2 MON HISTORIQUE | 3 MON VÉHICULE

Conducteur principal

Sexe :

[✓ Homme] Femme

Date de naissance :

__ / __ / ____

Profession :

-- Sélectionnez --

Situation maritale : ?

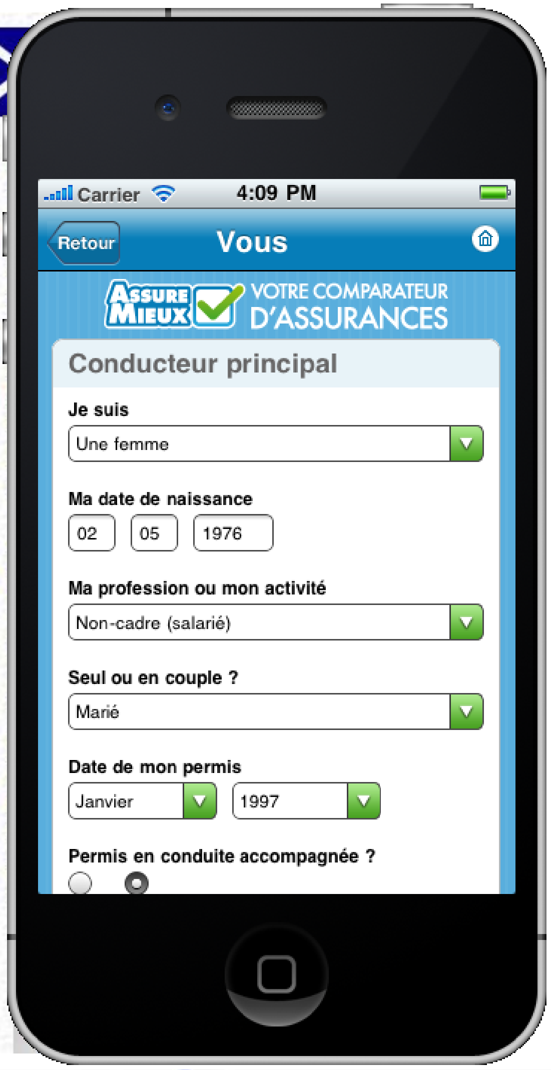
-- Sélectionnez --

Date d'obtention du permis de conduire :

Mois | Année

Permis obtenu en conduite accompagnée ? ?

Oui [✓ Non]



Carrier 4:09 PM

Retour | Vous

ASSURE MIEUX VOTRE COMPARATEUR D'ASSURANCES

Conducteur principal

Je suis: Une femme

Ma date de naissance: 02 | 05 | 1976

Ma profession ou mon activité: Non-cadre (salarié)

Seul ou en couple ? Marié

Date de mon permis: Janvier | 1997

Permis en conduite accompagnée ?

The story

Effective Content Display

- Content Management
  - Labels
  - Layout & images
- Clean code
  - Strong Quality
  - Easy Maintenance

using APT Tooling

- APT Engine
- APT Processors
  - Generate technical code
  - Generate reports
  - Generate patterns

based on i18n

- @Message
- @MessageBundle
- Dedicated APT Processors

https://github.com/lesfurets/ez18n

Improved i18n
for text display

Java i18n pattern

- The JDK default tooling to:
  - Dynamically bind the content
  - Usable for Texts, but also CSS and images (urls)
- Tooling :
  - java.util.ResourceBundle : for .properties reading
  - java.util.MessageFormat : tiny templating
  - .properties files with naming pattern

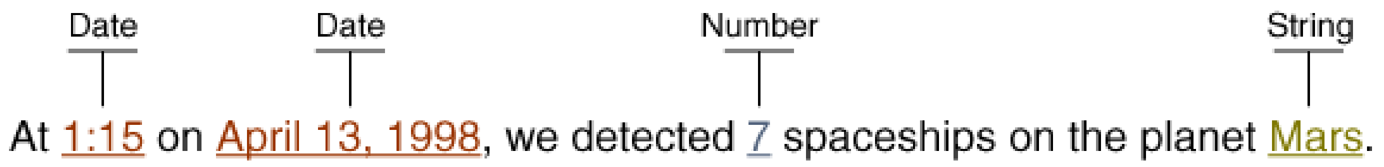
java.util.ResourceBundle

- The .properties loader for a given Locale
- Key / Value in .properties
- Naming convention for the storage

$$\texttt{Messages\_}\underbrace{\boxed{\texttt{en\_}}}_{\text{Language}}\underbrace{\boxed{\texttt{EN}}}_{\text{Country}}\texttt{.properties}$$

```
ResourceBundle myResources =
     ResourceBundle.getBundle("MyResources", currentLocale);
```

java.util.MessageFormat



At 1:15 on April 13, 1998, we detected 7 spaceships on the planet Mars.

```
template = At {2,time,short} on {2,date,long}, \
    we detected {1,number,integer} spaceships on \
    the planet {0}.
```

```
currentLocale = en_US
At 10:16 AM on July 31, 2009, we detected 7
spaceships on the planet Mars.
currentLocale = de_DE
Um 10:16 am 31. Juli 2009 haben wir 7 Raumschiffe
auf dem Planeten Mars entdeckt.
```

- Tiny templating
- format(“<pattern>”, args)
- Date, numbers are formatted according to the Locale
- Options, conditional values easy to use

.properties issues

- Low quality control
  - Keys are strings in the code
  - Poor IDE support
    - No warning on unused or wrong keys
  - Encoding Hell
    - use \uxxxx or you’re in trouble
- Forces you to maintain two files in sync
  - key declaration / value in .properties
  - Key usage in the .java files

Improved i18n

Ez18n : improved i18n

- Interfaces representing each .properties
- The methods acts as keys

```java
@MessageBundle
public interface Messages {

 @Message(value = "Love Me Tender")
 String loveMeTender();

 @Message("I love {0}")
 String doYouLove(String name);

}
```

Messages.java

```properties
loveMeTender=Love Me Tender
doYouLove=I love {0}
```

Messages.properties

Annotations and Code generation

- Same pattern as in GWT, but for J2SE
- New Annotations in the code :
  - @MessageBundle to mark interfaces
    - ➔ represents a ResourceBundle
  - @Message to mark methods
    - ➔represents a localization key
- Generate :
  - .properties file (for 'default')
  - A ResourceBundle for each .properties
  - Manage other languages out-side your code

Improved i18n benefits

- Now you can
  - Refactor your keys
  - Maintain the ‘default’ in Java
  - Never change a .properties file for default locale
- And use it with other libs:
  - GWT (done on GitHub)
  - Even JQuery, Dojo, CoffeeScript (planned)
- We called that ez18n

APT to generate .properties and ResourceBundle classes from annotations

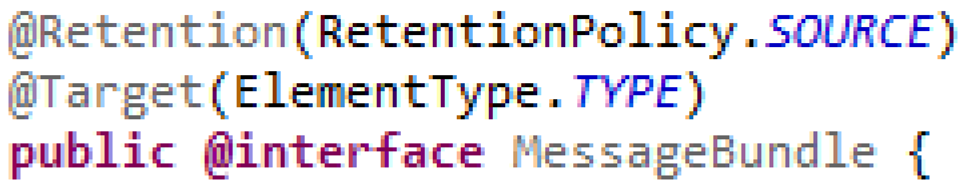
Behind the scene
How APT works

APT basics

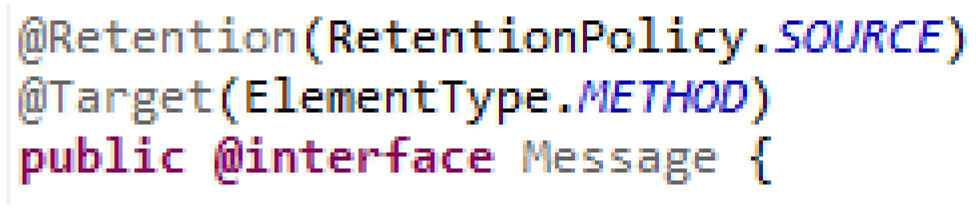
- APT - Annotation Processing Tool
- Kind of old-school pre-processing
- Standard in JDK6+ (JSR 269)
- No runtime overload
- Based on annotations in source code
- Standard since JDK 1.6 (available in Sun JDK 1.5)

APT annotations

- Use @Retention, @Target



```
@Retention(RetentionPolicy.SOURCE)
@Target(ElementType.TYPE)
public @interface MessageBundle {
```



```
@Retention(RetentionPolicy.SOURCE)
@Target(ElementType.METHOD)
public @interface Message {
```

APT Processors

- javax.annotation.processing.Processor
- Code parsing similar to Reflection
  - No need of compiled code
  - Some limitations
- 2 key elements :
  - @SupportedAnnotationTypes to declare the matching annotations
  - FileObject : the future generated file

SPI Discovery

- SPI - Service Provider Interface
- Is a built in way to discover Classes at runtime
- Based on Interface implementation
- @see java.util.ServiceLoader
  - /META-INF/services/javax.annotation.processing.Processor

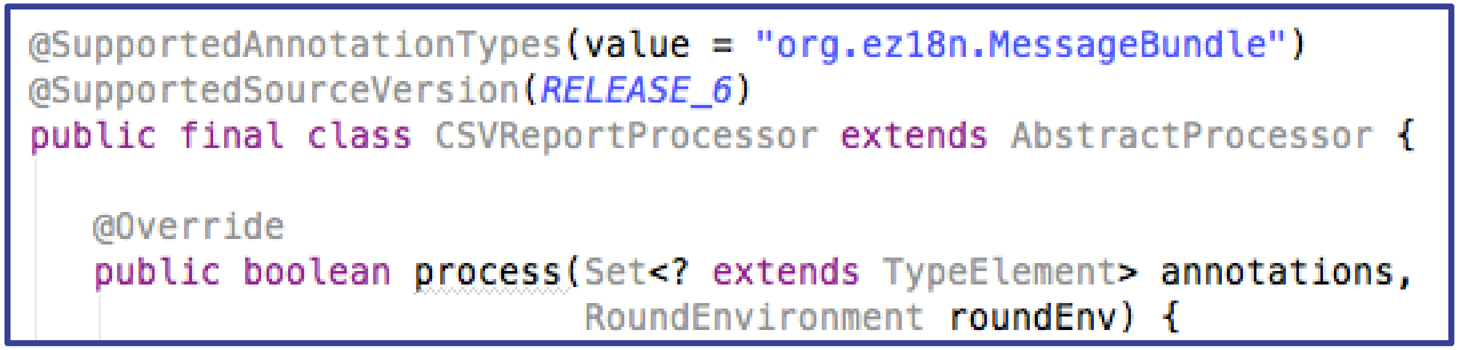
Similarities with java.lang.reflect

Java.lang.reflect	Javax.annotation.processing
java.lang.Class	TypeElement
Constructor	ExecutableElement
Field, Parameter	VariableElement
Method	ExecutableElement
java.lang.Package	PackageElement

- NO Class.newInstance()
- NO instanceOf, NO isAssignable()
- NO getConstructor, getMethod, …
- Weak inheritance support

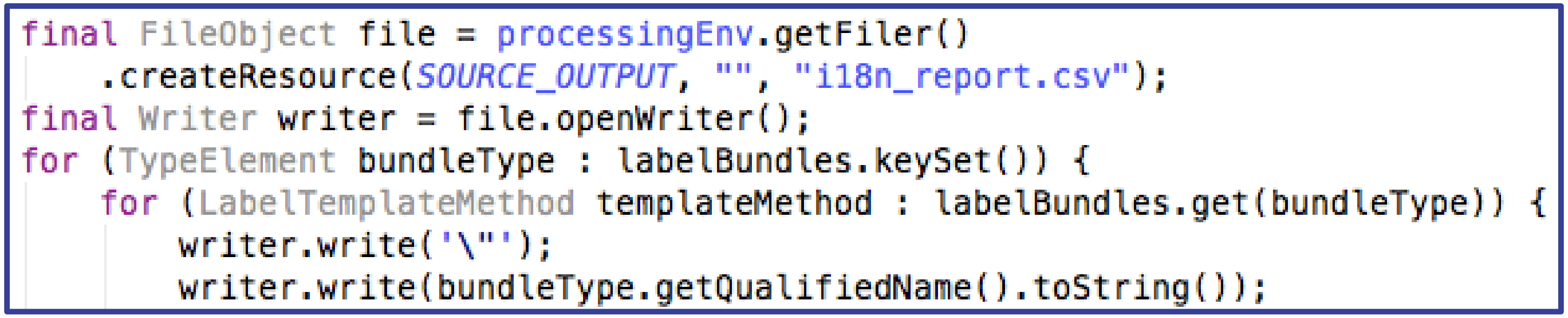
Processor code sample

- Processor declaration



```java
@SupportedAnnotationTypes(value = "org.ez18n.MessageBundle")
@SupportedSourceVersion(RELEASE_6)
public final class CSVReportProcessor extends AbstractProcessor {

    @Override
    public boolean process(Set<? extends TypeElement> annotations,
                           RoundEnvironment roundEnv) {
```

- Use a FileObject to generate the content



```java
final FileObject file = processingEnv.getFiler()
    .createResource(SOURCE_OUTPUT, "", "i18n_report.csv");
final Writer writer = file.openWriter();
for (TypeElement bundleType : labelBundles.keySet()) {
    for (LabelTemplateMethod templateMethod : labelBundles.get(bundleType)) {
        writer.write('\"');
        writer.write(bundleType.getQualifiedName().toString());
```

APT command line

```
javac
    -cp $CLASSPATH
    -proc:only                              Or -proc:none
    -encoding UTF-8
    -processor $PROCESSOR                     processors fqcn list
    -d $PROJECT_HOME\target\classes
    -s $PROJECT_HOME\target\generated-sources\apt
    -sourcepath $SOURCE_PATH
    -verbose
    $FILES                                          optional
```

APT tooling

- Maven integration
  - maven-processor-plugin (google-code)
  - Maven java compiler simply
- Ant integration
  - javac
- IDE integration
  - Extend the JDK compilation options

APT usages

- Generate required repetitive code :
  - Not always possible at runtime
  - Unit tests, JMX declarations
  - Utility code with coverage and debug
- Build your reports on your code
  - Your metrics without runtime overload
  - Even fail the build if you want !

One or Two phase compilation

- One phase :
  - APT runs during the compilation
  - Generated code is directly produced as bytecode (.class)
  - Harder to debug (no .java created)
- Two phases : “proc:only”
  - javac with proc:only then with proc:none
  - Creates .java files in the sourcepath

Problems with APT

- Beware of the “Generate” golden hammer
  - generate needed code
- APT Processors can be tricky:
  - hard to test / maintain
  - bad error management (hidden errors !)
  - Not really (well) documented
- No built-in templating mechanism
- Enforced file path creation
- Beware of maven parallel builds
  - Because javac is not thread safe

It’s time to convince your team

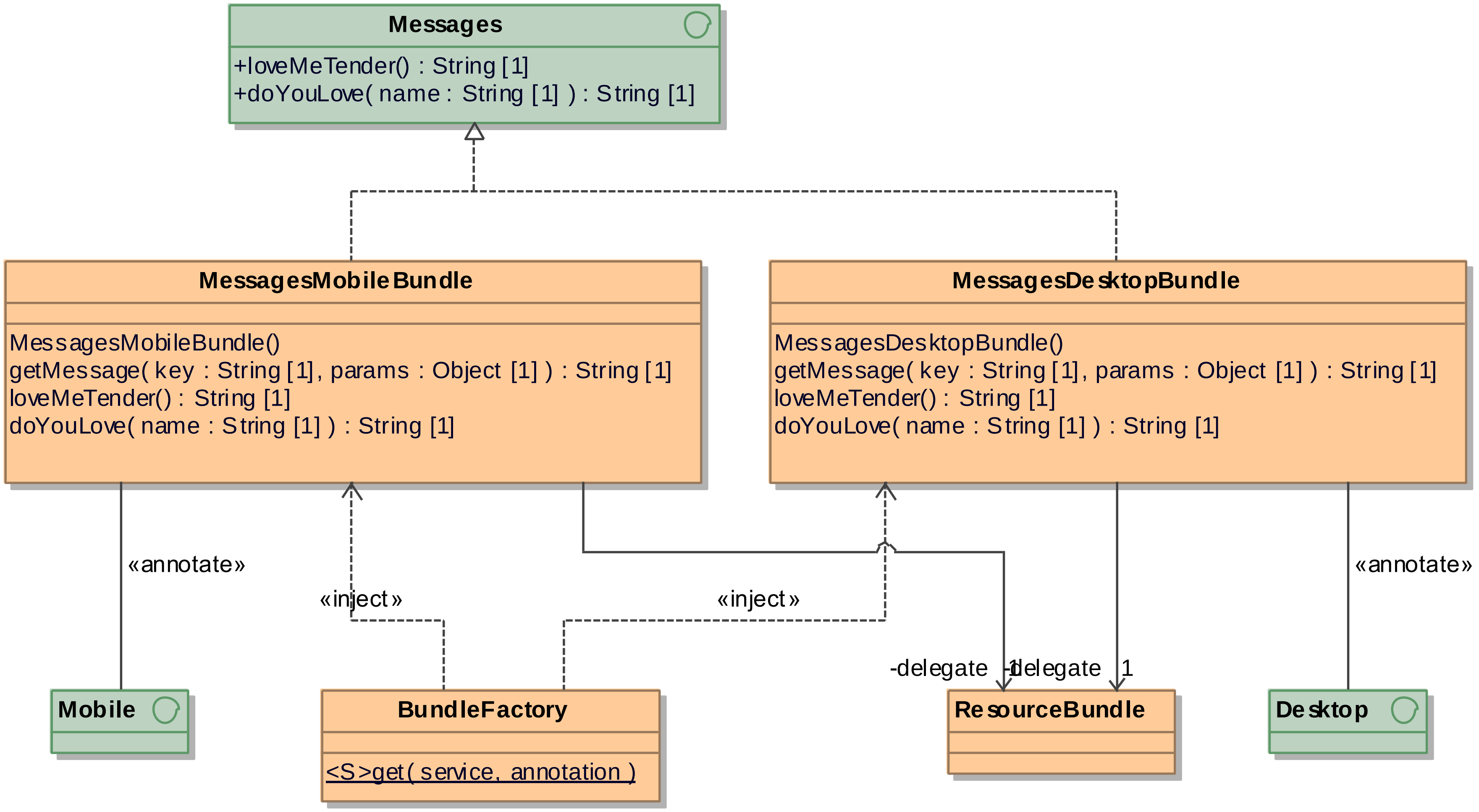
- APT parses the source code to generate
  - Java Files & .class, Reports (.csv, …)
  - Build log information or even build failures
- It allows you to have a source level DSL
  - Annotate your code & Generate the plumbing
  - Compile / Debug the generated code
- APT framework is compact

Go deep in APT usage with Ez18n

Demo

- The Stock-watcher available on
  - http://github.com/lesfurets/ez18n
  - In the ez18n-webapp module
  - Derived from a GWT Sample
- With a desktop browser
- With a mobile browser

Ez18n - Big picture

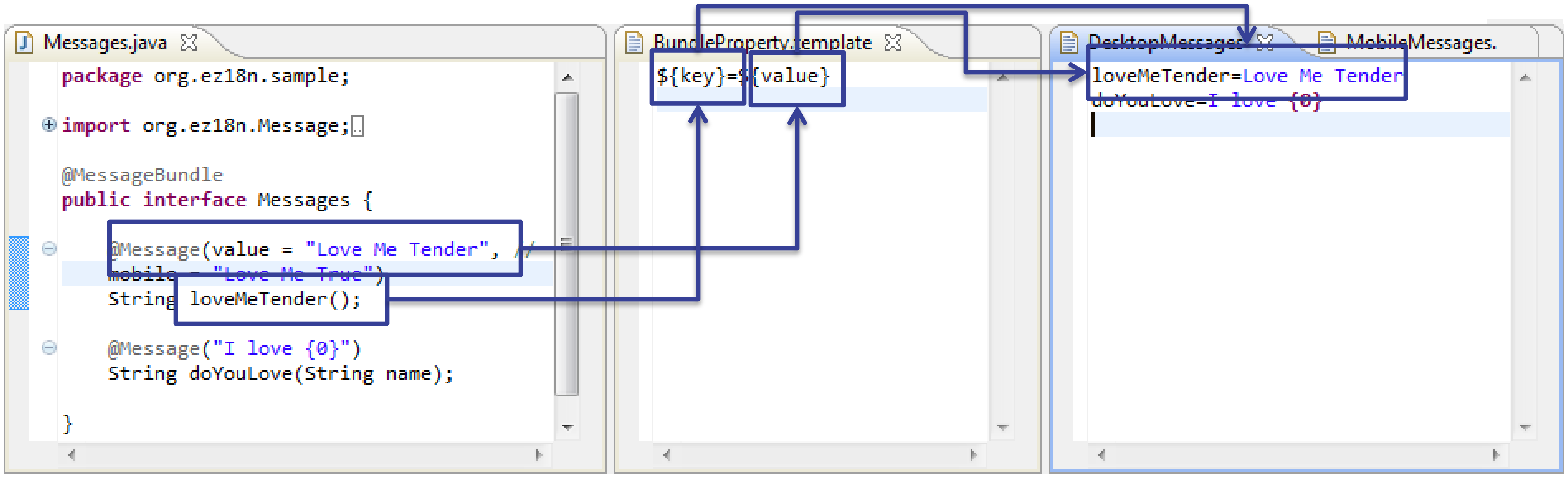

Messages
+loveMeTender() : String [1]
+doYouLove(name : String [1]) : String [1]
MessagesMobileBundle
MessagesMobileBundle()
getMessage(key : String [1], params : Object [1]) : String [1]
loveMeTender() : String [1]
doYouLove(name : String [1]) : String [1]
MessagesDesktopBundle
MessagesDesktopBundle()
getMessage(key : String [1], params : Object [1]) : String [1]
loveMeTender() : String [1]
doYouLove(name : String [1]) : String [1]
«annotate»
«inject»
«inject»
«annotate»
-delegate 1
-delegate 1
Mobile
BundleFactory
<S>get(service, annotation)
ResourceBundle
Desktop

Ez18n - APT chaining

```xml
<plugin>
  <groupId>org.bsc.maven</groupId>
  <artifactId>maven-processor-plugin</artifactId>
  <executions>
    <execution>
      <id>generate-i18n-source</id>
      <goals>
        <goal>process</goal>
      </goals>
      <phase>generate-sources</phase>
      <configuration>
        <compilerArguments>-encoding UTF-8</compilerArguments>
        <outputDirectory>${project.build.directory}/generated-sources/apt</outputDirectory>
        <processors>
          <processor>org.ez18n.apt.processor.MobileBundleProcessor</processor>
          <processor>org.ez18n.apt.processor.MobileBundlePropertiesProcessor</processor>
          <processor>org.ez18n.apt.processor.DesktopBundleProcessor</processor>
          <processor>org.ez18n.apt.processor.DesktopBundlePropertiesProcessor</processor>
          <processor>org.ez18n.apt.processor.CSVReportProcessor</processor>
          <processor>org.ez18n.apt.processor.MetaInfServicesProcessor</processor>
        </processors>
      </configuration>
    </execution>
```

From Messages to DesktopMessages.properties

- One property file per interface with **@MessageBundle**
- One property entry per method with **@Message**

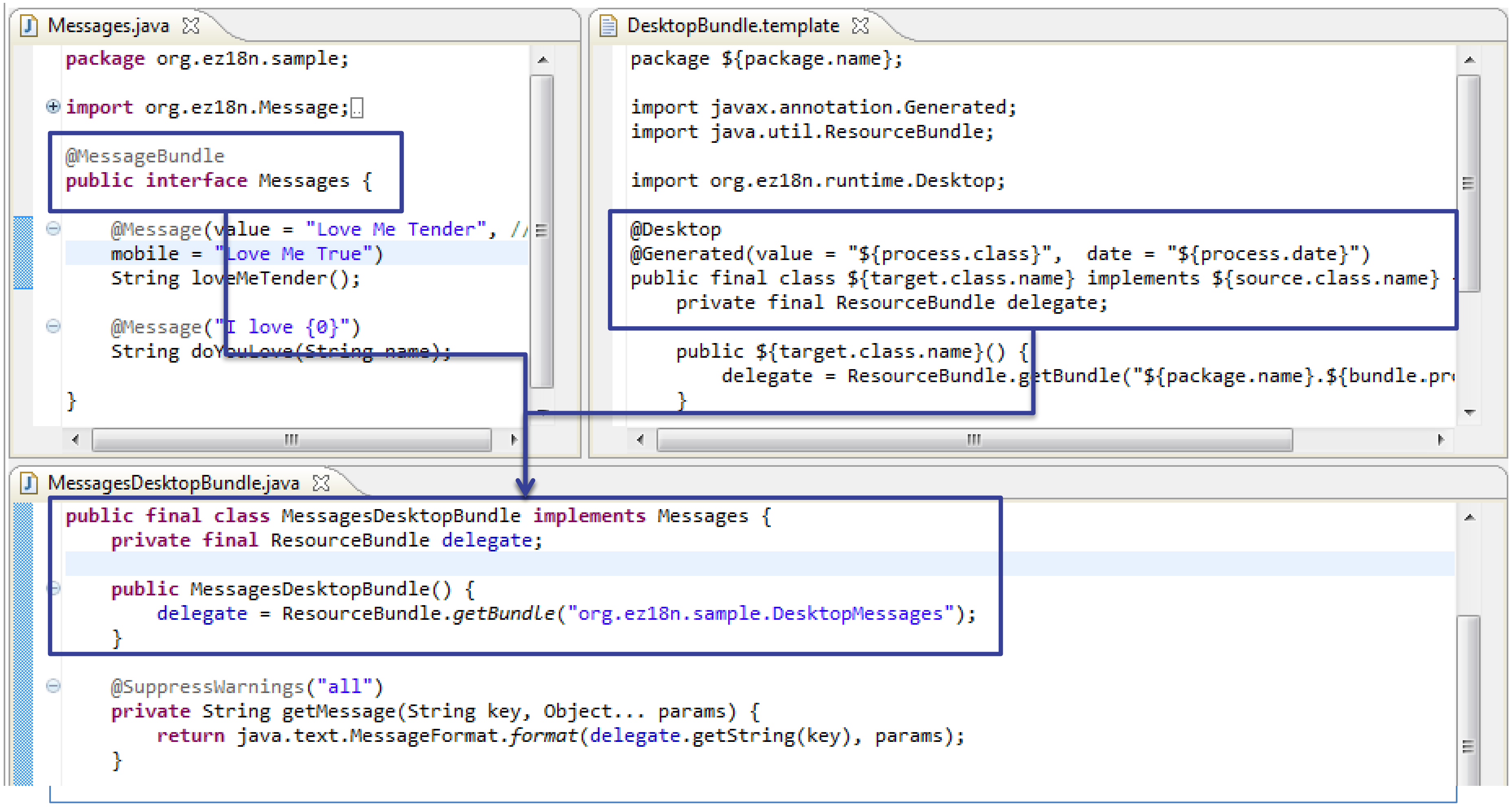


```
package org.ez18n.sample;

import org.ez18n.Message;

@MessageBundle
public interface Messages {

    @Message(value = "Love Me Tender", //
    mobile = "Love Me True")
    String loveMeTender();

    @Message("I love {0}")
    String doYouLove(String name);

}
```

```
${key}=${value}
```

```
loveMeTender=Love Me Tender
doYouLove=I love {0}
```

From Messages to MessagesDesktopBundle.java (1/2)



Messages.java

```
package org.ez18n.sample;

import org.ez18n.Message;

@MessageBundle
public interface Messages {

    @Message(value = "Love Me Tender", //
    mobile = "Love Me True")
    String loveMeTender();

    @Message("I love {0}")
    String doYouLove(String name);

}
```

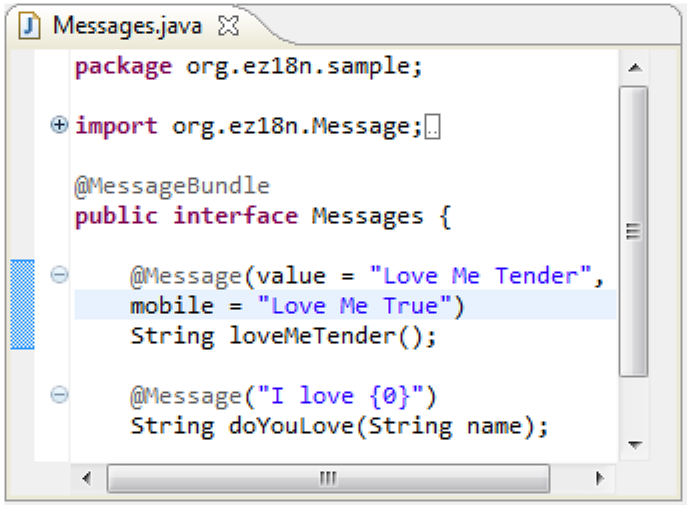
DesktopBundle.template

```
package ${package.name};

import javax.annotation.Generated;
import java.util.ResourceBundle;

import org.ez18n.runtime.Desktop;

@Desktop
@Generated(value = "${process.class}",  date = "${process.date}")
public final class ${target.class.name} implements ${source.class.name}
    private final ResourceBundle delegate;

    public ${target.class.name}() {
        delegate = ResourceBundle.getBundle("${package.name}.${bundle.pr
    }
```

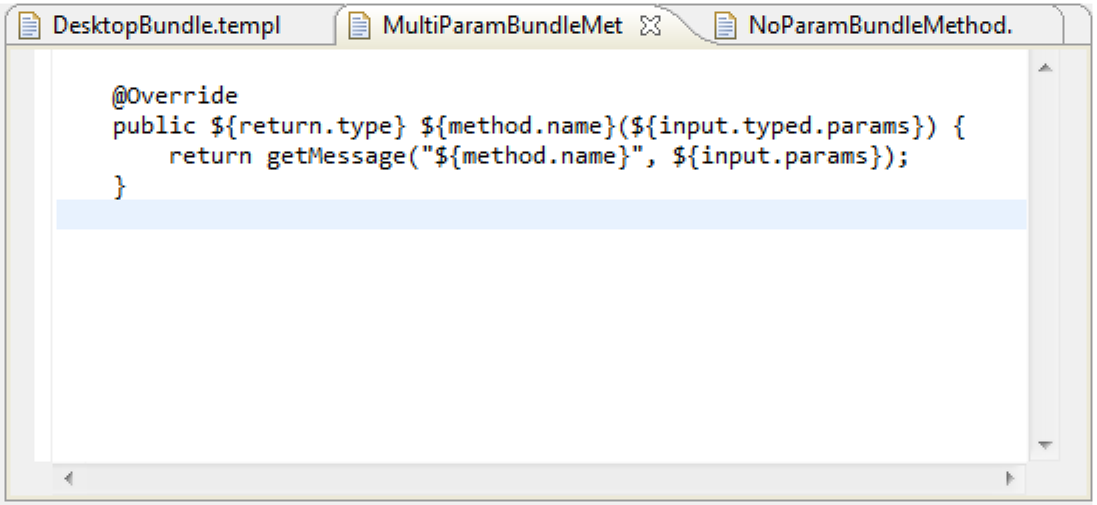
MessagesDesktopBundle.java

```
public final class MessagesDesktopBundle implements Messages {
    private final ResourceBundle delegate;

    public MessagesDesktopBundle() {
        delegate = ResourceBundle.getBundle("org.ez18n.sample.DesktopMessages");
    }

    @SuppressWarnings("all")
    private String getMessage(String key, Object... params) {
        return java.text.MessageFormat.format(delegate.getString(key), params);
    }
```

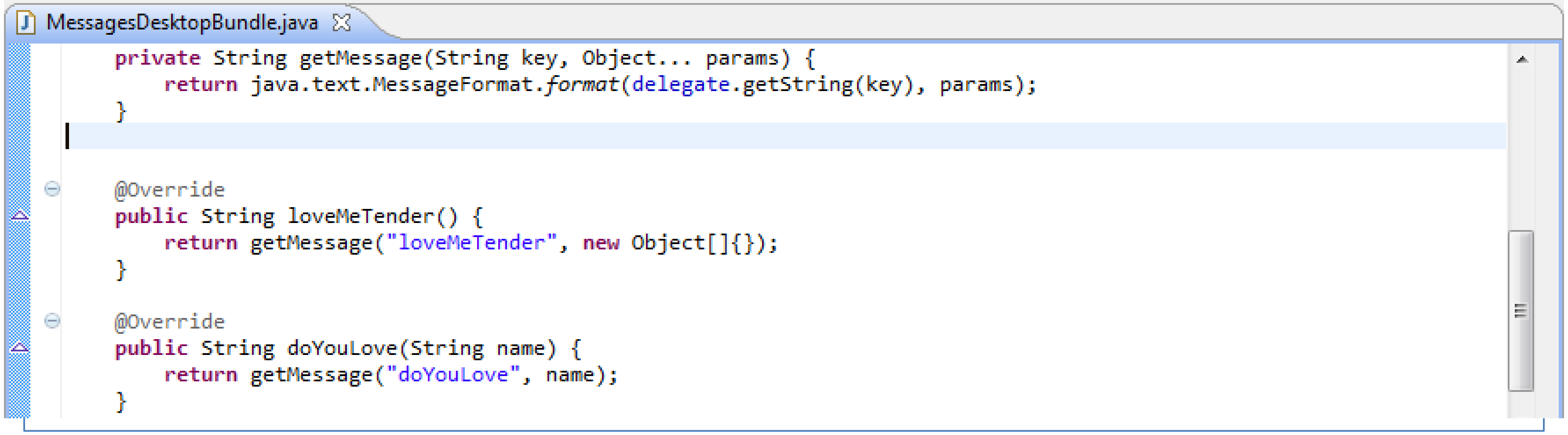
From Messages to MessagesDesktopBundle.java (2/2)


Messages.java

```
package org.ez18n.sample;

import org.ez18n.Message;

@MessageBundle
public interface Messages {

    @Message(value = "Love Me Tender",
    mobile = "Love Me True")
    String loveMeTender();

    @Message("I love {0}")
    String doYouLove(String name);
```

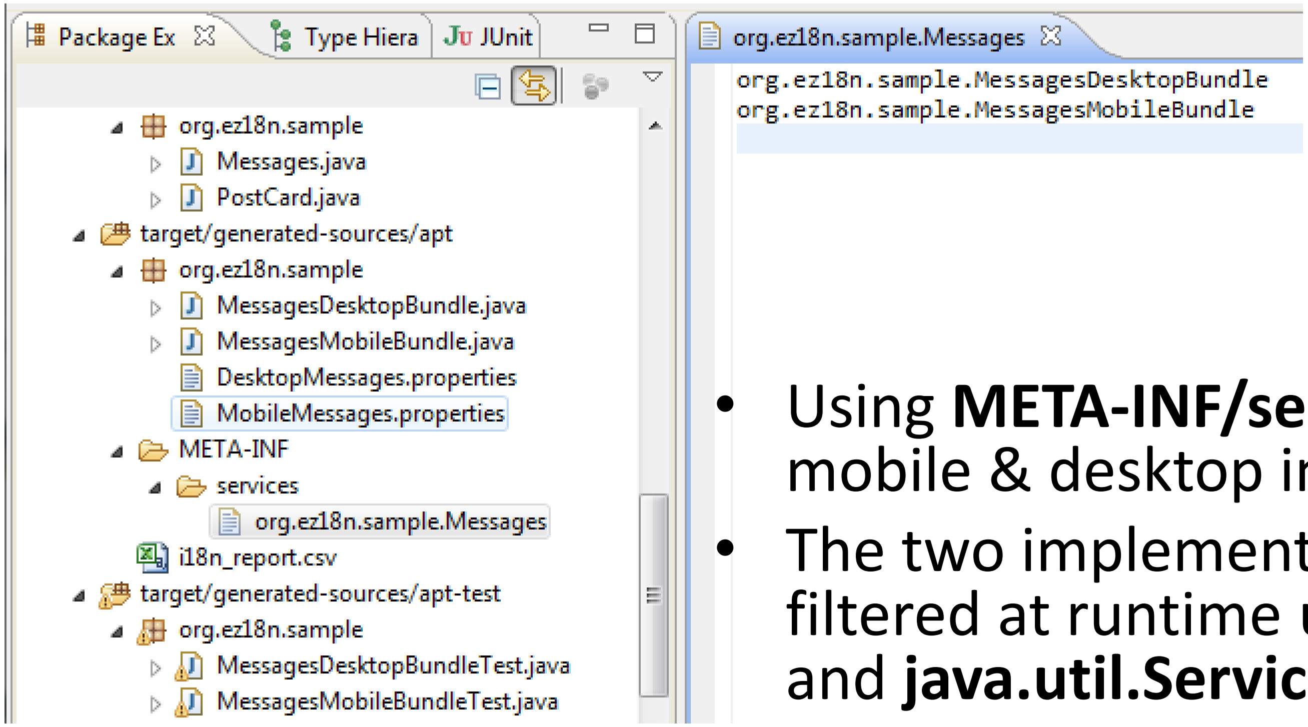

DesktopBundle.templ | MultiParamBundleMet | NoParamBundleMethod.

```
    @Override
    public ${return.type} ${method.name}(${input.typed.params}) {
        return getMessage("${method.name}", ${input.params});
    }
```


MessagesDesktopBundle.java

```
    private String getMessage(String key, Object... params) {
        return java.text.MessageFormat.format(delegate.getString(key), params);
    }


    @Override
    public String loveMeTender() {
        return getMessage("loveMeTender", new Object[]{});
    }

    @Override
    public String doYouLove(String name) {
        return getMessage("doYouLove", name);
    }
```

From Messages to META-INF/services/org.ez18n.sample.Messages



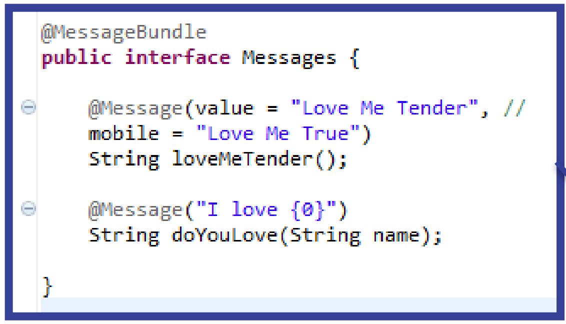
```
org.ez18n.sample
    Messages.java
    PostCard.java
target/generated-sources/apt
  org.ez18n.sample
    MessagesDesktopBundle.java
    MessagesMobileBundle.java
    DesktopMessages.properties
    MobileMessages.properties
  META-INF
    services
      org.ez18n.sample.Messages
  i18n_report.csv
target/generated-sources/apt-test
  org.ez18n.sample
    MessagesDesktopBundleTest.java
    MessagesMobileBundleTest.java
```

```
org.ez18n.sample.MessagesDesktopBundle
org.ez18n.sample.MessagesMobileBundle
```

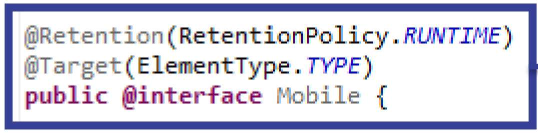
- Using **META-INF/services** to inject the mobile & desktop implementation
- The two implementations could be filtered at runtime using **annotations** and **java.util.ServiceLoader**
  - **@Mobile**
  - **@Desktop**

A factory for the Messages implementations

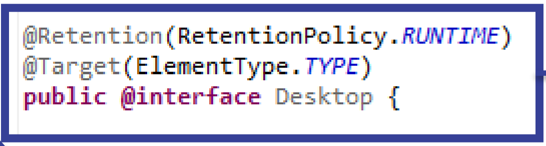
- Using **java.util.ServiceLoader** to inject the interface with **@MessageBundle**
- **@Desktop** and **@Mobile** used to filter the injection result



```
@MessageBundle
public interface Messages {

    @Message(value = "Love Me Tender", //
    mobile = "Love Me True")
    String loveMeTender();

    @Message("I love {0}")
    String doYouLove(String name);

}
```



```
@Retention(RetentionPolicy.RUNTIME)
@Target(ElementType.TYPE)
public @interface Mobile {
```

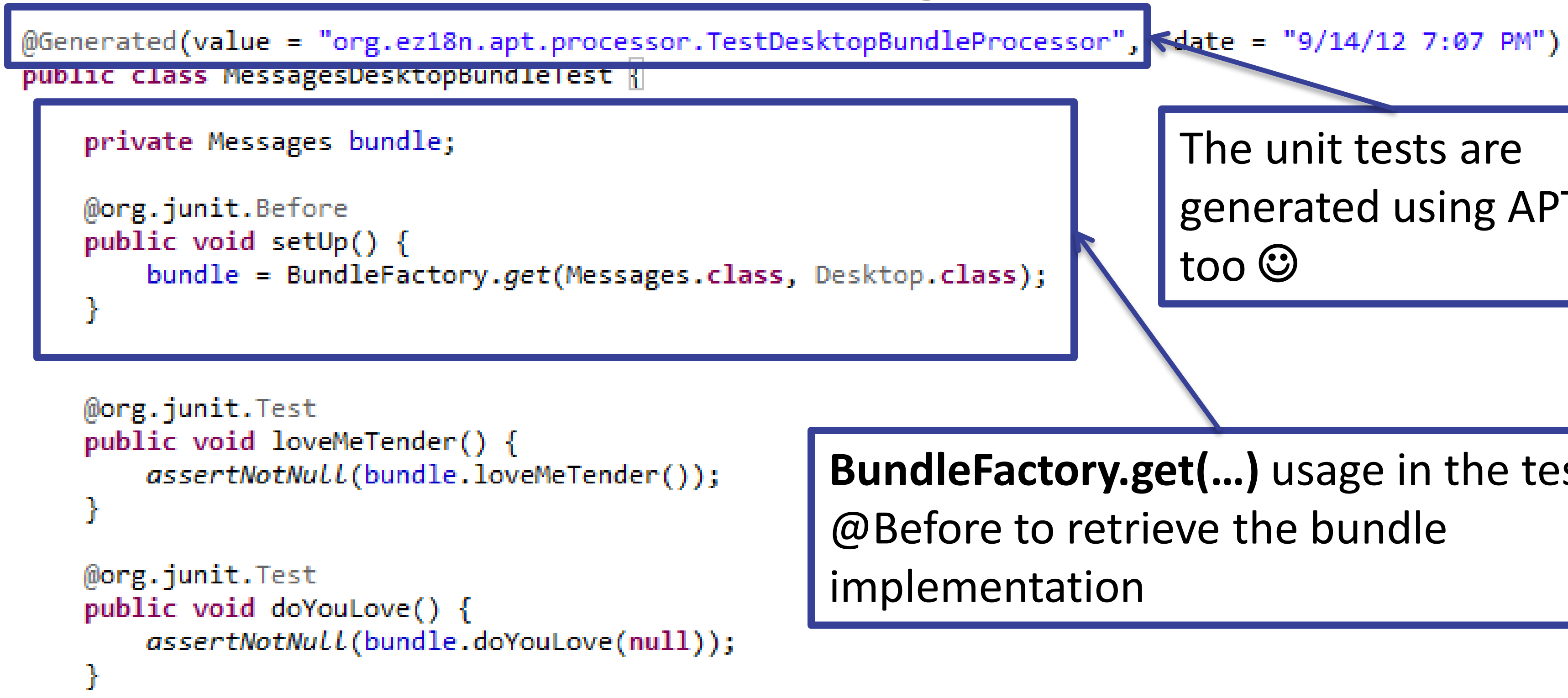


```
@Retention(RetentionPolicy.RUNTIME)
@Target(ElementType.TYPE)
public @interface Desktop {
```

```
public class BundleFactory {
    public static final <S> S get(Class<S> service, Class<? extends Annotation> annotation) {
        final ServiceLoader<S> loader = ServiceLoader.<S> load(service);
        for (S bundle : loader) {
            if (bundle.getClass().getAnnotation(annotation) != null)
                return bundle;
        }
        throw new IllegalStateException("bundle not found for " + service.getName());
    }
}
```

Client code sample with JUnit

- Some basic JUnit test using the API

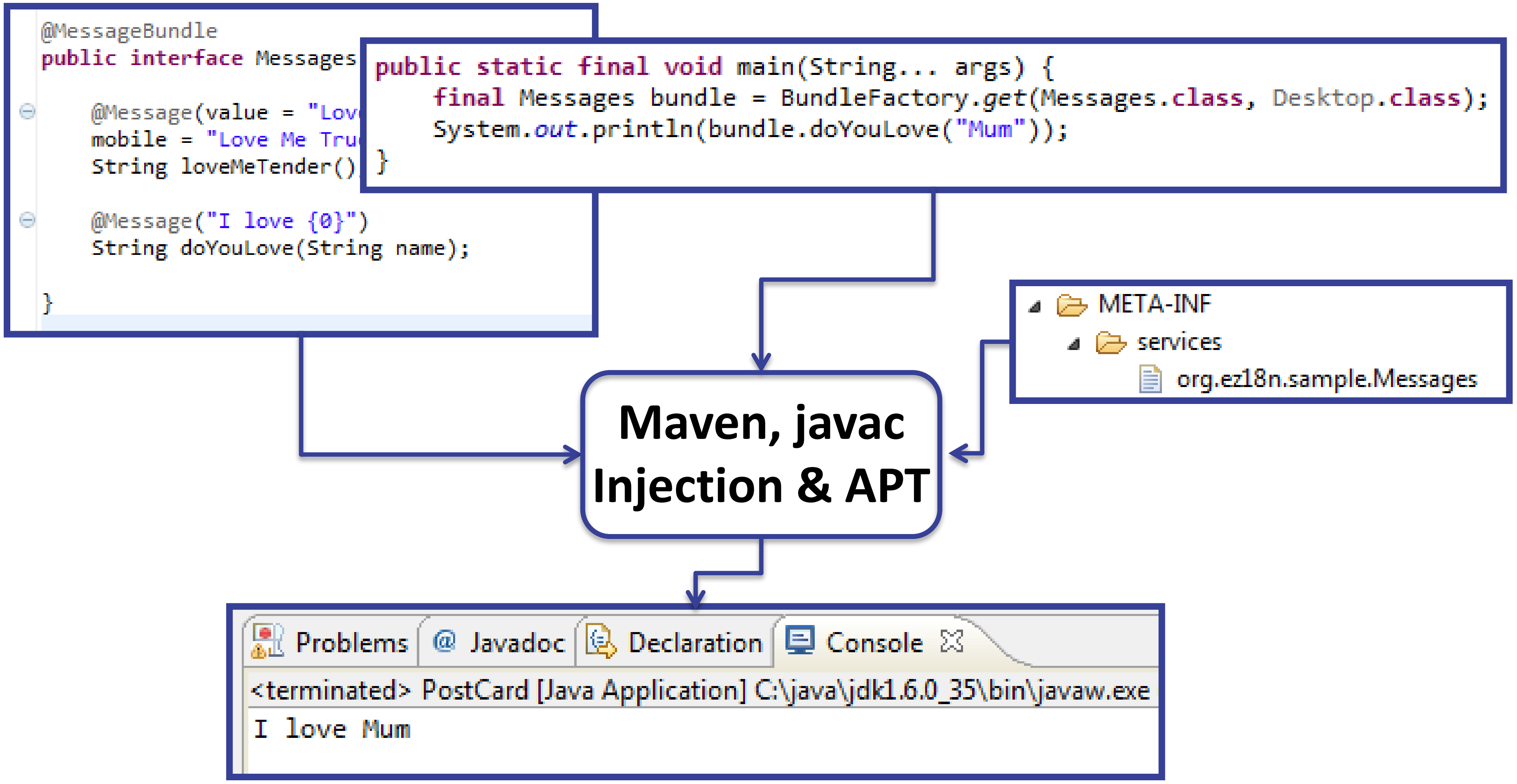


```
@Generated(value = "org.ez18n.apt.processor.TestDesktopBundleProcessor", date = "9/14/12 7:07 PM")
public class MessagesDesktopBundleTest {

    private Messages bundle;

    @org.junit.Before
    public void setUp() {
        bundle = BundleFactory.get(Messages.class, Desktop.class);
    }

    @org.junit.Test
    public void loveMeTender() {
        assertNotNull(bundle.loveMeTender());
    }

    @org.junit.Test
    public void doYouLove() {
        assertNotNull(bundle.doYouLove(null));
    }
```

The unit tests are generated using APT too ☺

BundleFactory.get(…) usage in the test @Before to retrieve the bundle implementation

Ez18n - Summary



```
@MessageBundle
public interface Messages

    @Message(value = "Lov
    mobile = "Love Me Tru
    String loveMeTender()

    @Message("I love {0}")
    String doYouLove(String name);

}
```

```
public static final void main(String... args) {
    final Messages bundle = BundleFactory.get(Messages.class, Desktop.class);
    System.out.println(bundle.doYouLove("Mum"));
}
```

```
META-INF
  services
    org.ez18n.sample.Messages
```

Maven, javac
Injection & APT

```
Problems  @ Javadoc  Declaration  Console
<terminated> PostCard [Java Application] C:\java\jdk1.6.0_35\bin\javaw.exe
I love Mum
```

If you'd like a JSR for ez18n please tell us !

Ez18n =
@Message
@MessageBundle
Set of Processors

APT Adoption

“As the lead engineer on JSR 269 in JDK 6, I'd be heartened to see greater adoption and use of annotation processing by Java developers.”

Joseph D. Darcy (Oracle)

APT JDK 8

- possibilité d'ajouter une annotation sur les types d'objets (JSR 308)
- possibilité de répéter une annotation sur une déclaration (JEP 120)
- portage de l'API "javax.lang.model" au runtime pour qu'elle ne soit pas disponible uniquement à la compilation (JEP 119)
- Voir les notes : http://blog.soat.fr/2012/11/devoxx-2012-jsr-308-annotations-on-java-types/

JavaOne 2012
APT virtual mini-track

- Sessions
  - **Advanced Annotation Processing with JSR 269**
    - Jaroslav Tulach
  - **Build Your Own Type System for Fun and Profit**
    - Werner Dietl and Michael Ernst
  - **Annotations and Annotation Processing: What's New in JDK 8?**
    - Joel Borggrén-Franck
  - **Hack into Your Compiler!**
    - Jaroslav Tulach
  - **Writing Annotation Processors to Aid Your Development Process**
    - Ian Robertson

- Thanks to
  - Joseph D. Darcy (APT spec lead) - https://blogs.oracle.com/darcy/

Thank you !

Ez18n is on GitHub
Just fork it !

https://github.com/lesfurets/ez18n