EclipseLink

Developing JAXB Applications Using EclipseLink MOXy

Release 2.6

June 2014

Developing JAXB Applications Using EclipseLink MOXy, Release 2.6

Print date: June 10, 2014

Contents

3 Mapping Type Levels

4 Mapping Simple Values

5 Mapping Special Schema Types

6 Privately Owned Relationships

7 Mapping Shared Reference Relationships

8 Advanced Concepts

9 Using Dynamic JAXB

10 Using JSON Documents

Preface

EclipseLink provides specific annotations (*EclipseLink extensions*) in addition to supporting the standard Java Architecture for XML Binding (JAXB) implementation. You can use these EclipseLink extensions to take advantage of EclipseLink's extended functionality and features within your JPA entities.

Audience

This document is intended for application developers who want to develop applications using EclipseLink with Java Architecture for XML Binding (JAXB). This document does not include details about related common tasks, but focuses on EclipseLink functionality.

Developers should be familiar with the concepts and programming practices of

- Java SE and Java EE.
- Java Architecture for XML Binding (JAXB) specification (`http://jcp.org/aboutJava/communityprocess/mrel/jsr222/index.html`)
- Java Persistence specification (`http://jcp.org/en/jsr/detail?id=317`)
- Eclipse IDE (`http://www.eclipse.org`)

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

1 Introduction

JAXB (Java Architecture for XML Binding – JSR 222) is the standard for XML Binding in Java. JAXB covers 100% of XML Schema concepts and EclipseLink provides a JAXB implementation with many extensions. See http://jcp.org/en/jsr/detail?id=222 for complete information on the JAXB specification.

The EclipseLink MOXy component enables developers to efficiently bind Java classes to XML schemas and JSON documents. MOXy implements JAXB, allowing developers to provide their mapping information through annotations *as well as providing support for storing the mappings in XML and JSON format*s.

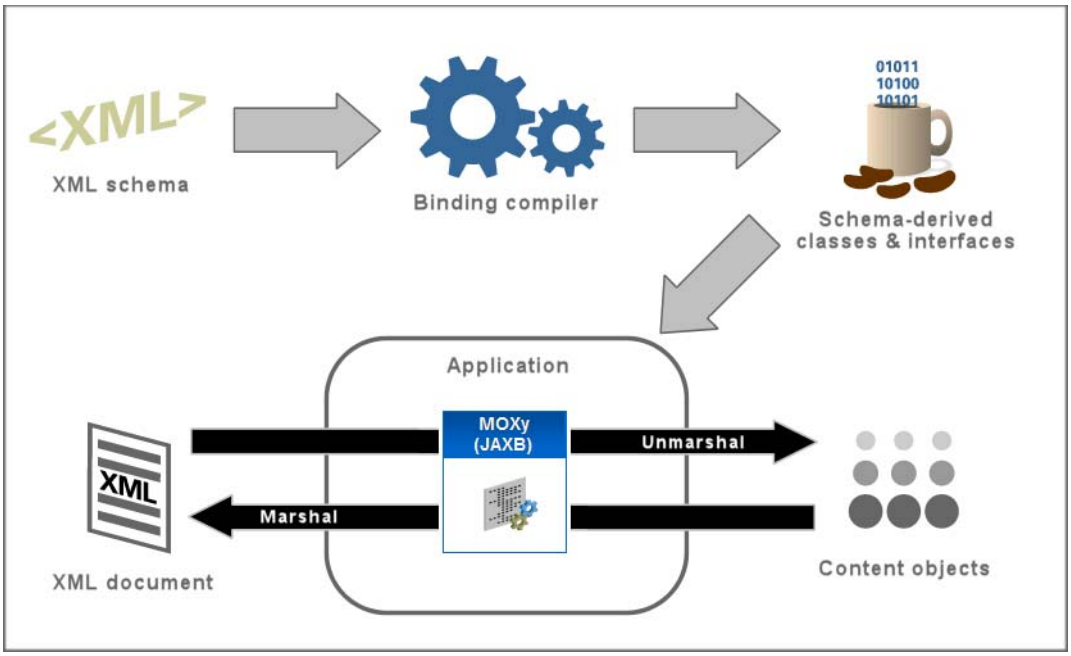
This chapter includes the following sections:

About EclipseLink MOXy

When using EclipseLink MOXy as the JAXB provider, no metadata is required to convert your existing object model to XML or JSON. You can supply metadata (using annotations, XML, or JSON) only when fine-tuning of the XML or JSON representation is required.

EclipseLink MOXy includes many advanced mappings that allows you to handle complex XML structures without having to mirror the schema in the Java class model.

Figure 1–1 Sample JAXB Architecture



Solving Object-XML Impedance Mismatch

Although XML is a common format for the exchange of data, for many applications *objects* are the preferred programmatic representation – not XML. In order to work at the object-level, the XML data needs to be converted to object form. The mismatch between XML and objects is known as *object-xml impedance mismatch*.

JAXB allows you to interact with XML data by using domain-like objects. Unlike DOM objects, the JAXB content model provides insight into the XML document based on the XML schema. For example, if the XML schema defines XML documents that contain customer information, your content model will contain objects such as **Customer**, **Address**, and **PhoneNumber**. Each *type* in the XML schema will have a corresponding Java class.

With EclipseLink MOXy, you can efficiently bind Java classes to XML schemas or JSON documents. MOXy implements JAXB by allowing you to provide mapping information through annotations *as well as storing the mappings in XML* or JSON. By using the EclipseLink's advanced mappings, you can manage complex XML structures *without* having to mirror the schema in your Java class model.

About This Documentation

EclipseLink is the reference implementation of the Java Persistence Architecture (JPA) specification It also includes many enhancements and extensions.

Other Resources

For more information, see:

- EclipseLink documentation center
  http://www.eclipse.org/eclipselink/documentation/

- The EclipseLink API reference documentation (Javadoc) for complete information on core JAXB plus the EclipseLink enhancements
  http://www.eclipse.org/eclipselink/api/
- Java Architecture for XML Binding (JAXB) specification
  http://www.jcp.org/en/jsr/detail?id=222
- Examples that display the use of a number of JAXB and EclipseLink MOXy features
  http://wiki.eclipse.org/EclipseLink/Examples/MOXy
- JAXB Tutorial
  http://www.oracle.com/technetwork/articles/javase/index-140168.html

2

EclipseLink MOXy Runtime

This chapter introduces and describes EclipseLink MOXy. EclipseLink MOXy is one implementation of the standard runtime defined by the JAXB specification.

To specify EclipseLink MOXy as your JAXB provider:

- Add the JAXB APIs (included in Java SE 6) and `eclipselink.jar` on your classpath.
- Use a `jaxb.properties` file (in the same package as your domain classes).

This chapter includes the following sections:

Specifying the EclipseLink Runtime

To use EclipseLink MOXy as your JAXB implementation, identify the EclipseLink `JAXBContextFactory` in your `jaxb.properties` file.

1. Create a text file named `jaxb.properties`, specifying EclipseLink's `JAXBContextFactory` as the factory used to build new `JAXBContexts`:

   ```
   javax.xml.bind.context.factory=org.eclipse.persistence.jaxb.JAXBContextFactory
   ```

2. Copy the file to the same package (directory) in which your model classes reside.
3. Use the standard `JAXBContext.newInstance(Class... classesToBeBound)` API to create a JAXBContext:

   ```
   JAXBContext jaxbContext = JAXBContext.newInstance(Customer.class);
   ```

Because you do not need to change any application code, you can easily switch between different JAXB implementations.

For more information on different ways to create a `JAXBContext`, see "Bootstrapping" on page 2-2.

Bootstrapping

EclipseLink MOXy offers several options when creating your `JAXBContext`. You have the option of bootstrapping from:

- A list of one or more JAXB-annotated classes
- A list of one or more EclipseLink XML bindings documents defining the mappings for your Java classes
- A combination of classes and XML bindings
- A list of context paths
- A list of session names, referring to EclipseLink sessions defined in `sessions.xml`

Using the JAXBContext API

The methods on `JAXBContext` (shown in Example 2–1) are used to create new instances.

Example 2–1 JAXBContext Methods

```
public static JAXBContext newInstance(Class... classesToBeBound) throws
JAXBException

public static JAXBContext newInstance(Class[] classesToBeBound, Map<String,?>
properties) throws JAXBException

public static JAXBContext newInstance(String contextPath) throws JAXBException

public static JAXBContext newInstance(String contextPath, ClassLoader classLoader)
throws JAXBException

public static JAXBContext newInstance(String contextPath, ClassLoader classLoader,
Map<String,?> properties) throws JAXBException
```

`JAXBContext` accepts the following options:

- **classesToBeBound** – List of Java classes to be recognized by the new `JAXBContext`
- **contextPath** – List of Java package names (or EclipseLink session names) that contain mapped classes
- **classLoader** – The class loader used to locate the mapped classes
- **properties** – A map of additional properties.

The APIs in Example 2–1 expect to find a `jaxb.properties` file in your Java package/context path. For more information see "Specifying the EclipseLink Runtime" on page 2-1.

Bootstrapping from Classes

If you have a collection of Java classes annotated with JAXB annotations, you can provide a list of these classes directly:

```
JAXBContext context = JAXBContext.newInstance(Company.class, Employee.class);
```

Other classes that are reachable from the classes in the array (for example, referenced classes, super class) will automatically be recognized by the `JAXBContext`. Subclasses or classes marked as `@XmlTransient` will not be recognized.

Bootstrapping from a Context Path

Another way to bootstrap your `JAXBContext` is with a `String`, called the *context path*. This is a colon-delimited list of package names containing your mapped classes:

```
JAXBContext context = JAXBContext.newInstance("example");
```

Using this approach, there are a few different ways that EclipseLink will discover your model classes:

- Using a `jaxb.index` File
- Using an ObjectFactory
- Using MetadataSource

Using a `jaxb.index` File

The context path could contain a file named `jaxb.index`, which is a simple text file containing the class names from the current package that will be brought into the `JAXBContext`:

`src/example/jaxb.index:`

Example 2–2 Sample jaxb.index File

```
Employee
PhoneNumber
```

Other classes that are reachable from the classes in list (for example, referenced classes, super class) will automatically be recognized by the `JAXBContext`. Subclasses or classes marked as `@XmlTransient` will not be recognized.

Using an ObjectFactory

The context path could also contain a class called `ObjectFactory`, which is a special factory class that JAXB will look for. This class contains `create()` methods for each of the types in your model. Typically the `ObjectFactory` will be generated by the JAXB compiler, but one can be written by hand as well.

`src/example/ObjectFactory.java:`

Example 2–3 Sample ObjectFactory

```
@XmlRegistry
public class ObjectFactory {
private final static QName _Employee_QNAME = new QName("", "employee");
private final static QName _PhoneNumber_QNAME = new QName("", "phone-number");
public ObjectFactory() {
}
public EmployeeType createEmployeeType() {
return new EmployeeType();
}
@XmlElementDecl(namespace = "", name = "employee")
 public JAXBElement<EmployeeType> createEmployee(EmployeeType value) {
        return new JAXBElement<EmployeeType>(_Employee_QNAME, EmployeeType.class,
null, value);
    }
```

```
    public PhoneNumberType createPhoneNumberType() {
        return new PhoneNumberType();
    }

    @XmlElementDecl(namespace = "", name = "phone-number")
    public JAXBElement<PhoneNumberType> createPhoneNumber(PhoneNumberType value) {
        return new JAXBElement<PhoneNumberType>(_PhoneNumber_QNAME,
PhoneNumberType.class, null, value);
    }

}
```

Using MetadataSource

EclipseLink MOXy also has the ability to retrieve mapping information from an implementation of EclipseLink's `MetadataSource`. Using this approach, you are responsible for creating your own `XmlBindings`.

Example 2–4 Sample Metadata Source

```
package org.eclipse.persistence.jaxb.metadata;
public interface MetadataSource {

    /**
     * @param properties - The properties passed in to create the JAXBContext
     * @param classLoader - The ClassLoader passed in to create the JAXBContext
     *
     * @return the XmlBindings object representing the metadata
     */
    XmlBindings getXmlBindings(Map<String, ?> properties, ClassLoader
classLoader);

}
```

For information on using a MetadataSource, see "Using MetadataSource" on page 2-13.

Bootstrapping from EclipseLink XML Bindings

To have more control over how your classes will be mapped to XML, you can bootstrap from an EclipseLink XML bindings document. Using this approach, you can take advantage of EclipseLink's robust mappings framework and customize how each complex type in XML maps to its Java counterpart.

Links to the actual documents are passed in via the **properties** parameter, using a special key, `JAXBContextProperties.OXM_METADATA_SOURCE`:

Example 2–5 Using an EclipseLink Bindings Document

```
InputStream iStream =
myClassLoader.getResourceAsStream("example/xml-bindings.xml");

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, iStream);

JAXBContext context = JAXBContext.newInstance(new Class[]{ Customer.class },
properties);
```

For more information on the XML Bindings format, see "Using XML Bindings" on page 2-6.

Combining Annotated Classes and XML Bindings

When bootstrapping from annotated classes, additional mapping information can be provided with an EclipseLink XML bindings document. For instance, you might annotate your model classes with JAXB-spec-only annotations, and put your EclipseLink-specific mapping customizations into an XML bindings document (negating the need to import EclipseLink annotations in your model classes).

For example, review the annotated `Employee` class in Example 2–6.

Example 2–6 Sample Java Class

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement

@XmlAccessorType(XmlAccessType.FIELD)
public class Employee {
   @XmlElement(name="phone-number")
   private PhoneNumber phoneNumber;
   ...
}
```

You can customize the `Employee` to use an EclipseLink XMLAdapter for marshalling/unmarshalling `PhoneNumbers` by using the XML Bindings in Example 2–7.

Example 2–7 Using an XML Bindings Document

```
<?xml version="1.0" encoding="US-ASCII"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm">
  <java-types>
    <java-type name="example.Employee">
      <java-attributes>
        <xml-element java-attribute="phoneNumber">
          <xml-java-type-adapter value="example.util.PhoneNumberProcessor"/>
        </xml-element>
      </java-attributes>
    </java-type>
  </java-types>
</xml-bindings>
```

Finally, pass both the list of annotated classes and the link to the XML Bindings to the `JAXBContext`, as shown in Example 2–8.

Example 2–8 Sample Application Code

```
InputStream iStream =
myClassLoader.getResourceAsStream("example/xml-bindings.xml");

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, iStream);

Class[] classes = new Class[] { Company.class, Employee.class };
JAXBContext context = JAXBContext.newInstance(classes, properties);
```

Using XML Bindings

In addition to standard JAXB annotations, EclipseLink offers another way of expressing your metadata: the EclipseLink XML Bindings document. Not only can XML Bindings separate your mapping information from your actual Java class, it can also be used for more advanced metadata tasks such as:

- Augmenting or overriding existing annotations with additional mapping information
- Specifying all mappings information externally, with no annotations in Java at all
- Defining your mappings across multiple Bindings documents
- Specifying "virtual" mappings that do not correspond to concrete Java fields
- and more..

This section describes the XML Bindings format and demonstrates some basic use cases.

Understanding the XML Bindings Format

An XML Bindings document is XML that specifies Java type information, mapping information, context-wide properties – everything you need to define your JAXB system. An example Bindings document is shown in Example 2–9.

Example 2–9 Sample Bindings Document

```
<?xml version="1.0" encoding="US-ASCII"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
    package-name="example" xml-accessor-type="PUBLIC_MEMBER"
xml-accessor-order="ALPHABETICAL"
    xml-mapping-metadata-complete="false"
xml-name-transformer="example.NameGenerator"
    supported-versions="2.4" >

    <xml-schema element-form-default="QUALIFIED">
        <xml-ns prefix="ns1" namespace-uri="http://www.example.org/type" />
    </xml-schema>

    <java-types>
        <java-type name="Employee">
            <xml-type namespace="http://www.example.org/type" />
            <java-attributes>
                <xml-attribute java-attribute="empId" xml-path="@id" />
                <xml-element java-attribute="empName" name="name" />
                <xml-element java-attribute="salary" />
                <xml-element java-attribute="type" type="EmployeeType" />
            </java-attributes>
        </java-type>
        <java-type name="Company">
            <xml-root-element name="company" />
            <xml-attribute java-attribute="empId" xml-path="@id" />
            <xml-element java-attribute="empName" name="name" />
            <java-attributes>
                <xml-element java-attribute="employees" name="employee"
```

```
                    type="example.Employee" container-type="java.util.ArrayList"
/>
            </java-attributes>
        </java-type>
    </java-types>

    <xml-registries>
        <xml-registry name="example.ObjectFactory">
            <xml-element-decl java-method="createEmpleado"
                name="empleado" type="example.Employee" />
            <xml-element-decl java-method="createCorporacion"
                name="corporacion" type="example.Company" />
        </xml-registry>
    </xml-registries>

    <xml-enums>
        <xml-enum java-enum="EmployeeType" value="java.lang.String">
            <xml-enum-value java-enum-value="CONTRACT">CONTRACT</xml-enum-value>
            <xml-enum-value java-enum-value="PART_TIME">PART_TIME</xml-enum-value>
            <xml-enum-value java-enum-value="FULL_TIME">FULL_TIME</xml-enum-value>
        </xml-enum>
    </xml-enums>

</xml-bindings>
```

Table 2–1 Binding Document Attributes

Attribute	Description
`<xml-bindings>`	The root of the XML Bindings document. This is also where you can define top-level properties for your JAXB system, such as the `package-name` of your classes, specify a default `xml-accessor-type`, and so on.
`<xml-schema>`	Defines properties related to the schema-level of your JAXB system. Corresponds to the JAXB `@XmlSchema` annotation.
`<java-types>`	Defines mapping information for each of your Java classes.
`<xml-enums>`	Defines Java enumerations that can be used with your Java types.
`<xml-registries>`	Defines an `ObjectFactory` for use in your JAXB system.

Bootstrapping with XML Bindings

When instantiating a `JAXBContext`, links to Bindings documents are passed in via the properties parameter, using a special key, `JAXBContextProperties.OXM_METADATA_SOURCE`. The value of this key will be a handle to the Bindings document, in the form of one of the following:

- `java.io.File`
- `java.io.InputStream`
- `java.io.Reader`
- `java.net.URL`
- `javax.xml.stream.XMLEventReader`
- `javax.xml.stream.XMLStreamReader`
- `javax.xml.transform.Source`
- `org.w3c.dom.Node`

- `org.xml.sax.InputSource`

To bootstrap from multiple XML Bindings documents:

- Maps of the above inputs are supported, keyed on Java package name.
- Lists of the above inputs are acceptable as well (`<xml-bindings>` must have package attribute).

Using XML Bindings with Annotations

The most typical use of an XML Bindings document is in conjunction with JAXB annotations. You may have situation where you are not permitted to edit your Java domain classes, but want to add additional mapping functionality. Or, you may wish to avoid importing any EclipseLink code into your domain model, but still take advantage of MOXy's advanced mapping features. When Bindings metadata is provided during context creation, its mapping information will be combined with any JAXB annotation information.

For example, consider the simple JAXB domain class and its default JAXB XML representation shown in Example 2–10.

Example 2–10 Sample JAXB Domain Class and XML

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
   @XmlAttribute
   private Integer custId;
   private String name;
   private Double salary;
   private byte[] picture;
   ...
}
```

```
<?xml version="1.0" encoding="UTF-8"?>
<customer custId="15">
   <name>Bob Dobbs</name>
   <salary>51727.61</salary>
   <picture>AgQIECBA</picture>
</customer>
```

Now, assume that we would like to make the following mapping changes:

- Change the XML element name of `custId` to `customer-id`
- Change the root element name of the class to `customer-info`
- Write the picture to XML as `picture-hex` in hex `binary` format, and use our own custom converter, `MyHexConverter`.

We can specify these three customizations in an XML Bindings document as shown in Example 2–11.

Example 2–11 Customized XML Bindings

```
<?xml version="1.0" encoding="US-ASCII"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
    package-name="example">

    <java-types>
        <java-type name="Customer">
            <xml-root-element name="customer-info" />
            <java-attributes>
                <xml-attribute java-attribute="custId" name="customer-id" />
                <xml-element java-attribute="picture" name="picture-hex">
                    <xml-schema-type name="hexBinary" />
                    <xml-java-type-adapter
                        value="example.adapters.MyHexConverter" />
                </xml-element>
            </java-attributes>
        </java-type>
    </java-types>

</xml-bindings>
```

The Bindings must then be provided during JAXB context creation. Bindings information is passed in via the `properties` argument:

Example 2–12 Providing Bindings

```
ClassLoader classLoader = Thread.currentThread().getContextClassLoader();
InputStream iStream =
classLoader.getResourceAsStream("metadata/xml-bindings.xml");

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, iStream);

JAXBContext ctx = JAXBContext.newInstance(new Class[] { Customer.class },
properties);
```

When providing Bindings, during JAXB context creation EclipseLink will:

1. `Customer.class` will be analyzed and JAXB mappings will be generated as usual.
2. The Bindings document is then analyzed, and the original JAXB mappings will be merged with the information in the Bindings document.

After applying the XML Bindings, we have the desired XML representation:

```
<?xml version="1.0" encoding="UTF-8"?>
<customer-info customer-id="15">
   <name>Bob Dobbs</name>
   <salary>51727.61</salary>
   <picture-hex>020408102040</picture-hex>
</customer-info>
```

Using Multiple Bindings Documents

Starting with version 2.3, EclipseLink allows you to use mapping information from multiple XML Bindings documents. Using this approach, you can split your metadata up as you wish.

Example 2–13 Using a List of XML Bindings:

```
...
FileReader file1 = new FileReader("base-bindings.xml");
FileReader file2 = new FileReader("override-bindings.xml");

List<Object> fileList = new ArrayList<Object>();
fileList.add(file1);
fileList.add(file2);

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, fileList);

JAXBContext ctx = JAXBContext.newInstance(new Class[] { Customer.class },
properties);

...
```

When using a List of Bindings documents, each one must define the package attribute of `<xml-bindings>`, to indicate the package for each set of Bindings.

Example 2–14 Using a Map for multiple packages:

```
...

FileReader fooFile1 = new FileReader("foo/base-bindings.xml");
FileReader fooFile2 = new FileReader("foo/override-bindings.xml");

List<Object> fooFileList = new ArrayList<Object>();
fooFileList.add(fooFile1);
fooFileList.add(fooFile2);

FileReader barFile1 = new FileReader("bar/base-bindings.xml");
FileReader barFile2 = new FileReader("bar/override-bindings.xml");

List<Object> barFileList = new ArrayList<Object>();
barFileList.add(barFile1);
barFileList.add(barFile2);

Map<String, List> metadataMap = new HashMap<String, List>();
metadataMap.put("foo", fooFileList);
metadataMap.put("bar", barFileList);

properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, metadataMap);

JAXBContext ctx = JAXBContext.newInstance(new Class[] { Customer.class },
properties);

...
```

Understanding Override Rules

When multiple sources of metadata are encountered for the same package, a unified set of mappings will be created by merging the complete set of metadata. First, the annotations from the Java class will be processed, and then any XML Bindings information will be applied. The order that Bindings are specified is relevant; values in subsequent documents will override the ones defined in previous ones.

The following rules will be used for merging:

- `xml-schema`
  - For values such as `namespace`, `elementform`, `attributeform`, the later file will override.
  - The list of namespace declarations from `XmlNs` will be merged into a single list containing all entries from all files.

    In the case of conflicting entries (the same prefix bound to multiple namespaces), the last file will override the declarations from previous files.
- `java-types`
  - The merged bindings will contain all unique `java-type` entries from all bindings files.
  - If the same `java-type` occurs in multiple files, any values that are set in the later file will override values from the previous file.
  - Properties on each `java-type` will be merged into a unified list. If the same property is referenced in multiple files, this will be an exception case.
  - Class-level `XmlJavaTypeAdpater` entries will be overridden if specified in a later bindings file.
  - Class-level `XmlSchemaTypes` will create a merged list. If an entry for the same type is listed in multiple bindings files at this level, the last file's entry will override all previous ones.
- `xml-enums`
  - The merged bindings will contain all unique `xml-enum` entries from all bindings files.
  - For any duplicated java-enums, a merged list of `XmlEnumValues` will be created. If an entry for the same enum facet occurs in multiple files, the last file will override the value for that facet.
- `xml-java-type-adapters`
  - Package-level Java type adapters will be merged into a single list. In the case that an adapter is specified for the same class in multiple files, the last file's entry will win.
- `xml-registries`
  - Each unique `XmlRegistry` entry will be added to the final merged list of `XmlRegistries`.
  - For any duplicated `XmlRegistry` entries, a merged list of `XmlElementDecls` will be created.

    In the case that an `XmlElementDecl` for the same `XmlRegistry` class appears in multiple bindings files, that `XmlElementDecl` will be replaced with the one from the later bindings.
- `xml-schema-types`
  - `XmlSchemaType` entries will be merged into a unified list.
  - In the case that an `XmlSchemaType` entry for the same java-type appears at the package level in multiple bindings files, the merged bindings will only contain the entry for the last one specified.

Using Complete Metadata

If you would like to store all of your metadata in XML Bindings and ignore any JAXB annotations in your Java class, you can include the `xml-mapping-metadata-complete` attribute in the `<xml-bindings>` element of your Bindings document. Default JAXB mappings will still be generated (the same as if you were using a completely un-annotated class with JAXB), and then any mapping data defined in the XML Bindings will be applied.

This could be used, for example, to map the same Java class to two completely different XML representations: the annotations on the actual Java class would define the first XML representation, and then a second XML representation could be defined in an XML Bindings document with `xml-mapping-metadata-complete="true"`. This would essentially give you a "blank canvas" to remap your Java class.

If you would like to ignore the default mappings that JAXB generates, you can specify `xml-accessor-type="NONE"` in your `<java-type>` element. Using this approach, only mappings that are explicitly defined in Bindings document will be applied.

Using the **Customer** example from above, the following examples demonstrate the XML representations that will be generated when using `xml-mapping-metadata-complete`:

Example 2–15 Sample Customer Class

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
   @XmlAttribute
   private Integer custId;
   private String name;
   private Double salary;
   private byte[] picture;
   ...
}
```

Example 2–16 XML Bindings

```
<?xml version="1.0" encoding="US-ASCII"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
    package-name="example" xml-mapping-metadata-complete="true">

    <java-types>
        <java-type name="Customer">
            <xml-root-element />
            <java-attributes>
                <xml-attribute java-attribute="name" name="customer-name" />
            </java-attributes>
        </java-type>
    </java-types>

</xml-bindings>
```

Example 2–17 XML Representation

```
<?xml version="1.0" encoding="UTF-8"?>
<customer>
   <custId>15</custId>
   <customer-name>Bob Dobbs</customer-name>
   <picture>AgQIECBA</picture>
   <salary>51727.61</salary>
</customer>
```

- Default JAXB mapping is generated for `custId` (note that `custId` is now an XML element, as if there were no annotation on the Java field)
- The name element has been renamed to `customer-name`
- Default JAXB mappings are generated for `picture` and `salary`

Example 2–18 XML Bindings (with xml-accessor-type="NONE")

```
<?xml version="1.0" encoding="US-ASCII"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
    package-name="example" xml-mapping-metadata-complete="true">

    <java-types>
        <java-type name="Customer" xml-accessor-type="NONE">
            <xml-root-element />
            <java-attributes>
                <xml-attribute java-attribute="name" name="customer-name" />
            </java-attributes>
        </java-type>
    </java-types>

</xml-bindings>
```

Example 2–19 XML Representation

```
<?xml version="1.0" encoding="UTF-8"?>
<customer>
   <customer-name>Bob Dobbs</customer-name>
</customer>
```

- Specifying `xml-accessor-type="NONE"` will prevent any default mappings from being generated
- The XML representation contains only the mappings defined in the XML Bindings document

Using Virtual Mappings

XML Bindings can also be used to specify virtual mappings – mappings that do not correspond to a concrete Java field. For example, you might want to use a `HashMap` as the underlying structure to hold data for certain mappings. For information on using Virtual Mappings, see "Using Virtual Access Methods" on page 8-5.

Using MetadataSource

The `MetadataSource`, introduced in EclipseLink 2.3, is responsible for serving up EclipseLink metadata. This allows you to store mapping information outside of your

application and have it retrieved when the application's JAXBContext is being created or refreshed.

Implementing a MetadataSource

To implement your own MetadataSource, you can:

- Create a new class that implements the org.eclipse.persistence.jaxb.metadata.MetadataSource interface.
- Create a new class that extends the org.eclipse.persistence.jaxb.metadata.MetadataSourceAdapter class. Using this method is preferred, as it will insulate you from future additions to the interface.

In either case, you will be responsible for implementing the following method:

Example 2–20 Implementing the XMlBindings Method

```
/**
 * Retrieve XmlBindings according to the JAXBContext bootstrapping information.
 *
 * @param properties - The properties passed in to create the JAXBContext
 * @param classLoader - The ClassLoader passed in to create the JAXBContext
 * @return the XmlBindings object representing the metadata
 */
XmlBindings getXmlBindings(Map<String, ?> properties, ClassLoader classLoader);
```

Using an XmlBindings Object

Internally, EclipseLink metadata is stored in an XmlBindings object, which itself is mapped with JAXB. This means that you can actually use a JAXB unmarshaller to read external metadata and create an XmlBindings from it:

Example 2–21 Sample XmlBindings Object

```
package example;

import org.eclipse.persistence.jaxb.xmlmodel.XmlBindings;
...
JAXBContext xmlBindingsContext =
JAXBContext.newInstance("org.eclipse.persistence.jaxb.xmlmodel");
FileReader bindingsFile = new FileReader("xml-bindings.xml");
XmlBindings bindings = (XmlBindings)
xmlBindingsContext.createUnmarshaller().unmarshal(bindingsFile);
```

Specifying the MetadataSource

To use a MetadataSource in creating a JAXBContext, add it to the properties map with the key JAXBContextProperties.OXM_METADATA_SOURCE:

Example 2–22 Adding MetadataSource to the Properties Map

```
MetadataSource metadataSource = new MyMetadataSource();

Map<String, Object> properties = new HashMap<String, Object>(1);
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, metadataSource);
```

```
JAXBContext jc = JAXBContext.newInstance(new Class[] { Customer.class },
properties);
```

MetadataSource Example

The following example creates an `XmlBindings` object by unmarshalling from a URL:

Example 2–23 Sample XmlBindings Object

```
package example;

import java.net.URL;
import java.util.Map;

import javax.xml.bind.JAXBContext;

import org.eclipse.persistence.jaxb.metadata.MetadataSourceAdapter;
import org.eclipse.persistence.jaxb.xmlmodel.XmlBindings;

public class MyMetadataSource extends MetadataSourceAdapter {

   private JAXBContext bindingsContext;
   private URL bindingsUrl;

   private final String XML_BINDINGS_PACKAGE =
"org.eclipse.persistence.jaxb.xmlmodel";
   private final String METADATA_URL =
"http://www.example.com/private/metadata/xml-bindings.xml";

   public MyMetadataSource() {
      try {
         bindingsContext = JAXBContext.newInstance(XML_BINDINGS_PACKAGE);
         bindingsUrl = new URL(METADATA_URL);
      } catch (Exception e) {
         throw new RuntimeException(e);
      }
   }

   @Override
   public XmlBindings getXmlBindings(Map<String, ?> properties, ClassLoader
classLoader) {
      try {
         Unmarshaller u = bindingsContext.createUnmarshaller();
         XmlBindings bindings = (XmlBindings) u.unmarshal(bindingsUrl);
         return bindings;
      } catch (Exception e) {
         throw new RuntimeException(e);
      }
   }

}
```

Building XmlBindings Programatically

You also have the option of building your own `XmlBindings` object from scratch in code. The example below modifies the `pCode` field of the **Address** class to use a locale-specific name:

Example 2–24 Sample XmlBindings Object

```
package example;

import java.util.Locale;
import java.util.Map;

import org.eclipse.persistence.jaxb.metadata.MetadataSourceAdapter;
import org.eclipse.persistence.jaxb.xmlmodel.JavaType;
import org.eclipse.persistence.jaxb.xmlmodel.JavaType.JavaAttributes;
import org.eclipse.persistence.jaxb.xmlmodel.ObjectFactory;
import org.eclipse.persistence.jaxb.xmlmodel.XmlBindings;
import org.eclipse.persistence.jaxb.xmlmodel.XmlBindings.JavaTypes;
import org.eclipse.persistence.jaxb.xmlmodel.XmlElement;

public class AddressMetadataSource extends MetadataSourceAdapter {

    private ObjectFactory factory;
    private XmlBindings xmlBindings;

    public AddressMetadataSource() {
        factory = new ObjectFactory();

        xmlBindings = new XmlBindings();
        xmlBindings.setPackageName("example");
        xmlBindings.setJavaTypes(new JavaTypes());
    }

    @Override
    public XmlBindings getXmlBindings(Map<String, ?> properties, ClassLoader
classLoader) {
        JavaType javaType = new JavaType();
        javaType.setName("Address");
        javaType.setJavaAttributes(new JavaAttributes());

        XmlElement pCodeElement = new XmlElement();
        pCodeElement.setJavaAttribute("pCode");

        String country = Locale.getDefault().getCountry();
        if (country.equals(Locale.US.getCountry())) {
            pCodeElement.setName("zip-code");
        } else if (country.equals(Locale.UK.getCountry())) {
            pCodeElement.setName("post-code");
        } else if (country.equals(Locale.CANADA.getCountry())) {
            pCodeElement.setName("postal-code");
        }

        javaType.getJavaAttributes().getJavaAttribute().add(factory.createXmlEleme
nt(pCodeElement));

        xmlBindings.getJavaTypes().getJavaType().add(javaType);
        return xmlBindings;
    }

}
```

Generating an XML Schema

To generate an XML schema from a Java object model:

1. Create a class that extends `javax.xml.bind.SchemaOutputResolver`.

```
private class MySchemaOutputResolver extends SchemaOutputResolver {

   public Result createOutput(String uri, String suggestedFileName)
throws IOException {
      File file = new File(suggestedFileName);
      StreamResult result = new StreamResult(file);
      result.setSystemId(file.toURI().toURL().toString());
      return result;
   }

}
```

2. Use an instance of this class with `JAXBContext` to capture the generated XML Schema.

```
Class[] classes = new Class[4];
classes[0] = org.example.customer_example.AddressType.class;
classes[1] = org.example.customer_example.ContactInfo.class;
classes[2] = org.example.customer_example.CustomerType.class;
classes[3] = org.example.customer_example.PhoneNumber.class;
JAXBContext jaxbContext = JAXBContext.newInstance(classes);

SchemaOutputResolver sor = new MySchemaOutputResolver();
jaxbContext.generateSchema(sor);
```

Validating Against an XML Schema

If you would like to validate your objects against an XML Schema during marshalling and unmarshalling, you can make use of JAXB's `ValidationEventHandler`.

Example 2–25 Sample XML Schema

In this example we would like to validate our objects against the following XML schema:

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">

    <xs:element name="customer">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="name" type="stringMaxSize5"/>
                <xs:element ref="phone-number" maxOccurs="2"/>
             </xs:sequence>
        </xs:complexType>
    </xs:element>

    <xs:element name="phone-number">
        <xs:complexType>
            <xs:sequence/>
        </xs:complexType>
    </xs:element>

    <xs:simpleType name="stringMaxSize5">
        <xs:restriction base="xs:string">
            <xs:maxLength value="5"/>
        </xs:restriction>
```

```
    </xs:simpleType>

</xs:schema>
```

Notice the following constraints:

- The customer's name cannot be longer than five (5) characters.
- The customer cannot have more than two (2) phone numbers.

The **Customer** class is shown below. Notice that the class *does not* contain any validation code.

Example 2–26 Sample Customer Class

```
package example;

import java.util.ArrayList;
import java.util.List;

import javax.xml.bind.annotation.XmlElement;
import javax.xml.bind.annotation.XmlRootElement;

@XmlRootElement
public class Customer {
   private String name;

   private List<PhoneNumber> phoneNumbers = new ArrayList<PhoneNumber>();

   public String getName() {
      return name;
   }

   public void setName(String name) {
      this.name = name;
   }

   @XmlElement(name="phone-number")
   public List<PhoneNumber> getPhoneNumbers() {
      return phoneNumbers;
   }

   public void setPhoneNumbers(List<PhoneNumber> phoneNumbers) {
      this.phoneNumbers = phoneNumbers;
   }
}
```

Using a ValidationEventHandler

You can receive JAXB validation events by providing your own subclass of `ValidationEventHandler`. The event is represented as an instance of `ValidationEvent`, and provides many details about the issue. The data is similar to what is available from a `SAXParseException`.

- Returning **false** from the `handleEvent` method will cause the JAXB operation to stop.
- Returning **true** will allow the method to continue, if possible.

In Example 2–27, we will simply print out an event's data when one is received:

Example 2–27 Sample ValidationEventHandler

```
package example;

import javax.xml.bind.ValidationEvent;
import javax.xml.bind.ValidationEventHandler;

public class MyValidationEventHandler implements ValidationEventHandler {

    public boolean handleEvent(ValidationEvent event) {
        System.out.println("\nEVENT");
        System.out.println("SEVERITY:  " + event.getSeverity());
        System.out.println("MESSAGE:  " + event.getMessage());
        System.out.println("LINKED EXCEPTION:  " + event.getLinkedException());
        System.out.println("LOCATOR");
        System.out.println("    LINE NUMBER:  " +
event.getLocator().getLineNumber());
        System.out.println("    COLUMN NUMBER:  " +
event.getLocator().getColumnNumber());
        System.out.println("    OFFSET:  " + event.getLocator().getOffset());
        System.out.println("    OBJECT:  " + event.getLocator().getObject());
        System.out.println("    NODE:  " + event.getLocator().getNode());
        System.out.println("    URL:  " + event.getLocator().getURL());
        return true;
    }

}
```

Enabling Validation

In addition to providing an implementation of `ValidationEventHandler`, an instance of `Schema` must be set on the `Marshaller` or `Unmarshaller`.

Example 2–28 Sample Java Code

```
package example;

import java.io.File;
import javax.xml.XMLConstants;
import javax.xml.bind.JAXBContext;
import javax.xml.bind.Unmarshaller;
import javax.xml.validation.Schema;
import javax.xml.validation.SchemaFactory;

public class UnmarshalDemo {

    public static void main(String[] args) throws Exception {
        SchemaFactory sf = SchemaFactory.newInstance(XMLConstants.W3C_XML_SCHEMA_
NS_URI);
        Schema schema = sf.newSchema(new File("customer.xsd"));

        JAXBContext jc = JAXBContext.newInstance(Customer.class);

        Unmarshaller unmarshaller = jc.createUnmarshaller();
        unmarshaller.setSchema(schema);
        unmarshaller.setEventHandler(new MyValidationEventHandler());
        Customer customer = (Customer) unmarshaller.unmarshal(new
```

```
File("input.xml"));
    }

}
```

Input (input.xml File)

```
<customer>
   <name>Jane Doe</name>
   <phone-number/>
   <phone-number/>
   <phone-number/>
</customer>
```

Output

The validation performed during the unmarshal raised three events. The first two events are related to the text value of the **name** element being too long. The third event is related to the extra **phone-number** element.

```
EVENT
SEVERITY:  1
MESSAGE:  cvc-maxLength-valid: Value 'Jane Doe' with length = '8' is not
facet-valid with respect
          to maxLength '5' for type 'stringWithMaxSize5'.
LINKED EXCEPTION:  org.xml.sax.SAXParseException: cvc-maxLength-valid: Value 'Jane
Doe' with length = '8'
                   is not facet-valid with respect to maxLength '5' for type
'stringWithMaxSize5'.
LOCATOR
    LINE NUMBER:  3
    COLUMN NUMBER:  25
    OFFSET:  -1
    OBJECT:  null
    NODE:  null
    URL:  null

EVENT
SEVERITY:  1
MESSAGE:  cvc-type.3.1.3: The value 'Jane Doe' of element 'name' is not valid.
LINKED EXCEPTION:  org.xml.sax.SAXParseException: cvc-type.3.1.3: The value 'Jane
Doe' of element
                   'name' is not valid.
LOCATOR
    LINE NUMBER:  3
    COLUMN NUMBER:  25
    OFFSET:  -1
    OBJECT:  null
    NODE:  null
    URL:  null

EVENT
SEVERITY:  1
MESSAGE:  cvc-complex-type.2.4.d: Invalid content was found starting with element
'customer'. No child
          element '{phone-number}' is expected at this point.
LINKED EXCEPTION:  org.xml.sax.SAXParseException: cvc-complex-type.2.4.d: Invalid
content was found starting
                   with element 'customer'. No child element '{phone-number}' is
```

```
expected at this point.
LOCATOR
    LINE NUMBER:  7
    COLUMN NUMBER:  12
    OFFSET:  -1
    OBJECT:  null
    NODE:  null
    URL:  null
```

Understanding Events

JAXB offers several mechanisms to get event callbacks during the marshalling and unmarshalling processes. You can specify callback methods directly on your mapped objects, or define separate `Listener` classes and register them with the JAXB runtime.

Adding Event Listener Methods on JAXB Mapped Objects

On any of your objects you have mapped with JAXB, you have the option of specifying some special methods to allow you to receive event notification when that object is marshalled or unmarshalled. The methods must have the following signatures:

```
/**
 * Invoked by Marshaller after it has created an instance of this object.
 */
void beforeMarshal(Marshaller m);

/**
 * Invoked by Marshaller after it has marshalled all properties of this object.
 */
void afterMarshal(Marshaller m);

/**
 * This method is called immediately after the object is created and before the
unmarshalling of this
 * object begins. The callback provides an opportunity to initialize JavaBean
properties prior to unmarshalling.
 */
void beforeUnmarshal(Unmarshaller u, Object parent);

/**
 * This method is called after all the properties (except IDREF) are unmarshalled
for this object,
 * but before this object is set to the parent object.
 */
void afterUnmarshal(Unmarshaller u, Object parent);
```

The following example shows how to write to a log every time a **Company** object is processed.

Example 2–29 Sample Event Listener

```
package example;

import java.util.Date;
import java.util.logging.Logger;
import javax.xml.bind.annotation.*;
```

```
@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Company {

   @XmlAttribute
   private String id;

   void beforeMarshal(Marshaller m) {
      Logger.getLogger("example").info("COMPANY:[id=" + id + "] " +
Thread.currentThread());
   }

   void afterMarshal(Marshaller m) {
      Logger.getLogger("example").info("COMPANY:[id=" + id + "] " +
Thread.currentThread());
   }

   void beforeUnmarshal(Unmarshaller u, Object parent) {
      Logger.getLogger("example").info("COMPANY:[id=" + id + "] " +
Thread.currentThread());
   }

   void afterUnmarshal(Unmarshaller u, Object parent) {
      Logger.getLogger("example").info("COMPANY:[id=" + id + "] " +
Thread.currentThread());
   }

}
```

Registering Listeners on Marshallers and Unmarshallers

JAXB's Marshaller and Unmarshaller interfaces both define a `setListener()` method, which allows you to set your own custom Listener to intercept marshal and unmarshal events.

```
package javax.xml.bind;

public interface Marshaller {
   ...
   public static abstract class Listener {
     /**
      * Callback method invoked before marshalling from source to XML.
      *
      * This method is invoked just before marshalling process starts to marshal
source.
      * Note that if the class of source defines its own beforeMarshal method,
      * the class specific callback method is invoked just before this method is
invoked.
      *
      * @param source instance of JAXB mapped class prior to marshalling from it.
      */
      public void beforeMarshal(Object source) {}

     /**
      * Callback method invoked after marshalling source to XML.
      *
      * This method is invoked after source and all its descendants have been
marshalled.
      * Note that if the class of source defines its own afterMarshal method,
```

```
      * the class specific callback method is invoked just before this method is
invoked.
      *
      * @param source instance of JAXB mapped class after marshalling it.
      */
      public void afterMarshal(Object source) {}
   }
}

package javax.xml.bind;

public interface Unmarshaller {
   ...
   public static abstract class Listener {

     /**
      * Callback method invoked before unmarshalling into target.
      *
      * This method is invoked immediately after target was created and
      * before the unmarshalling of this object begins. Note that
      * if the class of target defines its own beforeUnmarsha method,
      * the class specific callback method is invoked before this method is
invoked.
      *
      * @param target non-null instance of JAXB mapped class prior to
unmarshalling into it.
      * @param parent instance of JAXB mapped class that will eventually reference
target.
      *               null when target is root element.
      */
      public void beforeUnmarshal(Object target, Object parent) {}

     /**
      * Callback method invoked after unmarshalling XML data into target.
      *
      * This method is invoked after all the properties (except IDREF) are
unmarshalled into target,
      * but before target is set into its parent object.
      * Note that if the class of target defines its own afterUnmarshal method,
      * the class specific callback method is invoked before this method is
invoked.
      *
      * @param target non-null instance of JAXB mapped class prior to
unmarshalling into it.
      * @param parent instance of JAXB mapped class that will reference target.
      *               null when target is root element.
      */
      public void afterUnmarshal(Object target, Object parent) {}
   }
}
```

This example performs the same logging as above, but using generic `Listener` classes. This makes it easier to log all JAXB objects in the system.

Example 2–30 Logging with the Listener Class

```
package example;

import java.util.logging.Logger;
```

```
private class MarshalLogger extends Marshaller.Listener {
   @Override
   public void afterMarshal(Object source) {
      Logger.getLogger("example").info(source + " "   + Thread.currentThread());
   }

   @Override
   public void beforeMarshal(Object source) {
      Logger.getLogger("example").info(source + " "   + Thread.currentThread());
   }
}

package example;

import java.util.logging.Logger;

private class UnmarshalLogger extends Unmarshaller.Listener {
   @Override
   public void afterUnmarshal(Object target, Object parent) {
      Logger.getLogger("example").info(target + " "   + Thread.currentThread());
   }

   @Override
   public void beforeUnmarshal(Object target, Object parent) {
      Logger.getLogger("example").info(target + " "   + Thread.currentThread());
   }
}
```

The following code sets up the listeners:

```
Marshaller marshaller = jaxbContext.createMarshaller();
marshaller.setListener(new MarshalLogger());

Unmarshaller unmarshaller = jaxbContext.createUnmarshaller();
unmarshaller.setListener(new UnmarshalLogger());
```

An example of a typical marshal/unmarshal example, showing both the class-level and Marshaller/Unmarshaller-level event output:

```
Jun 2, 2011 6:31:59 PM example.Company beforeMarshal
INFO: COMPANY:[id=Zoltrix] Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger beforeMarshal
INFO: example.Company@10e790c Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger beforeMarshal
INFO: example.Employee@1db7df8 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger afterMarshal
INFO: example.Employee@1db7df8 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger beforeMarshal
INFO: example.Employee@3570b0 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger afterMarshal
INFO: example.Employee@3570b0 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger beforeMarshal
INFO: example.Employee@79717e Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger afterMarshal
INFO: example.Employee@79717e Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Company afterMarshal
INFO: COMPANY:[id=Zoltrix] Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$MarshalLogger afterMarshal
INFO: example.Company@10e790c Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Company beforeUnmarshal
```

```
INFO: COMPANY:[id=null] Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger beforeUnmarshal
INFO: example.Company@f0c0d3 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger beforeUnmarshal
INFO: example.Employee@4f80d6 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger afterUnmarshal
INFO: example.Employee@4f80d6 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger beforeUnmarshal
INFO: example.Employee@1ea0252 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger afterUnmarshal
INFO: example.Employee@1ea0252 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger beforeUnmarshal
INFO: example.Employee@3e89c3 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger afterUnmarshal
INFO: example.Employee@3e89c3 Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Company afterUnmarshal
INFO: COMPANY:[id=Zoltrix] Thread[main,5,main]
Jun 2, 2011 6:31:59 PM example.Tester$UnmarshalLogger afterUnmarshal
INFO: example.Company@f0c0d3 Thread[main,5,main]
```

Querying Objects by XPath

In addition to using conventional Java access methods to get and set your object's values, EclipseLink MOXy also allows you to access values using an XPath statement. There are special APIs on EclipseLink's `JAXBContext` to allow you to get and set values by XPath.

For example, consider the following XML document:

```
<customer id="1141">
   <first-name>Jon</first-name>
   <last-name>Smith</last-name>
   <phone-number>
      <area-code>515</area-code>
      <number>2726652</number>
   </phone-number>
</customer>
```

Typical application code might look something like this:

```
Customer customer = (Customer)
jaxbContext.createUnmarshaller().unmarshal(instanceDoc);
...
int customerId = customer.getId();
customer.setFirstName("Bob");
customer.getPhoneNumber().setAreaCode("555");
...
jaxbContext.createMarshaller().marshal(customer, System.out);
```

You could instead use XPath to access these values:

```
Customer customer = (Customer)
jaxbContext.createUnmarshaller().unmarshal(instanceDoc);
...
int customerId = jaxbContext.getValueByXPath(customer, "@id", null,
Integer.class);
jaxbContext.setValueByXPath(customer, "first-name/text()", null, "Bob");
jaxbContext.setValueByXPath(customer, "phone-number/area-code/text()", null,
"555");
...
```

```
jaxbContext.createMarshaller().marshal(customer, System.out);
```

Binding to an Existing Document

The JAXB Binder interface (introduced in JAXB 2.0) allows you to preserve an entire XML document, even if only some of the items are mapped.

Normally, when using an Unmarshaller to load the XML document into objects, and a Marshaller to save the objects back to XML, the unmapped content will be lost.

A Binder can be created from the JAXBContext to interact with the XML in the form of a DOM. The Binder maintains an association between the Java objects and their corresponding DOM nodes.

Example 2–31 Using a Binder

```
import java.io.File;
import javax.xml.bind.*;
import javax.xml.parsers.*;
import javax.xml.transform.*;
import javax.xml.transform.dom.DOMSource;
import javax.xml.transform.stream.StreamResult;
import org.w3c.dom.*;

public class BinderDemo {

    public static void main(String[] args) throws Exception {
        DocumentBuilderFactory dbf = DocumentBuilderFactory.newInstance();
        DocumentBuilder db = dbf.newDocumentBuilder();
        File xml = new File("input.xml");
        Document document = db.parse(xml);

        JAXBContext jc = JAXBContext.newInstance(Customer.class);

        Binder<Node> binder = jc.createBinder();
        Customer customer = (Customer) binder.unmarshal(document);
        customer.getAddress().setStreet("2 NEW STREET");
        PhoneNumber workPhone = new PhoneNumber();
        workPhone.setType("work");
        workPhone.setValue("555-WORK");
        customer.getPhoneNumbers().add(workPhone);
        binder.updateXML(customer);

        TransformerFactory tf = TransformerFactory.newInstance();
        Transformer t = tf.newTransformer();
        t.transform(new DOMSource(document), new StreamResult(System.out));
    }

}
```

The Binder applies the changes to the original DOM instead of creating a new XML document, thereby preserving the entire XML infoset.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<customer>
    <UNMAPPED_ELEMENT_1/>
    <name>Jane Doe</name>
    <!-- COMMENT #1 -->
    <address>
```

```
        <UNMAPPED_ELEMENT_2/>
        <street>2 NEW STREET</street>
        <!-- COMMENT #2 -->
        <UNMAPPED_ELEMENT_3/>
        <city>Any Town</city>
    </address>
    <!-- COMMENT #3 -->
    <UNMAPPED_ELEMENT_4/>
    <phone-number type="home">555-HOME</phone-number>
    <!-- COMMENT #4 -->
    <phone-number type="cell">555-CELL</phone-number>
    <phone-number type="work">555-WORK</phone-number>
    <UNMAPPED_ELEMENT_5/>
    <!-- COMMENT #5 -->
</customer>
```

3

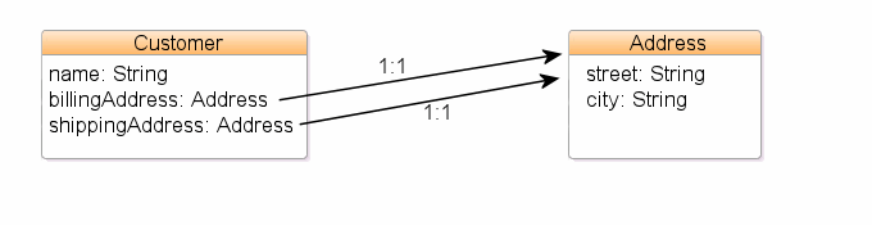
Mapping Type Levels

This chapter includes the following sections:

Defining the Default Root Element

At least one of your mapped classes must have a default root element defined. This tells EclipseLink what the top-level root of your XML document will be. Consider the **Customer** and **Address** classes shown in Figure 3–1:

Figure 3–1 Sample Mapped Classes



These classes correspond to the XML schema shown in Example 3–1. The schema contains a top-level element of type `customer-type`, therefore our **Customer** class will need to have a default root element specified.

Example 3–1 Sample XML Schema

```
<xsd:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
   <xsd:complexType name="address-type">
      <xsd:sequence>
         <element name="street" type="xsd:string"/>
         <element name="city" type="xsd:string"/>
      </xsd:sequence>
   </xsd:complexType>

   <xsd:element name="customer" type="customer-type"/>

   <xsd:complexType name="customer-type">
      <xsd:sequence>
         <xsd:element name="name" type="xsd:string"/>
```

```
         <xsd:element name="billing-address" type="address-type"/>
         <xsd:element name="shipping-address" type="address-type"/>
      </xsd:sequence>
   </xsd:complexType>
</xsd:schema>
```

Example 3–2 shows how to annotate your Java class to specify a default root element. All that is needed is the standard JAXB `@XmlRootElement` annotation.

Example 3–2 Using the @XmlRootElement Annotation

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement
public class Customer {
   private String name;

   @XmlElement(name="billing-address")
   private Address billingAddress;

   @XmlElement(name="shipping-address")
   private Address shippingAddress;

   ...
}
```

Example 3–3 shows how specify a default root element in EclipseLink's OXM metadata format.

Example 3–3 Specifying a Default Root Element

```
...
<java-type name="Customer">
   <xml-root-element/>
   <java-attributes>
      <xml-element java-attribute="name"/>
      <xml-element java-attribute="billingAddress" name="billing-address"/>
      <xml-element java-attribute="shippingAddress" name="shipping-address"/>
   </java-attributes>
</java-type>
...
```

Customizing the Default Root Element

In Example 3–2, our class is called **Customer**, and our root element name in XML is `customer`. By default, when `@XmlRootElement` is specified, the name of the class has its first letter lower-cased, and this is set as the root element name. If, however, the element name in XML is different from the Java class name, a name attribute can be included in the annotation (as in Example 3–4) or OXM metadata (as in Example 3–5):

Example 3–4 Using Annotations

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement(name="my-customer")
```

```
public class Customer {
   private String name;

   @XmlElement(name="billing-address")
   private Address billingAddress;

   @XmlElement(name="shipping-address")
   private Address shippingAddress;

   ...
}
```

Example 3–5 Using OXM Metadata

```
...
<java-type name="Customer">
   <xml-root-element name="my-customer"/>
   <java-attributes>
      <xml-element java-attribute="name"/>
      <xml-element java-attribute="billingAddress" name="billing-address"/>
      <xml-element java-attribute="shippingAddress" name="shipping-address"/>
   </java-attributes>
</java-type>
...
```

For more information on JAXB name-binding algorithms, see "Appendix D: Binding XML Names to Java Identifiers" of the Java Architecture for XML Binding (JAXB) Specification (http://jcp.org/en/jsr/detail?id=222).

Understanding How EclipseLink Uses the Default Root Element

When an instance of the **Customer** class is persisted to XML, the EclipseLink runtime performs the following:

- Gets the default root element. The **Customer** class instance corresponds to the root of the XML document. The EclipseLink runtime uses the default root element (`customer`) specified in either annotations or OXM to start the XML document. EclipseLink then uses the mappings on the class to marshal the object's attributes.

  ```
  <customer>
     <name>...</name>
  </customer>
  ```

- When the EclipseLink runtime encounters an object attribute such as `billingAddress`, it checks the mapping associated with it to determine with what element (billing-`address`) to continue.

  ```
  <customer>
     <name>...</name>
     <billing-address/>
  </customer>
  ```

- The EclipseLink runtime checks the mapping's reference descriptor (**Address**) to determine what attributes to persist.

  ```
  <customer>
     <name>...</name>
     <billing-address>
        <street>...</street>
        <city>...</city>
  ```

```
      </billing-address>
   </customer>
```

Setting Up Namespace Information

Most XML documents are qualified with a namespace. You can namespace-qualify elements of your Java class at the following levels:

- Qualifying at the Package Level
- Qualifying at the Type Level
- Qualifying at the Field/Property Level

In most cases, package-level annotation is sufficient. You can use the other levels to customize your document. Use the `@XmlSchema` annotation to specify the namespace.

Qualifying at the Package Level

Use the `@XmlSchema` annotation on the package to set a default namespace and specify that all elements in the package are qualified with the namespace. This information is specified in a special Java source file, `package-info.java`.

Example 3–6 Using Annotations

```
@XmlSchema(
   namespace="http://www.example.org/package",
   elementFormDefault=XmlNsForm.QUALIFIED)
package example;

import javax.xml.bind.annotation.XmlNsForm;
import javax.xml.bind.annotation.XmlSchema;
```

This can be defined in EclipseLink XML Bindings as follows:

Example 3–7 Using OXM Metadata

```
<?xml version="1.0" encoding="UTF-8"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm">
    <xml-schema
        element-form-default="QUALIFIED"
        namespace="http://www.example.org/package">
    </xml-schema>

    <java-types>
        <java-type name="Customer">
        ...

</xml-bindings>
```

Using a simple **Customer** class, Example 3–6 and Example 3–7 will produce the following XML:

```
<customer xmlns="http://www.example.org/package">
   <name>Jane Doe</name>
   <account>36328721</account>
</customer>
```

All elements are qualified with the **http://www.example.org/package** namespace.

Qualifying at the Type Level

Type level annotations will override the package level namespace.

Example 3–8 Using Annotations

```
package example;

@XmlRootElement
@XmlType(namespace="http://www.example.org/type")
public class Customer {
   private String name;

   private String account;

   ...
}
```

This can be defined in EclipseLink XML Bindings as follows:

Example 3–9 Using XML Bindings File

```
<?xml version="1.0" encoding="UTF-8"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm">
    <xml-schema
        element-form-default="QUALIFIED"
        namespace="http://www.example.org/package">
    </xml-schema>

    <java-types>
        <java-type name="Customer">
            <xml-type namespace="http://www.example.org/type" />
            <java-attributes>
                <xml-element java-attribute="name" />
                <xml-element java-attribute="account" />
            </java-attributes>
        </java-type>
    </java-types>
</xml-bindings>
```

This will produce the following XML:

```
<custom xmlns="http://www.example.org/package"
xmlns:ns0="http://www.example.org/type">
   <ns0:name>Bob</ns0:name>
   <ns0:account>1928712</ns0:account>
</custom>
```

Elements inside the **Customer** type are qualified with the **http://www.example.org/type** namespace.

Qualifying at the Field/Property Level

You can override the package or type namespaces at the property/field level. All attribute and element annotations accept the **namespace** parameter.

Example 3–10 Overriding the Namespace

```
package example;

@XmlRootElement
```

```
@XmlAccessorType(XmlAccessType.FIELD)
@XmlType(namespace="http://www.example.org/type")
public class Customer {
   private String name;

   @XmlElement(namespace="http://www.example.org/property")
   private String account;

   ...
}
```

This can be defined in EclipseLink XML Bindings as follows:

Example 3–11 Sample Bindings File

```
<?xml version="1.0" encoding="UTF-8"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm">
    <xml-schema
        element-form-default="QUALIFIED"
        namespace="http://www.example.org/package">
    </xml-schema>

    <java-types>
        <java-type name="Customer">
            <xml-type namespace="http://www.example.org/type" />
            <java-attributes>
                <xml-element java-attribute="name" />
                <xml-element java-attribute="account"
namespace="http://www.example.org/property" />
            </java-attributes>
        </java-type>
    </java-types>
</xml-bindings>
```

This will produce the following XML:

```
<custom xmlns="http://www.example.org/package"
xmlns:ns1="http://www.example.org/property"
   xmlns:ns0="http://www.example.org/type">
   <ns0:name>Bob</ns0:name>
   <ns1:account>1928712</ns1:account>
</custom>
```

Only the **account** element is qualified with the **http://www.example.org/property** namespace.

Specifying Inheritance

EclipseLink MOXy provides several ways to represent your inheritance hierarchy in XML:

- Using xsi:type
- Using Substitution Groups
- Using @XmlDiscriminatorNode/@XmlDiscriminatorValue

Using xsi:type

By default, EclipseLink will use the `xsi:type` attribute to represent inheritance in XML.

In this example an abstract super class (**ContactInfo**) contains all types of contact information. **Address** and **PhoneNumber** are the concrete implementations of **ContactInfo**.

Example 3–12 Sample Java Classes

```
public abstract class ContactInfo {
}

public class Address extends ContactInfo {

   private String street;
   ...

}

public class PhoneNumber extends ContactInfo {

   private String number;
   ...

}
```

Because the **Customer** object can have different types of contact information, its property refers to the superclass.

```
@XmlRootElement
public class Customer {

   private ContactInfo contactInfo;
   ...

}
```

Marshalling an example **Customer** would produce the following XML:

```
<customer>
   <contactInfo
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:type="address">
      <street>323 Main Street</street>
   </contactInfo>
</customer>
```

Note the `xsi:type` attribute on the `contactInfo` element.

Using Substitution Groups

Another way to model inheritance in XML is through XML Schema's substitution groups functionality. Using this approach, the element name *itself* determines which subclass to use.

Taking the same Example 3–12, we will add `@XmlRootElement` annotations to each of the subclasses, which will act as the inheritance indicator.

Example 3–13 Using @XmlRootElement Annotation

```
public abstract class ContactInfo {
}

@XmlRootElement
public class Address extends ContactInfo {

   private String street;
   ...

}

@XmlRootElement
public class PhoneNumber extends ContactInfo {

   private String number;
   ...

}
```

Using this approach, marshalling an example **Customer** would produce the following XML:

```
<customer>
   <address>
      <street>323 Main Street</street>
   </address>
</customer>
```

Note that the **Address** object is marshalled to the `address` element.

Using @XmlDiscriminatorNode/@XmlDiscriminatorValue

You can also use the MOXY-specific `@XmlDiscriminatorNode` and `@XmlDiscriminatorValue` annotations (introduced in EclipseLink 2.2) to represent inheritance. With this approach, you can select the attribute to represent the subtype.

Using Example 3–13, the **ContactInfo** class uses the `@XmlDiscriminatorNode` annotation to specify the XML attribute (classifier) that will hold the subclass indicator. **Address** and **PhoneNumber** are annotated with **@XmlDiscriminatorValue**, indicating that class' indicator name (`address-classifier` and `phone-number-classifier`).

Example 3–14 Using the @XmlDiscriminatorNode and @XmlDiscriminatorValue Annotations

```
@XmlDiscriminatorNode("@classifier")
public abstract class ContactInfo {
}

@XmlDiscriminatorValue("address-classifier")
public class Address extends ContactInfo {

   private String street;
   ...

}

@XmlDiscriminatorValue("phone-number-classifier")
public class PhoneNumber extends ContactInfo {
```

```
   private String number;
   ...

}
```

Example 3–14 produces the following XML:

```
<customer>
   <contactInfo classifier="address-classifier">
      <street>323 Main Street</street>
   </contactInfo>
</customer>
```

Notice that **Address** is marshalled to the `contactInfo` element. Its classifier attribute contains the discriminator node value `address-classifier`.

4

Mapping Simple Values

This chapter includes the following sections:

5

Mapping Special Schema Types

This chapter includes the following sections:

- Mapping Dates and Times
- Mapping to a Union Field
- Binary Types

Mapping Dates and Times

You can use the `@XmlSchemaType` annotation to customize the XML representation of date and time information. Additionally, EclipseLink MOXy supports the following types which are not covered in the JAXB specification (JSR-222):

- `java.sql.Date`
- `java.sql.Time`
- `java.sql.Timestamp`

The following XML schema contains a **date-of-birth** element of type `xsd:date`:

Example 5–1 Sample XML Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
   <xsd:element name="customer">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element name="date-of-birth" type="xsd:date" minOccurs="0"/>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
</xsd:schema>
```

Understanding the Generated Model

The JAXB XML Schema to Java compiler (XJC) can be used to generate a class model from the sample schema. For example:

```
> xjc -d output-dir -p example date.xsd
```

will generate the following **Customer** class:

Example 5–2 Sample Customer Class

```
package example;

import javax.xml.bind.annotation.XmlAccessType;
import javax.xml.bind.annotation.XmlAccessorType;
import javax.xml.bind.annotation.XmlElement;
import javax.xml.bind.annotation.XmlRootElement;
import javax.xml.bind.annotation.XmlSchemaType;
import javax.xml.bind.annotation.XmlType;
import javax.xml.datatype.XMLGregorianCalendar;

@XmlAccessorType(XmlAccessType.FIELD)
@XmlType(name = "", propOrder = {"dateOfBirth"})
@XmlRootElement(name = "customer")
public class Customer {

    @XmlElement(name = "date-of-birth")
    @XmlSchemaType(name = "date")
    protected XMLGregorianCalendar dateOfBirth;

    public XMLGregorianCalendar getDateOfBirth() {
        return dateOfBirth;
    }

    public void setDateOfBirth(XMLGregorianCalendar value) {
        this.dateOfBirth = value;
    }

}
```

Notice that:

- The `dateOfBirth` property is of type `javax.xml.datatype.XMLGregorianCalendar`
- The `dateOfBirth` property uses the `@XmlSchemaType` annotation

Some Java data types (like **XMLGregorianCalendar**) have multiple XML representations (such as `xsd:date`, `xsd:time`, or **xsd:dateTime**). Use `@XmlSchemaType` to select the appropriate representation.

Using a Different Date (or Calendar) Property

By default, the JAXB XML schema to Java compiler (XJC) generates a property of type `XMLGregorianCalendar`. However, you can easily change this to `java.util.Date` or `java.util.Calendar`, as shown in Example 5–3:

Example 5–3 Using java.util.Date

```
package blog.date;

import java.util.Date;

import javax.xml.bind.annotation.XmlAccessType;
import javax.xml.bind.annotation.XmlAccessorType;
import javax.xml.bind.annotation.XmlElement;
import javax.xml.bind.annotation.XmlRootElement;
import javax.xml.bind.annotation.XmlSchemaType;

@XmlAccessorType(XmlAccessType.FIELD)
@XmlRootElement(name = "customer")
```

```
public class Customer {

    @XmlElement(name = "date-of-birth")
    @XmlSchemaType(name = "date")
    protected Date dateOfBirth;

    public Date getDateOfBirth() {
        return dateOfBirth;
    }

    public void setDateOfBirth(Date value) {
        this.dateOfBirth = value;
    }

}
```

Mapping to a Union Field

The following XML schema and class diagram show a typical use of an XML Schema Union:

Example 5–4 XML Schema Union

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
    <xsd:element name="customer" type="customer-type" />
    <xsd:complexType name="customer-type">
        <xsd:sequence>
            <xsd:element name="shoe-size" type="size-type" />
        </xsd:sequence>
    </xsd:complexType>
    <xsd:simpleType name="size-type">
        <xsd:union memberTypes="xsd:decimal xsd:string" />
    </xsd:simpleType>
</xsd:schema>
```

Figure 5–1 Mapping to a Union Field

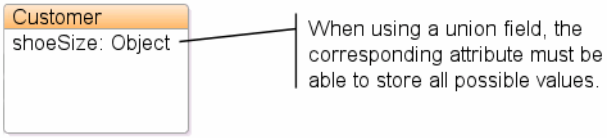
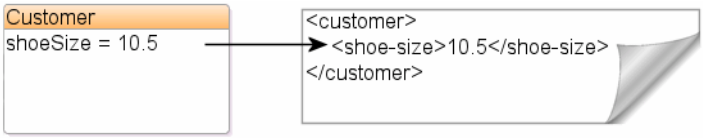


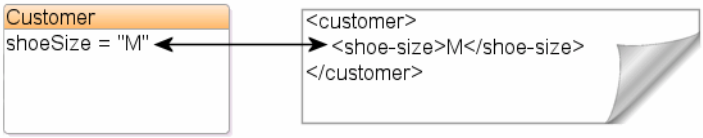
Figure 5–2 illustrates a mapping to a union field in an XML document that conforms to the example schema. When EclipseLink unmarshalls the XML document, it tries each of the union types until it can make a successful conversion. The first schema type in the union is `xsd:decimal`. Because **10.5** is a valid decimal, EclipseLink converts the value to the appropriate type.

Figure 5–2 Mapping to a Union Field in an XML Document



In Figure 5–3, the value **M** is *not* a valid `xsd:decimal` type, so the next union type is tried, `xsd:string`.

Figure 5–3 Mapping to a Union Field



Currently, EclipseLink does not support the mapping of Unions using Annotations or OXM Metadata. However, an EclipseLink XML Customizer can be used to create the mapping.

First, we annotate the `shoeSize` attribute with `@XmlTransient`, to avoid automatically generating a mapping for it. We also include an `@XmlCustomizer` annotation; the `CustomerCustomizer` class will create the Union mapping in code.

Example 5–5 Using an EclipseLink Customizer

```
package example;

import javax.xml.bind.annotation.*;
import org.eclipse.persistence.oxm.annotations.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
@XmlCustomizer(CustomerCustomizer.class)
public class Customer {
   @XmlTransient
   private Object shoeSize;

   ...
}
```

The `CustomerCustomizer` class can be used to manually add a mapping to the `shoeSize` attribute. In Example 5–6, an `XMLUnionField` is configured on the mapping, and the possible Union member types are added by calling `addSchemaType()`:

Example 5–6 Mapping a Union Field

```
package example;

import org.eclipse.persistence.config.DescriptorCustomizer;
import org.eclipse.persistence.descriptors.ClassDescriptor;
import org.eclipse.persistence.oxm.*;

public class CustomerCustomizer implements DescriptorCustomizer {

   @Override
   public void customize(ClassDescriptor descriptor) throws Exception {
```

```
        XMLDirectMapping shoeSizeMapping = new XMLDirectMapping();
        shoeSizeMapping.setAttributeName("shoeSize");

        XMLUnionField shoeSizeField = new XMLUnionField();
        shoeSizeField.setXPath("shoe-size/text()");
        shoeSizeField.addSchemaType(XMLConstants.DECIMAL_QNAME);
        shoeSizeField.addSchemaType(XMLConstants.STRING_QNAME);

        shoeSizeMapping.setField(shoeSizeField);

        descriptor.addMapping(shoeSizeMapping);
    }

}
```

Understanding Conversion Order

The order of the calls to `addSchemaType()` is important; when converting an XML value into Java, EclipseLink will attempt the conversions in the order that they were added to the field, and return as soon as a successful conversion is made. For example, when unmarshalling a `shoeSize` of **10.5**:

```
...
shoeSizeField.addSchemaType(XMLConstants.DECIMAL_QNAME);
shoeSizeField.addSchemaType(XMLConstants.STRING_QNAME);
...
```

A `BigDecimal` will be created to store the value. If, however, your XMLUnionField was set up like this:

```
...
shoeSizeField.addSchemaType(XMLConstants.STRING_QNAME);
shoeSizeField.addSchemaType(XMLConstants.DECIMAL_QNAME);
...
```

The shoeSize value will be a `String` **("10.5")**.

Customizing Conversion Classes

EclipseLink uses a set of default conversions to create a value for the Java attribute (in this case, `xsd:decimal` will be converted into a `BigDecimal`). You can override this behavior in Java code using the XMLUnionField method addConversion. For example, if you want your Java object to store `shoeSize` as a `Float`:

```
shoeSizeField.addConversion(XMLConstants.DECIMAL_QNAME, Float.class);
```

Binary Types

There are additional items to consider when mapping to binary type fields, such as `byte[]` or `Byte[]`.

Specifying Binary Formats Base64 and Hex

EclipseLink supports marshalling and unmarshalling binary data in two different representation formats: `base64Binary` (default) and `hexBinary`. You can specify the desired binary format using the `@XmlSchemaType` annotation, or `<xml-schema-type>`

element in EclipseLink OXM. The examples below shows the result of marshalling the same `byte[]` to each of these formats.

Example 5–7 Annotations

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement
public class BinaryData {

   @XmlSchemaType(name="hexBinary")
   public byte[] hexBytes;

   @XmlSchemaType(name="base64Binary")
   public byte[] base64Bytes;

}
```

Example 5–8 EclipseLink OXM

```
...
<java-type name="example.BinaryData">
    <xml-root-element/>
    <java-attributes>
        <xml-element java-attribute="hexBytes">
            <xml-schema-type name="hexBinary"/>
        </xml-element>
        <xml-element java-attribute="base64Bytes">
            <xml-schema-type name="base64Binary"/>
        </xml-element>
    </java-attributes>
</java-type>
...

BinaryData b = new BinaryData();
b.hexBytes = new byte[] {2,4,8,16,32,64};
b.base64Bytes = b.hexBytes;

jaxbContext.createMarshaller().marshal(b, System.out);
```

Example 5–9 Output

```
<?xml version="1.0" encoding="UTF-8"?>
<binaryData>
   <hexBytes>020308102040</hexBytes>
   <base64Bytes>AgMIECBA</base64Bytes>
</binaryData>
```

Understanding byte[] versus Byte[]

Unlike other Java primitive/wrapper types, EclipseLink differentiates between `byte[]` (primitive) and `Byte[]` (wrapper) data types. By default, `byte[]` will marshal to a single element or attribute, whereas `Byte[]` will marshal each `byte` as its own element, as illustrated by the following example:

Example 5–10 Using byte[] and Byte[]

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement
public class BinaryData {

   public byte[] primitiveBytes;
   public Byte[] byteObjects;

}

BinaryData b = new BinaryData();
b.primitiveBytes = new byte[] {34,45,56,67,78,89,89,34,23,12,12,11,2};
b.byteObjects = new Byte[] {23,1,112,12,1,64,1,14,3,2};

jaxbContext.createMarshaller().marshal(b, System.out);
```

Example 5–11 Output

```
<?xml version="1.0" encoding="UTF-8"?>
<binaryData>
   <primitiveBytes>Ii04Q05ZWSIXDAwLAg==</primitiveBytes>
   <byteObjects>23</byteObjects>
   <byteObjects>1</byteObjects>
   <byteObjects>112</byteObjects>
   <byteObjects>12</byteObjects>
   <byteObjects>1</byteObjects>
   <byteObjects>64</byteObjects>
   <byteObjects>1</byteObjects>
   <byteObjects>14</byteObjects>
   <byteObjects>3</byteObjects>
   <byteObjects>2</byteObjects>
</binaryData>
```

Working with SOAP Attachments

If you are using EclipseLink MOXy in a Web Services environment, certain types of binary data may be created as an MTOM/XOP Attachment, instead of written directly into an XML element or attribute. This is done as an optimization for large amounts of binary data.

The following table shows the Java types that are automatically treated as Attachments, along with their corresponding MIME type:

Table 5–1 Java Attributes Treated as Attachments

Java Type	MIME Type
java.awt.Image	image/gif
java.awt.Image	image/jpeg
javax.xml.transform.Source	text/xml
application/xml	*
javax.activation.DataHandler	*/*

Note: For more information on the basics of SOAP Attachments, see "Appendix H: Enhanced Binary Data Handling" of the Java Architecture for XML Binding (JAXB) Specification (http://jcp.org/en/jsr/detail?id=222).

The following Java class contains two binary fields: a simple `byte[]`, and a `java.awt.Image`. In a Web Services environment, the Image data will automatically be created as an attachment.

Example 5–12 Sample Java Class

```
package example;

import java.awt.Image;

import javax.xml.bind.annotation.*;

@XmlRootElement
public class BinaryData {

   public byte[] bytes;

   public Image photo;

}
```

Marshalling the object in Example 5–12 in a Web Services environment would look something like Example 5–13 (the actual appearance will depend on your application server's implementation of `AttachmentMarshaller`):

Example 5–13 Resulting XML

```
<?xml version="1.0" encoding="UTF-8"?>
<binaryData>
   <bytes>Ii04Q05ZWSIXDAwLAg==</bytes>
   <photo>
      <xop:Include href="cid:1"
xmlns:xop="http://www.w3.org/2004/08/xop/include"/>
   </photo>
</binaryData>
```

Using @XmlInlineBinaryData

If you would like to force your binary data to be written as an inline `string` in your XML, you can annotate the field with the `@XmlInlineBinaryData` annotation:

Example 5–14 Using the @XmlInlineBinaryData Annotation

```
package example;

import java.awt.Image;

import javax.xml.bind.annotation.*;

@XmlRootElement
public class BinaryData {
```

```
   public byte[] bytes;

   @XmlInlineBinaryData
   public Image photo;

}
```

This will result in an XML document like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<binaryData>
   <bytes>Ii04Q05ZWSIXDAwLAg==</bytes>
   <photo>/9j/4AAQSkZJRgABAgAAAQABAAD/2wBDAAgGBgcGBQgHB ... Af/2Q==</photo>
</binaryData>
```

Using @XmlMimeType

You can explicitly set the MIME Type for an binary field using the `@XmlMimeType` annotation. Your application's `AttachmentMarshaller` and `AttachmentUnmarshaller` will be responsible for processing this information.

Example 5–15 Using the @XmlMimeType Annotation

```
package example;

import java.awt.Image;

import javax.xml.bind.annotation.*;

@XmlRootElement
public class BinaryData {

   public byte[] bytes;

   @XmlMimeType("image/gif")
   public Image photo;

}
```

6

Privately Owned Relationships

This chapter includes the following sections:

Mapping Privately Owned One-to-One Relationships

This section demonstrates several ways to map a one-to-one relationship between objects. By default, one-to-one relationships are privately-owned in JAXB – their XML content will appear nested inside the owning element. For example, a **Customer** with a one-to-one mapping to a **PhoneNumber** would be marshalled as:

Example 6–1 Sample XML Mapping

```
<customer>
   <name>Bob Smith</name>
   <id>1982812</id>
   <phone-number>
      <area-code>613</area-code>
      <number>5550210</number>
      <extension>20016</extension>
   </phone-number>
</customer>
```

Mapping to an Element

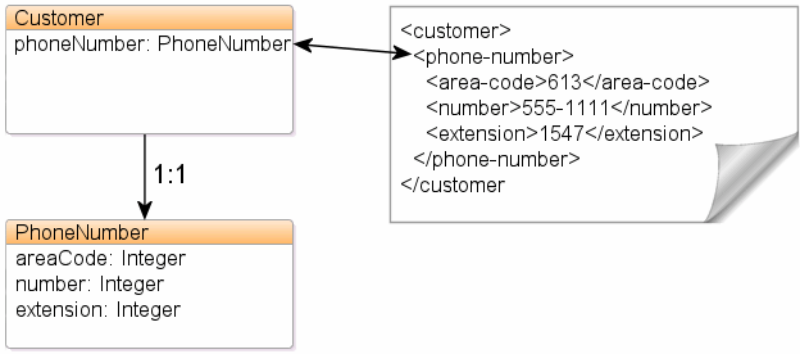
Given the XML schema in Example 6–2, Figure 6–1 illustrates a one-to-one (1:1) relationship between two complex types.

Example 6–2 Sample XML Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">

   <xsd:element name="customer" type="customer-type"/>

   <xsd:complexType name="customer-type">
      <xsd:element name="phone-number" type="phone-type"/>
   </xsd:complexType>

   <xsd:complexType name="phone-type">
      <xsd:element name="area-code" type="xsd:int"/>
      <xsd:element name="number" type="xsd:int"/>
```

```
      <xsd:element name="extension" type="xsd:int"/>
   </xsd:complexType>

</xsd:schema>
```

Figure 6–1 One-to-one Relationship



Example 6–3 shows how to annotate your Java class to obtain this mapping with EclipseLink. The standard JAXB `@XmlElement` annotation can be used to indicate that the associated Java field should be mapped to an XML element.

> **Note:** By default, JAXB will assume all fields on your Java object are `@XmlElements`, so in many cases the annotation itself is not required. If, however, you want to customize the Java field's XML name, you can specify an `@XmlElement` annotation with a name argument.

Example 6–3 Using the @XmlElement Annotation

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
   @XmlElement(name="phone-number")
   private PhoneNumber phoneNumber;

   ...
}
```

```
package example;

import javax.xml.bind.annotation.*;

@XmlAccessorType(XmlAccessType.FIELD)
public class PhoneNumber {
   @XmlElement(name="area-code")
   private Integer areaCode;

   private Integer number;

   private Integer extension;
```

```
   ...
}
```

Example 6–4 shows how to define your mapping information in an EclipseLink's XML Bindings document.

Example 6–4 Sample XML Mapping

```
...
<java-type name="Customer">
   <xml-root-element name="customer"/>
   <java-attributes>
      <xml-element java-attribute="phoneNumber" name="phone-number"
type="PhoneNumber"/>
   </java-attributes>
</java-type>

<java-type name="PhoneNumber">
   <java-attributes>
      <xml-value java-attribute="areaCode" name="area-code"
type="java.lang.Integer"/>
      <xml-value java-attribute="number" type="java.lang.Integer"/>
      <xml-value java-attribute="extension" type="java.lang.Integer"/>
   </java-attributes>
</java-type>
...
```

Using EclipseLink's @XmlPath Annotation

By default, your Java attributes will be mapped to XML based on their attributes Java name, or by a name specified in an `@XmlElement` annotation. This mapping is based on XPath, and EclipseLink's `@XmlPath` annotation allows you to customize this mapping. For example, you can use it to control the nesting of your elements in XML:

Example 6–5 Using the @XmlPath Annotation

```
package example;

import javax.xml.bind.annotation.*;
import org.eclipse.persistence.oxm.annotations.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
   @XmlPath("contact-info/phone-number")
   private PhoneNumber phoneNumber;

   ...
}
```

Example 6–6 Using EclipseLink XML Bindings

```
...
<java-type name="Customer">
   <xml-root-element name="customer"/>
   <java-attributes>
      <xml-element java-attribute="phoneNumber" name="phone-number"
         type="PhoneNumber" xml-path="contact-info/phone-number"/>
```

```
   </java-attributes>
</java-type>
...
```

This will produce the following XML:

```
<customer>
   <contact-info>
      <phone-number>
         <number>555-631-2124</number>
      </phone-number>
   </contact-info>
</customer>
```

You can also use `@XmlPath` to map to different occurrences of the same element in XML, by index. For example:

Example 6–7 Using the @XmlPath Annotation

```
package example;

import javax.xml.bind.annotation.*;
import org.eclipse.persistence.oxm.annotations.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
   @XmlPath("contact-info/phone[1]")
   private PhoneNumber homePhone;
   @XmlPath("contact-info/phone[2]")
   private PhoneNumber workPhone;
   ...
}
```

will produce the following XML:

```
<customer>
   <contact-info>
      <phone>
         <number>555-631-2124</number>
      </phone>
      <phone>
         <number>555-631-8298</number>
      </phone>
   </contact-info>
</customer>
```

For information on using XPath in your mappings, see "Mapping Using XPath Predicates" on page 8-16.

Mapping Privately Owned One-to-Many Relationships

This section illustrates how to map one-to-many relationships with EclipseLink.

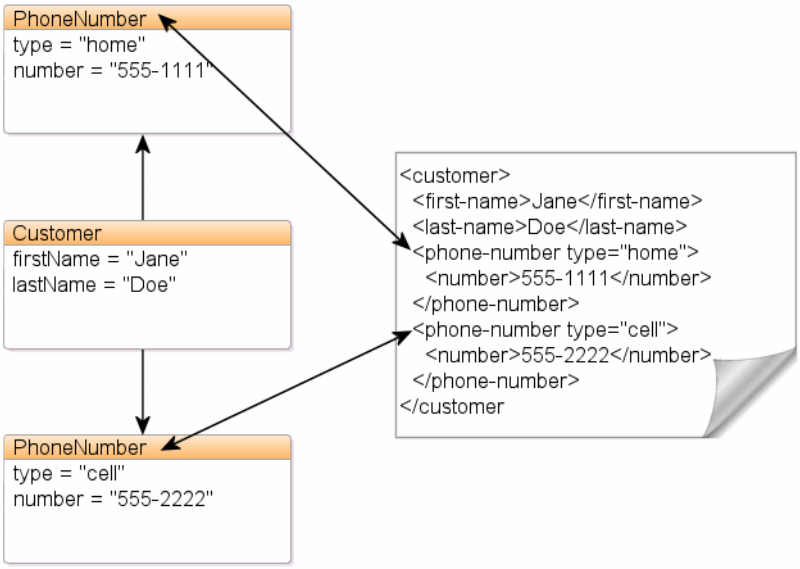
The schema in Example 6–8 a typical one-to-many (1:M) relationship between Customer and PhoneNumber, as shown in Figure 6–2.

Example 6–8 Sample XML Mapping

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
```

```
   <xsd:element name="customer" type="customer-type"/>

   <xsd:complexType name="customer-type">
      <xsd:sequence>
         <xsd:element name="first-name" type="xsd:string"/>
         <xsd:element name="last-name" type="xsd:string"/>
         <xsd:element name="phone-number" type="phone-type" minOccurs="0"
maxOccurs="unbounded"/>
      </xsd:sequence>
   </xsd:complexType>

   <xsd:complexType name="phone-type">
      <xsd:sequence>
         <xsd:attribute name="type" type="xsd:string"/>
         <xsd:element name="number" type="xsd:int"/>
      </xsd:sequence>
   </xsd:complexType>

</xsd:schema>
```

Figure 6–2 One-to-many Relationship



Mapping to Elements

Example 6–9 shows how to annotate your Java class to obtain this mapping with EclipseLink. The standard JAXB `@XmlElement` annotation, when used on a Collection or array field, can achieve this.

Example 6–9 Using the @XmlElement Annotation

```
package example;

import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
```

```
   @XmlElement(name="first-name")
   private String firstName;
   @XmlElement(name="last-name")
   private String lastName;
   @XmlElement(name="phone-number")
   private List<PhoneNumber> phoneNumbers;

   ...
}

package example;

import javax.xml.bind.annotation.*;
import org.eclipse.persistence.oxm.annotations.*;

@XmlAccessorType(XmlAccessType.FIELD)
public class PhoneNumber {
   @XmlAttribute
   private String type;
   private Integer number;

   ...
}
```

Example 6–10 shows how to define your mapping information in EclipseLink's OXM metadata format.

Example 6–10 Sample XML Mapping

```
...
<java-type name="Customer">
   <xml-root-element name="customer"/>
   <java-attributes>
      <xml-element java-attribute="firstName" name="first-name"
type="java.lang.String"/>
      <xml-element java-attribute="lastName" name="last-name"
type="java.lang.String"/>
      <xml-element java-attribute="phoneNumbers" name="phone-number"
type="PhoneNumber" container-type="java.util.ArrayList"/>
   </java-attributes>
</java-type>

<java-type name="PhoneNumber">
   <java-attributes>
      <xml-attribute java-attribute="type" type="java.lang.String"/>
      <xml-value java-attribute="number" type="java.lang.Integer"/>
   </java-attributes>
</java-type>
...
```

Grouping Elements using the @XmlElementWrapper Annotation

To make the elements of the Collection appear inside a grouping element, you can use `@XmlElementWrapper`:

Example 6–11 Using the @XmlElementWrapper Annotation

```
package example;
```

```
import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
   @XmlElement(name = "phone-number")
   @XmlElementWrapper(name="phone-numbers")
   private List<PhoneNumber> phoneNumbers;

   ...
}
```

This will produce the following XML:

```
<customer>
   <first-name>Bob</first-name>
   <last-name>Smith</last-name>
   <phone-numbers>
      <phone-number type="Home">
         <number>5559827222</number>
      </phone-number>
      <phone-number type="Work">
         <number>5558872216</number>
      </phone-number>
   </phone-numbers>
</customer>
```

7

Mapping Shared Reference Relationships

This chapter includes the following sections:

Understanding Keys and Foreign Keys

EclipseLink supports shared reference keys and foreign keys through:

- Single key
- Composite Key
- Embedded Key Class

Mapping Single Key Relationships

To model non-privately-owned relationships, your "target" objects must have IDs (keys) defined, and your "source" object must use these IDs to map the relationship.

Relationships represented with keys use the `@XmlID` and `@XmlIDREF` annotations. Although the JAXB specification requires that the property marked with `@XmlID` be a String, MOXy JAXB does not enforce this restriction.

In Example 7–1, each **Employee** has one **manager** but multiple **reports**.

Example 7–1 Using the @XmlID and @XmlIDREF Annotations

```
package example;

import javax.xml.bind.annotation.*;

@XmlAccessorType(XmlAccessType.FIELD)
public class Employee {
    @XmlAttribute
    @XmlID
    private Integer id;

    @XmlAttribute
    private String name;

    @XmlIDREF
```

```
    private Employee manager;

    @XmlElement(name="report")
    @XmlIDREF
    private List<Employee> reports;

    ...
}
```

The following example shows how to define this mapping information in EclipseLink's OXM metadata format.

Example 7–2 Sample XML Mapping

```
...
<java-type name="Employee">
   <java-attributes>
      <xml-attribute java-attribute="id" type="java.lang.Integer" xml-id="true"/>
      <xml-attribute java-attribute="name" type="java.lang.String"/>
      <xml-element java-attribute="manager" type="mypackage.Employee"
xml-idref="true"/>
      <xml-element java-attribute="reports" type="mypackage.Employee"
container-type="java.util.ArrayList" xml-idref="true"/>
   </java-attributes>
</java-type>
...
```

This would produce the following XML:

```
<company>
    <employee id="1" name="Jane Doe">
        <report>2</report>
        <report>3</report>
    </employee>
    <employee id="2" name="John Smith">
        <manager>1</manager>
    </employee>
    <employee id="3" name="Anne Jones">
        <manager>1</manager>
    </employee>
</company>
```

The **manager** and **reports** elements contain the IDs of the **Employee** instances they are referencing.

Using @XmlList

Because the `@XmlIDREF` annotation is also compatible with the `@XmlList` annotation, the **Employee** object could be modeled as:

Example 7–3 Using the @XmlList Annotation

```
package example;

import javax.xml.bind.annotation.*;

@XmlAccessorType(XmlAccessType.FIELD)
public class Employee {
    @XmlID
    @XmlAttribute
```

```
    private Integer id;

    @XmlAttribute
    private String name;

    @XmlIDREF
    private Employee manager;

    @XmlIDREF
    @XmlList
    private List<Employee> reports;

    ...
}
```

This would produce the following XML:

```
<company>
   <employee id="1" name="Jane Doe">
      <reports>2 3</reports>
   </employee>
   <employee id="2" name="John Smith">
      <manager>1</manager>
   </employee>
   <employee id="3" name="Anne Jones">
      <manager>1</manager>
   </employee>
</company>
```

Using the Embedded Key Class

With JAXB, you can derive an XML representation from a set of JPA entities, when a JPA entity has an embedded ID class.

In Example 7–4, the `EmployeeId` is the embedded ID of the **Employee** class:

Example 7–4 Sample Embedded ID

```
@Entity
public class PhoneNumber {

    @ManyToOne
    @JoinColumns({
        @JoinColumn(name="E_ID", referencedColumnName = "E_ID"),
        @JoinColumn(name="E_COUNTRY", referencedColumnName = "COUNTRY")
    })
    private Employee contact;

}

@Entity
@IdClass(EmployeeId.class)
public class Employee {

    @EmbeddedId
    private EmployeeId id;

    @OneToMany(mappedBy="contact")
    private List<PhoneNumber> contactNumber;
```

```
}

@Embeddable
public class EmployeeId {

    @Column(name="E_ID")
    private BigDecimal eId;

    private String country;

}
```

For the JAXB bindings, the XML accessor type will be set to **FIELD** for all the model classes. This can be set as a package level JAXB annotation, as shown here:

```
@XmlAccessorType(XmlAccessType.FIELD)
package com.example.model;

import javax.xml.bind.annotation.XmlAccessType;
import javax.xml.bind.annotation.XmlAccessorType;
```

Example 7–5 uses the EclipseLink extension `@XmlCustomizer` which extends the JAXB specification. Because the contact attribute is a bidirectional relationship, it includes the EclipseLink extension `@XmlInverseReference`.

Example 7–5 Using the @XmlCustomizer Annotation

```
@Entity
@IdClass(EmployeeId.class)
@XmlCustomizer(EmployeeCustomizer.class)
public class Employee {

    @EmbeddedId
    private EmployeeId id;

    @OneToMany(mappedBy="contact")
    @XmlInverseReference(mappedBy="contact")
    private List<PhoneNumber> contactNumber;

}
```

To embed the content of the **EmployeeId** class in the complex type corresponding to the **Employee** class, change the XPath on the mapping for the `id` property to be *self* or **.** . Then specify the XPath to the XML nodes which represent the ID.

Example 7–6 Changing the XPath

```
import org.eclipse.persistence.config.DescriptorCustomizer;
import org.eclipse.persistence.descriptors.ClassDescriptor;
import org.eclipse.persistence.oxm.mappings.XMLCompositeObjectMapping;

public class EmployeeCustomizer implements DescriptorCustomizer {

    public void customize(ClassDescriptor descriptor) throws Exception {
        XMLCompositeObjectMapping idMapping =
            (XMLCompositeObjectMapping)
descriptor.getMappingForAttributeName("id");
        idMapping.setXPath(".");
```

```
        descriptor.addPrimaryKeyFieldName("eId/text()");
        descriptor.addPrimaryKeyFieldName("country/text()");
    }

}
```

If the target object had a single ID then we would use `@XmlIDREF`. Since the target object has a compound key, we will mark the field `@XmlTransient`, and use the EclipseLink extension `@XmlCustomizer` to set up the mapping.

Example 7–7 Using the @XmlTransient Annotation

```
@Entity
@XmlCustomizer(PhoneNumberCustomizer.class)
public class PhoneNumber {

    @ManyToOne
    @JoinColumns({
        @JoinColumn(name="E_ID", referencedColumnName = "E_ID"),
        @JoinColumn(name="E_COUNTRY", referencedColumnName = "COUNTRY")
    })
    @XmlTransient
    private Employee contact;

}
```

An `XMLObjectReferenceMapping` will be created. The mapping will include multiple key mappings.

```
import org.eclipse.persistence.config.DescriptorCustomizer;
import org.eclipse.persistence.descriptors.ClassDescriptor;
import org.eclipse.persistence.oxm.mappings.XMLObjectReferenceMapping;

public class PhoneNumberCustomizer implements DescriptorCustomizer {

    public void customize(ClassDescriptor descriptor) throws Exception {
        XMLObjectReferenceMapping contactMapping = new
XMLObjectReferenceMapping();
        contactMapping.setAttributeName("contact");
        contactMapping.setReferenceClass(Employee.class);
        contactMapping.addSourceToTargetKeyFieldAssociation("contact/@eID",
"eId/text()");
        contactMapping.addSourceToTargetKeyFieldAssociation("contact/@country",
"country/text()");
        descriptor.addMapping(contactMapping);
    }

}
```

Mapping Composite Key Relationships

If the objects that you want to map have multi-part keys (that is, a combination of fields that determines uniqueness), you can use EclipseLink's `@XmlKey` and `@XmlJoinNodes` to set up this relationship.

One or more `@XmlKey` annotations can be used to declare the primary keys in a given class. For a single key, either `@XmlID` or `@XmlKey` can be used. For composite primary keys, multiple `@XmlKey` annotations can be used, or a single `@XmlID` can be combined with one or more `@XmlKey` annotations.

Note: Composite Keys can be useful when using JAXB to map JPA entities. For more information see Converting JPA entities to/from XML (via JAXB).

In Example 7–8, each **Employee** has one **manager** but multiple **reports**, and **Employees** are uniquely identified by the combination of their `id` and `name` fields.

Example 7–8 Using the @XmlKey and @XmlJoinNodes Annotations

```
package example;

import javax.xml.bind.annotation.*;
import org.eclipse.persistence.oxm.annotations.*;

@XmlAccessorType(XmlAccessType.FIELD)
public class Employee {
    @XmlID
    @XmlAttribute
    private Integer id;

    @XmlKey
    @XmlAttribute
    private String name;

    @XmlJoinNodes( {
        @XmlJoinNode(xmlPath = "manager/@id", referencedXmlPath = "@id"),
        @XmlJoinNode(xmlPath = "manager/@name", referencedXmlPath = "@name") })
    public Employee manager;

    @XmlJoinNodes( {
        @XmlJoinNode(xmlPath = "report/@id", referencedXmlPath = "@id"),
        @XmlJoinNode(xmlPath = "report/@name", referencedXmlPath = "@name") })
    public List<Employee> reports = new ArrayList<Employee>();

    ...
}
```

Example 7–9 shows how to define this mapping information in EclipseLink's OXM metadata format.

Example 7–9 Sample XML Mapping

```
...
<java-type name="Employee">
    <java-attributes>
        <xml-attribute java-attribute="id" xml-id="true" />
        <xml-attribute java-attribute="name" xml-key="true" />
        <xml-join-nodes java-attribute="manager">
            <xml-join-node xml-path="manager/@id" referenced-xml-path="@id" />
            <xml-join-node xml-path="manager/@name" referenced-xml-path="@name" />
        </xml-join-nodes>
        <xml-join-nodes java-attribute="reports"
container-type="java.util.ArrayList">
            <xml-join-node xml-path="report/@id" referenced-xml-path="@id" />
            <xml-join-node xml-path="report/@name" referenced-xml-path="@name" />
        </xml-join-nodes>
    </java-attributes>
</java-type>
```

```
...
```

This would produce the following XML:

```
<company>
   <employee id="1" name="Jane Doe">
      <report id="2" name="John Smith"/>
      <report id="3" name="Anne Jones"/>
   </employee>
   <employee id="2" name="John Smith">
      <manager id="1" name="Jane Doe"/>
   </employee>
   <employee id="3" name="Anne Jones">
      <manager id="1" name="Jane Doe"/>
   </employee>
</company>
```

Mapping Bidirectional Relationships

In order to map bidirectional relationships in EclipseLink MOXy, the back-pointer must be annotated as an `@XmlInverseReference`. Without this annotation, the cyclic relationship will result in an infinite loop during marshalling.

`@XmlInverseReferences` must specify the `mappedBy` attribute, which indicates the property on the opposite side of the relationship.

In Example 7–11, an `Employee` has a collection of `PhoneNumbers`, and each `PhoneNumber` has a back-pointer back to its `Employee`:

Example 7–10 Using the @XMlInverseReference Annotation

```
@XmlAccessorType(XmlAccessType.FIELD)
public class Employee {
   private String name;
   private List<PhoneNumber> phones = new ArrayList<PhoneNumber>();
   ...
}

@XmlAccessorType(XmlAccessType.FIELD)
public class PhoneNumber {
   private String number;
   @XmlInverseReference(mappedBy="phones")
   private Employee employee;
   ...
}
```

Example 7–11 shows how to define this mapping in EclipseLink's OXM metadata format:

Example 7–11 Sample XML Mapping

```
...
<java-type name="Employee">
   <java-attributes>
      <xml-element java-attribute="name" type="java.lang.String"/>
      <xml-element java-attribute="phones" type="PhoneNumber"
container-type="java.util.ArrayList"/>
   </java-attributes>
</java-type>
```

```
<java-type name="PhoneNumber">
   <java-attributes>
      <xml-element java-attribute="number" type="java.lang.String"/>
      <xml-inverse-reference java-attribute="employee" type="Employee"
mapped-by="phones" />
   </java-attributes>
</java-type>
...

In addition, when using @XmlInverseReference, it is not necessary to explicitly
set the back-pointer in your Java code; EclipseLink will do this for you
automatically:
Employee emp = new Employee();
emp.setName("Bob Smith");

PhoneNumber p = new PhoneNumber();
p.setNumber("555-1212");

emp.getPhones().add(p);

// Not Necessary
// p.setEmployee(emp);
```

`@XmlInverseReference` back-pointers can be used with the following types of mappings:

- One-To-One Relationships (see "Mapping Privately Owned One-to-One Relationships" on page 6-1)
- One-To-Many Relationships (see "Mapping Privately Owned One-to-Many Relationships" on page 6-4)
- Single Key Relationships (see "Mapping Single Key Relationships" on page 7-1)
- Composite Key Relationships (see "Mapping Composite Key Relationships" on page 7-5)

`@XmlInverseReference` can be particularly useful when mapping JPA entities to XML (see "Using XML Bindings" on page 2-6)

See also

For more information, see:

- Binding JPA Relationships to XML
  http://wiki.eclipse.org/EclipseLink/Examples/MOXy/JPA/Relationships

8

Advanced Concepts

This chapter includes the following sections:

Refreshing Metadata

Introduced in EclipseLink MOXy 2.3, you can refresh the `JAXBContext` metadata at runtime. This allows you to make changes to existing mappings in a live application environment and see those changes immediately without having to create a new `JAXBContext`.

In order to use the **Metadata Refresh** feature, your metadata information must be provided in one of the following formats:

- `javax.xml.transform.Source`
- `org.w3c.dom.Node`
- `org.eclipse.persistence.jaxb.metadata.MetadataSource`

Example 8–1 Refreshing Metadata

This example will be bootstrapped from the following EclipseLink OXM file:

```
<?xml version="1.0"?>
<xml-bindings
      xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
    package-name="example">
    <java-types>
        <java-type name="Root">
            <java-attributes>
                <xml-element java-attribute="name" name="orig-name"/>
```

```
            </java-attributes>
        </java-type>
    </java-types>
</xml-bindings>
```

The `JAXBContext` is created in the standard way:

```
...
ClassLoader classLoader = ClassLoader.getSystemClassLoader();

DocumentBuilderFactory dbf = DocumentBuilderFactory.newInstance();
dbf.setNamespaceAware(true);
DocumentBuilder db = dbf.newDocumentBuilder();
InputStream metadataStream =
classLoader.getResourceAsStream("example/eclipselink-oxm.xml";
Document metadataDocument = db.parse(metadataStream);
metadataStream.close();

Map<String, Object> props = new HashMap<String, Object>(1);
props.put(JAXBContextProperties.OXM_METADATA_SOURCE, metadataDocument);
JAXBContext context = JAXBContextFactory.createContext(new Class[] { Root.class },
props);
...
```

At this point, if we were to marshal a `Root` object to XML, it would look like this:

```
<root>
    <orig-name>RootName</orig-name>
</root>
```

For this example, we will modify the metadata Document directly to change the XML name for the name field. We can then refresh the metadata using the `refreshMetadata()` API:

```
...
Element xmlElementElement = (Element)
metadataDocument.getElementsByTagNameNS("http://www.eclipse.org/eclipselink/xsds/p
ersistence/oxm", "xml-element").item(0);
xmlElementElement.setAttribute("name", "new-name");
JAXBHelper.getJAXBContext(jc).refreshMetadata();
...
```

After refreshing metadata, the same `Root` object will be marshalled as follows:

```
<root>
      <new-name>RootName</new-name>
</root>
```

Customizing XML Name Conversions

JAXB has well-established rules for converting Java names to XML names, which can be overridden through the use of annotations. This can become burdensome if your names follow common rules (such as making everything upper-case). Starting with EclipseLink MOXy 2.3, you can override this default naming algorithm.

This example will create an implementation of `XMLNameTransformer` to provide a naming algorithm to MOXy.

Using the XMLNameTransformer

The `XMLNameTransformer` interface defines several methods for customizing name generation:

- `transformElementName` – called when creating an element from a Java field or method
- `transformAttributeName` – called when creating an attribute from a Java field or method
- `transformTypeName` – called when creating a simple type or complex type from a Java class
- `transformRootElementName` – called when creating a (root) simple type or complex type from a Java class

Example 8–2 defines an `XMLNameTransformer` that does the following:

- Root element will be the unqualified Java class name
- Other types will be named (unqualified Java class name) + "Type"
- Camel-case element names will be converted to lower-case, hyphenated names
- XML attributes will appear in all upper-case

Example 8–2 Using an XMLNameTransformer

```
package example;

public class NameGenerator implements
org.eclipse.persistence.oxm.XMLNameTransformer {

    // Use the unqualified class name as our root element name.
    public String transformRootElementName(String name) {
        return name.substring(name.lastIndexOf('.') + 1);
    }

    // The same algorithm as root element name plus "Type" appended to the end.
    public String transformTypeName(String name) {
        return transformRootElementName(name) + "Type";
    }

    // The name will be lower-case with word breaks represented by '-'.
    // Note:  A capital letter in the original name represents the start of a new
word.
    public String transformElementName(String name) {
        StringBuilder strBldr = new StringBuilder();
        for (char character : name.toCharArray()) {
            if (Character.isUpperCase(character)) {
                strBldr.append('-');
                strBldr.append(Character.toLowerCase(character));
            } else {
                strBldr.append(character);
            }
         }
        return strBldr.toString();
    }

    // The original name converted to upper-case.
    public String transformAttributeName(String name) {
        return name.toUpperCase();
```

```
    }

}
```

Example Model

The domain model in Example 8–3 will be used. To save space, the accessors have been omitted.

Example 8–3 Customer

```
import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlType(propOrder={"fullName", "shippingAddress"})
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {

    @XmlAttribute
    private long id;

    private String fullName;

    private Address shippingAddress;

}
```

Example 8–4 Address.java

```
import javax.xml.bind.annotation.*;

@XmlAccessorType(XmlAccessType.FIELD)
public class Address {

    @XmlAttribute
    private String type;

    private String street;

}
```

Specifying the Naming Algorithm

Our implementation of the naming algorithm can be provided via the `@XmlNameTransformer` annotation (package or type level) or via the external bindings file in XML.

1. At the type level:

```
@XmlNameTransformer(example.NameGenerator.class)
public class Customer
```

2. At the package level (package-info.java):

```
@XmlNameTransformer(example.NameGenerator.class)
package example;
```

3. External bindings file:

```
<?xml version='1.0' encoding='UTF-8'?>
<xml-bindings xmlns='http://www.eclipse.org/eclipselink/xsds/persistence/oxm'
xml-name-transformer='example.NameGenerator'>
   <xml-schema/>
   <java-types/>
</xml-bindings>
```

XML Output

Without any customization, JAXB's default naming algorithm will produce XML that looks like the following:

```
<?xml version="1.0" encoding="UTF-8"?>
<customer id="123">
    <fullName>Jane Doe</fullName>
    <shippingAddress type="residential">
        <street>1 Any Street</street>
    </shippingAddress>
</customer>
```

By leveraging our customized naming algorithm we can get the following output without specifying any additional metadata on our domain classes:

```
<?xml version="1.0" encoding="UTF-8"?>
<Customer ID="123">
   <full-name>Jane Doe</full-name>
   <shipping-address TYPE="residential">
      <street>1 Any Street</street>
   </shipping-address>
</Customer>
```

Using Virtual Access Methods

In addition to standard JAXB properties (represented by Java fields and accessor methods), EclipseLink MOXy 2.3 introduced the concept of virtual properties and virtual access methods, which instead rely on special `get()` and `set()` methods to maintain mapping data. For example, you might want to use a `HashMap` as the underlying structure to hold data for certain mappings. The mappings that use virtual method access must be defined in EclipseLink OXM metadata.

In order to add virtual properties to an entity:

- the Java class must be marked with an `@XmlVirtualAccessMethods` annotation, or `<xml-virtual-access-methods>` element in OXM
- the Java class must contain getter and setter methods to access virtual property values:
  - `public <ValueType> get(String propertyName)`
  - `public void set(String propertyName, <ValueType> value)`

method names are configurable
`<ValueType>` can be `Object`, or any other Java type (if you would like to use a particular type of value class in the method signature)

Note: By default, EclipseLink will look for methods named `set` and `get`. To customize accessor method names, see "Specifying Alternate Accessor Methods" on page 8-8.

For an example of using virtual properties in a multi-tenant architecture, see "Using Extensible MOXy" on page 8-11.

Configuring Virtual Access Methods

Virtual Access Methods can be configured either by through Java annotations (see Example 8–5) or EclipseLink OXM metadata (see Example 8–6).

Example 8–5 Using Java Annotations

```
package example;

import java.util.Map;
import java.util.HashMap;

import javax.xml.bind.annotation.*;

import org.eclipse.persistence.oxm.annotations.XmlVirtualAccessMethods;

@XmlRootElement
@XmlVirtualAccessMethods
@XmlAccessorType(XmlAccessType.PROPERTY)
public class Customer {

   private int id;

   private String name;

   private Map<String, Object> extensions = new HashMap<String, Object>();

   public Object get(String name) {
      return extensions.get(name);
   }

   public void set(String name, Object value) {
      extensions.put(name, value);
   }

   @XmlAttribute
   public int getId() {
   ...

}
```

Example 8–6 Using OXM Metadata

```
...
<java-types>
   <java-type name="Customer">
      <xml-virtual-access-methods />
      <java-attributes>
         <xml-attribute java-attribute="id" />
         <xml-element java-attribute="name" />
```

```
      </java-attributes>
   </java-type>
...
```

Example

For this example we will use the **Customer** class (Example 8–3), along with an EclipseLink OXM file to define our virtual mappings. Any property encountered in this file that does not have a corresponding Java attribute will be considered a virtual property and will be accessed through the virtual access methods. Because there is no associated Java field, the `type` information must also be provided.

Example 8–7 The virtualprops-oxm.xml File

```
...
<java-types>
    <java-type name="Customer">
        <java-attributes>
            <xml-element java-attribute="discountCode" name="discount-code"
                type="java.lang.String" />
        </java-attributes>
    </java-type>
</java-types>
...
```

When creating the `JAXBContext`, we pass in the `virtualprops` metadata along with our **Customer** class.

To set the values for virtual properties, we will use the aforementioned `set()` method.

```
InputStream oxm = classLoader.getResourceAsStream("virtualprops-oxm.xml");
Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, oxm);

Class[] classes = new Class[] { Customer.class };
JAXBContext ctx = JAXBContext.newInstance(classes, properties);

Customer c = new Customer();
c.setId(7761);
c.setName("Bob Smith");
c.set("discountCode", "SIUB372JS7G2IUDS7");

ctx.createMarshaller().marshal(e, System.out);
```

This will produce the following XML:

```
<customer id="7761">
   <name>Bob Smith</name>
   <discount-code>SIUB372JS7G2IUDS7</discount-code>
</customer>
```

Conversely, we use the `get(String)` method to access virtual properties:

```
...
Customer c = (Customer) ctx.createUnmarshaller().unmarshal(CUSTOMER_URL);

// Populate UI
customerWindow.getTextField(ID).setText(String.valueOf(c.getId()));
customerWindow.getTextField(NAME).setText(c.getName());
customerWindow.getTextField(DCODE).setText(c.get("discountCode"));
```

```
...
```

Using XmlAccessType.FIELD and XmlTransient

If you are using an `@XmlAccessorType` of `XmlAccessType.FIELD`, you will need to mark your virtual properties `Map` attribute to be `@XmlTransient`, to prevent the `Map` itself from being bound to XML:

Example 8–8 Marking the Map Attribute

```
package example;

import javax.xml.bind.annotation.*;

import org.eclipse.persistence.oxm.annotations.XmlVirtualAccessMethods;

@XmlRootElement
@XmlVirtualAccessMethods
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {

   @XmlTransient
   private Map<String, Object> extensions;
   ...
```

Options

- Specifying Alternate Accessor Methods
- Specifying Schema Generation Options

Specifying Alternate Accessor Methods

To use different method names as your virtual method accessors, specify them using the `getMethodName` and `setMethodName` attributes on `@XmlVirtualAccessMethods`:

Example 8–9 Using Alternate Accessor Methods

```
package example;

import java.util.Properties;

import javax.xml.bind.annotation.*;

import org.eclipse.persistence.oxm.annotations.XmlVirtualAccessMethods;

@XmlRootElement
@XmlVirtualAccessMethods(getMethod = "getCustomProps", setMethod =
"putCustomProps")
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
```

```
   @XmlAttribute
   private int id;

   private String name;

   @XmlTransient
   private Properties<String, Object> props = new Properties<String, Object>();

   public Object getCustomProps(String name) {
      return props.getProperty(name);
   }

   public void putCustomProps(String name, Object value) {
      props.setProperty(name, value);
   }

}
```

In OXM:

Example 8–10 Using the xml-virtual-access-methods Element

```
...
<java-types>
  <java-type name="Customer">
    <xml-virtual-access-methods get-method="getCustomProps"
set-method="putCustomProps" />
    <java-attributes>
      <xml-attribute java-attribute="id" />
      <xml-element java-attribute="name" />
      <!-- virtual -->
      <xml-element java-attribute="discountCode" name="discount-code"
        type="java.lang.String" />
    </java-attributes>
  </java-type>
...
```

Specifying Schema Generation Options

You can configure how virtual properties should appear in generated schemas using the `schema` attribute on `@XmlVirtualAccessMethods`. EclipseLink offers two options. Virtual properties can be:

- written as individual nodes, or
- consolidated into a single `<any>` element.

Virtual Properties as Individual Nodes This is EclipseLink's default behavior, or can be specified explicitly as an override as follows:

Example 8–11 Mapping as Individual Nodes

```
package example;

@XmlRootElement
@XmlVirtualAccessMethods(schema = XmlVirtualAccessMethodsSchema.NODES)
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {

   ...
```

For example:

Example 8–12 Original Customer Schema

```
<xs:schema ...>

    <xs:element name="customer">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="first-name" type="xs:string" />
                <xs:element name="last-name" type="xs:string" />
            </xs:sequence>
        </xs:complexType>
    </xs:element>

</xs:schema>
```

Example 8–13 Generated Schema (After adding middle-initial and phone-number)

```
<xs:schema ...>

    <xs:element name="customer">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="first-name" type="xs:string" />
                <xs:element name="last-name" type="xs:string" />
                <xs:element name="middle-initial" type="xs:string" />
                <xs:element name="phone-number" type="xs:string" />
            </xs:sequence>
        </xs:complexType>
    </xs:element>

</xs:schema>
```

Virtual Properties in an <any> Element EclipseLink can also use an <any> element to hold all of the virtual properties in one node:

Example 8–14 Using an <any> Element

```
package example;

@XmlRootElement
@XmlVirtualAccessMethods(schema = XmlVirtualAccessMethodsSchema.ANY)
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {

   ...
```

From Example 8–14, a newly generated schema using this approach would look like:

Example 8–15 Generated Schema

```
<xs:schema ...>

    <xs:element name="customer">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="first-name" type="xs:string" />
```

```
                <xs:element name="last-name" type="xs:string" />
                <xs:any minOccurs="0" />
            </xs:sequence>
        </xs:complexType>
    </xs:element>

</xs:schema>
```

Using Extensible MOXy

In a multi-tenant architecture, a single application runs on a server serving multiple client organizations (tenants). Good multi-tenant applications allow per-tenant customizations. When these customizations are made to data, it can be difficult for the binding layer to handle them.

JAXB is designed to work with domain models that have *real* fields and properties. EclipseLink MOXy virtual properties provide a way to extend a class without modifying the source.

Using the @XmlVirtualAccessMethods Annotation

The `@XmlVirtualAccessMethods` annotation is used to specify that a class is extensible. An extensible class is required to have a `get` method that returns a value by property name, and a `set` method that stores a value by property name. The default names for these methods are `get` and `set`, and can be overridden with the `@XmlVirtualAccessMethods` annotation.

Since we will have multiple extensible classes in this example, we'll configure a base class for this behavior that extensible classes can extend. We will use the `@XmlTransient` annotation to prevent `ExtensibleBase` from being mapped as an inheritance relationship. The *real* properties represent the parts of the model that will be common to all tenants. The per-tenant extensions will be represented as *virtual* properties.

Example 8–16 Sample ExtensibleBase

```
package examples.virtual;

import java.util.HashMap;
import java.util.Map;

import javax.xml.bind.annotation.XmlTransient;

import org.eclipse.persistence.oxm.annotations.XmlVirtualAccessMethods;

@XmlTransient
@XmlVirtualAccessMethods(setMethod="put")
public class ExtensibleBase {

    private Map<String, Object> extensions = new HashMap<String, Object>();

    public <T> T get(String property) {
        return (T) extensions.get(property);
    }

    public void put(String property, Object value) {
        extensions.put(property, value);
    }
```

```
}
```

Example 8–17 Customer

The **Customer** class will be extensible since it inherits from a domain class that has been annotated with `@XmlVirtualAccessMethods`.

```
package examples.virtual;

import javax.xml.bind.annotation.XmlRootElement;

@XmlRootElement
public class Customer extends ExtensibleBase {

    private String firstName;
    private String lastName;
    private Address billingAddress;

    public String getFirstName() {
        return firstName;
    }

    public void setFirstName(String firstName) {
        this.firstName = firstName;
    }

    public String getLastName() {
        return lastName;
    }

    public void setLastName(String lastName) {
        this.lastName = lastName;
    }

    public Address getBillingAddress() {
        return billingAddress;
    }

    public void setBillingAddress(Address billingAddress) {
        this.billingAddress = billingAddress;
    }

}
```

Example 8–18 Address

It is not necessary to have every class in your model be extensible. In this example the **Address** class will not have any virtual properties.

```
package examples.virtual;

public class Address {

    private String street;

    public String getStreet() {
        return street;
    }
```

```
    public void setStreet(String street) {
        this.street = street;
    }

}
```

Example 8–19 PhoneNumber

Like **Customer**, **PhoneNumber** will be an extensible class.

```
package examples.virtual;

import javax.xml.bind.annotation.XmlValue;

public class PhoneNumber extends ExtensibleBase {

    private String number;

    @XmlValue
    public String getNumber() {
        return number;
    }

    public void setNumber(String number) {
        this.number = number;
    }

}
```

Creating Tenant 1

The first tenant is an online sporting goods store that requires the following extensions to the model:

- Customer ID
- Customer's middle name
- Shipping address
- A collection of contact phone numbers
- Type of phone number (i.e. home, work, or cell)

The metadata for the virtual properties is supplied through MOXy's XML mapping file. Virtual properties are mapped in the same way as real properties. Some additional information is required including type (since this cannot be determined via reflection), and for collection properties a container type.

The virtual properties defined in Example 8–20 for **Customer** are: **middleName**, **shippingAddress**, and **phoneNumbers**. For **PhoneNumber** the virtual property is the `type` property.

Example 8–20 binding-tenant1.xml

```
<?xml version="1.0"?>
<xml-bindings
    xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
    package-name="examples.virtual">
    <java-types>
        <java-type name="Customer">
```

```
            <xml-type prop-order="firstName middleName lastName billingAddress
shippingAddress phoneNumbers"/>
            <java-attributes>
                <xml-attribute
                    java-attribute="id"
                    type="java.lang.Integer"/>
                <xml-element
                    java-attribute="middleName"
                    type="java.lang.String"/>
                <xml-element
                    java-attribute="shippingAddress"
                    type="examples.virtual.Address"/>
                <xml-element
                    java-attribute="phoneNumbers"
                    name="phoneNumber"
                    type="examples.virtual.PhoneNumber"
                    container-type="java.util.List"/>
            </java-attributes>
        </java-type>
        <java-type name="PhoneNumber">
            <java-attributes>
                <xml-attribute
                    java-attribute="type"
                    type="java.lang.String"/>
            </java-attributes>
        </java-type>
    </java-types>
</xml-bindings>
```

The `get/set` methods are used on the domain model to interact with the *real* properties and the accessors defined on the `@XmlVirtualAccessMethods` annotation are used to interact with the *virtual* properties. The normal JAXB mechanisms are used for marshal and unmarshall operations:

```
Customer customer = new Customer();

//Set Customer's real properties
customer.setFirstName("Jane");
customer.setLastName("Doe");

Address billingAddress = new Address();
billingAddress.setStreet("1 Billing Street");
customer.setBillingAddress(billingAddress);

//Set Customer's virtual 'middleName' property
customer.put("middleName", "Anne");

//Set Customer's virtual 'shippingAddress' property
Address shippingAddress = new Address();
shippingAddress.setStreet("2 Shipping Road");
customer.put("shippingAddress", shippingAddress);

List<PhoneNumber> phoneNumbers = new ArrayList<PhoneNumber>();
customer.put("phoneNumbers", phoneNumbers);

PhoneNumber workPhoneNumber = new PhoneNumber();
workPhoneNumber.setNumber("555-WORK");
//Set the PhoneNumber's virtual 'type' property
workPhoneNumber.put("type", "WORK");
phoneNumbers.add(workPhoneNumber);
```

```
PhoneNumber homePhoneNumber = new PhoneNumber();
homePhoneNumber.setNumber("555-HOME");
//Set the PhoneNumber's virtual 'type' property
homePhoneNumber.put("type", "HOME");
phoneNumbers.add(homePhoneNumber);

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE,
"examples/virtual/binding-tenant1.xml");
JAXBContext jc = JAXBContext.newInstance(new Class[] {Customer.class,
Address.class}, properties);

Marshaller marshaller = jc.createMarshaller();
marshaller.setProperty(Marshaller.JAXB_FORMATTED_OUTPUT, true);
marshaller.marshal(customer, System.out);
```

Example 8–21 Output

```
<?xml version="1.0" encoding="UTF-8"?>
<customer>
   <firstName>Jane</firstName>
   <middleName>Anne</middleName>
   <lastName>Doe</lastName>
   <billingAddress>
      <street>1 Billing Street</street>
   </billingAddress>
   <shippingAddress>
      <street>2 Shipping Road</street>
   </shippingAddress>
   <phoneNumber type="WORK">555-WORK</phoneNumber>
   <phoneNumber type="HOME">555-HOME</phoneNumber>
</customer>
```

Creating Tenant 2

The second tenant is a streaming media provider that offers on-demand movies and music to it's subscribers. It requires a different set of extensions to the core model: a single contact phone number

For this tenant we will also leverage the mapping file to customize the mapping of the real properties, as shown in Example 8–22:

Example 8–22 binding-tenant2.xml

```
<?xml version="1.0"?>
<xml-bindings
    xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
    package-name="examples.virtual">
    <xml-schema namespace="urn:tenant1" element-form-default="QUALIFIED"/>
    <java-types>
        <java-type name="Customer">
            <xml-type prop-order="firstName lastName billingAddress phoneNumber"/>
            <java-attributes>
                <xml-attribute java-attribute="firstName"/>
                <xml-attribute java-attribute="lastName"/>
                <xml-element java-attribute="billingAddress" name="address"/>
                <xml-element
```

```
                    java-attribute="phoneNumber"
                    type="examples.virtual.PhoneNumber"/>
            </java-attributes>
        </java-type>
    </java-types>
</xml-bindings>

Customer customer = new Customer();
customer.setFirstName("Jane");
customer.setLastName("Doe");

Address billingAddress = new Address();
billingAddress.setStreet("1 Billing Street");
customer.setBillingAddress(billingAddress);

PhoneNumber phoneNumber = new PhoneNumber();
phoneNumber.setNumber("555-WORK");
customer.put("phoneNumber", phoneNumber);

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE,
"examples/virtual/binding-tenant2.xml");
JAXBContext jc = JAXBContext.newInstance(new Class[] {Customer.class,
Address.class}, properties);

Marshaller marshaller = jc.createMarshaller();
marshaller.setProperty(Marshaller.JAXB_FORMATTED_OUTPUT, true);
marshaller.marshal(customer, System.out);
```

Example 8–23 Output

Note that even though both tenants share several real properties, the corresponding XML representation can be quite different due to virtual properties:

```
<?xml version="1.0" encoding="UTF-8"?>
<customer xmlns="urn:tenant1" firstName="Jane" lastName="Doe">
   <address>
      <street>1 Billing Street</street>
   </address>
   <phoneNumber>555-WORK</phoneNumber>
</customer>
```

Mapping Using XPath Predicates

By default, JAXB will use the Java field name as the XML element name:

Example 8–24 Sample Java Code and XML Schema

```
public class Customer {
   @XmlElement
   private String firstName;
   @XmlElement
   private String lastName;
}
```

```
<?xml version="1.0" encoding="UTF-8"?>
<customer>
   <firstName>Bob</firstName>
   <lastName>Roberts</lastName>
</customer>
```

Or, the XML name can be customized using the name attribute of the `@XmlElement` annotation:

Example 8–25 Sample Java Code and XML Schema

```
public class Customer {
   @XmlElement(name="f-name")
   private String firstName;
   @XmlElement(name="l-name")
   private String lastName;
}
```

```
<?xml version="1.0" encoding="UTF-8"?>
<customer>
   <f-name>Bob</f-name>
   <l-name>Roberts</l-name>
</customer>
```

However, sometimes elements need to be mapped based on their position in the document, or based on an attribute value of an element:

```
<?xml version="1.0" encoding="UTF-8"?>
<node>
   <name>Jane</name>
   <name>Doe</name>
   <node name="address">
      <node name="street">123 A Street</node>
   </node>
   <node name="phone-number" type="work">555-1111</node>
   <node name="phone-number" type="cell">555-2222</node>
</node>
```

For cases like this, EclipseLink MOXy allows you to use XPath predicates to define an expression that will specify the XML element's name.

Mapping with XPath Predicates

An XPath predicate represents an expression that will be evaluated against the element specified. For example, the XPath statement:

```
node[2]
```

Would match the second occurrence of the node element ("DEF"):

```
<?xml version="1.0" encoding="UTF-8"?>
<data>
   <node>ABC</node>
   <node>DEF</node>
</data>
```

Predicates can also match based on an attribute value:

```
node[@name='foo']
```

Would match the **node** element with the attribute **name="foo"** (that is, **ABC**). It would not match the node that contains **DEF**.

```
<?xml version="1.0" encoding="UTF-8"?>
<data>
   <node name="foo">ABC</node>
   <node name="bar">DEF</node>
</data>
```

Note: For more information on XPath Predicates, see "2.4 Predicates" of the XML Path Language (XPath) specification (http://www.w3.org/TR/xpath).

Mapping Based on Position

In the following example, our XML contains two **name** elements; the first occurrence of **name** should represent the **Customer's** first name, and the second **name** will be their last name. To map this, we will specify XPath expressions for each property that will match the appropriate XML element. Note that we also use `@XmlType(propOrder)` to ensure that our elements will always be in the proper positions.

Example 8–26 Using the @XmlType(propOrder) Annotation

```
package example;

import javax.xml.bind.annotation.*;

import org.eclipse.persistence.oxm.annotations.XmlPath;

@XmlRootElement
@XmlType(propOrder={"firstName", "lastName"})
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {
    @XmlPath("name[1]/text()")
    private String firstName;

    @XmlPath("name[2]/text()")
    private String lastName;

    ...
}
```

This same configuration can be expressed in an EclipseLink XML Bindings document as follows:

Example 8–27 Using the prop-order Attribute

```
...
<java-type name="Customer">
   <xml-root-element/>
   <xml-type prop-order="firstName lastName"/>
   <java-attributes>
      <xml-element java-attribute="firstName" xml-path="name[1]/text()"/>
      <xml-element java-attribute="lastName" xml-path="name[2]/text()"/>
   </java-attributes>
</java-type>
```

```
...
```

This will give us the desired XML representation:

Example 8–28 Resulting XML

```
<?xml version="1.0" encoding="UTF-8"?>
<customer>
   <name>Bob</name>
   <name>Smith</name>
</customer>
```

Mapping Based on an Attribute Value

Since EclipseLink MOXy 2.3, you can also map to an XML element based on an Attribute value. In this example, all of our XML elements are named **node**, differentiated by the value of their **name** attribute:

Example 8–29 Sample XML Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<node>
   <node name="first-name">Bob</node>
   <node name="last-name">Smith</node>
   <node name="address">
      <node name="street">123 A Street</node>
   </node>
   <node name="phone-number" type="work">555-1111</node>
   <node name="phone-number" type="cell">555-2222</node>
</node>
```

We can use an XPath in the form of `element-name[@attribute-name='value']` to map each Java field:

Example 8–30 Sample Mappings

```
package example;

import javax.xml.bind.annotation.*;

import org.eclipse.persistence.oxm.annotations.XmlPath;

@XmlRootElement(name="node")
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {

    @XmlPath("node[@name='first-name']/text()")
    private String firstName;

    @XmlPath("node[@name='last-name']/text()")
    private String lastName;

    @XmlPath("node[@name='address']")
    private Address address;

    @XmlPath("node[@name='phone-number']")
    private List<PhoneNumber> phoneNumbers = new ArrayList<PhoneNumber>();

    ...
```

```
}

package example;

import javax.xml.bind.annotation.*;

import org.eclipse.persistence.oxm.annotations.XmlPath;

@XmlAccessorType(XmlAccessType.FIELD)
public class Address {

    @XmlPath("node[@name='street']/text()")
    private String street;

    ...
}

package example;

import javax.xml.bind.annotation.*;

@XmlAccessorType(XmlAccessType.FIELD)
public class PhoneNumber {

    @XmlAttribute
    private String type;

    @XmlValue
    private String number;

    ...
}
```

Creating "Self" Mappings

EclipseLink allows you to configure your one-to-one mappings so the data from the target object will appear inside the source object's XML element. Expanding on the previous example, we could map the **Address** information so that it would appear directly under the **customer** element, and *not* wrapped in its own element. This is referred to as a "self" mapping, and is achieved by setting the target object's XPath to **.** (dot).

Example 8–31 demonstrates a self mapping declared in annotations.

Example 8–31 Self Mapping Example

```
package example;

import javax.xml.bind.annotation.*;

import org.eclipse.persistence.oxm.annotations.XmlPath;

@XmlRootElement(name="node")
@XmlAccessorType(XmlAccessType.FIELD)
public class Customer {

    @XmlPath("node[@name='first-name']/text()")
    private String firstName;
```

```
    @XmlPath("node[@name='last-name']/text()")
    private String lastName;

    @XmlPath(".")
    private Address address;

    @XmlPath("node[@name='phone-number']")
    private List<PhoneNumber> phoneNumbers = new ArrayList<PhoneNumber>();

    ...
}
```

Using a self mapping, EclipseLink produces the desired XML. The **street** data is stored in the root **node**.

```
<?xml version="1.0" encoding="UTF-8"?>
<node>
   <node name="first-name">Bob</node>
   <node name="last-name">Smith</node>
   <node name="street">123 A Street</node>
   <node name="phone-number" type="work">555-1111</node>
   <node name="phone-number" type="cell">555-2222</node>
</node>
```

Using an XmlAdapter

Some Java classes may not be well suited for use with JAXB and at first glance may seem "unmappable" – for example, classes that do not have a default `no-arg` constructor, or classes for which an XML representation cannot be automatically determined. Using JAXB's `XmlAdapter`, you can define custom code to convert the unmappable class into something that JAXB can handle. Then, you can use the `@XmlJavaTypeAdapter` annotation to indicate that your adapter should be used when working with the unmappable class.

`XmlAdapter` uses the following terminology:

- `ValueType` – The type that JAXB knows how to handle out of the box.
- `BoundType` – The type that JAXB doesn't know how to handle. An adapter is written to allow this type to be used as an in-memory representation through the ValueType.

The outline of an XmlAdapter class is as follows:

Example 8–32 XmlAdapter Class Outline

```
public class AdapterName extends XmlAdapter<ValueType, BoundType> {

   public BoundType unmarshal(ValueType value) throws Exception {
      ...
   }

   public ValueType marshal(BoundType value) throws Exception {
      ...
   }

}
```

Using java.util.Currency

Our first example will use the following domain class:

Example 8–33 Sample Domain Class

```
package example;

import java.util.Currency;

import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class PurchaseOrder {

   private Double amount;

   private Currency currency;

   ...
}
```

Here, the **Currency** cannot be automatically mapped with JAXB because it does not contain a no-argument constructor. However, we can write an adapter that will convert the **Currency** into something that JAXB does know how to handle – a simple `String`. Luckily, in this case the **Currency's** `toString()` method returns the currency code, which can also be used to create a new **Currency**:

Example 8–34 Using an Adapter

```
package example;

import java.util.Currency;

import javax.xml.bind.annotation.adapters.XmlAdapter;

public class CurrencyAdapter extends XmlAdapter<String, Currency> {

   /*
    * Java => XML
    * Given the unmappable Java object, return the desired XML representation.
    */
   public String marshal(Currency val) throws Exception {
      return val.toString();
   }

   /*
    * XML => Java
    * Given an XML string, use it to build an instance of the unmappable class.
    */
   public Currency unmarshal(String val) throws Exception {
      return Currency.getInstance(val);
   }

}
```

To indicate that our adapter should be used for the **Currency** property, we annotate it with `@XmlJavaTypeAdapter` and provide the class name of our adapter:

Example 8–35 Using the @XmlJavaTypeAdapter Annotation

```
package example;

import java.util.Currency;

import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class PurchaseOrder {

   private Double amount;

   @XmlJavaTypeAdapter(CurrencyAdapter.class)
   private Currency currency;

   ...
}
```

Using java.awt.Point

Sometimes the best way to handle an unmappable class is to write a "stand-in" class which *can* be mapped with JAXB, and convert between the two classes in the `XmlAdapter`. In this example, we want to use the **Point** class. Because of that class' `getLocation()` method (which JAXB will pickup automatically and map), an infinite loop will occur during marshalling. Because we cannot change the **Point** class, we will write a new class, **MyPoint**, and use it in the adapter.

Example 8–36 Using java.awt.Point

```
package example;

public class MyPoint {

   private int x, y;

   public MyPoint() {
      this(0, 0);
   }

   public MyPoint(int x, int y) {
      this.x = x;
      this.y = y;
   }

   public int getX() {
      return x;
   }

   ...
}

package example;

import java.awt.Point;

import javax.xml.bind.annotation.adapters.XmlAdapter;
```

```
public class MyPointAdapter extends XmlAdapter<MyPoint, Point> {

   /*
    * Java => XML
    */
   public MyPoint marshal(Point val) throws Exception {
      return new MyPoint((int) val.getX(), (int) val.getY());
   }

   /*
    * XML => Java
    */
   public Point unmarshal(MyPoint val) throws Exception {
      return new Point(val.getX(), val.getY());
   }

}
```

Finally, our **Point** properties are marked with `@XmlJavaTypeAdapter`:

Example 8–37 Using the @XmlJavaTypeAdapter Annotation

```
package example;

import java.awt.Point;

import javax.xml.bind.annotation.*;

@XmlRootElement
@XmlAccessorType(XmlAccessType.FIELD)
public class Zone {

   private String name;

   @XmlJavaTypeAdapter(MyPointAdapter.class)
   private Point startCoord;

   @XmlJavaTypeAdapter(MyPointAdapter.class)
   private Point endCoord;

   ...
}
```

Specifying Package-Level Adapters

In Example 8–37, we annotated both **Point** properties with the `@XmlJavaTypeAdapter` annotation. If you have many of these types of properties – for example, in other domain classes – it can be more convenient to specify the **@XmlJavaTypeAdapters** at the package level.

We could define both of the adapter classes in **package-info.java**, and would no longer have to annotate any further **Currency** or **Point** properties:

```
@XmlJavaTypeAdapters({
   @XmlJavaTypeAdapter(value=CurrencyAdapter.class,type=Currency.class),
   @XmlJavaTypeAdapter(value=MyPointAdapter.class,type=Point.class)
})
package example;
```

Specifying Class-Level @XmlJavaTypeAdapters

If you have a Java class and you would like to always use an `XmlAdapter` during marshalling and unmarshalling, then you can specify the `@XmlJavaTypeAdapter` directly at the class level:

```
package example;

import javax.xml.bind.annotation.adapters.XmlJavaTypeAdapter;

@XmlJavaTypeAdapter(DataStructureAdapter.class)
public class DataStructure {

   ...

}
```

Now, any object that has a **DataStructure** property will automatically use the `DataStructureAdapter`, without the need for an annotation on the property itself.

Using XML Transformations

In many cases, you can use MOXy's `@XmlTransformation` annotation to give you considerably more control over the marshalling and unmarshalling of your objects. `@XmlTransformation` can be used to create a custom mapping where one or more XML nodes can be used to create the value for the Java attribute.

To handle the custom requirements at marshal (write) and unmarshall (read) time, `@XmlTransformation` uses instances of `org.eclipse.persistence.mappings.transformers` (such as `AttributeTransformer` and `FieldTransformer`), providing a non-intrusive solution that avoids the need for domain objects to implement any 'special' interfaces.

For example, if you wanted to map the following XML to objects and combine the values of `DATE` and `TIME` into a `single java.util.Date` object, you can use an `@XmlTransformation`:

```
<ELEM_B>
   <B_DATE>20100825</B_DATE>
   <B_TIME>153000</B_TIME>
   <NUM>123</NUM>
   <C_DATE>20100825</C_DATE>
   <C_TIME>154500</C_TIME>
</ELEM_B>
```

Note: Ordinarily, you would use `@XmlAdapter`. However:

- Although the **DATE/TIME** pairings are repeated throughout the document, the element name changes each time (such as **B_DATE/B_TIME**, **C_DATE/C_TIME**, and so on).
- Because each pairing is missing a grouping element, you would need to adapt the *entire* **ElemB** class.

Because of these issues, MOXy's transformation mapping is much easier to implement:

Example 8–38 Mapping Example

```
package example;

import java.util.Date;

import javax.xml.bind.annotation.*;
import org.eclipse.persistence.oxm.annotations.*;

@XmlAccessorType(XmlAccessType.FIELD)
@XmlRootElement(name="ELEM_B")
public class ElemB {

    @XmlTransformation
    @XmlReadTransformer(transformerClass=DateAttributeTransformer.class)
    @XmlWriteTransformers({
        @XmlWriteTransformer(xmlPath="B_DATE/text()",
transformerClass=DateFieldTransformer.class),
        @XmlWriteTransformer(xmlPath="B_TIME/text()",
transformerClass=TimeFieldTransformer.class),
    })
    private Date bDate;

    @XmlElement(name="NUM")
    private int num;

    @XmlTransformation
    @XmlReadTransformer(transformerClass=DateAttributeTransformer.class)
    @XmlWriteTransformers({
        @XmlWriteTransformer(xmlPath="C_DATE/text()",
transformerClass=DateFieldTransformer.class),
        @XmlWriteTransformer(xmlPath="C_TIME/text()",
transformerClass=TimeFieldTransformer.class),
    })
    private Date cDate;

}
```

Using an AttributeTransformer

Use an `AttributeTransformer` to construct the Java attribute value:

Example 8–39 Sample AttributeTransfomer

```
package example;

import java.text.ParseException;
import java.text.SimpleDateFormat;

import org.eclipse.persistence.internal.helper.DatabaseField;
import org.eclipse.persistence.mappings.foundation.AbstractTransformationMapping;
import org.eclipse.persistence.mappings.transformers.AttributeTransformer;
import org.eclipse.persistence.sessions.Record;
import org.eclipse.persistence.sessions.Session;

public class DateAttributeTransformer implements AttributeTransformer {

    private AbstractTransformationMapping mapping;
    private SimpleDateFormat yyyyMMddHHmmss = new
```

```
SimpleDateFormat("yyyyMMddHHmmss");

    public void initialize(AbstractTransformationMapping mapping) {
        this.mapping = mapping;
    }

    public Object buildAttributeValue(Record record, Object instance, Session
session) {
        try {
            String dateString = null;
            String timeString = null;

            for (DatabaseField field : mapping.getFields()) {
                if (field.getName().contains("DATE")) {
                    dateString = (String) record.get(field);
                } else {
                    timeString = (String) record.get(field);
                }
            }
            return yyyyMMddHHmmss.parseObject(dateString + timeString);
        } catch(ParseException e) {
            throw new RuntimeException(e);
        }
    }

}
```

Using a FieldTransformer

Use a `FieldTransformer` to construct the XML field value from the Java object.

Each transformation mapping may have multiple write transformers. In this example, you will need two:

- The first write transformer writes the year, month, and day in **yyMMdd** format:

Example 8–40 First Write Transformer

```
package example;

import java.text.SimpleDateFormat;
import java.util.Date;

import org.eclipse.persistence.mappings.foundation.AbstractTransformationMapping;
import org.eclipse.persistence.mappings.transformers.FieldTransformer;
import org.eclipse.persistence.sessions.Session;

public class DateFieldTransformer implements FieldTransformer {

    private AbstractTransformationMapping mapping;
    private SimpleDateFormat yyyyMMdd = new SimpleDateFormat("yyyyMMdd");

    public void initialize(AbstractTransformationMapping mapping) {
        this.mapping = mapping;
    }

    public Object buildFieldValue(Object instance, String xPath, Session session)
{
        Date date = (Date) mapping.getAttributeValueFromObject(instance);
        return yyyyMMdd.format(date);
```

```
    }

}
```

- The second write transformer writes out the hour, minutes, and seconds in **HHmmss** format.

Example 8–41 Second Write Transformer

```
package example;

import java.text.SimpleDateFormat;
import java.util.Date;

import org.eclipse.persistence.mappings.foundation.AbstractTransformationMapping;
import org.eclipse.persistence.mappings.transformers.FieldTransformer;
import org.eclipse.persistence.sessions.Session;

public class TimeFieldTransformer implements FieldTransformer {

    private AbstractTransformationMapping mapping;
    private SimpleDateFormat HHmmss = new SimpleDateFormat("HHmmss");

    public void initialize(AbstractTransformationMapping mapping) {
        this.mapping = mapping;
    }

    public Object buildFieldValue(Object instance, String xPath, Session session)
{
        Date date = (Date) mapping.getAttributeValueFromObject(instance);
        return HHmmss.format(date);
    }

}
```

Generating Java Classes from an XML Schema

Use the JAXB Compiler to generate Java classes from an XML schema. The generated classes will contain JAXB annotations that represent the XML binding metadata.

Running the JAXB Compiler

Use the **.sh** or **.cmd** file to run the JAXB Compiler:

```
<ECLIPSELINK_HOME>/eclipselink/bin/jaxb-compiler.sh <source-file.xsd>
[-options]
```

or

```
<ECLIPSELINK_HOME>\eclipselink\bin\jaxb-compiler.cmd <source-file.xsd>
[-options]
```

The JAXB Compiler supports the following options:

Option	Description
`-nv`	Do not perform *strict* validation of the input schemas.
`-extension`	Allow vender-specific extensions; do not strictly follow the Compatibility Rules in Appendix E.2 of the JAXB specification

Option	Description
`-b <file/directory>`	Specify the external binding files to process. **Note**: Each file must use its own `-b` flag.
`-d <directory>`	Specify the output directory for the generated files.
`-p <package>`	Specify the target package.
`-classpath <arg>`	Specify where to find user class files.
`-verbose`	Enable additional compiler output, such as informational messages.
`-quiet`	Disable compiler output.
`-version`	Display the compiler version.

For example:

```
jaxb-compiler.sh -d jaxb-compiler-output config/Customer.xsd
```

To display a complete list of compiler options, use:

```
jaxb-compiler.sh -help
```

Customizing Generated Mappings

When bootstrapping from an XML Schema (or an EclipseLink project from `sessions.xml`), you can customize the mappings that EclipseLink generates by using your own EclipseLink OXM Bindings file. This file contains your additional mappings and allows you to combine OXM with XSD bootstrapping. This means that you can use EclipseLink mappings to customize an existing XML schema.

This section shows how to override mappings defined in the schema. Although the schema defines **addresses** in Canadian format (with province and postal code), you can use XML that contains the **address** is USA format (with state and zip code).

First, you must create an `eclipselink-oxm.xml` file that contains the mapping overrides. In Example 8–42, we modify the XPaths for `province` and `postalCode`:

Example 8–42 Sample eclipselink-oxm.xml File

```
<?xml version="1.0" encoding="US-ASCII"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
package-name="example">
      <java-types>
        <java-type name="Address">
            <java-attributes>
                <xml-element java-attribute="province" xml-path="state/text()"/>
                <xml-element java-attribute="postalCode"
xml-path="zip-code/text()"/>
            </java-attributes>
        </java-type>
    </java-types>
</xml-bindings>
```

When you create a `DynamicJAXBContext`, use the properties argument to pass this binding file to the `DynamicJAXBContextFactory` (in addition to the Schema):

```
// Load Schema
InputStream xsdStream =
myClassLoader.getSystemResourceAsStream("example/resources/xsd/customer.xsd");
```

```
// Load OXM with customizations, put into Properties
InputStream oxmStream =
myClassLoader.getSystemResourceAsStream("example/resources/eclipselink/eclipselink
-oxm.xml");
Map<String, Object> props = new HashMap<String, Object>();
props.put(JAXBContextProperties.OXM_METADATA_SOURCE, oxmStream);

// Create Context
DynamicJAXBContext dContext =
DynamicJAXBContextFactory.createContextFromXSD(inputStream, null, myClassLoader,
props);
```

9

Using Dynamic JAXB

This chapter includes the following sections:

- Understanding Static and Dynamic Entities
- Specifying the EclipseLink Runtime
- Bootstrapping from XML Schema (XSD)
- Bootstrapping from EclipseLink Metadata (OXM)

Understanding Static and Dynamic Entities

There are two high-level ways to use EclipseLink JAXB: using pre-existing Java classes (Using Static MOXy), or using EclipseLink-generated in-memory Java classes (Using Dynamic MOXy).

Using Static MOXy

The most common way to use EclipseLink JAXB is with existing Java classes, mapped to XML using Java annotations and/or EclipseLink OXM metadata. These classes might be ones that you have written yourself, or they could be generated from an XML Schema using the XJC compiler tool.

Using this approach, you will be dealing with your actual domain objects when converting to and from XML. Example 9–1 shows a simple Java class that can be used with JAXB.

Example 9–1 Sample Java Class

```
import javax.xml.bind.annotation.XmlAttribute;
import javax.xml.bind.annotation.XmlRootElement;

@XmlRootElement
public class Customer {
   @XmlAttribute
   private long id;

   private String name;

   // ...
   // get() and set() methods
   // ...
}
```

Note: When using static classes with JAXB, you can take advantage of JAXB's defaulting behavior and only annotate things which differ from the default. For example, all fields on a Java class will default to being mapped to an XML element, so no annotation is needed on the `name` field. We want the `id` field, however, to map to an XML attribute, so have annotated it as such.

Example 9–2 demonstrates how to unmarshal, modify, and marshal an object using static JAXB:

Example 9–2 Marshalling and Unmarshalling Example

```
JAXBContext jaxbContext = JAXBContext.newInstance(Customer.class, Address.class);
Customer customer = (Customer)
jaxbContext.createUnmarshaller().unmarshal(instanceDoc);

Address address = new Address();
address.setStreet("1001 Fleet St.");

customer.setAddress(address);

jaxbContext.createMarshaller().marshal(customer, System.out);
```

Using Dynamic MOXy

With EclipseLink Dynamic MOXy, you can bootstrap a `JAXBContext` from a variety of metadata sources and use existing JAXB APIs to marshal and unmarshal data…*without having compiled Java class files on the classpath*. This allows you to alter the metadata as needed, without having to update and recompile the previously-generated Java source code.

You should consider using Dynamic MOXy when:

- You want EclipseLink to generate mappings from an XML schema (XSD).
- You do not want to deal with concrete Java domain classes.

Using Dynamic Entities

Instead of using actual Java classes (such as `Customer.class` or `Address.class`), Dynamic MOXy uses a simple `get(propertyName)/set(propertyName, propertyValue)` API to manipulate data. EclipseLink generates (in memory) a `DynamicType` associated with each `DynamicEntity`.

Note: `DynamicTypes` are similar to Java classes; whereas `DynamicEntities` can be thought of as instances of a `DynamicType`.

Example 9–3 demonstrates how to unmarshal, modify, and marshal an object using dynamic JAXB:

Example 9–3 Marshalling and Unmarshalling Example

```
DynamicJAXBContext dynamicJAXBContext =
DynamicJAXBContextFactory.createContextFromXSD(xsdInputStream, null,
```

```
myClassLoader, null);
DynamicEntity customer = (DynamicEntity)
dynamicJAXBContext.createUnmarshaller().unmarshal(instanceDoc);

String lastName = customer.get("lastName");
List orders = customer.get("orders");
...
DynamicEntity address =
dynamicJAXBContext.newDynamicEntity("mynamespace.Address");
address.set("street", "1001 Fleet St.");

customer.set("lastName", lastName + "Jr.");
customer.set("address", address);

dynamicJAXBContext.createMarshaller().marshal(customer, System.out);
```

Note: XML names found in the metadata (complex type names, element names, attribute names) will be translated to Java identifiers according to the algorithms described in "Appendix D: Binding XML Names to Java Identifiers" of the Java Architecture for XML Binding (JAXB) 2.2 Specification (http://jcp.org/en/jsr/detail?id=222).

In Example 9–3, `last-name` in XML was translated to `lastName` for the Java object.

Specifying the EclipseLink Runtime

In order to use EclipseLink Dynamic MOXy as your JAXB implementation, you must identify the EclipseLink `DynamicJAXBContextFactory` in your `jaxb.properties` file.

1. Create a text file named `jaxb.properties`, specifying `DynamicJAXBContextFactory` as the factory used to build new `JAXBContexts`.

   ```
   javax.xml.bind.context.factory=org.eclipse.persistence.jaxb.dynamic.Dyn
   amicJAXBContextFactory
   ```

2. Copy the `jaxb.properties` file to the context path used to create the `JAXBContext`.
3. Use the standard `JAXBContext.newInstance(String contextPath)` API to create a `DynamicJAXBContext`.

   ```
   DynamicJAXBContext jaxbContext = (DynamicJAXBContext)
   JAXBContext.newInstance("org.example.mypackage");
   ```

Because you do not need to change any application code, you can easily switch between different JAXB implementations.

Instantiating a DynamicJAXBContext

The following methods on JAXBContext can be used to create new instances of DynamicJAXBContexts:

```
public static JAXBContext newInstance(String contextPath) throws JAXBException
public static JAXBContext newInstance(String contextPath, ClassLoader classLoader)
throws JAXBException
public static JAXBContext newInstance(String contextPath, ClassLoader classLoader,
Map<String,?> properties) throws JAXBException
```

- **contextPath** – Location of `jaxb.properties` file.
- **classLoader** – The application's current class loader, which will be used to first lookup classes to see if they exist before new `DynamicTypes` are generated.
- **properties** – A map of properties to use when creating a new `DynamicJAXBContext`. This map must contain one of the following two keys:
  - `org.eclipse.persistence.jaxb.JAXBContextFactory.XML_SCHEMA_KEY`, which can have several possible values:

One of the following, pointing to your XML Schema file:
`java.io.InputStream`
`org.w3c.dom.Node`
`javax.xml.transform.Source`

  - `org.eclipse.persistence.jaxb.JAXBContextProperties.OXM_METADATA_SOURCE`, which can have several possible values:

One of the following, pointing to your OXM file:
`java.io.File`
`java.io.InputStream`
`java.io.Reader`
`java.net.URL`
`javax.xml.stream.XMLEventReader`
`javax.xml.stream.XMLStreamReader`
`javax.xml.transform.Source`
`org.w3c.dom.Node`
`org.xml.sax.InputSource`

Note: If using one of these options, a package-name element must be defined in the `xml-bindings` element of your OXM file.

A List of objects from the set above.

Note: If using this option, a package-name element must be defined in the `xml-bindings` element of your OXM file.

A `Map<String, Object>`, where `String` is a package name, and `Object` is the pointer to the OXM file, from the set of possibilities above.

Bootstrapping from XML Schema (XSD)

With EclipseLink MOXy, you can provide an existing XML schema from which to create a `DynamicJAXBContext`. EclipseLink will parse the schema and generate `DynamicTypes` for each complex type. This is achieved by use of the `DynamicJAXBContextFactory` class. A `DynamicJAXBContext` cannot be instantiated directly; it must be created through the factory API.

You can pass the XML Schema to `DynamicJAXBContextFactory` by using:

- `java.io.InputStream`
- `org.w3c.dom.Node`

- `javax.xml.transform.Source`

> **Note:** EclipseLink MOXy uses Sun's XJC (XML-to-Java Compiler) APIs to parse the schema into an in-memory representation and generate dynamic types and mappings. When bootstrapping from XSD, you will need to include `jaxb-xjc.jar` (from the JAXB reference implementation) on your **CLASSPATH**.

The APIs used to create a DynamicJAXBContext are as follows:

Example 9–4 Creating a DynamicJAXBContext

```
/**
 * Create a DynamicJAXBContext, using XML Schema as the metadata source.
 *
 * @param schemaStream
 *      java.io.InputStream from which to read the XML Schema.
 * @param resolver
 *      An org.xml.sax.EntityResolver, used to resolve schema imports.  Can be null.
 * @param classLoader
 *      The application's current class loader, which will be used to first lookup
 *      classes to see if they exist before new DynamicTypes are generated.  Can be
 *      null, in which case Thread.currentThread().getContextClassLoader() will be used.
 * @param properties
 *      Map of properties to use when creating a new DynamicJAXBContext.  Can be null.
 *
 * @return
 *      A new instance of DynamicJAXBContext.
 *
 * @throws JAXBException
 *      if an error was encountered while creating the DynamicJAXBContext.
 */
public static DynamicJAXBContext createContextFromXSD(java.io.InputStream schemaStream,
EntityResolver resolver,
   ClassLoader classLoader, Map<String, ?> properties) throws JAXBException

public static DynamicJAXBContext createContextFromXSD(org.w3c.dom.Node schemaDOM, EntityResolver
resolver,
   ClassLoader classLoader, Map<String, ?> properties) throws JAXBException

public static DynamicJAXBContext createContextFromXSD(javax.xml.transform.Source schemaSource,
EntityResolver resolver,
   ClassLoader classLoader, Map<String, ?> properties) throws JAXBException
```

> **Note:** The classLoader parameter is your application's current class loader, and will be used to first lookup classes to see if they exist before new `DynamicTypes` are generated. The user may pass in `null` for this parameter, and `Thread.currentThread().getContextClassLoader()` will be used instead.

This example shows how to create and marshall a new object using Dynamic MOXy.

Example 9–5 Sample XML Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema targetNamespace="example" xmlns:myns="example"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
    attributeFormDefault="qualified" elementFormDefault="qualified">

    <xs:element name="customer" type="myns:customer"/>

    <xs:complexType name="customer">
        <xs:sequence>
            <xs:element name="first-name" type="xs:string"/>
            <xs:element name="last-name" type="xs:string"/>
            <xs:element name="address" type="myns:address"/>
        </xs:sequence>
    </xs:complexType>

    <xs:complexType name="address">
        <xs:sequence>
            <xs:element name="street" type="xs:string"/>
            <xs:element name="city" type="xs:string"/>
            <xs:element name="province" type="xs:string"/>
            <xs:element name="postal-code" type="xs:string"/>
        </xs:sequence>
    </xs:complexType>

</xs:schema>
```

The code snippet in Example 9–6:

- Passes the XML Schema to `DynamicJAXBContextFactory` to create a `DynamicJAXBContext`
- Creates new `DynamicEntities` and sets their properties
- Creates a `JAXBMarshaller` and marshals the Java objects to XML

Example 9–6 Sample Application Code

```
InputStream inputStream =
myClassLoader.getSystemResourceAsStream("example/resources/xsd/customer.xsd");
DynamicJAXBContext dContext =
DynamicJAXBContextFactory.createContextFromXSD(inputStream, null, myClassLoader,
null);

DynamicEntity newCustomer = dContext.newDynamicEntity("example.Customer");
newCustomer.set("firstName", "George");
newCustomer.set("lastName", "Jones");

DynamicEntity newAddress = dContext.newDynamicEntity("example.Address");
newAddress.set("street", "227 Main St.");
newAddress.set("city", "Toronto");
newAddress.set("province", "Ontario");
newAddress.set("postalCode", "M5V1E6");

newCustomer.set("address", newAddress);

dContext.createMarshaller().marshal(newCustomer, System.out);
```

Importing Other Schemas / EntityResolvers

If the XML schema that you use to bootstrap imports other schemas, you must configure an `org.xml.sax.EntityResolver` to resolve the locations of the imported schemas. You can then pass the `EntityResolver` to the `DynamicJAXBContextFactory`.

In Example 9–7, each type is defined in its own schema:

Example 9–7 Sample XML Schema

```
<!-- customer.xsd -->

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:myns="example" xmlns:add="addressNamespace"
   xmlns:xs="http://www.w3.org/2001/XMLSchema" targetNamespace="example">

    <xs:import namespace="addressNamespace" schemaLocation="address.xsd"/>

    <xs:element name="customer" type="myns:customer"/>

    <xs:complexType name="customer">
        <xs:sequence>
            <xs:element name="first-name" type="xs:string"/>
            <xs:element name="last-name" type="xs:string"/>
            <xs:element name="address" type="add:address"/>
        </xs:sequence>
    </xs:complexType>

</xs:schema>
```

You must supply an `EntityResolver` implementation to resolve the location of the imported schema.

Example 9–8 illustrates the `EntityResolver`:

Example 9–8 Sample Application Code

```
class MyEntityResolver implements EntityResolver {

   public InputSource resolveEntity(String publicId, String systemId) throws
SAXException, IOException {
      // Imported schemas are located in ext\appdata\xsd\

      // Grab only the filename part from the full path
      String filename = new File(systemId).getName();

      // Now prepend the correct path
      String correctedId = "ext/appdata/xsd/" + filename;

      InputSource is = new
InputSource(ClassLoader.getSystemResourceAsStream(correctedId));
      is.setSystemId(correctedId);

      return is;
   }

}
```

When you create the `DynamicJAXBContext`, pass the `EntityResolver` to it, as shown here:

```
InputStream inputStream =
ClassLoader.getSystemResourceAsStream("com/foo/sales/xsd/customer.xsd");
DynamicJAXBContext dContext =
DynamicJAXBContextFactory.createContextFromXSD(inputStream, new
MyEntityResolver(), null, null);
```

If you encounter the following exception when importing another schema:

```
Internal Exception: org.xml.sax.SAXParseException: schema_reference.4:
Failed to read schema document '<imported-schema-name>', because 1) could
not find the document; 2) the document could not be read; 3) the root
element of the document is not <xsd:schema>.
```

You should disable XJC's schema correctness check option, either in code:

```
System.setProperty("com.sun.tools.xjc.api.impl.s2j.SchemaCompilerImpl.noCo
rrectnessCheck", "true")
```

or from the command line:

```
-Dcom.sun.tools.xjc.api.impl.s2j.SchemaCompilerImpl.noCorrect
```

Customizing Generated Mappings with XJC External Binding Customization Files

When bootstrapping from an XSD, you have the option to customize the mappings that will be generated through the use of XJC's External Binding Customization file format (`.xjb`). In the example below, the package name of the dynamic classes has been overridden, and the name attribute has been renamed to `last-name-comma-first-name`.

Example 9–9 custom1.xjb File

```
<jxb:bindings version="1.0" xmlns:jxb="http://java.sun.com/xml/ns/jaxb"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
    <jxb:bindings schemaLocation="employee.xsd" node="/xs:schema">

        <!-- Customize the package name that is generated for each schema -->
        <jxb:schemaBindings>
            <jxb:package name="com.acme.internal"/>
        </jxb:schemaBindings>

        <!-- Rename the 'name' element to 'last-name-comma-first-name' -->
        <jxb:bindings node="//xs:complexType[@name='person']">
            <jxb:bindings node=".//xs:element[@name='name']">
                <jxb:property name="last-name-comma-first-name"/>
            </jxb:bindings>
        </jxb:bindings>

    </jxb:bindings>
</jxb:bindings>
```

For complete information on the External Binding Customization file format, please see http://download.oracle.com/docs/cd/E17802_01/webservices/webservices/docs/2.0/tutorial/doc/JAXBUsing4.html.

Note: If you wish to use External Binding Customization files, you will need to use **Source** objects to point to your XML Schema. **Sources** are used to load the `.xjb` files as well, and they must all have the same System ID set.

Example 9–10 illustrates bootstrapping from an XSD, and customizing the mapping generation using two separate `.xjb` files.

Example 9–10 Bootstrapping Example

```
ClassLoader classLoader = Thread.currentThread().getContextClassLoader();
String xsd = "example/resources/xsd/employee.xsd";
String xjb1 = "example/resources/xsd/custom1.xjb";
String xjb2 = "example/resources/xsd/custom2.xjb";

InputStream xsdStream = classLoader.getSystemResourceAsStream(xsd);
Source xsdSource = new StreamSource(xsdStream);
// Set SYSTEM_ID to the filename part of the XSD
xsdSource.setSystemId("employee.xsd");

InputStream xjbStream = classLoader.getResourceAsStream(xjb1);
Source xjbSource = new StreamSource(xjbStream);
// Set SYSTEM_ID to be the same as the XSD
xjbSource.setSystemId(xsdSource.getSystemId());

InputStream xjbStream2 = classLoader.getResourceAsStream(xjb2);
Source xjbSource2 = new StreamSource(xjbStream2);
// Set SYSTEM_ID to be the same as the XSD
xjbSource2.setSystemId(xsdSource.getSystemId());

ArrayList<Source> xjbFiles = new ArrayList<Source>(2);
xjbFiles.add(xjbSource);
xjbFiles.add(xjbSource2);

// Put XSD and XJBs into Properties
Map<String, Object> properties = new HashMap<String, Object>();
properties.put(DynamicJAXBContextFactory.XML_SCHEMA_KEY, xsdSource);
properties.put(DynamicJAXBContextFactory.EXTERNAL_BINDINGS_KEY, xjbFiles);

// Create Context
DynamicJAXBContext jaxbContext = (DynamicJAXBContext)
JAXBContext.newInstance("example", classLoader, properties);
```

The value of `EXTERNAL_BINDINGS_KEY` can be either a single `Source` or a `List<Source>`, pointing to your External Binding Customization file(s).

Bootstrapping from EclipseLink Metadata (OXM)

If you would like to have more control over how your `DynamicEntities` will be mapped to XML, you can instead bootstrap from an EclipseLink OXM Metadata file. Using this approach, you can take advantage of EclipseLink's robust mappings framework and customize how each complex type in XML maps to its Java counterpart. The following API on `DynamicJAXBContextFactory` can be used to bootstrap from an OXM file:

Example 9–11 Creating a DynamicJAXBContext

```
/**
 * Create a <tt>DynamicJAXBContext</tt>, using an EclipseLink OXM file as the metadata source.
 *
 * @param classLoader
 *      The application's current class loader, which will be used to first lookup classes to
 *      see if they exist before new <tt>DynamicTypes</tt> are generated. Can be <tt>null</tt>,
 *      in which case <tt>Thread.currentThread().getContextClassLoader()</tt> will be used.
 * @param properties
 *      Map of properties to use when creating a new <tt>DynamicJAXBContext</tt>.  This map must
 *      contain a key of JAXBContext.ECLIPSELINK_OXM_XML_KEY, with a value of... (see below)
 *
 * @return
 *      A new instance of <tt>DynamicJAXBContext</tt>.
 *
 * @throws JAXBException
 *      if an error was encountered while creating the <tt>DynamicJAXBContext</tt>.
 */
public static DynamicJAXBContext createContextFromOXM(ClassLoader classLoader, Map<String, ?>
properties) throws JAXBException {
```

Links to the actual OXM files are passed in via the `properties` parameter, using a special key, `JAXBContextProperties.OXM_METADATA_SOURCE`. The value of this key will be a handle to the OXM metadata file, in the form of one of the following:

- `java.io.File`
- `java.io.InputStream`
- `java.io.Reader`
- `java.net.URL`
- `javax.xml.stream.XMLEventReader`
- `javax.xml.stream.XMLStreamReader`
- `javax.xml.transform.Source`
- `org.w3c.dom.Node`
- `org.xml.sax.InputSource`

`Lists` of the above inputs are acceptable as well, to bootstrap from multiple OXM files. For more information, see the documentation on the `DynamicJAXBContextFactory` class.

In the following example, we will obtain our OXM file as a resource from our `ClassLoader`, and use the resulting `InputStream` to bootstrap a `DynamicJAXBContext`:

```
InputStream iStream =
myClassLoader.getResourceAsStream("example/resources/eclipselink/eclipselink-oxm.x
ml");

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, iStream);

DynamicJAXBContext jaxbContext =
DynamicJAXBContextFactory.createContextFromOXM(myClassLoader, properties);
```

Example

Using the sample OXM in Example 9–12, we will show an example of how to create and marshall a new object using Dynamic MOXy. It is important to note the `type` attributes. Because there is no underlying Java class, the types of each property must be explicitly specified.

Example 9–12 Sample XML Schema

```
<?xml version="1.0" encoding="US-ASCII"?>
<xml-bindings xmlns="http://www.eclipse.org/eclipselink/xsds/persistence/oxm"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:xs="http://www.w3.org/2001/XMLSchema" package-name="example">

    <java-types>
        <java-type name="Customer">
            <xml-root-element name="customer"/>
            <java-attributes>
                <xml-element java-attribute="firstName" type="java.lang.String"/>
                <xml-element java-attribute="lastName" type="java.lang.String"/>
                <xml-element java-attribute="address" type="example.Address"/>
            </java-attributes>
        </java-type>

        <java-type name="Address">
            <java-attributes>
                <xml-element java-attribute="street" type="java.lang.String"/>
                <xml-element java-attribute="city" type="java.lang.String"/>
                <xml-element java-attribute="province" type="java.lang.String"/>
                <xml-element java-attribute="postalCode" type="java.lang.String"/>
            </java-attributes>
        </java-type>
    </java-types>

</xml-bindings>
```

The code in Example 9–13 demonstrates:

- Passing the OXM file to `DynamicJAXBContextFactory` to create a `DynamicJAXBContext`
- Creating new `DynamicEntities` and setting their properties
- Creating a `JAXBMarshaller` and marshalling the Java objects to XML

Example 9–13 Sample Application Code

```
InputStream iStream =
myClassLoader.getResourceAsStream("example/resources/eclipselink/eclipselink-oxm.x
ml");

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.OXM_METADATA_SOURCE, iStream);

DynamicJAXBContext jaxbContext =
DynamicJAXBContextFactory.createContextFromOXM(myClassLoader, properties);

DynamicEntity newCustomer = dContext.newDynamicEntity("example.Customer");
newCustomer.set("firstName", "George");
newCustomer.set("lastName", "Jones");
```

```
DynamicEntity newAddress = dContext.newDynamicEntity("example.Address");
newAddress.set("street", "227 Main St.");
newAddress.set("city", "Toronto");
newAddress.set("province", "Ontario");
newAddress.set("postalCode", "M5V1E6");

newCustomer.set("address", newAddress);

dContext.createMarshaller().marshal(newCustomer, System.out
```

10

Using JSON Documents

Starting in Release 2.4, EclipseLink MOXy supports the ability to convert objects to and from JSON (JavaScript Object Notation). This feature is useful when creating RESTful services; JAX-RS services can accept both XML and JSON messages.

This chapter includes the following sections:

Understanding JSON Documents

EclipseLink supports all MOXy object-to-XML options when reading and writing JSON, including:

- EclipseLink's advanced and extended mapping features (in addition to the JAXB specification)
- Storing mappings in external bindings files
- Creating dynamic models with Dynamic JAXB
- Building extensible models that support multitenant applications

Marshalling and Unmarshalling JSON Documents

Use the **eclipselink.media-type** property on your JAXB Marshaller or Unmarsaller to produce and use JSON documents with your application, as shown in Example 10–1.

Example 10–1 Marshalling and Unmarshalling

```
...

Marshaller m = jaxbContext.createMarshaller();
m.setProperty("eclipselink.media-type", "application/json");

Unmarshaller u = jaxbContext.createUnmarshaller();
u.setProperty("eclipselink.media-type", "application/json");

...
```

You can also specify the `eclipselink.media-type` property in the `Map` of the properties used when you create the `JAXBContext`, as shown in Example 10–2.

Example 10–2 Using a Map

```
import org.eclipse.persistence.jaxb.JAXBContextProperties;
import org.eclipse.persistence.oxm.MediaType;

Map<String, Object> properties = new HashMap<String, Object>();
properties.put("eclipselink.media-type", "application/json");

JAXBContext ctx = JAXBContext.newInstance(new Class[] { Employee.class },
properties);
Marshaller jsonMarshaller = ctx.createMarshaller();
Unmarshaller jsonUnmarshaller = ctx.createUnmarshaller();
```

When specified in a Map, the Marshallers and Unmarshallers created from the `JAXBContent` will automatically use the specified media type.

You can also configure your application to use JSON documents by using the `MarshallerProperties`, `UnmarshallerProperties`, and `MediaType` constants, as shown in Example 10–3.

Example 10–3 Using MarshallerProperties and UnarshallerProperties

```
import org.eclipse.persistence.jaxb.MarshallerProperties;
import org.eclipse.persistence.jaxb.UnarshallerProperties;
import org.eclipse.persistence.oxm.MediaType;

m.setProperty(MarshallerProperties.MEDIA_TYPE, MediaType.APPLICATION_JSON);
u.setProperty(UnmarshallerProperties.MEDIA_TYPE, MediaType.APPLICATION_JSON);
...
```

Specifying JSON Bindings

Example 10–4 shows a basic JSON binding that does not require compile time dependencies in addition to those required for normal JAXB usage. This example shows how to unmarshal JSON from a `StreamSource` into the user object `SearchResults`, add a new `Result` to the collection, and then marshal the new collection to `System.out`.

Example 10–4 Using Basic JSON Binding

```
package org.example;

import org.example.model.Result;
import org.example.model.SearchResults;

import java.util.Date;

import javax.xml.bind.JAXBContext;
import javax.xml.bind.JAXBElement;
import javax.xml.bind.Marshaller;
import javax.xml.bind.Unmarshaller;
import javax.xml.transform.stream.StreamSource;

public class Demo {
```

```
    public static void main(String[] args) throws Exception {
        JAXBContext jc = JAXBContext.newInstance(SearchResults.class);

        Unmarshaller unmarshaller = jc.createUnmarshaller();
        unmarshaller.setProperty("eclipselink.media-type", "application/json");
        StreamSource source = new
StreamSource("http://search.twitter.com/search.json?q=jaxb");
        JAXBElement<SearchResults> jaxbElement = unmarshaller.unmarshal(source,
SearchResults.class);

        Result result = new Result();
        result.setCreatedAt(new Date());
        result.setFromUser("bsmith");
        result.setText("You can now use EclipseLink JAXB (MOXy) with JSON :)");
        jaxbElement.getValue().getResults().add(result);

        Marshaller marshaller = jc.createMarshaller();
        marshaller.setProperty(Marshaller.JAXB_FORMATTED_OUTPUT, true);
        marshaller.setProperty("eclipselink.media-type", "application/json");
        marshaller.marshal(jaxbElement, System.out);
    }

}
```

You can also write MOXy External Bindings files as JSON documents. Example 10–5 shows how to use `bindings.json` to map **Customer** and **PhoneNumber** classes to JSON.

Example 10–5 Using External Bindings

```
{
   "package-name" : "org.example",
   "xml-schema" : {
      "element-form-default" : "QUALIFIED",
      "namespace" : "http://www.example.com/customer"
   },
   "java-types" : {
      "java-type" : [ {
         "name" : "Customer",
         "xml-type" : {
            "prop-order" : "firstName lastName address phoneNumbers"
         },
         "xml-root-element" : {},
         "java-attributes" : {
            "xml-element" : [
                {"java-attribute" : "firstName","name" : "first-name"},
                {"java-attribute" : "lastName", "name" : "last-name"},
                {"java-attribute" : "phoneNumbers","name" : "phone-number"}
            ]
         }
      }, {
         "name" : "PhoneNumber",
         "java-attributes" : {
            "xml-attribute" : [
                {"java-attribute" : "type"}
            ],
            "xml-value" : [
                {"java-attribute" : "number"}
            ]
```

```
         }
      } ]
   }
}
```

Example 10–6 shows how to use the JSON file (created in Example 10–5) when bootstrapping a `JAXBContext`.

Example 10–6 Using JSON to Bootstrap a JAXBContext

```
Map<String, Object> properties = new HashMap<String, Object>(2);
properties.put("eclipselink-oxm-xml", "org/example/binding.json");
properties.put("eclipselink.media-type", "application/json");
JAXBContext context = JAXBContext.newInstance("org.example",
Customer.class.getClassLoader() , properties);

Unmarshaller unmarshaller = context.createUnmarshaller();
StreamSource json = new StreamSource(new File("src/org/example/input.json"));
...
```

Specifying JSON Data Types

Although XML has a single datatype, JSON differentiates between strings, numbers, and booleans. EclipseLink supports these datatypes automatically, as shown in Example 10–7

Example 10–7 Using JSON Data Types

```
public class Address {

   private int id;
   private String city;
   private boolean isMailingAddress;

}
```

```
{
   "id" : 1,
   "city" : "Ottawa",
   "isMailingAddress" : true
}
```

Supporting Attributes

JSON does not use attributes; anything mapped with a `@XmlAttribute` annotation will be marshalled as an element. By default, EclipseLink triggers *both* the attribute and element events, thereby allowing either the mapped attribute or element to handle the value.

You can override this behavior by using the `JSON_ATTRIBUTE_PREFIX` property to specify an attribute prefix, as shown in Example 10–8. EclipseLink prepends the prefix to the attribute name during marshal and will recognize it during unmarshal.

In the example below the `number` field is mapped as an attribute with the prefix @.

Example 10–8 Using a Prefix

```
jsonUnmarshaller.setProperty(UnmarshallerProperties.JSON_ATTRIBUTE_PREFIX, "@");
jsonMarshaller.setProperty(MarshallerProperties.JSON_ATTRIBUTE_PREFIX, "@") ;
```

```
{
   "phone" : {
      "area-code" : "613",
      "@number" : "1234567"
   }
}
```

You can also set the `JSON_ATTRIBUTE_PREFIX` property in the Map used when creating the `JAXBContext`, as shown in Example 10–9. All marshallers and unmarshalers created from the context will use the specified prefix.

Example 10–9 Setting a Prefix in a Map

```
Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.JSON_ATTRIBUTE_PREFIX, "@");

JAXBContext ctx = JAXBContext.newInstance(new Class[] { Phone.class },
properties);
```

Supporting no Root Element

EclipseLink supports JSON documents without a root element. By default, if no `@XmlRootElement` annotation exists, the marshalled JSON document will not have a root element. You can override this behavior (that is omit the root element from the JSON output, even if the `@XmlRootElement` *is* specified) by setting the `JSON_INCLUDE_ROOT` property when marshalling a document, as shown in Example 10–10.

Example 10–10 Marshalling no Root Element Documents

```
marshaller.setProperty(MarshallerProperties.JSON_INCLUDE_ROOT, false);
```

When unmarshaling a document with no root elements, you should set the `JSON_INCLUDE_ROOT` property as shown in Example 10–10.

Example 10–11 Unmarshalling no Root Element Documents

```
unmarshaller.setProperty(UnmarshallerProperties.JSON_INCLUDE_ROOT, false);
JAXBElement<SearchResults> jaxbElement = unmarshaller.unmarshal(source,
SearchResults.class);
```

Note: If the document has no root element, you must specify the class to unmarshal to.

Using Namespaces

Because JSON does not use namespces, by default all namespaces and prefixes are ignored when marshaling and unmarshaling. In some cases, this may be an issue if

you have multiple mappings with the same local name – there will be no way to distinguish between the mappings.

With EclipseLink, you can supply a Map of namespace-to-prefix (or an instance of `NamespacePrefixMapper`) to the Marshaller and Unmarshaller. The namespace prefix will appear in the marshalled document prepended to the element name. EclipseLink will recognize the prefix during an unmarshal operation and the resulting Java objects will be placed in the proper namespaces.

Example 10–12 shows how to use the `NAMESPACE_PREFIX_MAPPER` property.

Example 10–12 Using Namesapces

```
Map<String, String> namespaces = new HashMap<String, String>();
namespaces.put("namespace1", "ns1");
namespaces.put("namespace2", "ns2");
jsonMarshaller.setProperty(MarshallerProperties.NAMESPACE_PREFIX_MAPPER,
namespaces);
jsonUnmarshaller.setProperty(UnmarshallerProperties.JSON_NAMESPACE_PREFIX_MAPPER,
namespaces);
```

The `MarshallerProperties.NAMESPACE_PREFIX_MAPPER` applies to *both* XML and JSON; `UnmarshallerProperties.JSON_NAMESPACE_PREFIX_MAPPER` is a *JSON-only* property. XML unmarshalling can obtain the namespace information directly from the document.

When JSON is marshalled, the namespaces will be given the prefix from the Map separated by a dot (**.**):

```
{
   "ns1.employee : {
      "ns2.id" : 123
   }
}
```

The dot separator can be set to any custom character by using the `JSON_NAMESPACE_SEPARATOR` property. Here, a colon (**:**) will be used instead:

```
jsonMarshaller.setProperty(MarshallerProperties.JSON_NAMESPACE_SEPARATOR, ':');
jsonUnmarshaller.setProperty(UnmarshallerProperties.JSON_NAMESPACE_SEPARATOR,
':');
```

Using Collections

By default, when marshalling to JSON, EclipseLink marshals empty collections as `[ ]`, as shown in Example 10–13.

Example 10–13

```
{
   "phone" : {
      "myList" : [ ]
   }
}
```

Use the `JSON_MARSHAL_EMPTY_COLLECTIONS` property to override this behavior (so that empty collections are not marshalled at all).

```
jsonMarshaller.setProperty(MarshallerProperties.JSON_MARSHAL_EMPTY_COLLECTIONS,
```

```
Boolean.FALSE) ;
```

```
{
   "phone" : {
   }
}
```

Mapping Root-Level Collections

If you use the `@XmlRootElement(name="root")` annotation to specify a root level, the JSON document can be marshaled as:

```
marshaller.marshal(myListOfRoots, System.out);
```

```
[ {
   "root" : {
      "name" : "aaa"
   }
}, {
   "root" : {
      "name" : "bbb"
   }
} ]
```

Because the root element *is* present in the document, you can unmarsal it using:

```
unmarshaller.unmarshal(json);
```

If the class *does not* have an `@XmlRootElement` (or if `JSON_INCLUDE_ROOT` = false), the marshal would produce:

```
[ {
   "name":"aaa"
}, {
   "name":"bbb"
} ]
```

Because the root element *is not* present, you must indicate the class to unmarshal to:

```
unmarshaller.unmarshal(json, Root.class);
```

Wrapping XML Values

JAXB supports one or more `@XmlAttributes` on `@XmlValue classes`, as shown in Example 10–14

Example 10–14 Using @XmlAttributes

```
public class Phone {

   @XmlValue
   public String number;

   @XmlAttribute
   public String areaCode;
```

```
   public Phone() {
      this("", "");
   }

   public Phone(String num, String code) {
      this.number = num;
      this.areaCode = code;
   }

}
```

To produce a valid JSON document, EclipseLink uses a `value` wrapper, as shown in Example 10–15.

Example 10–15 Using a value Wrapper

```
{
   "employee" : {
      "name" : "Bob Smith",
      "mainPhone" : {
         "areaCode" : "613",
         "value" : "555-5555"
      },
      "otherPhones" : [ {
         "areaCode" : "613",
         "value" : "123-1234"
      }, {
         "areaCode" : "613",
         "value" : "345-3456"
      } ]
   }
}
```

By default, EclipseLink uses **value** as the name of the wrapper. Use the `JSON_VALUE_WRAPPER` property to customize the name of the value wrapper, as shown in Example 10–16.

Example 10–16

```
jsonMarshaller.setProperty(MarshallerProperties.JSON_VALUE_WRAPPER, "$");
jsonUnmarshaller.setProperty(UnmarshallerProperties.JSON_VALUE_WRAPPER, "$");
```

Would produce:

```
{
   "employee" : {
      "name" : "Bob Smith",
      "mainPhone" : {
         "areaCode" : "613",
         "$" : "555-5555"
      },
      "otherPhones" : [ {
         "areaCode" : "613",
         "$" : "123-1234"
      }, {
         "areaCode" : "613",
         "$" : "345-3456"
      } ]
   }
}
```

You can also specify the `JSON_VALUE_WRAPPER` property in the `Map` of the properties used when you create the `JAXBContext`, as shown in Example 10–17.

Example 10–17 Using a Map

```
Map<String, Object> properties = new HashMap<String, Object>();
properties.put(JAXBContextProperties.JSON_VALUE_WRAPPER, "$");

JAXBContext ctx = JAXBContext.newInstance(new Class[] { Employee.class },
properties);
Marshaller jsonMarshaller = ctx.createMarshaller();
Unmarshaller jsonUnmarshaller = ctx.createUnmarshaller();
```

When specified in a Map, the Marshallers and Unmarshallers created from the `JAXBContent` will automatically use the specified value wrapper.