# Common Annotations for the Java™ Platform™

Final Release


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# Contents

# 1

# Introduction

With the addition of JSR 175 (A Metadata Facility for the Java™ Programming Language) in the Java platform we envision that various technologies will use annotations to enable a declarative style of programming. It would be unfortunate if these technologies each independently defined their own annotations for common concepts. It would be valuable to have consistency within the Java EE and Java SE component technologies, but it will also be valuable to allow consistency between Java EE and Java SE.

It is the intention of this specification to define a small set of common annotations that will be available for use within other specifications. It is hoped that this will help to avoid unnecessary redundancy or duplication between annotations defined in different Java Specification Requests (JSR). This would allow us to have the common annotations all in one place and let the technologies refer to this specification rather than have them specified in multiple specifications. This way all technologies can use the same version of the annotations and there will be consistency in the annotations used across the platforms.

## 1.1 Goals

**Define annotations for use in Java EE 5:** This JSR will define annotations for use within component technologies in Java EE 5 as well as the platform as a whole.

**Define annotations for use in future revisions of Java SE:** This JSR will define annotations for use in JSRs targeted for Java SE as well as a future revision of Java SE.

## 1.2 Non-Goals

**Support for Java versions prior to J2SE 5.0**

Annotations were introduced in J2SE 5.0. It is not possible to do annotation processing in versions prior to J2SE 5.0. It is not a goal of this specification to define a way of doing annotation processing of any kind for versions prior to J2SE 5.0.

## 1.3 Compatibility

The annotations defined in this specification may be included individually as needed in products that make use of them. Other Java specifications will require support for subsets of these annotations. Products that support these Java specifications must include the required annotations.

## 1.4 Conventions

The keywords 'MUST', 'MUST NOT', 'REQUIRED', 'SHALL', 'SHALL NOT', 'SHOULD', 'SHOULD NOT', 'RECOMMENDED', 'MAY' AND 'OPTIONAL' in this document are to be interpreted as described in RFC 2119.

Java code is formatted as shown below in figure 1.1:

Figure 1.1 Example Java code

```
package com.wombat.hello;
public class Hello {
    public static void main(String[] args) {
        System.out.println("Hello world");
    }
}
```

## 1.5 Expert Group Members

The following expert group members participated in the JSR -

Cedric Beust (individual)

Bill Burke (JBoss)

Wayne Carr (Intel)

Robert Clevenger (Oracle)

Evan Ireland (Sybase)

Woo Jin Kim (Tmax Soft)

Gavin King (JBoss)

Rajiv Mordani (Sun Microsystems, Specification lead)

Ted Neward (individual)

Anurag Prasar (Pramati technologies)

Michael Santos (individual)

Hani Suleiman (Ironflare AB)

Seth White (BEA)

## 1.6 Acknowledgements

In addition to the expert group listed above the following people Roberto Chinnici, Joe Darcy, Linda DeMichiel, Graham Hamilton, Ron Monzillo, Eduardo Pelegri-Llopart, Scott Seligman and Bill Shannon all of whom work at Sun Microsystems have provided input to this specification.

# 2

# Annotations

This chapter describes the standard annotations, some guidelines for annotation inheritance and the usage of these annotations where possible.

## 2.1 General Guidelines for Inheritance of Annotations

The interplay of annotations and inheritance in the Java language is potentially a source of complexity for developers. Developers will rely on some implicit assumptions when figuring out how annotations compose with other language features. At the same time, annotation semantics are defined by individual specifications, hence the potential for inconsistencies to arise. For instance, consider the following example:

```
public class Base {
    @TransactionAttribute(REQUIRES_NEW)
    public void foo {....}
}
@Stateless
public class Derived extends Base {
    @TransactionAttribute(NEVER)
    public void foo {....}
}
```

In keeping with the concept of method overriding, most developers will assume that in the `Derived` class, the effective `TransactionAttribute` annotation for method `foo` is `@TransactionAttribute(NEVER)`. On the other hand, it might have been possible for the specification governing the semantics of the `TransactionAttribute` annotations type to require that the effective `TransactionAttribute` to be the most restrictive one in the whole inheritance tree, that is, in the example above `@TransactionAttribute(REQUIRES_NEW)`. A motivation for this semantics might have been that the `foo` method in the `Derived` class may call `super.foo()`, resulting in the execution of some code that needs a transaction to be in place. Such a choice on the part of the specification for `TransactionAttribute` would have contradicted a developer's intuition on how method overriding works.

In order to keep the resulting complexity in control, below are some guidelines recommended for how annotations defined in the different specifications should interact with inheritance:

1. Class-level annotations only affect the class they annotate and their members, that is, its methods and fields. They never affect a member declared by a superclass, even if it is not hidden or overridden by the class in question.

2. In addition to affecting the annotated class, class-level annotations may act as a shorthand for member-level annotations. If a member carries a specific member-level annotation, any annotations of the same type implied by a class-level annotation are ignored. In other words, explicit member-level annotations have priority over member-level annotations implied by a class-level annotation. For example, a `@WebService` annotation on a class implies that all the public method in the class that it is applied on are annotated with `@WebMethod` if there is no `@WebMethod` annotation on any of the methods. However if there is a `@WebMethod` annotation on any method then the `@WebService` does not imply the presence of `@WebMethod` on the other public methods in the class.

3. The interfaces implemented by a class never contribute annotations to the class itself or any of its members.

4. Members inherited from a superclass and which are not hidden or overridden maintain the annotations they had in the class that declared them, including member-level annotations implied by class-level ones.

5. Member-level annotations on a hidden or overridden member are always ignored.

These set of guidelines guarantees that the effects of an annotation are local to the class on, or inside, which it appears. In order to find the effective annotation for a class member, a developer has to track down its last non-hidden and non-overridden declaration and examine it. If the sought-for annotation is not found there, then (s)he will have to examine the enclosing class declaration. If even this step fails to provide an annotation, no other source file will be consulted.

Below are some examples that explain how the guidelines defined above will be applied to the `TransactionAttribute` annotation.

```
@TransactionAttribute(REQUIRED)
class Base {
    @TransactionAttribute(NEVER)
    public void foo() {...}
    public void bar() {...}
}

@Stateless
class ABean extends Base {
    public void foo() {...}
}

@Stateless
public class BBean extends Base {
    @TransactionAttribute(REQUIRES_NEW)
    public void foo() {...}
}

@Stateless
@TransactionAttribute(REQUIRES_NEW)
public class CBean extends Base {
    public void foo() {...}
    public void bar() {...}
}

@Stateless
@TransactionAttribute(REQUIRES_NEW)
public class DBean extends Base {
    public void bar() {...}
}

@Stateless
@TransactionAttribute(REQUIRES_NEW)
```

```
public class EBean extends Base {
}
```

The table below shows the effective `TransactionAttribute` annotation in each of the cases above by applying the guidelines specified for annotations and inheritance:

**TABLE 2-1**

| Methods in derived classes | Effective TransactionAttribute value |
|---|---|
| `foo() in ABean` | `REQUIRED (Default TransactionAttribute as defined by the EJB specification).` |
| `foo() in BBean` | `@TransactionAttribute(REQUIRES_NEW)` |
| `foo() in CBean` | `@TransactionAttribute(REQUIRES_NEW)` |
| `bar() in DBean` | `@TransactionAttribute(REQUIRES_NEW)` |
| `bar() in EBean` | `@TransactionAttribute(REQUIRED)` |

For more details about `TransactionAttribute` see the EJB 3 Core Contracts specification.

All annotations defined in this specification follow the guidelines defined above unless explicitly stated otherwise.

## 2.2 javax.annotation.Generated

The Generated annotation is used to mark source code that has been generated. It can be specified on a class, methods or fields. It can also be used to differentiate user written code from generated code in a single file. When used, the value element MUST have the name of the code generator. The recommended convention is to use the fully qualified name of the code generator. For example:

`com.company.package.classname`. The date element is used to indicate the date the source was generated. The date element MUST follow the ISO 8601 standard. For example the date element would have the following value:

```
2001-07-04T12:08:56.235-0700
```

which represents 2001-07-04 12:08:56 local time in the U.S. Pacific Time time zone.

The comments element is a place holder for any comments that the code generator may want to include in the generated code.

```
package javax.annotation;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target({ANNOTATION_TYPE, CONSTRUCTOR, FIELD, LOCAL_VARIABLE,
METHOD, PACKAGE, PARAMETER, TYPE})
@Retention(SOURCE)
public @interface Generated {
    String[] value();
    String date() default "";
    String comments() default "";
}
```

**TABLE 2-2**

| Element | Description | Default |
|---|---|---|
| `value` | Name of the code generator | |
| `date` | Date source was generated. MUST follow ISO 8601 standard | "" |
| `comments` | placeholder for comments that the generator may want to include in the generated code | "" |

The following example shows the usage of the annotation defined above:

```
@Generated("com.sun.xml.rpc.AProcessor")
public interface StockQuoteService extends java.rmi.Remote {
    this.context = context;
```

```
}
```

## 2.3 javax.annotation.Resource

The Resource annotation is used to declare a reference to a resource. It can be specified on a class, methods or on fields. When the annotation is applied on a field or method, the container will inject an instance of the requested resource into the application when the application is initialized. If the annotation is applied to a class, the annotation declares a resource that the application will look up at runtime. Even though this annotation is not marked `Inherited`, if used all superclasses MUST be examined to discover all uses of this annotation. All such annotation instances specify resources that are needed by the application. Note that this annotation may appear on private fields and methods of the superclasses. Injection of the declared resources needs to happen in these cases as well, even if a method with such an annotation is overridden by a subclass.

The `name` element is the JNDI name of the resource. When the `Resource` annotation is applied on a field, the default value of the `name` element is the field name qualified by the class name. When applied on a method, the default is the JavaBeans property name corresponding to the method qualified by the class name. When applied on a class, there is no default and the name MUST be specified.

The `type` element defines the Java type of the resource. When the `Resource` annotation is applied on a field, the default value of the `type` element is the type of the field. When applied on a method, the default is the type of the JavaBeans property. When applied on a class, there is no default and the type MUST be specified. When used, the type MUST be assignment compatible.

The `authenticationType` element is used to indicate the authentication type to use for the resource. It can take one of two values defined as an `Enum`: `CONTAINER` or `APPLICATION`. This element may be specified for resources representing a connection factory of any supported type and MUST NOT be specified for resources of other types.

The `shareable` element is used to indicate whether a resource can be shared between this component and other components. This element may be specified for resources representing a connection factory of any supported type or ORB object instances and MUST NOT be specified for resources of other types.

The `mappedName` element is a product specific name that this resource should be mapped to. The name of this resource, as defined by the `name` element or defaulted, is a name that is local to the application using the resource. Many application servers provide a way to map these local names to names of resources known to the

application server. The mapped name could be of any form. Application servers are not required to support any particular form or type of mapped name, nor the ability to use mapped names. The mapped name is product-dependent and often installation-dependent. No use of mapped name is portable.

The `description` element is the description of the resource. The description is expected to be in the default language of the system on which the application is deployed. The description can be presented to help in choosing the correct resource.

```
package javax.annotation;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target({TYPE, METHOD, FIELD})
@Retention(RUNTIME)
public @interface Resource {
    public enum AuthenticationType {
        CONTAINER,
        APPLICATION
    }
    String name() default "";
    Class type() default Object.class;
    AuthenticationType authenticationType() default
                            AuthenticationType.CONTAINER;
    boolean shareable() default true;
    String mappedName() default "";
    String description() default "";
}
```

**TABLE 2-3**

| Element | Description | Default |
|---|---|---|
| `name` | The JNDI name of the resource | "" |
| `type` | The Java type of the resource | `Object.class` |
| `authenticationType` | The authentication type to use for the resource | `CONTAINER` |

**TABLE 2-3**

| Element | Description | Default |
|---|---|---|
| `shareable` | Indicates whether the resource can be shared. | `true` |
| `mappedName` | A product specific name that the resource should map to. | "" |
| `description` | Description of the resource. | "" |

## *Field based injection:*

To access a resource a developer declares a field and annotates it as being a resource reference. If the name and type elements are missing from the annotation it will be inferred by looking at the field declaration itself. It is an error if the type specified by the `@Resource` annotation and the type of the field are incompatible.

For example:

```
@Resource
private DataSource myDB;
```

In the example above the effective name is `com.example.class/myDB` and the effective type is `javax.sql.DataSource.class`.

```
@Resource(name="customerDB")
private DataSource myDB;
```

In the example above the name is `customerDB` and the effective type is `javax.sql.DataSource.class`.

## *Setter based injection:*

To access a resource a developer declares a setter method and annotates it as being a resource reference. The name and type of resource may be inferred by inspecting the method declaration if necessary. The name of the resource, if not declared, is the name of the JavaBeans property as determined from the name of the setter method in question. The setter method MUST follow the standard JavaBeans convention - name starts with a "set", `void` return type, and only one parameter. Additionally, the type of the parameter MUST be compatible with the type specified as a property of the Resource, if present.

For example:

```
@Resource
private void setMyDB(DataSource ds) {
    myDB = ds;
}
private DataSource myDB;
```

In the example above the effective name is `com.example.class/myDB` and the type is `javax.sql.DataSource.class`.

```
@Resource(name="customerDB")
private void setMyDB(DataSource ds) {
    myDB = ds;
}
private DataSource myDB;
```

In the example above the name is `customerDB` and the type is `javax.sql.DataSource.class`.

The table below shows the mapping from Java type to the equivalent resource type in Java EE 5 deployment descriptors:

**TABLE 2-4**

| Java Type | Equivalent Resource type |
|---|---|
| java.lang.String | env-entry |
| java.lang.Character | env-entry |
| java.lang.Integer | env-entry |
| java.lang.Boolean | env-entry |
| java.lang.Double | env-entry |
| java.lang.Byte | env-entry |
| java.lang.Short | env-entry |
| java.lang.Long | env-entry |
| java.lang.Float | env-entry |
| javax.xml.rpc.Service | service-ref |
| javax.xml.ws.Service | service-ref |
| javax.jws.WebService | service-ref |

| Java Type | Equivalent Resource type |
|---|---|
| javax.sql.DataSource | resource-ref |
| javax.jms.ConnectionFactory | resource-ref |
| javax.jms.QueueConnectionFactory | resource-ref |
| javax.jms.TopicConnectionFactory | resource-ref |
| javax.mail.Session | resource-ref |
| java.net.URL | resource-ref |
| javax.resource.cci.ConnectionFactory | resource-ref |
| org.omg.CORBA_2_3.ORB | resource-ref |
| any other connection factory defined by a resource adapter | resource-ref |
| javax.jms.Queue | message-destination-ref |
| javax.jms.Topic | message-destination-ref |
| javax.resource.cci.InteractionSpec | resource-env-ref |
| javax.transaction.UserTransaction | resource-env-ref |
| Everything else | resource-env-ref |

## 2.4 javax.annotation.Resources

The `Resource` annotation is used to declare a reference to a resource. Since repeated annotations are not allowed, the `Resources` annotation acts as a container for multiple resource declarations.

```
package javax.annotation;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target({TYPE})
@Retention(RUNTIME)
public @interface Resources {
    Resource[] value;
```

}

**TABLE 2-5**

| Element | Description | Default |
|---|---|---|
| `value` | Container for defining multiple resources. | |

The following example shows the usage of the annotation defined above:

```
@Resources ({
    @Resource(name=”myDB” type=javax.sql.DataSource),
    @Resource(name=”myMQ” type=javax.jms.ConnectionFactory)
})
public class CalculatorBean {
    //...
}
```

## 2.5 javax.annotation.PostConstruct

The `PostConstruct` annotation is used on a method that needs to be executed after dependency injection is done to perform any initialization. This method MUST be invoked before the class is put into service. This annotation MUST be supported on all classes that support dependency injection. The method annotated with `PostConstruct` MUST be invoked even if the class does not request any resources to be injected. Only one method can be annotated with this annotation. The method on which the `PostConstruct` annotation is applied MUST fulfill all of the following criteria:

- The method MUST NOT have any parameters except in the case of EJB interceptors in which case it takes an `InvocationContext` object as defined by the EJB specification.
- The return type of the method MUST be `void`.
- The method MUST NOT throw a checked exception.
- The method on which `PostConstruct` is applied MAY be `public`, `protected`, package private or `private`.

- The method MUST NOT be static except for the application client.

- The method MAY be final or non-final, except in the case of EJBs where it MUST be non-final.

- If the method throws an unchecked exception the class MUST NOT be put into service. In the case of EJBs the method annotated with `PostConstruct` can handle exceptions and cleanup before the bean instance is discarded.

```
package javax.annotation;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target(METHOD)
@Retention(RUNTIME)
public @interface PostConstruct {
}
```

The following example shows the usage of the annotation defined above:

```
@Resource
private void setMyDB(DataSource ds) {
    myDB = ds;
}

@PostConstruct
private void initialize() {
    //Initialize the connection object from the DataSource
    connection = myDB.getConnection();
}

private DataSource myDB;
private Connection connection;
```

## 2.6 javax.annotation.PreDestroy

The `PreDestroy` annotation is used on methods as a callback notification to signal that the instance is in the process of being removed by the container. The method annotated with `PreDestroy` is typically used to release resources that it has been holding. This annotation MUST be supported by all container managed objects that support `PostConstruct` except the application client container in Java EE 5. The method on which `the PreDestroy` annotation is applied MUST fulfill all of the following criteria:

- The method MUST NOT have any parameters except in the case of EJB interceptors in which case it takes an `InvocationContext` object as defined by the EJB specification.

- The return type of the method MUST be `void`.

- The method MUST NOT throw a checked exception.

- The method on which `PreDestroy` is applied MAY be `public`, `protected`, package private or `private`.

- The method MUST NOT be static.

- The method MAY be final or non-final, except in the case of EJBs where it MUST be non-final.

- If the method throws an unchecked exception it is ignored except in the case of EJBs where the method annotated with `PreDestroy` can handle exceptions.

```
package javax.annotation;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target(METHOD)
@Retention(RUNTIME)
public @interface PreDestroy {
}
```

The following example shows the usage of the annotation defined above:

```
@Resource
private void setMyDB(DataSource ds) {
```

```
    myDB = ds;
}

@PostConstruct
private void initialize() {
    //Initialize the connection object from the DataSource
    connection = myDB.getConnection();
}
@PreDestroy
private void cleanup() {
    //Close the connection to the DataSource.
    connection.close();
}

private DataSource myDB;
private Connection connection;
```

## 2.7 javax.annotation.security.RunAs

The `RunAs` annotation defines the role of the application during execution in a Java EE container. It can be specified on a class. This allows developers to execute an application under a particular role. The role MUST map to the user / group information in the container's security realm. The `value` element in the annotation is the name of a security role.

```
package javax.annotation.security;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target(TYPE)
@Retention(RUNTIME)
public @interface RunAs {
    String value();
}
```

**TABLE 2-6**

| Element | Description | Default |
|---|---|---|
| `value` | Security role of the application during execution in a Java EE container | |

The following example shows the usage of the annotation defined above:

```
@RunAs("Admin")
public class Calculator {
    //....
}
```

## 2.8 javax.annotation.security.RolesAllowed

The `RolesAllowed` annotation specifies the security roles permitted to access method(s) in an application. The `value` element of the `RolesAllowed` annotation is a list of security role names.

The `RolesAllowed` annotation can be specified on a class or on method(s). Specifying it at a class level means that it applies to all the methods in the class. Specifying it on a method means that it is applicable to that method only. If applied at both the class and method level, the method value overrides the class value.

```
package javax.annotation.security;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target({TYPE,METHOD})
@Retention(RUNTIME)
public @interface RolesAllowed {
    String[] value();
}
```

**TABLE 2-7**

| Element | Description | Default |
|---|---|---|
| `value` | List of roles permitted to access methods in the application | |

The following example shows the usage of the annotation defined above:

```
@RolesAllowed("Users")
public class Calculator {
    @RolesAllowed("Administrator")
    public void setNewRate(int rate) {
    //..
}
```

## 2.9 javax.annotation.security.PermitAll

The `PermitAll` annotation specifies that all security roles are allowed to invoke the specified method(s), that is, that the specified method(s) are "unchecked". It can be specified on a class or on methods. Specifying it on the class means that it applies to all methods of the class. If specified at the method level, it only affects that method.

```
package javax.annotation.security;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target({TYPE,METHOD})
@Retention(RUNTIME)
public @interface PermitAll {
}
```

The following example shows the usage of the annotation defined above:

```
import javax.annotation.security.*;
@RolesAllowed("Users")
public class Calculator {
```

```
    @RolesAllowed("Administrator")
    public void setNewRate(int rate) {
        //...
    }
    @PermitAll
    public long convertCurrency(long amount) {
        //...
    }
}
```

## 2.10 javax.annotation.security.DenyAll

This annotation specifies that no security roles are allowed to invoke the specified method(s), that is, that the method(s) are to be excluded from execution in the Java EE container.

```
package javax.annotation.security;
import static java.lang.annotation.ElementType.*;
import static java.lang.annotation.RetentionPolicy.*;
@Target(METHOD)
@Retention(RUNTIME)
public @interface DenyAll {
}
```

The following example shows the usage of the annotation defined above:

```
import javax.annotation.security.*;
@RolesAllowed("Users")
public class Calculator {
    @RolesAllowed("Administrator")
    public void setNewRate(int rate) {
        //...
    }
    @DenyAll
    public long convertCurrency(long amount) {
```

```
        //...
    }
}
```

## 2.11 PermitAll, DenyAll and RolesAllowed interactions

The `PermitAll`, `DenyAll` and `RolesAllowed` annotations all define what security roles are allowed to access the methods on which they are applied. This section describes how these annotations interact and which usages of these annotations are valid.

1. `PermitAll`, `DenyAll` and `RolesAllowed` annotations MUST NOT be applied on the same method or class.
2. If `PermitAll` is applied at the class level and `RolesAllowed` or `DenyAll` are applied on methods of the same class, then the method level annotations take precedence over the class level annotation.
3. If `DenyAll` is specified at the class level and `PermitAll` or `RolesAllowed` are specified on methods of the same class, then the method level annotation takes precedence over the class level annotation.
4. If `RolesAllowed` is specified at the class level and `PermitAll` or `DenyAll` are specified on methods, then the method level annotation takes precedence over the class level annotation.

## 2.12 javax.annotation.security.DeclareRoles

This annotation is used to specify the security roles by the application. It can be specified on a class. It typically would be used to define roles that could be tested (i.e., by calling `isUserInRole`) from within the methods of the annotated class. It could also be used to declare roles that are not implicitly declared as the result of their use in a `RolesAllowed` annotation on the class or a method of the class.

```
package javax.annotation.security;
import static java.lang.annotation.ElementType.*;
```

```
import static java.lang.annotation.RetentionPolicy.*;
@Target(TYPE)
@Retention(RUNTIME)
public @interface DeclareRoles{
    String[] value();
}
```

**TABLE 2-8**

| Element | Description | Default |
|---|---|---|
| `value` | List of security roles specified by the application | |

The following example shows the usage of the annotation defined above:

```
@DeclareRoles("BusinessAdmin")
public class Calculator {
    public void convertCurrency() {
        if(x.isUserInRole("BusinessAdmin")) {
          //....
        }
    }
    //...
}
```

CHAPTER 3

# References


1. JSR 175: A Metadata Facility for the Java Programming Language. *http://jcp.org/en/jsr/detail?id=175*
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3. Java 2 Platform, Standard Edition, v5.0 (J2SE). *http://java.sun.com/j2se*
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5. RFC 2119. *http://www.faqs.org/rfcs/rfc2119.html*