

# Java Compat Mapping for Interfaces



The mapping of Slice [interfaces](#) revolves around the idea that, to invoke a remote operation, you call a member function on a local class instance that is a [proxy](#) for the remote object. This makes the mapping easy and intuitive to use because making a remote procedure call is no different from making a local procedure call (apart from error semantics).

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## Java Classes Generated for an Interface

The compiler generates quite a few source files for each Slice interface. In general, for an interface `<interface-name>`, the following source files are created by the compiler:

- `<interface-name>.java`  
This source file declares the `<interface-name>` Java interface.
- `<interface-name>Holder.java`  
This source file defines a [holder type](#) for the interface.
- `<interface-name>Prx.java`  
This source file defines the [proxy interface](#) `<interface-name>Prx`.
- `<interface-name>PrxHelper.java`  
This source file defines the [helper type](#) for the interface's proxy.
- `<interface-name>PrxHolder.java`  
This source file defines the [holder type](#) for the interface's proxy.
- `_<interface-name>Operations.java`  
• `_<interface-name>OperationsNC.java`  
These source files each define an interface that contains the operations corresponding to the Slice interface. The `Operations` interface is used for [tie classes](#).

These are the files that contain code that is relevant to the client side. The compiler also generates a file that is specific to the server side, plus three additional files:

- `_<interface-name>Disp.java`  
This file contains the definition of the [server-side skeleton](#) class.
- `_<interface-name>Del.java`
- `_<interface-name>DelD.java`
- `_<interface-name>DelM.java`  
These files contain code that is internal to the Java mapping; they do not contain any functions of relevance to application programmers.

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## Proxy Interfaces in Java

On the client side, a Slice interface maps to a Java interface with methods that correspond to the operations on that interface. Consider the following simple interface:

## Slice

```
interface Simple
{
    void op();
}
```

The Slice compiler generates the following definition for use by the client:

## Java Compat

```
public interface SimplePrx extends ObjectPrx
{
    public void op();
    public void op(java.util.Map<String, String> context);
}
```

As you can see, the compiler generates a *proxy interface* `SimplePrx`. In general, the generated name is `<interface-name>Prx`. If an interface is nested in a module `M`, the generated class is part of package `M`, so the fully-qualified name is `M.<interface-name>Prx`.

In the client's address space, an instance of `SimplePrx` is the local ambassador for a remote instance of the `Simple` interface in a server and is known as a proxy instance. All the details about the server-side object, such as its address, what protocol to use, and its object identity are encapsulated in that instance.

Note that `SimplePrx` inherits from `ObjectPrx`. This reflects the fact that all Ice interfaces implicitly inherit from `Ice::Object`.

For each operation in the interface, the proxy class has a method of the same name. For the preceding example, we find that the operation `op` has been mapped to the method `op`. Also note that `op` is overloaded: the second version of `op` has a parameter `context` of type `java.util.Map<String, String>`. This parameter is for use by the Ice run time to store information about how to deliver a request. You normally do not need to use it. (We examine the `context` parameter in detail in [Request Contexts](#). The parameter is also used by [IceStorm](#).)

Because all the `<interface-name>Prx` types are interfaces, you cannot instantiate an object of such a type. Instead, proxy instances are always instantiated on behalf of the client by the Ice run time, so client code never has any need to instantiate a proxy directly. The proxy references handed out by the Ice run time are always of type `<interface-name>Prx`; the concrete implementation of the interface is part of the Ice run time and does not concern application code.

A value of `null` denotes the null proxy. The null proxy is a dedicated value that indicates that a proxy points "nowhere" (denotes no object).

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## Interface Inheritance in Java

Inheritance relationships among Slice interfaces are maintained in the generated Java classes. For example:

## Slice

```
interface A { ... }
interface B { ... }
interface C extends A, B { ... }
```

The generated code for `CPrx` reflects the inheritance hierarchy:

## Java Compat

```
public interface CPrx extends APrx, BPrx
{
    ...
}
```

Given a proxy for `C`, a client can invoke any operation defined for interface `C`, as well as any operation inherited from `C`'s base interfaces.

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# The ObjectPrx Interface in Java

All Ice objects have `Object` as the ultimate ancestor type, so all proxies inherit from `ObjectPrx`. `ObjectPrx` provides a number of methods:

## Java Compat

```
public interface ObjectPrx
{
    boolean equals(java.lang.Object r);
    Identity ice_getIdentity();
    boolean ice_isA(String id);
    boolean ice_isA(String id, java.util.Map<String, String> context);
    String[] ice_ids();
    String[] ice_ids(java.util.Map<String, String> context);
    String ice_id();
    String ice_id(java.util.Map<String, String> context);
    void ice_ping();
    void ice_ping(java.util.Map<String, String> context);
    // ...
}
```

The methods behave as follows:

- **equals**

This operation compares two proxies for equality. Note that all aspects of proxies are compared by this operation, such as the communication endpoints for the proxy. This means that, in general, if two proxies compare unequal, that does *not* imply that they denote different objects. For example, if two proxies denote the same Ice object via different transport endpoints, `equals` returns `false` even though the proxies denote the same object.

- **ice\_getIdentity**

This method returns the identity of the object denoted by the proxy. The identity of an Ice object has the following Slice type:

## Slice

```
module Ice
{
    struct Identity
    {
        string name;
        string category;
    }
}
```

To see whether two proxies denote the same object, first obtain the identity for each object and then compare the identities:

## Java Compat

```
ObjectPrx o1 = ...;
ObjectPrx o2 = ...;
Identity i1 = o1.ice_getIdentity();
Identity i2 = o2.ice_getIdentity();

if(i1.equals(i2))
{
    // o1 and o2 denote the same object
}
else
{
    // o1 and o2 denote different objects
}
```

- **ice\_isA**

The [ice\\_isA](#) method determines whether the object denoted by the proxy supports a specific interface. The argument to `ice_isA` is a [type ID](#). For example, to see whether a proxy of type `ObjectPrx` denotes a `Printer` object, we can write:

#### Java Compat

```
ObjectPrx o = ...;
if(o != null && o.ice_isA("::Printer"))
{
    // o denotes a Printer object
}
else
{
    // o denotes some other type of object
}
```

Note that we are testing whether the proxy is null before attempting to invoke the `ice_isA` method. This avoids getting a `NullPointerException` on if the proxy is null.

- **ice\_ids**

The [ice\\_ids](#) method returns an array of strings representing all of the type IDs that the object denoted by the proxy supports.

- **ice\_id**

The [ice\\_id](#) method returns the type ID of the object denoted by the proxy. Note that the type returned is the type of the actual object, which may be more derived than the static type of the proxy. For example, if we have a proxy of type `BasePrx`, with a static type ID of `::Base`, the return value of `ice_id` might be `::Base`, or it might something more derived, such as `::Derived`.

- **ice\_ping**

The [ice\\_ping](#) method provides a basic reachability test for the object. If the object can physically be contacted (that is, the object exists and its server is running and reachable), the call completes normally; otherwise, it throws an exception that indicates why the object could not be reached, such as `ObjectNotExistException` or `ConnectTimeoutException`.

The `ice_isA`, `ice_ids`, `ice_id`, and `ice_ping` methods are remote operations and therefore support an additional overloading that accepts a [request context](#). Also note that there are [other methods](#) in `ObjectPrx`, not shown here. These methods provide different ways to dispatch a call and also provide access to an object's [facets](#).

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## Proxy Helper Methods in Java

For each Slice interface, the Slice-to-Java compiler generates static helper methods that support down-casting and type discovery:

#### Java Compat

```
public static SimplePrx checkedCast(ObjectPrx b);
public static SimplePrx checkedCast(ObjectPrx b, java.util.Map<String, String> context);
public static SimplePrx checkedCast(ObjectPrx b, String facet);

public static SimplePrx checkedCast(ObjectPrx b, String facet, java.util.Map<String, String> context);
public static SimplePrx uncheckedCast(ObjectPrx b);
public static SimplePrx uncheckedCast(ObjectPrx b, String facet);
public static String ice_staticId();
```

For `checkedCast`, if the passed proxy is for an object of type `Simple`, or a proxy for an object with a type derived from `Simple`, the cast returns a non-null reference to a proxy of type `SimplePrx`; otherwise, if the passed proxy denotes an object of a different type (or if the passed proxy is null), the cast returns a null reference. Overloaded methods allow you to optionally specify a [facet](#) and a [request context](#).

For the default Java mapping, these helper methods are generated in `SimplePrx`. For the Java Compat mapping, these helper methods are generated in `SimplePrxHelper`.

Given a proxy of any type, you can use a `checkedCast` to determine whether the corresponding object supports a given type, for example:

## Java Compat

```
ObjectPrx obj = ...;           // Get a proxy from somewhere...

SimplePrx simple = SimplePrxHelper.checkedCast(obj);
if(simple != null)
{
    // Object supports the Simple interface...
}
else
{
    // Object is not of type Simple...
}
```

Note that a `checkedCast` contacts the server. This is necessary because only the implementation of an object in the server has definite knowledge of the type of an object. As a result, a `checkedCast` may throw a `ConnectTimeoutException` or an `ObjectNotExistException`. (This also explains the need for the helper method: the Ice run time must contact the server, so we cannot use a simple Java down-cast.)

In contrast, an `uncheckedCast` does not contact the server and unconditionally returns a proxy of the requested type. However, if you do use an `uncheckedCast`, you must be certain that the proxy really does support the type you are casting to; otherwise, if you get it wrong, you will most likely get a run-time exception when you invoke an operation on the proxy. The most likely error for such a type mismatch is `OperationNotExistException`. However, other exceptions, such as a marshaling exception are possible as well. And, if the object happens to have an operation with the correct name, but different parameter types, no exception may be reported at all and you simply end up sending the invocation to an object of the wrong type; that object may do rather nonsensical things. To illustrate this, consider the following two interfaces:

## Slice

```
interface Process
{
    void launch(int stackSize, int dataSize);
}

// ...

interface Rocket
{
    void launch(float xCoord, float yCoord);
}
```

Suppose you expect to receive a proxy for a `Process` object and use an `uncheckedCast` to down-cast the proxy:

## Java Compat

```
ObjectPrx obj = ...;           // Get proxy...
ProcessPrx process = ProcessPrxHelper.uncheckedCast(obj); // No worries...
process.launch(40, 60);         // Oops...
```

If the proxy you received actually denotes a `Rocket` object, the error will go undetected by the Ice run time: because `int` and `float` have the same size and because the Ice protocol does not tag data with its type on the wire, the implementation of `Rocket::launch` will simply misinterpret the passed integers as floating-point numbers.

In fairness, this example is somewhat contrived. For such a mistake to go unnoticed at run time, both objects must have an operation with the same name and, in addition, the run-time arguments passed to the operation must have a total marshaled size that matches the number of bytes that are expected by the unmarshaling code on the server side. In practice, this is extremely rare and an incorrect `uncheckedCast` typically results in a run-time exception.

A final warning about down-casts: you must use either a `checkedCast` or an `uncheckedCast` to down-cast a proxy. If you use a Java cast, the behavior is undefined.

Another method generated for every interface is `ice_staticId`, which returns the [type ID](#) string corresponding to the interface. As an example, for the Slice interface `Simple` in module `M`, the string returned by `ice_staticId` is `"::M::Simple"`.

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## Using Proxy Methods in Java

The base proxy class `ObjectPrx` supports a variety of [methods for customizing a proxy](#). Since proxies are immutable, each of these "factory methods" returns a copy of the original proxy that contains the desired modification. For example, you can obtain a proxy configured with a ten second invocation timeout as shown below:

#### Java Compat

```
ObjectPrx proxy = communicator.stringToProxy(...);
proxy = proxy.ice_invocationTimeout(10000);
```

A factory method returns a new proxy object if the requested modification differs from the current proxy, otherwise it returns the current proxy. With few exceptions, factory methods return a proxy of the same type as the current proxy, therefore it is generally not necessary to repeat a `checkedCast` or `uncheckedCast` after using a factory method. However, the Java Compat mapping still requires a regular cast as shown in the example below:

#### Java Compat

```
ObjectPrx base = communicator.stringToProxy(...);
HelloPrx hello = HelloPrxHelper.checkedCast(base);
hello = (HelloPrx)hello.ice_invocationTimeout(10000); // Type is preserved but a down-cast is required
hello.sayHello();
```

The only exceptions are the factory methods `ice_facet` and `ice_identity`. Calls to either of these methods may produce a proxy for an object of an unrelated type, therefore they return a base proxy that you must subsequently down-cast to an appropriate type using `checkedCast` or `uncheckedCast`.

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## Object Identity and Proxy Comparison in Java

Proxies provide an [equals](#) method that compares proxies:

#### Java Compat

```
interface ObjectPrx
{
    boolean equals(java.lang.Object r);
}
```

Note that proxy comparison with `equals` uses *all* of the information in a proxy for the comparison. This means that not only the object identity must match for a comparison to succeed, but other details inside the proxy, such as the protocol and endpoint information, must be the same. In other words, comparison with `equals` tests for *proxy* identity, *not* object identity. A common mistake is to write code along the following lines:

#### Java Compat

```
ObjectPrx p1 = ...;           // Get a proxy...
ObjectPrx p2 = ...;           // Get another proxy...

if(!p1.equals(p2))
{
    // p1 and p2 denote different objects      // WRONG!
}
else
{
    // p1 and p2 denote the same object        // Correct
}
```

Even though `p1` and `p2` differ, they may denote the same Ice object. This can happen because, for example, both `p1` and `p2` embed the same object identity, but each use a different protocol to contact the target object. Similarly, the protocols may be the same, but denote different endpoints (because a single Ice object can be contacted via several different transport endpoints). In other words, if two proxies compare equal with `equals`, we know that the two proxies denote the same object (because they are identical in all respects); however, if two proxies compare unequal with `equals`, we know absolutely nothing: the proxies may or may not denote the same object.

To compare the object identities of two proxies, you can use a helper function in the `Util` class:

### Java Compat

```
public final class Util
{
    public static int proxyIdentityCompare(ObjectPrx lhs, ObjectPrx rhs);
    public static int proxyIdentityAndFacetCompare(ObjectPrx lhs, ObjectPrx rhs);
    // ...
}
```

`proxyIdentityCompare` allows you to correctly compare proxies for identity:

### Java Compat

```
ObjectPrx p1 = ...;           // Get a proxy...
ObjectPrx p2 = ...;           // Get another proxy...

if(Util.proxyIdentityCompare(p1, p2) != 0)
{
    // p1 and p2 denote different objects      // Correct
}
else
{
    // p1 and p2 denote the same object        // Correct
}
```

The function returns 0 if the identities are equal, -1 if `p1` is less than `p2`, and 1 if `p1` is greater than `p2`. (The comparison uses name as the major and category as the minor sort key.)

The `proxyIdentityAndFacetCompare` function behaves similarly, but compares both the identity and the [facet name](#).

In addition, the Java mapping provides two wrapper classes that allow you to wrap a proxy for use as the key of a hashed collection:

### Java Compat

```
public class ProxyIdentityKey
{
    public ProxyIdentityKey(ObjectPrx proxy);
    public int hashCode();
    public boolean equals(java.lang.Object obj);
    public Ice.ObjectPrx getProxy();
}

public class ProxyIdentityFacetKey
{
    public ProxyIdentityFacetKey(ObjectPrx proxy);
    public int hashCode();
    public boolean equals(java.lang.Object obj);
    public Ice.ObjectPrx getProxy();
}
```

The constructor caches the identity and the hash code of the passed proxy, so calls to `hashCode` and `equals` can be evaluated efficiently. The `getProxy` method returns the proxy that was passed to the constructor.

As for the comparison functions, `ProxyIdentityKey` only uses the proxy's identity, whereas `ProxyIdentityFacetKey` also includes the facet name.

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## Deserializing Proxies in Java

Proxy objects implement the `java.io.Serializable` interface that enables serialization of proxies to and from a byte stream. You can use the standard class `java.io.ObjectInputStream` to deserialize all Slice types *except* proxies; proxies are a special case because they must be created by a communicator.

To supply a communicator for use in deserializing proxies, an application must use the Ice-provided class `ObjectInputStream`:

## Java Compat

```
public class ObjectInputStream extends java.io.ObjectInputStream
{
    public ObjectInputStream(Communicator communicator, java.io.InputStream stream)
        throws java.io.IOException;

    public Communicator getCommunicator();
}
```

The code shown below demonstrates how to use this class:

## Java Compat

```
Communicator communicator = ...
byte[] bytes = ... // data to be deserialized
java.io.ByteArrayInputStream byteStream = new java.io.ByteArrayInputStream(bytes);
ObjectInputStream in = new ObjectInputStream(communicator, byteStream);
ObjectPrx proxy = (ObjectPrx)in.readObject();
```

Ice raises `java.io.IOException` if an application attempts to deserialize a proxy without supplying a communicator.

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## See Also

- [Interfaces, Operations, and Exceptions](#)
- [Proxies for Ice Objects](#)
- [Type IDs](#)
- [Java Compat Mapping for Operations](#)
- [Request Contexts](#)
- [Operations on Object](#)
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