CAROL Library User Manual

CAROL (Common Architecture for RMI ObjectWeb Layer), a RMI manager

Guillaume Riviere

Guilllaume.Riviere@inrialpes.fr

CAROL Library User Manual: CAROL (Common Architecture for RMI ObjectWeb Layer), a RMI manager

by Guillaume Riviere

CAROL is a library allowing to use different RMI implementations. Thanks to CAROL, a Java server application can be independent of RMI implementations and accessible simultaneously by RMI clients using different RMI implementations. CAROL allows to design, implement, compile, package, deploy, and execute distributed applications compliant with the RMI model.

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Chapter 1. Introduction

1.1. About this manual

This manual was meant as a tutorial that can give you an introduction on how to use the CAROL RMI IIOP library.

> **Note:** Please note that this manual is designed to be used along with, not instead of, the RMI IIOP Tutorial (http://java.sun.com/j2se/1.4/docs/guide/rmi-iiop/tutorial.html) and the JNDI tutorial (http://java.sun.com/products/jndi/tutorial). There are a number of cases where it is much easier to refer to the rather RMI IIOP and JNDI tutorials than trying to rehash what it already covers.

This manual will teach you the general way to use the CAROL abstraction in order to manipulate remote object on multi-RMI architecture. You will learn in particulars:

- The CAROL configuration rules for each RMI architecture,
- the RMI IIOP general mechanism and programming rules,
- the JNDI general mechanism and programming rules,
- the Extended RMI JRMP mechanisms for implicit context propagation.

1.2. What is CAROL?

CAROL is a library allowing to use different RMI implementations. Thanks to CAROL, a Java server application can be independent of RMI implementations and accessible simultaneously by RMI clients using different RMI implementations. CAROL allows to design, implement, compile, package, deploy, and execute distributed applications compliant with the RMI model. CAROL provide tools for accessing to a Java server, in the same time, through the ObjectWeb JEREMIE RMI like RPC, through the JAVA standard RMI RPC and through a CORBA RPC (via a RMI IIOP). Therefore, a Java server using CAROL manipulates remote object only through RMI IIOP API classes and interfaces and never through CAROL classes or interface. So, CAROL allows a Java server to be independent, by configuration, of the RMI architecture and provider.

The CAROL library basically provides support (CAROL basic SPIs) for the following RMI implementations:

- ObjectWeb JEREMIE (JRMP 1.1 and 1.2)
- Sun RMI JRMP (JRMP 1.1 and 1.2)
- Sun JDK 1.4 RMI IIOP
- CAROL LMI implementation
- CAROL CMI implementation

The CAROL library provides also non standard tools for RMI and JNDI architecture:

- a set of mechanisms for implicit context propagation in RMI JRMP,
- a set of mechanisms for Referenceable and Reference objects binding in a CosNaming.
- a set of mechanisms for RMI Registry, Jeremie Registry and CosNaming management.

Please see the Non standard CAROL tools and mechanisms chapter for more information.

1.3. Why CAROL?

CAROL is basically design to be a solution for implementing J2EE specifications on interoperability and implicit context propagation. This library allows a J2EE server to be accessible, at the same time, by IIOP and JRMP clients.

Chapter 2. CAROL overview

2.1. Presentation of the CAROL library

This section describes the general CAROL architecture and development rules. CAROL is based on an API/SPI mechanism for export and registering RMI objects. This section describes which API are used by CAROL and how to develop a server using this API. This section is supposed to be used with the RMI IIOP tutorial (http://java.sun.com/j2se/1.4/docs/guide/rmi-iiop/tutorial.html) and the JNDI tutorial (http://java.sun.com/products/jndi/tutorial).

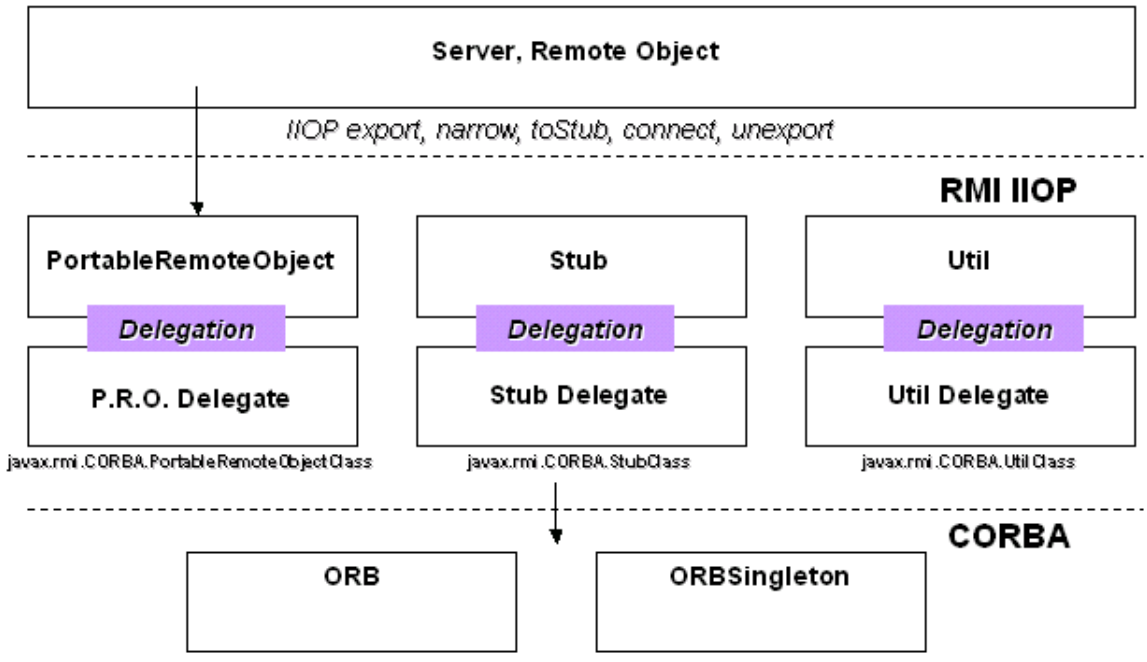
2.2. CAROL standard architecture

2.2.1. CAROL architecture

CAROL is behind the standard RMI IIOP and JNDI API. A Java server using CAROL have to be a standard RMI IIOP server and use only the JNDI interfaces for name service connections (see the section RMI IIOP Development rules and the JNDI Development rules section). A standard RMI IIOP server is required to migrate to the CAROL library without any code modification. Using CAROL library, in this case, is only a configuration manipulation. CAROL simulates a standard RMI IIOP PortableRemoteObjectDelegate and a standard JNDI context factory for interceptions and manipulations of the RPC and naming mechanism. CAROL allows any RMI IIOP remote object to be manipulate by a server on different RMI architectures and different naming services, in the same time, without code modification on the server or on the client side.

CAROL uses the standard RMI IIOP PortableRemoteObject to abstract the export mechanism. The figure 2.1 shows that the server only manipulate remote object via the RMI IIOP PortableRemoteObject and this PortableRemoteObject is a delegation to a "configured by system properties" PortableRemoteObjectDelegate class.

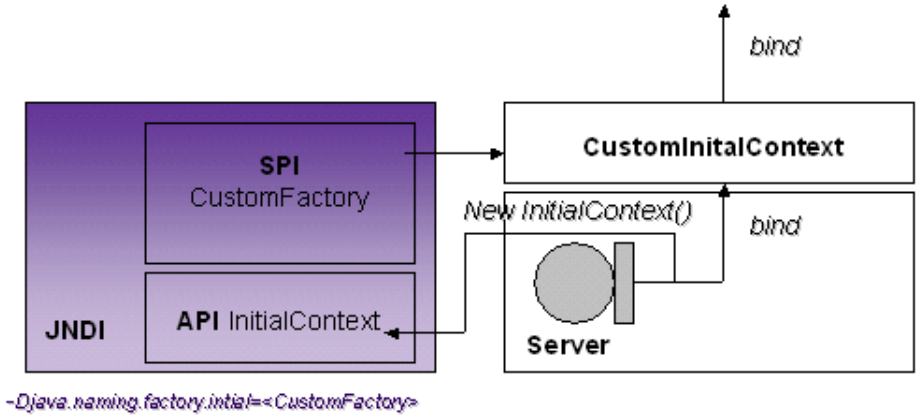
Figure 2-1. RMI IIOP mechanism



In fact, the CAROL remote object API is the standard RMI IIOP API. A Java server using CAROL is supposed to use only the java.rmi.* and the javax.rmi.* classes and never to call directly the CAROL library classes.

The same mechanism is used for objects registering through JNDI: a CAROL server is supposed to use only the JNDI interface to manipulate and contact the remote object name service. So, with JNDI, a CAROL server use the InitialContext mechanism, for (un)registering object, and this InitialContext delegate the registering to a context object build by a factory "configured by system properties". In the figure 2.2 we can see that the server only manipulates remote object registered via the JNDI InitialContext API.

Figure 2-2. JNDI mechanism



2.2.2. RMI IIOP development rules

This section describes the basic rules of RMI IIOP development. For more information, see the Sun entry for *RMI IIOP Documentation* (http://java.sun.com/j2se/1.4/docs/guide/rmi-iiop/index.html). This RMI IIOP quick start guide is design for a 3 step development:

- Development of the RMI IIOP remote objects and development of the RMI server part
- Java and CAROL RMI IIOP objects compilation
- Deployment step in a distributed environment

The Java classes used in this section are:

- `java.rmi.Remote` (http://java.sun.com/j2se/1.4/docs/api/java/rmi/Remote.html)
- `javax.rmi.PortableRemoteObject` (http://java.sun.com/j2se/1.4/docs/api/javax/rmi/PortableRemoteObject.html)

2.2.2.1. RMI IIOP remote objects development step

A RMI IIOP remote object needs only to expose its remote methods in a Java interface extending `Remote`. This is exactly the same development rules than in classical RMI JRMP. In the example 2-1, the remote object `Foo` exposes its remote method `myMethod()` in the remote interface `FooRemoteInterface`.

Example 2-1. RMI basic example

```
//The foo object is a remote object
import java.rmi.RemoteException;

//The class foo implements only
//the FooRemoteInterface interface
public class Foo implement FooRemoteInterface {

    //This method is remote
    public Integer myMethod() throws RemoteException{
return new Integer(0);
    }
}


//The foo remote interface
//extends only the Remote interface
//and exposes the remote methods
import java.rmi.Remote;
import java.rmi.RemoteException;

public interface FooRemoteInterface extends Remote {

    //This method is remote
    public Integer myMethod() throws RemoteException;

}
```

Note: The method `myMethod()` throws a RemoteException if an exceptions occurs in the remote method call.

2.2.2.2. RMI IIOP server development step

The RMI IIOP server has to manage remote objects. This section only describes the (un)export management of a RMI IIOP remote object. Please see the JNDI development rules section for the remote object (un)registering managment. One of the most important step in a remote object life cycle is the export step (and the opposite unexport step). To Exporte a remote object means to prepare this object to receive remote call. RMI IIOP abstracts the intricate CORBA implementation mechanism of this export with the API class `PortableRemoteObject`. To Export a remote object is mandatory for remote call. There is two way for this export:

- The implicit method: if the remote object class implements the `PortableRemoteObject` class, this remote object is automatically export in is creation time. In the example 2-2 the remote object is implicitly exported by inheritance. In this case, the server only needs to construct the remote object to exported it.

Example 2-2. RMI implicit export

```
//The foo object is a remote object
import java.rmi.RemoteException;
import javax.rmi.PortableRemoteObject;

//The class foo extends PortableRemoteObject
//and implements the FooRemoteInterface interface
public class Foo extends PortableRemoteObject
 implements FooRemoteInterface {

    //The constructor
    public Foo() throws RemoteException {
super();
    }

    //This method is remote
    public Integer myMethod() throws RemoteException {
return new Integer(0);
    }
}

//The foo remote object server
import java.rmi.RemoteException;
import org.objectweb.carol.util.configuration.CarolConfiguration;

public class Server {

    //The main method of this server
    public static void main(String [] args)  {
try {
    //initialize carol
    CarolConfiguration.init();

    FooRemoteInterface myFoo = new Foo();
    // the object is automatically
    // exported on RMI IIOP
} catch (RemoteException e) {
    //Foo construction problem
}

    }
}
```

- The explicit method: if the remote object class do not implement the `PortableRemoteObject` class, this remote object has to be explicitly exported by the server. The `public static void exportObject(java.rmi.Remote)` method in `PortableRemoteObject` class allow to do that. In the example 2-3 the remote object is explicitly exported by the server.

Example 2-3. RMI explicit export

```
//The foo object is a remote object
import java.rmi.RemoteException;

//The class foo implements
//only the FooRemoteInterface interface
public class Foo implement FooRemoteInterface {

    //The constructor
    public Foo() throws RemoteException {
super();
    }

    //This method is remote
    public Integer myMethod() throws RemoteException {
return new Integer(0);
    }
}

//The foo remote object server
import java.rmi.RemoteException;
import javax.rmi.PortableRemoteObject;
import org.objectweb.carol.util.configuration.CarolConfiguration;

public class Server {

    //The main method of this server
    public static void main(String [] args)  {
try {
    //initialize carol
    CarolConfiguration.init();

    FooRemoteInterface myFoo = new Foo();
    //The object is explicitly exported on RMI IIOP:
    PortableRemoteObject.exportObject(myFoo);
} catch (RemoteException e) {
    //Foo construction problem
}

    }
}
```

2.2.2.3. CAROL RMI IIOP compilation step

The compilation step is designed by Java and RMI. There is no particular compilation step in order to use CAROL. Therefore, you need to compile Java classes and to compile stubs and skeletons with each RMI provider compiler for each RMI architecture (IIOP, JRMP, JEREMIE ...).

2.2.2.4. CAROL RMI IIOP server deployment step

The 3 points below are mandatory for CAROL server deploying on multi-RMI architecture:

- There is 2 ways for carol initialization: first, the best way, is to call the org.objectweb.carol.util.configuration.CarolConfiguration.init() method. The second way is to set the 2 system property javax.rmi.CORBA.PortableRemoteObjectClass =org.objectweb.carol.rmi.multi.MultiPRODelegate and java.naming.factory.initial =org.objectweb.carol.jndi.spi.MultiOrbInitialContextFactory in the server JVM. This second method doesn't allows to switch off carol features by configuration: The properties carol.start.rmi=false and carol.start.jndi=false doesn't work with this configuration method.
- The `carol.properties` file can be configured (see the CAROL Configuration chapter) and visible in the JVM classpath.
- For each RMI architecture all remote objects stub and skeleton have to be visible in the classpath.

  Note: For the moment, in CAROL library, there is 3 remote architectures available (CAROL SPI implementation): IIOP, JRMP and JEREMIE. There is no, in those 3 architectures, stub/skeleton class conflicts. For example, if my remote object is Foo with FooItf remote interface:

  - The stub/skel name for IIOP are: `_FooItf_Stub`/`_Foo_Tie`
  - The stub/skel name for JRMP are: `FooItf_Stub`/`FooItf_Skel`
  - The stub/skel name for JEREMIE are: `FooItf_OWStub`/`FooItf_OWSkel`

  And so there is no class name conflict, those 3 RMI architectures can be available in the same JVM. The Java classes used in this section are:

  - `javax.naming.InitialContext` (http://java.sun.com/j2se/1.4/docs/api/javax/naming/InitialContext.html)
  - `org.objectweb.carol.rmi.jrmp.interceptor.JServerRequestInterceptor`
  - `org.objectweb.carol.rmi.jrmp.interceptor.JServerRequestInfo`
  - `org.objectweb.carol.rmi.jrmp.interceptor.JServiceContext`
  - `org.objectweb.carol.rmi.jrmp.interceptor.JClientRequestInterceptor`
  - `org.objectweb.carol.rmi.jrmp.interceptor.JClientRequestInfo`
  - `org.objectweb.carol.rmi.jrmp.interceptor.JInitializer`
  - `org.objectweb.carol.rmi.jrmp.interceptor.JInitInfo`
  - `org.objectweb.carol.rmi.jrmp.interceptor.ProtocolInterceptorInitializer`
  - `org.objectweb.carol.jndi.iiop.IIOPContextWrapperFactory`
  - `org.objectweb.carol.jndi.iiop.IIOPContextWrapper`

Warning

But, be careful, there is stubs and/or skeletons class name conflicts for different providers of the same RMI architecture. For example, this is not possible, with CAROL, to deploy a remote object on two RMI provider with the same architecture (for example RMI JRMP 1.1 and RMI JRMP 1.2 or DAVID RMI IIOP and SUN JDK 1.4 RMI IIOP) because there are a stubs and/or skeletons class name conflicts in the server JVM.

2.2.3. JNDI development rules

This section describes the basic JNDI development rules. For more information, see the Sun entry for *JNDI Documentation* (http://java.sun.com/products/jndi/1.2/javadoc/). This JNDI start guide is designed for a 2 steps development:

- Development of the JNDI server part
- JNDI deployment step on a distributed environment

2.2.3.1. Development of the JNDI server part

For remote object access with CAROL, the first part is to develop and deploy RMI IIOP remote objects (see the RMI IIOP Development rules chapter) on a Java server. The second part is to register those objects in one/many name service through the standard JNDI Interface. For this, the server needs to build a `InitialContext` object and to register all remote objects in this context like in the Example 2-4:

Example 2-4. JNDI basic example

```
//The foo remote object server
import java.rmi.RemoteException;
import javax.naming.InitialContext;
import javax.naming.NamingException;
import org.objectweb.carol.util.configuration.CarolConfiguration;

public class Server {

    //The main method of this server
    public static void main(String [] args)  {
try {
    //initialize carol
    CarolConfiguration.init();

    // the object is automatically
    // exported on RMI IIOP
    FooRemoteInterface myFoo = new Foo();

    // now the server bind this object trough JNDI
    // with the name myobjectname
    InitialContext ic = new InitialContext();
    ic.rebind("myobjectname", myFoo)

} catch (RemoteException e) {
    //Foo construction problem
}catch (NamingException ne) {
    //Foo binding problem
}

    }
```

```
}
```

> **Note:** In this example, the server use a default `IntialContext` without configuration. You may want to configure your server JNDI for each name service (registry, cosnaming ...). Please use only the CAROL configuration to setup your multi JNDI name service. For this feature, a Java server, needs the CAROL JNDI context factory (see the CAROL Configuration chapter).

2.2.3.2. JNDI deployment step on a distributed environment

The 3 points below are mandatory for CAROL server deploying on multi name service architecture:

- The system property java.naming.factory.initial need to be instantiated to `org.objectweb.carol.jndi.spi.MultiOrbInitialContextFactory` in the server JVM.
- The `carol.properties` and the `jndi.properties` files need to be configured (see the CAROL Configuration chapter) and visible in the server JVM classpath.
- Each name service (registry, cosnaming, ...) can be launched in the distribute environment.

> **Warning**
>
> Be careful, the InitialContext need to be configured for CAROL with the system property java.naming.factory.initial instantiated to `org.objectweb.carol.jndi.spi.MultiOrbInitialContextFactory`. Every other properties configured directly in the server InitialContext will be lost. The important point is to understand that the `IntialContext` is an indirection to an other context, the CAROL one, which manage all the contexts for each name service.

2.3. Non standards CAROL tools and mechanisms

2.3.1. Implicit context propagation with RMI JRMP

One of the non standard features (API) provided by CAROL is the possibility to instantiate, for a Java server, an implicit context propagation. This API is very useful for security and transaction behavior. This API is a simplification of CORBA portable interceptor concept. Therefore, this feature use a server and client interceptor with an initializer registering mechanism. This mechanism is pure Java without any CORBA classes connection (only the `rt.jar` classes is needed). This mechanism works with 1.1 and 1.2 RMI version. This section explain the way to build, register and use server and client interceptor through RMI JRMP.

2.3.1.1. CAROL RMI JRMP interceptors API

Implementing JRMP interceptors is very easy. A server interceptor only need to implements the `JServerRequestInterceptor` interface and use the `JServerRequestInfo` interface to propagate a `JServiceContext`. On the client side this is the same concept with `JClientRequestInterceptor` interface and `JClientRequestInfo` interface. For propagation, a CAROL propagation context need only to be a Serializable (or Externalizable) object and to implements the interface `JServiceContext`.

2.3.1.2. CAROL RMI JRMP Client interceptor

A JRMP client interceptor is a class implements the `JClientRequestInterceptor`. All the methods in this class are executed in the same Thread than the client remote call. All JServiceContext registered in the JClientRequestInfo (in the send_* methods) are send to the Server. All JServiceContext send by the server can be found in the JClientRequestInfo (in the receive_* methods).

2.3.1.3. CAROL RMI JRMP Server interceptor

A JRMP server interceptor is a class implements the `JServerRequestInterceptor`. All the methods in this class are executed in the same Thread than the server remote call. All JServiceContext registered in the JServerRequestInfo (in the send_* methods) are send to the Client. All JServiceContext send by the client can be found in the JServerRequestInfo (in the receive_* methods).

2.3.1.4. CAROL RMI JRMP JServiceContext

For each call,A CAROL JServiceContext can be find with is context_id. A JServiceContext is just a Serializable Object. For performance reason, it can be interesting to decrease the Context size by using a Externalizable mechanism. Carol provide a tool (org.objectweb.carol .util.perfs .CarolJRMPPerfomanceHelper) with static methods to calculate the Serializable size of a Serializable object.

2.3.1.5. CAROL RMI JRMP interceptor registering

To register interceptor in CAROL is very easy. A server/client initializer implements the `JInitializer` and use the pre_init and post_init methods for registering server and client interceptors through `JInitInfo` interface. For JVM CAROL JRMP initialization, use the org.objectweb.PortableInterceptor.JRMPInitializerClass.XXX property where XXX is the JInitializer full classname (for example pass -Dorg.objectweb.PortableInterceptor.JRMPInitializerClass .org.objectweb.carol.rmi.jrmp.interceptor.ProtocolInterceptorInitializer register into CAROL the `ProtocolInterceptorInitializer` class). Register more than one JInitializer is possible with CAROL (The `ProtocolInterceptorInitializer` is mandatory for CAROL multi protocol management).

2.3.2. Referenceable an Reference binding through a RMI IIOP CosNaming

The second non standard CAROL features is a way to register Referenceable/Reference and Serializable objects in a CosNaming through JNDI. The IIOP InitialContext delivered for IIOP wrap the Referenceable/Reference or Serializable object into a standard remote object. This remote object is exported into the JNDI context bind(or rebind) method and unexported into the JNDI context unbind method. CAROL use automatically, on the server side, this mechanism with a standard CAROL IIOP configuration (you need to call the IIOP protocol 'iiop' in the `carol.properties` file see the CAROL configuration chapter).

For a JNDI java RMI IIOP client you can use the `IIOPContextWrapperFactory` by setting the -Djava.naming.factory.initial jvm properties (with the full name of the factory). This factory builds a JNDI Context based on you `jndi.properties` uses the wrapping mechanism. For other client (Non JNDI), you can re-build manually the Referenceable or Serializable object for the CosNaming wrapper remote object (see inside the `IIOPContextWrapper` class for a detailed mechanism. A CAROL server can be also an IIOP CAROL client without any extra configuration than in a classical IIOP CAROL server.

2.3.3. Name Service Management

The third non standard CAROL features is a way to start and stop automatically RMI Name Services. This mechanism is based on a API/SPI system. The API is represented by the `org.objectweb.carol.jndi.ns.NameServiceManager`. This class provide static methods for start and stop configured name services for each protocol. A CAROL configuration property can be set inside the carol.properties for automatically start all non started and configured Name Services (see the configuration chapter). Carol provide also three Name Service SPI implementation for RMI Registry, Jeremie Registry and CosNaming management. This mechanism start those Name Services on the port defined by the jndi url property.

2.4. Getting started conclusion

CAROL is only configured by system properties and files. There is no intrusion of CAROL classes in a standard RMI IIOP server. The server is RMI architecture independent but work simultaneously on different RMI architectures. The next chapter explains the general rules for this configuration.

Chapter 3. CAROL Configuration

3.1. Presentation of the CAROL library configuration

This section describes the configuration rules for different RMI and name services managed by CAROL. Currently, CAROL is distributed with tools and classes that allow to use:

- ObjectWeb/Jonathan JEREMIE (http://objectweb.org/jonathan) RMI JRMP like
- Sun RMI JRMP (http://java.sun.com/j2se/1.4/docs/guide/rmi/index.html) (version 1.1 and 1.2)
- Sun RMI IIOP (>JDK 1.4) (http://java.sun.com/j2se/1.4/docs/guide/idl/index.html)
- Local Method Invocation (LMI) for embedded server

CAROL allows to configure a remote (or local) Java server to be accessible by one,two or three of those RMI architectures, in the same time, by configuration.

3.2. CAROL configuration

3.2.1. General configuration files

CAROL configuration is based on three properties files. The `carol-defaults.properties` file, the `carol.properties` file and the `jndi.properties` file. The `carol-defaults.properties` file is mandatory to configure CAROL. This file is embedded in the carol jar file and the CAROL user is not suppose to modify those defaults properties. Carol load first this default file properties and erase all configuration property with the property find in the jndi file configuration and (after) with the property find in the carol file configuration. So, the only important file for the CAROL user is the `carol-defaults.properties`. We are going to describe, in the next section, only the content of this file.

> **Note:** If there is an (rpc-)URL property in the `jndi.properties`, the RMI name of the url is use instead of the `carol-defaults.properties` configured one (jrmp). By default, in the `carol.properties`, no configuration is needed.

The configuration described below only use the `carol.properties` file. Do not forget that the JNDI configuration (of one of the activated protocols) can be set inside the `jndi.properties` file.

3.2.2. General configuration rules for all RMI and JNDI architectures

The `carol.properties` file is a standard Java properties file. All properties, in this file, follow the rules below (we suppose that XXX is the RMI name like ’jrmp’, ’iiop’,’jeremie’,’cmi’ or ’lmi’. For all those defaults provided RMI protocol, please use those names.

Table 3-1. Carol general properties

Property name	Property value	Description	Required
carol.protocols	’XXX protocol-name’, ’YYY protocol-name’	Activated protocols names. The first (XXX) is the default protocol for CAROL. This default protocol is used by the server when there is no entrant protocol	No, default: jrmp
carol.start.ns	’true’, ’false’	CAROL will automatically start all non started and configured Name Services if this property is set to ’true’	No, default: false
carol.start.rmi	’true’, ’false’	The CAROL PortableRemoteObjectDelegate mechanism will be deactivated if this property is set to ’false’	No, default: true
carol.start.jndi	’true’, ’false’	The CAROL InitialContextFactory mechanism will be deactivated if this property is set to ’false’	No, default: true
carol.jvm.’property-name’	’property-value’	All extra JVM properties for RMI (directly pass to the JVM with ’name’ name and ’value’ value without any verifications). This is equivalent to put -D’property-name’=’property-value’ in the Java JVM option	No
carol.jndi.’property-name’	’property-value’	All JNDI properties for all RMI (directly pass to JNDI with ’name’ name and ’value’ value without any verifications). This is equivalent to put ’property-name’=’property-value’ in the JNDI properties file	No

Table 3-2. Carol RMI XXX specifics properties

Property name	Property value	Description	Required

Property name	Property value	Description	Required
carol.XXX .PortableRemoteObjectClass	'XXX portable remote object class name'	The portable remote object delegate class name for this RMI (CAROL provide implementation of those classes for RMI JRMP,JEREMIE, LMI and CMI, see below)	No, There is a default for each RMI provided by carol
carol.XXX .NameServiceClass	'XXX carol Name Service class name'	The Name Service class name for this RMI (CAROL provide implementation of those classes for RMI JRMP, RMI IIOP and JEREMIE, see below)	No, this property is only necessary for automatically start a Name Service for this protocol and there is a default for each RMI provided by carol
carol.XXX.url 'property-name'	'property-value'	JNDI url value. This property is equivalent to the jndi java.naming. provider.url property	No, there is defaults for each RMI provided by carol
carol.XXX.context. factory 'property-name'	'property-value'	JNDI initial context factory class name. This property is equivalent to the jndi java.naming. factory.initial property	No, there is defaults for each RMI provided by carol.
carol.XXX. interceptors	'interceptor 1 name','interceptor 2 name'	Interceptors initializers names	No

3.2.3. RMI JRMP configuration

One of the SPI personality provided by CAROL is the standard Sun RMI JRMP. This personality can be used with all standard RMI JRMP features. CAROL allow implicit context propagation with RMI JRMP (like a transactional or a security context) via a RMI IIOP Interceptors like mechanism. The example below explains the general way for CAROL RMI JRMP configuration:

Example 3-1. RMI JRMP `carol.properties` file.

```
# activated protocols
carol.protocols=jrmp

# Example of Interceptors initializer class
carol.jrmp.interceptors=
 org.objectweb.carol.jtests.conform.interceptor.jrmp.Initializer
```

In the file above we see a JRMP standard configuration, note that nothing is needed except custom interceptors configuration. You can customized your configuration with:

Table 3-3. Carol RMI JRMP specifics properties

Property name	Property value	Description	Required
carol.jrmp. PortableRemoteObjectClass	'JRMP portable remote object class name'	JRMP implementation of the Portable Remote Object class name	No, there is a default for JRMP
carol.jrmp. NameServiceClass	'JRMP carol Name Service class name'	JRMP implementation of the Carol name service	No, there is a default for JRMP based on the registry
carol.jvm.jrmp. server.portnumber	'jrmp port number'	All jndi properties needed for XXX name service configuration. This is equivalent to put 'property-name'='property-value' in the jndi.properties file	No, there is a default for JRMP (0)
carol.jvm.org. objectweb. PortableInterceptor. JRMPInitializerClass. 'jrmp initializer name'	'' (empty)	Initializer for JRMP inteceptors	No, there is defaults for JRMP. If there is a multi protocol configuration, CAROL automaticaly put interceptors for multi protocol management. This property is equivalent, for jrmp, to the carol.jrmp .interceptors one

3.2.4. RMI IIOP configuration

One of the SPI personality provided by CAROL is the standard Sun RMI IIOP. This personality can be used with all standard RMI IIOP features. CAROL allow implicit context propagation with RMI IIOP (like a transactional or a security context) via a RMI IIOP Interceptors mechanism. The example below explains the general way for CAROL RMI IIOP configuration:

Example 3-2. RMI IIOP `carol.properties` file.

```
# activated protocols
carol.protocols=iiop

# Example of Interceptors initializer class (class name with package)
carol.iiop.interceptors=
 org.objectweb.carol.jtests.conform.interceptor.iiop.IIOPInitializer
```

In the file above we see a IIOP standard configuration, note that nothing is needed except custom interceptors configuration. You can customized your configuration with:

Table 3-4. Carol RMI IIOP specifics properties

Property name	Property value	Description	Required
carol.iiop. PortableRemoteObjectClass	'IIOP portable remote object class name'	IIOP implementation of the Portable Remote Object class name	No, there is a default for IIOP
carol.iiop. NameServiceClass	'IIOP carol Name Service class name'	IIOP implementation of the Carol name service	No, there is a default for IIOP based on the tnameserv CosNaming
carol.jvm.org.objectweb. PortableInterceptor. IIOPInitializerClass. 'iiop initializer name'	" (empty)	Initializer for IIOP inteceptors	No, there is defaults for IIOP. If there is a multi protocol configuration, CAROL automaticaly put interceptors for multi protocol management. This property is equivalent, for iiop, to the carol.iiop .interceptors one

3.2.5. RMI JEREMIE personality configuration

One of the SPI personality available/provided by CAROL is the ObjectWeb Jonathan JEREMIE personality. This personality can be used with all standard JEREMIE features. CAROL also allow JEREMIE to propagate implicitly a context (like a transactionnal or a security context) via a JEREMIE handler mechanism. This section explains the general way for CAROL JEREMIE configuration in the two jonathan.xml and carol.properties files:

Example 3-3. JEREMIE `jonathan.xml` file

```
<?xml version="1.0"?>
<!DOCTYPE Configuration SYSTEM "configuration.dtd">
  <CONFIGURATION>
    <ELEM name="DavidCarolHandler">
      <ATOM class="org.objectweb.carol.rmi.jonathan.david.DavidCarolHandler"/>
    </ELEM>
    <ELEM name="david/orbs/iiop/services_handler_context/1534">
      <ALIAS name="/DavidCarolHandler" />
    </ELEM>
    <ELEM name="JeremieCarolHandler">
      <ATOM
class="org.objectweb.carol.rmi.jonathan.jeremie.JeremieCarolHandler"/>
    </ELEM>
    <ELEM name="jeremie/service_handler_context/1535">
      <ALIAS name="/JeremieCarolHandler" />
    </ELEM>
    <ELEM name="jeremie/stub_factories/std">
      <CONFIGURATION>
<ELEM name="Stub name extension">
  <PROPERTY type="String" value="OW"/>
</ELEM>
      </CONFIGURATION>
```

```
    </ELEM>
  </CONFIGURATION>
```

Inside The above file, JEREMIE is configured to use the OW extension for stub/skeleton and to use the CAROL protocol handler.

Example 3-4. JEREMIE `carol.properties` file

```
# activated protocols
carol.protocols=jeremie
```

In the file above we see a JEREMIE standard configuration, note that nothing is needed except custom interceptors configuration. You can customized your configuration with:

Table 3-5. Carol RMI JEREMIE specifics properties

Property name	Property value	Description	Required
carol.jeremie. PortableRemoteObjectClass	'JEREMIE portable remote object class name'	JEREMIE implementation of the Portable Remote Object class name	No, there is a default for JEREMIE
carol.jeremie. NameServiceClass	'JEREMIE carol Name Service class name'	JEREMIE implementation of the Carol name service	No, there is a default for JEREMIE based on the jeremie registry

3.2.6. LMI personality configuration

One of the SPI personality available/provided by CAROL is the CAROL LMI personality. This personality is for, an only for, local methods call. With this personality, jndi register (and return) local java references. The Referenceable mechanism is also provide in LMI context. For the moment, LMI is only tested in a non multi protocol environment.

> **Note:** This implementation is not conform to RMI specifications: There is no serialization and the server "remote" call is executed is the client thread. This is a fake implementation, faster than standard RMI but not conform.

Example 3-5. LMI `carol.properties` file

```
# activated protocols
carol.protocols=lmi
```

In the file above we see a LMI standard configuration, note that nothing is needed. You can customized your configuration with:

Table 3-6. Carol RMI LMI specifics properties

Property name	Property value	Description	Required
carol.lmi. PortableRemoteObjectClass	'LMI portable remote object class name'	LMI implementation of the Portable Remote Object class name	No, there is a default for LMI
carol.lmi. NameServiceClass	'LMI carol Name Service class name'	LMI implementation of the Carol name service (fake)	No, there is a default for LMI based on a fake registry service

3.2.7. MULTI RMI configuration

The example below describes a general RMI configuration with 3 RMI architectures configured and 2 RMI activated (RMI IIOP and JEREMIE) and with RMI IIOP default:

Example 3-6. MULTI RMI `carol.propertiess` file

```
# carol properties
# (note that for this configuration only this
# property is needed)
carol.protocols=iiop,jeremie

# start or not all non started name services
carol.start.ns=true

# use carol rmi (Multi PORD)
carol.start.rmi=true

# use carol naming (Multi JNDI)
carol.start.jndi=true

#####################################################
# Configuration for Rmi JRMP                        #
#####################################################

# portable remote object delegate class
carol.rmi.PortableRemoteObjectClass
 =org.objectweb.carol.rmi.multi.JrmpPRODelegate

# Name service class for this protocol
carol.rmi.NameServiceClass
 =org.objectweb.carol.jndi.ns.JRMPRegistry

# here, for jndi we take the jndi.properties but
# we can make some :
```

```
# configuration for rmi jrmp jndi
# java.naming.factory.initial property
carol.jrmp.context.factory
 =com.sun.jndi.rmi.registry.RegistryContextFactory
# java.naming.provider.url property
carol.jrmp.url
 =rmi://localhost:1099

# port number
carol.jvm.jrmp.server.portnumber=10

#######################################################
# Configuration for Rmi IIOP                          #
#######################################################

# portable remote object delegate class for this protocol
carol.iiop.PortableRemoteObjectClass
 =com.sun.corba.se.internal.javax.rmi.PortableRemoteObject

# Name service class for this protocol
carol.iiop.NameServiceClass
 =org.objectweb.carol.jndi.ns.IIOPCosNaming

# configuration for rmi jrmp jndi
# java.naming.factory.initial property
carol.iiop.context.factory
 =org.objectweb.carol.jndi.iiop.IIOPReferenceContextWrapperFactory
# java.naming.provider.url property
carol.iiop.url
 =iiop://localhost:2000

#######################################################
# Configuration for JEREMIE                           #
#######################################################

# portable remote object delegate class for this protocol
carol.jeremie.PortableRemoteObjectClass
 =org.objectweb.carol.rmi.multi.JeremiePRODelegate

# Name service class for this protocol
carol.jeremie.NameServiceClass
 =org.objectweb.carol.jndi.ns.JeremieRegistry

# here, for jndi we take the jndi.properties but we can make some :
# configuration for rmi jrmp jndi
# java.naming.factory.initial property
carol.jeremie.context.factory
 =org.objectweb.jeremie.libs.services.registry.jndi.JRMIInitialContextFactory
# java.naming.provider.url property
carol.jeremie.url
 =jrmi://localhost:2001

#######################################################
# Configuration for CMI                               #
#######################################################

# portable remote object delegate class for this protocol
```

```
carol.cmi.PortableRemoteObjectClass
 =org.objectweb.carol.rmi.multi.CmiPRODelegate

# Name service class for this protocol
carol.cmi.NameServiceClass
 =org.objectweb.carol.jndi.ns.CmiRegistry

# here, for jndi we take the jndi.properties but we can make some :
# configuration for rmi jrmp jndi
# java.naming.factory.initial property
carol.cmi.context.factory
 =org.objectweb.carol.cmi.jndi.CmiInitialContextFactory

# java.naming.provider.url property
carol.cmi.url
 =cmi://localhost:2002

#####################################################
# Configuration for LMI                             #
#####################################################

# portable remote object delegate class for this protocol
carol.lmi.PortableRemoteObjectClass
 =org.objectweb.carol.rmi.multi.LmiPRODelegate

# Name service class for this protocol
carol.lmi.NameServiceClass
 =org.objectweb.carol.jndi.ns.LmiRegistry

# here, for jndi we take the jndi.properties but we can make some :
# configuration for rmi jrmp jndi
# java.naming.factory.initial property
carol.lmi.context.initial
 =org.objectweb.carol.jndi.lmi.LmiInitialContextFactory

# java.naming.provider.url property
# (only for carol, no importance)
carol.lmi.url
 =lmi://nohost:0

#####################################################
# Configuration for Interceptor                     #
#####################################################

# xtra properties for the jvm (only in use in the multi protocol case)

# Protocol Interceptors initializer class
carol.jrmp.interceptors=
 org.objectweb.carol.interceptor.myJRMPInterceptorInitializer

# Protocol Interceptors initializer class
carol.iiop.interceptors=
 .org.objectweb.carol.interceptor.myIIOPInterceptorInitializer

#####################################################
# Configuration for Global JNDI                     #
#####################################################
```

```
# note that all other jndi properties than
# url and context factory can be found in
# the jndi.properties file or in the jvm
# (like this one)
carol.jndi.java.naming.factory.url.pkgs
 =org.objectweb.carol.naming
```

Chapter 4. CAROL requirements

This chapter describe the system requirements for CAROL.

Web sites index

General CAROL requirements

Java environment

- A CAROL Java server need a JDK 1.2 or greater
- A CAROL Java server need the `carol.jar` file in it's classpath

CAROL RMI JRMP requirements

Server Environement

- A CAROL RMI JRMP Java server need a JDK 1.2 or greater

Client Environement

- A CAROL RMI JRMP Java client need a JDK 1.2 or greater
- A CAROL RMI JRMP Java client need the `carol.jar` file in it's classpath

CAROL RMI IIOP requirements

Server Environement

- A CAROL RMI IIOP Java server need a JDK 1.4 or a 2.6 CORBA with RMI IIOP

Client Environement

- A CAROL IIOP client need a CORBA 2.6
- A CAROL RMI IIOP Java client need a JDK 1.4 or a 2.6 CORBA with RMI IIOP and the `carol.jar` file in it's classpath

CAROL JEREMIE requirements

Server Environement

- A CAROL JEREMIE Java server need a JDK 1.2 and a Jonathan 3.0 alpha10 or greater

Client Environement

- A CAROL JEREMIE Java client need a JDK 1.2 and a Jonathan 3.0 alpha10 or greater

Chapter 5. Links and Reference

Web site list and book reference

Web sites index

ObjectWeb web sites

ObjectWeb
- ObjectWeb main web site

CAROL
- CAROL ObjectWeb web site

JONATHAN
- JONATHAN ObjectWeb web site

Monolog
- Monolog ObjectWeb web site

SUN web sites

Java Sun
- Java Sun main web site

JDK 1.4
- Java JDK 1.4 API

RMI
- RMI documentation and tutorial web site

RMI IIOP
- RMI IIOP documentation and tutorial web site

OMG web sites

OMG
- OMG main web site

CORBA web page
- CORBA web page

PortableInterceptor
- PortableInterceptor documentation

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Glossary

RMI

(Remote Method Invocation) This is the standard specifications of the Java RPC.

RPC

(Remote Procedure Call) all remote method call protocol is a RPC.

JVM

(Java Virtual Machine) The Java virtual machine.

JDK

(Java Development Kit) A set a Java tools (compiler, jvm, library ...) for Java programs development.

API

(Application Programming Interface) Interfaces allowing to use library in programs.

SPI

(Service Provider Interface) Interface for provider library plugging in an other library.

JNDI

(Java Naming Directory Interface) Standard API/SPI for J2EE naming interface .

OMG

(Object Management Group) Industrial group for computer standard specifications.

CORBA

(Common Object Request Broker Architecture) OMG RPC specification.

IIOP

(Inter-operable Internet Object Protocol) CORBA RPC standard protocol on TCP/IP

JRMP

(Java Remote Method Protocol)Java RMI standard protocol