JacORB 2.0 Programming Guide

Gerald Brose

gerald.brose@xtradyne.com

Nicolas Noffke

nicolas.noffke@web.de

André Spiegel

spiegel@gnu.org

September 1, 2003

Contents

1 Introduction

This document gives an introduction to programming distributed applications with JacORB, a free Java object request broker. JacORB comes with full source code, a couple of CORBA Object Service implementations, and a number of example programs. This document is *not* an introduction to CORBA in general. Please see [BVD01, Sie00, Vin97] for this purpose and [HV99] for more advanced issues. The JacORB version described in this document is JacORB 2.0. This document is intended to give a few essential hints on how to install and use JacORB, but it will not suffice as either a gentle introduction to CORBA or a tutorial.

2 Installing JacORB

In this chapter we explain how to obtain and install JacORB and give an overview of the package contents.

2.1 Downloading JacORB

JacORB can be downloaded as a g-zipped tar–archive or as a zip–archive from the JacORB home page at http://www.jacorb.org.

To install JacORB, just unzip and untar (or simply unzip) the archive somewhere. This will result in a new directory `JacORB2_0`. Make sure your CLASSPATH environment variable contains `JacORB2_0/lib/jacorb.jar`. Extend your search path with `JacORB2_0/bin`, so that the shell scripts and batch files for the utilities in this directory are found.

2.2 Installation

2.2.1 Requirements

JacORB requires JDK 1.2 or above properly installed on your machine. To build JacORB (and compile the examples) you need to have the XML–based make tool "Ant" installed on your machine. Ant can be downloaded from http://jakarta.apache.org/ant. All make files (`build.xml`) are written for this tool. To rebuild JacORB completely, just type `ant` in the installation directory. Optionally, you might want to do a `ant clean` first.

For SSL, you need an implementation of the SSL protocol. We currently support:

1. IAIK's [1] implementation consisting of the crypto provider IAIK–JCE 2.5 (or higher) and the SSL library iSaSiLk 3.0 (or higher). Using this implementation allows you to access the clients authenticated certificates.

2. Sun's JSSE Reference implementation included in the JDK 1.4 and separately available from the Developer Connection.

[1] http://jcewww.iaik.tu-graz.ac.at/

2.2.2 Configuration

JacORB has a number of configuration options which can be set as Java properties. Before we will go about explaining some of the more basic options here, let's look at the different ways of setting properties. Specific options that apply, e.g., to the Implementation Repository or the Trading Service are explained in the chapter discussing these modules. There are three options for doing this.

The most general case is in a properties file. JacORB looks for and loads a file called either `.jacorb_properties` or `jacorb.properties`. The properties files will be searched in the following places:

1. in the classpath.
2. in the home directory of the user running JacORB. This is obtained by calling `System.getProperty( "user.home" )`. So if in doubt where your home directory is, write a small java programm that prints out this property.
3. in the current directory.
4. in the `lib` directory of the JDK installation. The JDKs home directory is obtained by calling `System.getProperty( "java.home" )`.

The places are searched in the order presented above. If a properties file is found, it is loaded and searching is terminated.

For more application–specific properties, you can pass a `java.util.Properties` object to `ORB.init()` during application initialization. Properties set this way will override properties set by a properties file. The following code snippet demonstrates how to pass in a `Properties` object (`args` is the String array containing command line arguments):

```
java.util.Properties props = new java.util.Properties();
props.setProperty("jacorb.implname","StandardNS");
// use put() under Java 1.1

org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init(args, props);
```

The next way of specifying properties is by setting the JVMs system properties. These properties must be set prior to calling `ORB.init()`, and will override both properties that are loaded via file and an additional `Properties` object. System properties can also be set using the `-D<prop name>=<prop value>` command line arg. This is a command line argument to the java command (and not something we invented), but can be used with the `jaco` script as well. The only thing you have to take care of is that this argument must be placed somewhere in front of the class name argument. Anything that follows after the class name is interpreted (by `java`) as a command line argument to the class and will be visible in the `args` parameter of the classes main method.

If you want to set more than one property on the command line, you can use the special property "custom.props". The value of this property has to be the filename to a properties file, which contains the properties you want to load. The filename is used "as is", and not interpreted to be relative to any other directory as the current one. The properties contained in the specified file will override any properties already set by the "normal" properties file. As an example, imagine that you usually use plain TCP/IP connections, but in some cases want to use SSL (see section 11). If you use just one properties file, you always have to edit that if you want to switch between SSL and plaintext connections. If you don't want to edit the properties file all the time, you can also add every different property in the way described in the previous paragraph, which may lead to very long commands. If you use a custom properties file, you have all the additional properties to set in one single file, and you only have to add one command line property, for example:

```
$ jaco -Dcustom.props=ssl_props MyServer
```

We are now ready to have a look at the most basic JacORB configuration properties. Here is an example `jacorb_properties` file:

```
##
##  JacORB configuration options
##

########################################
#                                      #
#   Initial references configuration   #
#                                      #
########################################

#
# URLs where IORs are stored (used in orb.resolve_initial_service())
# DO EDIT these! (Only those that you are planning to use,
# of course ;-).
#
# The ORBInitRef references are created on ORB startup time. In the
# cases of the services themselves, this may lead to exceptions being
# displayed (because the services aren't up yet). These exceptions
# are handled properly and cause no harm!

#ORBInitRef.NameService=corbaloc::160.45.110.41:38693/\
#                       StandardNS/NameServer-POA/_root
#ORBInitRef.NameService=file:/c:/NS_Ref
ORBInitRef.NameService=http://www.x.y.z/~user/NS_Ref
#ORBInitRef.TradingService=http://www.x.y.z/~user/TraderRef

# JacORB-specific URLs
jacorb.ImplementationRepositoryURL=http://www.x.y.z/~user/ImR_Ref
jacorb.ProxyServer.URL=http://www.x.y.z/~user/Appligator_Ref

##################################
#                                #
#   Debug output configuration   #
```

```
#                                #
##################################

# use (java) jacorb.util.CAD to generate an appropriate
# verbosity level
# 0 = off
# 1 = important messages and exceptions
# 2 = informational messages and exceptions
# >= 3 = debug-level output (may confuse the unaware user :-)
jacorb.verbosity=1

# where does output go? Terminal is default
#jacorb.logfile=LOGFILEPATH

# Whether to timestamp log entries
jacorb.log.timestamp=off

# If logging to file whether to append to existing file or overwrite
jacorb.logfile.append=off

# If jacorb.logfile.append is on, set rolling log size in kilobytes.
# A value of 0 implies no rolling log
jacorb.logfile.maxLogSize=0

# hexdump outgoing messages
jacorb.debug.dump_outgoing_messages=off

# hexdump incoming messages
jacorb.debug.dump_incoming_messages=off

##################################################
#                                                #
#    WARNING: The following properties should    #
#    only be edited by the expert user. They     #
#    can be left untouched for most cases!       #
#                                                #
##################################################

################################
#                              #
#   Basic ORB Configuration    #
#                              #
################################

# number of retries if connection cannot directly be established
jacorb.retries=5

# how many msecs. do we wait between retries
jacorb.retry_interval=500
```

```
# size of network buffers for outgoing messages
jacorb.outbuf_size=2048

# client-side timeout, set no non-zero to stop blocking
# after so many msecs.
#jacorb.connection.client_timeout=0

# max time a server keeps a connection open if nothing happens
#jacorb.connection.server_timeout=10000

#jacorb.reference_caching=off
...

#########################
#                       #
#   POA Configuration   #
#                       #
#########################

# displays a GUI monitoring tool for servers
jacorb.poa.monitoring=off

# thread pool configuration for request processing
jacorb.poa.thread_pool_max=20
jacorb.poa.thread_pool_min=5

# if set, request processing threads in thePOA
# will run at this priority. If not set or invalid,
# MAX_PRIORITY will be used.
#jacorb.poa.thread_priority=

# size of the request queue, clients will receive Corba.TRANSIENT
# exceptions if load exceeds this limit
jacorb.poa.queue_max=100
...
```

Configurable options include the size of network buffers, the number of retries JacORB makes if a connection cannot be established, and how long it shall wait before retrying. The string value for `ORBInitRef.NameService` is a URL for a resource used to set up the JacORB name server. This URL will be used by the ORB to locate the file used to store the name server's object reference (see also chapter 4).

The `verbosity` option tells JacORB how much diagnostic output it should emit at runtime. Unless the `logfile` property is set to a file name, diagnostic output will be sent to the terminal. Setting the verbosity property to 0 means don't print any, while a level of 2 is a verbose debug mode. Level 1 will emit some information, e.g. about connections being opened, accepted and closed. If you like to selectively suppress specific output you can use the tool `jacorb.util.CAD` to generate a special verbosity level.

The `jacorb.poa.monitoring` property determines whether the POA should bring up a monitoring GUI for servers that let you examine the dynamic behavior of your POA, e.g. how long the request queue gets and whether your thread pool is big enough. Also, this tool lets you change the state of a POA, e.g. from *active* to *holding*. Please see chapter 5 on the POA for more details.

You can now test your installation by typing `ant` in one of the subdirectories of the `demo/` directory which contains a number of examples for using JacORB.

3 Getting Started

Before we explain an example in detail, we will have a look at the general process of developing CORBA applications with JacORB. We'll follow this roadmap when working through the example. The example can be found in `demo/grid` which also contains a build file so that the development steps do not have to be carried out manually every time. Still, you should know what is going on.

As this document gives only a short introduction to JacORB programming and does not cover all the details of CORBA IDL, we recommend that you also look at the other examples in the `demo/` directory. These are organized so as to show how the different aspects of CORBA IDL can be used with JacORB.

3.1 JacORB development: an overview

The steps we will generally have to take are:

1. write an IDL specification.
2. compile this specification with the IDL compiler to generate Java classes.
3. write an implementation for the interface generated in step 2
4. write a "Main" class that instantiates the server implementation and registers it with the ORB
5. write a client class that retrieves a reference to the server object.

3.2 IDL specifications

Our example uses a simple server the definition of which should be clear if you know IDL. Its interface is given in `server.idl`. All the source code for this example can be found in `JacORB2_0/demo/grid`.

```
// server.idl
```

```
// IDL definition of a 2-D grid:
module demo
{
  module grid
  {
    interface MyServer
    {
        typedef fixed <5,2> fixedT;

        readonly attribute short height;  // height of the grid
        readonly attribute short width;   // width of the grid

        // set the element [n,m] of the grid, to value:
        void set(in short n, in short m, in fixedT value);

        // return element [n,m] of the grid:
        fixedT get(in short n, in short m);

        exception MyException
        {
            string why;
        };

        short opWithException() raises( MyException );
    };
  };
};
```

3.3 Generating Java classes

Feeding this file into the IDL compiler

```
$ idl -d ../..  server.idl
```

produces a number of Java classes that represent the IDL definitions. This is done according to a set of rules known as the IDL–to–Java language mapping as standardized by the OMG. If you are interested in the details of the language mapping, i.e. which IDL language construct is mapped to which Java language construct, please consult the specifications available from `www.omg.org`. The language mapping used by the JacORB IDL compiler is the one defined in CORBA 2.3 and is explained in detail in [BVD01]. For practical usage, please consult the examples in the `demo` directory.

The most important Java classes generated by the IDL compiler are the interfaces `MyServer` and `MyServerOperations` plus the stub and skeleton files `_MyServerStub`, MyServerPOA and MyServerPOATie. We will use these classes in the client and server as well as in the implementation of the grid's functionality and explain each in turn.

Note that the IDL compiler will produce a directory structure for the generated code that corresponds to the module structure in the IDL file, so it would have produced a subdirectory demo/grid in the current directory had we not directed it to put this directory structure to ../.. by using the compiler's -d switch. Where to put the source files for generated classes is a matter of taste. Some people prefer to have everything in one place (as using the -d option in this way achieves), others like to have one subdirectory for the generated source code and another for the output of the Java compiler, i.e. for the .class files.

3.4 Implementing the interface

Let's try to actually provide an implementation of the functionality promised by the interface. The class which implements that interface is called gridImpl. Apart from providing a Java implementation for the operations listed in the IDL interface, it has to inherit from a generated class that both defines the Java type that represents the IDL type MyServer and contains the code needed to receive remote invocations and return results to remote callers. This class is MyServerPOA.

You might have noticed that this approach is impractical in situations where your implementation class needs to inherit from other classes. As Java only has single inheritance for implementations, you would have to use an alternative approach — the "tie"–approach — here. The tie approach will be explained later.

Here is the Java code for the grid implementation. It uses the Java library class java.math.BigDecimal for values of the IDL fixed–point type fixedT:

```
package demo.grid;

/**
 * A very simple implementation of a 2-D grid
 */

import demo.grid.MyServerPackage.MyException;

public class gridImpl
    extends MyServerPOA
{
    protected short height = 31;
    protected short width = 14;
    protected java.math.BigDecimal[][] mygrid;

    public gridImpl()
```

```
    {
        mygrid = new java.math.BigDecimal[height][width];
        for( short h = 0; h < height; h++ )
        {
            for( short w = 0; w < width; w++ )
            {
                mygrid[h][w] = new java.math.BigDecimal("0.21");
            }
        }
    }

    public java.math.BigDecimal get(short n, short m)
    {
        if( ( n <= height ) && ( m <= width ) )
            return mygrid[n][m];
        else
            return new java.math.BigDecimal("0.01");
    }

    public short height()
    {
        return height;
    }

    public void set(short n, short m, java.math.BigDecimal value)
    {
        if( ( n <= height ) && ( m <= width ) )
            mygrid[n][m] = value;
    }

    public short width()
    {
        return width;
    }

    public short opWithException()
        throws demo.grid.MyServerPackage.MyException
    {
        throw new demo.grid.MyServerPackage.MyException("This is only a test exc
    }
}
```

3.5 Writing the Server

To actually instantiate a `gridImpl` object which can be accessed remotely as a CORBA object of type `MyServer`, you have to instantiate it in a main method of some other class and register it with a component of the CORBA architecture known as the *Object Adapter*. Here is the class `Server` which does all that is necessary to activate a CORBA object of type `MyServer` from a Java `gridImpl` object:

```
package demo.grid;

import java.io.*;
import org.omg.CosNaming.*;

public class Server
{
    public static void main( String[] args )
    {
        org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init(args, null);
        try
        {
            org.omg.PortableServer.POA poa =
                org.omg.PortableServer.POAHelper.narrow(
                     orb.resolve_initial_references("RootPOA"));

            poa.the_POAManager().activate();

            org.omg.CORBA.Object o = poa.servant_to_reference(new gridImpl());

            if( args.length == 1 )
            {
                // write the object reference to args[0]

                PrintWriter ps = new PrintWriter(
                                    new FileOutputStream(
                                       new File( args[0] )));
                ps.println( orb.object_to_string( o ) );
                ps.close();
            }
            else
            {
                // register with the naming service

                NamingContextExt nc =
                     NamingContextExtHelper.narrow(
                        orb.resolve_initial_references("NameService"));
                nc.bind( nc.to_name("grid.example"), o);
```

```
            }
        }
        catch ( Exception e )
        {
            e.printStackTrace();
        }
        orb.run();
    }
}
```

After initializing the ORB we need to obtain a reference to the object adapter — the POA — by asking the ORB for it. The ORB knows about a few initial references that can be retrieved using simple names like “RootPOA”. The returned object is an untyped reference of type `CORBA.Object` and thus needs to be narrowed to the correct type using a static method `narrow()` in the helper class for the type in question. We now have to activate the POA because any POA is created in “holding” state in which it does not process incoming requests. After calling `activate()` on the POA’s POAManager object, the POA is in an active state and can now be asked to create a CORBA object reference from a Java object also know as a `Servant`.

In order to make the newly created CORBA object accessible, we have to make its object reference available. This is done using a publicly accessible directory service, the naming server. A reference to the naming service is obtained by calling `orb.resolve_initial_references("NameService")` on the ORB and narrowing the reference using the `narrow()` method found in class `org.omg.CosNaming.NamingContextExtHelper`. Having done this, you should call the `bind()` operation on the name server. The name for the object which has to be supplied as an argument to `bind()` is not simply a string. Rather, you need to provide a sequence of `CosNaming.NameComponents` that represent the name. In the example, we chose to use an extended Name Server interface that provides us with a more convenient conversion operation from strings to Names.

3.6 Writing a client

Finally, let’s have a look at the client class which invokes the server operations:

```
package demo.grid;

import org.omg.CosNaming.*;

public class Client
{
   public static void main(String args[])
   {
       try
       {
```

```
MyServer grid;
org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init(args,null);

if(args.length==1 )
{
    // args[0] is an IOR-string
    grid = MyServerHelper.narrow(orb.string_to_object(args[0]));
}
else
{
    NamingContextExt nc =
        NamingContextExtHelper.narrow(
           orb.resolve_initial_references("NameService"));

    grid = MyServerHelper.narrow(
              nc.resolve(nc.to_name("grid.example")));
 }

 short x = grid.height();
 System.out.println("Height = " + x);

 short y = grid.width();
 System.out.println("Width = " + y);

 x -= 1;
 y -= 1;

 System.out.println("Old value at (" + x + "," + y +"): " +
                   grid.get( x,y));

 System.out.println("Setting (" + x + "," + y +") to 470.11");

 grid.set( x, y, new java.math.BigDecimal("470.11"));

 System.out.println("New value at (" + x + "," + y +"): " +
                   grid.get( x,y));

try
{
    grid.opWithException();
}
catch (jacorb.demo.grid.MyServerPackage.MyException ex)
{
    System.out.println("MyException, reason: " + ex.why);
}
```

```
        }
        catch (Exception e)
        {
            e.printStackTrace();
        }
    }
}
```

After initializing the ORB, the client obtains a reference to the “grid” service by locating the reference using the name service. Again, resolving the name is done by getting a reference to the naming service by calling `orb.resolve_initial_references("NameService")` and querying the name server for the `"grid"` object by calling `resolve()`. The argument to the resolve operation is, again, a string that is converted to a Name. The result is an object reference of type `org.omg.CORBA.Object` which has to be narrowed to the type we are expecting, i.e. `MyServer`.

After compiling everything we’re now ready to actually run the server and the client on different (virtual) machines. Make sure the name server is running before starting either the server or the client. If it isn’t, type something like:

```
$ ns /home/me/public_html/NS_Ref
```

where `/home/me/public_html/NS_Ref` is the name of a locally writable file which can be read by using the URL given in both the remote client and server code. (This is to avoid using a well–known address for the name server, so both client and server look up the location of the name server via the URL and later communicate with it directly.)

You can now launch the server:

```
$ jaco demo.grid.Server
```

The client can be invoked on any machine you like:

```
$ jaco demo.grid.Client
```

Running the client after starting the server produces the following output on your terminal:

```
Height = 31
Width = 14
Old value at (30,13): 0.21
Setting (30,13) to 470.11
New value at (30,13): 470.11
MyException, reason: This is only a test exception, no harm done :-)
done.
```

3.6.1 The Tie Approach

If your implementation class cannot inherit from the generated servant class `MyServerPOA` because, e.g., you need to inherit from another base class, you can use the tie approach. Put simply, it replaces inheritance by delegation. Instead of inheriting from the generated base class, your implementation needs to implement the generated *operations interface* `MyServerOperations`:

```
package demo.grid;

import demo.grid.MyServerPackage.MyException;

public class gridOperationsImpl
    implements MyServerOperations
{
...
}
```

Your server is then written as follows:

```
package demo.grid;

import java.io.*;
import org.omg.CosNaming.*;

public class TieServer
{
    public static void main( String[] args )
    {
        org.omg.CORBA.ORB orb =
            org.omg.CORBA.ORB.init(args, null);
        try
        {
            org.omg.PortableServer.POA poa =
                org.omg.PortableServer.POAHelper.narrow(
                     orb.resolve_initial_references("RootPOA"));

            // use the operations implementation and wrap it in
            // a tie object

            org.omg.CORBA.Object o =
                poa.servant_to_reference(
                     new MyServerPOATie( new gridOperationsImpl()) );

            poa.the_POAManager().activate();

            if( args.length == 1 )
            {
                // write the object reference to args[0]
```

```
                PrintWriter ps = new PrintWriter(
                    new FileOutputStream(new File( args[0] )));
                ps.println( orb.object_to_string( o ) );
                ps.close();
            }
            else
            {
                NamingContextExt nc =
                     NamingContextExtHelper.narrow(
                        orb.resolve_initial_references("NameService"));
                NameComponent [] name = new NameComponent[1];
                name[0] = new NameComponent("grid", "whatever");
                nc.bind( name, o );
            }
        }
        catch ( Exception e )
        {
            e.printStackTrace();
        }
        orb.run();
    }
}
```

4 The JacORB Name Service

Name servers are used to locate objects using a human–readable reference (their name) rather than a machine or network address. If objects providing a certain service are looked up using the service name, their clients are decoupled from the actual locations of the objects that provide this service. The binding from name to service can be changed without the clients needing to know.

JacORB provides an implementation of the OMG's Interoperable Naming Service (INS) which supports binding names to object references and to lookup object references using these names. It also allows clients to easily convert names to strings and vice versa. The JacORB name service comprises two components: the name server program, and a set of interfaces and classes used to access the service.

One word of caution about using JDK 1.2 with the JacORB naming service: JDK 1.2 comes with a couple of outdated and apparently buggy naming service classes that do not work properly with JacORB. To avoid having these classes loaded and used inadvertently, please make sure that you always use the `NamingContextExt` interface rather than the plain `NamingContext` interface in your code. Otherwise, you will see your application receive null pointer or other exceptions.

4.1 Running the Name Server

The JacORB name server is a process that needs to be started before the name service can be accessed by programs. Starting the name server is done by typing on the command line either simply

```
$ ns [<ior filename>][-p port] [-t <timeout>]
```

You can also start the Java interpreter explicitly by typing

```
$ jaco jacorb.naming.NameServer [<filename>][-p port] [-t <timeout>]
```

In the example

```
$ ns /home/me/public_html/NS_Ref
```

we direct the name server process to write location information (its own object reference) to the file `/home/me/public_html/NS_Ref`. A client–side ORB uses this file to locate the name server process. The client–side ORB does not, however, need to be able to access the file through a local or shared file system because the file is read as a resource by using a URL pointing to it. This implies that the name server log file is accessible through a URL in the first place, i.e., that you know of a web server in your domain which can answer HTTP request to read the file.

The advantage of this approach is that clients do not need to rely on a hard–coded well known port and that the name server is immediately available world–wide if the URL uses HTTP. If you want to restrict name server visibility to your domain (assuming that the log file is on a shared file system accessible throughout your domain) or you do not have access to a web server, you can use file URLs rather than HTTP URLs, i.e. the URL pointing to your name server log file would looks like

`file:/home/brose/public_html/NS_Ref`

rather than

`http://www.inf.fu-berlin.de/˜brose/NS_Ref`

Specifying file URLs is also useful is clients and servers are run on a single machine that may have no network connection at all. Please note that the overhead of using HTTP is only incurred once — when the clients first locate the name server. Subsequent requests will use standard CORBA operation invocations which means they will be IIOP requests (over TCP). In JacORB 1.4, the file name argument was made optional because the JacORB 1.4 name server also answers requests that are made using simplified corbaloc: URLs of the form `corbaloc::ip-address:port/NameService`. This means that all you need to know to construct an object reference to your name service is the IP address of the machine and the port number the server process is listening on (the one specified using `-p`).

The name server stores its internal state, i.e., the name bindings in its context, in files in the current directory unless the property `jacorb.naming.db_dir` is set to a different directory name. This saving is done when the server goes down regularly, i.e. killing the server with CTRL-C will result in loss of data. The server will restore state from its files if any files exist and are non–empty.

The second parameter is a port number on which you want the name service to listen for incoming requests. If this parameter is not set, the name server will come up on the first free port it is provided with by the operating system. The port number can also be set using specific properties in the properties file, but the -p switch was added merely for convenience.

The last parameter is a time–out value in msecs. If this value is set, the name server will shut down after the specified amount of time and save its state. This is useful if the name server is registered with the Implementation Repository and can thus be restarted on demand.

Configuring a Default Context

Configuring a naming context (i.e. a name server) as the ORB's default or root context is done by simply writing the URL that points to this server's bootstrap file to the properties file `.jacorb_properties`. Alternatively, you can set this file name in the property `ORBInitRef.NameService` either on the command line or within the application as described in 2.2. After the default context has thus been configured, all operations on the NamingContextExt object that was retrieved by a call to `orb.resolve_initial_references("NameService")` will go to that server — provided it's running or can be started using the Implementation Repository.

4.2 Accessing the Name Service

The JacORB name service is accessed using the standard CORBA defined interface:

```
    // get a reference to the naming service
```

```
ORB orb = ORB.init(args, null);
org.omg.CORBA.Object o = orb.resolve_initial_references("NameService")
NamingContextExt nc = NamingContextExtHelper.narrow( o );

// look up an object
server s = serverHelper.narrow( nc.resolve(nc.to_name("server.service")) );
```

Before an object can be looked up, you need a reference to the ORB's name service. The standard way of obtaining this reference is to call `orb.resolve_initial_references("NameService")`. In calls using the standard, extended name service interface, object names are represented as arrays of `NameComponent`s rather than as strings in order to allow for structured names. Therefore, you have to construct such an array and specify that the name's name is "server" and that it is of kind "service" (rather than "context"). Alternatively, you can convert a string "server.service" to a name by calling the `NamingContextExt` interface's `to_name()` operation, as shown above.

Now, we can look up the object by calling `resolve()` on the naming context, supplying the array as an argument.

4.3 Constructing Hierarchies of Name Spaces

Like directories in a file system, name spaces or contexts can contain other contexts to allow hierarchical structuring instead of a simple flat name space. The components of a structured name for an object thus form a path of names, with the innermost name space directly containing the name binding for the object. This can very easily be done using `NameManager` but can also be explicitly coded.

A new naming context within an enclosing context can be created using either `new_context()` or `bind_new_context()`. The following code snippet requests a naming context to create an inner or subcontext using a given name and return a reference to it:

```
// get a reference to the naming service
ORB orb = ORB.init();
org.omg.CORBA.Object o =
   orb.resolve_initial_references("NameService");
NamingContextExt rootContext =
   NamingContextExtHelper.narrow( o );

// look up an object
NameComponent[] name = new NameComponent[1];
name[0] = new NameComponent("sub","context");
NamingContextExt subContext =
  NamingContextExtHelper.narrow( rootContext.bind_new_context( name ));
```

Please note that the JacORB naming service always uses `NamingContextExt` objects internally, even if the operation signature indicates `NamingContext` objects. This is necessary because of the limitations with JDK 1.2 as explained at the beginning of this section.

4.4 NameManager — A simple GUI front-end to the Naming Service

The graphical front-end to the name service can be started by simply calling

```
$ nmg
```

The GUI front-end will simply look up the default context and display its contents. Figure 4.1 gives a screen shot.

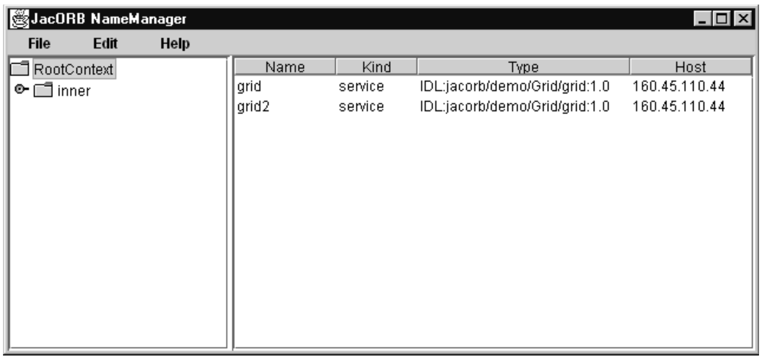


Figure 4.1: NameManager Screenshot

NameManager has menus that let you unbind names and create or delete naming contexts within the root context. Creating a nested name space, e.g., can be done by selecting the `RootContext` and bringing up a context by clicking the right mouse button. After selecting “new context” from that menu, you will be prompted to enter a name for the new, nested context.

5 The server side: POA, Threads

This chapter describes the facilities offered by JacORB for controlling how servers are started and executed. These include an activation daemon, the Portable Object Adapter (POA), and threading.

This chapter gives only a very superficial introduction to the POA. A thorough explanation of how the POA can be used in different settings and of the different policies and strategies it offers is beyond our scope here, but can be found in [BVD01]. Other references that explain the POA are [HV99, Vin98]. More in–depth treatment in C++ can be found in the various C++-Report Columns on the POA by Doug Schmidt and Steve Vinoski. These articles are available at http://www.cs.wustl.edu/ schmidt/report-doc.html. The ultimate reference, of course, is the CORBA specification.

5.1 POA

The POA provides a comprehensive set of interfaces for managing object references and servants. The code written using the POA interfaces is now portable across ORB implementations and has the same semantics in every ORB that is compliant to CORBA 2.2 or above.

The POA defines standard interfaces to do the following:

- Map an object reference to a servant that implements that object
- Allow transparent activation of objects
- Associate policy information with objects
- Make a CORBA object persistent over several server process lifetimes

In the POA specification, the use of pseudo-IDL has been deprecated in favor of an approach that uses ordinary IDL, which is mapped into programming languages using the standard language mappings, but which is locality constrained. This means that references to objects of these types may not be passed outside of a server's address space. The POA interface itself is one example of a locality–constrained interface.

The object adapter is that part of CORBA that is responsible for creating CORBA objects and object references and — with a little help from skeletons — dispatching operation requests to actual object implementations. In cooperation with the Implementation Repository it can also activate objects, i.e. start processes with programs that provide implementations for CORBA objects.

5.2 Threads

JacORB currently offers one server–side thread model. The POA responsible for a given request will obtain a request processor thread from a central thread pool. The pool has a certain size which is always between the maximum and minimum value configure by setting the properties `jacorb.poa.thread_pool_max` and `jacorb.poa.thread_pool_min`.

When a request arrives and the pool is found to contain no threads because all existing threads are active, new threads may be started until the total number of threads reaches `jacorb.poa.thread_pool_max`. Otherwise, request processing is blocked until a thread is returned to the pool. Upon returning threads that have finished processing a request to the pool, it must be decided whether the thread should actually remain in the pool or be destroyed. If the current pool size is above the minimum, a processor thread will not be out into the pool again. Thus, the pool size always oscillates between max and min.

Setting `min` to a value greater than one means keeping a certain number of threads ready to service incoming requests without delay. This is especially useful if you now that requests are likely to come in in a bursty fashion. Limiting the pool size to a certain maximum is done to prevent servers from occupying all available resources.

Request processor threads usually run at the highest thread priority. It is possible to influence thread priorities by setting the property `jacorb.poa.thread_priority` to a value between Java's Thread.MIN_PRIORITY and Thread.MAX_PRIORITY. If the configured priority value is invalid JacORB will assign maximum priority to request processing threads.

6 Implementation Repository

> "... it is very easy to be blinded to the essential uselessness of them by the sense of achievement you get from getting it to work at all. In other words — and that is a rock-solid principle on which the whole of the Corporation's Galaxywide success is founded — their fundamental design flaws are completely hidden by their superficial design flaws."
>
> D. Adams: So Long and Thanks for all the Fish

The Implementation Repository is not, as its name suggests, a database of implementations. Rather, it contains information about where requests to specific CORBA objects have to be redirected and how implementations can be transparently instantiated if, for a given request to an object, none is reachable. "Instantiating an implementation" means starting a server program that hosts the target object. In this chapter we give a brief overview and a short introduction on how to use the Implementation Repository. For more details please see [HV99].

6.1 Overview

Basically, the Implementation Repository (ImR) is an indirection for requests using persistent object references. A persistent object reference is one that was created by a POA with a PERSISTENT lifespan policy. This means that the lifetime of the object is longer than that of its creating POA. Using the Implementation Repository for objects the lifetime of which does not exceed the life time of its POA does not make sense as the main function of the Implementation Repository is to take care that such a process exists when requests are made — and to start one if necessary.

To fulfill this function, the ImR has to be involved in every request to "persistent objects". This is achieved by rewriting persistent object references to contain *not* the address of its server process but the address of the ImR. Thus, requests will initially reach the ImR and not the actual server — which may not exist at the time of the request. If such a request arrives at the ImR, it looks up the server information in its internal tables to determine if the target object is reachable or not. In the latter case, the ImR has to have information about how an appropriate server process can be started. After starting this server, the client receives a LOCATION_FORWARD exception from the ImR. This exception, which contains a new object reference to the actual server process now, is handled by its runtime system transparently. As a result, the client will automatically reissue its request using the new reference, now addressing the target directly.

6.2 Using the JacORB Implementation Repository

The JacORB Implementation Repository consists of two separate components: a repository process which need only exist once in a domain, and process startup daemons, which must be present on every host that is to start processes. Note that none of this machinery is necessary for processes that host objects with a TRANSIENT life time, such as used by the RootPOA.

First of all, the central repository process (which we will call ImR in the following) must be started:

```
$ imr [-n] [-p <port>] [-i <ior_file>][-f <file>][-b <file>] [-a]
```

The ImR is located using the configuration property `ORBInitRef.ImplementationRepository`. This property must be set such that a http connection can be made and the ImR's IOR can be read. Next, startup daemons must be created on selected hosts. To do this, the following command must is issued on each host:

```
$ imr_ssd
```

When a startup daemon is created, it contacts the central ImR.

To register a program such that the ImR can start it, the following command is used (on any machine that can reach the ImR):

```
$ imr_mg add "AServerName" -c "jaco MyServer"
```

The `imr_mg` command is the generic way of telling the ImR to do something. It needs another command parameter, such as `add` in this case. To add a server to the ImR, an *implementation name* is needed. Here, it is `"AServerName"`. If the host were the server should be restarted is not the local one, use the `-h hostname` option. Finally, the ImR needs to know how to start the server. The string `"jaco MyServer"` tells it how. The format of this string is simply such that the server daemon can execute it (using the Java API call `exec()`), i.e. it must be intelligible to the target host's operating system. For a Windows machine, this could, e.g. be `"start jaco MyServer"` to have the server run in its own terminal window, under Unix the same can be achieved with `"xterm -e jaco MyServer"`.

The startup command is a string that is passed as the *single* argument to javas `Runtime.exec()` method, without interpreting it or adding anything. Since `Runtime.exec()` has system–dependent behaviour, the startup string has to reflect that. While for most unix systems it is sufficient to avoid shell–expansions like * and ˜, windows–based systems do not pass the string to a commandline interpreter so a simple `jaco MyServer` will fail even if it works if directly typed in at the dos prompt. Therefore you have to "wrap" the core startup command in a call to a commandline interpreter. On NT the following startup command will do the job: `cmd /c "jaco MyServer"`. Please keep in mind that if you use the `imr_mg` command to set the startup command, you have to escape the quotes so they appear inside of the resulting string.

If you don't intend to have your server automatically started by the ImR you can also set the property "`jacorb.imr.allow_auto_register`" or use the `-a` switch of the ImR process. If this property is set, the ImR will automatically create a new entry for a server on POA activation, if the server has not been registered previously. In this case you don't have to use the ImR Manager to register your server.

For a client program to be able to issue requests, it needs an object reference. Up to this point, we haven't said anything about how persistent object references come into existence. Reference creation happens as usual, i.e. in the server application one of the respective operations on a POA is called. For a reference to be created as “persistent”, the POA must have been created with a PERSISTENT lifespan policy. This is done as in the following code snippet:

```
/* init ORB and root POA */
orb = org.omg.CORBA.ORB.init(args, props);
org.omg.PortableServer.POA rootPOA =
    org.omg.PortableServer.POAHelper.narrow(
                    orb.resolve_initial_references("RootPOA"));

/* create policies  */

org.omg.CORBA.Policy [] policies = new org.omg.CORBA.Policy[2];
policies[0] = rootPOA.create_id_assignment_policy(
                            IdAssignmentPolicyValue.USER_ID);
policies[1] = rootPOA.create_lifespan_policy(
                            LifespanPolicyValue.PERSISTENT);

/* create POA */

POA myPOA = rootPOA.create_POA("XYZPOA",
                            rootPOA.the_POAManager(), policies);

/* activate POAs */
poa.the_POAManager().activate();
```

(Note that in general the id assignment policy will be `USER_ID` for a POA with persistent object references because this id will often be a key into a database where the object state is stored). If a POA is created with this lifespan policy and the ORB property “use_imr” is set, the ORB will try to notify the ImR about this fact so the ImR knows it doesn’t need to start a new process for requests that target objects on this POA. To set the ORB policy, simply set the property `jacorb.use_imr=on`. The ORB uses another property, `jacorb.implname`, as a parameter for the notification, i.e. it tells the ImR that a process using this property’s value as its *implementation name* is present. If the server is registered with the ImR, this property value has to match the implementation name that is used when registering.

The application can set these properties on the command line using `java -Djacorb.implname=MyName`, or in the code like this:

```
/* create and set properties */
java.util.Properties props = new java.util.Properties();
props.setProperty("jacorb.use_imr","on");
props.setProperty("jacorb.implname","MyName");

/* init ORB  */
orb = org.omg.CORBA.ORB.init(args, props);
```

There are a few things you have to consider especially when restoring object state at startup time or saving the state of your objects on shutdown. It is important that, at startup time, object initialization is complete when the object is activated because from this instant on operation calls may come in. The repository knows about the server when the first POA with a PERSISTENT lifespan policy registers, but does not forward object references to clients before the object is actually reachable. (Another, unreliable way to handle this problem is to increase the `jacorb.imr.object_activation_sleep` property, so the repository waits longer for the object to become ready again.)

When the server shuts down, it is equally important that object state is saved by the time the last POA in the server goes down because from this moment the Implementation Repository regards the server as down and will start a new one upon requests. Thus, a server implementor is responsible for avoiding reader/writer problems between servers trying to store and restore the object state. (One way of doing this is to use POA managers to set a POA to holding while saving state and to inactive when done.)

Please keep in mind that even if you don't have to save the state of your objects on server shutdown you *must* deactivate your POAs prior to exiting your process (or at least use `orb.shutdown(...)` which includes POA deactivation). Otherwise the ImR keeps the server as active and will return invalid IORs. In case of a server crash you can either notify the ImR manually by using the command `imr_mg setdown AServerName` or allow the ImR to detect the crashed server and restart it if necessary.

6.3 Server migration

The implementation repository offers another useful possibility: server migration. Imagine the following scenario: You have written your server with persistent POAs, but after a certain time your machine seems to be too slow to serve all those incoming requests. Migrating your server to a more powerful machine is the obvious solution. Using the implementation repository, client references do not contain addressing information for the slow machine, so server migration can be done transparently to client.

Assuming that you added your server to the repository, and it is running correctly.

```
$ imr_mg add AServerName -h a_slow_machine -c "jaco MyServer"
```

The first step is to *hold* the server, that means the repository delays all requests for that server until it is released again.

```
$ imr_mg hold AServerName
```

Now your server will not receive any requests for its registered POAs. If you can't shut your server down such that it sets itself down at the repository, i.e. your POAs are set to inactive prior to terminating the process, you can use

```
$ imr_mg setdown AServerName
```

to do that. Otherwise your POAs can't be reactivated at the repository because they are still logged as active.

If you want your server to be restarted automatically, you have to tell the repository the new host and maybe a new startup command.

```
$ imr_mg edit AServerName -h the_fastest_available_machine
```

```
-c "jaco MyServer"
```

If your server can be restarted automatically, you now don't even have to start it manually, but it is instead restarted by the next incoming request. Otherwise start it manually on the desired machine now.

The last step is to release the server, i.e. let all delayed requests continue.

```
$ imr_mg release AServerName
```

By now your server should be running on another machine, without the clients noticing.

6.4 A Note About Security

Using the imr can pose a major security threat to your system. Imagine the following standard setup: an imr is running on a machine, its IOR file is placed in a directory where it can be read by the web server, and several imr_ssds are running on other machines. An attacker can now execute processes on the machines the ssds are running on by taking the following steps:

1. Setting the `ORBInitRef.ImplementationRepository` property to the IOR file on your server.
2. Creating a new logical server with the desired command to execute as startup command on the desired host (where a ssd is running). This is the crucial point. The ssd calls `Runtime.exec()` with the supplied string, and there is no way to check if the command does what it is supposed to do, i.e. start a server.
3. Start the server with the imr_mg. The startup command of the server will be exec'd on the specified host.

Now this should not generally discourage you to use the imr but show you that there are risks, which can be reduced significantly nonetheless. There are several ways to encounter this threat and we don't consider this list to be complete:

1. Try to control the distribution of the IOR file. Hiding it should not be considered here, because *security by obscurity* is generally a bad approach. Try to make use of file system mechanisms like groups and ACLs.
2. Use a firewall which blocks of incoming traffic. Keep in mind that if the attacker is inside of your protection domain, the firewall won't help. It is also not that hard to write a Trojan that can tunnel those firewalls that block incoming traffic.
3. Enforce SSL connections to the imr. This blocks all client connections that don't have a certificate signed by a CA of your choice. See chapter 11 for more information.

7 Dynamic Management of Any Values

by Jason Courage

The purpose of this chapter is to describe the DynAny specification, which is the specification for the dynamic management of Any values. This chapter only describes the main features of the DynAny specification; for the complete specification consult the appropriate chapter of the CORBA specification available from the OMG.

7.1 Overview

DynAny objects are used to dynamically construct and traverse Any values. A DynAny can represent a value of a basic type, such as boolean or long, or a constructed type, such as enum or struct.

7.2 Interfaces

The UML diagram below shows the relationship between the interfaces in the org.omg.DynamicAny module.

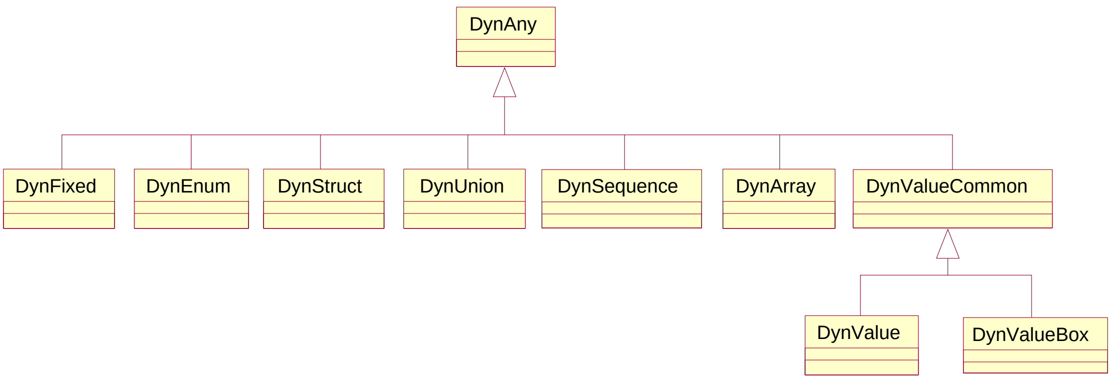


Figure 7.1: DynAny Relationships

The DynAny interface is the base interface that represents values of the basic types. For each constructed type there is a corresponding interface that extends the DynAny interface and defines operations specific to the constructed type. The table below lists the interfaces in the DynamicAny module and the types they represent.

Interface	Type
`DynAny`	`basic types (boolean, long, etc.)`
`DynFixed`	`fixed`
`DynEnum`	`enum`
`DynStruct`	`struct`
`DynUnion`	`union`
`DynSequence`	`sequence`
`DynArray`	`array`
`DynValue*`	`non-boxed valuetype`
`DynValueBox*`	`boxed valuetype`

* Not currently implemented by JacORB.

7.3 Usage Constraints

Objects that implement interfaces in the DynamicAny module are intended to be local to the process that constructs and uses them. As a result, references to these objects cannot be exported to other processes or externalized using ORB::object_to_string; an operation that attempts to do so will throw the MARSHAL system exception.

7.4 Creating a DynAny Object

The DynAnyFactory interface is used to create a DynAny object. There are two operations for creating a DynAny object; these are listed in the table below.

Operation	Description
`create_dyn_any`	`Constructs a DynAny object from an Any value`
`create_dyn_any_from_type_code`	`Constructs a DynAny object from a TypeCode`

The example below illustrates how to obtain a reference to the DynAnyFacory object and then use it to construct a DynAny object with each of the create operations. Exception handling is omitted for brevity.

The following line of code imports the classes in the DynamicAny package.

```
import org.omg.DynamicAny.*;
```

The following code segment obtains a reference to the DynAnyFacory object.

```
DynAnyFactory factory = null;
DynAny DynAny = null;
DynAny DynAny2 = null;
org.omg.CORBA.Any any = null;
org.omg.CORBA.TypeCode tc = null;
org.omg.CORBA.Object obj = null;

// obtain a reference to the DynAnyFactory
obj = orb.resolve_initial_references ("DynAnyFactory");

// narrow the reference to the correct type
factory = DynAnyFactoryHelper.narrow (obj);
```

The following code segment creates a DynAny with each of the create operations.

```
// create a DynAny object from an Any
any = orb.create_any ();
any.insert_long (1);
DynAny = factory.create_dyn_any (any);

// create a DynAny object from a TypeCode
tc = orb.get_primitive_tc (org.omg.CORBA.TCKind.tk_long);
DynAny2 = factory.create_dyn_any_from_type_code (tc);
```

If the Any value or TypeCode represents a constructed type then the DynAny can be narrowed to the appropriate subtype, as illustrated below.

The following IDL defines a struct type.

```
// example struct type
struct StructType
{
   long field1;
   string field2;
};
```

The following code segment illustrates the creation of a DynStruct object that represents a value of type StructType.

```
StructType type = null;
DynStruct dynStruct = null;
```

```
// create an Any that contains an object of type StructType
type = new StructType (999, "Hello");
any = orb.create_any ();
StructTypeHelper.insert (any, type);

// construct a DynAny from an Any and narrow it to a DynStruct
dynStruct = (DynStruct) factory.create_dyn_any (any);
```

7.5 Accessing the Value of a DynAny Object

The DynAny interface defines a set of operations for accessing the value of a basic type represented by a DynAny object. The operation to get a value of basic type <type> from a DynAny has the form get_<type>. The operation to insert a value of basic type <type> into a DynAny has the form insert_<type>. A TypeMismatch exception is thrown if the type of the operation used to get/insert a value into a DynAny object does not match the type of the DynAny.

The operations for accessing the value of a constructed type represented by a DynAny are defined in the interface specific to the constructed type. For example, the DynStruct interface defines the operation get_members, which returns a sequence of name/value pairs representing the members of the struct or exception represented by a DynStruct object.

7.6 Traversing the Value of a DynAny Object

DynAny objects can be viewed as an ordered collection of component DynAnys. For example, in a DynStruct object the ordered collection of component DynAnys is the members of the struct or exception it represents. For DynAny objects representing basic types or constructed types that do not have components, the collection of component DynAnys is empty.

All DynAny objects have a current position. For DynAnys representing constructed types that have components, the current position is the index of the component DynAny that would be obtained by a call to the current_component operation (described in the table below). The component DynAnys of a DynAny object are indexed from 0 to n-1, where n is the number of components. For DynAnys representing basic types, or constructed types that do not have components, the current position is fixed at the value -1.

The operations for traversing the component DynAnys of a DynAny object are common to all DynAny subtypes, hence they are defined in the DynAny base interface. The table below lists the operations available for traversing a DynAny object.

Operation	Description
`seek`	`Sets the current position to the specified index`

Operation	Description
rewind	Sets the current position to the first component (index 0)
next	Advances the current position to the next component
component_count	Returns the number of components
current_component	Returns the component at the current position

The following code segment illustrates one way of traversing the component DynAnys of a DynStruct object. As the DynStruct is traversed, the value of each component is obtained and printed. Exception handling is omitted for brevity.

```
DynAny curComp = null;

// print the value of the first component
curComp = dynStruct.current_component ();
System.out.println ("field1 = " + curComp.get_long ());

// advance to the next component
dynStruct.next ();

// print the value of the second component
curComp = dynStruct.current_component ();
System.out.println ("field2 = " + curComp.get_string ());
```

The next code segment illustrates another way to perform the same task.

```
// go back to the first component
dynStruct.rewind ();  // same as calling seek (0)

// print the value of the first component
System.out.println ("field1 = " + dynStruct.get_long ());

// advance to the next component
dynStruct.seek (1);

// print the value of the second component
System.out.println ("field2 = " + dynStruct.get_string ());
```

As the second code segment illustrates, if the component DynAny represents a basic type, its value can be extracted (or inserted) by calling the accessor operation on the parent DynAny directly, rather than first obtaining the component using the current_component operation.

7.7 Constructed Types

This section describes the interfaces in the DynamicAny module that represent the constructed types supported by JacORB. Each of these interfaces extends the DynAny interface.

7.7.1 DynFixed

A DynFixed object represents a fixed value. Since IDL does not have a generic type to represent a fixed type, the operations in this interface use the IDL string type. The value represented by a DynFixed object can be accessed (as a string) using the get_value and set_value operations.

A DynFixed object has no components.

7.7.2 DynEnum

A DynEnum object represents a single enumerated value. The integer (ordinal) value of the enumerated value can be accessed with the get_as_ulong and set_as_ulong operations. The string (IDL identifier) value of the enumerated value can be accessed with the get_as_string and set_as_string operations.

A DynEnum object has no components.

7.7.3 DynStruct

A DynStruct object represents a struct value or an exception value. The current_member_name and current_member_kind operations return the name and TCKind value of the TypeCode of the member at the current position of the DynStruct. The members of the DynStruct can be accessed with the get_members and set_members operations.

The component DynAnys of a DynStruct object are the members of the struct or exception. A DynStruct representing an empty exception has no components.

7.7.4 DynUnion

A DynUnion object represents a union value. The value of the discriminator can be accessed using the get_discriminator and set_discriminator operations.

If the discriminator is set to a value that names a member of the union then that member becomes active. Otherwise, if the value of the discriminator does not name a member of the union then there is no active member.

If there is an active member, the member operation returns its value as a DynAny object, and the member_name and member_kind operations return its name and the TCKind value of its TypeCode. These operations throw an InvalidValue exception if the union has no active member.

A DynUnion object can have either one or two components. The first component is always the discriminator value. The second component is the value of the active member, if one exists.

7.7.5 DynSequence

A DynSequence object represents a sequence. The length of the sequence can be accessed using the get_length and set_length operations. The elements of the sequence can be accessed using the get_elements and set_elements operations.

The component DynAnys of a DynSequence object are the elements of the sequence.

7.7.6 DynArray

A DynArray object represents an array. The elements of the array can be accessed using the get_elements and set_elements operations.

The component DynAnys of a DynArray object are the elements of the array.

7.8 Converting between Any and DynAny Objects

The DynAny interface defines operations for converting between Any objects and DynAny objects. The from_any operation initialises the value of a DynAny with the value of a specified Any. A TypeMismatch exception is thrown if the type of the Any does not match the type of the DynAny. The to_any operation creates an Any from a DynAny.

As an example of how these operations might be useful, suppose one wants to dynamically modify the contents of some constructed type, such as a struct, which is represented as an Any. The following steps will accomplish this task:

1. A DynStruct object is constructed from the TypeCode of the struct using the DynAnyFactory::create_dyn_any_from_type_code operation.
2. The DynAny::from_any operation is used to initialise the value of the DynStruct with the value of the Any.
3. The contents of the DynStruct can now be traversed and modified.
4. A new Any can be created to represent the modified struct using the DynAny::to_any operation.

7.9 Further Examples

The demo/dynany directory of the JacORB repository contains example code illustrating the use of DynAny objects. Further code can be found in the org.jacorb.test.orb.dynany package of the JacORB-Test repository.

8 Objects By Value

Until CORBA 2.3, objects could only be passed using reference semantics: there was no way to specify that object state should be copied along with an object reference. A further restriction of the earlier CORBA versions was that all non-object types (structs, unions, sequences, etc.) were *values*, so you could not use, e.g. a reference-to-struct to construct a graph of structure values that contained shared nodes. Finally, there was no inheritance between structs.

All these shortcomings are addressed by the *objects-by-value* (OBV) chapters of the CORBA specification: the addition of stateful value types supports copy semantics for objects and inheritance for structs, boxed value types introduce reference semantics for base types, and abstract interfaces determine whether an argument is sent by-value or by-reference by the argument's runtime type. The introduction of OBV into CORBA presented a major shift in the CORBA philosophy, which had been to strictly avoid any dependence on implementation details (state, in particular). It also added a considerable amount of marshaling complexity and interoperability problems. (As a personal note: Even in CORBA 2.6, the OBV marshaling sections are still not particularly precise...)

JacORB 2.0 implements most of the OBV specification. Boxed value types and regular value types work as prescribed in the standard (including value type inheritance, recursive value types, and factories). Still missing in the current implementation is run-time support for abstract value types (although the compiler does accept the corresponding IDL syntax), and the marshaling of truncatable value types does not yet meet all the standard's requirements (and should thus be called "beta").

8.1 Example

To illustrate the use of various kinds of value types, here's an example which is also part of the demo programs in the JacORB distribution. The demo shows the use of boxed value types and a recursive stateful value type. Here's the IDL definition from `demo/value/server.idl`:

```
module demo {
  module value {

     valuetype boxedLong   long;
     valuetype boxedString string;

     valuetype Node {
        public long id;
        public Node next;
     };
```

```
     interface ValueServer {
        string receive_long   (in boxedLong p1, in boxedLong p2);
        string receive_string (in boxedString s1, in boxedString s2);
        string receive_list   (in Node node);
     };
  };
};
```

From the definition of the boxed value type `boxedLong` and `boxedString`, the IDL generates the following Java class, which is simply a holder for the long value. No mapped class is generated for the boxed string value type.

```
package demo.value;

public class boxedLong
    implements org.omg.CORBA.portable.ValueBase
{
    public int value;
    private static String[] _ids = { boxedLongHelper.id() };

    public boxedLong(int initial )
    {
        value = initial;
    }
    public String[] _truncatable_ids()
    {
        return _ids;
    }
}
```

The boxed value definitions in IDL above permit uses of non-object types that are not possible with IDL primitive types. In particular, it is possible to pass Java `null` references where a value of a boxed value type is expected. For example, we can call the operation `receive_long` and pass one initialized `boxedLong` value and a null reference, as show in the following snippet from the client code:

```
    ValueServer s = ValueServerHelper.narrow( obj );
    boxedLong boxL = new boxedLong (774);

    System.out.println ("Passing two integers: "
                       + s.receive_long ( boxL , null ));
```

With a regular `long` parameter, a `null` reference would have resulted in a `BAD_PARAM` exception. With boxed value types, this usage is entirely legal and the result string returned from the `ValueServer` object is ‘‘`one or two null values`’’.

A second new possibility of the reference semantics that can be achieved by “boxing” primitive IDL types is *sharing* of values. With primitive values, two variables can have copies of the same value, but they cannot both refer to the same value. This means that when one of the variables is changed, the other one retains its orignal value. With shared values that are *referenced*, both variables would always point to the same value.

The stateful value type `Node` is implemented by the programmer in a class `NodeImpl` (see the JacORB distribution for the actual code). The relationship between this implementation class and the corresponding IDL definition is not entirely trivial, and we will discuss it in detail below.

8.2 Factories

When an instance of a (regular) value type is marshaled over the wire and arrives at a server, a class that implements this value type must be found, so that a Java object can be created to hold the state information. For interface types, which are only passed by reference, something similar is accomplished by the POA, which accepts remote calls to the interface and delivers them to a local implementation class (the *servant*). For value type instances, there is no such thing as a POA, because they cannot be called remotely. Thus, the ORB needs a different mechanism to know which Java implementation class corresponds to a given IDL value type.

The CORBA standard introduces *value factories* to achieve this. Getting your value factories right can be anywhere from trivial to tricky (we will cover the details in a minute), and so the standard suggests that ORBs also provide convenience mechanisms to relieve programmers from writing value factories if possible. JacORB’s convenience mechanism is straightforward:

> *If the implementation class for an IDL value type A is named AImpl, resides in the same package as A, and has a no-argument constructor, then no value factory is needed for that type.*

In other words, if your implementation class follows the common naming convention (“...Impl”), and it provides a no-arg constructor so that the ORB can instantiate it, then the ORB has all that it needs to (a) find the implementation class, and (b) create an instance of it (which is then initialized with the unmarshaled state from the wire).

This mechanism ought to save you from having to write a value factory 99% of them time. It works for all kinds of regular value types, including those with inheritance, and recursive types (where a type has members of its own type).

If you do need more control over the instance creation process, or the unmarshaling from the wire, you can write your own value factory class and register it with the ORB using `ORB.register_value_factory(`*repository_id, factory*`)`. The *factory* object needs to implement the interface `org.omg.CORBA.portable.ValueFactory`, which requires a single method:

```
public Serializable read_value (InputStream is);
```

When an instance of type *repository_id* arrives over the wire, the ORB calls the `read_value()` method, which must unmarshal the data from the input stream, create an instance of the appropriate implementation class from it, and return that.

The easiest way to implement this method is to create an instance of the implementation class, and call the `_read()` method on it, which is defined in the abstract superclass generated by JacORB:

```
public Serializable read_value (InputStream is) {
  A result = new AImpl();
  result._read (is);
  return result;
}
```

The `_read()` method contains all the necessary unmarshaling logic for objects of type A. However, this method won't work as expected for complex value graphs with *back references*: if the state of a value type instance a contains an object that has a reference to a itself, that is a "back reference", and the reference-sharing semantics of value types require the ORB to reproduce this reference structure faithfully upon unmarshaling. However, while the state of the object a is unmarshaled, a itself is not yet finished, and so the back reference would have nothing to point to. For this reason, we must register the implementation object with the unmarshaling engine, *after* it has been created, but *before* its state is actually read:

```
public Serializable read_value (InputStream is) {
  A result = new AImpl();

  // register the instance
  ((org.jacorb.orb.CDRInputStream)is).register_value (result);

  result._read (is);
  return result;
}
```

(`register_value()` is a JacORB-specific extension, there is no standard CORBA mechanism for this.)

The value factory must be registered with the ORB using `register_value_factory()`, as shown above. As a special convenience (defined in the CORBA standard), if the value factory class for type `A` is called `ADefaultFactory`, then the ORB will find it automatically and use it, unless a different factory has been explicitly registered.

It sometimes causes confusion that you can also define *factory methods* in a value type's IDL. These factory methods are completely unrelated to the unmarshaling mechanism discussed above; they are simply a portable means to declare what kinds of "constructors" a value type implementation should have. They are purely for local use, but since they are "factories", the corresponding methods must also be implemented in the type's `ValueFactory` implementation.

9 Interface Repository

Run–time type information in CORBA is managed by the ORB's *Interface Repository* (IR) component. It allows to request, inspect and modify IDL type information dynamically, e.g., to find out which operations an object supports. Some ORBs may also need the IR to find out whether a given object's type is a subtype of another, but most ORBs can do without the IR by encoding this kind of type information in the helper classes generated by the IDL compiler.

In essence, the IR is just another remotely accessible CORBA object that offers operations to retrieve (and in theory also modify) type information.

9.1 Type Information in the IR

The IR manages type information in a hierarchical containment structure that corresponds to the structure of scoping constructs in IDL specifications: modules contain definitions of interfaces, structures, constants etc. Interfaces in turn contain definitions of exceptions, operations, attributes and constants. Figure 9.1 illustrates this hierarchy.

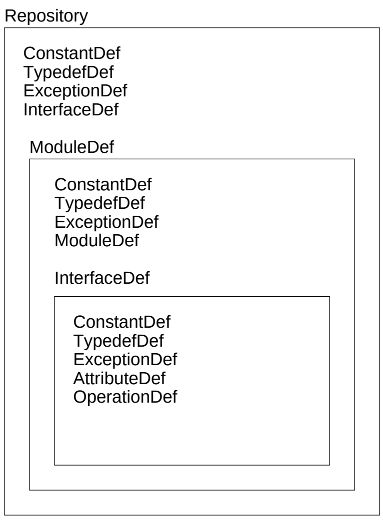


Figure 9.1: Containers in the Interface Repository

The descriptions inside the IR can be identified in different ways. Every element of the repository has a unique, qualified name which corresponds to the structure of name scopes in the IDL specification. An interface I1 which was declared inside module M2 which in turn was declared inside module M1 thus has a qualified name M1::M2::I1. The IR also provides another, much more flexible way of naming IDL constructs using *Repository Ids*. There are a number of different formats for RepositoryIds but every Repository must be able to handle the following format, which is marked by the prefix "IDL:" and also carries a suffix with a version number, as in, e.g., "IDL:jacorb/demo/grid:1.0". The name component between the colons can be set freely using the IDL compiler directives #pragma prefix and #pragma ID. If no such directive is used, it corresponds to the qualified name as above.

9.2 Repository Design

When designing the Interface Repository, our goal was to exploit the Java reflection API's functionality to avoid having to implement an additional data base for IDL type descriptions. An alternative design is to use the IR as a back-end to the IDL compiler, but we did not want to introduce such a dependency and preferred to a have a rather "light–weight" repository server. As it turned out, this design was possible because the similarities between the Java and CORBA object models allow us to derive the required IDL information at run time. As a consequence, we can even do without any IDL at compile time. In addition to this simplification, the main advantage of our approach lies in avoiding redundant data and possible inconsistencies between persistent IDL descriptions and their Java representations, because Java classes have to be generated and stored anyway.

Thus, the Repository has to load Java classes, interpret them using reflection and translate them into the appropriate IDL meta information. To this end, the repository realizes a reverse mapping from Java to IDL. Figure 9.2 illustrates this functionality, where f^{-1} denotes the reverse mapping, or the inverse of the language mapping.

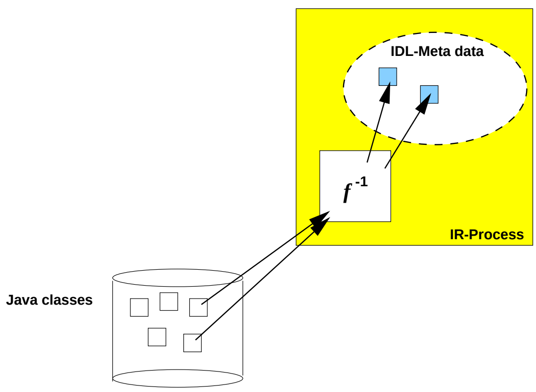


Figure 9.2: The JacORB Interface Repository

9.3 Using the IR

For the ORB to be able to contact the IR, the IR server process must be running. To start it, simply type the `ir` command and provide the required arguments:

```
$ ir /home/brose/classes /home/brose/public_html/IR_Ref
```

The first argument is a path to a directory containing `.class` files and packages. The IR loads these classes and tries to interpret them as IDL compiler–generated classes. If it succeeds, it creates internal representations of the adequate IDL constructs. The second argument on the command line above is simply the name of the file where the IR stores its object reference for ORB bootstrapping.

To view the contents of the repository, you can use the GUI IRBrowser tool or the query command. First, let's query the IR for a particular repository ID. JacORB provides the command `qir` ("query IR") for this purpose:

```
$ qir IDL:raccoon/test/cyberchair/Paper:1.0
```

As result, the IR returns an InterfaceDef object, and `qir` parses this and prints out:

```
interface Paper
{
   void read(out string arg_0);
   raccoon::test::cyberchair::Review getReview(in long arg_0);
   raccoon::test::cyberchair::Review submitReview(
       in string arg_0, in long a rg_1);
   void listReviews(out string arg_0);
};
```

To start the IRBrowser, simply type

```
$ irbrowser
```

Figure 9.3 gives a screen shot of the IR browser.

The Java classes generated by the IDL compiler using the standard OMG IDL/Java language mapping do not contain enough information to rebuild all of the information contained in the original IDL file. For example, determining whether an attribute in an interface was `readonly` or not is not possible, or telling the difference between `in` and `inout` parameter passing modes. Moreover, IDL modules are not explicitly represented in Java, so telling whether a directory in the class path represents an IDL module is not easily possible. For these reasons, the JacORB IDL compiler generates a few additional classes that hold the required extra information if the compiler switch `-ir` is used when compiling IDL files:

```
$ idl -ir myIdlFile.idl
```

The additional files generated by the compiler are:

- a `_XModule.java` class file for any IDL module X
- a `YIRHelper.java` class file for any interface Y.

If no `.class` files that are compiled from these extra classes are found in the class path passed to the IR server process, the IR will not be able to derive any representations. Note that the IDL compiler does not make any non–compliant modifications to any of the standard files that are defined in the Java language mapping — there is only additional information.

One more caveat about these extra classes: The compiler generates the `_XModule.java` class only for genuine modules. Java package scopes created by applying the `-d` switch to the IDL compiler do not represent proper modules and thus do not generate this class. Thus, the contents of these directories will not be considered by the IR.

When an object's client calls the `get_interface()` operation, the ORB consults the IR and returns an `InterfaceDef` object that describes the object's interface. Using `InterfaceDef` operations on this description object, further description objects can be obtained, such as descriptions for operations or attributes of the interface under consideration.

The IR can also be called like any other CORBA object and provides `lookup()` or `lookup_name()` operations to clients so that definitions can be searched for, given a qualified name. Moreover, the complete contents of individual containers (modules or interfaces) can be listed.

Interface Repository meta objects provide further description operations. For a given `InterfaceDef` object, we can inspect the different meta objects contained in this object (e.g., `OperationDef` objects). It is also possible to obtain descriptions in form of a simple structure of type `InterfaceDescription` or `FullInterfaceDescription`. Since structures are passed by value and a `FullInterfaceDescription` fully provides all contained descriptions, no further — possibly remote — invocations are necessary for searching the structure.

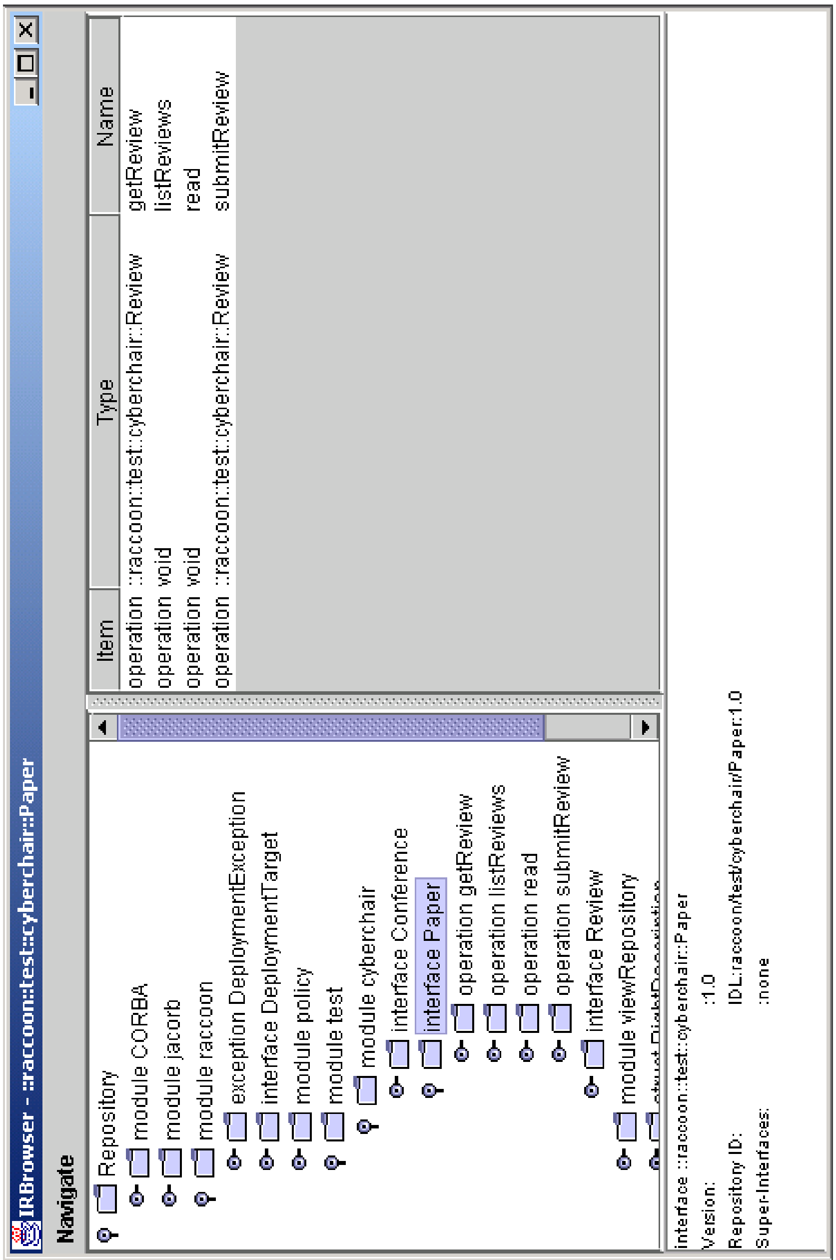


Figure 9.3: IRBrowser Screenshot

10 The JacORB Appligator

by Sebastian Müller and Steve Osselton

Version 1.4 of JacORB includes a new implementation of the Appligator. This is a portable interceptor based IIOP proxy. Using this proxy you can both run Java Applets with JacORB and use JacORB across firewalls and the Internet. This new implementation no longer supports HTTP tunneling.

10.1 Appligator Functionality

The Appligator is a GIOP proxy. When the Appligator is used, instead of a client calling directly to a server it calls to the Appligator which then itself calls on to the server. This is all transparent as far as a client is concerned. The basic mechanism of operation is as follows:

1. A client that wishes to use the Appligator installs a client side interceptor.
2. When the client makes a call the interceptor checks to determine whether the call should be redirected to an Appligator. If so, then the original call target is encoded within a service context and a ForwardRequest exception is thrown so that the ORB redirects the call to the Appligator.
3. When the Appligator receives a forwarded request it extracts the original target from the service context and calls onto the original target. The actual proxy implementation within the Appligator is invoked via DSI and calls on to the target via DII.

10.2 Using The Appligator

The Appligator can be run as a normal CORBA server via the 'appligator' shell script or batch file. The Appligator is configured vis both command line arguments and properties stored in the ORB configuration file 'jacorb.properties'.

10.2.1 Starting Appligator

The Appligator can be invoked as follows:

```
$ appligator <port> <filename> [-dynamic]
```

This starts the Appligator on the specified port and writes it's IOR to the specified file.

The ’-dynamic’ flag is optional and determines whether the object key used for the Appligator IOR is dynamically (i.e. randomly) selected or fixed. If a fixed id is used then the configuration property ’jacorb.ProxyServer.ID’ is used as the object key value. If this is not set then this defaults to ’Appligator’. Using a fixed object key has the advantage that this key is used every time the Appligator restarts so a remote client would not have to update it’s reference to the Appligator (typically an IOR file).

10.2.2 Client Configuration

Appligator clients need to install the appropriate client side interceptor class. This can be done by configuring the portable ORB initializer class ’ProxyClientInitializer’ by setting the following ORB initialization property:

```
org.omg.PortableInterceptor.ORBInitializerClass.org.jacorb.
proxy.ProxyClientInitializer
```

10.2.3 Appligator Configuration Appligator

configuration properties are placed in the ’jacorb.properties’ file, all have the common prefix ’jacorb.ProxyServer’. Configuration properties are used either for the configuration of the Appligator server itself or for the configuration of Appligator clients.

Appligator Server Properties

If the ’jacorb.ProxyServer.Name’ property is set and the name service has been configured and is available then the Appligator will register itself in the name service using this name. If the ’jacorb.ProxyServer.ID’ property is set and the Appligator has not been run with the ’-dynamic’ flag then this property is used as the object key in the created Appligator IOR.

Appligator Client Properties

The ’jacorb.ProxyServer.URL’ configuration property is used by clients to locate the default Appligator. This URL should map to an IOR file written by an Appligator. If the ’jacorb.ProxyServer.Network’ and ’jacorb.ProxyServer.Netmask’ properties are set these are used to determine the local network address for a client. If this is set then any calls to objects within this network will not be redirected to the Appligator. This is useful when a CORBA server may need to call to an Appligator to access remote servers but may want to communicate with local servers directly. The dotted decimal form should be used for both these properties, for example:

```
jacorb.ProxyServer.Netmask=255.255.255.0
```

```
jacorb.ProxyServer.Network=160.45.110.0
```

Clients can be configured to use different Appligators to access objects in different subnets. To do this configuration properties of the form ’jacorb.ProxyServer.URL-¡network¿-¡netmask¿’ can be used. Here the URL property should map to the Appligator IOR for the particular subnet identified by ¡network¿ and ¡netmask¿. For example:

```
jacorb.ProxyServer.URL-160.45.120.0-255.255.255.0=file:/tmp/net1.ior
```

10.3 Applet Support

Regular Java programs can connect to every host on the Internet, applets can only open connections to their applethost (the host they are downloaded from). This lets Applets only use CORBA servers on their applethost, if no proxy is used. With JacORB Appligator, access for your Applets is no longer restricted. Placed on the applethost, Appligator handles all connections from and to your Applet transparently.

Due to the transparency of JacORB Appligator you can write your Applet as if it were a normal CORBA program. The only thing you have to do is to use a special initialization of the ORB by calling the ORB init operation that takes an Applet as a parameter:

```
ORB orb = ORB.init (applet, properties);
```

A normal JacORB program reads a local jacorb.properties file to get the URL of its name server and other vital settings. An Applet of course has no local properties file, but a remote one: You have to place the properties file (which has the same syntax and parameters as the normal file) in the same directory as your Applet (the file name has to be: jacorb.properties, without a leading dot).

Similar to the name server, Appligator writes its IOR to a file. Your Applet has to know the location of this file to retrieve the IOR of Appligator. You must set the location of the IOR file via the jacorb.properties file (jacorb.ProxyServer.URL) or with an Applet parameter in the ¡APPLET¿ HTML tag (JacorbProxyServerURL).

10.3.1 Summary

- Init the ORB with jacorb.orb.init(applet,properties), where applet is this Applet and properties are java.util.Properties (which can be null).
- Put a jacorb.properties file in the directory of the Applet.
- Specify the location for the Appligator IOR file in the jacorb.properties (jacorb.ProxyServer.URL) or in an Applet parameter (JacorbProxyServerURL)
- Make sure the name server IOR file is accessible for the Applet (lies on the applethost)
- Start Appligator on the applethost (web server) with:

  ```
  $ appligator <port> <filename>
  ```

  Where filename is the location where the Appligator IOR is written and is the location specified in the JacORB properties file or Applet parameter.

10.3.2 Applet Properties

As described above there are some ways for the Applet to get its JacORB properties file. The most important property is the URL to the Appligator IOR file. Without this property the Applet will not work. If you use a name server, the URL to the name server IOR must also be specified.

Properties can be set in three ways:

1. In the ORB.init() call with the java.util.Properties parameter.
2. In the JacORB properties file located in the same directory as the Applet
3. The URL to the name server and Appligator IOR file can be set in the Applet tag in the HTML file

10.3.3 Appligator and Netscape/IE, appletviewer

Netscape Navigator/Communicator comes with its own (outdated) CORBA support. You have to delete Netscape's CORBA classes to use JacORB. To do this you have to delete the file iiop10.jar located in NS ROOT/java/classes. It's a good idea to store a backup of Netscape's file in another directory. Note that renaming this jar file in the original directory does not suffice if you don't also change the .jar extension because Netscape loads all jar files in this directory. You then need to install jacorb.jar in this directory.

If Netscape loads wrong classes or throws security exceptions (have a look at Netscape's Java Console to see this) be sure to check your CLASSPATH and look for old jar files or ".". Remove all JacORB and VisiBroker classes from your CLASSPATH. We succeeded running JacORB Applet clients on Netscape 4.72 with the Java 1.3 plugin.

Microsoft's Internet Explorer is stricter than Netscape: Even downloaded classes are not allowed to listen on a socket. We strongly advise to use Sun's Java 1.3 plugin with IE also. To trick IE into using JacORB, you need to copy JacORB classes to $WINNT\Java\TrustLib. You can either copy the entire jacorb.jar and unpack it in this directory or just copy the directories jacorb, org,and HTTPClient.

Appligator works well with Sun's appletviewer. You only have to make the appletviewer replace the Sun's CORBA classes with JacORB's classes. A typical appletviewer call for JacORB Applets looks like this (written in one command line):

```
$ appletviewer http://www.example.com/CORBA/dii example.html
```

There is a shell script called "jacapplet" in JacORB's bin directory, which calls the appletviewer with the appropriate options (you have to edit it to match your local JDK path).

If you use the Appligator with other browsers or if you know a way to load the JacORB classes without removing and copying jars please let us know.

10.3.4 Examples

There are some example applets in the demo directory (jacorb/demo/applet). They are based on the normal examples. The examples include a HTML file which calls the Applet. To run the example start the name server first. Start Appligator on your web server and than the normal example server corresponding to the Applet example on any computer in any order. Then you can call the example Applet with the JDK appletviewer or Netscape.

Be sure to have a jacorb.properties file and the jacorb.jar in place.

10.4 Firewall Support

Typically firewalls do two things: filter traffic by port, and filter traffic by protocol. The JacORB Appligator can be used to deal with port restrictions.

The Appligator was written to avoid the sandbox restrictions for Java applets. Unsigned applets can only have connections to the host they are loaded from, which makes them useless in most distributed CORBA scenarios. The Appligator is a GIOP proxy, which enables applets to connect to every CORBA server by redirecting the traffic from the Applet to the CORBA server to the proxy. The Appligator also works the other way round: Every connection the Applet is redirected to the Appligator.

Even without applets the Appligator can be used as a GIOP proxy on a firewall. The Appligator is a CORBA object itself and is explicitly started on a given port using a command line argument ¡port¿. All incoming traffic to the Appligator will go to port ¡port¿. If you configure your CORBA object behind the firewall to be aware of the Appligator all traffic from and to this objects will go through the Appligator.

To make your port filtering firewall working with CORBA and GIOP messages you must ask your system administrator to assign a port for GIOP messages on the firewall. Start the Appligator on this port.

Now all CORBA servers (which are aware of the Appligator) in your enclave can be contacted over the Appligator. If your CORBA client wants to contact a server in the Internet outside the firewall the connection will go over the Appligator. Callbacks from the Internet to your client do not work with Netscape.

Finally you have to specify the location on the Appligator. This is done the same way as JacORB determines to location of the name server: When the Appligator starts the IOR of the Appligator is written to a file which is put to the location you specified as command parameter. This file must be accessible to all clients that want to use the Appligator. You can use a shared file system to access this file or put it on a web server etc. The location of the file in which the IOR of the Appligator is stored must be set in the jacorb.properties file. Use the ”jacorb.ProxyServer.URL” property for this.

10.4.1 Summary

- Use the Appligator as a GIOP proxy on a firewall if your firewall is configured to block all traffic but traffic on some special ports.
- Ask your system administrator to assign a special port for GIOP on your firewall and start the Appligator on this port on the firewall: for example: `$ appligator 7777 app.ior`
- All CORBA objects that should be reachable from outside the firewall or need to contact a CORBA object outside the firewall must use the Appligator as a proxy. Configure the client side ORB

initializer for those applications

- Set the location of the Appligator in the jacorb.properties file of your clients (jacorb.ProxyServer.URL)

10.4.2 NAT Firewalls

Most commercial firewalls support Network Address Translation (NAT). Here the address of an internal server is not made directly visible to the external Internet, but transformed into another configured address (typically that of the firewall).

The problem here is that the IOR written by an Appligator will contain it's internal address. If a remote client wishes to access this Appligator via a NAT firewall then it cannot use this IOR direct as it will not contain a routeable address. To support this the Appligator IOR used by a remote client must be patched to contain the NAT address of the firewall. A new utility 'fixior' has been provided to do this. This can be run as follows:

```
$ fixior <host> <port> <ior_file>
```

10.4.3 Security Considerations

When allowing Appligator traffic through a fixed port in a firewall the Appligator can in effect allow access to any internal CORBA server. As the real service target is contained within a service context a knowledgeable user could attempt to exploit this to access an unauthorized service. To do this a hacker would have to know the object key used for the Appligator and a CORBA reference to an internal service. For this reason if fixed Appligator keys are used it is recommended that the default value is not used. A much better solution is to tunnel the Appligator communication through a secure channel such as afforded by a Secure Shell (SSH) or a Virtual Private Network (VPN).

10.4.4 Use of SSH

Rather than configure a firewall to allow direct access to an Appligator a better solution is to enable SSH and use SSH as a secure tunnel to the Appligator. To do this you first need to patch the Appligator IOR file used by the client so that this refers to a local port on the local host:
`$ fixior 127.0.0.1 11111 app.ior`

SSH can then be used to create a secure tunnel between this port and the remote port on the server machine used by the Appligator. If the Appligator was running on remote machine 'server' on port 22222 this could be done as follows:

```
$ ssh -T -L 11111:server:22222 server
```

If you have a scenario where the server needs to callback to a client and dual Appligators are deployed on either side of a firewall then SSH can be used to create a tunnel for each Appligator as follows:

```
$ ssh -T -L 11111:server:22222 -R 33333:client:44444 server
```

Here SSH has created a local tunnel between port 11111 on 'client' and port 22222 on 'server' and a remote tunnel between port 33333 on 'server' and port 44444 on 'client'. The 'server' Appligator would be running on port 22222 and the 'client' Appligator on port 44444. The Appligator IOR used by 'client' to access the 'server' Appligator would be patched to have endpoint 127.0.0.1:11111 and the Appligator IOR used by 'server' to access the 'client' Appligator would be patched to have endpoint 127.0.0.1:33333.

11 IIOP over SSL

Using SSL to authenticate clients and to protect the communication between client and target requires no changes in your source code. The only notable effect is that SSL/TLS type sockets are used for transport connections instead of plain TCP sockets — and that connection setup takes a bit longer.

The only prerequisites are that you rebuild JacORB with cryptography support. You also need to set up a key store file that holds your cryptographic keys, and to configure SSL by setting a few properties. All of this is described in this chapter.

11.1 Re–Building JacORB's security libraries

In the standard distribution, the JacORB security libraries are not enabled. To do so, you simply need to recompile JacORB with the required SSL libraries in your CLASSPATH. If these libraries are not found, JacORB will be rebuilt without SSL support.

To successfully rebuild JacORB with SSL support, the following is required:

- when using IAIKs libraries:
  - IAIK-JCE 2.591 or later, the security provider classes downloadable from http://jcewww.iaik.tu-graz.ac.at,
  - iSaSiLk 3.0 or later, the SSL implementation from the same source.
- when using Suns libraries:
  - JDK 1.4 or jsse1.0.2 available from the Developer Connection (for jsse1.0.2, please see the `README.jsse_1_0_2` in `src/org/jacorb/security/ssl/sun_jsse` on how to compile).
  - For key management, you also need additional packages like OpenSSL. These are not necessary for JacORB to work.

Install the desired packages and read the documentation carefully. After successfull installation, build JacORB anew by typing `ant` in your JacORB installation directory.

11.2 IAIK specific setup

This section covers topics that are specific to IAIKs libraries.

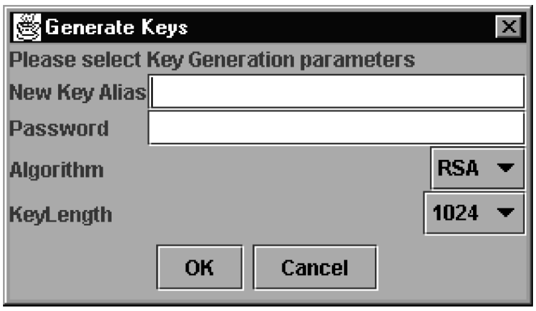
11.2.1 Setting up an IAIK key store

SSL relies on public key certificates in the standard X.509 format. These certificates are presented in the authentication phase of the SSL handshake and used to compute and exchange session keys. This section explains how to create and store these certificates.

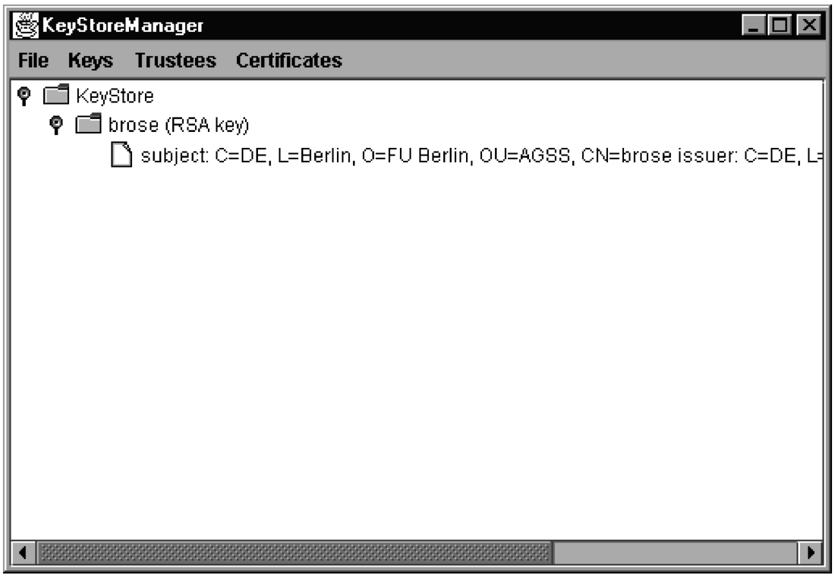
The Java 2 security API provides interfaces that access a persistent data structure called *KeyStore*. A key store is simply a file that contains public key certificates and the corresponding private keys. It also contains other certificates that can be used to verify public key certificates. All cryptographic data is protected using passwords and accessed using names called *aliases*.

JacORB provides a GUI tool to create and manipulate key store files, the KeyStoreManager. It can generate key pairs, sign public keys, import or export certificates, and define trusted certificate authorities. To start the KeyStoreManager, simply type `ks` on the command line. The GUI lets you select and open existing key store files, or create new ones.

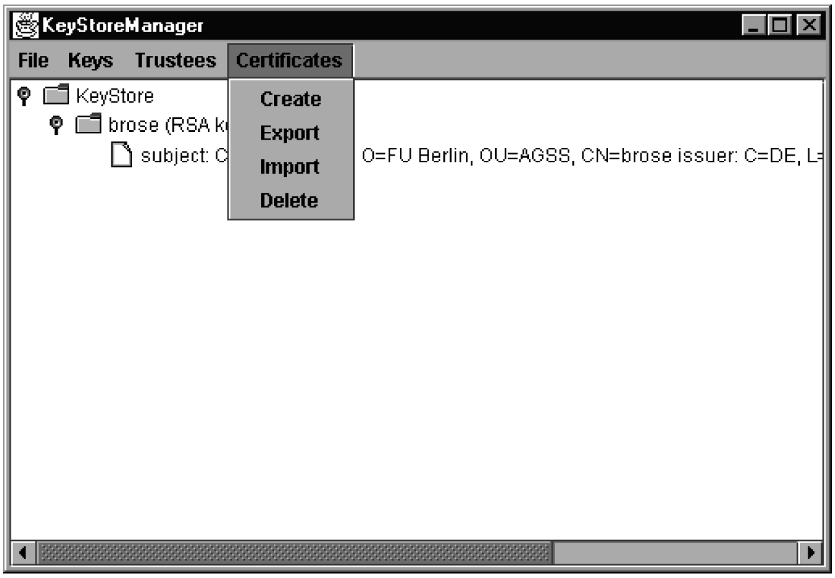
Starting with an empty key store, you first need to create a new key store and then a key pair and certificate. Select `New` from the `File` menu to create a key store, and then `New` from the `Keys` menu. You will then be asked to provide a new alias name for your new key entry. You also need to choose a password. You can leave the algorithm and key length fields in the combobox menu unchanged.



You now have a public key certificate that you can present for authentication, claiming identity with the alias name that has been embedded in the certificate. Since anybody could present such a certificate, receivers require that the certificate be digitally signed by someone they trust, a *Certificate Authority* (CA). By signing the certificate, a CA supports the identity claim of the certificate subject. Whose signature is accepted as trustworthy is just a matter of configuration, but normally proper CAs are expected to only sign certificates that they have carefully scrutinized — or even created themselves.



For convenience you can act as a CA yourself, using the KeyStoreManager GUI to import certificates and then sign and export them again. The originating key store can then re–import the certificate that now bears the digital signature of someone acting as a CA. The key store has a standard key chain format that must be used to store public key certificates. The first entry in the key chain is your own public key certificate as generated by the key store. It is automatically signed with its own private key. Second in the chain is the public key certificate that is signed by the CA. The last entry in a key chain must hold the CA's public key certificate, signed using its private key. Trust in the CA key is "axiomatic".



You can check the validity of a key chain by selecting an alias and then choosing `Verify Chain` from the `Keys` menu. Unless the key chain has the proper format *and* the CA's public key certificate is also declared as trusted using the `Trustees--add` menu, the verification will fail. Only of the verification succeeds will you be able to use a public key certificate in the SSL connection setup. More documentation on key stores can be found in the Java tool documentation for the `keytool` command. If you care for “real” security, be advised that setting up and managing (or finding) a properly administered CA is essential for the overall security of your system.

Finally, note that key stores are normally used only for client authentication in JacORB. Servers may, but need not, have their own keys and passwords because server authentication is optional and not mandatory like client authentication. Technically, this is achieved by exchanging the client and server roles at SSL setup. This is entirely transparent to applications, of course, but might prevent interoperation with other ORBs over SSL if their SSL setup is not prepared to handle this role change.

11.2.2 Step–By–Step certificate creation

In order to generate a simple public key infrastructure you can perform the following steps:

1. Create new keystores (File/new) and keypairs (Keys/new) for the CA and for the user.
2. Open the user keystore (File/open), select the key entry and export the self-signed certificate (Certificates/Export).
3. Open the CA keystore and add the user certificate as a Trustee (Trustees/add. . .).
4. Select the trusted user certificate and create a signed public key certificate (Certificates/Create). Leave the role name field empty, enter the CAs private key password and save the new certificate by clicking OK.
5. Export the CAs self-signed certificate to a file (as explained above). Delete the trusted certificate from the CA keystore (Trustees/Delete).
6. Open the user keystore again. Select the key entry, the import the CA-signed user cert (Certificates/Import), and the self-signed CA cert.
7. Add the self-signed CA cert as a trustee. This is only needed for verifying the chain, therefor the keystore can be deployed without it. Please note that a failed verification might result in a SignatureException.

11.3 Configuring SSL properties

When the ORB is initialized by the application, a couple of properties are read from files and the command line. To turn on SSL support, you have to set the following property to “on”:

```
jacorb.security.support_ssl=on
```

This will just load the SSL classes on startup. The configuration of the various aspects of SSL is done via additional properties.

As explained in the previous section, cryptographic data (key pairs and certificates) is stored in a keystore file. To configure the file name of the keystore file, you need to define the following property:

```
jacorb.security.keystore=AKeystoreFileName
```

The keystore file name can either be an absolute path or relative to the home directory. Keystores are searched in this order, and the first one found is taken. If this property is not set, the user will be prompted to enter a keystore location on ORB startup.

To avoid typing in lots of aliases and passwords (one for the key store, and one for each entry that is used), you can define default aliases and passwords like this:

```
# the name of the default key alias to look up in the keystore
jacorb.security.default_user=brose
jacorb.security.default_password=jacorb
```

These SSL settings can be further refined using security options as in the following property definitions:

```
jacorb.security.ssl.client.supported_options=0
jacorb.security.ssl.client.required_options=0

jacorb.security.ssl.server.supported_options=0
jacorb.security.ssl.server.required_options=0
```

The value of these security options is a bit mask coded as a hexadecimal integer. The meanings of the individual bits is defined in the CORBA Security Service Specification and reproduced here from the `Security.idl` file:

```
typedef unsigned short   AssociationOptions;

const AssociationOptions NoProtection = 1;
const AssociationOptions Integrity = 2;
const AssociationOptions Confidentiality = 4;
const AssociationOptions DetectReplay = 8;
const AssociationOptions DetectMisordering = 16;
const AssociationOptions EstablishTrustInTarget = 32;
const AssociationOptions EstablishTrustInClient = 64;
const AssociationOptions NoDelegation = 128;
const AssociationOptions SimpleDelegation = 256;
const AssociationOptions CompositeDelegation = 512;
```

11.3.1 Client side configuration

```
jacorb.security.ssl.client.supported_options=20 //EstablishTrustInTarget
```

This value indicates that the client can use SSL. Actually, this is default SSL behaviour and must always be supported by the client.

```
jacorb.security.ssl.client.supported_options=40 //EstablishTrustInClient
```

This makes the client load it's own key/certificate from it's keystore, because it must be prepared to authenticate to the server.

```
jacorb.security.ssl.client.required_options=20 //EstablishTrustInTarget
```

This enforces SSL to be used.

```
jacorb.security.ssl.client.required_options=40 //EstablishTrustInClient
```

This enforces SSL to be used. Actually, this is no meaningfuly value, since in SSL, the client can't force it's own authentication to the server.

11.3.2 Server side configuration

```
jacorb.security.ssl.server.supported_options=1 //NoProtection
```

This tells the clients that the server also supports unprotected connections. If NoProtection is set, no required options should be set as well, because they override this value.

```
jacorb.security.ssl.server.supported_options=20 //EstablishTrustInTarget
```

This value indicates that the server supports SSL. Actually, this is default SSL behaviour and must always be supported by the server. This also makes the server load it's key/certificate from the keystore.

```
jacorb.security.ssl.server.supported_options=40 //EstablishTrustInClient
```

This value is ignored, because authenticating the client is either required, or not done at all (the client can't force its own authentication).

```
jacorb.security.ssl.server.required_options=20 //EstablishTrustInTarget
```

This enforces SSL to be used.

```
jacorb.security.ssl.server.required_options=40 //EstablishTrustInClient
```

This enforces SSL to be used, and will request the client to authenticate. It also will load trusted certificates for the authentication process.

12 BiDirectional GIOP

BiDirectional GIOP has its main use in configurations involving callbacks with applets or firewalls where it sometimes isn't possible to open a direct connection to the desired target. As a small example, imagine that you want to monitor the activities of a server via an applet. This would normally be done via a callback object that the applet registers at the server, so the applet doesn't have to poll the server for events. To accomplish this without BiDirectional GIOP, the server would have to open a new connection to the client which will not work because applets usually arent allowed to act as servers, i.e. open ServerSockets. At this point BiDirectional GIOP can help because it allows to reuse the connection the applet opened to the server for GIOP requests from the server to the applet (which isn't allowed in "standard" GIOP).

12.1 Setting up Bidirectional GIOP

Setting up BiDirectional GIOP consists of two steps:

1. Setting an ORBInitializer property and creating the BiDir policy
2. Adding this policy to the servant's POA.

12.1.1 Setting the ORBInitializer property

The first thing that is necessary for BiDirectional GIOP to be available is the presence of the following property, which can be added by the usual ways (see section 2.2.2):

```
org.omg.PortableInterceptor.ORBInitializerClass.bidir_init=
    org.jacorb.orb.connection.BiDirConnectionInitializer
```

If this property is present on ORB startup, the corresponding policy factory and interceptors will be loaded.

12.1.2 Creating the BiDir Policy

Creating the necessary BiDir Policy is done via a policy factory hidden in the ORB.

```
import org.omg.BiDirPolicy.*;
```

```
import org.omg.CORBA.*;

[...]

Any any = orb.create_any();
BidirectionalPolicyValueHelper.insert( any, BOTH.value );

Policy p  = orb.create_policy( BIDIRECTIONAL_POLICY_TYPE.value,
                               any );
```

The value of the new policy is passed to the factory inside of an any. The ORB is the told to create a policy of the specified type with the specified value. The newly created policy is then used to create a user POA. Please note that if *any* POA of has this policy set, *all* connections will be enabled for BiDirectional GIOP, that is even those targeted at object of POAs that don't have this policy set. For the full source code, please have a look at the bidir demo in the `demo` directory.

12.2 Verifying that BiDirectional GIOP is used

From inside of your application, it is impossible to tell whether requests arrived over a unidirectional or BiDirectional connection. Therefore, to check if connections are used in both directions, you can either use a network monitoring tool or take a look at JacORBs output to tell you if your server created a new connection to the client, or if the existing one is being reused.

If the debug level is set to 2 or larger, the following output on the server side will tell you that a connection is being reused:

```
[ ConnectionManager: found conn to target <my IP>:<my port> ]
```

If, on the other hand, the connection is not being reused, the client will show the following output:

```
[ Opened new server-side TCP/IP transport to <my host>:<my port> ]
```

12.3 TAO interoperability

There is one problem that may prevent TAO and JacORB to interoperate using BiDirectional GIOP: If JacORB uses IP addresses as host names (JacORBs default) and TAO uses DNS names as host names (TAOs default), connections from JacORB clients to TAO servers will not be reused. If, on the other hand, both use the same “format” for host addresses, interoperability will be successful. There are two ways to solve this problem:

1. Use `‘‘-ORBdotteddecimaladdresses 1’’` as an command line argument to the TAO server.
2. Recompile JacORB with DNS support (See the INSTALL file for more information).

13 Portable Interceptors

Since revision 1.1 JacORB provides support for Portable Interceptors These interceptors are compliant to the standard CORBA specification. Therefore we don't provide any documentation on how to program interceptors but supply a few (hopefully helpful) hints and tips on JacORB specific solutions.

The first step to have an interceptor integrated into the ORB is to register an *ORBInitializer*. This is done by setting a property the following way:

```
org.omg.PortableInterceptor.ORBInitializerClass.<any_suffix>=
   <orb initializer classname>
```

For compatibility reasons with the spec, the properties format may also be like this:

```
org.omg.PortableInterceptor.ORBInitializerClass.<orb initializer classname>
```

The suffix is just to distinguish between different initializers and doesn't have to have any meaningful value. The value of the property however has to be the fully qualified classname of the initializer. If the verbosity is set to ≥ 2 JacORB will display a `ClassNotFoundException` in case the initializers class is not in the class path.

An example line might look like:

```
org.omg.PortableInterceptor.ORBInitializerClass.my_init=
   test.MyInterceptorInitializer
```

Unfortunately the interfaces of the specification don't provide any access to the ORB. If you need access to the ORB from out of the initializer you can cast the `ORBInitInfo` object to `jacorb.orb.portableInterceptor.ORBInitInfoImpl` and call `getORB()` to get a reference to the ORB that instantiated the initializer.

When working with service contexts please make sure that you don't use `0x4A414301` as an id because a service context with that id is used internally. Otherwise you will end up with either your data not transfered or unexpected internal exceptions.

14 Asynchronous Method Invocation

JacORB allows you to invoke objects asynchronously, as defined in the *Messaging* chapter of the CORBA specification (chapter 22 in CORBA 3.0). Only the callback model is implemented at this time; there is no support for polling yet.

Asynchronous Method Invocation (AMI) means that when you invoke a method on an object, control returns to the caller immediately; it does not block until the reply has been received from the remote object. The results of the invocation are delivered later, as soon as they are received by the client ORB. Asynchronous Invocation is entirely a client-side feature. The server is never aware whether it is invoked synchronously or asynchronously.

In the callback model, replies are delivered to a special *ReplyHandler* object that is registered at the client side when the asynchronous invocation is started. Here is a brief example for this (see the *Messaging* specification for further details). Suppose you have a Server object, defined in a file server.idl.

```
interface Server
{
    long operation (in long p1, inout long p2);
};
```

The first step is to compile this IDL definition with the "ami_callback" compiler switch:

```
idl -ami_callback server.idl
```

This lets the compiler generate an additional ReplyHandler class, named AMI_ServerHandler. For each operation of the Server interface, this class has an operation with the same name that receives the return value and out parameters of the original operation. There is an additional method named operation_excep that is called if the invocation raises an exception. If it were defined in IDL, the ReplyHandler class for the above Server would look like this:

```
interface AMI_ServerHandler : Messaging::ReplyHandler
{
   void operation (in long ami_return_val, in long p2);
   void operation_excep (in Messaging::ExceptionHolder excep_holder);
};
```

To implement this interface, extend the corresponding POA class (or use the tie approach), as with any CORBA object:

```
public class AMI_ServerHandlerImpl extends AMI_ServerHandlerPOA
{
     public void operation (int ami_return_val, int p2)
     {
         System.out.println ("operation reply received");
     }

     public void operation_excep
              (org.omg.Messaging.ExceptionHolder excep_holder)
     {
         System.out.println ("received an exception");
     }

}
```

For each method m of the original Server interface, the IDL compiler generates a special method sendc_m into the stub class if the "ami_callback" switch is on. The parameters of this method are (1) a reference to a ReplyHandler object, and (2) all *in* or *inout* parameters of the original operation, with their mode changed to *in* (*out* parameters are omitted from this operation). The sendc operation does not have a return value.

To actually make an asynchronous invocation, an instance of the ReplyHandler needs to be created, registered with the ORB, and passed to the sendc method. The code for this might look as follows:

```
ORB    orb = ...
Server s   = ...

// create handler and obtain a CORBA reference to it
AMI_ServerHandler h = new AMI_ServerHandlerImpl()._this (orb);

// invoke sendc
((_ServerStub)s).sendc_operation (h, 4, 5);
```

Note that the sendc operation is only defined in the stub, and therefore the cast is necessary to invoke it. There is not yet any consensus in the OMG whether the sendc operation should also be declared in any of the Java interfaces that make up the Server type. Thus, the fact that you need to make a cast to the stub class may change in a future version of JacORB.

If you want to try asynchronous invocations with code such as above, make sure that your client process does something else or at least waits after the invocation has been made, otherwise it will likely exit before the reply can be delivered to the handler.

The *Messaging* specification also defines a number of CORBA policies that allow you to control the timing of asynchronous invocations. Since these policies are applicable to both synchronous and asynchronous invocations, we describe them in a separate section (see chapter 15).

15 Quality of Service

JacORB implements a subset of the QoS policies defined in chapter 22.2 of the CORBA 3.0 specification. In the following, we describe each of the policies we have currently implemented, along with notes on particular JacORB issues concerning each policy. Policies not listed in the following are not yet implemented.

As of yet, all the policies in this chapter are *client-side override policies*. That means that you must specify them for individual objects, always using the same mechanism:

Step 1. Get an Any from the ORB and put the value for the policy into it.

Step 2. Get a Policy object from the ORB which encapsulates the desired value (the Any value from the previous step).

Step 3. Apply the policy to a particular object using *_set_policy_override()*.

Here is the code for this, using the *SyncScopePolicy* (described in the following section) as an example:

```
SomeCorbaType     server = ...
org.omg.CORBA.ORB orb    = ...
org.omg.CORBA.Any a      = orb.create_any();
a.insert_short (SYNC_WITH_SERVER.value); // policy value
try
{
    Policy p =
        orb.create_policy(SYNC_SCOPE_POLICY_TYPE.value, a);
    server._set_policy_override (new Policy[]{ p },
                                 SetOverrideType.ADD_OVERRIDE);
}
catch (PolicyError e)
{
    throw new RuntimeException ("policy error: " + e);
}
```

Because this is somewhat cumbersome to write, JacORB allows you to simplify it by creating the Policy object directly via its constructor:

```
SomeCorbaType server  = ...

Policy p = new org.jacorb.orb.policies.SyncScopePolicy
                                  (SYNC_WITH_TARGET.value);
server._set_policy_override (new Policy[]{ p },
                             SetOverrideType.ADD_OVERRIDE);
```

See the package org.jacorb.orb.policies to find out which constructors are defined for the individual policy types.

15.1 Sync Scope

The *SyncScopePolicy* specifies at which point a oneway invocation returns to the caller. (The policy is ignored for non-oneway invocations.) There are four possible values:

SYNC_NONE The invocation returns immediately.

SYNC_WITH_TRANSPORT The invocation returns after the request has been passed to the transport layer.

SYNC_WITH_SERVER The server sends an acknowledgement back to the client when it has received the request, but *before* actually invoking the target. The client-side call blocks until this acknowledgement has been received.

SYNC_WITH_TARGET An ordinary reply is sent back by the server, *after* the target invocation has completed. The client-side call blocks until this reply has been received.

The default mechanism in JacORB is *SYNC_WITH_TRANSPORT*, since the call to the socket layer is a synchronous one. In order to implement *SYNC_NONE*, an additional thread is created on the fly which in turn calls the socket layer, while the client-side invocation returns after this thread has been created. Given this additional overhead, it is unlikely that *SYNC_NONE* yields a significant performance gain for the client, not even on a multiprocessor machine.

15.2 Timing Policies

For each CORBA request four different points in time can be specified:

Request Start Time the time after which the request may be delivered to its target

Request End Time the time after which the request may no longer be delivered to its target

Reply Start Time the time after which the reply may be delivered to the client

Reply End Time the time after which the reply may no longer be delivered to the client

Each of these points in time can be specified on a per-object level as a client-side override policy: *RequestStartTimePolicy*, *RequestEndTimePolicy*, *ReplyStartTimePolicy*, and *ReplyEndTimePolicy* (see below for concrete code examples).

Each of these policies specifies an absolute time, which means that they will usually have to be set again for each individual request. As a convenience, there are two additional policies that allow you to specify a *relative* time for *Request End Time* and *Reply End Time*; they are called *RelativeRequestTimeoutPolicy* and *RelativeRoundtripTimeoutPolicy*, respectively. These timeouts are simply more convenient ways for expressing these two times; before each individual invocation, the ORB computes absolute times from them (measured from the start of the invocation at the client side) and handles them just as if an absolute *Request End Time* or *Reply End Time* had been specified. We will therefore only discuss the four absolute timing policies below.

All of these policies apply to synchronous and asynchronous invocations alike.

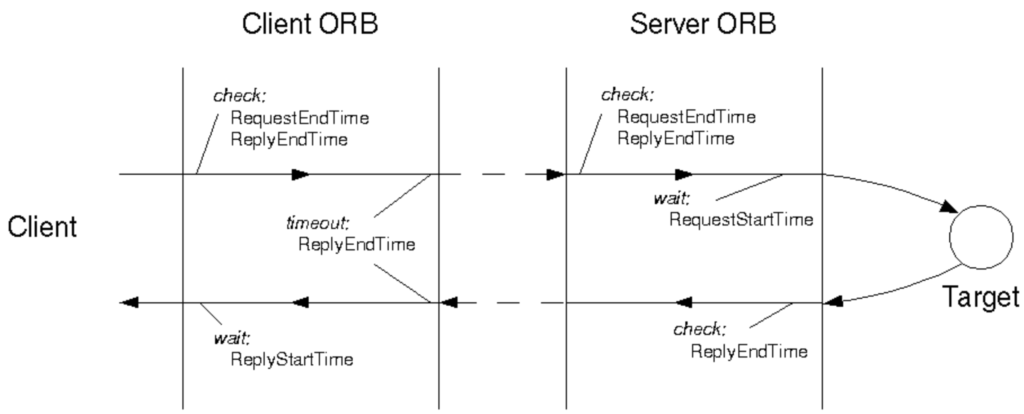


Figure 15.1: Timing Policies in JacORB

Figure 15.1 shows how JacORB interprets the timing policies in the course of a single request.

- As soon as the ORB receives control (prior to marshaling), it converts any *RelativeRequestTimeoutPolicy* or *RelativeRoundtripTimeoutPolicy* to an absolute value, by adding the relative value to the current system time.

- The ORB then checks whether *Request End Time* or *Reply End Time* have already elapsed. If so, no invocation is made, and an `org.omg.CORBA.TIMEOUT` is thrown to the client.
- After the ORB has sent the request, it waits for a reply until *Reply End Time* has elapsed. If it receives no reply before that, the request is discarded and an `org.omg.CORBA.TIMEOUT` thrown to the client. (JacORB does not currently cancel the outstanding request, it simply discards the reply, should one arrive after the timeout has elapsed.)
- On the server side (before demarshaling), the ORB checks whether *Request End Time* or *Reply End Time* have already elapsed. If so, the request is not delivered to the target, and an `org.omg.CORBA.TIMEOUT` is thrown back to the client.
- If the request proceeds, the ORB waits until the *Reply Start Time* has been reached, if one was specified, and has not already elapsed. After that, the request is delivered to the target.
- After the target has returned control to the ORB, it checks whether *Reply End Time* has already elapsed. If it has, the ORB sends an `org.omg.CORBA.TIMEOUT` back to the client, rather than the actual reply.
- If the reply arrives at the client before *Reply End Time* has elapsed, the ORB waits until *Reply Start Time* has been reached, if one was specified, and has not already elapsed. After that, the reply is delivered back to the client.

The bottom line of this is that for a simple, per-invocation timeout, you should specify a *RelativeRoundtripTimeoutPolicy*. Note that since this relative time is converted into an absolute time, and also checked on the server side, the clocks on both the server and the client need to be synchronized at least to the same order of magnitude as the desired timeout.

Programming

In CORBA, points of time are specified to an accuracy of 100 ns, using values of struct `TimeBase::UtcT`. To allow easy manipulation of such values from Java, JacORB provides a number of static methods in `org.jacorb.util.Time`. For example, to convert the current Java time into a `UtcT` value, write

```
UtcT currentTime = org.jacorb.util.corbaTime();
```

To create a `UtcT` value that specifies a time n ms in the future, you can write

```
UtcT time = org.jacorb.util.corbaFuture (10000 * n);
```

(The argument to `corbaFuture()` is in CORBA time units of 100 ns; we multiply n by 10000 here to convert it from Java time units (milliseconds).)

The following shows how to set a timing policy for an object using the standard mechanism (see the beginning of this chapter for an explanation). In this example, we set a *Reply End Time* that lies one second in the future:

```
import org.omg.CORBA.*;

SomeCorbaType server  = ...  // the object for which we want to set
                             // a timing policy
org.omg.CORBA.ORB orb = ...
org.omg.CORBA.Any a   = orb.create_any();

org.omg.TimeBase.UtcT replyEndTime
    = org.jacorb.util.Time.corbaFuture (1000);  // one second

org.omg.TimeBase.UtcTHelper.insert (a, replyEndTime);

try
{
    Policy p
        = orb.create_policy (REPLY_END_TIME_POLICY_TYPE.value, a);
    server._set_policy_override (new Policy[]{ p },
                                 SetOverrideType.ADD_OVERRIDE);
}
catch (PolicyError e)
{
    ...
}
```

Using the constructors of JacORB's implementations of policy values, this becomes less verbose:

```
SomeCorbaType server  = ...

Policy p = new org.jacorb.orb.policies.ReplyEndTimePolicy
                         (org.jacorb.util.Time.corbaFuture (1000));

server._set_policy_override (new Policy[]{ p },
                             SetOverrideType.ADD_OVERRIDE);
```

Likewise, to set a *Relative Roundtrip Timeout* of one second, write:

```
SomeCorbaType server  = ...

Policy p =
    new org.jacorb.orb.policies.RelativeRoundtripTimeoutPolicy (1000);

server._set_policy_override (new Policy[]{ p },
                             SetOverrideType.ADD_OVERRIDE);
```

The difference between this and the example before, where a *Reply End Time* was used, is that the latter specifies a *relative time* to CORBA. The policy will therefore be valid for all subsequent invocations, because the absolute deadline will be recomputed before each invocation. In the first example, the deadline will no longer make sense for any subsequent invocations, since only an absolute time was specified to the ORB.

16 Connection Management and Connection Timeouts

JacORB offers a certain level of control over connections and timeouts. You can

- set connection idle timeouts.
- set request timing.
- set the maximum number of accepted TCP/IP connections on the server.

16.1 Timeouts

Connection idle timeouts can be set individually for the client and the server. They control how long an idle connection, i.e. a connections that has no pending replies, will stay open. The corresponding properties are `jacorb.connection.client_idle_timeout` and `jacorb.connection.server_timeout` and take their values as microseconds. If not set, connections will stay open indefinitely (or until the OS decides to close them).

Request timing controls how long an individual request may take to complete. The programmer can specify this using QoS policies, discussed in chapter 15.

16.2 Connection Management

When a client wants to invoke a remote object, it needs to send the request over a connection to the server. If the connection isn't present, it has to be created. In JacORB, this will only happen once for every combination of host name and port. Once the connection is established, all requests and replies between client and server will use the same connection. This saves resources while adding a thin layer of necessary synchronization, and is the recommended approach of the OMG. Occasionally people have requested to allow for multiple connections to the same server, but nobody has yet presented a good argument that more connections would speed up things considerably.

On the server side, the property `jacorb.connection.max_server_transports` allows to set the maximum number of TCP/IP connections that will be listened on for requests. When using a network sniffer or tools like netstat, more inbound TCP/IP connections than the configured number may be displayed. This is for the following reason: Whenever the connection limit is reached, JacORB tries to close existing idle connections (see the subsection below). This is done on the thread that accepts the new connections, so JacORB will not actively accept more connections. However, the ServerSocket is initialized with a backlog of 20. This means that 20 more connections will be quasi-accepted by the OS. Only the 21st will be rejected right away.

16.2.1 Basics and Design

Whenever there is the need to close an existing connection because of the connection limit, the question arises on which of the connection to close. To allow for maximum flexibility, JacORB provides the interface `SelectionStrategy` that allows for a custom way to select a connection to close. Because selecting a connection usually requires some sort of statistical data about it, the interface `StatisticsProvider` allows to implement a class that collects statistical data.

```
package org.jacorb.orb.connection;

public interface SelectionStrategy
{
    public ServerGIOPConnection
        selectForClose( java.util.List connections );
}

public interface StatisticsProvider
{
    public void messageChunkSent( int size );
    public void flushed();
    public void messageReceived( int size );
}
```

The interface `SelectionStrategy` has only the single method of `selectForClose()`. This is called by the class `GIOPConnectionManager` when a connection needs to be closed. The argument is a `List` containing objects of type `ServerGIOPConnection`. The call itself is synchronized in the `GIOPConnectionManager`, so no additional synchronization has to be done by the implementor of `SelectionStrategy`. When examining the connections, the strategy can get hold of the `StatisticsProvider` via the method `getStatisticsProvider()` of the class `GIOPConnection`. The strategy implementor should take care only to return idle connections. While the connection state is checked anyway while closing (it may have changed in the meantime), it seems to be more efficient to avoid cycling through the connections. When no suitable connection is available, the strategy may return `null`. The `GIOPConnectionManager` will then wait for a configurable time, and try again. This goes on until a connection can be closed.

The interface `StatisticsProvider` is used to collect statistical data about a connection and provide it to the `SelectionStrategy`. Because the nature of this data may vary, there is no standard access to the data via the interface. Therefore, `StatisticsProvider` and `SelectionStrategy` usually need to be implemented together. Whenever a new connection is created[1], a new `StatisticsProvider` object is instanciated and stored with the `Transport`[2]. The `StatisticsProvider` interface is oriented along the mode of use of the `Transport`. For efficiency reasons, messages are not sent as one big byte array. Instead, they are sent piecewise over the wire. When such a chunk is sent, the method `messageChunkSent(int size)` will be called. After the message has been completely sent, method `flush()` is called. This whole process is synchronized, so all consecutive `messageChunkSent`s until a `flush()` form a single message. Therefore, no synchronization on this level is necessary. However, access to gathered statistical data by the `SelectionStrategy` is concurrent, so care has to be taken. Receiving messages is done only on the whole, so there exists only one method, `messageReceived(int size)`, to notify the `StatisticsProvider` of such an event.

JacORB comes with two pre-implemented strategies: least frequently used and least recently used. LFU and LRU are implemented by the classes `org.jacorb.orb.connection.L[F|R]USelectionStrategyImpl` and `org.jacorb.orb.connection.L[F|R]UStatisticsProviderImpl`.

16.2.2 Configuration

To configure connection management, the following properties are provided:

`jacorb.connection.max_server_transports` This property sets the maximum number of TCP/IP connections that will be listened on by the server–side ORB.

`jacorb.connection.wait_for_idle_interval` This property sets the interval to wait until the next try is made to find an idle connection to close. Value is in microseconds.

`jacorb.connection.selection_strategy_class` This property sets the `SelectionStrategy`.

`jacorb.connection.statistics_provider_class` This property sets the `StatisticsProvider`.

`jacorb.connection.delay_close` If turned on, JacORB will delay closing of TCP/IP connections to avoid certain situations, where message loss can occur. See also section 16.2.3.

16.2.3 Limitations

No sunshine without rain. When trying to close a connection, it is first checked that the connection is idle, i.e. has no pending messages. If this is the case, a GIOP CloseConnection message is sent, and the TCP/IP connection is closed. Under high load, this can lead to the following situation:

1. Server sends the CloseConnection message.
2. Server closes the TCP/IP connection.

[1] Currently, connection management is only implemented for the server side. Therefore, only accepted `ServerGIOPConnection`s will get a `StatisticsProvider`

[2] This is actually only done when a `StatisticsProvider` is configured

3. The client sends a new request into the connection, because it hasn't yet read and acted on the CloseConnection message.
4. The server–side OS will send a TCP RST, which cancels out the CloseConnection message.
5. The client finds the connection closed and must consider the request lost.

To get by this situation, JacORB takes the following approach. Instead of closing the connection right after sending the CloseConnection message, we delay closing and wait for the client to close the connection. This behaviour is turned off by default, but can be enabled by setting the property `jacorb.connection.delay_close` to "yes". When non-JacORB clients are used care has to be taken that these ORBs do actively close the connection upon receiving a CloseConnection message.

17 Extensible Transport Framework

The *Extensible Transport Framework (ETF)*, which JacORB implements, allows you to plug in other transport layers besides the standard IIOP (TCP/IP) protocol[1].

To use an alternative transport, you need to (a) implement it as a set of Java classes following the ETF specification, and (b) tell JacORB to use the new transport instead of (or alongside with) the standard IIOP transport. We cover both steps below.

17.1 Implementing a new Transport

The interfaces that an ETF-compliant transport must implement are described in the ETF specification, and there is thus no need to repeat that information here. JacORB's default IIOP transport, which is realized in the package `org.jacorb.orb.iiop`, can also serve as a starting point for implementing your own transports.

For each transport, the following interfaces must be implemented (defined in `ETF.idl`, the package is `org.omg.ETF`):

Profile encapsulates addressing information for this transport

Listener server-side communication endpoint, waits for incoming connections and passes them up to the ORB

Connection an actual communication channel for this transport

Factories contains factory methods for the above interfaces

The `Handle` interface from the ETF package is implemented in the ORB (by the class `org.jacorb.orb.BasicAdapter`), not by individual transports. There is currently no support in JacORB for the optional zero-copy mechanism; the interface `ConnectionZeroCopy` therefore needn't be implemented.

On the server side, the `Listener` must pass incoming connections up to the ORB using the "Handle" mechanism; the `accept()` method needn't be implemented. Once a `Connection` has been passed up to the ORB, it will never be "returned" to the `Listener` again. The method `completed_data()` in the `Listener` interface therefore needn't be implemented, and neither should the `Listener` ever call `Handle.signal_data_available()` or `Handle.closed_by_peer()` (these methods throw a `NO_IMPLEMENT` exception in JacORB).

[1] At the time of this writing (July 2003), ETF is still a draft standard (OMG TC document mars/2003-02-01).

At the time of this writing (July 2003), there is still uncertainty in ETF about how server-specific Profiles (as returned by `Listener.endpoint()`, for example) should be turned into object-specific ones for inclusion into IORs. We have currently added three new operations to the `Profile` interface to resolve this issue, see JacORB's version of `ETF.idl` for details.

17.2 Configuring Transport Usage

You tell JacORB which transports it should use by listing the names of their `Factories` classes in the property `jacorb.transport.factories`. In the standard configuration, this property contains only `org.jacorb.orb.iiop.IIOPFactories`, the `Factories` class for the standard IIOP transport. The property's value is a comma-separated list of fully qualified Java class names; each of these classes must be found somewhere on the CLASSPATH that JacORB is started with. For example:

```
jacorb.transport.factories = my.transport.Factories, org.jacorb.orb.iiop.IIOPFactories
```

By default, a JacORB server creates listeners for each transport listed in the above property, and publishes profiles for each of these transports in any IOR it creates. The order of profiles within an IOR is the same as that of the transports in the property.

If you don't want your servers to listen on each of these transports (e.g. because you want some of your transports only to be used for client-side connections), you can specify the set of actual listeners in the property `jacorb.transport.server.listeners`. The value of this property is a comma-separated list of numeric profile tags, one for each transport that you want listeners for, and which you want published in IOR profiles. The numeric value of a transport's profile tag is the value returned by the implementation of `Factories.profile_tag()` for that transport. Standard IIOP has profile tag 0 (`TAG_INTERNET_IOP`). Naturally, you can only specify profile tag numbers here for which you have a corresponding entry in `jacorb.transport.factories`.

So, to restrict your server-side transports to standard IIOP, you would write:

```
jacorb.transport.server.listeners = 0
```

On the client side, the ORB must decide which of potentially many transports it should use to contact a given server. The default strategy is that for each IOR, the client selects *the first profile for which there is a transport implementation available at the client side* (specified in `jacorb.transport.factories`). Profiles for which the client has no transport implementation are skipped.

Note that this is a purely static decision, based on availability of an implementation. JacORB does not attempt to actually establish a transport connection in order to find out which transport can be used. Also, should the selected transport fail, JacORB does not "fall back" to the next transport in the list. (This is because JacORB opens connections lazily, only when the first actual data is being sent.)

You can customize this strategy by providing your own implementation of `org.jacorb.orb.ProfileSelector`, and specifying it in the property `jacorb.transport.client.selector`. The interface `ProfileSelector` requires a single method,

```
public Profile selectProfile (List profiles,
                              ClientConnectionManager ccm);
```

For each IOR, this method receives a list of all profiles from the IOR for which the client has a transport implementation, in the order in which they appear in the IOR. The method should select one profile from this list and return it; this profile will then be used for communication with the server.

To help with the decision, JacORB's `ClientConnectionManager` is passed as an additional parameter. The method implementation can use it to check whether connections with a given transport, or to a given server, have already been made; it can also try and pre-establish a connection using a given transport and store it in the `ClientConnectionManager` for later use. (See the JacORB source code to find out how to deal with the `ClientConnectionManager`.)

The default `ProfileSelector` does not use the `ClientConnectionManager`, it simply returns the first profile from the list, unconditionally. To let JacORB use your own implementation of the `ProfileSelector` interface, specify the fully qualified classname in the property:

```
jacorb.transport.client.selector=my.pkg.MyProfileSelector
```

18 JacORB utilities

In this chapter, we will briefly explain the executables that come with JacORB. These include the IDL–compiler, the JacORB name server.

18.1 idl

The IDL compiler parses IDL specifications and maps these to a set of Java classes. IDL interfaces are translated into Java interfaces, and typedefs, structs, const declarations etc. are mapped onto corresponding Java classes. Using `idl`, stubs and skeletons for all interface types in the IDL specification will automatically be generated.

Usage

```
idl [-h|-help] [-v|-version] [-Dsymbol[=value]] [-Idir] [-U <symbol>]
[-W debug_level] [-all] [-ami_callback] [-ami_polling] [-jdk14] [-d
<Output Dir>] [-i2jpackage x:y][-i2jpackagefile <filename>] [-ir]
[-nofinal] [-noskel] [-nostub] [-p <package_prefix>] [-sloppy_forward]
[-sloppy_names] [-syntax] <filelist>
```

The option `-v` prints out a short version string while `-h` or `-help` displays brief usage information.

With the `-D` option you can define symbols that can be used by the preprocessor while processing the IDL file. If no value is specified, the symbol will be defined with a value of 1. The `-U` option lets you undefine symbols again.

The `-I` options allows you to specify one or more search paths for IDL files included from within `<filelist>`. If no path is given, only the current directory will be considered.

The `-W` option specifies the amount of debug information the IDL compiler will output.

The compiler does not, by default, generate code for included files. If that is desired, you have to use the `-all` option which causes code to be generated for every IDL file directly or indirectly included from within `<filelist>`. If you want to make sure that for a given IDL no code will be generated even if this option is set, you can use the (proprietary) preprocessor directive `#pragma inhibit_code_generation`.

The `-ami_callback` flag allows you to use the callback model of Asynchronous Method Invocation. See chapter 14.

The `-ami_polling` flag allows you to use the polling model of Asynchronous Method Invocation.

See chapter 14.

Compiling a file with a module `ModuleX` and an interface `InterfaceY` in it will result in a subdirectory `ModuleX` with `InterfaceY.java` in it (and possibly more `.java`–files). By default, the root directory for all of the files created during the process is the current directory. You can, however, provide a different directory in which these files are to be placed by using the -d option. Using the -d option when you are only checking the syntax of an IDL file has no effect.

The `-jdk14` option makes the IDL compiler do extra checks to ensure JDK1.4 compatible code is generated.

To be able to flexibly redirect generated Java classes into packages, the `-i2jpackage` switch can be used. Using this option, any IDL scope x can be replaced by one (or more) Java packages y. Specifying `-i2jpackage X:a.b.c` will thus cause code generated for IDL definitions within a scope x to end up in a Java package `a.b.c`, e.g. an IDL identifier `X::Y::ident` will be mapped to `a.b.c.y.ident` in Java. It is also possible to specify a file containing these mappings using the `-i2jpackagefile` switch.

The `-ir` option instructs the compiler to generate additional files that contain information needed by the Interface Repository. Basically, there is one (very small) extra file for each IDL module, and another additional file per IDL interface.

By using the `-nofinal` option the compiler can be made to generate class definitions that are not final. This will override the default behaviour, which is to generate final class definitions in certain circumstances to allow for their optimisation during compilation.

The `-noskel` option suppresses the generation of skeleton files, which may be unnecessary if you only want to *use* a reference and thus need client–side code.

The `-nostub` option suppresses the generation of client stubs.

The `-sloppy_forward` option allows forward declarations without later definitions.

The `-sloppy_name` option allows less strict checking of module name scoping.

Invoking `idl` with the `-syntax` option allows you to check your IDL specification for syntactic errors without producing code. Without `-syntax`, the compiler creates directories according to the Java package structure.

(The IDL parser was generated with Scott Hudson's CUP parser generator. The LALR grammar for the CORBA IDL is in the file `jacorb/Idl/parser.cup`.)

18.2 ns

JacORB provides a service for mapping names to network references. The name server itself is written in Java like the rest of the package and is a straightforward implementation of the CORBA "Naming Service" from Common Object Services Spec., Vol.1 [OMG97]. The IDL interfaces are mapped to Java according to our Java mapping.

Usage

```
$ ns <filename> [<timeout>]
```

or

```
$ jaco jacorb.Naming.NameServer <filename> [<timeout>]
```

Example

```
$ ns ~/public_html/NS_Ref
```

The name server does *not* use a well known port for its service. Since clients cannot (and need not) know in advance where the name service will be provided, we use a bootstrap file in which the name server records an object reference to itself (its *Interoperable Object Reference* or IOR). The name of this bootstrap file has to be given as an argument to the `ns` command. This bootstrap file has to be available to clients network-wide, so we demand that it be reachable via a URL — that is, there must be an appropriately configured HTTP server in your network domain which allows read access to the bootstrap file over a HTTP connection. (This implies that the file must have its read permissions set appropriately. If the binding to the name service fails, please check that this is the case.) After locating the name service through this mechanism, clients will connect to the name server directly, so the only HTTP overhead is in the first lookup of the server.

The name bindings in the server's database are stored in and retrieved from a file that is found in the current directory unless the property `jacorb.naming.db_dir` is set to a different directory name. When the server starts up, it tries to read this file's contents. If the file is empty or corrupt, it will be ignored (but overridden on exit). The name server can only save its state when it goes down after a specified timeout. If the server is interrupted (with `CTRL-C`), state information is lost and the file will not contain any usable data.

If no timeout is specified, the name server will simply stay up until it is killed. Timeouts are specified in milliseconds.

18.3 nmg

The JacORB NameManager, a GUI for the name service, can be started using the `nmg` command. The NameManager then tries to connect to an existing name service.

Usage

```
$ nmg
```

18.4 lsns

This utility lists the contents of the default naming context. Only currently active servers that have registered are listed. The `-r` option recursively lists the contents of naming contexts contained in the root context. If the graph of naming contexts contains cycles, trying to list the entire contents recursively will not return...

Usage

```
$ lsns [-r]
```

Example

```
$ lsns
/grid.service
```

when only the server for the grid example is running and registered with the name server.

18.5 dior

JacORB comes with a simple utility to decode an interoperable object reference (IOR) in string form into a more readable representation.

Usage

```
$ dior <IOR-string> | -f <filename>
```

Example

In the following example we use it to print out the contents of the IOR that the JacORB name server writes to its file:

```
$ dior -f ~/public_html/NS_Ref
```

```
------IOR components-----
TypeId  :       IDL:omg.org/CosNaming/NamingContextExt:1.0
Profile Id   :  TAG_INTERNET_IOP
IIOP Version :  1.0
Host    :       160.45.110.41
Port    :       49435
Object key :    0x52 6F 6F 74 50 4F 41 3A 3A 30 D7 D1 91 E1 70 95 04
```

18.6 pingo

“Ping” an object using its stringified IOR. Pingo will call `_non_existent()` on the object’s reference to determine whether the object is alive or not.

Usage

```
$ pingo <IOR-string> | -f <filename>
```

18.7 ir

This command starts the JacORB Interface Repository, which is explained in chapter 9.

Usage

```
$ ir <reppository class path> <IOR filename>
```

18.8 qir

This command queries the JacORB Interface Repository and prints out re–generated IDL for the repository item denoted by the argument repository ID.

Usage

```
$ qir <reppository Id>
```

18.9 ks

This command starts the JacORB KeyStoreManager, which is explained in chapter 11

Usage

```
$ ks
```

18.10 fixior

This command patches host and port information into an IOR file.

Usage

$ fixior <host> <port> <ior_file>

19 Configuration Properties

A comprehensive listing and description of the properties which are used to configure JacORB are given in the following tables.

Table 19.1: ORB Configuration

Property	Description	Type
ORBInitRef.<service>	Properties of this form configure initial service objects which can be resolved via the ORB resolve_initial_references. A variety of URL formats are supported.	URL
org.omg.PortableInterceptor.ORBInitializerClass.<name>	A portable interceptor initializer class instantiated at ORB creation.	class
jacorb.orb.objectKeyMap.<name>	Maps an object key to an arbitrary string thereby enabling better readability for corbaloc URLs.	string
jacorb.orb.print_version	If enabled, the ORB's version number is printed whenever the ORB is initialized. Default is on.	boolean
jacorb.verbosity	Diagnostic verbosity level: 0 = off, 1 = important messages and exceptions, >= 3 = debug-level output (output may be extensive)	integer
jacorb.logfile	Output destination for diagnostic log file. If not set, then diagnostics are sent to standard output.	file
jacorb.logfile.append	If logging to file whether to append to existing file or overwrite. Default is off.	boolean
jacorb.logfile.maxLogSize	If appending to a file sets the size in kilobytes at which the file is rolled over. Default is off (0).	integer
jacorb.log.timestamp	Whether to timestamp log messages. Default is off	boolean
jacorb.debug.dump_outgoing_messages	Hex dump outgoing messages. Default is off.	boolean
jacorb.debug.dump_incoming_messages	Hex dump incoming messages. Default is off.	boolean
jacorb.giop_minor_version	The GIOP minor version number to use for newly created IORs. Default is 2.	integer
jacorb.retries	Number of retries if connection cannot directly be established. Default is 5.	integer
jacorb.retry_interval	Time in milliseconds to wait between retries. Default is 500.	millisec.

Table 19.1: ORB Configuration

Property	Description	Type
jacorb.outbuf_size	Size of network buffers for outgoing messages in bytes. Default is 2048.	byte
jacorb.maxManagedBufSize	This is NOT the maximum buffer size that can be used, but just the largest size of buffers that will be kept and managed. This value will be added to an internal constant of 5, so the real value in bytes is 2** (5 + maxManagedBufSize - 1). You only need to increase this value if you are dealing with LOTS of LARGE data structures. You may decrease it to make the buffer manager release large buffers immediately rather than keeping them for later reuse. Default is 18.	integer
jacorb.bufferManagerFlushMax	Whether to use an additional unlimited size buffer cache for CDROutputStreams. If -1 then off, if zero then this is feature is enabled, if greater than zero then it is enabled and flushed every x seconds. Default is -1.	integer
jacorb.connection.client.pending_reply_timeout	Wait the specified number of msecs for a reply to a request. If exceeded, a org.omg.CORBA.TIMEOUT exception will be thrown. Not set by default. Default to zero	millisec.
jacorb.connection.client_idle_timeout	Client-side timeout. This is set to non-zero in order to stop blocking after specified number of milliseconds. Not set by default.	millisec.
jacorb.connection.server_timeout	Maximum time in milliseconds that a server keeps a connection open if nothing happens. Not set by default.	millisec.
jacorb.connection.max_server_transports	This property sets the maximum number of TCP/IP connections that will be listened on by the server–side ORB. Default is unlimited connections	integer
jacorb.connection.wait_for_idle_interval	This property sets the interval to wait until the next try is made to find an idle connection to close. Default is 500	millisec.
jacorb.connection.selection_strategy_class	This property sets the `SelectionStrategy`	class
jacorb.connection.statistics_provider_class	This property sets the `StatisticsProvider`	class
jacorb.connection.delay_close	This property controls the behaviour after sending a GIOP CloseConnection messsage. If set to “on”, the TCP/IP connection won’t be closed directly. Instead, it is waited for the client to do so first. Default is off.	boolean
jacorb.transport.factories	This property controls which transport plug-ins are available to the ORB. The value is a list of classes that implement the ETF `Factories` interface.	comma-separated list of classes

Table 19.1: ORB Configuration

Property	Description	Type
jacorb.transport.server.listeners	Controls which transports should be offered by JacORB on the server side. The value is a list of numeric profile tags for each transport that should be available on the server side.	comma-separated list of integers
jacorb.transport.client.selector	Name of a class that selects the transport profile to use for communication on the client side. The value is the fully qualified name of a class that implements org.jacorb.orb.ProfileSelector.	class
jacorb.reference_caching	Whether or not JacORB caches objects references. Not set by default.	boolean
jacorb.hashtable_class	The following property specifies the class which is used for reference caching. WeakHashtable uses WeakReferences, so entries get garbage collected if only the Hashtable has a reference to them. This is useful if you have many references to short-living non-persistent CORBA objects. It is only available for java 1.2 and above. On the other hand the standard Hashtable keeps the references until they are explicitly deleted by calling _release(). This is useful for persistent and long-living CORBA objects. Defaults to Hashtable.	class
jacorb.use_bom	Use GIOP 1.2 byte order markers, since CORBA 2.4-5. Default is off.	boolean
jacorb.giop.add_1_0_profiles	Add additional IIOP 1.0 profiles even if using IIOP 1.2. Default is off.	boolean
jacorb.dns.enable	Use DNS when DNS support has been included in build. Default is on.	boolean
jacorb.compactTypecodes	Whether to send compact typecodes. Options are 0 (off), 1 (Partial compaction), 2 (full compaction of all optional parameters) Default is 2.	integer
jacorb.cacheTypecodes	Whether to cache read typecodes. Default is off.	boolean
jacorb.cachePoaNames	Whether to cache scoped poa names. Default is off.	boolean
jacorb.interop.indirection_encoding_disable	Turn off indirection encoding for repeated typecodes. This fixes interoperability with certain broken ORB's eg. Orbix 2000. Default is off.	boolean
jacorb.interop.comet	Enable additional buffer length checking and adjustment for interoperability with Comet CORBA/COM bridge which can incorrectly encode buffer lengths. Default is off.	boolean
jacorb.interop.lax_boolean_encoding	Treat any non zero CDR encoded boolean value as true (strictly should be 1 not non zero). Default is off.	boolean
org.omg.PortableInterceptor.ORBInitializerClass.bidir_init	This portable interceptor must be configured to support bi-directional GIOP. Not set by default.	class

Table 19.1: ORB Configuration

Property	Description	Type
jacorb.ior_proxy_host	The jacorb.ior_proxy_host and jacorb.ior_proxy_port properties inform the ORB what IP/port IORs should contain, if the ServerSockets IP/port can't be used (e.g. for traffic through a firewall). WARNING: this is just dumb replacing, so you have to take care of your configuration! Not set by default.	node
jacorb.ior_proxy_port	See jacorb.ior_proxy_host above. Not set by default.	port
OAIAddr	The Object Adapter Internet Address: IP address on multi-homed host (this gets encoded in object references). NOTE: Addresses like 127.0.0.X will only be accessible from the same machine! Not set by default.	node
OAPort	See OAIAddr above. Not set by default.	port
org.omg.PortableInterceptor.ORBInitializerClass.standard_init	Standard portable interceptor. DO NOT REMOVE.	class
jacorb.net.socket_factory	Sets or defines the socket factory that must implement the operations defined in the org.jacorb.orb.factory.SocketFactory interface.	class
jacorb.net.server_socket_factory	Sets or defines the socket factory that must implement the operations defined in the org.jacorb.orb.factory.ServerSocketFactory interface.	class
jacorb.net.socket_factory.port.min	Sets the minimum port number that can be used for an additional supported socket factory. This property is used in conjunction with the jacorb.net.socket_factory.port.max property. These properties enable the factory to traverse firewalls through a fixed port range. Default is unset, disabling the factory.	integer
jacorb.net.socket_factory.port.max	Sets the maximum port number that can be used for the additional supported socket factory. Refer to jacorb.net.socket_factory.port.min above. Default is unset, disabling the factory.	integer

Table 19.2: Appligator Configuration

Property	Description	Type
jacorb.ProxyServer.URL	This is the URL for the default Appligator and is used when applets or firewall traversal is supported via the JacORB Appligator.	URL

Table 19.2: Appligator Configuration

Property	Description	Type
`jacorb.ProxyServer.URL-<network>-<netmask>`	Additional appligators can be configured for remote subnets using this subnet form of URL configuration. The subnet for a scoped appligator is calculated by the logical ANDing of the network and netmask values.	URL
`jacorb.ProxyServer.Name`	The name the appligator uses when adding itself to the Name Service (if available) on start up. Default is Appligator.	string
`jacorb.ProxyServer.ID`	Defines the object identity for the appligator IOR. If not set, then this defaults to 'Appligator': it is recommended that this is set to some other value for additional security.	string
`jacorb.ProxyServer.Netmask`	Optionally used to configure the network for the local client. When used, the calls to objects within the local subnet will not be redirected. Not set by default.	IP address
`jacorb.ProxyServer.Network`	See jacorb.ProxyServer.Netmask above. Not set by default.	IP address

Table 19.3: POA Configuration

Property	Description	Type
`jacorb.poa.monitoring`	Displays a GUI monitoring tool for servers. Default is off.	boolean
`jacorb.poa.thread_pool_max`	Maximum thread pool configuration for request processing	integer
`jacorb.poa.thread_pool_min`	Minimum thread pool configuration for request processing	integer
`jacorb.poa.thread_priority`	If set, request processing threads in the POA will run at this priority. If not set or invalid, MAX_PRIORITY will be used. Not set by default.	integer
`jacorb.poa.queue_max`	The size of the request queue. Clients will receive Corba.TRANSIENT exceptions if load exceeds this limit. Default is 100.	integer

Table 19.4: Implementation Repository Configuration

Property	Description	Type
`jacorb.use_imr`	Switch on to contact the Implementation Repository (IR) on every server start-up. Default is off.	boolean
`jacorb.use_imr_endpoint`	Switch off to prevent writing the IMR address into server IORs. This property is ignored if jacorb.use_imr = off. Default is off.	boolean

Table 19.4: Implementation Repository Configuration

Property	Description	Type
`jacorb.imr.allow_auto_register`	If set to on servers that don't already have an entry on their first call to the IR, will get automatically registered. Otherwise, an UnknownServer exception is thrown. Default is off.	boolean
`jacorb.imr.check_object_liveness`	If set on the IR will try to ping every object reference that it is going to return. If the reference is not alive, then TRANSIENT is thrown. Default is off.	boolean
`ORBInitRef.ImplementationRepository`	The initial reference for the IR.	URL
`jacorb.imr.table_file`	File in which the IR stores data.	file
`jacorb.imr.backup_file`	Backup data file for the IR.	file
`jacorb.imr.ior_file`	File to which the IR writes its IOR. This is usually referred to by the initial reference for the IR (configured above).	file
`jacorb.imr.timeout`	Time in milliseconds that the implementation will wait for a started server to register. After this timeout is exceeded the IR assumes the server has failed to start. Default is 12000 (2 minutes).	millisec.
`jacorb.imr.no_of_poas`	Initial number of POAs that can be registered with the IR. This is an optimization used to size internal data structures. This value can be exceeded. Default is 100.	integer
`jacorb.imr.no_of_servers`	Initial number of servers that can be registered with the IR. This is an optimization used to size internal data structures. This value can be exceeded. Default is 5.	integer
`jacorb.imr.port_number`	Starts the IMR on a fixed port (equivalent to the -p option).	integer
`jacorb.imr.connection_timeout`	Time in milliseconds that the IR waits until a connection from an application client is terminated. Default is 2000.	millisec.
`jacorb.implname`	The implementation name for persistent servers. Persistent servers should set this to a unique name. This is the service name that is registered in the IR.	name
`jacorb.java_exec`	Command used by the IR to start servers.	command

Table 19.5: Security Configuration

Property	Description	Type
`OASSLPort`	The port number used by SSL, will be dynamically assigned by default.	port
`org.omg.PortableInterceptor.ORBInitializerClass.ForwardInit`	Portable interceptor required to support SSL. Not set by default.	class
`jacorb.security.access_decision`	The qualified classname of access decision object.	class

Table 19.5: Security Configuration

Property	Description	Type
jacorb.security.principal_authenticator	A list of qualified classnames of principle authenticator objects, separated by commas (no whitespaces.). The first entry (that can be successfully created) will be available through the principal_authenticator property.	class
jacorb.ssl.socket_factory	The qualified classname of the SSL socket factory class.	class
jacorb.ssl.server_socket_factory	The qualified classname of the SSL server socket factory class.	class
jacorb.security.change_ssl_roles	Exchange SSL client server roles to enforce client authentication. Beware: this causes problems with peers that not prepared to handle this role change. Default is off.	boolean
jacorb.security.support_ssl	Whether SSL security is supported. Default is off.	boolean
jacorb.security.ssl.client.supported_options	SSL client supported options - IIOP/SSL parameters (numbers are hex values, without the leading 0x): NoProtection = 1, EstablishTrustInClient = 40, EstablishTrustInTarget = 20, mutual authentication = 60. Default is 0. Please see the programming guide for more explanation.	integer
jacorb.security.ssl.client.required_options	SSL client required options (See IIOP/SSL parameters above). Default is 0.	integer
jacorb.security.ssl.server.supported_options	SSL server supported options (See IIOP/SSL parameters above). Default is 0.	integer
jacorb.security.ssl.server.required_options	SSL server required options (See IIOP/SSL parameters above). Default is 0.	integer
jacorb.security.ssl.corbaloc_ssliop.supported_options	Used in conjunction with jacorb.security.ssl.corbaloc_ssliop.required_options. If these properties are set, then two values will be placed in the IOR, "corbaloc:ssliop and "ssliop. If not set, only EstablishTrustInTarget is used for both supported and required options.	integer
jacorb.security.ssl.corbaloc_ssliop.required_options	Default is 0.	integer
jacorb.security.keystore	The name and location of the keystore. This may be absolute or relative to the home directory. NOTE (for Sun JSSE users): The javax.net.ssl.trustStore [Password] properties doesn't seem to take effect, so you may want to add trusted certificates to normal keystores. In this case, please set the property jacorb.security.jsse. trustees_from_ks to on, so trusted certificates are taken from the keystore instead of a dedicated truststore.	file

Table 19.5: Security Configuration

Property	Description	Type
jacorb.security.keystore_password	The keystore password.	string
jacorb.security.trustees	Files with public key certificates of trusted Certificate Authorities (CA). WARNING: If no CA certificates are present, the IAIK chain verifier will accept ALL otherwise valid chains.	file
jacorb.security.default_user	The name of the default key alias to look up in the keystore.	name
jacorb.security.default_password	The name of the default key alias to look up in the keystore.	string
jacorb.security.iaik_debug	Sets IAIKS SSL classes to print debug output to standard output. Default is off.	boolean
jacorb.security.jsse.trustees_from_ks	Sun JSSE specific settings: Use the keystore to take trusted certificates from. Default is off.	boolean
jacorb.security.ssl.server.cipher_suites	A comma-separated list of cipher suite names which must NOT contain whitespaces. See the JSSE documents on how to obtain the correct cipher suite strings.	string
jacorb.security.ssl.client.cipher_suites	See jacorb.security.ssl.server.cipher_suites above.	string

20 Limitations, Feedback

A few limitations and known bugs (list is incomplete):

- the IDL compiler does not support
  - the `context` construct
- the API documentation and this document are incomplete.

Feedback and bug reports

For bug reporting, please use our Bugzilla bugtracking database available at http://www.jacorb.org/bugzilla. Please send problems as well as criticism and experience reports to our developer mailing list available from http://www.jacorb.org/contact.html.

Bibliography

[BVD01] Gerald Brose, Andreas Vogel, and Keith Duddy. *Java Programming with CORBA*. John Wiley & Sons, 3rd edition, 2001.

[HV99] Michi Henning and Steve Vinoski. *Advanced CORBA Programming with C++*. Addison–Wesley, 1999.

[OMG97] OMG. *CORBAservices: Common Object Services Specification*, November 1997.

[Sie00] Jon Siegel. *CORBA 3 Fundamentals and Programming*. Wiley, 2nd edition, 2000.

[Vin97] Steve Vinoski. Corba: Integrating diverse applications within distributed heterogeneous environments. *IEEE Communications Magazine*, 14(2), February 1997.

[Vin98] Steve Vinoski. New features for corba 3.0. *CACM*, 41(10):44–52, October 1998.