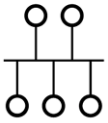


Orbix®

CORBA Tutorial C++

Version 6.3, December 2005

Making Software Work Together™

Updated: 09-Dec-2005

Contents

CHAPTER 1

Getting Started with Orbix

You can use the CORBA Code Generation Toolkit to develop an Orbix application quickly.

Given a user-defined IDL interface, the toolkit generates the bulk of the client and server application code, including makefiles. You then complete the distributed application by filling in the missing business logic.

In this chapter

This chapter contains the following sections:

Creating a Configuration Domain

Overview

This section describes how to create a simple configuration domain, `simple`, which is required for running basic demonstrations. This domain deploys a minimal set of Orbix services.

Prerequisites

Before creating a configuration domain, the following prerequisites must be satisfied:

- Orbix is installed.
- Some basic system variables are set up (in particular, the `IT_PRODUCT_DIR`, `IT_LICENSE_FILE`, and `PATH` variables).

Fore more details, please consult the *Installation Guide*.

Licensing

The location of the license file, `licenses.txt`, is specified by the `IT_LICENSE_FILE` system variable. If this system variable is not already set in your environment, you can set it now.

Steps

To create a configuration domain, `simple`, perform the following steps:

1. Run itconfigure.
2. Choose the domain type.
3. Specify service startup options.
4. Specify security settings.
5. Specify fault tolerance settings.
6. Select services.
7. Confirm choices.
8. Finish configuration.

Run itconfigure

To begin creating a new configuration domain, enter `itconfigure` at a command prompt. An **Orbix Configuration Welcome** dialog box appears, as shown in Figure 1.

Select **Create a new domain** and click **OK**.

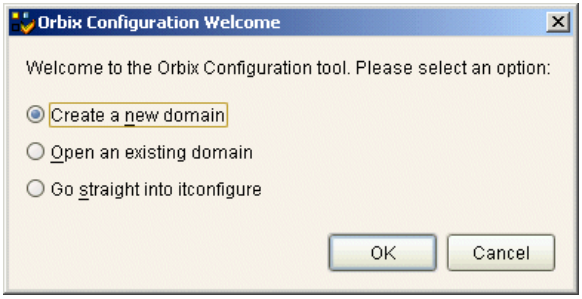


Figure 1: *The Orbix Configuration Welcome Dialog Box*

Choose the domain type

A **Domain Type** window appears, as shown in Figure 2.

In the **Configuration Domain Name** text field, type `simple`. Under **Configuration Domain Type**, click the **Select Services** radiobutton.

Click **Next>** to continue.

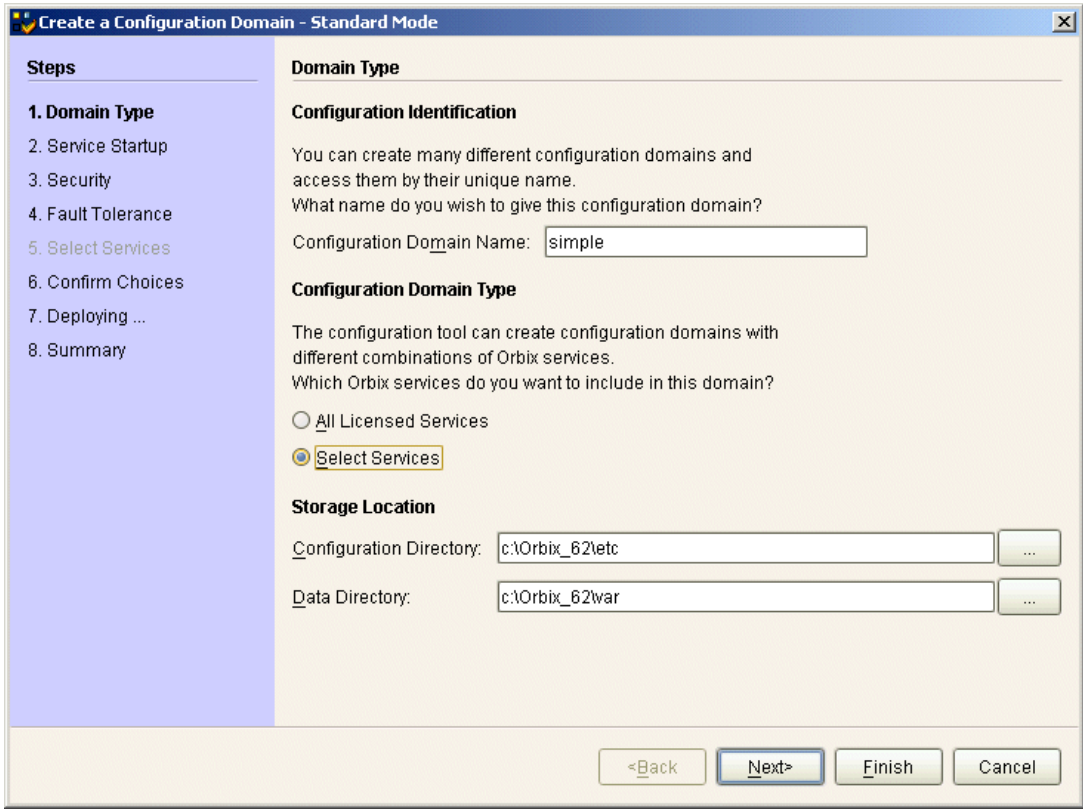


Figure 2: *The Domain Type Window*

Specify service startup options

A **Domain Type** window appears, as shown in Figure 3.

You can leave the settings in this Window at their defaults.

Click **Next>** to continue.

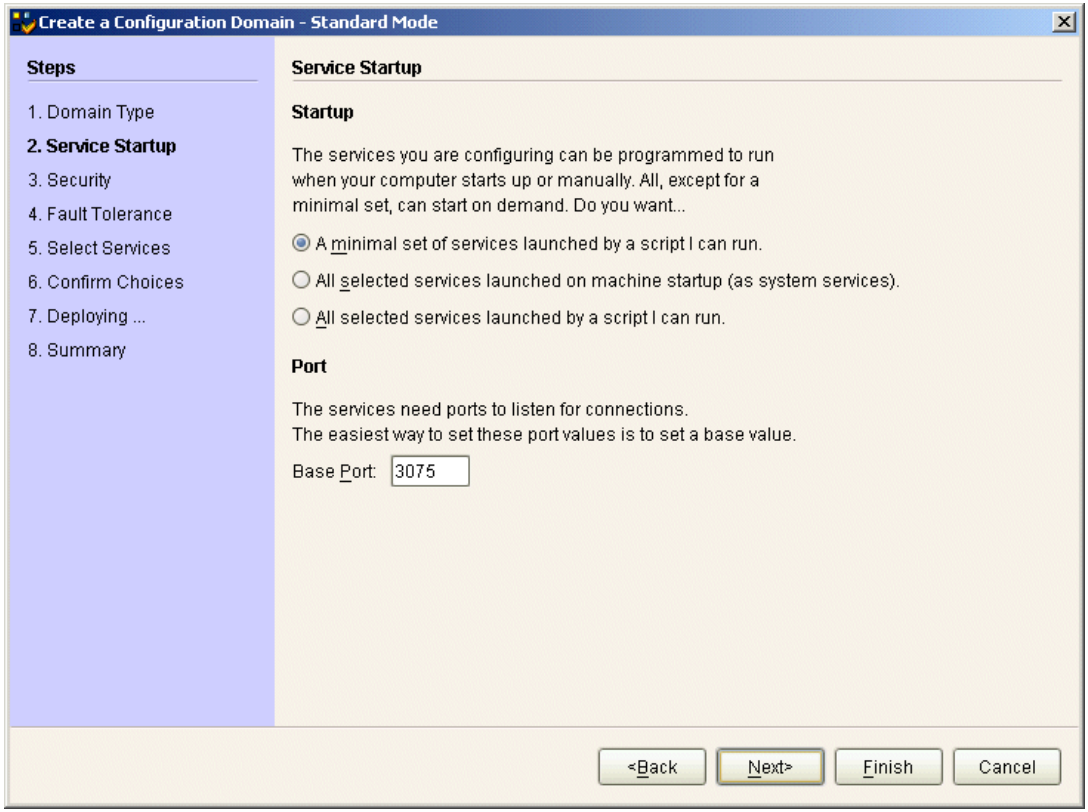


Figure 3: *The Service Startup Window*

Specify security settings

A **Security** window appears, as shown in Figure 4.

You can leave the settings in this Window at their defaults (no security).

Click **Next>** to continue.

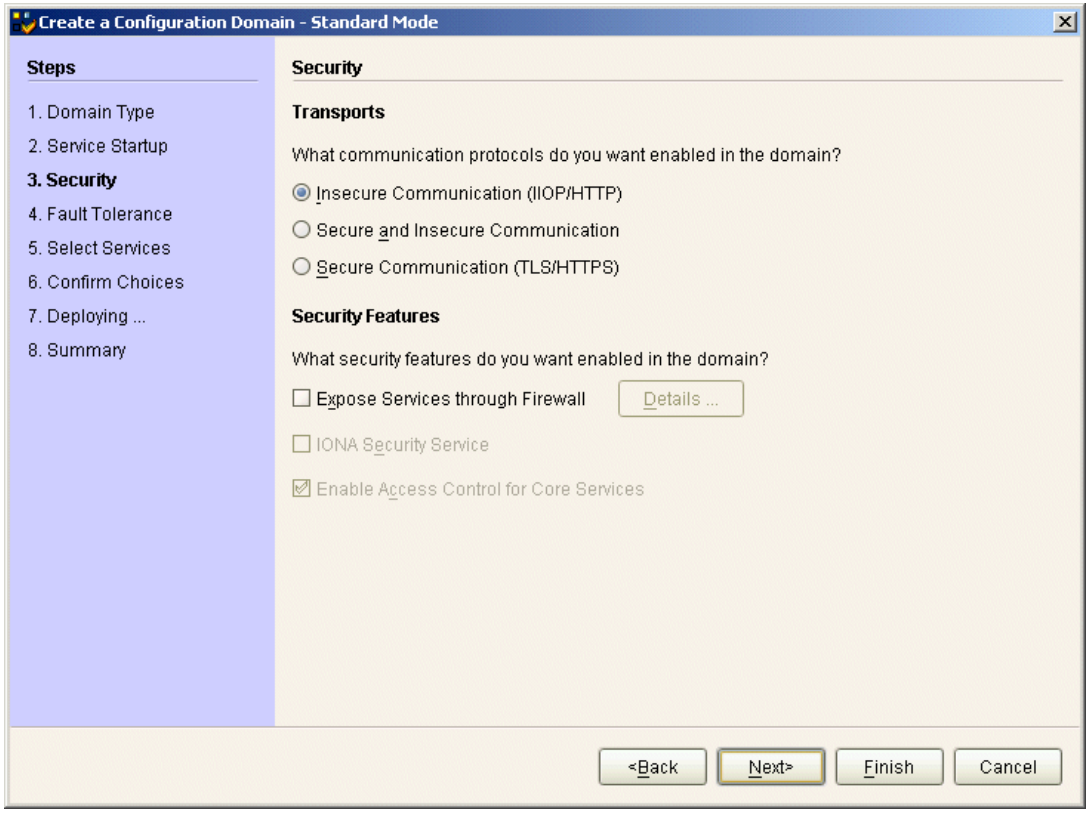


Figure 4: *The Security Window*

Specify fault tolerance settings

A **Fault Tolerance** window appears, as shown in Figure 5.

You can leave the settings in this Window at their defaults.

Click **Next>** to continue.

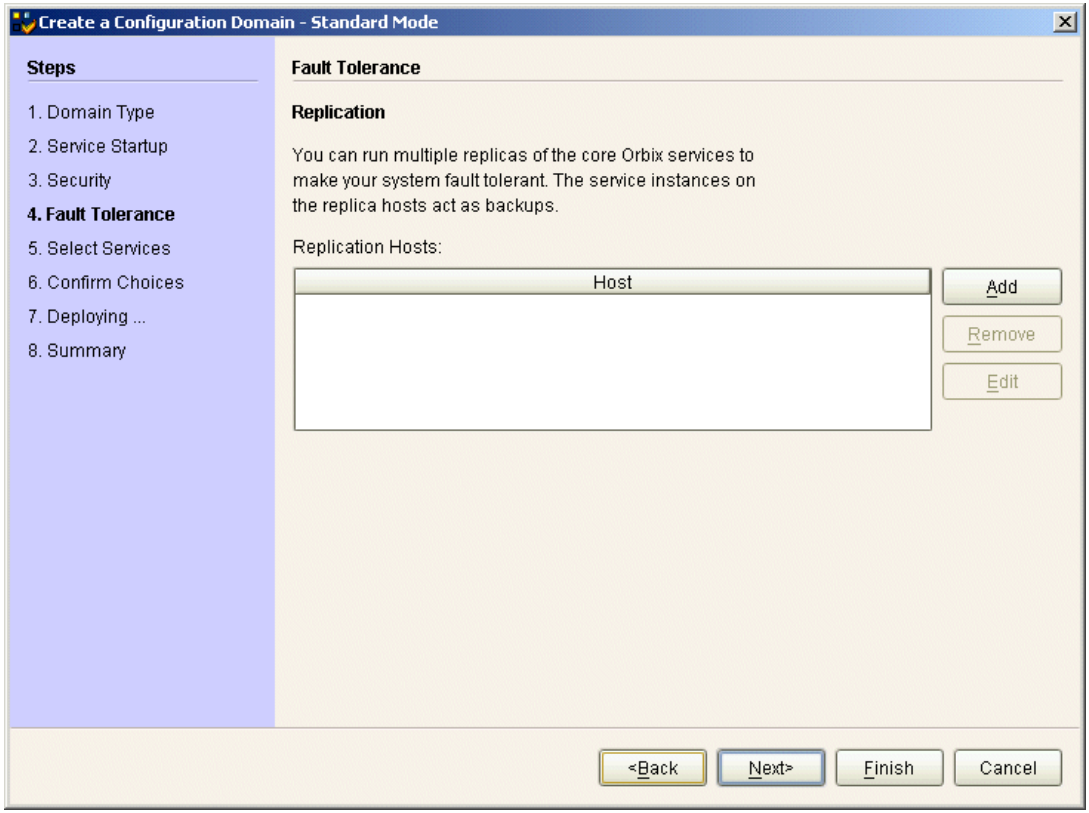


Figure 5: *The Fault Tolerance Window*

Select services

A **Select Services** window appears, as shown in Figure 6.

In the Select Services window, select the following services and components for inclusion in the configuration domain: **Location**, **Node daemon**, **Management**, **CORBA Interface Repository**, **CORBA Naming**, and **demos**.

Click **Next>** to continue.

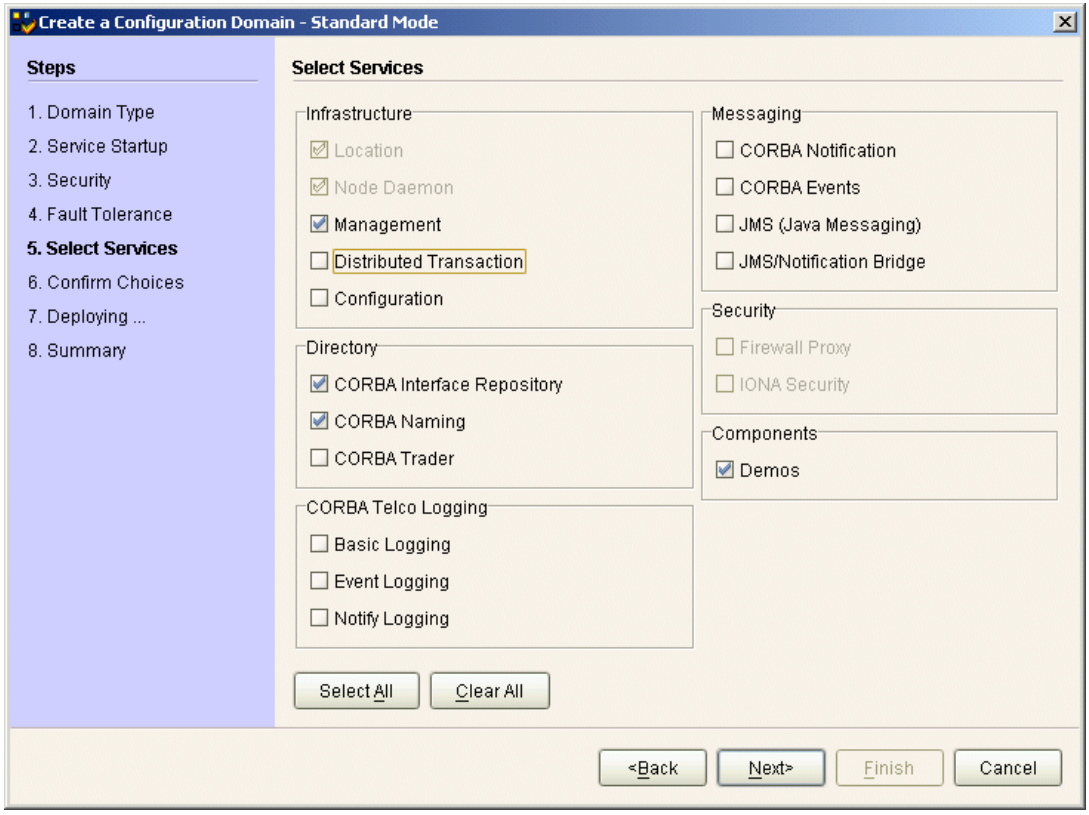


Figure 6: *The Select Services Window*

Confirm choices

You now have the opportunity to review the configuration settings in the **Confirm Choices** window, Figure 7. If necessary, you can use the **<Back** button to make corrections.

Click **Next>** to create the configuration domain and progress to the next window.

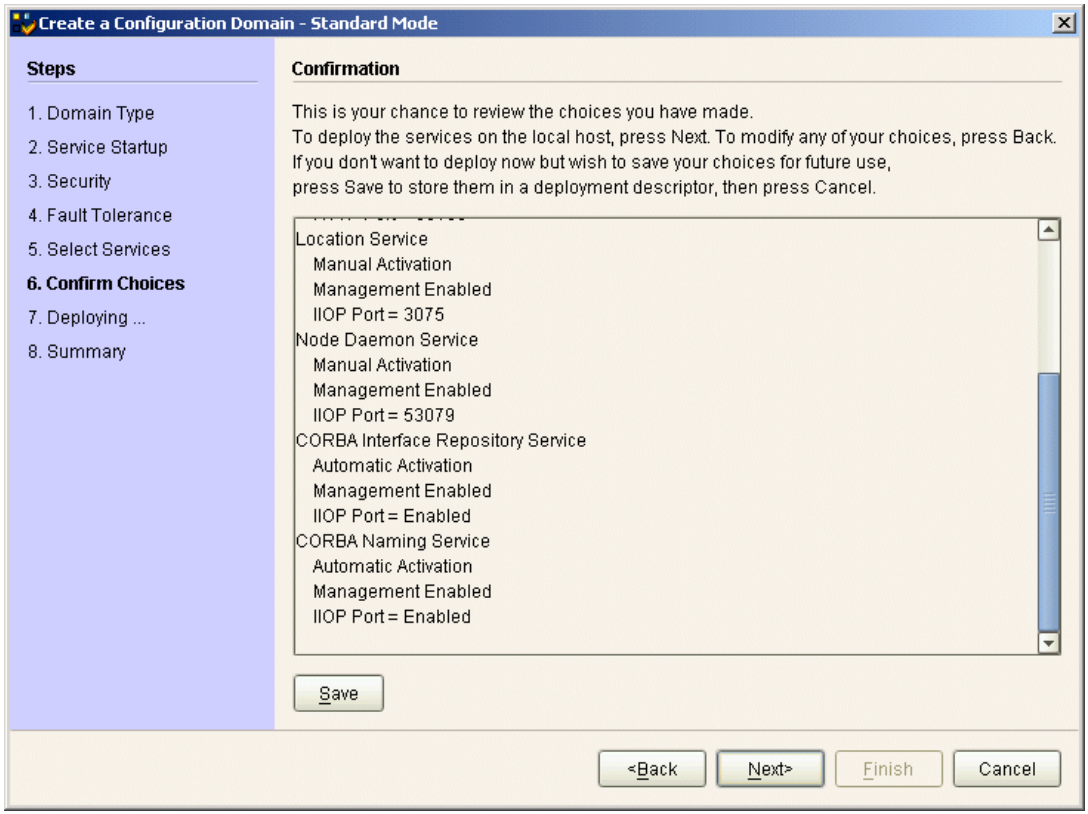


Figure 7: *The Confirm Choices Window*

Finish configuration

The `itconfigure` utility now creates and deploys the `simple` configuration domain, writing files into the *OrbixInstallDir*`/etc/bin`, *OrbixInstallDir*`/etc/domain`, *OrbixInstallDir*`/etc/log`, and *OrbixInstallDir*`/var` directories.

If the configuration domain is created successfully, you should see a **Summary** window with a message similar to that shown in Figure 8.

Click **Finish** to quit the `itconfigure` utility.

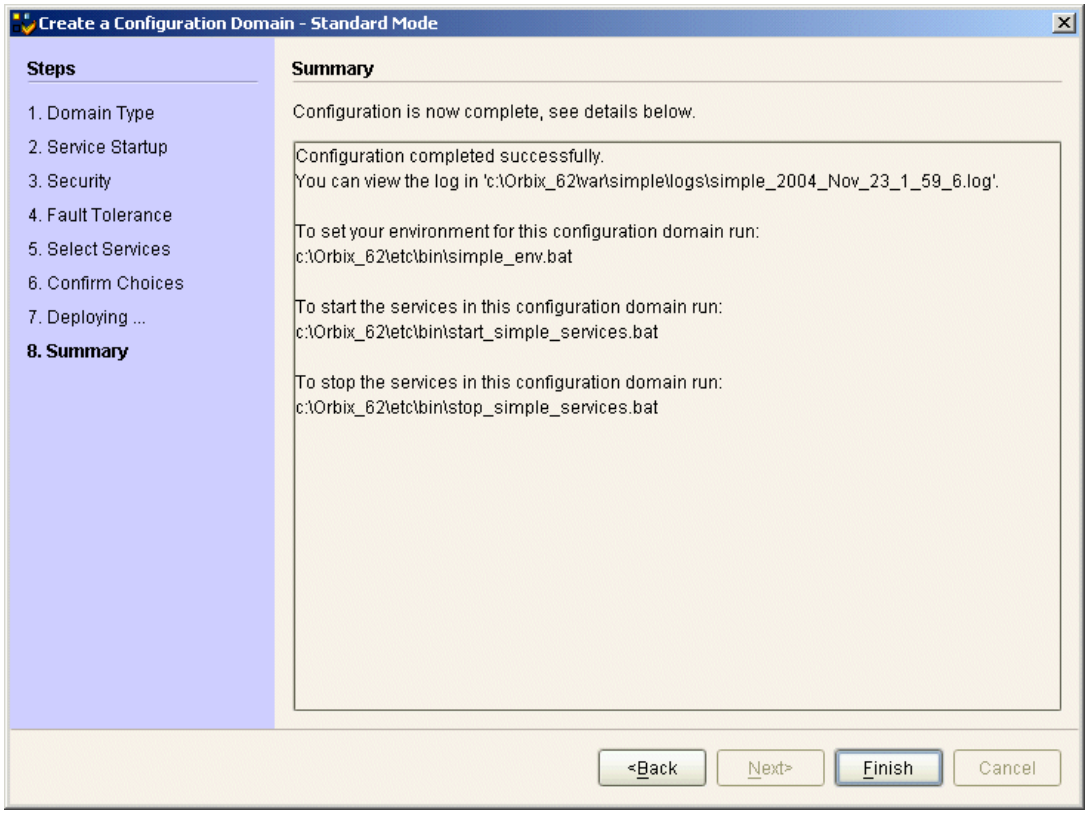


Figure 8: *Configuration Summary*

Setting the Orbix Environment

Prerequisites

Before proceeding with the demonstration in this chapter you need to ensure:

- The CORBA developer's kit is installed on your host.
- Orbix is configured to run on your host platform.

The *Administrator's Guide* contains more information on Orbix configuration, and details of Orbix command line utilities.

Note: OS/390, both native and UNIX system services, do not support the code generation toolkit and distributed genies. For information about building applications in a native OS/390 environment, see the readme files and JCL that are supplied in the DEMO data sets of your iPortal OS/390 Server product installation.

Setting the Domain

The scripts that set the Orbix environment are associated with a particular *domain*, which is the basic unit of Orbix configuration. Consult the *Installation Guide*, and the *Administrator's Guide* for further details on configuring your environment.

To set the Orbix environment associated with the *domain-name* domain, enter:

Windows

```
> config-dir\etc\bin\domain-name_env.bat
```

UNIX

```
% . config-dir/etc/bin/domain-name_env
```

config-dir is the root directory where the Appliation Server Platform stores its configuration information. You specify this directory while configuring your domain. *domain-name* is the name of a configuration domain.

Hello World Example

This chapter shows how to create, build, and run a complete client/server demonstration with the help of the CORBA code generation toolkit. The architecture of this example system is shown in Figure 9.

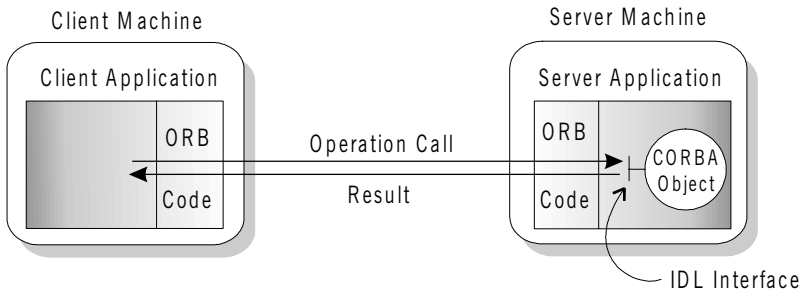


Figure 9: *Client makes a single operation call on a server*

The client and server applications communicate with each other using the Internet Inter-ORB Protocol (IIOP), which sits on top of TCP/IP. When a client invokes a remote operation, a request message is sent from the client to the server. When the operation returns, a reply message containing its return values is sent back to the client. This completes a single remote CORBA invocation.

All interaction between the client and server is mediated via a set of IDL declarations. The IDL for the Hello World! application is:

```
//IDL
interface Hello {
    string getGreeting();
};
```

The IDL declares a single `Hello` interface, which exposes a single operation `getGreeting()`. This declaration provides a language neutral interface to CORBA objects of type `Hello`.

The concrete implementation of the `Hello` CORBA object is written in C++ and is provided by the server application. The server could create multiple instances of `Hello` objects if required. However, the generated code generates only one `Hello` object.

The client application has to locate the `Hello` object—it does this by reading a stringified object reference from the file `Hello.ref`. There is one operation `getGreeting()` defined on the `Hello` interface. The client invokes this operation and exits.

Development Using the Client/Server Wizard

Overview

On the Windows NT platform, Orbix provides a wizard add-on to the Microsoft Visual Studio integrated development environment (IDE) that enables you to generate starting point code for CORBA applications.

If you are not working on a Windows platform or if you prefer to use a command line approach to development, see "Development from the Command Line" on page 25.

Installing the client/server wizard

You can install the Orbix v6.2 Client/Server wizard into the Microsoft Visual C++ 6.0 development environment either automatically or manually.

Automatic Install

To install the client/server wizard automatically, use Windows Explorer to navigate to the following directory:

OrbixInstallDir`\asp\6.2\etc\wizard`

Double-click `setup.exe` in this directory to install the wizard files.

Manual Install

To install the client/server wizard manually, copy the following files from the *OrbixInstallDir*`\asp\6.2\etc\wizard` directory:

```
it_artwiz5_vc60.awx
it_artwiz5_vc60.hlp
```

Paste these files into the *VisualStudioInstallDir*`\Common\MSDev98\Template` directory. The value of *VisualStudioInstallDir* is usually `C:\Program Files\Microsoft Visual Studio`.

Prerequisites

You must ensure that the Orbix include and library directories are added to the Microsoft Visual Studio configuration. Start up the Microsoft Visual C++ 6.0 IDE, select **Tools|Options...** from the menu bar, and click on the **Directories** tab. Use this dialog box to add the following Orbix directories to the Visual Studio configuration:

Orbix Include Directory

OrbixInstall`\asp\6.2\include`

Orbix Library Directory

OrbixInstall`\asp\6.2\lib`

Steps to implement Hello World

You implement the `Hello World!` application with the following steps:

1. Define the IDL interface, `Hello`.
2. Generate the server.
3. Complete the server program by implementing the single IDL `getGreeting()` operation.
4. Build the server program.
5. Generate the client.
6. Complete the client program by inserting a line of code to invoke the `getGreeting()` operation.
7. Build the client program.
8. Run the demonstration.

Define the IDL interface

Create the IDL file for the Hello World! application. First of all, make a directory to hold the example code:

```
> mkdir C:\OCGT\HelloExample
```

Create an IDL file `C:\OCGT\HelloExample\hello.idl` using a text editor.

Enter the following text into the `hello.idl` file:

```
//IDL
interface Hello {
    string getGreeting();
};
```

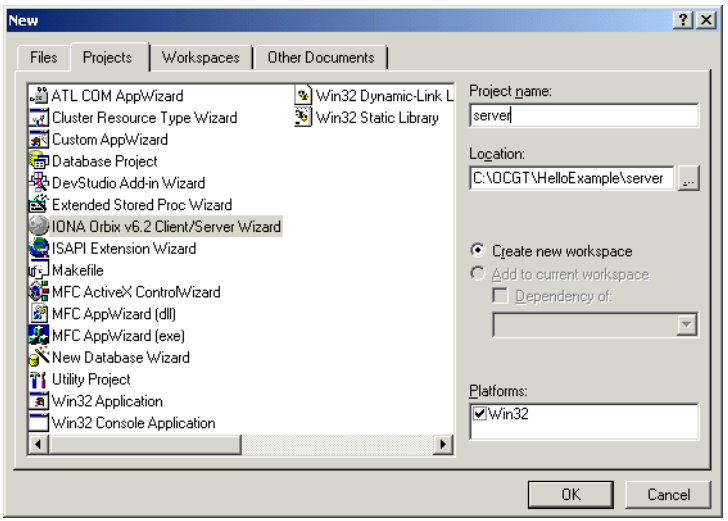
This interface mediates the interaction between the client and the server halves of the distributed application.

Generate the server

Generate files for the server application using the CORBA Code Generation Toolkit.

To create a server project using the IONA Orbix client/server wizard:

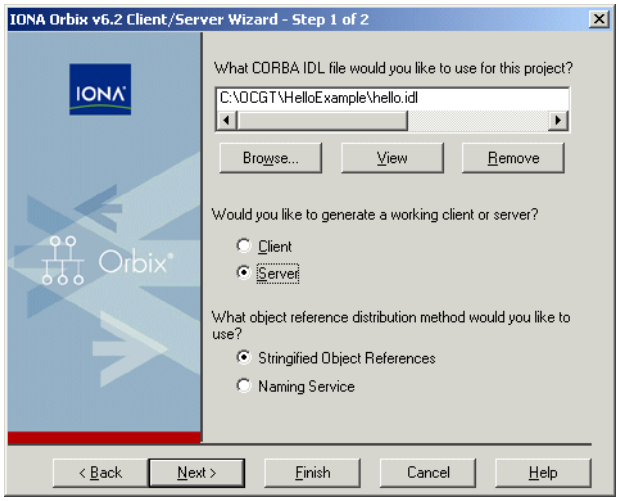
1. Open the Microsoft Visual C++ 6.0 integrated development environment (IDE).
2. From the Visual C++ menus**, s**elect **File|New**
3. In the New dialog, click on the Projects tab.
4. In the Projects tab, perform these actions:
   - Select **IONA Orbix v6.2 Client/Server Wizard**
   - In the **Project name** text box, enter `server`
   - Under the **Location** text box, enter `C:\OCGT\HelloExample\server`



5. Click **OK**.

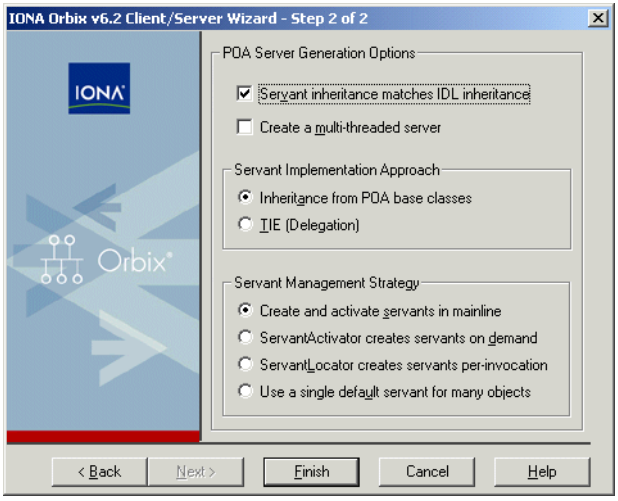
   The client/server wizard dialog displays.

6. Answer two questions as follows:
   - **What CORBA IDL file would you like to use for this project?**
     Enter the location of `hello.idl`.
   - **Would you like to generate a working client or server?**
     Select **Server**

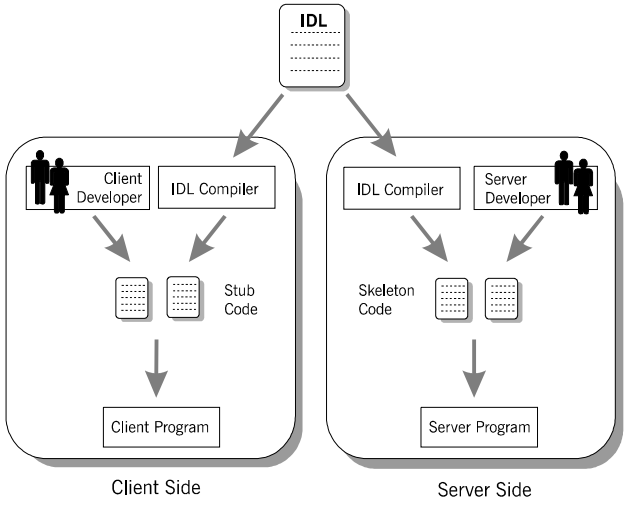


7. Advance to the next screen by clicking **Next**.

8. The server wizard displays the following dialog:



9. Accept the default settings and click **Finish** to generate the server.
10. The New Project Information scrollbox tells you about the generated files. Browse the information and select **OK**.
11. The server workspace is generated with the following source files:



12. Read the text file `ReadmeOrbixServer.txt`.

Complete the server program

Complete the implementation class, `HelloImpl` by providing the definition of `getGreeting()`. This method implements the IDL operation `Hello::getGreeting()`.

Delete the generated boilerplate code that occupies the body of `HelloImpl::getGreeting()` and replace it with the highlighted line of code:

```
//C++
...
char*
HelloImpl::getGreeting()
{
    char* _result;

    _result = CORBA::string_dup("Hello World!");

    return _result;
}
...
```

The function `CORBA::string_dup()` allocates a copy of the string on the free store. This is needed to be consistent with the style of memory management used in CORBA programming.

Build the server program

From within the Visual C++ IDE select **Build**|**Build server.exe** to compile and link the server.

By default, the project builds with debug settings and the server executable is stored in `C:\OCGT\HelloExample\server\Debug\server.exe`.

Close the server workspace by selecting **File**|**Close Workspace**

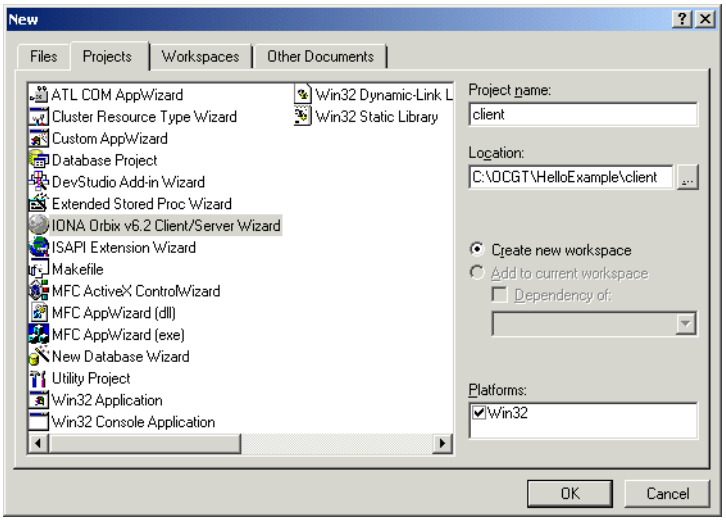
Generate the client

Generate files for the client application using the Orbix code generation toolkit.

To create a client project using the IONA Orbix client/server wizard:

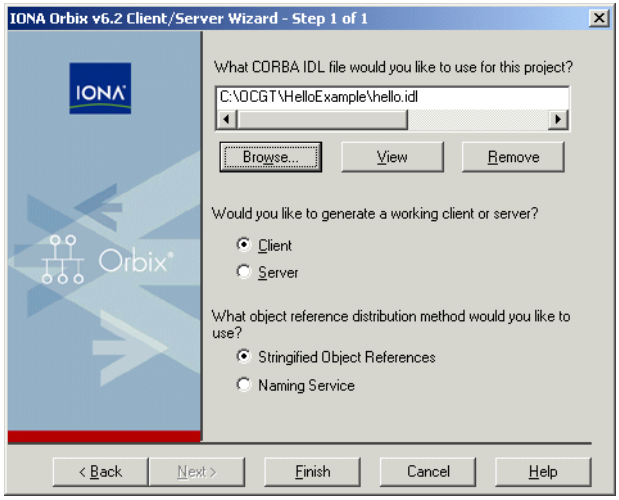
1. Open the Microsoft Visual C++ 6.0 IDE.
2. From the Visual C++ menus, select **File**|**New**
3. In the New dialog, click on the Projects tab.

4. In the Projects tab, perform the following actions:
   - Select **IONA Orbix v6.2 Client/Server Wizard**
   - In the **Project name** text box, enter `client`
   - Under the **Location** text box, enter `C:\OCGT\HelloExample\client`

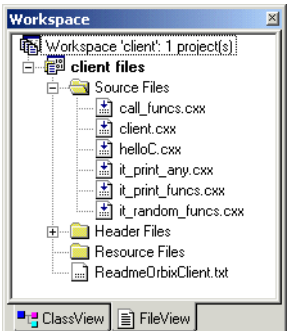


5. Click **OK**.
6. The client/server wizard displays.

7. Answer two questions as follows:
   - **What CORBA IDL file would you like to use for this project?**
     Enter the location of `hello.idl`
   - **Would you like to generate a working client or server?**
     Select **Client**



8. To generate the client project, click **Finish**
9. The New Project Information scrollbox tells you about the generated files. Browse the information and select **OK**
10. The client workspace is generated with the following source files:



11. Read the text file `ReadmeOrbixClient.txt`

Complete the client program

Complete the implementation of the client `main()` function in the `client.cxx` file. You must add a couple of lines of code to make a remote invocation of the operation `getGreeting()` on the `Hello` object.

Search for the line where the `call_Hello_getGreeting()` function is called. Delete this line and replace it with the two lines of code highlighted in bold font below:

```
//C++
//File: 'client.cxx'
...
     if (CORBA::is_nil(Hello1))
     {
          cerr << "Could not narrow reference to interface "
               << "Hello" << endl;
     }
     else
     {
          CORBA::String_var strV = Hello1->getGreeting();
          cout << "Greeting is:  " << strV << endl;
     }
...
```

The object reference `Hello1` refers to an instance of a `Hello` object in the server application. It is already initialized for you.

A remote invocation is made by invoking `getGreeting()` on the `Hello1` object reference. The ORB automatically establishes a network connection and sends packets across the network to invoke the `HelloImpl::getGreeting()` function in the server application.

The returned string is put into a C++ object, `strV`, of the type `CORBA::String_var`. The destructor of this object will delete the returned string so that there is no memory leak in the above code.

Build the client program

From within the Visual C++ IDE select **Build**|**Build client.exe** to compile and link the client.

By default, the project will build with debug settings and the client executable will be stored in `C:\OCGT\HelloExample\client\Debug\client.exe`.

Close the client workspace by selecting **File**|**Close Workspace**.

Run the demonstration

Run the application as follows:

1. Run the Orbix services (if required).

   If you have configured Orbix to use file-based configuration, no services need to run for this demonstration. Proceed to step **2**.

   If you have configured Orbix to use configuration repository based configuration, start up the basic Orbix services.

   ```
   > start_domain-name_services.bat
   ```

   Where *domain-name* is the name of your configuration domain.

2. Set the Application Server Platform's environment.

   ```
   > domain-name_env.bat
   ```

3. Run the server program.

   ```
   > cd C:\OCGT\HelloExample\server\Debug
   > start server.exe
   ```

   A new window opens and the server outputs the following lines:

   ```
   Initializing the ORB
   Writing stringified object reference to Hello.ref
   Waiting for requests...
   ```

   The server performs the following steps when it is launched:

   - It instantiates and activates a single `Hello` CORBA object.
   - The stringified object reference for the `Hello` object is written to the file `C:\temp\Hello.ref`.
   - The server opens an IP port and begins listening on the port for connection attempts by CORBA clients.

4. Run the client program.

   ```
   > cd C:\OCGT\HelloExample\client\Debug
   > client.exe
   ```

The client outputs the following lines to the screen:

```
Client using random seed 0
Reading stringified object reference from Hello.ref
Greeting is: Hello World!
```

The client performs the following steps when it is run:

- It reads the stringified object reference for the `Hello` object from the `C:\temp\Hello.ref` file.
- It converts the stringified object reference into an object reference.
- It calls the remote `Hello::getGreeting()` operation by invoking on the object reference. This causes a connection to be established with the server and the remote invocation to be performed.

5. When you are finished, terminate all processes.
   - The server can be shut down by typing **`Ctrl-C`** in the window where it is running.
6. Stop the Orbix services (if they are running).

   From a DOS prompt enter:

```
> stop_domain-name_services
```

Development from the Command Line

Starting point code for CORBA client and server applications can also be generated using the `idlgen` command line utility, which offers equivalent functionality to the client/server wizard presented in the previous section.

The `idlgen` utility can be used on Windows and UNIX platforms.

You implement the `Hello World!` application with the following steps:

1. Define the IDL interface, `Hello`.
2. Generate starting point code.
3. Complete the server program by implementing the single IDL `getGreeting()` operation.
4. Complete the client program by inserting a line of code to invoke the `getGreeting()` operation.
5. Build the demonstration.
6. Run the demonstration.

Define the IDL interface

Create the IDL file for the `Hello World!` application. First of all, make a directory to hold the example code:

Windows

```
> mkdir C:\OCGT\HelloExample
```

UNIX

```
% mkdir -p OCGT/HelloExample
```

Create an IDL file `C:\OCGT\HelloExample\hello.idl` (Windows) or `OCGT/HelloExample/hello.idl` (UNIX) using a text editor.

Enter the following text into the file `hello.idl`:

```
//IDL
interface Hello {
    string getGreeting();
};
```

This interface mediates the interaction between the client and the server halves of the distributed application.

Generate starting point code

Generate files for the server and client application using the CORBA Code Generation Toolkit.

In the directory `C:\OCGT\HelloExample` (Windows) or `OCGT/HelloExample` (UNIX) enter the following command:

```
idlgen cpp_poa_genie.tcl -all hello.idl
```

This command logs the following output to the screen while it is generating the files:

```
hello.idl:
cpp_poa_genie.tcl: creating it_servant_base_overrides.h
cpp_poa_genie.tcl: creating it_servant_base_overrides.cxx
cpp_poa_genie.tcl: creating HelloImpl.h
cpp_poa_genie.tcl: creating HelloImpl.cxx
cpp_poa_genie.tcl: creating server.cxx
cpp_poa_genie.tcl: creating client.cxx
cpp_poa_genie.tcl: creating call_funcs.h
cpp_poa_genie.tcl: creating call_funcs.cxx
cpp_poa_genie.tcl: creating it_print_funcs.h
cpp_poa_genie.tcl: creating it_print_funcs.cxx
cpp_poa_genie.tcl: creating it_random_funcs.h
cpp_poa_genie.tcl: creating it_random_funcs.cxx
cpp_poa_genie.tcl: creating Makefile
```

You can edit the following files to customize client and server applications:

Client:

`client.cxx`

Server:

`server.cxx`
`HelloImpl.h`
`HelloImpl.cxx`

Complete the server program

Complete the implementation class, `HelloImpl`, by providing the definition of the `HelloImpl::getGreeting() function` . This C++ function provides the concrete realization of the `Hello::getGreeting()` IDL operation.

Edit the `HelloImpl.cxx` file, and delete most of the generated boilerplate code occupying the body of the `HelloImpl::getGreeting()` function. Replace it with the line of code highlighted in bold font below:

```
//C++
//File 'HelloImpl.cxx'
...
char *
HelloImpl::getGreeting() throw(
    CORBA::SystemException
)
{
    char *                          _result;

    _result = CORBA::string_dup("Hello World!");

    return _result;
}
...
```

The function `CORBA::string_dup()` allocates a copy of the `"Hello World!"` string on the free store. It would be an error to return a string literal directly from the CORBA operation because the ORB automatically deletes the return value after the function has completed. It would also be an error to create a copy of the string using the C++ `new` operator.

Complete the client program

Complete the implementation of the client `main()` function in the `client.cxx` file. You must add a couple of lines of code to make a remote invocation of the `getGreeting()` operation on the `Hello` object.

Edit the `client.cxx` file and search for the line where the `call_Hello_getGreeting()` function is called. Delete this line and replace it with the two lines of code highlighted in bold font below:

```
//C++
//File: 'client.cxx'
...
     if (CORBA::is_nil(Hello1))
     {
          cerr << "Could not narrow reference to interface "
               << "Hello" << endl;
     }
     else
     {
          CORBA::String_var strV = Hello1->getGreeting();
          cout << "Greeting is:  " << strV << endl;
     }
...
```

The object reference `Hello1` refers to an instance of a `Hello` object in the server application. It is already initialized for you.

A remote invocation is made by invoking `getGreeting()` on the `Hello1` object reference. The ORB automatically establishes a network connection and sends packets across the network to invoke the `HelloImpl::getGreeting()` function in the server application.

The returned string is put into a C++ object, `strV`, of the type `CORBA::String_var`. The destructor of this object will delete the returned string so that there is no memory leak in the above code.

Build the demonstration

The `Makefile` generated by the code generation toolkit has a complete set of rules for building both the client and server applications.

To build the client and server complete the following steps:

1. Open a command line window.
2. Go to the `../OCGT/HelloExample` directory.
3. Enter:

Windows

```
> nmake
```

UNIX

```
% make -e
```

Run the demonstration

Run the application as follows:

1. Run the Orbix services (if required).

   If you have configured Orbix to use file-based configuration, no services need to run for this demonstration. Proceed to step **2**.

   If you have configured Orbix to use configuration repository based configuration, start up the basic Orbix services.

   Open a DOS prompt in Windows, or `xterm` in UNIX. Enter:

   ```
   start_domain-name_services
   ```

   Where *`domain-name`* is the name of the configuration domain.

2. Set the Application Server Platform's environment.

   ```
   > domain-name_env
   ```

3. Run the server program.

   Open a DOS prompt, or `xterm` window (UNIX). From the `C:\OCGT\HelloExample` directory enter the name of the executable file—`server.exe` (Windows) or `server` (UNIX).The server outputs the following lines to the screen:

   ```
   Initializing the ORB
   Writing stringified object reference to Hello.ref
   Waiting for requests...
   ```

   The server performs the following steps when it is launched:

   - It instantiates and activates a single `Hello` CORBA object.
   - The stringified object reference for the `Hello` object is written to the local `Hello.ref` file.
   - The server opens an IP port and begins listening on the port for connection attempts by CORBA clients.

4. Run the client program.

Open a new DOS prompt, or `xterm` window (UNIX). From the `C:\OCGT\HelloExample` directory enter the name of the executable file—`client.exe` (Windows) or `client` (UNIX).

The client outputs the following lines to the screen:

```
Client using random seed 0
Reading stringified object reference from Hello.ref
Greeting is: Hello World!
```

The client performs the following steps when it is run:

- It reads the stringified object reference for the `Hello` object from the `Hello.ref` file.
- It converts the stringified object reference into an object reference.
- It calls the remote `Hello::getGreeting()` operation by invoking on the object reference. This causes a connection to be established with the server and the remote invocation to be performed.

5. When you are finished, terminate all processes.

   Shut down the server by typing **`Ctrl-C`** in the window where it is running.

6. Stop the Orbix services (if they are running).

   From a DOS prompt in Windows, or `xterm` in UNIX, enter:

   ```
   stop_domain-name_services
   ```

The passing of the object reference from the server to the client in this way is suitable only for simple demonstrations. Realistic server applications use the CORBA naming service to export their object references instead (see Chapter 18).

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