RFC Java Class Library (BC-FES-AIT)

HELP.BCFESDEG

Release 4.6C

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RFC Java Class Library (BC-FES-AIT)

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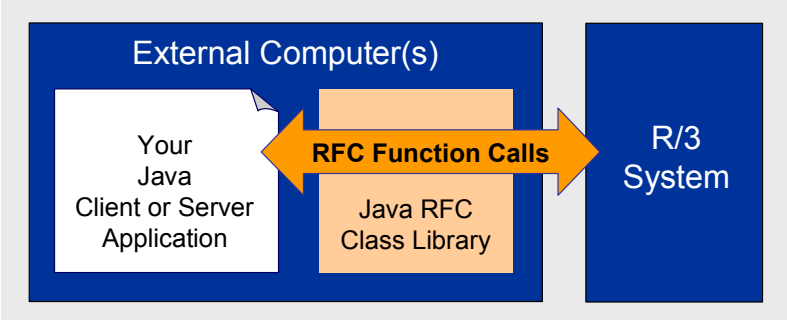
Purpose

The *Java RFC Class Library* provides a simple, object-oriented Java view of the SAP RFC (Remote Function Call) API.

Based on the *RFC Library* (which provides the *RFC API*), the *Java RFC Class Library* allows you to easily write Java programs that use the RFC protocol to communicate with R/3 applications. The *Java RFC Class Library* hides all the low-level details of the native C or C++ calls, thereby reducing much of the complexity for programming RFC in Java.

The *Java RFC Class Library* allows you to develop both RFC client and RFC server applications. This means that applications you develop with the *Java RFC Class Library* can either send client requests to R/3 using RFC calls, or they can act as a RFC servers to R/3 function calls.



Note that we sometimes refer to the *Java RFC Class Library* in short as the *Java RFC*.

Implementation Considerations

You can use the *Java RFC Class Library* with an R/3 system 2.x and higher if the R/3 system had been set up to send or receive remotely callable functions.

Java RFC Architecture

Underlying Software

The *Java RFC* is based on the *RFC Library* (also called the *RFC API*).

The Java RFC packages in some cases also use the framework provided by the RFC C++ Class Library [Ext.] (which is a part of the SAP Automation suite of products [Ext.]), to take advantage of the object-oriented paradigm of the *RFC C++ Class Library*.

Java RFC Class Library

The *Java RFC Class Library* provides packages that include interfaces and classes for creating RFC client or RFC server applications.

The *Java RFC Class Library* is structured as two layers:

- The Java RFC Interface layer (fixed)

  This layer contains the definition of the interfaces and classes that you use when programming with the *Java RFC Class Library*. This layer stays consistent, in that the definition of existing classes and interfaces does not change. SAP may add interfaces or classes over time.

  This layer also contains the implementation of the classes that are a part of the Java RFC interface definition.

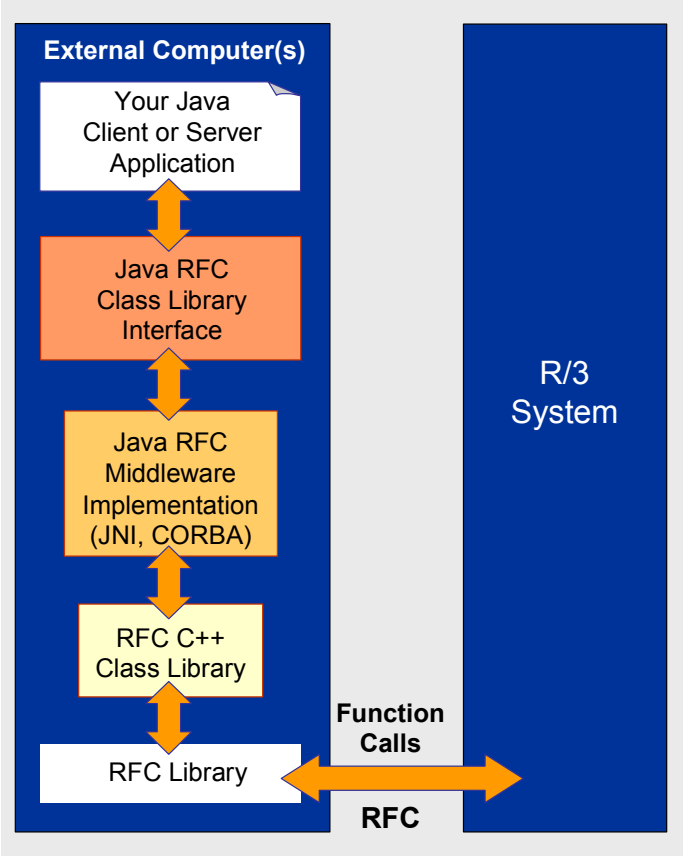
- Middleware implementation layer (pluggable)

  This layer contains the implementation of the interfaces that are a part of the Java RFC interface definition layer.

  The middleware implementation layer is pluggable, meaning that the *Java RFC Class Library* allows you to interchange middleware implementations. SAP provides two different types of middleware implementations for you to use with the *Java RFC Class Library.* Other companies provide the middleware implementation for the *Java RFC Class Library* as well.

The following diagram shows the components used by the *Java RFC*.

Java RFC Architecture



The *Java RFC Class Library* allows you to choose between two types of provided middleware:

- CORBA (Orbix) [Page 10]
- Java Native Interface (JNI) [Page 12]

See Also

Middleware Used by Java RFC [Page 9]

Middleware Used by Java RFC

Middleware Types

The *Java RFC Class Library* allows you to choose between two types of middleware:

- CORBA
- Java Native Interface (JNI)

SAP provides two middleware implementations with the *Java RFC Class Library* (one of each of those two type):

Middleware Type	Bundled Implementation
CORBA	IONA Technologies' Orbix
JNI	SAP's JNI

You choose which of the middleware implementation you wish to use with the *Java RFC Class Library*.

Comparing Middleware Types

Using the CORBA middleware implementation that uses IONA Technologies' Orbix allows you to distribute the RFC application across the network. This means that you can use it to program Java applets that make RFC calls to R/3.

The JNI middleware implementation does not allow you to distribute your RFC application to remote client computers. This means that you cannot use it to implement Java applets that make RFC calls.

On the other hand, the JNI middleware is easier to use, and it is more efficient to use if all the RFC components of your RFC application reside on the same computer.

This means that the JNI implementation is appropriate for creating Web server-side applications that make RFC calls to R/3.

See Also

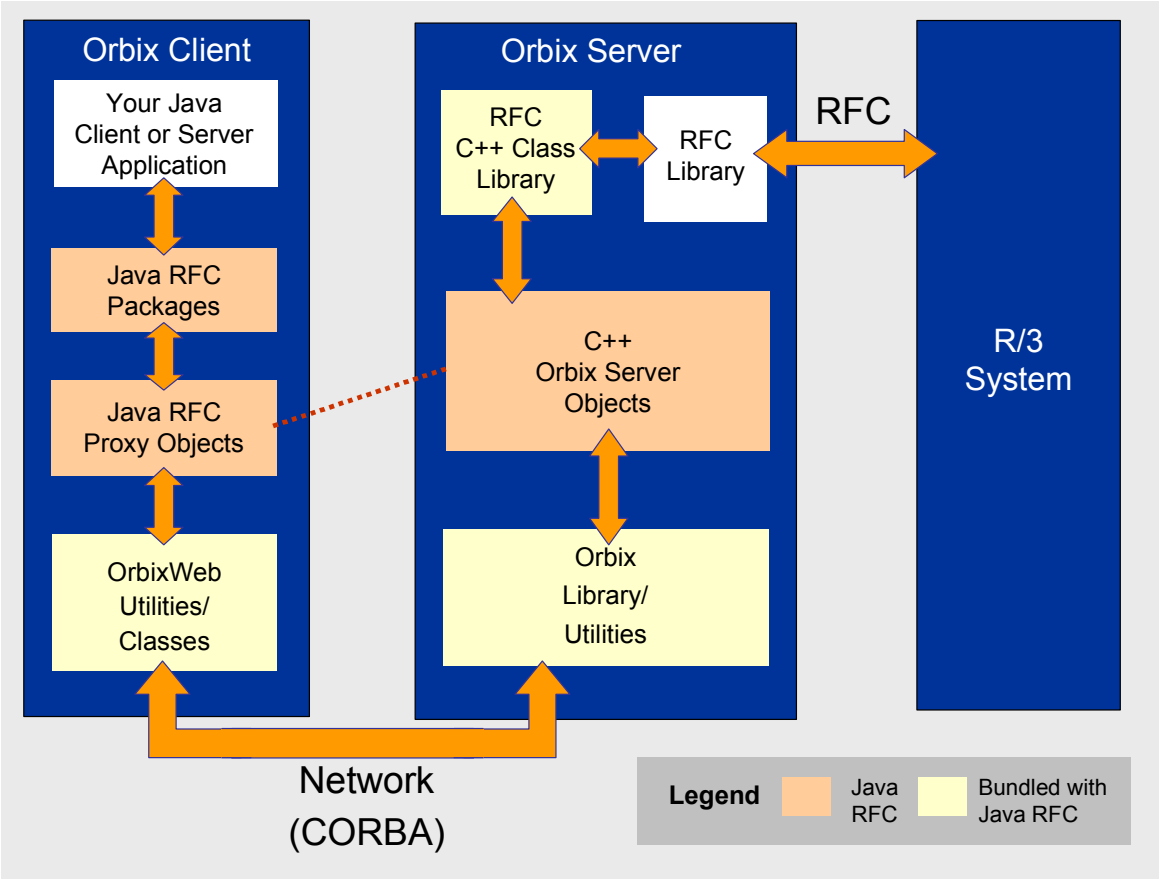
For a more detailed explanation of the differences between the architecture of the Java RFC components when using each of these middleware implementations, see the following topics:

- CORBA-type Middleware: Orbix [Page 10]
- SAP JNI Middleware [Page 12]

CORBA-type Middleware: Orbix

The *Java RFC Class Library* offers a CORBA implementation of the middleware using IONA Technologies' Orbix 2.3c and OrbixWeb 3.0.

The following diagram shows the different components used by the *Java RFC Class Library* when using the Orbix middleware. The arrows show the flow of communication from your application all the way to the R/3 Application server and back.



Notes on the above illustration:

- Among the components shown, the *Java RFC Packages*, *Java RFC Proxy Objects,* and the *C++ Orbix Server Objects* are part of the *Java RFC* product. The Orbix components and the *C++ Class Library* are also bundled with the *Java RFC*.
- *Your Java Client or Server Application* is the program that uses *Java RFC* to communicate with R/3.
  - In the case of a Java application it can be an RFC client application (meaning that it issues RFC function calls to an R/3 application) or it can be an RFC server application (meaning that it can accept and process RFC function calls from an R/3 application).
  - In the case of Java applets, it can only be an RFC client application.

  - **In the case of Java applets, the Orbix server must run on the same machine as the Web server**, due to restrictions on applet operations enforced by Web browsers.

- The dashed line in the diagram is to indicate that the Orbix client packages create proxy objects for the “real” objects on the Orbix server. The proxy objects operate on behalf of the real objects transparently to the client.
- The communication between the Orbix client and Orbix server is through Common Object Request Broker Architecture (CORBA) interfaces. The ORB (Object Request Broker) used are Orbix and OrbixWeb from IONA Technologies.

  Java RFC uses *Orbix* and *OrbixWeb* to facilitate cross network communications between Orbix client and Orbix server machines, and for hiding marshaling and networking details from your application (marshaling and unmarshaling are the processes of packaging and interpreting network messages).

  The necessary *Orbix* and *OrbixWeb runtime files* are bundled with Java RFC.

As you can see from the above illustration, both the Orbix and the Java RFC products are composed of a client and a server portions, which can be installed on separate computers.

This division between the client and server portions of the Orbix middleware implementation allows you to distribute the RFC application across the network.

This division allows multiple applications to share a single RFC server. In this scenario, the Orbix server portion is installed on one computer, and the client portion can be installed on multiple clients.

This division also allows the use of Java applets that make RFC calls to R/3. In this scenario, the Java applet resides on the Web server computer. When a Web Browser (on the client computer) calls an applet, the Web server ships the applet to the client computer. The applet runs on the Web client computer. The Orbix software takes care of the communication over the network between the Web client and the Web Server when the applet makes RFC calls.

Note on the Use of the Client and Server Terms

Note that there may be a confusion with the use of the client and server terminology when using the Orbix middleware with the *Java RFC Class Library*. The terms client and server are used in two contexts:

- When using the Orbix middleware, both the Orbix software and the *Java RFC Class Library* consist of a client and a server portion. This is what allows you to distribute your application.

  In this context we refer to these terms as the "Orbix client" or "Orbix server".

- The whole purpose of using the *Java RFC Class Library* is to create either an RFC client or an RFC server application, relative to RFC calls to R/3 applications.

  In this context we refer to these terms as the "RFC server" or "RFC client".

Note that we use the full terms ("RFC client", for example, instead of "client") only when confusion may arise and only when it does not make the discussion cumbersome.

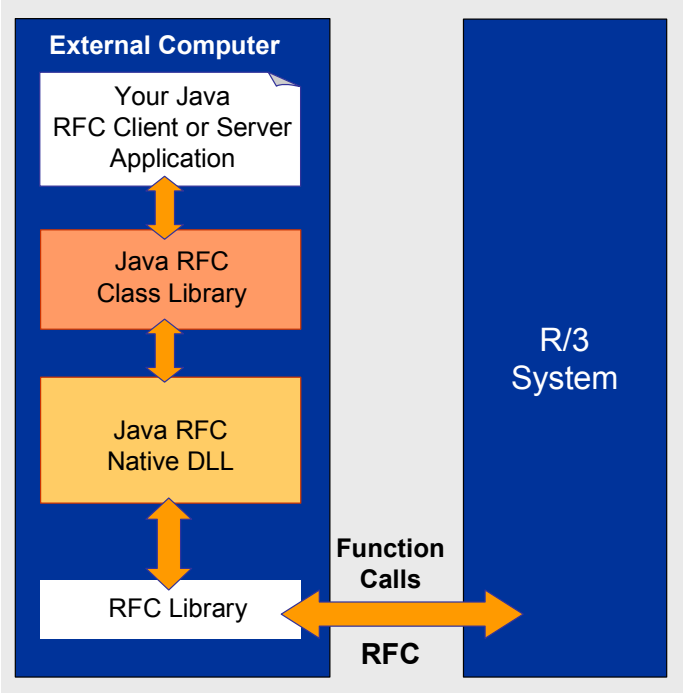
See Also

SAP JNI Middleware [Page 12], Middleware used by Java RFC [Page 9]

SAP JNI Middleware

The following diagram shows the components used by the *Java RFC Class Library* when using the JNI middleware.

The arrows show the flow of communication from your application all the way to the R/3 Application server and back.



Notes on the above illustration:

- Your *Java Client or Server Application* represents the program that uses the *Java RFC* to communicate with R/3. It can be an RFC client application (meaning that it issues RFC function calls to an R/3 application) or it can be an RFC server application (meaning that it can accept RFC function calls from an R/3 application).

  It cannot be a Java applets

- The *Java RFC Class Library* layer represents the exposed interfaces and their implementation classes of the *Java RFC* packages.
- The *Java RFC* packages encapsulate the *RFC API* and the *RFC C++ Class Library*. The *RFC C++ Class Library* is bundled with Java RFC. The *RFC API* is part of the SAP Presentation CD.
- The *Java RFC Native DLL* component is the SAP middleware implementation of JNI. It is also bundled with the *Java RFC*.

As you can see from the above illustration, all the components that participate in providing the *Java RFC* interfaces when using the JNI middleware implementation reside on the same computer.

Therefore, the JNI middleware implementation does not allow for distributed computing. You cannot distribute your RFC application to different computers, and you cannot use it to implement Java applets that make RFC calls.

On the other hand, the JNI middleware is easier to use.

Because less communications needs to take place between various internal components (as with the arrangement of the Orbix client and server components), the JNI middleware implementation is more efficient to use if you do not need to distribute your application.

The JNI implementation is appropriate for creating Web server-side applications that make RFC calls to R/3. In this scenario you install all the Java RFC components on the Web server computer.

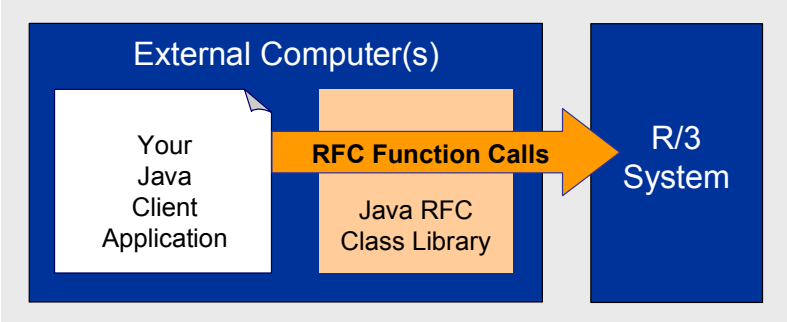
See Also

CORBA-type Middleware: Orbix [Page 10], Middleware used by Java RFC [Page 9]

Java RFC Features

Client Interface Features

The *Java RFC Class Library* offers classes and objects that allow you to write RFC client application programs that send RFC requests to R/3.

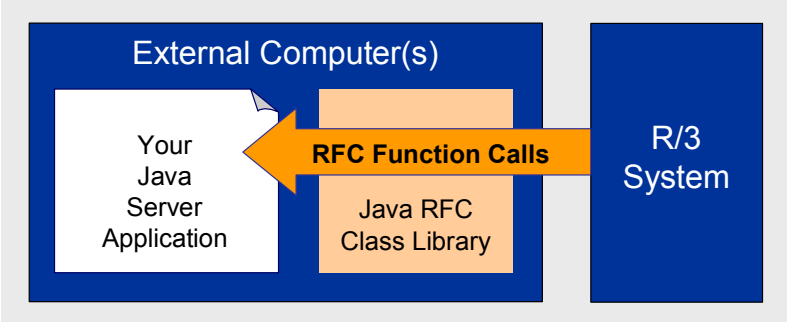


The features the Java RFC Class Library offers specifically for building RFC client applications are:

- Transparent RFC calls from Java: using this package you can easily build applications/applets that communicate with R/3 through RFC completely in Java.
- Establishing and closing down connections to R/3: All modes of RFC connection are supported.
- Handling a single connection is easy with the SessionManager [Page 43] and related objects. You can also handle multiple connections [Page 126], by using the FactoryManager and related objects.
- Handling parameters in calls to RFC:
  - Packaging all import and table parameter values into the right RFC-required format
  - Marshalling them over the network before each call
  - Extracting all export and table parameter values
  - De-marshalling them into appropriate client side parameter objects after each call

Server Interface Features

The *Java RFC Class Library* also offers classes and objects that allow you to write application programs that act as RFC server to R/3.



RFC server applications using the *Java RFC* can:

- Register themselves in the SAP Gateway
- Wait for incoming RFC calls
- Accept RFC function calls
- Process the data from the call
- Return results of the processing to the calling client

When handling parameters that are communicated to and from the server application, the *Java RFC*:

- Extracts all import and table parameter values in the RFC format
- De-marshals them into appropriate parameter objects for the application
- Packages all export and table parameter values into the appropriate RFC format
- Send them over the network

General Feature of the java RFC Class Library

The features the Java RFC Class Library offers for building RFC client or server applications are:

- Pluggable middleware architecture

  We refer to the underlying implementation of the Java RFC (as opposed to the interface definition) as *Middleware*.

  You can use a middleware type of your choice. The Java RFC class Library comes with a CORBA [Page 10] and a JNI [Page 12] implementation of the middleware. See Middleware Used by Java RFC [Page 9].

- The interfaces provided are designed to hide middleware implementation details. The application can specify the middleware type to use through two properties files. You then use the properties files when working with the global SessionManager [Page 43] object. Most of your application code can remain unchanged regardless of the middleware implementation you use. It is not recommended, however, to switch middleware while a Java RFC application is running.
- Creation of connection objects (for RFC client applications), function and function module objects (for RFC server and client applications respectively), and parameter objects (including table objects) are all done through factories. Different middleware implementers supply different factories, yet from the application's view they all support the same set of interfaces.

Java RFC Features

- Function module objects and table/structure parameter objects can be created manually or automatically. When creating objects manually, the application constructs the metadata for the function module and its parameters. When creating objects automatically, the application does not need to construct metadata information. *Java RFC* obtains the metadata from R/3 at runtime (with the overhead of additional RFC calls).
- When setting or getting parameter values, all RFC data types are supported, and they can be converted to any Java native types on demand when possible. For example, for an RFC NUMC (numerical string) type field, the application can ask to get the value in the form of any of the following: String, byte, short, int, long, BigInteger, BigDecimal, float, double, or byte array, as long as the value can be converted into these forms. If the conversion is impossible, an exception is thrown (for example, if you attempt to convert a number into short when the number is larger than the maximum short value).

To improve the efficiency of transferring table data, *Java RFC* performs:

  - Smart caching of rows, meaning that a row access will result in buffering of adjacent rows. The application can set each table's read buffer size at any time.
  - Delta management of data, meaning that the *Java RFC* only transports data that had changed to the R/3 system, and not the whole data set.

- *Java RFC* provides exception handling
- Both RFC client and RFC server applications using the *Java RFC* are multi-thread safe.

Additional Orbix Server Features

The following are items that are unique to the Orbix middleware:

- The Orbix server uses the SAP *RFC C++ Class Library* and has client side multi-threading capabilities.
- The Orbix server process uses a pool of threads to handle client requests concurrently. The number of threads in the pool is configurable from the command line.

  Orbix also allows the administrator of the Orbix server to configure a number of separate server processes to handle multiple client requests.

- The Orbix server will stay active as long as there are open connections from the client. When there are no client connections, it may timeout and exit. The timeout period is configurable from the command line. The default is infinite timeout.
- The Orbix server keeps a reference list of server objects created for each client connection. These objects will stay around until the connection is closed down. Upon close of connection, the server will automatically clean up all server side objects created on behalf of this client. No client side calls for cleanup is required.
- For performance reasons, all structure and table data are transferred over the network as byte streams.
- Marshaling and unmarshaling (between the Orbix server and the Orbix client) are done implicitly.
- Uses IONA's Orbix 2.3c for the underlying CORBA transport layer.

There are no special features or considerations when using the JNI middleware.

Java RFC Documentation

How to Use this Help Document

This document describes how to program with the *Java RFC Class Library*. It is geared towards developers who are building Java applications or applets that communicate with R/3 using the SAP RFC interface.

This document assumes that are familiar with the following:

- Java Programming
- R/3 RFC protocol, including setting up the necessary infrastructure for using it
- When programming an RFC client application, you also need to be familiar with the specific RFC function(s) you wish to call

Related Reference Documentation

The full reference documentation for the various client and server interfaces and classes within the *Java RFC Class Library* are in a separate HTML document, which we refer to as the *Java RFC HTML Reference*. It was previously called the *Java RFC Client HTML Reference* .It is available in the Java RFC program group after installation of the *Java RFC Class Library*.

Release Information

The *Java RFC Class Library* is compatible with JDK 1.1 and JDK 1.2.

This version of Java RFC supports the features of R/3 version 2.x and higher.

The Orbix server platform must be Windows NT.

The Orbix server component requires the 2.3C version of IONA Technologies' Orbix product

What's New in Release 4.6A?

The code for establishing a single connection to R/3 is much simpler now: less steps are required for establishing such a connection, and there is no need to refer to a connection object in methods dealing with an RFC function module within a single connection.

To provide for this simplified code, the SessionManager object has been added to the Java RFC class library. The SessionManager handles a single connection. As part of this role it can create the five factory objects of the Java RFC in the same manner as the FactoryManager can. When creating objects, the SessionManager ensures that objects have all the information they need to establish a connection.

When using a single connection the SessionManager can therefore take the place of the FactoryManager.

However, when using multiple connections in your program you should use the FactoryManager. Using the FactoryManager to handle connections or to create objects is similar to the process of creating any connection in the previous release of the Java RFC.

Note that while you can use the SessionManager to simplify new coding, the FactoryManager and all of its methods are still available as in the previous release of the Java RFC. There is no need to change existing code using the FactoryManager.

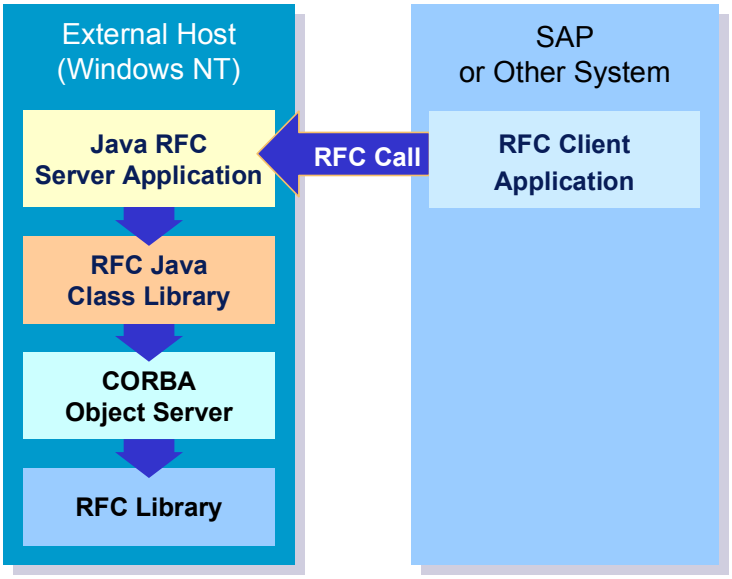
See Also

See the topic Client Side Interface [Page 41] and all of its subtopics for the details of how to use the SessionManager.

The Advanced Topics [Page 125] section describes how to program multiple connections using the FactoryManager.

What's New in Release 4.6B?

The 4.6B version of RFC Java Class Library offers server functionality. This release of the RFC Java Class Library offers new classes and interfaces for application programmers who wish to develop Java RFC server applications that run on external personal computers. These Java RFC server application programs, with the help of this new server functionality, can implement RFC function calls in Java, and then register themselves in the SAP Gateway to wait for RFC calls from a client (most likely an R/3 system). Once an RFC call is received, the Java server application program can process the data from the RFC call and then return the results to the client.



New Objects

To allow for building applications that offer server functionality the following objects have been added:

- *ServerApp*
- *IServerFunction*
- *IServerProcess*
- *IServerFunctionFactory*

See the description of these objects in Java RFC Server Classes and Interfaces [Page 101]

In addition, the *IRfcFunction* interface was added as a parent interface common to *IRfcModule* (for client applications) and *IServerFunction*.

What's New in Release 4.6C?

- The *Java RFC Class Library* can now be used with Java Native Interface (JNI) middleware. The *Java RFC Class Library* now comes with an SAP implementation of JNI. This is in addition to the supplied CORBA-based middleware (Orbix).

  Both the JNI and the Orbix middleware can be used for creating either RFC client or RFC server applications.

  See the overview discussion in the Middleware Used by the Java RFC [Page 9] and in CORBA-type Middleware: Orbix [Page 10], and SAP JNI Middleware [Page 12]. Also see the details of the installation [Page 23] for each of the middleware type.

  To accommodate the ability to use different middleware, the SessionInfo object now uses two properties files [Page 45], instead of one. See the discussion in that topic and in the topic Specifying Middleware Type [Page 64].

- RFC server applications (applications that act as servers to R/3 RFC calls) can now let the *Java RFC Class Library* automatically create server function objects [Page 107]. This allows for a dynamic creation of parameter objects, and it frees the programmer from the task of manually creating and adding the parameter objects [Page 104]. Manual creation was the only option in the previous release.

- Server applications are now multi-thread safe when more than one client makes RFC calls to them.

Installation and Setup

Purpose

Before you can use the RFC Java Class Library, you must install the necessary components. This document describes the process you must follow to install and successfully configure this software. The RFC Java Class Library consists of the following components:

- For the Orbix middleware:
  - Java RFC Orbix server component software
  - Java RFC Orbix client component software
  - Java RFC server component software
  - IONA Technologies' Orbix object middleware and OrbixWeb products (included)
- For the JNI middleware: the Java RFC Native DLL
- README files
- Documentation:
  - This online HTML Help document
  - *Java RFC HTML Reference* documentation

Procedure

1. Locate the R/3 Presentation CD. You install the Java RFC components from this CD as part of the installation of SAP Automation.

   You can also download the installation program or directly install this software from the SAP Automation Web site at http://www.saplabs.com.

2. You can now install the RFC Java Class Library to work with the SAP JNI middleware implementation [Page 24], or to work with the Orbix middleware implementation [Page 25].

See Also

See the instructions for installing the Java RFC with the desired middleware implementation. Also see the discussion of Middleware Used by Java RFC [Page 9] and in CORBA-type Middleware: Orbix [Page 10], and SAP JNI Middleware [Page 12].

Installing Java RFC for JNI Middleware

Use

Installing the Java RFC to work with the JNI middleware is very simple, and it is similar to installing the Orbix client portion [Page 27].

Procedure

1. Locate the Java RFC installation software at the R/3 Presentation CD or at the SAP Automation Web site.

   You install the Java RFC components from this CD as part of the installation of SAP Automation.

2. Start the installation procedure by running the JRFC.EXE file.

3. To install the necessary Java RFC components:

   You may accept all the defaults offered by the installation program. This includes answering "*No*" to the question regarding the installation of the Orbix Daemon as an NT service. However, your answer in this case does not make a difference.

   Make sure that at least the *JRFC Client* option in the *Select Component* dialog is checked. You can check both the client and the server options. Note, though, that the server option installs the Orbix server portion, which you do not need.

In addition to installing the Java RFC software, you must also specify middleware type to be the SAP JNI, by using the correct values in the Java RFC properties files [Page 45]. See the topic specifying the middleware type to use with the Java RFC [Page 64].

Result

Installing the client automatically copies the necessary Java RFC files to your client computer. This includes:

- The Java RFC implementation class packages
- The Java RFC client and server packages (*com.sap.rfc* and *com.sap.rfc.exceptions*)
- The Java RFC Native DLL

Orbix Installation and Setup

The Orbix middleware implementation allows you to distribute the RFC calls in your application and it allows you to create applets that make RFC calls from Java.

When you install the Java RFC to work with the Orbix middleware implementation, you can decide whether to install the Orbix client and server portions on the same computer.

In the case of using the Java RFC for Java applets, the applet and the Orbix client must be on the same computer. The Orbix server can be anywhere.

Prerequisites

- Locate the Java RFC installation software at the R/3 Presentation CD or at the SAP Automation Web site.

  You install the Java RFC components from this CD as part of the installation of SAP Automation.

- Decide how you want to install the Orbix **server component** of the Java RFC. The Orbix server component is necessary to run programs containing the Java RFC calls. The Orbix server computer is not necessarily the computer on which the R/3 application server resides. It can be a Web server, for example. It can also be on the same computer as the client. You can install the client or the server components of Java RFC separately, or you can install both at the same time.
  - If you install the client and Orbix server at the same time, both the client and server components are installed on the same computer.
  - To install the Orbix server components on another computer, install the client and server components separately, each on their target computer.
- The Orbix server component requires the 2.3C version of IONA Technologies' Orbix product. If you have installed a version of IONA's Orbix service on your server that is earlier than 2.3C, we recommend that you back up your configuration files, and any entries related to Orbix in the Windows environment, such as in the Windows Registry. See the topic Java RFC Server Orbix Installation Processing [Page 34] to determine what you need to back up.
- Get Administrative rights to the Java RFC server and all client PCs.
- Review the README files for the RFC server and client components for any late-breaking product information.

Process Flow

1. Run the installation program. To do this, during the SAP Automation installation, select the *Java RFC* component. The file JRFC.EXE is copied to a directory of your choice. Use the *Save As* dialog to specify the directory to place this file.
2. Install the **client component** of Java RFC to use the Java RFC interfaces in your programs. To install the client components [Page 27], simply choose the *JRFC Client* option during the Java RFC installation procedure.
3. Install and configure the **Orbix server component** of Java RFC to run a program containing Java RFC calls. You must install and configure the server components of the Java RFC before running programs that issue requests from the Java RFC client.

Orbix Installation and Setup

The Orbix server component requires the following setup:

a. Install the Orbix server components [Page 28] of the Java RFC on the server computer. The server computer is not necessarily the computer on which the R/3 application server resides. It can be a Web server, for example. It can also be on the same computer as the client.

b. Restart the Orbix server computer.

c. Start the Orbix Daemon [Page 30] before you run any program that sends Java RFC client requests. The Orbix daemon automatically starts the necessary Orbix server processes as needed, once it receives client requests.

   If you specified that the Orbix daemon is installed as an NT service, then the Orbix daemon is started automatically at system startup. You can skip this step in this case. See the discussion of the installation of the Orbix daemon as an NT service in the topic Installing the Orbix Server [Page 28].

d. Use the Orbix Server Manager utility to configure the properties of the Java RFC server [Page 32].

Installing the Orbix Client

Use

Installing the client components of the Java RFC allows you to use the Java RFC interfaces in a Java program, application, or applet.

Procedure

1. Start the installation procedure by running the JRFC.EXE file.
2. To install the client components, check the *JRFC Client* option in the *Select Component* dialog.

Result

Installing the client automatically copies the necessary client files to your client computer. This includes:

- The Java RFC implementation class packages
- The Java RFC client and server packages (*com.sap.rfc* and *com.sap.rfc.exception*)
- The IONA Orbix/Web Utilities and classes

Installing the Orbix Server

Use

Installing the Orbix server component copies and sets up the required Orbix server files on the Orbix server computer.

Orbix server installation is only the first step required for Orbix server setup. See the Orbix Installation and setup [Page 25] topic for other steps you must take to complete the setup of the Orbix server computer.

Prerequisites

The Orbix server computer must use the Windows NT operating system (Windows NT 4.0 or 3.5.1)

The Java RFC Class Library requires the use of the IONA Technologies' Orbix and OrbixWeb utilities. The current version of the Java RFC requires version 2.3C of Orbix.

Procedure

1. Start the Java RFC installation procedure by running the JRFC.EXE file.
2. To install the server components, select the *JRFC Server* option in the *Select Component* dialog during the installation procedure. You can also install the client [Page 27] on the same computer.
3. Specify a destination folder for the files of the Java RFC server components. The default for CD installations is *C:\SAP\JRFC*.
4. If you have an installed IONA's Orbix service of version earlier than 2.3c, you will be asked if you wish to overwrite this version. If you have such a version of Orbix installed, we recommend that you exit the Java RFC installation program and backup Orbix-related information in Windows.

   See the topic Java RFC Orbix Server Installation Processing [Page 34] to determine what you need to back up. Restart the Java RFC installation after this, and this time allow it to overwrite the existing Orbix installation.

   IONA does not recommend having two versions of Orbix running on the same computer.
5. Next, you may have to answer whether to install the Orbix daemon as an NT service. See the following section for a discussion of how to answer this question.
6. Restart the computer. You can let the installation procedure restart your computer, or you can restart it at a later time.

Deciding Whether to Install the Orbix Daemon as an NT Service

The Orbix daemon coordinates the establishment and closing of client connections to the server. On the NT platform, it can be installed either as a stand-alone Windows application or as an NT service.

The Orbix daemon starts the Java RFC Orbix server automatically when it receives its first client connection request.

The Implications of the Orbix Daemon Setup Choices

If you install the Orbix daemon as an NT service:

- Windows launches the Orbix service automatically at system startup.
- Both the Orbix service and the Java RFC Orbix server processes run in the background. Because of this, neither the daemon nor the server window is visible. If you start the Orbix daemon as an NT service, you will not be able to monitor diagnostic messages, such as the opening and closing of client connections, or the operations of the Orbix server. If you receive a server daemon error, you must go to the Control Panel to restart the *Orbix Daemon* service.

If you install the daemon as a stand-alone service (by **not** installing the Orbix daemon as an NT service):

- You must manually start the Orbix daemon as a stand-alone Windows application before you can receive any connection requests.
- Both the Orbix service and the Java RFC server processes run in the foreground. Java RFC servers are started in a console window. Some status and diagnostic messages (for example, connection and client shutdown notifications) are displayed in the Java RFC server window.

You can reverse your decision regarding how the Orbix daemon is installed [Page 31] later.

After Installation

See the topic Java RFC Server Orbix Installation Processing [Page 34] if you have an existing Orbix service installed on your server computer. You may have to accommodate your existing Orbix setup (for example, when selecting port numbers) to make RFC calls from clients.

Starting the Orbix Daemon

Use

The Orbix daemon must be running before your clients issue any requests to the Java RFC server. Once it is running, the Orbix daemon starts the Java RFC Orbix server after it receives the first request.

If you have specified that the Orbix daemon is installed as an NT service, then the Orbix daemon starts automatically at system startup. It runs in the background, and is not visible.

If you have installed the Orbix daemon as a stand-alone service, then you need to invoke it manually before any client request occurs.

Procedure

- To start the Orbix daemon in the foreground, use the Java RFC program group from the Windows Start menu:

  Start→Programs→Java RFC→Start Orbix Daemon

- To start the Orbix daemon in the background, use the Windows Control Panel:

  Control Panel→Services

  Select *Orbix Daemon* from the list of services, and choose *Start*.

Also, you can use the Services dialog of the Control Panel to shut down the Orbix service, or to change the startup mode of the Orbix daemon if necessary. See Changing the Orbix Daemon Setup after Installation [Page 31] for more information about this process.

Changing the Orbix Daemon Setup After Installation

Use

After installation of the JRFC Orbix server components, you may choose to reverse your decision regarding the installation of the Orbix daemon as an NT service.

Procedure

To reverse the setup performed by the JRFC Orbix server installation, you need to perform the following tasks:

- Install or uninstall the Orbix daemon as an NT service. Use the items from the Java RFC program group [Page 38] to do so.
- Set the Orbix daemon startup mode. If you are making the Orbix daemon an NT service, you can select either automatic or manual operation at startup.

Changing the Start Mode of the Orbix daemon

1. Use the Windows Control Panel:

   Control Panel→Services

2. Select *Orbix daemon* from the list of services.
3. Choose *Startup*.
4. Select either the *Automatic* or *Manual* Startup Type.

You can also manually start or stop the Orbix daemon using the same Windows dialog.

Configuring the Java RFC Orbix Server

Use

The Orbix run-time component includes various utilities for managing your Orbix server. The most important one is the Orbix Server Manager utility.

You can use the Orbix Server Manager to manually configure the Java RFC Orbix server. More specifically, you can:

- Specify the maximum number of Orbix servers that can be launched
- View and specify who is authorized to invoke a Java RFC Orbix server, and who can send requests to it
- Customize the Orbix server invocation command to control server timeout and Orbix server thread pool size
- Connect to one or more hosts where the Orbix daemon is running. Note that the Orbix daemon has to be started on the host(s) for the Orbix Server Manager to be able to connect.
- Manually launch or stop the Orbix server. The Orbix server's icon is animated when it is running and still when it is stopped.

Prerequisites

The Java RFC Orbix server components must be installed [Page 28], and the Orbix daemon must be started [Page 30].

Procedure

1. Invoke the Server Manager utility from the Java RFC program group in the Start menu:

   Start→Programs→Java RFC→Server Manager.

2. Use the Server Manager to enter any custom properties for the Orbix server. The Server Manager lists the Java RFC server as *RFC* under your server computer name. To enter this information double-click on the *RFC* entry to bring up the *Server Record* dialog.

3. Enter any of these properties for the RFC server in the *Server Record* dialog:

Tab	Property	Use
Name	Number of Orbix Server Objects	Use this field to specify the maximum number of instances of the Orbix server process that can be launched for multiple client requests.
	Orbix Server Name	This property has to be “RFC” for Java RFC clients to obtain proper connections.

Rights	Launch and Invoke Rights	Launches the rights control that governs who can start the Orbix server process. Invokes the rights control that governs who can use the RFC server. It also governs who can invoke the rights control's methods. Choosing “all” grants rights to everyone, and is the default setting for the Orbix server. You can choose to restrict rights for specific NT users.
Methods	Marker/Method	This value is set by default to “*”, indicating that all Java RFC requests use the launch command as specified below. Do not change this entry.
Methods	Launch/ Command	The Orbix daemon uses this command to automatically launch the Orbix server when the Orbix server receives its first client request. You can specify a customized JRFC server launch command using this property; that is, you may specify the Orbix server's timeout and thread pool size parameters by entering the complete command in this field. Enter the command in double quotes. For example, to specify an Orbix server timeout of five seconds, enter the following (include the double quotes): "jrfcserver -t 5" See the topic Starting the Java RFC Orbix Server [Page 36] for the syntax of the Orbix server launch command. If you specify a customized launch command, it is added to the existing launch command at the *Server Record* dialog. Delete any existing launch command to ensure that the command you have specified takes effect.

4. Save your changes by choosing OK at the *Server Record* dialog.

Java RFC Orbix Server Installation Processing

Purpose

This document describes the processing performed by the JRFC.EXE installation utility. In all examples, assume that you install the Orbix server component onto a directory called *TARGETDIR*.

Process Flow

The Orbix installation procedure:

- Checks for existing Orbix versions:
  - If Orbix is not installed on your Orbix server computer, the Java RFC installation installs the necessary components of the Orbix service.
  - If you have an Orbix service of a version earlier than 2.3C installed, you have to overwrite it to continue with the Java RFC installation.

    In both of the above cases, the Java RFC installation copies the Orbix Library/Utilities (IONA's Orbix 2.3C runtime components, OrbixWeb, and the Orbix configuration files) to the Orbix server computer.
  - If you have version 2.3C of Orbix installed, then the Java RFC installation checks for certain Orbix components. It may install some missing tools or additional helper files in the target directory you specify.
- Copies the Java RFC Orbix server executable (jrfcserver.exe) and the RFC Dynamic Link Library (librfc32.dll) to your server computer.
- Self-registers the JRFC Orbix server with the Orbix daemon.

In addition, if you are installing the Orbix utilities FOR THE FIRST TIME, the JRFC.EXE installation program:

- Changes the IT_CONFIG_PATH environment variable to point to the *TARGETDIR*\cfg subdirectory.
- Sets the IT_CONFIG_PATH entry under HKEY_LOCAL_MACHINE in the Windows Registry to TARGETDIR\cfg.
- If you specify that the Orbix daemon is to be installed as an NT service, then the Java RFC Orbix server installation also sets the SYSTEM\CurrentControlSet\Services\Orbix daemon\Start Windows Registry entry under HKEY_LOCAL_MACHINE to *0x2*. This means that the Orbix Daemon service will automatically start at system startup time.

  If you do not want to have the service start automatically, you may change the setting from the Control Panel, or modify this registry entry to *0x3*.
- Sets the following lines in the Orbix configuration file (Orbix.cfg) in *TARGETDIR*\cfg:
  - IT_DAEMON_PORT is set to 1571

    This is required by the Orbix client, which looks for the Orbix daemon on the Orbix server host only at this port number. This is different from the default Orbix port number 1570. If you have an existing version of Orbix, the Java RFC installation does not change this entry.

Since the Java RFC setup assumes the use of Port number 1571, if you have an existing Orbix installation that uses another port number, you must set the port number used by the client side to the one defined in your Orbix configuration. You do this by using the MiddlewareInfo object. See the *get/setOrbDaemonPort* methods of MiddlewareInfo in the *Java RFC HTML Reference* document.

- IT_LOCAL_DOMAIN is set to empty

  This field can be overwritten from the Java RFC client, using the MiddlewareInfo object. See the *get/setLocalDomainName* methods of MiddlewareInfo in the *Java RFC HTML Reference* document.

  If you have an existing version of Orbix, the Java RFC installation also does not modify this value.

- Adds the SAP Java RFC program group [Page 38] to the Windows Start menu.

Starting the Java RFC Orbix Server

Use

The Orbix daemon starts a Java RFC Orbix server automatically when it receives the first client request.

By default, after the Orbix daemon registers the Java RFC Orbix server, it launches the Orbix server after receiving the first client request. The daemon does so by calling the Java RFC executable (jrfcserver.exe) without parameters.

If you wish, you can add one or both of the parameters discussed below to configure the command that the daemon uses to launch the Orbix server. To make one of these changes, modify the *Server Record* dialog in the Orbix Server Manager utility. See the topic Configuring the Java RFC Orbix Server [Page 32] for details.

Also, you may want to start the Java RFC Orbix server manually, to eliminate the need for the first client request to wait for the server to start up. You can also use the steps in this procedure to change these parameters.

Prerequisites

The Orbix daemon must be running [Page 30] before you can launch the Java RFC server.

Procedure

You can launch the Java RFC Orbix server manually, by running the Java RFC executable from a console window (a DOS window).

The Java RFC executable is jrfcserver.exe, and it resides in the *server\bin* subdirectory under the directory you specify during installation.

Java RFC Server Launch Command Parameters

The Java RFC executable accepts the following parameters:

- Orbix server timeout.

  This parameter specifies the timeout period between client connections. This means that if the server is idle, with no client connection active for the specified length of time, it will shut down automatically.

  The default timeout is infinite. To specify any other timeout, use the –t option with the timeout in seconds. For example, to set the timeout to 5 seconds, specify the following:

  ```
  jrfcserver -t 5
  ```

- Orbix server thread pool size.

  The server uses this parameter to create the specified number of threads in a pool it uses when processing multiple client requests concurrently.

  The default thread pool size is 5. To specify any other pool size, use the –p option. For example to set the thread pool size to 10, specify the following:

  ```
  jrfcserver -p 10
  ```

You can specify both parameters on the same command line:

jrfcserver -t 5 -p 10

See Also

See the topic Configuring the Java RFC Orbix Server [Page 32] for how to apply these parameters to a registered server.

The SAP Java RFC Program Group

Use

The Java RFC program group contains the following items:

Java RFC Program Menu Option	Description
Install Orbix daemon NT Service	This item is added to the Java RFC program group only if the Java RFC installation performed a full installation of the Orbix service. This item allows you to configure the Orbix daemon as an NT service at any time.
Java RFC HTML Reference	A detailed reference document in HTML format for the various Java RFC interfaces and classes.
JRFC Client Readme	This document describes the new features in this release of the JRFC Client component and contains important instructions regarding its setup and use.
JRFC Orbix Server Readme	This document describes the new features in this release of the JRFC Orbix Server component and contains important instructions regarding its setup and use.
Orbix Server Manager	This item is added to the Java RFC program group if it finds an existing Orbix installation, or you are installing the Orbix utilities for the first time. However, this Orbix program does not include some necessary tools. You can use this item to configure the Java RFC Orbix server using the Orbix Service Manager utility [Page 32]
Start Orbix daemon	This item is added to the Java RFC program group only if the Java RFC installation performed a full installation of the Orbix service. Use this item to start the Orbix daemon [Page 30]. This is only necessary if you have chosen to install the Orbix daemon as a stand-alone Windows service. You must do so each time you start a new Windows session, before the first Java RFC client request occurs.
Uninstall Orbix daemon NT Service	This item is added to the Java RFC program group only if the Java RFC installation performed a full installation of the Orbix service. This item allows you to configure the Orbix daemon as stand-alone service at any time.

Activities

Use the Windows Start menu: *Start→Programs→Java RFC* to choose the desired item.

RFC Java Library Programming Guide

Running Programs that Use JDK 1.2 and Java RFC

JDK 1.2 CORBA Class Compatibility with JRFC

JDK 1.2 provides an implementation for *org.omg.CORBA* classes. These class files are not compatible with the Java RFC Class Library.

Using -Xbootclasspath to Override the Default CORBA Classes Used

If you are using the JDK 1.2 classes with Java RFC, you need to use the java *-Xbootclasspath* option to override the Java JDK 1.2 classes with the classes of the desired middleware.

For example, to specify using the Orbix implementation of the *org.omg.CORBA* classes (which is compatible with the Java RFC and is also provided with the Java RFC kit), you must issue the following command when running your Java program:

`java -Xbootclasspath:<`*`JRFC-install-directory`*`>\client\classes;<`*`classpaths-list`*`>`
`<`*`Java-class-file-name`*`>`

Where:

`JRFC-install-directory`	directory where the Java RFC Class Library is installed
`classpaths-list`	semicolon separated list of paths to all other classes you need to use
`Java-class-file-name`	name of your Java program class file containing main

Example

Assume that the Java RFC program is installed in c:\sap\JRFC and JDK 1.2.1 is installed in c:\. To run a program called RfcClientMain, issue the following command at the console:

```
java
-Xbootclasspath:c:\sap\JRFC\client\classes;c:\jdk1.2.1\jre\lib\rt.jar
apps\RfcClientMain
```

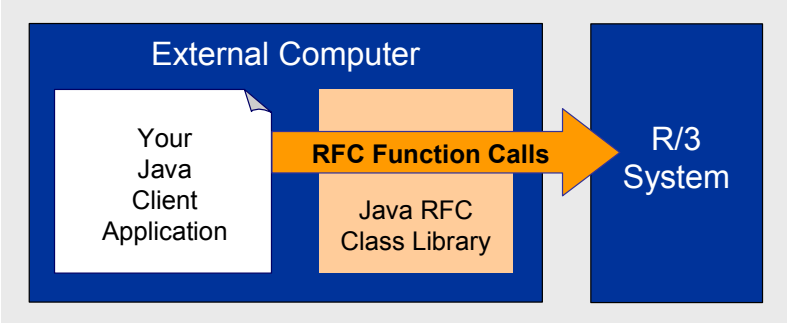
Deploying Your Program to an End User

When deploying a program that uses the JDK 1.2 and the Java RFC Class Library, you may need to provide your users with a batch file containing the above command for setting the CORBA classes.

The batch files for running the sample programs delivered with the Java RFC kit [Page 77] contain a similar commands for setting up the reference to the class files.

Interface for Building Client Applications

The *Java RFC Class Library* offers classes and objects that allow you to write client application programs that send RFC requests to R/3.



The exposed Java RFC client Interfaces are defined in the *com.sap.rfc* package.

Exceptions are defined in the *com.sap.rfc.exception* package

The following features apply to virtually all Java RFC classes:

- Can be cloned by calling the clone() method
- Can be converted to a string representation by calling the toString() method

The next topics discuss the various interfaces and classes and how to use them.

Java RFC Client Files and Objects

The following topics discuss the various files, classes and interfaces for building RFC client interfaces.

Note that many of these files, classes and interfaces are also used when you build RFC server applications.

The SessionManager and SessionInfo Objects

Use

The SessionManager Object

RFC function calls require a connection to R/3.

When using the Java RFC Class Library you can set up and start a connection once, and then you can use that connection for multiple calls.

The Java RFC SessionManager object handles the different aspects of the connection to R/3 for RFC calls. Once you set up the required connection information [Page 80], the SessionManager handles the session. As part of this role, for example, the SessionManager ensures that any objects created during the session contain the necessary connection properties.

The SessionManager can handle a single connection. If you wish to use multiple connections [Page 126], use the FactoryManager object [Page 128], instead.

The SessionManager is a singleton (meaning that there is only one instance of it).

The SessionInfo Object

The SessionManager uses the SessionInfo object to hold connection information.

The information required to make a connection is divided into three categories:

Category	Information
Middleware information	Description of the implementation of the middleware software you are using with the Java RFC Class Library [Page 9]. In case of the Orbix middleware, also information on the computer acting as the Object Request Broker (ORB) server
Connection information	Different parameters of the R/3 system to connect to, such as R/3 application server name and system details
User information	User logon details such as user name, password, and language

The Java RFC SessionInfo object contains all of the above categories of connection information.

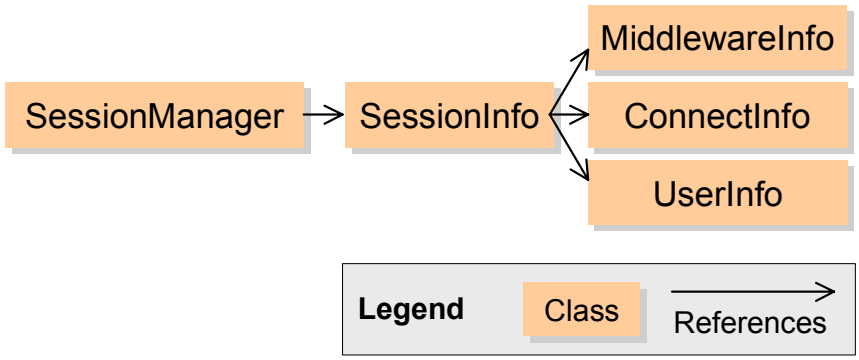
MiddlewareInfo, ConnectInfo, and UserInfo Objects

The SessionInfo object comprises the MiddlewareInfo, ConnectInfo, and UserInfo objects. They each contain one of the categories of the information in the SessionInfo object.

Object	Contains
MiddlewareInfo	Middleware information
ConnectInfo	Connection information
UserInfo	User information

Integration

The following diagram summarizes the relationship between the various connection-related objects.



See Also

The Java RFC Properties Files [Page 45], Setting Up and Starting a Session [Page 80], Using the Properties Files to Set Up SessionInfo [Page 82]

Also see the *Java RFC HTML Reference* documentation for the details of each of the classes.

The Java RFC Properties Files

Use

Information Required by the *SessionManager*

The SessionManager object [Page 43] needs the following information for both RFC client and RFC server applications:

- Which middleware implementation to use with the *Java RFC*
- Connection information for logging onto the R/3 system when necessary

The *SessionManager* needs to know which middleware implementation to use in order to create the appropriate factory objects.

Connection information is essential when creating an RFC client application because your application needs to log onto the server R/3 system. Connection information is also necessary in RFC server applications when you are creating any of the function objects automatically [Page 107]. The *SessionManager* needs this information because it connects to the R/3 system to get function metadata.

Specifying the Required Information

You can set the values of all of these parameters programmatically, by setting the appropriate *MiddlewareInfo*, *ConnectionInfo*, and *UserInfo* objects.

However, the best way to define this information is through special Java properties files used by the *SessionManager*.

Java RFC Properties Files

The *SessionManager* uses two properties files, in conjunction with the SessionInfo object [Page 43] to obtain this information.

The two properties files are described in the following table.

Properties File Name	Role
r3_connection.props	Contains information equivalent to the information in the *UserInfo*, *ConnectionInfo*, and *MiddlewareInfo* objects. More specifically for middleware, it specifies the type of middleware used. If Orbix is used as the middleware implementation, then it specifies the computer acting as the Object Request Broker (ORB) server. If you specify the middleware implementation to use as custom, (by specifying *4* for middleware type - see the contents of the file below) then the *SessionManager* looks at the second properties file (*jrfc.props*), for the details of the middleware.
jrfc.props	Specifies the files that implement the various factory interfaces. By specifying the factory interfaces you specify the type of middleware implementation to use.

Using the properties files allows you to define middleware implementation and connection information in advance, and independently from your program. This allows you to work with

different middleware implementations or with different R/3 systems without changing your program code.

Location of the Properties Files

The *Java RFC* installation places a sample *r3_connection.props* file and two *jrfc.props* files in the following directory:

C:\SAP\JRFC\Client\Property Files

The supplied *jrfc.props* files are one each for the Orbix and the SAP JNI middleware implementation.

The properties files should resides in:

user.home/sap/user.name/r3_connection.props

The *user.home* and the *user.name* elements of this path are the standard Java.lang.System property names for the user home directory and user name respectively.

After installation, move or create the files in the above directory.

It is easier to create your properties files by copying the provided sample files. You can then supplement and change the *r3_connection.props* to fit your needs. We especially recommend that you copy the *jrfc.props* file for the middleware implementation you wish to use, since the sample files contains all the necessary values for working with the desired middleware implementation.

Contents of the Properties Files

r3_connection.props Fields

The following table describes the fields in the *r3_connection.props* properties file.

Fields listed in bold are required fields. Most of the fields are required information for establishing a connection. Some are required middleware information. All other fields are optional. However, all of the fields in the properties file are optional in the sense that you do not have to include any or all of the fields in the properties file to begin with (You can instead set the information directly into the relevant property of SessionInfo).

Properties File Field	Type	Description
jrfc.middleware.type	int	Number indicating the middleware used for implementing the interface. Use *4* to specify that the middleware is defined through the *jrfc.props* properties file. You can use the direct values for specifying middleware type: *1* for Orbix or *3* for the Sap JNI. However, we recommend that you use the indirect definition of middleware type by using the value *4*. This indirect definition of middleware type allows you to keep the *r3_connections.props* file as read-only, which is what we recommend that you do if you wish to preserve password information in that file (see Setting Up and Starting a Session [Page 80]).
jrfc.middleware.orbServer.name	str	Name of the computer acting as the ORB server
jrfc.middleware.orbServer.port	int	Port number of the ORB computer
jrfc.middleware.orbServer.domain	str	Network domain of the ORB computer
jrfc.middleware.orbServer.diagnosticsLevel	int	Level of ORB messages shown. Higher level shows more messages. Orbix uses the following values for message level: 0 None 1 Simple 2 Full
jrfc.connection.isLoadBalancing	str	If true, use load balancing, that is, connect to the least loaded, available R/3 application server. The default is to not use load balancing.

jrfc.connection.host.name	str	Name of the R/3 application server to connect to. You can specify the name of the server as an IP address, or in the format: computername.networkname.domain name You can prefix the computer name with router name. This is a required field when you do not use load balancing. If you use load balancing, then you must specify the next three fields, instead.
jrfc.connection.group.name	str	Group of computers from which the message server will choose an application server. Required field when using load balancing.
jrfc.connection.messageServer	str	Computer coordinating the load balancing. Required field when using load balancing.
jrfc.connection.system.name	str	Name of the R/3 system. Required field when using load balancing.
jrfc.connection.system.number	str	R/3 system number
jrfc.connection.gateway.host	str	Host name of the computer on which the RFC gateway process resides, if it is different from the R/3 application server. The RFC gateway process dispatches RFC requests to R/3. If it resides on the same computer as the R/3 application server, you do not need to specify this parameter.
jrfc.connection.gateway.service	str	The name of the RFC gateway service, which is the service name entry in the SAP Services file (for example "sapgw16").
jrfc.connection.mode	int	Connection mode

`jrfc.connection.destination`	str	Destination lookup name used by saprfc.ini or *sideinfo* file
`jrfc.connection.isCheckingAuthorization`	boolean	If *True*, verify password upon connecting to R/3. The default is *True*. If not checked at connection time, the user authorization will be checked at the first RFC call that requires a valid user logon.
`jrfc.user.client`	str	Client number
`jrfc.user.name`	str	User name
`jrfc.user.password`	str	User password
`jrfc.user.language`	str	Session language
`jrfc.user.codePage`	str	Number representing a code page, which defines character set

Sample *r3_connection.props* File

The following shows an example of an *r3_connection.props* file with fictitious values:

```
jrfc.middleware.orbServer.name=orbMachine
jrfc.middleware.type=4
jrfc.connection.host.name=/H/204.75.155.5/H/205.215.205.15
jrfc.connection.system.name=API
jrfc.connection.system.number=0
jrfc.user.client=300
jrfc.user.name=smith
jrfc.user.password=mypassword
jrfc.user.language=E
```

Because the *r3_connection*.props file uses *4* for the middleware type, then the *Java RFC* looks at the *jrfc.props* file.

Supplied *jrfc.props* Properties Files

The following code shows the sample *jrfc.props* file provided with the *Java RFC* for using Orbix:

```
com.sap.rfc.IRfcConnectionFactory=com.sap.rfc.orbix.JRfcConnectionFactory
com.sap.rfc.IRfcModuleFactory=com.sap.rfc.orbix.JRfcModuleFactory
com.sap.rfc.ISimpleFactory=com.sap.rfc.util.JSimpleFactory
com.sap.rfc.IStructureFactory=com.sap.rfc.orbix.JStructureFactory
com.sap.rfc.ITableFactory=com.sap.rfc.orbix.JTableFactory
com.sap.rfc.IServerFunctionFactory=com.sap.rfc.orbix.ServerFunctionFactory
```

The following code shows the sample *jrfc.props* file provided with the *Java RFC* for using the SAP JNI:

```
com.sap.rfc.IRfcConnectionFactory=com.sap.rfc.jni.JRfcConnectionFactory
com.sap.rfc.IRfcModuleFactory=com.sap.rfc.jni.JRfcModuleFactory
com.sap.rfc.ISimpleFactory=com.sap.rfc.util.JSimpleFactory
com.sap.rfc.IStructureFactory=com.sap.rfc.jni.JStructureFactory
com.sap.rfc.ITableFactory=com.sap.rfc.jni.JTableFactory
com.sap.rfc.IServerFunctionFactory=com.sap.rfc.jni.ServerFunctionFactory
```

Integration

When it is instantiated, the *SessionManager* reads the *r3_connection.props* properties file, if it exists. The *SessionManager* then sets the equivalent fields of the *SessionInfo* object with the information from the *r3_connection.props*.

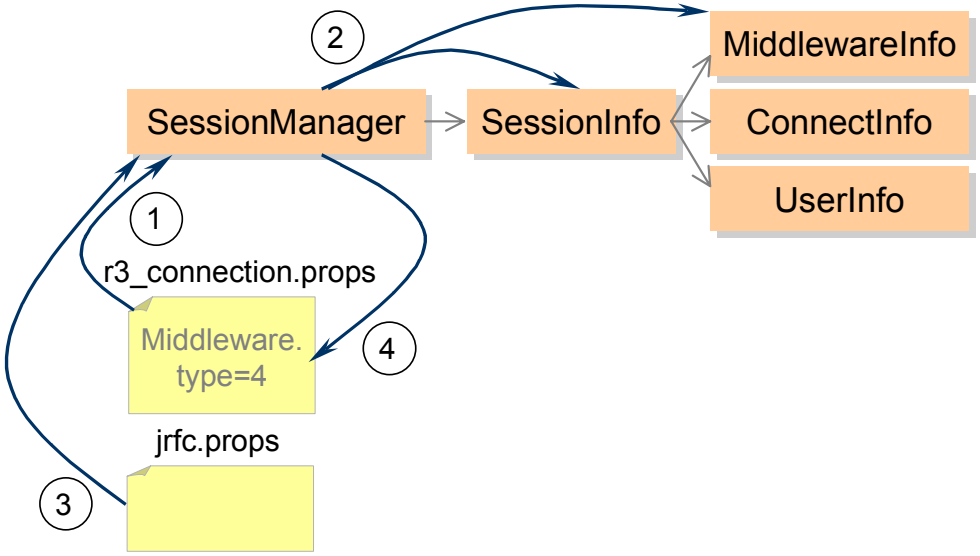
If middleware type is defined as custom, then the *SessionManager* reads the second properties file, *jrfc.props*, when it needs information on the factory objects.

If the *r3_connection.props* properties file does not exist, then the *SessionManager* creates it with the information from the *SessionInfo* object.

If the *r3_connection.props* properties file does exist, the *SessionManager* re-writes its contents after establishing a connection. Note that the *SessionManager* does not write password information into the *r3_connection.props* file.

The *SessionManager* only reads information from the *jrfc.props* file. It does not write to it.

The following diagram summarizes the role of the *SessionManager* in moving information between the *SessionInfo* object and the Properties files.



See Also

The SessionManager and the SessionInfo Objects [Page 43], Specifying Middleware Type [Page 64], Setting Up and Starting a Session [Page 80], Using the Properties File to Set Up SessionInfo [Page 82]

Also see the *Java RFC HTML Reference* documentation for the details of each of the classes.

The Function Module Object (IRfcModule)

Definition

An IRfcModule object represents an RFC function module.

Use

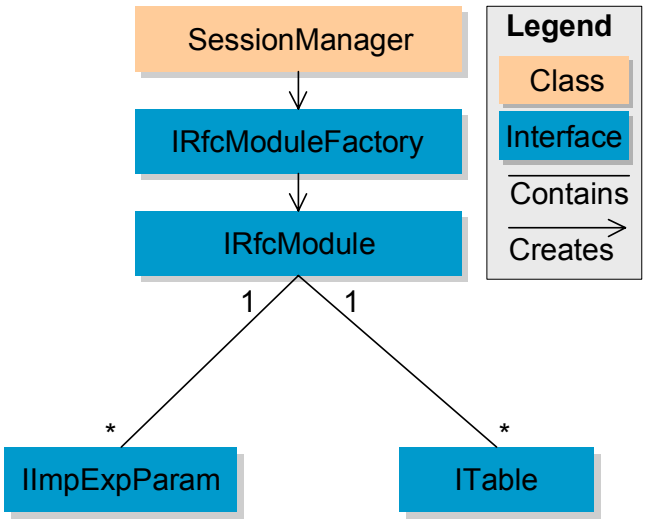
Use the IRfcModule object to call an RFC function module. The IRfcModule object manages all of the RFC function module parameters, including import, export, and table parameters.

The IRfcModule object supports all calling capabilities as an RFC client, including transactional client calls.

Depending on the parameters of the RFC function an IRfcModule object may contain one or more ITable objects, and one or more IImpExpParam objects. For every table parameter of the RFC function, the IRfcModule object contains an ITable object. For every import and export parameter, the IRfcModule object contains an IImpExpParam object, regardless of whether it is a single field parameter or a structure parameter.

You construct an IRfcModule object from IRfcModuleFactory. You obtain an IRfcModuleFactory object from the SessionManager. The SessionManager ensures that the IRfcModuleFactory obtains all the appropriate connection information.

The following diagram shows the relationship between IRfcModule and its parameter objects.



See Also

Parameter and Field Interfaces [Page 53], Setting Up the Function Module Object [Page 86]

When using multiple connections [Page 126], use FactoryManager [Page 128] instead of SessionManager to obtain the IRfcModuleFactory.

Also see the *Java RFC HTML Reference* documentation for the details of each of the classes and interfaces.

Parameter and Field Interfaces

Use

A parameter of an RFC function module can be either a:

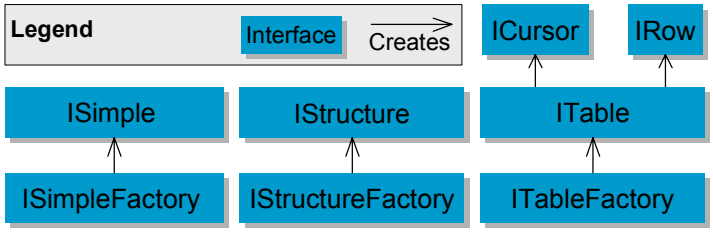
- simple parameter, which can be either an export or an import parameter
- structure parameter, which can be either an export or an import parameter
- table parameter, which is both an import and an export parameter

A simple parameter of an RFC function also represent an ABAP field. A structure parameter of an RFC function also represent an ABAP structure.

To reflect this relationship, Java RFC offers a hierarchy of interfaces and classes for handling RFC function parameters and ABAP fields.

RFC Function Module Parameter Objects

The main interfaces for RFC parameter objects are the ISimple, IStructure, and ITable interfaces. They can be constructed with the ISimpleFactory, IStructureFactory, and ITableFactory objects respectively.



The following table describes the main RFC parameter and related interfaces.

Interface	Description
ISimple	Main interface for a simple RFC parameter. Allows you to get or set both the value and the metadata of simple fields or parameters.
IStructure	Main interface for a structure RFC parameter. Allows you to get or set both the value and the metadata of structure fields or parameters.
ITable	Main interface for a table RFC parameter. Allows you to get or set both the value and the metadata of table parameters.
ICursor	A cursor to the table, which points to a row in the table. Provides navigation within the table.
IRow	Represents a single row in a table

Base Interfaces for Parameters and Fields

Java RFC provides two base interfaces for RFC function parameters and ABAP fields:

Interface	Represents	Methods Summary

IParameter	Base interface for classes representing RFC parameters	Getting or setting parameter name and metadata information
IField	Base interface for classes representing ABAP fields	Getting or setting field name and field metadata information

ISimple, IStructure, and ITable interfaces ultimately derive from IParameter, since they represent the three types of RFC function parameters.

Since ISimple and IStructure objects represent both a parameter of an RFC function and an ABAP field, they also derive (indirectly) from the IField interface.

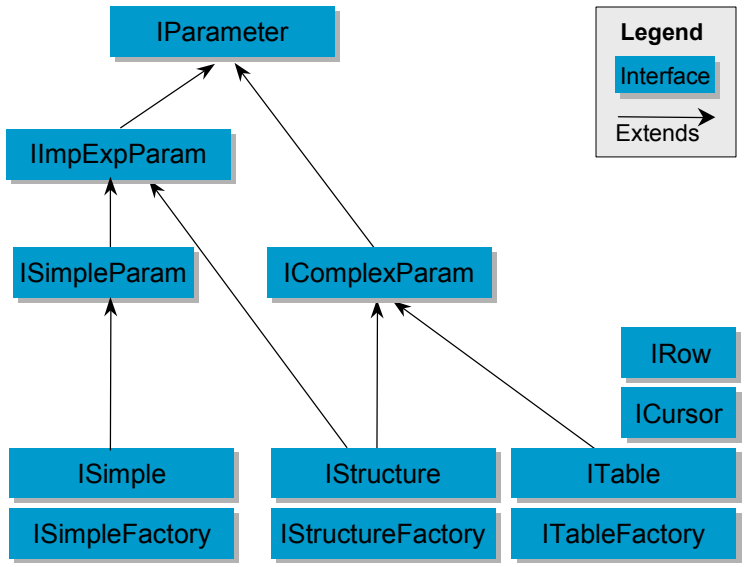
The following topics discuss the IParameter and the IField base interfaces and the interfaces that extend them.

IParameter and Related Interfaces

IParameter and its derived interfaces represent RFC parameters.

Using IParameter and the objects that extend it you can get or set parameter metadata and values.

The following diagram shows the hierarchy of IParameter and the objects that extend it.



The following table describes the interfaces that extend IParameter:

Interface	Represents	Methods Summary
IParameter	Base interface for classes representing RFC parameters	Getting or setting parameter name and metadata information

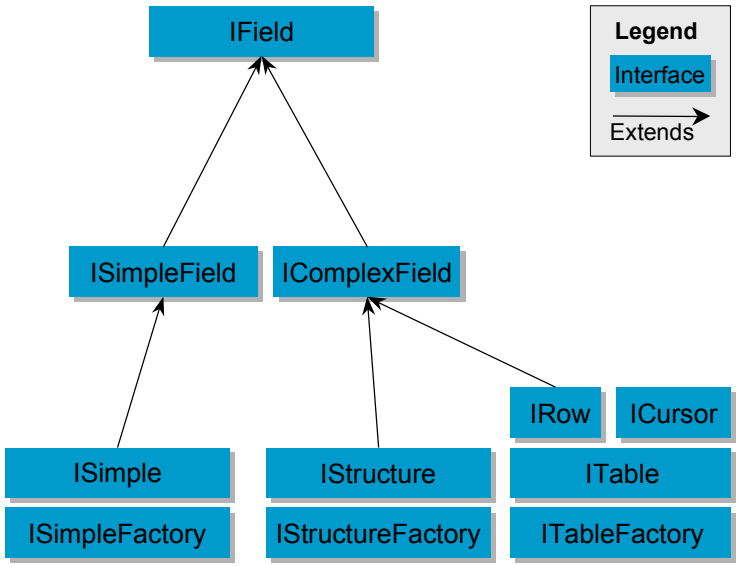
IImpExpParam	Either Import and export parameters	The import or export parameters of an RFC function module can be either simple or structure parameters. IImpExpParam is an empty interface, serving as the common “type” for simple and structure parameters.
ISimpleParam	Simple parameters	Getting or setting the SimpleInfo [Page 58] for the parameter. SimpleInfo stores the metadata information of simple parameters.
IComplexParam	Complex parameters, namely tables and structures	Getting or setting the ComplexInfo [Page 58] for the parameter. ComplexInfo stores the metadata information of both structure and table parameters.

IField and Related Interfaces

The IField represents an ABAP field.

Using its objects you can obtain field names or values, perform data type conversions, and retrieve field metadata information.

The following diagram shows the hierarchy of IField and the objects that extend it.



The following table describes the interfaces that extend IField:

Interface	Represents	Methods Summary
IField	Base interface for classes representing ABAP fields	Getting or setting field name and field metadata information

ISimpleField	A single data field	Getting and setting field values. Data conversion functionality between RFC types and Java types. For example, the *getString* method of ISimpleField provides conversion to a string from other field types.
IComplexFiel d	A structured data record	Obtaining individual data fields (ISimpleField) or nested fields (IField, or IComplexField). Note that nested fields, which are available in the Java RFC, are not currently supported by RFC.

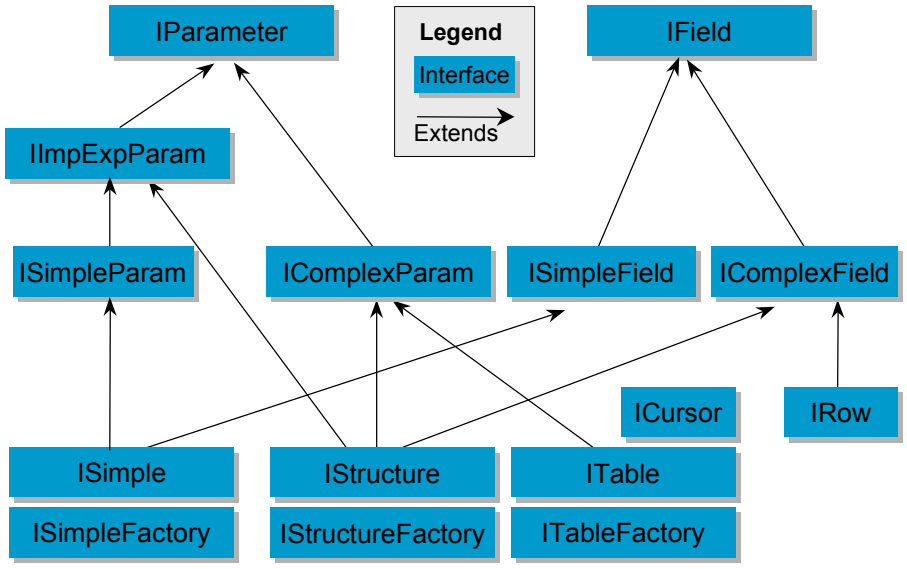
Relationship Between the Two Hierarchies

The main interfaces for RFC parameter objects may be derived from both the parameter and the field interface hierarchies:

- ISimple, representing a single value RFC parameter, is derived from both ISimpleParam (which in turn is derived from IImpExpParam) and ISimpleField, in the sense that it is both a simple parameter and a single data field.
- IStructure, representing a structure-type RFC parameter, is derived from IImpExpParam, IComplexParam, and IComplexField. This means that IStructure, which can be an import or export parameter for RFCs, is a parameter with complex structures, and represents a structured data record.

ITable, representing RFC table parameters, is derived only from IComplexParam, meaning that it is a parameter with complex structures. The IRow interface, representing a table row is derived only from IComplexField, meaning that is a structured data record.

The following diagram combines the parameter interface hierarchy and the field interface hierarchy to show the derivation of ISimple, IStructure, and ITable.



See Also

The IParameter and IField interfaces and their related objects deal with both metadata and values of parameters and fields. See the separate discussion of Parameter and Field Metadata [Page 58] for the additional objects that store the metadata portion of the information.

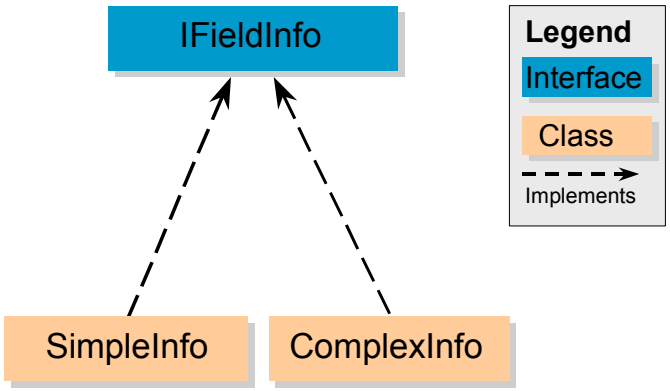
See the topic Using the Client Interface to make an RFC Call [Page 66] and its subtopics for how to use these objects to work with an RFC function module.

Also see the *Java RFC Client HTML Reference* documentation for the details of each of the interfaces.

Parameter and Field Metadata Classes

IFieldInfo, SimpleInfo, ComplexInfo

Metadata information for fields and parameters is stored in IFieldInfo and two classes that implement it:



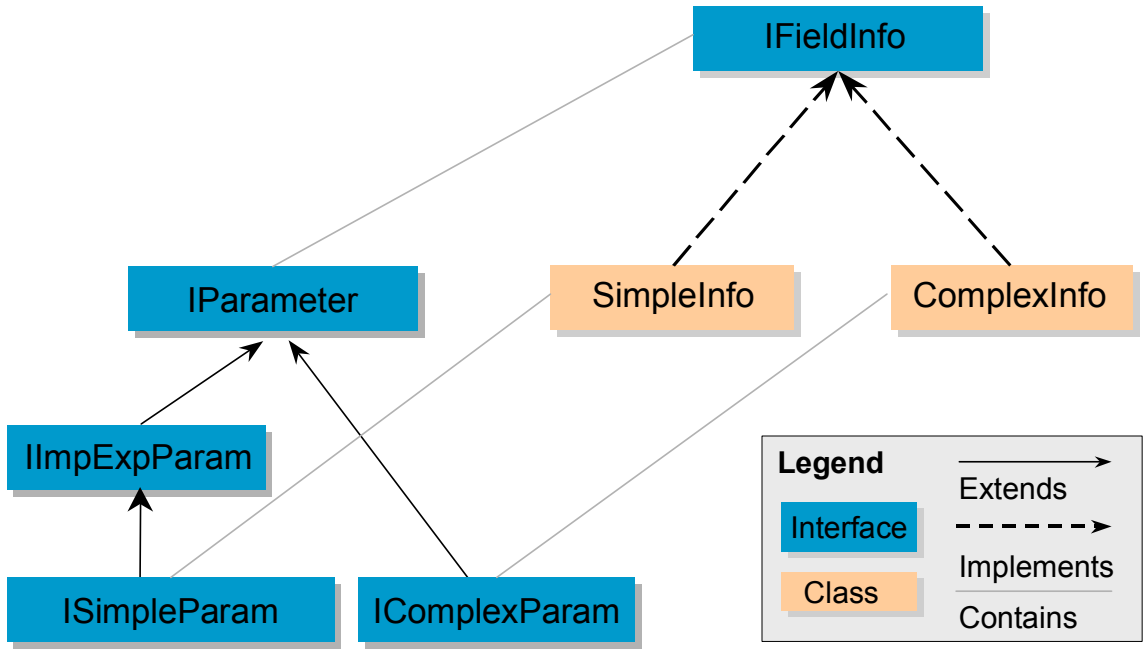
The following table describes these objects:

Interface/Class	Description
IFieldInfo	The base interface for classes representing the metadata for fields and parameters. IFieldInfo is an abstract interface that is implemented by the classes SimpleInfo and ComplexInfo. IFieldInfo stores only the field name, type, and length.
SimpleInfo	Implements IFieldInfo for simple parameters or fields. Stores metadata for a single (simple) field or parameter.
ComplexInfo	Stores metadata for a Structure or a Table. ComplexInfo contains a list of IFieldInfos (a combination of SimpleInfos and ComplexInfos) describing the elements of the structure. The metadata for individual fields (IFieldInfo) of a structure or a table can be obtained from ComplexInfo. Because the ComplexInfo class itself implements the IFieldInfo interface, this means that a ComplexInfo may contain nested ComplexInfos of indefinite depth.

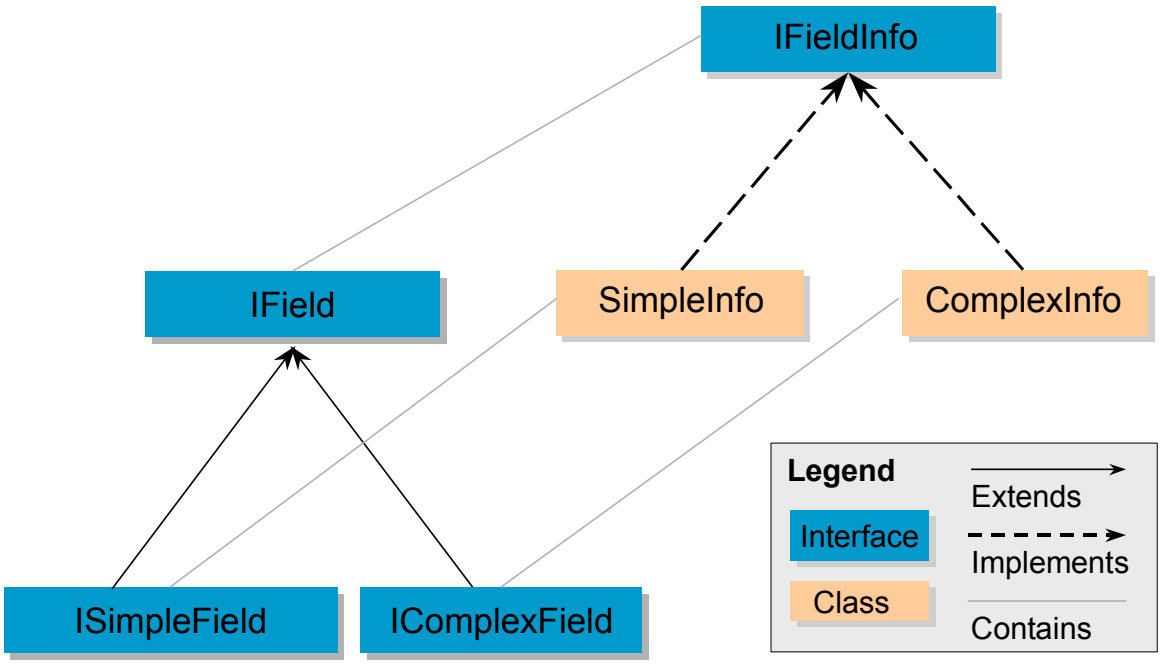
Metadata Objects and the Field and Parameter Objects

The IFieldInfo and its related objects are used by both the IParameter and the IField object hierarchies [Page 53]. They provide field metadata for IField and its related objects and they provide parameter metadata for IParameter and its related objects.

For example, the IFieldInfo, SimpleInfo, and ComplexInfo objects are used by the IParameter, ISimpleParam, and IComplexParam objects respectively. An IParameter object contains one IFieldInfo object. When the IParameter object is an ISimpleParam object, the IFieldInfo it contains is in fact SimpleInfo. When the IParameter object is an IComplexParam object, the IFieldInfo it contains is ComplexInfo. The following diagram illustrates this relationship.



The same relationship exists between IFieldInfo and IField, ComplexInfo and IComplexField, and SimpleInfo and ISimpleField.



See Also

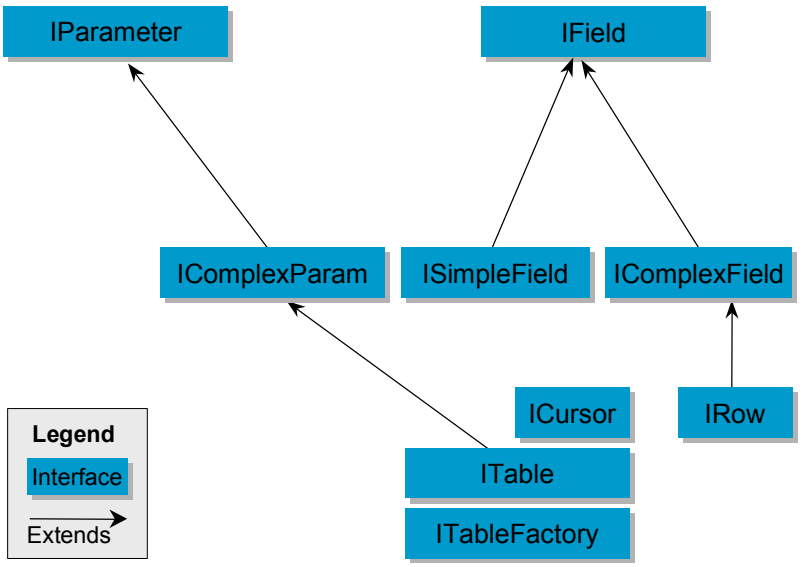
See the topic Using the Client Interface to make an RFC Call [Page 66] and its subtopics for how to use these objects to get metadata information for an RFC function module.

Also see the *Java RFC HTML Reference* documentation for the details of each of the classes and interfaces.

Table, Row, and Cursor Interfaces

ITable, IRow, and ICursor

The ITable, IRow, and ICursor interfaces are three table-related interfaces. The following diagram shows the relationship between these interfaces.



The main interface, ITable, represents RFC table parameters. Objects of the IRow interface represent rows of a certain table, and can be manipulated through the table object. ICursor is provided for table navigation.

See Also

See the topic Using the Client Interface to make an RFC Call [Page 66] and its subtopics for how to use these objects to get metadata information for an RFC function module. Especially see the topics: Setting Up the Function Module Object [Page 86], Reading the Data from Export Parameters [Page 94], and Working with Table Data [Page 96].

Also see the *Java RFC HTML Reference* documentation for the details of each of the interfaces.

Factory Objects

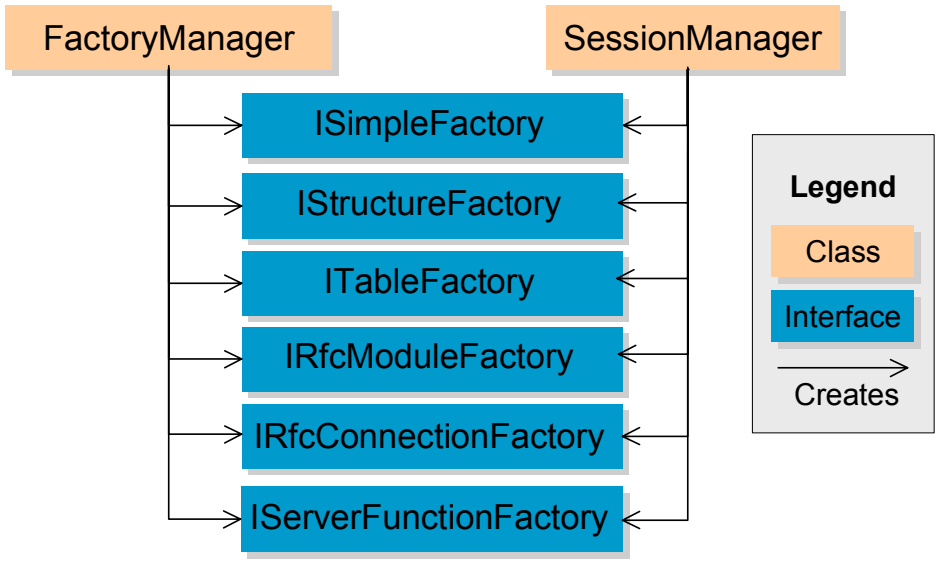
Use

Factory objects are used for obtaining other objects. The com.sap.rfc package includes the following five factory objects:

Factory	Creates the Object	Representing
IRfcConnectionFactory	IRfcConnection objects	RFC connections
IRfcModuleFactory	IRfcModule objects	RFC function modules
ISimpleFactory	ISimple objects	single-valued RFC parameters
IStructureFactory	IStructure objects	structured RFC parameters
ITableFactory	ITable objects	RFC table parameters
IServerFunctionFactory	IServerFunction objects	RFC server function objects

Integration

Both the SessionManager [Page 43] and the FactoryManager [Page 128] objects can obtain the same five factory objects.



Use the SessionManager for obtaining the factory objects when using a single connection [Page 80] in client applications.

When using a single connection you do not need to use an IRfcConnection object. Therefore you do not usually need to obtain the IRfcConnectionFactory from the SessionManager.

Use the FactoryManager for obtaining the factory objects, including IRfcConnectionFactory, when using multiple connections [Page 126].

See Also

See the *Java RFC HTML Reference* documentation for the details of each of the classes and interfaces.

Specifying Middleware Type

Purpose

The SessionManager object [Page 43] needs to know which middleware implementation to use with the *Java RFC*, for it to create the appropriate factory objects.

The *SessionManager* needs this information for both RFC client and RFC server applications.

The best way to specify the middleware implementation to use, is by specifying middleware type through the Java RFC properties files [Page 45].

Process Flow

1. Create the *r3_connection.props* properties files. Specify one of the following values for the *jrfc.middleware.type* field in the *r3_connection.props* properties files

Value	Meaning
1	Use the Orbix implementation
3	Use the SAP JNI implementation
4	Use custom middleware type: use the implementation of the factory interfaces as specified in the *jrfc.props* file.

   We recommend that you always use *4* as the value of the *jrfc.middleware.type* field.

   This value can be used for a custom implementation of the middleware, that is, for a middleware implementation that is not supplied with the *Java RFC*.

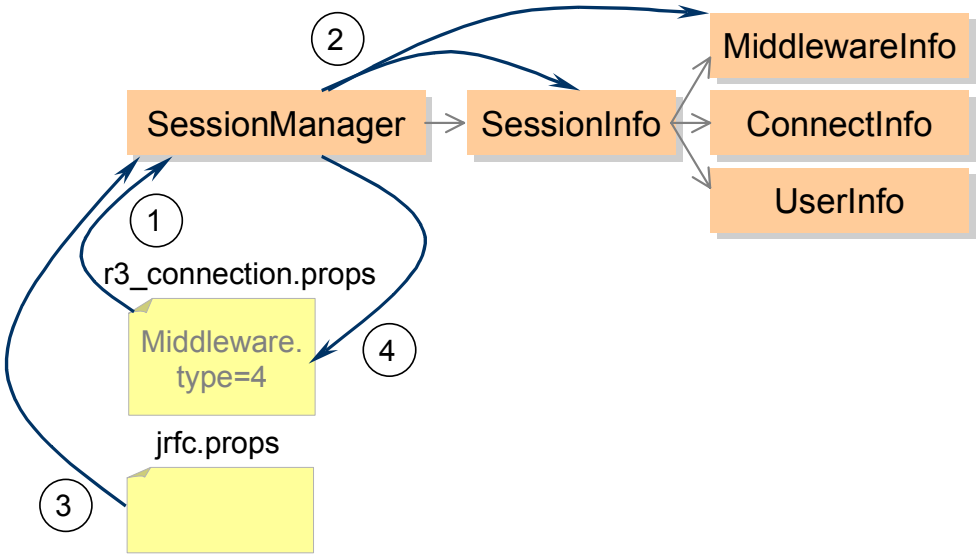
   More importantly, when you use this value, you direct *Java RFC* to determine the middleware type from the *jrfc.props* file, rather than from the *r3_connection.props* file. This is useful when you want to keep the *r3_connection.props* file as read-only, for the sake of preserving password information file (as we recommend in Setting Up and Starting a Session [Page 80]).

2. If you use custom middleware type, then also create the *jrfc.props* properties file.
3. The *SessionManager* obtains middleware information from the *r3_connection.props* file. The *SessionManager* does so when it is instantiated. The *SessionManager* also sets *SessionInfo* (and *MiddlewareInfo*) with the middleware type from *r3_connection.props*.
4. If you specify *4* for the *jrfc.middleware.type* field, the *SessionManager* obtains factory information from the *jrfc.props* file, when it needs it to create factory objects.
5. The *SessionManager* re-write the *r3_connection.props* file (re-writing middleware type

If the *r3_connection.props* properties file does not exists, then the *SessionManager* creates it with the middleware type from the *SessionInfo* object.

The *SessionManager* does not write into the *jrfc.props* file.

The following diagram summarizes this process.



For the details of the contents of the two properties files, see The Java RFC Properties Files [Page 45].

See Also

The SessionManager and the SessionInfo Objects [Page 43], Setting Up and Starting a Session [Page 80], Using the Properties File to Set Up SessionInfo [Page 82]

Also see the *Java RFC HTML Reference* documentation for the details of each of the classes mentioned here.

Using the Client Interface to Make an RFC Call

Purpose

Programming with the Java RFC Class Library allows you to make a call to an RFC function module.

Using the client interface you set the various parameters of the function module you wish to call, and then you issue the RFC call.

Prerequisites

Specify middleware type to use with the Java RFC [Page 64].

Note that you set up the middleware type through the Java RFC properties files [Page 45]. You also use the same properties files for setting up the connection parameters. We suggest that you set up the properties files only after reading all the topics regarding setting the properties files, specifying middleware type, and setting up the connection (the first step below).

Process Flow

The following steps describe the process of making an RFC function call using a single connection.

1. You must first set up the connection and start a session [Page 80].

   An RFC call requires a connection an R/3 system. The Java RFC Class Library provides the SessionManager class [Page 43] for managing all the aspects of the connection to R/3. You set up the necessary connection information and then you let the SessionManager object handle the connection.

   a. Obtain the SessionManager object.

   b. Set up connection information in SessionInfo of the SessionManager.

      You can use the r3_connection.props properties file [Page 45] to define the various connection parameters, in which case the connection information is automatically set in SessionInfo. See Using the Properties Files to Set Up SessionInfo [Page 82].

   c. Use the *Open* method of the SessionManager to start a session.

2. Prepare the IRfcModule and its parameters [Page 86].

   a. Obtain an IRfcModuleFactory object.

   b. Create an IRfcModule object with all of the parameters of the RFC function module.

      You can auto-create the IRfcModule object [Page 89], or you can manually create it [Page 91].

      If you manually create the IRfcModule object, you need to create and add all of its parameters.

   c. Set the value of any required or desired import parameters.

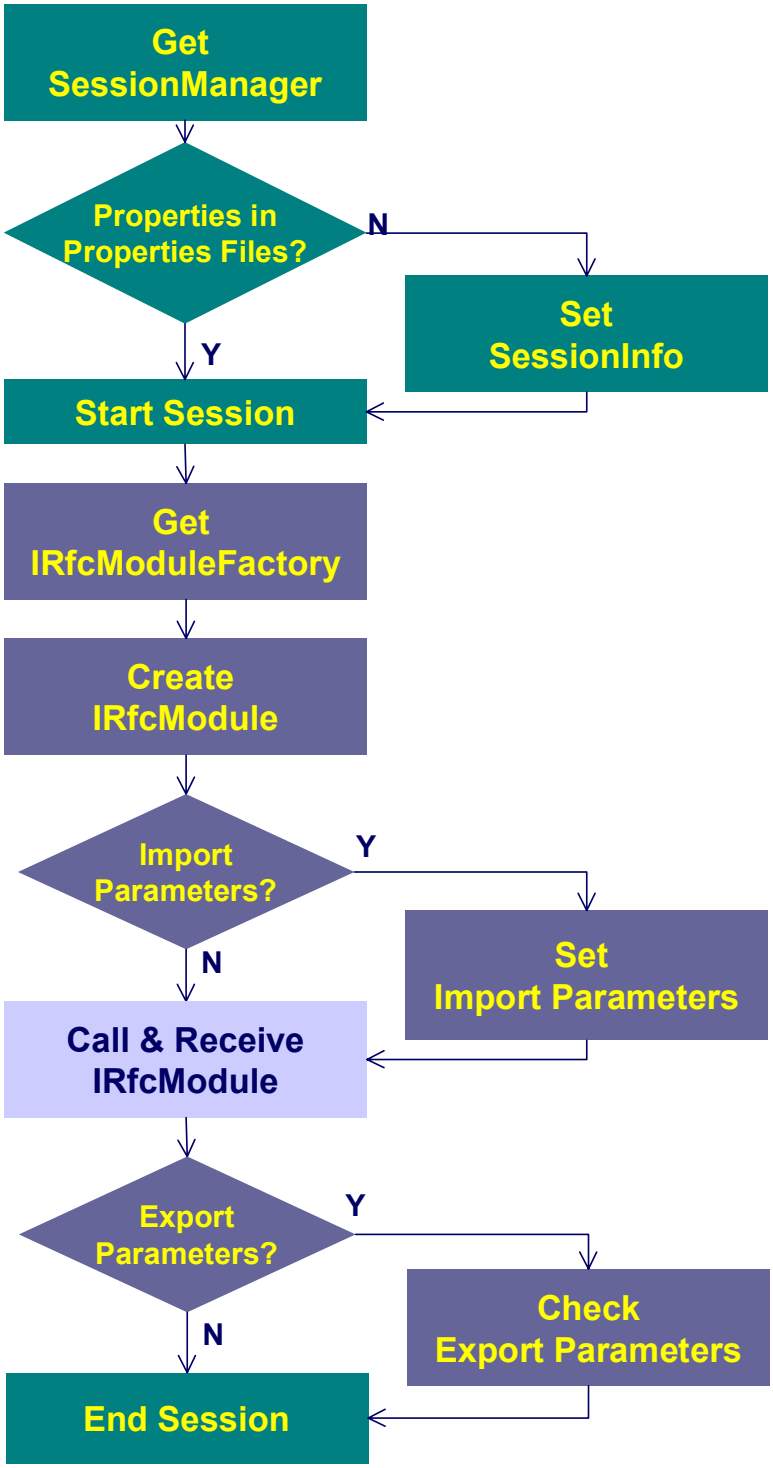
3. Make the RFC call [Page 93].

4. Retrieve returned export and table parameter values [Page 94].

5. Close down the connection using the *Close* method of the SessionManager.

You can close down the connection immediately after calling the function module even before checking the value of the export parameters.

The following diagram summarizes the process of making an RFC call with the client interface.


Get SessionManager
Properties in Properties Files?
N
Y
Set SessionInfo
Start Session
Get IRfcModuleFactory
Create IRfcModule
Import Parameters?
Y
N
Set Import Parameters
Call & Receive IRfcModule
Export Parameters?
Y
N
Check Export Parameters
End Session

See Also

Follow the links for the various individual steps within this process to see the details and an example of each of the steps.

Also see Programming Multiple Connections [Page 126] for how to call RFC functions within different connections.

Examples

Example: Calling RFC Functions with No Parameters

The following example creates an IRfcModule for the RFC function RFC_PING, which has no parameters.

This example uses a properties file to set up the necessary connection information [Page 82].

Note that the example manually creates the IRfcModule object. Since the function has no parameters there is no work involved in defining its parameters.

```
// Obtain an instance of the SessionManager:
SessionManager  sessionMgr = SessionManager.getInstance();
// Start the session:
SessionMgr.open();
// Create the factory for constructing a module:
IRfcModuleFactory moduleFac = SessionMgr.getRfcModuleFactory();
// Create the IRfcModule object
IRfcModule rfcModule = moduleFac.CreateRfcModule("RFC_PING");
// Call the RFC_PING function
rfcModule.callReceive();
// Close the session
sessionMgr.close();
```

Example: RFC Function with an Export Parameter

The following example calls the RFC function GET_SYSTEM_NAME, which has no import parameter. It has one export parameter, namely SYSTEM_NAME, providing the name of the system the client is connected to.

This example, too, uses a properties file to set up the necessary connection information [Page 82].

```
// Obtain an instance of the SessionManager and start a session
SessionManager  sessionMgr = SessionManager.getInstance();
SessionMgr.open();
// Get a module factory object and create the module
IRfcModule rfcModule =
sessionMgr.getRfcModuleFactory().autoCreateRfcModule("GET_SYSTEM_NAME");
int retCode = rfcModule.callReceive();
// Get the value of the simple export parameter
String sysName =
rfcModule.getSimpleExportParam("SYSTEM_NAME").getString();
System.out.println("System name = " + sysName);
// Close the session
sessionMgr.close();
```

Example: Calling an RFC Function with Parameters

The following example uses the Java RFC client interfaces to call an RFC function called *BAPI_GL_ACC_GETLIST*.

We use parts of this example in the topics that discuss the steps of making an RFC call [Page 66].

RFC Function Description

The *BAPI_GL_ACC_GETLIST* function is the internal implementation of the GETLIST BAPI (method) for the SAP business object GeneralLedgerAccount.

We use the *BAPI_GL_ACC_GETLIST* function not as a demonstration of how to use the SAP BAPI technology, but rather because this RFC function offers a good combination of simple, structure and table parameters.

The *BAPI_GL_ACC_GETLIST* function returns the list of G/L accounts (G/L account number, short text and long text) for a specified company in a specified language.

The following table lists the parameters of the *BAPI_GL_ACC_GETLIST* function (note that the order of the parameters within the function is not important, since RFC uses named parameters):

Parameter Name	Category	Type	Internal Name	Mandatory?
ACCOUNT_LIST	Imp/Exp	Table	BAPI3006_1	N
COMPANYCODE	Import	Field	COMP_CODE	Y
LANGUAGE	Import	Field	LANGU	N
LANGUAGE_ISO	Import	Field	LANGU_ISO	N
RETURN	Export	Structure	BAPIRETURN	N

The function returns the list of G/L accounts in the table parameter ACCOUNT_LIST, which has the following columns (note that the order of the columns in the table is important when creating and adding the fields to the table):

Field Name	Type	Length
COMP_CODE	CHAR	4
GL_ACCOUNT	CHAR	10
SHORT_TEXT	CHAR	20
LONG_TEXT	CHAR	50

The function also returns a structure containing information on any error messages. It has the following fields (note that the order of the fields in the structure is important when creating and adding the fields to the structure):

Field Name	Type	Length
TYPE	CHAR	1
CODE	CHAR	5
MESSAGE	CHAR	220

Example: Calling an RFC Function with Parameters

LOG_NO	CHAR	20
LOG_MSG_NO	NUMC	6
MESSAGE_V1	CHAR	50
MESSAGE_V2	CHAR	50
MESSAGE_V3	CHAR	50
MESSAGE_V4	CHAR	50

The internal names of the fields of both the table and the structure are the same as the name of the parameter.

Java RFC Code for Making this RFC Function Call

The following code uses a properties file for setting connection information [Page 82]. The code creates the IRfcModule object manually [Page 91].

```
// Obtain an instance of the session manager
SessionManager sessionMgr = SessionManager.getInstance();
// Start the session:
SessionMgr.open();

// Get a module factory object
IRfcModuleFactory moduleFactory = sessionMgr.getRfcModuleFactory();

// **** Manually Create the IRfcModule object ****
IRfcModule rfcModule =
moduleFactory.createRfcModule("BAPI_GL_ACC_GETLIST");
// Obtain the factories for creating parameters
ISimpleFactory simpleFactory = sessionMgr.getSimpleFactory();
IStructureFactory structureFactory = sessionMgr.getStructureFactory();
ITableFactory tableFactory = sessionMgr.getTableFactory();

// Create the import parameter(s) of the function module
ISimple paramCompany = simpleFactory.createSimple(
        new SimpleInfo(null, IFieldInfo.RFCTYPE_CHAR, 4, 0),
        "COMPANYCODE");

ISimple paramLanguage = simpleFactory.createSimple(
        new SimpleInfo(null, IFieldInfo.RFCTYPE_CHAR, 1, 0),
        "LANGUAGE");

ISimple paramLanguageIso = simpleFactory.createSimple(
        new SimpleInfo(null, IFieldInfo.RFCTYPE_CHAR, 2, 0),
        "LANGUAGEISO");

// Add the import parameters to the function module
rfcModule.addImportParam(paramCompany);
rfcModule.addImportParam(paramLanguage);
rfcModule.addImportParam(paramLanguageIso);

// Create the table parameter(s) of the function module
IFieldInfo[] tableColumns = {
```

```
    new SimpleInfo("COMP_CODE",  IFieldInfo.RFCTYPE_CHAR, 4,  0),
    new SimpleInfo("GL_ACCOUNT", IFieldInfo.RFCTYPE_CHAR, 10, 0),
    new SimpleInfo("LONG_TEXT",  IFieldInfo.RFCTYPE_CHAR, 50, 0),
    new SimpleInfo("SHORT_TEXT", IFieldInfo.RFCTYPE_CHAR, 20, 0),
};
ComplexInfo tableMetaData = new ComplexInfo(tableColumns, null);
ITable tableAccountList = tableFactory.createTable(tableMetaData,
"ACCOUNT_LIST");
    //An alternative way of creating the table parameter,
    //   which automatically creates the columns of the table:
    //tableFactory.autoCreateTable("ACCOUNT_LIST", "BAPI3006_1");

// Add the table parameter(s) to the function module
rfcModule.addTableParam(tableAccountList);

// Create the export parameter(s) of the function module
IFieldInfo[] returnFieldTypes = {
    new SimpleInfo("CODE",       IFieldInfo.RFCTYPE_CHAR, 5,   0),
    new SimpleInfo("LOG_MSG_NO", IFieldInfo.RFCTYPE_NUM,  6,   0),
    new SimpleInfo("LOG_NO",     IFieldInfo.RFCTYPE_CHAR, 20,  0),
    new SimpleInfo("MESSAGE",    IFieldInfo.RFCTYPE_CHAR, 220, 0),
    new SimpleInfo("MESSAGE_V1", IFieldInfo.RFCTYPE_CHAR, 50,  0),
    new SimpleInfo("MESSAGE_V2", IFieldInfo.RFCTYPE_CHAR, 50,  0),
    new SimpleInfo("MESSAGE_V3", IFieldInfo.RFCTYPE_CHAR, 50,  0),
    new SimpleInfo("MESSAGE_V4", IFieldInfo.RFCTYPE_CHAR, 50,  0),
    new SimpleInfo("TYPE",       IFieldInfo.RFCTYPE_CHAR, 1,   0),
};
ComplexInfo returnType = new ComplexInfo(returnFieldTypes, null);
IStructure paramReturn = structureFactory.createStructure(returnType,
"RETURN");
    //An alternative way of creating the structure parameter,
    //   which automatically creates the fields of the structure:
    //structureFactory.autoCreateStructure("RETURN", "BAPIRETURN");

// Add the export parameter(s) to the function module
rfcModule.addExportParam(paramReturn);
// **** End of Manually Creating the IRfcModule object ****

// An alternative way for creating the IRfcModule object,
//   which automatically creates and adds all of its parameters:
// IRfcModule rfcModule =
moduleFactory.autoCreateRfcModule("BAPI_GL_ACC_GETLIST");

// Set the values of the import parameters
paramCompany.setString("3000");
paramLanguage.setString("E");

try
{
    // Call the RFC function
    int retCode = rfcModule.callReceive();

    // Print out values of various parameters
```

Example: Calling an RFC Function with Parameters

```
    System.out.println("BAPI_GL_ACC_GETLIST return code = " + retCode);
    System.out.println("==================================");

    for (int i = 0; i < rfcModule.getExportParamCount(); i++)
    {
        System.out.print(rfcModule.getExportParam(i));
    }

    for (int j = 0; j < rfcModule.getTableParamCount(); j++)
    {
        ITable table = rfcModule.getTableParam(j);
        System.out.println("Showing table " + j);
        System.out.print(rfcModule.getTableParam(j));
        System.out.println();
    }
    for (int k = 0; k < rfcModule.getImportParamCount(); k++)
    {
        System.out.println("Showing import param " + k);
        System.out.print(rfcModule.getImportParam(k));
        System.out.println();
    }
}
// Handle errors
catch (JRfcRfcAbapException e)
{
    e.printStackTrace();
}
catch (JRfcRemoteServerException e)
{
    e.printStackTrace();
}
catch (JRfcRfcConnectionException e)
{
    e.printStackTrace();
}
```

Additional Java RFC Client Samples

Two sets of samples are provided with the Java RFC Client package.

Sample Directories

The following table lists the directories of the sample programs, and describes the JDK version they are compatible with:

Directory Name	Compatible with
Samples	JDK 1.1.x and JDK 1.2
Samples.jdk102	JDK 1.02

Both sets of samples perform the same tasks.

Batch Files for Running the Samples

Each set of samples (subdirectories samples and samples.jdk102) contains the following three sets of sample JRFC codes (listed by the Windows batch file that runs the program):

Batch File Name	Calls the Program Containing
RFCPing	a simple call to RFCPING
RFCCustomerGet	a call to RFC_CUSTOMER_GET, getting back all customer records with the specified selection criteria. The function module's parameters are explicitly created and added to the function object in the program. Note that this sample code uses FactoryManager even though it uses a single connection. For an example using the SessionManager, see Example: Calling an RFC Function with Parameters [Page 73].
RFCCustomerGetAuto Create	a call to RFC_CUSTOMER_GET, getting back all customer records with the specified selection criteria. The function module's parameters are automatically created when creating the function object, using the "auto-create" feature. Note that this sample code uses FactoryManager even though it uses a single connection. For an example using the SessionManager, see Auto-Creating the IRfcModule Object [Page 89].

Sample Code Files

The following table lists the contents of some of the important files composing the sample code:

Batch File Name	File	Contains
RFCPing	ClientMain	Main program. Mainly calls other programs.
	PingClient	The essence of the PING call

RFCCustomerGet and RFCCustomerGetAutoCreate	ClientMain	Main program. Mainly calls other programs.
	Client.java	Code for setting up the FactoryManager and the IRfcConnection and for starting a connection.
	GetCustomerModuleAuto	Code for auto-creating the function module.
	GetCustomerModuleManual	Code for manually creating the function module.
	GetCustomerClient	Reads the returned table parameter data. Pay special attention to the code in the *SetParamValues* and *GetParamValues* methods, where operations on table and simple parameter fields are performed

In certain cases where there are more than one way of achieving the same goal, alternative code segments are supplied in comments. Tasks such as using a table cursor and updating a table row are demonstrated.

In all of the samples, the user is responsible for entering the following information (some defaults are supplied):

- Orbix server for RFC: the host name where the JRFC server is located.
- R/3 logon information, including R/3 application server host name, system number, client, user, password and language.
- Selection criteria: for example, the customer number and name criteria for selection from the customer table.

Compiling the Samples

Prerequisite: Setting Path

To build the samples, you first need to make sure your environment variable PATH contains a path pointing to where your Java compiler is located, and CLASSPATH contains a path pointing to JDK1.1 core packages.

To set the path in Windows:

1. Choose the Windows Control Panel, System, which invokes the *System properties* dialog.
2. Choose the Environment tab in the *System properties* dialog.
3. Set the *PATH* variable to include the path of the directory where your Java compiler resides. (in addition to what the *PATH* variable already contains)
4. If you are using JDK 1.02 or 1.1.x, you also need to add the JDK classes to the *CLASSPATH* variable.

Compiling

Run the compile.bat utility in one of the subdirectories as described in the following table:

Command	For Building with Compiler Type

`compile jdk`	**JDK compiler**
`Compile jdk12 <jdk12RootDirectory>`	**JDK 1.2 compiler (specify the path to the JDK 1.2 root directory after installation)**
`compile jvc`	**Visual J++ compiler**

If you use compilers from other vendors, you need to modify the compile.bat file.

Running the Samples

The following table describes the commands for running the three applications:

Command	Runs the Application that Calls
`rfcping`	**RFCPING**
`rfccustomerget`	**RFC_CUSTOMER_GET (using manual create)**
`rfccustomergetac`	**RFC_CUSTOMER_GET (using auto-create)**

Viewing the Sample Applets

To view the three applets, you need to modify the CODEBASE line of the applet in each of the HTML files to point to the directory where you have the JRFC Client classes files installed.

Default input values can also be supplied through the applet parameters in the HTML files.

To cleanup, run the following:

```
compile clean
```

Setting Up and Starting a Session

Purpose

If you only need a single connection to R/3, use the SessionManager object [Page 43] to handle that connection.

The SessionManager object uses system properties, the SessionInfo object, and the r3_connection.props properties file [Page 45] to obtain information it needs for the connection.

To enable the SessionManager to handle the connection, you must set up the various connection properties of the SessionInfo object.

Process Flow

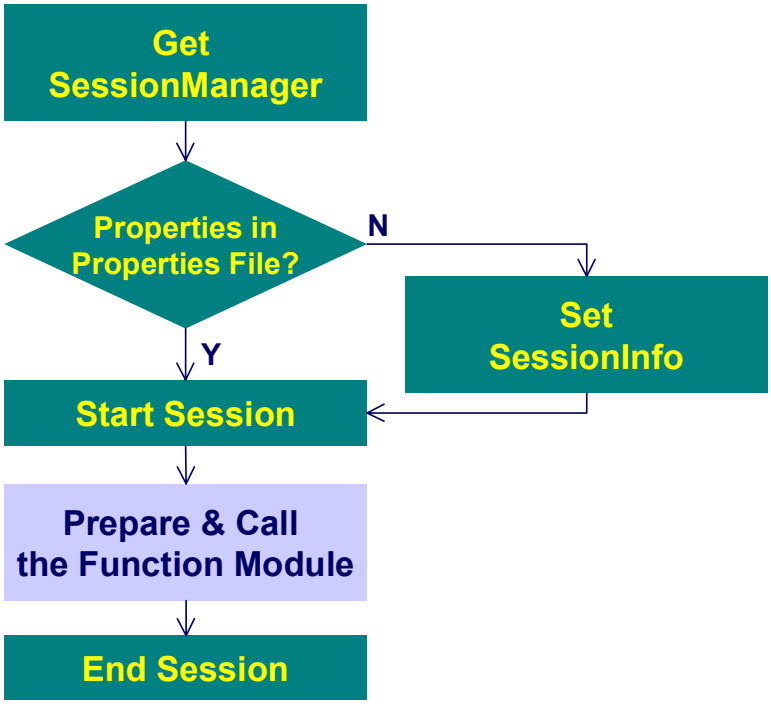
1. Obtain the SessionManager object.
2. Set the connection properties of SessionInfo.

   You can set the information in SessionInfo using one of the following two methods:

Manually setting the properties of SessionInfo [Page 85]
Storing the information in the r3_connection.props properties file and then letting the SessionManager take care of filling the information into SessionInfo [Page 82]. Using a properties file for connection information simplifies the code you need to write for establishing a connection. You can override or change any of the properties in SessionInfo that were taken from the properties file [Page 83].

   Follow the links above to see the detailed procedure and examples of using each of these methods of setting the properties of SessionInfo.
3. Use the *open* method of SessionManager to start a session.
4. You can now set up the IRfcModule object and its parameters, and then call the function module.
5. After calling the function module, you can close the connection.

The following diagram summarizes this process.



Result

If you the r3_connection.props properties file [Page 45] exists, then the SessionManager reads its information to set SessionInfo. You can modify this information.

SessionManager starts a connection using the information in SessionInfo.

If the connection is established successfully, the SessionManager then re-writes the contents of the properties file. To enable this update, make sure that the properties file is write-enabled.

However, the SessionManager never writes password information into the properties file. If you have password information in this properties file, it will no longer exist after the first connection because the SessionManager overwrites its contents. If you wish to preserve the password in the properties file, then make the file read-only. Note that setting the properties file to read-only does not result in an exception.

If there is no *r3_connection.props* properties file, the SessionManager creates it in the default directory (*user.home/sap/user.name/*) and it fills it with the information from SessionInfo.

See Also

If you wish to use multiple connections, you use IRfcConnection objects for each of the connections, and you use the FactoryManager instead of the SessionManager to create objects. See the topic Programming Multiple Connections [Page 126] for details.

Using the Properties Files to Set Up SessionInfo

Use

To provide the SessionManager [Page 43] with the necessary information for handling the connection, you must set the properties of SessionInfo.

If you set up an r3_connection.props properties file [Page 45] with all the necessary fields (including user password), starting an R/3 session is simple. You do not need to take any action to set the SessionInfo; the SessionManager sets the necessary properties automatically, taking the information from the properties file.

Procedure

All you need to do to start a session is:

1. Create the properties file [Page 45].

   Since the SessionManager never writes password information into the properties file, if you keep password information in the properties file and you wish to preserve it, then make the file read-only.

   However, if you are going to supplement or change in your program any of the information in the properties file [Page 83], then make the file write-enabled.

2. Instantiate the SessionManager object.
3. Use the *open* method of SessionManager to start a session.

Result

The SessionManager copies the information in the properties file into SessionInfo, and then starts a connection using SessionInfo.

If the connection is established successfully, the SessionManager re-writes the contents of the properties file (except for the password).

Next Step

You can now use this connection to create, manage and call RFC function module(s).

Your next step is to set up the IRfcModule object and all of its parameters [Page 86].

Example

The following code uses the SessionInfo properties file. It instantiates the SessionManager and then starts a session:

```
// Obtain an instance of the SessionManager:
SessionManager  sessionMgr = SessionManager.getInstance();
// Start the session:
SessionMgr.open();
```

Adding or Changing Connection Properties Used

Use

If you use an r3_connection.props properties file [Page 45] to set connection information, you can override any of the values in the properties file by setting new values in your program.

If the information in the properties file is not complete (for example, if you do not wish to store user password in the properties file), you must update SessionInfo before you can start a connection.

Procedure

1. Obtain the SessionManager object.

   When instantiated, the SessionManager creates SessionInfo and sets it with the information from the properties file.

2. Use the *getSessionInfo* method of the SessionManager to obtain a copy of the information that exists in SessionInfo (which is the information from the properties file).
3. Change or add to any of the properties. Note that you are changing the copy of SessionInfo.
4. Update the original SessionInfo of the SessionManager.
5. Now you can start a session by using the *open* method of the SessionManager.

Result

The SessionManager starts a connection using the properties of SessionInfo.

If the connection is established successfully, the SessionManager re-write the contents of the properties file (except for password information).

Next Step

You can now use the connection to create, manage and call RFC function module(s).

Your next step is to set up the IRfcModule object and all of its parameters [Page 86].

Example

The following code example assumes that the properties file contains all the necessary connection information, except for the user password. The example overrides the username value and it adds the password. It then starts a session.

```
// Obtain the instance of the SessionManager:
SessionManager sessionMgr = SessionManager.getInstance();
// Read session information
SessionInfo  sessionInfo = SessionMgr.getSessionInfo();
java.util.Properties props = sessionInfo.getProperties();
// Change user name and add password value
//   using the JDK1.2 setProperty method
props.setProperty(SessionInfo.PROP_KEY_USER_USER_NAME, "JoeUser");
props.setProperty(SessionInfo.PROP_KEY_USER_PASSWORD,  "JoePassword");
// Set the session information using a Properties object
sessionMgr.setSessionInfo(props);
```

Adding or Changing Connection Properties Used

```
// Start the session
sessionMgr.open();
```

The following code example performs the same tasks, but it uses UserInfo to get and set the appropriate properties.

```
SessionManager sessionMgr = SessionManager.getInstance();
// Read user information using UserInfo
SessionInfo sessionInfo = SessionMgr.getSessionInfo();
UserInfo userInfo = sessionInfo.getUserInfo();
// Change user name and add password using UserInfo
userInfo.setUserName("JoeUser");
userInfo.setPassword("JoePassword");
// Set the session information from UserInfo using a SessionInfo object
sessionInfo.setUserInfo(userInfo);
sessionMgr.setSessionInfo(sessionInfo);
// Start the session
sessionMgr.open();
```

Manually Setting the Properties of SessionInfo

Use

If you do not use a properties file [Page 45] to set up the connection parameters, you need to set the necessary connection information by manually setting the properties of the SessionInfo object.

Procedure

1. Instantiate the SessionManager object.
2. Set the properties of SessionInfo.
3. Use the *open* method of the SessionManager to start a session.

Result

The SessionManager starts a connection using the properties of SessionInfo.

If the connection is established successfully, the SessionManager writes the connection information into the r3_connection.props properties file (except for password information). If the properties file does not exist, it creates it. If it exists, it rewrites its contents.

Next Step

You can now use the connection to create, manage, and call RFC function module(s).

Your next step is to set up the IRfcModule object and all of its parameters [Page 86].

Example

The following code example sets the various properties of SessionInfo. It then starts a session.

```
// Create an instance of the SessionManager:
SessionManager sessionMgr = SessionManager.getInstance();
// Enter properties using the JDK1.2 setProperty method
Properties props = new java.util.Properties();
props.setProperty(SessionInfo.PROP_KEY_MIDDLEWARE_SERVER_NAME,
"ORBMachine1");
//... (set other middleware properties)
props.setProperty(SessionInfo.PROP_KEY_CONNECTION_HOST_NAME,
"205.215.205.15");
//... (set other connection properties)
props.setProperty(SessionInfo.PROP_KEY_USER_USER_NAME, "JoeUser");
//... (set other user properties)
// Set SessionInfo with the session information
sessionMgr.setSessionInfo(props);
// Start the session
sessionManager.open();
```

Setting Up the Function Module Object

Purpose

Before making an RFC function call you must prepare the IRfcModule object representing the RFC function module with all of the parameters of the RFC function.

Prerequisites

You must first obtain a SessionManager object, set up the necessary connection information and start a session [Page 80] before you can start working with RFC function modules.

Process Flow

1. Obtain an IRfcModuleFactory by using the *getRfcModuleFactory* method of the SessionManager.

   The SessionManager supplies the necessary connection information to the IRfcModuleFactory for creating the IRfcModule object.

2. Use the IRfcModuleFactory to create an IRfcModule object.

   There are two ways to create an IRfcModule object:

Method	Advantage/Disadvantage of Using
Manually, using the createRfcModule method of IRfcModuleFactory [Page 91]	If you create the IRfcModule object with *createRfcModule*, you have to explicitly create and add all of the parameters of the RFC function into the IRfcModule object. You have to do so for all of the import, export, and table parameters of the function. Using *createRfcModule* saves calls to R/3 for retrieving function metadata. Use *createRfcModule*, for example, if you know that the RFC function does not have any parameters.
Automatically, using the autoCreateRfcModule method of IRfcModuleFactory [Page 89]	If you use *autoCreateRfcModule*, the IRfcModule object is created together with all the necessary metadata of all the parameters of the RFC function module. You save the work required for creating and adding the parameters' metadata. However, using *autoCreateRfcModule* is less efficient, because it may result in multiple calls to the R/3 system for obtaining the metadata of the function module.

   See the relevant topics above for the details of how to create an IRfcModule object and all of its parameters.

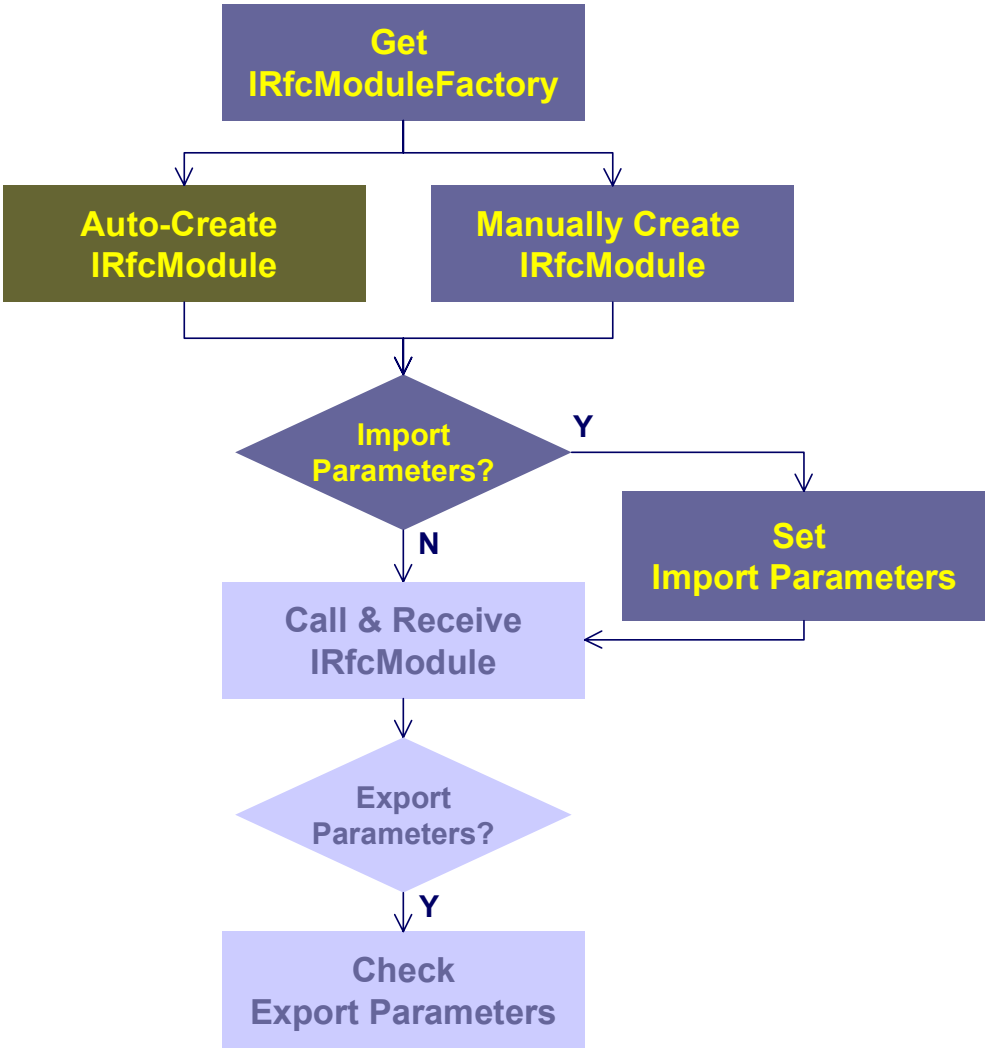
3. After creating the IRfcModule object with all of its parameters you need to set the value of import parameters of IRfcModule.

   You only need to set the values of the parameters representing required import parameters of the RFC function. You may set any other import parameters.

   Remember that table parameters may be both import and export parameters, and you may need to set their values as well.

If the RFC module has no parameters, you can call the function module [Page 93] immediately after creating the IRfcModule object.

The following diagram summarizes this process.



See Also

For the details of creating an IRfcModule that has parameters see one of the following topics:

- Auto-Creating the IRfcModule Object [Page 89]
- Manually Creating the IRfcModule Object [Page 91]

For examples see the following topics:

- Example: Calling an RFC Module with no Parameters [Page 71]

Setting Up the Function Module Object

- Example: Calling an RFC Module with Parameters [Page 73]

Auto-Creating the IRfcModule Object

Use

Using *autoCreateRfcModule* creates the IRfcModule object together with all the necessary metadata of all the parameters of the RFC function module.

Using *autoCreateRfcModule* eliminates the need to explicitly create and add the metadata of all the parameters of the function.

However, using *autoCreateRfcModule* is less efficient, because it may result in multiple calls to the R/3 system for obtaining the metadata of the function module.

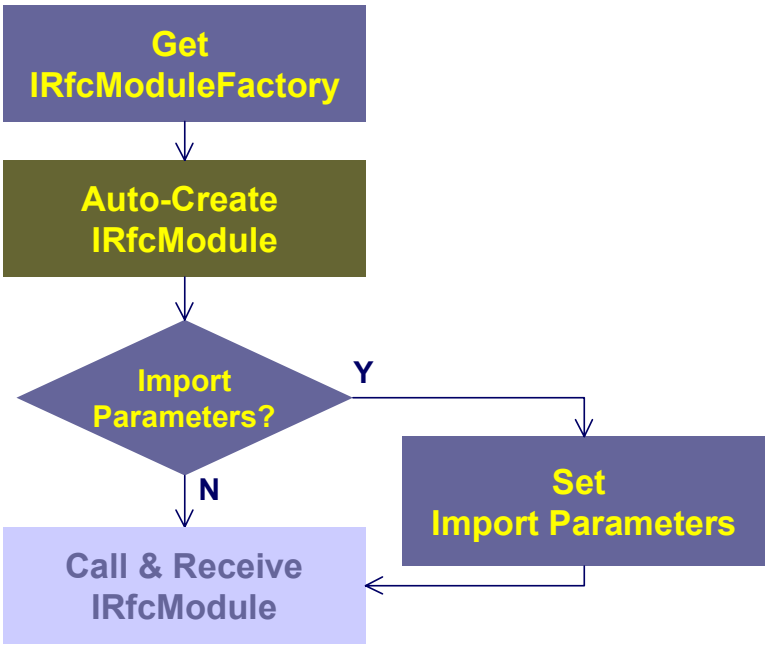
Prerequisites

SessionManager and all the necessary connection properties must be set up [Page 80].

Procedure

4. Obtain an IRfcModuleFactory by using the *getRfcModuleFactory* method of the SessionManager.
5. Use the *autoCreateRfcModule* method of the IRfcModuleFactory to create the IRfcModule.
6. Set the values of import parameters as necessary.

The following diagram summarizes this process:



Result

The IRfcModule object is created with all of its metadata, that is, it is created with all of the parameters of the RFC function modules defined in it.

Auto-Creating the IRfcModule Object

You can access the metadata of the various parameters of the function module by using the various get methods of the IRfcModule object.

Example

The following example creates a function module for the RFC function *BAPI_GL_ACC_GETLIST*.

The *BAPI_GL_ACC_GETLIST* function returns the list of G/L accounts (G/L account number, short text and long text) for a specified company in a specified language. It has the following parameters:

Parameter Name	Category	Type	Internal Name	Mandatory?
ACCOUNT_LIST	Imp/Exp	Table	BAPI3006_1	N
COMPANYCODE	Import	Field	COMP_CODE	Y
LANGUAGE	Import	Field	LANGU	N
LANGUAGE_ISO	Import	Field	LANGU_ISO	N
RETURN	Export	Structure	BAPIRETURN	N

This example uses auto-create to create the function module. Compare its code with the code for creating the same function module manually [Page 73].

```
// Create the module factory
IRfcModuleFactory moduleFac = SessionMgr.getRfcModuleFactory();
// Create the IRfcModule object
IRfcModule rfcModule =
moduleFac.autoCreateRfcModule("BAPI_GL_ACC_GETLIST");
// Set the values of COMPANYCODE and LANGUAGE import parameters
rfcModule.getSimpleImportParam("COMPANYCODE").setString ("3000");
rfcModule.getSimpleImportParam("LANGUAGE").setString ("E");
// Call the function module
rfcModule.callReceive();
```

Manually Creating the IRfcModule Object

Use

Creating the IRfcModule object manually means that you initially create an empty IRfcModule object and then you create and add its parameters in a separate step.

Manually creating the IRfcModule object involves more work, but it gives you more control over the creation of the parameters of the function module.

Another reason for creating the IRfcModule object manually is when you know that the RFC function does not have any parameters. In such a case, it is not necessary to create or add any parameters to the IRfcModule object. Using auto-create may result in an unnecessary connection to the R/3 system to get the metadata of the parameters of the function, when there is none.

Prerequisites

SessionManager and all the necessary connection properties must be set up [Page 80].

Procedure

1. Obtain an IRfcModuleFactory by using the *getRfcModuleFactory* method of the SessionManager.
2. Create the IRfcModule object using the *createRfcModule* method of IRfcModuleFactory.
3. Obtain an ISimpleFactory, IStructureFactory, and ITableFactory interfaces as necessary for constructing the various types of parameters that exist in the function module.

   For example, if the function module contains only simple parameters (individual fields), then you only need to obtain an ISimpleFactory. If the function module also contains a structure parameter, you need to also obtain an IStructureFactory.

   You only need to obtain a single factory interface for all the parameters of the same type.
4. Perform the following steps for every parameter of the RFC function module:
   a. Create the parameter.
   b. Add the parameter to the IRfcModule object.

      You have to perform these two steps for all of the import, export, and table parameters of the function.

      Note that RFC function parameter are named parameters, meaning that the order of the parameters within the function is not important. Therefore it is not important which parameter you create or add first.
   c. For each table and structure parameters you must also create and add the individual fields of that table or structure. To do so, perform the following steps:
      i. Instantiate an array of *SimpleInfo* objects representing the fields in the table or structure.
      ii. Create an *ISimpleField* object for every element of that array.
      iii. Create a *ComplexInfo* object
      iv. Assign the array of *SimpleInfo* objects to the *ComplexInfo* object.

v. Use the *ComplexInfo* object to construct the *ITable* or the *IStructure* object, using the *ITableFactory* or the *IStructureFactory* respectively.

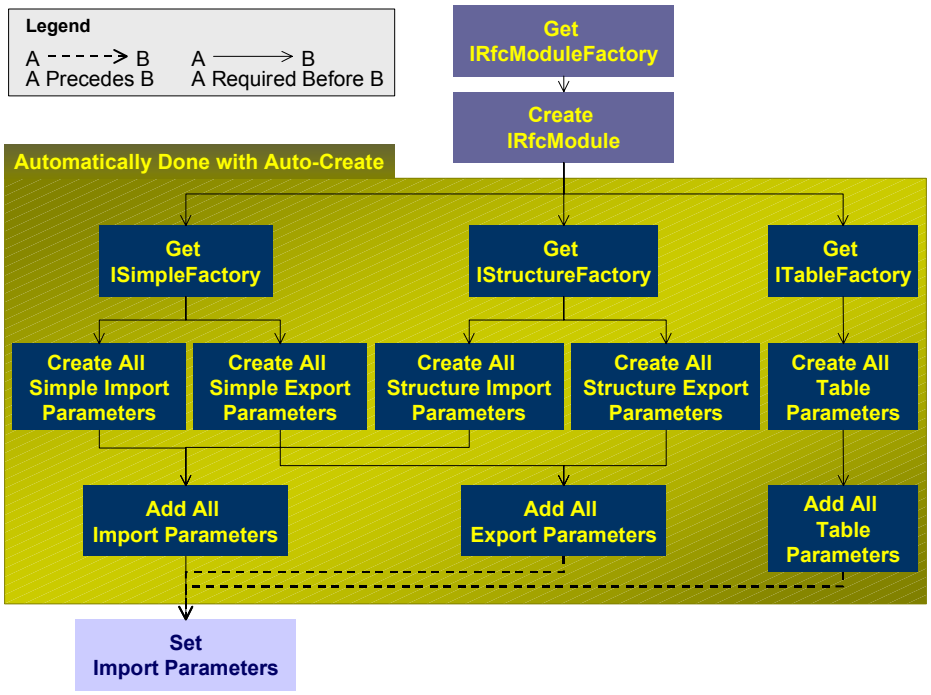
Note that the order of the fields in a structure or a table is important.

As an alternative to creating all the individual fields of a table or a structure, you can auto-create the table or the structure.

After completing this step (Step 4) you have defined the IRfcModule object and all of its metadata (that is, all of the metadata of the parameters of the RFC function modules). You can now access the metadata of the various parameters of the function module by using the various get methods of the IRfcModule object.

5. Set the value of import parameters for the function module.

The following diagram summarizes the steps for manually creating an IRfcModule and its parameters. Inside the rectangular area are tasks that are performed automatically if you use auto-create to create the IRfcModule [Page 89].



Example

The code in Example: Calling an RFC Function with Parameters [Page 73] manually creates the IRfcModule object and creates and adds all the parameters to it.

Calling an RFC Function Module

Use

Making an RFC function module call to an R/3 system.

Prerequisites

1. A connection must be established [Page 80].
2. The IRfcModule object must have been created along with all of its parameters.
3. All the required import parameters must be set in the IRfcModule object.

See the topic Setting Up the Function Module Object [Page 86] for the details of creating and setting the IRfcModule object with all the necessary parameters.

Procedure

Use the *callReceive* method or a combination of the *call* and the *receive* methods of the IRfcModule object.

Example

Sample code for making an RFC call (Assuming *rfcModule* is the IRfcModule object.)

```
rfcModule.callReceive();
```

Result

If the RFC function call is successful, returned values are available from the export and table parameter objects upon returning from *callReceive* or from *receive*.

You can now get the values of the various export parameters [Page 94].

Reading the Data from Export Parameters

Use

After calling an RFC function you can look at the resulting export parameters by using the IRfcModule and related objects.

Procedures

The following procedures suggest methods you can use for reading the data from export parameters. They are not necessarily the only methods with which you can access this data.

Reading Simple Export Parameters

1. Use the *getSimpleExportParam* of the IRfcModule object to get an ISimple object for the export parameter.
2. Use one of the *get* methods of ISimple (Inherited from ISimpleField) to get the value of the parameter depending on the type of parameter (See ISimpleField methods, such as *getChar*, *getInt*, and so on in the *Java RFC HTML Reference*).

Example

The following example reads the data from the export parameter SYSTEM_NAME of the RFC function GET_SYSTEM_NAME (The complete code for creating and calling the function is in Example: RFC Function with an Export Parameter [Page 72]).

```
ISimple sysNameParam = rfcModule.getSimpleExportParam("SYSTEM_NAME");
String sysName = sysNameParam.getString();
```

Reading Structure Export Parameters

1. Use the *getStructExportParam* of the IRfcModule object to get an IStructure object for the export parameter.
2. Use methods of the IStructure object inherited from IComplexIField to get the individual fields of the structure. For example, you can use *getSimpleField* to get an ISimpleField object for each of the fields of the structure.
3. Use one of the *get* methods of ISimpleField to get the value of a field in the structure depending on the type of field it is.

Example

The following example reads one of the fields from the structure export parameter RFCSI_EXPORT of the RFC function RFC_SYSTEM_INFO. The structure export parameter RFCSI_EXPORT contains various fields providing information on the system the client is connected to. The RFCOPSYS field in that structure provides operating system information. It is a string of 10 characters.

```
// Obtain an instance of the SessionManager and start a session
SessionManager  sessionMgr = SessionManager.getInstance();
sessionMgr.open();
// Get a module factory object and create the module
IRfcModule rfcModule =
sessionMgr.getRfcModuleFactory().autoCreateRfcModule("RFC_SYSTEM_INFO")
```

```
;
int retCode = rfcModule.callReceive();
// Get the structure export parameter
IStructure sysinfoStruct =
rfcModule.getStructExportParam("RFCSI_EXPORT");
//get the value of the RFCOPSYS field
String OpSys = sysinfoStruct.getSimpleField("RFCOPSYS").getString();
System.out.println("Operating System = " + opSys);
// Close the session
sessionMgr.close();
```

Reading Export Data from Table Parameters

Tables are both import and export parameters. Possible steps for reading the export data from a table parameter:

1. Use the *getTableParam* method of the IRfcModule object to get an ITable object for the parameter.
2. For each of the rows of the table get an IRow object representing a copy of the row in the table.

   You can do so with methods of the ITable object (for example *getRow*) or by using a cursor (using the various get methods of ICursor). You can also use the standard Java ResultSet interface to get at rows of the table. See the detailed discussion in Working with Table, Rows, and Cursors [Page 96].
3. Use the *getSimpleField* method of the IRow object (inherited from IComplexIField) to get the ISimpleField object for each of the fields of the row.
4. Use one of the *get* methods of ISimpleField to get the value of an individual field in the row.

Example

The code in Example: Calling an RFC Function with Parameters [Page 73] prints out the contents of the returned table parameter of and RFC function.

Also see the examples in Working with Table Data [Page 96].

Working with Table Data

There are two ways to work with tables:

Method	Advantage
Using the standard Java ResultSet object	Programming with standard methods of the Java language
Using the SAP Java RFC ITable, IRow, and ICursor interfaces	Allows you to use multiple cursors in a single table

Using the ITable, IRow, and ICursor interfaces of Java RFC directly you can perform the same tasks as when using the java.sql ResultSet methods.

Note that not all of the java.sql ResultSet methods were implemented in Java RFC, because not all of the methods are applicable to working with RFC tables (See the list of excluded methods in the *Java RFC HTML Reference*).

However, the majority of the methods were implemented, and methods that were implemented use the Java RFC ITable, IRow, and ICursor interfaces.

Using ITable, IRow, and ICursor Directly

ITable

Tables are stored and accessed on a row-by-row basis.

ITable provides methods for specifying how the table is handled

ITable can create ICursor objects to navigate between rows.

ITable also includes a *getResultSet* method, which allows you to create an object implementing the standard Java (java.sql) ResultSet interface.

IRow

Each IRow object contains a reference back to the originating ITable object, from which the metadata information (ComplexInfo) of the fields can be obtained.

An IRow inherits all methods of IComplexField.

ICursor

ICursor is used for navigating the table, moving between various rows.

The ITable object can create an unlimited number of ICursor objects, each containing a reference back to the table.

If you do not specify the row to point to when creating a cursor, it points to the first row by default.

Note that cursors are not necessarily updated automatically when rows are inserted or deleted from a table. We recommend that you finish your work with all cursors before adding or deleting rows.

Row Buffering

Tables are managed on the client side through “smart-caching”: no rows are shipped from the Orbix server to the client until the client requests a certain row. When the client requests a row,

that particular row along with the next or previous few rows are cached on the client side. More rows are cached as the client accesses rows that are out of the current cache.

With the *setFetchForward* method you can specify the direction of the fetching of rows, that is, you can specify whether the rows after the requested row are fetched, or the rows before the requested row are fetched.

The size of the read buffer (in terms of number of rows included in it) for each cache operation is configurable and accessible through the methods *setReadBufferSize* and *getReadBufferSize*. You can specify no caching by setting the buffer size to 0. You can ask for the whole table to be cached by setting the buffer size to -1. The default buffer size is -1.

Row Updates

The *getRow* method of ITable and the various get methods of ICursor return a clone of a row in the table, not the row itself. As a result, any modifications to the returned row have no effect on the row of the originating table. To apply the changes to the originating table, call the *updateRow* method, passing to it the modified row copy.

Update Policies

You can control when updates of the table on the client side are sent back to the server, by specifying one of the following update policies:

Update Policy	Time of Updates
UPDATE_POLICY_BUFFERED (Default)	All updates are cached on the client side until either *acceptUpdate* is called or until the next RFC call.
UPDATE_POLICY_IMMEDIATE	Any call to *updateRow* results in a call back to the server to synchronize with the update.

The update policy can be set and retrieved through the methods *setUpdatePolicy* and *getUpdatePolicy* respectively. The default policy is UPDATE_POLICY_BUFFERED.

Examples Using ITable, IRow, and ICursor

The following examples show how to deal with two fields in the table parameter CUSTOMER_T (internal name: **BRFCKNA1)** of the RFC function RFC_CUSTOMER_GET. The two fields we show are KUNNR (customer number) and NAME1 (first line in customer name). Handling the two fields is shown as an example of how to handle all the fields in the row of the table.

Appending a Row to a Table

```
//Create the table
ITable tableFactory.autoCreateTable("CUSTOMER_T", "BRFCKNA1");
IRow theRow = theTable.createEmptyRow();
theRow.getSimpleField("KUNNR").setString(custNo);
theRow.getSimpleField("NAME1").setString(custName);
theTable.appendRow(theRow);
```

Updating a Row

```
ITable theTable = ...; //Create the table
IRow rowCopy = theTable.getRow(0); //get a copy of the first row
rowCopy.getSimpleField("KUNNR").setString(custNo);
```

```
rowCopy.getSimpleField("NAME1").setString(custName);
theTable.updateRow(0, rowCopy); // VERY IMPORTANT STEP!!!
```

Traversing a Table

```
ITable theTable = ...; //Create the table
//gets the number of columns for the table
int fieldCount = theTable.getComplexInfo().getCount();
ICursor cur = theTable.createCursor();
IRow theRow = cur.getCurrentRow();  //get a copy of the first row
while( null != theRow )
{
   //prints out all fields in this row in the form of strings
   for (int nColumn = 0; nColumn < nFieldCount; nColumn++)
   {
      System.out.print(theRow.getSimpleField(nColumn).getString());
      System.out.print("\t");
   }
   System.out.print("\n");
   theRow = cur.getNextRow(); //get a copy of the next row
}
```

Examples Using the Standard Java ResultSet Interface

Appending a Row to a Table

```
ITable theTable = ...; //Create the table
java.sql.ResultSet resultSet = theTable.getResultSet(false);
resultSet.afterLast();
resultSet.moveToInsertRow();
resultSet.updateString("KUNNR", custNo);
resultSet.updateString("NAME1", custName);
theTable.insertRow();
```

Updating a Row

```
ITable theTable = ...; //Create the table
java.sql.ResultSet resultSet = theTable.getResultSet(false);
resultSet.first(); //move to the first row
//this is equivalent to: resultSet.absolute(1);

resultSet.updateString("KUNNR", custNo);
resultSet.updateString("NAME1", custName);
resultSet.updateRow();
```

Traversing a Table

```
ITable theTable = ...; //Create the table
java.sql.ResultSet resultSet = theTable.getResultSet(false);
int fieldCount = resultSet.getMetaData().getColumnCount();
//gets the number of columns for the table
//upon creation, resultSet's internal cursor is positioned
//before the first row
while( resultSet.next() ) //move cursor to next row
{
   //prints out all fields in this row in the form of strings
   for (int nColumn = 1; nColumn <= nFieldCount; nColumn++)
```

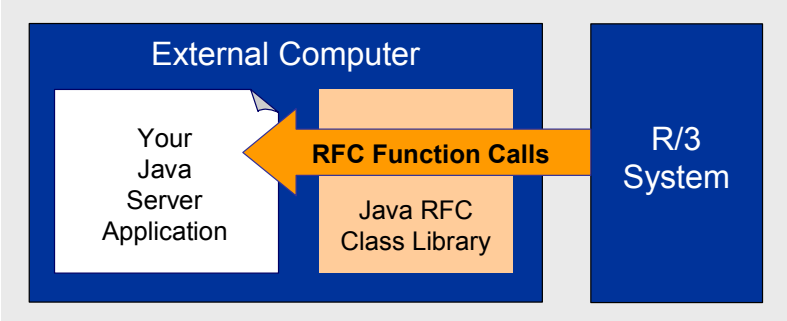
```
    {
       System.out.print(resultSet.getString(nColumn));
    System.out.print("\t");
    }
    System.out.print("\n");
}
```

See Also

See the *Java RFC HTML Reference* documentation for the details of each of the table-related interfaces.

Interface for Building Server Applications

The *Java RFC Class Library* offers classes and objects that allow you to write application programs that act as an RFC Server to R/3.



These applications can:

- Register themselves in the SAP Gateway
- Wait for incoming RFC calls
- Accept RFC function calls
- Process the data from the call
- Return results of the processing to the calling client
- Offer multi-threaded, safe operations

Java RFC Server Classes and Interfaces

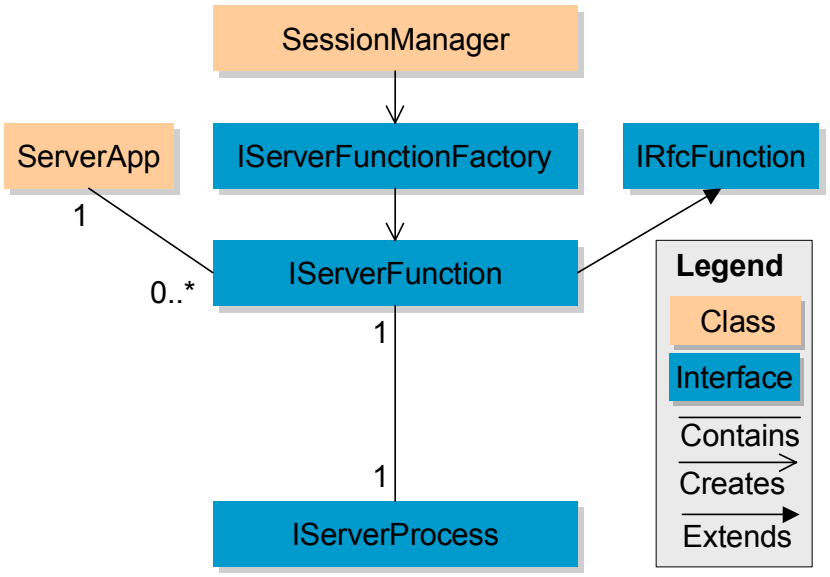
The exposed Java RFC client Interfaces are defined in the *com.sap.rfc* package.

Exceptions [Page 139] are defined in the *com.sap.rfc.exception* package.

When programming a server application you use mainly the following objects:

- *ServerApp*
- *IServerFunction*
- *IServerProcess*
- Factory Objects [Page 62], especially the SessionManager and the IServerFunctionFactory, but you can also use the FactoryManager.
- Parameter and Field Interfaces [Page 53]

The following diagram shows the relationship between the various objects used for creating Java RFC server applications.



In addition to the above interfaces and classes, your RFC server application also uses many of the interfaces and classes that are used by the RFC client applications. For example, you use the SessionManager for creating the various factory interfaces, and you use all the parameter-related objects when using the IServerFunction. See the discussion of these objects in the appropriate sections.

Building Java RFC Server Applications

When creating server applications with the *Java RFC Class Library* you can manually create all the parameter objects for the RFC function you are serving. As an alternative, you can let the *Java RFC Class Library* automatically create all the necessary parameter objects.

Manual Creation of Parameter Objects

When you create server function objects manually, you perform more steps: you must construct the parameter objects for each of the server function offered by your program.

You must perform the following steps for each server function object:

- Create all of its import parameter objects (each import parameter object can be a simple parameter or a structure parameter).
- Create all of its export parameter objects (each export parameter object can be a simple parameter or a structure parameter).
- Create all of its table parameter objects.
- If a parameter is a table or a structure, you must also create and add all of the individual field objects to the parameter object.
- Add the created parameter objects to their parent server function object.

Automatic Creation of Parameter Objects

Letting the *Java RFC Class Library* automatically create server function objects eliminates the tedious tasks of creating and adding the parameter objects to the server function object.

To allow for automatic creation of parameter objects, you must first define the signatures needed by the server function you intend to offer in your application (This means that you create a dummy RFC function in R/3 with the parameters of the function you intend to offer).

You do so in the R/3 system, using the R/3 Function Builder (Transaction *SE37*).

Once you define the signatures of your function in the R/3 system, the *Java RFC Class Library* can obtain the function's metadata for the purpose of automatic creation of your server function and its parameter objects.

Note that although it is not required to do so, you may define a dummy function in the R/3 system for a function you offer even when you manually create all function objects. The dummy function in this case can be useful for testing the RFC function on the calling R/3 system.

Comparison of the Methods

When using automatic creation of parameter objects, the *Java RFC Class Library* makes calls to R/3 to obtain this metadata.

Therefore, while the advantage of creating function objects automatically is in saving programming effort, it results in more calls to the R/3 system, which may be less efficient at run time.

For the details of creating a server application with one of these methods, see the topics:

- Server Programming with Manual Creation of Function Objects [Page 104]
- Server Programming with Automatic Creation of Function Objects [Page 107]

Server Programming with Manual Creation of Function Objects

Use

When creating server applications with the *Java RFC Class Library* you can manually create all the parameter objects for the RFC function you are offering in your application.

When you create server function objects manually you perform more steps than if you let the *Java RFC Class Library* automatically create those objects [Page 107]: you must construct the parameter objects for each of the server functions offered by your program.

Prerequisite

Set up the two properties files [Page 45] to define the middleware type [Page 64] to use.

Procedure

	Task Description
1.	Obtain a single instance of *SessionManager*. See Obtaining SessionManager [Page 110] for more details and an example.
2.	Obtain a single instance of *ServerApp*. See Obtaining the ServerApp Object [Page 111] for more information.
3.	Use the *SessionManager* to create an *IServerFunctionFactory* object. See Using the IServerFunctionFactory Object [Page 112] for more information.
4.	Obtain instances of *ISimpleFactory*, *IStructureFactory* and *ITableFactory* as necessary for constructing the various types of parameters that exist in all the RFC functions that you intend to offer. For example, if any of your functions contains simple parameters (individual fields), then you need to obtain an *ISimpleFactory*. If any of your functions contains a structure parameter, you need to also obtain an *IStructureFactory*, and so on. Note that you only need to obtain a single factory interface for all the parameters of the same type throughout your program (meaning that you do not need to create the factories separately for each function).
	Perform the following steps for every RFC function that you intend to offer in your application:
5.	Use the *IServerFunctionFactory* to create an empty *IServerFunction* object representing the RFC function. Do so by calling *IServerFunctionFactory*.*createEmptyServerFunction*(). See Using the IServerFunctionFactory Object [Page 112] for more information.
	Perform the following steps for every parameter of the function:

6.	Create the parameter as either a simple, structure, or table parameter object, using the appropriate factory object (*ISimpleFactory*, *IStructureFactory* and *ITableFactory respectively)*. See Using the Parameter Factory Objects [Page 113] for more information.	
7.	If the parameter is a structure or a table parameter, then you also have to create and add all of its individual fields. To do so, perform the following steps:	
	a.	Instantiate an array of *SimpleInfo* objects representing the fields in the table or structure.
	b.	Create an *ISimpleField* object for every element of that array.
	c.	Create a *ComplexInfo* object for the table or structure.
	d.	Assign the array of *SimpleInfo* objects to the *ComplexInfo* object.
	e.	Use this *ComplexInfo* object to construct the *ITable* or the *IStructure* object, using the *ITableFactory* or the *IStructureFactory* respectively.
8.	Call *either the addImportParam()*, the *addExportParam*() or the *addTableParam() method of IServerFunction* to add the parameter objects that you have created in step (6) above to the server function object. See Adding Parameter Objects to IServerFunction [Page 115] for more information.	
9.	Create a server process class that implements the *IServerProcess* interface. This class implements the *process()* method of the *IServerProcess* interface. This *process()* method is where you implement the processing logic of the RFC function you intend to offer. The processing logic manipulates the import data received from an incoming call, and generates export data for returning information to the calling client. See Creating a Server Process for Incoming Calls [Page 116] for more information.	
10.	Instantiate a server process object belonging to your new server process class.	
11.	Call *IServerFunction.setServerProcess(IServerProcess)* to store the reference of your server process object in your server function object. See Associating IServerFunction and IServerProcess [Page 117] for more information.	
12.	Call *ServerApp.addServerFunction(IServerFunction)* to add the newly created and configured *IServerFunction* object to the single instance of *ServerApp* you have obtained in step (2). See Adding IServerFunction to ServerApp [Page 118] for more information.	
13.	Call the *ServerApp.setAcceptArgs* method to set the RFC destination where the server application is to be registered. See Registering a Server Application at the SAP Gateway [Page 119] for more information.	

14..	Adjust the number of threads for processing incoming RFC calls. See Adjusting the Number of Server Threads [Page 121] for more information
15.	Call *ServerApp.run()* to wait for incoming RFC calls and process these calls. See Running a Server Application [Page 122] for more information.

Result

You server application is ready to accept RFC calls from an R/3 system.

See Also

Note that the procedure for manually creating *IServerFunction* object is very similar to the procedure for manually creating the IRfcModule object [Page 91] (when programming a client application with the *Java RFC Class Library).*

Server Programming with Automatic Creation of Function Objects

Use

When creating server applications with the *Java RFC Class Library* you can let the *Java RFC Class Library* automatically create the parameter objects for the RFC functions you offer in your application.

Letting the *Java RFC Class Library* automatically create server function objects eliminates the tasks of creating and adding the parameter objects to the server function objects, as done with manual creation of these parameters [Page 104].

Prerequisites

- To provide the necessary metadata of the server function to the *Java RFC Class Library*, you must first define the signature for the server function in the calling R/3 system (This means that you create a dummy RFC function in the calling R/3 system with the parameters of the server function).

  You do so by using the Function Builder (Transaction *SE37)* in the calling R/3 system.

  Once you define the signatures of your function in the R/3 system, the *Java RFC Class Library* can obtain the function's metadata for the purpose of automatic creation of your server function and parameter objects.

- Set up the two properties files [Page 45] to define the middleware type [Page 64] to use.
- You also need to define connection parameters (in the r3_connection.props properties file) [Page 82] for logging onto the R/3 system. The connection information is required because the *Java RFC* connects to the R/3 system to obtains function metadata information.

Procedure

	Task Description
1.	Obtain a single instance of *SessionManager*. See Obtaining SessionManager [Page 110] for more details and an example.
2.	Obtain a single instance of *ServerApp*. See Obtaining the ServerApp Object [Page 111] for more information.
3.	Use the *SessionManager* to create an *IServerFunctionFactory* object. See Using the IServerFunctionFactory Object [Page 112] for more information.

Perform the following steps for every RFC function that you intend to offer in your application:	
4.	Use the *IServerFunctionFactory* to create an *IServerFunction* object representing the RFC function. Call the *IServerFunctionFactory.createCompleteServerFunction*() to create all the necessary function objects automatically. See Using the IServerFunctionFactory Object [Page 112] for more information.
5.	Create a server process class that implements the *IServerProcess* interface. This class implements the *process()* method of the *IServerProcess* interface. This *process()* method is where you implement the processing logic of the RFC function you intend to offer. The processing logic manipulates the import data received from an incoming call, and generates export data for returning information to the calling client. See Creating a Server Process for Incoming Calls [Page 116] for more information.
6.	Instantiate a server process object belonging to your new server process class.
7.	Call *IServerFunction.setServerProcess(IServerProcess)* to store the reference of your server process object in your server function object. See Associating IServerFunction and IServerProcess [Page 117] for more information.
8.	Call *ServerApp.addServerFunction(IServerFunction)* to add the newly created and configured *IServerFunction* object to the single instance of *ServerApp* you have obtained in step (2). See Adding IServerFunction to ServerApp [Page 118] for more information.
9.	Call the *ServerApp.setAcceptArgs* method to set the RFC destination where the server application is to be registered. See Registering a Server Application at the SAP Gateway [Page 119] for more information.
10.	Adjust the number of threads for processing incoming RFC calls. See Adjusting the Number of Server Threads [Page 121] for more information.

11.	Call *ServerApp.run()* to wait for incoming RFC calls and process these calls. See Running a Server Application [Page 122] for more information.

Result

You server application is ready to accept RFC calls from an R/3 system.

Obtaining SessionManager

Notes on Working with SessionManager

The RFC Java Class Library ensures that there is only one instance of the *SessionManager* for one the application program.

Example

The following example shows the typical preparation for obtaining a *SessionManager* reference before using it.

```
com.sap.rfc.SessionManager _sessionMan = null;
try
{

_sessionMan.open();
}
catch (JRfcBaseRuntimeException je)
{
System.out.println("Bind to object failed.\n"
+ "Unexpected JRFC runtime exception:\n" + je.toString ());
return;
}
catch (JRfcRfcConnectionException rce)
{
System.out.println("JRfcRfcConnectionException occurred " +
"when opening a session.\n" +
"Exception message is: " +
rce.toString());
return;
}
```

See Also

The *SessionManager* is also used when creating Java RFC client applications. For more information on using the *SessionManager* in client applications, see The SessionManager and the SessionInfo Objects [Page 43].

Obtaining the ServerApp Object

You can only create and use one instance of *ServerApp* object per application program.

Example

The following example shows the typical manner in which you can obtain a reference to a single instance of this class.

```
com.sap.rfc.ServerApp _serverApp = null;

_serverApp = com.sap.rfc.ServerApp.getInstance();
```

Using the IServerFunctionFactory Object

The *IServerFunctionFactory* object is used to create *IServerFunction* objects.

To obtain a reference to an *IServerFunctionFactory* object, use the *SessionManager*.

Once an application program obtains a reference to an *IServerFunctionFactory*, the program can create either an empty or a complete server function objects (depending on whether you are using manual [Page 104] or automatic [Page 107] creation of server function objects).

Note that an empty server function object does not have any parameter objects, and it is therefore useless for processing incoming RFC calls. You must create and add its parameters before accepting any incoming RFC calls to it.

Example

The following example shows how to obtain a server function factory object to create empty server function objects.

Note that this example assumes that a reference to the Factory Manager object is ready for use.

```
// _sessionMan is a reference to SessionManager
com.sap.rfc.IServerFunctionFactory serverFactory = null;
com.sap.rfc.IServerFunction rfcComputeTax = null;
serverFactory = _sessionMan.getServerFunctionFactory();
rfcComputeTax =
serverFactory.createEmptyServerFunction("RFC_COMPUTE_TAX");

              // When using manual creation
rfcComputeTax =
serverFactory.createCompleteServerFunction("RFC_COMPUTE_TAX");

              // Using automatic creation
```

Using the Parameter Factory Objects to Add and Create Parameters

After creating an empty server function object you must create and add the parameter objects for all of the parameters of the function.

To create the necessary parameter objects, you must first obtain the relevant factory objects: *ISimpleFactory* (for creating simple parameters), *IStructureFactory* (for creating structure parameters), and *ITableFactory* (for creating table parameters).

Example

To continue the *rfcComputeTax* example (in Using the IServerFunctionFactory [Page 112]), which implements the RFC function *RFC_COMPUTE_TAX*, the following example adds the appropriate parameter objects to the function.

This example shows how to create simple and table parameter objects.

Note that this example assumes that a reference to the *SessionManager* object is ready for use.

```
// _sessionMan is a reference to SessionManager
com.sap.rfc.ISimpleFactory simpleFactory =
_sessionMan.getSimpleFactory();
com.sap.rfc.IStructureFactory structureFactory =
_sessionMan.getStructureFactory();
com.sap.rfc.ITableFactory tableFactory = _sessionMan.getTableFactory();
com.sap.rfc.ITable _expenseTable = null;
com.sap.rfc.ISimple _name = null;
// Note that a com.sap.rfc.SimpleInfo object is needed to create a
// simple parameter object
_name = _simpleFactory.
createSimple(
new SimpleInfo(null, IFieldInfo.RFCTYPE_CHAR, 32, 0),
"NAME");
// Note that an array of com.sap.rfc.SimpleInfo objects are needed
// to create a com.sap.rfc.ComplexInfo object first, then the
// com.sap.rfc.ComplexInfo object is used to create a table
// parameter or structure parameter object
IFieldInfo[] eTableInfo = new SimpleInfo[4];
int i = 0;
eTableInfo[i++] = new SimpleInfo("EXPENSE_DESCRIPTION",
IFieldInfo.RFCTYPE_CHAR, 200, 0);
eTableInfo[i++] = new SimpleInfo("EXPENSE_TYPE",
IFieldInfo.RFCTYPE_CHAR, 4, 0);
eTableInfo[i++] = new SimpleInfo("DATE",
IFieldInfo.RFCTYPE_DATE, 8, 0);
eTableInfo[i++] = new SimpleInfo("AMOUNT",
IFieldInfo.RFCTYPE_BCD, 8, 2);
_expenseTable = _tableFactory.createTable
(new ComplexInfo(eTableInfo, ""));
_expenseTable.setParameterName("EXPENSE_LIST");
```

See Also

For the detailed syntax of using the factory methods, see the *Java RFC HTML Reference* documentation.

Adding Parameter Objects to IServerFunction

Most RFC functions use parameters to hold data to be processed, and to return data resulting from processing.

An RFC server function must contain parameter objects for encapsulating the parameters of the function.

Import, Export and Table Parameters

When adding parameter objects to the *IServerFunction* object, you must consider the direction and type of the parameter object.

Parameters can be used to perform either import or export operations The direction is relative to the server function. All parameters that are passed from client to server are considered *import* parameters. All parameters that are returned from server to client are considered *export* parameters.

Simple and structure parameters can be either import or export parameters. Table parameters are always bi-directional.

Example

This example uses the *com.sap.rfc.IServerFunction* object *rfcComputeTax*, created in the topic Using the IServerFunctionFactory Object [Page 112]. Also, this example uses the simple and table parameters created in the Using the Parameter Factory Objects [Page 113] example.

```
rfcComputeTax.addImportParam(_name);

rfcComputeTax.addTableParam(_expenseTable);
```

Creating a Server Process for Incoming Calls

You must create a server process class that implements the *IServerProcess* interface, and implements the method *IServerProcess.process()*.

The *process()* method contains the processing logic of the RFC server function you intend to offer. Each *process()* method reads the import and table parameter information and processes the data. Then, it uses the export and table parameters to return the results of the processing.

See the discussion of simple, structure, and table parameters [Page 53] in the RFC client section of this Help document. Also see the details of each of the objects in the *Java RFC HTML Reference* document.

Example

```
public class ComputeTaxProcess implements com.sap.rfc.IServerProcess

{
    public ComputeTaxProcess()
    {
        // constructor actions
    }
public void process(IServerFunction serverFunction)
    {
        // Here you put in the code that reads import
        //  and table parameter data, and processes the data
com.sap.rfc.ISimple _name =
            serverFunction.getImportParam("NAME");
        com.sap.rfc.ITable _expensesTable =
            serverFunction.getTableParam("EXPENSE_LIST");
   }
}
```

Associating IServerFunction and IServerProcess

After creating a server process class, you need to associate an instance of this server process class with the *IServerFunction* object you have been constructing.

To do so, first create a new instance of the server process class, then call the method *IServerFunction.setServerProcess(IServerProcess)* of the *IServerFunction* object.

Example

The following section of code shows how this is done.

The code uses the *IServerFunction* **object we have been constructing in the examples in** Using the IServerFunctionFactory Object [Page 112] **and** Adding Parameter Objects to IServerFunction [Page 115]**. It also uses the server process class from the example in** Creating a Server Process for Incoming Calls [Page 116]**.**

```
com.sap.rfc.IServerProcess processComputeTax =

 new ComputeTaxProcess();

rfcComputeTax.setServerProcess(processComputeTax);
```

Adding IServerFunction to ServerApp

You must add the *IServerFunction,* which you have created in the previous steps, to the single instance of the *ServerApp* object.

Example

In the following section of code, _*serverApp* is a reference to the single instance of *ServerApp*.

The *IServerFunction* object was created in Using the IServerFunctionFactory Object [Page 112] **and in** Adding Parameter Objects to IServerFunction [Page 115]**.**

```
_serverApp.addServerFunction(rfcComputeTax);
```

Registering a Server Application at the SAP Gateway

To receive RFC calls from an R/3 client, a server application program running on an external computer must be registered in an RFC destination at an SAP Gateway. This means that you must first define an RFC destination suitable for your needs.

Defining an RFC Destination in the Calling R/3 System

To define an RFC destination on the R/3 system that will be making client RFC calls to your server application program, use Transaction *SM59*. In this transaction, enter an RFC destination name; for example, **`MYDEST`**. You must select **`T`** for the *Connection Type* and **`REGISTRATION`** for the *Activation Type*. Then, enter **`MYDEST`** as the *program ID*. After you enter this information, you are ready to save this RFC destination definition.

Defining an RFC Destination on the Application's Computer

Destination Entry in the saprfc.ini File

The RFC destination that you defined above must be reflected in the *saprfc.ini* file where your server application resides.

Note that in the following example *saprfc.ini* file, **`nnn.nnn.nnn.nnn`** is the IP address of the computer hosting the SAP Gateway (which usually resides on the same server as the R/3 system). If you wish, you do not have to use the IP address to specify the host. You can also enter the host name of the host. Also in the example below, the entry **`GWSERV`** is set to **`sapgw??`**, where **`??`** is the *system number* of the R/3 application server.

```
DEST=MYDEST

TYPE=R

PROGID=mydest

GWHOST=nnn.nnn.nnn.nnn

GWSERV=sapgw??

RFC_TRACE=1
```

Location of the SAPRFC.INI Files

You must place a copy of the *saprfc.ini* file in one of two places:

1. In the same directory as the *jrfcserver.exe*, which comes with RFC Java Class Library installation.
2. In a directory of your choice. Then, you need to define an environment variable *RFC_INI* that points to this file.

   Example:

   ```
   RFC_INI=C:\myprojects\rfc\java\saprfc.ini
   ```

Referring to the Destination in Your Server Application

You specify the destination to use in your server application by using the *setAcceptArgs*(*String[]*) method of the *ServerApp* object.

Registering a Server Application at the SAP Gateway

You specify the destination as a string containing the destination name prefixed with "-D" (note that it must be the uppercase letter D). The destination name is the same as you defined in your saprfc.ini file and on the R/3 system. You assign this string to the first element of the argument to *setAcceptArgs.*

Example

The following example sets the RFC destination for the server application. It assumes that all the necessary objects and variable have been defined earlier.

```
// _serverApp is a reference to the single instance
// of com.sap.rfc.ServerApp class
String[] acceptArgs = new String[1];
acceptArgs[0] = new String();
acceptArgs[0] = "-DMYDEST";
_serverApp.setAcceptArgs(acceptArgs);
// Use uppercase D ("-D")
//   in the string in acceptArgs[0] = "-DMYDEST";
```

Adjusting the Number of Server Threads

The *ServerApp* class handles the spawning and destruction of threads used in listening to incoming RFC calls and processing those calls.

The *ServerApp.run*() method starts with only one thread (in addition to itself) for listening to incoming calls.

ServerApp spawns more thread as necessary when more concurrent RFC calls are received.

ServerApp stops spawning new threads when one of the following conditions are met:

- The existing number of threads are sufficient to service the incoming calls.
- The maximum allowed number of threads has been reached.

Initially, the maximum allowed number of threads is **five**. Before invoking *ServerApp.run*(), you can adjust the maximum allowed number of threads by calling *ServerApp.increaseMaximumThreadCount(int)*. Note that the argument passed to this method is the number of threads to add to the current number (the delta), rather than the absolute number for the maximum allowed.

Running a Server Application

After building the *ServerApp* and *IServerFunction* objects, you are ready to run the server application and wait for incoming calls from the client. The steps required to run a server application program are quite simple, as are illustrated by the example below.

Example

The following section of code assumes that all the preparatory steps discussed in previous sections are taken.

_*serverApp* is a reference to the single instance of ServerApp class.

```
try
{
    _serverApp.run();
}
catch(JRfcRfcConnectionException rce)
{
    rce.toString();
}
catch(JRfcMiddlewareException me)
{
    me.toString();
}
```

Server Sample Programs: Srfctest and SrfctestAuto

The RFC Java Class Library development kit provides two sample programs to demonstrate how to construct and use the *com.sap.rfc.IServerFunction* and *com.sap.rfc.IServerProcess* objects:

Sample Program	Method of Constructing Function Objects
Srfctest	manual creation
SrfctestAuto	automatic creation

Each of these programs offers the following two RFC functions:

- STFC_CONNECTION
- STFC_PERFORMANCE.

These two functions work with the R/3 program *SRFCTEST*. *SRFCTEST* includes many options, two of which can make client calls to our sample application programs: *Connection* can call *STFC_CONNECTION* and *Performance* can call *STFC_PERFORMANCE*.

STFC_CONNECTION

STFC_CONNECTION is implemented using the class *StfcConnection*.

This function receives a simple parameter of type CHAR and echoes this parameter. It then returns another simple parameter of its own, of type CHAR.

STFC_PERFORMANCE

STFC_PERFORMANCE is implemented by the class *StfcPerformance*.

This function tests the performance of a predefined set of operations.

STFC_PERFORMANCE receives two table parameters and returns two table parameters.

Received Table Parameters

Parameter	Type
ITAB0332	H332
ITAB1000	H1000

Returned Table Parameter

Parameter	Type
ETAB0332	H332
ETAB1000	H1000

The *STFC_PERFORMANCE* function receives four simple parameters of type NUMC (numeric character):

Table Parameter	Expected No. of Rows From R/3
LGIT0332	ITAB0332
LGIT1000	ITAB1000

LGET0332	ETAB0332
LGET1000	ETAB1000

The *STFC_PERFORMANCE* function returns a single-character code, *EXITCODE*. When its value is `O (the letter "O")`, the function call was successful. When its value is `E`, the function encountered an error during processing. This function performs the following processing:

1. The *STFC_PERFORMANCE* function checks the expected number of rows of *ITAB0332* against the received number of rows of that table parameter, and then it does the same with *ITAB1000*. When there is error, it returns `E` for *EXITCODE*.
2. Next, the *STFC_PERFORMANCE* function appends the expected number of table rows to *ETAB0332*, as indicated by *LGET0332*. In each row, a header indicates the row number. The rest of the row is filled with a numeric digit.
3. Then, the *STFC_PERFORMANCE* function appends the expected number of table rows to *ETAB1000*, as indicated by *LGET1000*. In each row, a header indicates the row number. The rest of the row is filled with a numeric digit.

Testing the Programs

To run the *Srfctest* or the *SrfctestAuto* programs as a server application:

1. Supply an RFC destination on the command line when invoking the program (see Registering a Server Application at the SAP Gateway [Page 119] for setting up RFC destinations).
2. Log onto the R/3 System where the RFC destination is defined.
3. Use Transaction *SE38*, and enter the program name: *SRFCTEST*.
4. Choose either *Performance* or *Connection* to test the applicable function in *Srfctest* or *SrfctestAuto*.
5. Enter the RFC destination used by your server application.

Advanced Topics

Programming Multiple Client Connections

The procedures for starting a session [Page 80] as well as for creating and using an IRfcModule [Page 86] in the Client Side Interface sections assumed that you use a single, default connection.

When using a single connection, use the SessionManager object [Page 43] for handling all the aspects of this connection, including creating and using an IRfcModule and its parameters.

When working with multiple connections, you should instead:

- Use the FactoryManager [Page 128], instead of the SessionManager, for creating all the factory interfaces.
- Create an IRfcConnection [Page 129] object (using the IRfcConnectionFactory) for every connection you wish to use.

See the description of these objects, and the topic Handling Multiple Connections [Page 133].

Classes and Interfaces for Multiple Connections

FactoryManager

Use

When handling multiple connections, use the FactoryManager object (instead of the SessionManager object [Page 43]) as the central connection point from the client to the server.

The FactoryManager is also available for compatibility with the previous version of the Java RFC, in which the FactoryManager was the only mechanism for creating factory interfaces.

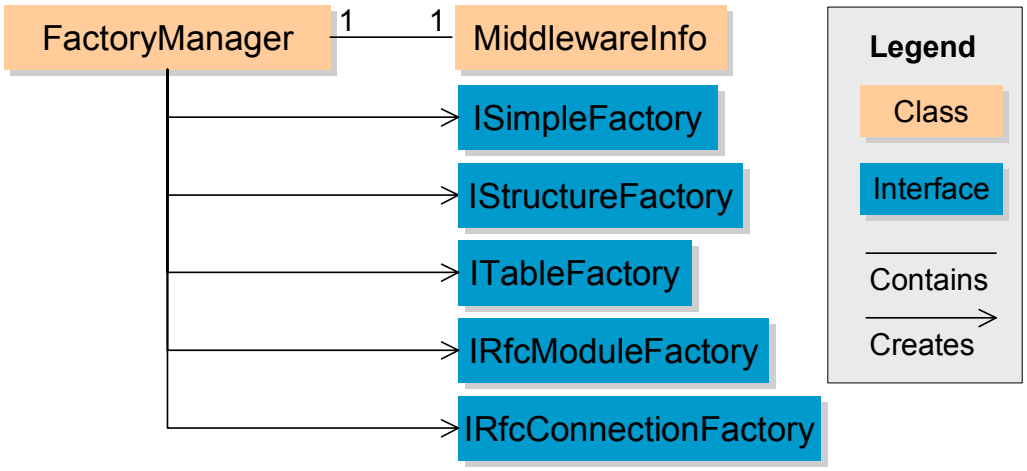
A client application or applet is only allowed to have a single FactoryManager object.

The FactoryManager object creates and manages various factory objects [Page 62] that can produce corresponding server objects on the server and proxy objects for the client.

MiddlewareInfo

The FactoryManager instance needs the MiddlewareInfo class to produce the factory objects with the right middleware implementation.

The following diagram shows the relationship between the FactoryManager and the other objects.



The middleware implementers need to implement the various factory interfaces for creation and management of the respective server and proxy objects.

See Also

See the *Java RFC HTML Reference* documentation for the details of each of the classes and interfaces.

IRfcConnection and Related Objects

Definition

An IRfcConnection object represents an R/3 connection.

Use

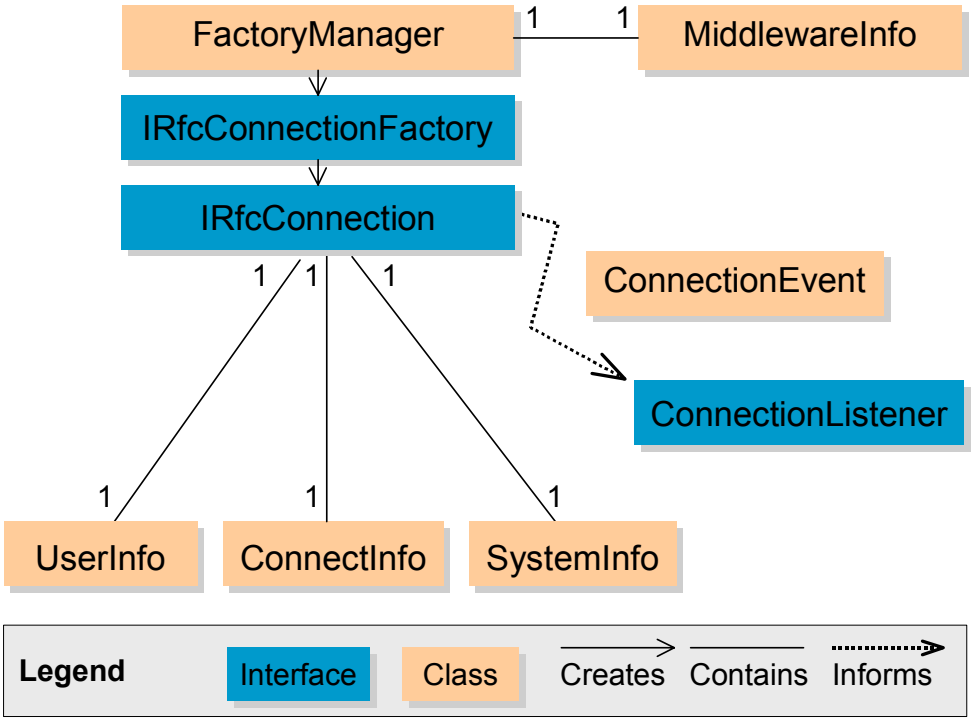
While you can handle a single connection with the SessionManager object [Page 43], if you wish to create and use multiple connections [Page 133], you need to create an IRfcConnection object for each connection.

Once you set up the appropriate IRfcConnection object(s) you can create and use IRfcModule objects and their parameters within the context of a particular connection.

To use IRfcModule and its parameters within a particular connection you specify the IRfcConnection object in methods that create objects that require a connection (for example, when creating the IRfcModule object).

Integration

The following diagram shows the classes and interfaces related to the IRfcConnection.



You create an IRfcConnection object with the IRfcConnectionFactory object.

You create an IRfcConnectionFactory object with the FactoryManager object [Page 128].

When creating an IRfcConnection object, you provide two objects as parameters:

- A UserInfo object, which contains the R/3 logon user information
- A ConnectInfo object, which contains the R/3 system information

UserInfo and ConnectInfo are the same objects as used by the SessionManager [Page 43] for managing a connection. They supply the user logon information and the parameters of the system to connect to.

To create an additional connection with different user or system parameters you simply use a different IRfcConnection object, and set its UserInfo and the ConnectInfo objects with different properties.

From an established RFC connection, you can obtain the R/3 system information by calling *getSystemInfo*. The method returns a SystemInfo object, which contains a list of name-value items that describe the R/3 system properties.

The ConnectionEvent and ConnectionListener classes are for subscribing to connection open, close, or abort events. The implementation class of the IRfcConnection interface fires *ConnectionEvents* whenever an action is made on the connection. The subscriber of these events should implement the ConnectionListener interface.

See Also

See the *Java RFC HTML Reference* documentation for the details of each of the classes and interfaces.

IRfcModule in the Context of a Connection

Use

An IRfcModule object is always created within the context of a connection.

IRfcModules you create using the procedures described earlier [Page 86] create the IRfcModule object within the single default connection.

If you use multiple connections [Page 133], you need to specify the connection as a parameter when creating the IRfcModule within a connection other than the default. This is true regardless of whether you create the IRfcModule manually or with an autoCreate.

When you call an RFC function with the IRfcModule object, the relevant connection must be open. The connection must also be open whenever you use an autoCreate method to create the IRfcModule object or any of its parameters.

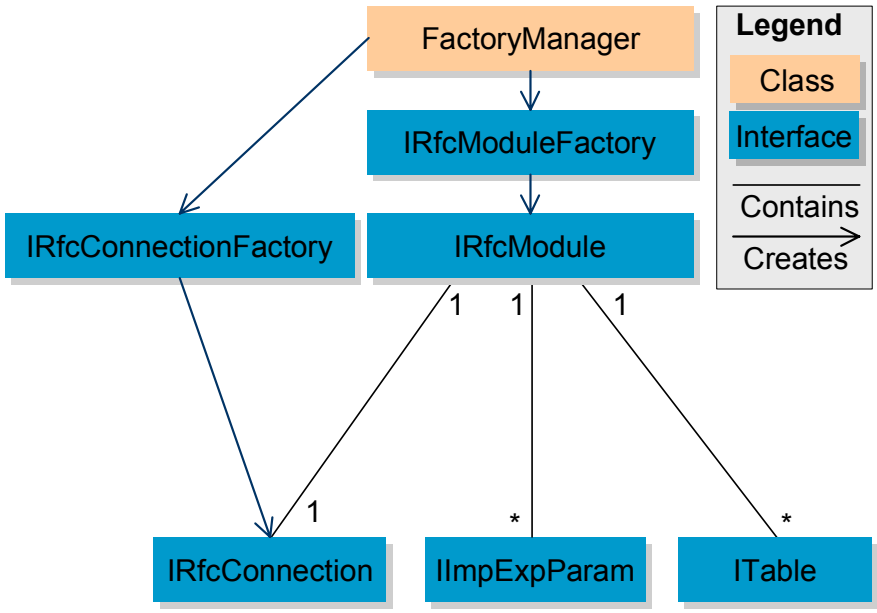
Integration

Regardless of whether it is used within a single or multiple connections, an IRfcModule object may contain one or more ITable, and one or more IImpExpParam objects.

When creating an IRfcModule for use with multiple connections, the IRfcModule object also references an IRfcConnection object.

The IRfcConnection object is created with the IRfcConnectionFactory.

The following diagram shows the relationship between IRfcModule and the other interfaces.



See Also

See the *Java RFC HTML Reference* documentation for the details of each of the classes and interfaces.

Handling Multiple Connections

Use

You can use multiple connections and call different RFC functions within the context of these different connections. The different connections can be to different R/3 systems or to the same system but using different user accounts, for example.

Procedure

To use multiple connections, you create one or more IRfcConnection object [Page 129](s), one for each additional connection you wish to use. You create an IRfcConnection object from the IRfcConnectionFactory object, which you obtain from FactoryManager [Page 128].

You then create and call the different IRfcModules within the context of the different connections.

1. Obtain the FactoryManager instance and set it up with MiddlewareInfo [Page 137].
2. Obtain an IRfcConnectionFactory with the *getIRfcConnectionFactory* method of the FactoryManager.
3. For every connection you wish to work with (represented by IRfcConnection):

   a. Set the UserInfo and ConnectInfo objects with the parameters of the connection you wish to establish.

   b. Use the IRfcConnectionFactory object to create an IRfcConnection object for this connection.

      When creating the IRfcConnection object, specify the UserInfo and ConnectInfo as parameters.

      You can create an empty connection by not specifying UserInfo and ConnectInfo as parameters, but then you will need to set these before opening the connection.

   c. Start the connection with the *open* method of the IRfcConnection object.

      (Note that you start a single connection with the *open* method of the SessionManager object.)

4. Create the IRfcModule object within the context of the relevant connection:

   a. You need to specify the connection as a parameter when creating the IRfcModule within a connection. This is true regardless of whether you create the IRfcModule manually or with an autoCreate.

   b. If you are automatically creating any of the structure or table parameters of the IRfcModule object, you must also specify the connection object as a parameter to the autoCreate method (this is because AutoCreate connects to R/3 to obtain the parameter metadata).

      Make sure you use the same connection as the one you have used for creating the IRfcModule object whose parameter you are creating.

Handling Multiple Connections

When you call the RFC function module, the IRfcModule uses the connection you have specified when creating the module.

Example

The following example uses two connections to call the RFC function GET_SYSTEM_NAME twice: once in each connection. Since it connects to two different systems, the value of the resulting SYSTEM_NAME export parameter is different after the two calls. The example uses a Properties file for both connections.

```
/**
 * Run the function in multiple connections.
 * This example connects to two different R/3 systems and calls
 * a function module on both.
 */
public void run()
{
    // Activate the Factory Manager instance
    FactoryManager factoryMgr  = FactoryManager.getSingleInstance();
    SessionInfo sessionInfo = getSessionInfo(PROPS_FILE);
    factoryMgr.setMiddlewareInfo(sessionInfo.getMiddlewareInfo());

    // Obtain the necessary factories
    IRfcModuleFactory moduleFac = factoryMgr.getRfcModuleFactory();
    IRfcConnectionFactory connectionFac = factoryMgr.getRfcConnectionFactory();

    // Run a function module using the first connection
    try
    {
        // PROPS_FILE1 is a String constant representing the properties file
        SessionInfo    sessionInfo1 = getSessionInfo(PROPS_FILE1);

        IRfcConnection connection1  =
            connectionFac.createRfcConnection(sessionInfo1.getConnectInfo(),
                                              sessionInfo1.getUserInfo());

        connection1.open();

        // Specify the connection when creating the module
        IRfcModule module1  =
            moduleFac.autoCreateRfcModule(connection1, "GET_SYSTEM_NAME");

        int    retCode1 = module1.callReceive();
        String sysName1 =
module1.getSimpleExportParam("SYSTEM_NAME").getString();

        System.out.println("System name = " + sysName1);

        connection1.close();
    }
    catch (Exception e)
    {
        e.printStackTrace();
    }
```

```
    // Run a function module using the second connection
    try
    {
        // PROPS_FILE2 is a String constant representing the properties file
        SessionInfo    sessionInfo2 = getSessionInfo(PROPS_FILE2);

        IRfcConnection connection2  =
            connectionFac.createRfcConnection(sessionInfo2.getConnectInfo(),
                                              sessionInfo2.getUserInfo());

        connection2.open();

        // Specify the connection when creating the module
        IRfcModule module2  =
            moduleFac.autoCreateRfcModule(connection2, "GET_SYSTEM_NAME");

        int    retCode2 = module2.callReceive();
        String sysName2 =
module2.getSimpleExportParam("SYSTEM_NAME").getString();

        System.out.println("System name = " + sysName2);

        connection2.close();
    }
    catch (Exception e)
    {
        e.printStackTrace();
    }
}

/**
 * Obtain a SessionInfo object initialized to the values
 * in a desired properties file.
 * @param  propertiesFile name of the desired properties file
 *
 */
private SessionInfo getSessionInfo(String propertiesFile)
{
    SessionInfo sessionInfo = new SessionInfo();

    try
    {
        Properties properties  = new Properties();

        properties.load(
            new java.io.BufferedInputStream(
                new java.io.FileInputStream(propertiesFile)));
        sessionInfo.setProperties(properties);
    }
    catch (java.io.IOException e)
    {
        // You could initialize the sessionInfo to some safe defaults.
```

```
            e.printStackTrace();
        }

        return sessionInfo;
    }
```

See Also

If you use a single connection, you can use the SessionManager object [Page 43] to handle the connection. See all the subtopics of Using the Client Interface to Make an RFC Call [Page 66].

Setting Up the Factory Manager

Use

If you use the FactoryManager object [Page 128] to create the various factory objects (instead of using the SessionManager), then you need to set it up with the appropriate middleware properties.

To use the Orbix middleware, for example, you must first initialize the Factory Manager object with this middleware type.

Procedure

Set the middleware type in your program:

1. Create a MiddlewareInfo object specifying the middleware type (for example Orbix) and the Java RFC server host.
2. Obtain the global FactoryManager object and set the MiddlewareInfo object to it.

If you wish to use a custom middleware type, or if you wish to specify the middleware type through the jrf.props properties file, then you need to specify middleware type to be *MiddlewareInfo.middlewareTypeCustom*. See the Java RFC Properties Files [Page 45] topic. Note that the FactoryManager does not use the *r3_connection.props* properties file.

Example

Sample code to set up the FactoryManager object with the provided CORBA/Orbix middleware:

```
MiddlewareInfo mdInfo = new MiddlewareInfo ();
mdInfo.setMiddlewareType (MiddlewareInfo.middlewareTypeOrbix);
mdInfo.setOrbServerName(rfcHost); //pass in the hostname where the
                                  //Java RFC server is running.
facMan = FactoryManager.getSingleInstance();
facMan.setMiddlewareInfo(mdInfo);
```

Multi-Threading in RFC Client Applications

The Java RFC client packages are thread safe in the following sense:

- The global FactoryManager object is synchronized, meaning that multiple threads can concurrently invoke FactoryManager methods.
- The SessionManager object is synchronized.
- The MiddlewareInfo, UserInfo, ConnectInfo and the IRfcConnection's implementation classes support multi-threaded subscriptions to their property change events.
- The IRfcConnection's implementation class support multi-threaded subscriptions to its connection events.
- No class in the Java RFC implementation package has static variables. This means that multi-threaded accesses to any of the classes through the exposed interfaces are safe.

Note that the Java RFC server is also thread safe.

It is the your responsibility, however, to create and handle threads in your application program, and to synchronize individual objects if there are potentially multiple threads accessing them concurrently.

For example, if your application contains an IRfcModule object, and there are multiple threads that can add or set parameter values and invoke RFC calls through it, then this object along with its parameter objects need to be synchronized by your application. Only one function call is allowed to occur in a specific connection at any given time.

Handling Exceptions and Errors

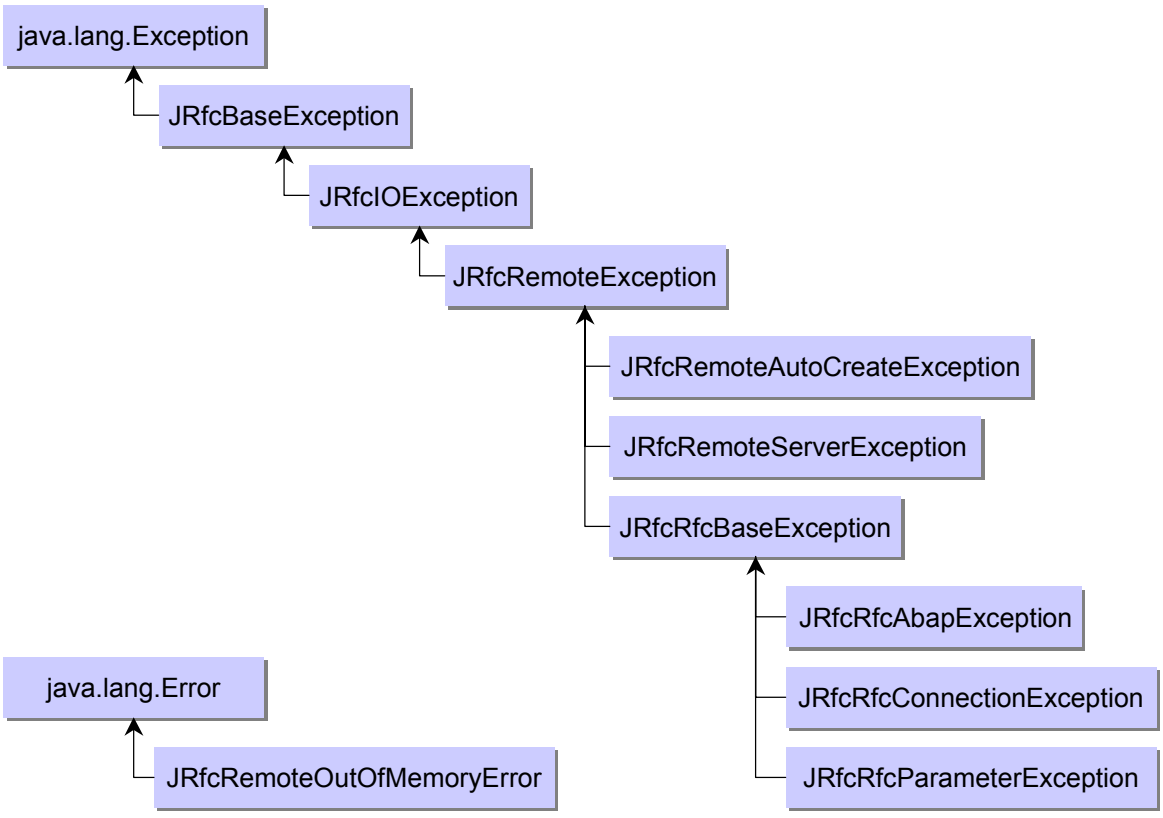
Only one error is defined for the Java RFC: JRfcRemoteOutOfMemoryError. It is thrown when the server process runs out of memory.

The Java RFC exceptions are divided into two main categories:

Exception Category	Derived from	Description
Exceptions (JRfcBaseException)	java.lang.Exception	The base for all exceptions that need to be caught and processed by the client.
Runtime exceptions (JRfcBaseRuntimeException)	java.lang.RuntimeException	Exceptions in this category do not need to be declared or handled to allow for compilation

JRFC Exceptions

The following diagram shows the inheritance relationships between exception classes:



The JRfcBaseException class is the base class for all Java RFC non-runtime exceptions. Only one type of exception is directly derived from the base: JRfcIOException, from which

Handling Exceptions and Errors

JRfcRemoteException is derived. The JRfcRemoteException is the root exception class for all exceptions that can be thrown during Orbix server operations.

Among JRfcRemoteException's children, JRfcRemoteAutoCreateException is thrown when an exception happens at the Orbix server side during an "auto-create" operation, either for creating a function module and its parameter objects, or for creating a structure or table object along with its metadata. The JRfcRemoteServerException is thrown when a general exception occurred at the Orbix server side. The JRfcRfcBaseException serves as the base for all RFC related exceptions.

Among JRfcRfcBaseException's children, the JRfcRfcAbapException is thrown when the ABAP function module throws an exception string, such as "RECORD_NOT_FOUND". The JRfcRfcConnectionException is thrown when an error occurs during an RFC communication. The JRfcRfcParameterException is thrown when the provided RFC parameters do not match the called RFC interface, such as missing a mandatory parameter.

JRFC Runtime Exceptions

The following diagram shows the inheritance relationships between runtime exception classes:

The JRfcBaseRuntimeException class is the base class for all Java RFC runtime exceptions. It is derived from the java.lang.RuntimeException class, meaning that the Java RFC runtime exceptions do not need to be declared or caught for the code to compile.

JRfcBaseRuntimeException stands for all exceptions that can be thrown from any object during the normal operation of the application or applet.

You determine at what granularity to handle exceptions: you may handle the more specific exceptions (using JRfcSimpleDataCastException for example), or you may decide to handle the general-purpose errors, using the base or the base runtime exceptions.

See the *Java RFC HTML Reference* documentation for each of the classes for details.

Example

Sample code for handling one specific exception, while handling all others with the base exception:

```
try
{
    int rc = module.callReceive();
}
catch (JRfcRfcConnectionException re) //catch specific RFC errors
{
    System.out.println("Unexpected communication error while calling
RFC:\n" +
                       re.toString());
    return;
}
catch (JRfcBaseException je) //catch all other non-runtime exceptions
{
//error handling
}
```

Sample code for handling several levels of JRFC exceptions:

```
try
   {
      //...
      int retCode = rfcModule.callReceive();
      //...
   }
   catch (JRfcRfcAbapException e)
   {
      e.printStackTrace();
   }
   catch (JRfcRemoteAutoCreateException e)
   {
      e.printStackTrace();
   }
   catch (JRfcRemoteServerException e)
   {
      e.printStackTrace();
   }
   catch (JRfcRfcConnectionException e)
   {
      e.printStackTrace();
   }
```

See Also

See the *Java RFC HTML Reference* documentation for the details of each of the exceptions.