iSeries™

IBM

Programming with VisualAge® RPG

Version 6.0 for Windows®

SC09-2449-07

iSeries™

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Version 6.0 for Windows®

SC09-2449-07

Note!
Before using this information and the product it supports, be sure to read the general information under “Notices” on page 455.

Eighth Edition (June 2005)

This edition applies to Version 6.0 of IBM WebSphere Development Studio Client for iSeries and to all subsequent releases and modifications until otherwise indicated in new editions.

This edition replaces SC09-2449-06 .

Changes or additions to the text and illustrations are indicated by a vertical line to the left of the change or addition.

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Contents

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About this Book

This book is a guide for using VisualAge® RPG to develop client/server applications. It describes the steps at every stage of the application development cycle, from design to packaging and distribution. Programming examples are included, to clarify the concepts and the process.

Who Should Use This Book

This book is written for programmers who will be using VisualAge RPG to develop client/server applications. It assumes that you are familiar with developing RPG applications on iSeries™ 400™ systems.

Prerequisite and Related Information

Use the iSeries Information Center as your starting point for looking up iSeries and AS/400e technical information. You can access the Information Center in two ways:

- From the following Web site:

  `http://www.ibm.com/eserver/iseries/infocenter`
- From CD-ROMs that ship with your OS/400 order:

  iSeries Information Center, SK3T-4091-00. This package also includes the PDF versions of iSeries manuals, *iSeries Information Center: Supplemental Manuals*, SK3T-4092-00, which replaces the Softcopy Library CD-ROM.

The iSeries Information Center contains advisors and important topics such as CL commands, system application programming interfaces (APIs), logical partitions, clustering, Java ™ , TCP/IP, Web serving, and secured networks. It also includes links to related IBM® Redbooks and Internet links to other IBM Web sites such as the Technical Studio and the IBM home page.

How to Use This Book

Note: For information on the product, see *Getting Started with WebSphere Development Studio Client for iSeries*, SC09-2625-06.

The *Programming with VisualAge RPG* book consists of the following parts:

A First Look at Client/Server Applications
This part describes the steps involved in creating a client/server application with VisualAge RPG. It walks you through the design and development of a sample application, and discusses design issues.

Working with Parts
This part contains tips about creating a graphical user interface with VisualAge RPG parts and writing program logic to drive those parts. It does not describe how to use every operation code, nor does it describe the details of every attribute or event. For such information, see the *VisualAge RPG Language Reference*and *VisualAge RPG Parts Reference*.

Working with iSeries 400 Data
This part discusses how to set up your application to access data on an

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iSeries 400 server, and how to reuse existing server applications by converting them to VisualAge RPG applications that run on a programmable workstation (PWS).

Advanced Topics
This part highlights the many features you can add to your VisualAge RPG application. It covers topics such as printing from your application, editing output, using the debugger, using picture and sound files, creating online help, adding messages, and running your application on a DBCS system. It also describes the many different ways VisualAge RPG applications can share data and communicate.

Distributing Your Application
This part discusses how to package the VisualAge RPG runtime code and your application. It also describes how to install the runtime code and the application on a user's PWS.

The VisualAge RPG Library

The VisualAge RPG library contains the following publications:

Programming with VisualAge RPG

This book contains specific information about creating applications with VisualAge RPG. It describes the steps you have to follow at every stage of the application development cycle, from design to packaging and distribution. Programming examples are included to clarify the concepts and the process of developing VisualAge RPG applications.

VisualAge RPG Parts Reference

This book provides information on the VisualAge RPG **parts**, **part attributes**, **part events**, and **event attributes**. It is a reference for anyone who is developing applications using VisualAge RPG.

VisualAge RPG Language Reference

This book provides information about the RPG IV language as implemented using the VisualAge RPG compiler. It contains:
- Language fundamentals such as the character set, symbolic names and reserved words, compiler directives, and indicators
- Data types and data formats
- Error and exception handling
- Specifications
- Built-in functions, expressions, and operation codes.

For an overview of the entire product, see *Getting Started with WebSphere Development Studio Client for iSeries*.

For a list of **related publications**, see the Bibliography at the end of this book.

You can also find the most current information about IBM WebSphere Development Studio Client for iSeries on the following online source:

The Development Studio Client Home Page
`ibm.com/software/ad/wdsc/`

How to Send Your Comments

Your feedback is important in helping us to provide the highest quality information possible. IBM welcomes any comments about this book or any other iSeries documentation.

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  1-845-491-7727

Be sure to include the following:

- The name of the book
- The publication number of the book
- The page number or topic to which your comment applies.

Accessing Online Information

VisualAge RPG contains a variety of online books and online help. You can access the help while you are using the product, and can view the books either while you are using the product, or independently.

Using Online Books

To view an online book, either:

- Select the name of the book from the **Help** pull-down menu of the VisualAge RPG GUI Designer or the editor window.
- Access the books from the **Start** menu. Select **Programs → IBM WebSphere Development Studio Client for iSeries**. Then select **Documentation**.

Publications in PDF Format

VisualAge RPG publications are available in Portable Document Format (PDF) from the iSeries Information Center at URL `http://www.ibm.com/eserver/iseries/infocenter` .

Note: You need the Adobe Acrobat Reader, Version 3.01 or later for Windows, to view the PDF format of our publications on the workstation. If your location does not have the reader, you can download a copy from the Adobe Systems Web site (http://www.adobe.com).

The following VisualAge RPG publications are available in PDF format:

- *Programming with VisualAge RPG*
- *VisualAge RPG Parts Reference*
- *VisualAge RPG Language Reference*

For information on the product, see *Getting Started with WebSphere Development Studio Client for iSeries*, SC09-2625-06.

Using Online Help

Online help is available for all areas of VisualAge RPG. To get help for a particular window, dialog box, or properties notebook, select the **Help** push button (when available).

Note: To view help that is in HTML format, your workstation must have a frames-capable Web browser, such as Netscape Navigator 4.04 or higher, or Microsoft® Internet Explorer 4.01 or higher. (Recommended browser is Netscape Navigator 4.6 or Internet Explorer 5.0)

Using context-sensitive help

To receive context-sensitive help at any time, press F1. The help that appears is specific to the area of the interface that has input focus. Input focus can be on menu items, windows, dialog boxes, and properties notebooks, or on specific parts of these.

For context-sensitive help on dialog boxes, click on the question mark (when available) in the top right-hand corner of the window. A question mark will appear beside the mouse arrow. Click on a word or field and help information on that specific field will be displayed.

Using language-sensitive help

To receive language sensitive help, press F1 in an edit window. If the cursor is on an operation code, you receive help for that operation code; otherwise, you receive help for the current specification.

What's New in This Release

Changes in WebSphere Development Studio Client for iSeries Version 6.0 include:

- **VARPG Run-time Library Version Check:** When installing or launching a VARPG application, the application will check the version of the VARPG run-time library installed is sufficient.
- **Application Packaging Utility:**
  - Added a choice to disable repeated messages. (eg. ″file exist...″)
  - If a specified directory already exists, allow override.
- **Project Description Text:** Enable project description text to be set when the project is saved for the first time. This description is then displayed in the Open Component dialog.
- **Backup & Restore Utilities:** Support adding & displaying a short project description.
- **Open File dialog:** Allow selection of multiple files, and selection of a folder name.
- **(For Citrix users) New ″Use Separate Folder″ option:** Added to the User Preference dialog.

  The ″Use Separate Folder″ check box is added for Citrix server users only. If checked, the security file that stores the user ID and password (file FVDCSEC.TXT) is stored in a different directory for each user. For example, for user username, the file is stored in c:\Documents and Settings\username\Application Data\IBM\VARPG. At run time, if you want to use a different security file for each user, create a file called fvdvarpg.ini in x:\vrpgrt\system (x:\vrpgrt is where the VARPG runtime is installed) that contains only this line:

  ```
  USE_SEPARATE_FOLDER=TRUE
  ```

  If Use Separate Folder is unchecked(default), all users will share the same security file.

Part changes:

- **Container:** Allow setting of READONLY for the entire container. If the record number is set to 0, READONLY applies to the whole container.
- **Line Graph:** Allow clicking a point on a line graph to set group & point values. Previously, this operation was allowed on Bar or Pie graphs only. When clicked on, the group & point value is set and the point is highlighted with a circle.

This publication includes updates from the Readme files of previous releases and other technical corrections.

Changes are noted by a vertical bar (|).

Changes in WebSphere Development Studio Client for iSeries Version 5.1.2

- **Java Version:** JDK 1.4.2 is supported.
- **Component Package Utility:** The utility now remembers the library settings in the build options dialog box.
- **ODBC Support:** Corrected a problem which caused an ″invalid cursor state″ error.

Part changes:

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- ***component:**
  - Attributes **SelFolder**, **DlgPrompt**, and **FolderName** can be used to select a folder.
  - Attribute **FocusPart** returns the name of the part that has the focus.
- **Subfile**: Attribute **ByteComp** can be set when sorting a subfile column. When this value is set to 1, the sorting algorithm does a byte-by-byte comparison of the two strings (the default is still to do a language sensitive comparison).
- **Media:** This part now works on Windows XP.

Changes in WebSphere Development Studio Client for iSeries Version 5.1

- **Print Settings:** The printer file Open function now uses the printer settings from a previously shown Printer Selection dialog in the application.
  - A new file spec keyword called **DEVMODE** is added for printer files. You can use it to specify a Windows operating system GDI DEVMODE data structure to directly set printer settings for the printer file open.
  - A new attribute called **PRTDEVMODE** is added to the ***component**T part. You can use it to pass the the address of a DEVMODE data structure to the *COMPONENT **SELPRINTER** attribute's Printer Selection dialog, to prime the print settings shown initially on the dialog.
- **DSPLY opcode:** For the free-form syntax version of the DSPLY operation, *DFT can be coded as a placeholder for a blank second operand. For example, DSPLY message *DFT reply.
  - The response operand is no longer required on the DSPLY operation, but is optional.
  - The Factor 2 operand, which is the message-window-definition-name, is now optional as well.
- **Subfile part:** Can now make the left columns remain static when scrolling horizontally. Use the **FreezeCol** attribute to control the number of columns kept static.

  Can now also set the font for individual records in a subfile.
- **Container part:** A new Presentation Manager (PM) compatible style allows you to quickly add records to a container part. You also no longer experience any problems when you add a large number of items to the container part.
- **ActiveX events:** You can now access and change the parameters of an ActiveX event when it occurs. You can also use a pointer type parameter when you call an ActiveX method.
- **Canvas part:** JPEG format support is added. Also, you can now use a **VKeyPress** event. The event occurs when you press a virtual key on your screen, and when one of the parts in the canvas has focus.
- **GUI Designer:** When you open a project, you can now press a character key to scroll to the project whose name begins with that key.

Changes in WebSphere Development Studio Client for iSeries Version 5.0

- **Launching from the IDE:** You can launch the VARPG GUI Designer from the workbench.
- Language enhancements made in ILE RPG V5R2 and V5R1 are now available.
- **Qualified GUI attribute access**: A new syntax is supported for accessing GUI part attributes in expressions or free-form calculations, as an alternative to the %GETATR and %SETATR built-in functions.
- **Free-form action subroutines:** When you define a new event, the corresponding action subroutine is added to the program source code in a free-form style. This happens when the location where the subroutine is added falls within a

free-form section. In essence, this applies when an /END-FREE directive follows the end of the calculation specifications, but before any output, procedure, or compile-time data specifications.

- **Client conversion support for iSeries database fields with CCSID 65535:** Until now, VARPG programs have not been able to work with iSeries database fields specified with CCSID 65535, which designates that no conversion be done when accessing the field data. The client workstation operating in ANSI could not understand the received EBCDIC data.

  A new File specification keyword CVTHEX has been added for externally-described remote disk files. When specified, any character fields with a CCSID of 65535 in the file will be converted to the workstation CCSID for use in the application. (The client-side conversion process uses the server sign-on job CCSID in place of the field's 65535 CCSID to perform the conversion.) Note that CVTHEX is not supported when compiling to Java.
- **PRTFMT(*SYS) for Windows device context printing:** A new File specification keyword PRTFMT(*SYS) has been added for printer files when you compile to Windows. This new keyword enables the files to perform output using a device context and perform graphics device interface calls to the operating system, instead of the usual raw text output. After opening the file, the device context handle is copied to positions 81 to 84 of the printer file INFDS, so that the application can reference it when making its own Windows GDI calls. Note that PRTFMT does not apply when compiling to Java.
- **ActiveX:** The main application and its components can now access the same type of ActiveX part.
- JPEG support is added to the Graphic push button.
- **Subfile part:** You can set a subfile row as bold, italic, strikeout, or underscore. However, you must set the Index attribute first, and set the FontArea to 3. For example, if you wanted to set a row to be italic, you would need to set the Index to 4, the FontArea to 3, an the FontItalic to 1. You can also use GETATR for these features, in a specific row (indicated by the Index attribute). The run time environment is changed so that defined messages are now shown as is. Previous behavior deleted empty rows, and ignored the CR/NewLine control character at the end of each row.
- **Subfile part:** The runtime can now perform validation for the Character type subfile field.
- **List Box part:** The **TOPITEM** attribute is added to the List box part.
- Corrected a problem which produced an unrecoverable error when using the Open File dialog.

Part 1. A First Look at Client/Server Applications

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Chapter 1. Creating a Client/Server Application

This section describes how to create a client/server application using VisualAge® RPG. A sample application is used to describe the following stages of the development process:

1. Designing what the user will see and do with the application.
2. Creating the graphical user interface (GUI).
3. Setting attributes for the GUI parts.
4. Writing the program logic to drive the GUI.
5. Writing messages and online help for the application.

About the Sample Application

The sample application, called the Video Store Catalog, was created with VisualAge RPG, and is in the VisualAge RPG Samples folder. It provides an online catalog that customers can use to buy videos, and has a preview component that customers can use to view video clips before they place their order.

The information about the videos is stored in a database on the iSeries 400 server. Customers using the Video Store Catalog are actually viewing data stored on the iSeries server. The information that customers provide, such as their name and phone number, is also stored on the host.

Note: Another sample application, Video Store Cashier, can access the same database on the host. It uses the information from the customers' orders to update the inventory of the video store and to bill customers. The Video Store Cashier is not discussed in this section. For information about building and running it, see the comments in the CASHIER.VPG file in the Video Store Cashier project folder.

Building the Sample Application

The Video Store Catalog application requires the files defined in the F specification to be on an iSeries server. The *WDSC\samples\vidcust* subdirectory has the save file *VIDEOSTORE.sav* of the library with the required files.

To upload the necessary files and build the application and its associated preview component, follow these steps:

1. Ensure that both VisualAge RPG and the VisualAge RPG Samples are installed.
2. Upload and restore the VIDEOSTORE.sav file on your iSeries server as follows:
   a. On your iSeries server, create a save file named VIDEOSTORE in any library, for example, USER.
   b. On your workstation, change your current directory to *vidcust* and issue the ftp command as follows:

      ```
      x:\...\WDSC\samples\vidcust>ftp HOSTNAME
      ```

      c: is the drive where you installed the product and **HOSTNAME** is the name of the iSeries server where you created the save file. (You can use your server's TCP/IP address, instead.)
   c. Enter your user ID when prompted for it.
   d. Enter your password when prompted for it.
   e. After you are signed on, make the USER library your current library. Enter:

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```
ftp>cd user
```

f. Specify the file transfer as binary. Enter:

```
ftp>binary
```

The *200 Representation type is binary IMAGE* message appears.

g. Transfer the save file. Enter:

```
ftp>put VIDEOSTORE.sav
```

The *File transfer completed successfully.* message indicates that the VIDEOSTORE.sav was uploaded.

h. Enter: `ftp>quit`

The VIDEOSTORE save file should now be in library USER on your iSeries server.

i. Use RSTLIB to restore the library and retain the same name - VIDEOSTORE - on your iSeries server. Otherwise, change the *REMOTE_FILE_NAME* parameter in the Catalog.rst file to the name you restored the save file to.

j. In the Catalog.rst file, change the *REMOTE_LOCATION_NAME* parameter to point to the Remote location name of your iSeries server.

3. Build the Video Store Catalog sample application. Select **Build>Windows** or **Build>Java** from the pop-up menu of the Video Store Catalog project folder in the VisualAge RPG Sample Applications folder. When the project builds successfully, an executable program, CATALOG.EXE for Windows, or CATLAOG.CLASS for Java is created in the Video Store Catalog project folder.
4. Build the associated Preview component. Select **Build>Windows** or **Build>Java** from the pop-up menu of the Preview project folder. When the project builds successfully, a dynamic link library (COMMON.DLL) for Windows, or a COMMON.CLASS file for Java is created.

Use one of the following methods to run the Video Store Catalog application:

- Select **Run>Windows** or **Run>Java** from the pop-up menu of the Video Store Catalog project folder.
- Open the Video Store Catalog project folder and double-click on the CATALOG.EXE icon.
- Type `catalog` on a command line.

Notes:

1. The multimedia aspects of this application require additional hardware and software. To run the audio in the preview, you must have a sound card on your system. To run the video clip in the preview, you must have Media Player installed. Java applications require the Java Media Framework (JMF) API.
2. The video clips are .AVI files (for Windows) or .MOV files (for Java) that are stored in the Preview folder.
3. To build and run Java applications, you must have Sun's Java 2 Software Development Kit (J2SDK) Version 1.2, or higher, installed on your workstation. If you do not have the J2SDK, you can download it from Sun Microsystems at the following URL:

   `http://java.sun.com/products/`

   After installing the J2SDK, set the PATH environment variable to point to the location of both the Java compiler and the Java Runtime Environment (JRE). For example, if your home directory for the J2SDK is *c:\jdk1.2*, add the following path statement: `c:\jdk1.2\bin`

Deciding What to Show the User

A key step in creating your application is to decide what you want users to do with your application, and then to determine what you need to provide so that they can do it.

During the planning stages of the Video Store application, we decided that customers should be able to list the videos in a particular category (such as Action/Adventure or Comedy). They should also be able to list the videos that are made by their favorite director, feature their favorite actor, or are among the top-10 sellers in the store. To help them decide whether they want to buy a particular video, they should be able to preview it. After they find the video they want to buy, they can place their order and then pay for their purchase at the cashier counter.

Now that we have itemized what the customers should be able to do with the application, we can design what they will see when they display the video catalog. This is the time to start designing the content, number, and order of windows in the application.

Welcome to the Video Store Catalog

The main window, or entry point to the application, is the Video Catalog — Welcome window. It sets the stage for what customers can do with the catalog. To use the catalog, the customers must press a graphic push button to select from the following choices:

```
Browse by Category...

New releases...

Top 10 Best Sellers...

Search for Specific Titles...

Help Catalog
```

Selecting **Help Catalog** displays the *Get Help on using theCatalog* window. If they press one of the other push buttons, another window is displayed from which they can perform other actions, such as view lists, preview clips, or submit a purchase order.

Browsing by Category

Selecting **Browe by Category** displays the Video Catalog — Categories window. This window presents a list of video categories to choose from:

```
Action/Adventure        Horror
Children                Western
Science Fiction         Romance
Comedy                  Classics
```

To select a category, the customer presses its associated push button. This displays the Video Titles window, which lists the items for that category. Customers can preview some of the titles, add a title to their order, delete it from their order if they change their mind, and submit their order to the cashier.

Searching for Specific Titles

The Video Catalog — Search window lets customers search for a video by category, title, director, or actor. After they specify the search criteria and press the **Search** push button to initiate a search of the database, the results are displayed in the Video Titles window.

Previewing Titles

Customers can preview a video that is on a list by reading a review of it or, if they have the appropriate hardware and software, by viewing a clip of it with associated audio.

Modifying and Submitting Orders

The Video Catalog — Review/Order My Selections window lets customers modify their order. They can delete videos from the list, change the number of copies they want to buy, and change the type of medium they want the video to be on (tape or laser disk). This window is displayed when customers select a video from a list in a Video Titles window and then press the **Review/submit order** push button.

When all the information for their order is entered, customers submit their order from this window.

Submitting Orders

When customers submit their orders, they must provide their name, address, and phone number on the Video Catalog — Order Reference window. This information is stored in a database on the iSeries 400 server.

High-Level Window Design

Discussing how to create every one of the windows in the Video Store Catalog is beyond the scope of this section. The following sections describe how you could use the GUI Designer to create two windows resembling the Comedy and the Preview windows, modify some of their part attributes, and write some of the associated program logic. You find these windows by taking the following path through the Video Store Catalog application:

Video Catalog — Welcome 	Pressing the **Browse by Category** push button on the Video Catalog — Welcome window displays the Video Catalog — Categories window.
Video Catalog — Categories 	Pressing the **Comedy** push button on the Video Catalog — Categories window displays the Video Catalog — Comedy window.
Video Catalog — Comedy 	Pressing the **Preview** button after selecting a title on the Video Catalog — Comedy window displays a Preview window.

Video Catalog — Preview	The preview runs in this window.

If you want to see the design for the sample application, select **Edit** from the pop-up menu of the Video Store Catalog project folder in the VisualAge RPG Sample Applications folder. This displays the application's project window and the parts palette. The project window shows all the windows defined for the application. Double-click on an entry to see its design window with the associated parts. To view the project's VARPG source code, select **Project>Edit source code** from the project window.

Creating the Comedy Window

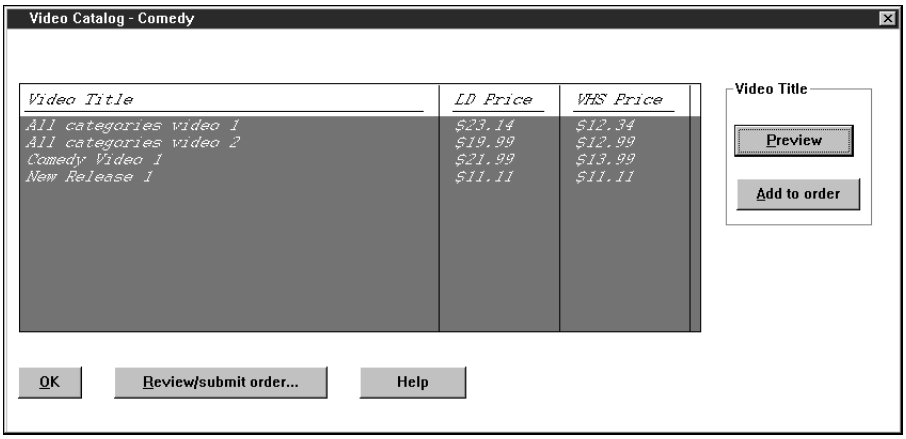

Figure 1. The Comedy window

The Comedy window displays the list of comedy videos that customers can purchase. This section describes how you can create a window similar to this one.

Creating the GUI

Select a window with canvas part from the parts palette with the right mouse button, move the pointer icon onto the project view of the GUI Designer, and right-click again. This becomes the design window, on which you put the following parts from the palette: group box, push button, static text, and subfile.

Aligning the parts

You can use the alignment tools in the GUI Designer to size, align, and space the parts so that they resemble those shown in Figure 1. For information on using these tools, see the online help or HTML tutorial.

Setting Attributes

After a part is placed and positioned on the window, you can modify the default settings for the part attributes using its properties notebook. To do this, right-click on the part and select **Properties** from the part's pop-up menu.

Some of the part attributes you can modify are described below.

Window attributes

You can select the items you want to appear on the window (such as system menu, title bar, and minimize and maximize buttons), and configure the border of the window. By default, the window uses the system font and has a white background. You can change the font and color.

Canvas attributes

By default, the canvas part uses the system font, and is the same color as the folder background. You can change the font and background color of the canvas part. You can also place a graphic on the canvas part.

Subfile attributes

By default, the subfile part is created with no columns. If you know the database field names, you can create subfile entry fields using the GUI Designer. Otherwise, you can reference the existing fields in the database by following these steps:

1. Select **Define reference fields** from the **Server** menu. The Define Reference Fields window appears.
2. Specify the iSeries 400 server and library information to view the database field information.
3. Select the appropriate fields from the **Fields** list box with the right mouse button, move the pointer icon onto the subfile part in the design window, and right-click again.

   The new subfile entry field inherits the attributes from the original field: **Length** is set to the column width, and **Type** is set to the data type.

Set the style and data type for a subfile entry field using the appropriate properties notebook. For example, you can set the length, or the type of data.

Push button attributes

Label each of the push buttons to indicate its purpose to the user. To create a mnemonic for each push button, put the mnemonic identifier before a character in the label. For Windows, use an ampersand (&). Note that we put an ellipsis (...) in the label of the **Review/submit order** push button so that users know that they will have to provide more information after they press the button to place their order.

For each push button, specify what action will happen when the user presses it. For example, for the **Preview** push button, an action subroutine will be performed; for the **Help** push button, help for the window will be displayed. You can set this information on the Action tab of the push button's properties notebook. (See "Creating the Online Help" on page 15 for related information.)

Adding Program Logic

Program logic is required to drive certain GUI functions. This section describes some of the Video Store Catalog's program logic. (The source file, CATALOG.VPG, is in the Video Store Catalog folder.)

Note: You can type the program logic for a particular event by invoking an edit session from the GUI Designer. For example, to add program logic to the **Press** event for a particular push button, select **Events>Press** from the push button's pop-up menu.

Displaying the Comedy window

To have the Comedy window appear when the user presses the **Comedy** push button on the Video Titles — Categories window, do the following:

1. Write an action subroutine to handle the **Press** event for the **Comedy** push button.

   We wrote the COMEDYGPB action subroutine (shown in Figure 2) to handle this event. When the user presses the push button, the COMEDYGPB subroutine calls the **brComedy** user subroutine. This subroutine reads the database and calls another user subroutine, **dspbrowse**, to check if the database is empty. If it is, a message is displayed. If it is not empty, control returns to the brComedy user subroutine, the title of the window is changed, and the results of the database search are displayed.

```
**********************************************************************
**                                                                  **
**  Categories window action-link subroutines                       **
**                                                                  **
**                                                                  **
**********************************************************************
*
* This routine is executed when the Comedy graphic push button in the
* Categories window is pressed.
*
C     COMEDYGPB     BEGACT    PRESS         CATW
C                   z-add     0             srchdir
C                   z-add     0             srchact
C                   exsr      brComedy
C                   ENDACT
```

Figure 2. Handling the PRESS event

2. Write program logic to read the Comedy video titles from the database and populate the subfile part with the list of titles. Call the dspbrowse subroutine to check whether the database is empty. If the database is not empty, set the title for the browse window to display the found comedy titles. Otherwise, display message number MSG0001 to inform the user that no match was found in the database. See Figure 3 on page 10.

```
     ****************************************************************
     *                                                              *
     * User Subroutine: brComedy                                    *
     * Description    : Show browse window with comedy videos       *
     *                                                              *
     ****************************************************************

    C     brComedy      BEGSR
    C                   clear                   browsesf
     * Get records from vil0004, the logical file on the AS/400
     * for comedy type videos.
    C     *start        setll     vil0004
    C                   read      vil0004                           61
    C     *IN61         doweq     '0'
    C                   exsr      ckcriteria
    C                   read      vil0004                           61
    C                   end
    C                   exsr      dspbrowse
     * The next three lines set the browse window's title bar text.
    C                   movel     *blanks       vdocatstl
    C                   movel     stlcmdy       vdocatstl
    C                   eval      %setatr('browsew':'browsew':'Label') =
    C                               vdocatttl
    C                   ENDSR
```

⋮

```
     ****************************************************************
     *                                                              *
     * User Subroutine: dspbrowse                                   *
     * Description    : Check if the browse subfile is empty.  If so,    *
     *           display message MSG0001 saying match not found.    *
     *                                                              *
     ****************************************************************

    C     dspbrowse     BEGSR
    C                   eval      items=%getatr('BROWSEW':'BROWSESF':'Count')
    C     items         ifeq      0
    C     *MSG0001      dsply                   msgrsp            9 0
    C                   else
    C                   eval      %setatr('BROWSEW': 'BROWSEW': 'VISIBLE')=1
    C                   eval      %setatr('BROWSEW': 'BROWSEW': 'FOCUS')=1
    C                   endif
    C                   ENDSR
```

Figure 3. Reading the iSeries Database and showing the results window

Displaying the Preview Window

We wrote an action subroutine (see Figure 4 on page 11) to handle the PRESS event for the **Preview** push button on the Comedy window. When the user presses the button, the PREVIEWPB action subroutine is called to start the common component that displays the Preview window.

```
*********************************************************************
* When the preview button in the browse window is pressed, the common
* component is started.  The common component displays the preview
* window of a video.
*
*
C     PREVIEWPB     BEGACT    PRESS         BROWSEW
C                   READS     BROWSESF                              55
C     *IN55         ifeq      '0'
C                   start     'common'
C                   parm                    brsfpart
C                   endif
C                   ENDACT
```

Figure 4. Action subroutine for displaying the Preview window

Creating the Preview Window

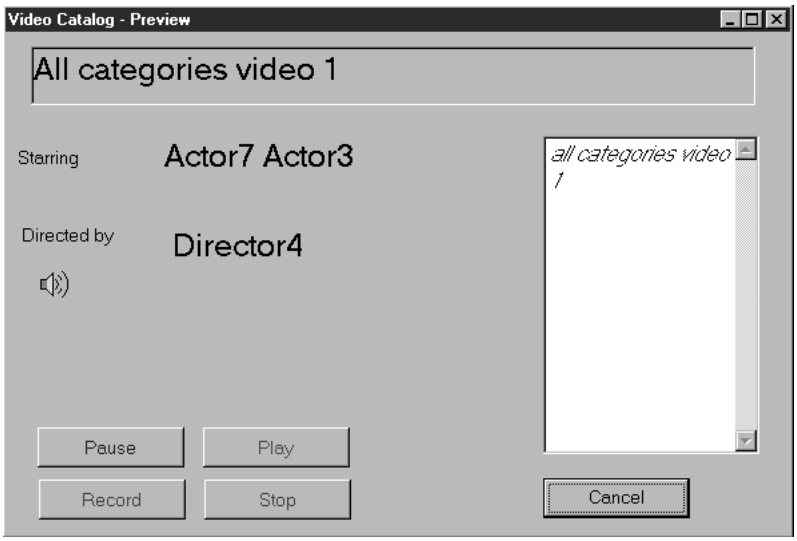

Figure 5. The Preview Window

The Preview window uses the multimedia capabilities of the operating system to give customers a glimpse of a video clip. This section describes how you can create a window that resembles the above.

Note: To run the audio in the preview, you must have a sound card on your system. To run the video clip, you must have a Media Player installed. Java applications require the Java Media Framework (JMF) API.

Creating the GUI

Point-and-click the following parts onto a window with canvas part to create a window that resembles the Preview window:

- Media part
- Multiline edit part
- Push button parts
- Static text parts

Setting Attributes at Design Time

After the parts are placed and positioned in the window, you can set the part attributes using their respective properties notebook. Some of the attributes you can set are described below.

Media part attributes

Push button parts are used to control the playback of the video clip: **Play**, **Pause**, **Record**, and **Stop**. The **AudioMode** attribute sets the operating mode of the media part.

Static text attributes

You can change the font attribute of a static text part to make it stand out from the other text on the display. Resize the static text part so that it is large enough to hold the longest text. (It is a good idea to leave a bit of extra room, if your application is to be translated in the future.)

Multiline edit part

In the code, we set the multiline edit (MLE) part called ABSTMLE to accept text. In the part's properties notebook, we indicated that the part is read-only.

Setting Attributes at Run Time

To change the title of the displayed window at run time, we used the SETATR operation code to set the **Label** attribute (see Figure 6 on page 13).

See also "Getting and Setting Part Attributes" on page 25.

Adding Program Logic

You have to provide some program logic to drive certain GUI functions on the Preview window. This section describes some of the program logic (see Figure 6 on page 13) for the Preview component.

Specifying the video to preview

The video selected in the Comedy window determines which video preview is played. The **previeww** action subroutine reads which video is to be used, and then determines the file name of the actual video file.

Controlling the video

You can write code to control video by using the media part. In our sample, the media part is used to play a digital video file associated with the video selected.

Push buttons with the associated AudioMode attribute control the playback of the video file:

1 Pause

2 Play

3 Record

4 Stop

The code for the Preview component follows:

```
 ****************************************************************
 *
Fvideo     if   e           k disk    remote BLOCK(*YES)
 *
DFlg             s              1    inz(*OFF)
DFldx            s             12
 *
 ****************************************************************
 *
C     *entry        PLIST
C                   parm                    partno            5 0
 *
 ****************************************************************
 * Action link subroutines for PREVIEWW                         *
 ****************************************************************
 *
C     PREVIEWW      BEGACT    CREATE        PREVIEWW
C     partno        setll     video                                50
C  N50*msg0001      DSPLY                   msgrsp            9 0
C                   read      video                                51
C     *IN51         IFEQ      '0'
C     'TITLEST'     SETATR    vititle       'label'
C     'DIRST'       SETATR    vidirect      'label'
 *
C     viactr1       CAT       viactr2:1     actors           41
C     'ACTST'       SETATR    actors        'label'
 *
C     'ABSTMLE'     SETATR    vireview      'text'
 *
 *  If its for Java, use .mov file
 /If defined(COMPILE_JAVA)
 *
C     vibitmap      CAT       '.mov':0      videofil         13
 *  If its not for Java, then use .avi file
 /else
C     vibitmap      CAT       '.avi':0      videofil         13
 /EndIf
C                   endif
 *signify videofil is not yet loaded to Audio part
C                   move      'N'           loaded
 *
C                   ENDACT
 *                                                              *
```

Figure 6. The Preview Component (Part 1 of 3)

```
 ***************************************************************************
 *
C     PBPLAY        BEGACT    PRESS         PREVIEWW
 *
C                   if        loaded='N'
C                   eval      %setatr('previeww':'audo':'FileName')
C                              =videofil
C                   move      'Y'           loaded            1
C                   endif
 *
C                   eval      %setatr('previeww':'audo':'audioMode')=2
 *
C                   ENDACT
 *                                                                         *
 ***************************************************************************
 *
C     PBPAUSE       BEGACT    PRESS         PREVIEWW
 *
C                   eval      %setatr('previeww':'audo':'audioMode')=1
C                   ENDACT
 *                                                                         *
 ***************************************************************************
 *
C     PBRECORD      BEGACT    PRESS         PREVIEWW
 *
C                   eval      %setatr('previeww':'audo':'audioMode')=3
C                   ENDACT

 *                                                                         *
 ***************************************************************************
 *
C     PBSTOP        BEGACT    PRESS         PREVIEWW
 *
C                   eval      %setatr('previeww':'audo':'audioMode')=4
C                   ENDACT
 *                                                                         *
```

Figure 6. The Preview Component (Part 2 of 3)

```
 ***************************************************************************
 *
C     CANCELPB      BEGACT    PRESS         PREVIEWW
 *
C                   move      *on           Flg
C                   STOP
C                   ENDACT
 *                                                                         *
 ***************************************************************************
 *
C     PREVIEWW      BEGACT    CLOSE         PREVIEWW
 *
C                   if        Flg=*ON
C                   eval      Fldx='*DEFAULT'
C                   else
C                   eval      Fldx='*NODEFAULT'
C                   endif
C                   ENDACT    Fldx
 *
```

Figure 6. The Preview Component (Part 3 of 3)

Creating Messages

To add messages, select **Project>Define messages** from the GUI Designer. The Define Messages window appears. Select **Create**, and then select the type of message you want to create (for example, information or warning). Type the actual text for the message, and any additional information or second-level help, in the spaces provided.

VisualAge RPG automatically generates a message ID for the message you create. Reference that message ID in your code. For example, in Figure 3 on page 10, MSG0001 is used by the DSPLY operation code.

Creating the Online Help

We added different types of help to the Video Store Catalog application. The following sections describe how you can replicate some of this help.

Context-sensitive help

Add context-sensitive help to the **Browse by Category** graphic push button part by selecting **Help text** from the part's pop-up menu. This starts an edit session that already contains information similar to that shown in Figure 7.

```
:h1 res=01.PSB0000C
:p.Help
```

Figure 7. Edit session for adding online help

The `:h1 res=01.` is a heading tag containing a resource identifier. The resource identifier is automatically generated — do **not** edit this text. The heading appears directly after this tag; it is used on the help panel and listed in the help index at run time. By default, the name of the part for which you are adding text is used as the heading. You should replace that with a heading that identifies the purpose of the help panel and is more meaningful to users. Type the actual help text after the `:p.` tag. By default, the word **Help** appears in the edit session.

An example of help text from the Video Store Catalog application is shown in Figure 8. The help panel that is generated from that source and displayed at run time is shown in Figure 9 on page 16.

```
:h1 res=12.Browse by Category
:p.Select this to browse videos by categories.
```

Figure 8. Help for the Browse by Category graphic push button

Figure 9. Example of context-sensitive online help panel

Creating Help push buttons

To create the help graphic push button at the bottom of the Preview window or the Comedy window, select a graphic push button from the parts palette with the right mouse button, move the pointer icon onto the design window, and right-click again. In the properties notebook, specify the image to be displayed on the graphic push button, and specify that you want to display help when the **Press** event occurs.

Figure 10 shows the source for the push button that provides help for the Welcome window. The `:link.` tag is used to link related pieces of help information so that users can find the appropriate information quickly and easily. You place this tag around text that is related to the help text in another panel. The text between the `:link.` and `:elink.` tags is highlighted in the runtime application (see Figure 11 on page 17). By selecting the highlighted text, the user jumps to the related target help panel. The resource id (resid) of the target panel is a parameter of the link tag.

```
:h1 res=22.Get Help on using the Catalog
:p.Select one of the graphic push buttons.
:p.
:link reftype=hd res=12.Browse by Category:elink.
Press this button to browse by categories.
:p.
:link reftype=hd res=19.New Releases:elink.
Press this button to view the new video releases.
:p.
:link reftype=hd res=20.Top 10 Bestsellers:elink.
Press this button to view the 10 best ranked.
:p.
:link reftype=hd res=21.Search for Specific Titles:elink.
Press this button to search for specific titles.
```

Figure 10. Help for the Welcome window

Figure 11. Example of help for a window that contains a hypertext link

For more information about creating online help for your application, see the following topics:

- Chapter 13, "Tips for Creating Online Help with IPF," on page 245
- Chapter 14, "Tips for Creating and Using Windows Help," on page 249
- Chapter 15, "Tips for Creating JavaHelp," on page 253

A Review of Visual Programming

The steps described in the previous sections are similar to the ones you will take when you create your own application using VisualAge RPG. These steps are:

1. Deciding What to Show the User

   Before you begin creating a new application, you should select the purpose of your application, how it will be presented to the user, and how it will communicate with other applications.
2. Creating the GUI using the GUI Designer

   After you have designed the application, you can use the GUI Designer to create the graphical user interface. VisualAge RPG provides a catalog of GUI parts for you to choose from, and gives you the ability to create user-defined parts to suit your needs. You can select the parts that you want to appear in the interface, and select their positions on a design window. Customize the parts as required.

   See the online help for information about creating windows, adding parts to the window, and aligning and customizing them.
3. Getting and Setting Attributes

   You can set some part attributes during design time using the part's properties notebook. You can also use GETATR and SETATR operations codes, or %getatr and %setatr built-in functions, to get or set the attributes for a part during run time. When getting or setting part attributes, you reference a part by using the name defined for it in the GUI Designer.

   For more information about the parts, and how you can get and set part attributes, refer to *VisualAge RPG Parts Reference*.
4. Writing Program Logic

   Each part responds to a set of predefined events. Events are typically generated as a result of some user interaction with the GUI. For example, selecting a push button signals a **Press** event. Events can also be generated by your program. For example, the DDE client part generates a **Timeout** event if it is unable to start a conversation with a server program within a predetermined period of time.

You respond to events in your program by coding the BEGACT (begin action) and ENDACT (end action) operation codes. The code between these operation codes, called an action subroutine, is executed for a particular event. If you do not code an action subroutine, no action is taken when the event occurs.

5. Adding Messages and Online Help

   In addition to creating the GUI and writing some program logic to make it run, you can add messages and online help to your application.

Chapter 2. Planning Your Application

This section discusses what you should do before you begin coding a new application or converting an existing OS/400* application into a VisualAge RPG application.

If you are creating a new application, this is the time to decide on its purpose, how it will be presented to the user, and how it will communicate with other applications.

If you are planning to reuse an existing OS/400 application, this is the time to evaluate the old character screen displays and decide how to improve them using the power of graphical user interface parts. (For more information about reusing existing applications, see Part 3, "Working with iSeries Data," on page 191.)

The information in this section will help you design an application that meets the user's needs and is practical to implement.

Enabling Secure Java Applications

If you plan to deploy Java applications for use on the World Wide Web, note that only systems running on the OS/400, Version 4 Release 4, or later, support the Secure Sockets Layer (SSL) specification. Data flow between workstation applications and servers running on earlier OS/400 versions will not be secure.

For information on setting up SSL support for VisualAge RPG, see Appendix D, "Secure Sockets Layer (SSL) Setup," on page 449. If your VARPG applications will be running applets that use the client security file, see "Using the Security File for Applets" on page 210.

Decide What Functions to Provide

First, determine what the main purpose of your application is, and what functions you must provide to address it. After you determine the core functions, tackle the advanced functions such as dynamic data exchange (DDE) and printing.

Help Your Users

Users will have varying degrees of experience with GUIs. Consider providing online help that is tailored for the level of knowledge of a typical user. VisualAge RPG makes it easy for you to add online help to the GUI. You can add four kinds of help:

Context-sensitive help
: Help information that is adapted to the current context of a choice, object, or group of choices or objects.

Task help
: Information about tasks the user can perform with your application.

ToolTip help
: Hover-type help about the tools available to the user.

Window-level help
: Information about the contents of a window.

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Other ways to help your users are to give them all the information they need to complete a task, and to provide meaningful prompts and labels on GUI parts. You can use an ellipsis (...) to indicate that more information is needed before a particular action can be performed. (For example, use **Display...** to tell users that they will be prompted for more information before the display action is carried out.) Do not use an ellipsis on a label if the action will be performed immediately after the button is pressed. For example, a **Help** button does not need an ellipsis because the help information is displayed as soon as the button is pressed. You can also provide help in the form of a static text field that is updated when the mouse pointer moves over different parts of your interface.

You can minimize the amount of information that your users have to provide by setting default values. For example, you can use a combination box part to give users the option of selecting from a list of commonly used choices. This prevents key-in errors at run time.

Keep Window Design Simple

There are two basic aspects to good window design:
- The number and structure of windows in your application
- The content of each window

Number of Windows

It is a good idea to have one main window from which the user can initiate all of the main tasks. Provide secondary windows for additional information that users must specify to complete a task.

Avoid a lot of nested windows because too many layers make a simple task look complex. Also remember that too many windows will clutter the screen, especially if the user has more than one application running. Users can also get lost if they have many windows on their screen.

Try to minimize the number of parts in each window. This will increase performance when windows are displayed. An application with many windows and few parts per window will perform better than the same application with fewer windows and more parts per window.

Content of Each Window

Group all related information in one place. Use the group box part and the outline box part to visually indicate which radio buttons are related.

Use graphic images and icons to identify tasks or to complement the words in the window. Make sure that all text is spelled correctly.

Position the parts in a window in a neat, logical manner. You do not have to plan the position of some parts because their position is predetermined. For example, a menu bar part is always located just below the window's title bar.

If windows have common parts, you should display those parts in a consistent location. This makes it easier for users to find common information.

Plan Your Code Effectively

After you design the GUI, you must decide what code is needed to support actions that will be performed by users. VisualAge RPG helps you create the GUI without writing a lot of code — it does the routine tasks for you. All parts have default attributes, which you can modify using the GUI Designer or in your program. You have to explicitly set other attributes. For example, if you want users to be able to view graphics by pressing a push button labeled **Display...**, you must do more than point and click the push button part from the palette onto your design window: at the very least you must set the label attribute to read **Display...** and write logic to find and display the data.

Keep the User Informed

Use messages to provide particularly important or urgent information. Give detailed but not verbose messages that describe the problem and, if at all possible, explain how to correct it. VisualAge RPG provides three ways of displaying messages, and you should choose the method most appropriate for the type of information you want displayed:

Window
: To provide urgent information that the user should know about; for example, a process that was not completed successfully.

Message subfile
: To provide information about a choice, or to contain a message about the completion of an action or process.

Second-level message help
: To provide an extra level of detail that may not be required at all times by all users; for example, to describe a course of action that novice users may not know about.

For long processes, you may want to add a progress indicator to keep the user informed.

Plan to provide text, visual, or audio cues to users to present exceptions. For example, you may want to show that a push button is not available by dimming the text on it. No one can plan for every possible user action, so you should also plan how your application will inform users about actions it cannot interpret. For example, you may want to display a message if a user tries to exit a file without saving the changes made during an edit session.

Use a Consistent Style

Use consistent terms to minimize confusion. For example, if you use Login on one window, do not use User ID to refer to the same concept somewhere else.

Use consistent mnemonics across the application windows. A mnemonic is a letter key that can be pressed to select a choice or perform an action. The letter key corresponds to the underlined letter of a choice on a push button or in a menu. For example, if you use **Save** to represent the save function on a push button in one window, use it on every window that has that push button.

Anticipate Translation Issues

Even if your current plans do not include translating the application into another language, you should design and create your application so that it could be easily translated in the future. By doing so you will have less to rework if the need to translate arises.

Consider keeping the executable code separate from the text. This way you can use the text in the appropriate language with the standard executable code.

Note: There are other reasons why you should consider separating the text from the code. You can correct errors in the text and make changes to terminology in future releases more easily.

You can create separate message files for each language and assign different file extensions to each. Each of the message files should have identical message numbers but text written in a different language. You can build one .EXE for all languages simply by using the appropriate message file. For example, an English version of the compiled message file could be named SAMPLE.ENG and a German version could be named SAMPLE.GER. You can instruct users to rename the appropriate message file to SAMPLE.MSG before running the application. For more information, see Chapter 16, “Working with Messages,” on page 259.

Also keep in mind that translation can change the sizing requirements for text (such as labels), entry fields, buffer, and windows. When sizing a part in the GUI Designer that will have a substitution label, keep in mind that translated text may be longer than the original.

If you use mnemonics, remember that the mnemonic character may be different for different languages.

Part 2. Working with Parts

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Chapter 3. Programming with Parts

This section presents some tips for programming with parts. Topics include how to get and set part attributes, reference parts in your program, respond to events and system attributes, work with event and system attributes, and code static text and entry field parts.

Getting and Setting Part Attributes

You can set some part attributes during design time using the part's properties notebook.

Some attributes can be set or retrieved at run time in the application by using:

- Qualified Attribute Names: Part attributes can be accessed directly in expressions or free-form calculations using the qualified naming syntax of *window-name.part-name.attribute-name*.
- Built-in functions **%getatr** and **%setatr**: These are useful when the window or part may vary at run time, and for which the name is identified in program variables in the application code.
- The fixed-format operation codes **GETATR** and **SETATR** were the earliest form of accessing part attributes, and can only be used to reference parts on the same window as the part that generated the event.

  For example, if the part that generated the event is on WINDOW1, the fixed operation codes can reference only parts on WINDOW1. If a GETATR or SETATR operation code references a part on another window, compile-time errors occur for single-link action subroutines because the compiler verifies that the referenced part exists on that window. Run time errors occur for multiple-link action subroutines.

  To reference parts on different windows, use the other alternatives.

For more information about the attributes and where you can set them, refer to the *VisualAge RPG Parts Reference*.

See the *VisualAge RPG Language Reference* for information about using these operation codes and built-in functions.

Referencing Parts in Your Program

When getting or setting part attributes, you reference a part by using the name defined for it in the GUI Designer. The name must follow AS/400 system naming conventions. Specifically, the name:

- Must not exceed 10 characters in length. Only SBCS characters are allowed. Characters must be letters A-Z, numbers 0-9, @, #, $, or _ (underscore).
- Must begin with the letters A-Z, @, #, or $.
- Can be entered in upper case or lower case.
- Must **not** have embedded blanks.
- Must **not** be an extended name (that is, must not be in double-quotation marks).

Note: When your program is running, you can reference only those parts that have been **created**. Parts are created when the window they are on is also created. Creating a window or part loads it into memory. Any attempt to reference a part that is not yet created results in a *Part not found* message.

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Responding to Events

Each part responds to a set of predefined events. You can use one of the following methods to obtain a list of predefined events:

1. Refer to the *VisualAge RPG Parts Reference* for a complete list.
2. Press F1 when focus is on the part in the palette or catalog to get a general description of the part and a list of the attributes and events associated with it.
3. In the GUI Designer, invoke the pop-up menu for the part, and select the **Events** item.

Events are typically generated as the result of some interaction with the user interface. For example, pressing a push button signals a **Press** event. Events can also be generated by your program. For example, the DDE Client part generates a **Timeout** event if it is unable to start a conversation with a server program within a predetermined time period. If your program changes the text value of an entry field part, a **Change** event is signaled by the entry field.

You respond to events in your program by coding the BEGACT (begin action) and ENDACT (end action) operation codes. The code between these operation codes, called an **action subroutine**, is executed for a particular event. When you create an action subroutine for a specific event, an **action link** is defined. If you did not code an action subroutine for a particular event, no action is taken when the event occurs. The code in an action subroutine is executed until the ENDACT operation code is reached. Therefore, if you coded EXSR operation codes within an action subroutine, these subroutines (called **user subroutines**) are also executed.

You cannot invoke an action subroutine using the EXSR operation code. You can, however, invoke a particular action subroutine by more than one action. For example, you can have code that is executed when a push button is pressed or when a menu item is selected. You can review which events have action subroutines and modify link events to action subroutines in the Action Subroutines window. To display the Action Subroutines window:

1. Select **Edit source code** from the **Project** menu in the GUI Designer. This starts an edit session.
2. From the edit session, select **Edit>Action subroutines**. The Action Subroutines window appears.

Event attributes contain data that is relevant to an event. For example, the **MouseMove** event stores the X and Y coordinates to indicate where the mouse was located when the event occurred. Before you can use event attributes in your program, they must be defined on definition specifications. The name of the event attribute is the name of the entity on the definition specification. Because the compiler does not verify the length of the variable and some attributes have varying lengths, be sure to specify a length large enough to contain the expected value.

Note: Event attributes cannot be changed by your program. Therefore, they cannot appear in a result field or as the target field for an EVAL operation.

The *VisualAge RPG Parts Reference* describes all the event attributes.

The following example illustrates how the **%MouseX** and **%MouseY** event attributes can be defined and used in a program.

```
 *
 * Define mouse x and y coordinate event attributes
 *
DName++++++++++ETDsFrom+++To/L+++IDc.Keywords++++++++++++++++++++++++
D%MouseX          S              4P 0
D%MouseY          S              4P 0
 *
 * Check if Mouse coordinates in range:
 *
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq...
CSRN01Factor1+++++++Opcode(E)+Extended-factor2++++++++++++++++++++++++++
C     %MouseX       ifgt      100
C     %MouseY       andgt     100
C                    ..
C                   endif
 *
 ***** End of Source
```

System Attributes

System attributes pertain to your application rather than to a specific part.

As with event attributes, system attributes must be defined on a definition specification. They cannot be modified by your program.

VisualAge RPG supports the following system attributes:

Table 1. System Attributes

Attribute	Description	Type	Length
%DspHeight	Returns the height of the screen at run time, in pixels.	Numeric	4
%DspWidth	Returns the width of the screen at run time, in pixels.	Numeric	4

Working with Event and System Attributes

Each event attribute is valid for a particular event and can be used only within action subroutines that are linked to that event. For example, if you use an event attribute for the **MouseMove** event within an action subroutine that is linked to the **ReSize** event, a runtime error is issued. Type checking is performed only on event attributes at run time. If you define a character field for a numeric event attribute, this error is detected only at run time.

System attributes can be used anywhere within your program because they are not linked to any particular event. Type checking is performed on system attributes at compile time.

Event and system attributes must be defined on a definition specification before they can be used throughout the VisualAge RPG component. They are treated by the compiler as read-only fields in automatic storage. Any nested and active action subroutine has its own copy of an event attribute.

For example, assume that the ENT0000A+CHANGE+WIN1 action subroutine is linked to window WIN1, entry field part ENT0000A, and event CHANGE.

```
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq..
CSRN01Factor1+++++++Opcode(E)+Extended-factor2++++++++++++++++++++++++
C     ENT0000A      BEGACT    CHANGE        WIN1
C                     .
C                     .
C     %PART         dsply     boxid         reply
 * 'ENT0000A' is displayed.
C                     .
C                     .
C                   endact
```

Also assume that the PSB0000A+PRESS+WIN1 subroutine is linked to window WIN1, push button part PSB0000A, and event PRESS.

```
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq..
CSRN01Factor1+++++++Opcode(E)+Extended-factor2++++++++++++++++++++++++
C     PSB0000A      BEGACT    PRESS         WIN1
C                     .
C     %PART         dsply     boxid         reply
 * 'PSB0000A' is displayed.
C                     .
C     ENT0000A      SETATR    10            TEXT
 * This triggers the CHANGE event for entry field ENT0000A
 * which causes action subroutine ENT0000A+CHANGE+WIN1 to be
 * invoked.
C                     .
C                     .
C     %PART         dsply     boxid         reply
 * 'PSB0000A' is displayed.
C                     .
C                     .
C                   endact
```

When push button PSB0000A is pressed, action subroutine PSB0000A+PRESS+WIN1 is invoked. When the SETATR operation is performed, the CHANGE event is triggered for entry field part ENT0000A. This invokes the ENT0000A+CHANGE+WIN1 action subroutine.

Each action subroutine has its own storage for %PART because event attribute fields are in automatic storage:

- In action subroutine PSB0000A+PRESS+WIN1, %PART contains 'PSB0000A'.
- In action subroutine ENT0000A+CHANGE+WIN1, %PART contains 'ENT0000A'.
- When action subroutine ENT0000A+CHANGE+WIN1 completes and action subroutine PSB0000A+PRESS+WIN1 continues executing, %PART contains 'PSB0000A', not 'ENT0000A'.

Coding Static Text and Entry Field Parts

The following section contains some tips for coding static text and entry field parts.

Creating and Retrieving Entry Field Parts

Note: This section also applies to static text parts. For simplicity, only entry field parts are mentioned in the text.

When a READ is performed, where does VisualAge RPG store the retrieved value? When a WRITE is performed, what value does VisualAge RPG use to set the value?

For each entry field part, VisualAge RPG creates a field with the same name as the part. This field is defined to match the definition of the **Text** attribute (or the **Label** attribute for static text parts). For example, if there is an entry field part called ENT00012, and the **Text** attribute is defined as character 20, then VRPG automatically defines a 20-character field called *ENT00012*. You can use this field in your program.

You can override the definition of the field on a definition specification by defining a field of the same name. However, the definition of the field must comply with the rules of VisualAge RPG concerning type and length compatibility. For example, the field must be the same length as the attribute definition. For numeric fields, the field does not have to be the same type as the attribute definition.

When you run your application, the value of an entry field is initialized by the value that you supplied in the GUI Designer. However, you can overwrite this value by setting the INZ keyword in your definition specification, or by moving a value into the program field. In these cases, the value stored in each of these fields does not necessarily match the value that you see on the screen for the corresponding part.

If you store a different value in a field in a user or action subroutine, VisualAge RPG does not reflect that new value on the screen. Therefore, the value stored in the field is different from what is displayed on the screen. To reflect the stored value on the screen, you must use a WRITE operation or a SETATR operation.

The same holds true for SHOWWIN. When a window is first opened, the values that appear on the screen correspond to the values supplied for the parts in the GUI Designer. If you change the stored value for a corresponding VisualAge RPG field before you show the window, then the value in the field does not match what is seen on the screen. To make the two values identical, you have to perform a WRITE operation or a set attribute operation in an action subroutine that is linked to the **Create** event for the window. This synchronizes the value stored in the field with the value on the screen, and the user sees only the new value when the window is shown.

In general, it is a good idea to use an action subroutine that is linked to the **Create** event to set values that should appear on the screen when a window is opened.

Operation Codes for Window Parts

Several operation codes have been enhanced in VisualAge RPG to operate on windows and their parts: READ, WRITE, CLEAR, and RESET. These operation codes can be used with windows and affect static text and entry field parts.

READ Performs get attribute operations on all the affected static text and entry field parts.

WRITE
Performs set attribute operations on all of the affected static text and entry field parts.

CLEAR
Sets all numeric entry field parts to zero, and all character entry field parts to blanks. (It does not operate on static text parts.)

RESET
Sets static text and entry field parts back to their initial values.

The window operation codes use these attributes:

Text Attribute of entry field parts that is used to perform READ, WRITE, CLEAR, and RESET operations.

Label Attribute of static text parts that is used to perform READ, WRITE, and RESET operations.

Using Window Operation Codes on Parts with Identical Names

You can have two entry fields with the same name, two static text parts with the same name, or even an entry field part that has the same name as a static text part, as long as the parts belong to different windows. This section describes how to avoid inadvertently setting the value of one of these parts to the value of another.

Only one program field is created for a given part name. If there is an entry field part in window W1 named MYPART, and an entry field part in window W2 named MYPART, then one VisualAge RPG field is created, called MYPART. The compiler creates the definition to match one of the part definitions.

If you have more than one part with the same name, the compiler will issue an error message if the parts do not have compatible definitions. Parts are compatible if they accept the same type of data (numeric or character), are the same length, and (if numeric) have the same number of decimal positions.

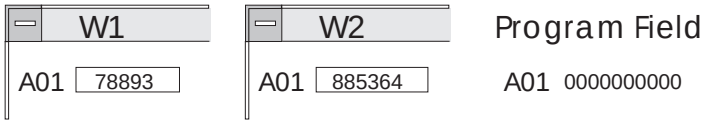
If the parts that share a field have different initial values, then the initial value of the field is set depending on the part the compiler encounters first when creating the internal fields for entry field parts. This can vary from one build to another, so when multiple parts share the same field you should not depend on the field having a specific initial value, unless you set all the initial values to be the same.

Performing an operation on one of the windows containing one of these parts itself, or on one of the parts, results in the entry field containing a value that matches the screen value of the part involved in the operation. However, the field contains a value that probably does not match the screen values of the other parts on other windows that share this field. Even though multiple parts share the same field, an operation on any of these parts affects only the part specified on the operation or contained in the window specified on the operation. The other parts that share the field are not affected.

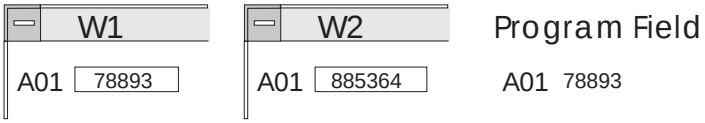
Example

The following example shows what can happen when you set the value of one of the parts to a value of another part when the parts share a field.

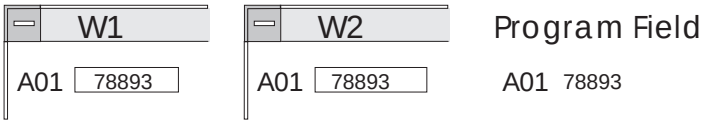
1. Define the fields: The Entry field A01 in window W1 is defined as character 10, and the Entry field A01 in window W2 is defined as character 10. The value on the screen for W1 is *78893*, and the value on the screen for W2 is *885364*. Field A01 contains the value *0000000000*. These are the initial values.



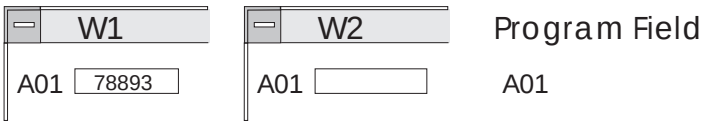
2. Perform a READ on W1: Field A01 now contains *78893*. This matches entry field A01 in W1.



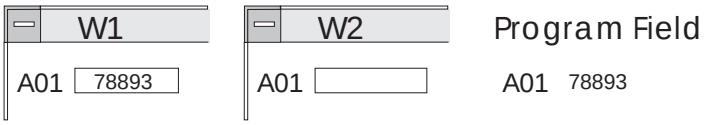
3. Perform a WRITE on W2: The screen value of entry field A01 in W2 is now *78893*.



4. Perform a CLEAR on W2: Field A01 now contains blanks. This matches entry field A01 in W2. The Entry field A01 in W1 - value on screen is *78893*. The Entry field A01 in W2 - value on screen is blank.



5. Perform a GETATR on entry field A01 in W1 with target field A01: Field A01 now contains *78893*. This matches entry field A01 in W1.



If you want all the parts that share a field to display the same value, then you have to perform SETATR operations on all the parts using the field as the source value, or perform WRITE operations on all the windows that contain one of these parts.

It is recommended that you give unique names to all entry field parts in your component to avoid accidentally setting the value of one of the parts to the value of another.

Chapter 4. Sample Programs for VisualAge RPG

The Samples folder (in the VisualAge RPG projects folder) contains the source code and the runtime version of the sample applications discussed in this part of the book. Table 2 lists the sample programs.

Table 2. Sample programs for VisualAge RPG

Program	Description
Animation	Animation control part example
ActiveX	ActiveX control example
Bean	Java bean part example
Calendar	Calendar part example
Component Reference Part	Component reference example
Container	Container part example
Customer Maintenance*	Customer maintenance example
DDE Client	DDE client part example
DDE Hotlink	DDE hot link example
Drag and Drop	Data transfer example
Graph	Graph part example
Image*	Image part example
Listbox	List box part example
Message Subfile	Message subfile part example
Multiline Edit	Multiline edit part example
Notebook	Notebook part example
Odbcceld	ODBC/JDBC interface part example
Popup Menu	Pop-up menu part example
Progress	Progress bar part example
Resize	Resize example
Runtime_control_of_server_connections	Control of server connection using the Signon API example
Scroll	Scroll bar part example
Slider**	Slider part example
Spin Button	Spin button part example
Subfile*	Subfile part example
Timer	Timer part example
VARPG Plug-in	Vendor plug-in example
Video Store Cashier*	Video store cashier example
Video Store Catalog*	Video store catalog example
Welcome	Welcome example

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Notes:

1. * This example requires data on an iSeries 400 server.
2. ** Also shows how to use the **BackMix** and **ForeMix** attributes

Before You Begin

Before you can run the sample applications, you must install the VisualAge RPG component. The associated samples are in the Samples folder, which is in the VRPG Projects folder.

Read the comments in the sample programs. The comments contain tips and requirements, as well as any restrictions.

Before you can build and run Java applications, you must have Sun Microsystem's Java 2 Software Development Kit (J2SDK) Version 1.2, or higher, installed on your workstation. If you do not have the J2SDK, you can download it from Sun Microsystems at the following URL:

`http://java.sun.com/products/`

After installing the J2SDK, set the PATH environment variable to point to the location of both the Java compiler and the Java Runtime Environment (JRE). For example, if your home directory for the J2SDK is *c:\jdk1.2*, add the following path statement: `c:\jdk1.2\bin`

If you plan to run VisualAge RPG applets inside a browser, the international version of the JRE must be installed on the client workstation.

Building the Examples

If you want to run most of the samples, you must first build the application.

To build one of the sample programs, display the pop-up menu for the sample's folder, and select **Build>Windows** or **Build>Java**.

Running the Examples

To run a sample program, display the pop-up menu for the program, and select **Run>Windows** or **Run>Java**.

Accessing an iSeries 400 Server

Some sample programs, such as the subfile example, access data on an iSeries 400 server. The data files used by these programs are not shipped with VisualAge RPG. However, the source file comment section describes the file layout for that example. You must create the data file on the server and supply data.

To run these examples, start the GUI Designer on the sample program, and use the Define iSeries Information notebook in the **Servers** pull-down menu to do the following:

1. Change the remote location parameter to point to the server that you want to access.
2. Change the remote file name parameter so that you can access the appropriate data file for the example.

See Chapter 8, "iSeries Connectivity," on page 193 for more information about defining iSeries 400 information.

Chapter 5. Common Attributes

This section lists the attributes that are common to most parts and describes how you can use them.

PartName Attribute

All parts have a name. VisualAge RPG automatically generates this name when the part is created. You can change the name of the part in its properties notebook or by editing it directly in the tree view of the GUI Designer's project window. The *component part name cannot be edited.

Note: You cannot change the part name at run time.

Each window must have a unique name, and all parts on a given window must have unique names. Parts on different windows can have the same name, except for subfile part names, which must be unique across your component.

The compiler implicitly defines a field name for entry field and static text parts using the **PartName** attribute. You can use that name in your program if you want to refer to the value of these parts. For more information, see Chapter 3, "Programming with Parts," on page 25.

If you change the name of a part, you must change all references to that part in your program source. If you attempt to reference the old name of a part that has been renamed, you will get either compile errors, or a runtime error indicating that the part could not be found.

ParentName Attribute

The **ParentName** attribute returns the name of the parent part. The parent is the window on which a part is placed. For a window part, the parent is the window itself.

PartType Attribute

You can use the **PartType** attribute to determine the type of a part in your program. **PartType** returns the type of the part as defined by VisualAge RPG. The value returned for VisualAge RPG parts consists of the string *FVDES* followed by the part type. For example, for an entry field part, the part type would be FVDESEntryField. One exception to this rule is the component reference part; it has a prefix of FVDESV.

Table 3 summarizes the **PartType** attribute value for each VisualAge RPG part.

Table 3. The PartType attribute for VisualAge RPG parts

PartType attribute	VisualAge RPG part
FVDESOCX	ActiveX
FVDESAnimationControl	Animation control
FVDESCalendar	Calendar
FVDESCanvas	Canvas

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Table 3. The PartType attribute for VisualAge RPG parts (continued)

PartType attribute	VisualAge RPG part
FVDESCheckBox	Check box
FVDESComboBox	Combination box
FVDESContainerControl	Container
FVDESVComponentReference	Component reference
FVDESDDEClient	DDE client
FVDESEntryField	Entry field
FVDESGraph	Graph
FVDESGraphicPushButton	Graphic push button
FVDESGroupBox	Group box
FVDESHScrollBar	Horizontal scroll bar
FVDESImage	Image
FVDESJavaBean	Java Bean
FVDESListBox	List box
FVDESAudio	Media
FVDESMediaPanel	Media panel
FVDESMenuItem	Menu item
FVDESMessageSubfile	Message subfile
FVDESMultiLineEdit	Multiline edit
FVDESNotebook	Notebook
FVDESNotebookPage	Notebook page
FVDESODBCInterface	ODBC/JDBC Interface
FVDESOutlineBox	Outline box
FVDESPopUpMenu	Pop-up menu
FVDESProgressBar	Progress bar
FVDESPushButton	Push button
FVDESRadioButton	Radio button
FVDESSlider	Slider
FVDESSpinButton	Spin button
FVDESStaticText	Static text
FVDESStatusBar	Status bar
FVDESSubfile	Subfile
FVDESSubmenu	Submenu
FVDESTimer	Timer
FVDESVScrollBar	Vertical scroll bar
FVDESFrameWindow	Window

Color Attributes

You can change the color of most parts by using the **BackColor** and **ForeColor** attributes. The attribute values are numbers that represent specific colors. The compiler provides a set of figurative constants, such as *RED and *GREEN, that you can use to set the colors. Refer to the *VisualAge RPG Language Reference* for these names.

You can specify a color mix for the part by using the **ForeMix** and **BackMix** attributes. The value of these attributes represents a mixture of the primary colors of red, green, and blue. This is often referred to as the **RGB** color value. This RGB value is a string consisting of three values separated by colons (:). Each value represents the intensity of red, green, and blue, in that order. The value of each color is between 0 and 255.

In the following code example, the background color mix of a static text part is set to a medium shade of blue:

```
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq..
 *
C     'ST1'         setatr    '000:000:128' 'BackMix'
```

For a more detailed example on how to specify the **ForeMix** and **BackMix** attributes, see "Slider" on page 145.

Enabled Attribute

When a part is enabled, it can respond to user interaction and generate events. For example, when an enabled push button is pressed, it generates a **Press** event that may then be handled by your program.

You may not want a part to be enabled until a certain condition exists. In the case of the push button, you may want the user to be able to press it only when an item has been selected in a list box.

When a part is not enabled, it does not respond to user interaction, and its label is dimmed.

To enable a part, set its **Enabled** attribute value to *1*. If you do not want it to be enabled, set this value to *0*.

Size and Position Attributes

You can use the **Height** and **Width** attributes to indicate the size, in pixels, of most parts.

You can also use the **Left**, **Bottom** and **Top** attributes to specify the position of the part in its containing part (usually a window). The position value is also expressed in pixels. When you position any part, the values are relative to the top left corner.

These attributes are useful because they dynamically change the size and position of the parts at run time. For example:

- If a user can resize a window, you may want to code an action subroutine to handle the **ReSize** event and alter the position of the parts on that window so that they remain centered within the window. If you do not do this, the parts will remain relative to the top left corner of the window.

- If your application runs on systems that use monitors with different resolutions, you can use the **%DspWidth** and **%DspHeight** system attributes to ensure that the windows are visible regardless of the screen resolution. You may want to position the window in the center of the screen, or at some other coordinate.

Here's a calculation that can be done in the **Create** event for a window. This example calculates the appropriate coordinates to center a window called *Window1*; then moves the window to a new coordinate before displaying it on the screen.

```
 *
DName++++++++++++ETDsFrom+++To/L+++IDc.Keywords++++++++++++++++++++++++++
 *
 * Declare the display size system attributes
D%DspHeight        S             4P0
D%DspWidth         S             4P0
 *
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq
 *
 * Handle create event for Window1.
 * Gets screen size and calculates pixel coordinates to
 * position the window in the center of the screen.
 *
C     WINDOW1       BEGACT    CREATE        WINDOW1
 *
 * Get the windows dimensions:
C     'Window1'     GETATR    'Width'       winWidth          4 0
C     'Window1'     GETATR    'Height'      winHeight         4 0
 *
 * Calculate new coordinates to center window
C     %DspWidth     SUB       winWidth      newLeft           4 0
C     %DspHeight    SUB       winHeight     newBottom         4 0
C     newLeft       DIV       2             newLeft
C     newBottom     DIV       2             newBottom
 *
 * Center the window and make it visible
C     'Window1'     SETATR    newLeft       'Left'
C     'Window1'     SETATR    newBottom     'Bottom'
C     'Window1'     SETATR    1             'Visible'
C                   ENDACT
 *
```

Visible Attribute

You can use the **Visible** attribute to specify when you want a part or a window to be displayed. For example, you may want a push button to appear on the screen only at run time. To do this, when you create the push button in the GUI Designer, go to the properties notebook for the part and set the visible flag off. Then, at run time, set the **Visible** attribute value to *1* when you want the push button to appear.

Focus Attribute

The area of a window where a user can interact with the interface has input focus. The part that has input focus must be enabled to respond to user actions, such as the pressing of a key or a button.

There are times when you want to focus on a part in your program so that the user can use it immediately. For example, if you are checking several entry fields and require the user to re-enter information in a particular entry field, you would set the **Focus** attribute value to *1* for that entry field. When you set the attribute, the cursor appears where the user can begin typing data into the entry field.

In addition to giving focus to a particular part, you can determine if a part has gained focus. A part gains focus when the user selects it by either tabbing to it or by selecting it with the mouse. When this happens, a **GotFocus** event is generated for the part. Conversely, a **LostFocus** event is generated when a part loses focus.

UserData Attribute

All parts support the **UserData** attribute. Use this attribute to assign any text string to a part. This string has no effect on the value of any other attribute of the part, and it is not displayed. The **UserData** attribute can contain a maximum of 65,535 characters.

Label Attribute

Several parts have a **Label** attribute. This is descriptive text that explains the purpose of the part. The text that appears on a push button is an example of this attribute.

The following parts have a **Label** attribute:
- Check box
- Container
- Group box
- Menu item
- Push button
- Radio button
- Static text
- Window
- Window with canvas

Label Substitution

You can substitute the text of a label by using a symbol when you set the **Label**, **TabLabel**, or **InfoLabel** attributes. This is particularly useful if you are developing applications for use with other languages, because it allows you to translate labels and messages that you defined in the GUI Designer.

When you specify label substitution for a part, an entry is made in the component's message file. Multiple parts can use the same label substitution (for example, ^OK.). The same message file entry is used for all references.

You define a substitution label for a part in its properties notebook by specifying a string, with no imbedded blanks, preceded by the caret (^) symbol. This adds a message to the message file. Select **Project>Define Messages...** to invoke the message editor and add the message text you want to replace the **Label** attribute when the application is run.

Translation Tips

When sizing a part in the GUI Designer that will have a substitution label, keep in mind that translated text may be longer than the original.

If you use mnemonics, remember that the mnemonic character may be different for other languages.

You can have more than one translated message file in the runtime subdirectories by assigning different file extensions to each. For example, an English version of the compiled message file could be named SAMPLE.ENG and a German version

named SAMPLE.GER. You can instruct the user to copy the appropriate message file to SAMPLE.MSG before running the application.

Chapter 6. Using Data Transfer

This section discusses how you can use data transfer to manipulate the value of some parts.

Note: Data transfer is not supported for Java applications.

A Typical Data Transfer Scenario

In a typical data transfer scenario the user selects a part (called the **source part**) with the mouse, drags it to another part (called the **target part**) and releases the button to drop the value on the target part. This transfers information from the source part to the target part, and the target part can then act upon that information.

Note: The part itself is not being moved with data transfer. It is the value of the part that is being transferred.

Parts That Support Data Transfer

The following table lists the parts that support data transfer, and the data that each of them acts on.

Table 4. VisualAge RPG parts that support data transfer

Part	Data Transferred
Combination box	The value in the entry field portion of the combination box, or the selected item for a drop-down list type of combination box
Entry field	The **Text** attribute value
List box	The selected item
Message subfile	The selected message
Multiline edit	The **Text** attribute value
Static text	The **Label** attribute value

Enabling Parts for Data Transfer

If you want a part to be a source part, set the **DragEnable** attribute for it to a value of 1 and if you want it to be a target part, set the **DropEnable** attribute for it to a value of 1. You can set these attributes in the part's properties notebook or in your program. You can **not** reset these attributes during run time: once you enable a part for data transfer, it remains set.

After you have set the **DragEnable** and **DropEnable** attributes, you can drag the source part and drop it on the target part. This causes the **Drop** event to occur for the target part.

Note: The **DragEnable** and **DropEnable** attributes are not supported in Java applications.

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Data Transfer Example

In the following example, a window has two entry fields named **EF1** and **EF2**. The **DragEnable** attribute is set for EF1, and the **DropEnable** attribute is set for EF2. The text value of EF1 can then be dragged and dropped onto EF2.

Entry field **EF2** only allows certain values. In the **Drop** event for this part, the action subroutine checks that the dropped value is valid. If the value is not valid, a message is added to the message subfile part.

```
 ****************************************************************
 *                                                              *
 * Program ID . . : DragDrop                                    *
 *                                                              *
 * Description  . : Sample program to illustrate how to respond *
 *                  to the DROP event, and access the dropped data. *
 *                                                              *
 *                  Note:  Drag and drop is not supported for Java  *
 *                                                              *
 ****************************************************************
 *
 * Define the DROP data event attribute
D%Data            S              5A
 ****************************************************************
 *                                                              *
 * Window . . : MAIN                                            *
 *                                                              *
 * Part . . . : PB_EXIT                                         *
 *                                                              *
 * Event  . . : PRESS                                           *
 *                                                              *
 * Description: End the program                                 *
 *                                                              *
 ****************************************************************
 *
C     PB_EXIT       BEGACT    PRESS         MAIN
 *
C                   move      *on           *inlr
 *
C                   ENDACT
```

Figure 12. Sample Drag and Drop Code (Part 1 of 2)

```
*****************************************************************
*                                                               *
* Window . . : MAIN                                             *
*                                                               *
* Part . . . : EF2                                              *
*                                                               *
* Event  . . : DROP                                             *
*                                                               *
* Description: This action subroutine will get control when a   *
*              value has been 'dropped' onto the entry field EF2*
*              By checking the %Data event attribute, it will   *
*              determine if the dropped value is allowed for the*
*              entry field and add a message to the message     *
*              subfile part accordingly.                        *
*                                                               *
*****************************************************************
*
C     EF2           BEGACT    DROP          MAIN
*
* Clear the message subfile
C     'Msg1'        setatr    0             'RemoveMsg'
*
* Check that dropped value is allowed
*
C                   if        %Data <> 'Yes  ' and
C                             %Data <> 'No   ' and
C                             %Data <> 'Maybe'
*
C     'Msg1'        setatr    1             'AddMsgID'
C                   endif
*
C                   ENDACT
*****************************************************************
*                                                               *
* Window . . : MAIN                                             *
*                                                               *
* Part . . . : EF2                                              *
*                                                               *
* Event  . . : CHANGE                                           *
*                                                               *
* Description:                                                  *
*                                                               *
*****************************************************************
*
C     EF2           BEGACT    CHANGE        MAIN
*
C                   ENDACT
```

Figure 12. Sample Drag and Drop Code (Part 2 of 2)

Chapter 7. Using Parts

This section contains helpful hints about using VisualAge RPG parts. Each part description contains a list of the attributes and events which apply to the part. The following parts are described in detail.

Note: The parts are presented in alphabetical order, not in the order in which you must use them. You must use the window part or the window with canvas part first to start building your application, and then add other parts as required.

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For more information about part attributes, events, and event attributes, see the *VisualAge RPG Parts Reference*. For additional programming tips, see Chapter 3, “Programming with Parts,” on page 25.

ActiveX

* **Restriction:** This part is unsupported in Java applications.

Use the ActiveX part to add ActiveX control objects to your project. Your applications can then access their attributes and monitor for events. (ActiveX controls are developed and provided by third party vendors.)

You must be familiar with the ActiveX controls you are adding. The VARPG GUI Designer cannot control the functions provided by these parts.

Note: VARPG only works with ActiveX controls that have interfaces written in C++. Check with your ActiveX control provider to make sure that VARPG will work with the ActiveX control you want to use.

Part Attributes

Activate	AddEvent	Bottom	DeActivate
HasPrpPage	Height	Left	Method
OCXProp	OCXPropIdx	OCXValue	Parameter
paramindex	parentname	partname	parttype
refresh	ReturnVal	RmvEvent	ShowProp
Top	UserData	Visible	Width

Applicable Events

Create	Destroy	OCXEvent

Adding ActiveX Controls

To add an ActiveX control to your project, click on the ActiveX part in the parts palette. Click the mouse pointer onto the design window where you want the ActiveX part placed. An Insert Object dialog appears. Select the ActiveX control you want to work with.

An ActiveX control can contain properties, methods, and events that a programmer can manipulate, call, and respond to respectively. The term **ActiveX control** refers to the actual ActiveX component you are using. Examples include a graph, calendar, or spreadsheet control. The term *ActiveX part* refers to the ActiveX part found on the VARPG parts palette.

Setting Properties

You can set the properties of an ActiveX control at build or run time. To set properties during build time, open the ActiveX Part Properties notebook from the design window. Right-click on the ActiveX icon in the design window and select **Properties**. If a properties editor is available for the ActiveX control, it will be displayed, as well. You can then directly edit the property values.

The properties, methods, and events of the ActiveX control appear on the Information page of the ActiveX Part Properties notebook. Select the appropriate radio button to view what is available.

Setting or getting a property during run time requires two steps. First, set the ActiveX part's **OCXProp** attribute to the property name of the ActiveX control you are using. Use the **OCXValue** attribute to set or get the property.

The following example sets the Depth property for an ActiveX pie chart control:

```
C     'PieChart'    Setatr    'Depth'       'OCXProp'
C     'PieChart'    Setatr    DepthValue    'OCXValue'
```

Note: The **OCXValue** attribute takes a string value. The VisualAge RPG run time will handle the appropriate conversions before forwarding the value to your ActiveX control.

The **OCXPropIdx** attribute sets or retrieves the index for an ActiveX string array property type. You can use this attribute together with the **OCXProp** and **OCXValue** attributes to manipulate string array property types.

For example, the following code sets the first element of the property ***DataFiles*** to `c:\temp\Sample.mdb`, that is, DataFiles[0]='c:\temp\Sample.mdb'.

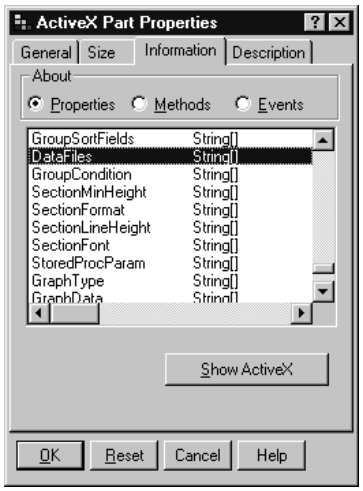
```
C                   EVAL      %SETATR('WINNEWJOB':ocxname:'OCXPROP')=
C                              'DataFiles'
C                   EVAL      %SETATR('WINNEWJOB':ocxname:'OCXPROPIDX')='0'
C                   EVAL      %SETATR('WINNEWJOB':ocxname:'OCXVALUE')
C                              ='C:\temp\Sample.mdb'
```

To set an element of a multi-dimensional array property, pass the index value for each element in a string as 'n1 n2 n3', where n1 is the index for element 1 and so on. For example, the following code sets 3DImageData[2][4][7] to 200:

```
C                   EVAL      %SETATR('WINNEWJOB':ocxname:'OCXPROP')=
C                              '3DImageData'
C                   EVAL      %SETATR('WINNEWJOB':ocxname:'OCXPROPIDX')
C                             = '2 4 7'
C                   EVAL      %SETATR('WINNEWJOB':ocxname:'OCXVALUE')
C                              = 200
```

Each time the **OCXProp** attribute is set, the internal index value for an array at run time is reset to NULL. So, to set or get the array properties, first set **OCXProp** to the property name. Then, set **OCXPropIdx** to the index value in the array. Lastly, set or get the **OCXValue** attribute.

The ActiveX part properties notebook shows the property types in the Information tab. If the type of a property is a string array, the Information tab displays `String[][]...[]`, where the number of `[]` pairs indicates the dimension of the array. For a numeric array, `Numeric[][]...[]` is displayed. For a non-array property, either "Numeric" or "String" is displayed. In the following example, the properties are all string arrays:



Calling Methods

The VisualAge RPG IDE attempts to compile a listing of available methods for your ActiveX control. This list is available on the Information page of the ActiveX Part Properties notebook. For each method, the parameters are shown with brace brackets containing IN for an input parameter, OUT for an output parameter, or nothing if no information is available.

Note: It may not be possible for the builder to discover all available methods for your ActiveX control. Consult the control's documentation for a complete listing.

Calling an ActiveX control's methods is performed at run time by setting the ActiveX part's **Method** attribute. The **Method** attribute takes a string value containing the method name, followed by zero or more parameter values separated by a comma. The syntax is:

```
method_name, value1, value2, ...
```

The following example calls the *AboutBox* method of an ActiveX pie chart control. The method takes no parameters.

```
C     'PieChart'    Setatr    'AboutBox'    'Method'
```

The next example calls the *AddData* method of an ActiveX pie chart control. This method takes two parameters: a string label and a float value.

```
D datax           C                   const('AddData, ItemX, 3.0')

C     'PieChart'    Setatr    datax         'Method'
```

Responding to Events

VisualAge RPG can respond to any events generated by the ActiveX control you are using. ActiveX control events are accepted by VisualAge RPG as an **OCXEvent**. You can use the **%RealName** event to retrieve the actual name of the event.

To receive an event from an ActiveX control, you must first register the event with the VisualAge RPG run time. Set the ActiveX part's **AddEvent** attribute to the string name of the event to be received. You can also set the **AddEvent** attribute to *ALL to receive all events generated by the ActiveX control. To unregister an event, set the **RmvEvent** attribute to the string name of the event.

```
 * Declare the event attribute
D %RealName         s         20a

 * Register the event with the VisualAge RPG run time
C     'DataQ'       Setatr    'Click'       'AddEvent'

 * Respond to the OCXEvent
C     DATAQ         BEGACT     OCXEVENT      FRA000000B
C                   if         %RealName = 'Click'
 * Do something here
C                   endif
```

When an ActiveX part fires an event, the event may contain some parameters. Prior to WDSC V5.1, these parameters were ignored. They were not available to the application. Now, with the introduction of these two attributes in V5.1, the event parameters are available to the application.

To access a parameter, these are the steps:

1.When an OCXEVENT fires, in its event action-subroutine, the parameter index should be set first:

```
C     'ocx'         setatr    2             'PARAMINDEX'
```

2.Get the parameter and put it into a Character variable ″param″:

```
C     'ocx'         getatr    'Parameter'   param
```

3. If the parameter is a numeric value, convert ″param″ into numeric format.

The above steps are for accessing a non-pointer parameter. For pointer parameters, the following must be done:

Take for example an ActiveX control, DieRoll, which simulates a dice roll, which has the event,

```
BeforeRollTo(PTR to Variant number, PTR to Boolean useNumber )
```

The above info shows that the event has 2 parameters. The first one, number, is a pointer to a Variant structure which contains a bstrVal member, and this bstrVal may contain a value from ″one″ to ″six″, the number of dots on a dice. The value of vstrVal can be retrieved and be changed to a different number in the action subroutine. The second one, useNumber, is a pointer to a Boolean value. If this value is set to be ″true″, the Dice control will roll to the number set here (e.g., suppose number=″Four″; if it is set to ″five″, the dice will display 5 dots. If there is no change, the dice will display 4 dots).

Please note that in order to pass a parameter back to the control, the control must define the parameter as a pointer (to desired types), and allow the pointer to be

passed back (some pointer parameters are for ″read″ only, applications can not change their value. This is controled by the ActiveX control developer.).

How to access and change the BOOL parameter of the event:

```
     d BoolVal         s              1b 0 based(pBool)
     d Bool            DS
     d pBool                   1      4*                                      Pointer
     d PB_Value                1      4b 0
     d*'param' is used to receive the pointer parameter. Then
     d*move it into 'PB_Value' to get the numeric value.
     d param           s              8A                                      pointer, char

     C*Get the second parameter, a Bool pointer ( BOOL *).
     C     'ocx2'        setatr    2             'PARAMINDEX'
     C     'ocx2'        getatr    'Parameter'   paramBool        7
     C     'msb'         setatr    paramBool     'addmsgtext'
     C                   EVAL      PB_Value = 0
     C                   MOVE      PARAMBool     PB_Value
     C*Change the value to be TRUE, so that the DieRoll control
     C*will use the new parameter1 value set here in this subroutine.
     C                   eval      Boolval = x'01'
```

To access and change the first parameter of the event, it is helpful to look at the VARIANT structure first:

```
struct VARIANT {
       VARTYPE vt;  //Indicate data type of this structure. VT_BSTR(8) is a string.
       unsigned short wReserved1;
       unsigned short wReserved2;
       unsigned short wReserved3;
       union {
         unsigned char bVal;        // VT_UI1
         short    iVal;             // VT_I2
         long     lVal;             // VT_I4
         float    fltVal;           // VT_R4
         double       dblVal;           // VT_R8
         VARIANT_BOOL xbool;             // VT_BOOL
         DATE     date;             // VT_DATE
         BSTR     bstrVal;          // VT_BSTR
         short    FAR* piVal;       // VT_BYREF|VT_I2
         long     FAR* plVal;       // VT_BYREF|VT_I4
         ... ...
}
```

NOTE: Refer to MicroSoft's ActiveX control document for more info.

In this case, ″number″ is defined as a string, so the type, vt, is VT_BSTR (which is 8), and ″bstrVal″ member in the union will point to a string (like ″five″).

When the event fires, the first parameter will point to a structure like this. Use this pointer, the values in the structure can be changed. This is how to do it:

```
     d*'param' is used to receive the pointer parameter. Then
     d*move it into 'PTR_Value' to get the numeric value.
     d param           s              8A                                      pointer, char
     dTEST             DS
     d P1                      1      4*                                      Pointer
     d PTR_Value               1      4b 0
     d
     d*This structure is for receiving a VARIANT * pointer from runtime
     d*when an event is fired.
     d*The value 'bstrValParam' can then be changed.
     d VARIANTStrPar   DS                  based(p1)                             8=VT_BSTR
```

```
d typeStrParam            1      2b 0
d reserved1Param          3      4b 0
d reserved2Param                 6b 0
d reserved3Param          7      8b 0
d bstrValParam                    *                                     String
d B0                      9     12B 0
d padding2Param          13     16b 0
d
d*Change the 'bstrValParam' member of the structure.
d NewBSTRVal      s             20A   based(bstrValParam)
d

C     OCX2          BEGACT    OCXEVENT      MAIN
C                   IF        %REALNAME='BeforeRollToVariant'
C*Get the pointer (char string), and transform it into a pointer.
C*The first parameter is a pointer to a VARIANT structure.
C     'ocx2'        setatr    1             'PARAMINDEX'
C*Please note that the length of the returned "PARAMETER" string
C*varies. E.g., the length of the first parameter here is 8, while
C*the second one is 7. So, a long-enough variable need to be
C*defined to receive the string, and it's need to be processed so
C*that there's no SPACE characters in it before it is converted
C*to a numeric value.
C     'ocx2'        getatr    'Parameter'   param
C                   EVAL      PTR_Value = 0
C                   MOVE      PARAM         PTR_Value
C*Change the value of 'bstrValParam' member of the structure.
C                   eval      strFour='four'+x'00'
C                   eval      NewBSTRVal=strFour
```

This way, the contents of the structure pointed to by the first parameter can be changed. The above code will make the Dice display 4 dots.

Animation Control

In Windows applications, the animation control part plays video files with the AVI extension. This part differs from the media part in that the video is actually played independently of the program logic. One typical use of this part is to display an AVI file that shows some progress, such as a file being moved from one folder to another.

The animation control part plays video files with no sound. The AVI file cannot be in compressed format, unless it was compressed with the Running-Length Encoded (RLE) method.

In Java applications, the animation control part is used to play back an animated GIF file sequence using the **NbrOfImage** attribute.

Part Attributes

FileName	FrameRate	Handle*	Left
Mode	NbrOfImage	ParentName	PartName
PartType	Top	UserData	Visible

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy

Calendar

The calendar part represents a monthly calendar. By clicking on one of the month arrows, the user can navigate the calendar by going to the next or previous month.

You also have complete program control over the calendar such as going to a specific date, determining which date the user has selected, and adding short text comments to individual days in the calendar.

Part Attributes

Border	Bottom	ClearAll	ClearDate
ClearMonth	ClearYear	Color	ColorArea
ColorMix	Date	DateIdx	DateText
DateUnder	Day	DayIdx	DayLen
DayNumPos	DayNumRect	DayStart	Enabled
FontArea	FontBold	FontItalic	FontName
FontSize	FontStrike*	FontUnder*	FrmtString
Handle*	Height	HRule	Left
Month	MonthArrow	MonthIdx	MonthLen
OutlineRcl	ParentName	PartName	PartType
Refresh	ShowRects	ShowText	TipText
Top	UserData	Visible	VRule
WeekDay	WeekDayIdx	Width	Year
YearIdx	YearLen		

*** Note:** See the attribute description for restrictions.

Applicable Events

Click	Create	Destroy	DblClick
MouseDown	MouseEnter	MouseExit	MouseMove
MouseUp	MthChange	YearChange	

Determining Which Date the User Selected

The **DateUnder** attribute can be used to determine which date the mouse pointer is over. In the following example, the date is being retrieved when the user clicks on the calendar. Note that we are checking that the **DateUnder** value is not blank. This is because the click event occurs no matter where the mouse is. If the mouse is not over a specific date, the **DateUnder** attribute will be blank.

Also note that the date is returned as character string in the form of YYYYMMDD:

```
C     'Cal1'        Getatr    'DateUnder'   YYYYMMDDA         8
*
 * If mouse is over a day...
C                   If        YYYYMMDDA <> *Blanks
 *
 * Make date numeric
C                   Move      YYYYMMDDA     YYYYMMDD          8 0
 *
 * Process the date
 *                  ...
 *                  ...
C                   EndIf
 *
```

Figure 13. Example of the calendar part

Using Date Index Attributes

Several attributes are provided that allow you to access the calendar without affecting what is currently being displayed. In this example, a comment is being added to a specific day in the calendar.

```
 *
 * Set index to date to reference
C     'Cal1'        Setatr    '19971210'    'DateIdx'
 *
 * Set comment for the day
C     'Cal1'        Setatr    'Vacation'    'DateText'
 *
```

Figure 14. Adding a comment

Canvas

Use the canvas part with a window or a notebook page if you want to place more than one part on your window or notebook page. You can point and click various parts onto the canvas, position them, and organize them to produce a graphical user interface.

The canvas part occupies the client area of either a window or a notebook page. If there is no canvas in your window or notebook page, then you can put only one part on the client area, unless the parts are extensions to the window, such as menu bars and message subfiles.

More often than not, you will be creating windows and notebook pages with more than one part on them. In that case, you should use the notebook page with canvas part and the window with canvas part. They save you a step because they already contain the canvas part.

At build time, you can also include a bitmap image as the canvas background by specifying the **FileName** attribute. This image can be tiled by setting the **Tile** attribute. For Java applications, you can include GIF or JPG images as the background.

Notes:

1. The canvas part, the window (without canvas) part, and the notebook page (without canvas) part are located on the parts catalog, not the parts palette. If you want to use them frequently, you can add them to the parts palette.
2. If parts located on a canvas part have the default font setting specified (*Default System Font*), they will inherit the font definition specified for the canvas part. To apply a certain font to the majority of parts on a canvas, specify that font for the canvas part rather than for each individual part.

For related information, see:
- "Window" on page 180
- "Window with Canvas" on page 181
- "Notebook Page" on page 118
- "Notebook Page with Canvas" on page 119.

Part Attributes

BackColor	BackMix	Bottom*	Enabled
FileName	FontBold	FontItalic	FontName
FontSize	FontStrike*	FontUnder*	Handle*
Height	Left	ParentName	PartName
PartType	ReadOnly	Refresh	Tile
Top*	UserData	Width	

* **Note:** See the attribute description for restrictions.

Applicable Events

Click	Create	DblClick	Destroy
MouseDown	MouseMove	MouseUp	Popup
VKeyPress			

Check Box

Use the check box part if you want the user to choose between two clearly distinguishable states; for example, on and off.

A label associated with the check box describes what its setting is when it is selected.

Typically, you use a group of check boxes to provide a list of options. The user can select one or more check boxes, or not select any. The options are not mutually exclusive; therefore, selecting one check box has no effect on others on the window. If you want the user to be able to select only one option from two or more, use radio buttons instead. See "Radio Button" on page 142 for more information.

To set the state of a check box, the user can either click on it with the mouse, press the space bar on the keyboard when the check box is in focus, or (if you have assigned one) press the mnemonic key.

Part Attributes

AddLink*	AllowLink*	BackColor	BackMix
Bottom	Checked	Enabled	Focus
FontBold	FontItalic	FontName	FontSize
FontStrike*	FontUnder*	ForeColor	ForeMix
Handle*	Height	Highlight*	Label
Left	ParentName	PartName	PartType
Refresh	RemoveLink*	ShowTips	TipText
Top	UserData	Visible	Width

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	MouseEnter	MouseExit
MouseMove	Popup	Select	

Setting the State of a Check Box Part

Set the **Checked** attribute to one of the following values to describe the state of the check box:

1 The check box is set and the state is turned on.

0 The check box is not set and the state is turned off.

The check box contains a check mark when its state is on.

Setting a Mnemonic

Note: Mnemonics are not supported in Java applications.

To specify a mnemonic key for the check box, place the mnemonic identifier in front of a character in the check box label. For Windows, use an ampersand (&). This character is the mnemonic key and will be displayed on your interface with an underscore (for example, **Visible**). The underscore informs users that they can select the check box by pressing the underlined character on the keyboard.

Signaling Events

When the user selects a check box to turn the state either on or off, a **Select** event is signaled.

Combination Box

A combination box provides the user with the option of entering specific information, or selecting from a list of commonly used choices.

It consists of an entry field with an attached list box that presents a list of values which the user can scroll through. If the user selects one of these values, it will appear in the entry field and replace any existing text. Alternatively, the user can type a value, that does not have to match any of the listed ones, directly into the entry field.

Combination boxes come in different styles. You can select the style you want from the part's properties notebook

For related information, see:
- "List Box" on page 92
- "Entry Field" on page 75

Part Attributes

AddItemEnd	AutoScroll*	BackColor	BackMix
Bottom	Case*	Count	DelimChar
DeSelect*	DragEnable*	DropEnable*	Enabled
FieldExit	FirstSel	Focus	FontBold
FontItalic	FontName	FontSize	FontStrike*
FontUnder*	ForeColor	ForeMix	GetItem
Handle*	Height	Index	InsertItem*
ItemKey	Left	ParentName	PartName
PartType	ReadOnly	Refresh	RemoveItem
Search*	SearchType*	Selected	SelectItem
Sequence*	SetItem	SetTop*	Showtips
SizeToFit*	Text	TipText	Top
UseDelim	UserData	Visible	Width

*** Note:** See the attribute description for restrictions.

Applicable Events

Change	Create	Destroy	Drop*
DropDown*	Enter	GotFocus	KeyPress
LostFocus	MouseEnter	MouseExit	MouseMove
Popup	Select	VKeyPress	

* **Note:** See the event description for restrictions.

Selecting the Type of Combination Box

In the combination box properties notebook, choose the type of combination box you want to create:

Combination box
Displays both the entry field and the list box portions of the combination box.

Drop-down combination box
Displays the entry field portion. The list box portion is hidden until the down arrow (⇓) is pressed.

Drop-down list combination box
Displays the entry field portion. The list box portion is hidden until the down arrow (⇓) is pressed. The entry field does not accept text; it is used only to display the selection from the list box portion.

Note: All types of combination boxes support dragging from the entry field portion. Only the simple combination box supports dragging from the list box portion. All types support dropping onto the entry field portion, not onto the list box portion.

Adding and Setting the Initial Sequence of Items

You can use the combination box properties notebook to place an initial list of items in a combination box at design time.

By default, items are displayed in the combination box in the order in which you added them. If you want them displayed in a more precise order, then before you start adding them, set the **Sequence** attribute to either ascending, descending, or index. This sorts the items in ASCII collating sequence as they are added.

You cannot use the **Sequence** attribute to change the order of items that are already in the combination box.

Adding Items at Run Time

You can insert items into a combination box at run time by using the **InsertItem** attribute. The order in which items are displayed is determined by the **Sequence** attribute.

Updating Items in a List

You can update items that are already in the list. Use the **Index** attribute to indicate which item you want to change, and then use the **SetItem** attribute to set the changed data.

Note: The **SetItem** attribute replaces an item to its original location in a list, regardless of the value you set for the **Sequence** attribute. For example, if

you had set the **Sequence** attribute to ascending order before the combination box was filled, the items appear in the combination box in ascending sequence; however, if you then retrieve an item, change its value, and use the **SetItem** attribute to replace it in the combination box, the item is inserted in the same position it was in before. Therefore, the list may or may not be in ascending sequence after the change.

Setting the Top of the List

Use the **SetTop** attribute to specify which list item should appear at the top of the combination box. Setting this item does **not** reorder the items in the list; it scrolls the list so that the item you select is displayed at the top, followed by the items that came after it.

Removing Items

Use the **RemoveItem** attribute and the **Index** value of the item you want to remove. **Index** values start at *1*. When an item is removed from the list, all items following the removed item are moved up one position in the list.

To remove all items in the list, specify an **Index** value of *0*.

Selecting and Deselecting Items

The user can select and deselect items by using the mouse or the keyboard. You can select and deselect items using the **Selected** and **DeSelect** attributes in your program. Before you use these attributes, set the **Index** attribute.

Retrieving a User-Selected Item

When the user selects an item from the list in a combination box, that item is placed into the entry field. You can use the **Text** attribute to get the item. Also, you can use the **FirstSel** attribute to determine the index of the item that was selected.

The user may also type a value into the entry field portion of the combination box. This value does not have to be one of those in the list. If you want the user to be able to select only items that are in the list, set the **ReadOnly** attribute value to *0*.

You can use the **Count** attribute to determine if there are items to retrieve.

Using Keys

Both the list box and the combination box allow you to add items to the list that consist of a 'key' portion and a 'data' portion. When items are added to the list, only the data portion of the item is displayed. When the user selects an item you can programatically retrieve the key portion of the item.

To enable keys in a list, you must check the 'Use separator' check box on the 'Separator' page of the parts settings notebook and specify a separator character. The default separator character is the semicolon (;). The items in the list consist of the key portion, followed by the separator, followed by the data portion. For example:

```
01;Shipping
```

As an example, assume you wish to display a list of departments in a list allowing the user to make a selection. In your database you store the department as a 2 character field but you want the user to see the descriptive name. You would add the following data to the list:

- 01;Shipping
- 02;Manufacturing
- 03;Payroll
- 04;Distribution

Note: With the combination box you can add the default list on the Data page of its settings notebook.

When the user makes a selection from the list the following code could be used to get the key portion of the item

```
C     'Combo1'      Getatr    'FirstSel'    X                2 0
C     'Combo1'      Setatr    X             'Index'
C     'Combo1'      Getatr    'ItemKey'     Key
```

Setting the Entry Field Text

When a combination box is first displayed, its entry field is blank. If you want to place one of the list items in the entry field, set the **SelectItem** attribute value with the index of the item to be used.

Signaling Events

The **Select** event is signaled when:

- The user selects an item that is in a combination box.
- You select an item in the list in your program.
- The user selects an item that is already selected.

The **Enter** event is signaled when:

- The user double-clicks on an item that is in the combination box
- The Enter key is pressed when the list box has focus and an item has been selected.

In your action subroutine for these events, you can use the **Selected** attribute to determine which item was selected.

Component Reference

The component reference part enables one VARPG component to communicate with another. You use the component reference part to affect a part on the other component. The component being referenced must be running in the same application as the component reference part.

The component reference part also monitors a specified event in the other component. When the monitored event occurs, a **Notify** event is signaled by the component reference part.

Part Attributes

AddSrcEvt	AttrValue	Bottom	CompName
Left	NotSrcEvt	NotSrcPart	NotSrcWin
ParentName	PartName	PartType	RefAttr
RefParent	RefPart	RmvSrcEvt	UserData
Visible			

Applicable Events

Create	Destroy	Notify

Referencing Part Attributes in Other Components

There are two methods you can use to reference an attribute of a part in another component:

1. Define the attribute in the properties notebook of the component reference part.
2. Set the appropriate component reference part attributes at run time.

Before you can reference part attributes in another component, you must ensure that the other component is running. Use the START operation code to start another component.

The following code fragment illustrates how a component reference part in one component can change the value of a part attribute in another. In this example, the **FileName** attribute of an image part (IMG1) on window WIN01 in component COMPB is being updated with a new value.

```
 *
 * Change the bitmap for image part IMG1 on
 * window WIN01 in component COMPB
C     'CR1'         Setatr    'COMPB'       'CompName'
C     'CR1'         Setatr    'WIN01'       'RefParent'
C     'CR1'         Setatr    'IMG1'        'RefPart'
C     'CR1'         Setatr    'FILENAME'    'RefAttr'
C     'CR1'         Setatr    'D:\PIC.BMP'  'AttrValue'
 *
```

Monitoring for Events in Another Component

You can use the component reference part in one component to monitor for an event that occurs in another component running in the same application. Define the event to be monitored in the component reference part's properties notebook, or at run time by setting the appropriate attributes. When the event being monitored in the other component occurs, a **Notify** event is signaled by the component reference part.

The following code fragment shows how a component reference part can be set at run time to monitor for an event in another component. In this example, the event being monitored is the **Press** event for a push button called PB1 on window WIN01 in component COMPB.

```
 *
 * Monitor for the PRESS event of push button
 * PB1 on window WIN01 in component COMPB
C     'CR1'         Setatr    'COMPB'       'CompName'
C     'CR1'         Setatr    'PRESS'       'NotSrcEvt'
C     'CR1'         Setatr    'PB1'         'NotSrcPart'
C     'CR1'         Setatr    'WIN01'       'NotSrcWin'
 *
```

Container

Use the container part to store related records. The records can be shown in an icon view, tree view, text tree view, or details view.

Part Attributes

AddRcd	Arrange	BackColor	BackMix
BlankChar	Bottom	ChildCount	ChildList
Collapsed	ColNumber	Count	DeleteRcd
DeSelect	EditItem	Enabled	ExtSelect*
FirstSel	Focus	FontBold	FontItalic
FontName	FontSize	FontStrike*	FontUnder*
ForeColor	ForeMix	GetNewID	GetRcdFld
GetRcdIcon	GetRcdText	Handle*	Height
InUse*	Label	Left	MiniIcon
ParentId	ParentList	ParentName	PartName
PartType	ReadOnly	RecordID	Refresh
RemoveRcd	Selected	SelectRcd	SetRcdFld
SetRcdIcon	SetRcdText	SetTop*	ShowTips
SortAsc	SortDesc	TipText	Top
UserData	View*	Visible	VisTitle
VisTitlSep	Width		

* **Note:** See the attribute description for restrictions.

Applicable Events

Click	Collapsed	ColSelect	Create
DblClick	Destroy	Enter	Expanded
GotFocus	KeyPress	LostFocus	MouseDown
MouseEnter	MouseExit	MouseMove	MouseUp
Popup	Select	VKeyPress	

Adding Columns to a Container

In a details view, a record corresponds to a row in the container part, and each column in that row corresponds to a field in that record. Before you can add a record to a container, you must add the columns required to display the fields by using the container part's properties notebook.

You have to specify which of the following four types of columns you want to create:

Object text

An object text column displays the descriptive text that is specified when the record is created. You can change the text at run time with the **SetRcdText** attribute. Users can change this text at run time by pressing the Alt key and selecting the field with the mouse. To get the value of this column, use the **GetRcdText** attribute.

Object icon
An object icon column displays the icon file that is specified when the record is created. You can change the icon file name at run time using the **SetRcdIcon** attribute.

Text Text is a string containing additional information. A text column can contain any string value. The text cannot have any blanks in it. If you want a blank to appear at run time, use an underscore (_) character in the string. Use the **SetRcdFld** attribute to change this text at run time. Users can change the text at run time by pressing the Alt key and selecting the field with the mouse. To get the value of this column, use the **GetRcdFld** attribute.

Icon An icon shows additional graphical record information. An icon column displays an icon file. Use the **SetRcdIcon** to change the icon file name at run time.

You can add up to 20 columns to a container part. Of these, up to 15 can be some combination of object text and text columns, and up to five can be object icon columns and icon columns. Note that under Windows, only the first column can contain an icon.

The number of columns and column types cannot be changed at run time. If you add records that have more fields than the number of columns in the container, the extra fields are ignored.

Adding Records to a Container

In your code, use the **AddRcd** attribute to add records to a container. This attribute consists of a string of the following:

```
ID Text FileName ParentID {field_data field_data ...}
```

Blanks are used as delimiters. The parameters are:

ID A unique numeric value you give to a record. This number must be greater than zero. To ensure that you assign a unique ID to each record you create, use the **GetNewID** attribute.

Text The text that is displayed with the object icon. The text can be changed at run time by using the **SetRcdText** attribute.

FileName
The name of a file containing the icon image for an object icon column. This icon is displayed in the container's Icon and Tree views. You can change the icon file name at run time using the **SetRcdIcon** attribute.

ParentID
The unique ID of the record under which this record will appear. If this record does not have a parent record, put a *0* in this field.

Field_data
Additional information for a record that is displayed in a text or icon column. Each *field_data* value updates a corresponding column in the container part. If you want to have an empty text column or icon container column, you must specify an underscore (_) in the corresponding *field_data* parameter.

The following code fragment shows the parameters that are specified to add a sample record to a container. No column data is added in this example.

```
 *
 * This is not a child record
C                   Eval      Parent = '0'
 *
 * Use the icon text specified in the GUI designer
C                   Eval      IconText = '_'
 *
 * Set the icon file name to be used for this record
C                   Eval      IconFile = '.\\TOM.ICO'
 *
 * Get a new container record ID and make it character
C     'CT1'         Getatr    'GetNewId'    NextIDN           6 0
C                   Move      NextIDN       NextID            6
 *
 * Create the container record structure
C                   Eval      NextRcd = NextID + ' ' +
C                                       IconText + ' ' +
C                                       IconFile + ' ' +
C                                       Parent
 *
 * Add the record to the container
C     'CT1'         Setatr    NextRcd       'AddRcd'
 *
```

Use the **Count** attribute to determine how many records are in a container.

Updating Container Columns

Once a record has been added to a container, the data in the record fields is displayed in the corresponding columns of the container. You can update data in individual container text columns by updating the record fields.

Note: You can update only the data in the columns; you cannot change the number of columns in the container. The number of columns is set when you create the container in the GUI Designer.

To update a column, set the **RecordID** attribute to the record that corresponds to that column, and set the **ColNumber** attribute to the field on that record that contains the updated data. The following code fragment illustrates how to update the third column in a container:

```
 *
 * Set the record id to be referenced
C     'CT1'         Setatr    NextIDN       'RecordID'
 *
 * Reference the third column in the record
C     'CT1'         Setatr    3             'ColNumber'
 *
 * Update the column with the new data
C     'CT1'         Setatr    'Larry'       'SetRcdFld'
 *
```

If you want the new column value to contain imbedded blanks, use the underscore character to represent each blank. The underscore characters are replaced by blanks when the column is updated. For example:

```
 *
 * 'New data' is set in the column
C     'CT1'         Setatr    'New_data'    'SetRcdFld'
 *
```

Use the **GetRcdFld** attribute to retrieve the contents of a record field. Set the **RecordID** attribute to the unique ID of the record, and the **ColNumber** attribute to the desired column number.

Removing Records from a Container

Use the **RemoveRcd** attribute to remove records from a container part and to remove the record ID that uniquely identifies that record. To remove all records in the container, set the record ID value to zero.

The following code fragment illustrates how a record is removed from a container:

```
 *
 * Get ID of first selected record
C     'CT1'         Getatr    'FirstSel'    TmpID             6 0
 *
 * If a record was selected, remove it from the container
C                   If        TmpID <> 0
C     'CT1'         Setatr    TmpID         'RemoveRcd'
C                   EndIf
 *
```

Changing the Container View

To change the view, use the **View** attribute. The container part can display the following views of the data: icon, tree icon, tree text, and details.

Icon view

An icon view has each record represented by an icon, with text beneath it. Child records are not displayed in icon view. You specify the icon file name and the descriptive text in the record structure when you add the record to the container.

You can change the icon and icon text at run time by using the **SetRcdIcon** and **SetRcdText** attributes.

To have the icons displayed in rows in the container, set the **Arrange** attribute to *1*.

To use mini icons, set the **MiniIcon** attribute to *1* or check the Mini Icon box on the properties notebook's 'Style' page.

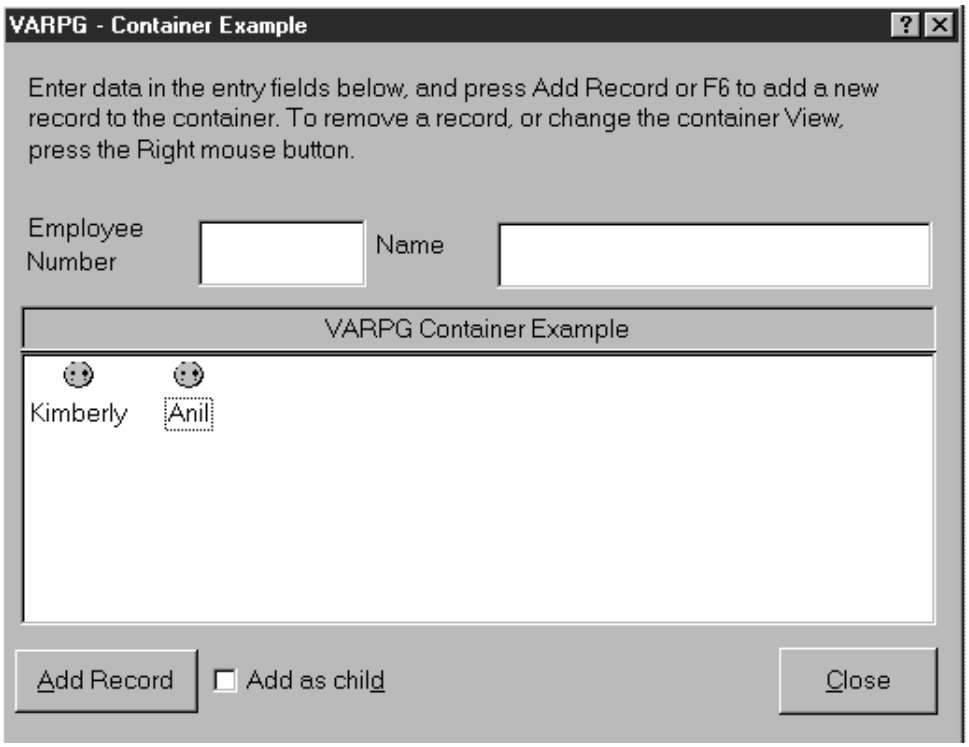


Figure 15. Sample icon view

Tree view

In a tree view, records are presented in a hierarchy. The **tree icon** view displays each record with its icon and icon text beside it. If a record has child records, a plus sign is displayed next to its icon. Selecting the plus sign shows all the records related to this record. The **tree text** view displays records in the same way as the tree icon view, except in text-only mode, without icons.

Connecting lines are drawn between related records to show their relationship.

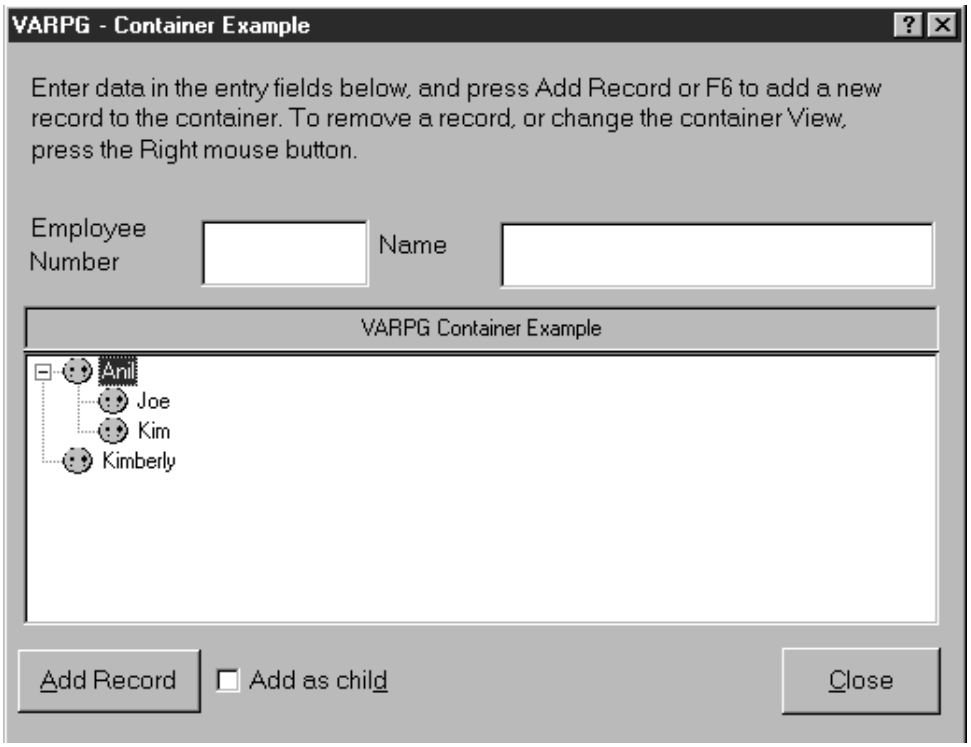


Figure 16. Sample tree view

Details View

In a details view, records are shown one after the other with each column displayed (similar to a subfile). Child records are not displayed in this type of view.

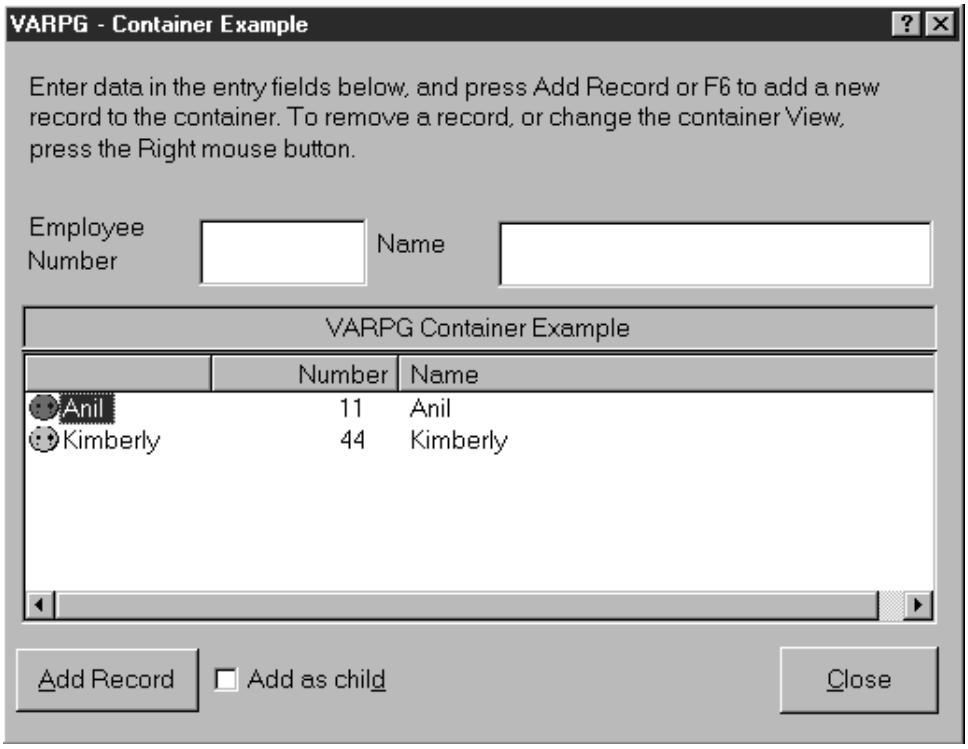


Figure 17. Sample details view

If the container is not large enough to display all records at once, scroll bars are automatically added.

To change the view, use the **View** attribute.

Mini Icons

This option allows the programmer to specify whether the icons contained in the container part will be shown as regular icons, or as mini icons. This will only affect the icon view, and will leave the tree and details views unchanged.

DDE Client

*** Restriction:** This part is unsupported in Java applications.

Use the DDE client part to exchange data with other applications, such as spreadsheet applications, that support the dynamic data exchange (DDE) protocol.

The exchange is called a **DDE conversation**. The application that initiates the conversation is the **client**, and the application that responds is the **server**. To determine if an application supports DDE, refer to the documentation that came with it.

The DDE client part supports both **cold-link** and **hot-link conversations**. A cold-link conversation consists of a client program making explicit requests to the server program. A hot-link conversation consists of a server program automatically updating the client program when its data changes.

You can configure cold-link or hot-link conversations from the DDE client part's properties notebook and in your program logic.

Part Attributes

AppName	Bottom	DDEAddLink	DDEMode
DDERmvLink	Execute	Format	Item
Left	ParentName	PartName	PartType
Poke	Request	TimeOut	Top
Topic	UserData	Visible	

Applicable Events

Create	Data	Destroy	ExecuteAck
PokeAck	Terminate	TimeOut	

Entry Field

Use the entry field part if you want the user to input something that you cannot predict the value of. An entry field is an area into which the user can type or place text. Its boundaries are usually indicated. The user can scroll through the text in the entry field if more information is available than is currently visible.

You can configure the entry field part to accept character, numeric, or double-byte character set (DBCS) data.

You can also make the entry field read-only, so that it contains information that cannot be directly altered by the user.

You can point and click on an entry field part in the parts palette and then click it onto the subfile part to create a subfile entry field.

Part Attributes

AddLink*	Alignment	AllowLink*	AutoScroll*
AutoSelect	BackColor	BackMix	Bottom
CapsLock	Copy	CsrAtEnd	Cut
DataType	Delete	DragEnable*	DropEnable*
Enabled	FieldExit	Focus	FontBold
FontItalic	FontName	FontSize	FontStrike*
FontUnder*	ForeColor	ForeMix	Handle*
Height	InsertMode*	Left	Masked
ParentName	PartName	PartType	Paste
ReadOnly	Refresh	RemoveLink*	ShowTips
Text	TextEnd	TextLength	TextSelect
TextStart	TipText	Top	UserData
Visible	Width		

* **Note:** See the attribute description for restrictions.

Applicable Events

Change	Click	Create	DblClick
Destroy	Drop	GotFocus	KeyPress
Link*	LostFocus	MouseDown	MouseEnter
MouseExit	MouseMove	MouseUp	Popup
VKeyPress			

*** Note:** See the event description for restrictions.

Using the InsertMode Attribute

In Windows, insert mode is always on. It cannot be turned off.

Using the Text Attribute

Use the **Text** attribute to get or set the value of an entry field. The field you use to do this must be defined as the same type as the entry field. For example, if you are getting the value of a numeric entry field, the field that receives the value must also be defined as numeric.

Getting and Setting Information for a Window

During compilation, the compiler implicitly defines fields in your program with the same name as the entry field part, and with the same data type and length. By using the READ and WRITE operation codes with a window name specified in factor 2, the **Text** attribute value is automatically copied to or from these fields. The READ and WRITE operation codes are most useful if you have many entry fields in your user interface because you do not have to execute a series of get and set attributes.

See Chapter 3, “Programming with Parts,” on page 25 for more information.

Validity Checking

You can use the properties notebook to specify that an entry field should accept only data that meets criteria you specify. To ensure that the data matches certain values, set the **Compare** values. To ensure that the data falls within a range of predefined values, set the **Range** values.

Note: VisualAge RPG uses the ASCII collating sequence for validity checking. This differs from the server, which uses the EBCDIC collating sequence. Therefore, results may vary between systems.

To have validity checking performed, you must have at least one push button or graphic push button on the window that has the **Validate** attribute set. When the push button is pressed, validity checking is performed for each entry field that has validity checking criteria defined. If any of the entry fields fail this validity check, a message window is displayed and no press event is signaled to your program.

You can also use the field at the top of the properties notebook to set the message that is displayed if the validity check fails. Either enter the text of the message to be diplayed or the named message file (such as *MSG0001) to have the corresponding message appear. If this field is left blank, the default system message is displayed whenever there is a validity check failure.

Note: There is a 15 character limit on this field.

Preventing User Input

To prevent the user from entering data in an entry field, do one of the following:

- Set the **ReadOnly** attribute to *1*. After you set this attribute, you can still change the value of the entry field in your program.
- Set the **Enabled** attribute to *0*. After you set this attribute, the entry field does not respond to events and the user cannot tab to it.

Masking Sensitive Data

If the entry field contains sensitive data, such as a password or an account number, set the **Masked** attribute to *1*. When this attribute is set, the asterisk character (*) appears in the entry field for each character typed. This does not affect the actual data read from the entry field.

Graph

The graph part allows you to create and design a graph in your project. At runtime, you can send data to the graph and change graph attributes and the graph type. The graph part supports Pie, Line, Bar, and Line and Bar graph types.

The Bar and Line graph types support the **ToolTip** text control. When enabled, moving the mouse over a data point displays the tooltip text control. To use this support in your program logic, set the value for the point into the **TipText** attribute and set the **ShowTips** attribute on for the window that contains the graph part.

Part Attributes

AutoInc	BarLabel	Bottom	Color
ColorArea	ColorMix	DataGroup	DataPoint
DataValue	Enabled	FillStyle*	FontArea
FontBold	FontItalic	FontName	FontSize
FontStrike*	FontUnder*	GnEqGrpCol	GnEqPntCol
GraphType	GroupLabel	GrphHiLite	Handle*
Height	HitItem*	HlitPoints*	LabelPlace
Left	LegendType	ParentName	PartName
PartType	Refresh	StartNew	TipText
Title	TitlePlace	Top	UnderPoint*
UseData	UserData	Visible	Width
XAxisLabel	YAxisLabel	YInc	

*** Note:** See the attribute description for restrictions.

Applicable Events

Click	Create	DblClick	Destroy
MouseDown	MouseEnter	MouseExit	MouseMove
MouseUp	Popup		

Sending data to the Graph

Before you send data to the graph, you must indicate which **DataGroup** and which **DataPoint** is to receive the value. The **DataPoint** attribute represents the positional element of the graph that represents the value. For a Bar chart, this would be a Bar. For a line graph, a point, and for a Pie graph, which slice. The **DataGroup** is optional. This attribute indicates that there are groups of data to be graphed. The default **DataGroup** is one. Setting the **DataValue** attribute sets the value of the selected element.

As an example of a **DataGroup**, assume you wish to plot the high and low temperature of each month for a given year. This graph would have two data groups. The first would represent the low temperature for a month and the second the high temperature for the month. For this graph, you first set the **DataGroup** attribute to 1. Then, in a loop, you would set the **DataValue** for each **DataPoint** to the low temperature value. To complete the graph repeat the same steps for the high temperatures by setting the **DataGroup** to 2.

Sending data to the graph does not update the graph. You must set the **UseData** attribute to display the data.

The following code fragment shows how this may be done:

```
 *
C                   Do        2             Group             2 0
C     'Graph1'      Setatr    Group         'DataGroup'
 *
C                   Do        12            Point             2 0
C     'Graph1'      Setatr    Point         'DataPoint'
 *
C                   If        Group = 1
C     'Graph1'      Setatr    Low(Point)    'DataValue'
 *
C                   Else
C     'Graph1'      Setatr    High(Point)   'DataValue'
C                   Endif
 *
C                   EndDo
 *
C                   EndDo
 *
C     'Graph1'      Setatr    1             'UseData'
```

Figure 18. Sending data to the graph

If the graph is a pie graph, each group is represented as a separate pie.

Graphic Push Button

Use graphic push buttons to provide convenient access to frequently used actions.

A graphic push button provides the same function as a push button. It indicates an action that will be initiated when the user selects it, but instead of displaying a label to describe its function, it displays an image. The **FileName** attribute specifies the name of the image to use.

Valid **Windows** image formats include:
- Windows and OS/2® Bitmaps (BMP, VGA, BGA, RLE, DIB, RL4, RL8)
- Icon (ICO)
- Microsoft/Aldus Tagged Image File Format (TIF, TIFF)
- CompuServe Graphics Interchange Format (GIF)
- ZSoft PC Paintbrush Image File Format (PCX)
- Truevision Targa/Vista Bitmap (TGA, VST, AFI)
- Amiga Interleaved Bitmap Format (IFF, ILBM)
- X Windows Bitmap (XBM)
- IBM Printer Page Segment (PSE, PSEG, PSEG38PP, PSEG3820)
- Joint Photographic Experts Group format (JPG, JPEG)

Note: This product's support for the JPG/JPEG format is based in part on the work of the Independent JPEG Group.

Valid **Java** image formats include:
- CompuServe Graphics Interchange Format (GIF)
- Joint Photographic Experts Group format (JPG, JPEG)

For related information, see "Push Button" on page 140.

Part Attributes

Bottom	Enabled	FileName	Focus
Handle*	Height	HelpEnable	HighLight
Left	ParentName	PartName	PartType
Refresh	ShowTips	TipText	Top
UserData	Validate	Visible	Width

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	GotFocus	LostFocus
MouseEnter	MouseExit	MouseMove	Popup
Press			

Setting the Image

To set the image that is displayed on a graphic push button, use the **FileName** attribute, and specify a valid bitmap (.BMP) or icon (.ICO) file name. You must store system-specific bitmap and icon files in the appropriate runtime directory. For more information, see Chapter 12, “Using Picture, Sound, and Video Files,” on page 243.

Assigning Command Keys

You can assign a command key to a graphic push button. To do this, open the properties notebook and select one of the command keys from the available list. When the user presses the command key at run time, it has the same effect as pressing the mouse button or a key on the keyboard. A **Press** event is signaled to your program.

Signaling Events

When the push button is pressed, a **Press** event is signaled to your program.

Group Box

Use a group box to visually distinguish a group of parts in a window.

A group box is a rectangular box that is drawn around a group of parts to indicate that they are related. It is generally advisable to label a group box. If a label is not needed, you can use an outline box.

Part Attributes

Bottom	Enabled	FontBold	FontItalic
FontName	FontSize	FontStrike*	FontUnder*
ForeColor	ForeMix	Handle*	Height
Label	Left	ParentName	PartName
PartType	Refresh	Top	UserData
Visible	Width		

Note: See the attribute description for restrictions.

Applicable Events

Create	Destroy

Labeling a Group Box

Use the **Label** attribute to specify what string is to be used for the group box label.

Grouping Radio Buttons

See “Grouping Radio Buttons” on page 142 for related information.

Horizontal Scroll Bar

Use the horizontal scroll bar part to allow users to scroll through a pane of information from left-to-right, or right-to-left. The information can be a list of files, records in a database, columns in a document, and so on. You can use the **Range** attribute to represent the total number of objects to be scrolled through and the **PageSize** attribute to determine the number of objects that can be displayed on a page.

Part Attributes

Bottom	Enabled	Focus	Handle*
Height	Left	NextLine	NextPage
PageSize	ParentName	PartName	PartType
Position	PrevLine	PrevPage	Range
Top	UserData	Visible	Width

* **Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	Scroll

Image

Use the image part to display a picture. The **FileName** attribute specifies the name of the image to use.

Valid **Windows** image formats include:
- Windows and OS/2 Bitmaps (BMP, VGA, BGA, RLE, DIB, RL4, RL8)
- Icon (ICO)
- Microsoft/Aldus Tagged Image File Format (TIF, TIFF)
- CompuServe Graphics Interchange Format (GIF)
- ZSoft PC Paintbrush Image File Format (PCX)
- Truevision Targa/Vista Bitmap (TGA, VST, AFI)
- Amiga Interleaved Bitmap Format (IFF, ILBM)
- X Windows Bitmap (XBM)
- IBM Printer Page Segment (PSE, PSEG, PSEG38PP, PSEG3820)
- Joint Photographic Experts Group format (JPG, JPEG)

Note: This product's support for the JPG/JPEG format is based in part on the work of the Independent JPEG Group.

Valid **Java** image formats include:
- CompuServe Graphics Interchange Format (GIF)
- Joint Photographic Experts Group format (JPG, JPEG)

These files reside on the programmable workstation (PWS), not on the host. You should store system-specific bitmap and icon files in the appropriate runtime directory (RT_JAVA, or RT_WIN32) so that the packaging utility includes them when you package your application.

Note: The image part can only be dropped on a notebook page with canvas or window with canvas.

Part Attributes

AddLink*	AllowLink*	BackColor	BackMix
Border	Bottom	Enabled	FileName
Handle*	Height	Left	Magnify
Panel	ParentName	PartName	PartType
Print	PrintAsIs	Refresh	RemoveLink*
ShowTips	TipText	Top	UserData
Visible	Width		

* **Note:** See the attribute description for restrictions.

Applicable Events

Click	Create	DblClick	Destroy
Link*	MouseEnter	MouseExit	MouseMove

* **Note:** See the event description for restrictions.

Creating the Image Part

The image part can be created only on a canvas part.

Setting the File Name

To display a picture in the image part, set the **FileName** attribute with the name of the file containing the image. In Windows applications, the file must contain a valid bitmap or icon image. In Java applications, the file must contain a valid GIF or JPG image. The image may appear differently on individual workstations depending on the display device driver. If you specify a file name that is not valid, no picture will be displayed. You can clear the image part by setting the **FileName** attribute to blanks. If you get an error (such as *File not found*) when using the SETATR operation code to set a file name, the error indicator is turned on. For more information, see Chapter 12, “Using Picture, Sound, and Video Files,” on page 243.

Controlling the Magnification Panel

By default, the image part is created with a magnification panel. You can remove the magnification panel by disabling it in the properties notebook of the image part.

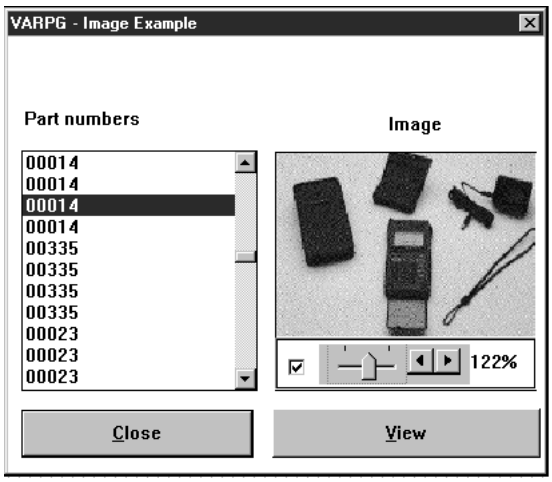
You can also enable or disable the magnification panel by using the **Panel** attribute in your program. If you set the **Panel** attribute to *0*, the magnification panel is not displayed, and more of the picture can be shown. If you set it to *1*, the magnification panel is displayed, and there is less room for the picture to be shown.

You can set the amount of magnification in your program. The magnification value is represented by a percentage between 25 and 200. Specifying a value of 0 will result in the best fit, where the image will just fit in the image window while keeping the horizontal to vertical ratio constant.

Image Example

In this example, a file is read from the iSeries 400 server. Each record in the file contains a part number field, which is inserted into the list box as each record is

read. When the user selects a part number in the list box and presses the **View** push button, the part number is concatenated with the string *.BMP* to form a file name. That file name is then used to set the **FileName** attribute of the image part to display the picture. The **Label** attribute of the PINFO static text part is updated to indicate the result of setting the file name attribute. Press the **Close** push button to terminate the program.




```
*********************************************************************
*                                                                   *
* Program ID . . : IMAGE                                            *
*                                                                   *
* Description  . : Example of the Image Part                        *
*                                                                   *
*                  This sample program illustrates how the image    *
*                  part can be implemented in VARPG Client.         *
*                                                                   *
*                  The example assumes there is file on the host    *
*                  AS/400 system called PARTS. That file format     *
*                  consists of a field called PARTNO.               *
*                                                                   *
*                  When the application is started, the Create      *
*                  event for window WIN1 is invoked which reads all *
*                  records from the file and inserts the PARTNO     *
*                  field value into list box LB1.                   *
*                                                                   *
*                  When the user presses the View push button,      *
*                  the image file name is constructed and used to   *
*                  set the FILENAME attribute of the image part     *
*                  IMG1.                                            *
*                                                                   *
*********************************************************************
 *
H
 * Define the PARTS file
 *
FPARTS     IF   E            DISK    REMOTE
 *
DPath            C                   ''
dnopic           C                   'Picture not available'
 *
```

Figure 19. Sample Using the Image Part (Part 1 of 3)

```
 ********************************************************************
 *                                                                  *
 * Window . . : WIN1                                                *
 *                                                                  *
 * Part . . . : Close                                               *
 *                                                                  *
 * Event  . . : Press                                               *
 *                                                                  *
 * Description: Terminate the program                               *
 *                                                                  *
 ********************************************************************
 *
C     CLOSE         BEGACT    PRESS         WIN1
 *
C                   move      *on           *inlr
 *
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Window . . : WIN1                                                *
 *                                                                  *
 * Part . . . : WIN1                                                *
 *                                                                  *
 * Event  . . : Create                                              *
 *                                                                  *
 * Description: This action subroutine is executed when window WIN1  *
 *              is created.                                         *
 *              It will fill the list box with the part number values*
 *              from the PARTS file.                                *
 *                                                                  *
 ********************************************************************
 *
C     WIN1          BEGACT    CREATE        WIN1
 *
 * Fill the listbox part with items from the database
C                   read      produc1                           9999
 *
C     *in99         doweq     *off
C     'LB1'         setatr    partno        'InsertItem'
C                   read      produc1                           9999
C                   enddo
 *
C                   ENDACT
 *
```

Figure 19. Sample Using the Image Part (Part 2 of 3)

```
 ********************************************************************
 *                                                                  *
 * Window . . : WIN1                                                *
 *                                                                  *
 * Part . . . : VIEW                                                *
 *                                                                  *
 * Event  . . : PRESS                                               *
 *                                                                  *
 * Description: Display the image for the selected part             *
 *                                                                  *
 ********************************************************************
 *
C     VIEW          BEGACT    PRESS         WIN1
 *
 * Get index of selected item
C     'LB1'         getatr    'FirstSel'    x                4 0
 *
 * If an item was selected, build the bitmap file name
C     x             ifgt      *zero
C     'LB1'         setatr    x             'Index'
C     'LB1'         getatr    'GETITEM'     tmp20           20
C                   movel     tmp20         part             5
C                   endif
 *
C                   move      *blanks       fullpath        64
C                   move      *blanks       tmp64           64
C     path          cat       part:0        tmp64
C     tmp64         cat       '.gif':0      fullpath
 *
 * Set the file name in the image FILENAME attribute
 * to display the image
C     'IMG1'        setatr    fullpath      'FILENAME'            80
 *
 * If indicator 80 is on, the set the image file name
 * failed. i.e. the file was not found.
 * Set the Label attribute for the static text part PINFO to
 * indicate status
C     *in80         ifeq      *on
C     'PINFO'       setatr    nopic         'Label'
 *
C                   else
C     'PINFO'       setatr    *BLANKS       'Label'
C                   endif
 *
C                   ENDACT
 *
```

Figure 19. Sample Using the Image Part (Part 3 of 3)

Java Bean

*** Restriction:** This part is unsupported in Windows applications.

Use the Java Bean part to add JavaBeans® to your project. You can use JavaBeans by calling Java methods, directly. For more information on calling Java methods, see Chapter 18, “Calling Java Methods from VisualAge RPG Programs,” on page 279.

To develop applications that use the Java Bean part, you must have Sun Microsystem’s Java 2 Software Development Kit (J2SDK), Standard Edition, version 1.2 or higher, installed on your workstation. If you do not have the J2SDK, you can download it from Sun Microsystems at the following URL:

```
http://java.sun.com/products/
```

After installing the J2SDK, set the PATH environment variable to point to the location of the Java compiler. For example, if your home directory for the J2SDK is *x:\jdk1.2*, add the following path statement:

```
x:\jdk1.2\bin
```

Also, set the JVM_DIR environment variable to point to the location of the **jvm.dll**, which is part of the J2SDK and JRE (Java Runtime Environment). For example, if your home directory for the J2SDK is *x:\jdk1.2*, set JVM_DIR to the following statements:

```
x:\jdk1.2\jre\bin\classic
```

Part Attributes

AddEvent	Bottom	Enabled	Height
Left	ParentName	PartName	PartType
RmvEvent	ShowProp	Top	UserData
Visible	Width		

Applicable Events

Create	Destroy	BeanEvent

Adding Beans to your Project

To add a bean to your project, click on the Java Bean part in the parts palette. Click the mouse pointer onto the design window where you want the bean placed. A file Open dialog appears. Select the JAR file containing the bean (or beans) you want to work with. A window appears listing all the beans available in the JAR file. After you select a bean from the list, the bean will be instantiated. It will be shown in a seperate window together with the associated property-sheet dialog and the bean-customizer, if available. (You can change the properties of the bean through the property-sheet dialog and the bean customizer.)

To show the properties, methods, and events for a bean, open the Java Bean Part Properties notebook from the design window. Right-click on the Java Bean icon in

the design window and select **Properties**. The properties, methods, and events of a bean are on the Information page. Select the appropriate radio button to view what is available.

Not all bean events are supported. VARPG-supported events are prefixed with an asterisk(*) in the Events list.

Location of Bean JAR Files

All bean-related JAR files for the project should be in the internal bean directory, `x:\...\WDSC\beans`, where *x:\...\WDSC* is the home directory where VARPG is installed. This directory should include any bean-dependent JAR files, as well. For example, if BeanA is found in BeanA.jar and requires class files in beanclass.jar, both BeanA.jar and beanclass.jar must be copied to the internal bean directory.

While editing a project, you may select a bean from a JAR file that is not in the internal bean directory. This JAR file will be copied to the internal bean directory after you build the project. However, you still need to copy any bean-dependent JAR files to this directory.

Remove any unused JAR files from the internal bean directory. Doing this avoids the loading of unnecessary, non-project JARs.

Setting the JAR Classpath

The VARPG packaging utility does not handle the classpath setup for JAR files. You must set the classpath variable to include all the JAR files used by the beans in your project. For example, if BeanA uses BeanA.jar and depends on beanclasses.jar, set the classpath as follows:

```
SET CLASSPATH=x:\beandir\BeanA.jar;x:\beandir\beanclasses.jar;%CLASSPATH%;
```

where *x:\beandir* is the path for bean's the JAR files.

Setting/Getting JavaBean Properties and Invoking Methods

VARPG supports invoking java methods directly. (See Chapter 18, “Calling Java Methods from VisualAge RPG Programs,” on page 279 for details.) The VARPG run time provides a Java accessor class to access the JavaBeans objects in your projects. The accessor class, *com.ibm.varpg.parts.VarpgBeanPart*, is in the varpg.jar file. This class allows you to retrieve the bean objects that are instantiated by the VARPG run time. These bean objects are parts of the VARPG project. The method to get the bean object is:

```
public static Object getBeanObject(String strComponentName,
                                   String strParentName,
                                   String strPartName );
```

where *strComponentName* is the name of component containing the bean part, *strParentName* is the name of the window containing the bean part, and *strPartName* is the name of the bean part. The caller must check for any null references returned by the method to make sure the call is successful.

To find the actual method specification for setting or getting properties and invoking methods, refer to the Bean’s documentation as provided by the vendor, or view the Information page of the Java Bean Part Properties Notebook.

List Box

Use the list box part to provide the user with a list of items from which one or more items can be selected. A list box consists of read-only items. An item in a list box is a string of characters.

Horizontal and vertical scroll bars allow the user to view sections of the list that are not currently displayed. You can configure the list box so that the user can select either just one item or multiple items. You can use the **Search**, **SearchType**, and **Case** attributes to easily search for a particular item in the list.

Part Attributes

AddItemEnd	AddLink*	AllowLink*	BackColor
BackMix	Bottom	Case*	Count
DelimChar	DeSelect	DragEnable*	DropEnable*
Enabled	ExtSelect*	FirstSel	Focus
FontBold	FontItalic	FontName	FontSize
FontStrike*	FontUnder*	ForeColor	ForeMix
GetItem	Handle*	Height	Index
InsertItem*	ItemKey	Left	MultSelect
NbrOfSel	ParentName	PartName	PartType
Refresh	RemoveItem	RemoveLink*	Search*
SearchType*	Selected	SelectItem	SelectList
Sequence*	SetItem	SetTop	ShowTips
SizeToFit	TipText	Top	TopItem
UseDelim	UserData	Visible	Width

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	Drop*	Enter*
GotFocus	KeyPress	LostFocus	MouseEnter
MouseExit	MouseMove	Popup	Select
VKeyPress			

*** Note:** See the event description for restrictions.

Adding and Setting the Sequence of Items

By default, items are displayed in the list box in the order in which you added them. If you want them displayed in a more precise order, then before you start adding them, set the **Sequence** attribute to either ascending, descending, or index. This sorts the items in ASCII collating sequence as they are added.

You cannot use the **Sequence** attribute to change the order of items that are already in the list box.

Adding Items at Run Time

You can insert items into a list box at run time by using the **InsertItem** attribute. The order in which items are displayed is determined by the **Sequence** attribute.

Updating Items in a List

You can change items that are already in the list. Use the **Index** attribute to indicate which item you want to change, and the **SetItem** attribute to specify the changed data.

Note: When you change an item using the **SetItem** attribute, the item remains in its original location, regardless of the value of the **Sequence** attribute. For example, if you had set the **Sequence** attribute to ascending order when you created the list, the items appear in the list box in ascending order; however, if you then retrieve an item, change its value, and use the **SetItem** attribute to replace it in the list box, the item is inserted in the same position it was in before. Therefore, the list may or may not be in ascending sequence after the change.

Setting the Top of the List

Use the **SetTop** attribute to specify which list item should appear at the top of the list box. Setting this item scrolls the list. It changes the display, but it does **not** reorder the items in the list.

Removing Items

Use the **RemoveItem** attribute to remove items from the list. Use the index value to specify the item that is to be removed. Index values start at *1*. When an item is removed from the list, all items following the removed item are moved up one position in the list.

To remove all items in the list, specify an index value of *0*.

Selecting and Deselecting Items

The user can select or deselect items by using the mouse or the keyboard. You can select and deselect items by setting the **Selected** and **DeSelect** attributes in your program. To use these attributes, first set the **Index** attribute.

Types of Selection

You can use attributes to specify how items are selected in a list box. Single, multiple, and extended selection are available.

Single selection
Single selection (the default) permits only one item in a list to be selected at one time. If an item is currently selected, it will be deselected when another item is selected.

Multiple selection
The user can select any number of objects, or not select any.

Extended selection
This type of selection is optimized for the selection of a single object, but the user can extend selection to more than one object, if required.

Retrieving Items from the List

To retrieve an item from a list box, use the **GetItem** attribute. First set the **Index** attribute to indicate which item you want to retrieve.

You typically retrieve items that have been selected by the user. To determine which items in a list box have been selected, use the **FirstSel** or **Selected** attribute. The **FirstSel** attribute returns the index of the first selected item in the list. If you need to check for additional selected items, be sure to use the **DeSelect** attribute to deselect this item; otherwise the **FirstSel** attribute returns the same item.

To determine if a specific item has been selected, use the **Selected** attribute. The **Selected** attribute uses the **Index** attribute value to determine if that item has been selected.

You can use the **Count** attribute to determine if there are any items to retrieve.

Using Keys

Both the list box and the combination box allow you to add items to the list that consist of a 'key' portion and a 'data' portion. When items are added to the list, only the data portion of the item is displayed. When the user selects an item you can programatically retrieve the key portion of the item.

See the Using Keys section in the combination box part description for more information.

Signaling Events

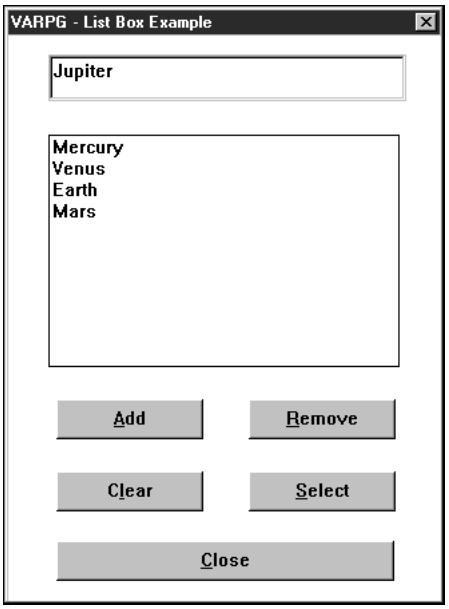
The **Select** event is signaled when:
- The user selects an item that is in a list box.
- You select an item in the list in your program.
- The user selects an item that is already selected.

The **Enter** event is signaled when:
- The user double-clicks over an item that is in the list box
- The user presses the Enter key when the list box has focus and an item has been selected.

In your action subroutine for these events, you can use the **Selected** or **FirstSel** attribute to determine which item was selected.

List Box Example

Press the **Add** push button to insert the text value from the entry field part into the list. Press the **Clear** push button to clear the list, the **Select** push button to select an item from the list and the **Remove** push button to remove the selected item from the list. Press **Close** to end the program.


VARPG - List Box Example
Jupiter
Mercury
Venus
Earth
Mars
Add
Remove
Clear
Select
Close

```
 ********************************************************************
 *                                                                  *
 * Program ID . . : LISTBOX                                         *
 *                                                                  *
 * Description  . : Sample program to demonstrate the Listbox part. *
 *                                                                  *
 ********************************************************************
 *
 ********************************************************************
 *                                                                  *
 * Window . . : MAIN                                                *
 *                                                                  *
 * Part . . . : CLEAR                                               *
 *                                                                  *
 * Event  . . : PRESS                                               *
 *                                                                  *
 * Description: Clear the listbox and the entry field. Give focus   *
 *              to the entry field part.                            *
 *                                                                  *
 ********************************************************************
 *
C     CLEAR         BEGACT    PRESS         MAIN
 *
C     'LB1'         setatr    0             'RemoveItem'
C     'EF1'         setatr    *blanks       'Text'
C     'EF1'         setatr    1             'Focus'
 *
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Window . . : FRA0000B                                            *
 *                                                                  *
 * Part . . . : CLOSE                                               *
 *                                                                  *
 * Event  . . : PRESS                                               *
 *                                                                  *
 * Description: Terminate the program                               *
 *                                                                  *
 ********************************************************************
 *
C     CLOSE         BEGACT    PRESS         MAIN
 *
C                   move      *on           *INLR
 *
C                   ENDACT
```

Figure 20. Coding Example Using the List Box Part (Part 1 of 3)

```
*************************************************************************
*                                                                       *
* Window . . : MAIN                                                     *
*                                                                       *
* Part . . . : REMOVE                                                   *
*                                                                       *
* Event  . . : PRESS                                                    *
*                                                                       *
* Description: Remove the selected item from the list box.              *
*              The 'FirstSel' attribute is used to determine the        *
*              index of the first selected item.                        *
*                                                                       *
*************************************************************************
*
C     REMOVE        BEGACT    PRESS         MAIN
*
C     'LB1'         getatr    'FirstSel'    Index             3 0
*
C     Index         ifgt      *zero
C     'LB1'         setatr    Index         'RemoveItem'
C                   endif
*
C                   ENDACT
*************************************************************************
*                                                                       *
* Window . . : FRA0000B                                                 *
*                                                                       *
* Part . . . : ADD                                                      *
*                                                                       *
* Event  . . : PRESS                                                    *
*                                                                       *
* Description: Adds the value in the entry field part as a new item *
*              to the list box part.                                    *
*                                                                       *
*************************************************************************
*
C     ADD           BEGACT    PRESS         MAIN
*
C     'EF1'         getatr    'TEXT'        tmp              30
*
C     tmp           ifne      *blanks
C     'LB1'         setatr    tmp           'InsertItem'
C     'EF1'         setatr    *blanks       'Text'
C     'EF1'         setatr    1             'Focus'
C                   endif
*
C                   ENDACT
```

Figure 20. Coding Example Using the List Box Part (Part 2 of 3)

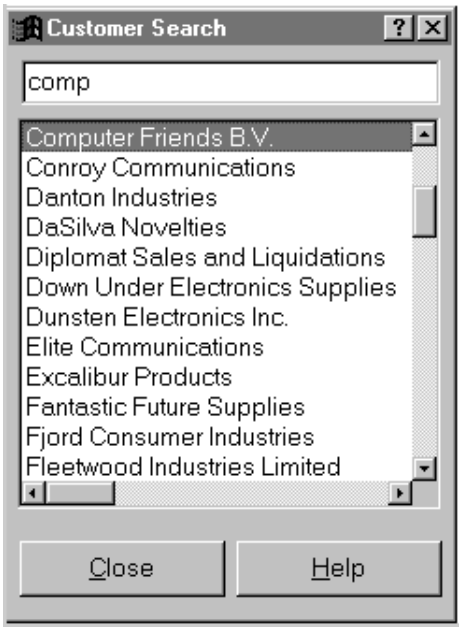
```
 ************************************************************************
 *                                                                      *
 * Window . . : MAIN                                                    *
 *                                                                      *
 * Part . . . : SELECT                                                  *
 *                                                                      *
 * Event  . . : PRESS                                                   *
 *                                                                      *
 * Description: Retrieves the selected item from the list box and       *
 *              copies it to the entry field.                           *
 *                                                                      *
 ************************************************************************
 *
C     SELECT        BEGACT    PRESS         MAIN
 *
C     'LB1'         getatr    'FirstSel'    x                3 0
 *
C     x             ifgt      *zero
C     'LB1'         setatr    x             'Index'
C     'LB1'         getatr    'GetItem'     temp            20
C     'EF1'         setatr    temp          'Text'
C                   endif
 *
C                   ENDACT
 ************************************************************************
 *                                                                      *
 * Window . . : MAIN                                                    *
 *                                                                      *
 * Part . . . : EF1                                                     *
 *                                                                      *
 * Event  . . : CHANGE                                                  *
 *                                                                      *
 * Description: For CRP sample's notify event purpose                   *
 *                                                                      *
 ************************************************************************
 *
C     EF1           BEGACT    CHANGE        MAIN
 *
C                   ENDACT
 *
```

Figure 20. Coding Example Using the List Box Part (Part 3 of 3)

Search Example

You can use the Search, SearchType, and Case attributes to search for a particular item in the list. Using them is faster than reading each item in your program and comparing for specific values.

The following example shows how to locate a customer name in a list box as the user types a name in the entry field. The window is named MAIN, the list box is LB1, and the entry field is EF1. The user interface follows:



In the window's Create event, we set the Case attribute of the list box to 0 to indicate that the search is not case sensitive. The SearchType attribute is set to 1 indicating we only want to compare the number of characters in the search string with the first characters of the list item. The rest of the code is filling the list box with records from the iSeries database.

```
C     MAIN          BEGACT    CREATE        MAIN
 *
C     'LB1'         Setatr    0             'Case'
C     'LB1'         Setatr    1             'SearchType'
 *
C                   Read      Custom01                                99
 *
C                   DoW       NOT *in99
C     'LB1'         Setatr    CustNa        'AddItemEnd'
C                   Read      Custom01                                99
C                   EndDo
 *
C     'LB1'         Setatr    1             'SelectItem'
 *
C                   ENDACT
```

The following code is the action subroutine for the Change event of the entry field EF1. Each time a character is typed in the entry field, this action subroutine is invoked.

The value of the Text attribute of the entry field is retrieved, and if it is not blank, that value is used as the search string for the Search attribute of the list box. If a match is found (Index attribute is greater than 0), the found item is selected and then moved to the top of the list box with the Settop attribute.

```
C     EF1           BEGACT    CHANGE        MAIN
 *
C     'EF1'         Getatr    'Text'        Search          40
 *
C                   If        Search <> *Blanks
C     'LB1'         Setatr    Search        'Search'
 *
C                   If        %Getatr('Main':'LB1':'Index')<>0
```

```
C                   Eval      %Setatr('Main':'LB1':'SelectItem')=
C                               %Getatr('Main':'LB1':'Index')
C                   Eval      %Setatr('Main':'LB1':'SetTop')=
C                               %Getatr('Main':'LB1':'Index')
C                   EndIf
 *
C                   Else
C     'LB1'         Setatr    1             'SetTop'
C     'LB1'         Setatr    1             'SelectItem'
C     'LB1'         Setatr    1             'Index'
 *
C                   EndIf
 *
C                   ENDACT
```

If the entry field is blank, the first item in the list box is moved to the top, and is selected. The INDEX attribute is set to 1 so that subsequent searches begin at the top of the list.

Media

Use the media part to play or record audio information or to play video files.

The media part gives your programs the ability to process wave (.WAV), MIDI (.MID), and QuickTime Movie (.MOV) files. If you want to use audio files, the computer must be equipped with a sound card capable of processing these files. To record a sound file, you will need a microphone or some other supported input device for the sound card. MIDI files cannot be recorded with the media part.

Java applications require the Java Media Framework (JMF) API. The media part only supports the playback of audio and video files in the Java environment.

The video file formats that can be processed are: MPEG (*.mpg) files, QUICKTIME Movie (*.mov) files, *.dat files, Microsoft® Video for Windows *.avi files are supported for Windows. To play these video files, the computer must have the appropriate drivers.

Part Attributes

AddLink*	AllowLink*	AudioMode	Bass*
Bottom	FileName	Handle*	InPlace
Left	Length	Panel	ParentName
PartName	PartType	Position	RemoveLink*
ShowPlyBar*	Top	Treble*	UserData
Visible	Volume		

* **Note:** See the attribute description for restrictions.

Applicable Events

Complete	Create	Destroy	Link*

* **Note:** See the event description for restrictions.

Specifying a File Name

Use the **FileName** attribute value to specify the name of the file you want to process. For more information, see Chapter 12, “Using Picture, Sound, and Video Files,” on page 243.

Note: Some wave files are shipped in compressed format. The media part processes only noncompressed wave files.

Setting AudioMode

To process a file, set the **AudioMode** attribute to one of the following values:

Value	Description
1	Pause — Suspends processing the file

2 Play — Plays the file

3 Record — Records a file

4 Stop — Stops processing the file

Setting the Volume

Use the **Volume** attribute to set the volume for the for the media part and the system's waveout and synthesizer.

Setting the Position

Use the **Position** attribute to determine the start position in the file to be processed. Express the attribute value in milliseconds.

Using the Media Panel Part

You can use the media panel part to control the media part. In the media panel part's properties notebook, set the media part name in the **AddLink** attribute, and enable the **AllowLink** attribute. This allows the user to control the media part simply by pressing the appropriate button on the media panel. See "Media Panel" on page 103 for more information.

Signaling Events

When the media part has completely processed a file, a **Complete** event is signaled.

Media Panel

Note: This part is not supported in Java applications.

Use the media panel part to provide convenient access to frequently used actions.

You can also use it to give the user control over other parts without your having to write any program logic. For example, you can use it to create push buttons or slider controls that control the volume or mode of a media part.

In the properties notebook for the media panel part, you can determine:
- Which buttons, from a defined set of buttons, the media panel will contain
- Whether or not the position and volume slider controls will be visible

Note: The media panel part can only be dropped on a notebook page with canvas or window with canvas.

Part Attributes

AddLink	AllowLink	BackColor	BackMix
Bottom	Enabled	Handle	Height
Left	PanelItem	PanelMode	ParentName
PartName	PartType	Position	RemoveLink
Top	UserData	Visible	Volume
Width			

Applicable Events

Change	Create	Destroy	Link
MouseEnter	MouseExit	MouseMove	Popup
Press			

Creating a Media Panel Part

A media panel part can be created only on a canvas part.

Linking Other Parts

There are two methods for linking a media panel part to another part: one involves using the properties notebook and the other involves writing program logic. The first method is the simplest. The only time you need to write program logic is if you want the link to be set during run time, and then you would set the **AddLink** and **AllowLink** attributes. A typical example would be to link the media panel to a media part. When a control is changed on the media panel, the link mechanism automatically affects the media part.

When you create a link from the media panel part to another part, only certain buttons are enabled on the media panel part. To make all the buttons enabled, you must also create a link from the other part back to the media panel part.

Refer to the **AddLink** description in *VisualAge RPG Parts Reference*, SC09-2450-05 for more information about the parts you can link to a media panel part.

Signaling Events

When the volume slider or the position slider is moved, a **Change** event is signaled. Use the **PanelItem** attribute to determine which slider was changed. Use the **Volume** attribute to determine the value of the volume slider, and the **Position** attribute to determine the value of the position slider.

When a push button on the media panel is pressed, a **Press** event is signaled. Use the numeric value returned by the **PanelItem** attribute to determine which button caused the **Press** event. Refer to *VisualAge RPG Parts Reference*, SC09-2450-05for a list of possible values.

Menu Bar

Use the menu bar part to give users access to pull-down menus. You can add submenu parts and menu item parts to the menu bar.

A menu bar appears near the top of the window frame, just below the title bar. When the user selects a menu item from it, a pull-down menu appears, showing the items on that menu. Selecting a menu item immediately initiates the action it describes.

Note: You can manipulate this part's properties, events, and so on, only from its pop-up menu in the project tree view.

For related information, see:
- "Menu Item" on page 106
- "Submenu" on page 171
- "Pop-up Menu" on page 138

Part Attributes

PartType	PartName	ParentName	UserData

Applicable Events

Create	Destroy

Creating Pull-down Menus

You cannot open the properties notebook of a menu bar, submenu, or menu item by double clicking on it or via pop-up menus. You must manipulate it in the tree view.

Menu Item

Use menu items to construct pull-down or pop-up menus.

A menu item describes an action that is initiated when the user selects that item.

To construct a menu:
1. Drop a submenu part onto a menu bar or pop-up menu.
2. Drop menu items onto the submenu.

Note: You can manipulate this part's properties, events, and so on, only from its pop-up menu in the project tree view.

For related information, see:
- "Menu Bar" on page 105
- "Pop-up Menu" on page 138
- "Submenu" on page 171

Part Attributes

Checked	Enabled	FileName	Label
ParentName	PartName	PartType	UserData
Visible			

Applicable Events

Create	Destroy	MenuSelect

Placing a Check Mark beside a Menu Item

A check mark symbol next to a menu item informs the user that the action represented by the menu item is selected. For example, if a check mark appears next to a **Show Grid** menu item, a grid is displayed.

To display a check mark next to a menu item, set the **Checked** attribute to *1*. To remove a check mark, set the attribute to *0*.

Setting Menu Text

Use the **Label** attribute to set the text for a menu item.

Setting a Mnemonic

Note: Mnemonics are not supported in Java applications.

To specify a mnemonic key for the menu item, place the mnemonic identifier in front of a character in the text of the **Label** attribute. For Windows, use an ampersand (&). The designated character is displayed on the interface with an underscore, for example, **Display**. The underscore informs users that they can select the menu item by pressing the underlined character on the keyboard.

Enabling Menu Items

You can control whether or not a **MenuSelect** event is issued when the user selects a menu item.

By default, the menu item is enabled when you create it. An enabled menu item generates a **MenuSelect** event when selected.

Set the **Enabled** attribute to *0* if you do not want a menu item enabled. When a menu item is not enabled, it is dimmed on the display, and it does not generate a **MenuSelect** event when selected.

Signaling Events

When the user selects a menu item, a **MenuSelect** event is signaled.

Note: Only menu items signal a **MenuSelect** event. Submenus (such as cascaded menus), which are attached to other menu items do not.

Message Subfile

Use the message subfile part to display predefined messages or to display text that you supply in your program logic: for example, error or status information.

This part is always positioned at the bottom of the window frame and runs the width of the window. You cannot resize its width; you can, however, resize its height so that it shows more messages. At run time, users can use scroll bars to view all of the messages.

Part Attributes

AddMsgID	AddMsgText	Count	DragEnable*
DropEnable*	Enabled	FirstSel	FontBold
FontItalic	FontName	FontSize	FontStrike*
FontUnder*	ForeColor	ForeMix	GetItem
Handle*	Height	Index	MsgSubText
NbrOfSel	ParentName	PartName	PartType
RemoveMsg	Selected	ShowTips	TipText
UserData	Visible		

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	Drop	Enter
MouseEnter	MouseExit	MouseMove	Popup
Select			

Displaying Predefined Messages

To display messages that are already defined in the GUI Designer, set the **AddMsgId** attribute to the ID number of the message you want to display. Use the numeric portion of the message identifier.

Displaying Text Supplied in Your Program

To display text that is not part of a predefined message, use the **AddMsgText** attribute in your program and supply a text string or literal as the message value.

Using Substitution Variables

The message subfile part supports substitution variables. A substitution variable is defined when you create the message by typing an percent (%) character followed by a numeric value (for example, *%123*). This substitution variable is replaced by data your program provides before you add the message. Message substitution data applies to the **AddMsgID** and **AddMsgText** attributes.

Message substitution data is a series of words separated by blanks. Each substitution word replaces the corresponding substitution variable before the

message is added to the message subfile part. To set the message substitution data, use the **MsgSubText** attribute **before** you set the **AddMsgID** attribute.

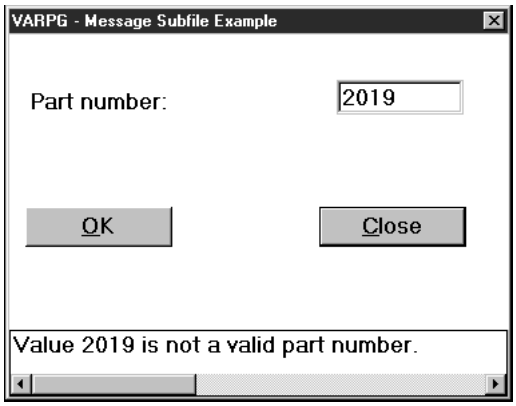
Note: The substitution data remains in effect until another **MsgSubText** attribute is used.

Removing Messages

Use the **RemoveMsg** attribute to remove a message from the message subfile part. Specify the index number of the message to be removed. To remove all messages, use an index value of *0*.

Message Subfile Example

In this example, the user is prompted to enter a part number for processing. The part number must be greater than zero and less than 2000. When the **OK** push button is pressed, the program checks that the value is in the required range. If the value is not in the range, a message is added to the message subfile part.




```
*************************************************************************
*                                                                       *
* Program ID . . : MESSAGE                                              *
*                                                                       *
* Description  . : Sample program to demonstrate the Message            *
*                  subfile part.                                        *
*                                                                       *
*************************************************************************
*
*************************************************************************
*                                                                       *
* Window . . : MAIN                                                     *
*                                                                       *
* Part . . . : PB_CLOSE                                                 *
*                                                                       *
* Event  . . : PRESS                                                    *
*                                                                       *
* Description: Terminate the program                                    *
*                                                                       *
*************************************************************************
 *
C     PB_CLOSE      BEGACT    PRESS         MAIN
 *
C                   move      *on           *inlr
 *
C                   ENDACT
```

Figure 21. Coding Example Using the Message Subfile Part (Part 1 of 2)

```
*****************************************************************
*                                                               *
* Window . . : MAIN                                             *
*                                                               *
* Part . . . : PB_OK                                            *
*                                                               *
* Event  . . : PRESS                                            *
*                                                               *
* Description: Check that the value entered is allowed. If not, *
*              add a message to Message subfile part.           *
*                                                               *
*              The value entered is used as substitution text in*
*              the message.                                     *
*                                                               *
*****************************************************************
*
C     PB_OK         BEGACT    PRESS         MAIN
*
* Clear the message subfile
*
C     'Msg1'        setatr    0             'RemoveMsg'
*
* Get the part number
*
C     'PartNum'     getatr    'Text'        tmp4             4 0      *
* If part number is not valid, add a message to the
* Message part. The partnumber entered by the user is
* used as the substition text.
* Since substitution text must be a string, we move the
* numeric part number value to a character field, and use
* it as the substitution text.
C     tmp4          ifle      *zero
C     tmp4          orgt      1999
C                   move      tmp4          char4            4
C     'Msg1'        setatr    char4         'MsgSubText'
C     'Msg1'        setatr    1             'AddMsgID'
*
* Give the PartNum entry field FOCUS, so the cursor will
* return to it.
C     'PartNum'     setatr    1             'Focus'
*
* Part number is OK, continue processing
C                   else
*                    ...
*                    ...
*                    ...
```

Figure 21. Coding Example Using the Message Subfile Part (Part 2 of 2)

Multiline Edit

Use the multiline edit part if you want the user to be able to type in several lines of text.

The multiline edit part has defined boundaries. Sometimes not all of its text is visible. The user can scroll up, down, left, or right to view text that is currently not visible.

Part Attributes

AddLineEnd	AddOffset	BackColor	BackMix
Bottom	CanUndo	CharOffset	Copy
CsrLine	CsrPos	Cut	Delete
DragEnable*	DropEnable*	Enabled	Focus
FontBold	FontItalic	FontName	FontSize
FontStrike*	FontUnder*	ForeColor	ForeMix
Handle*	Height	InsertLine	InsertText
Left	LineNumber	LineText	NbrOfLines
ParentName	PartName	PartType	Paste
ReadOnly	Refresh	ShowTips	Text
TextEnd	TextLength	TextSelect	TextStart
TextString	TipText	Top	TopLine
Undo	UserData	Visible	Width
WordWrap			

*** Note:** See the attribute decription for restrictions.

Applicable Events

Change	Click	Create	DblClick
Destroy	Drop	GotFocus	KeyPress
LostFocus	MouseDown	MouseEnter	MouseExit
MouseMove	MouseUp	Popup	VKeyPress

Getting and Setting the Text

Use the **Text** attribute to get or set the text of the multiline edit part.

Note: The default text entered in the properties notebook for the multiline edit part is not saved. Text for a multiline edit part can only be set at run time.

Manipulating Lines of Text in a Multiline Edit Part

To insert new lines into a multiline edit part:

1. Set the **LineNumber** attribute to the line number after which you want to insert text.
2. Use the **InsertLine** attribute.

   Your text is inserted after the line you specify. Any lines that are below the line you specified are moved down to make room for the inserted text.

Manipulating Characters in a Multiline Edit Part

To insert a string of characters into a multiline edit part:

1. Set the **CharOffset** attribute to specify where you want the new text inserted. Text following the **CharOffset** value will be replaced with the new text.
2. Use the **AddOffset** attribute to add text at **CharOffset**.

Manipulating Selected Portions of Text in a Multiline Edit Part

You can use several attributes to manipulate selected portions of text in a multiline edit part.

To return just the selected text, use the **TextSelect** attribute. If no text is selected, the **TextSelect** attribute returns a null string, and the result field that is to receive the text remains unchanged.

Use the **TextStart** and **TextEnd** attributes to return the starting and ending character positions of the selected text.

Changing Color

If a multiline edit part exists on a canvas part whose background color is set to the system default, changes to the background color of the canvas will be inherited by the multiline edit part. Additional multiline edit parts added to the canvas will not inherit this color. To correct this, defer setting the background color of the canvas until you have placed all multiline edit parts on it. Alternatively, you can make the multiline edit parts inherit the color by setting the color of the canvas to the system default and then back to your predefined RGB color setting.

If you drag and drop a color onto the scroll bar of a multiline edit part, that color is not saved. The multiline edit part will be changed to the new color, but when you close and reopen the window, the color will be changed back to the original.

Choosing Fonts

Not all fonts are supported by the multiline edit part. After you select a font for this part, it will adjust to display the closest match for the selected font.

Preventing User Input

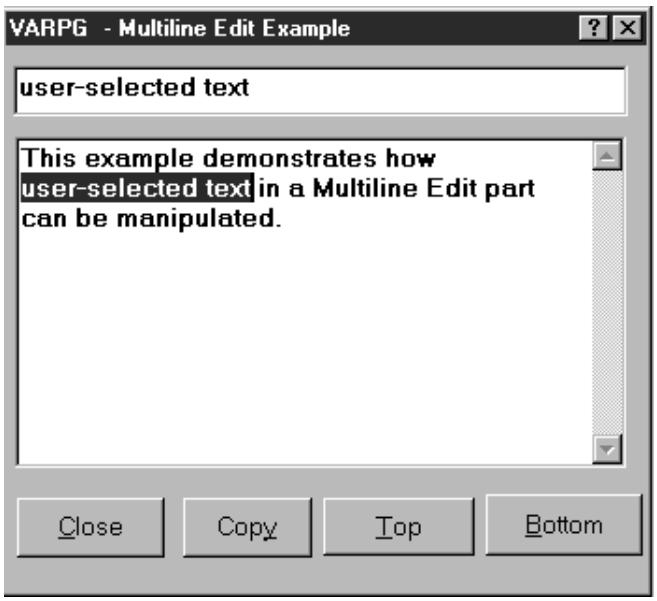
You can prevent users from entering text in the multiline edit part by doing one of the following:

- Set the **ReadOnly** attribute to *0*.
- Set the **Enabled** attribute to *0*. (This also prevents the multiline edit part from responding to events such as **Change** and **GotFocus**.)

You can still change the value of the multiline edit part in your program.

Multiline Edit Example

In this example, pressing the **Copy** push button copies the selected text from the multiline edit to the entry field. Pressing the **Close** push button ends the program.


VARPG - Multiline Edit Example
user-selected text
This example demonstrates how
user-selected text in a Multiline Edit part
can be manipulated.
Close
Copy
Top
Bottom

```
*****************************************************************
*                                                               *
* Program ID . . : MLE                                          *
*                                                               *
* Description  . : Sample program to demonstrate the Multiline Edit *
*                  part.                                        *
*                                                               *
*****************************************************************
*****************************************************************
*                                                               *
* Window . . : MAIN                                             *
*                                                               *
* Part . . . : PB_CLOSE                                         *
*                                                               *
* Event  . . : PRESS                                            *
*                                                               *
* Description: Terminate the program                            *
*                                                               *
*****************************************************************
*
C     PB_CLOSE      BEGACT    PRESS         MAIN
*
C                   move      *on           *inlr
*
C                   ENDACT
*****************************************************************
*                                                               *
* Window . . : MAIN                                             *
*                                                               *
* Part . . . : PB_COPY                                          *
*                                                               *
* Event  . . : PRESS                                            *
*                                                               *
* Description: Copy the selected text in the MLE to the entry field *
*              part.                                            *
*                                                               *
*****************************************************************
*
C     PB_COPY       BEGACT    PRESS         MAIN
*
C     'EF1'         setatr    *blanks       'Text'
C     'MLE1'        getatr    'TextStart'   start             5 0
C     'MLE1'        getatr    'TextSelect'  selected        128
*
C     start         ifgt      *zero
C     'ef1'         setatr    selected      'Text'
C                   endif
*
C                   ENDACT
```

Figure 22. Coding Example Using the Multiline Edit Part (Part 1 of 2)

```
 ********************************************************************
 *                                                                  *
 * Window . . : Main                                                *
 *                                                                  *
 * Part . . . : Top                                                 *
 *                                                                  *
 * Event  . . : Press                                               *
 *                                                                  *
 * Description: Set the 5th line in the MLE part as top line.       *
 *                                                                  *
 * Change activity:                                                 *
 *                                                                  *
 ********************************************************************
 *
C     TOP           BEGACT    PRESS         MAIN
 *
C                   eval      %setatr('MAIN':'MLE1':'TOPLINE') = 5
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Window . . :  Main                                               *
 *                                                                  *
 * Part . . . :  Bottom                                             *
 *                                                                  *
 * Event  . . :  Press                                              *
 *                                                                  *
 * Description:  Set bottom                                         *
 *                                                                  *
 ********************************************************************
 *
C     BOTTOM        BEGACT    PRESS         MAIN
 *
C                   eval      %setatr('MAIN':'MLE1':'TOPLINE') = 0
C                   ENDACT
```

Figure 22. Coding Example Using the Multiline Edit Part (Part 2 of 2)

Notebook

Use the notebook part to present data that can be logically grouped by topic: for example, customer information divided into categories such as Name, Shipping Address, Orders, and Credits.

A notebook part is a graphical representation of a bound notebook. (In Windows applications, this is known as a tab control.) You can add pages to the notebook, and you can group the pages into sections separated by tabbed dividers. If the notebook page has a canvas, you can add more than one part to it. If it does not have a canvas, you can add only one part to it.

The user can turn the pages of the notebook to move from one page to the next, or go straight to a section by clicking on its divider tab.

You can add notebook pages by:
- Using the properties notebook for the notebook part
- Pointing-and-clicking (or dragging-and-dropping) a properties tab or notebook page with canvas onto the notebook part

For related information, see:
- "Notebook Page" on page 118
- "Notebook Page with Canvas" on page 119

Part Attributes

BackColor	BackMix	Bottom	Count
Enabled	Focus	FontBold	FontItalic
FontName	FontSize	FontStrike*	FontUnder*
ForeColor	ForeMix	Handle*	Height
Left	PageNumber	ParentName	PartName
PartType	Refresh	ShowTabs*	Top
UserData	Visible	Width	

* **Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy

Changing Font Emphasis

Changing the font emphasis for a notebook part to underscore or strikeout causes the status text to take on the new emphasis but not the tab text.

Notebook Page

Use the notebook page part to add pages to a notebook.

You can add only one part to a notebook page; that part will be automatically sized to fit the entire page. If you want to add more than one part on a page, you must point-and-click a canvas part onto the notebook page. Alternatively, you can use the notebook page with canvas part to save a step.

Note: You can manipulate this part's properties, events, and so on, only from its pop-up menu in the project tree view.

The user can press the left and right arrow keys to move from one page to the next.

For related information, see
- "Notebook" on page 117
- "Notebook Page with Canvas" on page 119

Part Attributes

Enabled	OnTop	ParentName	PartName
PartType	Refresh	TabImage	TabLabel
UserData	Visible		

Applicable Events

Create	Destroy	PageSelect	SelPending*

* **Note:** See the event description for restrictions.

Showing Tab Text

On a DBCS machine, the tab of a notebook page may not show all its text when the MINCHO Proportional font is used. Changing the font to another style, such as MINCHO Normal or MINCHO System, will fix this.

Setting a Mnemonic

To specify a mnemonic key for the notebook page, place the mnemonic identifier in front of a character in the text of the **Label** attribute. This designated character is displayed on the interface with an underscore (for example, **D**isplay). Note that for Windows, mnemonics are displayed, but do not function on notebook pages.

Note: Mnemonics are not supported in Java applications

Notebook Page with Canvas

Use the notebook page with canvas to add pages to a notebook part.

The canvas part occupies the client area of a notebook page part. By adding parts to the canvas part, you can create a graphical user interface.

If you want to add only one part to the page, you can use the notebook page part instead of the notebook page with canvas part. Because the notebook page part does not have a canvas on it, the part you add will be sized automatically.

For related information, see:
- "Notebook" on page 117
- "Notebook Page" on page 118

Part Attributes

Enabled	OnTop	ParentName	PartName
PartType	Refresh	TabImage	TabLabel
UserData	Visible		

Applicable Events

Create	Destroy	PageSelect	SelPending

ODBC/JDBC Interface

The ODBC/JDBC Interface part provides the ability to process database files that support the Windows ODBC API or Sun Microsystem's JDBC API. Examples of these database file types include Foxpro, Access, and Paradox.

To develop applications that can use the ODBC/JDBC Interface part, you must be familiar with SQL and have either the Windows ODBC SDK or Sun Microsystem's Java 2 Software Development Kit (J2SDK), Standard Edition, installed on your workstation.

If you do not have the ODBC SDK, you can download it from Microsoft at the following URL:

`http://www.microsoft.com/odbc/download.htm`

The JDBC support is part of the Java™ 2 Software Development Kit (J2SDK) Version 1.2 for Windows. If you do not have the J2SDK, you can download it from Sun Microsystems at the following URL:

`http://java.sun.com/products/`

Applications that access and manipulate data in a JDBC database require the appropriate JDBC 2.0 compliance driver. You can find JDBC driver and other information at the following URL:

`http://java.sun.com/products/jdbc/`

Note: JDBC is not supported in applets.

An ODBC or JDBC database consists of one or more tables. Data is stored in a table as a series of rows. Each row, or record, contains a number of columns with data. Your program can submit SQL statements along with ODBC/JDBC Interface part attributes to manipulate rows, or to move data between program fields and table columns.

Before you can process an existing database, your VARPG program must first connect to the database and indicate which table to reference. To manipulate the rows in a table, your program must create a record set that identifies the records to be returned and maintained by the ODBC/JDBC Interface part. To access the data in a row, you must bind each column used in the table row with a program field in your program. In Java applications, pointers are not supported. A column is bound to a part; only the static text and entry field parts can be used for binding.

If you are creating a Java application that uses the ODBC/JDBC interface part, end users running your application must install the *varpgjdb.jar* file on their workstation and add its location to their classpath statement. The packaging utility does inlcude this JAR file. The JAR file is located in the *WDSC\java* subdirectory.

Part Attributes

AllowChg*	BindPart	Bottom	BufferDec*
BufferLen*	BufferPtr*	BufferType*	CharData

Column	ColumnDec	ColumnLen	ColumnName
Columns	ColumnType	Connect	Connected
ConnectStr	CurrentRow	DeleteRow	ExecuteSQL
Fetch	FetchNext	FetchPrior	GetTables
Handle*	Height	InsertRow	IsData
Left	ParentName	PartName	PartType
Refresh	Rows*	SQLError	SQLMsgBox
SQLQuery	Top	UnBind	UpdateRow
UserData	Visible	Width	

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy

Connecting to an ODBC Database

Before you can process an existing database, your VARPG program must first connect to the database and indicate which table to reference.

Note: The VARPG ODBC/JDBC Interface part can only connect to one table at a time. If that table has dependencies or relations with other tables, your program cannot update or delete records in the database.

To connect to a database, first set the ConnectStr attribute to the required connection string for the database. Then, use the Connect attribute to do the connection. In Windows, if you set the ConnectStr attribute to *BLANKS, the ODBC Manager will display the Select Data Source dialog from which you can select the table to connect to. Once the connection is made, the Connected attribute will be set to 1. If the connection fails, the Connected attribute is set to 0.

When the following code fragment is executed, the Select Data Source dialog will be displayed. If a table was selected, the ConnectStr attribute will contain the connection string. The Connect attribute is set to make the connection.

```
C     'ODBC'        Setatr    *Blanks       'ConnectStr'
C     'ODBC'        Setatr    1             'Connect'
C                   If        %Getatr('Main':'ODBC':'Connected')=1
C                   ...
C                   Else
C                   ...
C                   EndIf
```

Creating a Record Set

Once you have connected to a database, you must create a record set before you can access any data in the database. To create a record set, submit a SELECT statement to the ODBC/JDBC Interface part using the SQLQuery and ExecuteSQL attributes. The SELECT statement identifies which table in the database is being accessed and which group of records in the table is to be processed.

The following code segment is an example of creating a record set of all records in table CUSTOMERS:

```
D SelAll          C                   'Select * From "Customers"'
 *
C     'ODBC'        Setatr    SelAll        'SQLQuery'
C     'ODBC'        Setatr    1             'ExecuteSQL'
```

Accessing Table Data

Data is stored in a table as a series of rows. Each row contains a number of columns with data. You can manipulate the rows in a table by using the ODBC/JDBC Interface part attributes such as FetchNext, FetchPrior, UpdateRow, and so on. However, to access the data in a row, you must bind each column in the table row with a program field in your program. Once this binding is set, the ODBC/JDBC Interface part can move data between the program fields and the table columns.

To bind the program field, you use the following ODBC/JDBC Interface part attributes:

Column
Establishes which column in the table is to be bound.

BufferPtr
Contains the address of the program field to bind to the column.

BufferDec
Specifies the number of decimal places for the buffer column.

BufferLen
Specifies the length of the program field.

BufferType
Indicates the data type of the program field.

In the following example, 2 fields defined in the D specifications are being bound to columns 1 and 2 in a table:

```
D first           S             20
D last            S             30
 *
D fptr            S               *   INZ(%Addr(first))
D lptr            S               *   INZ(%Addr(last))
 *
C     'ODBC1'       Setatr    1             'Column'
C     'ODBC1'       Setatr    20            'BufferLen'
C     'ODBC1'       Setatr    fptr          'BufferPtr'
C     'ODBC1'       Setatr    1             'BufferType'
 *
C     'ODBC1'       Setatr    2             'Column'
C     'ODBC1'       Setatr    30            'BufferLen'
C     'ODBC1'       Setatr    lptr          'BufferPtr'
C     'ODBC1'       Setatr    1             'BufferType'
```

You can also use the %ADDR built-in directly on the C specifications to avoid coding the D specifications to define the pointers:

```
C                   Eval      %Setatr(`Main':'ODBC1':'BufferPtr')=%Addr(first)
```

Data Types

Use the BufferType attribute to indicate the data type of the program field referenced by the BufferPtr attribute. The ODBC/JDBC Interface part uses the BufferType attribute to perform the correct data translation when moving data

between the program field and table column. It is important to set this attribute correctly, as there is no checking for proper field types.

Set the Column attribute before using the BufferType attribute. If the program field is associated with a part on the interface, you can use the DataType attribute to get the buffer type.

Use the following chart to set the VARPG data type for the corresponding, supported SQL data type. Specify the BufferLen and BufferDec attributes only as listed in the chart.

For character, decimal, integer, or small integer data types, specify only the BufferLen attribute.

Note that Double, Float, and Real data types can be defined, in VARPG, as either Float(F) or Zoned. If you define these as Zoned, the VARPG run time will only use the number of decimal places specified by the BufferDec attribute when moving data from the column. This can result in a loss of precision if the data source has more decimal places than is specified by the BufferDec attribute. If you define these fields as Float(F), do **NOT** specify the BufferLen or BufferDec attribute.

SQL Data Type	VARPG Data Type	Specify Program Field Length (use BufferLen)	Specify Decimal Places for Buffer Column (use BufferDec)
Character	CHAR	X	
Decimal	Zoned	X	
Integer	Zoned	X	
Small Integer	Zoned	X	
Double	8F		
Double	Zoned	X	X
Float	4F		
Float	Zoned	X	X
Real	4F		
Real	Zoned	X	X

If a column contains a data type that is not supported by the ODBC/JDBC Interface part, set the AllowChg attribute to 0 for that column. The ODBC/JDBC Interface part will not move data between any program field and the column. The data remains unchanged.

Retrieving Table Rows

To process rows in a table, you must first create a record set. A record set is a group of records returned and maintained by the ODBC/JDBC Interface part. Your program submits an SQL statement to the ODBC/JDBC Interface part using the SQLQuery and ExecuteSQL attributes. First, the SQLQuery attribute is set to the SQL statement to execute. Then, the ExecuteSQL attribute is set to 1 to execute the query.

In the following example, all records are being selected from the table Customers:

```
D SelAll          C                   'Select * From "Customers"'
 *
C     'ODBC1'       Setatr    SelAll        'SQLQuery'
C     'ODBC1'       Setatr    1             'ExecuteSQL'
```

To determine the number of rows that were returned as the result of an SQLQuery, you can check the value of the Rows attribute.

Once a record set has been returned, you can process each row using the FetchNext and FetchPrior attributes. Set the FetchNext attribute to 1 to return the next row in the record set. Set the FetchPrior attribute to 1 to return the previous row in the record set. To determine if a FetchNext or FetchPrior successfully returned a row, check the value of the IsData attribute. A value of 1 indicates that data was returned. Otherwise, the IsData value is set to 0.

In the following example, all of the records in a record set are read and the value of column 1 (field first) is added to list box LB1.

```
C     'ODBC1'       Setatr    1             'FetchNext'
C     'ODBC1'       Getatr    'IsData'      Temp              1 0
 *
C                   DoW       Temp = 1
C     'LB1'         Setatr    first         'AddItemEnd'
C     'ODBC1'       Getatr    'IsData'      Temp
C                   EndDo
```

Updating Row Data

To update data in a row, use the UpdateRow attribute to specify the row to be updated. Be aware that UpdateRow will cause any row to be updated. You do not need to fetch the row first. Typically however, you will update a row that has just been fetched. In this case, you would use the CurrentRow attribute. This attribute contains the row number of a row just fetched.

In the following code segment, assume a row has been read and information has been displayed on a window. The user presses the update button after making changes.

```
C     PB_Update     BEGACT    PRESS         Main
 *
C                   Read      'Main'
C     'ODBC1'       Getatr    'CurrentRow'  Row               1 0
C     'ODBC1'       Setatr    Row           'UpdateRow'
 *
C                   ENDACT
```

Deleting a Row

Deleting a row is similar to updating one. (See "Updating Row Data.") Use the DeleteRow attribute to specify the row to be deleted. As with the UpdateRow attribute, DeleteRow will cause any row in the row set to be deleted. It is not necessary to fetch the row first.

In the following example, the user has pressed the Delete push button to delete a record that has just been fetched and is currently being displayed on a window.

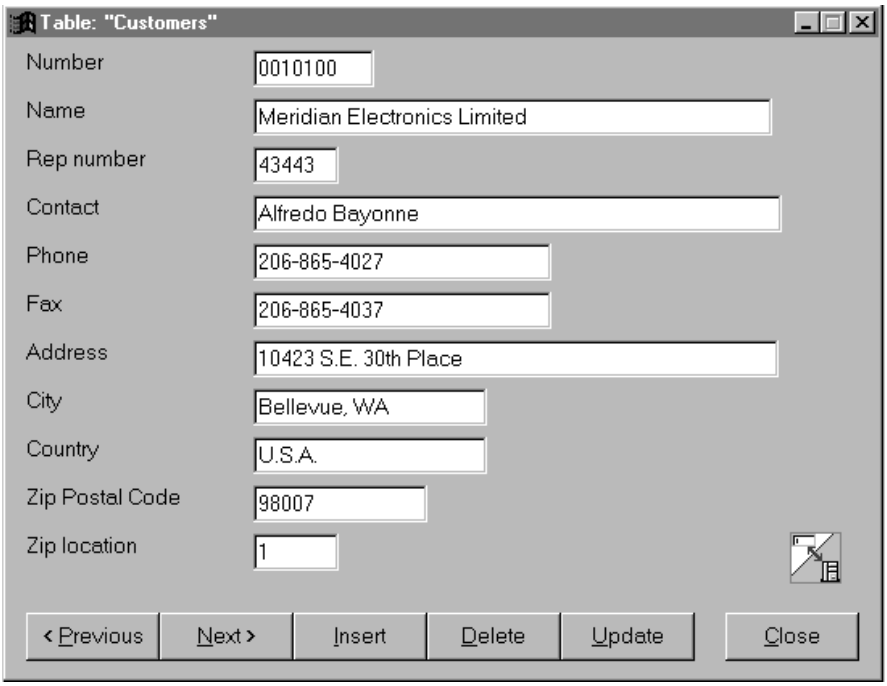
```
C     PB_Delete     BEGACT    PRESS         Main
 *
C     'ODBC1'       Getatr    'CurrentRow'  Row               1 0
C     'ODBC1'       Setatr    Row           'DeleteRow'
 *
C                   ENDACT
```

ODBC/JDBC Interface Part Example

The following example uses a database created with Microsoft Access. The database has one table named *CUSTOMERS*. This simple inquiry program displays

a window containing details about a customer. Push buttons are provided that allow the user to go to the next and previous records, and to update and delete the current record.

The following figure shows the inquiry window:



The code for this example follows.

```
 ********************************************************************

 * Define connect string
 *
D ConnectStr      C                   'DSN=MS Access 97 Database;DBQ=-
D                                     CelDial.mdb;-
D                                     DriverId=25;FIL=-
D                                     MS Access;MaxBufferSiz'
 * Working variables
DClr              S              2  0
DCol              S             10
DSQL              S            255A
D%ColNumber       S              2  0
D%Part            S             10
D%Character       S              2
D AppStart        C                   'HourGlas.ANI'
 *
DDel              M                   MsgNbr(*MSG0003)
D                                     MsgData(CustNo:CustNa)
D J               S              4  0
D I               S              4  0
 *
D CSENDINFO       S              1S 0
 *
 * Define pointers to field buffers
 *
DCBalance         S             18S 3                                   Balance (Numeric-Double)
DP_001            S               *                                     Number
DP_002            S               *                                     Name
DP_003            S               *                                     Rep number
DP_004            S               *                                     Contact
DP_005            S               *                                     Phone
DP_006            S               *                                     Fax
DP_007            S               *                                     Address
DP_008            S               *                                     City
DP_009            S               *                                     Country
DP_010            S               *                                     Zip Postal Code
DP_011            S               *                                     Zip location
DP_012            S               *                                     Balance
DP_013            S               *                                     Send Market Info to?
 *
 * Select ALL records
 *
DSelAll           C                   'Select * From "Customers"'
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 1 of 11)

```
 ********************************************************************
 *                                                                  *
 * Window/Part/Event:                                               *
 *                                                                  *
 * Description: Bind program fields to columns and connect to the   *
 *              database table CUSTOMERS                            *
 *                                                                  *
 ********************************************************************
 *
C     Main          BEGACT    CREATE        Main
 *
C     'Main'        Setatr    appstart      'MouseIcon'
C     'ODBC'        Setatr    0             'Visible'
C                   MoveL     'ASC '        Seq               4
C                   Eval      CLR = *White
C                   Move      '255:255:255' Mix
C     'SFL1'        Setatr    1             'SizeToFit'
C     'SFL1'        Getatr    'BackColor'   RowClr            2 0
 * Bind fields to columns
 *
 * Bind column: Number
C     'ODBC'        SetAtr    1             'Column'
C     'ODBC'        SetAtr    7             'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_001=%Addr(CUSTNO)
C     'ODBC'        SetAtr    P_001         'BufferPtr'
 *
 * Bind column: Name
C     'ODBC'        SetAtr    2             'Column'
C     'ODBC'        SetAtr    40            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_002=%Addr(CUSTNA)
C     'ODBC'        SetAtr    P_002         'BufferPtr'
 *
 * Bind column: Rep number
C     'ODBC'        SetAtr    3             'Column'
C     'ODBC'        SetAtr    5             'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_003=%Addr(Repno)
C     'ODBC'        SetAtr    P_003         'BufferPtr'
 *
 * Bind column: Contact
C     'ODBC'        SetAtr    4             'Column'
C     'ODBC'        SetAtr    30            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_004=%Addr(Contac)
C     'ODBC'        SetAtr    P_004         'BufferPtr'
 *
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 2 of 11)

```
 * Bind column: Phone
C     'ODBC'        SetAtr    5             'Column'
C     'ODBC'        SetAtr    17            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_005=%Addr(CPhone)
C     'ODBC'        SetAtr    P_005         'BufferPtr'
 *
 * Bind column: Fax
C     'ODBC'        SetAtr    6             'Column'
C     'ODBC'        SetAtr    17            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_006=%Addr(CFax)
C     'ODBC'        SetAtr    P_006         'BufferPtr'
 *
 * Bind column: Address
C     'ODBC'        SetAtr    7             'Column'
C     'ODBC'        SetAtr    40            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_007=%Addr(CAddr)
C     'ODBC'        SetAtr    P_007         'BufferPtr'
 *
 * Bind column: City
C     'ODBC'        SetAtr    8             'Column'
C     'ODBC'        SetAtr    30            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_008=%Addr(CCity)
C     'ODBC'        SetAtr    P_008         'BufferPtr'
 *
 * Bind column: Country
C     'ODBC'        SetAtr    9             'Column'
C     'ODBC'        SetAtr    20            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_009=%Addr(CCount)
C     'ODBC'        SetAtr    P_009         'BufferPtr'
 *
 * Bind column: Zip Postal Code
C     'ODBC'        SetAtr    10            'Column'
C     'ODBC'        SetAtr    10            'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_010=%Addr(CZip)
C     'ODBC'        SetAtr    P_010         'BufferPtr'
 *
 * Bind column: Zip location
C     'ODBC'        SetAtr    11            'Column'
C     'ODBC'        SetAtr    1             'BufferLen'
C     'ODBC'        SetAtr    1             'BufferType'
C                   Eval      P_011=%Addr(CZiplo)
C     'ODBC'        SetAtr    P_011         'BufferPtr'
 *
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 3 of 11)

```
 * Bind column: Balance
C     'ODBC'        SetAtr    12            'Column'
C     'ODBC'        SetAtr    18            'BufferLen'
C     'ODBC'        SetAtr    0             'BufferType'
C     'ODBC'        SetAtr    3             'BufferDec'
C                   Eval      P_012=%Addr(CBalance)
C     'ODBC'        SetAtr    P_012         'BufferPtr'
C     'ODBC'        SetAtr    ConnectStr    'ConnectStr'
 *
 * Bind column: Send Info
C     'ODBC'        SetAtr    13            'Column'
C     'ODBC'        SetAtr    1             'BufferLen'
C     'ODBC'        SetAtr    0             'BufferType'
C     'ODBC'        SetAtr    0             'BufferDec'
C                   Eval      P_013=%Addr(CSendInfo)
C     'ODBC'        SetAtr    P_013         'BufferPtr'
 *
 * Connect to the database and select all records
C     'ODBC'        SetAtr    1             'Connect'
C     'ODBC'        SetAtr    SelAll        'SQLQuery'
C     'ODBC'        SetAtr    1             'ExecuteSQL'
 *
C     'Main'        Setatr    1             'ProgresBar'
C     'ODBC'        Getatr    'Rows'        Rows              4 0
C     'Main'        Setatr    Rows          'PBRange'
C                   Eval      %Setatr('Main':'Main':'PBStepSize')=110
 *
C                   Z-Add     22            MaxRows           2 0
C                   Exsr      Fill
 *
C                   ENDACT
 ************************************************************************
 *                                                                      *
 * Window/Part/Event: Main/PB_Close/Press                               *
 *                                                                      *
 * Description: End the program                                         *
 *                                                                      *
 ************************************************************************
 *
C     PB_CLOSE      BEGACT    PRESS         Main
 *
C                   Move      *ON           *INLR
 *
C                   ENDACT
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 4 of 11)

```
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Main/PB_OK/Press                              *
 *                                                                  *
 * Description: Close the Detail window                             *
 *                                                                  *
 ********************************************************************
 *
C     PB_OK         BEGACT    PRESS         DETAIL
 *
C                   ClsWin    'Detail'
 *
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Main/SFL1/Enter                               *
 *                                                                  *
 * Description: Show detail on selected customer                    *
 *                                                                  *
 ********************************************************************
 *
C     SFL1          BEGACT    ENTER         MAIN
 *
C                   ReadS     SFL1
C                   Eval      SQL='SELECT * FROM CUSTOMER WHERE CUSTNO='+
C                               Custno
C                   ShowWin   'Detail'                            80
C                   Write     'Detail'
C                   Eval      %Setatr('Detail':'Detail':'Focus')=1
 *
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Main/PB_Columns/Press                         *
 *                                                                  *
 * Description: Show the options window                             *
 *                                                                  *
 ********************************************************************
 *
C     PB_COLUMNS    BEGACT    PRESS         MAIN
 *
C                   ShowWin   'Columns'                           88
C                   Eval      %Setatr('Columns':'Columns':'Focus')=1
 *
C                   ENDACT
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 5 of 11)

```
 ****************************************************************
 *                                                              *
 * Window/Part/Event: Columns/PB_Cancel/Press                   *
 *                                                              *
 * Description: Close the options window                        *
 *                                                              *
 ****************************************************************
 *
C     PB_CANCEL     BEGACT    PRESS         COLUMNS
 *
C                   ClsWin    'Columns'
 *
C                   ENDACT
 ****************************************************************
 *                                                              *
 * Window/Part/Event: Main/SFL1/ColSelect                       *
 *                                                              *
 * Description: Sort columns by selected column                 *
 *                                                              *
 ****************************************************************
 *
C     SFL1          BEGACT    COLSELECT     MAIN
 *
C                   Eval      SQL='SELECT * FROM CUSTOMERS ORDER BY ' +
c                             %EditC(%ColNumber:'1') + ' ' + Seq
C     'ODBC'        Setatr    SQL           'SQLQuery'
C     'ODBC'        Setatr    1             'ExecuteSQL'
C                   Exsr      Fill
 *
C                   ENDACT
 ****************************************************************
 *                                                              *
 * Window/Part/Event: Main/PB_Update/Press                      *
 *                                                              *
 * Description: Updated changed record                          *
 *                                                              *
 ****************************************************************
 *
C     PB_UPDATE     BEGACT    PRESS         MAIN
 *
C                   ReadC     SFL1                                  99
 *
C                   If        NOT *IN99
C     'SFL1'        Getatr    'FirstSel'    Sel               4 0
C     'ODBC'        Setatr    Sel           'UpdateRow'
 *
C                   Else
C     *MSG0002      Dsply                   mRC               9 0
C                   EndIf
 *
C                   ENDACT
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 6 of 11)

```
 ****************************************************************
 *                                                              *
 * Window/Part/Event: Main/PB_Delete/Press                      *
 *                                                              *
 * Description: Delete selected record                          *
 *                                                              *
 ****************************************************************
 *
C     PB_DELETE     BEGACT    PRESS         MAIN
 *
C                   ReadS     SFL1                                99
 *
C                   If        NOT *in99
C     Del           Dsply                   mRC
 *
C                   If        mRC=*YESButton
C     'SFL1'        Getatr    'FirstSel'    Sel             4 0
C     'ODBC'        Setatr    Sel           'DeleteRow'
C                   EndIf
 *
C                   EndIf
 *
C                   ENDACT
 ****************************************************************
 *                                                              *
 * Window/Part/Event: Main/PB_Opt/Press                         *
 *                                                              *
 * Description: Show the options window                         *
 *                                                              *
 ****************************************************************
 *
C     PB_Opt        BEGACT    PRESS         MAIN
 *
C                   ShowWin   'Columns'                         88
 *
C                   ENDACT
 ****************************************************************
 *                                                              *
 * Window/Part/Event: Columns/CB_Hrule/Select                   *
 *                                                              *
 * Description: Toggle horizontal rule                          *
 *                                                              *
 ****************************************************************
 *
C     CB_HRULE      BEGACT    SELECT        COLUMNS
 *
C                   Eval      %Setatr('Main':'SFL1':'HRule')=
C                               %Getatr('Columns':'CB_HRule':'Checked')
 *
C                   ENDACT
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 7 of 11)

```
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Columns/CB_VRule/Select                       *
 *                                                                  *
 * Description: Toggle vertical rule                                *
 *                                                                  *
 ********************************************************************
 *
C     CB_VRULE      BEGACT    SELECT        COLUMNS
 *
C                   Eval      %Setatr('Main':'SFL1':'VRule')=
C                               %Getatr('Columns':'CB_VRule':'Checked')
 *
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Subroutine: Fill                                                 *
 *                                                                  *
 * Description: Fill the subfile from the database                  *
 *                                                                  *
 ********************************************************************
C     Fill          Begsr
 *
C     'Main'        Setatr    99            'MouseShape'
C                   Z-Add     0             Count
C                   Eval      *IN01 = *OFF
C                   Clear                   SFL1
C     'SQL'         Setatr    SQL           'Text'
C     'ODBC'        Setatr    1             'FetchNext'
C     'ODBC'        Getatr    'IsData'      Temp              1 0
 *
 * Do while there is data
C                   DoW       Temp = 1
C                   Write     SFL1
 *
C                   Eval      *IN01 = NOT *IN01
 *
C                   If        *IN01
C                   Eval      %Setatr('Main':'SFL1':'RowBGMix')=Mix
C                   EndIf
 *
 * Move the progress bar
C                   Add       1             Count
C     'Main'        Setatr    1             'PBStep'
 * Check if there is another row
C     'ODBC'        Setatr    1             'FetchNext'
C     'ODBC'        Getatr    'IsData'      Temp              1 0
C                   EndDo
 *
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 8 of 11)

```
C     'Main'        Setatr    0             'PBSetPos'
C     'Count'       Setatr    Count         'Label'
C     'SFL1'        Setatr    1             'SelectItem'
C                   Eval      %Setatr('Main':'SQL':'Text')=
C                              %Getatr('Main':'ODBC':'SQLQuery')
C     'Main'        Setatr    1             'MouseShape'
 *
C                   EndSr
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Columns/ST06/Click                            *
 *                                                                  *
 * Description: Change list colour                                  *
 *                                                                  *
 ********************************************************************
 *
C     ST06          BEGACT    CLICK         COLUMNS
 *
C                   Eval      *IN01 = *OFF
C                   Eval      I=%Getatr('Main':'SFL1':'Count')
C     %Part         Getatr    'BackMix'     Mix              11
 *
C                   Do        I             J
C                   Eval      *IN01 = NOT *IN01
 *
C                   If        *IN01
C                   Eval      %Setatr('Main':'SFL1':'Index')=J
C                   Eval      %Setatr('Main':'SFL1':'RowBGMix')=Mix
C                   EndIf
 *
C                   EndDo
 *
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Main/PB_Sql/Press                             *
 *                                                                  *
 * Description: Process SQL statement                               *
 *                                                                  *
 ********************************************************************
 *
C     PB_SQL        BEGACT    Press         MAIN
 *
C     'SQL'         Getatr    'Text'        SQL
C                   Eval      %Setatr('Main':'ODBC':'SQLQuery')=SQL
C                   Eval      %Setatr('Main':'ODBC':'ExecuteSQL')=1
C                   Exsr      Fill
 *
C                   ENDACT
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 9 of 11)

```
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Columns/CB01/Select                           *
 *                                                                  *
 * Description: Hide/Show columns                                   *
 *                                                                  *
 ********************************************************************
 *
C     CB01          BEGACT    SELECT        COLUMNS
 *
C                   MoveL     %Part         TempName          4
C                   Move      TempName      Num2              2 0
C                   Eval      %Setatr('Main':'SFL1':'ColNumber')=Num2
C     %Part         Getatr    'Checked'     State             1 0
 *
C                   If        State = 1
C                   Eval      State = 0
 *
C                   Else
C                   Eval      State=1
C                   EndIf
 *
C                   Eval      %Setatr('Main':'SFL1':'Hidden')=State
 *
C                   ENDACT
 ********************************************************************
 *                                                                  *
 * Window/Part/Event: Columns/CB_Sort/Select                        *
 *                                                                  *
 * Description: Set sort sequence                                   *
 *                                                                  *
 ********************************************************************
 *
C     CB_SORT       BEGACT    SELECT        COLUMNS
 *
C                   If        %Getatr('Columns':'CB_Sort':'Checked')=1
C                   Eval      SEQ = 'ASC '
 *
C                   Else
C                   Eval      SEQ = 'DESC'
C                   EndIf
 *
C                   ENDACT
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 10 of 11)

```
 ***************************************************************************
 *                                                                         *
 * Window/Part/Event: Detail/Detail/Create                                 *
 *                                                                         *
 * Description: Set all fields to read only                                *
 *                                                                         *
 ***************************************************************************
 *
C     DETAIL        BEGACT    CREATE        DETAIL
 *
C     'CAN0000037'  Setatr    1             'ReadOnly'
 *
C                   ENDACT
 ***************************************************************************
 *                                                                         *
 * Window/Part/Event: Main/MI_Tips/MenuSelect                              *
 *                                                                         *
 * Description: Toggle display of tip text                                 *
 *                                                                         *
 ***************************************************************************
 *
C     MI_TIPS       BEGACT    MENUSELECT    MAIN
 *
C                   If        %Getatr('Main':'MI_Tips':'Checked')=0
C                   Eval       %Setatr('Main':'MI_Tips':'Checked')=1
 *
C                   Else
C                   Eval       %Setatr('Main':'MI_Tips':'Checked')=0
C                   EndIf
C                   Eval      %Setatr('Main':'Main':'ShowTips')=
C                              %Getatr('Main':'MI_Tips':'Checked')
 *
C                   ENDACT
```

Figure 23. Code for ODBC/JDBC Inquiry Example (Part 11 of 11)

Outline Box

Use an outline box around a group of parts to indicate that they are related.

An outline box is a rectangular, unlabeled box. If you need a label on the box, use the group box part instead.

For related information, see “Group Box” on page 82.

Part Attributes

Bottom	Handle*	Height	Left
ParentName	PartName	PartType	Refresh
Top	UserData	Visible	Width

Note: See the attribute description for restrictions.

Applicable Events

Create	Destroy

Special Height and Width Settings

You can create lines using two outline box attributes. Set the **Width** attribute to *1* to create a vertical line, or set the **Height** attribute to *1* to create a horizontal line.

Pop-up Menu

Use the pop-up menu part to display a number of choices that pertain to a particular part on your interface. You can add menu item parts and submenu parts to the pop-up menu part.

The menu is called a "pop-up" because it appears when the user presses the appropriate key or mouse button.

Note: You can manipulate this part's properties, events, and so on, only from its pop-up menu in the project tree view.

For related information, see:
- "Menu Bar" on page 105
- "Menu Item" on page 106
- "Submenu" on page 171

Part Attributes

Handle*	InvName	InvPName	ParentName
PartName	PartType	UserData	Visible*
X	Y		

*** Note:** See the attribute description for restrictions.

Applicable Events

There are no events for this part.

Progress Bar

Use the progress bar part to indicate graphically the progress of a process, such as copying files, loading a database, and so on.

For example, to show the progress of copying 100 files, you could set the **PBRange** attribute to 100 and the **PBStepSize** attribute to 10. Your code could then monitor the copyfile process and move the progress bar indicator forward in steps for every ten files copied.

In Java applications, if the progress bar's width is smaller than its height, the progress bar will have a vertical orientation.

Part Attributes

Bottom	Handle*	Height	Left
ParentName	PartName	PartType	PBRange
PBSetPos	PBStep	PBStepSize	Top
UserData	Visible	Width	

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy

Progress Bar Example

In the following example, the progress bar indicator is updated every time a read operation occurs:

```
*...1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq----
 *
C                   EVAL      %setatr('win01':'WIN1':'PBRange')=10
C                   EVAL      %setatr('win01':'WIN1':'PBStepSize')=1
C                   DO        10
C                   Read      Input
C                   EVAL      %setatr('win01':'WIN1':'PBStep')=1
C                   EndDo
 *
```

Push Button

Use push buttons to provide convenient access to frequently used actions.

Each push button part controls a specific action. When the user clicks on a push button, its action is initiated immediately. The text label on the push button describes its action.

Compare with "Graphic Push Button" on page 80.

Part Attributes

BackColor	BackMix	Border*	Bottom
Enabled	Focus	FontBold	FontItalic
FontName	FontSize	FontStrike*	FontUnder*
ForeColor	ForeMix	Handle*	Height
HelpEnable	HighLight	Label	Left
ParentName	PartName	PartType	Refresh
ShowTips	TipText	Top	UserData
Validate	Visible	Width	

* **Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	GotFocus	LostFocus
MouseEnter	MouseExit	MouseMove	Popup
Press			

Setting a Default Push Button

In the properties notebook of a push button part, you can specify that you want the push button to be the default push button for the window you are designing. The default push button is displayed with a heavy black border, and the action associated with it is performed when the user presses the Enter key.

Note: You can define only one default push button per window. If you define more than one, VisualAge RPG will choose one.

Setting a Mnemonic

Note: Mnemonics are not supported in Java applications.

For each push button, use the **Label** attribute to associate text with a specific push button. That text appears on the button.

To specify a mnemonic key for the push button, place the mnemonic identifier in front of a character in the text of the **Label** attribute. For Windows, use an ampersand (&). This designated character is displayed on the interface with an

underscore (for example, **C**ancel). The underscore informs users that they can select the push button by pressing the Alt key and the underlined character on the keyboard.

Assigning Command Keys

You can assign a command key to a push button. To do this, open the part's properties notebook and select one of the command keys from the available list.

When the user presses the command key at run time, it has the same effect as pressing the mouse button or a key on the keyboard. A **Press** event is signaled to your program.

Signaling Events

A **Press** event is signaled to your program when:

- the user selects a push button.
- the user presses the Enter key if a default push button is defined.
- the user presses a command key that is assigned to a push button.

Radio Button

Use radio buttons if you want the user to select only one of a group of related but mutually exclusive choices. When the user makes a selection, the previously selected choice in the group is deselected.

A radio button appears as a raised circular button that is labeled with text beside it. When selected, the circular button displays a dot.

Do not use radio buttons if you want the user to be able to select more than one choice at a time. In that case, see "Check Box" on page 58.

Part Attributes

BackColor	BackMix	Bottom	Checked
Enabled	Focus	FontBold	FontItalic
FontName	FontSize	FontStrike*	FontUnder*
ForeColor	ForeMix	Handle*	Height
HighLight*	Label	Left	ParentName
PartName	PartType	Refresh	SelectIdx
ShowTips	TipText	Top	UserData
Visible	Width		

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	Enter	MouseEnter
MouseExit	MouseMove	Popup	Select

Setting a Mnemonic

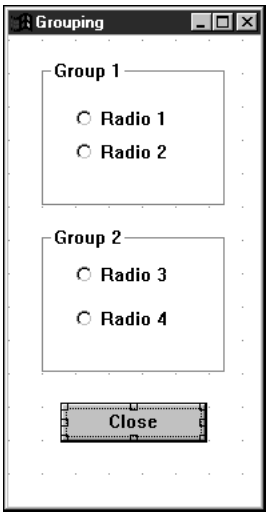
To specify a mnemonic key for the radio button, place the mnemonic identifier in front of a character in the text of the **Label** attribute. For Windows, use an ampersand (&). This designated character is displayed on the interface with an underscore (for example, **B**lue). The underscore informs users that they can select the radio button by pressing the underlined character on the keyboard.

Note: Mnemonics are not supported in Java applications.

Grouping Radio Buttons

When you create radio buttons, group them logically, so that selecting a button will affect only the state of buttons in its own group.

For example, assume that you have four radio buttons on a design window. RB1 and RB2 are mutually exclusive to each other, and RB3 and RB4 are mutually exclusive to each other. You must group these buttons into two logical groups. The following figure illustrates how these radio buttons can be grouped on the design window:



To arrange radio buttons in logical groups:

1. Arrange the radio buttons as desired, and optionally place a group box around each group. (See "Group Box" on page 82.)
2. Select the canvas part in the design window and press mouse button 2.
3. From the pop-up menu, select **Tabs and Groups...**.

   The Customize Tabs and Groups window appears, listing all of the parts on the design window. Resize this window, if necessary, to see all the parts.
4. Click mouse button 1 to select the radio button that will be the first button in the first group. In this example, RB1 is the first radio button in group 1.
5. Click mouse button 2 to get the pop-up menu for this radio button part, and select **Group mark**.

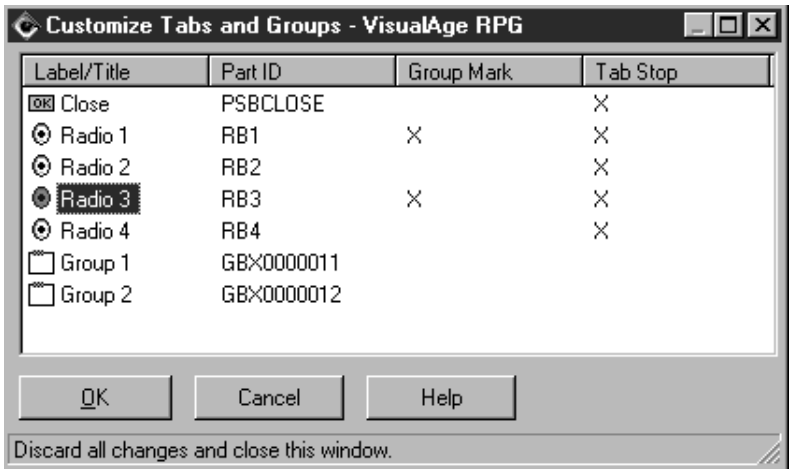
   An X mark symbol appears next to the radio button under the **Group Mark** column.

   Note: You can also set the group mark in the properties notebook for the part.
6. Use Ctrl+Up Arrow and Ctrl+Down Arrow to position RB2 after RB1. Note that this positioning can also be done within the tree view and can also be done using **move up** and **move down** menu items. Ensure that the **Group mark** attribute is not set for RB2.

   This specifies that RB2 is the second radio button in group 1.
7. Press **OK** to close the window.

   Note: Do **not** close the window using the system menu, or your changes will not be saved.

RB1 and RB2 are now considered to be part of one group, so selecting either will only affect the other. Repeat the same process for RB3 and RB4. The following figure shows the Customize Tabs and Groups window after parts have been grouped:



Note: Tab stops and group marks can also be set for individual parts from within a part's properties notebook.

Setting the State of a Radio Button

In the radio button's properties notebook, you can indicate if the radio button is to be initially selected or not. Only one radio button in a group may be selected at one time. If you select more, only the last one in the group will be selected.

By default, when you create a radio button, the **Checked** attribute is set to *0*. This means that the radio button is not set and the state is turned off. The radio button is displayed with the circle empty.

If you want to create a radio button that is set and the state is turned on, you must set the **Checked** attribute to *1*. In this case, the radio button is displayed with the circle partially filled.

You can set the **Checked** attribute in the properties notebook or in your program.

Signaling Events

When the user selects a radio button, a **Select** event is signaled.

Slider

Use the slider part if you want the user to be able to display, set, or modify a value by moving a slider arm along a slider shaft.

Sliders are typically used for values that have familiar increments, such as seconds or degrees, or to show the percentage of a task that has been completed.

By default, a slider is placed horizontally in the center of a box with the slider shaft on the left side. A scale can be displayed to show the units of measure for the shaft.

Use the properties notebook for the slider part to:
- Set the range of values that a slider can return
- Position the slider vertically or horizontally in a window
- Provide a scale to indicate the units of measure represented by the slider

Part Attributes

AddLink*	AllowLink*	BackColor	BackMix
Bottom	Enabled	Focus	FontBold
FontItalic	FontName	FontSize	FontStrike*
FontUnder*	ForeColor	ForeMix	Handle*
Height	Left	Maximum	Minimum
ParentName	PartName	PartType	Refresh
RemoveLink*	ShowTips	TickLabel	TickNumber
TipText	Top	UserData	Value
Visible	Width		

*** Note:** See the attribute description for restrictions.

Applicable Events

Change	Create	Destroy	GotFocus
Link*	LostFocus	MouseEnter	MouseExit
MouseMove	Popup		

*** Note:** See the event description for restrictions.

Getting and Setting the Slider Value

You can get or set the value of the slider by using the **Value** attribute.

When you get the **Value** attribute, make sure that you have defined a large enough result field to contain the returned value.

Signaling Events

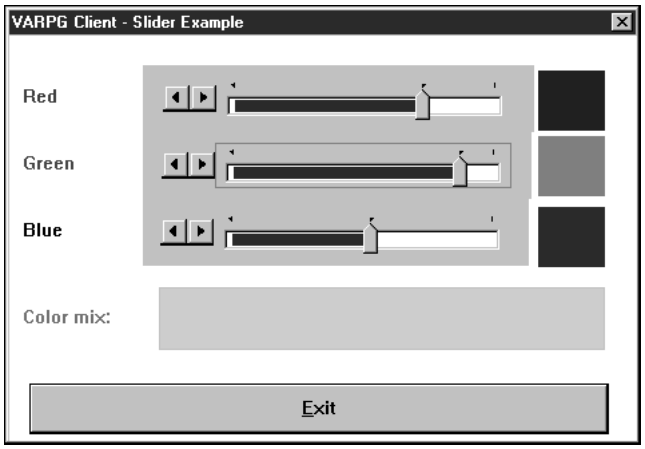
The **Change** event is signaled when the position of the slider arm changes.

If you use increment buttons to move the slider arm, the **Change** event is signaled continuously as long as the buttons are pressed.

If you use the mouse to move the slider arm, the **Change** event occurs when the mouse button is released.

Slider Example

This example illustrates how the slider part can be used to control the color of other parts by using the **BackMix** attribute. As each slider is moved, its value is used to determine the background color mix of its corresponding static text part to show the intensity of that color. The background color of the static text labeled **Sample** is updated to show the combined color mix of all three colors.



```
*************************************************************************
*                                                                       *
* Program ID . . : Slider                                               *
*                                                                       *
* Description  . : Sample program to illustrate the slider part.        *
*                                                                       *
*                  As each slider arm is moved, a CHANGE event is       *
*                  signalled for that slider.                           *
*                  The CHANGE action subroutine retrieves the value     *
*                  of the slider, and updates the background colour     *
*                  mix of its corresponding static text part to         *
*                  show the intensity of that colour.                   *
*                                                                       *
*                  The background colour mix of static text part        *
*                  'SAMPLE' is also updated to show the result of       *
*                  mixing all the colour values.                        *
*                                                                       *
*************************************************************************
*
H
*
*************************************************************************
*                                                                       *
* Window . . : MAIN                                                     *
*                                                                       *
* Part . . . : PB_EXIT                                                  *
*                                                                       *
* Event  . . : PRESS                                                    *
*                                                                       *
* Description: Terminate the program.                                   *
*                                                                       *
*************************************************************************
*
C     PB_EXIT       BEGACT    PRESS         MAIN
*
C                   move      *on           *inlr
*
C                   ENDACT
```

Figure 24. Coding Example Using the Slider Part (Part 1 of 4)

```
 ***************************************************************************
 *                                                                         *
 * Window . . : MAIN                                                       *
 *                                                                         *
 * Part . . . : GREEN                                                      *
 *                                                                         *
 * Event  . . : CHANGE                                                     *
 *                                                                         *
 * Description: Update the Green colour value.                             *
 *                                                                         *
 ***************************************************************************
 *
C     GREEN         BEGACT    CHANGE        MAIN
 *
C     'green'       getatr    'Value'       val               3 0
C                   move      val           grnmix            3
C                   move      *blanks       mix              11
C                   movel     '000:'        mix
C     mix           cat       grnmix:0      mix
C     mix           cat       ':000':0      mix
C     'STGreen'     setatr    mix           'BackMix'
C                   exsr      update
 *
C                   ENDACT
 ***************************************************************************
 *                                                                         *
 * Window . . : MAIN                                                       *
 *                                                                         *
 * Part . . . : BLUE                                                       *
 *                                                                         *
 * Event  . . : CHANGE                                                     *
 *                                                                         *
 * Description: Update the Blue colour value.                              *
 *                                                                         *
 ***************************************************************************
 *
C     BLUE          BEGACT    CHANGE        MAIN
 *
C     'blue'        getatr    'Value'       val
C                   move      val           blumix            3
C                   move      *blanks       mix
C                   movel     '000:000:'    mix
C     mix           cat       blumix:0      mix
C     'STBlue'      setatr    mix           'BackMix'
C                   exsr      update
 *
C                   ENDACT
```

Figure 24. Coding Example Using the Slider Part (Part 2 of 4)

```
*****************************************************************
*                                                               *
* Subroutine . . : UPDATE                                       *
*                                                               *
* Description  . : Updates the background colour mix of the static  *
*                  text part 'Sample' to show the results of    *
*                  combining the colour values from the three   *
*                  sliders.                                     *
*                                                               *
*****************************************************************
*
C     UPDATE        BEGSR
*
C                   move      *blanks       smpmix           11
C                   movel     redmix        smpmix
C     smpmix        cat       ':':0         smpmix
C     smpmix        cat       grnmix:0      smpmix
C     smpmix        cat       ':':0         smpmix
C     smpmix        cat       blumix:0      smpmix
C     'Sample'      setatr    smpmix        'BackMix'
*
C                   ENDSR
*****************************************************************
*                                                               *
* Window . . : MAIN                                             *
*                                                               *
* Part . . . : RED                                              *
*                                                               *
* Event  . . : CHANGE                                           *
*                                                               *
* Description: Update Red colour value.                         *
*                                                               *
*****************************************************************
*
C     RED           BEGACT    CHANGE        FRA0000B
*
C     'red'         getatr    'Value'       val
C                   move      val           redmix            3
C                   move      *blanks       mix
C                   movel     redmix        mix
C     mix           cat       ':000:000':0  mix
C     'STRed'       setatr    mix           'BackMix'
C                   exsr      update
*
C                   ENDACT
```

Figure 24. Coding Example Using the Slider Part (Part 3 of 4)

```
 ***********************************************************************
 *                                                                     *
 * Window . . : MAIN                                                   *
 *                                                                     *
 * Part . . . : MAIN                                                   *
 *                                                                     *
 * Event  . . : CREATE                                                 *
 *                                                                     *
 * Description: Initialize the color mix                               *
 *                                                                     *
 ***********************************************************************
 *
C     MAIN          BEGACT    CREATE        MAIN
 *
C                   move      '000'         grnmix
C                   move      '000'         blumix
C                   move      '000'         redmix
 *
C                   ENDACT
```

Figure 24. Coding Example Using the Slider Part (Part 4 of 4)

Spin Button

Use the spin button part to display, in sequence, a group of related but mutually exclusive choices that have a logical consecutive order; for example, months of the year. The choices are displayed as though they were arranged in a ring. The user can move (or "spin") through the choices by pressing the up arrow to go to the next higher value, or the down arrow to go to the next lower one. Alternatively, one of the choices can be typed directly into the entry field for the spin button.

Part Attributes

AddItemEnd	Alignment*	BackColor	BackMix
Bottom	Enabled	Focus	FontBold
FontItalic	FontName	FontSize	FontStrike*
FontUnder*	ForeColor	ForeMix	Handle*
Height	Left	Maximum	Minimum
ParentName	PartName	PartType	ReadOnly
Refresh	RemoveItem	ShowTips	Text
TipText	Top	UserData	Value
Visible	Width		

* **Note:** See the attribute description for restrictions.

Applicable Events

Change	Create	Destroy	GotFocus
Link*	LostFocus	MouseEnter	MouseExit
MouseMove	Popup	SpinDown	SpinEnd
SpinUp			

* **Note:** See the event description for restrictions.

Setting Spin Button Values

The data type of the spin button determines the method used to set the spin list values.

To specify the allowed values for a numeric spin button, set the **Maximum** and **Minimum** attributes.

To set the initial spin list values of a character spin button, set the **AddItemEnd** attribute for each item you want to add. Add the items in the order in which you want them to appear because the character spin button items are not sorted automatically.

Getting the Spin Button Value

The attribute you use to retrieve the value that is selected in a spin button depends on the type of spin button.

- For character spin buttons, use the **Text** attribute.

- For numeric spin buttons, use the **Value** attribute. This attribute returns a value ranging from the minimum to the maximum value specified for the spin button.

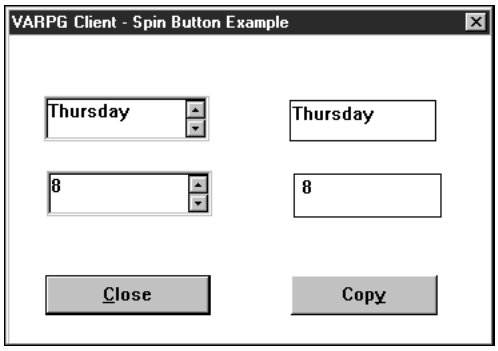
Preventing User Input

You can prevent the user from typing a value directly into the field associated with the spin button by setting the **ReadOnly** attribute in the spin button properties notebook or by setting the **ReadOnly** attribute to *1* in your program.

Spin Button Example

This example illustrates how to set and get the values for a numeric and a character spin button. When you start the program, an initial list is inserted into each spin button. When you select the **Copy** push button, the value of each spin button is copied to the associated entry field part.

Press the **Close** push button to end the program.



```
 ********************************************************************
 *                                                                  *
 * Program ID . . : SPIN                                            *
 *                                                                  *
 * Description  . : Sample program to demonstrate the Spin button   *
 *                  part.                                           *
 *                                                                  *
 *                  A Character, and Numeric spin button are used   *
 *                  to show how they are initialized, and how their *
 *                  values are retrieved.                           *
 *                                                                  *
 ********************************************************************
 *
H
 *
DDAY              S             10A   DIM(7) PERRCD(1) CTDATA
 *
 ********************************************************************
 *                                                                  *
 * Window . . : MAIN                                                *
 *                                                                  *
 * Part . . . : PB_COPY                                             *
 *                                                                  *
 * Event  . . : PRESS                                               *
 *                                                                  *
 * Description: Copy the value from each Spin button to its         *
 *              corresponding entry field part.                     *
 *                                                                  *
 ********************************************************************
 *
C     PB_COPY       BEGACT    PRESS         MAIN
 *
C     'SPB1'        Getatr    'Value'       tmp2N             2 0
C     'EF1'         Setatr    tmp2N         'Text'
 *
C     'SPB2'        Getatr    'Text'        tmp              10
C     'EF2'         Setatr    tmp           'Text'
 *
C                   ENDACT
```

Figure 25. Coding Example Using the Spin Button Part (Part 1 of 2)

```
      ******************************************************************
      *                                                                *
      * Window . . : MAIN                                              *
      *                                                                *
      * Part . . . : MAIN                                              *
      *                                                                *
      * Event  . . : CREATE                                            *
      *                                                                *
      * Description: Center the window on the display, and             *
      *              initialize the spin buttons.                      *
      *                                                                *
      ******************************************************************
      *
     C     MAIN          BEGACT    CREATE        MAIN
      *
      * Initialize the Character spin button with the days of the
      * week from the array DAY
     C                   Do        7             I                2 0
     C     'SPB2'        Setatr    day(i)        'AddItemEnd'
     C                   EndDo
      *
      * Initialize the numeric spin button
     C     'SPB1'        Setatr    1             'Minimum'
     C     'SPB1'        Setatr    10            'Maximum'
      *
     C                   ENDACT
      ******************************************************************
      *                                                                *
      * Window . . : MAIN                                              *
      *                                                                *
      * Part . . . : PB_EXIT                                           *
      *                                                                *
      * Event  . . : PRESS                                             *
      *                                                                *
      * Description: Terminate the program.                            *
      *                                                                *
      ******************************************************************
      *
     C     PB_EXIT       BEGACT    PRESS         MAIN
      *
     C                   Move      *On           *INLR
      *
     C                   ENDACT
**CTDATA DAY
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
```

Figure 25. Coding Example Using the Spin Button Part (Part 2 of 2)

Static Text

Use the static text part as a label for other parts, such as a prompt for an entry field part. Static text parts do not accept end user input. In Java applications, static text can be displayed only on a single line.

Part Attributes

Alignment	BackColor	BackMix	Bottom
DataType	DragEnable*	DropEnable*	DropValue*
Enabled	FontBold	FontItalic	FontName
FontSize	FontStrike*	FontUnder*	ForeColor
ForeMix	Handle*	Height	Label
Left	ParentName	PartName	PartType
Refresh	ShowTips	TipText	Top
UserData	Visible	Width	

* **Note:** See the attribute description for restrictions.

Applicable Events

Click	Create	DblClick	Destroy
Drop	Link*	MouseDown	MouseEnter
MouseExit	MouseMove	MouseUp	Popup

* **Note:** See the event description for restrictions.

Changing the Text of a Static Text Part

The static text part is a rectangular area into which text is placed. Use the **Label** attribute to change the text of a static text part.

If you change the text so that it is longer than the original text, the new text will be clipped at the borders of the enclosing rectangle. The text will also be clipped if you change the **FontName** and **FontSize** attributes to a larger font or size.

When you change text in your program, make sure that the static text part in the GUI Designer is large enough to show the new text.

Getting Static Text Values

To get the value of a static text part, you must specify the **Label** attribute. If you are getting the value of a numeric static text part, the field that receives the value must also be defined as numeric.

Getting and Setting Information for a Window

During compilation, the compiler implicitly defines fields in your program with the same name as the static text part, and with the same data type and length. By using the READ and WRITE operation codes with a window name specified in factor 2, the **Label** attribute value is automatically copied to or from these fields.

The READ and WRITE operation codes are most useful if you have many static text parts in your user interface because you do not have to execute a series of get and set attributes.

See Chapter 3, “Programming with Parts,” on page 25 for more information.

Editing Output

You can edit the contents of a static text part if the data type is numeric. See Chapter 11, “Editing Output,” on page 239 for a description of editing.

Status Bar

Use the status bar part to provide additional information about a process or action for your window. You can create up to five panes for the status bar. The status bar part provides more flexibility than the **StatusBar** attribute for the window part.

By default, a status bar is created at the bottom of the window. However, you can use the properties notebook to reposition it to the top. You can also set the border style, number of panes, and text alignment.

Part Attributes

Handle*	ParentName	PartName	PartType
SBIndex	SBLabel	SBPanes	UserData
Visible			

* **Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy

Status Bar Example

In the following example, the status bar label is updated while some initial processing occurs:

```
*...1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq----
 *
C     STBAR         BEGACT    CREATE        MAIN
C     'STBAR'       SETATR    'Wait...'     'SBLABEL'
 *
 * Do some processing.
 *
C                   DO
C                   ...
C                   ENDDO
 *
 * Clear the status bar label.
 *
C     'STBAR'       SETATR    *BLANKS       'SBLABEL'
C                   ENDACT
 *
```

Subfile

Use the subfile part to display a list of records, each consisting of one or more fields.

The subfile part has similar function to an iSeries™ subfile. The user can scroll horizontally or vertically through the list using the subfile's scroll bars.

To create a subfile entry field, point-and-click on a field from the Define Reference Fields window or the parts palette and click it onto the subfile part. You can also add fields using the properties notebook.

Note: The subfile part can only be point-and-clicked onto a notebook page with canvas or window with canvas.

Part Attributes

AddItemEnd	AllowEdit	AutoSelect	BackColor
BackMix	Bottom	ButtonIdx	Buttons
ButtonTip	ByteComp	CapsLock	CellBGClr
CellBGMix	CellFGClr	CellFGMix	ColBGClr
ColBGMix	ColFGClr	ColFGMix	ColNumber
ColWidth	Count	DColFRVCol	DeSelect
EditColumn	EditIndex	EditText	EnableBtn
Enabled	ExtSelect*	FirstSel	Focus
FontArea	FontBold	FontItalic	FontName
FontSize	FontStrike*	FontUnder*	ForeColor
ForeMix	Handle*	HdgBGClr	HdgBGMix
HdgFGClr	HdgFGMix	HdgIdx	HdgText
Height	Hidden	HRule	Index
ItemCount	Left	MapViewCol	MultSelect
NbrOfSel	OpenEdit	PageSize	ParentName
PartName	PartType	RemoveItem	RowBGClr
RowBGMix	RowFGClr	RowFGMix	Scale
Selected	SelectItem	SelectList	SetTop
SflNxtChg	ShowTips	SizeToFit	SortAsc
SortDesc	StartAt	TipText	Top
TopRecord	UserData	VColFRDCol	ViewColumn
Visible	VRule	Width	

*** Note:** See the attribute description for restrictions.

Applicable Events

Change	ColSelect	Create	Destroy
Enter	FirstRec	GotFocus	KeyPress
LastRec	LostFocus	MouseEnter	MouseExit
MouseMove	NextRec	PageDown	PageEnd
PageTop	PageUp	Popup	PrevRec
Select	VKeyPress		

Creating a Subfile Part

You can create a subfile part only on a canvas part.

Maximum Number of Fields per Subfile

You can define a maximum of 99 fields for a subfile.

Operation Codes for Manipulating Subfile Parts

In addition to using attributes to control a subfile, you can use several operation codes to affect the subfile part. Specify the name of the subfile in factor 2. Do **not** enclose it in quotation marks.

The following operation codes are supported. For a complete description of each, refer to *VisualAge RPG Language Reference*, SC09-2451-04, or to the language-sensitive help.

Code Operation

CHAIN
Reads a record from a subfile by specifying an index.

CLEAR
Clears all records from the subfile.

DELETE
Deletes a record from the subfile. All records following the deleted record are moved up one position.

READC
Reads a record if the value of any of the entry fields in the record has changed.

READS
Reads a selected record from the subfile. Users can select a record with either the mouse or the keyboard. After the record has been read, it is deselected.

UPDATE
Updates an existing subfile record. A record must have been read before this operation code can be used.

WRITE
Adds a new record to the subfile.

Loading a Subfile

To display information in a subfile part, the information is written one record at a time to the subfile part. Subfile fields that were defined in the GUI Designer for the subfile part are set to the desired values, and the WRITE operation is performed on the subfile record format.

Determining the Subfile Size

Unlike the iSeries 400 subfile, the subfile part does not have subfile or subfile page sizes. The number of records a subfile can hold is limited by the amount of memory on your workstation. The subfile page size (that is, the number of records shown at one time) is determined when you create the subfile in the GUI Designer.

Getting the Record Count

To determine how many records are currently in a subfile, use the **Count** attribute.

Reading and Updating Records

Records in a subfile part can be updated or deleted. To update records, you must first position the subfile to the record that you want to update. You can position the subfile by a CHAIN, READC, or READS operation. These operations cause the field values from the retrieved record to be assigned to the corresponding program fields for the subfile record format. Your program can then modify the field values.

An UPDATE operation that is run on the subfile part then sends the current values from the associated fields back out to the subfile. Use CHAIN to select records by relative position within a subfile, READC to select records that the user has changed on the subfile display, and READS for the records that the user selected.

The following example shows a READS operation do a loop to obtain all the selected records in a subfile, process them, and update them one record at a time. This is coded in an action subroutine for the **Press** event for a push button called **Report**.

```
.
.
.
     C     REPORT        BEGACT    PRESS         WIN1
      *
     C                   READS     SUBF1                                  99
      *
     C     *IN99         DOWEQ     *OFF
      *
      *
      *         For the selected record, process it, and mark it
      *         as 'Reported' in the subfile display.
      *
     C                   MOVEL     '(Reported)'  SF1NAME
      *
     C                   UPDATE    SUBF1
      *
     C                   READS     SUBF1                                  99
     C                   END
      *
     C                   ENDACT
```

Figure 26. Coding example of reading and modifying records

Changing Subfile Fields

Note: A subfile field cannot be changed by the user if it is set as read-only.

Before a field in a subfile can be changed by the user, it must be opened for editing, either by the user of your application or by you in your program:

1. The user selects the field with the mouse pointer then clicks mouse button 1 while holding down the Alt key. The user can then use the tab and back-tab keys to move to different fields on the same record, and use the up and down arrow keys to move to different records.
2. To open a field for editing in your program:
   a. Use the **Index** attribute to indicate which record contains the field to be edited.
   b. Set the **ColNumber** attribute to indicate the column number of the field to be edited.
   c. Set the **OpenEdit** attribute value to *1* to open the field for editing. (You can set this attribute value to *0* to close any fields that are currently open for editing.)

Use the READC operation to determine if the user has changed any field in the subfile.

Hidden Fields

In the subfile part's properties notebook, you can set subfile fields to be *Hidden* so that they are not displayed. For example, a subfile record can contain record key information in a hidden field. You cannot see the hidden field, but the field is returned to the program with the subfile record.

Formatting Subfile Fields

The fields in a subfile can be highlighted in several ways. Foreground and background colors can be set for both subfile headings and individual subfile fields. You can place horizontal or vertical line separators within a subfile.

See Chapter 11, "Editing Output," on page 239 for information.

Enabling Tabbing

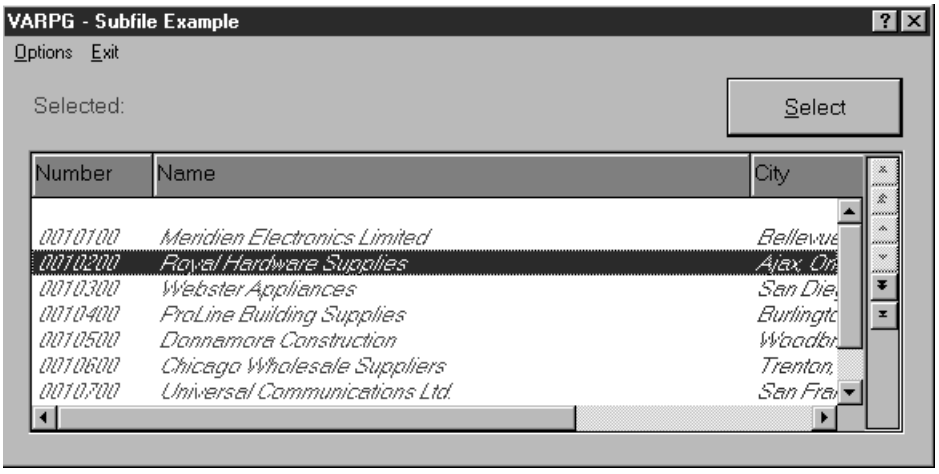
Use the Customize Tabs and Groups dialog to enable tabbing to a subfile part. Right-click on the canvas part of the window containing the subfile part. Select **Tabs and Groups** from the pop-up menu. The Customize Tabs and Groups dialog appars. To set or clear the Tab stop setting, right-click on the part name and select the **Tab stop** menu item.

Subfile Example

In the following example, a subfile part is used to display records from a database file on an iSeries 400 server. Rather than filling the subfile with all records from the database, navigation push buttons (FirstRec, LastRec, PageTop, PageUp, PageDown, PrevPage, NextPage) are provided to control scrolling through the records in the subfile.

When you press the **Select** push button, the READS operation code is used to determine which record was selected, and the value of the CUSTNO field is displayed in the static text part. Also, the first field in the record is opened for editing.

Select the **Exit** menu item to end the program.



```
 ****************************************************************
 *                                                              *
 * Program ID . . : SUBFILE                                     *
 *                                                              *
 * Description  . : Sample program to demonstrate the subfile part.  *
 *                                                              *
 *                  This sample program requires a physical database *
 *                  file on the AS/400 called CUSTOMER.         *
 *                                                              *
 ****************************************************************
 *
H
FCUSTOMER  IF   E             DISK    REMOTE INFDS(INFDS) BLOCK(*Yes)
 *
 * INFDS for database file. FileSize will contain the number
 * of records in the file when the file is opened.
DINFDS            DS
DFileSize               156    159B 0
 *
 ****************************************************************
 *                                                              *
 * Subroutine . . : *INZSR                                      *
 *                                                              *
 * Description  . : Initialize working variables.               *
 *                                                              *
 ****************************************************************
 *
C     *INZSR        BEGSR
 *
C                   Z-Add     10            PageSize          2 0
C                   Z-Add     1             CurRec            6 0
C     FileSize      Sub       PageSize      LastPage          6 0
C                   Add       1             LastPage
 *
C                   ENDSR
 *                                                                *
```

Figure 27. Coding Example Using the Subfile Part (Part 1 of 10)

```
 ****************************************************************
 *                                                              *
 * Subroutine . . : NEXTPAGE                                    *
 *                                                              *
 * Description  . : Get the next page of records from the database.  *
 *                                                              *
 ****************************************************************
 *
C     NEXTPAGE      BEGSR
 *
C                   add       PageSize      CurRec
 *
C     CurRec        IfGt      FileSize
C                   Sub       PageSize      CurRec
 *
C                   Else
C                   Exsr      FillPage
C     'SFl1'        setatr    2             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C                   EndIf
 *
C                   ENDSR
```

Figure 27. Coding Example Using the Subfile Part (Part 2 of 10)

```
 ***********************************************************************
 *                                                                     *
 * Subroutine . . : PREVPAGE                                           *
 *                                                                     *
 * Description  . : Return the previous page of records from the       *
 *                  database.                                          *
 *                                                                     *
 ***********************************************************************
 *
C     PREVPAGE      BEGSR
 *
C                   Sub       PageSize      CurRec
 *
C     CurRec        IfLe      *zero
C                   Add       PageSize      CurRec
 *
C                   Else
C                   Exsr      FillPage
C     'SFL1'        setatr    5             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C                   EndIf
 *
C                   ENDSR
 ***********************************************************************
 *                                                                     *
 * Subroutine . . : FILLPAGE                                           *
 *                                                                     *
 * Description  . : Fill the subfile part with a page of records       *
 *                  from the database.                                 *
 *                                                                     *
 ***********************************************************************
 *
C     FILLPAGE      BEGSR
 *
C                   Clear                   Sfl1
C     CurRec        Setll     customer
C                   Z-Add     1             count             2 0
C                   Read      customer                                9999
 *
C     *in99         DoWeq     *off
C     count         AndLE     PageSize
C                   Write     Sfl1
 *
C                   If        %Getatr('Main':'HILITE':'Checked')=1
C     'SFL1'        Setatr    Count         'Index'
C     'SFL1'        Setatr    1             'ColNumber'
C     'SFL1'        Setatr    *DarkGreen    'CellFGClr'
C     'SFL1'        Setatr    2             'ColNumber'
C     'SFL1'        Setatr    *DarkPink     'CellFGClr'
C     'SFL1'        Setatr    3             'ColNumber'
C     'SFL1'        Setatr    *DarkBlue     'CellFGClr'
C                   EndIf
```

Figure 27. Coding Example Using the Subfile Part (Part 3 of 10)

```
 *
C                   Add       1             count
C                   Read      customer                              9999
C                   EndDo
 *
C                   Read      customer                              9999
 *
C     CurRec        ifeq      1
C     'SFl1'        setatr    1             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C     'SFl1'        setatr    2             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C     'SFl1'        setatr    5             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C     'SFl1'        setatr    6             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C                   endif
 *
C     *in99         ifeq      *on
C     CurRec        oreq      LastPage
C     'SFl1'        setatr    1             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C     'SFl1'        setatr    2             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C     'SFl1'        setatr    5             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C     'SFl1'        setatr    6             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C                   endif
C                   ENDSR
 *
 ******************************************************************************
 *                                                                            *
 * Window . . : MAIN                                                          *
 *                                                                            *
 * Part . . . : MAIN                                                          *
 *                                                                            *
 * Event  . . : CREATE                                                        *
 *                                                                            *
 * Description: Get the first page of records.                                *
 *                                                                            *
 ******************************************************************************
 *
C     MAIN          BEGACT    CREATE        MAIN
 *
C                   Exsr      FillPage
 *
C     'SFL1'        Setatr    *Green        'HdgBGClr'
C     'SFL1'        Setatr    *Black        'HdgFGClr'
C     'SFL1'        Setatr    1             'ColNumber'
```

Figure 27. Coding Example Using the Subfile Part (Part 4 of 10)

```
 *
C     'MAIN'        Setatr    1             'Visible'
C     'SFL1'        Setatr    1             'BUTTONIDX'
C     'SFL1'        Setatr    '*MSG0001'    'BUTTONTIP'
C     'SFL1'        Setatr    0             'ENABLEBTN'
C     'SFL1'        Setatr    2             'BUTTONIDX'
C     'SFL1'        Setatr    '*MSG0002'    'BUTTONTIP'
C     'SFL1'        Setatr    0             'ENABLEBTN'
C     'SFL1'        Setatr    3             'BUTTONIDX'
C     'SFL1'        Setatr    0             'ENABLEBTN'
C     'SFL1'        Setatr    4             'BUTTONIDX'
C     'SFL1'        Setatr    0             'ENABLEBTN'
C     'SFL1'        Setatr    5             'BUTTONIDX'
C     'SFL1'        Setatr    '*MSG0004'    'BUTTONTIP'
C     'SFL1'        Setatr    6             'BUTTONIDX'
C     'SFL1'        Setatr    '*MSG0005'    'BUTTONTIP'
 *
C                   ENDACT
 *                                                                     *
 **********************************************************************
 *                                                                     *
 * Window . . : MAIN                                                  *
 *                                                                     *
 * Part . . . : PB_SELECT                                             *
 *                                                                     *
 * Event  . . : PRESS                                                 *
 *                                                                     *
 * Description: Read the selected subfile record.                     *
 *              The static text part 'Selected' is updated to show    *
 *              the selected customer number.                         *
 *              The first field in the subfile is opened for editing.*
 *                                                                     *
 **********************************************************************
 *
C     PB_SELECT     BEGACT    PRESS         MAIN
 *
C                   Reads     sfl1                                    27
 *
C     *in27         IfEq      *off
C     'Selected'    Setatr    custno        'Label'
C     'SFL1'        Setatr    1             'ColNumber'
C     'SFL1'        Setatr    1             'OpenEdit'
C                   EndIf
 *
C                   ENDACT
```

Figure 27. Coding Example Using the Subfile Part (Part 5 of 10)

```
 ****************************************************************************
 *                                                                          *
 * Window . . : MAIN                                                        *
 *                                                                          *
 * Part . . . : HRULE                                                       *
 *                                                                          *
 * Event  . . : MENUSELECT                                                  *
 *                                                                          *
 * Description:                                                             *
 *                                                                          *
 ****************************************************************************
 *
C     HRULE         BEGACT    MENUSELECT    MAIN
 *
C                   If        %Getatr('Main':'HRULE':'Checked')=1
C     'SFL1'        Setatr    0             'HRule'
C     'HRULE'       Setatr    0             'Checked'
 *
C                   Else
C     'SFL1'        Setatr    1             'HRule'
C     'HRULE'       Setatr    1             'Checked'
C                   EndIf
 *
C                   ENDACT
 ****************************************************************************
 *                                                                          *
 * Window . . : MAIN                                                        *
 *                                                                          *
 * Part . . . : VRULE                                                       *
 *                                                                          *
 * Event  . . : MENUSELECT                                                  *
 *                                                                          *
 * Description:                                                             *
 *                                                                          *
 ****************************************************************************
 *
C     VRULE         BEGACT    MENUSELECT    MAIN
 *
C                   If        %Getatr('Main':'VRULE':'Checked')=1
C     'SFL1'        Setatr    0             'VRule'
C     'VRULE'       Setatr    0             'Checked'
 *
C                   Else
C     'SFL1'        Setatr    1             'VRule'
C     'VRULE'       Setatr    1             'Checked'
C                   EndIf
 *
C                   Exsr      FillPage
 *
C                   ENDACT
```

Figure 27. Coding Example Using the Subfile Part (Part 6 of 10)

```
 ***********************************************************************
 *                                                                     *
 * Window . . : MAIN                                                   *
 *                                                                     *
 * Part . . . : HILITE                                                 *
 *                                                                     *
 * Event  . . : MENUSELECT                                             *
 *                                                                     *
 * Description:                                                        *
 *                                                                     *
 ***********************************************************************
 *
C     HILITE        BEGACT    MENUSELECT    MAIN
 *
C                   If        %Getatr('Main':'HILITE':'Checked')=1
C                   Eval      %Setatr('Main':'HILITE':'Checked')=0
 *
C                   Else
C                   Eval      %Setatr('Main':'HILITE':'Checked')=1
C                   EndIf
 *
C                   Exsr      FillPage
 *
C                   ENDACT
 ***********************************************************************
 *                                                                     *
 * Window . . :  MAIN                                                  *
 *                                                                     *
 * Part . . . :  SFL1                                                  *
 *                                                                     *
 * Event  . . :  PAGETOP                                               *
 *                                                                     *
 * Description:                                                        *
 *                                                                     *
 ***********************************************************************
 *
C     SFL1          BEGACT    PAGETOP       MAIN
 *
C                   Z-Add     1             CurRec
C                   Exsr      FillPage
 *
C                   ENDACT
```

Figure 27. Coding Example Using the Subfile Part (Part 7 of 10)

```
 ***************************************************************************
 *                                                                         *
 * Window . . :  MAIN                                                      *
 *                                                                         *
 * Part . . . :  SFL1                                                      *
 *                                                                         *
 * Event  . . :  PAGEUP                                                    *
 *                                                                         *
 * Description:                                                            *
 *                                                                         *
 ***************************************************************************
 *
C     SFL1          BEGACT    PAGEUP        MAIN
 *
C                   exsr      PrevPage
 *
C                   ENDACT
 *
 ***************************************************************************
 *                                                                         *
 * Window . . :  MAIN                                                      *
 *                                                                         *
 * Part . . . :  SFL1                                                      *
 *                                                                         *
 * Event  . . :  LASTREC                                                   *
 *                                                                         *
 * Description:                                                            *
 *                                                                         *
 ***************************************************************************
 *
C     SFL1          BEGACT    LASTREC       MAIN
 *
C     FileSize      Sub       PageSize      CurRec
C                   Add       1             CurRec
 *
C     CurRec        IfLt      1
C                   Z-Add     1             CurRec
C                   EndIf
 *
C                   Exsr      FillPage
 *
C     'SFL1'        setatr    1             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C     'SFL1'        setatr    2             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C     'SFL1'        setatr    5             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C     'SFL1'        setatr    6             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C                   ENDACT
```

Figure 27. Coding Example Using the Subfile Part (Part 8 of 10)

```
 ***************************************************************************
 *                                                                         *
 * Window . . :  MAIN                                                      *
 *                                                                         *
 * Part . . . :  SFL1                                                      *
 *                                                                         *
 * Event  . . :  PAGEDOWN                                                  *
 *                                                                         *
 * Description:                                                            *
 *                                                                         *
 ***************************************************************************
 *
C     SFL1          BEGACT    PAGEDOWN      MAIN
 *
C                   Exsr      NextPage
 *
C                   ENDACT
 ***************************************************************************
 *                                                                         *
 * Window . . :  MAIN                                                      *
 *                                                                         *
 * Part . . . :  SFL1                                                      *
 *                                                                         *
 * Event  . . :  FIRSTREC                                                  *
 *                                                                         *
 * Description:                                                            *
 *                                                                         *
 ***************************************************************************
 *
C     SFL1          BEGACT    FIRSTREC      MAIN
 *
C                   Z-Add     1             CurRec
C                   Exsr      FillPage
 *
C     'SFL1'        setatr    1             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C     'SFL1'        setatr    2             'BUTTONIDX'
C     'SFL1'        setatr    0             'ENABLEBTN'
C     'SFL1'        setatr    5             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C     'SFL1'        setatr    6             'BUTTONIDX'
C     'SFL1'        setatr    1             'ENABLEBTN'
C                   ENDACT
```

Figure 27. Coding Example Using the Subfile Part (Part 9 of 10)

```
*********************************************************************
*                                                                   *
* Window . . :  MAIN                                                *
*                                                                   *
* Part . . . :  EXIT                                              *
*                                                                   *
* Event  . . :  MENUSELECT                                          *
*                                                                   *
* Description:                                                      *
*                                                                   *
*********************************************************************
 *
C     EXIT          BEGACT    MENUSELECT    MAIN
 *
C                   Move      *on           *inlr
 *
C                   ENDACT
```

Figure 27. Coding Example Using the Subfile Part (Part 10 of 10)

Signaling Events

The **Select** event is signaled when:
- The user selects an item that is in a subfile
- You select an item in the list in your program
- The user selects an item that is already selected

The **Enter** event is signaled when:
- The user double-clicks over an item that is in the subfile
- The user presses the Enter key when the subfile has focus, and an item has been selected

In your action subroutine for these events, you can use the READS operation code to determine which item was selected.

Submenu

Use a submenu to:
- Start a new cascaded menu from a menu item on an existing menu.
- Start a pull-down menu from a menu item on the menu bar.

After creating a submenu, you can add menu items to it by pointing-and-clicking (or dragging-and-dropping) the menu item part onto the submenu part in the tree view only.

Note: You can manipulate this part's properties, events, and so on, only from its pop-up menu in the project tree view.

For related information, see "Menu Item" on page 106.

Part Attributes

ParentName	PartName	PartType	UserData

Applicable Events

Create	Destroy

Timer

Use the timer part if your program must perform certain operations at preset time intervals. For example, you can use it to close a window, or perhaps end an application, after a certain period of inactivity.

A timer part counts units of time and tracks the preset time interval between two events, triggering the second event once the interval has passed.

When you create a timer part in the GUI builder, the part is represented as an icon on the design window. However, in the properties notebook for a timer part, you can specify that you do not want the icon displayed while the program is executing.

Note: Do not use the timer part when precise timing is required. Due to other programs running on your system, the **Tick** event may not necessarily occur at the exact interval you specify.

Part Attributes

AddLink*	AllowLink*	Bottom	Interval
Left	Multiplier	ParentName	PartName
PartType	RemoveLink*	TimerMode	TimerTicks
Top	UserData	Visible	

* **Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	Link*	Tick

* **Note:** See the event description for restrictions.

Displaying the Timer Icon

By default, the **Visible** attribute is set to *1* so that the timer icon is displayed while the program is executing. If you do **not** want this icon displayed, set this attribute to *0*.

Setting the Interval

The timer interval is expressed in milliseconds. When the interval elapses, a timer **Tick** event is signaled. You can set this interval in the timer part's properties notebook. You can also set it in your program by using the **Interval** attribute.

Note: The minimum timer interval is 100 milliseconds.

The timer part has a **Multiplier** attribute. By setting this attribute you can determine how many times the interval value elapses before a timer **Tick** event is generated. The default multiplier value is set to *1*, so that the timer generates a **Tick** event at the end of each interval.

Generating Tick Events

When a timer is started, its interval value is reset to zero. When the interval value is reached, the timer generates a **Tick** event and updates the interval value.

Getting the Timer Value

Each time the timer generates a **Tick** event, its value is incremented by one. Use the **Value** attribute to get the current value of the timer. You can set the timer value in the properties notebook or in your program.

Controlling the Timer Using Timer Modes

Use the **TimerMode** attribute to control the timer.

Set **TimerMode** to *1* to start the timer. Starting the timer causes it to begin generating **Tick** events, and its **Value** attribute is incremented when the interval value is reached.

Set **TimerMode** to *2* to stop the timer. When the timer stops, it ceases generating **Tick** events, and its value is not updated.

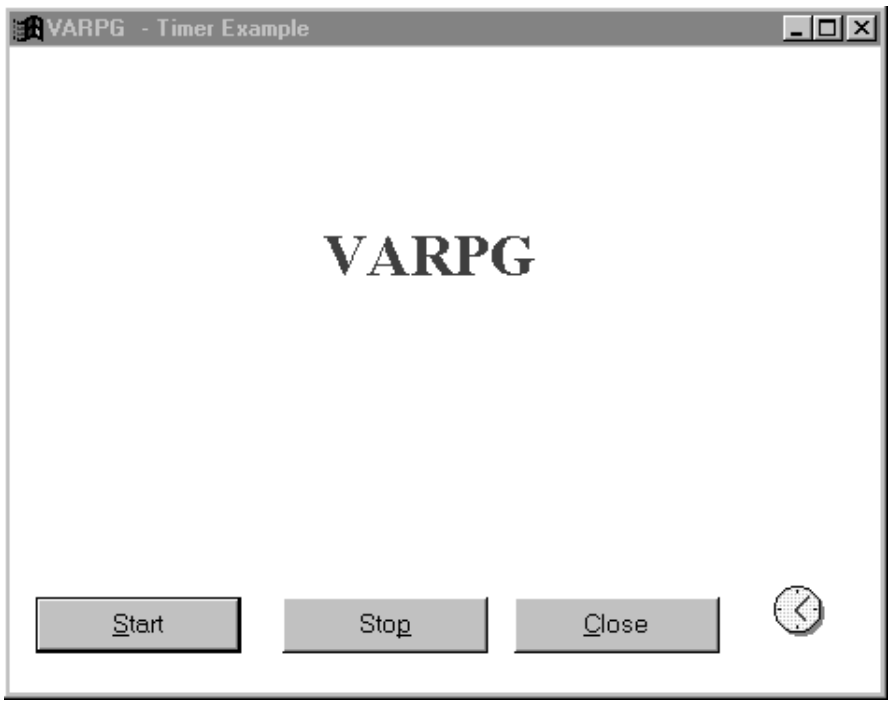
Timer Example

In this example, a static text part is moved in the window for each timer **Tick** event.

When you press the **Start** push button, the timer mode is set to *1*. This starts the timer and generates **Tick** events. During the processing of the **Tick** event, new coordinates are calculated for the static text part, and the part is set to the new location.

When you press the **Stop** push button, the **TimerMode** is set to *2*. This stops the timer.

Press the **Close** push button to terminate the program.




```
 ***************************************************************************
 *                                                                         *
 * Program ID . . : TIMER                                                  *
 *                                                                         *
 * Description  . : Sample program to demonstrate the timer part          *
 *                  by moving a static text part in a window each          *
 *                  time the timer 'Ticks'.                                *
 *                                                                         *
 ***************************************************************************
 *
H
 *
 * Declare display size System attributes
D%DspHeight       S              4  0
D%DspWidth        S              4  0
 *
 * Declare new size event attributes
D%NewHeight       S              4  0
D%NewWidth        S              4  0
 *
 * Define working variables
DminX             S              4  0 INZ(0)
DmaxX             S              4  0
DminY             S              4  0
DmaxY             S              4  0
DxChange          S              4  0 INZ(5)
DyChange          S              4  0 INZ(5)
 *
```

Figure 28. Coding Example Using the Timer Part (Part 1 of 6)

```
*****************************************************************
*                                                               *
* Window . . : FRA0000B                                         *
*                                                               *
* Part . . . : FRA0000B                                         *
*                                                               *
* Event  . . : CREATE                                           *
*                                                               *
* Description: Center the window on the display.                *
*                                                               *
*              Calculate starting values.                       *
*              Since the height attribute of the window part    *
*              includes the title bar, we subtract the height of*
*              the title bar so the static text part remains within *
*              the window frame.                                *
*                                                               *
*              For SVGA, this value is about 20 pixels. It could*
*              be adjusted for other resolutions.               *
*                                                               *
*****************************************************************
 *
C     FRA0000B      BEGACT    CREATE        FRA0000B
 *
 * Get beginning window height and width
C     'FRA0000B'    getatr    'Height'      winHeight         4 0
C     'FRA0000B'    getatr    'Width'       winWidth          4 0
 *
 * Center the window on the display
C                   eval      %setatr('FRA0000B':
C                                     'FRA0000B':
C                                     'Left')=(%DspWidth-winWidth)/2
 *
C                   eval      %setatr('FRA0000B':
C                                     'FRA0000B':
C                                     'Bottom')=(%DspHeight-winHeight)/2
 *
 * Get beginning coordinates of static text part
C     'ST1'         getatr    'Left'        picX              4 0
C     'ST1'         getatr    'Bottom'      picY              4 0
 *
 * Get dimensions of static text part
C     'ST1'         getatr    'Height'      picHeight         4 0
C     'ST1'         getatr    'Width'       picWidth          4 0
 *      * Calculate minimum and maximum Y coordinates
C     'Start'       getatr    'Height'      startH            4 0
C     'Start'       getatr    'Bottom'      startB            4 0
C                   eval      minY = startB + startH
C                   eval      maxY = winHeight - picHeight - 20
 *
```

Figure 28. Coding Example Using the Timer Part (Part 2 of 6)

```
 * Calculate maximum X coordinate
C                   eval      maxX = winWidth - picWidth
 *
C                   ENDACT
 ****************************************************************************
 *                                                                          *
 * Window . . : FRA0000B                                                    *
 *                                                                          *
 * Part . . . : START                                                       *
 *                                                                          *
 * Event  . . : PRESS                                                       *
 *                                                                          *
 * Description: Start the timer.                                            *
 *                                                                          *
 ****************************************************************************
 *
C     START         BEGACT    PRESS         FRA0000B
 *
C     'Timer1'      setatr    1             'TimerMode'
 *
C                   ENDACT
 ****************************************************************************
 *                                                                          *
 * Window . . : FRA0000B                                                    *
 *                                                                          *
 * Part . . . : STOP                                                        *
 *                                                                          *
 * Event  . . : PRESS                                                       *
 *                                                                          *
 * Description: Stop the timer.                                             *
 *                                                                          *
 ****************************************************************************
 *
C     STOP          BEGACT    PRESS         FRA0000B
 *
C     'Timer1'      setatr    2             'TimerMode'
 *
C                   ENDACT
```

Figure 28. Coding Example Using the Timer Part (Part 3 of 6)

```
 ***********************************************************************
 *                                                                     *
 * Window . . : FRA0000B                                               *
 *                                                                     *
 * Part . . . : CLOSE                                                  *
 *                                                                     *
 * Event  . . : PRESS                                                  *
 *                                                                     *
 * Description: Terminate the program.                                 *
 *                                                                     *
 ***********************************************************************
 *
C     CLOSE         BEGACT    PRESS         FRA0000B
 *
C                   eval      *inlr = *on
 *
C                   ENDACT
 ***********************************************************************
 *                                                                     *
 * Window . . : FRA0000B                                               *
 *                                                                     *
 * Part . . . : TIMER1                                                 *
 *                                                                     *
 * Event  . . : TICK                                                   *
 *                                                                     *
 * Description: Respond to timer tick events by moving the static     *
 *              text part in the window.                               *
 *                                                                     *
 *              If the static text part moves outside the window       *
 *              frame, its' xChange or yChange values are multiplied   *
 *              by -1 to reverse the direction.                        *
 *                                                                     *
 ***********************************************************************
```

Figure 28. Coding Example Using the Timer Part (Part 4 of 6)

```
 *
C     TIMER1        BEGACT    TICK          FRA0000B
 *
 * Calculate new static text coordinates
C                   eval      picX = picX + xChange
C                   eval      picY = picY + yChange
 *
 * Check static text remains in window boundaries
C                   select
 *
C     picX          whenlt    0
C                   eval      xChange = xChange * -1
C                   eval      picX = minX + xChange
 *
C     picX          whengt    maxX
C                   eval      xChange = xChange * -1
C                   eval      picX = maxX + xChange
 *
C     picY          whenlt    minY
C                   eval      yChange = yChange * -1
C                   eval      picY = minY + yChange
 *
C     picY          whengt    maxY
C                   eval      yChange = yChange * -1
C                   eval      picY = maxY + yChange
 *
C                   endsl
 *
 * Move static text to new coordinates
C     'ST1'         setatr    picX          'Left'
C     'ST1'         setatr    picY          'Bottom'
 *
 *
C                   ENDACT
```

Figure 28. Coding Example Using the Timer Part (Part 5 of 6)

```
 ********************************************************************
 *                                                                  *
 * Window . . : FRA0000B                                            *
 *                                                                  *
 * Part . . . : FRA0000B                                            *
 *                                                                  *
 * Event  . . : RESIZE                                              *
 *                                                                  *
 * Description: Get the size of the window after it has been resized *
 *              so static part uses entire window.                  *
 *                                                                  *
 ********************************************************************
 *
C     FRA0000B      BEGACT    RESIZE        FRA0000B
 *
C                   eval      maxY = %NewHeight - picHeight - 20
C                   eval      maxX = %NewWidth - picWidth
 *
C                   ENDACT
```

Figure 28. Coding Example Using the Timer Part (Part 6 of 6)

Vertical Scroll Bar

Use the vertical scroll bar part to allow users to scroll through a pane of information vertically. The information can be a list of files, records in a database, columns in a document, and so on. You can use the **Range** attribute to represent the total number of objects to be scrolled through and the **PageSize** attribute to determine the number of objects that can be displayed on a page.

Part Attributes

Bottom	Enabled	Focus	Handle*
Height	Left	NextLine	NextPage
PageSize	ParentName	PartName	PartType
Position	PrevLine	PrevPage	Range
Top	UserData	Visible	Width

*** Note:** See the attribute description for restrictions.

Applicable Events

Create	Destroy	Scroll

Window

Windows are the user's primary means of interacting with your program. Your application must contain at least one window.

You can add only one part to the client area of a window, except for parts that are extensions to the window frame, such as menu bars, pop-up menus and message subfiles. The part you add is automatically sized to fit the client area.

If you want a window to contain more than one part, you must add a canvas part to it. Or, use the window with canvas part to save a step.

Note: The window part is located in the **Frames** section of the parts catalog, not on the parts palette.

For related information, see:
- "Canvas" on page 56
- "Window with Canvas" on page 181

Part Attributes

Bottom	Center	Enabled	FileName*
Focus*	FontBold*	FontItalic*	FontName*
FontSize*	FontStrike*	FontUnder*	Handle*
Height	IconHandle*	Label	Left
MouseIcon*	MouseShape*	ParentName	PartName
PartType	PBRange	PBSetPos	PBStep
PBStepSize	Print	PrintAsIs	ProgresBar
Refresh	SBLabel	SBPosition	SBStyle
ShowTips	StatusBar	Top	UserData
Visible	Width	WindowMode*	

*** Note:** See the attribute description for restrictions.

Applicable Events

Activate	Close	Create	DeActivate
Destroy	LClickTray	Moved	RClickTray
ReSize	ShutDown		

Window with Canvas

Windows are the end user's primary means of interacting with your program. The canvas, on a window with canvas part, allows you to add many parts to the window.

You can point and click various parts onto the canvas portion, position them, and organize them to produce a graphical user interface. You can also add parts that are extensions of the window's frame, such as menu bars, pop-up menus and message subfiles.

If you need to put only one part on the client area of the window, you do not need the window with canvas part: you should use the window part instead (found in the **Frames** section of the parts catalog). Without a canvas, the part you add will be automatically sized to fit the client area.

For related information, see:
- "Canvas" on page 56
- "Window" on page 180

Part Attributes

Bottom	Center	Enabled	FileName*
Focus*	FontBold*	FontItalic*	FontName*
FontSize*	FontStrike*	FontUnder*	Handle*
Height	IconHandle*	Label	Left
MouseIcon*	MouseShape*	ParentName	PartName
PartType	PBRange	PBSetPos	PBStep
PBStepSize	Print	PrintAsIs	ProgresBar
Refresh	SBLabel	SBPosition	SBStyle
ShowTips	StatusBar	Top	UserData
Visible	Width	WindowMode*	

*** Note:** See the attribute description for restrictions.

Applicable Events

Activate	Close	Create	DeActivate
Destroy	LClickTray	Moved	RClickTray
ReSize	ShutDown		

Displaying a Window

By default, all windows are marked as **Visible** and **Open Immediately** when they are created in the GUI Designer.

Decide which window you want the user to see first. That window is called the main or primary window and you must set the **Visible** and **Open Immediately** attributes accordingly for it. If you do not change the default settings, all the windows will appear when the user starts your application.

Setting the Open Immediately attribute

Set this attribute at design time if you want the window to be created when the application starts. Creating a window loads it into memory: because there is an overhead associated with this, you should decide which windows need to be loaded when the application starts. (You can have the other windows loaded later on.) You can use the SHOWWIN operation code to display windows that are not displayed very often (such as a window that displays a product copyright), instead of setting them so that they open immediately.

Note: The **Open Immediately** attribute does not control whether a window is actually displayed on the screen. To display a window, you must set its **Visible** attribute to *1* in your program, or mark it as **Visible** in its properties notebook.

Using the SHOWWIN operation code

You can load a window in your program by specifying the window name in Factor 2 of the SHOWWIN operation code. This operation code loads the window into memory.

Note: The SHOWWIN operation does not control whether a window is actually displayed on the screen. To display a window, you must set its **Visible** attribute to *1* in your program or mark it **Visible** in its properties notebook.

You can set a window's attributes only after it has been loaded. To load a window, either select the **Open Immediately** check box on the Startup page of the part's notebook, or use the SHOWWIN operation code in your program.

If a window is defined as **Open Immediately**, and you issue the SHOWWIN operation code for that window in your program, you will receive a runtime error indicating that the window has already been loaded. You can avoid this error by coding an error indicator on the SHOWWIN operation code and checking the error indicator in your program. If the indicator is turned on, then the window is already up and you should set the **Visible** attribute on. This will display the window, and the error will not be issued.

Referencing

The parts on a window are created when the window is created. Therefore, if you attempt to reference any part on a window that has not been loaded, or to reference a window attribute before the window is created, you will receive a *Part not found* message.

Hint

If a window is displayed and you cannot click on its title bar, use this method to move the window:

1. Position the mouse cursor somewhere on the visible portion of the window.
2. Click and release mouse button 1.
3. Press the Alt-space key combination. Then press M.
4. Use the arrow keys to reposition the window.
5. When the window is in the desired position, press Enter.

Resizing a Window

There are two things you can do to create your application so that the user has one or more ways to resize a window:

- In the GUI Designer, set the border of a window as **Sizeable**. This setting allows the user to select the window border with the mouse button, and resize the border while keeping the mouse button pressed. When the mouse button is released, the **ReSize** event is signaled.
- Add a **Maximize** and a **Minimize** button to the window. The user can then change the size of the window by selecting one of these buttons.

You can position parts on the window so that they maintain their relative position and size within the window's boundaries after the window is resized. To do this, use the **ReSize** event with the **%NewHeight** and **%NewWidth** event attributes.

In the following coding example, a push button part labeled PB1 is located in the upper right corner of a window. When the window is resized, the **ReSize** action subroutine calculates new **Left** and **Bottom** attribute values to ensure that the push button remains within the window's boundaries.

```
 ********************************************************************
 *                                                                  *
 * Program ID . . : ReSize                                          *
 *                                                                  *
 * Description  . : Sample program to demonstrate how to ensure     *
 *                  parts remain within a window after it has been  *
 *                  resized.                                        *
 *                                                                  *
 *                  A push button is located in the upper right     *
 *                  corner of the window. If the window is resized  *
 *                  to a smaller size, the push button will no      *
 *                  longer be visible, since all parts maintain     *
 *                  their relation with the lower-left corner of the*
 *                  window.                                         *
 *                  The RESIZE event is used to ensure the push     *
 *                  button also maintains its position relative to  *
 *                  the upper right corner of the window.           *
 *                                                                  *
 ********************************************************************
 *
H
 *
 * Declare display size System attributes
D%DspHeight       S              4  0
D%DspWidth        S              4  0
 *
```

Figure 29. Ensuring parts are displayed correctly after a window is resized (Part 1 of 3)

```
 * Declare %NewHeight, and %NewWidth event attributes. These will
 * contain the width and height of the window after it has been
 * resized.
D%NewHeight       S              4  0
D%NewWidth        S              4  0
 ******************************************************************
 *                                                                *
 * Window . . : FRA0000B                                          *
 *                                                                *
 * Part . . . : FRA0000B                                          *
 *                                                                *
 * Event  . . : RESIZE                                            *
 *                                                                *
 * Description: Ensure the push button part 'PB1' remains visible.*
 *                                                                *
 ******************************************************************
 *
C     FRA0000B      BEGACT    RESIZE        FRA0000B
 *
C     %NewWidth     sub       HOffset       NewLeft           4 0
C     %NewHeight    sub       VOffset       NewBottom         4 0
C     'PB1'         setatr    NewLeft       'Left'
C     'PB1'         setatr    NewBottom     'Bottom'
 *
C                   ENDACT
 ******************************************************************
 *                                                                *
 * Window . . : FRA0000B                                          *
 *                                                                *
 * Part . . . : PSB0000D                                          *
 *                                                                *
 * Event  . . : PRESS                                             *
 *                                                                *
 * Description: Terminate the program.                            *
 *                                                                *
 ******************************************************************
 *
C     PSB0000D      BEGACT    PRESS         FRA0000B
 *
C                   move      *on           *inlr
 *
C                   ENDACT
```

Figure 29. Ensuring parts are displayed correctly after a window is resized (Part 2 of 3)

```
*****************************************************************
*                                                               *
* Window . . : FRA0000B                                         *
*                                                               *
* Part . . . : FRA0000B                                         *
*                                                               *
* Event  . . : CREATE                                           *
*                                                               *
* Description: Center the window on the display.                *
*              Get current coordinate of push button PB1 and its*
*              offset from the upper right corner of the window.*
*                                                               *
*****************************************************************
 *
C     FRA0000B      BEGACT    CREATE        FRA0000B
 *
C     'FRA0000B'    getatr    'Height'      winHeight         4 0
C     'FRA0000B'    getatr    'Width'       winWidth          4 0
C     %DspWidth     sub       winWidth      diffWidth         4 0
C     %DspHeight    sub       winHeight     diffHeight        4 0
 *
C                   eval      %setatr('FRA0000B':
C                                     'FRA0000B':
C                                     'Left') = diffWidth / 2
 *
C                   eval      %setatr('FRA0000B':
C                                     'FRA0000B':
C                                     'Bottom') = diffHeight / 2
 *
 * Calculate the offsets of the push button part 'PB1' from
 * the upper right corner of the window. These values are used
 * to maintain this offset if the window is resized.
C     'PB1'         getatr    'Left'        PBLeft            4 0
C     'PB1'         getatr    'Bottom'      PBBottom          4 0
C     'FRA0000B'    getatr    'Width'       WinWidth          4 0
C     'FRA0000B'    getatr    'Height'      WinHeight         4 0
C     WinWidth      sub       PBLeft        HOffset           4 0
C     WinHeight     sub       PBBottom      VOffset           4 0
 *
C                   ENDACT
```

Figure 29. Ensuring parts are displayed correctly after a window is resized (Part 3 of 3)

Setting the Focus

Determine which window you want the user to work with first, and use the **Focus** attribute to give that window focus. If you do not, VisualAge RPG determines which window has focus when your application is loaded. By default, it will be the last window created that has the **Visible** attribute set.

Window List

In the properties notebook for a window part, you can indicate if the window should appear in the window list. This list appears when you press the Ctrl+Alt+Delete in Windows. By default, window parts do not appear in the window list. You should set at least the main window to appear in the window list. You can use the task list to redisplay the window.

Terminating a Program

If the user selects the **Close** option from the system menu on a window, the operating system closes the window but does not necessarily terminate your program. To prevent this from happening, you can do one of the following:

- Select the **Terminate on close** check box in the second Style page in the window's properties notebook. This will terminate your program when the user closes the window.
- In the first Style page of the window's properties notebook, deselect the **System Menu** check box so that your windows are created without a System Menu. (By default, all windows are created with a system menu.)
- Use the **Close** event. This event is signaled when the user selects **Close** from the system menu. In the **Close** event action subroutine, you could set the **LR** indicator on, or prompt the user to confirm that this window should be closed, and set the **ENDACT** return point accordingly. For example, by setting the return value to **NODEFAULT* the close request is ignored and the window is not closed.

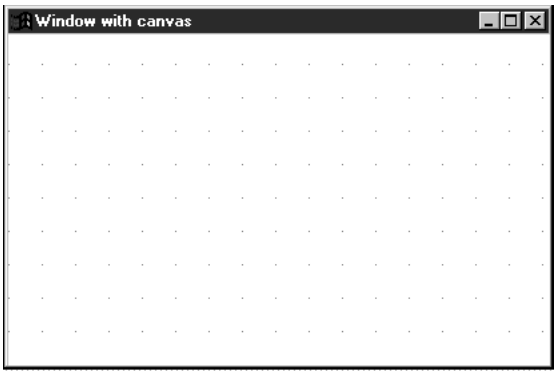
```
 *
 * Define message box variables
Dstyle            M                   button(*yesbutton: *nobutton)
D                                     style(*WARN)
Dmsg              M                   msgtext('Are sure you want to exit?')
 *
 ********************************************************************
 *                                                                  *
 * Window . . : FRA0000B                                            *
 *                                                                  *
 * Part . . . : FRA0000B                                            *
 *                                                                  *
 * Event  . . : CLOSE                                               *
 *                                                                  *
 * Description: Handle Close event from system menu to verify user  *
 *              wants to close this window.                         *
 *                                                                  *
 ********************************************************************
 *
C     FRA0000B      BEGACT    CLOSE         FRA0000B
 *
 * Prompt for close
C     msg           dsply     style         rc               9 0
 *
 * If Yes, terminate program, allow close to occur
C     rc            ifeq      *YESBUTTON
C                   move      *on           *inlr
C                   movel     '*DEFAULT    'return          12
 *
 * Else, do not close this window
C                   else
C                   movel     '*NODEFAULT  'return
C                   endif
 *
C                   ENDACT    return
```

Clearing Fields on a Window

If you have several entry fields on a window, you can use the CLEAR operation code. This will clear all entry field values to their default values. Numeric fields are cleared with zeros and character fields are cleared with blanks.

Example of a Window Part

The window part shown below has a **System** menu, a **Minimize** button, and a **Maximize** button.



*Component

The *component part allows programmers to access and use component- and system-wide attributes.

A *component part is the ″part representation″ of the component. One *component part is created for each component automatically; it is invisible and not on the palette.

Part Attributes

Active*	Alarm	AppData	Button
ClipBoard	CurrentDir	Dialog	DIRName*
DlgOwner	DlgPrompt*	DoEvents*	DspHeight
DspWidth	FileName	FocusPart*	FolderName*
HelpWindow	HostName*	LookNFeel*	MsgData
MsgFile*	MsgID	MsgText	Name
OS	Parent	PartCount	PartList
Platform	PlugCmd*	PlugDLL*	PlugID*
PlugRC*	PlugResult*	Printer*	PrtDevmode
SelFolder*	SelPrinter*	ShData	ShDataLen
ShDataName	ShDataPos	ShowMsgID	SwitchTo*
WrkStnName*			

*** Note:** See the attribute description for restrictions.

Applicable Events

There are no events associated with this part.

Using the *component part

The *component part allows programmers to access and use component- and system-wide attributes. A *component part is the 'part representation' of the component. One *component part is created for each component automatically; it is not visible and is not on the parts palette.

Displaying a File Open/Save As dialog.

The **Button**, **FileName**, **Dialog**, and **DlgOwner** attributes of the *component part are used to display the Windows common File Open or Save As dialog. The dialog attribute determines which type of dialog to display. Set it to 1 to display an Open dialog or to 2 to display a Save As dialog. The **DlgOwner** attribute specify which part is the 'owner' of the dialog. When this attribute is set, the owner is 'modal' to the dialog. That is it can not respond to events until the dialog is dismissed. Setting the **FileName** attribute displays the file open dialog. To determine which button the user used to dismiss the dialog, retrieve the value of the **Button** attribute.

In the following example, a File Open dialog is displayed. Notice that **FileName** attribute can be set to display only files with a certain extension:

```
 *
 * Display File Open dialog
C     '*Component'  Setatr    1             'Dialog'
 *
 * This window is the owner
C     '*Component'  Setatr    'Main Main'   'DlgOwner'
 *
 * Show only .DAT files
C     '*Component'  Setatr    '*.DAT'       'Filename'
 *
 * Get the button pressed
C     '*Component'  Getatr    'Button'      Button            1 0
 *
 * Handle the OK button
C                   If        Button = 1
 *
 * User canceled
C                   Else
 *
C                   EndIf
```

Figure 30. Displaying a File Open dialog

The following example shows how to use a File Open dialog to select multiple files.

```
 *
C                   eval      %setatr('*Component':'*Component'
C                                     :'MulSel') = 1
C                   eval      %setatr('*Component':'*Component'
C                                     :'Dialog') = 1
C                   eval      %setatr('*Component':'*Component'
C                                     :'Filename')='*.jpg'
C*Get the number of selected files.
C                   z-add     0             num
c     '*component'  getatr    'NumOfSel'    num
C*Get the path of the selected files.
C                   eval      str=
C                             %getatr('*Component':'*Component':
C                             'folderName')
C*Retrieve the name of the selected files.
C     1             do        num           idx               4 0
C                   eval      %setatr('*Component':'*Component'
C                                     :'FileIndex') = idx
C                   eval      str=
C                             %getatr('*Component':'*Component':
C                             'filename')
C                   enddo
```

Figure 31. Use a File Open dialog to select multiple files

Selecting a printer

If your application prints to a printer attached to the workstation you can use the **SelPrinter** and **Printer** attributes to allow the user to select to which printer the output is to be sent. Setting the **SelPrinter** attribute to 1 displays the Windows Print dialog to be displayed. When the user selects a printer from that dialog, the printed output from your application will be sent to that printer.

Initial settings shown in the dialog can be set by the **PrtDevmode** attribute.

Using Plugins

The **PlugDLL, PlugID, PlugCmd, PlugRC,** and **PlugResult** attributes give you the ability to extend the functionality of the GUI Designer. You provide the additional functionality in a program that you have developed. Once your application is registered to the GUI Builder by using the Vendor menu, your application can interact with the GUI Designer. See chapter 20 for more details on creating plugins.

Querying the Parts in a Component

The **Parent, PartCount** and **PartList** attributes can be used at runtime to query the part names in a component. For example, you could use these attributes to resize and reposition parts on a window if the window has been resized.

Part 3. Working with iSeries Data

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Chapter 8. iSeries Connectivity

If you are using an iSeries server while you are developing your application (for example, importing display files) or while you are running it (for example, accessing iSeries database files for I/O), you must define the iSeries information used by the application. This information is stored separately from the application, so that it can be updated without changing the application itself.

This section discusses the following topics:
- Defining iSeries information
- Setting up an iSeries server at design time and at run time
- Using data areas
- Using iSeries database files
- Database I/O considerations
- Controlling server connections at run time
- Using the security file for applets

Defining iSeries Information

During the development of your application, you can use the **Define iSeries Information** properties notebook to define aliases (override names) for the following iSeries information:
- Servers
- Files
- Programs
- Data areas
- Lock level

Once you have developed an application and are ready to install it on your user's workstation, you need to ensure that either:
- For SNA communications the following is configured:

  A router must be defined using Client Access. This router name is also used as the Remote Location Name.
- For TCP/IP communications the following is configured:

  Use the host name defined for your iSeries server as the Remote Location Name.

Additionally, refer to the online help for the steps you must take to define iSeries information.

Notebook Considerations

If the Define iSeries Information properties notebook pages do not contain the override name for the program, the data area, or the database file, then the following occurs:
1. The name of the program, data area, or database file in the program is used.
2. If the program name, data area, or database file is library-qualified in the program, then this library is used.
3. If the program name or database file is not library-qualified in the program, the library list (*LIBL) on the iSeries server is searched.
4. The first server listed on the server page is used.

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Note: The first server listed in the server page of the Define iSeries Information notebook is known as the default server. At least one server is required for every program that makes use of an iSeries server.

Setting Up a Server

You must set up a server when you are developing your application, so that you can access it while you edit, compile, and debug your application. When you package and distribute your application to other workstations, you also have to set up a server if the running application accesses a different server than the one used during design time.

Whenever you set up a server, ensure that the library list of the service job contains the remote resource that you want to work with.

Setting a Server at Design Time

If you need to use a server while you are developing your application, you must define server information using the Define Server Logon window and the Define iSeries Information notebook. See the online help for more information.

You must also define an iSeries job description to set up the library list. You can associate a library list with a job description on the iSeries server. This job description can then be associated with a user profile. Use the user ID from this user profile when you are prompted by the VisualAge RPG to logon to a server. The iSeries service job contains the correct library list.

Setting a Server at Run Time

If you need to access a server while you are running your application, you must verify that the iSeries information points to the correct server. Use the Define iSeries Information utility to invoke the Define iSeries Information notebook.

You must also set up the library list, either by changing the job description or by using the CL commands QCMDDDM or QCMDEXC.

Defining a job description to set up a library list

You can associate a library list with a job description on the iSeries server. This job description can then be associated with a user profile. Use the user ID from this user profile when you are prompted by the VisualAge RPG to logon to a server. The iSeries service job contains the correct library list.

Changing the library list

If a VisualAge RPG program calls CL commands:

- Specify a CALL to QCMDDDM if the CL command issues commands for iSeries files.
- Specify a CALL to QCMDEXC if the CL command issues commands to server programs or data areas.

CL commands can be issued to be run in the DDM service job using the CALL operation code. A special program must be called in order for the CL command to be run in the DDM service job. The special program is QCMDDDM. This interface is the same as the interface for calling QCMDEXC. The difference between QCMDEXC and QCMDDDM is that QCMDEXC runs in a separate job that is used to service remote call requests and data area requests.

QCMDDDM can be used to change the library list of the DDM service job to ensure that the library containing the database files is present in the DDM job's library list.

Using Data Areas

Before your application can use data areas, you must set up the server.

If your application accesses a data area, the name of this data area can be either the name of the data area or an override name. You can define the override name in the GUI Designer using the Data area page of the Define iSeriesInformation notebook.

See "Notebook Considerations" on page 193 if the notebook page does not contain an override name for the data area.

Table 5 and Figure 32 illustrate how to access a data area using an override name.

Table 5. Enter this information on the Data area page of the Define iSeriesInformation notebook

Data area override name:	DTAARA (this must be entered in uppercase)
Remote data area name:	REMDTAARA
Server alias name:	SERVER01

Be sure the data area has been initialized before you attempt to use it. A runtime exception is issued if a data area on the server does not contain a valid packed decimal value when attempting to retrieve it into a data area data structure with a packed decimal subfield in a VisualAge RPG program.

```
 ****************************************************************************
 *                                                                          *
 * Program ID . . : dtaaraex.vpg                                            *
 *                                                                          *
 * Description  . : Code segment to get the contents of an AS/400           *
 *                  data area.                                              *
 ****************************************************************************
 *
D dtaara          S              6P 0 DTAARA
 ****************************************************************************
 *                                                                          *
 * Window . . : WIN1                                                        *
 *                                                                          *
 * Part . . . : PSB0000C                                                    *
 *                                                                          *
 * Event  . . : PRESS                                                       *
 *                                                                          *
 * Description: Get the contents of the AS/400 data area.                   *
 ****************************************************************************
 *
C     PSB0000C      BEGACT    PRESS         WIN1
C                   IN        dtaara
C                   ENDACT
```

Figure 32. Accessing a data area

Using iSeries 400 Database Files

Before your application can access iSeries 400database files, you must set up the server.

Remote DISK file names used in your VisualAge RPG programs can be either the iSeries 400 file name or a file alias name. You can define a file alias name using the File page of the Define iSeriesInformation notebook. See "Notebook Considerations" on page 193 for information about what happens if the notebook page does not contain a file alias for the iSeries 400file.

Database file overrides issued in the remote server DDM job are ignored by open requests issued by the VisualAge RPG application. Open requests made by server programs that run in the DDM service job may elect to either ignore or apply the file overrides.

The VisualAge RPG supports overriding the server's library name, file name, and member name using the File page in the Define iSeriesInformation notebook.

The Define iSeriesInformation notebook is used when the application is being built and while the application is running. At build time, the File page is used during file extracts to find the external descriptions of the files. It is also used for an externally described data structure when so specified in a definition specification.

At application run time, the File page is used to locate the actual remote iSeries 400 database files being used. The file alias name used in the VisualAge RPG program is used to find an appropriate entry in the File page.

If no entry exists in the File page, then the library list of the first server defined in the server page is used to find a file with the same name as the file in the VisualAge RPG program.

Keeping the actual file name separate from the file name used in the VisualAge RPG program allows you to retarget the actual file. You can direct it to a different file on the same iSeries server or a different iSeries server without changing the VisualAge RPG program.

Figure 33 on page 197 contains an example that illustrates:
- The association of file names with file entries in the File page of the Define iSeriesInformation notebook.
- Matching part names with fields.

Note: The NAME and ADDRESS information must be entered on the application's window. The information is entered on the database when the **OK** push button is pressed.

```
 ************************************************************************
 *                                                                      *
 * Program ID . . : ioex.vpg                                            *
 *                                                                      *
 * Description  . : Create Database records using data from window.     *
 *                                                                      *
 * Files  . . . . : FILE1                                               *
 *                                                                      *
 ************************************************************************
 *
FFILE1     UF A E             DISK    REMOTE USROPN
 ************************************************************************
 *                                                                      *
 * Window . . : WIN1                                                    *
 *                                                                      *
 * Part . . . : *INZSR                                                  *
 *                                                                      *
 * Event  . . : Initialization routine                                  *
 *                                                                      *
 * Description: Open Database file (FILE1).                             *
 *                                                                      *
 ************************************************************************
 *
C     *INZSR        BEGSR
C                   OPEN      FILE1
C                   ENDSR
 ************************************************************************
 *                                                                      *
 * Window . . : WIN1                                                    *
 *                                                                      *
 * Part . . . : PSB0000D                                                *
 *                                                                      *
 * Event  . . : PRESS                                                   *
 *                                                                      *
 * Description: User is finished creating records. End Application.     *
 *                                                                      *
 ************************************************************************
 *
C     PSB0000D      BEGACT    PRESS         WIN1
C                   SETON                                         LR
C                   ENDACT
```

Figure 33. Database file example (Part 1 of 2)

```
*********************************************************************
*                                                                   *
* Window . . : WIN1                                                 *
*                                                                   *
* Part . . . : PSB0000C                                             *
*                                                                   *
* Event  . . : PRESS                                                *
*                                                                   *
* Description: Read field information from screen and add record    *
*              to AS/400 Database file.                             *
*                                                                   *
*                                                                   *
*********************************************************************
*
C     PSB0000C      BEGACT    PRESS         WIN1
C                   READ      'WIN1'
C                   WRITE     FORMAT1
C                   ENDACT
```

Figure 33. Database file example (Part 2 of 2)

FILE1 in the file specification is used as a file alias, since an entry exists in the File page of the associated Define iSeriesInformation notebook.

The first member of FILE1 in library LIB1 on server TORAS180 is used during file open. FILE1 in the remote name does not have to match the override name in the file entry. The override name represents a link between the file entry in the File page and the file name used in the VisualAge RPG program.

The part names of the two entry fields are NAME and ADDRESS. The VisualAge RPG creates fields with the same names and the same attributes. In this example, NAME and ADDRESS are 20-character fields. The database file also contains two fields named NAME and ADDRESS, both 20 characters. The following is the DDS for these fields:

```
            R RECORD100
A             NAME             20A
A             ADDRESS          20A
```

When field names and their attributes match, only one field is created. This example reads the data from the window.

```
C* N01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq..

C                   READ      'WIN1'
```

When this READ is performed, data is moved automatically from the screen into the two fields NAME and ADDRESS. Since the data is now in the appropriate fields, it can be written directly to the database without any further field movement.

```
C* N01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq..

C                   WRITE     FORMAT1
```

In this example, the data in the two fields NAME and ADDRESS is moved to the output buffer automatically before the write command is issued to the iSeries 400 database.

Level Checking

The VisualAge RPG supports level checking between a VisualAge RPG program and the iSeries 400 database files being used.

The compiler always provides the information required by level checking. Level checking occurs on a record-format basis when the file is opened, unless you specify LVLCHK(*NO) when creating or changing the database file.

Note: If a level check occurs, it is handled as an I/O error. For more information, see *VisualAge RPG Language Reference*.

Locking Database Files

The OS/400 system allows a lock state (exclusive, exclusive allow read, shared for update, shared no update, or shared for read) to be placed on a file used during the execution of a job. Programs within a job are not affected by file lock states. A file lock state applies only when a program in another job tries to use the file concurrently. The file lock state can be allocated with the CL command ALCOBJ (Allocate Object). For more information on allocating resources and lock states, see the see the *CL and APIs* section of the *Programming* category in the **Information Center** at this Web site - **http://www.ibm.com/eserver/iseries/infocenter**.

The OS/400 system places the following lock states on database files when it opens the files:

- Opened for INPUT: Lock state of Shared for read
- Opened for UPDATE: Lock state of Shared for update
- Opened for ADD: Lock state of Shared for update
- Opened for OUTPUT: Lock state of Shared for update

Overriding Database Files

To override the library name or file name of a database file, use the QCMDDDM command as shown in the following example:

```
     D QCMDDDM         C                   'QCMDDDM' Linkage(*Server)
     C     OvrMenufl     BEGSR

     C                   Eval      QCMDDDM_Parm1 = 'OVRDBF FILE(MENUFL)' +
     C
' TOFILE(SYSLIBT/MENUFL)' +
     C
' MBR(' + MemberName + ')' +
     C
' OVRSCOPE(*JOB)' +
     C
' OPNSCOPE(*JOB)'
     C                   Exsr      CallExecDDM

     C                   ENDSR


     C     CallExecDDM   BEGSR

     C                   EVAL      QCMDDDM_Parm2 =  %LEN(QCMDDDM_Parm1)
     C                   Call          QCMDDDM
     C                   Parm                    QCMDDDM_Parm1
     C                   Parm                    QCMDDDM_Parm2

     C                   ENDSR
```

iSeries 400 Database I/O Considerations

In general, all VisualAge RPG database I/O operations available in the ILE RPG/400 language are also available in the VisualAge RPG language, and are semantically equivalent. See *VisualAge RPG Language Reference* for more information, including which operation codes support local access, remote access, or both.

Using Record Blocking to Improve Performance

If your application reads data from an iSeries 400 server, you can improve the performance of your application by using record blocking. Record blocking means that file I/O operations are done on multiple sequential records (on blocks of records) instead of on one record at a time.

VisualAge RPG offers default record blocking if any of the following are true:
- The file is output-only and contains only one record format.
- The file is a combined file.
- The file is input-only, contains only one record format, and uses only OPEN, CLOSE, FEOD, and READ operation codes.
- The RECNO keyword is not specified on the file description specification.

In addition, you can perform explicit record blocking on files that meet the following criteria:
- The File Addition entry (position 20) is blank.
- The RECNO keyword is not used on the file.
- The file has only one record format.
- The CHAIN, SETLL or SETGT operation codes are used on the file.
- The READE, READP, or READPE operation codes are **not** used on the file.

If a file meets the above criteria, you can enable record blocking by updating your program with BLOCK(*YES) on the file description and recompiling the program. Figure 34 shows an example that uses the BLOCK keyword option.

```
     FFILE1     IF   E           K DISK    BLOCK(*YES)
     F                                     REMOTE
⋮
     C     FLD2          SETLL     REC1
⋮
     C                   READ      REC1                                   10
```

Figure 34. Example using BLOCK keyword option

If you use BLOCK(*NO) on a file description and recompile the program, no record blocking will take place, not even the default record blocking that VisualAge RPG supports.

iSeries 400 Servers Used

If you use TCP/IP, the Optimized Central server and the Remote Command server must be activated. Use the STRHOSTSVR command to start these servers. Go to the iSeries Information Center at URL `http://www.ibm.com/eserver/iseries/infocenter` for more information on this command.

These servers are required when you develop your applications. In addition, when you run your applications, you should have the TCP/IP DDM server active as well. Use the STRTCPSRV command to start this server.

Controlling Server Connections at Run Time

VARPG has a default way to establish connections to remote servers, for most applications this default way of connecting an application to a remote server is sufficient. In some instances requirements surfaced to allow a more dynamic way of connecting to remote servers. These APIs are made available for VARPG programmers to use, in case the application they write has a need to use a non default connection setup.

The default VARPG runtime controlled connection startup works as follows:
1. The VARPG runtime gets the server name from the project's Remote Server Table (.RST) file,
2. The VARPG runtime gets the userid/password information from the VARPG security file if available. If this information is not available the user gets prompted for userid/password.
3. The VARPG runtime then establishes the connection.

If an application has requirements that can't be handled thru this default connection startup the programmer is encouraged to use these VARPG connection APIs.

VARPG provides two types of connection APIs:
1. The Set server APIs to set the server name (Remote Location) to connect to
2. The Connect APIs to control the initiation of the connection with the pre-set server, including authentication.

Here are two scenarios why a programmer would want to implement a non default connection start up:
1. The application needs to dynamically switch servers without re-starting it
2. Signon information needs to be handled without using the VARPG security file, but signon information needs to be available for multiple VARPG applications to avoid multiple prompts for authentication.

Programmers can use the Set server and Connect APIs individually or in conjunction with each other. When used together, one of the Set server APIs has to be used first to set the server name, then one of the Connect APIs can be used to establish the connection to this server.

Both API types are described in this section, first the Set server APIs and then the Connect APIs.

In the VARPG environment, connections normally remain active during the lifetime of an application. Connections are shared by components running inside the application's process. This behavior is true for user controlled VARPG connections, too.

Setting the Remote Location name

As described before, by default the remote location name of the server is specified in the .RST file and the connection gets set to the remote location name at start up of the application. If the programmer wants to supply the remote location name dynamically instead of using the .RST file he can use one of the two Set server

APIs supplied in VARPG. These APIs will set the connection environment, they will not establish a connection. The connection can then be established by accessing the server (opening a file or invoking a remote program) or by using the Connect APIs described in the second half of this chapter.

VARPG provides these two Set server APIs:

- The Set Server API allows the programmer to set a server to a new Remote Location name regardless of which remote server a current session is already connected to. In the case an active connection is already established this connection will be terminated.
- The Change Server API allows a programmer to specify a new Remote Location name for a specific remote server connection already in use. It will stop the communications session already in place and will set the connection to the new Remote Location name so a subsequent request to connect to the server alias will result in establishing a session with this new server.

  The only difference to the Set server API is the fact that the programmer can qualify the server name to be terminated and changed. The parameters for new remote location name and keep job are the same as in the Set Server function.

These two APIs allow the VARPG programmer to easily write VARPG programs that can dynamically change the target server, and allow the application to connect to different servers without ending the VARPG application.

For the user controlled connection startup, the programmer uses the APIs to pass the existing server name, new server name, and information how to deal with jobs on an existing connection. The functions whose interface is described by these APIs are located in the FVDCWVC9.DLL. This DLL is part of the VARPG run time and is located in the path; there is no need to rearrange the path environment for applications using this API.

The Set remote location function, VARPG_Set_Remote_Location, accepts the following parameters and provides a numeric return code indicating the success or failure of the change server process:

- New Remote Location name
- Keep job

The parameters are null terminated character variables passed by reference. The following example shows the C signature and the RPG IV prototype for the API:

```
 * Set server  prototype
 * extern "C" VARPG_ENTRY int VARPG_Set_Remote_Location( char *
 *                        newRmtLocation, char * keepServerJob );
 *
D setsrv          pr             5i 0 dll('FVDCWVC9') extproc
D                                     ('VARPG_Set_Remote_Location')
D newrmtl                          *   value options(*string)
D keepjob                          *   value options(*string)
```

If you need to set the remote location name back to the default, specify "" (an empty string) in the new remote location name parameter.

When terminating an existing connection, if the programmer wants to end the active VARPG jobs running on the iSeries server for this session, he needs to specify the literal 'OFF' for the keepServerJob parameter. Only if the jobs are supposed to continue running, after the VARPG communications session terminated, specify 'ON'. The programmer has to manage non terminated VARPG

jobs himself, and has to make sure they get terminated eventually. The VARPG runtime doesn't have access to these jobs after a server has been switched.

The Change remote location function, VARPG_Chg_Remote_Location, accepts the following parameters and provides a numeric return code indicating success or failure of the change server process:
- Old Remote location name
- New Remote Location name
- Keep job

The parameters are null terminated character variables passed by reference.

The following example shows the C signature and the RPG IV prototype for the API:

```
 * Change server  prototype
 * extern "C" VARPG_ENTRY int VARPG_Chg_Remote_Location( char *
 *                        oldRmtLocation, char * newRmtLocation,
 *                        char * keepServerJob );
 *
Dchangesrv        pr             5i 0 dll('FVDCWVC9') extproc
D                                     ('VARPG_Chg_Remote_Location')
D oldrmtl                          *   value options(*string)
D newrmtl                          *   value options(*string)
D keepjob                          *   value options(*string)
```

The return codes for these APIs are listed in Figure 35 on page 205.

Connecting to a remote location

A user-controlled connection differs from a default VARPG connection in the way the signon information gets provided. For a user controlled connection the programmer provides the authentication information through the connection API. For a default connection the authentication information is provided in the VARPG security file and if not specified there the default signon dialog is displayed to gather this information.

VARPG provides two APIs to control connection startup at run time. These APIs can be used directly in VARPG programs.
1. The Signon API allows programmers to connect to an iSeries server by providing their own signon information.
2. The Change Password API allows programmers to handle changes to the signon password.

For the user controlled connection startup, the programmer uses the Signon API to identify the server name, user Id, and password so the VARPG run time can establish the connection. The functions whose interface is described by these APIs are located in the FVDCWVC9.DLL. This DLL is part of the VARPG runtime and is located in the path; there is no need to rearrange the path environment for applications using this API.

It is important to note the programmer can't switch servers by just using the Connect APIs and specifying a new server name, in order to switch a server, one of the Set server APIs has to be used first to re-set the VARPG communications environment, then the Set Signon function which is part of the Connect APIs can be used to establish the connection to the new server.

The Set Signon function, VARPG_Set_Signon_Info, accepts the following parameters and provides a numeric return code indicating its success or failure:
- Server name
- UserId
- Password

The parameters are null terminated character variables passed by reference.

The following example shows the C signature and the RPG IV prototype for the API:

```
* Signon prototype
* extern "C" int VARPG_Set_Signon_Info(char * server, char * userid,
*   char * password);


D signon          pr             5I 0 dll('FVDCWVC9')
D                                     extproc('VARPG_Set_Signon_Info')
D system                         *    VALUE options(*string)
D userid                         *    VALUE options(*string)
D password                       *    VALUE options(*string)
```

The Change Password function, VARPG_Change_Password, has one additional parameter - the new password to be used. The function also returns a numeric value indicating success or failure of the API execution. Its parameters are:
- Server name
- UserId
- Old password
- New password

These parameters are null terminated character variables passed by reference.

The following example shows the C API and the corresponding RPG prototype:

```
* New password prototype
* VARPG_ENTRY int __cdecl VARPG_Change_Password(char * server,
*    char * userid, char * password, char * newpassword);


D newpassw        pr             5I 0 dll('FVDCWVC9')
D                                     extproc('VARPG_Change_Password')
D system                         *    value options(*string)
D userid                         *    VALUE options(*string)
D oldpassword                    *    VALUE options(*string)
D newpassword                    *    VALUE options(*string)
```

There are many different ways to gather the server/user Id information. The sample program provided in VARPG uses its own signon dialog written in VARPG. Remember that the connection is established for the VARPG application and its components. If you start another VARPG application, by default the VARPG run time will use its usual connection startup mechanism again the same way it does for the first VARPG application. The programmer has two options to change this behavior.
1. Use the control specification option INHERITSIGNON in the application to re-use the previously specified authentication information
2. Use these Connect APIs to control how to deal with server authentication

When using the Signon API in a VARPG application with remote server files, make sure to specify the USROPN keyword in the file specifications for the remote files. If USROPN is not specified, the server connection will be established at application

startup before you have a chance to invoke the SIGNON function. In components started after the communication session has been established, you can use the RPG implicit opening of files by not specifying the USROPN keyword in these components. The components will reuse the existing connection of the application.

The return codes for these Connection and Signon APIs are:

```
OK                                          0
INVALID_PARAMETER                           1
INTERNAL_ERROR                              2
FUNCTION_NOT_SUPPORTED                      3
COMMUNICATIONS_ERROR                        4
SERVER_INVALID                              101
USER_ID_UNKNOWN                             201
USER_ID_REVOKED                             202
NEW_PWD_LENGTH_LONGER_THAN_MAX              301
NEW_PWD_LENGTH_SHORTER_THAN_MIN             302
NEW_PWD_CONTAINS_CHAR_USED_THAN_ONCE        303
NEW_PWD_CONTAINS_ADJACENT_DIGIT             304
NEW_PWD_CONTAINS_REPEATED_CONSECUTIVELY     305
NEW_PWD_PREVIOUSLY_USED                     306
NEW_PWD_MUST_CONTAIN_ONE_NUMERIC            307
NEW_PWD_CONTAINS_INVALID_CHAR               308
NEW_PWD_CONATINS_DISALLOWED_WORD            309
NEW_PWD_CONTAINS_USERID                     310
PASSWORD_INCORRECT                          311
PASSWORD_DISABLED_NEXT_INVALID_ATTEMPT      312
PASSWORD_EXPIRED                            313
NEW_PWD_CONTAINS_CHAR_SAME_POSITION_AS_LAST 315
```

Figure 35. Return codes for the Connection and Signon APIs

Sample Program Using the Signon API

The sample application presents a window with a ″Signon to server″ push button. Pressing this button starts the Signon component, which gathers the userID/password information. The component will signal back whether or not the connection is successful. This application uses the component reference part to monitor the Signon component for completion.

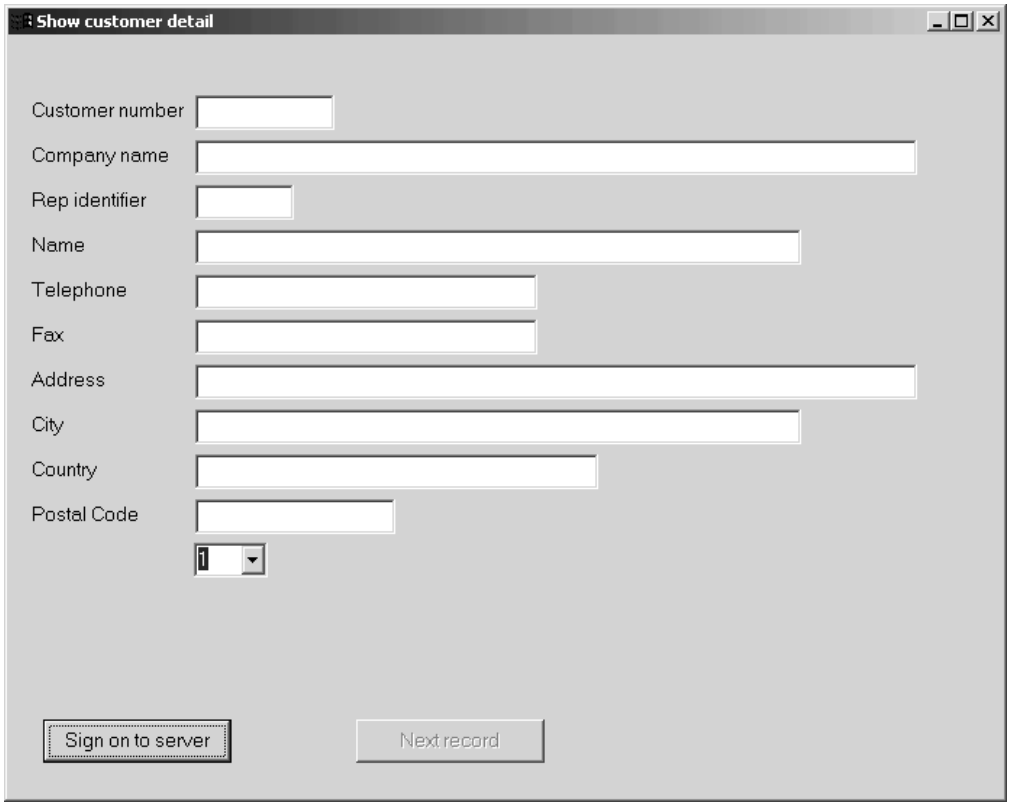
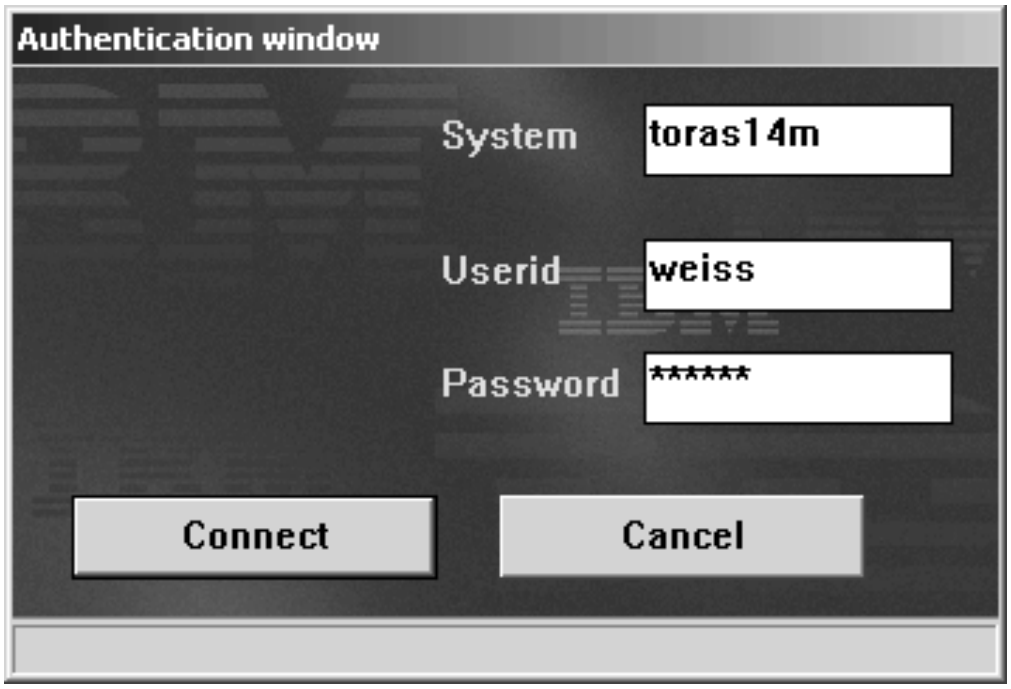
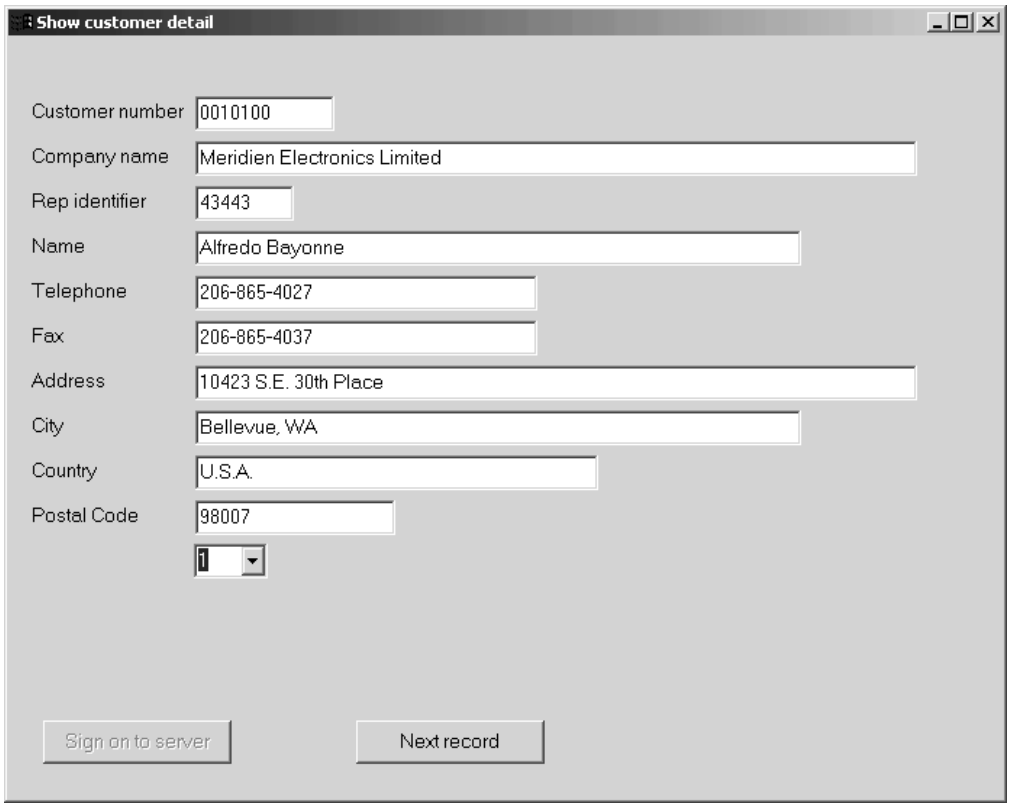


Figure 36. Initial Window with Signon Push Button

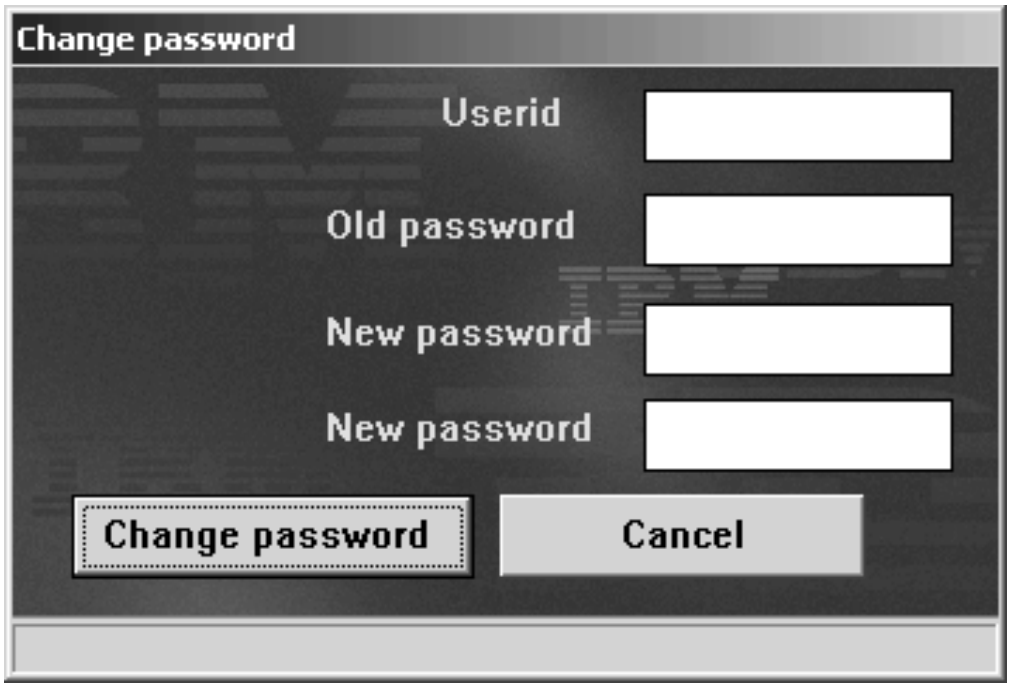
Files have been specified with the USROPN keyword, so no connection request is made by the VARPG run time. Pressing ″Sign on to server″ will start the component.



The user can now specify the server and userID/password information. The component will use this data to start the signon API and establish the connection to the server. When the initial window gets notified that a connection has been established successfully, the program accesses the customer database on the iSeries server.



A variation that is implemented in this sample is to show a ***Change password*** dialog if the user's password has expired. This condition can be detected by checking the return code of the SIGNON function.



The program uses this dialog to get the new password and then send it to the VARPG communications layer by invoking the VARPG_Change_Password function. The code for all of these functions is included in the **Runtime_control_of_server_connections** sample program.

Handling Server Sign-On Errors

The first time an application requires server access (to open a file or perform a remote program call) it will seek to establish a server connection. A sign-on dialog may then be displayed to prompt for a userid and password, if these settings were not pre-defined. If this dialog is cancelled by the user, then a runtime error is issued. (1421 - Logon cancelled by user) If the error is passed to the RPG default error handler, a runtime error dialog is shown.

To avoid showing this runtime error, the application can instead handle the error by:

- Handling file open errors
- Explicitly connecting to the server
- Setting up a general program error handler

Explicitly Handling File Open Errors

To explicitly handle file open errors, the file must first be opened directly by the application code, so it must be specified with File keyword USROPN. Then, open it with OPEN(E) or with a result error indicator, and check the results.

Note:

Note: All files in the application must be changed to USROPN, to prevent the otherwise implicit file opens that are done at application startup trying to connect first.

```
fcustoml3  uf   e           k disk    remote usropn

C                   open      customl3                              90
```

```
C     *IN90         ifeq      *ON
C* error openning the file.
C                   else
C* open ok.
C                   endif
```

Explicitly connecting to the server

Another approach is to control the establishing of the server connection directly. Refer to the sample project **runtime_control_of_server_connection**.

This must be done before the application requires the connection for implicit file opens, file access, or program calls. (Make all files USROPN, or move the files to a sub-component started only after the connection is established)

Setting up a general program error handler

Another approach is to use a *PSSR, which has the benefit that files can still be implicitly opened. (Instead of using **USROPN**.)

However, this receives control for other errors as well, so care should be taken to handle the errors specifically; allowing for unexpected errors.

```
D*A program exception/error subroutine can be specified by coding *PSSR in factor 1 of
D*a BEGSR operation.
C     *PSSR         BEGSR
C                   ENDSR     '*CANCL'
```

If you would like to determine the cause of the exception/error in *PSSR subroutine, you can use a program status data structure:

```
D*Information regarding the program exception/error is made
D*available through a program status data structure that is specified with an S in
D* position 23 of the data structure statement on the definition specifications.
DMYPSDS          SDS
D PROC_NAME         *PROC                                          * Component n
D PGM_STATUS        *STATUS                                        * Status code
D PRV_STATUS             16     20S 0                              * Previous st
D LINE_NUM               21     28                                 * Src list li
D ROUTINE           *ROUTINE                                       * Routine nam
D PARMS             *PARMS                                         * Num passed
D EXCP_TYPE              40     42                                 * Exception t
D EXCP_NUM               43     46                                 * Exception n
D*
D EXCP_DATA              91    170                                 * Exception d
D*
D DATE1                 191    198                                 * Date (*DATE
D YEAR                  199    200S 0                              * Year (*YEAR
D LAST_FILE             201    208                                 * Last file u
D FILE_INFO             209    243                                 * File error
D*
D JOB_DATE              270    275S 0                              * Date (UDATE
D RUN_DATE              276    281S 0                              * Run date (U
D RUN_TIME              282    287S 0                              * Run time (U
D CRT_DATE              288    293                                 * Create date
D CRT_TIME              294    299                                 * Create time
D CPL_LEVEL             300    303                                 * Compiler le
D SRC_FILE              304    313                                 * Source file
D
D*The following is a general error handler. If any error occur, it
D*will get called. You can then determine the cause by checking PGM_STATUS
D*in the above PSDS.
```

```
C     *PSSR         BEGSR
C* Do error handling here...
C                   ENDSR     '*CANCL'
```

Using the Security File for Applets

When a VARPG application needs an iSeries resource, such as a database file, a valid user ID and password is required to connect to the iSeries server. For VARPG, the user ID and password are stored in a security file on the client workstation. However, applets by default, cannot access any files on the client workstation. This results in the user being prompted for a user ID and password each time the applet is run. If you want to use the security file when running applets and avoid this prompting, you need to give each applet *permission* to read the security file. You do this by using the **PolicyTool** utility that is part of Sun Microsystem's J2SDK. You can find more information on how to use PolicyTool in the Tool Documentation section of the J2SDK 1.2 documentation.

Note: The procedure described here only works for Windows clients.

1. Create the security file on the client workstation.

   If not already done, install the VARPG runtime on the client workstation. From the **Start** menu, choose **Programs>VisualAge RPG Runtime>Define Server Logon**. The Define Server Logon dialog appears. Add the user ID and password for a specific iSeries server to store them in the security file.
2. Create the required permissions.

   Permissions are required so that the Java VM can read the security file. To create the permissions, do the following:
   a. From an MS DOS prompt, type **PolicyTool** and press enter. The Policy Tool dialog box appears.

      If this is the first time you have used PolicyTool, a message indicating that the policy file cannot be found in a certain directory is also displayed. Make a note of the name and directory of the policy file in the message. This will be the location you will save your policy file to in a later step.
   b. From the Policy Tool dialog, click the **Add Policy Entry** button. The Policy Entry dialog appears. In the CodeBase entry field, type:

      ```
      "http://xxxx/-"
      ```

      where xxxx is the URL and directory that contains the applet that is to be given permission to the security file.
   c. Click the **Add Permission** button. Complete the Permissions dialog as follows:
      - From the Permissions combination box, choose **RuntimePermission**.
      - From the Target combination box, choose **loadLibrary.<library name>**.
      - In the entry field immediately to the right of the Target combination box, change **loadLibrary.<library name>** to **loadLibrary.fvdcjava**.
      - Press **OK** to return to the Policy Entry dialog.
   d. From the Policy Entry dialog, again click the **Add Permission** button. Complete the Permissions dialog as follows:
      - From the Permissions combination box, choose **FilePermission**.
      - In the entry field immediately to the right of the Target combination box, type the name of the security file. This file is located in the ibmcom subdirectory of your Windows directory. For example:

        ```
        c:\windows\ibmcom\fvdcsec.txt
        ```

        where your Windows directory is *c:\windows*.
      - From the Actions drop down combination box, choose **read**.

- Press **OK** to return to the Policy Entry dialog.
- Press **Done** to return to the Policy Tool dialog.

e. From the Policy Tool dialog, choose **File** then **Save as** from the menu. Save the policy file you have just created to the file name and directory you noted in 2a on page 210. Now choose **File**, then **Exit** to exit the PolicyTool.

   If you are still prompted for the user ID and password, use PolicyTool again to verify that you have specified all the parameters correctly.

Chapter 9. Reusing iSeries Applications

When you develop your VisualAge RPG application, you may want to reuse an existing iSeries 400 application or various pieces of it. This section describes some of the things you must consider when reusing iSeries 400 applications.

Reuse Scenario

You can use VisualAge RPG to modify applications that run on the server so that they run on a PWS, access data on the host, and have a graphical user interface. This section provides an overview of the steps involved.

Importing display files: The Import utility converts existing display files to a graphical user interface on a PWS. After you import a display file, the record formats are converted to user-defined parts and stored on the Imported page of the parts catalog. You can move the parts to the parts palette as you work on the application, and then store them in the parts catalog when you finish working on the application until you need them again.

For example, importing the 5250 screen shown in Figure 37 results in the GUI shown in Figure 38 on page 214. Records are converted to a group of parts, fields are converted to entry field parts, and constants are converted to static text parts. All command keys are converted to push button parts, and the push button labels reflect the original command key keyword.

```
000 00 0000              00000000000000000000000000000      Status: 0000000

                    Purchase Order Header Maintenance   P.O. Number: 666666
-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.
       Vendor Number: 99999 00000000000000000000000       000000000000000
                            00000000000000000000000     66666666-666-6666
                            00000000000000000 0000000
                                     00000000000000000000000000000

             Ship to: 9999  00000000000000000000000000000
                            00000000000000000000000000000
                            00000000000000000000000000000
               Print : B (Y,N)
              Ship Via: BBBBBBBBBB              Date Entered: 000 00 0000
                F.O.B.: BBBBBBBBBBBBBB          Date Revised: 000 00 0000
          Terms Code : BBBB 000000000000000                   000 00 0000
            Password :                          Originator  : 000000000000000
  Prep./Collect/Chg : B (P,C,X)
     Confirm./Orig. : B (C,O)
           Warehouse: BB 00000000000000000000000000000
         Requested by: BBBBBBBBBBBBBB          Work Order #: 9999999
-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.
Cmd1 Exit Cmd3 PO Notes Cmd4 Lookup Cmd5 Material Status Cmd9 Vendor Maint.
Cmd11 Delete            Cmd15 Vendor Notes  Cmd16 Vendor Quotes
```

Figure 37. Sample 5250 screen from a Purchase Order application

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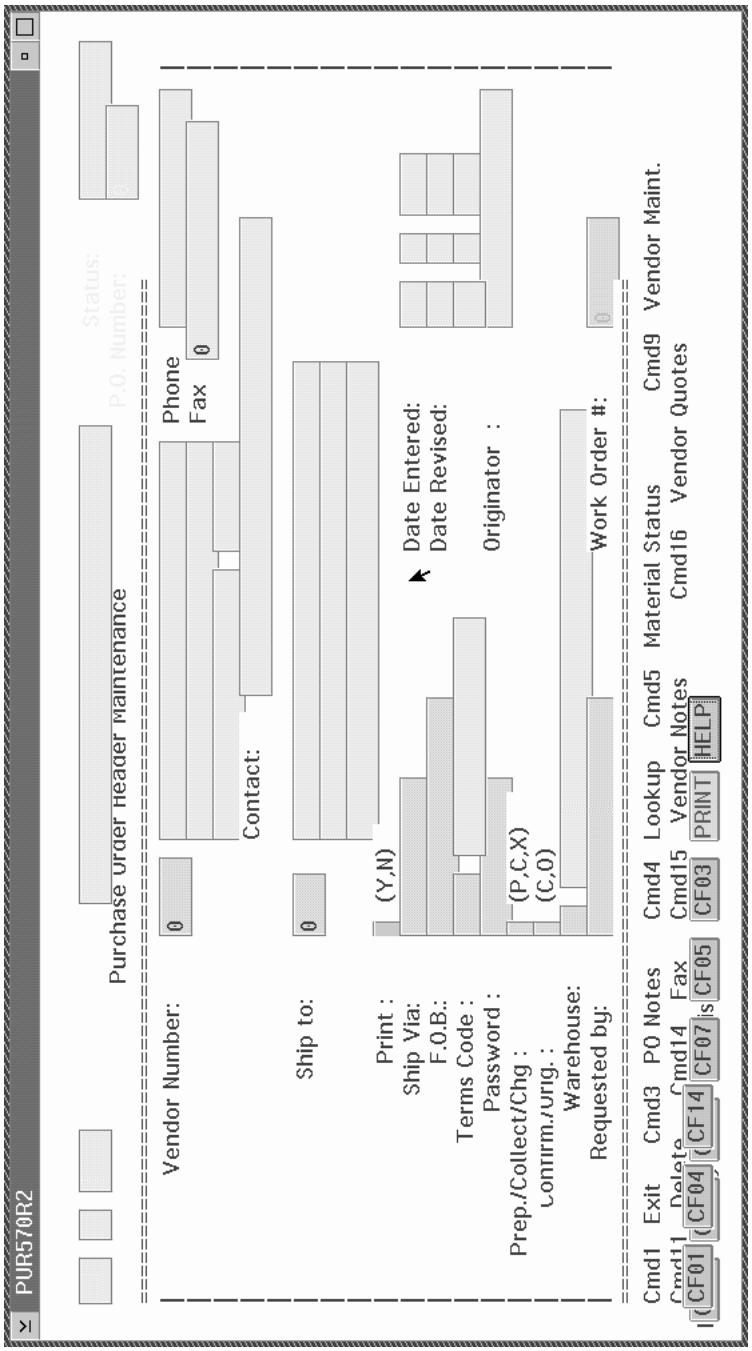

Figure 38. Result of importing the Purchase Order screen

Note: The new parts inherit the original field names, but you can rename them if you like. Retaining the same field name improves productivity when manipulating program logic for reuse.

You may want to customize the imported parts to take advantage of the basic design issues discussed in Chapter 2, “Planning Your Application,” on page 19.

Customizing the GUI:

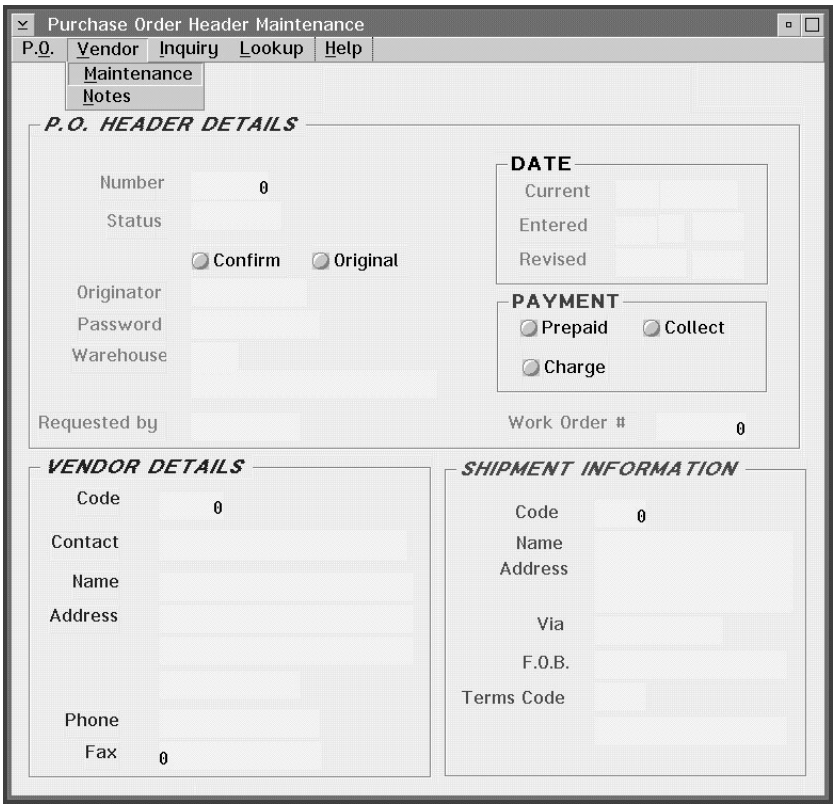

Figure 39. Customized GUI for the Purchase Order application

Figure 39 shows how the imported window would look if you made the following changes to the interface:

- Replace the command keys with a menu bar and associated menu items. For example, a **Vendor** menu contains actions that were originally converted to push buttons. This gives users easy access to frequently performed actions, and launches related windows.
- Group related information, using group box parts to provide a visual cue for users. For example, a group box labeled **Shipment Information** contains entry fields that pertain to shipment information.
- Use grouped radio buttons for information that requires a user to select from a number of known choices. For example, only three methods of payment are possible (prepaid, collect, charge); therefore users need to select only one radio button to indicate the method being used. The radio buttons are in a group box labeled **Payment**.

These changes take advantage of the graphical capabilities that VisualAge RPG offers.

Reusing online help: When you reuse an application, you may want to reuse the existing User Interface Manager (UIM) help, too. You will have to modify it somewhat to reflect the look of the new GUI; however, it could save you the effort required to create help from scratch.

You can customize the converted UIM help and add new types of help using the Information Presentation Facility (IPF). You can write help for each window and context-sensitive help for each part, and you can link the help information by

creating hypertext links in the help source. See “Reusing UIM Help” on page 222, and Chapter 13, “Tips for Creating Online Help with IPF,” on page 245 for more information.

Writing program logic: You can reuse logic written in RPG IV because the compiler is based on that language. Simply cut-and-paste existing code for reuse.

You also have to write some additional program logic, using event-driven programming. For every event associated with a part, there is an action subroutine which describes how the program responds to an event. Procedural operation codes for program control are not required; program control is implicit. Some of the VisualAge RPG operation codes unique to VisualAge RPG applications are:

BEGACT
: Begins an action subroutine

ENDACT
: Ends an action subroutine

SETATR
: Sets the value of a part attribute

GETATR
: Retrieves the value of a part attribute

SHOWWIN
: Displays a window

CLSWIN
: Closes a window

Figure 40 on page 217 contains an action subroutine from a sample purchase order application. When SHOWWIN is called from a particular window to display the PUR570R2 window, an action subroutine is coded for the **Create** event to prepare the window for the user’s next action.

If this is a new purchase order (#PONUM = 0), the menu items **change**, **delete**, **print**, and **fax** are set to **not** respond to the MENUSELECT event. For each of the menu items, the %setatr function is used to set the **enabled** attribute to *0*. The BEGACT operation code indicates the beginning of the action subroutine, and ENDACT indicates the end of it.

```
 ********************************************************************
 ********************************************************************
 *
 * Window . . :  PUR570R2 PO Header Maintenance                     *
 *                                                                  *
 ********************************************************************
 ********************************************************************-
 *
C     PUR570R2      BEGACT    CREATE        PUR570R2
c*
c*
C                   if        #PONUM = 0
C                   eval      %setatr('pur570r2':'m2_change':'enabled')=0
C                   eval      %setatr('pur570r2':'m2_delete':'enabled')=0
C                   eval      %setatr('pur570r2':'m2_print':'enabled')=0
C                   eval      %setatr('pur570r2':'m2_fax':'enabled')=0
c                   end
c                   exsr      POCHECK
c                   write     'PUR570R2'
C                   ENDACT
 ********************************************************************-
```

Figure 40. Sample action subroutine

Connecting to the Host: If your application uses iSeries 400 database fields or imports iSeries 400 display files when you are building your application, you must define the iSeries 400 server it uses. You can communicate with the host at any time, as long as the server logon information is appropriately defined. See the online help for more information about defining server information.

Importing Display Files

If you have a display file that contains record formats you wish to include on a design window, you can import these record formats from an iSeries server to the VisualAge RPG environment. After the import is completed, the record is converted to a user-defined part and stored on the Imported page of the parts catalog. Before you can import a display file:

- define the server that you will be accessing. See the online help.
- You must have a minimum of *USE authority for these display files.

To import a display file:

1. Choose the **Server→Import display file** from the GUI Designer.
2. Select a display file using one of these methods:
   - Type the full name of the display file (*<server>library/file*) in the **File name** entry field, and press Enter while the cursor is still in the field.
   - Do the following:
     a. Select one of the servers that is displayed. A list of libraries is displayed under the server name.
     b. Select one of these library names. A list of display file objects is displayed.
     c. Select one of these display file objects. A list of records in the file is displayed.
3. Select the record that you want to import.
4. If you do not want to use the default part name, type a part name in the **Part name** entry field.
5. If you do not want to use the default icon, you can press the **Find** push button to use the Find an Icon window.
6. Select one of the following to indicate where you want the part to reside:

Catalog only
The part is added to the Imported page in the catalog.

Catalog and palette
The part is added to the Imported page in the catalog, and the icon for the imported part appears on the palette.

7. Choose **Import**.

Converting Display Files

When you import a display file, the record formats, fields, and keywords that have equivalent parts or attributes are converted, and you can use these parts as you would any other part. The record formats, fields, and keywords that do not have an equivalent part are not converted.

In general,
- Record formats are converted to a VisualAge RPG window or a group of parts, depending on the record type.
- Fields are converted to entry fields.
- Constants are converted to static text parts.
- Conditioning indicator options are ignored.

Note: Fields with a length greater than 64 bytes are sized to 64 bytes on the GUI; however, the length attribute in the properties notebook is set to the original length.

Record Formats

The following list describes how display record formats are converted to parts.

MNUBAR
The MNUBAR record format is converted to a menu bar part that you can drop onto a window with canvas.

PULLDOWN
The PULLDOWN record format is used with the MNUBAR record format to create a submenu part. The PULLDOWN record format is converted to menu item parts for the MNUBAR record format that it references.

RECORD
The RECORD record format is converted to a group of parts that you can drop onto a window with canvas.

SFL, SFLCTL
These record formats are converted to a subfile part that you can drop onto a window with canvas.

Constants in the SFL records are not converted.

WINDOW
The WINDOW definition record format is converted to a window with canvas part. The WINDOW reference record format is converted to a group of parts that you can drop onto a window with canvas.

These record formats are not converted: ERRSFL, SFLMSG, and USRDFN. The PULLDOWN and WINDOW keywords within a subfile are not converted.

Positional Entries

The following table describes how positional entries in the DDS used to create a display file determine how formats and fields are converted.

Table 6. Positional entries and conversion

Columns	Meaning	Entry and Conversion Results	
8-16	Indicators		Not converted
17	Record type	**R**	Converted as described in Record Formats
		H	Not converted
19-28	Name		If a named field, used as the name of the part
29	Reference	**R**	Not converted
30-34	Length		Sets the data length
35	Keyboard shift	**A**	Converted to character
		E	Data type set to DBCS Either
		G	Data type set to DBCS Only
		I	Read-only, Disabled
		J	Data type set to DBCS Only
		O	Data type set to DBCS Mixed
		D F M N S W X Y	Not converted
36-37	Decimals		Determines the number of decimal positions in the converted part. If specified, sets data type to Numeric.
38	Usage	**I B**	Enabled
		M P	Not converted
		O	Read-only, Enabled
		H	Converted if the field is a subfile field
39-41	Location		Determines the position of the part on the window
45-80	Keywords	**Constant**	Creates a static text part

Display File Keywords

The following list describes how display file keywords are converted to parts. Options used with these keywords can determine whether or not the keywords are converted.

CFnn, CAnn
These keywords are converted to push buttons that have a label identical to the name of the keyword.

CHOICE
See MLTCHCFLD and SNGCHCFLD.

CNTFLD
The CNTFLD keyword is converted to a multiline edit part.

COLOR
The COLOR keyword determines the foreground color attribute of the part. If there is more than one COLOR keyword, the last one is used.

COMP
The COMP keyword is used to set the comparison attributes in the part's properties notebook.

DATE The DATE keyword is converted to a static text part.

DFT The text associated with DFT becomes the label for the part.
- If the field that is being converted is a constant field, the DFT value is used on the label.
- If the field that is being converted is specified on a named field, the DFT keyword value is converted to the default text of the part.

DFTVAL
The DFTVAL keyword value is converted to the default value of the part.

DSPATR
If the DSPATR display attribute is:
- HI, the foreground color is made brighter.
- ND, the converted field is set to not visible.
- PR, the converted field is set to disabled.

Any other display attributes are not converted.

HELP The HELP keyword is converted to a push button with the label HELP. The help function is not converted.

MLTCHCFLD
If the MLTCHCFLD keyword is used inside a PULLDOWN record, each CHOICE keyword associated with it is converted to a menu item part on a submenu part. The converted menu item part has a check mark next to it to indicate that it is active.

If the MLTCHCFLD keyword is used outside a PULLDOWN record, each CHOICE keyword associated with it is converted to a check box part. Check boxes are positioned horizontally with the same default space between them. They are not grouped.

MNUBAR
The MNUBAR record format is converted to a menu part.

MNUBARCHC
Each MNUBARCHC is converted to a menu item.

PRINT
The PRINT keyword is converted to a push button with the label PRINT. The print function is not converted.

PSHBTNCHC, PSHBTNFLD
The PSHBTNFLD is converted to a push button part. The text associated with the PSHBTNCHC keyword is converted to the label on a push button part.

PULLDOWN
The PULLDOWN record format is used with the MNUBAR record format to create a submenu part. The PULLDOWN record format is converted to the menu item parts for the MNUBAR record format that it references.

RANGE
The RANGE keyword is converted to the range attribute for the part.

SFL, SFLCTL
These record formats are converted to a subfile part.

SFLPAG
Influences the initial height of the subfile part.

SNGCHCFLD
If the SNGCHCFLD keyword is used inside a PULLDOWN record, each CHOICE keyword associated with it is converted to a menu item part on a submenu part.

If the SNGCHCFLD keyword is used outside a PULLDOWN record, each CHOICE keyword associated with it is converted to a radio button part. The radio buttons are arranged horizontally with the same default space between them. They are not grouped.

SYSNAME
The SYSNAME keyword is converted to a static text part.

TIME The TIME keyword is converted to a static text part.

USER The USER keyword is converted to a static text part.

VALUES
The VALUES keyword causes the field to be converted to a drop-down combination box part. The values associated with the VALUES keyword are used on the drop-down list.

WDWTITLE
The WDWTITLE keyword is used to determine the label and attributes for a window with canvas part.
- If the title text is assigned to a program-to-system field, it is not converted.
- If the title text is assigned to a literal field, the label for the window with canvas part is set to this text.

WINDOW
The WINDOW definition record format is converted to a window with canvas part. The WINDOW reference record format is converted to a group of parts that you can drop onto a window with canvas.

No other keywords are converted.

Converting Color

Character-based computer screen entry fields are converted to entry field parts that are color-coded.

Note: Not all displays support these colors. On VGA displays, for example, the converted entry fields will be white.

The color of each converted entry field depends on the type and attributes defined in the display file:

Table 7. Original and Converted Field Attributes

Field Type	Field Attributes	GUI Attributes
I/O*		ReadOnly: Off Enabled: On Color: Light Yellow

Table 7. Original and Converted Field Attributes (continued)

Output		ReadOnly: On Enabled: On Color: Light Green
Input		ReadOnly: Off Enabled: On Color: Light Blue
Input or I/O	Protected	ReadOnly: Off Enabled: Off Color: Light Red
Input or I/O	Inhibited keyboard	ReadOnly: On Enabled: On Color: Medium Red
Input or I/O	Inhibited keyboard Protected	ReadOnly: On Enabled: Off Color: Deep Pink

Note: I/O = Input and output

The color-coding allows you to visually determine the attributes that are set for the entry field part. For example, if a light-green entry field is displayed, you know that it is used by the program to display data and cannot receive user input. If a light-red entry field is displayed, you know that it can receive user input, but that it is not enabled because it was a protected field in the original application.

Reusing UIM Help

You can reuse the iSeries 400 help that was written using **User Interface Manager** (UIM) even though VisualAge RPG help files are written using the **Information Presentation Facility** (IPF). Both UIM and IPF formats use **General Markup Language** (GML) principles and are highly inter-changeable. For detailed information about using IPF, see *Information Presentation Facility Guide and Reference*(available online). You should also see the online document entitled *IPF Restrictions*. This document provides details on the subset of IPF tags that you are restricted to in a Windows environment.

To reuse UIM help files:
1. Use the editor to copy and paste the members containing the UIM help.
2. Change the UIM tags to the appropriate IPF tags.

The following sections compare some of the UIM and IPF tags.

UIM and IPF functions that use the same tags

There are functions in UIM and IPF that are equivalent and are tagged exactly the same way. In these cases you can use your UIM tags verbatim.

Table 8. Identical UIM and IPF Tags

UIM Tag	Tag Function	IPF Tag
:DL.	Definition List	:dl.
:FIG.	Figure	:fig.
:HP1.	Highlighted Phrase	:hp1.
:HP2.	Highlighted Phrase	:hp2.

Table 8. Identical UIM and IPF Tags (continued)

UIM Tag	Tag Function	IPF Tag
:HP3.	Highlighted Phrase	:hp3.
:HP4.	Highlighted Phrase	:hp4.
:HP5.	Highlighted Phrase	:hp5.
:HP6.	Highlighted Phrase	:hp6.
:HP7.	Highlighted Phrase	:hp7.
:HP8.	Highlighted Phrase	:hp8.
:HP9.	Highlighted Phrase	:hp9.
:LINES.	Lines	:lines.
:LI.	List Item	:li.
:LP.	List Part	:lp.
:NT.	Note	:nt.
:OL.	Ordered List	:ol.
:P.	Paragraph	:p.
:PARML.	Parameter List	:parml.
:P	Parameter Description	:pd.
:PT.	Parameter Term	:pt.
:SL.	Simple List	:sl.
:UL.	Unordered List	:ul.
:XMP.	Example	:xmp.
&AMP.	Ampersand (&)	&amp.
&COLON.	Colon (:)	&colon.
&period.	Period (.)	&period.
&SLR.	Right slash (/)	&slr.

Equivalent UIM and IPF functions that use different tags

There are functions in UIM and IPF that are equivalent but are tagged differently. In this situation, change the UIM tagging to its equivalent IPF tagging.

Table 9. Equivalent UIM and IPF Tags

UIM Tag	Function	IPF Tag
:CIT.	Citation	:hp5.
:H1.	Heading	:h2.
:H2.	Heading	:h3.
:H3.	Heading	:h4.
:H4.	Heading	:h5.
:HELP.	Heading	:help.
:ISCH.	Index item	:i1.
:ISCHSYN.	Index synonym	:isyn.
:PK.	Programming keyword	:hp2.
:PK. with :DEF.	Default programming keyword	:hp7.

Table 9. Equivalent UIM and IPF Tags (continued)

UIM Tag	Function	IPF Tag
:PV.	Programming variable	:hp5.

UIM Functions with no IPF equivalents

There are functions available in UIM that are not available in IPF. In this situation, either delete the function or find another way to implement the function using IPF tagging.

Table 10. UIM Tags with No IPF Equivalents

UIM Tag	Function	Suggested IPF Substitutions
:HP0.	No highlighting	Use no :hp*n* tag around the text.
:PC.	Paragraph continuation	Use no tag. Continue with the text of the paragraph.
:RT.	Reverse text	Use a different type of highlighting using a :hp*n* tag.
:XH1.	Extended help heading	There is no extended help in IPF. Use a :link. tag to create a hypertext link to another help window (:h1.) where you provide extended help.
:XH2.	Extended help heading	There is no extended help in IPF. Use a :link. tag to create a hypertext link to another help window (:h1.) where you provide extended help.
:XH3.	Extended help heading	There is no extended help in IPF. Use a :link. tag to create a hypertext link to another help window (:h1.) where you provide extended help.
:XH4.	Extended help heading	There is no extended help in IPF. Use a :link. tag to create a hypertext link to another help window (:h1.) where you provide extended help.

Reusing RPG Source

To reuse RPG source code on a server:

1. If the source code is not RPG IV syntax, convert it to RPG IV syntax using the ILE RPG conversion tool (**CVTRPGSRC**) on the server.
2. Use the editor to **copy** and **paste** the members containing the RPG source and commonly used subroutines.
3. The syntax checker highlights any operation codes that are not supported by the compiler. See *VisualAge RPG Language Reference* for a description of the supported operation codes.

   Note: In addition to differences between operation codes, there are a number of other differences between the RPG IV language and the VisualAge RPG compiler you must be aware of prior to reusing RPG source. For a description of the differences between the RPG IV language and the VisualAge RPG language, see *VisualAge RPG Language Reference*.

Part 4. Advanced Topics

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Chapter 10. Debugging Your Application

The debugger provided with VisualAge RPG helps you detect and diagnose any errors in your application. It can be used to debug multiple-language applications. You can:

- Manage execution of applications and DLLs
- Set and control breakpoints
- Display and modify program states by using storage, registers, variables, and call stack windows.

This section illustrates some of these features using a VisualAge RPG program.

To debug Java code generated by VARPG, you need Windows NT and the Distributed Debugger.

Starting the Debugger

To start the debugger, select the **Debug** menu item from the Project menu. Two windows appear. The **Debug Session Control** window and the **VisualAge RPG Source** window. Figure 41 illustrates these two windows.

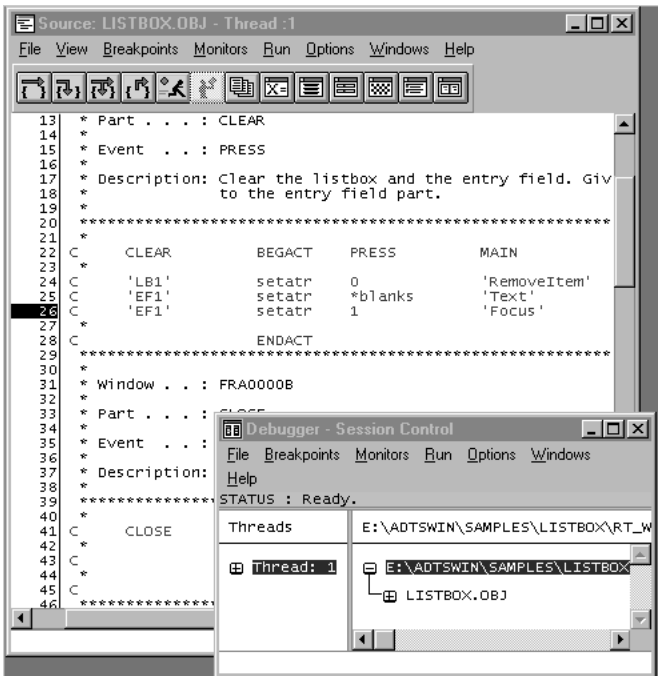

Figure 41. The VisualAge RPG Source and Debug Session Control Windows

When the debugger starts, it searches for the **VisualAge RPG source member** and then displays it in the **Source** window. Once the source is displayed, you can perform debugging tasks.

Note: The current position of the executing program is indicated by a highlighted line number. Here, the first line of the source member is highlighted.

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Displaying the Assembly Code

If the debugger does not find the VisualAge RPG source, it loads the program and displays the **assembly source code** instead of the VisualAge RPG source code. The window that is displayed is similar to the one displayed in Figure 42.

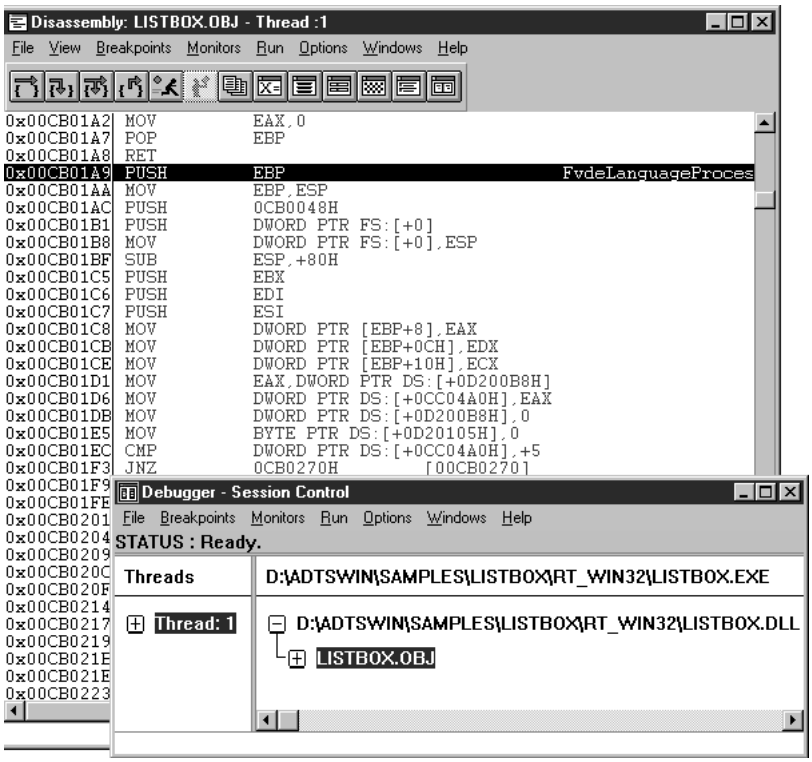

Figure 42. The Disassembly Window.

To correct this problem, make sure that the VisualAge RPG source code (.VPG file) resides on your workstation.

Loading the DLL Occurrence

If the assembly source code is displayed, it means that the VisualAge RPG source member cannot be found. To resolve this, select **Set load occurrence** from the **Breakpoints** pull-down menu. The load occurrence breakpoint window is displayed (Figure 43 on page 229). From this window, you can load the **DLL occurrence**. Type the following information, and then select OK:

```
application_name.DLL
```

This returns you to the debug session. When the assembly source view is displayed again, press the R key to resume execution of the program. When the DLL is loaded, the system displays a message and the name of your application is displayed in the control window. You can now click on the application to get the source to display. If the source does not display this means you have lost or deleted the source.

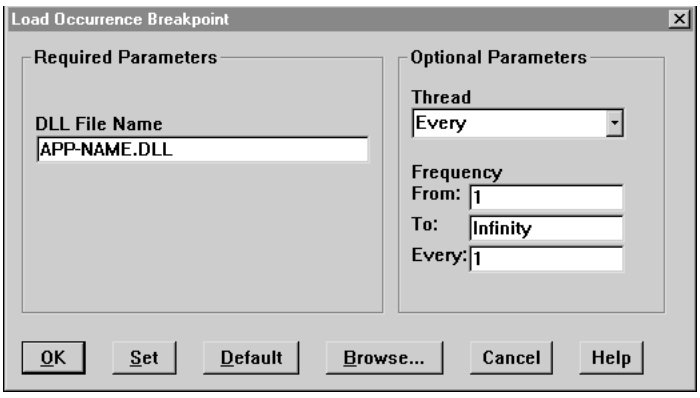

Figure 43. Setting the Load Occurrence Breakpoint.

If your application uses the START opcode to start another component, you will have to use this procedure to load the other component DLL. This will allow you to set breakpoints within the other components.

Entering Debug Startup Information

If the executable file cannot be located, the debugger displays a window similar to the one in Figure 44 below. You can re-enter the program name and parameters on this window.

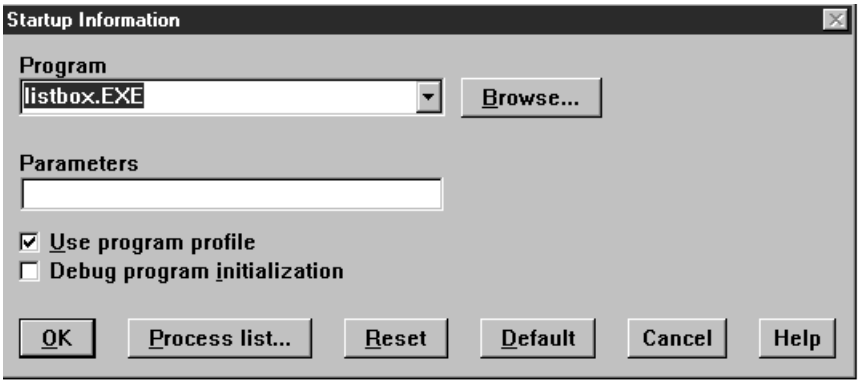

Figure 44. Startup Information.

Setting a Breakpoint

You can control how your program executes by setting breakpoints. A breakpoint stops the execution of your program at a specific location or when a specific event occurs. To set a breakpoint, move the cursor to the line number that you would like to break at and double-click mouse button 1. The debugger highlights the line number with a red mark. You can repeat this process as many times to mark all the necessary lines that you would like to break at. Figure 45 on page 230 illustrates the way the screen looks with several breakpoints set. You can view all of your breakpoints in the Breakpoints List window.

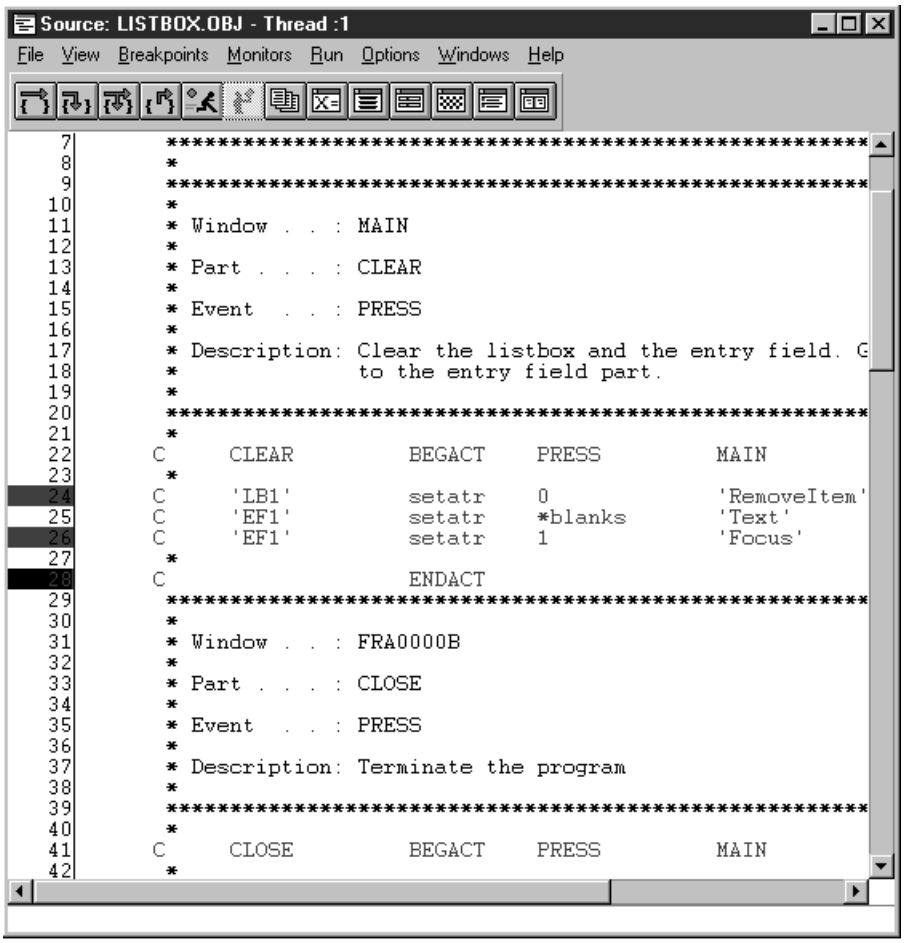

Figure 45. Setting Several Breakpoints.

Select **Breakpoints>List** to display this window. The following information is also provided for each breakpoint:

- The enablement state
- The type of breakpoint
- The position of the breakpoint
- The condition under which the breakpoint is activated

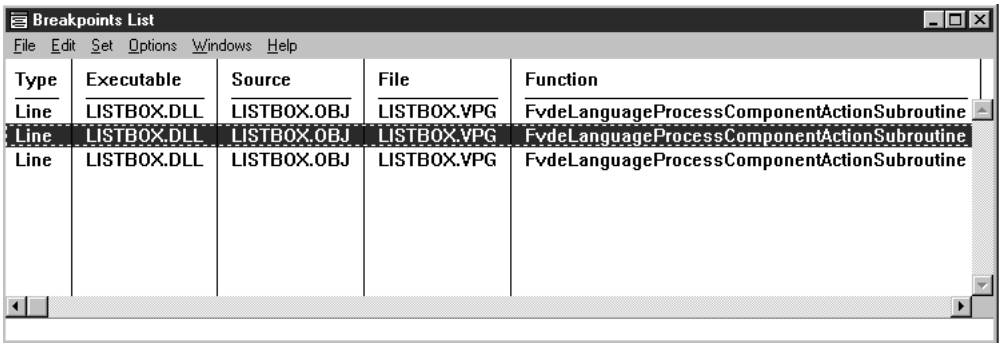

Figure 46. The Breakpoints List Window.

Running with Breakpoints

Pressing the R key causes the program to run. It stops at the first breakpoint that it encounters. When the debugger encounters a breakpoint, it stops and highlights the entire line as shown in Figure 47 below. This indicates the position where the executing program has paused.

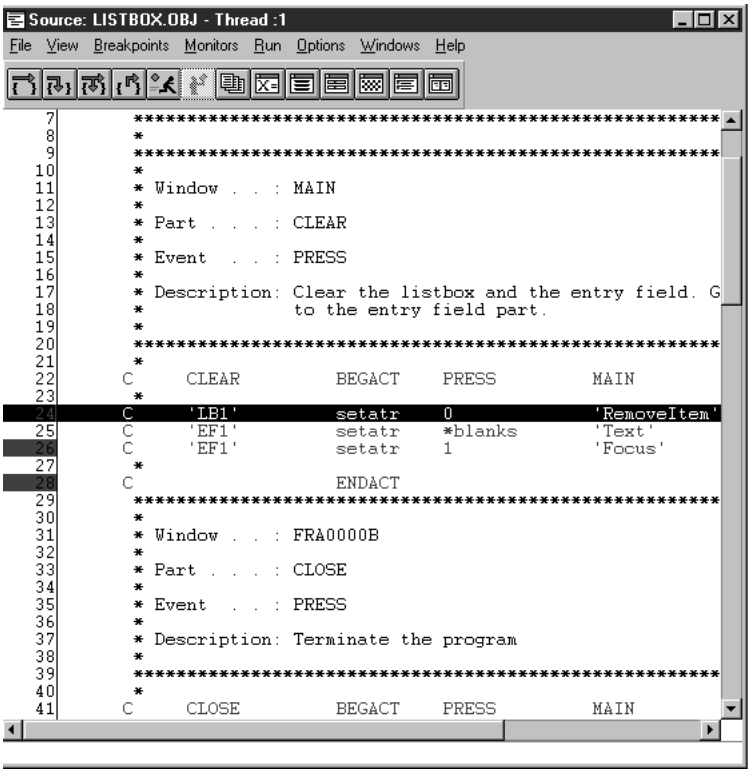

Figure 47. Running with Breakpoints.

Using the Mouse or Keyboard to Start Debug Functions

Most debug functions can be started using the mouse or keyboard. For example, to set a breakpoint location, you double-click mouse button 1 on a line number. The same thing can be accomplished by selecting **Line** from the **Breakpoints** pull-down menu. When you select Line, the Line Breakpoint window is displayed. You must then enter the line number. When you enter the line number and press Enter, the line you selected is highlighted with red.

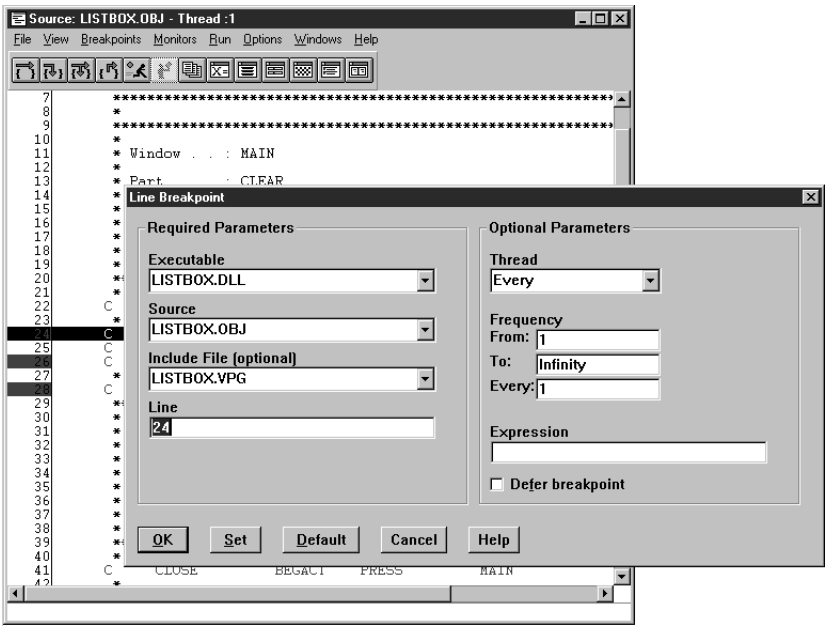

Figure 48. The Line Breakpoints Window.

You can also resume execution of the program in different ways. Do any of the following:

- Press the letter R
- Move the mouse to the **Run** pull-down menu, then select **Run**
- Move the mouse to the run icon on the **tool bar** and single-click **mouse button 1**

Selecting Options from the Tool Bar

The following table lists all the options available on the tool bar and briefly explains each one.

Figure 49. Tool Bar Options.

Icon **Function**

Step over
Executes the current (highlighted) line in the program, but does not enter any called function.

Step into
Executes the current (highlighted) line in the program and enters any called program or function.

Step debug
Executes the current (highlighted) line in the program. The debugger steps over any function for which debug information is not available, and steps into any function for which debugging information is available.

Step return
Automatically executes the lines of code up to, and including, the return statement of the current function.

Run Begins execution of the program at the current (highlighted) line.

Halt Stops execution of the program.

Views Toggles to the next view.

Monitor expression
Displays a variable or expression in a monitor window.

Call stack
Views the active functions of a thread's call stack.

Registers
Displays the threads registers in the register window.

Storage
Displays the contents of storage in the storage window.

Breakpoints
Lists all the breakpoints that have been set.

Debug session control
Displays the debug session control window.

Displaying and Changing Variables, Arrays, and Structures

Displaying a variable, array or other valid VisualAge RPG structure while debugging is a commonly used function. The easiest way to do this is to move the mouse to any specification where fields are allowed and double-click mouse button 1. For example, move the mouse to the conditioning indicator, factor 1, factor 2, result field, and/or the resulting indicators and double-click. This causes the specification's contents to be displayed.

Note: If the variable is an operand for the EVAL operation code, select the variable you want to display by highlighting it with the mouse, then double-click.

If the field or structure you would like to display or change is in view, then the simplest way to display its content is to use the mouse and double-click it. However, if you are dealing with a large program, and you cannot locate a certain variable or structure easily, then **Monitor expression** from the **Monitors** pull down menu (Note that pressing Ctrl-M accomplishes the same thing).

On the Monitor Expression window, as shown in Figure 50, type the expression, field or structure that you would like to display, then press Enter.

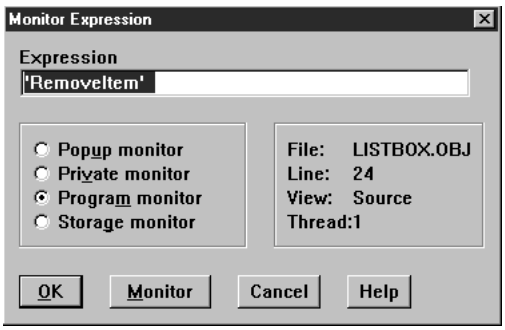

Figure 50. The Monitor Expression Window.

After you press Enter, the VisualAge RPG field or structure is displayed in the Program Monitor window, as shown in Figure 51 on page 234.

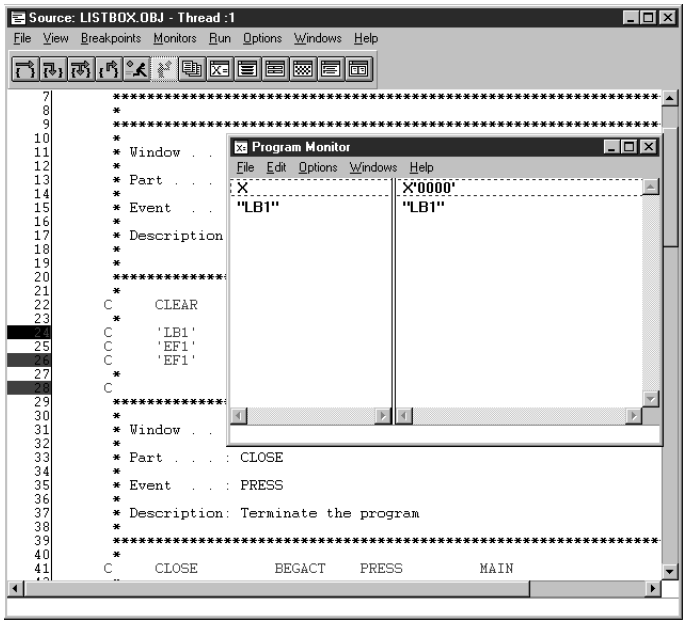

Figure 51. The Program Monitor Window.

Changing the Contents of a Field or Structure

Once you display a field or a VisualAge RPG structure, you can change its contents. To do this, double-click on the value in the Program Monitor window, type the new value, then press Enter.

Changing the Representation

The debugger allows you to change the representation for any displayed variable on the program monitor. Representation types can be decimal, hexadecimal, binary, or string; any valid representation for that variable or structure. To do this, select a variable in the Program Monitor window. Then select a representation from the **Edit>Representation** menu. The contents of the variable is now displayed in the representation you selected.

Changing the Default Representation

Variables have default representation types. For example, a character field would be displayed in the Program Monitor window as characters, not hexadecimal. The debugger allows you to alter this behavior. You have the option of setting the default representation for each data type. To change the default representation for a field, select **Options>Debugger settings>Default data representation>System**. The Default Data Representation window is displayed.

Displaying Pointers and Storage

One of the data types supported by VisualAge RPG is pointers. Figure 52 on page 235 illustrates an example of displaying a pointer value by using the Storage window. Select **Monitor>Storage** to display the Storage window.

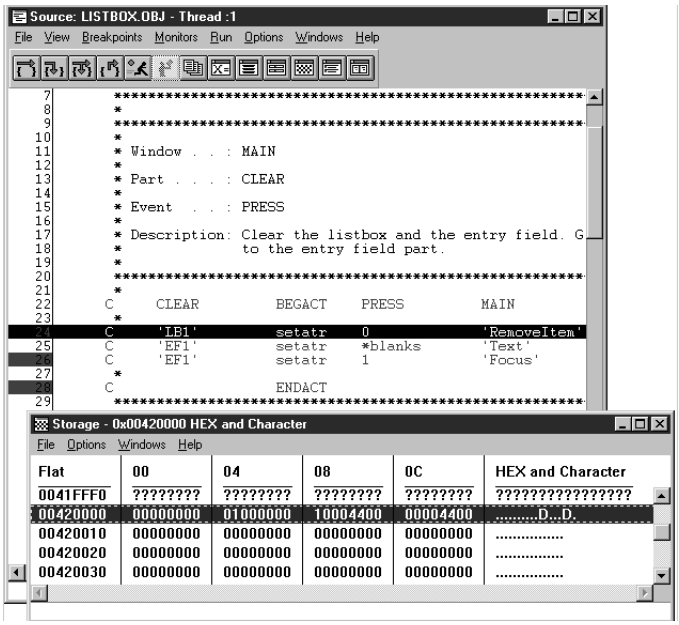

Figure 52. Displaying a Pointer Value.

Changing the Debugger Views

Most of the examples in this section illustrate the VisualAge RPG Source view. The debugger also displays other views: disassembly and mixed view. To change views, select an option from the **View** menu, as shown in Figure 53.

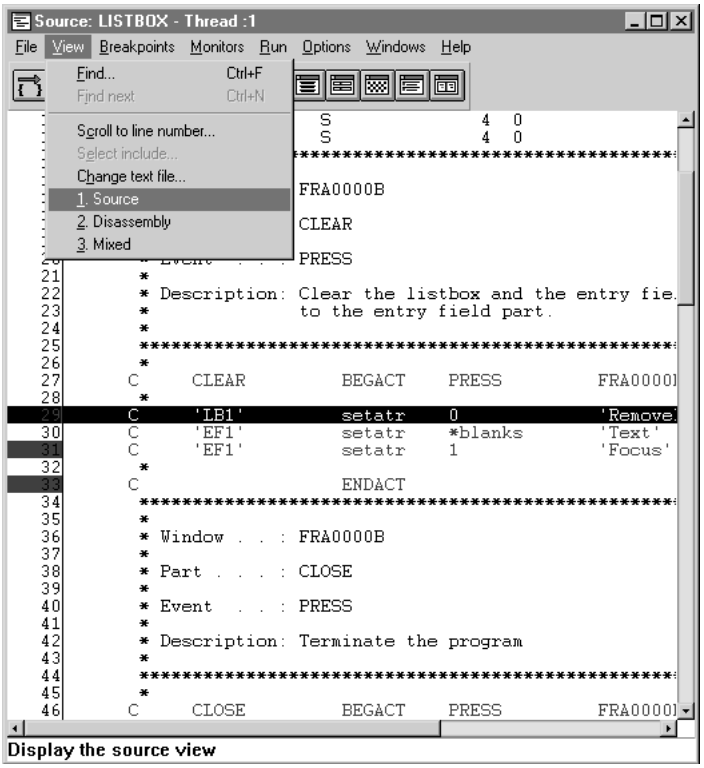

Figure 53. Changing the Debug Views.

Setting Fonts

There are many options available in the debugger that allow you to customize your debug session. For example, you can set your fonts. Figure 54 displays the font window. To display the font window, select **Options>Window settings>Fonts**. In the font window, select the desired font, style, and size, then select OK. The font changes display in your debugging session.

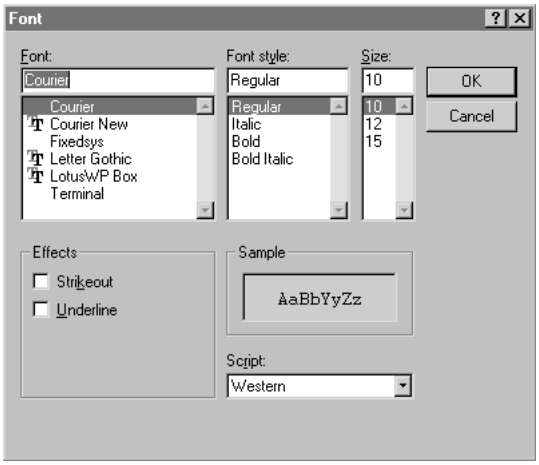

Figure 54. Setting fonts.

Chapter 11. Editing Output

The compiler supports editing capabilities that determine how data is formatted when it is displayed in entry field and static text parts. To edit the output, you can set **edit codes** or **edit words** in the properties notebook for these parts.

Edit codes let you format data according to predefined formats, while edit words let you define your own formatting. You can specify either an edit code or an edit word for a part: you cannot specify both.

Edit codes and edit words can be specified only for numeric entry field and numeric static text parts.

When data from a formatted entry field is read into your program, the compiler strips all editing characters before returning the data to your program.

Note: Edit code entries on the control specification in your application are ignored; they have no effect on the output of these edit codes.

Edit Codes

Several edit codes are supported to format the data into predefined formats. These formats insert the proper thousand and decimal separators, and determine how a negative number is displayed by providing a fixed or floating minus sign or the CR (Credit) symbol.

You can optionally specify asterisk protection or floating currency symbol with the edit codes. If you specify asterisk protection, an asterisk is displayed with each zero that is suppressed. If you specify floating currency symbol, the symbol appears to the left of the first significant digit. The symbol does not display on a zero balance when an edit code is used that suppresses the zero balance.

The actual characters to be used for the thousand and decimal separators and currency symbol are determined by the operating system when the application is run.

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The following table summarizes the supported edit codes and the editing they provide, and provides examples.

Note: The compiler does not support user-defined edit codes. User-defined edit codes are defined and stored on the AS/400 system, and are not available to VisualAge RPG programs.

Table 11. VisualAge RPG Edit Codes

Edit Code	Com-mas	Deci-mal Point	Sign for Negative Balance	Positive Number Example	Negative Number Example	Zero balance
none	No	Yes	Yes	0123456789	0123456789-	
1	Yes	Yes	No Sign	124,567.89	124,567.89	.00
2	Yes	Yes	No Sign	124,567.89	124,567.89	
3	No	Yes	No Sign	124567.89	124567.89	.00
4	No	Yes	No Sign	124567.89	124567.89	
A	Yes	Yes	CR	124,567.89	124,567.89CR	.00
B	Yes	Yes	CR	124,567.89	124,567.89CR	
C	No	Yes	CR	124567.89	124567.89CR	.00
D	No	Yes	CR	124567.89	124567.89CR	
J	Yes	Yes	-(minus)	124,567.89	124,567.89-	.00
K	Yes	Yes	-(minus)	124,567.89	124,567.89-	
L	No	Yes	-(minus)	124567.89	124567.89-	.00
M	No	Yes	-(minus)	124567.89	124567.89-	
N	Yes	Yes	-(floating minus)	124,567.89	-124,567.89	.00
O	Yes	Yes	-(floating minus)	124,567.89	-124,567.89	
P	No	Yes	-(floating minus)	124567.89	-124567.89	.00
Q	No	Yes	-(floating minus)	124567.89	-124567.89	
Y (2.)				1984-12-25		
Z (3.)	No	No	No Sign	1234567	1234567	

Notes:

1. All edit codes suppress leading zeros
2. The Y edit code is used to date fields. The date field should be defined as a numeric field. The output of this edit code is in the form *nnnn-nn-nn*. This format cannot be changed. The date separator character is determined by the operating system when the application is run.
3. The Z edit code removes the + or – sign.

Edit Words

You can use edit words if none of the supplied edit codes meets your editing requirements. An edit word is a template that is applied to your data before it is placed in the part. With edit words you can specify:

- Suppression of leading zeros
- Leading asterisks
- The fixed/floating currency symbol
- The position of thousands and decimal separators.

Note: When you use edit words, make sure that you specify the currency, decimal, and thousands symbols correctly. If the symbols do not match the edit word, you will get improperly formatted output but no runtime error. These symbols are replaced by the runtime operating system values when the application is run.

Parts of an Edit Word

An edit word consists of the body, the status and the expansion. These parts are shown in the following example:

```
 x  x  x  ,  x  x  $  0  .  x  x  &  C  R  *  x  T  O  T  A  L
|                                ||       ||                   |
|-------------body--------------||-status-||----expansion-----|

where BLANK              = x
      CURRENCY SYMBOL    = $
      THOUSAND SEPARATOR = ,
      DECIMAL SYMBOL     = .
```

Body of an edit word

The body is the space for the digits that are transferred from the data field to the part. It begins at the farthest left position of the edit word. It contains a number of blanks plus one zero or asterisk, the total equals the number of digits in the data field to be edited.

The following characters have special meaning when used in the body of an edit word:

Blank A blank is replaced with the digit from the corresponding position of the data field.

Ampersand
An ampersand causes a blank in the edited display.

Zero A zero stops zero suppression. The zero is itself a digit position. Any zeros in the data field to the right of the stop-zero-suppression character are displayed. Each zero that is suppressed is replaced by a blank.

Asterisk
An asterisk instead of a zero can be used as a stop-zero-suppression character. This is called asterisk protection, and each zero that is suppressed is replaced by an asterisk. Any asterisks or zeros to the right of the stop-zero-suppression character are constants, and will be displayed as-is.

Currency Symbol
If you code a currency symbol immediately to the left of the stop-zero-suppression character, a currency symbol is inserted in the position to the left of the first significant digit. It is called a floating currency symbol when it is used in this manner. If you code a currency symbol in the farthest left position of the edit word, it is fixed and is displayed in the same location. It is called a fixed currency symbol.

Thousand Separator and Decimal Separators
Thousand and decimal separators are displayed in the same relative positions in which they are coded in the edit word. All other characters are displayed if they are to the right of significant digits in the edit word. If they are to the left of the high-order significant digit in the edit word, they are blanked out or replaced by an asterisk if asterisk protection is being used.

Status of an edit word

The status positions display the sign of the data. The status continues to the right of the body to either a credit (CR) or minus (-) symbol. These two symbols display only when the field is negative. An ampersand (&) is used for displaying a blank.

Expansion of an edit word

The expansion positions are not changed by the edit operations. The expansion position starts at the first position to the right of the status (or body, if status is not specified). The expansion cannot contain blanks. If a blank is required, use an ampersand in the edit word.

Chapter 12. Using Picture, Sound, and Video Files

The animation control, canvas, graphic push button, image, media, and menu item parts allow you to display images on your windows by specifying a valid image name in the **FileName** attribute.

Valid **Windows** image formats include:

OS/2 and Windows Bitmaps
The file extensions .BMP, .VGA, .BGA, .RLE, .DIB, .RL4, and .RL8 are recognized as OS/2 or Windows bitmaps.

Icon Format
The .ICO file extension is recognized as an icon file.

CompuServe Graphics Interchange Format
The .GIF file extension is recognized as a GIF file.

ZSoft PC Paintbrush Image File Format
The .PCX file extension is recognized as a Paintbrush file.

Microsoft/Aldus Tagged Image File Format
The .TIF and .TIFF file extensions are recognized as TIFF files.

Truevision Targa/Vista Bitmap
The file extensions .TGA, .VST, and .AFI are recognized as Targa/Vista files. This class only supports 8 bit-per-plane and 24 bit-per-plane images.

Amiga IFF/ILBM Interleaved Bitmap Format
The file extensions .IFF and .LBM are recognized as interleaved bitmap files.

X Windows Bitmap
The .XBM file extension is recognized as a X Bitmap file. This class supports X10 and X11 1bpp bitmaps. Some .XBM files with text strings inside look to be sprites or icons and are not supported.

IBM Printer Page Segment
The following file extensions .PSE, .PSEG, .PSEG38PP and .PSEG3820 are recognized as PSEG files. PSEG files are used to include image data in BookMaster documents. PSEG files only contain 1 bit-per-plane, which is always ink on paper, that is, black on white.

Valid **Java** image formats include:
- CompuServe Graphics Interchange Format (GIF)
- Joint Photographic Experts Group format (JPG, JPEG)

In addition, you can add sound and video by using the media part, which supports WAV, .MID, .MPG, .MOV, .DAT, and .AVI files.

When developing a VisualAge RPG application that includes pictures, sound, or video, avoid hard coding the **FileName** attribute for the parts. The user will probably install your application in a different directory than the one in which it was developed.

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To be sure that these files are found at run time, use the **Current directory** string (`.\`): a dot and a backslash followed by the file name. At run time, the file is found in the current directory from which the application is run.

For example, in the properties notebook for a graphic push button, specify the following as the file name for an icon named EXIT.ICO, so that it will be found at run time in the current directory.

```
.\\EXIT.ICO
```

Note: For applications running in Windows, the current directory must be specified in the AUTOEXEC.BAT file.

During build time, you must copy your picture files to the build-time directory to access these files.

Before packaging your application for distribution, copy all associated picture and sound files to the appropriate runtime subdirectory (RT_JAVA or RT_WIN32) of your project, because it is this directory that is packaged and distributed to users. See Part 5, “Distributing Your Application,” on page 413 for instructions on packaging your application.

Creating Icons for Windows

If you have VisualAge for C++ for Windows, you can use the Resource Workshop utility to create Windows icons.

Converting OS/2 Icons to Windows Format

VisualAge RPG includes a utility program to convert OS/2 icons and bitmaps into Windows versions. For details on this utility and its parameters, go to a DOS prompt and type `IBMPCNV -H`.

Chapter 13. Tips for Creating Online Help with IPF

The Information Presentation Facility (IPF) lets you create and manage online help files for your application. You can also use IPF to create tutorials and online documentation. With VisualAge RPG, the online help that you create will be native Windows help.

This section introduces IPF, and gives you some tips for creating online help for your application. For detailed information about using IPF, see *Information Presentation Facility Guide and Reference*(available online). You should also see the online document entitled *IPF Restrictions*. This document provides details on the subset of IPF tags that you are restricted to in a Windows environment.

You can reuse UIM help source from an AS/400 system, as well. See "Reusing UIM Help" on page 222.

Creating Online Help

To add online help for a part in your application:

1. Display the part's pop-up menu.
2. Choose **Help text**. An edit session opens.
3. Type the contextual help text for the part.
4. Tag the help text using the IPF tag language.
5. Save the help by choosing **Save** from the **File** menu.

Using IPF

The source for VisualAge RPG application help modules is in IPF format. IPF enables you to create online information, specify how it will appear on the screen, connect various parts of the information, and provide help information that can be requested by the user. IPF features include:

- A tagging language that formats text, provides ways to connect information units, and customizes windows
- A compiler that creates online documents and help windows
- A viewing program that displays formatted online documents

Supporting Help for Other Languages

You can copy and manually edit the .VPF file using any text editor. Do not, however, do either of the following:

- Modify or remove the number that appears after the `res=` text. That number is the resource identifier, and it is generated by the GUI Designer when you create the help for a part. The resource identifier is used to locate the appropriate help text. If you delete or change a resource identifier, the help text pertaining to it will not be located.
- Remove the heading information. You can replace the heading information with the translated text.

Adding Graphics to Your Online Help

Use the `:artwork.` tag to imbed graphics inside the source files, as required. The graphics must be in bitmap format (.BMP files).

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Deciding What Type of Help to Provide

Users can access help in three different ways within your VisualAge RPG application:

Context-sensitive help
Help information that is adapted to the current context of a choice or part. A user accesses this help by pressing F1 when a choice or part is in focus. You can provide this help via the part's pop-up menu.

Window-level help
Information about the purpose of a window. A user accesses this help by pressing on a help push button. You can provide this help by creating a **Help** push button and adding the associated help information.

Task help
Information about tasks the user can perform with your application. A user accesses this help by hypertext linking to other help information from within a help panel. You can supply this information by creating online information and creating a hypertext link to it from the window-level or context-sensitive help. A hypertext link allows a user to jump from one help panel to another, or from selected text within a help panel to related information.

ToolTip help
Hover help style information about the tools that are available for use. To create this help, go to the 'general' page of a part's properties notebook and type a description of the tool (up to 15 characters) in the entry field. You can also use a message identifier, for example *MSG0001, to specify the help text.

Adding Context-Sensitive Help

To add context-sensitive help for a part, select **Help text** from the part's pop-up menu. This starts an edit session that contains information similar to that shown in Figure 55.

```
:h1 res=01.PSB0000C
:p.Help
```

Figure 55. Edit session for adding online help

The `:h1 res=01.` is a resource identifier that is automatically generated. Do **not** edit this text. Type a heading after this tag that identifies the purpose of the help panel, and type the help text after the `:p.` tag.

Creating a Help Push Button

To create a **Help** push button, select a push button from the parts palette with the right mouse button, move the mouse pointer onto the design window, and right-click again. Select **Help text** from the push button's pop-up menu to edit the help information. Set the **Help Enable** attribute for that push button, and set the **Label** attribute to the word *Help*.

Creating Hypertext Links

To link related pieces of help information so that your users can find the appropriate information quickly and easily, use a link tag in your help text. You can create links to a help panel using a resid or a refid.

For linking to help panel defined with a `id=`:

```
:link reftype=hd refid=search.Search window:elink.
```

For linking to help panel defined with a `res=`:

```
:link reftype=hd res=15433.Search push button:elink.
```

Chapter 14. Tips for Creating and Using Windows Help

One of the features of VisualAge RPG is the ability to create cursor-sensitive help for your applications. You create the help by right clicking the mouse on a part in the design window and choosing **Help text**. This starts the editor. You write the help text using the Information Presentation Facility (IPF) tag language. During the build process, the help source is compiled to create the **HLP** file. The IPF tag language results in a help file with a distinctive OS/2 look. This section explains how you can create true Windows help for your application.

What you Need

You need two tools to create a Windows help file:
- A word processor capable of saving files in **Rich Text Format (RTF)** format
- The Windows help compiler

The help compiler uses a help source file saved in RTF as input. Several word processors, including Lotus WordPro, Microsoft Word, and WordPerfect are capable of saving files in RTF format. Note that the Windows WordPad editor can save files in RTF format. However, this particular RTF format cannot be used to create help files. It does not retain many of the formatting options required by the help compiler to create a help file.

The **Help Compiler Workshop** is a tool available from Microsoft that consists of an IDE for managing your help files, as well as the help compiler. It can be downloaded from the Microsoft help compiler FTP at URL:

```
ftp://ftp.microsoft.com/softlib/mslfiles/hcwsetup.exe
```

There are many tools on the market available, commercially and as shareware, that provide complete help authoring environments.In addition, there a several books available that describe how to use the Help Compiler workshop. Many of these books include a CD-ROM with the help compiler workshop, such as the *Microsoft Windows 95 Help Authoring Kit ISBN1-55615-892-0*.

Steps to creating Windows help

The basic steps to follow to use Windows help in your application are:
1. Establish the **resource id** for each part that will have help.
2. Write the help text.
3. Create the help **project file**.
4. Compile the help file.

Establishing the Resource ID

Every part, such as an entry field, push button, or window, has an identifier assigned to it usually referred to as a **resource ID**. VisualAge RPG assigns resource IDs for you and they cannot be changed. To see the resource ID for a part, right-click on the part in the design window. Select **Properties** to show its properties notebook. The resource Id is the number at the top of the General page. In the following example, it is the number **12** next to the Part ID:

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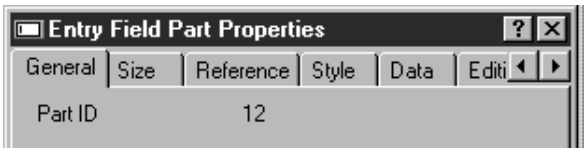

Figure 56. Displaying the Resource ID

During the build process, VisualAge RPG generates a resource ID table entry for each part that you have created help for using the **Help text** menu item from the part's popup menu. The Windows help engine uses this table to determine the resource ID for a part so it can display the correct help. You must create the help text for each part in this way for the part to have Windows help. Currently, VisualAge RPG does not create this table entry automatically for you. If you do follow this process, no help is displayed and no error message is generated.

Writing the Help Text

Before writing the help, you need to know a few Windows help terms. The following files are needed before you can create a Windows help file (HLP extension):

Topic file
: This file contains your help text. Your help project can consist of one or more topic files. Topic files contain one or more **topics**. You create the topic file with your word processor and save it in RTF format (RTF extension).

Project file
: The project file contains information about your help file. It contains such things as which topic files are to be included. The project file is maintained by the Help Workshop IDE. Typically, you do not modify it directly.

Contents file
: If you want a **Contents** tab when the help file is displayed, you must have a contents file. The Contents file is also created and maintained by the Help Workshop IDE.

The following example outlines the basic steps for creating a topic file with one topic. It has the help text for the entry field part. Lotus WordPro is used to create the topic file. When the new document is opened in your word processor, type a title at the top of the page such as *Help for Entry Field*. Following the title, type the body of the help text.

Each topic must have a topic ID. A topic ID is a footnote with the **#** symbol.

Here are the steps for creating the required footnote in WordPro. Follow the steps in your word processor for creating footnotes with the # symbol:

1. Position the cursor just before the topic heading.
2. Select **Create-Footnote/EndNote...**
3. On the Footnotes dialog press **OK**.
4. The cursor will be positioned at the bottom of the document in the footnote section.
5. Type the topic Id: HelpForEF.
6. Position the cursor at the beginning of the topic Id.
7. Right click the mouse and select **Text properties** from the pop-up menu.
8. On the Properties dialog, select the **Bullet and number** tab.
9. Check the **Edit on page** checkbox.
10. Type a **#** character before the topic Id.

11. Close the Text properties dialog.

Your document should look similar to the following. The data following the line is the footnote:

```
#Help for Entry field

This is help for the entry field part.

more stuff ...

_____________________________________

#HelpForEF
```

You can have several topics in a single topic file. Each topic must begin on a new page. Once you complete typing the help text, save your topic file in RTF format.

Creating the Help Project File

Following are the basic steps to create a minimum project file. Start the Microsoft Help Workshop and do the following:

1. Create a new project file by choosing **File-New** and select **New project**. A new project is created.
2. Press the **Files** push button.
3. On the Topic files dialog, press **Add...** and add the topic file you just created. Press **OK** to close the Topic Files dialog.
4. Press the **Windows** push button.
5. On the Window Properties dialog, press **Add** to display the Add a New Window Type dialog.
6. Create a window named **main**, and close all dialogs to return to the Help Workshop.
7. Map the topic Id(HelpForEF) in the topic file to the resource Id for the entry field part(12).
8. Press the **Map** push button.
9. On the Map dialog, press **Add**.
10. When the Add Map Entry dialog appears, type **HelpForEF** in the Topic ID field, and **12** in the Mapped numeric value field. Press **OK**.
11. Press **OK** to close the Map dialog.
12. Save and compile the project file. This will create the help (HLP) file.

Copy the new HLP file to the RT_WIN32 directory of the VARPG project.

Compiling the VARPG Program

During the build process, VisualAge RPG creates a HLP file in the RT_WIN32 directory. This will, of course, overwrite the HLP file you just copied. Also, a RTF file with will be created in the project's source directory. If you have saved your topic file here with the same name, it will be overwritten. To prevent this, open the project's Build Options properties notebook and go to the Help file page. Clear the **Create RTF Help file** check box. Now, VisualAge RPG will not build the help or create the RTF and HLP files.

Each time you add help to a part, you must recompile the VARPG program.

Testing the Help

Start the VARPG application. When the window appears, tab to the entry field and press F1. The help should be displayed in a Windows help window.

You can also display the help as **What's this?** help. To do this, open the properties notebook for the window. On the **Style** page, check the **Context** check box. The Minimize and Maximize button check boxes must be cleared.

To have the help displayed in a pop-window rather than a help window, check the **Popup** choice.

Creating a Contents File

If you want your help to have a Help Topics dialog box, you need to create a **Contents file**. A Contents file is created in the Help Workshop IDE when you select **File-New** and **New contents file**. Name the contents file the same name as the help file, and save it in the same directory.

Chapter 15. Tips for Creating JavaHelp

One of the features of VisualAge RPG is the ability to serve context-sensitive JavaHelp for your VARPG Java applications. (VisualAge RPG currently supports the JavaHelp 1.1 release.) To build and run VARPG Java applications that include JavaHelp, you need:

- A basic knowledge of the HTML 3.2 tags.
- JavaHelp metadata files for your application:
  - Navigational data - table-of-contents file (TOC)
  - HelpSet data - HelpSet and Map files
  - HTML topic files
- A copy of the Java 2 Software Development Kit, Standard Edition (J2SDK) version 1.2, or higher, installed on your workstation. (The J2SDK is available from Sun at URL `http://java.sun.com/products/`)

This section summarizes how to create basic, context-sensitive JavaHelp for your VARPG Java applications. For complete information on the JavaHelp System, see the *JavaHelp System User's Guide*. All JavaHelp documentation is available with the JavaHelp System, which you can download at URL `http://java.sun.com/products/javahelp`.

The following steps summarize how to create and incorporate JavaHelp into your application:

1. Create a HelpSet:
   - Create the HTML topics.
   - Create a HelpSet file.
   - Create a map file.
   - Create a table-of-contents (TOC) file.

     Optionally, you can create an index file and a full-text search database. Refer to the *JavaHelp System User's Guide* for details on these topics and the tools needed to implement search.
   - Compress and encapsulate the help files into a JAR file.
2. After creating your JavaHelp with all required files and packaging them in a JAR file, copy the JAR file to the RT_JAVA subdirectory of your propject.
3. Build and run your project.

The JavaHelp system is file based - topics are contained in files that are displayed in a suitable viewer, one file at a time. It is a good idea to group related topics together to keep them organized and to make it as easy as possible to link the topics together. It is also important to organize topics so they can be easily packaged into a compressed JAR for your application. It is usually best to organize your topics in a folder hierarchy that you can "tear off" and place in the JAR file.

The Video Store Catalog application contains sample JavaHelp files. They are located in the *javahelp* and *help* subdirectories of the *WDSC\samples\vidcust* directory. Use these files as templates for developing your own JavaHelp.

Note: In Java, file and folder names are case-sensitive. Type names exactly as shown in the samples provided.

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Creating a HelpSet File

When JavaHelp is started by your application, the first thing it does is read the HelpSet file. The HelpSet file defines the HelpSet for your application: the set of data that comprises your help system. The HelpSet file includes the following information:

Map file
The map file associates topic IDs with the URL or path name of your HTML topic files.

View information
Describes the navigators used in the HelpSet. The standard navigators are: table of contents, index, and full-text search.

HelpSet title
The name of the top-level TOC folder.

Home ID
The name of the (default) ID that is displayed when the help viewer is called without specifying an ID.

The HelpSet file (filename.hs) is coded in Extended Markup Language (XML) format. The following is an example of a HelpSet file:

```
<?xml version='1.0' encoding='ISO-8859-1' ?>
<!DOCTYPE helpset
  PUBLIC "-//Sun Microsystems Inc.//DTD JavaHelp HelpSet Version 1.0//EN"
         "http://java.sun.com/products/javahelp/helpset_1_0.dtd">

<helpset version="1.0">

  <!-- title -->
  <title>Video Store Catalog - Help</title>

  <!-- maps -->
  <maps>
     <homeID>11</homeID>
     <mapref location="Map.jhm"/>
  </maps>

  <!-- views -->
  <view>
    <name>TOC</name>
    <label>Table Of Contents</label>
    <type>javax.help.TOCView</type>
    <data>VIDCTOC.xml</data>
  </view>

</helpset>
```

Where:

<title> Names the HelpSet. This corresponds to the title of the help window.

<homeID>
Specifies the name of the (default) ID that is displayed when the help is called if an ID is not explicitly specified.

<data>
Specifies the path to the data used by the navigator. In our example, this is the TOC view. The TOC file name is uppercase and the xml extension is lowercase. The TOC file must exist in your help directory.

Creating the Map File

When your application activates JavaHelp, the first thing it does is read the application's HelpSet file. The next thing it does is read the map file listed in the HelpSet file. The map file associates topic IDs with URLs (paths to HTML topic files). By convention, map file names include the *jhm* suffix. The Map file is in XML format.

Following is an example of a map file:

```
<?xml version='1.0' encoding='ISO-8859-1' ?>
<!DOCTYPE map
  PUBLIC "-//Sun Microsystems Inc.//DTD JavaHelp Map Version 1.0//EN"
         "http://java.sun.com/products/javahelp/map_1_0.dtd">

<map version="1.0">
        <mapID target="11" url="help/welcome.htm" />
        <mapID target="18" url="help/catalog.htm" />
        <mapID target="14" url="help/browse.htm" />
        <mapID target="15" url="help/new.htm" />
        <mapID target="16" url="help/top10.htm" />
        <mapID target="17" url="help/search.htm" />
</map>
```

target Specifies the part ID for the VARPG part. The part ID is automatically assigned to the part by the GUI Designer. You can retrieve it from the part's properties notebook.

url Specifies the path to the HTML topic file containing the help text. The path can be relative or absolute.

Creating the TOC File

The table of contents (TOC) file describes to the TOC navigator the content and layout of the TOC. The TOC file is in XML format. Following is a small example of a TOC file:

```
<?xml version='1.0' encoding='ISO-8859-1'  ?>
<!DOCTYPE toc
  PUBLIC "-//Sun Microsystems Inc.//DTD JavaHelp TOC Version 1.0//EN"
         "http://java.sun.com/products/javahelp/toc_1_0.dtd">
<toc version="1.0">
<tocitem text="Video Store Catalog - help">

   <tocitem text="Welcome" target="11"/>
   <tocitem text="Help" target="22"/>
   <tocitem text="Browse" target="14"/>
   <tocitem text="New" target="19"/>
   <tocitem text="Top 10" target="20"/>
   <tocitem text="Search" target="21"/>

</tocitem>
</toc>
```

Where:

tocitem
The first TOC entry specifies the title for your table of contents. (You can nest TOC entries within a higher-level entry.)

text Specifies the text to use for subsequent TOC entries.

target Specifies the ID of the HTML topic to display when the user chooses this entry in the TOC. The ID corresponds to the part ID identified in the map file.

Creating the JAR File

Once all necessary help files are created, use the jar command to encapsulate and compress your files. Your jar file name must be as follows:

```
SOURCE_FILE_NAMEHS
```

Where the SOURCE_FILE_NAME part is the name specified in the *Source file* field on the Save as Application - VisualAge RPG window. The file name must end with HS and be in uppercase. The jar extension is lowercase.

Issue the command from the top most directory containing your help hierarchy. For example, if your help directory structure is as follows:

```
javahelp (directory)
    Map.jhm
    CATALOG.hs
    VIDCTOC.xml

    help (subdirectory)
        browse.htm
        catalog.htm
        new.htm
        search.htm
        top10.htm
        welcome.htm
```

Issue the jar command from the javahelp directory as follows:

```
jar -cf VIDCUSTHS.jar *.*
```

Copy the resultant jar file into the RT_JAVA subdirectory for your project. Build and run the project with the Java option (**Build>Java** or **Run>Java**, respectively.).

Chapter 16. Working with Messages

You can create, view, edit, and delete messages for your VARPG application.

You can view and delete existing messages directly from the Define Messages window. Use the Define Messages window to access the Edit Message window, from which you can create a new message or modify an existing one.

Messages fall into two groups in VARPG: those that you cannot reference in your code at run time, and those that you can.

The first group consists of a label-type message that is used to replace a substitution label; for example, on a push button or a window.

The second group contains four types of messages: Action, Critical, Information, and Warning. These messages can be displayed on a message window or in a message subfile part. They can be used to dynamically update text in your interface at run time; for example, to display installation progress messages.

Defining Text for Substitution Labels

To associate text with a substitution label:

1. Ensure that you have defined a substitution label on the part. Follow the procedure described in the online help.
2. Choose **Project→Define messages** from the GUI Designer. The Define Messages window opens.
3. Select a label-type message from the list that is displayed.
4. Choose the **Edit** push button. The Edit Message window opens displaying the label you selected.
5. In the **Message** field, type the text to be substituted for the label
6. Select **Save** to keep your changes, or **Cancel** (or double click in the window's system menu) to discard them.

Note: When sizing a part in the GUI Designer that has a substitution label, keep in mind that translated text may be longer than the original.

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Creating a New Message

To create a new message:

1. Choose **Project→Define messages** from the GUI Designer. The Define Messages window opens.
2. Select **Create**. The Edit Message window opens.
3. In the **Message Alias** field, type a string up to 10 characters long. It must not contain blanks. Your code can use the message alias instead of the message ID to display the message.
4. Select a message type from the **Type** drop-down box. There are four types to choose from:

   Message Type
   Meaning

   Action
   Use this type of message for situations in which the user must take **some** action to correct the situation or choose an alternative action.

   Critical
   Use this type of message for situations in which the user must take **immediate** action to correct the situation or choose an alternative action.

   Information
   Use this type of message for situations in which you simply want to inform the user about something; but the user does not have to perform any action.

   Warning
   Use this type of message when the user can continue the original request without modification, but should be aware of the existence of some situation.
5. Type the message text in the **Message** field.
6. If you want to provide help for the message, type it in the **Message Help** field.

   When you create message help and use the DSPLY operation code to display the message, a **Help** push button will appear at the bottom of the message window. When the user clicks on this push button, the help text will be displayed as additional information.
7. Select the **Moveable** check box if you want the user to be able to move the message to the background and continue with other tasks before taking action with the message.
8. From the **Buttons** drop-down box, select what combination of push buttons you want to appear at the bottom of the message window:

   Choice Buttons That Will Appear

   abortRetryIgnoreButton
   Abort, Retry and Ignore

   okButton
   OK

   okCancelButton
   OK and Cancel

   retryCancelButton
   Retry and Cancel

yesNoButton
Yes and No

yesNoCancelButton
Yes, No and Cancel

9. Select a default push button by selecting the **Button 1**, **Button 2**, or **Button 3** radio button. When the message window is displayed and the user presses the Enter key, the action associated with the default push button is performed.

   For example, if you selected enterCancelButton from the **Buttons** drop-down and you want the default push button to be Cancel, you would select the **Button 2** radio button.
10. Select **Save** to keep the message, or **Cancel** to discard it.

Note: Message identifiers (message IDs) range from MSG0001 to MSG9999, and are assigned by VisualAge RPG. When all message IDs in the range are used, VisualAge RPG posts an error when you try to create a new message, and no new message can be created until you delete one. After you delete a message, you can create a new message that uses the ID of the deleted one.

Editing a Message

To edit a message:
1. Select **Project→Define messages** from the GUI Designer. The Define Messages window appears.
2. Select a message from the list that is displayed. If you cannot find the message you want, follow the instructions in "Finding a Message."
3. Choose **Edit** from the Define Messages window. The Edit Message window opens, displaying the message you selected.
4. Change the message alias, type, text, help or message window information.
5. Select **Save** to keep your changes, or **Cancel** to discard them.

Deleting a Message

To delete a message:
1. Choose **Project→Define messages** from the GUI Designer. The Define Messages window opens.
2. Select a message from the list that is displayed. If you cannot find the message you want, follow the instructions in "Finding a Message."
3. Choose the **Delete** push button.

Finding a Message

Here are some tips for finding a message:
- If you know what the exact message ID is, use the **Sort by Message ID** feature of the Define Messages window. The messages appear in ascending order of message ID.
- If you know what type of message you are looking for, use the **Sort by Type** feature of the Define Messages window. The messages are sorted in ascending order of message ID within the following groups:
  1. Messages you can set at run time:
     a. Information
     b. Warning
     c. Action
     d. Critical

2. Messages you cannot set at run time (substitution labels).

You can move through the list of messages using either the arrow keys or the scroll bars. If the list is long, scrolling is the fastest way to find what you are looking for.

Using Messages with Logic

It is common practice to display messages in message windows at run time. Once a message is created, one way to display it is to use the DSPLY operation code and the message subfile part's **AddMsgID** attribute.

For information on the **AddMsgID** attribute, see the *VisualAge RPG Parts Reference*, SC09-2450-05 .

You can use the MSGDATA and MSGNBR keywords on the definition specification to define messages with substitution variables. A substitution variable is defined when you create the message by typing a percent (%) character followed by a numeric value (for example, *%1 %2 %3*). The substitution variable is replaced by the corresponding field defined in the MSGDATA keyword. For example, %1 would be replaced by the first field defined in MSGDATA, %2 by the second field defined in MSGDATA, and so on. The MSGNBR keyword must contain an 8-character message identifier; for example, *MSG0001.

To use message substitution on the DSPLY operation code, define a message data type on the D specification. For example:

```
DName++++++++++ETDsFrom+++To/L+++IDc.Keywords++++++++++++++++++++++++++
 *
D notFound        M                   MSGNBR(*MSG0001)
D                                     MSGDATA(cusno: file)
 *
```

The fields CUSNO and FILE are defined elsewhere in the program. Assume that the message text for message *MSG0001 is:

```
Customer number %1 was not found in file %2.
```

To display the message with the DSPLY operation and have substitution done, code the following on the C specification:

```
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq
C     notFound      DSPLY                   rc                9 0
```

For more information on the DSPLY operation code, see the *VisualAge RPG Language Reference*, SC09-2451-04.

Translating Message Files

You do not have to recompile your application to incorporate translated messages.

You can have more than one message file in a runtime directory, by assigning different file extensions to each. For example, an English version of the compiled message file could be named SAMPLE.ENG and a German version could be named SAMPLE.GER. You can instruct the user to rename the appropriate message file to SAMPLE.MSG before running the application.

Manually Changing Message Files

You can manually edit the .TXM ASCII file for translation purposes. This file contains the messages you created for your application. It is created in the source directory that is specified when the application is created.

An example of the record layout of the file is shown in Figure 57.

```
MSG
MSG0001I:The file was saved to your current working directory.
MSG0002W:Another user already has this file open for editing.
```

Figure 57. Sample record layout for a TXM file

Make sure that you edit only the text that appears after the colon (:) in the record layout.

The first record identifies the message prefix, and the following records each represent a message in the application.

Each message has a message prefix, *MSG*; a four-digit identifier or ID number; and a letter describing the type of message. In our example, message number 1 is an information message, and message number 2 is a warning message.

Do **not** do any of the following:

- Modify the message ID. Changing message IDs will cause unpredictable results. Without a message ID, your message cannot be displayed.
- Add a message. The message style will not be defined, and the message will never display in the Define Messages window.
- Delete a message. The Define Messages window will still display everything about the message except its message text.

Using Messages as Labels

You can set the label for any part that has a LABEL attribute from the message text in a message file. Any label with the prefix '*MSG' indicates the message text from a message file. In the example in Figure 58, the label for the push button PB1 is set with the text from message number 0001 in the message file.

```
C    'PB1'      SETATR   '*MSG0001'    'Label'
```

Figure 58. Dynamically setting a part label from a message file

If the message number cannot be found in the component message file, then the application searches the message file indicated by the *component MsgFile attribute for the message number. If the message number does not exist in either message file, then the message identifier (in this example, MSG0001) appears as the label text.

Chapter 17. Communicating Between Objects

With VisualAge RPG, you can perform various kinds of communications between objects.

Part to Part
You can link parts in VisualAge RPG so that one part notifies another that it has changed, and the recipient part issues an event when it is notified of this change.

VisualAge RPG application to other PWS applications
You can enable your application to exchange information with another application that supports the DDE protocol. A VisualAge RPG application can be either the client or the server in the exchange. For information on the client function, see "DDE Client" on page 74. The server function is described in this section.

Component to Component
You can enable one component to communicate with another.

You can also use operation codes to do the following:
- Call local functions
- Call local programs
- Start and stop components
- Call remote programs

This section provides helpful tips for each type of communication, and gives examples.

Linking Parts

The following parts can be linked using VisualAge RPG:
- Check box
- Entry field
- Image
- List box
- Media
- Media panel
- Slider
- Timer

A part that notifies another part when it changes is called the **source** part, and the part that is notified of this change is called the **target** part.

One way to set up communication between a source part and a target part is to use the Link page of the source part's properties notebook. In the fields provided, type the name of the target part and the name of the window in which it resides. If you want the target to issue a **Link** event when it is notified by the source part, select the **Enable notify target** check box.

Alternatively, you can set up the communication link by setting the **AddLink** attribute and the target in the form *WindowName*|*PartName*. If you want the target to issue a **Link** event, set the **AllowLink** attribute to *1*. Figure 59 on page 266

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shows sample code used to link a media panel part, MMP1, to a media part, AUDIO1.

```
 *
C     'MMP1'        SETATR    'WIN2|AUDIO1'  'AddLink'
C     'MMP1'        SETATR    1              'AllowLink'
 *
```

Figure 59. Sample code showing one part linked to another

Note: You can set only one link for a source part in the GUI Designer, but you can set multiple links in your code.

Using a VisualAge RPG Application as a DDE Server

Any VisualAge RPG application can act as a server in a dynamic data exchange (DDE) conversation.

Parts that can be a source of a LINK event can produce DDE data. A DDE client part can obtain data from a component of the same application or a different application. For more information about the DDE client part, see "DDE Client" on page 74.

For example, assume that you are building an application called CLIENT. It consists of a window called WINDOW_C, a DDE client part called DDECLI_C, and a static text part called STTEXT_C.

Suppose the application needs data from a server application called SERVER. This server application has a window called WINDOW_S and an entry field part called ENTRY_S. Whenever the value in the entry field of the server application is changed, the static text part of the client application is updated to reflect the change.

To establish a hot link between the client and server applications, you would specify the following attributes of the DDECLI_C DDE client part in the client application:

AppName

This is the name of the server application: SERVER.EXE.

Topic

This is the name of the server component, followed by a vertical bar, followed by the component instance name. For VisualAge RPG, in most cases the component name is the same as the component instance name, and also the same as the executable name. For this example, the component name is SERVER|SERVER.

Item

This is the name of the server part. For VisualAge RPG programs, this is the window name, followed by a vertical bar, followed by the part name. In this example, the item attribute value is WINDOW_S|ENTRY_S.

DDEAddLink

This is the name of the client part. It consists of the window name, followed by a vertical bar, followed by the part name. In this example, the **DDEAddLink** attribute is WINDOW_C|STTEXT_C.

DDEMode

Set **DDEMode** to *1* to begin the conversation and initiate the hot link between the server and the client. To terminate the conversation, set **DDEMode** to *2*. This signals the **Terminate** event to the client application.

Communicating Between Components

Components are projects in VisualAge RPG. They represent one or more application windows that were created with the GUI Designer. An example is a window that prompts a user to enter the name of an image file, and then displays the image. To enable one VisualAge RPG component to communicate with another, use a component reference part. For more information, see "Component Reference" on page 65.

Making Local Calls

This section discusses local calls you can make using these operation codes:

Operation Code
Purpose

CALLB
Calls a local function. The function can be in an object code file (OBJ) or exported from a dynamic link library (DLL).

CALLP
Calls a local program or function (procedure) . The function must be exported from a dynamic link library (DLL). For more information, see "Using Multiple Procedures" on page 274. Using CALLP is preferable to using CALLB.

START
Starts a new component in the application or calls a local program.

Using the CALLB Operation

Use the CALLB operation code to call a function from your VisualAge RPG application. If you are linking to an OBJ that was compiled in a language other than RPG, make sure that the runtime environment for the compiler is correctly initialized and terminated (see the compiler documentation for more information).

The following examples illustrate the different ways that you can call a C function using CALLB. Figure 60 on page 268 contains the sample C function that is called.

```
#include <stdio.h>
 *
/*The following two lines are required only if you compile */
/*the OBJ with the IBM C/C++ compiler.  These lines  */
/*are not required if the function is exported from a DLL. */
int  _CRT_init(void);
void _CRT_term(void);
 *
/* print the str and age parameters to a file */
void MYFUNC(char *str, int *age) {
   FILE *fp;
   int j;
 *
/*The following line is required only if you compile       */
/*the OBJ with the IBM C/C++ compiler.  This line    */
/*is not required if the function is exported from a DLL.  */
   _CRT_init();
  *
   fp=fopen("myfunc.log", "a");
  *
   /* print the character data to a file*/
   for (j=0; j<10; ++j) {
      fprintf(fp, "%c", str[j]);
   }
  *
   /* if an age is given, print the age */
   if ( age == NULL ) {
      fprintf(fp, "no age is given\n");
   } else {
      fprintf(fp, "num = %d\n", *age);
   }
  *
   fclose(fp);
  *
/*The following line is required only if you compile       */
/*the OBJ with the IBM C/C++ compiler.  This line    */
/*is not required if the function is exported from a DLL.  */
   _CRT_term();
}
```

Figure 60. Sample C function, MYFUNC

Calling functions using named constants or literals

The following examples illustrate how to call a function using a named constant or literal:

```
     DConst1           C                   CONST('MYFUNC')
     Dwilma            s             80a   inz('mydata')
     Dage              s              9b 0 inz(32)
      *
      *
     C     *inzsr        begsr
     c*************************************************************************
     c***********  ***   CALLB in VRPG  with a PLIST  ***  ******************
     c*************************************************************************
     C     myplist       plist
     C                   parm                    wilma
     C                   parm                    age
     C                   CALLB     Const1        myplist
     C                   seton                                          lr
     C                   endsr
```

Figure 61. Calling functions using a named constant

```
 *
Dwilma            s             80a   inz('mydata')
Dage              s              9b 0 inz(32)
C     *inzsr        begsr
C                   callb     'MYFUNC'
C                   parm                    wilma
C                   parm                    age
C                   seton                                        lr
C                   endsr
```

Figure 62. Calling library functions using a literal

Calling functions using a procedure pointer

The following example illustrates how to call a function using a procedure pointer. If a procedure pointer is used with CALLB, then the *ROUTINE field in the program status data structure (PSDS) is not updated with the name of the function being called. The field is set to blanks.

```
 *
Dp2               s               *   procptr inz(%paddr('MYFUNC'))
Dwilma            s             80a   inz('mydata')
Dage              s              9b 0 inz(32)
C     *inzsr        begsr
C                   callb     p2
C                   parm                    wilma
C                   parm                    age
C                   seton                                        lr
C                   endsr
```

Figure 63. Calling functions using a procedure pointer

Calling functions without the required parameters

The following example illustrates how to call a function with less than the required number of parameters. Use the *OMIT parameter which maps to a NULL pointer.

```
 *
Dp2               s               *   procptr inz(%paddr('MYFUNC'))
Dwilma            s             80a   inz('mydata')
Dage              s              9b 0 inz(32)
C     *inzsr        begsr
C                   callb     p2
C                   parm                    wilma
C                   parm                    *OMIT
C                   seton                                        lr
C                   endsr
```

Figure 64. Calling functions without the required parameters

Calling Local Programs using CALLP

Use CALLP to make calls to local programs synchronously. This means that the called program completes execution before the VisualAge RPG statement following CALLP is executed.

Each program that you call using CALLP requires a prototype. The prototype defines the system name of the called program and the number and types of parameters that the program is expecting. Specify this prototype using the PR type definition specification. This specification consists of:

Columns	Description
6	D
7-21	Name of the program to be used in the VisualAge RPG program
24-25	PR
44-80	keyword

Use the CLTPGM keyword with the system name of the program as a parameter.

If the program expects parameters, use one definition specification for each parameter immediately after the PR definition specification. These definition specifications should consist of the name, length, and type of parameter. Specify the precision of numeric parameters. Always specify the VALUE keyword. You can also specify the ASC, DATFMT, DESC, DIM, LIKE, NOOPT, OPTIONS, and TIMFMT keywords on your parameter definitions.

Figure 65 defines pgm1 to VisualAge RPG. One parameter can be passed to the program.

```
D pgm1              PR                  CLTPGM('testprog')
D  parm1                           20A  VALUE
```

Figure 65. Specifying definition specification parameters when calling local programs

In Figure 66, the CALLP operation code calls pgm1 with parameters f1d1 and 22.4.

```
C                   CALLP       pgm1(f1d1:22.4)
```

Figure 66. Calling a local program using CALLP

For more information on procedures, see "Using Multiple Procedures" on page 274.

Calling Local Programs using START

When you use the START operation code to call a program, VisualAge RPG does not wait for the called program to finish executing, but makes the call and then continues. From that point on, the called program executes independently of the VisualAge RPG program that called it.

When using START, you do not have to prototype local programs.

F2 can be a character literal, a named constant, or a variable name.

If F2 is a character literal, it is assumed to be a component. If it is a constant name and you specify LINKAGE(*CLIENT) on the definition of the constant, it is assumed to be a local program. See Figure 67 on page 271.

```
D test1              C                   'component'
D test2              C                   'testprog'   LINKAGE(*CLIENT)
 *
*To start a component:
C                    START               'xxx'
 *
*To start a component:
C                    START               test1
 *
*Starts local program testprog.exe:
C                    START               test2
```

Figure 67. Example using START to call local programs

If F2 is a variable name, it is assumed to be the component name unless you define the variable on a definition specification with LINKAGE(*CLIENT) specified. Any variable defined in this way can be used like any other RPG field. In Figure 68, the first START operation code will attempt to start a component, and the second START operation code will attempt to start a local program.

```
D name1              S             20A
D name2              S             20A        LINKAGE(*CLIENT)
 *
C                  START         name1
C                  START         name2
```

Figure 68. Defining variable names for the START operation code

START can still have a PLIST specified in the result field, or it can be followed by a list of PARMS. These PARMS are passed to the component or local program.

Restrictions for CALLP and START

Note these restrictions when using CALLP and START operation codes with local programs:

- The PATH environment variable is used to find the local program if the program name is not specified with a full path name.
- The program can normally have a maximum of 20 parameters. In some cases, this maximum is less than 20 because the command string must not exceed 1024 bytes. (The command string consists of the program name and the parameters converted to characters.)
- Pointers and procedure pointers are not allowed as parameters. Everything must be passed by value.
- When you use START with an error indicator to call local programs, the error indicator is set to ON if the local program cannot be started.
- LINKAGE(*SERVER) is not valid with the START operation code.
- When specifying the name of a program to call, include the extension if it is other than EXE. If you do not provide an extension, EXE is assumed. For example,

  CLTPGM('superc2')
  Calls SUPERC2.EXE

  CLTPGM('rexxpgm')
  Calls REXXPGM.EXE

  CLTPGM('rexxpgm.cmd')
  Calls REXXPGM.CMD

  This applies when specifying the program name as a named constant for START, or when passing the program name as a variable.

Starting Components using START

Use the **START** operation code to start a new component in the application, and the **STOP** operation code to terminate its execution. For a detailed description of the syntax for these two operation codes, see *VisualAge RPG Language Reference*.

The following section describes the behavior of START and STOP with your application's components.

Starting a Component

The START operation code starts a new component in the application. When the operation is performed, both the starting and the started components, together with any other active components in the application, are ready to receive user actions on all the parts currently enabled by all the components.

The START operation code is similar to the CALL operation code in the following ways:

- Parameters can be passed to a component.
- Parameters are mapped to the parameters in the *ENTRY PLIST of the target component.
- In the source component, factor 2 of the PARM operation code is copied to the result field of the same PARM operation code. When control returns to the source component, the result field is copied to factor 1.
- In the target component, the result field is copied to factor 1. When control returns to the source component, factor 2 is copied to the result field if the target component completes a successful startup.
- No checks or conversions are performed on the parameters.

The START operation code is different from the CALL operation code in the following ways:

- The terms **called** and **calling** are used with the CALL operation code. A **called program** is a program whose execution is requested by another program. A **calling program** is a program that requests the execution of another program. With the START operation code, the terms **target** (called) and **source** (calling) are used.
- CALL invokes a program, executes it, then returns back to the calling program with factor 1, factor 2, and the result field copied as described above. START initializes a component, executes its *INZSR, and returns to the source component with factor 1, factor 2, and the result field copied as described above. The difference is that with the START operation code, factor 2 in the target program is copied to the result field at the end of the *INZSR (if *INZSR is successful), not at the end of the program.
- Once the START operation has finished initializing the target component, the action subroutine in the source component continues executing, and the target component remains active with its action subroutines enabled to receive events.
- Since parameters are passed by address, any parameters that are passed can be accessed by both the source and target components after the initial START has ended. This means that both the source and target components can continue to share information using the parameter fields.

Terminating a Component

The STOP operation code terminates the execution of a component. If you do not specify the component name in factor 2, the component that is currently running is terminated. When a component is terminated, any child components that it may have started are terminated first.

When a STOP operation is performed that affects the currently executing component, operations following the STOP are not executed. In other words, the result of a STOP is immediate. For example, if COMPA starts COMPB, and COMPB is the component that is currently executing and it issues a STOP for COMPA, COMPB terminates first, followed by COMPA. No operations following the STOP are performed.

Terminating a component with a STOP is considered normal termination, and the *TERMSR is invoked for any final user processing.

Calling Remote Programs

This section discusses how your VisualAge RPG application can call an iSeries 400 program, and how an RPG application running on an iSeries 400 server can call a VisualAge RPG application.

Calling iSeries 400 Programs

Before your application can call an iSeries server program, you must set up the server.

The name of the called program can be either the iSeries server program name (optionally library-qualified) or an override name. You can define the program override using the Program page of the Define iSeries Information notebook. See "Notebook Considerations" on page 193 for information about what happens if the notebook pages do not contain an override name for the data area.

Table 12 and Figure 69 on page 274 illustrate how to call an iSeries program using an override name. The program in Figure 69 on page 274 calls MYLIB/LOOKUP on SERVER01.

Table 12. Enter this information on the Program page

Program override name:	REMPGM
Remote program name:	MYLIB/LOOKUP
Server alias name:	SERVER01

```
 ********************************************************************
 *                                                                  *
 * Program ID . . : rcallex.vpg                                     *
 *                                                                  *
 * Description  . : Code segment to call a remote program on the    *
 *                  AS/400.                                         *
 *                                                                  *
 ********************************************************************
 *
 * REMPGM is the remote program alias name
D as400pgm        S              6A   INZ('REMPGM') LINKAGE(*SERVER)
 * The following variables are parameters that are passed to the
 * remote program
 *    student_id   - input
 *    name         - output
D student_id      S              6S 0 INZ(32533)
D name            S             20A
 ********************************************************************
 *                                                                  *
 * Window . . : WIN1                                                *
 *                                                                  *
 * Part . . . : PSB0000C                                            *
 *                                                                  *
 * Event  . . : PRESS                                               *
 *                                                                  *
 * Description: Call a remote program on the AS/400 to get the name *
 *              of the person associated with a student id.         *
 *                                                                  *
 ********************************************************************
 *
C     PSB0000C      BEGACT    PRESS         WIN1
C                   CALL      as400pgm
C                   PARM                    student_id
C                   PARM                    name
C                   ENDACT
```

Figure 69. Calling an iSeries 400 program

Note: If the program on the iSeries server contains a workstation file, it will fail when the system attempts to open it. Since the remote call command is done through the DDM server, the display device is unknown to workstation data management. A technique you can use is to create the workstation file on the iSeries server with the Display Device value set to the name of the session (OMXxxxx) and set the Maximum Number of Devices parameter to a value greater than 1. This will allow parameters to be passed to the iSeries server program. Do not try to explicitly acquire the session with an ACQ statement. This will cause a conflict to occur which results in an error. You still cannot acquire any 5250 emulator display device on your workstation, because it will result in a deadlock that can only be ended by rebooting the workstation.

Starting Workstation Programs from the iSeries server

If you have an RPG application running on the server and would like to start a VisualAge RPG application on a Windows workstation, use the STRPCCMD command.

Using Multiple Procedures

The ability to code more than one procedure greatly enhances your ability to code a modular application.

A VisualAge RPG program consists of one or more modules. A procedure is any piece of code that can be called with a bound call. VisualAge RPG has two kinds of procedures: a main procedure and a subprocedure. A main procedure is a procedure that can be specified as the program entry procedure and receives control when it is first called. Note that a main procedure is only produced when creating an EXE.

A subprocedure is a procedure that is specified after the main source section. A subprocedure differs from a main procedure primarily in that:
- Names that are defined within subprocedure are not accessible outside the subprocedure.
- The call interface must be prototyped.
- Calls to subprocedures must be bound procedure calls.
- Only P, D, and C specifications can be used.

Subprocedures can provide independence from other procedures because the data items are local. Local data items are normally stored in automatic storage, which means that the value of a local variable is not preserved between calls to the procedure.

Subprocedures offer another feature. You can pass parameters to a subprocedure by value, and you can call a subprocedure in an expression to return a value.

Prototyped Calls

To call a subprocedure, you must use a prototyped call. You can also call any program or procedure that is written in any language by using a prototyped call. A prototyped call is one where the call interface is checked at compile time through the use of a prototype. A prototype is a definition of the call interface. It includes the following information:
- Whether the call is bound (procedure) or dynamic (program)
- How to find the program or procedure (the external name)
- The number and nature of the parameters
- Which parameters must be passed, and which are optionally passed
- The data type of the return value, if any (for a procedure)

The prototype is used by the compiler to call the program or procedure correctly, and to ensure that the caller passes the correct parameters. Figure 70 shows a prototype for a procedure FmtCust, which formats various fields of a record into readable form. It has two output parameters.

```
 * Prototype for procedure FmtCust  (Note the PR on definition
 * specification.)  It has two parameters.
D FmtCust         PR
D  Name                         100A
D  Address                      100A
```

Figure 70. Prototype for FmtCust Procedure

To produce the formatted output fields, FmtCust calls a procedure NumToChar. NumToChar has a numeric input parameter that is passed by value, and returns a character field. Figure 71 on page 276 shows the prototype for NumToChar.

```
 * Prototype for procedure NumToChar
 * The returned value is a character field of length 31.
D NumToChar         PR            31A
 * The input parameter is packed with 30 digits and 0 decimal
 * positions, passed by value.
D   NUMPARM                       30P 0   VALUE
```

Figure 71. Prototype for NumToChar Procedure

If the program or procedure is prototyped, you call it with CALLP or within an expression if you want to use the return value. You pass parameters in a list that follows the name of the prototype, for example, *name (parm1 : parm2 : ...)*.

Figure 72 shows a call to FmtCust. Note that the names of the parameters, shown in Figure 70 on page 275, do not match those in the call statement. The parameter names in a prototype are for documentation purposes only. The prototype serves to *describe* the attributes of the call interface. The actual definition of call parameters takes place inside the procedure itself.

```
C                   CALLP     FmtCust(RPTNAME : RPTADDR)
```

Figure 72. Calling the FmtCust Procedure

Using prototyped calls you can call (with the same syntax):
- Programs that are on the system at run time
- Exported procedures in other modules
- Subprocedures in the same module

In order to format the name and address properly, FmtCust calls NumToChar to convert the customer number to a character field. Because FmtCust wants to use the return value, the call to NumToChar is made within an expression. Figure 73 shows the call.

```
 *---------------------------------------------------------
 * CUSTNAME and CUSTNUM are formatted to look like this:
 *     A&P Electronics     (Customer number 157)
 *---------------------------------------------------------
C                   EVAL      Name = CUSTNAME + ' '
C                               + '(Customer number '
C                               + %trimr(NumToChar(CUSTNUM)) + ')'
```

Figure 73. Calling the NumToChar Procedure

The use of procedures to return values, as in the above figure, allows you to write any user-defined function you require. In addition, the use of a prototyped call interface opens up a number of options for parameter passing.
- Prototyped parameters can be passed in several ways: by reference, by value (for procedures only), or by read-only reference. The default method for RPG is to pass by reference. However, passing by value or by read-only reference gives you more options for passing parameters.
- If the prototype indicates that it is allowed for a given parameter, you may be able to do one or more of the following:
  - Pass *OMIT
  - Leave out a parameter entirely
  - Pass a shorter parameter than is specified (for character and graphic parameters, and for array parameters)

Procedure Considerations

- You cannot define return values for a main procedure. Parameters must be passed by value.
- A main procedure is only contained within an EXE. you specify that its parameters be passed by value.
- Any of the calculation operations may be coded in a subprocedure. However, all files must be defined globally, so all input and output specifications must be defined in the main source section. Similarly, all data areas must be defined in the main procedure, although they can be used in a subprocedure.
- The control specification can only be coded in the main source section since it controls the entire module.
- A subprocedure can be called recursively. Each recursive call causes a new invocation of the procedure to be placed on the call stack. The new invocation has new storage for all data items in automatic storage, and that storage is unavailable to other invocations because it is local. (A data item that is defined in a subprocedure uses automatic storage unless the STATIC keyword is specified for the definition.)

  The automatic storage that is associated with earlier invocations is unaffected by later invocations. All invocations share the same static storage, so later invocations can affect the value held by a variable in static storage.
- Exception handling within a subprocedure differs from that in a main procedure primarily because there is no default exception handler for subprocedures. Situations where the default handler would be called for a main procedure result in the abnormal end of the subprocedure.
- VisualAge RPG procedure names are in uppercase. When calling these procedures, make sure that the case matches that of the procedure.

Procedure Implications

As a programmer, you have the have the option of producing three possible target objects:

- A VisualAge RPG DLL (contains GUI operation codes)
- A utility DLL which contains only RPG subprocedures that do not include any GUI operation codes
- An RPG EXE which does not contain any GUI operation codes.

VisualAge RPG DLL Considerations

- VisualAge RPG DLL subprocedures are not externalized.

  These subprocedures are designated as internal only by the compiler. Entry points are not externalized to other modules. Any attempt to link to these subprocedures will cause the link step to fail.
- The EXPORT keyword is not allowed on procedure specifications, since procedures cannot be exported from VisualAge RPG DLLs.

Utility DLL Considerations

This DLL is built when the keyword NOMAIN is provided on the control specification.

The compiler will produce both a DLL and LIB file as a result of the compilation. The LIB file will contain all the procedures that have the EXPORT keyword on their Begin P-specification. The LIB file allows you to link to the subprocedures that the DLL contains.

- The DLL consists of procedures only.

  All subroutines (BEGSR) must be local to a procedure.
- There are no GUI operation codes allowed in the source.

This includes START, STOP, SETATR, GETATR, %SETATR, %GETATR, SHOWWIN, CLSWIN and READS. DSPLY can be used, but if the procedure containing it is called from a VisualAge RPG DLL, then the DSPLY operation code does nothing.
- *inzsr and *termsr are not permitted.
- *ENTRY parms are not permitted.
- Exception handling differs from the VisualAge RPG DLL in the following way:
  - No information about the exception is communicated back to the caller if the caller does not reside in the utility DLL.
  - The recommended way for a user to handle exceptions in a utility DLL is to have an error indicator, or a local *PSSR for each routine which returns an appropriate return code to the caller.
  - The default exception handler is never invoked from a utility DLL, since the default exception handler is not invoked when an exception occurs in a procedure. If an exception occurs in the utility DLL and there is no error indicator or *PSSR, an exit() is performed and information about the exception is written to the FVDCERRS.LOG file.

EXE Considerations

- An EXE is built when the keyword EXE is provided on the control specification.
- The EXE consists of procedures only.

  All subroutines (BEGSR) must be local to a procedure. The EXE must contain a procedure whose name matches the name of the source file. This will be the main entry point for the EXE (i.e. the main procedure).
- There are no GUI operation codes allowed in the source.

  This includes START, STOP, SETATR, GETATR, %SETATR, %GETATR, SHOWWIN, CLSWIN and READS. DSPLY can be used.
- *inzsr and *termsr are not permitted.
- *ENTRY parms are not permitted.

  If there are entry parameters, they are specified on the parameter definition for the main procedure, and they must be passed in by VALUE (the VALUE keyword must be specified for each parameter).
- The EXPORT keyword is not allowed on the Begin P specification.
- Exception handling differs from the VRPG DLL. The default exception handler is never invoked from an EXE. If an exception occurs in the EXE, and there is no error indicator or *PSSR, an exit() is performed and information about the exception is written to the FVDCERRS.LOG file.

Chapter 18. Calling Java Methods from VisualAge RPG Programs

This section describes how to call Java methods from VARPG programs that have been converted to Java source code, and the additions to the VARPG language to support this. In order to call Java methods, the VARPG compiler needs the following information:

- The name of the method
- The class that contains the method
- The class of the returned object if the method returns an object
- Whether or not the method is a static method
- The data types of the parameters passed to the method

In addition, if the method is not a static method, then an object must be instantiated in order to call the method. If the method returns an object, then the compiler must have somewhere to store that object. If the method accepts an object as a parameter, then there must be some way to create that object.

These requirements have led to the following additions to the VARPG language:

- The Object data type
- The CLASS keyword
- Extension of the EXTPROC keyword

The Object Data Type and CLASS Keyword

Fields that can store objects are declared using the **O** data type. To declare a field of type O, code O in column 40 of the D-specification and use the CLASS keyword to provide the class of the object. The CLASS keyword accepts two parameters:

```
CLASS(*JAVA:class_name)
```

*JAVA identifies the object as a Java object. Class_name specifies the class of the object. It must be a character literal, and the class name must be fully qualified. The class name is case sensitive.

For example, to declare a field that will hold an object of type BigDecimal:

```
D bdnum                 S               O   CLASS(*JAVA:'java.math.BigDecimal')
```

To declare a field that will hold an object of type String:

```
D string                S               O   CLASS(*JAVA:'java.lang.String')
```

Note that both class names are fully qualified and that their case exactly matches that of the java class.

Fields of type O cannot be defined as subfields of data structures. It is possible to have arrays of type O fields, but tables of type O are not allowed because they have to be preloaded at run time.

The following keywords cannot be used with the CLASS keyword:

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```
ALIGN, ALT, ASCEND, BASED, BUTTON, CLTPGM, CONST, CTDATA, DATFMT,
DESCEND, DTAARA, EXTFLD, EXTFMT, EXTNAME, FROMFILE, INZ, LINKAGE,
MSGDATA, MSGNBR, MSGTEXT, MSGTITLE, NOOPT, NOWAIT, OCCURS, OPTIONS,
OVERLAY, PACKEVEN, PERRCD, PREFIX, PROCPTR, STYLE, TIMFMT, TOFILE,
VALUE, VARYING
```

Prototyping a Java Method

Like subprocedures, Java methods must be prototyped in order to call them correctly. The VARPG compiler must know the name of the method, the class it belongs to, the data types of the parameters and the data type of the returned value (if any), and whether or not the method is a static method.

The extended EXTPROC keyword can be used to specify the name of the method and the class it belongs to. When prototyping a Java method, the expected format of the EXTPROC keyword is:

```
EXTPROC(*JAVA:class_name:method_name | *JAVARPG:class_name:method_name)
```

*JAVARPG identifies the method as a VARPG-generated Java method. *JAVA identifies the method as a Java method that was generated from code originally written in Java, and not VARPG-generated. This distinction is important because methods generated from *JAVARPG will allow certain data types to be passed by reference that normally cannot be passed by reference in Java. This allows the same source code to be used when targetting Windows and when generating Java source code.

Both the class name and the method name must be character literals. The class name must be a fully qualified Java class name and is case sensitive. The method name must be the name of the method to be called, and is case sensitive.

The extended form of the EXTPROC keyword can only be used when calling Java methods. If targeting Windows, using this form of the EXTPROC keyword will result in a compiler error.

The data types of the parameters and the returned value of the method are specified in the same way as they are when prototyping a subprocedure. The only twist on this is that the data types actually map to Java data types. The compiler maps VARPG data types to Java data types as follows:

Java Data Type	**VARPG Data Type**
char[]	graphic or unicode
boolean	indicator (N)
byte[]	alpha (A of any length)
byte	integer (3I)
int	integer (10I)
short	integer (5I)
long	integer (20I)
float	float (4F)
double	float (8F)
any object	object (O)

Zoned, Packed, Binary, and Unsigned data types are not available in Java. If you pass a Zoned, Packed, Binary, or Unsigned field as a parameter, the compiler will do the appropriate conversion, but this will most likely result in truncation and/or loss of precision.

If the method you are calling is a VARPG-generated method, meaning that *JAVARPG has been specified as the first parameter of the EXTPROC keyword, then Packed, Zoned, Binary, and Unsigned data types can be specified as the data type of parameters and returned values. Methods generated from code originally written in Java cannot use Packed, Zoned, Binary, and Unsigned data types on the prototype for parameters or return values.

When calling a method, the compiler will accept arrays as parameters if the parameter is prototyped using the DIM keyword. Otherwise, only scalar fields, data structures, and tables will be accepted.

Currently, you cannot call methods which expect the following Java data types or which return values of these types: byte, char, and long

If the return value of a method is an object, then you must provide the class of the object by coding the CLASS keyword on the prototype. The class name specified will be that of the object being returned. Use the EXTPROC keyword to specify the class of the method being called.

If the method being called is a static method, then you must be specify the STATIC keyword on the prototype.

In Java, the following data types can only be passed by value:

```
byte
int
short
long
float
double
```

Parameters of these types must have the VALUE keyword specified for them on the prototype.

If the method you are calling is a VARPG-generated method, meaning that *JAVARPG has been specified as the first parameter of the EXTPROC keyword, then these data types can be passed by reference and the VALUE keyword is not required.

Note that objects can only be passed by reference. The VALUE keyword cannot be specified with type O. Since arrays are seen by Java as objects, parameters mapping to arrays must also be passed by reference. This includes byte arrays.

Examples of Prototyping Java Methods

This section presents some examples of prototyping Java methods.

Example 1

The Java Integer class contains a static method called *toString*, which accepts an *int* parameter, and returns a String object. It is declared in Java as follows:

```
String  Integer.toString(int)
```

This method would be prototyped as follows:

```
D tostring            PR              O   EXTPROC(*JAVA:
D                                          'java.lang.Integer':
D                                          'toString')
D                                        CLASS(*JAVA:'java.lang.String')
D                                        STATIC
D    num                              10I 0 VALUE
```

The EXTPROC keyword identifies the method as a non VARPG-generated method. It also indicates that the method name is 'toString', and that it is found in class 'java.lang.Integer'.

The O in column 40 and the CLASS keyword tell the compiler that the method returns an object, and the class of that object is 'java.lang.String'.

The STATIC keyword indicates that the method is a static method, meaning that an Integer object is not required to call the method.

The data type of the parameter is specified as 10I, which maps to the Java *int* data type. Because the parameter is an int, it must be passed by value, and the VALUE keyword is required.

Example 2

The Java Integer class contains a static method called *getInteger*, which accepts String and Integer objects as parameters, and returns an Integer object. Is is declared in Java as follows:

```
Integer Integer.getInteger(String, Integer)
```

This method would be prototyped as follows:

```
D getint              PR              O   EXTPROC(*JAVA:
D                                          'java.lang.Integer':
D                                          'getInteger')
D                                        CLASS(*JAVA:'java.lang.Integer')
D                                        STATIC
D   string                            O   CLASS(*JAVA:'java.lang.String')
D   num                               O   CLASS(*JAVA:'java.lang.Integer')
```

This method accepts two objects as parameters. O is coded in column 40 of the D-specification and the CLASS keyword specifies the class of each object parameter.

Example 3

The Java Integer class contains a method called *shortValue*, which returns the short representation of the Integer object used to invoke the method. It is declared in Java as follows:

```
short shortValue()
```

This method would be prototyped as follows:

```
D shortval            PR             5I 0 EXTPROC(*JAVA:
D                                          'java.lang.Integer':
D                                          'shortValue')
```

The STATIC keyword is not specified because the method is not a static method. The method takes no parameters, so none are coded.

The returned value is specified as 5I, which maps to the Java short data type.

Example 4

The Java Integer class contains a method called *equals*, which accepts an Object as parameter and returns a boolean. It is declared in Java as follows:

```
boolean equals(Object)
```

This method would be prototyped as follows:

```
D equals              PR              N   EXTPROC(*JAVA:
D                                         'java.lang.Integer':
D                                         'equals')
D  obj                                O   CLASS(*JAVA:'java.lang.Object')
```

The returned value is specified as N, which maps to the Java boolean data type.

Creating Objects

In order to call a non-static method, an object is required. The class of the object must be the same as the class containing the method. Objects are instantiated, or created, by calling the class constructor. The class constructor is not a static method, but it does not require an object to call it. The special method name *CONSTRUCTOR is used when prototyping a constructor.

For example, in order to construct a *BigDecimal* object from a float value, the constructor that expects a float parameter must be called as follows:

```
BigDecimal(float)  returns a new BigDecimal object
```

The constructor would be prototyped as follows:

```
D bdcreate            PR              O   EXTPROC(*JAVA:
D                                         'java.math.BigDecimal':
D                                         *CONSTRUCTOR)
D                                         CLASS(*JAVA:'java.math.BigDecimal')
D    dnum                             4F   VALUE
```

Note that the parameter must be passed by value because it maps to the Java float data type.

Calling Java Methods

Java methods can be called using existing operation codes CALLP (when no return value is expected) and EVAL (when a return value is expected). No new syntax is required.

When calling a static method, an object is not required in order to make the call. When calling a non-static method, an object is required. The object to be used must be coded as the first parameter in the call. This parameter is not specified on the prototype, but is implied for all methods that are not static. This means that whenever a method that is not static is called, a minimum of one parameter must be specified.

Example 1

In this example, the goal is to add two BigDecimal values together. In order to do this, two BigDecimal objects must be instantiated by calling the constructor for the BigDecimal class, fields must be declared to store the BigDecimal objects, and the add() method in the BigDecimal class must be called.

```
 *
 *   Prototype the BigDecimal constructor that accepts a String
 *   parameter.  It returns a new BigDecimal object.
 *
D bdcreate1            PR              O   EXTPROC(*JAVA:
D                                           'java.math.BigDecimal':
D                                           *CONSTRUCTOR)
D                                          CLASS(*JAVA:'java.math.BigDecimal')
D    str                               O   CLASS(*JAVA:'java.lang.String')
 *
 *   Prototype the BigDecimal constructor that accepts a double
 *   parameter.  8F maps to the Java double data type and so must
 *   be passed by VALUE.  It returns a BigDecimal object.
 *
D bdcreate2            PR              O   EXTPROC(*JAVA:
D                                           'java.math.BigDecimal':
D                                           *CONSTRUCTOR)
D                                          CLASS(*JAVA:'java.math.BigDecimal')
D   double                            8F   VALUE
 *
 *   Define fields to store the BigDecimal objects.
 *
D bdnum1             S                 O    CLASS(*JAVA:'java.math.BigDecimal')
D bdnum2             S                 O    CLASS(*JAVA:'java.math.BigDecimal')
 *
 *
 *   Since one of the constructors we are using requires a String object,
 *   we will also need to construct one of those.  Prototype the String
 *   constructor that accepts a byte array as a parameter.  It returns
 *   a String object.
 *
D makestring         PR                O    EXTPROC(*JAVA:
D                                           'java.lang.String':
D                                           *CONSTRUCTOR)
D                                          CLASS(*JAVA:'java.lang.String')
D    bytes                           10A
 *
 *  Define a field to store the String object.
 *
D string             S                 O    CLASS(*JAVA:'java.lang.String')
 *
 *  Prototype the BigDecimal add method.  It accepts a BigDecimal object
 *  as a parameter, and returns a BigDecimal object (the sum of the parameter
 *  and of the BigDecimal object used to make the call).
 *
D add                PR                O    EXTPROC(*JAVA:
D                                           'java.lang.BigDecimal':
D                                           'add')
D                                          CLASS(*JAVA:'java.math.BigDecimal')
D   bd1                                O    CLASS(*JAVA:'java.math.BigDecimal')
 *
 *  Define a field to store the sum.
 *
D sum                S                 O    CLASS(*JAVA:'java.math.BigDecimal')
D
D double             S                 8F   INZ(1.1)
D fld1               S                10A
```

Here is the code that does the call.

```
C                      MOVEL     'mystring'    fld1            10
C*
C*  Call the constructor for the String class, to create a String
C*  object from fld1.  Since we are calling the constructor, we
```

```
C*  do not need to pass a String object as the first parameter.
C*
C                       EVAL      string = makestring(fld1)
C*
C*  Call the BigDecimal constructor that accepts a String
C*  parameter, using the String object we just instantiated.
C*
C                       EVAL      bdnum1 = bdcreate1(string)
C*
C*  Call the BigDecimal constructor that accepts a double
C*  as a parameter.
C*
C                       EVAL      bdnum2 = bdcreate2(double)
C*
C*  Add the two BigDecimal objects together by calling the
C*  add method.  The prototype indicates that add accepts
C*  one parameter, but since add is not a static method, we
C*  must also pass a BigDecimal object in order to make the
C*  call, and it must be passed as the first parameter.
C*  bdnum1 is the object we are using to make the
C*  call, and bdnum2 is the parameter.
C*
C                       EVAL      sum = add(bdnum1:bdnum2)
C*  sum now contains a BigDecimal object with the value
C*  bdnum1 + bdnum2.
```

Example 2

This example shows how to perform a TRIM in Java by using the trim() method as an alternative to the VARPG %TRIM built-in function. The trim() method in the String class is not a static method, so a String object is needed in order to call it.

```
 *
 *  Define a field to store the String object we wish to trim
 *
D str                 S               O   CLASS(*JAVA:'java.lang.String')
 *
 *  Prototype the constructor for the String class.  The
 *  constructor expects a byte array.
 *
D makestring          PR              O   EXTPROC(*JAVA:
D                                          'java.lang.String':
D                                          *CONSTRUCTOR)
D                                         CLASS(*JAVA:'java.lang.String')
D   parm                              10A
D
 *
 *  Prototype the String method getBytes which converts a String to a byte
 *  array.  We can then store this byte array in an alpha field.
 *
D makealpha           PR            10A   EXTPROC(*JAVA:
D                                          'java.lang.String':
D                                          'getBytes')
 *
 *  Prototype the String method trim.  It doesn't take any parameters,
 *  but since it is not a static method, must be called using a String
 *  object.
 *
D trimstring          PR              O   EXTPROC(*JAVA:
D                                          'java.lang.String':
D                                          'trim')
 *
D fld               S                 10A     INZ('   hello    ')
```

The call is coded as follows:

```
C*
C* Call the String constructor
C*
C                         EVAL      str = makestring(fld)
C*
C* Trim the string by calling the String trim() method.
C* We will reuse the str field to store the result.
C*
C                         EVAL      str = trimstring(str)
C*
C* Convert the string back to a byte array and store it
C* in fld.
C*
C                         EVAL      fld = makealpha(str)
```

Static methods are called in the same way, except that an object is not required to make a call. If the makealpha() method above was static, the call would look like:

```
C                         EVAL      fld = makealpha()
```

If the method does not return a value, use the CALLP operation code.

Additional Considerations

The compiler will not attempt to resolve classes at compile time. If a class cannot be located at run time, a runtime error will occur. It will indicate that an *UnresolvedLinkException* object was received from the Java environment.

The compiler does no type checking of parameters at compile time. If there is a conflict between the prototype and the method being called, an error will be received at run time.

It is very important that *JAVARPG be specified as the first parameter of EXTPROC if the method being called is a non VARPG-generated method. If this is not done, it is likely that one of the above two error situations will occur.

Chapter 19. Considerations When Compiling for Java

This section describes VARPG source restrictions, possible changes required in your VARPG source, and runtime behaviour diffferences when using the Java build option to create Java source.

Project File Name Convention

The project file name for a Java application must follow Java naming conventions. The first character must be alphabetic. If your project's name is incorrect, you can use the *Rename Project* utility to rename it. (Select **Rename project** from the pop-up menu of the project's icon.)

Conditional Compile Directives

Two conditional compiler directives are defined by the compiler to help maintain a single source file that can be used to create both Windows components and Java source code. These directives are:

- **COMPILE_WINDOWS** is defined by the compiler when a Windows build is requested.
- **COMPILE_JAVA** will be defined by the compiler when a Java build is requested.

Since the compiler defines these two names, it is not necessary to define them using the /DEFINE directive.

Java Source Code Restrictions

The following language elements are not supported when generating Java source code:

Keywords:

- ALIGN
- EXPROPTS
- STATIC on field definitions. STATIC is supported on Java method prototypes.

Operation codes:

- ALLOC
- CABxx
- CALLB
- DEALLOC
- DSPLY (only for NOMAIN and EXE; otherwise supported)
- GOTO
- REALLOC
- TAG

Operation extenders:

- M
- R

Language Elements:

- Embedded SQL

Data types:

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- Pointer data type

File types:

- SPECIAL

File operations:

- Writing records by relative record number

Possible VARPG Source Changes

This section summarizes the changes that may be required to your VARPG source in order to generate the Java source code.

1. The to/from notation must be used when defining subfields of the PSDS and INFDS in order to allow the compiler to validate the subfield definitions. The definition of subfields in the INFDS and PSDS must match the definitions specified in the VARPG Language Reference. A compile time error will be issued if they do not.
2. There cannot be an unconditional LEAVE or ITER operation as anything other than the last operation in a loop, otherwise the Java compiler will issue an error. If there is an unconditional LEAVE or ITER operation in a loop, all operations occuring after it in the loop should be deleted, as they will never be executed.
3. When adding and and subtracting date/time/timestamp durations, only values between maxint (2 147 483 647) and -maxint (-2 147 483 648) can be used.
4. Because Java does not allow int (10I), short (5I), float (4F), and double (8F) values to be passed by reference, Java code has to be generated by VARPG to retain this functionality for subprocedures being converted to Java. The code generated to accomplish this can cause java compiler errors when the VARPG source contains subprocedures with multiple return points and receives integer or float parameters passed by reference.

   Sample code that may cause Java compile errors:

   ```
   C                   IF        x = 1
   C                   ...
   C                   RETURN    1
   C                   ELSE
   C                   ...
   C                   RETURN    0
   C                   ENDIF
   ```

   The preceding code should be changed to:

   ```
   C                   IF        x = 1
   C                   ...
   C                   RETURN    1
   C                   ELSE
   C                   ...
   C                   ENDIF
   C                   RETURN    0
   ```
5. The characters '*', '#', and '@' cannot be used in Java identifiers. Because of this, all occurences of '*', '#', and '@' in VARPG names will be changed to '_'. It is possible that this conversion will result in duplicate names.
6. If a COMMIT or ROLBK operation is coded within an application that has no files, a severity 30 message (RNF7833) will be issued.
7. Due to the way that a local *PSSR is converted to Java, it is not possible to call a local *PSSR. Also note that since GOTO is not supported, the only way to leave a local *PSSR and avoid the default handler is to code a RETURN operation.
8. There is no short circuiting of logical expressions. This means that the order in which a compound logical expression is executed cannot be relied upon.

9. Varying length fields are implemented as a class when converting to Java. This means that they are not stored as documented in the VARPG Language Reference. Code that depends on them being stored a certain way will not work.
10. Data structure subfields will not be initialized to blanks if there is no initial value provided, but will be initialized to a default value depending on the datatype of the subfield. The default value is 0 for numerics, blanks for character, and *LOVAL for date, time, and timestamp. Varying length fields will have their length set to 0.
11. The *HIVAL and *LOVAL values are not allowed for graphic and UCS-2 fields.
12. If a length is specified for a data structure, it must match the total length of the subfields it contains, otherwise the compiler will issue a severity 30 diagnostic message.
13. Subroutines cannot be defined within subprocedures. The only exception to this is that a *PSSR can be defined within a subprocedure. Any subroutines within subprocedures should be moved outside the subprocedure. If the subroutine accesses local fields within the subprocedure, then either the fields need to be changed to global fields, or the subroutine should be changed to a subprocedure that accepts the local fields as parameters.
14. Unconditional LEAVE statements within DO loops are not supported. A Java compiler error will occur if this situation exists. Since an unconditional LEAVE within a DO loop means that the loop will only ever be executed once, the LEAVE should be removed and the code changed to remove the loop operation codes.
15. Using event attributes in fixed compound conditional statements currently causes Java compile errors. The equivalent free form expression should be used instead.

    Sample code that may cause Java compile errors:

    ```
    C     %mousex       IFEQ      x
    C     %mousey       ANDEQ     y
    C                   ...
    C                   ENDIF
    ```

    The preceding code should be changed to:

    ```
    C                   IF        %mousex = x AND
    C                             %mousey = y
    C                   ...
    C                   ENDIF
    ```
16. An unconditional RETURN operation cannot be coded unless it is the last statement in a user subroutine, action subroutine, or subprocedure. Otherwise, the Java compiler may report errors.
17. An unconditional LEAVESR operation cannot be coded unless it is the last statement in a user subroutine or action subroutine. Otherwise, the Java compiler may report errors.
18. SELECT statements can cause Java compile errors when they occur in subprocedures, contain RETURN operations, and no RETURN is coded within the main body of the subprocedure.

    Sample code that may cause Java compile errors:

    ```
    C                   SELECT
    C     x             WHENEQ    y
    C                   RETURN    1
    C     x             WHENEQ    z
    C                   RETURN    2
    C                   OTHER
    C                   RETURN    0
    C                   ENDSL
    ```

    The preceding code should be changed to:

```
C                   SELECT
C     x             WHENEQ     y
C                   RETURN     1
C     x             WHENEQ     z
C                   RETURN     2
C                   ENDSL
C                   RETURN     0
```

In general, a RETURN operation should be coded for all possible code paths of a subprocedure, otherwise the Java compiler may report errors.

19. Arrays cannot be passed by value to subprocedures.

Runtime Differences

Because of differences between the Windows and Java environments, an application may run differently under Java than it does under Windows. The following areas are affected:

1. The %SCAN builtin function will return an integer result. In Windows, it returns an unsigned result.
2. The truncate numeric build option is unreliable and should not be depended upon.
3. When an I/O exception occurs, the user will not be given the option to retry the operation.
4. Data structures are not treated as one large character field when the Java application is running. This may cause unexpected results if they are used as such.
5. The format of binary, integer, and unsigned datatypes is handled differently for local files. When reading and writing local files, the Java format is assumed, which means that the high order bytes are leftmost, whereas when running as a Windows application, they are rightmost.
6. Exception handling for subprocedures will behave the same as for action subroutines. The default error handler will be called if there is no local *PSSR or INFSR and no error indicator on the operation.
7. If an invalid date, time, or timestamp value is encountered when reading or writing a field to/from a file, the field will be set to the default value (*LOVAL). No error is reported.
8. Java can only handle a 3 digit millisecond portion in timestamps. When doing calculations with timestamps that use all 6 digits of the millisecond portion (meaning they do not have milliseconds in the form 000xxx), the results might not be as expected.
9. Intermediate results in expressions are not limited to 30 digits. In fact, when running in the VARPG environment, no attention is paid to the precision of intermediate results.
10. Memory cannot be shared between components. If a component is started by another component via START, changes made to passed parameters are not reflected across components.
11. Integer overflow or underflow will not be reported. Float overflow or underflow will be reported as status 9999.
12. If an error occurs while a subprocedure in a NOMAIN or EXE application is being executed, and there is no error indicator or *PSSR, then the error will be reported back to the caller and handled by the caller. When running under Windows, the application would terminate.
13. A status 50 error will never be issued when running Java applications. Java gives no diagnostic messages for character conversions it cannot handle. Java may issue a status 100 for an unsuccessful conversion or an ArrayIndexOutOfBoundsException when the converted string is used.
14. Positioning a host file to Null-Valued Records when ALWNULL(*NO) has been specified results in CPF5035.

Applet Restrictions

The following language elements are not supported when running a VARPG applet and will result in Java errors at run time:

- Printer files
- Local files
- Calling C functions, external subprocedures, EXEs.
- NOMAIN and EXE applications cannot be run as applets.

J2SDK 1.2 Printing Problems

The Java 2 Software Development Kit (J2SDK), version 1.2 or higher, is currently experiencing problems when text is sent to a printer device. One workaround for this problem is to run the Java application as follows:

```
java -Djava2d.font.usePlatformFont=true -ms32m -mx32m <classname>
```

However, the printed text may not appear as expected. This problem will be resolved when the existing problem with J2SDK 1.2 is fixed, without requiring a VARPG update.

Chapter 20. Creating and Running VisualAge RPG Applets

Once you have created a visual interface and the associated VARPG logic on your workstation, you can build and deploy your application as a Java applet that runs in any Web browser with an appropriate Java Virtual Machine (JVM). This gives you the extra flexibility of making your application widely available over the internet. Many users with browser access to your Web site can run the applet inside their browser and also communicate with data on the iSeries server.

This section describes how to build and deploy such VARPG applets.

Creating Applets

Note: In order to build the Java version of a project, the Java 2 Software Development Kit (J2SDK), version 1.2 or greater, must be installed on the workstation. The J2SDK is available from Sun Microsystems at URL

`http://java.sun.com/products/`

To run applets, the ***international*** version of the Java 2 Run Time Environment (J2RE) must be installed.

Applets are Java applications that run inside the context of a Web page. When a Web page containing an applet is loaded, the applet's code is downloaded from the HTTP server to the workstation and the Java applet is started. Typically, the applet is embedded in the main Web page and runs when the Web page is displayed in a browser. Teh applet can also be displayed in a separate window.

There are no special design or development steps required to create VARPG applets. Designing and coding your VARPG project is the same for applets as for Windows applications. However, you may want to consider writing ***thin clients*** when targeting as applets to avoid long download times. (See Appendix B, "Writing Thin Client Applications," on page 431 for more information.).

There are security restrictions for applets that you should be aware of. These security restrictions are not VisualAge RPG restrictions, but are part of the Java language run time specification for applets. Applets cannot:

- Access local resources on the client, such as, the file system and printers
- Open a socket connection to a different host from the one where the applet resides. This means that you cannot load an applet from one iSeries 400 server and access files that are on a different server.

You can , however, set up a policy file to relax some of these security restrictions. See "Using the Security File for Applets" on page 210 and the Java documentation for more information on setting up policy files.

Use the same steps to design and code your applet as you would to design and code a typical Windows application . However, be aware of the restrictions that apply when coding for the Java environment. Once you complete your applet's visual interface and the associated VARPG logic, build the application.

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You can control your applet's build options on the Java: Build options notebook. Select **Project>Build Options>Java** from the VisualAge RPG design window to display the Java Build Options for your project:

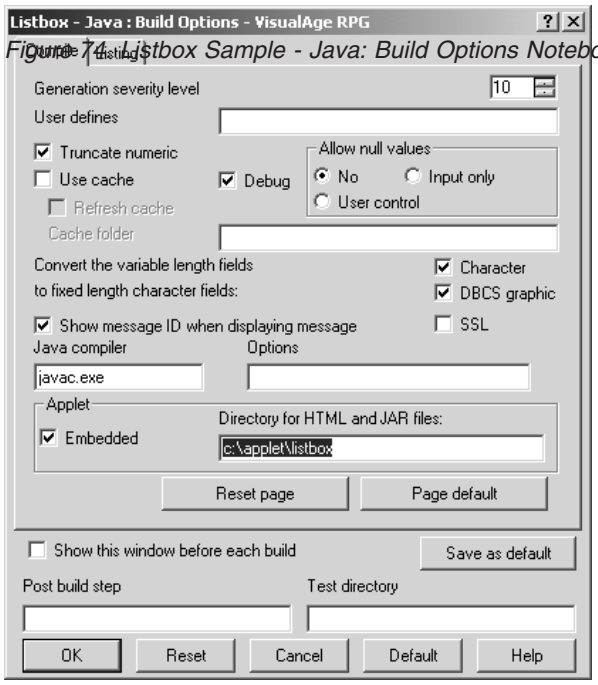

Figure 74. Listbox Sample - Java: Build Options Notebook

The majority of the settings are simliar to those used for building a Windows application, with the following exceptions:

SSL Select SSL if you want all TCP/IP connections between your iSeries server and Java applet or application to be encrypted using Secure Sockets Layer technology. (See Appendix D, "Secure Sockets Layer (SSL) Setup," on page 449 for information on SLL setup.)

Java Compiler
VisualAge RPG generates a Java source file (.java) from your project and relies on an external Java compiler to create the class file (.class) from the source. If you are not using the IBM or Sun Microsystem's Java 2 SDK, then you will need to specify the Java compiler you are using here.

Options
Pass any command line options you want to the Java compiler.

Applet - Embedded
Determines if your applet is run when the HTML page it is embedded in is displayed in a Web browser, or if your applet starts in an external window.

Applet - Directory for HTML and JAR files
You can specify a directory where you want all of the required runtime files for your applet to be placed. These files are generated when you build your project for Java. By default, these files are placed in the project's source directory on your workstation.

Hint: Map a network drive to your iSeries server and enter the IFS directory where you would like to deploy the applet from.

Now that you have configured the options for your applet, you are ready to build the project. From the project's design window, select **Project>Build>Java**. Upon a

successful build, the runtime files for the applet are created in the project's source directory or the directory specified in the ***Directory for HTML and JAR files*** Java build option.

For example, if you build the Listbox sample to create a Java application and specify `c:\applet\Listbox` as the directory to contain the applet's runtime files, you should see the following files in this directory:

```
listbox.htm
listbox_applet.htm
LISTBOX.jar
vapplet.jar
```

These files are used to deploy your applet from the Web server, as follows:

listbox.htm
: Launches your applet using the Java Plug-in.

listbox_applet.htm
: Checks the user's workstation for the required VisualAge RPG Java runtime (varpg.jar) file. If the workstation has the correct version of the run time, then the browser opens the ***listbox.htm*** page. Otherwise, the user is prompted to download and install the correct runtime file.

LISTBOX.jar
: Contains the LISTBOX.class, LISTBOXApplet.class, LISTBOX.ODX, LISTBOX.RST and any *Resources.properties (if you defined messages for the application) files used by your project.

vapplet.jar
: Contains a small subset of the VisualAge RPG Java run time that is required on the Web server.

Testing Your Applet

This section describes the set up required for testing your VisualAge RPG applet.

1. Install the IBM or Sun Microsystem's Java 2 Runtime Environment (J2RE).

   VisualAge RPG generated applets require the **international** version of the Java 2 Run Time Environment (J2RE) to execute prorperly. When you install the IBM or Sun Microsystem's Java 2 SDK (or JRE), the Java Plug-in is automatically installed. If you are running on your development machine, then the J2SDK you installed for developing the applet is sufficient.
2. Add the VisualAge RPG Java run time (varpg.jar) file to your JRE's extension directory.

   The VisualAge RPG Java run time file should be copied to each client machine and added to the local JRE's extension directory. Typically this is a subdirectory named `jre\lib\ext\`. This avoids having to download the run time from the HTTP server every time an applet is run from the Web page. The ***varpg.jar*** file is located in the JAVA subdirectory under the WDSC install directory. For example `c:\wdsc\java\varpg.jar`.
3. Copy your applet's runtime files to the iSeries IFS directory where you will be serving the applet from. In the Listbox sample, these files would be:

   ```
   listbox.htm
   listbox_applet.htm
   LISTBOX.jar
   vapplet.jar
   ```

Hint: Map a network drive to your iSeries server and enter the IFS directory in the ***Directory for HTML and JAR files*** Java build option before you create your applet.

4. Set up the iSeries HTTP server to allow access to the directory containing your applet.

   You will need to start and configure the IBM HTTP Server if you have not already done so. See *HTTP Server for iSeries Webmaster's Guide* for information on configuring the HTTP server.

   Add a ***PASS*** statement to your iSeries HTTP configuration file that allows access to the IFS directory where you placed the applet runtime files. For this example the applet files are in the IFS directory `/applets`. So, add the following PASS statement:

   ```
   Pass /applets/* /applets/*
   ```

5. Run the applet from your Web browser. For example, open your Web browser with the following URL:

   ```
   http://Toras14m:999/Listbox.htm
   ```

   where `Toras14m` is your iSeries server name, `999` is your HTTP port number, and `Listbox.htm` is the Web page containing your applet.

Here is the Listbox applet running inside the Windows browser:

Figure 75. Listbox Applet Running inside Internet Explorer

Troubleshooting

The following is a list of common configuration problems that can cause applets not to run:

- The proper J2RE is not installed. Ensure that the Java 2 SDK or ***international*** version of the J2RE is installed along with the Java Plug-in.

- The applet's required runtime files are not in the correct directory on the server. The files *AppName*.htm, *AppName*_applet.htm, vapplet.jar, and *APPNAME*.jar need to be in the directory referenced in the second parameter to the HTTP server's Pass statement.
- Java file names are **case sensitive**. This causes the majority of configuration issues. Make sure that all `.jar` files are in the correct case. Windows Explorer does not always show file names in their actual case. Use the OS/400 `wrklnk` command to check the case of the file names stored in the IFS.

If your applet is still not running, try enabling the Java Plug-in console to see if any error messages are being displayed. Start the Plug-in control pannel by selecting ***Start>Programs>Java Plug-in Control Panel***. From the basic tab, select **Show Java Console** and click ***Apply***. Close all open Web browser windows and restart the Web browser for the changes to take affect. The next time you run the applet, the Java Console window appears with messages.

Running One Applet from Another

You can run one VisualAge RPG-generated applet from another, by modifying the calling applet's main ***.htm*** file to include the called applet. For example, to start AppletB from AppletA, modify the ***AppletA.htm*** file as follows:

- Find the lines that inlcude `APPLETA.jar` and `varpg.jar`. Typically, the following lines:

```
<PARAM NAME = "archive" VALUE = "APPLETA.jar , varpg.jar">

 ...
     archive = "APPLETA.jar , varpg.jar"
```

- Insert ***, APPLETB.jar*** between the ***varpg.jar*** and closing quotes so the ***VALUE*** and ***archive*** values are now:

```
<PARAM NAME = "archive" VALUE = "APPLETA.jar , varpg.jar , APPLETB.jar">

 ...
    archive = "APPLETA.jar , varpg.jar , APPLETB.jar"
```

  Be sure to include a blank character before and after the comma delimiter.

When you display the AppletA.htm page in your Web browser, it should now run AppletB, too.

If the called applet (AppletB, in this example), also accesses data on the server, you need to give each applet *permission* to read the security file that resides on the workstation. Otherwise, the user will be prompted to enter a valid user Id and password each time that AppletB is run. See"Using the Security File for Applets" on page 210 for more information.

In this example, you need to modify the local ***policy file*** by adding the following lines:

```
        permission java.lang.RuntimePermission "modifyThreadGroup";
        permission java.lang.RuntimePermission "modifyThread";
```

The policy file (`java.policy`) is located in the Java run time `lib\security` subdirectory.

For socket permission, you may need to add a line like the following:

```
        permission java.net.SocketPermission
"server_name:port_number", "connect,resolve";
```

If you need to change the name or location of this policy file, modify the ***java.security*** file in the same directory.

Chapter 21. Calling System Functions when Compiling for Java

The VisualAge RPG compiler includes support for calling external procedures implemented as function entry points in Dynamic Link Libraries (DLLs) on the Windows platform through the Java Native Interface (JNI). This section discusses how to use this support.

Refer to the Java Native Interface (JNI) section of the Java 2 Software Development Kit (J2SDK) documentation as prerequisite reading.

A Simple Call

The first code example shows a simple call to an external procedure with no parameters and no return value. The simple VisualAge RPG application calls an external procedure in a sample dynamic link library. The JNI specification dictates the function name and interface to the native function being called. A function will be coded and compiled into a new DLL to be the target of the call. The following samples will only demonstrate native functions coded in the C language, but the illustrated coding principles apply equally to other language implementations. Once the native function has control, it is free to call other native functions, such as system APIs.

Code a procedure prototype for the procedure in VisualAge RPG, specifying the DLL keyword to provide the name of the DLL which will contain the native function being called. The EXTPROC keyword may optionally be coded to specify a function name different from the procedure name within the VisualAge RPG program.

Note: The value of the EXTPROC keyword is case sensitive. Code a call to the procedure in the VisualAge RPG source.

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```
 ********************************************************************
 *  Source File:  VCOMP1.VPG
 *
 *  Demonstrate calling an external procedure thru JNI.
 *
 ********************************************************************


 * This declares a procedure named 'sub1' which refers to
 * a function named 'proc1' in a Dynamic Link Library 'VSUB.DLL'

d sub1            pr                  dll('VSUB') extproc('proc1')

 * Without the EXTPROC keyword
d sub2            pr                  dll('VSUB')


C     *INZSR        BEGSR

C                   callp     sub1
C                   callp     sub2

c                   seton                                          lr

C                   ENDSR

 * This action subroutine is linked to a Create event for the Window.
 * It causes the component to end after running the INZSR.

C     CREATE1       BEGACT
C                   seton                                      LR
C                   ENDACT
```

Figure 76. Sample file VCOMP1.VPG

For the Windows platform, the native function is coded to use the StdCall program linkage. The function is coded as an exported function in the DLL. The exported function name must match the name dictated by the JNI specification. The format of the JNI Specification is:

```
Java_VARPGComponentName_ExternalProcedureName_OverloadedNativeMethods
```

The full native function names are 'Java_VCOMP1_proc1' and "Java_VCOMP1_SUB2' in this sample. The overloaded native method are not needed for this sample.

The JNI interface dictates the first two parameters: an interface pointer, and a *this* object pointer. Additional parameters correspond to the procedures declared parameters. The jni.h header file is included in the C language source program to provide interface definitions. This file is provided with the J2SDK. You may need to update your INCLUDE environment variable in your C compiler to include the directory containing the C language header files for J2SDK.

Lastly, the sample C source file is compiled into a DLL.

```
// Source File:  VSUB.C

// Add   (d:\jdk12\include;d:\jdk12\include\win32) to the INCLUDE setting
//      in order to find jni.h when compiling.

// Compiled with:  IBM VisualAge(TM) for C++ for Windows(R), Version 3.5
// Compile command:  icc  /q /ss /ge- /fe vsub.dll  vsub.c


#include <stdio.h>
#include <string.h>

#include <jni.h>


//-------------------------------------------------------------

void _Export __stdcall   Java_VCOMP1_proc1( void *je , void *jc)

{

  printf(" proc1 called successfully.\n");
}
//-------------------------------------------------------------

void _Export __stdcall   Java_VCOMP1_SUB2( void *je , void *jc)
{

  printf(" SUB2 called successfully.\n");
}
```

Figure 77. Sample File VSUB.C

Passing and Receiving Parameters

The JNI specification passes Java primitive data types directly, but VisualAge RPG processes all the VARPG data types through classes. This means that VARPG calls to native functions will always involve passing objects. The JNI specification provides interface functions for the native function to access the values of passed objects. Due to the different class methods for each VARPG data type, each type will be discussed individually.

Parameter Types

Character

VisualAge RPG implements character fields as byte arrays in Java including a character field of length one. The JNI interface function GetByteArrayElements returns the value of the byte array parameter. The value can be changed and returned to the calling function through the ReleaseByteArrayElements interface function.

Note: The value should not be used in the native function after calling the release function.

The first parameter for the native function in the C language source has been changed from a void pointer to a JNIEnv pointer. It points to a table of function pointers for JNI interface functions. The prototyped parameters for the external

procedure are added to the native function's parameters, after the two standard JNI pointers. The character parameters are declared as jbyteArray types in the native function.

The GetByteArrayElements interface function is used to obtain the value of the Java byte array for the VARPG character field.

The obtained value can be changed and returned to the Java caller with the ReleaseByteArrayElements interface function.

The obtained value should not be accessed after releasing it.

Note: It is possible the value obtained is the actual value in the Java object, and not a copy in memory. The changes made to it might be reflected in the Java caller even without calling the release function. Refer to the GetByteArrayElements function in the JNI documentation for more information.

```
 ****************************************************************
 *  Source File:  VCOMP1.VPG
 *
 *  Demonstrate calling an external procedure thru JNI.
 *
 ****************************************************************

 * This declares a procedure named 'sub1c' which refers to
 * a function named 'proc1c' in a dynamic Load Library 'VSUBC.DLL'

 * With 1 character parameter
d sub1c           pr                  dll('VSUBC') extproc('proc1c')

d                                  1

 * Without the EXTPROC keyword
 * With 2 character parameters
d sub2c           pr                  dll('VSUBC')
d                                  4
d                                 10

d c1              s                 1    inz('J')
d c4              s                 4    inz('blue')
d c10             s                10    inz('abcdefghij')

d mb1             m                       style(*info) button(*OK)

d rc              s                 9  0

C     *INZSR        BEGSR

C                   callp     sub1c(c1)
C                   callp     sub2c(c4:c10)

 * Display the changed values from the calls
c     c4            dsply     mb1           rc
c     c10           dsply     mb1           rc

c                   seton                                          lr
C                   ENDSR


 * This action subroutine is linked to a Create event for the Window.
 * It causes the component to end after running the INZSR.

C     CREATE1       BEGACT
C                   seton                                      LR
C                   ENDACT
```

Figure 78. Sample file VCOMPC.VPG

```
// Source File:  VSUBC.C
//               Native function with Character parameters

// Compiled with:  IBM VisualAge(TM) for C++ for Windows(R), Version 3.5
// Compile command:  icc  /q /ss /ge- /fe vsubc.dll  vsubc.c

#include <stdio.h>
#include <string.h>

#include <jni.h>

//-------------------------------------------------------------

void _Export __stdcall   Java_VCOMPC_proc1c(  JNIEnv *je , void *jc,
                                              jbyteArray p1)

{
  char  *c1;

  printf(" proc1c called successfully.\n");

  c1 = (char *) (*je)->GetByteArrayElements( je, p1, NULL);

  printf(" c1 = \'%c\'\n", c1[0]);
}
//-------------------------------------------------------------

void _Export __stdcall   Java_VCOMPC_SUB2C( JNIEnv *je , void *jc,
                                            jbyteArray p1, jbyteArray p2)
{
  char  *c4;
  char  *c10;

  printf(" SUB2C called successfully.\n");


  c4  = (char *) (*je)->GetByteArrayElements( je, p1, NULL);
  c10 = (char *) (*je)->GetByteArrayElements( je, p2, NULL);

  printf(" c4  = %.4s.\n",  c4);
  printf(" c10 = %.10s.\n", c10);
```

Figure 79. Sample file VSUBC.C (Part 1 of 2)

```
  // Now change the values

  memcpy( c4, "Gray", 4);
  memcpy(c10, ">Received<", 10);

  // Update the values back to the Java Caller

  // Fourth Parameter = 0 also causes the variable's storage to be freed,
  // so can not access the variables after this function call.



  (*je)->ReleaseByteArrayElements( je, p1, (signed char *) c4, 0);
  (*je)->ReleaseByteArrayElements( je, p2, (signed char *) c10, 0);
}
```

Figure 79. Sample file VSUBC.C (Part 2 of 2)

Zoned Numeric

```
 ****************************************************************
 *  Source File:  VCOMPN.VPG
 *
 *  Demonstrate calling an external procedure thru JNI.
 *
 ****************************************************************

 * With a Zoned(4,0)  parameter
d subz            pr                  dll('VSUBN')
d                                4S 0

 * With a Packed(9,2) parameter
d subp            pr                  dll('VSUBN')

d                                9P 2

 * With  Binary(4,0), Binary(9,0) parameter2
d subb            pr                  dll('VSUBN')
d                                4B 0
d                                9B 0

d z4              s               4S 0 inz(1234)
d p92             s               9P 2 inz(1234567.89)
d b4              s               4B 0 inz(1234)
d b9              s               9B 0 inz(123456789)
```

Figure 80. Sample File VCOMPN.VPG (Part 1 of 2)

```
d mb1             m                   style(*info) button(*OK)
d rc              s               9  0

C     *INZSR        BEGSR

C                   callp     subz(z4)
C                   callp     subp(p92)
C                   callp     subb(b4:b9)
 * Display the changed values from the calls
c     z4            dsply     mb1           rc
c     p92           dsply     mb1           rc

c     b4            dsply     mb1           rc
c     b9            dsply     mb1           rc

c                   seton                                          lr
C                   ENDSR

 * This action subroutine is linked to a Create event for the Window.
 * It causes the component to end after running the INZSR.

C     CREATE1       BEGACT
C                   seton                                      LR

C                   ENDACT
```

Figure 80. Sample File VCOMPN.VPG (Part 2 of 2)

```
// Source File:  VSUBN.C

//               Native function with Character parameters

// Add   (d:\jdk12\include;d:\jdk12\include\win32) to the INCLUDE setting
//      in order to find jni.h when compiling.

// Compiled with:  IBM VisualAge(TM) for C++ for Windows(R), Version 3.5
// Compile command:  icc  /q /ss /ge- /fe vsubn.dll  vsubn.c

#include <stdio.h>
#include <string.h>

#include <jni.h>

static void SwapBin2( short *b2);

static void SwapBin4( int *b4);

//-------------------------------------------------------------

void _Export __stdcall   Java_VCOMPN_SUBZ(  JNIEnv *je , void *jc,
                                            jobject p1)

{
  jclass     cls;
  jmethodID  mid;
  jobject    aryobj;
  char       *zd;

  printf(" SUBZ called successfully.\n");

  // p1:  Zoned
  // Call the method to get the zoned value

  cls = (*je)->GetObjectClass(je, p1);


  mid = (*je)->GetMethodID( je, cls, "zonedValue", "()[B");

  if ( mid == NULL)
  {
    printf(" ERROR: GetMethod.\n");
    return;
  }

  aryobj = (*je)->CallObjectMethod( je, p1, mid);

  zd = (char *) (*je)->GetByteArrayElements( je, aryobj, NULL);

  printf(" zd = %.4s.\n", zd);
```

Figure 81. Sample File VSUBN.C (Part 1 of 2)

```
  // Now change the values

  memcpy( zd, "9876", 4);

  // Returning the Zoned parameter

  // 1. Update the Byte array object with the changed value.


  (*je)->ReleaseByteArrayElements( je, aryobj, (signed char *) zd, 0);

  // 2. Prepare to call the method from the RpgNumeric class which
  //    takes a byte array object and assigns it's value into the
  //    RpgNumeric object.  Obtain the method ID.

  // cls = (*je)->GetObjectClass(je, p1);
  // (clS) still identifies the second parameter.  Re-use value

 mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");


  if ( mid == NULL)
  {
    printf(" ERROR 2: GetMethod.\n");
    return;
  }

  (*je)->CallVoidMethod( je, p1, mid,
                         aryobj,
                         (int) 1,    // = Component.ZONED_TYPE
                         0           // precision
                        );
}
```

Figure 81. Sample File VSUBN.C (Part 2 of 2)

An RpgZoned object is passed as the parameter. The RpgZoned::zonedValue method is used to obtain a byte array containing the numeric value of the object in zoned decimal format. Once the byte array is obtained on the Java side of the interface, the GetByteArrayElements JNI interface function is called to access the byte array on the native side of the interface.

To invoke the zonedValue method on the object, the GetObjectClass, GetMethodID, and CallObjectMethod interface functions are used. Care must be taken to specify the correct method signature on the GetMethodID call. (No parameters, and returning a byte array in this case.)

To alter the value on the Java side, the byte array value is changed, the ReleaseByteArrayElements interface function is invoked to set the byte array change on the Java side, and the appropriate RpgZoned class method is invoked on the Java side to set the RpgZoned object's value with the value represented in the byte array. In this case, it's the assignFromNative method which takes a byte array and two integers as parameters. (The RpgNumeric class referred to in the sample code is a parent class to the RpgZoned class.)

Packed Numeric

```
void _Export __stdcall   Java_VCOMPN_SUBP( JNIEnv *je , void *jc,
                                           jobject p1)  // P(9,2)
{
  jclass     cls;
  jmethodID  mid;
  jobject    aryobj;
  char       *packednum;

  printf(" SUBP called successfully.\n");

  // p1:  Packed 9,2
  // Call the method to get the zoned value

  cls = (*je)->GetObjectClass(je, p1);

  mid = (*je)->GetMethodID( je, cls, "packedValue", "()[B");


  if ( mid == NULL)
  {
    printf(" ERROR: GetMethod.\n");
    return;
  }

  aryobj = (*je)->CallObjectMethod( je, p1, mid);

  packednum = (char *) (*je)->GetByteArrayElements( je, aryobj, NULL);

  // Now change the values

  memcpy( packednum, "\x98\x76\x54\x32\x1C", 5);
```

Figure 82. Sample File VSUBN.C continued (Part 1 of 2)

```
  // Returning the Packed parameter

  // 1. Update the Byte array object with the changed value.

  // Fourth Parameter = 0 also causes the variable's storage to be freed,

  // so can not access the variables after this function call.

  (*je)->ReleaseByteArrayElements( je, aryobj, (signed char *) packednum, 0);

  // 2. Prepare to call the method from the RpgNumeric class which
  //    takes a byte array object and assigns it's value into the
  //    RpgNumeric object.  Obtain the method ID.

  // cls = (*je)->GetObjectClass(je, p1);
  // (cls) still identifies the second parameter.  Re-use value

  mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");


  if ( mid == NULL)
  {
    printf(" ERROR 2: GetMethod.\n");
    return;
  }


  (*je)->CallVoidMethod( je, p1, mid,
                         aryobj,
                         (int) 2,    // = Component.PACKED_TYPE
                         2           // precision  (Number of decimal places)
                        );
}
```

Figure 82. Sample File VSUBN.C continued (Part 2 of 2)

The packed decimal parameter case is similar to the zoned decimal. Only the appropriate methods for converting an RpgPacked object to and from a byte array value are used.

The RpgPacked::packedValue method is used to obtain a byte array containing the numeric value of the RpgPacked parameter object in native packed decimal format, and then the JNI interface functions are invoked to make the Java byte array accessible from the native side of the interface.

After altering the byte array on the native side and invoking the ReleaseByteArrayElements interface function to return the byte array to the Java side, the assignFromNative method is once again invoked to set the RpgPacked object's value from the Java byte array.

Binary

```
void _Export __stdcall   Java_VCOMPN_SUBB( JNIEnv *je , void *jc,
                                           jobject p1  // B(4,0)
                                          ,jobject p2) // B(9,0)
{
  jclass     cls;
  jmethodID  mid;
  jobject    aryobj;
  jobject    aryobj2;

  char       *binarynum;
  char       *b9;

  short      binary2;
  int        binary4;

  printf(" SUBB called successfully.\n");

  // p1:  Binary 4,0

  // Call the method to get the binary value

  cls = (*je)->GetObjectClass(je, p1);

  mid = (*je)->GetMethodID( je, cls, "binaryValue", "()[B");

  if ( mid == NULL)
  {
    printf(" ERROR: GetMethod.\n");
    return;
  }

  aryobj = (*je)->CallObjectMethod( je, p1, mid);

  binarynum = (char *) (*je)->GetByteArrayElements( je, aryobj, NULL);

  // Must reverse the byte order of the value received

  memcpy( &binary2, binarynum, 2);

  SwapBin2( &binary2);
```

Figure 83. Sample File VSUBN.C continued (Part 1 of 5)

```
printf(" binary = %hd\n", (short ) binary2);

// p2:  Binary 9,0
// Call the method to get the binary value

cls = (*je)->GetObjectClass(je, p2);

mid = (*je)->GetMethodID( je, cls, "binaryValue", "()[B");

if ( mid == NULL)
{
  printf(" ERROR: GetMethod.\n");
  return;
}

aryobj2 = (*je)->CallObjectMethod( je, p2, mid);

b9 = (char *) (*je)->GetByteArrayElements( je, aryobj2, NULL);


// Must reverse the byte order of the value received

memcpy( &binary4, b9, 4);
SwapBin4( &binary4);

printf(" binary = %d.\n", (int ) binary4 );
```

Figure 83. Sample File VSUBN.C continued (Part 2 of 5)

```
// Now change the values

binary2 = 5;

// Swap it back for returning to the Java value

SwapBin2( &binary2);
memcpy( binarynum, &binary2, 2);

// Returning the parameter

// 1. Update the Byte array object with the changed value.


// Fourth Parameter = 0 also causes the variable's storage to be freed,
// so can not access the variables after this function call.

(*je)->ReleaseByteArrayElements( je, aryobj, (signed char *) binarynum, 0);

// 2. Prepare to call the method from the RpgNumeric class which
//    takes a byte array object and assigns it's value into the
//    RpgNumeric object.  Obtain the method ID.

cls = (*je)->GetObjectClass(je, p1);

// (cls) still identifies the second parameter.  Re-use value

mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

if ( mid == NULL)
{
  printf(" ERROR 2: GetMethod.\n");
  return;
}
```

Figure 83. Sample File VSUBN.C continued (Part 3 of 5)

```
(*je)->CallVoidMethod( je, p1, mid,
                       aryobj,
                       (int) 3,    // = Component.BINARY_TYPE
                       0           // precision  (Number of decimal places)
                     );


// Now change the values

binary4 = 19981999;

// Swap it back for returning to the Java value

SwapBin4( &binary4);
memcpy( b9, &binary4, 4);

// Returning the parameter

// 1. Update the Byte array object with the changed value.

// Fourth Parameter = 0 also causes the variable's storage to be freed,
// so can not access the variables after this function call.

(*je)->ReleaseByteArrayElements( je, aryobj2, (signed char *) b9, 0);


// 2. Prepare to call the method from the RpgNumeric class which
//    takes a byte array object and assigns it's value into the
//    RpgNumeric object.  Obtain the method ID.

cls = (*je)->GetObjectClass(je, p2);
// (cls) still identifies the second parameter.  Re-use value

mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

if ( mid == NULL)
{
  printf(" ERROR 2: GetMethod.\n");
  return;
}
```

Figure 83. Sample File VSUBN.C continued (Part 4 of 5)

```
  (*je)->CallVoidMethod( je, p2, mid,
                         aryobj2,
                         (int) 3,    // = Component.BINARY_TYPE
                         0           // precision  (Number of decimal places)
                        );
}
//---------------------------------------------------------------------
static void SwapBin2( short *b2)
{
   char  tmp;
   char  *p;

   p = (char *) b2;

   tmp = p[0];
   p[0] = p[1];
   p[1] = tmp;

}
//---------------------------------------------------------------------
static void SwapBin4( int *b4)
{
   char  tmp;
   char  *p;

   p = (char *) b4;

   tmp = p[0];
   p[0] = p[3];
   p[3] = tmp;

   tmp = p[1];
   p[1] = p[2];
   p[2] = tmp;
}
```

Figure 83. Sample File VSUBN.C continued (Part 5 of 5)

This case is similar to the zoned decimal. Only the appropriate methods for RpgBinary objects are used. The only added complication is that the native Intel architecture platform stores binary integers in a low-order-bytes-leftmost format, but the Java side works with them in a low-order-bytes-rightmost format. The SwapBin2 and SwapBin4 functions are employed to reverse the byte order when converting between the two sides for two- and four-byte binary integers.

The RpgBinary::binaryValue method is used to obtain a byte array containing the numeric value of the RpgBinary parameter object in native binary format. Then the JNI interface functions are invoked to make the Java byte array accessible from the native side of the interface. After altering the byte array on the native side and invoking the ReleaseByteArrayElements interface function to return the byte array to the Java side, the assignFromNative method is once again invoked to set the RpgBinary object's value from the Java byte array.

Integer, Unsigned

```
      * With Parameters: Integer, unsigned
     d subiu           pr                  dll('VSUBO')
     d                                  5i 0
     d                                 10i 0
     d                                  5u 0
     d                                 10u 0
```

Figure 84. Sample VJNIO.VPG

```
static void SwapBin2( char *);
static void SwapBin4( char *);

void _Export __stdcall   Java_VJNIO_SUBIU(  JNIEnv *je , void *jc,
                      jobject p1, jobject p2, jobject p3, jobject p4)
{
  jclass     cls, cls2;
  jmethodID  mid;
  jshort     i2;
  jint       i4;
  jobject    aryobj3, aryobj4;
  unsigned short *u2;
  unsigned int   *u4;

  printf(" SUBIU called successfully.\n");


  // p1:  Integer, 2 byte
  // Call the method to get the value


   cls = (*je)->GetObjectClass(je, p1);
   mid = (*je)->GetMethodID( je, cls, "getValue", "()S");

   if ( mid == NULL)
   {
      printf(" ERROR: GetMethod.\n");
      return;
   }

   i2 = (*je)->CallShortMethod( je, p1, mid);

   printf(" i2 = %hd\n", (short) i2);


  // p2:  Integer, 4 byte
  // Call the method to get the value

   cls = (*je)->GetObjectClass(je, p2);

   mid = (*je)->GetMethodID( je, cls, "getValue", "()I");
```

Figure 85. Sample VSUBO.C (Part 1 of 6)

```
 if ( mid == NULL)
 {
    printf(" ERROR: GetMethod.\n");
    return;
 }

 i4 = (*je)->CallIntMethod( je, p2, mid);

 printf(" i4 = %d\n", (short) i4);


// p3:  Unsigned 2-byte.
// Call the method to get the double value

 cls = (*je)->GetObjectClass(je, p3);

 mid = (*je)->GetMethodID( je, cls, "unsignedValue", "()[B");

 if ( mid == NULL)
 {
    printf(" ERROR: GetMethod.\n");

    return;
 }

 aryobj3 = (*je)->CallObjectMethod( je, p3, mid);

 u2 = (unsigned short *) (*je)->GetByteArrayElements( je, aryobj3, NULL);

 // Must reverse the byte order of the value received
 SwapBin2( (char *) u2);

 printf(" u2 = %hu\n", *u2 );
```

Figure 85. Sample VSUBO.C (Part 2 of 6)

```
// p4:  Unsigned 4-byte.
// Call the method to get the double value

 cls = (*je)->GetObjectClass(je, p4);

 mid = (*je)->GetMethodID( je, cls, "unsignedValue", "()[B");


 if ( mid == NULL)
 {
    printf(" ERROR: GetMethod.\n");
    return;
 }

 aryobj4 = (*je)->CallObjectMethod( je, p4, mid);

 u4 = (unsigned int *) (*je)->GetByteArrayElements( je, aryobj4, NULL);

 // Must reverse the byte order of the value received
 SwapBin4( (char *) u4);

 printf(" u4 = %u\n", *u4 );



 // Now change the values

 i2 = 99;
 i4 = 88;
 *u2 = 77;
 *u4 = 66;


 // Must reverse the byte order of the value being returned
 SwapBin2( (char *) u2);
 SwapBin4( (char *) u4);

 // Return the array memory to Java.  Used later to set return
 // values for parameters

 (*je)->ReleaseByteArrayElements( je, p3, (signed char *) u2, 0);
 (*je)->ReleaseByteArrayElements( je, p4, (signed char *) u4, 0);
```

Figure 85. Sample VSUBO.C (Part 3 of 6)

```
// Returning P1: Integer 2-byte

//    Invoke the RpgShortRef::setValue method to set the object

//    value with a short parameter value

//    Obtain the method ID so it can be invoked.

cls = (*je)->GetObjectClass(je, p1);
mid = (*je)->GetMethodID( je, cls, "setValue", "(S)V");

if ( mid == NULL)
{
   printf(" ERROR 5: GetMethod.\n");
   return;
}

(*je)->CallVoidMethod( je, p1, mid, i2);

// Returning P2: Integer 4-byte

//    Invoke the RpgIntRef::setValue method to set the object

//    value with an integer parameter value

//    Obtain the method ID so it can be invoked.

cls = (*je)->GetObjectClass(je, p2);
mid = (*je)->GetMethodID( je, cls, "setValue", "(I)V");

if ( mid == NULL)
{
   printf(" ERROR 6: GetMethod.\n");
   return;
}

(*je)->CallVoidMethod( je, p2, mid, i4);
```

Figure 85. Sample VSUBO.C (Part 4 of 6)

```
   // Returning P3: Unsigned 2-byte

   //    Invoke the RpgNumeric::assignFromNative method to set the object

   //    value with an unsigned parameter value

   //    Obtain the method ID so it can be invoked.
   cls = (*je)->GetObjectClass(je, p3);
   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   if ( mid == NULL)
   {
      printf(" ERROR 7: GetMethod.\n");
      return;
   }

   // Pass (aryobj3) as first parameter to method because the
   // method expects a Java byte array object

   (*je)->CallVoidMethod( je, p3, mid,

                                  aryobj3,
                                  (int) 5,   // = Component.UNSIGNED_TYPE
                                  (int) 0);  // 0 decimal places


   // Returning P4: Unsigned 4-byte

   //    Invoke the RpgNumeric::assignFromNative method to set the object
   //    value with an unsigned parameter value

   //    Obtain the method ID so it can be invoked.

   cls = (*je)->GetObjectClass(je, p4);

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   if ( mid == NULL)
   {
      printf(" ERROR 8: GetMethod.\n");
      return;
   }

   (*je)->CallVoidMethod( je, p4, mid, aryobj4,
                                  (int) 5,   // = Component.UNSIGNED_TYPE
                                  (int) 0);  // 0 decimal places

}
```

Figure 85. Sample VSUBO.C (Part 5 of 6)

```
static void SwapBin2( char *p)
{
   char  tmp;

   tmp = p[0];
   p[0] = p[1];

   p[1] = tmp;
}

static void SwapBin4( char *p)
{
   char  tmp;

   tmp = p[0];
   p[0] = p[3];
   p[3] = tmp;

   tmp = p[1];
   p[1] = p[2];
   p[2] = tmp;
}
```

Figure 85. Sample VSUBO.C (Part 6 of 6)

Two-byte integers use the RpgShortRef::getValue and setValue methods to access their values into short values on the native side. Similarly four-byte integers use RpgIntRef::getValue and setValue methods to pass between native-side int values.

Unsigned parameters are complicated by the lack of a Java primitive matching an unsigned value. The unsigned object value is accessed through byte array primitives. The parameter access invokes the method to get the byte array representing the unsigned value then invokes the GetByteArrayElements interface function to access the array elements on the native side. Furthermore, on a native Intel/Windows platform, the byte value must first be byte-reversed to change it into the low-order-bytes-leftmost format. Returning the parameter follows a reverse process.

Float (4/8)

```
     * With Parameters: Float 4, Float 8.
    d subf            pr                  dll('VSUBO')
    d                                 4f
    d                                 8f
```

Figure 86. Sample VJNIO.VPG

```
void _Export __stdcall   Java_VJNIO_SUBF(  JNIEnv *je , void *jc,
                                            jobject p1, jobject p2)
{
  jclass     cls, cls2;
  jmethodID  mid;
  jfloat     f4;
  jdouble    f8;

  // p1:  Float
  // Call the method to get the float value

   cls = (*je)->GetObjectClass(je, p1);
   mid = (*je)->GetMethodID( je, cls, "getValue", "()F");

   if ( mid == NULL)
   {
      printf(" ERROR: GetMethod.\n");

      return;
   }

   f4 = (*je)->CallFloatMethod( je, p1, mid);

   printf(" f4 = %f\n", (float) f4);

  // p2:  Double
  // Call the method to get the double value

   cls2 = (*je)->GetObjectClass(je, p2);

   mid = (*je)->GetMethodID( je, cls2, "getValue", "()D");

   if ( mid == NULL)
   {
      printf(" ERROR: GetMethod.\n");
      return;
   }

   f8 = (*je)->CallDoubleMethod( je, p2, mid);


   printf(" f8 = %lf\n", (double) f8);
```

Figure 87. Sample VSUBO.C (Part 1 of 2)

```
  // Now change the values

  f4 = 999.888;
  f8 = 98789.65456;

   // Returning the Float parameter

   //    Invoke the method from the RpgFloatRef class which
   //    assigns a Float parameter value to the object

   //    Obtain the method ID so it can be invoked.

   mid = (*je)->GetMethodID( je, cls, "setValue", "(F)V");

   if ( mid == NULL)
   {
      printf(" ERROR 2: GetMethod.\n");

      return;
   }


   (*je)->CallVoidMethod( je, p1, mid, f4);

   // Returning the Double parameter

   //    Invoke the method from the RpgDoubleRef class which
   //    assigns a Double parameter value to the object

   //    Obtain the method ID so it can be invoked.

   mid = (*je)->GetMethodID( je, cls2, "setValue", "(D)V");

   if ( mid == NULL)
   {
      printf(" ERROR 2: GetMethod.\n");
      return;

   }

   (*je)->CallVoidMethod( je, p2, mid, f8);
}
```

Figure 87. Sample VSUBO.C (Part 2 of 2)

The float and double parameter cases are similar to the previous data types. Only the methods to access the parameter values work with Java primitive data types, which map to corresponding native primitives, instead of the usual byte arrays. JNI interface functions dealing with these specific primitives are used to invoke the methods to access the parameter values.

The RpgFloatRef::getValue, setValue, RpgDoubleRef::getValue, and setValue methods are used.

Date, Time, Timestamp

```
     * With Parameters: Date, Time, Timestamp.
    d subdtz          pr                  dll('VSUBO')
    d                                10d
    d                                 8t
    d                                26z

    d fd              s              10d   inz(D'1999-12-31')
    d ft              s               8t   inz(T'09.00.00')
    d fts             s              26z   inz(Z'2001-01-01-08.01.01')

    C                   callp     subdtz(fd:ft:fts)
```

Figure 88. Sample VJNIO.VPG

```
void _Export __stdcall   Java_VJNIO_SUBDTZ(  JNIEnv *je , void *jc,
                  jbyteArray p1, jbyteArray p2, jbyteArray p3)
{
  char   *fd, *ft, *fz;

  fd  = (char *) (*je)->GetByteArrayElements( je, p1, NULL);
  ft  = (char *) (*je)->GetByteArrayElements( je, p2, NULL);
  fz  = (char *) (*je)->GetByteArrayElements( je, p3, NULL);

  printf(" fd = %.10s.\n", fd);
  printf(" ft = %.8s.\n",  ft);
  printf(" fz = %.26s.\n", fz);

  // Now change the values


  memcpy( fd, "2000-01-01",10);
  memcpy( ft, "17.00.00",  8);
  memcpy( fz, "2222-22-22-02.02.02", 19);

  // Update the values back to the Java Caller

  // Fourth Parameter = 0 also causes the variable's storage to be freed,
  // so can not access the variables after this function call.

  (*je)->ReleaseByteArrayElements( je, p1, (signed char *) fd, 0);
  (*je)->ReleaseByteArrayElements( je, p2, (signed char *) ft, 0);
  (*je)->ReleaseByteArrayElements( je, p3, (signed char *) fz, 0);


}
```

Figure 89. Sample VSUBO.C

Date, time, and timestamp parameters work the same as character parameters, since they are implemented on the Java side as byte arrays.

Passing Arrays

Handling arrayed parameters is done one of two ways depending on the datatype. Invoke the GetObjectArrayElement interface function to get an address to an individual object element in the array, then process it like the scalar parameter methods. Or in the case of an array of Java primitives, there are specific interface functions to access them as an array of native primitives, and then release them back to Java.

```
d subca           pr                  dll('VSUBA')
d                                4
d                               10    dim(4)

d c1              s                1    inz('J')
d c4              s                4    inz('blue')
d c10             s               10    inz('abcdefghij') dim(4)

d subz            pr                  dll('VSUBA')
d                                4S 0 dim(4)

d subp            pr                  dll('VSUBA')

d                                9P 2 dim(4)

d subb            pr                  dll('VSUBA')
d                                4B 0 dim(4)
d                                9B 0 dim(4)

d z4              s                4S 0 dim(4)
d p92             s                9P 2 dim(4)
d b4              s                4B 0 dim(4)
d b9              s                9B 0 dim(4)

d subf            pr                  dll('VSUBA')

d                                4f   dim(4)
d                                8f   dim(4)
```

Figure 90. Sample VJNIA.VPG (Part 1 of 2)

```
d subdtz          pr                  dll('VSUBA')
d                                10d   dim(4)
d                                 8t   dim(4)
d                                26z   dim(4)

d subiu           pr                  dll('VSUBA')
d                                 5i 0 dim(4)
d                                10i 0 dim(4)

d                                 5u 0 dim(4)
d                                10u 0 dim(4)

d f4              s                4f   dim(4) inz(1234.56)
d f8              s                8f   dim(4) inz(1111.2222)
d fd              s               10d   dim(4) inz(D'1999-12-31')
d ft              s                8t   dim(4) inz(T'09.00.00')
d fts             s               26z   dim(4) inz(Z'2001-01-01-08.01.01')

d fi2             s                5i 0 dim(4) inz(1)

d fi4             s               10i 0 dim(4) inz(2)
d fu2             s                5u 0 dim(4) inz(3)
d fu4             s               10u 0 dim(4) inz(4)

C     *INZSR        BEGSR

C                   callp     subca(c4:c10)
C                   callp     subz(z4)
C                   callp     subp(p92)
C                   callp     subb(b4:b9)
C                   callp     subf(f4:f8)
C                   callp     subdtz(fd:ft:fts)

C                   callp     subiu(fi2:fi4:fu2:fu4)
c                   seton                                          lr
C                   ENDSR
```

Figure 90. Sample VJNIA.VPG (Part 2 of 2)

```
// Source File:  VSUBA.C
//               Native function with Character parameters
// Add   (d:\jdk12\include;d:\jdk12\include\win32) to the INCLUDE setting
//      in order to find jni.h when compiling.
// Compiled with:  IBM VisualAge(TM) for C++ for Windows(R), Version 3.5
// Compile command:  icc  /q /ss /ge- /fe vsuba.dll  vsuba.c
#include <stdio.h>
#include <string.h>
#include <jni.h>
static void SwapBin2( char *);
static void SwapBin4( char *);

void _Export __stdcall   Java_VJNIA_SUBCA( JNIEnv *je , void *jc,

                                           jbyteArray p1, jobjectArray p2)
{
  char  *c4;
  char  *c10;
  jobject  p2e;

  // Resolve to 2nd element of array parameter
  p2e = (*je)->GetObjectArrayElement( je, p2,
                                      1);  /* Array index, first element = 0.  */

  c4  = (char *) (*je)->GetByteArrayElements( je, p1, NULL);
  c10 = (char *) (*je)->GetByteArrayElements( je, p2e, NULL);

  printf(" c4  = %.4s.\n",  c4);

  printf(" c10 = %.10s.\n", c10);

  // Now change the values

  memcpy( c4, "Gray", 4);
  memcpy(c10, "Changed   ", 10);

  // Update the values back to the Java Caller

  (*je)->ReleaseByteArrayElements( je, p1, (signed char *) c4, 0);
  (*je)->ReleaseByteArrayElements( je, p2e, (signed char *) c10, 0);
}

void _Export __stdcall   Java_VJNIA_SUBZ(  JNIEnv *je , void *jc,
                                           jobject p1)
```

Figure 91. Sample VSUBA.C (Part 1 of 14)

```
{
  jclass     cls;
  jmethodID  mid;
  jobject    aryobj;
  char       *zd;
  jobject    pe;

  // Resolve to element of array parameter
  pe = (*je)->GetObjectArrayElement( je, p1,
                                     0);  /* Array index, first element = 0.  */

  // p1:  Zoned
  // Call the method to get the zoned value

   cls = (*je)->GetObjectClass(je, pe);

   mid = (*je)->GetMethodID( je, cls, "zonedValue", "()[B");


   aryobj = (*je)->CallObjectMethod( je, pe, mid);

   zd = (char *) (*je)->GetByteArrayElements( je, aryobj, NULL);

   printf(" zd = %.4s.\n", zd);


  // Now change the values

  memcpy( zd, "9876", 4);


   // Returning the Zoned parameter

   // 1. Update the Byte array object with the changed value.

  (*je)->ReleaseByteArrayElements( je, aryobj, (signed char *) zd, 0);
```

Figure 91. Sample VSUBA.C (Part 2 of 14)

```
   // 2. Prepare to call the method from the RpgNumeric class which

   //    takes a byte array object and assigns it's value into the
   //    RpgNumeric object.  Obtain the method ID.

   // cls = (*je)->GetObjectClass(je, p1);
   // (clS) still identifies the second parameter.  Re-use value

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   (*je)->CallVoidMethod( je, pe, mid,
                          aryobj,
                          (int) 1,    // = Component.ZONED_TYPE
                          0           // precision

                        );
}

void _Export __stdcall   Java_VJNIA_SUBP( JNIEnv *je , void *jc,
                                          jobject p1  // P(9,2)
                                          )
{
  jclass     cls;
  jmethodID  mid;
  jobject    aryobj;
  char       *packednum;
  char       tmp[80];         // For tracing
  jobject    pe;

  // Resolve to element of array parameter

  pe = (*je)->GetObjectArrayElement( je, p1,

                                     1);  /* Array index, first element = 0.  */

  // p1:  Packed 9,2
  // Call the method to get the zoned value

   cls = (*je)->GetObjectClass(je, pe);

   mid = (*je)->GetMethodID( je, cls, "packedValue", "()[B");

   aryobj = (*je)->CallObjectMethod( je, pe, mid);

   packednum = (char *) (*je)->GetByteArrayElements( je, aryobj, NULL);
```

Figure 91. Sample VSUBA.C (Part 3 of 14)

```
  // Now change the values
  memcpy( packednum, "\x98\x76\x54\x32\x1C", 5);


   // Returning the Packed parameter

   // 1. Update the Byte array object with the changed value.

   // Fourth Parameter = 0 also causes the variable's storage to be freed,
   // so can not access the variables after this function call.

  (*je)->ReleaseByteArrayElements( je, aryobj, (signed char *) packednum, 0);

   // 2. Prepare to call the method from the RpgNumeric class which
   //    takes a byte array object and assigns it's value into the

   //    RpgNumeric object.  Obtain the method ID.

   // cls = (*je)->GetObjectClass(je, p1);
   // (clS) still identifies the second parameter.  Re-use value

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   (*je)->CallVoidMethod( je, pe, mid,
                          aryobj,
                          (int) 2,    // = Component.PACKED_TYPE
                          2           // precision  (Number of decimal places)

                        );
}
//-------------------------------------------------------------
```

Figure 91. Sample VSUBA.C (Part 4 of 14)

```
void _Export __stdcall   Java_VJNIA_SUBB( JNIEnv *je , void *jc,
                                           jobject p1  // B(4,0)
                                          ,jobject p2  // B(9,0)
                                         )
{
  jclass     cls;
  jmethodID  mid;
  jobject    aryobj;
  jobject    aryobj2;
  char       *binarynum;
  char       *b9;

  short      binary2;
  int        binary4;
  jobject    pe,p2e;


  // Resolve to element of array parameter

  pe = (*je)->GetObjectArrayElement( je, p1,
                                     2);  /* Array index, first element = 0.  */

  // Resolve to element of array parameter

  p2e = (*je)->GetObjectArrayElement( je, p2,
                                     3);  /* Array index, first element = 0.  */

  // p1:  Binary 4,0

  // Call the method to get the binary value

   cls = (*je)->GetObjectClass(je, pe);

   mid = (*je)->GetMethodID( je, cls, "binaryValue", "()[B");

   aryobj = (*je)->CallObjectMethod( je, pe, mid);

   binarynum = (char *) (*je)->GetByteArrayElements( je, aryobj, NULL);
```

Figure 91. Sample VSUBA.C (Part 5 of 14)

```
 // Must reverse the byte order of the value received

 memcpy( &binary2, binarynum, 2);
 SwapBin2( (char *) &binary2);

 printf(" binary = %hd\n", (short ) binary2);


// p2:  Binary 9,0
// Call the method to get the binary value

 cls = (*je)->GetObjectClass(je, p2e);

 mid = (*je)->GetMethodID( je, cls, "binaryValue", "()[B");

 aryobj2 = (*je)->CallObjectMethod( je, p2e, mid);

 b9 = (char *) (*je)->GetByteArrayElements( je, aryobj2, NULL);

 // Must reverse the byte order of the value received

 memcpy( &binary4, b9, 4);
 SwapBin4( (char *) &binary4);


 printf(" binary = %d.\n", (int ) binary4 );

// Now change the values

binary2 = 5;

 // Swap it back for returning to the Java value

 SwapBin2( (char *) &binary2);
```

Figure 91. Sample VSUBA.C (Part 6 of 14)

```
 memcpy( binarynum, &binary2, 2);


 // Returning the Packed parameter

 // 1. Update the Byte array object with the changed value.

 // Fourth Parameter = 0 also causes the variable's storage to be freed,

 // so can not access the variables after this function call.

(*je)->ReleaseByteArrayElements( je, aryobj, (signed char *) binarynum, 0);

 // 2. Prepare to call the method from the RpgNumeric class which
 //    takes a byte array object and assigns it's value into the
 //    RpgNumeric object.  Obtain the method ID.

  cls = (*je)->GetObjectClass(je, pe);
 // (clS) still identifies the second parameter.  Re-use value


 mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

 (*je)->CallVoidMethod( je, pe, mid,
                        aryobj,
                        (int) 3,    // = Component.BINARY_TYPE
                        0           // precision  (Number of decimal places)
                      );


// Now change the values

binary4 = 19981999;

 // Swap it back for returning to the Java value

 SwapBin4( (char *) &binary4);


 memcpy( b9, &binary4, 4);
```

Figure 91. Sample VSUBA.C (Part 7 of 14)

```
   // Returning the Packed parameter

   // 1. Update the Byte array object with the changed value.

   // Fourth Parameter = 0 also causes the variable's storage to be freed,
   // so can not access the variables after this function call.

  (*je)->ReleaseByteArrayElements( je, aryobj2, (signed char *) b9, 0);

   // 2. Prepare to call the method from the RpgNumeric class which
   //    takes a byte array object and assigns it's value into the

   //    RpgNumeric object.  Obtain the method ID.

    cls = (*je)->GetObjectClass(je, p2e);
   // (clS) still identifies the second parameter.  Re-use value

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   (*je)->CallVoidMethod( je, p2e, mid,
                          aryobj2,
                          (int) 3,    // = Component.BINARY_TYPE
                          0           // precision  (Number of decimal places)

                        );
}

//-------------------------------------------------------------
```

Figure 91. Sample VSUBA.C (Part 8 of 14)

```
void _Export __stdcall   Java_VJNIA_SUBF(  JNIEnv *je , void *jc,
                                            jfloatArray p1, jdoubleArray p2)
{
  jclass     cls, cls2;
  jmethodID  mid;
  jfloat     *f4;
  jdouble    *f8;
  jobject    p1e,p2e;

  printf(" SUBF called successfully.\n");

  f4  =  (*je)->GetFloatArrayElements( je, p1, NULL);

  f8  =  (*je)->GetDoubleArrayElements( je, p2, NULL);

   printf(" f4 = %f\n", (float) f4[0]);


  // p2:  Double
  // Call the method to get the double value

   printf(" f8 = %lf\n", (double) f8[0]);

  // Now change the values

  f4[0] = 999.888;
  f8[1] = 98789.65456;

   // Returning the Float parameter

  (*je)->ReleaseFloatArrayElements( je, p1, f4, 0);
  (*je)->ReleaseDoubleArrayElements( je, p2, f8, 0);

}
```

Figure 91. Sample VSUBA.C (Part 9 of 14)

```
//-------------------------------------------------------------

void _Export __stdcall   Java_VJNIA_SUBDTZ(  JNIEnv *je , void *jc,
                  jbyteArray p1, jbyteArray p2, jbyteArray p3)
{
  char   *fd, *ft, *fz;
  jobject p1e, p2e, p3e;

  printf(" SUBDTZ called successfully.\n");

  // Resolve to element of array parameter

  p1e = (*je)->GetObjectArrayElement( je, p1,
                                      2);  /* Array index, first element = 0.  */


  p2e = (*je)->GetObjectArrayElement( je, p2,
                                      3);  /* Array index, first element = 0.  */
  p3e = (*je)->GetObjectArrayElement( je, p3,
                                      0);  /* Array index, first element = 0.  */


  fd  = (char *) (*je)->GetByteArrayElements( je, p1e, NULL);
  ft  = (char *) (*je)->GetByteArrayElements( je, p2e, NULL);
  fz  = (char *) (*je)->GetByteArrayElements( je, p3e, NULL);


  printf(" fd = %.10s.\n", fd);
  printf(" ft = %.8s.\n",  ft);
  printf(" fz = %.26s.\n", fz);

  // Now change the values

  memcpy( fd, "2000-01-01",10);
  memcpy( ft, "17.00.00",  8);
  memcpy( fz, "2222-22-22-02.02.02", 19);

  // Update the values back to the Java Caller

  (*je)->ReleaseByteArrayElements( je, p1e, (signed char *) fd, 0);
  (*je)->ReleaseByteArrayElements( je, p2e, (signed char *) ft, 0);
  (*je)->ReleaseByteArrayElements( je, p3e, (signed char *) fz, 0);


}
```

Figure 91. Sample VSUBA.C (Part 10 of 14)

```
//-------------------------------------------------------------

void _Export __stdcall   Java_VJNIA_SUBIU(  JNIEnv *je , void *jc,
                     jshortArray p1, jintArray p2, jobject p3, jobject p4)
{
  jclass     cls, cls2;
  jmethodID  mid;
  jshort     *i2;
  jint       *i4;
  jobject    aryobj3, aryobj4;
  unsigned short *u2;
  unsigned int   *u4;
  jobject    p1e, p2e, p3e, p4e;

  printf(" SUBIU called successfully.\n");


  // Resolve to element of array parameter

  i2  =  (*je)->GetShortArrayElements( je, p1, NULL);
  i4  =  (*je)->GetIntArrayElements( je, p2, NULL);

  p3e = (*je)->GetObjectArrayElement( je, p3, 2);
  p4e = (*je)->GetObjectArrayElement( je, p4, 3);


   printf(" i2 = %hd\n", (short) i2[0]);


   printf(" i4 = %d\n", (short) i4[1]);


  // p3:  Unsigned 2-byte.
  // Call the method to get the double value


   cls = (*je)->GetObjectClass(je, p3e);

   mid = (*je)->GetMethodID( je, cls, "unsignedValue", "()[B");

   aryobj3 = (*je)->CallObjectMethod( je, p3e, mid);

   u2 = (unsigned short *) (*je)->GetByteArrayElements( je, aryobj3, NULL);
```

Figure 91. Sample VSUBA.C (Part 11 of 14)

```
 // Must reverse the byte order of the value received
 SwapBin2( (char *) u2);

 printf(" u2 = %hu\n", *u2 );

// p4:  Unsigned 4-byte.
// Call the method to get the double value


 cls = (*je)->GetObjectClass(je, p4e);

 mid = (*je)->GetMethodID( je, cls, "unsignedValue", "()[B");

 aryobj4 = (*je)->CallObjectMethod( je, p4e, mid);

 u4 = (unsigned int *) (*je)->GetByteArrayElements( je, aryobj4, NULL);

 // Must reverse the byte order of the value received
 SwapBin4( (char *) u4);

 printf(" u4 = %u\n", *u4 );
```

Figure 91. Sample VSUBA.C (Part 12 of 14)

```
 // Now change the values

 i2[0] = 99;
 i4[1] = 88;

 *u2 = 77;
 *u4 = 66;

 // Must reverse the byte order of the value being returned
 SwapBin2( (char *) u2);
 SwapBin4( (char *) u4);

 // Return the array memory to Java.  Used later to set return
 // values for parameters

 (*je)->ReleaseByteArrayElements( je, p3e, (signed char *) u2, 0);
 (*je)->ReleaseByteArrayElements( je, p4e, (signed char *) u4, 0);


(*je)->ReleaseShortArrayElements( je, p1, i2, 0);

(*je)->ReleaseIntArrayElements( je, p2, i4, 0);



 // Returning P3: Unsigned 2-byte

 //    Invoke the RpgNumeric::assignFromNative method to set the object
 //    value with an unsigned parameter value

 //    Obtain the method ID so it can be invoked.
 cls = (*je)->GetObjectClass(je, p3e);
 mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

 // Pass (aryobj3) as first parameter to method because the

 // method expects a Java byte array object

 (*je)->CallVoidMethod( je, p3e, mid,
                                aryobj3,
                                (int) 5,   // = Component.UNSIGNED_TYPE
                                (int) 0);  // 0 decimal places
```

Figure 91. Sample VSUBA.C (Part 13 of 14)

```
   // Returning P4: Unsigned 4-byte

   //    Invoke the RpgNumeric::assignFromNative method to set the object
   //    value with an unsigned parameter value

   //    Obtain the method ID so it can be invoked.


   cls = (*je)->GetObjectClass(je, p4e);
   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   (*je)->CallVoidMethod( je, p4e, mid, aryobj4,
                                  (int) 5,   // = Component.UNSIGNED_TYPE
                                  (int) 0);  // 0 decimal places
}

static void SwapBin2( char *p)
{
   char  tmp;

   tmp = p[0];
   p[0] = p[1];
   p[1] = tmp;
}

static void SwapBin4( char *p)

{
   char  tmp;

   tmp = p[0];
   p[0] = p[3];
   p[3] = tmp;

   tmp = p[1];
   p[1] = p[2];
   p[2] = tmp;
}
```

Figure 91. Sample VSUBA.C (Part 14 of 14)

Returning A Char Value

```
     d subrc           pr            10    dll('VSUBR')

     d fc              s             10    inz('ibm varpg ')

     C                   eval      fc = subrc
```

Figure 92. Sample VJNIR.VPG

```
jbyteArray  _Export __stdcall   Java_VJNIR_SUBRC(  JNIEnv *je , void *jc)
{
  jbyteArray ba;
  char       *p;

  printf(" SUBRC called successfully.\n");

  // Create a new byte array object so it can be returned.

  ba = (*je)->NewByteArray( je, 10 /* = byte array length */ );

  // Pin the byte array element memory so native side can access it.
  p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

  memcpy( p, "Success   ",10);


  // Update the values back to the Java Caller

  // Fourth Parameter = 0 also causes the variable's storage to be freed,
  // so can not access the variables after this function call.

  (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);

  return ba;
}
```

Figure 93. Sample VSUBR.C

Returning a value from the function involves obtaining the appropriate Java object and then returning it. In this sample, a new object (matching a Character(10) field) was created, then it's value was assigned. Since the RPG character fields are implemented as Java byte arrays, a Java byte array object of length ten was created, then the GetByteArrayElements interface function was used to access the byte array elements on the native side, then released back to Java, and finally used to return from the function.

If the appropriate Java byte array object was already available from one of the input parameters, then it could have been used instead of creating a new object.

Returning A Zoned Value

```
     d subrs           pr             5s 0 dll('VSUBR')
     d fs              s              5s 0

     C                   eval      fc = subrc
```

Figure 94. Sample VJNIR.VPG

```
jobject  _Export __stdcall  Java_VJNIR_SUBRS( JNIEnv *je , void *jc)
{
  jclass     cls;
  jmethodID  mid;
  jobject    rzo;

  jbyteArray ba;
  char       *p;

  printf(" SUBRS called successfully.\n");

  // Create a new RpgZoned object.

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgZoned");

  mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

  rzo = (*je)->NewObject( je, cls, mid,
                          (int) 5, /* # of digits */

                          (int) 0  /* # of decimal places */
                        );

  // To set the zoned object value, we need a Java byte array to use
  // as an input parameter to the method for setting the zoned object.
  // Could constuct a new byte array object, or get one by retrieving
  // the zoned value from the object.

  // Will construct a byte array.

  // Create a new byte array object

  ba = (*je)->NewByteArray( je, 5 /* = byte array length */ );


  // Pin the byte array element memory so native side can access it.

  p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

  memcpy( p, "55555", 5);
```

Figure 95. Sample VSUBR.C (Part 1 of 2)

```
  // Update the values back to the Java Caller

  // Fourth Parameter = 0 also causes the variable's storage to be freed,
  // so can not access the variables after this function call.

  (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);


   //  Prepare to call the method from the RpgNumeric class which

   //  takes a byte array object and assigns it's value into the
   //  RpgNumeric object.  Obtain the method ID.

   // cls = (*je)->GetObjectClass(je, p1);
   // (cls) still identifies the second parameter.  Re-use value

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");


   (*je)->CallVoidMethod( je, rzo, mid,
                          ba,
                          (int) 1,    // = Component.ZONED_TYPE
                          0           // precision

                        );
  return rzo;
}
```

Figure 95. Sample VSUBR.C (Part 2 of 2)

An RpgZoned object is constructed so it may be returned. Its value is then set through a method call. However, the method to set the value requires a byte array object as an input parameter supplying the value, so the byte array object is constructed first.

An RpgZoned object is constructed by looking up the class, then the constructor method for the class, then invoking the constructor method. A Java byte array object is then constructed and set to a zoned format byte value. A method for setting the RpgZoned object's value is then resolved and invoked, passing it the byte array object as one of its parameters.

Returning A Packed Value

```
    d subrp           pr             5p 0 dll('VSUBR')
    d fp              s              5p 0

    C                   eval      fp = subrp
```

Figure 96. Sample VJNIR.VPG

```
jobject  _Export __stdcall  Java_VJNIR_SUBRP( JNIEnv *je , void *jc)
{
  jclass     cls;
  jmethodID  mid;
  jobject    ro;

  jbyteArray ba;
  char       *p;

  printf(" SUBRP called successfully.\n");

  // Create a new RpgPacked object.

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgPacked");

  mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

  ro = (*je)->NewObject( je, cls, mid,
                         (int) 5, /* # of digits */

                         (int) 0  /* # of decimal places */
                       );

  // To set the packed object value, we need a Java byte array to use
  // as an input parameter to the method for setting the packed object.
  // Could constuct a new byte array object, or get one by retrieving
  // the packed value from the object.

  // Create a new byte array object

  ba = (*je)->NewByteArray( je, 3 /* = byte array length */ );
```

Figure 97. Sample VSUBR.C (Part 1 of 2)

```
  // Pin the byte array element memory so native side can access it.

  p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

  memcpy( p, "\x55\x55\x5C", 3);

  // Update the values back to the Java Caller

  (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);

   //  Prepare to call the method from the RpgNumeric class which
   //  takes a byte array object and assigns it's value into the
   //  RpgNumeric object.  Obtain the method ID.


   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   (*je)->CallVoidMethod( je, ro, mid,
                          ba,         // The byte array object
                          (int) 2,    // = Component.PACKED_TYPE
                          0           // decimal places
                        );
  return ro;
}
```

Figure 97. Sample VSUBR.C (Part 2 of 2)

Returning a packed value is similar to the zoned case above.

An RpgPacked object is constructed by looking up the class, then the constructor method for the class, then invoking the constructor method. A Java byte array object is then constructed and set to a packed format byte value. A method for setting the RpgPacked object's value is then resolved to and invoked, passing it the byte array object as one of it's parameters.

Returning A Binary Value

```
     d subrb           pr             5b 0 dll('VSUBR')
     d fb              s              5b 0

     C                   eval      fb = subrb
```

Figure 98. Sample VJNIR.VPG

```
jobject  _Export __stdcall  Java_VJNIR_SUBRB( JNIEnv *je , void *jc)
{
  jclass     cls;
  jmethodID  mid;
  jobject    ro;

  jbyteArray ba;
  char       *p;

  printf(" SUBRB called successfully.\n");

  // Create a new RpgPacked object.

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgBinary");

  mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

  ro = (*je)->NewObject( je, cls, mid,
                          (int) 5, /* # of digits */

                          (int) 0  /* # of decimal places */
                        );
```

Figure 99. Sample VSUBR.C (Part 1 of 2)

```
  // To set the object value, we need a Java byte array to use
  // as an input parameter to the method for setting the object.

  // Create a new byte array object

  ba = (*je)->NewByteArray( je, 4 /* = byte array length */ );

  // Pin the byte array element memory so native side can access it.

  p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);


  memcpy( p, "\x00\x00\xD9\x03", 4);      // 55555 = 0xD903

  // Update the values back to the Java Caller

   (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);

   //  Prepare to call the method from the RpgNumeric class which
   //  takes a byte array object and assigns it's value into the
   //  RpgNumeric object.  Obtain the method ID.

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");


   (*je)->CallVoidMethod( je, ro, mid,
                          ba,         // The byte array object
                          (int) 3,    // = Component.Binary_TYPE
                          0           // decimal places
                        );
  return ro;
}
```

Figure 99. Sample VSUBR.C (Part 2 of 2)

Returning a binary value is similar to the zoned or packed cases above, only an RpgBinary object is returned.

Returning An Integer Value

```
     d subri2          pr             5i 0 dll('VSUBR')
     d subri4          pr            10i 0 dll('VSUBR')

     d fi2             s              5i 0
     d fi4             s             10i 0

     C                   eval      fi2= subri2
     C                   eval      fi4= subri4
```

Figure 100. Sample VJNIR.VPG

```
jshort  _Export __stdcall  Java_VJNIR_SUBRI2( JNIEnv *je , void *jc)
{
  jshort  rc;
  rc = -5555;
  return rc;
}

jint    _Export __stdcall  Java_VJNIR_SUBRI4( JNIEnv *je , void *jc)
{
  return -55555;
}
```

Figure 101. Sample VSUBR.C

Returning a two-byte or four-byte binary integer value is simple. This is due to the types supported as Java primitives.

Returning An Unsigned Value

```
     d subru           pr             10u 0 dll('VSUBR')
     d fu              s              10u 0
     C                   eval      fu = subru
```

Figure 102. Sample VJNIR.VPG

```
jobject  _Export __stdcall  Java_VJNIR_SUBRU( JNIEnv *je , void *jc)
{
  jclass     cls;
  jmethodID  mid;
  jobject    ro;

  jbyteArray ba;
  char       *p;

  printf(" SUBRU called successfully.\n");

  // Create a new RpgUnsigned object.

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgUnsigned");

  mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

  ro = (*je)->NewObject( je, cls, mid,
                         (int) 5, /* # of digits */

                         (int) 0  /* # of decimal places */
                       );

  // To set the object value, we need a Java byte array to use
  // as an input parameter to the method for setting the object.

  // Create a new byte array object

  ba = (*je)->NewByteArray( je, 4 /* = byte array length */ );

  // Pin the byte array element memory so native side can access it.

  p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);


  memcpy( p, "\x00\x00\xD9\x03", 4);      // 55555 = 0xD903
```

Figure 103. Sample VSUBR.C (Part 1 of 2)

```
  // Update the values back to the Java Caller

  (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);

   //  Prepare to call the method from the RpgNumeric class which
   //  takes a byte array object and assigns it's value into the
   //  RpgNumeric object.  Obtain the method ID.

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");


   (*je)->CallVoidMethod( je, ro, mid,
                          ba,         // The byte array object
                          (int) 5,    // = Component.UNSIGNED_TYPE
                          0           // decimal places
                        );
  return ro;
}
```

Figure 103. Sample VSUBR.C (Part 2 of 2)

Returning a two- or four-byte unsigned binary value is similar to the zoned or packed cases above, only an RpgUnsigned object is used.

Returning A Date, Time, or Timestamp Value

```
     d subrd           pr            10d   dll('VSUBR')
     d fd              s             10d
     C                   eval      fd = subrd
```

Figure 104. Sample VJNIR.VPG

```
jbyteArray  _Export __stdcall   Java_VJNIR_SUBRD(  JNIEnv *je , void *jc)
{
  jbyteArray ba;
  char       *p;

  // Create a new byte array object so it can be returned.

  ba = (*je)->NewByteArray( je, 10 /* = byte array length */ );

  // Pin the byte array element memory so native side can access it.

  p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

  memcpy( p, "2000-01-01",10);

  // Update the values back to the Java Caller


  (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);

  return ba;
}
```

Figure 105. Sample VSUBR.C

Date, time, and timestamp values are returned as Java byte arrays of the expected length. This is similar to the character data type.

Returning A Float Value

```
     d subrf           pr              4f   dll('VSUBR')
     d subrf8          pr              8f   dll('VSUBR')
     d ff              s               4f
     d ff8             s               8f

     C                   eval      ff = subrf
     C                   eval      ff8= subrf8
```

Figure 106. Sample VJNIR.VPG

```
jfloat   _Export __stdcall  Java_VJNIR_SUBRF( JNIEnv *je , void *jc)
{
  jfloat  rc;

  rc = -4444.4444;
  return rc;
}

jdouble   _Export __stdcall  Java_VJNIR_SUBRF8( JNIEnv *je , void *jc)
{
  return -7777777.55555;
}
```

Figure 107. Sample VSUBR.C

Returning a float or double (eight-byte float) value is done directly. This is due to the types supported as Java primitives.

Returning A Varying-Length Character Value

```
     d subrcv          pr            10    dll('VSUBR')  varying
     d fcv             s             10    varying
     C                   eval      fcv= subrcv
```

Figure 108. Sample VJNIR.VPG

```
jbyteArray  _Export __stdcall  Java_VJNIR_SUBRCV( JNIEnv *je , void *jc)
{
  jbyteArray ba;
  char       *p;

  // Return a byte array of the current data length

  // Create a new byte array object so it can be returned.

  ba = (*je)->NewByteArray( je, 4 /* = byte array length */ );

  // Pin the byte array element memory so native side can access it.

  p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);


  memcpy( p, "abcd",4);

  // Update the values back to the Java Caller

  (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);

  return ba;
}
```

Figure 109. Sample VSUBR.C

A varying-length character value is returned through a Java byte array, where the array length matches the current value length.

Returning Array Values

A JNI interface function is called to allocate an array object. If the array elements are Java primitive data types, then the interface functions for allocating these type of array objects is used. (There is a specific function for each primitive type.) These

also allocate the elements of the array. Then it is only a matter of calling the interface function to map the array elements to native memory and they can be set, relased back to Java, and then returned from the function.

If it is not the case of a Java primitive data type for the array elements, then a Java object must be allocated for each element of the array, its value set as desired , and then finally the object is assigned to the specific element of the array. Allocating the individual objects for the elements is similar to the scalar return value case for that datatype.

```
 *  Source File:  VJNIRA.VPG

d subrca          pr            10    dll('VSUBRA') dim(4)
d subrsa          pr             5s 0 dll('VSUBRA') dim(4)
d subrpa          pr             5p 0 dll('VSUBRA') dim(4)
d subrba          pr             5b 0 dll('VSUBRA') dim(4)
d subri2a         pr             5i 0 dll('VSUBRA') dim(4)
d subri4a         pr            10i 0 dll('VSUBRA') dim(4)
d subrua          pr            10u 0 dll('VSUBRA') dim(4)

d subrda          pr            10d   dll('VSUBRA') dim(4)
d subrfa          pr             4f   dll('VSUBRA') dim(4)
d subrf8a         pr             8f   dll('VSUBRA') dim(4)
d subrcva         pr            10    dll('VSUBRA')  varying dim(4)

d fc              s             10    dim(4)
d fs              s              5s 0 dim(4)
d fp              s              5p 0 dim(4)
d fb              s              5b 0 dim(4)

d fi2             s              5i 0 dim(4)
d fi4             s             10i 0 dim(4)
d fu              s             10u 0 dim(4)
d fd              s             10d   dim(4)
d ff              s              4f   dim(4)
d ff8             s              8f   dim(4)
d fcv             s             10    varying dim(4)

d mb1             m                   style(*info) button(*OK)
d rc              s              9  0
```

Figure 110. Sample VJNIRA.VPG (Part 1 of 2)

```
C     *INZSR        BEGSR

C                   eval      fc = subrca
c     fc(2)         dsply     mb1           rc
C                   eval      fs = subrsa
c     fs(2)         dsply     mb1           rc

C                   eval      fp = subrpa
c     fp(2)         dsply     mb1           rc

C                   eval      fb = subrba
c     fb(2)         dsply     mb1           rc


C                   eval      fi2= subri2a
c     fi2(2)        dsply     mb1           rc

C                   eval      fi4= subri4a
c     fi4(2)        dsply     mb1           rc

C                   eval      fu = subrua
c     fu(2)         dsply     mb1           rc

C                   eval      fd = subrda
c     fd(2)         dsply     mb1           rc

C                   eval      ff = subrfa

c     ff(2)         dsply     mb1           rc

C                   eval      ff8= subrf8a
c     ff8(2)        dsply     mb1           rc

C                   eval      fcv= subrcva
c     fcv(2)        dsply     mb1           rc
C                   eval      rc = %len(fcv(2))
c     rc            dsply     mb1           rc
c                   seton                                           lr
C                   ENDSR
```

Figure 110. Sample VJNIRA.VPG (Part 2 of 2)

```
// Source File:  VSUBRA.C

//               Native function which returns Array values

// Add   (d:\jdk12\include;d:\jdk12\include\win32) to the INCLUDE setting
//      in order to find jni.h when compiling.

// Compiled with:  IBM VisualAge(TM) for C++ for Windows(R), Version 3.5
// Compile command:  icc  /q /ss /ge- /fe vsubra.dll  vsubra.c


#include <stdio.h>
#include <string.h>

#include <jni.h>

static void SwapBin2( char *);

static void SwapBin4( char *);

//-------------------------------------------------------------

jobjectArray  _Export __stdcall   Java_VJNIRA_SUBRCA(  JNIEnv *je , void *jc)
{
  jobjectArray  oa;
  jclass     cls;
  jbyteArray ba;
  char       *p;
  int        i;

  printf(" SUBRCA called successfully.\n");


  // Create the object array

  cls = (*je)->FindClass( je, "java/lang/Object");
   if ( cls == NULL)
   {

      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }
```

Figure 111. Sample VSUBRA.C (Part 1 of 22)

```
  oa = (*je)->NewObjectArray( je, 4 /* array length */, cls, NULL );

   if ( oa == NULL)
   {
      printf(" ERROR 2: Newobj\n");
      return NULL;
   }

  // Populate the array
  for (i=0; i<4; i++)
  {
    // Create a new byte array object so it can be returned.

    ba = (*je)->NewByteArray( je, 10 /* = byte array length */ );

    // Set value of 2nd element

    if ( 1 == i)
    {
      // Pin the byte array element memory so native side can access it.

      p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

      memcpy( p, "Success   ",10);

      // Update the values back to the Java Caller

      // Fourth Parameter = 0 also causes the variable's storage to be freed,
      // so can not access the variables after this function call.

      (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);

     }


    (*je)->SetObjectArrayElement( je, oa, i /* array element, starting at 0 */
                                  , ba);
  }  // for i

  return oa;
}
//-------------------------------------------------------------
```

Figure 111. Sample VSUBRA.C (Part 2 of 22)

```
jobjectArray  _Export __stdcall  Java_VJNIRA_SUBRSA( JNIEnv *je , void *jc)
{
  jobjectArray  oa;
  int           i;
  jclass     cls;
  jmethodID  mid;
  jobject    rzo;

  jbyteArray ba;
  char       *p;


  printf(" SUBRSA called successfully.\n");

  // Create the object array

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgZoned");
   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }

  oa = (*je)->NewObjectArray( je, 4 /* array length */, cls, NULL );

   if ( oa == NULL)
   {
      printf(" ERROR 2: Newobj\n");
      return NULL;
   }

  // Populate the array
  for (i=0; i<4; i++)

  {

  // Create a new RpgZoned object.

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgZoned");
   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }
```

Figure 111. Sample VSUBRA.C (Part 3 of 22)

```
mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

 if ( mid == NULL)
 {
    printf(" ERROR: GetMethod.\n");
    return NULL;
 }

rzo = (*je)->NewObject( je, cls, mid,
                        (int) 5, /* # of digits */

                        (int) 0  /* # of decimal places */
                      );

 if ( rzo == NULL)
 {
    printf(" ERROR3: \n");
    return NULL;
 }

  // Set value of 2nd element
  if ( 1 == i)
  {


// To set the zoned object value, we need a Java byte array to use
// as an input parameter to the method for setting the zoned object.
// Could constuct a new byte array object, or get one by retrieving

// the zoned value from the object.

// Will construct a byte array.


// Create a new byte array object

ba = (*je)->NewByteArray( je, 5 /* = byte array length */ );


 if ( ba == NULL)
 {
    printf(" ERROR4: \n");
    return NULL;
 }
```

Figure 111. Sample VSUBRA.C (Part 4 of 22)

```
// Pin the byte array element memory so native side can access it.

p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

memcpy( p, "55555", 5);



// Update the values back to the Java Caller

// Fourth Parameter = 0 also causes the variable's storage to be freed,
// so can not access the variables after this function call.

(*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);



 //  Prepare to call the method from the RpgNumeric class which
 //  takes a byte array object and assigns it's value into the
 //  RpgNumeric object.  Obtain the method ID.


 // cls = (*je)->GetObjectClass(je, p1);
 // (clS) still identifies the second parameter.  Re-use value

 mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

 if ( mid == NULL)
 {
    printf(" ERROR 2: GetMethod.\n");
    return NULL;
 }


 (*je)->CallVoidMethod( je, rzo, mid,
                        ba,
                        (int) 1,    // = Component.ZONED_TYPE
                        0           // precision

                      );


  }
```

Figure 111. Sample VSUBRA.C (Part 5 of 22)

```
    (*je)->SetObjectArrayElement( je, oa, i /* array element, starting at 0 */
                                  , rzo);
  }  // for i

  return oa;

}
//-------------------------------------------------------------

jobjectArray  _Export __stdcall  Java_VJNIRA_SUBRPA( JNIEnv *je , void *jc)
{
  jobjectArray  oa;
  int           i;
  jclass     cls;
  jmethodID  mid;
  jobject    ro;


  jbyteArray ba;
  char       *p;

  printf(" SUBRPA called successfully.\n");

  // Create the object array

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgPacked");
   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }

  oa = (*je)->NewObjectArray( je, 4 /* array length */, cls, NULL );

   if ( oa == NULL)
   {
      printf(" ERROR 2: Newobj\n");
      return NULL;

   }

  // Populate the array
  for (i=0; i<4; i++)
  {
```

Figure 111. Sample VSUBRA.C (Part 6 of 22)

```
  // Create a new RpgPacked object.
#if 0
  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgPacked");
   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }
#endif

  mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

   if ( mid == NULL)
   {
      printf(" ERROR: GetMethod.\n");
      return NULL;
   }

  ro = (*je)->NewObject( je, cls, mid,

                         (int) 5, /* # of digits */
                         (int) 0  /* # of decimal places */
                       );

   if ( ro == NULL)
   {
      printf(" ERROR3: \n");
      return NULL;
   }


    // Set value of 2nd element
    if ( 1 == i)
    {

  // To set the packed object value, we need a Java byte array to use
  // as an input parameter to the method for setting the packed object.
  // Could constuct a new byte array object, or get one by retrieving

  // the packed value from the object.

  // Will construct a byte array.
```

Figure 111. Sample VSUBRA.C (Part 7 of 22)

```
// Create a new byte array object

ba = (*je)->NewByteArray( je, 3 /* = byte array length */ );


 if ( ba == NULL)
 {
    printf(" ERROR4: \n");
    return NULL;
 }


// Pin the byte array element memory so native side can access it.

p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

memcpy( p, "\x55\x55\x5C", 3);



// Update the values back to the Java Caller

// Fourth Parameter = 0 also causes the variable's storage to be freed,
// so can not access the variables after this function call.

(*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);




 //  Prepare to call the method from the RpgNumeric class which
 //  takes a byte array object and assigns it's value into the
 //  RpgNumeric object.  Obtain the method ID.


 // cls = (*je)->GetObjectClass(je, p1);
 // (clS) still identifies the second parameter.  Re-use value

 mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

 if ( mid == NULL)
 {
    printf(" ERROR 2: GetMethod.\n");
    return NULL;
 }
```

Figure 111. Sample VSUBRA.C (Part 8 of 22)

```
   (*je)->CallVoidMethod( je, ro, mid,
                          ba,         // The byte array object
                          (int) 2,    // = Component.PACKED_TYPE

                          0           // decimal places
                        );


    }

    (*je)->SetObjectArrayElement( je, oa, i /* array element, starting at 0 */
                                  , ro);
  }  // for i

  return oa;
}
//-------------------------------------------------------------

jobjectArray  _Export __stdcall  Java_VJNIRA_SUBRBA( JNIEnv *je , void *jc)
{
  jobjectArray  oa;
  int           i;
  jclass     cls;

  jmethodID  mid;
  jobject    ro;

  jbyteArray ba;
  char       *p;

  printf(" SUBRBA called successfully.\n");

  // Create the object array

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgBinary");
   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }
```

Figure 111. Sample VSUBRA.C (Part 9 of 22)

```
  oa = (*je)->NewObjectArray( je, 4 /* array length */, cls, NULL );

   if ( oa == NULL)
   {
      printf(" ERROR 2: Newobj\n");

      return NULL;
   }

  // Populate the array
  for (i=0; i<4; i++)
  {

  // Create a new RpgPacked object.
#if 0
  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgBinary");
   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }
#endif

  mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

   if ( mid == NULL)
   {
      printf(" ERROR: GetMethod.\n");
      return NULL;

   }

  ro = (*je)->NewObject( je, cls, mid,
                         (int) 5, /* # of digits */
                         (int) 0  /* # of decimal places */
                       );
```

Figure 111. Sample VSUBRA.C (Part 10 of 22)

```
 if ( ro == NULL)
 {
    printf(" ERROR3: \n");
    return NULL;
 }

  // Set value of 2nd element
  if ( 1 == i)
  {


// To set the packed object value, we need a Java byte array to use
// as an input parameter to the method for setting the packed object.

// Could constuct a new byte array object, or get one by retrieving
// the packed value from the object.

// Will construct a byte array.


// Create a new byte array object

ba = (*je)->NewByteArray( je, 4 /* = byte array length */ );


 if ( ba == NULL)
 {
    printf(" ERROR4: \n");
    return NULL;
 }


// Pin the byte array element memory so native side can access it.

p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);


memcpy( p, "\x00\x00\xD9\x03", 4);      // 55555 = 0xD903


// Update the values back to the Java Caller

// Fourth Parameter = 0 also causes the variable's storage to be freed,
// so can not access the variables after this function call.

(*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);
```

Figure 111. Sample VSUBRA.C (Part 11 of 22)

```
   //  Prepare to call the method from the RpgNumeric class which
   //  takes a byte array object and assigns it's value into the

   //  RpgNumeric object.  Obtain the method ID.

   // cls = (*je)->GetObjectClass(je, p1);
   // (clS) still identifies the second parameter.  Re-use value

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");

   if ( mid == NULL)
   {
      printf(" ERROR 2: GetMethod.\n");
      return NULL;
   }


   (*je)->CallVoidMethod( je, ro, mid,
                          ba,         // The byte array object
                          (int) 3,    // = Component.Binary_TYPE

                          0           // decimal places
                        );

    }

    (*je)->SetObjectArrayElement( je, oa, i /* array element, starting at 0 */
                                , ro);
  }  // for i

  return oa;
}
```

Figure 111. Sample VSUBRA.C (Part 12 of 22)

```
//-------------------------------------------------------------

jshortArray   _Export __stdcall  Java_VJNIRA_SUBRI2A( JNIEnv *je , void *jc)
{
  jshortArray  rc;
  jshort      *n;


  printf(" SUBRI2A called successfully.\n");

  rc = (*je)->NewShortArray( je, 4 /* = array length */ );

  // Pin the array element memory so native side can access it.

  n  =  (*je)->GetShortArrayElements( je, rc, NULL);

  n[1] = -5555;

  // Update the values back to the Java Caller

  (*je)->ReleaseShortArrayElements( je, rc, n, 0);

  return rc;
}
//-------------------------------------------------------------


jintArray   _Export __stdcall  Java_VJNIRA_SUBRI4A( JNIEnv *je , void *jc)
{
  jintArray  rc;
  jint       *n;
  printf(" SUBRI4A called successfully.\n");

  rc = (*je)->NewIntArray( je, 4 /* = array length */ );

  // Pin the array element memory so native side can access it.

  n  =  (*je)->GetIntArrayElements( je, rc, NULL);

  n[1] = -5555;

  // Update the values back to the Java Caller

  (*je)->ReleaseIntArrayElements( je, rc, n, 0);


  return rc;
}
```

Figure 111. Sample VSUBRA.C (Part 13 of 22)

```
//-------------------------------------------------------------

jobjectArray  _Export __stdcall  Java_VJNIRA_SUBRUA( JNIEnv *je , void *jc)
{
  jobjectArray  oa;
  int           i;
  jclass     cls;
  jmethodID  mid;
  jobject    ro;

  jbyteArray ba;
  char       *p;

  printf(" SUBRUA called successfully.\n");

  // Create the object array

  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgUnsigned");

   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }

  oa = (*je)->NewObjectArray( je, 4 /* array length */, cls, NULL );

   if ( oa == NULL)
   {
      printf(" ERROR 2: Newobj\n");
      return NULL;
   }

  // Populate the array
  for (i=0; i<4; i++)
  {

  // Create a new RpgPacked object.
#if 0
  cls = (*je)->FindClass( je, "com/ibm/varpg/rpgruntime/RpgUnsigned");
   if ( cls == NULL)

   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }
#endif
```

Figure 111. Sample VSUBRA.C (Part 14 of 22)

```
mid = (*je)->GetMethodID( je, cls, "<init>", "(II)V");

 if ( mid == NULL)
 {
    printf(" ERROR: GetMethod.\n");
    return NULL;
 }

ro = (*je)->NewObject( je, cls, mid,
                        (int) 5, /* # of digits */
                        (int) 0  /* # of decimal places */
                      );

 if ( ro == NULL)

 {
    printf(" ERROR3: \n");
    return NULL;
 }

  // Set value of 2nd element
  if ( 1 == i)
  {


// To set the packed object value, we need a Java byte array to use
// as an input parameter to the method for setting the packed object.
// Could constuct a new byte array object, or get one by retrieving
// the packed value from the object.

// Will construct a byte array.
```

Figure 111. Sample VSUBRA.C (Part 15 of 22)

```
// Create a new byte array object

ba = (*je)->NewByteArray( je, 4 /* = byte array length */ );

 if ( ba == NULL)
 {
    printf(" ERROR4: \n");
    return NULL;
 }

// Pin the byte array element memory so native side can access it.

p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

memcpy( p, "\x00\x00\xD9\x03", 4);      // 55555 = 0xD903

// Update the values back to the Java Caller

// Fourth Parameter = 0 also causes the variable's storage to be freed,

// so can not access the variables after this function call.

(*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);
```

Figure 111. Sample VSUBRA.C (Part 16 of 22)

```
   //  Prepare to call the method from the RpgNumeric class which
   //  takes a byte array object and assigns it's value into the
   //  RpgNumeric object.  Obtain the method ID.

   // cls = (*je)->GetObjectClass(je, p1);
   // (clS) still identifies the second parameter.  Re-use value

   mid = (*je)->GetMethodID( je, cls, "assignFromNative", "([BII)V");


   if ( mid == NULL)
   {
      printf(" ERROR 2: GetMethod.\n");
      return NULL;
   }


   (*je)->CallVoidMethod( je, ro, mid,
                          ba,         // The byte array object
                          (int) 5,    // = Component.UNSIGNED_TYPE
                          0           // decimal places
                        );


    }

    (*je)->SetObjectArrayElement( je, oa, i /* array element, starting at 0 */

                                  , ro);
  }  // for i

  return oa;
}
//-------------------------------------------------------------
```

Figure 111. Sample VSUBRA.C (Part 17 of 22)

```
jobjectArray  _Export __stdcall   Java_VJNIRA_SUBRDA(  JNIEnv *je , void *jc)
{
  jobjectArray  oa;
  jclass     cls;
  jbyteArray ba;
  char       *p;
  int        i;

  printf(" SUBRD called successfully.\n");

  // Create the object array

  cls = (*je)->FindClass( je, "java/lang/Object");

   if ( cls == NULL)
   {
      printf(" ERROR 1: FindClass.\n");
      return NULL;
   }

  oa = (*je)->NewObjectArray( je, 4 /* array length */, cls, NULL );

   if ( oa == NULL)
   {
      printf(" ERROR 2: Newobj\n");
      return NULL;
   }

  // Populate the array
  for (i=0; i<4; i++)
  {
    // Create a new byte array object so it can be returned.

    ba = (*je)->NewByteArray( je, 10 /* = byte array length */ );
```

Figure 111. Sample VSUBRA.C (Part 18 of 22)

```
    // Set all elements to a valid date value.

      // Pin the byte array element memory so native side can access it.

      p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

      memcpy( p, "2000-01-01",10);

      // Update the values back to the Java Caller

      // Fourth Parameter = 0 also causes the variable's storage to be freed,
      // so can not access the variables after this function call.


      (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);


    (*je)->SetObjectArrayElement( je, oa, i /* array element, starting at 0 */
                                , ba);
  }  // for i

  return oa;
}
//-------------------------------------------------------------

jfloatArray   _Export __stdcall  Java_VJNIRA_SUBRFA( JNIEnv *je , void *jc)
{
  jfloatArray  rc;
  jfloat      *n;

  printf(" SUBRF called successfully.\n");


  rc = (*je)->NewFloatArray( je, 4 /* = array length */ );

  // Pin the array element memory so native side can access it.

  n  =  (*je)->GetFloatArrayElements( je, rc, NULL);

  n[1] = -4444.4444;

  // Update the values back to the Java Caller

  (*je)->ReleaseFloatArrayElements( je, rc, n, 0);

  return rc;
}
```

Figure 111. Sample VSUBRA.C (Part 19 of 22)

```
//-------------------------------------------------------------

jdoubleArray   _Export __stdcall  Java_VJNIRA_SUBRF8A( JNIEnv *je , void *jc)

{
  jdoubleArray  rc;
  jdouble      *n;

  printf(" SUBRF8 called successfully.\n");

  rc = (*je)->NewDoubleArray( je, 4 /* = array length */ );

  // Pin the array element memory so native side can access it.

  n  =  (*je)->GetDoubleArrayElements( je, rc, NULL);

  n[1] = -7777777.55555;

  // Update the values back to the Java Caller

  (*je)->ReleaseDoubleArrayElements( je, rc, n, 0);

  return rc;

}
//-------------------------------------------------------------

jobjectArray  _Export __stdcall  Java_VJNIRA_SUBRCVA( JNIEnv *je , void *jc)
{
  // This is similar to fixed length character, only the individual
  // array elemnts can be created as byte arrays of different lengths
  // to reflect the current length of the varying length values.
```

Figure 111. Sample VSUBRA.C (Part 20 of 22)

```
jobjectArray  oa;
jclass     cls;
jbyteArray ba;
char       *p;
int        i;


printf(" SUBRCVA called successfully.\n");


// Create the object array

cls = (*je)->FindClass( je, "java/lang/Object");
 if ( cls == NULL)
 {
    printf(" ERROR 1: FindClass.\n");
    return NULL;
 }

oa = (*je)->NewObjectArray( je, 4 /* array length */, cls, NULL );

 if ( oa == NULL)
 {
    printf(" ERROR 2: Newobj\n");
    return NULL;
 }
```

Figure 111. Sample VSUBRA.C (Part 21 of 22)

```
  // Populate the array
  for (i=0; i<4; i++)

  {
    // Create a new byte array object so it can be returned.

    ba = (*je)->NewByteArray( je,
                         /* = byte array length */
                         (1==i) ? 4 : 10 );

    // Set value of 2nd element
    if ( 1 == i)
    {
      // Pin the byte array element memory so native side can access it.

      p  = (char *) (*je)->GetByteArrayElements( je, ba, NULL);

      memcpy( p, "abcd",4);

      // Update the values back to the Java Caller


      // Fourth Parameter = 0 also causes the variable's storage to be freed,
      // so can not access the variables after this function call.

      (*je)->ReleaseByteArrayElements( je, ba, (signed char *) p, 0);
     }



    (*je)->SetObjectArrayElement( je, oa, i /* array element, starting at 0 */
                                , ba);
  }  // for i

  return oa;
}
```

Figure 111. Sample VSUBRA.C (Part 22 of 22)

Chapter 22. Creating Non-GUI VisualAge RPG Programs

This section describes how to create standalone VARPG applications and **Dynamic Link Libraries** (DLLs). Standalone VARPG applications have no user interface, but they can access local and AS/400 files, and call AS/400 programs. DLLs are modules that cannot be executed directly; they contain procedures that can be called by other VARPG applications. DLLs can also access local files, as well as AS/400 files and programs. You can think of DLLs as you would of AS/400 service programs.

You can create standalone VARPG applications within the VARPG GUI designer, or by issuing commands in an MS-DOS command prompt. (See Appendix C, "Creating and Compiling Non-GUI Programs from MS-DOS," on page 447 for the commands.) This section describes how to use the GUI designer to create non-GUI programs.

When creating standalone applications or DLLs, the following restrictions apply:
- They must consist entirely of procedures.
- *ENTRY is not permitted.
- The special subroutines *INZSR and *TERMSR are not allowed.
- All subroutines must be local to a procedure.
- The EXPORT keyword is not allowed when creating standalone applications.
- Because standalone applications and DLLs have no user interface, the %GETATR and %SETATR built-ins, and GUI operation codes are not allowed. These include:
  – CLSWIN, GETATR, SETATR, START, STOP, SHOWWIN, READS

  The DSPLY operation code can be used. However, if the procedure containing it is called from a VisualAge RPG DLL, the DSPLY operation code does nothing. Also, the DSPLY operation code does not support a message data type in factor 1.

Creating Standalone VARPG Programs

A standalone VARPG program is created when the EXE keyword is specified on the control specification.

```
H  EXE
```

The program source must contain a procedure whose name matches the name of the source file. This will be the main entry point for the program. If there are parameters to be passed to the program, they must be specified on the parameter definition for the main procedure, and they must be passed in by value. That is, the **VALUE** keyword must be specified for each parameter. When calling an application from the command line, separate parameters by spaces. If more parameters or fewer are passed than are specified, no error message is displayed.

To create a standalone program in the GUI Designer, select **Project > New > Non GUI project** from the project window. The editor opens a new source file that has an H control specification template. Uncomment the `H * EXE` specification and code your program. When completed, save your project and build the application. You can set any needed build options from the project window, as well.

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In the following example, the standalone VARPG program accepts a single parameter. When run, the program will translate the parameter to uppercase and display the result using the DSPLY operation code. Note that the name of the main, and only, procedure is *MyPgm*. If you want to try this sample, be sure to specify MYPGM as the file name when you save it.

```
 * Sample standalone VARPG program
H EXE
 *
 * Prototype for the main procedure
D MyPgm           PR
D                                64A   Value
 *
 * Procedure definition for MYPGM
PMyPgm            B
 *
D MyPgm           PI
D  InString                      64A   Value
 *
D OutString       S              64A
 *
D LC              C                    'abcdefghijklmnopqrstuvwxyz'
D UC              C                    'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
 *
 * Translate input parameter to uppercase and display it
C     lc:uc         Xlate     InString      OutString
C     OutString     Dsply                   I                1
 *
PMyPgm            E
```

Creating DLLs

A DLL is created when the keyword NOMAIN is specified on the control specification:

```
H NOMAIN
```

To create a DLL in the GUI Designer, select **Project > New > Non GUI project** from the project window. The editor opens a new source file that has an H control specification template. Uncomment the `H * NOMAIN` specification and code your program. When completed, save your project and build the DLL. You can set any needed build options from the project window, as well.

When you build a DLL, the compiler produces the DLL and a LIB file. The LIB file is used to link the DLL to other applications. The LIB file will be in the same directory as the source and it will have the same name as the DLL. The LIB file contains all the procedures that have the EXPORT keyword on their Begin P-specification.

The following example shows how to code the part of program *MyPGM* that translates the lowercase string to uppercase as a procedure in a DLL. The source for the DLL has one procedure named *ToUpper* in it. Add the **Export** keyword to the procedure defintion so that this procedure can be called from other programs.

```
 * Sample VARPG DLL
H NOMAIN
 *
 * Prototype ToUpper procedure
D ToUpper         PR             64A
D                                64A   Value
 *
```

```
 * The ToUpper procedure
PToUpper          B                   Export
 *
D ToUpper         PI            64A
D  InString                     64A   Value
 *
D OutString       S             64A
 *
D LC              C                   'abcdefghijklmnopqrstuvwxyz'
D UC              C                   'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
 *
 *
C     lc:uc         Xlate     InString      OutString
C                   Return    OutString
 *
PToUpper          E
```

When you create and build a DLL, you can give it any name. For this example, we use *MyFunc*. A successful build will create the following files in the source directory:

- MyFunc.VPG - program source
- MyFunc.DLL - the DLL
- MyFunc.LST - the compiler listing
- MyFunc.LIB - the library file
- MyFunc.EVT - the event file (used by the GUI designer to display the error feedback window; not required to run the program)

Edit and modify the MyPGM source so it calls the ToUpper procedure in the MyFunc.DLL that was just created. The modified source follows:

```
0000  * Calling a procedure in a VARPG DLL
0001 H EXE
0002  *

0003 D ToUpper         PR            64A   DLL('MyFunc')
0004 D                                     ExtProc('TOUPPER')
0006 D                               64A   Value

0007  *
0008 D MyMain          PR
0009 D                               64A   Value
0010  *
0011 PMyMain           B
0012  *
0013 D MyMain          PI
0014 D  InString                     64A   Value
0015  *
0016 D Upper           S             64A
0017  *

0018 C                   Eval      Upper=ToUpper(Instring)

0019 C     Upper         Dsply                   I                1
0010  *
0011 PMyMain           E
```

Line **Description of Change**

0003 Define the prototype for the ToUpper procedure and specify that the procedure returns a parameter that is an alpha field, 64 bytes long. The DLL keyword specifies that the procedure is in the DLL named MyFunc.DLL.

0004 The ExtProc keyword specifies the name of the procedure to be called. Since the name is the same name that is used on the Definition specification (line 0003), you can omit the keyword. If the name is specified, however, it must be in uppercase, as shown.

0006 This statement indicates that the procedure expects one parameter - a 64 character alpha field. In this case, the parameter is being passed by VALUE.

0018 This is the call to the procedure.

If the procedure you are calling does not return a value, then you must use the CALLP operation code to invoke it:

```
C              CALLP     SomeFunc(parm1:parm2)
```

Exception Handling

Exception handling differs from GUI VARPG applications in the following ways:

- No information about the exception is communicated back to the caller if the caller does not reside in the utility DLL.
- The default exception handler is never invoked from a DLL, since the default exception handler is not invoked when an exception occurs in a procedure. If an exception occurs in the DLL and there is no error indicator or *PSSR, the DLL ends. Information about the exception is written to the FVDCERRS.LOG file.
- The recommended way to handle exceptions in a utility DLL is to have an error indicator or a local *PSSR for each routine which returns an appropriate return code to the caller.

Debugging Applications

To debug VARPG programs, be sure to use the debug compiler option when building the application. If the debug option is not set, you can still start the debugger on the program, but you will have to work with the assembler view of your program.

To run the debugger against your source, you must first build your application. From the project view, choose **Project > Build > Windows NT/95/98**. To start the debugger, select the **Debug** menu item from the Project menu. See Chapter 10, “Debugging Your Application,” on page 227 for more information on debugging.

Debugging Procedures

If you want to debug code in your DLL, you need to follow some extra steps:

1. Start the debugger for your main application- in our example, MyMain.
2. On the **Debugger - Session Control** dialog, choose **Breakpoints-Set load occurrence...**.
3. When the **Load Occurrence Breakpoint** dialog is displayed, type the name of the DLL, MyFunc, in the **DLL File Name** entry and press **OK**.
4. Run your program.

When the procedure is called in the DLL, a debugger message dialog is displayed indicating that the DLL is being loaded. Press **OK** and do the following:

1. Locate the Debug - Session Control dialog and note that there is a new entry in the right side panel with the name of the DLL.

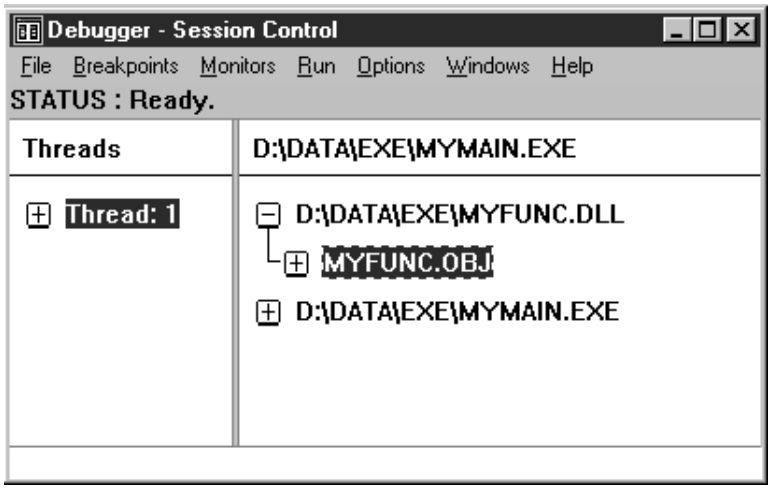

Figure 112. Selecting the MyFunc.DLL Object File

2. Click on the + sign next to the DLL name. It will expand to show the name of the object module, MyFunc.obj.
3. Double-click on the object module name.
4. The source view of the debugger will now show the source for procedure ToUpper in DLL MYFUNC.

You can now add breakpoints and display program variables in the DLL. Also, if you are currently **START**ing other VARPG components, or if you are calling your own 'C' functions, you can also use the above procedures to debug them.

Chapter 23. DBCS Considerations

If you plan to use VisualAge RPG on a **Double Byte Character Set** (DBCS) system, you must consider the following:

- The compiler does not allow shift-in and shift-out characters in literals. If you use the VisualAge RPG editor to open an AS/400 member in order to copy source into your VisualAge RPG program, you must remove the shift-in and shift-out characters from all literals. If they are not removed, compile errors occur.
- The compiler removes shift-in and shift-out characters from your VisualAge RPG source members when they are retrieved using the remote /COPY feature.
- DBCS characters are not allowed in the icon file name extension for an application.
- A VisualAge RPG application name that contains non-DBCS characters will cause a build failure.

VisualAge RPG Support for DBCS Data Types

VisualAge RPG supports a number of DBCS data types. When you run your application, certain rules are followed when the DBCS data types are used, in order to ensure that data is correctly transferred between the AS/400 server and the workstation. The following DBCS data types are supported:

DBCS Only
A field of this data type contains only DBCS data, and should be used when you are using the AS/400 database. It is equivalent to the J data type supported by the AS/400 database.

DBCS Either
A field of this data type contains all single-byte or all DBCS data. It should be used when you are using the AS/400 database. It is equivalent to the E data type supported by the AS/400 database.

DBCS Mixed
A field of this data type contains all single-byte or all DBCS data. It should be used when you are interchanging data with the AS/400 database. It is equivalent to the O data type supported by the AS/400 database.

AS/400 J, O and E data types require that DBCS data be bracketed by SO (Shift Out) and SI (Shift In) characters. The workstation fields DBCS Either, DBCS Mixed, and DBCS ONLY fields do not use SO and SI characters. When these fields are used to transfer data to the server, SO and SI characters are added appropriately. When data is being retreived from the server, SO and SI characters are stripped, and the VisualAge RPG field is padded with two single-byte blanks.

DBCS Either, DBCS Mixed, and DBCS ONLY fields are represented as character fields with the same names as their part names within the VisualAge RPG application.

The following example illustrates how data is converted when DBCS data is transferred to and from the server. In this example, a 10 byte DBCS ONLY field is created using VisualAge RPG. This means that the field can contain four DBCS characters, since each DBCS character requires two bytes. The extra two bytes are

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used to insert the SO and SI characters before the field is transferred to the server. Assume that the field contains the following data before being transferred to the server:

```
DBDBDBDBblbl

Where DB = 1 Double byte character.
      bl = 1 Single byte blank character.
```

Before the field is transferred to the server, it is converted so that the DBCS data is bracketed by the SO and SI characters. The single-byte blanks are treated as being insignificant, and they are replaced with the appropriate SO and SI characters. Therefore, the field would appear as follows before being transferred to the server:

```
SODBDBDBDBSI
```

If the same data is retrieved from the server, then the SO and SI characters are stripped and the field is padded with two single byte blanks:

```
DBDBDBDBblbl

Where DB = 1 Double byte character
      bl = 1 Single byte blank character
```

Note: The character fields representing the DBCS ONLY, DBCS Mixed, or DBCS Either data types must be padded with the appropriate number of single-byte blanks in order for the field to be transferred to the server and in order for the data within the field to be displayed in the window correctly.

VisualAge RPG ensures that enough single-byte blanks are present. When setting DBCS fields or retrieving information from DBCS fields using the SETATR and GETATR operation codes, respectively, you must ensure that the length of the field in the SETATR and GETATR operations is the same length as the field in the window. If it is not, it may not be transferred between the server and the workstation.

DBCS ONLY Data Type

VisualAge RPG ensures the following when the DBCS ONLY data type is used, regardless of whether the data is added via the field on the window or entered using the SETATR operation code:

- The minimum field length is 2. This ensures that there is enough room for the SO and SI characters that are added when the data is transferred to the server.
- The field contains valid DBCS characters. Each double-byte pair is checked to ensure that a valid DBCS character is used.
- The field is appropriately padded with blank characters. If a smaller value is entered than the field allows, the field is padded to the maximum length of 2 with double-byte blanks. The last two bytes of the field are padded with single-byte blanks.

DBCS Either Data Type

The DBCS Either data type must contain either all single-byte data or all double-byte data: mixture of DBCS and single-byte data is not allowed. If single-byte data is used, then the maximum length of the field can be used to hold the single-byte data and the maximum length of the data can be transferred to and from the server.

VisualAge RPG enforces the following rules when the first two bytes of the field represent a DBCS character, regardless of whether the data is added via the field on the window or entered using the SETATR operation code:

- The minimum field length is 2. This ensures that there is enough room for the SO and SI characters that are added when the data is transferred to the server.
- The field contains only valid DBCS characters. Each double-byte pair is checked to ensure that a valid DBCS character is used.
- The field is appropriately padded with blank characters. If a smaller value is entered than the field will allow, then the field is padded to the maximum length of 2 with double-byte blanks. The last two bytes of the field are padded with single-byte blanks.

DBCS Mixed Data Type

This field can contain any number of DBCS or single-byte characters interchangeably. VisualAge RPG enforces the following rules:

- This character field is always padded with single-byte blanks.
- For each change in DBCS mode, an SO and SI character must be accounted for. Each time the user changes between entering DBCS characters and entering single-byte characters, 2 is subtracted from the maximum length that can be entered. For example, assume a DBCS Mixed field is created with a length of 20 using VisualAge RPG. This field has the following value:

```
DBsbDBsbDBsbDBsb.

where DB = 1 DBCS character.
      sb = 1 single byte character.
```

  This is the maximum length of the field, since the field is converted to the following before being transferred to the server.

```
SODBSIsbSODBSIsbSODBSIsbSODBSIsb.

where SO = 1 shift out character.
      sb = 1 shift in  character.
```

  All 20 bytes of the field are used.

Pure DBCS Considerations

Both the VisualAge RPG language and the AS/400 database support a pure DBCS data type: the G or Graphic data type. Pure DBCS data does not require the SO (Shift Out) or the SI (Shift In) characters on the AS/400 server or the workstation. When Graphic data is converted between the AS/400 server and the workstation, no SO and SI characters are added or removed.

GUI entry fields do not directly map to the Graphic data type supported in the VisualAge RPG language. To use the full extent of the field, it is recommended that you create a character entry on the window. When you do, a VisualAge RPG character field is created with the same name as the GUI Designer part. A separate Graphic field can then be used to interact with the character entry field created, using the GUI Designer. Use the SETATR or GETATR operation code to interact with the entry fields. In this way, the entire length of the entry field can be used to store DBCS characters without concern for the SO and SI characters.

Chapter 24. Merging Code in Your Application

When programming, you may wish to merge two or more parts of a project or component and the associated code together. You can use the **Merge** function to do this. Select the Merge menu item from the **Project** pull-down menu. This will bring up the **Open Component - VisualAge RPG** dialog box, which will allow you to select the project that you would like to merge from.

This dialogue is similar in look and function to the **Find Folder/Project** dialog box. You can either specify the project in the entry field, including the complete path, or you can use the list box to select a drive and proceed to select folders to find the necessary project. Both methods will open the **GUI Objects Tree View** window for the specified project. Alternatively, you can select the **GUI Objects** menu item from the **View** pull-down menu in the project organizer.

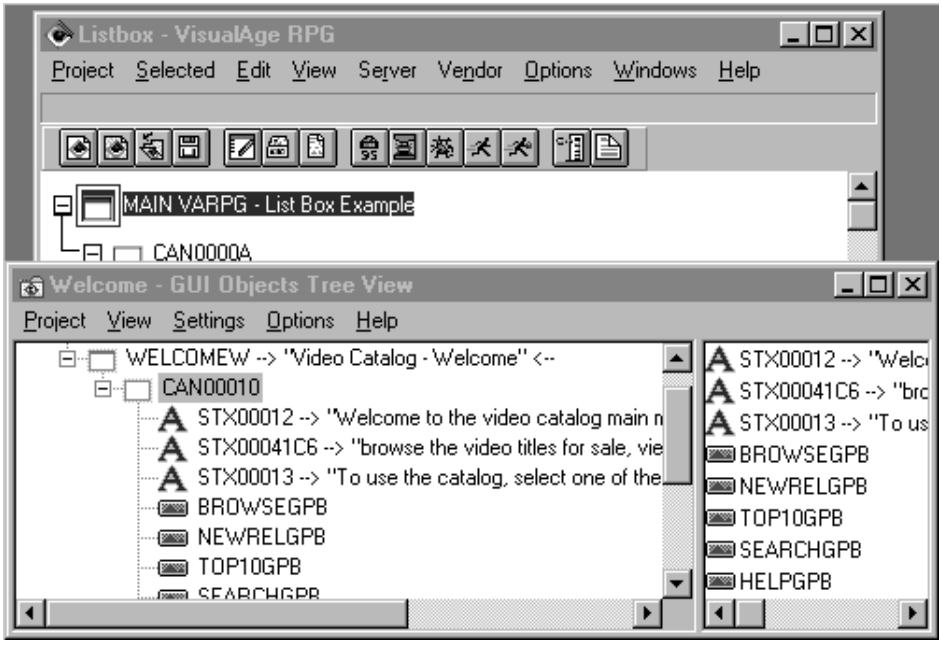

Figure 113. The Code Merge GUI Objects Tree View

This window shows two views, the one on the left contains the tree view of the project that you selected to merge from, and the one on the right contains all of the children of the part that is selected in the tree-view on the left. You can select multiple parts in the right side of the window much like you can in the Windows Explorer. This view may be used as an additional parts pallette because you can select items from here (either the left or the right pane), and then point-and-click them onto the current project's tree view or onto the design window. This works in the same way as the parts pallette in that you can only place parts into a frame-based part, and frame-based parts can only be placed into the root of your project tree. When you merge the GUI and the associated code, the builder will force a save of the current project that you are working on, in order to provide you with a backup of your work in the event that you are not satisfied with the merge results.

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In addition to the GUI layout, the merge will copy linked action subroutines, help panels, technical descriptions, references to media files, referenced user subroutines and user messages. There are a few rules to keep in mind about merging code in these specific cases.

- All linked action subroutines will be copied.
- Referenced media files are not copied along with the references. It is your responsibility to do this.
- File description specifications and definition specifications are not copied to the current project. Again, it is your responibility to do this.
- User subroutines, RPG procedures and User messages referenced by the action subroutine being copied will also be copied. This includes all references to user subroutines used by an EXSR or a CASxx operation code, RPG procedures referenced on a CALLP operation code, and user messages referenced with the DSPLY operation code.
- For parts which have been renamed, all action subroutines that refer to the part, and which have names that conform to the standard format will be renamed. For example, the following source code would be renamed as it follows the standard format. The requirement for this format is that the partname and windowname directly correspond to the location in which the part can be found.

```
*...1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
CSRN01Factor1+++++++Opcode(E)+Factor2+++++++Result++++++++Len++D+HiLoEq----
C     PSB000000C    BEGACT    PRESS         FRA000000B
    .
    .
    .
C                   ENDACT
```

- User messages which are copied are renamed consecutively begining with the first message copied. All merged user messages are numbered sequentially starting immediately after the last message in the current project. The message IDs are changed on DSPLY operation codes that reference them.
- If a name conflict is detected for a user subroutine, it will not be renamed and it will be added to a list contained in the merge log file. The log will also be displayed on the Code Merge Results window. The merge log file will be placed in the project directory, with a filename of **projectname.mrg** where projectname is the name of your project. This file will be overwritten if more than one merge is performed for the same project. The file is not automatically appended. The following example contains a listing of a sample merge file.

```
The following parts were copied to the target project:

    Source Name                       Target Name

    SEARCHW:CAN00023                  SEARCHW:CAN00023
    SEARCHW:SEARCHW                   SEARCHW:SEARCHW
    SEARCHW:SEARCHGB                  SEARCHW:SEARCHGB
    SEARCHW:STX00071                  SEARCHW:STX00071
    SEARCHW:TITLECB                   SEARCHW:TITLECB
    SEARCHW:STX00073                  SEARCHW:STX00073
    SEARCHW:STX00074                  SEARCHW:STX00074
    SEARCHW:STX00075                  SEARCHW:STX00075
    SEARCHW:CATCB                     SEARCHW:CATCB
    SEARCHW:DIRCB                     SEARCHW:DIRCB
    SEARCHW:ACTORCB                   SEARCHW:ACTORCB
    SEARCHW:SEARCHPB                  SEARCHW:SEARCHPB
    SEARCHW:CANCELSEPB                SEARCHW:CANCELSEPB
    SEARCHW:HELPPB                    SEARCHW:HELPPB
    SEARCHW:STX00082                  SEARCHW:STX00082
```

```
The following help panels were copied to the target project:

    Source Name                       Target Name

    24.SEARCHW                        88.SEARCHW
    79.SEARCHPB                       99.SEARCHPB
    80.CANCELSEPB                     100.CANCELSEPB
    81.HELPPB                         101.HELPPB

Merging Source Code:

    Action Subroutine                 CATW+CLOSE+CATW
      Renaming To                     SEARCHW+CLOSE+SEARCHW
    Action Subroutine                 TITLECB+CREATE+SEARCHW
    Action Subroutine                 DIRCB+CREATE+SEARCHW
    Action Subroutine                 ACTORCB+CREATE+SEARCHW
    Action Subroutine                 CATCB+CREATE+SEARCHW
    Action Subroutine                 TITLECB+ENTER+SEARCHW
    Action Subroutine                 CATCB+SELECT+SEARCHW
    Action Subroutine                 DIRCB+SELECT+SEARCHW
    Action Subroutine                 ACTORCB+SELECT+SEARCHW
    Action Subroutine                 CANCELSEPB+PRESS+SEARCHW
    Action Subroutine                 SEARCHPB+PRESS+SEARCHW
      Message                         *MSG0001 -> *MSG0003
      Message                         *MSG0001 -> *MSG0003
      Message                         *MSG0001 -> *MSG0003
      Message                         *MSG0001 -> *MSG0003
    User Subroutine                   WRTBRSFSR
    User Subroutine                   CASECAT
    User Subroutine                   CKCRITERIA
    User Subroutine                   DSPBROWSE
      Message                         *MSG0001 -> *MSG0003
    User Subroutine                   BRACTION
    User Subroutine                   BRCHILDREN
    User Subroutine                   BRSCIFI
    User Subroutine                   BRCOMEDY
    User Subroutine                   BRHORROR
    User Subroutine                   BRWESTERN
    User Subroutine                   BRROMANCE
    User Subroutine                   BRCLASSIC



The following messages were copied to the target project:

    Source Message                    Target Message

    1                                 3

Technical description of the following parts were copied to the target
project:

    Source Name                       Target Name

    SEARCHW:SEARCHPB                  SEARCHW:SEARCHPB
    SEARCHW:CANCELSEPB                SEARCHW:CANCELSEPB
    SEARCHW:HELPPB                    SEARCHW:HELPPB
```

The following rules apply to the resolution of part name conflicts:
- The merged part or window will be renamed.
- If a window gets renamed all of the parts contained in it will inherit the new window name.
- Action subroutines linked to a renamed window or part will be renamed and relinked, if they follow the standard naming format.
- Calculation Specifications containing a GETATR or SETATR operation code which refer to a renamed part will be changed.
- The merge process tries to correct part references in the code being merged to address part name changes.

User messages that are used in merged parts are also copied. The following rules apply:
- If there is a name conflict, for a user message, a rename will take place.
- References to renamed user messages will be updated.

Chapter 25. Vendor Plugins

Plugins are applications that are written by third party developers and are created to provide additional functionality to VisualAge RPG. A wide variety of tasks could be automated such as the insertion of a line of code to set the value of an attribute selected from a list for a named part; or a procedure which allows programmers to print their RPG source formatted to include page headings and footers.

Adding a Vendor Plugin

To add a plugin that you have either created or obtained from a third party developer, do the following:

1. Click on the **Vendor** pull-down menu.
2. Highlight the **Plugins** item to reveal the plugins submenu.
3. Click on the **Add plugin...** command to open the **Add plugin** window.
4. Select the vendor plugin that you would like to add from the files diplayed in the window. The files that are displayed have a .plg extension.

Invoking a Vendor Plugin

When you have added a plugin to the VisualAge RPG GUI designer, you then have to invoke the function. The most simple method of doing this is to select the plugin menu item that was defined by the vendor. The menu item can either be on the **Vendor** pull-down menu, or on the **Selected** pull-down menu or from a part's popup menu. In some cases the plugin will not have a menu item defined, and it will be necessary to invoke this plugin external to the GUI designer (to see an example of this method of invocation, see the LPEXSAMP sample plugin). As an example, add one or more of the vendor plugin samples provided with VisualAge RPG. To invoke these plugins, do the following:

1. Click on the **Vendor** pull-down menu.
2. Highlight the **Plugins** item to reveal the plugins submenu.
3. Highlight the menu item that is added along with the plugin. The name of this menu item is variable, because it is created by the developer of the plugin. Depending on the developer/vendor this may produce another submenu. If this is the case, go to step 4, otherwise, click the menu item to invoke the plugin.
4. Click on the appropriate menu item from the submenu to invoke the plugin.

Managing Vendor Plugins

If you have vendor plugins functioning in VisualAge RPG, you may want to find out information about a plugin, such as the developer, the developer's description of what it is that the plugin does, or the dll that is associated with the plugin. This information can be obtained in the **Manage plugins** window.

To open the **Manage plugins** window, do the following:

1. Click on the **Vendor** pull-down menu.
2. Highlight the **Plugins** item to reveal the plugins submenu.
3. Click on the **Manage plugins...** command to open the **Manage plugins** window.

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Chapter 26. Creating Plugins

You can create a plugin to address your own specific needs, or as a VisualAge RPG supplement to be shipped to other programmers who may benefit from your plugin. Plugins can be created using one of either VisualAge RPG, VisualAge C++, or REXX. The following steps outline the plugin creation process using VisualAge RPG code. Additional sections will follow that will address the exceptions and additional guidelines for creating plugins with VisualAge C++ or REXX.

Creating Plugins Using VisualAge RPG

There are two components required to create a plugin, the executable file and the plugin informations file. The executable file consists of compiled source code which performs the desired function. The plugin information file (.plg) acts as an interface between the GUI designer and the executable file. It contains important information such as the definitions for the pull-down menu items that are added to the GUI designer, as well as the actual call to the executable file.

It does not matter which of the two files that you create first, as both must be present for the plugin to function. This example starts with the .plg file.

Creating the .plg file

The .plg file acts as the interface between the plugin and the designer. It is an ASCII file which contains organizational information such as the location of the necessary DLL, the location of the associated help files, and the name of the plugin itself and the vendor. The .plg file also contains the information that is needed to interface the plugin with the designer. This includes the command line string, the desired text for the menu items, and the key combination that serves as an accelerator. The following list of keywords explains the various parameters, including the rules which apply, whether the parameter is required or optional, and the information that you need to provide. An example follows this list of keywords which illustrates how this file appears when it is finished.

Note: The spaces between the keyword and the parameter value that is being used for the value in your plugin are arbitrary. The spaces used in the examples are designed for presentation only.

Alternate_Paths

This is a string that indicates what relative paths should be used when loading the plugin DLL described below. This field is optional.

The string takes the form:

```
"&1\relativePath1;&1relativePath2;...;&1\relativePathN;"
```

where `&1\` will be converted to the full path to the .plg file. This means that if you have a suite of plugins that get installed in a directory such as `c:\myplugins`, and they all link to a common DLL: `c:\myplugins\plugutil\plugutil.dll`, then if each individual plugin was located in `c:\myplugins\plugN\plugN.plg`, you could specify the alternate path: `&1\..\util;`, which would be converted to: `c:\myplugins\plugN\..\util;` and be appended to the PATH before your DLL is loaded. The quotation marks are required if you choose to use this keyword.

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Instead of a string, you may also use a resource id to point to a path specified in an external source.

DLL_Names

The value for this field is a string that defines the name of the required DLL files for this plugin. This is an optional field, but if used, there must be a DLL named that is used by the plugin. Additionally, an mri.dll may be named. The mri.dll name is optional, but cannot be included without a plugin.dll. If both are included, they are delimited by a space. The name of the DLL files can include the path relative to the location of the plugin files.

plugin.dll
: This is the name of the DLL containing the code for the plugin. If the plugin is not a function call within a DLL, then this may be omitted.

mri.dll
: If mri (translatable strings) is in a separate DLL, name that dll here. The DLLS are specified first so that any strings to follow can be contained in the DLLs.

Whenever a string is required further on in the .plg file, if a string enclosed in quotation marks is not specified, then the value given is assumed to be a string resource id in either mri.dll or plugin.dll

Vendor_Name

This is either the name of the vendor enclosed in double quotation marks, or the resource id of a string. This field is optional, but recommended. An example of this string would be:

```
Vendor_Name:            "Plug-Me-In Inc."
```

Plugin_Name

This is either the name of the plugin enclosed in quotation marks, the resource id of a string. This field is optional, but recommended. An example of this field using a string is:

```
Plugin_Name:            "Who Am I?"
```

Help_File

This field is optional, and identifies the Windows .hlp file used for displaying help for the menu items. It is a string, not enclosed in quotation marks, which includes the relative path to the help file.

Unloading_Function

This field is optional. The **Unloading_Function** field cannot be used in conjunction with the **Unloading_Command_Line** field. This field is only used if there is information or a display element that needs to be modified or removed after the plugin is finished or removed. This string, enclosed in quotation marks, designates the function which will be used. This function must be contained in the DLL that accompanies the plugin.

The **Unloading_Function** is the name of the function to be called when the plugin is about to be unloaded. It has the following signature:

```
unsigned long
      unloadFunctionName(
            const char*     ppluginPath_,
            const char*     ppluginStub_,
            const char*     pdllPath_,
            const char*     builderId_,
            int             remove_)
```

where the parameters are:

ppluginPath_
The fully qualified path to the plugin being invoked, up to and including the final backslash.

ppluginStub_
The rest of the plugin filename (eg. ″myplug.plg″).

pdllPath_
The fully qualified path to the DLL containing VARPG's exposed methods.

builderId_
A string used by VARPG to identify the builder and which is used by the plugin when communicating with the builder.

remove_

0 The builder is shutting down.

1 The user has requested that the plugin be removed altogether. If this is the case, the plugin should remove any information it has stored in the registry at this time.

Return value

0 success

1 failure, or refusal

If the plugin returns a 1 from this function, the builder may prompt the user with the option to forcibly remove the plugin by unloading its DLL. If this occurs, it is possible that the plugin may then crash the designer. If this occurs, restart the designer.

Unloading_Command_Line

As mentioned above, this field cannot be used at the same time as the **Unloading_Function** field.

When this option is used, you provide a string to be executed as though it were being run from the command line. For example, you could start Netscape by specifying the string: `netscape.exe`

This method allows you to obtain the same set of parameters that would be available to a function in a DLL. This is accomplished through the definition of substitution variables. Whenever a '&0', '&1', '&2', '&3', '&4' or '&5' is found in the string specified, it is replaced with the following:

&0 ppluginPath_

&1 ppluginStub_

&2 pdllPath_

&3 builderId_

&4 remove_

&5 path to the GUI Designer's root directory

IBM_PluginInterface | PluginInterface

This is an advanced feature that is not required. This field allows you to expose your plugin as a programmable component. You cannot use these two options in the same .plg file. If you do not have a reason to specify either of these interfaces, do not do so.

When either one or the other of these options is used, the function name specified is used when other plugins interact with this plugin through a target/command/parameters interface.

The signature of the function should be:

```
unsigned long __stdcall IBMtargetCommandFunction(
                    const IString&  pluginPath_,
                    const IString&  dllPath_,
                    const IString&  builderId_,
                    const IString&  target_,
                    const IString&  command_,
                    IString&        arguments_);
```

for the IBM_ style function, where arguments_ is used for input and output.

For the non-IBM style function, the signature should be:

```
unsigned long __stdcall targetCommandFunction(
                    const char*     ppluginPath_,
                    const char*     pdllPath_,
                    const char*     pbuilderId_,
                    const char*     ptarget_,
                    const char*     pcommand_,
                    const char*     parguments_,
                    char**          ppreturnString_);
```

In this case, if there is a return string, `ppreturnString_` should be allocated memory by the plugin using `GlobalAlloc( GMEM_FIXED, [bufferSize])` so that VARPG can deallocate the memory when it is finished with it. If there is no return string required, this parameter can be ignored. The following is an example of this command:

```
{
  IString returnString = ...;
  ...

  *ppreturnString = GlobalAlloc( returnString. length() + 1);
  strcpy( *ppreturnString, returnString);
}
```

To see an example of a plugin that supports the IBM_PluginInterface feature, look at the LPEXSAMP sample provided in the x:\...\WDSC\samples\vndplugs\lpexsamp directory (where x corresponds to the letter of the drive onto which you installed VisualAge RPG).

Begin_Details ... End_Details

Between these tags, enter anything that you wish to show the user when this plugin's information is displayed in the **Manage plugins** dialog. You may want to give a brief description of the purpose and use of your plugin. You can enter text here, or you can use the String/Resid form described for the mri.dll. This field is optional, but is highly recommended.

Function_Name

This is the name of the function that should be called in the plugin.dll when the menu item is triggered. You can either use this field or the **Command_Line** field. You may not use both. It should have the following signature:

```
unsigned long
      pluginFunctionName(
            const char*     ppluginPath_,
            const char*     pdllPath_,
            const char*     builderId_,
            unsigned long   menuContextId_,
            const char*     partsIds_);
```

where the parameters are:

ppluginPath_
Same meaning as for unloadFunctionName().

pdllPath_
Same meaning as for unloadFunctionName().

builderId_
Same meaning as for unloadFunctionName().

menuContextId_
An unsigned long value representing the type of menu from which this plugin is invoked. This value determines the meaning of partsIds_. The possible values are:

1 The plugin was invoked from the menu bar, (that is, this is a project-scoped plugin) and partsIds_ is an empty string.

2 The plugin was invoked for a single selected part, (that is, this is a single-selection-scoped plugin) and partsIds_ contains the identifier of the selected part.

4 The plugin was invoked for a group of jointly-selected parts (that is, this is a multiple-selection-scoped plugin) and partsIds_ is a string containing the blank delimited set of part identifiers of the selected parts.

8 The plugin is invoked when the GUI designer is started.

partsIds_

This is a string representing the part or parts, to which the function call should apply as indicated by the menuContextId_. Within partsIds_, each individual part identifier is a sequence of dot-separated unsigned long values (eg. 432.5632.612) which represent the child-parent hierarchy of the given part. In the stated example, 612 is the ID of the part, 5632 is the ID of its parent, and 432 is the ID of the parent's parent.

Command_Line

When this option is used, you provide a string to be executed as though it was being run from the command line. For example, you could start Netscape by specifying the string: `netscape.exe`.

This method allows you to obtain the same set of parameters that would be available to a function in a DLL. This is accomplished through the definition of substitution variables. Whenever a '&0', '&1', '&2', '&3', '&4' or '&5' is found in the string you specify, it is replaced with the following:

&0 ppluginPath_

&1 pdllPath_

&2 builderId_

&3 menuContextId_

&4 partsIds_

&5 path to the GUI Designer's root directory.

Using the Netscape example above, suppose the vendor provided an HTML file with its plugin, and this particular menu item is intended to display that HTML file. Assume also that the plugin file is located in d:\vendor\plugins, and the HTML file is d:\vendor\plugins\htmlsrc\plugpage.html. To have the plugin display this web page, the definition of the command line might be as follows:

```
netscape &0htmlsrc\plugpage.html
```

Which would expand to, and be run as:

```
netscape d:\vendor\plugins\htmlsrc\plugpage.html
```

Menu_Name

This is either a string or a string resource id that indicates what the menu item should be. These strings have the format:

```
submenu1/submenu2/.../submenuN/menuitem
```

where submenu1 through submenuN are optional submenus.

For example:

```
Menu_Name:              "Plug-Me-In Inc./Who am I?"
```

where ″Plug-Me-In Inc.″ is the submenu and ″Who am I?″ is the menu item.

Menu_Info_Strings

This is a list of strings or string ids that are associated with the corresponding submenus/menuitem as specified in **Menu_Name**. The association works backwards.

For example, if you specify one submenu and one menu item in **Menu_Name**, but only specify one string in **Menu_Info_Strings**, then the string you specify in **Menu_Info_Strings** will be associated with the menu item, and the submenu will be ignored. (It is possible that a previous menu item addition defined an info-area string for the given menu item.)

Supported_Menus

As mentioned in **Function_Name**, the menuContextId_ indicates a type of menu. **Supported_Menus** indicates the menus to which this particular entry should be added.

Help_Id

If a help file has been specified, and there is help associated with this command, provide the help id here in the ulong_panel parameter of **Help_Id**. If the optional_force_window_parameter is provided and is a non-zero value, then the help will be displayed in a full help window rather than in the default context popup. This field takes the form of:

```
Help_Id:       ulong_panel optional_force_window_parameter
```

and a sample of how this is actually coded is:

```
Help_Id:       1000 1
```

Accelerator

This optional field specifies the accelerator to be associated with the item. It consists of one of F1 through F12, followed by one or more modifiers (SHIFT, ALT, CONTROL)

Note: <F1/10>, <Alt-F5/7/8/9/10>, and <Shift-F9/10> are already reserved by the designer, and if specified will be ignored.

To use this function, provide the following information:

```
Accelerator:           [F1 | F2 | F3 | ... | F12] [SHIFT] [CONTROL] [ALT]
```

This field, when used will look like the following sample:

```
Accelerator:           F8 Shift
```

End_of_Definition

This indicates to the parser that a function definition has ended and that a new one may begin.

Template for .plg file and sample

When using the previously described fields to create a .plg file for the GUI designer you need to follow this format:

Note: There must be at least one Function_Name or Command_Line definition. There is no limit on the maximum number allowed.

```
// Lines that begin with double forward-slashes are ignored
// (that is, treated as comments)

Alternate_Paths:        string_or_resId
dll_Names:              plugin.dll mri.dll
Vendor_Name:            string_or_resId
Plugin_Name:            string_or_resId
Help_File:              helpfile.hlp
Unloading_Function:     "unloadingFunction"
       (or)
Unloading_Command_Line: "command line invocation with substitution symbols &0, &1, &2, &3, &4, &5"
IBM_PluginInterface:    "IBMtargetCommandFunction"
       (or)
PluginInterface:        "targetCommandFunction"


Begin_Details:
   .
   .
   Optional text outlining the function of the plugin.
   .
   .
End_Details:


Function_Name:          "functionName1"
       (or)
Command_Line:           "command line invocation1 with substitution symbols &0, &1, &2, &3, &4"
Menu_Name:              string_or_resId
Menu_Info_Strings:      string_or_resId string_or_resId ...
Supported_Menus:        menuContextId1 menuContextId2 ...
Help_Id:                ulong_panel optional_force_window_parameter
Accelerator:            [F1 | F2 | F3 | ... | F12] [SHIFT] [CONTROL] [ALT]
End_of_definition:
```

Note:

- All filenames are given relative to the location of the .plg file.
- The unloaders are optional, but if you choose to have one, you can only have one or the other.
- Either the Function Name or Command Line may be specified.

The following is a specific example of a simple .plg file. There are some plugin samples provided with VisualAge RPG. The files can be found in the X:\...\WDSC\samples\vndplugs\ directory on the workstation where VisualAge RPG is installed (where X corresponds to the drive letter).

```
// Print project plugin

Vendor_Name:            "Plug-Me-In Inc."
Plugin_Name:            "Who Am I?"
Begin_Details:

Who Am I?

  This plugin will display information about the current
  project including its directory name and file name.

End_Details:

Command_Line:           "d:\myproj\whoami\rt_win32\whoami.exe &1 &2 &4"
Menu_Name:              "Plug-Me-In Inc./Who am I?"
Supported_Menus:        1
Accelerator:            F7 Shift
End_of_Definition
```

Creating the .EXE file

To create an .EXE file for the GUI designer you need to be aware of the following:

When using VisualAge RPG to create plugins, you use the *component part to interact with the designer. By setting values for the **PlugDLL**, **PlugId**, **PlugCmd**, **PlugRC**, and **PlugResult** attributes, all of the necessary information can be communicated between the designer and the plugin.

To create a working plugin you must establish proper communication by providing the designer with the following information:

builderId_
: This is the same id that was provided by the designer when the plugin was invoked.

target_
: This is a string representing the aspect of the designer you wish to interact with.

command_
: This is the specific action you wish the designer to take.

parameters_
: Any arguments required by the command.

Note: In a VARPG program, builderId_ corresponds to *component's **PlugId** attribute. In order to make a call to the Plugin interface, you must first have set **PlugId** and also **PlugDLL**. **PlugDLL** indicates to the VARPG runtime where the dll containing the builder's plugin interface is located. When issuing a command, first concatenate the values of target_, command_ and parameters_ using blanks for delimeters and then use the result to set *component's **PlugCmd** attribute.

You get a result and an error code in return. In the case of a function call, one of the parameters is set to contain the result string, and the returned unsigned long value contains the error code. The following are some basic return codes common to all commands. Any additional error codes will be defined in the respective table of Targets and Commands.

Return Code
Meaning

0 All went well, and the command was handled.

1 The target was not recognized.

2 The target did not recognize the command.

4 The builder can not be found.

5 Some unknown error occurred and the results of the command can not be trusted.

Targets/Commands and the associated Return Values

A list of the valid targets and commands follows, along with the semantics of their parameters and returned values.

Table 13. Target: Project

Command	Parameter(s)	Meaning/Return Value
Build	[win32|java] Default: win32	Builds either a win32 or java version of the project, depending on whether the platform is ″win32″ or ″java″. No return value, and returns immediately (that is, before the build completes).
BuildOptions	[win32|java] Default: win32	Shows the build options for either win32 or java, depending on whether the platform is ″win32″ or ″java″. No return value, but does not return until the (modal) dialog is dismissed.
CursoredPart	none	Returns a string containing the partId for the currently cursored part. If no design window is open, or if no open design window is the active design window, then this is an empty string.
ExpandAll	[1]	If this parameter=1, then the entire treeview is expanded; otherwise, it is collapsed.
ForceOpen	[projectName]	Opens the specified project without checking whether or not the current project needs to be saved. Returns a 1 indicating that the ForceOpen was successful, or a 0 to indicate that the ForceOpen was unsuccessful.

Table 13. Target: Project (continued)

Get	ProjectDir	Returns the current project's root directory.
	ProjectFileName	Returns the current project's fully qualified .IVG file name.
	ProjectTargetName	Returns the name of the file that will be generated when the project is built (for example, ″myproj.exe″).
	ProjectTitle	Returns the title of the current project.
	ProjectFileStub	Returns the filename (minus the extension) of the names of the current project (for example, ″myproj″).
IsSaveRequired	none	Returns 1 to indicate that the project has been modified, 0 to indicate that it hasn't been touched since being opened.
IsTemporary	none	Returns a 1 if this is an unnamed project, 0 otherwise.
MostRecentlyUsed	n	Returns the n'th most recently opened project, where n is equal to or greater than 1. Returns an empty string if the index is out of bounds.
Open	projectName	Checks to see if the user wants to save the project before opening another project. Returns 1 if a project was successfully opened, and 0 otherwise.
PartId	partName [windowName |[0|1|2]]	Returns a partId when given a part name. If you specify a windowName, then this will either return the id of the part, or if there is no such part, it will return an empty string. If you specify a searchType, then the following rules will be used when searching for a part with the given name: 0 (default) - Return the first part with the given name. 1 - Return all parts with the given name. 2 - If there is only one part with this name, return it; otherwise return nothing.
PromptedSave	none	Prompts the user for a project name and then saves the project. Returns a 1 to indicate that a successful save took place; otherwise it returns a 0.

Table 13. Target: Project (continued)

PromptExisting	none	Prompts the user for an existing project. Returns the project filename.
Run	none	Runs the current project.
Save	none	Saves the current project.
SaveAs	projectName	Saves the current project with the specified project name.
SelectedParts	none	Returns a string containing the partIds of all of the parts currently selected in the project's treeview.

Table 14. Target: PartClass

Command	Parameter(s)	Meaning/Return Value
AllAttributes	ClassName	Returns a list of the attributes supported by the given ClassName.
AllClasses	none	Returns a list of all available part classes. Each list item is embedded in double quotation marks since some may consist of multiple words (for example, in the case of vendor parts).
AllEvents	ClassName	Returns all registered events for the given class.
IBMClasses	none	Returns a list of all IBM supplied, non-vendor part classes.
IconDll	ClassName	Returns the path of the dll containing the icon that represents the given part class.
IconId	ClassName	Returns the resource id of the icon (in the dll given by "IconDll") for the given class.
IsType	TypeName	Returns 1 to indicate that the ClassName given class is of the given type; otherwise it returns a 0. Possible values for TypeName include: Frame, Canvas, MenuBar, NoteBook, NoteBookPage, PopUpMenu, SubMenu, MenuItem, Subfile and SubfileEntryField.
VendorClasses	none	Returns a list of all available vendor part part classes.

Table 15. Target: Part

Command	Parameter(s)	Meaning/Return Value

Table 15. Target: Part (continued)

ActionSubroutine	partId eventName	Locates the linked action subroutine, eventName or creates a link and scans to it if it does not already exist.
ActionSubroutines	partId	Returns a list of action subroutines defined for this part.
AllEvents	partId	Returns all registered events for the given part.
Children	[partId]	Returns a list of blank delimited partIds enumerating all of the specified part's children. If no partId is provided, a list of all of the project's windows is returned.
ClassName	partId	Returns the classname of the indicated part.
CreateChild	partId className	Creates a part of the given class name className as a child of the specified part. Returns the partID of the newly created part.
CreateFrame	ClassName	Creates a part of the specified class. The class must be a frame based part. Returns the partID of the newly created part.
DataInfo	dataType dataLength decimalPlaces where: dataType is '0'=Numeric or '1'=Character dataLength is the data length decimalPlaces is the number of decimal places	Returns a string of three numbers, each separated by a blank. Applicable parts include entry field, static text, and subfile entry field.
ExtraColorAreas see Note below	partId	Returns a count of the color areas that this part supports if this part supports color areas other than foreground and background.
FileName	partId	Obtains the file name set for this part. If the part doesn't support files, the return value is an empty string.
GetColor	partId [x] where x corresponds to the colorArea of the part indicated.	Get the color for the specified area. Returns a string with 4 blank delimited numbers: useDefault - (0 or 1) redMix - (0 - 255) greenMix - (0 - 255) blueMix - (0 - 255)

Table 15. Target: Part (continued)

GetFont	partId [x] where x corresponds to the fontArea of the part indicated.	Gets the part's font. Returns an empty string if the font is not supported. Otherwise, the first part of the returned string is a 0 or 1 indicating whether or not the default font is being used, the second word of the string is a point size, the third word of the string is a number which (ORs) together applicable font styles from the following: 1 - bold 2 - italic 4 - underscore 8 - strikeout 16 - outline The rest of the string is the font's facename.
GetRect	partId	Gets the coordinates (x y width height) of the part relative to its parent.
HasFile	partId	Returns a 1 to indicate that the part supports a file (for example, canvas, image, media, ...); otherwise it returns a 0.
IsColorArea see Note below	partId [x] where x corresponds to the colorArea of the part indicated.	Returns a 1 to indicate that the color area is supported; otherwise it returns a 0.
IsFontArea	partId [x] where x represents a fontArea of the part indicated.	Returns a 1 to indicate that the font area is supported; otherwise it returns a 0.
Label	partId	Returns the part's label (if it has one).
LinkedEvents	partId	Returns a list of events for which this part has action links.
Name	partId	Returns the name of the part as shown in the treeview and settings notebook.
OpenDesignWindow	partId [1]	When set to 1, opens and sets focus to the design window to which the indicated part belongs. If set to 0, then the design window is closed instead.
OpenPart	partId	Either opens the part's settings notebook, or if the part is a frame, opens the part's corresponding design window.
OpenSettings	partId	Opens the part's settings notebook.

Table 15. Target: Part (continued)

SetColor see Note below	partId colorArea useDefault redMix greenMix blueMix	Sets the color for the given area. See GetColor for more information for the allowed values for each of the parameters.
SetCursored	partId	If the part's design window is open the part becomes the active part but selection state doesn't change. If the design window is not open, this has no effect.
SetDataInfo	partId dataType dataLength decimalPlaces where: partId is the part's id dataType is '0'=Numeric or '1'=Character dataLength is the data length decimalPlaces is the number of decimal places	Sets the data properties of a part. Does not update the Properties Notebook of a part that is already open, or in use. The programmer must ensure new values are compatible with existing ones already defined for the part. Applicable parts include entry field, static text, and subfile entry field.
SetFileName	partId newFileName	Sets the file name for this part. Nothing happens if the part doesn't support files.
SetFont	partId fontArea setToDefault pointSize styles faceName	Sets the part's font.
SetLabel	partId newLabel	Attempts to set the part's label. If the given label is invalid, an error message is shown. Returns 1 to indicate that the label was set; otherwise it returns a 0.
SetName	partId newName	Attempts to set the name of the part. If the set fails, an error message is displayed. If the part has action links associated with it, a message is displayed asking the user if they wish to break the links. Returns 1 to indicate success, or 0 to indicate failure.
SetRect	partId x y width height	Sets the coordinates (x y width height) of the part relative to its parent.

Table 15. Target: Part (continued)

SetSelected	partId [0|1] [0|1]	Selects/deselects the given part. The first parameter in the string is turnOn, and the second is exclusive. If turnOn or exclusive are not specified, it is assumed they have the value ″1″. Exclusive indicates whether selecting the part should deselect all other parts and turnOn indicates whether or not the part's selection status should be altered.
SetStyles	partId styles extendedStyles [0|1]	Sets the styles and extended styles of the given part. Note that these settings will not necessarily be updated in the properties notebook or the design window if either is open. This command is intended for use when a part is being created and initialized. A ″0″ at the end of this string will indicate that the value is in decimal format, while a one indicates that hexadecimal notation is being used.
Styles	partId [0|1]	Returns two numeric values separated by a space representing the styles and extended styles of the given part. A ″0″ at the end of this string will indicate that the value is in decimal format, while a one indicates that hexadecimal notation is being used.
Zoom	partId [0|1]	Expands the treeview and scrolls to the indicated part. If ″1″ is specified, then the treeview is also given focus.

Note: A part will have a Foreground (1) color area, a Background (0) color area or no color area, or it will have Extra color areas. The window part, for example has no color areas. The Checkbox has foreground and background color areas. The graph has Extra color areas. Therefore, 0 and 1 only necessarily indicate background and foreground color if the part has no Extra colors.

The following require that the source file be open in LPEX.

Table 16. Target: Subroutine

Command	Parameter(s)	Meaning/Return Value
DeleteActionSub	routineName	Deletes the action subroutine with the given name.
DeleteUserSub	routineName	Deletes the user subroutine with the given name.

Table 16. Target: Subroutine (continued)

UserSubroutine	routineName	If the subroutine does not exist, creates a user subroutine with the given name and locates it in the source file. If it does exist, it is located in the source file.
UserSubroutines	none	Returns a list of user subroutines.

Table 17. Target: Grid

Command	Parameter(s)	Meaning/Return Value
IsOn	none	Returns a 1 if the grid is currently on, and a 0 if it is off.
TurnOn	[0|1]	If set to 1, will turn on the grid. If set to 0, will turn it off. (Defaults to on.)

Table 18. Target: Lpex

Command	Parameter(s)	Meaning/Return Value
DoIt	Any_LPEX_command	Passes your parameters to LPEX's ″DoIt″.
IsSourceFileOpen	none	Returns a 1 to indicate that the source file is open; otherwise it returns a 0.
OpenSourceFile	none	Opens the source file in LPEX.
Query	Any_LPEX_query	Passes your parameters to LPEX's ″Query″.

Table 19. Target: Plugin

Command	Parameter(s)	Meaning/Return Value
AddPlugin	filename	Attempts to add the specified plugin. Returns ″0″ if successful.
get	PluginCount	Returns the number of plugins currently installed.
	Plugin oneBasedIndex	Returns the fully qualified path of the oneBasedIndex'th plugin. If n is less than 1 or greater than the number of plugins, a null string is returned.
	Plugins	Returns a list of the fully qualified paths of all plugins.
InvokePlugin	oneBasedIndex target command parameters	Invokes the plugin using a target/command interface.

Table 20. Target: Registry

Command	Parameter(s)	Meaning/Return Value
DeleteKey	key	This command will delete the given key from the registry (including any subkeys).

Table 20. Target: Registry (continued)

Get	key [″defaultValue″]	If the key does not exist, the return value is defaultValue, otherwise it is the value of the key in the registry. When entering substitute the 'defaultValue' string with the string of your choice. The double quotation marks are required.
GetRect	key [″x y width height″]	This command will retreive a rectangle from the registry, and if the element with the given key is not found, the default values supplied will be returned instead. The double quotation marks are required.
Set	key value	Use this command to set a string value into the registry. No return value.
SetRect	key ″x y width height″	This command will store the given rectangle in the registry using normalized coordinates. The double quotation marks are required.

A note on using the registry commands.

Plugins are strongly urged to use an initial subkey that is likely to be uniquely theirs, so that they don't interfere with other plugins' registry entries.

All registry entries made using these commands will be restricted to a common subsection of VARPG's registry entry, however; it is possible to overlap across plugins.

To avoid such overlaps, plugins could use a variation on the pathname of the .PLG file as the initial subkey as follows:

If the plugin's pathname is:

```
"c:\plugins\My_Plugins\myplug.plg",
```

and the registry entry is to be used to store a window position, then an appropriate key to use for this value would be:

```
"c__plugins_my plugins_myplug.plg\Window Position"
```

(Note that case was eliminated from the path portion of the key, and that the colon and back-slashes were converted to underscores.) The keys and values specified must be enclosed in quotes, since the keys can contain spaces. Thus, if you were trying to set a string value you would use:

```
Set( "c__plugins_my_plugins_myplug.plg\Some relevant keyname" "The new value.")
```

Embedded quotes are prefaced with a backslash:

```
Set( "c__plugins_my_plugins_myplug.plg\Some relevant keyname" "The new \"quoted\"value.")
```

There are some other commands which apply to (some of) the GUI Designer's own constituant windows. (For example, the parts catalog)

Applicable Targets:
MainWindow
This is the main Gui Designer window.
Catalog
The parts catalog.
DBRefDlg
The Define Reference Fields window.
ImportDlg
The Import Display File window.
LPEX The editor window.

Note that these only apply when the indicated window is open.

Table 21. Target: GUI Designer constituent windows

Command	Parameter(s)	Meaning/Return Value
GetHandle	none	Returns the Windows HANDLE for the given window.
GetIWindowPointer	none	Returns the IWindow pointer for the given window.
MoveSizeTo	X Y Width Height	Sets the window's size and position.
MoveTo	X Y	Moves the window to position (X, Y).
Position	none	Returns the position of the window in the form "X,Y".
Rect	none	Returns the window's rectangle in the form "X,Y,Width,Height"
SetFocus	none	Sets focus to the indicated window.
SetSize	Width Height	Sets the size of the window.
ShowSetFocus	none	Shows the window (if it's not already visible) and sets focus to it.
Size	none	Returns the size of the window in the form "X Y".
NotifyOnClose	Window handle	Specifies which window is to be notified when the GUI Designer is closed.

Sample Plugin Source Code

The following is the source code for the plugin that corresponds to the plg file used the in section above.

```
*********************************************************************
*                                                                   *
* Program ID . . : WhoAmi                                           *
*                                                                   *
* Description  . : Sample program to illustrate the Vendor plugin   *
*                  interface of VARPG.                              *
*                                                                   *
*                  When invoked from the Vendor menu item on the    *
*                  GUI Designer this program will use the plugin    *
*                  interface to gather information about the        *
*                  current project and display it on a window       *
*                  named MAIN.                                      *
*                                                                   *
*  The following plugin file, WHOAMI.PLG, was specified when adding *
*  this plugin to the GUI designer                                  *
*                                                                   *
*  // WhoAmi.plg plug in file                                       *
*  Vendor_Name:         "Plug-Me-In Inc."                           *
*  Plugin_Name:         "Who Am I?"                                 *
*  Begin_Details:                                                   *
*      Who Am I?                                                    *
*      This plug-in will display information about the current      *
*      project including its directory name and file name.          *
*  End_Details:                                                     *
*  Command_Line:        "d:\myproj\whoami\rt_win32\whoami.exe &1 &2"*
*  Menu_Name:           "Plug-Me-In Inc./Who am I?"                 *
*  Supported_Menus:     1                                           *
*  Accelerator:         F7 Shift                                    *
*  End_of_Definition                                                *
*                                                                   *
*********************************************************************
 *
D Cmd             S            255A
 *
C     *Entry        Plist
C                   Parm                    PlugDLL          64
C                   Parm                    PlugID           64
```

```
 ********************************************************************
 *                                                                  *
 * Window . . : Main                                                *
 *                                                                  *
 * Part . . . : PB_Cancel                                           *
 *                                                                  *
 * Event  . . : Press                                               *
 *                                                                  *
 * Description: Terminate the program                               *
 *                                                                  *
 ********************************************************************
 *
C     PB_CANCEL     BEGACT    PRESS         MAIN
 *
C                   Move      *on           *inlr
 *
C                   ENDACT
 *
 ********************************************************************
 *                                                                  *
 * Window . . : Main                                                *
 *                                                                  *
 * Part . . . : Main                                                *
 *                                                                  *
 * Event  . . : Create                                              *
 *                                                                  *
 * Description: Set up the PLUGDLL and PLUGID values of the         *
 *              *COMPONENT part to establish communication with the *
 *              GUI builder.                                        *
 *                                                                  *
 *              Execute PLUGCMD attributes to collect information   *
 *              about the current project                           *
 *                                                                  *
 ********************************************************************
 *
C     MAIN          BEGACT    CREATE        MAIN
 *
C     '*Component'  Setatr    PlugDll       'PlugDLL'
C     '*Component'  Setatr    PlugID        'PlugID'
 *
C                   Eval      Cmd='Project Get ProjectDir'
C     '*Component'  Setatr    Cmd           'PlugCmd'
C     '*Component'  Getatr    'PlugResult'  DirName
 *
C                   Eval      Cmd='Project Get ProjectFileStub'
C     '*Component'  Setatr    Cmd           'PlugCmd'
C     '*Component'  Getatr    'PlugResult'  File
 *
C                   Eval      Cmd='Project Get ProjectTargetName'
C     '*Component'  Setatr    Cmd           'PlugCmd'
C     '*Component'  Getatr    'PlugResult'  TAR



 *
C                   Eval      Cmd='Project Get ProjectTitle'
C     '*Component'  Setatr    Cmd           'PlugCmd'
C     '*Component'  Getatr    'PlugResult'  Title
 *
C                   Eval      Cmd='Project Get ProjectFileName'
C     '*Component'  Setatr    Cmd           'PlugCmd'
C     '*Component'  Getatr    'PlugResult'  Folder
 *
C                   Write     'Main'
 *
C                   ENDACT
```

Packaging Your Application

The final step in creating the plugin is the compilation of the .EXE file. Select **Build** from the **File** pull-down menu, and then select the platform that you would like to use the plugin on. Once the file is compiled, it is ready for use. Refer back to the instructions for **Adding a Vendor Plugin** in order to add the plugin. From this point, you may use the plugin, or you can do any further testing that may be required.

Considerations when Creating Plugins using VisualAge for C++

The process for creating plugins using VisualAge for C++ is the same as for using VisualAge RPG. The only difference is that when you create the plugin using VisualAge for C++, you do not have the direct use of the *component part. Instead, to allow VisualAge for C++ programs to be used as plugins, the IBMExecuteVDECommand() function has been provided. Its use is demonstrated in the sample plugin, ″TreeSamp″.

If necessary, you can cut and paste the code from the x:\...\WDSC\samples\vndplugs\treesamp (where x corresponds to the letter of the drive onto which you installed VisualAge RPG) and the x:\...\WDSC\samples\vndplugs\plugutil directories in order to create the correct calls to the IBMExecuteVDECommand().

Considerations when Creating Plugins using REXX

The process for creating plugins using REXX is almost identical to that of the VisualAge RPG example. REXX programmers do not have direct access to the GUI designer using the *component part. To facilitate the use of REXX scripts as plugins, the RexxExecuteVDECommand() function is included amongst this set of functions. An example of how to use this function in a REXX file can be found in the sample plugin, ″RexxSamp″.

If necessary, you can cut and paste the code from the x:\...\WDSC\samples\vndplugs\rexxsamp (where x corresponds to the letter of the drive onto which you installed VisualAge RPG) directory in order to create the correct calls to the REXXExecuteVDECommand().

Part 5. Distributing Your Application

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Chapter 27. Packaging Runtime Code and Applications

After you build and test your application, you can package it and distribute it to other workstations that have the VisualAge RPG runtime code installed.

This section describes how to package the VisualAge RPG runtime code and VisualAge RPG applications.

Note: If the application will be using an iSeries server other than the one it accessed during the development cycle, all server objects used by the application should also be packaged and restored to the new server. They are not packaged by the VisualAge RPG application packaging utility.

Before You Begin

Make sure that the files needed by your application are stored in the appropriate runtime directory (RT_WIN32 for Windows or RT_JAVA for Java). Some files are automatically placed in the runtime directory after you build your application (for example, the .MSG, .HLP, .DLL, .BND, .RST, and .EXE files); others you will have to put in yourself (for example, any .BMP, .GIF, .ICO, .JPG, .MID, and .WAV files).

If you put additional files in the runtime directories before you package your application, make sure that the file names are not the same as those of any existing application files.

After you put all the files in the runtime directory, also make sure that no two files have the same name and first two characters in their file extension. For example, if you have two files FILEA.ABC and FILEA.ABB in the RT_WIN32 directory, one will be overwritten during the packaging process.

If you plan to package to diskettes, it is convenient to have pre-formatted diskettes available before you begin the packaging process.

Packaging the VisualAge RPG Runtime Code and Applications

This section describes the process you must follow to package either the VisualAge RPG runtime code, an application, or shared components.

Note: Verify that the remote location name in the RST file is the same server as your users will be using. If not, modify the Remote Location column for the entry on the Servers page in the Define iSeries Information notebook. To access this notebook from the GUI Designer, select **Define iSeries information** from the **Server** pull-down menu. To access it at run time, use the Define iSeries Information icon. To access it at packaging time, use the **Change server** button.

In the RST file, you must also specify the correct protocol used by your users.

For SNA, the remote location name is the name of the router defined in Client Access.

For TCP/IP, the remote location name is the iSeries server host name defined in your TCP/IP server list.

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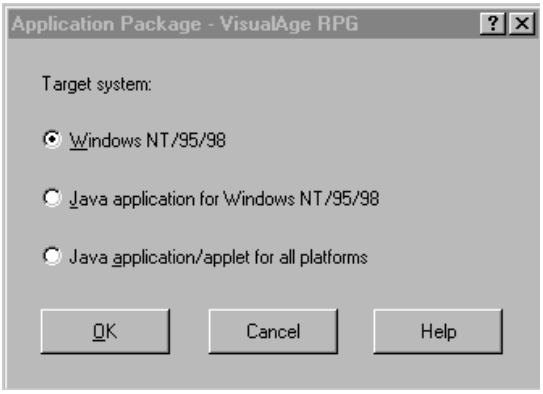
Starting the Packaging Utility

To start the packaging utility, use one of these methods:

- Select **Project>Package** from the Project Organizer
- Select the **Package** option from the project icon's pop-up menu
- Select **Application Packaging Utility** from the **Start > Programs > IBM WebSphere Development Studio Client for iSeries > VisualAge RPG** menu.

The Application Package window appears:



Specify the target system for your application:

- **Windows**

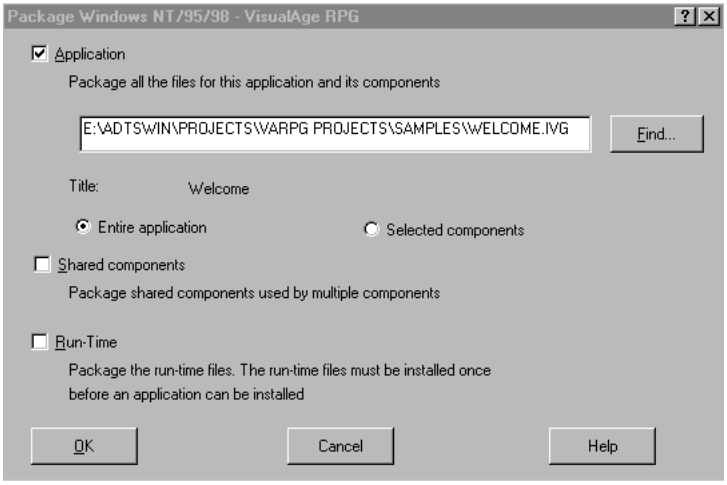
  Packages the Windows version of your application for the Windows platform.
- **Java applications for Windows**

  Packages the Java version of your application for the Windows platform.
- **Java application/applet for all platforms**

  Packages the Java version of your application for other operating systems.

Packaging Windows Applications for Windows

Select **Windows** and press OK. The Package Windows dialog appears:



Specify the following:

- What you want to package
- The application package information
- The runtime package information

Specifying What You Want to Package

In the Package window, specify the following information:

Application Name

The fully qualified application project name. You can type over the default (if any), or use the **Find** push button to invoke the Find Projects for Packaging window. When you specify an application project name, the title of the application will be displayed for your information.

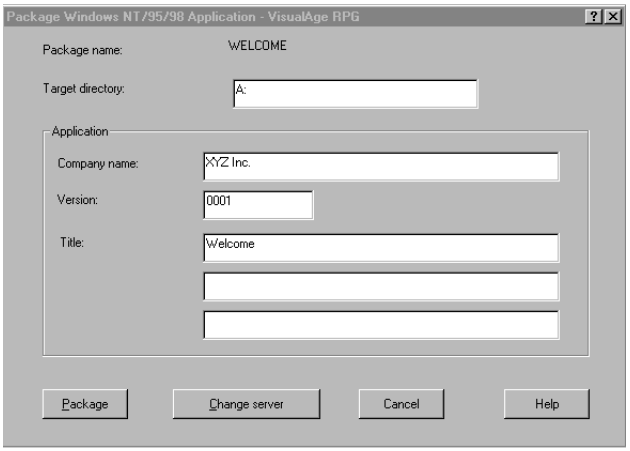
What you want to package

Use the check boxes to indicate whether you want to package the application, the shared components, the runtime code, or all three. If you select shared components, a window containing a list of shared components will open. You can select which shared components in the list should be packaged.

Use the radio buttons to indicate whether you want to package the entire application or only selected components. If you choose to package selected components, a window will open that contains a list of components within the application that you can select. You can also package additional shared components created by other applications. These shared components will be automatically added to the list the next time you choose to package by component.

Specifying the Application Package Information

After making your selections on the Package window, press OK. The package information window appears:



In the Package information window, specify the following information:

Target directory

The target directory for packaging. If you package to a diskette, the target directory can only be the root directory of the diskette; there can be no subdirectory. If you package to a directory, that directory must **not** contain other files.

Company Name

The company name that the application will be registered under.

Note: When you package an updated version of a previously distributed application, use the same company name for the revised application. Otherwise, the revised application will be treated like a new application.

Version
The version of the application.

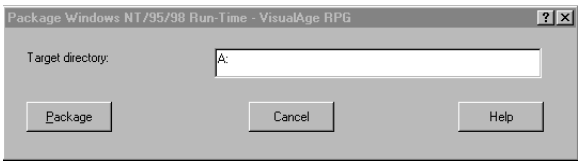
Title The title of the application.

Here you can use the **Change server** button to display a list of servers (remote locations) used by your application. You can modify the list so that the package will use the new names.

Select **Package** to begin the packaging. A progress indicator window appears. Messages are displayed to tell you what labels to put on the various diskettes as you create them. When packaging is completed, a completion message is displayed.

Specifying the Runtime Package Information

If you indicated that you want to package the runtime code, you must specify the target directory in the Package Run-Time window:



If you package to a diskette, the target directory can only be the root directory of the diskette; there can be no subdirectory. If you package to a directory, that directory must **not** contain other files.

Select **Package** to begin the packaging. A progress indicator window appears. A completion message indicates when packaging is completed.

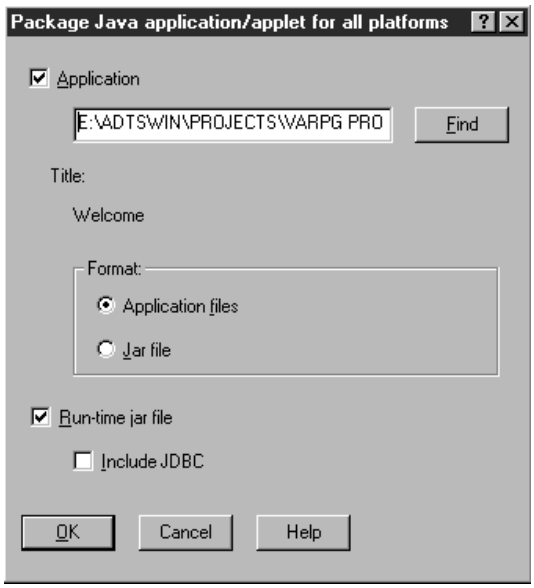
Packaging Java Applications for Windows

Packaging the Java version of your application for the Windows platform follows a similar set of dialogs as the Windows version.

Specify what you want to package and whether you want to package the run time. If you want to package the application, specify the application project name and select the application check box. Use the runtime checkbox to package the run time.

Packaging Java Applications for Other Platforms

Select **Java application/applet for all platforms** on the Application Package window and press OK. The Package Java window appears:



Specify the following:

- What you want to package: the application, run time, or both.
- The format of your package: the Application files (valid only for the Application choice) **or** the Jar file.

Specifying What You Want to Package

In the Package Java window, specify the following information:

Application Name

The fully qualified application project name. You can type over the default (if any), or use the **Find** push button to display the Find Projects for Packaging window. When you specify an application project name, the title of the application will be displayed for your information.

What you want to package

Indicate whether you want to package the application or the runtime jar file.

For the Application choice, you can choose one of the following formats:

- **Application files**

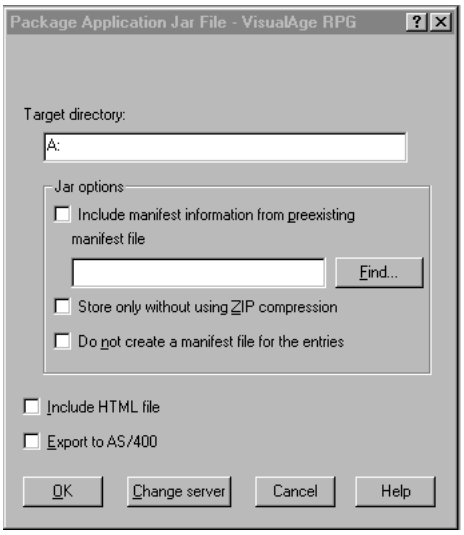
  Include all of the files in the runtime directory and place them in the target directory.
- **Jar file**

  Include all of the files for a component in its own jar file. (Any GIF image files will just be copied and not included in the jar file.)
- **Include JDBC**

  Include the JDBC class functions file in the jar.

Packaging the Application Jar File

If you select to have your application packaged as a Jar file, the following window appears:

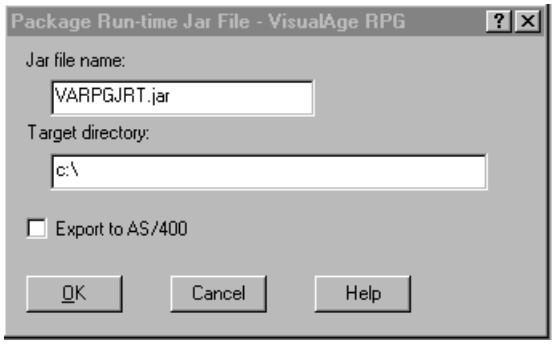


Specify the target directory. You can specify Jar options, as well. If you select **Inlcude HTML file**, the default HTML page for the application will be copied to the target diretory. If you select **Export to iSeries**, the Smart Guide to export files to the server will be displayed.

Note: If your application has multiple components, each component will have its own jar file. Also, any GIF image files will just be copied and not included in the jar file.

Packaging the Run Time

If you select to have a runtime Jar file, the following window appears:



Specify the jar file name and the target directory. If you select **Export to iSeries**, the Smart Guide to export files to the server will be displayed.

Chapter 28. Installing Windows NT/95/98 Runtime Code and Applications

This section describes installing the runtime code and applications for Windows NT/95/98, using InstallShield.

Note: The runtime code must always be installed **before** you install an application. Only one copy of the runtime code is installed on a workstation, regardless of how many applications are installed.

Installing the Runtime Code

Start the installation utility by running the

```
setup.exe
```

command in the package and follow the steps given in the dialog boxes.

The Define Server Logon, the Define AS/400 Information utility and the Define TCP/IP Server List are installed with the runtime code. Use these utilities to maintain and update the names and location of AS/400 resources at run time. See Chapter 8, "iSeries Connectivity," on page 193 for more information.

A Note About Embedded SQL

If your application has embedded SQL and is referencing a database to which your application was not bound at build time, you have to re-bind your application to a database to which it does have access.

Installing an Application

Install the application by calling the

```
setup.exe
```

in the package and follow the steps given in the dialog boxes.

The Define AS/400 Information utility is installed optionally with the application. Use this utility to maintain and update the names and location of AS/400 resources at run time. See Chapter 8, "iSeries Connectivity," on page 193 for more information.

Maintaining the Runtime Code and Applications

To update the runtime code or application, use the same setup.

To remove the runtime code or VisualAge RPG applications do the following:

1. From the Windows NT/95/98 Start pop-up menu on the Task Bar, select Settings and then Control Panel.
2. Invoke the Add/Remove Programs utility.

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Installing From the LAN

This section applies to Windows applications running on Windows NT/95/98.

To run from the LAN:

1. Package the runtime code or application to a LAN server.
2. Install the runtime code or application to the root directory of the same server. The directory name should be VRPGRT_LAN for the runtime code or XXX_LAN for the application. XXX is the name of the application's executable file.
3. Install the runtime code to the client workstation using the package from step 1. Select the compact option.
4. Install the application using the package from step 1. Select the compact option.

Installing Silently from the LAN

This section describes how to install the runtime or application code silently from a LAN server. The basic steps are:

1. Package the runtime or application code to your LAN server using the packaging utility. (See "Packaging the VisualAge RPG Runtime Code and Applications" on page 415 for instructions.)
2. Install the run time or application on the LAN server using the **-r** setup option:

   ```
   setup -r
   ```

   The `r` parameter enables the system to record your keystrokes during the installation process. This information is stored in the setup.iss file created in your Windows directory. Your keystrokes will be used for silent installation.
3. Copy the **setup.iss** file from your Windows directory to the LAN directory where you packaged the run time or application. For example, if c:\winnt is your Windows directory, the setup.iss file can be found under c:\winnt.

   Note: Make sure you copy the runtime setup.iss file before you install the application to its LAN directory with the `r` option. Otherwise the setup.iss file from the application install will overwrite the setup.iss file created by the runtime install step.
4. Modify the copy of the setup.iss file in the LAN directory where you packaged the run time or application. Change the `szDir` entry to point to the target drive and directory where the run time or application package will be installed to.
5. From the client workstation, go to the LAN directory where the run time or application was packaged. Run the following command:

   ```
   setup -s
   ```

   After installing the run time, shut down and restart your operating system.

Part 6. Appendixes

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Appendix A. Application Files

This section describes all the files that VisualAge RPG produces when you create a GUI, write logic, and build an application. Unless specified, do not edit, rename, or remove these files from the directory in which they were created.

Note: For Java applications, it is RT_JAVA. For Windows NT/95/98 applications, it is RT_WIN32.

Table 22. Application files

File name	Format	Description
filename.CLASS	Binary	The runtime directory contains the filename.CLASS file, which is created when a project is compiled for Java.
filename.DLL	Binary	The runtime directory contains the filename.DLL file, which is created using the .VPG file. A VisualAge RPG DLL is the program object for the application. The compiler can also create a utility DLL and its accompanying .LIB file.
filename.EVT	ASCII	The source directory for the application contains the filename.EVT file, which contains compiler feedback errors.
filename.EXE	Binary	The runtime directory contains the filename.EXE file, which contains the runtime mainline. The compiler can also create an EXE that is self-contained.
filename.HLP	Binary	The runtime directory contains the filename.HLP file, which is the compiled help file that was created using the .IPF, .IPM, .VPG, and .TXM files.
filename.HTM	ASCII	The source directory for the application contains the filename.HTM file, which includes HTML code for launching the compiled Java program as an applet.
filename_applet.HTM	ASCII	The source directory for the application contains the filename_applet.HTM file, which includes HTML code that checks the VARPG Java run time to ensure that the user has the correct version of the run time installed as an extension.
filename.IPF	ASCII	The source directory for the application contains the filename.IPF file, which contains all the control information needed to build online help.

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Table 22. Application files (continued)

File name	Format	Description
filename.IPM	ASCII	The source directory for the application contains the filename.IPM file, which contains all the second-level help you write for messages for windows and their parts. • Do not rename or remove this file from the directory it was created in. • Use the GUI Designer (Define Messages window) to edit this file. If you must edit this file outside of the GUI Designer, limit your changes to simple text editing such as correcting grammar and spelling mistakes. Do not remove or modify resource IDs, add messages, or delete messages.
filename.JAVA	ASCII	The source directory for the application contains the filename.JAVA file, which contains the generated Java source resulting from a Java compile.
filename.LIB	Binary	The filename.LIB file contains all the exported procedures that are part of a utility filename.DLL.
filename.LST	ASCII	The source directory for the application contains the filename.LST file, which contains the compile listing.
filename.ODF	Binary or ASCII	The source directory for the application contains the filename.ODF file, which contains all the information about your application's windows and their parts. • Do not rename or remove this file from the directory it was created in. • This file can only be edited using the GUI Designer.
filename.ODX	ASCII	The source directory contains the filename.ODX file, which is created using filename.ODF and is used at run time.
filenameResources.properties	ASCII	The runtime directory for the application contains the filenameResources.properties file, which contains all messages you write for the windows and their parts, in Java format.
filename.RST	ASCII	The source directory contains the master copy of this file. filename.RST contains all the server aliases, file overrides, data area overrides, program overrides, and lock level information you define for your application. You can change its contents at build time using the GUI Designer, or at run time using the Define AS/400 Information utility.

Table 22. Application files (continued)

File name	Format	Description
filename.TXC	ASCII	The source directory for the application contains the filename.TXC file, which contains all the programming notes you keep in the multiline edit fields provided for storing technical descriptions. • Do not rename or remove this file from the directory it was created in. • Use a part's properties notebook to change its settings.
filename.TXM	ASCII	The source directory for the application contains the filename.TXM file, which contains all messages you write for the windows and their parts. • Do not rename or remove this file from the directory it was created in. • Use the GUI Designer (Define Messages window) to edit this file. If you must edit this file outside of the GUI Designer, limit your changes to simple text editing such as correcting grammar and spelling mistakes. Do not remove or modify resource IDs (resids), add messages, or delete messages.
filename.VCX	Binary	The runtime and source directories for the application contain the filename.VCX file, which contains persistence information for any ActiveX parts used in your application.
filename.VPF	ASCII	The source directory for the application contains the filename.VPF file, which contains all the help text you write for windows and their parts. • Do not rename or remove this file from the directory it was created in. • You can edit this file by using either the GUI Designer's editor (using a pop-up menu for a part or using a properties notebook) .
filename.VPG	ASCII	The source directory for the application contains the filename.VPG file, which contains all the VisualAge RPG application source code you write. • Do not rename or remove this file from the directory it was created in. • Use the GUI Designer to edit the source code.

Appendix B. Writing Thin Client Applications

VisualAge RPG applications that mainly run on and utilise workstation resources are called **thick client** applications. **Thin client** applications mostly rely on the iSeries server to perform their processing and only leave the GUI handling to the client.

Thick client applications follow very much the same programming style found in today's RPG III or RPG IV applications, but they run mostly on the workstation instead of the iSeries server. File specifications are used to specify which database files to access, and native RPG operations like READ, CHAIN, and so on, are used to access the data on the server. The iSeries server functions as a data server and does minimal computing to support the VARPG application.

The thick client model has several disadvantages over its thin client counterpart. Its capability for module reuse is very limited and there is an increased overhead cost associated with change management. As well, moving processing onto the client workstation under utilises the processing power of the server.

Making the client portion of an application thinner, offers the following advantages:
- The amount of code running on the client can be easily reduced.
- Application reusability will be greatly enhanced.
- Maintainance of complex code will be easier.

This section discusses two possible implementations of the thin client model. Both implementations exploit multiple VARPG capabilities that provide integration with the iSeries server. The two examples include capabilities that use:
- External description of data structures to define externally described data in a data structure easily without the use of direct file access
- Remote call interface to provide a simple way of calling server programs and passing data
- Reference fields in the GUI designer. Fields in the subfile of the user interface are defined as reference fields, no additional definition of database fields is needed.

Implementing a VARPG Thin Application Model

The thin VARPG application model can be implemented in several, different ways. Two ways are described here. One implementation uses remote calls to an iSeries server; the other uses data queues on the iSeries server. The same user interface is used in both examples.

The simple client application reads data from a customer file and fills a subfile with 10 records at a time. The following illustration shows the user interface for this application:

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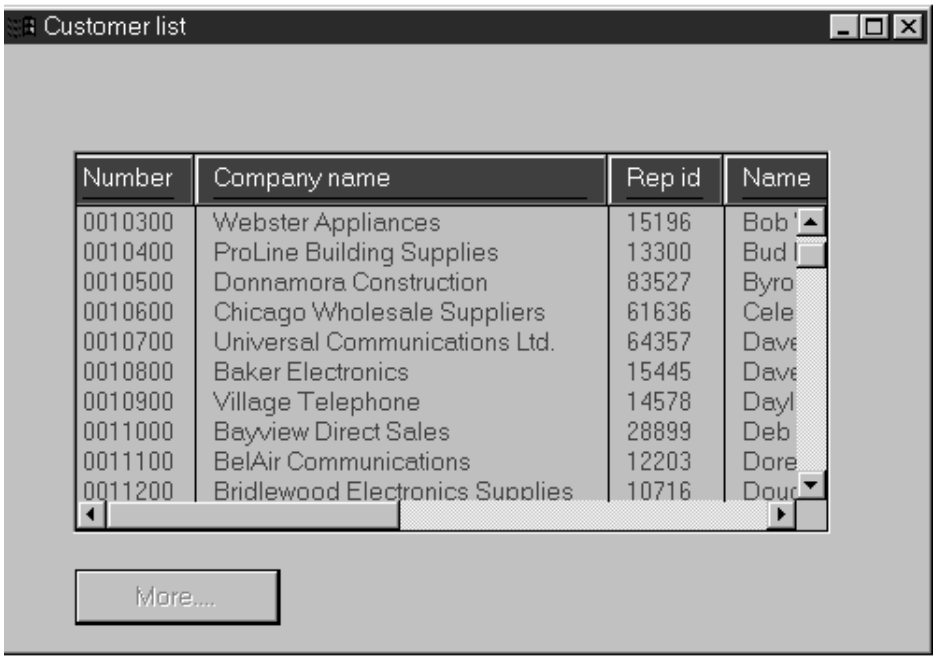


Figure 114. Client GUI Interface

The interface consists of a window with canvas, a subfile, and a push button to load one *More* page of records into the subfile. The subfile size for this particular example is 10 records. It can be changed by increasing the height of the subfile part.

The following names are used in this example:

Part **Name**

Window
WIN1

Subfile
SUB1

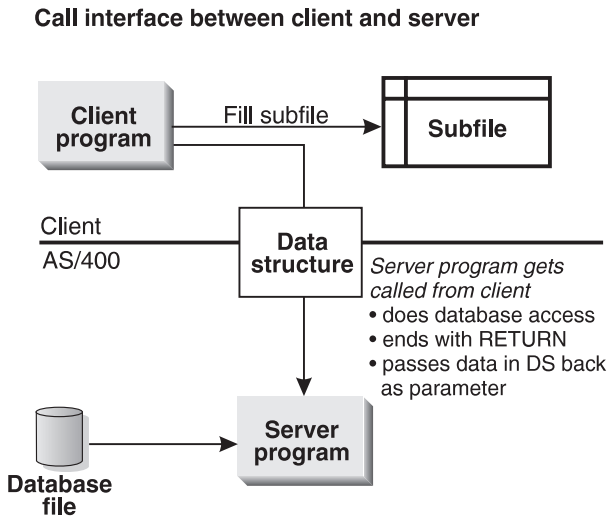
Push button
PSBMORE

Sample Application Using Remote Calls

In traditional RPG programs, user interface code and database access logic are intermixed in one module. Part of this structure stems from the history of RPG, and part from the usage of the Original Program Model (OPM) that forces the programmer to achieve good performance. One way to implement the thin application model is to split the user interface logic completely from the database access logic and have each piece run on different systems. The user interface logic runs on a Windows client, the database access logic runs on the iSeries server.

This sample application shows how to support reading records of data from the iSeries database and placing this data into a GUI subfile. The program on the iSeries server could just as well support full database access (READ and WRITE). This could be implemented by supplying one program for each different access method, or by passing the desired operations as parameters to a single server program.

The following diagram shows how this sample works:



The client program gets requests from the user interface. It calls a server program that reads records from a database program and passes this data back to the client through parameters. The subfile gets filled with the returned data.

The Client Program

The main part of the client side program is the user interface. It is created in the same way as all VARPG applications and can utilize the external database descriptions of the server by using database reference fields. Any validation checking specified in the database is done automatically on the client by the VARPG run time. The Client program requests data from the server by calling a server data access program, the data itself is passed via parameters. The Client program does not use file specifications; instead, the data definition is done through external described data structures. This way the programmer still gets the benefits of external field descriptions in the VARPG program.

Sample RPG Source for the Client Side

The VARPG program consists of D and C specifications. The D specifications contain the following data definitions:

- The fields used as parameters:
  - *cust*, a multi occurrence structure
  - *custelem*, a numeric field, contains the maximum number of records being requested
  - *eof*, a named indicator, gets passed when the end-of-file indicator is set to ON in the server program
  - *nrecords*, a numeric field, contains the number of records returned
- Two working fields:
  - *fileend*, a named indicator, for keeping the file end condition
  - *counter*, a counter for the DO loop
- *getrec*, a constant, defines the program being called on the server. It defines the linkage to the server and the actual name of the server program. The program name must be specified in UPPERCASE.

```
H
D cust          e ds                  extname(customer)
D                                     occurs(10)
D                                     inz
D eof             s              n    inz
```

```
D nrecords        s              2  0
D fileend         s               n   inz
D getrec          c                  linkage(*server)
D                                    const('GETREC')
D counter         s              2  0
D custelem        s              2  0 inz(%elem(cust))
```

The C specifications contain one action subroutine that is linked to 3 events:
- **Press** event from push button *PSBMore*
- **Create** event from window *Win1* (Linked to PSBmore/press action subroutine)
- **Pageend** event from subfile *Subf1*

The first statement is a call to the server program to fetch more records. The rest of the logic just processes the data passed via parameter and moves it from the multi occurrence data structure to the subfile. After the subfile is filled with a set of records the highest record number in the subfile is applied to the SETTOP attribute to move this set of record into the visible area of the subfile.

At the end, if the *end-of-file* is reached, the **More** push button gets set to be disabled. Note that the *Page Down* keys still work. It is still possible to cause an event that will trigger this action subroutine even with a disabled push button.

```
 *
C     PSBmore       begact    PRESS         win1
C                   call      GETREC
C                   parm                    cust
C                   parm                    custelem
C                   parm                    eof
C                   parm                    nrecords
C                   eval      counter=1
C                   dow       counter<=nrecords and not fileend
C     counter       occur     cust
C                   write     sub1
C                   eval      counter=counter+1
C                   enddo
C                   eval      %setatr('win1':
C                             'sub1':'settop')=%getatr('win1'§
C                             'sub1':'count')

C                   if        eof
C                   eval      %setatr('win1':
C                             'psbmore':'enabled')=0
C                   eval      fileend=*on
C                   endif
 *
C                   endact
```

As you can see, the client end of this code is straight forward and minimizes the processing on the workstation.

The Server Program

Since the VARPG client program excludes the database access logic, this function is now provided by the server program. The server program contains all FILE definitions and operations to handle the database processing. Data is exchanged by moving a data structure as a parameter between the client and the server program. The data structure contains the field definitions of the data file record format. In this example, a multi occurrence data structure is used for accessing a collection of records. The number of occurrences is equal to the numbers of records to be passed; in this example, 10. Any operational information, such as error information for example, could be passed by parameter, as well. The server program gets

invoked by the Call in the VARPG client program and ends after each request. The Return operation code is used to end the program and keep the invocation environment. This will benefit performance in subsequent calls, since no initialization is needed. This also requires the program to be created to run in a named activation group, since *NEW would destroy the invocation environment and free storage immediately.

Sample RPG Source for the Server Side

The File specification defines the external database file Customer. The data definition specifications define the parameters to be passed. These must be defined the same as on the client side. Count represents a work variable for the counter in the DO loop. Custelem contains the number of elements in the data structure CUST, it is used as a limit for the DO loop.

```
 * Program to read a set of records into a data structure
 ******************************************************
Fcustomer  if   e             disk
D cust          e ds                    extname(customer)
D                                       occurs(20)
D eof             s               n
D count           s              2  0
D custelem        s              2  0
```

At the top of the calculation specifications, the PLIST operation code defines the parameters being passed to this program. The DO loop reads from the database file and puts the data into data structure CUST, which will be passed back as a parameter to the client program. The other two parameters just indicate the status of the database access:

- EOF will be set to ON if indicator 99 gets set by the READ statement.
- Count contains the number of records being passed back to the client in data structure CUST.

```
C     *entry        plist
C                   parm                    cust
C                   parm                    custelem
C                   parm                    eof
C                   parm                    count
C                   eval      count=1
C     count         occur     cust
C                   read      customer                              9999
C                   dow       count<custelem and not *in99
C                   eval      count=count+1
C     count         occur     cust
C                   read      customer                              9999
C                   enddo
C                   if        *IN99
C                   eval      count=count-1
C                   eval      eof=*on
C                   endif
C                   return
```

When compiling the server program, be sure not to specify *NEW for Activation Group. If *NEW is specified (the default), any storage allocated by this program is freed when RETURN is executed. One of the benefits of this thin client example is the reusability of the server application by different applications. Even traditional 5250 applications can use the server modules for database access. This approach certainly makes it easier to maintain applications since changes in a server module are reflected in all applications that use it.

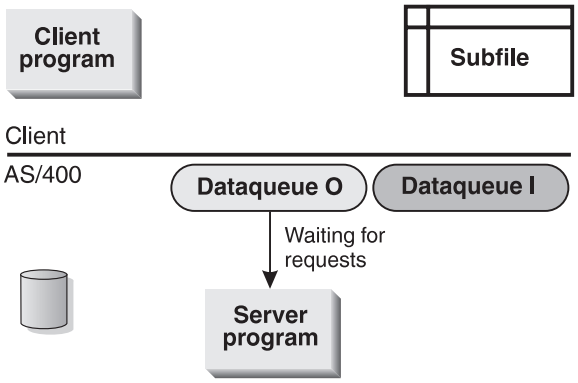
Sample Application Using Data Queues

The iSeries server provides built in support for data queues to allow applications to communicate with each other asynchronously. This sample application exploits data queues, instead of parameter passing, to exchange the data from the database with the VARPG client program. This application is based on 2 data queues on the server that are used by the client and server program. The server program in this example gets launched as an independent program on the server using the NOWAIT keyword in the D specifications of the client program.

The following diagrams illustrate how this example works.

First, two data queues are created and server program DATAQ is started. The server program begins requesting data from data queue 'O' and remains in an indefinite wait.

Server program waits for requests

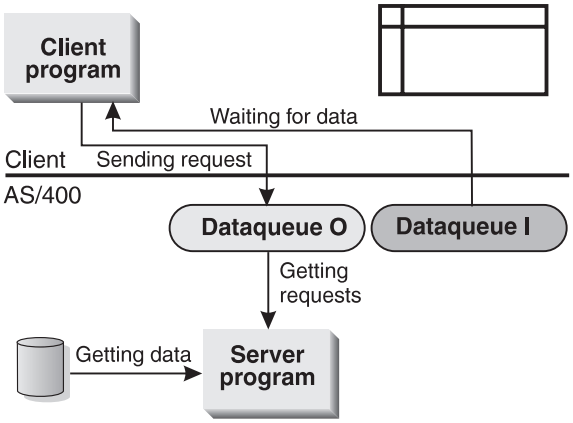


The next state is entered when a GUI event requests more data. (See Figure 114 on page 432 for the client interface.) The three events that trigger the action subroutine are:

- Create event from the window
- Press event from the More... push button
- Pageend event from the subfile

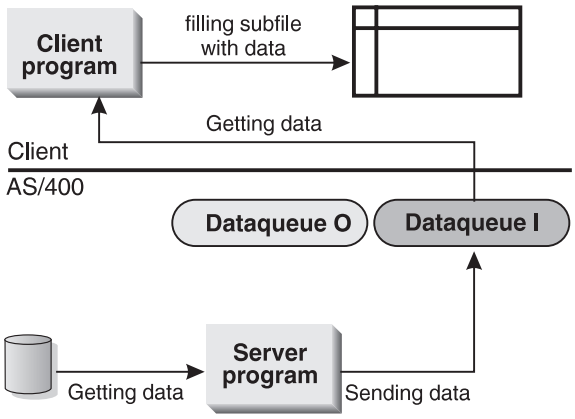
The client program then waits on data queue 'I' for data. The server program accesses the database file and gets the data.

Client program requests data



In the third state, the server program fills data queue 'I'. The client program becomes active and puts the data into the subfile. After this, the program returns to its initial state and the process starts again.

Server program sends data



The Client Application

The user interface is the same as that in the previous application, basically a subfile getting filled with data from the iSeries server database. The filling of the subfile starts with the create event of the window, and continues when the More... push button is pressed or a *pageend* event occurs using the page down keys. This is essentially the same as in the previous example.

The setup for the data queues is done in the create window action subroutine, which calls a program on the server to create 2 data queues in a library on the iSeries server. To create unique data queues for each client, we use the *component part's hostname attribute to retrieve the client's hostname and IP address. The last 5 characters of the IP address portion of the returned string get tagged onto the name of the data queues. The characters **'I'** or **'O'** at the end of the data queue name provide the unique names for the Input or Output data queues.

The server job receives commands from the **'O'** data queue; the client program sends commands to the **'O'** data queue.

After creating the data queues, the client program calls the server program and passes it the 2 data queue names. The server program waits on data queue **'O'** for commands from the client program.

The client program gets activated by GUI events and then sends requests to data queue **'O'**. It then waits on data queue **'I'** until this data queue is filled by the server job.

When the client program gets a termination request, the *TERMSR subroutine is invoked to signal the server program to end and the 2 data queues will be deleted.

Client Sample Source

This program is a bit larger because the data queue environment has to be managed in it, as well.

Data definitions

The data definitions for the client program:

```
D*
D* This program uses the *component part attribute hostname
D* variable to store the host name and IP address of the client.
D entipadd        s            100a
D*
D* Command strings to create and delete data queues
D QCMDEXC         s             10    inz('QCMDEXC')
D                                     linkage(*server)
D* Variables to hold command information
D cmd             s            256    INZ
D cmdlen          s             15p 5 inz(%size(cmd))
D cmd1            s            256    INZ('CRTDTAQ DTAQ(QGPL/')
D cmde            s            256    INZ('DLTDTAQ DTAQ(QGPL/')
D cmd2            s              9    inz(') MAXLEN(')
D*
D* Prefix for data queue name
D qname1          s              4    inz('CUSQ')
D*
D* Variables that contain the 2 data queue names used for one client
D qnamei          s             10
D qnameo          s             10
D
D* Define RCVDTAQ and SNDDTAQ programs as server programs
D QRCVDTAQ        s             10    inz('QRCVDTAQ')
D                                     linkage(*server)
D QSNDDTAQ        s             10    inz('QSNDDTAQ')
D                                     linkage(*server)
D* RPG IV server program defintion
D DATAQ           s             10    inz('DATAQ')
D                                     linkage(*server) nowait
D*
D* Data structure containing customer database data
D CustDS        e ds                  extname(customer) occurs(10)
D*
D* Data structure containing process information
D rinfo           ds
D eof                               n
D nrecords                         2  0
D filler                          20
D* Limit for loop
D custelem        s              2  0  inz(%elem(CustDS))
D* Indicator for file end reached
D fileend         s               n
```

```
D*
D* Parameters for data queue APIs
D msg_sz          s              5  0
D Name_of_Q       s             10
D Name_of_Lb      s             10
D count           s              2  0
D maxlen          s             10  0  inz(%size(custds:*all))
D wait_time       s              5  0
```

The create window action subroutine

The data queues are created and the server RPG program DATAQ is started, the program gets invoked with the NOWAIT keyword; the client program will not wait for it to end. Both programs are working completely asynchronously.

```
C*
C     WIN1          BEGACT    CREATE        WIN1
C* Get client IP address to build unique data queue names.
C* entipadd will contain the client's full host name and IP address.
C*
C                   eval      entipadd =
C                              %GetAtr('*component':
C                             '*component':'hostname')
C* hostname returns the string 'hostname IPAddress'.
C* We only use the IPAddress portion of the returned string.
C* Substring the second part of the returned string:
C                   eval      entipadd = %subst(entipadd: %scan(' ':
C                             entipadd)+1)
C* Create the names for the 'I' and 'O' data queues.
C* Use the last 5 characters of IPAddress and add 'I' or 'O'.
C                   eval      qnameI= qname1 +
C                             %subst(entipadd:%len
C                             (%trim(entipadd))-4:5) + 'I'
C                   eval      qnameO= qname1 +
C                             %subst(entipadd:%len
C                             (%trim(entipadd))-4:
C                             5) + 'O'
C* Set up command parameters to create data queues.
C                   eval      cmd=%trim(%trimr(cmd1) +
C                             qnamei + cmd2 +
C                             %editc(%size(
C                             CustDS:*all):'Z') + ')')
C* Create the data queues.
C                   call      QCMDEXC                              98
C                   parm                    cmd
C                   parm                    cmdlen
C*
C                   eval      cmd=*blank
C                   eval      cmd=%trim(%trimr(cmd1) +
C                             qnameo + cmd2 +
C                             %editc(%size(
C                             CustDS:*all):'Z') + ')')
C                   call      QCMDEXC                              98
C                   parm                    cmd
C                   parm                    cmdlen
C*
C* Call server program to access database on server
C                   call      DATAQ                                98
C                   parm                    qnamei
C                   parm                    qnameo
C* Initialization is done; now, do event processing.
```

```
C*
C                   exsr      callhost
C                   endact
C*
```

The action subroutine to handle requests for more data

A request is sent to data queue 'O'. The client program then waits for a response from the server program DATAQ, on data queue 'I'. After receiving the data, the subfile gets filled in a loop.

```
C*
C* Action subroutine gets invoked from:
C*  -  Press event of PSBMORE push button
C*  -  Pageend event from subfile
C     PSBmore       BEGACT    PRESS         win1
C*
C* Get data from server and display it in the subfile.
C                   EXSR      callhost
C                   ENDACT
C*

C*
C* User subroutine 'callhost' requests server data.
C*
C     callhost      begsr
C* As long as there is data, get more data.
C                   if        not fileend
C*
C*
C* Send a request to data queue 'O' to fetch data.
C*
C                   eval      nrecords=10
C                   call      QSNDDTAQ
C                   parm                    qnameo
C                   parm      'QGPL   '     NAME_OF_LB       10
C                   parm      23            MSG_SZ            5 0
C                   parm                    rinfo
C* Wait on data queue 'I' for data.
C* Expecting processing data here in DS rinfo.
C                   eval      wait_time=-1
C                   eval      MSG_sz=23
C                   call      QRCVDTAQ
C                   parm                    qnamei
C                   parm      'QGPL      '  NAME_OF_LB
C                   parm                    MSG_SZ
C                   parm                    rinfo
C                   parm                    WAIT_TIME
C* Expecting data from database here.
C                   eval      Msg_sz=%size(custds:*all)
C                   call      QRCVDTAQ
C                   parm                    QNAMEi
C                   parm      'QGPL      '  NAME_OF_LB
C                   parm                    MSG_SZ
C                   parm                    CustDS
C                   parm                    WAIT_TIME
C* For as many records as the server has read, fill the subfile.
C                   eval      count=1
C                   dow       count<=nrecords and not fileend
C     count         occur     CustDS
C                   write     sub1
C                   eval      count=count+1
C                   enddo
C                   eval      %setatr('win1':
```

```
C                           'sub1':'settop')=
C                           %getatr('win1':
C                           'sub1':'count')
C* If end-of-file was signaled, disable the push button.
C                   if      eof
C                   eval    %setatr('win1':
C                           'psbmore':'enabled')=0
C                   eval    fileend=*on
C                   endif
C                   endif
C* End of user subroutine
C                   endsr
```

Terminate subroutine

A termination request is sent to server program DATAQ and the 2 data queues are deleted.

```
C* When client app ends, clean up server environment
C*
C     *termsr       begsr
C* Indicate end of program to server program and send data to dataq 'O'
C                   eval    nrecords=0
C                   call    QSNDDTAQ                            98
C                   parm                    qnameo
C                   parm    'QGPL   '       NAME_OF_LB       10
C                   parm    23              MSG_SZ            5 0
C                   parm                    rinfo
C* Delete both data queues
C                   eval    cmd=*blank
C                   eval    cmd=%trim(%trimr(cmde) +
C                           qnamei + ')')
C                   call    QCMDEXC                             98
C                   parm                    cmd
C                   parm                    cmdlen
C                   eval    cmd=*blank
C                   eval    cmd=%trim(%trimr(cmde) +
C                           qnameo + ')')
C                   call    QCMDEXC                             98
C                   parm                    cmd
C                   parm                    cmdlen
C* Application ends
C                   endsr
```

The Server Program

After the server program gets launched, it enters a loop and waits on data queue **'O'** until it gets a request from the client program. Two different requests are possible in this example. The program determines which request has been sent: to read more data, or to end.

For a request for more data it will read 10 more records from the database and then send 2 items to data queue **'I'**.

The first item contains process information, how many records were actually read, and whether an end of file situation has occurred.

The second item contains the multi occurrence data structure with the data from the database file.

The client program will receive these records from data queue **'I'** and fill the subfile accordingly.

When the server program gets signaled that a termination is requested, the LR indicator will be set on and the DO loop will end. This will end the program. Any other cleanup will be managed by the client program.

Server Sample Source

File and data definitions

```
Fcustomer  if   e             disk
D* data structure containing database data to be passed to client
D CustDS        e ds                  extname(customer) occurs(10)
D* data structure to pass control information between client and server
D rinfo           ds
D eof                              n
D count                           2  0
D fill                           20
D* number of occurs in DS for loop limit
D custelem        s               2  0 inz(%elem(CustDS))
D* library name for dataq and data size to be send to dataq and wait time
D Name_of_LB      s              10    inz('QGPL')
D msg_sz          S               5  0
D wait_time       s               5  0
D* name of dataq's passed from client
D qnamei          s              10
D qnameo          s              10
```

Main line program

Process the DO loop, wait on data queue 'O' until requests arrive, read more records from the database, send the data to data queue 'I', and wait again for more requests.

```
C* Beginning of mainline
C    *entry        plist
C                  parm                    qnamei
C                  parm                    qnameo
C* DO loop runs forever until client program signals that it
C* terminates
C                  dow       not *inlr
C* Wait for client program to signal that it needs data
C                  eval      wait_time=-1
C                  eval      MSG_sz=23
C                  call      'QRCVDTAQ'
C                  parm                    qnameo
C                  parm                    NAME_OF_LB
C                  parm                    MSG_SZ
C                  parm                    rinfo
C                  parm                    WAIT_TIME
C*
C* Read 10 records from database file
C* count = 0 means client program is terminating
C                  if        count >0
C                  eval      count=1
C    count         occur     CustDS
C                  read      customer                                9999
C                  dow       count<custelem and not *in99
C                  eval      count=count+1
C    count         occur     CustDS
C                  read      customer                                9999
C                  enddo
C* Determine whether there is more data in file
C                  if        *IN99
C                  eval      count=count-1
C                  eval      eof=*on
C                  endif
```

```
C* Send information to the data queue.
C* Send one record with information on how many records are read and
C* whether end-of-file was reached
C*
C                   call      'QSNDDTAQ'                            98
C                   parm                    QnameI
C                   parm                    NAME_OF_LB
C                   parm      23            MSG_SZ
C                   parm                    rinfo
C* Send the data in DS from database file to dataq
C                   eval      msg_sz=%SIZE(custds:*all)
C                   call      'QSNDDTAQ'                            98
C                   parm                    qnamei
C                   parm                    NAME_OF_LB
C                   parm                    MSG_SZ
C                   parm                    CUSTds
C* When client program ends, it sends nrecords 0, then ends this
C* program as well
C                   else
C                   eval      *inlr=*on
C*
C                   end
C                   enddo
C*
C* End of MAINLINE
```

Other Possible Implementations

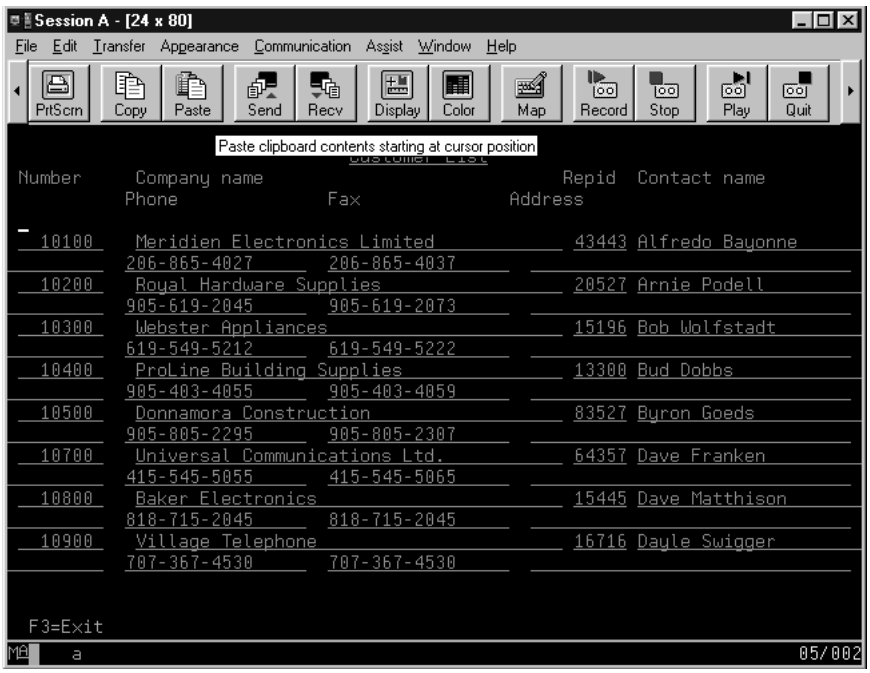
In addition to these specific examples, variations and combinations of both implementations are possible. The goal is to minimize client processing and use the server's power to run these applications. Reuse of modules on the server can be accomplished since 5250 and GUI applications can use the same server programs.

One possible implementation is to use requests in form of an SQL statement that gets passed to a server program, This server program issues the SQL statement and routes the received data to a data queue. The client program, waiting on the data queue, uses the data passed back to satisfy the end user request. In this particular application, a single keyed data queue is used instead of multiple data queues.

Another implementation could pass all input data from the user interface to a server program to do error checking and processing on the server; any error conditions would get passed back to the client. This approach allows a high degree of reusability of business logic between 5250 applications and GUI applications, and provides an even thinner client.

Reusable Server Program Example

The following RPG IV code for a 5250 subfile application uses the same server program, but drives a 5250 interface. This example shows the reuse capabilities of server programs for GUI and 5250 applications. The business logic contained in the 5250 server program can readily be used by thin client GUI programs. The following illustration shows a sample of the 5250 screen that displays the same database information as in the GUI sample in the beginning of this chapter.



This subfile only fits 8 records on the screen because each record occupies 2 rows on the subfile. The program source for this application follows:

```
H* Program to list customer records
F* Workstn file containing DSPF
Fgetrecs   cf   e             workstn  sfile(sub1:recnum)
D* Data structure to pass data from server program to the subfile
Dcust           e ds                   extname(customer) occurs(8)
D                                      inz
Deof              s              1    inz(*off)
Dnrecords         s              2  0
Dfileend          s              1    inz(*off)
Dcount            s              2  0
Dcustelem         s              2  0 inz(%elem(cust))
Drecnum           s              5  0 inz(1)
 * Main program to invoke subfile sub routine and end the program
 * In91 indicates that database file has not reached the end
C                   EVAL      *IN91=*ON
C                   exsr      more
C                   eval      *inlr=*on
c
C     more          BEGsr
 * LOOP to fetch more data and display in subfile
C                   dow       not *in03
 * Call server program to get data first time and when page down
 * is used.
C                   if        *in91
C                   call      'GETREC'
C                   parm                    cust
C                   parm                    custelem
C                   parm                    eof
C                   parm                    nrecords
C                   eval      count=1
 * recnum1 is sbfrcdnbr in subfile control record, to position top record
 * to be shown on screen
C                   EVAL      RECNUM1=RECNUM
 * Loop to fill subfile with new records
C                   dow       count<=nrecords
C     count         occur     cust
```

```
C                   write     sub1
C                   eval      count=count+1
C                   eval      recnum=recnum+1
C                   enddo
 * After the set of records is added to subfile, display it, plus header
 * and footer record formats
C                   write     record1
C                   write     footer
C                   exfmt     sub1ctl
 * Handle none pagedown keys
C                   else
C                   read      sub1ctl                                99
C                   endif
C                   if        eof=*on
 * IN90 enables PAGEDOWN key for additional records to be read.
 * At file end it gets disabled.
C                   eval      *in90=*on
C                   eval      recnum=recnum1
C                   endif
C                   enddo
 * Leave the LOOP when Exit requested
C                   ENDSR
```

Appendix C. Creating and Compiling Non-GUI Programs from MS-DOS

You can create standalone VARPG applications within the VARPG GUI designer, or by issuing commands in an MS-DOS command prompt. This section porvides the commands you can use from an command prompt. To use the GUI Designer, see Chapter 22, “Creating Non-GUI VisualAge RPG Programs,” on page 375.

To start the editor and create source in an MS-DOS command prompt, enter:

```
codeedit filename.VPG
```

Be sure to include the .VPG extension in the filename so you can benefit from the editor’s tokenizing and syntax checking of your source.

To run the **FVDFNFE** compiler, issue the compiler command from an MS-DOS command prompt. The syntax of the command is:

```
fvdfnfe filename.VPG [/compiler_option1 ... /compiler_optionn]
```

Note: You must include the .VPG extension in the source file name; it is not assumed.

The compiler options, which you can type in upper- or lowercase, are optional. They are as follows:

Option Description

/BL name
Link library name. If more than one, enclose in double quotes.

/D Generate debug information

/GL 1-99
Generation severity level

/L Generate an output listing

/LI Indentation

/LX Generate a cross-reference (XREF) listing

/LV Generate a Visual cross-reference (XREF) listing

/LD Expand DDS in listing

/LC Expand /COPY in listing

/LE Show external references

/LM2 Show second-level messages in listing

/LS Show excluded lines in listing

/LP 10-99
Lines per page (listing)

/HCU Host cache enabled

/HCR Host cache refresh

/RF Fix numeric

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/RN Allow null

/RNU Allow null under user control

/RT Truncate numeric

/TI Generate debug information (same as /D)

/SB Name
SQL bind file name

/SF XX
SQL format for date/time columns

/SI XX (RR RS CS UR) SQL isolation level

/SN Name
SQL database name

/SP Name
SQL package file name

/SR SQL record blocking

/SU Database user id

/SUP Database password

/SVC Convert variable character

/SVG Convert variable graphic

Accessing an AS/400 System

If the program is to access data on the AS/400 system or call AS/400 programs, you must create a **Remote Server Table** (RST) file. The RST file is an ASCII file that is read by the compiler and the VARPG run time to determine information about the system to use and the location of files. An RST file is created by the GUI Designer when you use the **Define AS/400 Information** dialog. During compile time, the RST file must be in the same directory as the program source. During run time, the RST file must be in the same directory as the program executable files.

Here is an example of an RST file:

```
DEFINE_SERVER  SERVER_ALIAS_NAME(MYAS400)
               REMOTE_LOCATION_NAME(TORAS40Z)
               NETWORK_PROTOCOL(*TCP)
               TEXT(Development - RST)

DEFINE_FILE  FILE_ALIAS_NAME(CUSTOMER)
             REMOTE_FILE_NAME(PRODUCT/CUSTMAST)
             SERVER_ALIAS_NAME(MYAS400)
             TEXT()
```

The **DEFINE_FILE** statement indicates where the files defined in the 'F' specifications can be found on the AS/400 system. In this example, the file named CUSTOMER in the 'F' specification actually refers to file CUSTMAST in library PRODUCT. If the file is in your library list, the DEFINE_FILE statement can be omitted. In that case, the library list, *LIBL, will be searched for the file.

The **TEXT** keyword is used for comments and can be blank.

Appendix D. Secure Sockets Layer (SSL) Setup

Secure Sockets Layer (SSL) provides secure connections by encrypting the data exchanged between a client and an iSeries 400 server session and performing server authentication. SSL can be used only with a SSL capable iSeries 400 server running OS/400, Version 4 Release 4 or later. The use of SSL connection significantly decreases performance of the product compared to the use of connection without encryption. It is recommended that SSL be used only when the sensitivity of data transferred merits the decrease in performance.

This section provides instructions on configuring your iSeries 400 server for Secure Sockets Layer support.

Note: If any fixes are applied to the VARPG run time, the following procedures must be repeated. For SSL to work properly on the iSeries 400 server, the QSECOFR user profile password must not be expired.

SSL Considerations

- A good knowledge of SSL is required for setup. You should know how to use the Digital Certificate Manager (DCM) program on the iSeries 400 server to perform SSL-related tasks, such as generating system certificates. For information on the DCM program, invoke its online help or go to the Information Center at URL http://www.ibm.com/eserver/iseries/infocenter.
- Ensure that you adhere to import and export regulations. IBM iSeries Client Encryption products provide SSL version 3.0 encryption support using non-exportable 128-bit for U.S. and Canada use only and exportable 56–bit for international use. In customer configurations where Client Encryption products might be downloaded across national boundaries, the customer is responsible for ensuring that the non exportable products are not made available outside the U.S. and Canada. Both the non-exportable and exportable Client Encryption products can be used in combination to allow the appropriate Client Encryption product to be downloaded on different Web sites.

Prerequisites

The following prerequisites must be met before setting up SSL:

- Software:
  - Crytographic Access Provider licensed program (5769-AC1, 5769-AC2, or 5769-AC3)
  - IBM iSeries Client Encryption program (5722-CE2 or 5722-CE3) where 5722-CE2 (56-bit) is for use in countries other than the U.S. or Canada, and 5722-CE3 (128-bit) is for use only in the U.S. and Canada.
- Hardware:
  - IBM HTTP Server for iSeries (5722-DG1)
  - Base operating system option 34 Digital Certificate Manager (DCM)
- Authorization:

  Provide proper authorizations for users to access the SSL files. Follow these steps to change the authority:

  1. Enter the command:

     ```
     wrklnk '/QIBM/ProdData/HTTP/Public/jt400/*
     ```

  2. Choose option **9** in the correct directory (SSL56, or SSL128).
  3. Give users ***RX** authority to the directory.

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Note: Individual users or groups of users can be authorized.

SSL Setup for the iSeries 400 Server

Follow the instructions below to setup your iSeries 400 server for SSL:

Start DCM:

1. Start the HTTP servers by using the command:
   ```
   STRTCPSVR SERVER(*HTTP) HTTPSVR (*ADMIN)
   ```
2. Access the iSeries 400 Administration server by typing in your server's URL address and port number. For example:
   ```
   http://your.server.name:2001/
   ```
   The proper security officer authority, plus `*secadm` and `*allobj` authorities are needed.
3. Enter your iSeries 400 user ID and password.
4. From the AS/400 Tasks page, access DCM by selecting the DCM link.

Obtain a system certificate for your iSeries 400 server from the Digital Certificate Manager program:

Click on the **?** icon for instructions on obtaining a system certificate. You can either obtain the system certificate from a trusted Certificate Authority (CA) or build your own.

- To obtain a system certificate from a trusted CA:

  Note: This is what you should use if your application is an internet application and you need to distribute your run time.

  Select a CA. You can get a certificate from one of the following companies:
  - VeriSign, Inc.
  - Integration Financial Network
  - Thawte Consulting
  - RSA Data Security

  Obtain request data for submission to the trusted CA from DCM. Refer to the DCM help for the exact steps you need to follow.Your CA will process your request form and provide you with the certificate. To install it onto your system, use the **Receive a System Certificate** option.
- To obtain your own system certificate:

  Note: This should only be used for an intranet because the run time created can only be used for your specific iSeries 400 server.

  1. Create your CA on the iSeries 400 server.
  2. Generate the system certificate from your own CA.

  For information on creating a CA, on the DCM page click on **Certificate Authority**.

Apply the system certificate to the following server applications:

```
QIBM_OS400_QZBS_SVR_CENTRAL
QIBM_OS400_QZBS_SVR_DATABASE
QIBM_OS400_QZBS_SVR_DTAQ
QIBM_OS400_QZBS_SVR_NETPRT
QIBM_OS400_QZBS_SVR_RMTCMD
QIBM_OS400_QZBS_SVR_SIGNON
QIBM_OS400_QZBS_SVR_FILE
QIBM_OS400_QRW_SVR_DDM_DRDA
```

SSL Setup for the Workstation

To set up SSL for the workstation, follow the steps below:

Download the appropriate version of the SSL Client Encryption software to your workstation from the iSeries 400 server:

Product	File to Download	Location for Download
5722-CE2	sslightx.zip	/QIBM/ProdData/HTTP/Public/jt400/SSL56
5722-CE3	sslightu.zip	/QIBM/ProdData/HTTP/Public/jt400/SSL128

If you built your own certificate, perform the following steps to download the CA certificate:

1. Download SSLTools.jar from the directory in which you downloaded the SSL Client Encryption.
2. Add SSLTools.jar and sslightu.zip to your CLASSPATH statement.
3. Create a temporary directory. For example, c:\tempkey.
4. Create the following subdirectory under c:\tempkey:

   ```
   com\ibm\as400\access
   ```
5. From the tempkey directory, run the following command in one line:

   ```
   java com.ibm.sslight.nlstools.keyrng com.ibm.as400.access.KeyRing
   connect <systemname>:<port>
   ```

   Where <systemname> is the name of your iSeries 400 server and <port> is your port number.

   Note: The server port can be any of the host servers to which you have access. For example, you can use 9476, which is the default port for the secure sign-on server on the iSeries 400 server. When you are prompted to enter a password, enter toolbox. This is the only password that works. The SSL tool then connects to the iSeries 400 server and lists the certificates it finds.
6. Enter the CA certificate number. Be sure to use the CA certificate and not the site certificate. A message will be issued stating that the certificate is being added to com.ibm.as400.access.KeyRing.class.
7. Delete the file SSLTools.jar.

A KeyRing.class file has been created in the directory.

Create a customized varpg.jar file by following the instructions below:

1. Create a temporary directory. For example, c:\tempjar.
2. Copy the file sslightu.zip to c:\tempjar.

3. Run the following command:

   ```
   jar xvf sslightu.zip
   ```

   You will find the meta-inf and com\ibm\sslight subdirectories created for you in c:\tempjar.
4. If you built your own certificate:
   a. Under subdirectory c:\tempjar\com\ibm add subdirectory \as400\access.
   b. Copy the KeyRing.class file in c:\tempkey\com\ibm\as400\access subdirectory to the c:\tempjar\com\ibm\as400\access subdirectory.
5. Copy the varpg.jar file into c:\tempjar.
6. From c:\tempjar, run the following command:

   ```
   jar uvf varpg.jar -C ./ com
   ```

   Note: C is in uppercase.
   Running this command updates the varpg.jar file so that it can be used with your SSL-enabled VARPG applications. This will also work for regular, non SSL-enabled applications.

Enable your application to use SSL:
1. Rename the varpg.jar in your VARPG install directory \WDSC\JAVA .
2. Compile your application with the **/SSL** user-defined option in the **Build options** dialog.
3. Run the application with the customized file varpg.jar.

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Programming Interface Information

This publication is intended to help you to create and manage VisualAge RPG applications and user interfaces on the workstation, in a client/server environment. This publication documents General-Use Programming Interface and Associated Guidance Information provided by IBM WebSphere Development Studio Client for iSeries.

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- *IBM Dictionary of Computing* , New York: McGraw-Hill, 1994.
- *Object-Oriented Interface Design IBM Common User Interface Guidelines*, SC34-4399-00, Carmel, IN: Que Corporation, 1992.

A

action. (1) Synonym for *action subroutine*. (2) An executable program or command file used to manipulate a project's parts or participate in a build.

action subroutine. Logic that you write to respond to a specific event.

active window. The window with which a user is currently interacting. This is the window that receives keyboard input.

activeX part. A part that adds ActiveX control objects to the project. VARPG applications can then access their attributes and monitor for events.

anchor. Any part that you use as a reference point for aligning, sizing, and spacing other parts.

animation control part. A part that allows the playback of video files, with the AVI extension, in Windows, or the playback of animated GIF sequences in Java applications.

API. Application programming interface.

applet. A program that is written in Java and runs inside of a Java-compatible browser or AppletViewer.

application. A collection of software components used to perform specific user tasks on a computer.

application programming interface (API). A functional interface supplied by the operating system or a separately orderable licensed program that allows an application program written in a high-level language to use specific data or functions of the operating system or the licensed program.

ASCII (American National Standard Code for Information Interchange). The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity check), that is used for information interchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control characters and graphic characters. (A)

B

BMP. The file extension of a bitmap file.

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build. The process by which the various pieces of source code that make up components of a VARPG application are compiled and linked to produce an executable version of the application.

button. (1) A mechanism on a pointing device, such as a mouse, used to request or start an action. (2) A graphical mechanism in a window that, when selected, results in an action. An example of a button is an OK push button that, when selected, initiates an action.

C

calendar part. A part that adds a calendar that can be modified by the user to include text, color and other attributes.

canvas part. A part onto which you can point and click various other parts, position them, and organize them to produce a graphical user interface. A canvas part occupies the client area of either a window part or a notebook page part. See also *notebook page with canvas part* and *window with canvas part*.

check box part. A square box with associated text that represents a choice. When a user selects a choice, an indicator appears in the check box to indicate that the choice is selected. The user can clear the check box by selecting the choice again. In VisualAge RPG, you point and click on a check box part in the parts palette or parts catalog and click it onto a design window.

click. To press and release a mouse button without moving the pointer off of the choice or object. See also *double-click*.

client. (1) A system that is dependent on a server to provide it with data. (2) The PWS on which the VARPG applications run. See also *DDE client*.

client area. The portion of the window that is the user's workspace, where a user types information and selects choices from selection fields. In primary windows, the area where an application programmer presents the objects that a user works on.

client/server. The model of interaction in distributed data processing in which a program at one site sends a request to a program at another site and awaits a response. The requesting program is called a client; the answering program is called a server. See also *client*, *server*, *DDE client*, *DDE server*.

clipboard. An area of storage provided by the system to hold data temporarily. Data in the clipboard is available to other applications.

cold-link conversation. In DDE, an explicit request made from a client program to a server program. The server program responds to the request. Contrast with *hot-link conversation*.

color palette. A set of colors that can be used to change the color of any part in your application's GUI.

combination box. A control that combines the functions of an entry field and a list box. A combination box contains a list of objects that a user can scroll through and select from to complete the entry field. Alternatively, a user can type text directly into the entry field. In VisualAge RPG, you can point and click on a combination box part in the parts palette or parts catalog and click it onto a design window.

Common User Access architecture (CUA architecture). Guidelines for the dialog between a human and a workstation or terminal.

compile. To translate a source program into an executable program (an object program).

component. A functional grouping of related files within a project. A component is created when the NOMAIN and EXE keywords are not present on the control specifications.

component reference part. A part that enables one component to communicate with another component in a VARPG application.

***component part.** A part that is the "part representation" of the component. One *component part is created for each component automatically, and it is invisible.

CONFIG.SYS. The configuration file, located in the root directory of the boot drive, for the DOS, OS/2, or Windows operating systems. It contains information required to install and run hardware and software.

configuration. The manner in which the hardware and software of an information processing system are organized and interconnected (T).

container part. A part that stores related records and displays them in a details, icon, or tree view.

CUA architecture. Common User Access architecture.

cursor. The visible indication of the position where user interaction with the keyboard will appear.

D

database. (1) A collection of data with a given structure for accepting, storing, and providing, on demand, data for multiple users. (T) (2) All the data files stored in the system.

data object. An object that conveys information, such as text, graphics, audio, or video.

DBCS. Double-byte character set.

DDE. Dynamic data exchange.

DDE client. An application that initiates a DDE conversation. Contrast with *DDE server*. See also *DDE client part*, *DDE conversation*.

DDE client part. A part used to exchange data with other applications, such as spreadsheet applications, that support the dynamic data exchange (DDE) protocol.

DDE conversation. The exchange of data between a DDE client and a DDE server. See also *cold-link conversation* and *hot-link conversation*.

DDE server. An application that provides data to another DDE-enabled application. Contrast with *DDE client*. See also *DDE conversation*.

default. A value that is automatically supplied or assumed by the system or program when no value is specified by the user. The default value can be assigned to a push button or graphic push button.

default action. An action that will be performed when some action is taken, such a pressing the Enter key.

dereferencing. The action of removing the association between a part and an AS/400 database field.

design window. The window in the GUI designer on which parts are placed to create a user interface.

details view. A standard contents view in which a small icon is combined with text to provide descriptive information about an object.

dimmed. Pertaining to the reduced contrast indicating that a part can not be selected or directly manipulated by the user.

direct editing. The use of techniques that allow a user to work with an object by dragging it with a mouse or interacting with its pop-up menu.

DLL. Dynamic link library.

double-byte character set (DBCS). A set of characters in which each character is represented by 2 bytes. Languages such as Japanese, Chinese, and Korean, which contain more symbols than can be represented by 256 code points, require double-byte character sets. Because each character requires 2 bytes, the typing, displaying, and printing of DBCS characters requires hardware and programs that support DBCS. Four double-byte character sets are supported by the system: Japanese, Korean, Simplified Chinese, and Traditional Chinese. Contrast with *single-byte character set (SBCS)*.

double-click. To quickly press a mouse button twice.

drag. To use a mouse to move or to copy an object. For example, a user can drag a window border to make it larger by holding a button while moving the mouse. See also *drag and drop*.

drag and drop. To directly manipulate an object by moving it and placing it somewhere else using a mouse.

drop-down combination box. A variation of a combination box in which a list box is hidden until a user takes explicit acts to make it visible.

drop-down list. A single selection field in which only the current choice is visible. Other choices are hidden until the user explicitly acts to display the list box that contains the other choices.

dynamic data exchange (DDE). The exchange of data between programs or between a program and a datafile object. Any change made to information in one program or session is applied to the identical data created by the other program. See also *DDE conversation*, *DDE client*, *DDE server*.

Dynamic link library (DLL). A file containing executable code and data bound to a program at load time or run time, rather than during linking. The code and data in a dynamic link library can be shared by several applications simultaneously.

E

EBCDIC. Extended binary-coded decimal interchange code. A coded character set of 256 8-bit characters.

emphasis. Highlighting, color change, or other visible indication of conditions relative to an object or choice that affects a user's ability to interact with that object or choice. Emphasis can also give a user additional information about the state of a choice or an object.

entry field part. An area on a display where a user can enter information, unless the field is read-only. The boundaries of an entry field are usually indicated. In VisualAge RPG, you point and click on an entry field part in the parts palette or parts catalog and click it onto a design window.

error logging. Keeps track of errors in an **error log**. The editor takes you to the place in the source where the error occurred.

event. A signal generated as a result of a change to the state of a part. For example, pressing a button generates a *Press* event.

exception. (1) In programming languages, an abnormal situation that may arise during execution, that may cause a deviation from the normal execution sequence, and for which facilities exist in a programming language to define, raise, recognize, ignore, and handle it. (I) (2) In VisualAge RPG, an event or situation that prevents, or could prevent, an action requested by a user from being completed in a manner that the user would expect. Exceptions occur when a product is unable to interpret a user's input.

EXE. The extension of an executable file.

EXE module. An EXE module consists of a main procedure and subprocedures. It is created when the EXE keyword is present on the control specification. All subroutines (BEGSR) must be local to a procedure. The EXE must contain a procedure whose name matches the name of the source file. This will be the main entry point for the EXE, that is, the main procedure.

export. A function that converts an internal file to some standard file format for use outside of an application. Contrast with *import*.

F

field. (1) An identifiable area in a window, such as an entry field where a user types text. (2) A group of related bytes, such as a name or amount, that is treated as a unit in a record.

file. A collection of related data that is stored and retrieved by an assigned name. A file can include information that starts a program (program-file object), contains text or graphics (data-file object), or processes a series of commands (batch file).

focus. Synonym for *input focus*.

font palette. A set of fonts that can be used to change the font of a part in your application's GUI.

G

graph part. A part that allows the user to add a graph to the GUI. The graph styles available are line, bar, line and bar, or pie chart.

graphical user interface (GUI). A type of user interface that takes advantage of high-resolution graphics. A graphical user interface includes a combination of graphics, the object-action paradigm, the use of pointing devices, menu bars and other menus, overlapping windows, and icons.

graphic push button part. A push button, labeled with a graphic, that represents an action that will be initiated when a user selects it. Contrast with *push button part*.

group box part. A rectangular frame around a group of controls to indicate that they are related and to provide an optional label for the group. In VisualAge RPG, you point and click on a group box part in the parts palette or parts catalog and click it onto a design window.

group marker. A mark that identifies a part as being the first one in a group. When a user moves the cursor through a group of parts and reaches the last part, the cursor returns to the first part in the group.

GUI designer. A suite of tools used to create interfaces by dragging and dropping parts from the parts palette to the design window.

H

hide button. A button on a title bar that a user clicks on to remove a window from the workplace without closing the window. When the window is hidden, the state of the window, as represented in the window list, changes. Contrast with *maximize button* and *minimize button*.

horizontal scroll bar part. A part that adds a horizontal scroll bar to a window. This part allows users to scroll through a pane of information, from left-to-right or right-to-left.

hot-link conversation. In DDE, an automatic update of a client program by a server program when data changes on the server. Contrast with *cold-link conversation*.

I

ICO. The file extension of an icon file.

icon. A graphical representation of an object, consisting of an image, image background, and a label.

icon view. A standard contents view in which each object contained in a container is displayed as an icon.

image part. A part used to display a picture, from a BMP or ICO file, on a window.

import. A function that converts AS/400 display file objects to the appropriate VARPG part. Contrast with *export*.

inactive window. A window that can not receive keyboard input at a given moment.

index. The identifier of an entry in VARPG parts such as list boxes or combination boxes.

information area. A part of a window in which information about the object or choice that the cursor is on is displayed. The information area can also contain a message about the normal completion of a process. See also *status bar*.

Information Presentation Facility (IPF). A tool used to create online help on a programmable workstation.

Information Presentation Facility (IPF) file. A file in which the application's help source is stored.

INI. The file extension for a file in the OS/2 or Windows operating system containing application-specific information that needs to be preserved from one call of an application to another.

input focus. The area of a window where user interaction is possible from either the keyboard or the mouse.

input/output (I/O). Data provided to the computer or data resulting from computer processing.

IPF. Information Presentation Facility

item. In dynamic data exchange, a unit of data. For example, the top left cell position in a spreadsheet is row 1, column 1. This cell position may be referred to as item R1C1.

J

JAR files (.jar). In Java, abbreviation for Java ARchive. A file format that is used for aggregating many files into one.

Java. An object-oriented programming language for portable interpretive code that supports interaction among remote objects. Java was developed and specified by Sun Microsystems, Incorporated.

java bean part. A part that allows VARPG applications to access Sun Microsystem's JavaBeans.

JavaBeans. In Java, a portable, platform-independent reusable component model.

Java Database Connectivity (JDBC). An industry standard for database-independent connectivity between Java and a wide range of databases. The JDBC provides a call-level application programming interface (API) for SQL-based database access.

Java 2 Software Development Kit (J2SDK). Software that Sun Microsystems distributes for Java developers. This software includes the Java interpreter, Java classes, and Java development tools. The development tools include a compiler, debugger, dissassembler, AppletViewer, stub file generator, and documentation generator.

Java Native Interface (JNI). A programming interface that allows Java code that runs inside of a Java Virtual Machine (JVM) to interoperate with functions that are written in other programming languages.

Java Runtime Environment (JRE). A subset of the Java Developer Kit for end users and developers who want to redistribute the JRE. The JRE consists of the Java Virtual Machine, the Java Core Classes, and supporting files.

Java Virtual Machine (JVM). The part of the Java Runtime Environment (JRE) that is responsible for interpreting Java bytecodes.

L

link event. An event that a target part receives whenever the state of a source part changes.

list box part. A control that contains scrollable choices that a user can select. In VisualAge RPG, you can point and click on a list box part in the parts palette or parts catalog and click it onto a design window.

M

main procedure. A main procedure is a subprocedure that can be specified as the program entry procedure and receives control when it is first called. A main procedure is only produced when creating an EXE. See *EXE module*

main source section. In a VARPG program, the main source section contains all the global dedfinitions for a module. For a component, this section also includes the action and user subroutines.

main window. See *primary window*.

manipulation button. See *mouse button 2*.

maximize button. A button on the rightmost part of a title bar that a user clicks on to enlarge the window to its largest possible size. Contrast with *minimize button*, *hide button*.

media panel part. A part used to give the user control over other parts. For example, a media panel part can be used to control the volume of a media part.

media part. A part that gives a program the ability to process sound files and video files.

menu. A list of choices that can be applied to an object. A menu can contain choices that are not available for selection in certain contexts. Those choices are dimmed.

menu bar part. The area near the top of a window, below the title bar and above the rest of the window, that contains choices that provide access to other menus. In VisualAge RPG, you can point and click on a menu bar part in the parts palette or parts catalog and click it onto a design window.

menu item part. A part that is a graphical or textual item on a menu. A user selects a menu item to work with an object in some way.

message. (1) Information not requested by a user but displayed by a product in response to an unexpected event or when something undesirable could occur. (2) A communication sent from a person or program to another person or program.

message file. A file containing application messages. The file is created from the message source file during the build process. See also *build*.

message subfile part. A part that can display predefined messages or text supplied in program logic.

migrate. (1) To move to a changed operating environment, usually to a new release or version of a system. (2) To move data from one hierarchy of storage to another.

MID. The file extension of a MIDI file.

MIDI file. Musical Instrument Digital Interface file.

minimize button. A button, located next to the rightmost button in a title bar, that reduces the window to its smallest possible size. Contrast with *maximize button* and *hide button*.

mnemonic. A single character, within the text of a choice, identified by an underscore beneath the character. See also *mnemonic selection*.

mnemonic selection. A selection technique whereby a user selects a choice by typing the mnemonic for that choice.

mouse. A device with one or more push buttons used to position a pointer on the display without using the keyboard. Used to select a choice or function to be performed or to perform operations on the display, such as dragging or drawing lines from one position to another.

mouse button. A mechanism on a mouse used to select choices, initiate actions, or manipulate objects with the pointer. See also *mouse button 1* and *mouse button 2*.

mouse button 1. By default, the left button on a mouse used for selection.

mouse button 2. By default, the right button on a mouse used for manipulation.

mouse pointer. Synonym for *cursor*.

multiline edit (MLE) part. A part representing an entry field that allows the user to enter multiple lines of text.

N

navigation panel. A group of buttons that can be used to control the visible selection of records in a subfile.

NOMAIN module. A module that contains only subprocedures. There are no action or standalone user subroutines in it. A NOMAIN module is created when the NOMAIN keyword is present on the control specification.

notebook part. A graphical representation of a notebook. You can add notebook pages to the notebook part and then group the pages into sections separated by tabbed dividers. In Windows, a notebook is sometimes referred to as a Windows tab control. See also *notebook page part*, *notebook page with canvas part*.

notebook page part. A part used to add pages to a notebook part. See also *notebook*.

notebook page with canvas part. A combination of a notebook page part and a canvas page part. See also *notebook*, *canvas part*.

O

object. (1) A named storage space that consists of a set of characteristics that describe itself and, in some situations, data. An object is anything that exists in and occupies space in storage and on which operations can be performed. Some examples of objects are programs, files, libraries, and folders. (2) A visual component of a user interface that a user can work with to perform a task. An object can appear as text or an icon.

object-action paradigm. A pattern for interaction in which a user selects an object and then selects an action to apply to that object.

object-oriented programming. A method for structuring programs as hierarchically organized classes describing the data and operations of objects that may interact with other objects. (T)

object program. A target program suitable for execution. An object program may or may not require linking. (T)

odbc/jdbc part. A part that allows VAPRG applications to access and process database files that support the Windows ODBC API or Sun Microsystem's JDBC API.

operating system. A collection of system programs that control the overall operation of a computer system.

outline box part. A part that is a rectangular box positioned around a group of parts to indicate that all the parts are related.

P

package. A function used to collect all the parts of a VARPG application together for distribution.

parts. Objects that make up the GUI of a VARPG application.

parts catalog. A storage space for all of the parts used to create graphical user interfaces for VARPG applications.

parts palette. A collection of parts that are most appropriate for building the current graphical user interface for an application. When you finish one GUI, you can wipe the palette clean and add parts from the parts catalog that you require for the next application.

plugin. A function created by the user or an outside vendor that can be used in VARPG programs.

point and click. (1) A selection method which is used to copy a part from the parts palette or catalog to the GUI design window, the icon view, or the tree view. (2) To place a part in any of the desired views, point to and click on the part, then move the cursor to the chosen window and point the cursor and click where you want the part to appear. In the icon and tree views, the part will be placed on the parent part, and you will then have to move it where you would like it to appear in the design window.

pop-up menu. A menu that, when requested, appears next to the object with which it is associated. It contains choices appropriate for the object in its current context.

pop-up menu part. A part that, when added to an object on your interface, appears next to the object with which it is associated when requested. You can point and click on a pop-up menu part in the parts palette or parts catalog and click it onto a design window.

pop-up window. A movable window, fixed in size, in which a user provides information required by an application so that it can continue to process a user request. Synonymous with *secondary window*.

primary window. The window in which the main interaction between the user and the application takes place. Synonymous with *main window*.

procedure. A procedure is any piece of code that can be called with the CALLP operation code.

procedure interface definition. A procedure interface definition is a repetition of the prototype information within the definition of a procedure. It is used to declare the entry parameters for the procedure and to ensure that the internal definition of the procedure is consistent with the external definition (the prototype)

programmable workstation (PWS). A workstation that has some degree of processing capability and that allows a user to change its functions.

progress bar part. A part that can be used to indicate graphically the progress of a process, such as copying files, loading a database, and so on.

progress indicator. One or more controls used to inform a user about the progress of a process.

project. The complete set of data and actions needed to build a single target, such as dynamic link library (DLL) or an executable file (EXE).

prompt. (1) A visual or audible message sent by a program to request the user's response. (T) (2) A displayed symbol or message that requests input from the user or gives operational information. The user must respond to the prompt in order to proceed.

properties notebook. A graphical representation that resembles a bound notebook containing pages separated into sections by tabbed divider pages. Select the tabs of a notebook to move from one section to another.

prototype. A prototype is a definition of the call interface. It includes information such as: whether the call is bound (procedure) or dynamic (program); the external name; the number and nature of the parameters; which parameters must be passed; the data type of any return value (for a procedure)

pull-down menu. A menu that extends from a selected choice on a menu bar or from a system-menu symbol. The choices in a pull-down menu are related to one another in some manner.

push button part. A button labeled with text that represents an action that starts when a user selects the push button. You can point and click on a push button part in the parts palette or parts catalog and click it onto a design window. See also *graphic push button part*.

PWS. Programmable workstation.

R

radio button part. A circle with text beside it. Radio buttons are combined to show a user a fixed set of choices from which only one can be selected. The circle is partially filled when a choice is selected. You can point and click on a radio button part in the parts palette or parts catalog and click it onto a design window.

reference field. An AS/400 database field from which an entry field part can inherit its characteristics.

restore button. A button that appears in the rightmost corner of the title bar after a window has been maximized. When the restore button is selected, the window returns to the size and position it was in before it was maximized. See also *maximize button*.

S

SBCS. Single-byte character set.

scroll bar. A part that shows a user that more information is available in a particular direction and can be moved into view by using a mouse or the page keys.

secondary window. A window that contains information that is dependent on information in a primary window, and is used to supplement the interaction in the primary window. See also *primary window*. Synonym for *pop-up window*.

secure sockets layer (SSL). A popular security scheme that was developed by Netscape Communications Corp. and RSA Data Security, Inc. SSL allows the client to authenticate the server and all data and requests to be encrypted. The URL of a secure server that is protected by SSL begins with https rather than http.

selection border. The visual border that appears around a VARPG part or a custom-made part, allowing the part to be moved with the mouse or keyboard.

selection button. See *mouse button 1*.

server. A system in a network that handles the requests of another system, called a client.

server alias. A name you define that can be used instead of the server name.

shared component. A component that can be accessed by more than one project.

single-byte character set (SBCS). A character set in which each character is represented by a one-byte code. Contrast with *double-byte character set (DBCS)*.

sizing border. The border or frame around a part (or set of parts) that you select to resize the part (or set of parts) using the mouse or the keyboard.

slider part. A visual component of a user interface that represents a quantity and its relationship to the range of possible values for that quantity. A user can also change the value of the quantity. You can point and click on a slider part in the parts palette or parts catalog and click it onto a design window.

slider arm. The visual indicator in the slider that a user can move to change the numerical value.

source directory. The directory in which all source files for a VARPG application are stored.

source part. A part that can notify target parts whenever the state of the source part changes. A source part can have multiple targets.

spin button part. A type of entry field that shows a ring of related but mutually exclusive choices through which a user can scroll and select one choice. A user can also type a valid choice in the entry field. You can point and click on a spin button part in the parts palette or parts catalog and click it onto a design window.

SSL. Secure sockets layer.

static text part. A part used as a label for other parts, such as a prompt for an entry field part.

status bar. A part of a window that displays information indicating the state of the current view or object. See also *information area*.

status bar part. A part on a window that can display additional information about a process or action for the window.

subfile field. A field used to define fields in a subfile part. See also *subfile part*.

subfile part. A part used to display a list of records, each consisting of a number of fields. This part is similar to an AS/400 subfile. See also *subfile field*.

submenu. A menu that appears from, and contains choices related to, a cascading choice in another menu. Submenus are used to reduce the length of a pull-down menu or a pop-up menu. See also *submenu part*.

submenu part. A part used to start a submenu from a menu item or existing menu, or to start a pull-down menu from a menu item on a menu bar. See also *submenu* and *menu item part*.

subprocedure. A subprocedure is a procedure specified after the main source section. It must have a corresponding prototype in the definition specifications of the main source section

syntax checking. Verifies that the syntax of each line is correct while you are editing the source. By doing so, it can avoid compile errors. You can set this option on or off. You can view only certain specification types, such as C specs, or a line with a specific string.

T

tab stop. An attribute used to set a tab stop for a part so that users can focus on it when they use the Tab key to move through the interface.

target part. A part that receives a link event from a source part whenever the state of the source part changes.

target directory. The directory in which the compiled VARPG application is stored after a build. Contrast with *target folder*.

target folder. The object in which the icon representing a VARPG application is placed.

target program. The object to be built by the project, such as a dynamic link library (DLL).

thread. The smallest unit of operation to be performed within a process.

timer part. A part used to track the interval of time between two events and trigger the second event when the interval has passed.

title bar. The area at the top of each window that contains the system-menu symbol.

token highlighting. Enhances the readability of the code. You can configure highlighting of different language constructs with different colors or fonts to identify the program structures. You can turn token highlighting on or off.

tool bar. A menu that contains one or more graphical choices representing actions a user can perform using a mouse.

topic. In dynamic data exchange (DDE), the set of data that is the subject of a DDE conversation.

tree view. A way of displaying the contents of an object in a hierarchical fashion.

U

user-defined part. A part, consisting of one or more parts you have customized, that you save to the parts palette or parts catalog for reuse. When in the palette or catalog, you can point and click this part onto the design window as you would any other VARPG part.

utility DLL. See *NOMAIN module*

V

vertical scroll bar part. A part that adds a vertical scroll bar to a window. This part allows users to scroll through a pane of information vertically.

W

WAV. The file extension of a wave file.

wave file. A file used for audio sounds on a waveform device.

window part. An area with visible boundaries that represents a view of an object or with which a user conducts a dialog with a computer system. You can point and click on a window part from the parts palette or parts catalog and click it onto the project window.

window with canvas part. A combination of the window part and the canvas part. See also *window part* and *canvas part*.

work area. An area used to organize objects according to a user's tasks. When a user closes a work area, all windows opened from objects contained in the work area are removed from the workplace.

workplace. An area that fills the entire display and holds all of the objects that make up the user interface.

workstation. A device that allows a user to do work. See also *programmable workstation*.

Bibliography

For additional information about topics related to WebSphere Development Studio Client, refer to the following IBM publications:

WebSphere Development Studio Client manuals:
- *Getting Started with WebSphere Development Studio Client for iSeries*, SC09-2625-06, provides information about WebSphere Development Studio Client for iSeries, giving an overview of the various components, how they work together, and the business advantages of using them.

VisualAge RPG manuals:
- *Programming with VisualAge RPG*, SC09-2449-05, contains specific information about creating applications with VisualAge RPG. It describes the steps you have to follow at every stage of the application development cycle, from design to packaging and distribution. Programming examples are included to clarify the concepts and the process of developing VARPG applications.
- *VisualAge RPG Parts Reference*, SC09-2450-05, provides a description of each VARPG part, part attribute, part event, part attribute, and event attribute. It is a reference for anyone who is developing applications using VisualAge RPG.
- *VisualAge RPG Language Reference*, SC09-2451-04, provides reference information about the VARPG language and compiler.
- *Java for RPG Programmers* introduces you to the Java language (and RPG IV) by comparing it to the RPG language. It is a good first step in your Java journey. It also includes an interactive CD tutorial on Java and VisualAge for Java, by MINDQ.
- *Experience RPG IV Tutorial* is an interactive CD tutorial that teaches you RPG IV and ILE, in a fun and step-by-step approach. The book is a handbook with questions and exercises to help you get hands-on experience with this exciting new version of RPG.
- Another non-IBM book of interest to VisualAge RPG users is *VisualAge for RPG by Example*.

If you have internet access, you can obtain current iSeries and AS/400e information and publications from the following Web site:

`http://www.ibm.com/eserver/iseries/infocenter`

For the PDF version of iSeries publications, refer to the CD ROM *iSeries Information Center: Supplemental Manuals*, SK3T-4092-00.

Application Development Manager manuals:
- *ADTS/400: Application Development Manager Introduction and Planning Guide*, GC09-1807-00, describes the basic concepts and the planning needed to make effective use of the Application Development Manager feature.
- *ADTS: Application Development Manager User's Guide*, SC09-2133-02, describes how to create and manage projects defined to the Application Development Manager feature.
- *ADTS/400: Application Development Manager Self-Study Guide*, SC09-2138-00, provides practical hands-on experience using the Application Development Manager feature. The guide illustrates how to use the Application Development Manager feature by leading you through a series of step-by-step exercises.

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- *ADTS/400: Application Development Manager API Reference*, SC09-2180-00, describes how application programmers can write their own interface to the Application Development Manager feature.

Information Presentation Facility manual:
- *Information Presentation Facility Programming Guide* G25H-7110, describes the elements that make up the Information Presentation Facility (IPF). IPF is a tool that supports the design and development of online documents and online help facilities.

SQL manuals:
- *IBM SQL Reference Version 2* SC26-8416, Volume 2, compares the facilities of
  - DB2
  - SQL/DS™
  - DB2/400™
  - DB2/6000™
  - IBM SQL
  - ISO-ANSI (SQL92E)
  - X/Open™ (XPG4-SQL).
- *DB2 Universal Database Administration Guide* S10J-8157, provides information necessary to use and administer the DB2 product.
- *DB2 Universal Database Embedded SQL Programming Guide* S10J-8158, describes how to design and code application programs that access DB2 Client/Server family servers (such as DB2 or DB2/400). It presents detailed information on the use of Structured Query Language (SQL), and API calls in applications.

Index

Special characters

A

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B

C

D

E

F

G

H

I

J

L

M

N

O

P

Q

R

S

T

U

V

W

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