

IBM WebSphere Development Studio Client for iSeries



Tutorial: Maintaining an iSeries project-based RPG or COBOL application

Version 5.1

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Introduction to this tutorial

The development cycle behind iSeries Projects involves creating and populating an iSeries Project with source members. These members are then edited locally and verified for syntax errors. Next, the members are pushed to the iSeries host and a build is issued against them, depending on the Build Style associated with the project. The errors from the compiles can be retrieved and viewed locally, and the members can be modified accordingly. Finally, once all members compile error free, they can be checked into a team server for source management, if team development is required. The team server can be specified by associating the project with a Team provider. The rest of this tutorial walks you through each of these development steps, and applies them in the context of updating an existing payroll application.

In this tutorial you will follow the typical iSeries™ application development life cycle tasks using a payroll application written in RPG or COBOL. You will work through a series of exercises that will teach you about iSeries project based application development.

Tutorial purpose:

Before you begin, take a minute to read the learning objectives for the tutorial.

Length of time:

This tutorial takes approximately 1.5 hours to complete.

Modules:

Work on the modules in sequence. The pictures in the modules show similar tasks. Some of the names and icons may be different from the environment you will be working with when you complete the modules.

Prerequisites

You should also learn about the prerequisite knowledge for the tutorial before beginning. This section describes the type of knowledge you need to already have to fully benefit from this tutorial.

Learning objectives

In this tutorial, you will learn how to perform some typical iSeries native development tasks. You will walk through a development cycle using iSeries Projects where you are given the task of updating an existing payroll application and re-pushing it back to the iSeries host. The development cycle involves creating and populating an iSeries project with the existing code for the payroll application. It then involves editing and verifying the code locally, and pushing it back to the iSeries host. Finally, a build has to be submitted to the iSeries host to compile your new and improved native application.

This tutorial is broken into ten modules, each with their own specific learning objectives. Each module is composed of several exercises. These exercises must be completed in order to successfully achieve the module's goals.

The first module, Reviewing the 5250 payroll application, helps you learn about the 5250 payroll application before you use the new iSeries Development tools to maintain it.

The second module, Starting Development Studio Client helps you learn about the workbench and workspace. You will then learn how to start Development Studio Client.

The third module, Opening a perspective helps you learn about a perspective, and specifically the iSeries Projects perspective. You will then learn how to open the iSeries Projects perspective.

The fourth module, Configuring a connection to an iSeries system and connecting to an iSeries, explains how to create a connection to an iSeries server. You will learn the steps to configure and create a connection.

The fifth module, Setting up an iSeries Project and enabling a merged view describes how to create an iSeries project and to populate it with members. It also explains how to show remote objects or local objects or both.

The sixth module, Editing source, helps you learn about some of the language features available in the Remote Systems LPEX Editor while you edit ILE RPG source or ILE COBOL source.

The seventh module, Verifying source, explains how to verify ILE RPG source or ILE COBOL source in the Remote Systems LPEX Editor. You learn how to find and fix errors identified in the iSeries Error list.

The eighth module, Building the iSeries Project, helps you learn how to select a build style, submit a build and run the application.

The ninth module, Designing screens, helps you learn about the various aspects of the CODE Designer while modifying a display file to add a screen.

The tenth module, Debugging a program, explains the Debug perspective and how to start the debugger, set breakpoints, monitor variables, run and step into a program, view the call stack in the Debug view, remove a breakpoint, add a storage monitor, and set watch breakpoints.

Be sure to read about the Prerequisite knowledge for the tutorial before beginning. This section describes the type of knowledge you need to already have to fully benefit from this tutorial.

Prerequisite knowledge

In order to complete this tutorial end to end, you should already have working knowledge of the following:

- Basic Microsoft® Windows® operations such as working with the desktop and basic mouse operations such as opening folders and performing drag-and-drop operations.

It is also useful, but not necessary, for you to have basic knowledge of the following:

- ILE RPG or ILE COBOL
- DDS

When you are ready to begin, start with the first module.

Chapter 1. Reviewing the 5250 payroll application

In this module, you are going to explore the application by invoking it from a 5250 session and working with the applications green screens and command keys.

You will learn about the 5250 application, before you start to use the new iSeries Development tools to maintain it. This will allow you to become familiar with the 5250 screens and the behavior of the application.

Remember: Before beginning this module, you should learn about the Prerequisite knowledge for the tutorial.

In order to review the 5250 order entry application, there are several steps you will need to learn about and follow:

- Start the 5250 application
- Know what screens the application provides
- Know how the application works in its 5250 environment
- Know what command keys are supported and what functions they allow

In order to accomplish these learning objectives, there are several steps that are involved, including:

- Starting the 5250 application
- Maintaining an employee record
- Maintaining a project record
- Maintaining a reason code

The exercises in this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 5 minutes to complete.

Starting the 5250 application

To start the order entry application you need a 5250 emulator on your workstation.

On the 5250 emulation screen on your desktop, displaying the sign-on screen:

1. Enter your User ID.
2. Enter your password.
3. On the command line of a 5250 screen, add the library RSELABXX to your library list.

```
ADDLIBLE RSELABXX
```

4. Now, invoke the Payroll application:

```
CALL PAYROLL
```

The application starts and shows the first panel. This first screen asks you to enter an X beside the application you want to maintain.

5. Choose the application that you want to maintain.

Maintaining an employee record

To maintain an employee record:

1. Type x beside **Employee Master Maintenance**.

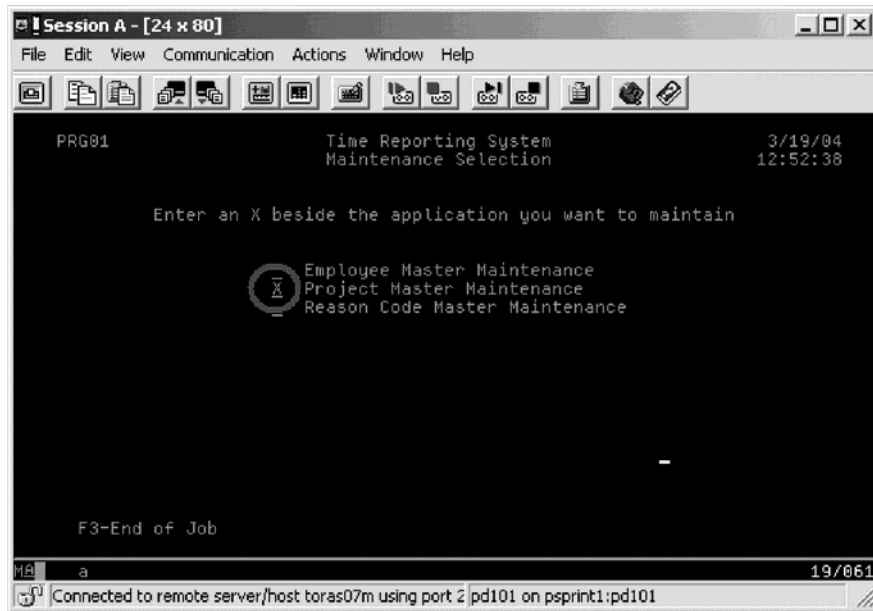


2. Press **Enter**.
3. Type 123 for the Employee Number.
4. Type A for the Action Code to add employee **123**.
5. Press **Enter**.
6. Type any information you like about the employee.
7. Press **Enter**.
8. Play in the employee records as much as you like.
9. Press **F4** to return to the maintenance selection.

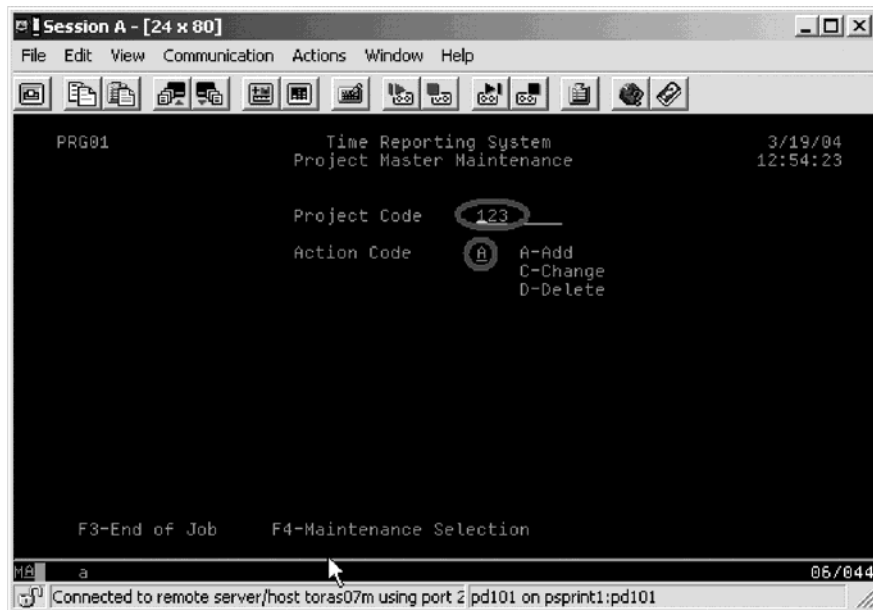
Maintaining a project code

To maintain a project code:

1. Type x beside **Project Master Maintenance**.



2. Press **Enter**.
3. Type 123 for the Project Code.
4. Type A for the Action Code to add project **123**.



5. Press **Enter**.
6. Type any information you like about the project.
7. Press **Enter**.
8. Play in the project records as much as you like.
9. Press **F4** to return to the maintenance selection.

Maintaining a reason code

To maintain a reason code:

1. Type x beside **Reason Code Master Maintenance**.
2. Press **Enter**.
3. Type 123 for the Reason Code.
4. Type A for the Action Code to add reason code **123**.
5. Press **Enter**.
6. Type any information you like about the reason code.
7. Press **Enter**.
8. Play in the reason codes as much as you like.
9. Press **F3** to end the PAYROLL program.

Recap

Congratulations! You have completed this module. You should now understand how to:

- Start the payroll application
- Maintain an employee record
- Maintain a project code
- Maintain a reason code
- Exit the application.

You have reviewed all the panels in the payroll application. Continue to the next module.

Chapter 2. Starting Development Studio Client

In this module you are introduced to workbench and the workspace. You then learn how to start Development Studio Client..

In order to get started with Development Studio Client and the Remote System Explorer, there are several steps you will need to learn about and follow:

- Explain workspace and workbench
- Start Development Studio Client

In order to accomplish these learning objectives, you are going to complete the step: Starting Development Studio Client.

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

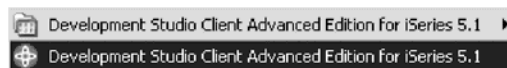
Length of time:

This module will take approximately 5 minutes to complete.

Starting Development Studio Client

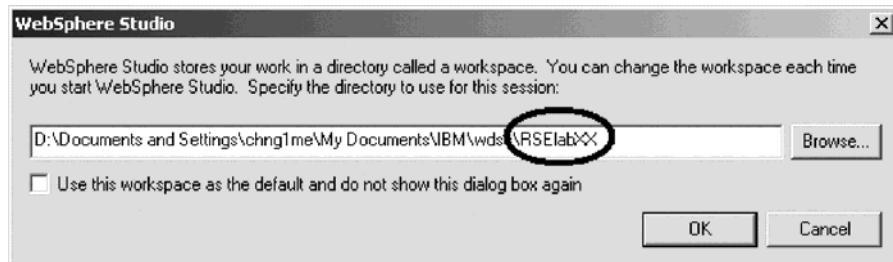
To start Development Studio Client:

1. Click **Start** on the task bar of your desktop
2. Select **Programs > IBM® WebSphere® Studio > Development Studio Client Advanced Edition for iSeries 5.1**



Note: If the Advanced Edition Version of the product is not installed on your workstation then you will not see the words "Advanced Edition" in the Start menu

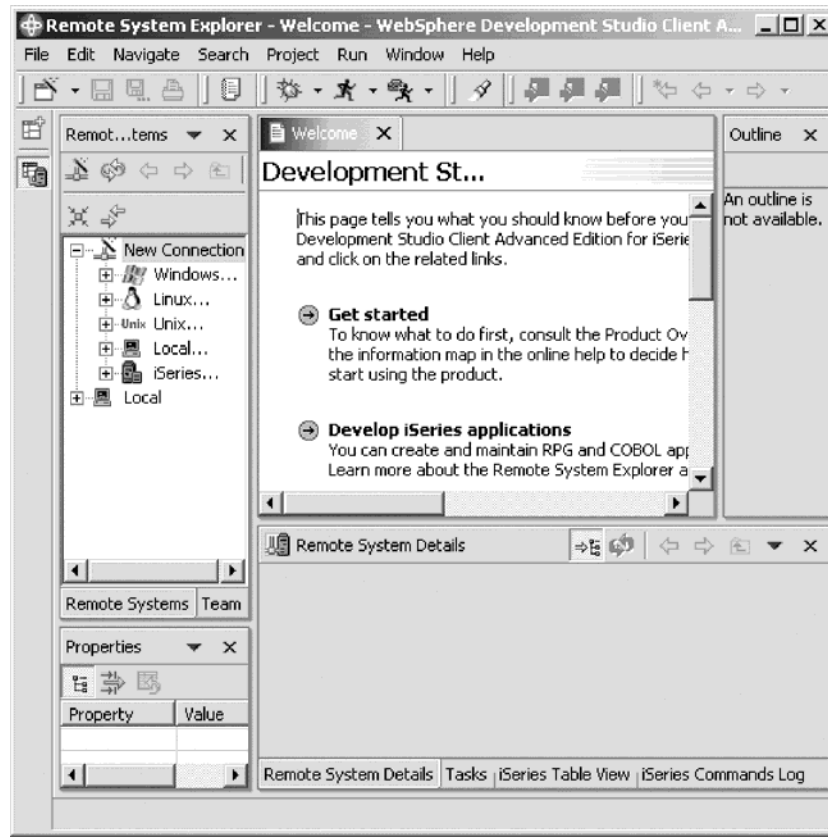
3. A dialog may appear. Here you specify the name of the workspace where your projects and other resources such as folders, subfolders and files that you are developing in the workbench will reside.



4. (Optional) Change the field in this dialog and use a unique directory name, for example, RSElabXX (where XX is a unique number).

Note: If you have completed the tutorial called Maintaining an ILE RPG or ILE COBOL application, then make sure that you use a different workspace. Also make sure that you have restored the RSELABxx savefile to overwrite changes made when you completed this other tutorial.

5. Click OK to open the workbench.



The workbench refers to the desktop development environment. The workbench aims to achieve seamless tool integration and controlled openness by providing a common paradigm for the creation, management, and navigation of workbench resources. Each workbench window contains one or more perspectives.

Checkpoint

Complete this checkpoint to determine if you are ready to move on to the next module.

1. A workspace:
 - a. Aims to achieve seamless tool integration and controlled openness by providing a common paradigm for the creation, management, and navigation of workbench resources.
 - b. Defines the initial set and layout of views in the Workbench window.
 - c. Refers to the desktop development environment.
 - d. Specifies where your projects and other resources such as folders, subfolders and files that you are developing in the workbench will reside
2. A workbench:
 - a. Aims to achieve seamless tool integration and controlled openness by providing a common paradigm for the creation, management, and navigation of workbench resources.
 - b. Defines the initial set and layout of views in the Workbench window.
 - c. Refers to the desktop development environment.

- d. Specifies where your projects and other resources such as folders, subfolders and files that you are developing in the workbench will reside.
- e. A and C

Recap

Congratulations! You have completed this module. You should now understand:

- The concepts of the workbench and the workspace
- How to start Development Studio Client

Now that you have started Development Studio Client, you can move on to opening a perspective. Continue to the next module.

Chapter 3. Opening a perspective

In this module you are introduced to a perspective. You then learn how to open a perspective.

In order to open a perspective there are several steps you will need to learn about and follow:

- Explain perspectives
- Describe the iSeries Projects perspective
- Open the iSeries Projects perspective

In order to accomplish these learning objectives, you are going to complete the following steps:

- Introducing perspectives
- Opening the iSeries Projects perspective

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 5 minutes to complete.

Introducing a perspective

A perspective defines the initial set and layout of views in the Workbench window. Within the window, each perspective shares the same set of editors. Each perspective provides a set of capabilities aimed at accomplishing a specific type of task or working with specific types of resources. For example, the Java™ perspective combines views that you would commonly use while editing Java source files, while the Debug perspective contains views that you would use while debugging Java programs. Perspectives contain views and editors and control what appears in certain menus and tool bars.

Opening the iSeries Projects perspective

When you do iSeries project based development you will want to work in the iSeries Projects perspective. This perspective serves two main purposes, namely for performing iSeries offline development on Windows clients and for enabling team development.

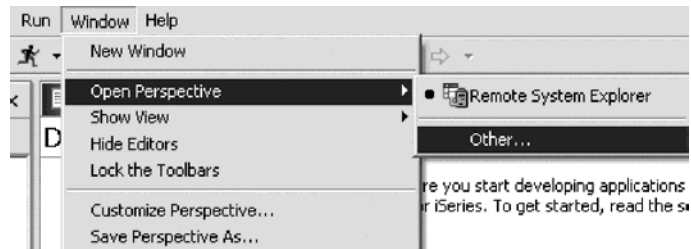
Offline development allows for a disconnected mode of development where a live connection to a host is only required when code updates or builds are needed.

Team development is needed when code changes need to be shared between a team of developers and synchronization of these changes is needed as part of the development cycle.

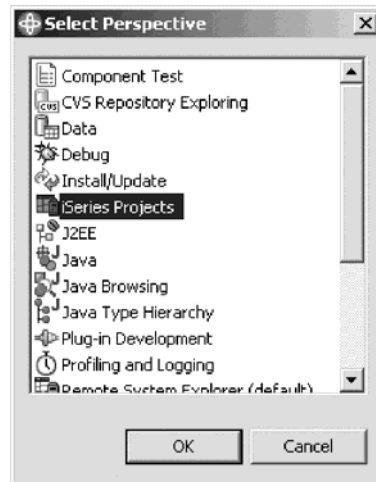
Typically, you create local source physical files and members and edit them locally. You can also download existing members from any remote library into your project. Once done with the local editing, you can submit a build that will push all your changes to the associated library of the iSeries Project and perform a build on the remote members. The code pushed to this scratch library is only pushed there

for the purpose of performing that build. If source code management is needed, the iSeries Project could be associated with any Team provider that is installed with the Development Studio Client.

1. Click **Window** on the workbench menu.



2. Click **Open Perspective > Other** on the pop-up menu.
The Select Perspective dialog opens.
3. Select **iSeries Projects**.



4. Click **OK**.
The iSeries Projects perspective opens in the workbench.

Checkpoint

Complete this checkpoint to determine if you are ready to move on to the next module.

1. A perspective:
 - a. Aims to achieve seamless tool integration and controlled openness by providing a common paradigm for the creation, management, and navigation of workbench resources.
 - b. Defines the initial set and layout of views in the Workbench window.
 - c. Refers to the desktop development environment.
 - d. Specifies where your projects and other resources such as folders, subfolders and files that you are developing in the workbench will reside.
2. Match the perspective with its correct definition:
 - a. Combines views that you would commonly use while editing Java source files
 - b. Contains views that you would use while debugging Java programs
 - c. Contains views that you would use while developing Web applications

- d. Contains views that you would use while maintaining iSeries project based applications.
 - a. Java perspective
 - b. Web perspective
 - c. Debug perspective
 - d. iSeries Projects perspective
3. In the Remote System Explorer perspective you can:
 - a. Display configured connections
 - b. Create a new connection
 - c. Connect and disconnect defined connections
 - d. Work with iSeries files, commands, jobs, IFS files
 - e. All of the above

More practice

Want more practice? Try this!

Given your experience in opening the a perspective, open the Web perspective. See a list of tools and views available to the Web developer. Next open the Java perspective. See a list of tools and views available to the Java developer. Now since you are supposedly in the Java perspective, open the Web perspective. Be careful not to open another Web perspective.

Tip: Look in the workbench left-frame for the Web perspective icon. Now close both the Java perspective and the Web perspective.

Recap

Congratulations! You have completed this module. You should know understand:

- The concept of a perspective
- The concept of the iSeries Projects perspective
- How to open the iSeries Projects perspective

Now that you have opened a perspective, you can move on to getting connected to an iSeries system. Continue to the next module.

Chapter 4. Configuring a connection to an iSeries system and connecting to an iSeries

In this module, you will create a connection to an iSeries server and select objects. You will learn the steps to create a connection.

In order to configure and then connect, there are several steps you will need to learn about and follow:

- Explain the Remote Systems view
- Configure a connection to an iSeries system
- Connect to an iSeries system
- Describe what you need to set up a connection
- Describe a profile

In order to accomplish these learning objectives, there are several steps involved, including:

- Configuring a connection to an iSeries system
- Connecting to an iSeries system

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 10 minutes to complete.

Configuring a connection to an iSeries system

When you first start the workbench and open a perspective, you are not connected to any system except your local hard drive on your workstation. To connect to a remote iSeries system, you need to define a connection. When you define a connection, you specify the name or IP address of the remote system and you give your connection a unique name that acts as a label in your workspace so that you can easily connect and disconnect. When you connect to the iSeries system, the workbench prompts you for your user ID and password on that host.

The first time you connect to an iSeries system, you need to define a profile.

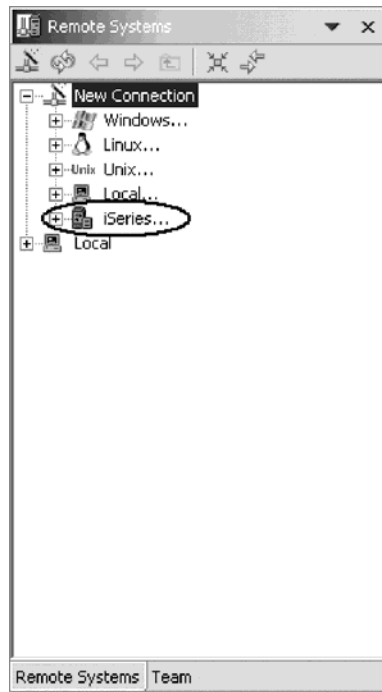
Ok, let's get started.

Remember, you have already opened the iSeries Projects perspective in the previous module.

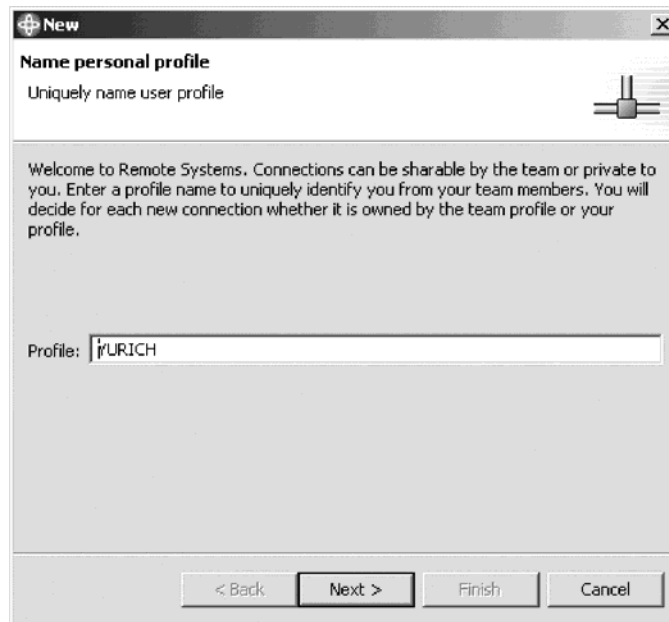
To configure a connection:

1. In the Remote Systems view, **New Connection** is automatically expanded to show the various remote systems types you can connect to through the Remote

Systems view.



Expand **iSeries** to configure a connection to an iSeries system.
The Name personal profile page opens:

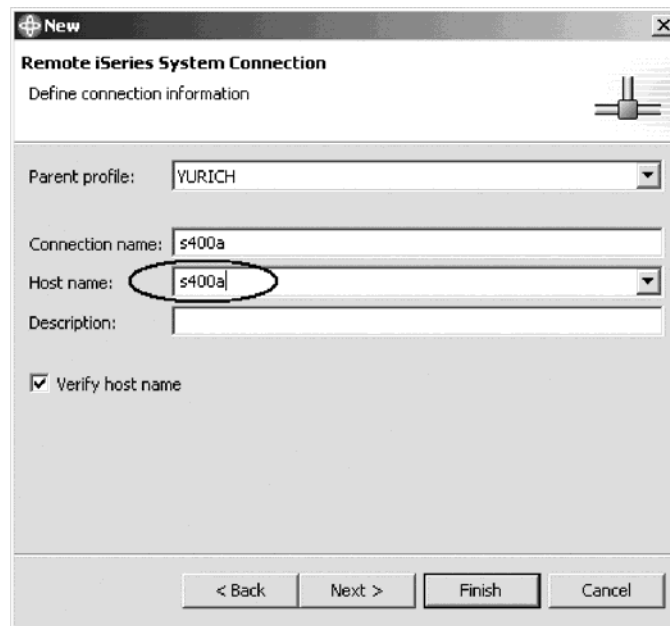


On this page of the New connection wizard and since it is the first time you connect to an iSeries system, you need to define a profile. All connections, filters, and filter pools belong to profiles. Profiles offer a way to group connections, share connections, or keep them private, and they help you partition data if you have a lot of connections or filter pools.

Your first profile will be for your local workstation. This is your personal profile. You use this profile as you want to keep your connection private. You do not want to share resources and information with other people.

2. Leave the **Profile** information default value. Click **Next**.

The Remote iSeries System Connection page opens:



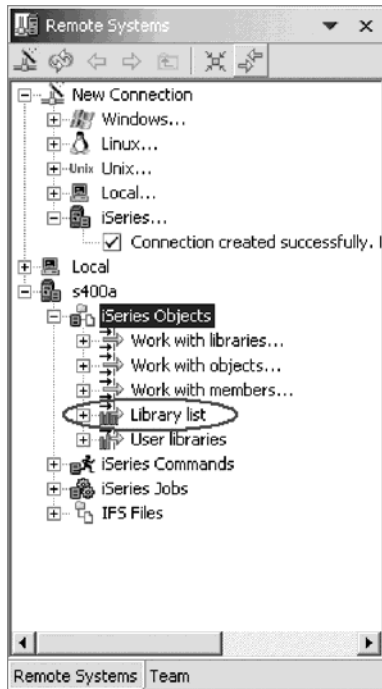
On this second page you specify the information for your connection. The cursor on this page is positioned in the **Host Name** field.

3. In the **Host name** field, type the name of your host system.
The Connection name is automatically filled with the host name. Leave it this way. This name displays in your Remote Systems view and must be unique to the profile.
4. Leave the **Parent profile** default value. You don't need to change it. As the files will be kept private the parent profile defaults to the default profile shown on the previous page of the wizard. If you were sharing resources you would select a team profile that you would have created earlier.
5. Leave the **Verify host name** check box selected.
6. Click **Finish** to define your system.

Connecting to an iSeries system

After you configure a connection to an iSeries system, you can easily connect and expand your new connection to reveal your subsystems. Subsystems are a function grouping of the various types of remote resources that can be explored in the remote system. There are four subsystems:

- iSeries Objects is a PDM-like group, allowing access to libraries, objects and members
- iSeries Commands allow you to predefine command sets each of which contain one or more often used commands. When run, all commands in a command set are sent to the remote system and executed, and the results are logged in the Commands view
- iSeries Jobs allow you to see various jobs, subset by job attributes, and to perform a limited number of operations on those jobs.
- IFS Files allow you to explore folders and files in the Integrated File System of the remote iSeries system



To connect to an iSeries system:

1. In the Remote Systems view, your new connection is expanded to reveal your subsystems. The **iSeries Objects** subsystem is the subsystem you will use most often! It is very similar to PDM, in that it allows you to access objects in the QSYS file system, and perform actions on those objects.
2. Notice the first three entries under the **iSeries Objects** subsystem are named after the PDM options, because they have similar capabilities:
 - **Work with libraries** (similar to WRKLIBPDM)
 - **Work with objects** (similar to WRKOBJPDM)
 - **Work with members** (similar to WRKMBRPDM)

In addition there are entries for working with library lists and user libraries:

- **Library list** (to simulate PDMs WRKLIBPDM LIB(*LIBL) you can start with the pre-defined Library list filter, that when expanded lists all libraries in your library list.)
- **User libraries**

Now let's work with a library in our library list.

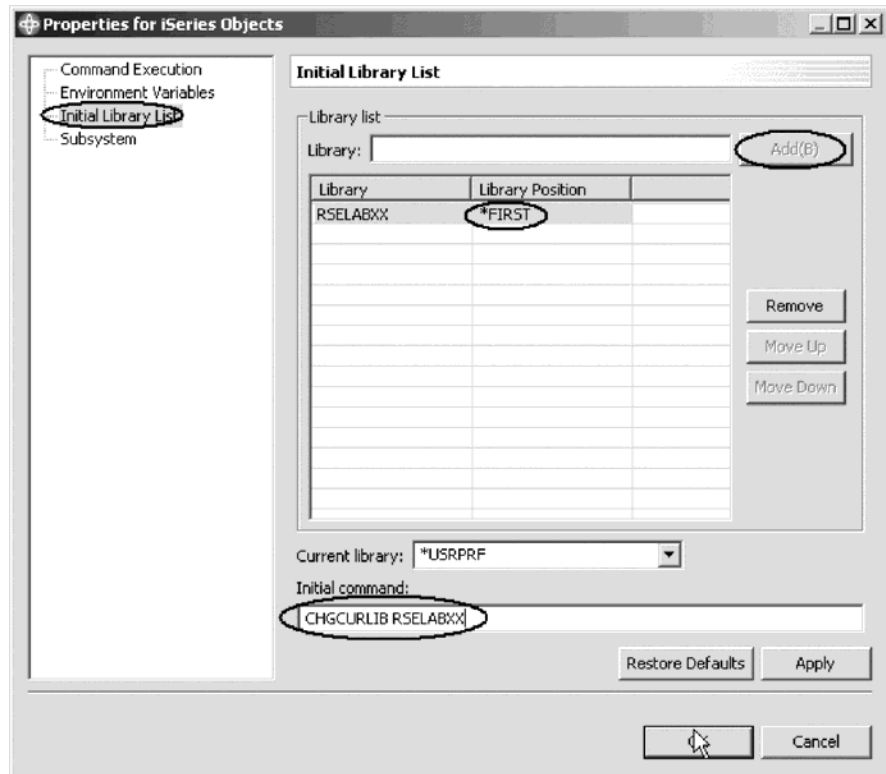
3. Expand the **Library list** folder.

Now the connection will be activated and you will be prompted for a user ID and password.

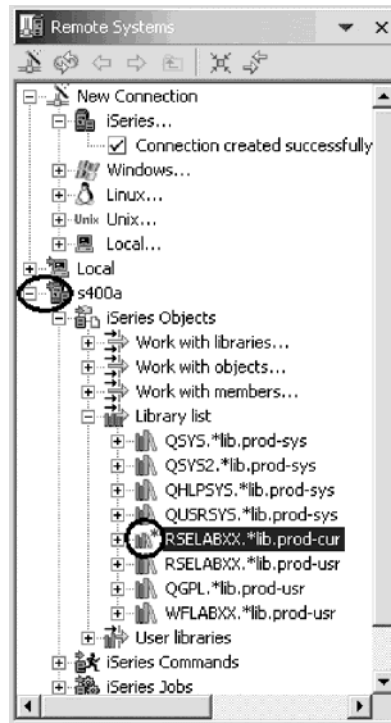


4. Enter your user ID and password.
5. Select the **Permanently change user ID** check box.
6. Select the **Save password** check box.
7. Click **OK**.

Note: Make sure that your user ID has been setup, so that your library has been added to the library list automatically. You can use the properties for iSeries Objects dialog to set connection information such as adding a library to a library list and changing the current library. You can right-click on iSeries Objects then click Properties to see this dialog. You will need this setup to run jobs interactively from your workstation.



Back in the workbench you will see the libraries in your job's library list.



Notice that the s400a node now has a small green arrow in the icon to indicate it is an active connection.

Also your RSELABXX library should have a small green star that indicates it is the current library.

Note: If you do not see RSELABXX in your library list you can right-click on the Library list and use the Add Library List Entry window to add RSELABXX to your library list. If you also don't see RSELABXX as the current library you can right-click Library list and use the Change Current Library window to change the current library to RSELABXX.

For each library, you can right-click and select from a number of actions. For example, there is an action to create a new source file within the selected library, to refresh the contents of the library if it is expanded, to rename the library, copy the library or delete the library.

Checkpoint

Complete the checkpoint below to determine if you are ready to move on to the next module.

1. When you first start the workbench and open a perspective, you are not connected to any system except your local workstation. To connect to a remote iSeries system, you need to:
 - a. Start Remote System Explorer communication server
 - b. Start a 5250 session
 - c. Define a connection. Specify the name or IP address of a remote system
 - d. Define a profile
2. The first time you connect to an iSeries system, you need to define a:
 - a. Profile

- b. Filter
 - c. Filter pool
 - d. Connection
 - e. All of the above
3. Profiles:
 - a. Help partition data when you have a lot of connections or filter pools
 - b. Include all connections, filters, and filter pools
 - c. Group connections
 - d. Share connections
 - e. Keep connections private
 - f. All of the above
4. There are several types of profiles:
 - a. Team
 - b. Personal
 - c. Both
5. A team profile is used to share resources and information with other people. (T, F)
6. Subsystems include:
 - a. iSeries Objects
 - b. iSeries Jobs
 - c. IFS Files
 - d. iSeries Commands
 - e. All of the above
7. iSeries objects include:
 - a. Work with libraries
 - b. Work with objects
 - c. Work with members
 - d. Library list
 - e. All of the above

More practice

Want more practice? Try this!

Given that you have access to your own iSeries systems, configure a new connection and connect to this iSeries system. Now rename the connection, move the connection up or change the attributes of the connection. Then use the iSeries objects subsystem to list the libraries in your library list.

Use the Development Studio Client for iSeries online help to assist you in these tasks.

Recap

Congratulations! You have completed this module. You should now understand:

- The concepts of profiles, subsystems, iSeries objects
- How to define connection information for an iSeries server

- How to select the iSeries Objects subsystem and view the libraries in the library list

Now that you have set up a connection, you are ready to create an iSeries project and populate it with objects.

Continue with the next module.

Chapter 5. Setting up an iSeries Project and enabling the merged view

In this module, you will learn how to create an iSeries Project and import the source you have just located for the green-screen application into that project. You will also learn how to manage local and remote objects.

In order to create an iSeries Project and manage local and remote objects, there are several steps you will need to learn about and follow:

- Describe iSeries Projects
- Create the iSeries Project
- Select the build style
- Populate the iSeries Project
- Show only local objects
- Show only remote objects
- Show both local and remote objects
- Recognize local and remote objects by their icons

In order to accomplish these learning objectives there are several steps involved, including:

- Creating an iSeries Project
- Populating the iSeries Project
- Enabling the merged view
- Modifying the view to show local objects, remote objects or both

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 10 minutes to complete.

Creating an iSeries Project

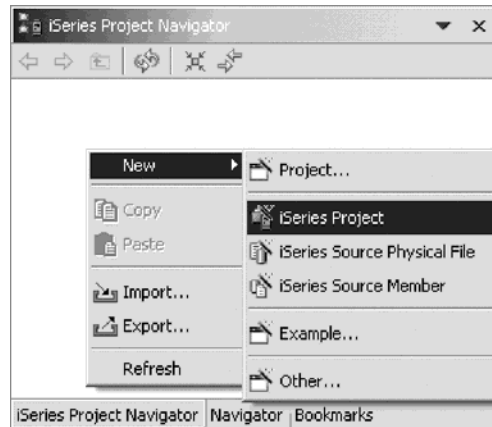
iSeries Projects are projects that are dedicated for holding iSeries source members destined to be pushed and compiled on an iSeries machine. They follow the Workbench paradigm in that they have a special perspective, the iSeries Projects Perspective, dedicated to showing and working with these projects. When a new iSeries project is created three properties need to be associated with it. These are an iSeries Connection, an Associated Library, and a Build Style.

Tip: Only iSeries projects can hold source physical files and members. Since you can create various types of projects with the Development Studio Client for iSeries, each project type is identified by a distinct icon. Specifically, iSeries projects are distinguished by blue on the top right corner of the project icon.

Now that you have located the source code, you need to import it into an iSeries project for editing. You can create a new iSeries project from scratch by using the New iSeries Project Wizard.

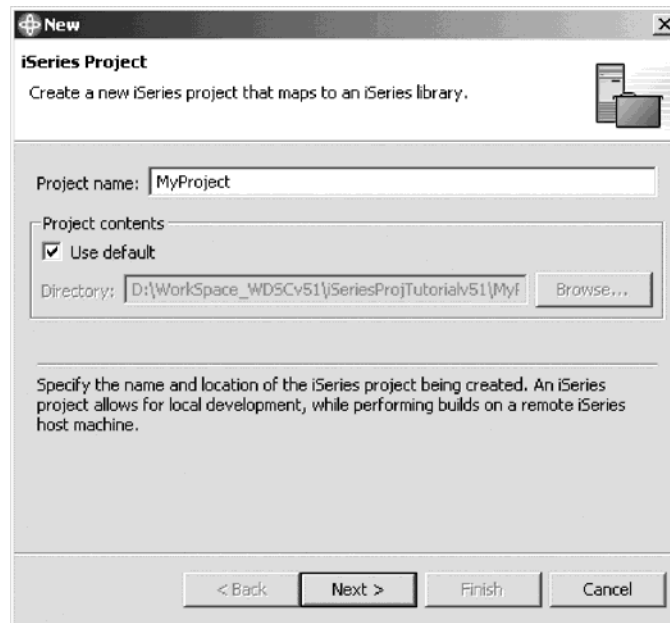
To create an iSeries project:

1. In the iSeries Project Navigator, right-click and click **New > iSeries Project** on the pop-up menu.



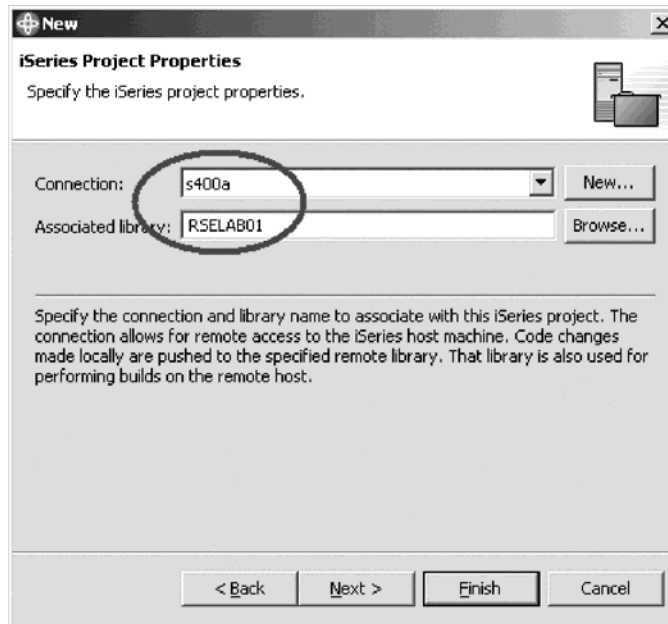
The iSeries Project page opens.

2. In the **Project name** field, type MyProject.



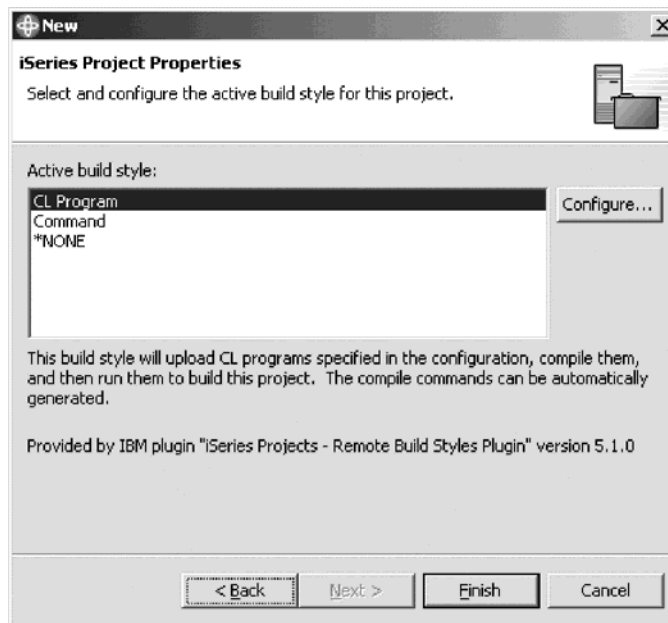
3. Click **Next**.
4. Select your connection from the **Connection** list, for example, s400a.
The property iSeries connection allows for remote access to the iSeries host machine, and handles various aspects, including user ID and password authentication to the remote host. It also provides the initial environment for builds, including the base library list.

5. In the **Associated library** field, type RSELABxx



The associated library is a "scratch" library on the remote iSeries system that an iSeries project maps to. It is used for pushing code changes made locally to the remote host and for performing builds on that remote host. It is expected that this library is a "personal" library and the goal is that there should not be any need for any source in it to be edited directly on the host. It is meant to be a sandbox in which a single developer can perform tasks.

6. Click **Next**.
7. Under **Active build style**, select **CL Program**.



The property build style determines how a given iSeries Project is built. It determines how source physical files and members are pushed to the remote host, and how these members are compiled there.

8. Click **Finish**.

This will create an empty iSeries project that you have to populate. This is useful when you are creating new iSeries members from scratch and you don't have them already on a host.

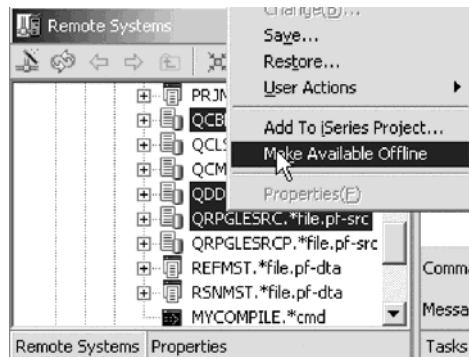
Populating the project with members

You have an existing green screen application that you need to import into an iSeries project. There are several ways of importing members into an iSeries project, but the quickest way is to use the Make Available Offline action.

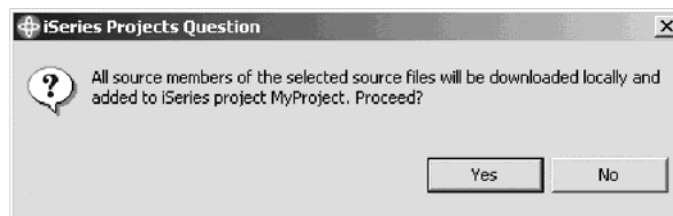
The Make Available Offline action downloads the selected files or members locally to their corresponding iSeries project. The corresponding iSeries project has the same host and the same library properties as the host name and the library of the selected source physical files or members. If such an iSeries project is not found, one will automatically be created. In your case, this action created a new iSeries Project with the name being connectionName_libraryName. If there was one or more existing iSeries projects which had the same connection and mapped to the same library as the Associated Library, then this action would have prompted you to select one of these existing projects.

To populate the project with members:

1. In the iSeries Projects perspective look for the Remote Systems view. It is located under the iSeries Project Navigator.
2. In the Remote Systems View Library filter, right-click the QDDSSRC, QRPGLSRC and QCBLLSRC source physical files and click **Make Available Offline** on the pop-up menu.

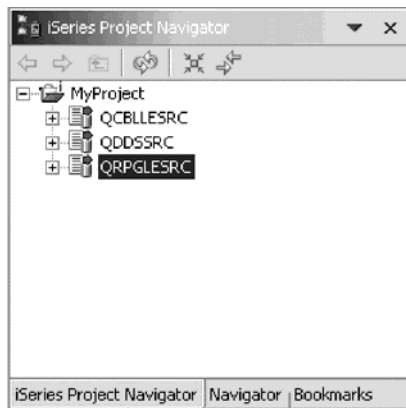


A dialog opens asking you to confirm the download of files to your project.



3. Click Yes.

The files will be added to your project:



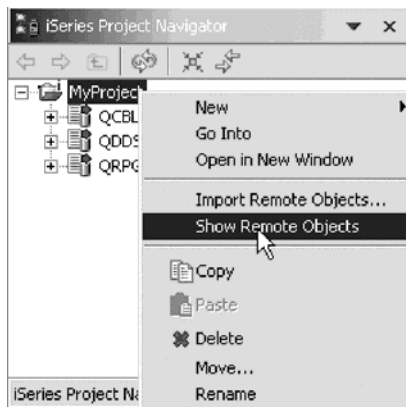
Enabling the merged view

Once the iSeries project has been created and populated with source files and members, you can display the remote objects that exist in the associated library of the project by selecting the Show Remote Objects action from the project pop-up menu. This action displays the "bleed-through" view that merges all the local resources with all the remote resources that exist in the remote library.

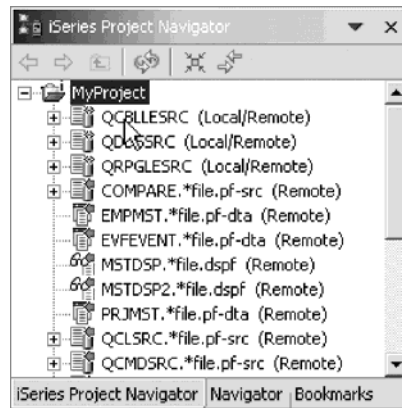
Now you want to display the "bleed-through" view that merges all the local resources with all the remote resources that exist in the remote library.

To enable the merged view:

1. Right-click your project.
2. Click **Show Remote Objects** on the pop-up menu.



3. Your iSeries Project Navigator will now look like this:



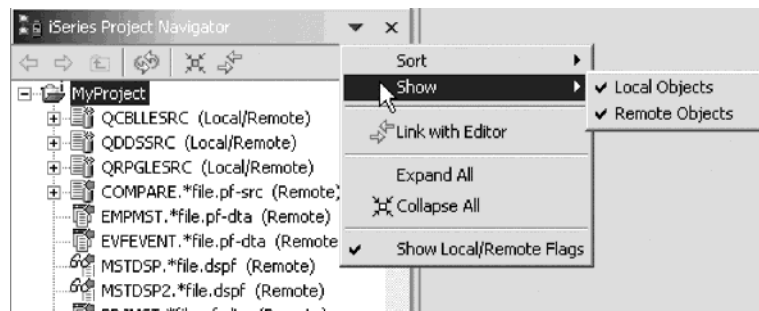
Notice how some members are flagged with the yellow arrow. This shows that there are objects that are local and remote.

Modifying the view

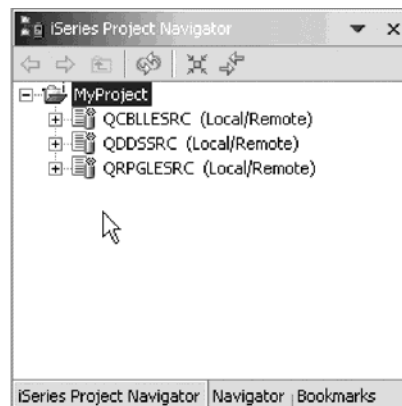
Next you modify the view to filter out remote objects.

To modify the view:

1. Go to the iSeries Project Navigator toolbar.
2. Click the drop down arrow.
3. Click **Show > Remote Objects** on the pop-up menu.



This removes all objects that are only remote from the view.



Recap

Congratulations! You have completed this module. You should know understand:

- The concept of an iSeries Project
- How to create an iSeries Project
- How to populate the iSeries Project with members
- The concept of a merged view
- How to enable a merged view
- How to view remote objects, local objects or both

Now that you have created an iSeries Project, populated it with members and enabled the merged view continue to the next module.

Chapter 6. Editing Source

In this module, you will edit ILE RPG source member PAYROLL or ILE COBOL source member PAYROLLC and learn about some of the Remote Systems LPEX Editor's language features.

In order to edit source, there are several steps you will need to learn about and follow:

- Describe the features of the Remote Systems LPEX Editor
- Edit columns in RPG source
- Invoke SEU commands in the prefix area
- Undo and redo edit changes
- Invoke RPG programming language specific help
- Prompt for language specific information
- Indent RPG source
- Find and replace
- Filter source
- Find a string in multiple files with the search utility
- Compare two files with the compare utility
- Identify lines with syntax errors
- Correct syntax errors

In order to accomplish these learning objectives there are several steps involved, including:

- Introducing the Editor
- Editing columns in RPG source
- Entering SEU commands
- Requesting Undo and Redo operations
- Invoking Language-Sensitive help
- Displaying COBOL line types
- Prompting RPG Language Specifications
- Indenting RPG source
- Finding and replacing text
- Filtering lines by string
- Searching multiple files
- Comparing file differences from the Remote Systems view
- Checking syntax

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin. You might want to maximize the Editor window during this module.

Length of time:

This module will take approximately 20 minutes to complete.

Introducing the editor

Your program editing tasks are simplified with the Remote Systems LPEX Editor. The editor can access source files on your workstation or your iSeries system directly. When a compilation results in errors, you can jump from the compiler messages to an editor containing the source. The editor opens with the cursor positioned at the offending source statements so that you can correct them.

Editing local source members under iSeries projects is the same as editing remote source members in the Remote Systems Explorer. The LPEX editor can be launched on any local member and the same functionality is available, such as the Outline view, prompter and the code completion feature.

There is one major difference though when editing source members using the LPEX editor in the Remote System Explorer perspective as opposed to using the LPEX editor in the iSeries Project Perspective. When a source member is opened in LPEX in the Remote System Explorer perspective, it is locked on the host, and it cannot be modified on the host while the local edit session is in place. Any code changes that you make locally will be pushed to the host when the Save action is performed in the LPEX editor.

On the other hand, when a member is opened in LPEX in the iSeries Projects perspective, the member is not locked on the host. It can be modified on the host by anyone with enough authority to the library. If you do a Refresh on the iSeries Project, a double sided red arrow will indicate that the member has been modified on the host. If you perform a push action, you will be warned that you will be overwriting remote changes, and you are given the chance to cancel the operation.

Here is a list of the some of the basic editor features that you would expect in a workstation editor:

- Cut, copy, and paste
- Block marking of lines, characters, or rectangles with copy, move, and delete operations
- Powerful find and replace function
- Unlimited undo and redo

In addition there are a few more functions that you may not have seen in a workstation editor:

- Token highlighting where different language constructs are highlighted using different colors and fonts to help identify them in a program
- SEU-like format-line rulers to show the purpose of each column for column-sensitive languages like RPG and DDS. These rulers can automatically update themselves to reflect the current specification.
- SEU-like specification prompting for RPG and DDS
- Sequence numbers, which allow SEU-style commands in the prefix area
- Intelligent tabbing between columns for column-sensitive languages
- Automatic uppercasing for languages that expect uppercase
- Settings for column-sensitive languages simplify text insertions and deletions
- On-line language reference

LPEX provides special support for insertion and deletion in column-sensitive languages. When column sensitive editing is selected, each column is considered as a separate entry space. For example, in an RPG source member, if you are inserting

or deleting characters into a string that is in the Factor 2 entry, the Result field entry does not move. The default editor preference is that column sensitive editing is off. You can switch this support on by going to the workbench preferences window. The LPEX Editor has predefined settings, but also has an associated preference page containing settings that you can define. The name of the category is LPEX Editor and it appears in the tree view of the Preferences window.

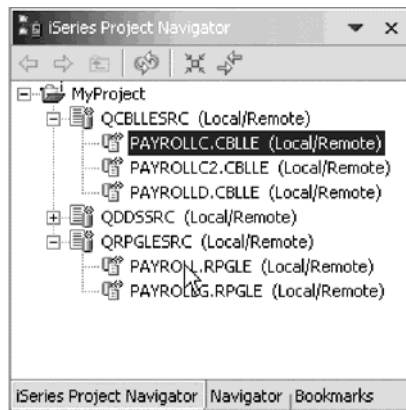
Now let's try some of these features.

Opening a member in the iSeries Projects perspective

Now you are ready to open a member for edit in your iSeries Project.

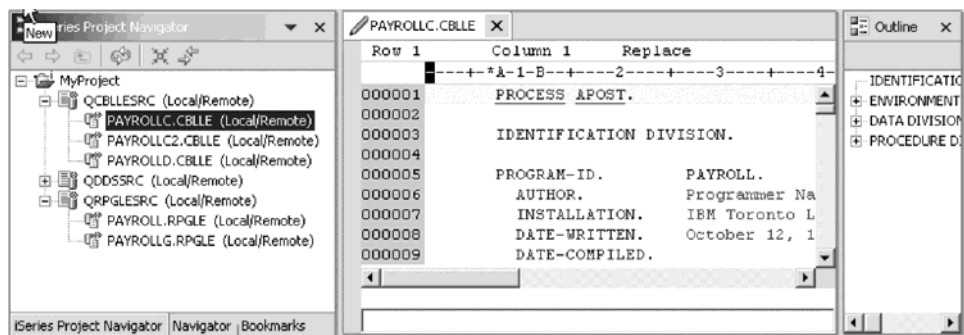
To open a member to edit:

1. In the iSeries Projects Navigator, expand either QRPGLSRC if you want to work with RPG source members or QCBLLSRC if you want to work with COBOL source members.



2. Double-click PAYROLL to edit RPG source or double-click PAYROLLC to edit COBOL source.

The LPEX Editor opens with the selected member.



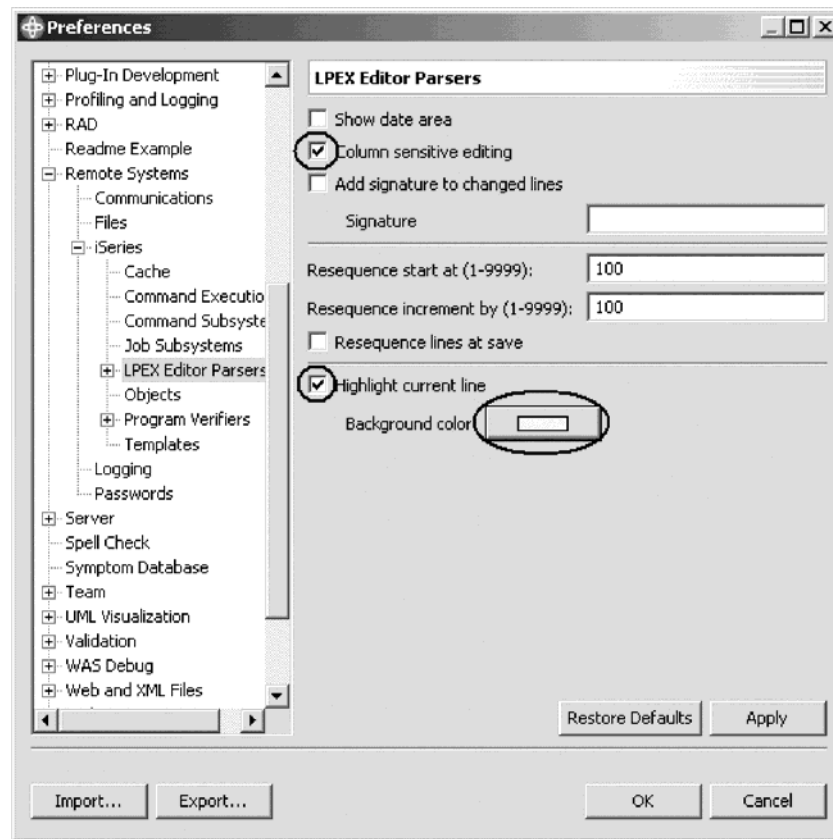
3. Double-click the tab to maximize the editor window.

Editing columns in RPG source

To edit columns:

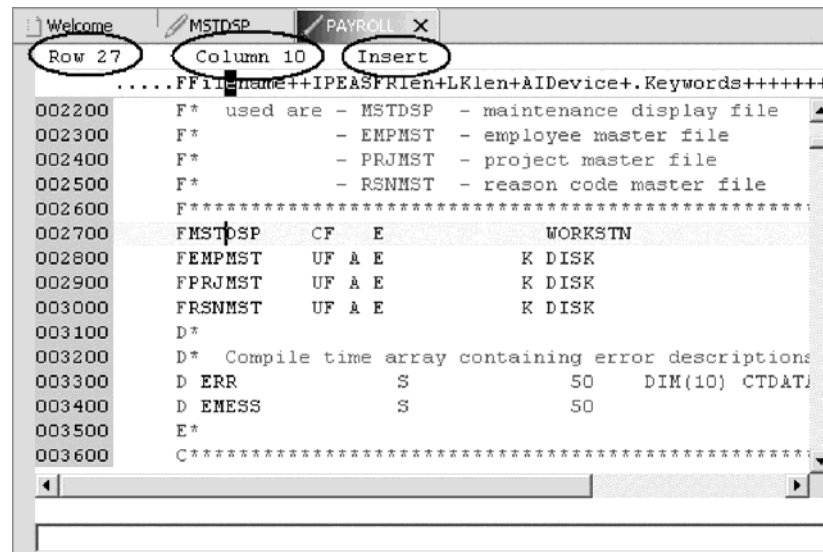
1. Click **Window > Preferences** from the workbench menu.

The Preferences window opens.



2. In the left pane of the Preferences window, expand Remote Systems.
3. Expand iSeries under Remote Systems.
4. Click LPEX Editor Parsers under iSeries.
The right pane allows you to set preferences for this feature.
5. In the right pane of the Preferences window, select the **Column sensitive editing** check box.
When selected, each column is considered as a separate entry space.
6. In the right pane of the Preferences window, select the **Highlight current line** check box.
This option highlights the line that the cursor is currently on. The option applies to all source files opened in the editor area.
7. In the right pane of the Preferences window, click **Background color**.
The Color palette opens.
8. Select **light yellow** from the Color palette.
9. Click **OK**.
The Preferences window shows.
Other interesting preference settings are located under LPEX Editor Parsers. When you expand this entry you see preference settings for the individual language environments.
10. Click **OK** again on the Preferences window.

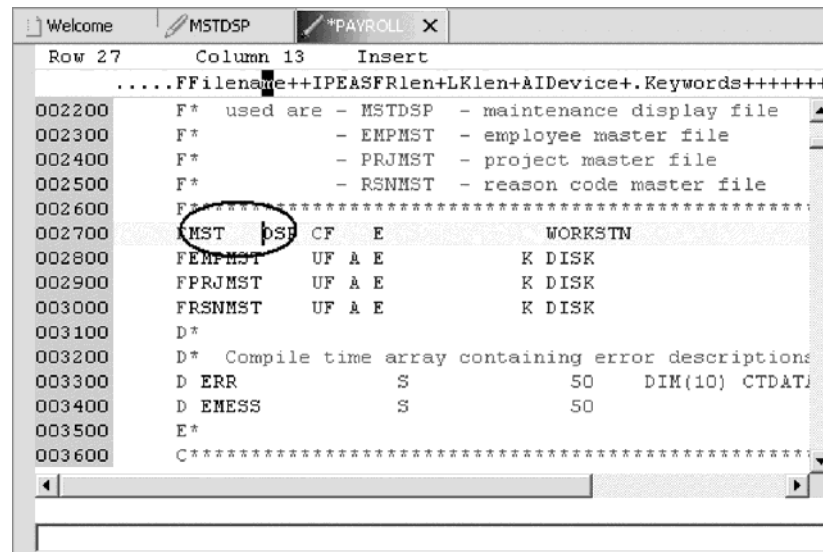
Now let's see what this does.



Return to the Editor window.

11. Move the cursor to line 27, column 10.
12. Make sure the editor is in **Insert** mode. If the status area shows **Replace** press the **Insert** key.
13. Press the spacebar 3 times.

Notice that only the filename is shifted but none of the other columns to the right are effected.



14. Press the **Backspace** 3 times.
Once again the filename is shifted but no other columns are effected.

Entering SEU commands

You can configure the LPEX Editor to adopt the keyboard and command personalities of many popular editors. Most editor profiles differ only in the keys and commands used to perform various editor tasks. Some base editor profiles, listed below, also add prefix information and command area at the start of each line:

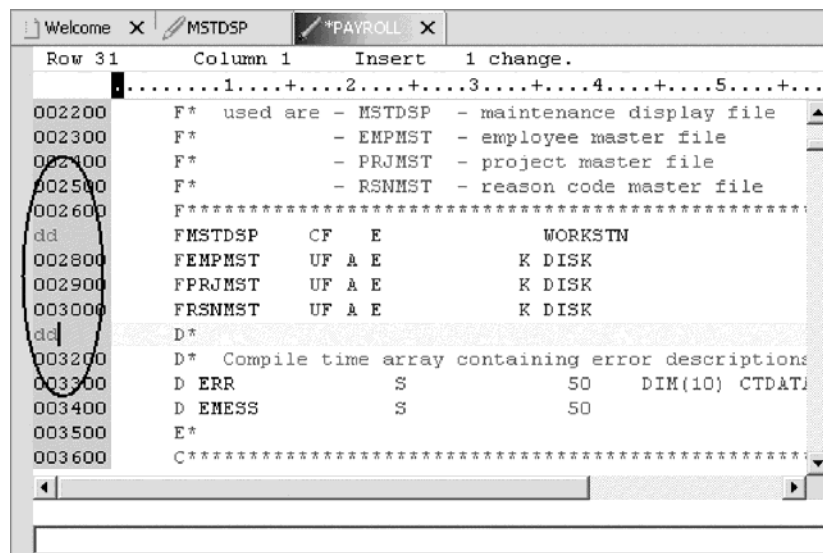
- ispf
- seu
- xedit

The editor recognizes prefix commands used by these editor profiles. Depending on which profile you are using, you can enter SEU, XEDIT, or ISPF commands when the prefix area is active.

If you are an SEU expert you will appreciate the ability to use SEU commands.

To enter SEU commands:

1. Move the cursor into the gray sequence number area to the left of the edit area for PAYROLL or PAYROLLC.



2. On any sequence number type dd.
3. Go down a few lines and type dd again and press **Enter**.
Notice that the lines have been deleted.
4. Now type i5 in the sequence number area.
5. Make sure the cursor is within the sequence number area.
6. Press **Enter**.
Five new lines are inserted.

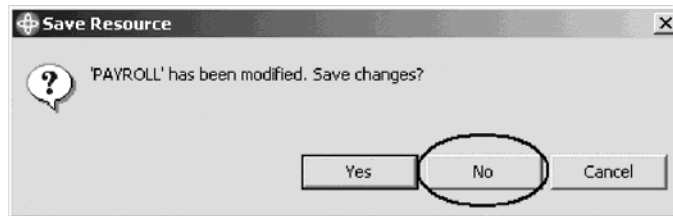
Requesting undo and redo operations

The editor records each set of changes you make to a file in the Editor window. The number of changes made since the last file save is displayed on the status line. If you want to undo a set of changes made to a file you use the Undo operation. You can also cancel the effects of an Undo operation by using the Redo operation.

Now you are going to undo some of the changes you just made to the file. Then you will cancel the changes by using the Redo operation. Finally you will reload the source so that it is back to its original form.

To undo and redo edit changes:

1. Select **Edit > Undo** from the workbench menu.
Notice that the 5 new lines disappear.
2. Press **Ctrl+Z** to undo the first change.
Notice that the deleted lines reappear.
3. Select **Edit > Redo** from the workbench menu.
Notice that the lines are deleted again.
At this point you will reload the source to make sure that it is back in its original form.
4. Select **File > Close** option on the workbench menu.
A Save Resource dialog opens asking if you want to save the latest changes.



5. Click **No**.
6. Go back to the workbench in the iSeries Projects perspective and open the PAYROLL member in the QRPGLSRC file or the PAYROLLC member in the QCBLLSRC file.

Invoking language-sensitive help

Inside the editor, there is cursor-sensitive language-reference help available. This help is invaluable if you cannot remember the order of fields in an RPG specification or the possible values for a variable field. This help is available from the LPEX Editor window.

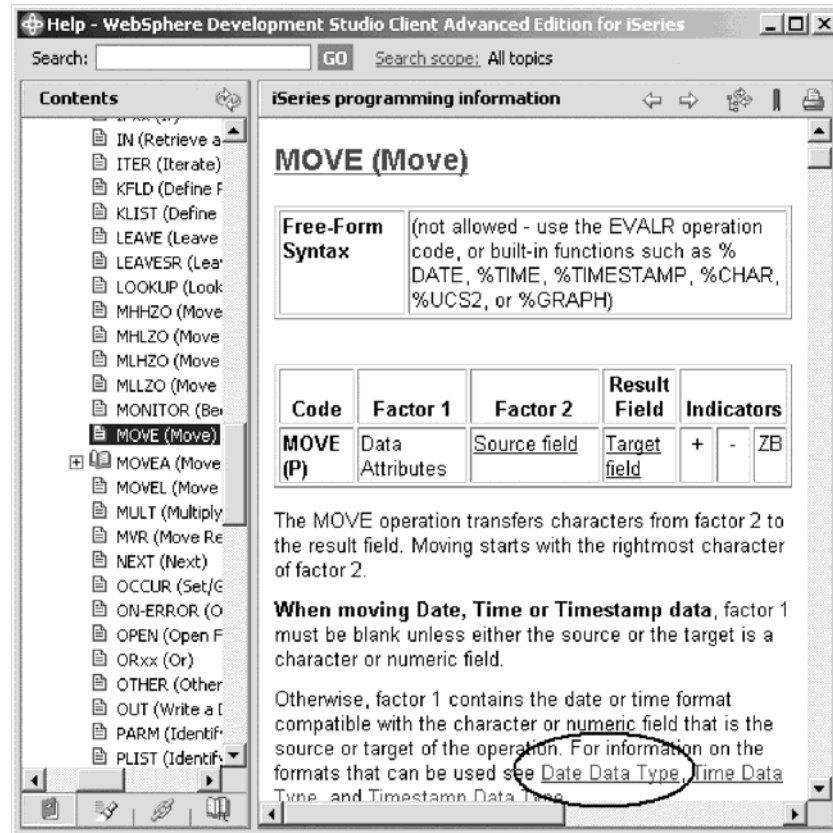
To receive language sensitive help, press F1 in an Edit window. If the cursor is on an operation code, you receive help for that operation code; otherwise, you receive help for the current specification.

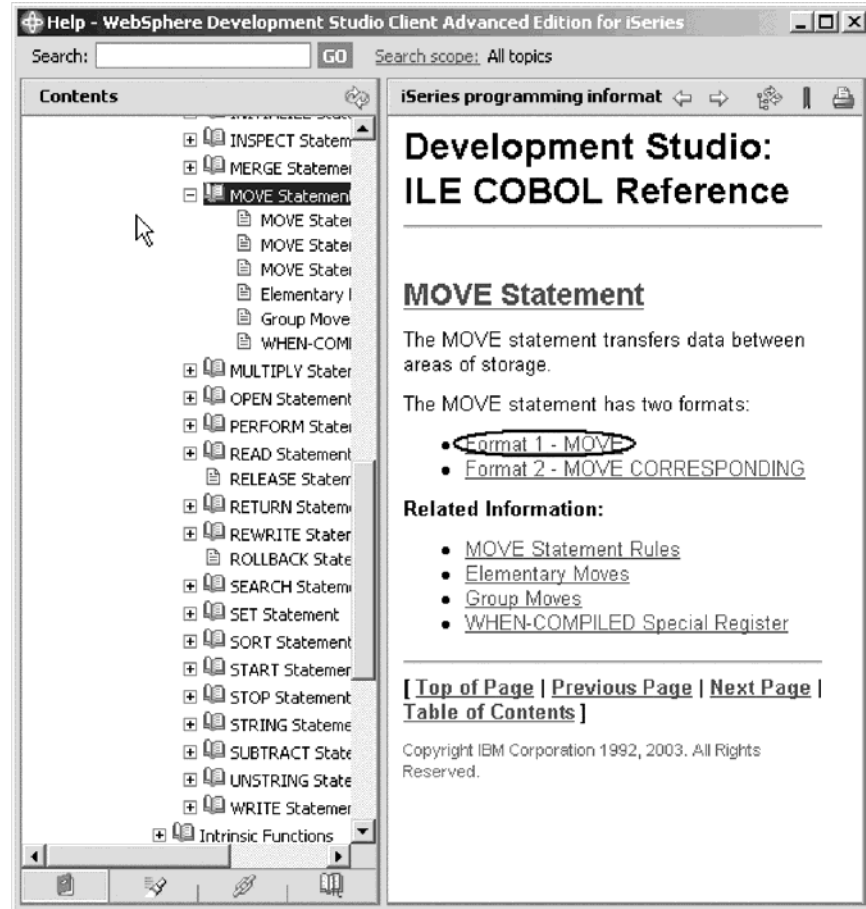
To access language sensitive help:

1. Position the cursor over the word MOVE in line 112 of the ILE RPG source or 231 in the ILE COBOL source.
2. Press **F1**.

Language-sensitive help for the MOVE operation code appears in a Help window.

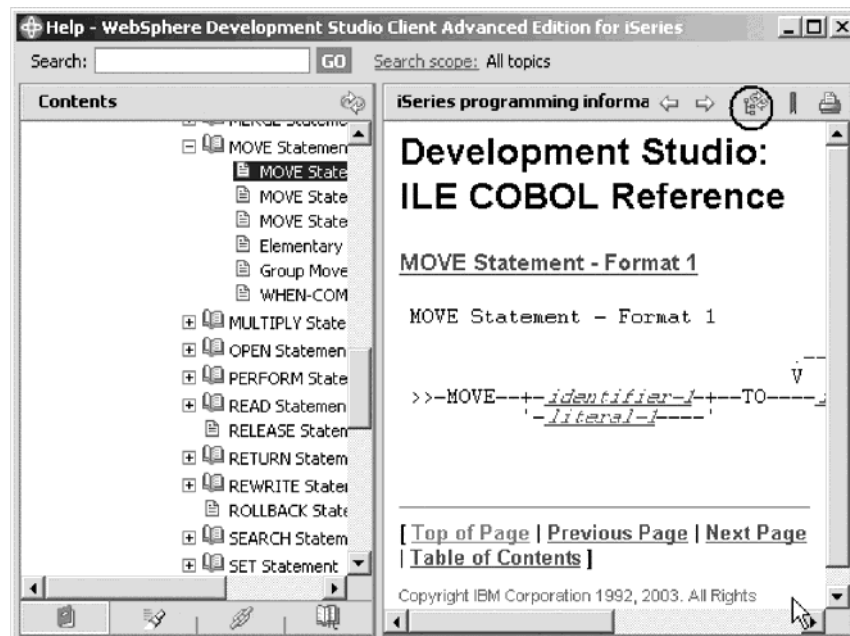
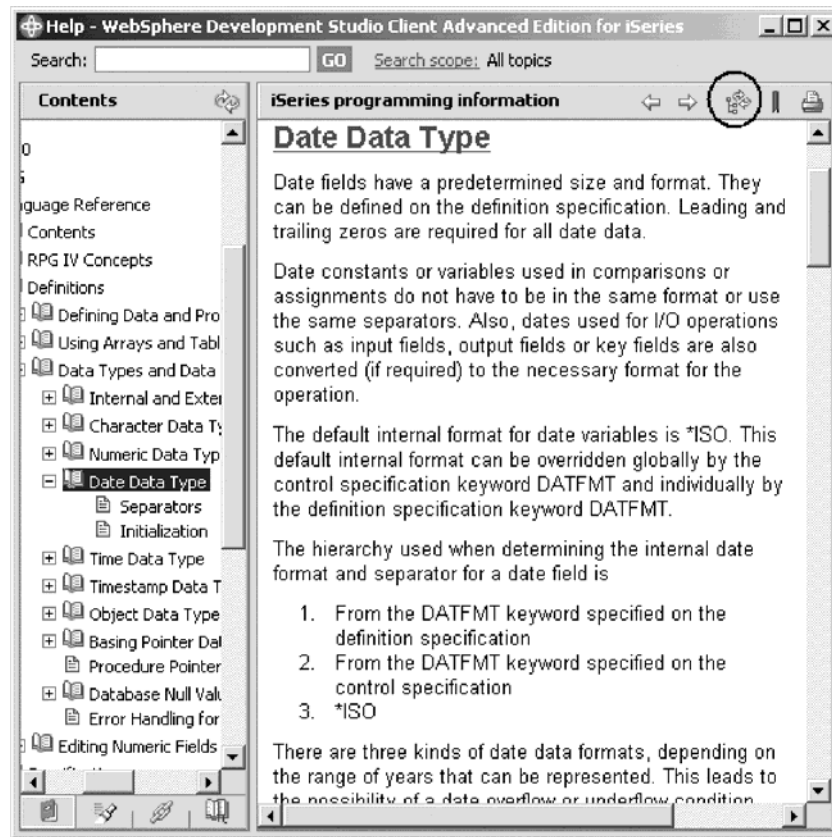
Text marked in blue in the Help window contains the link to detailed information about the topic in blue.





3. Click the link Date Data Type for the RPG help or Format 1–MOVE for COBOL help.

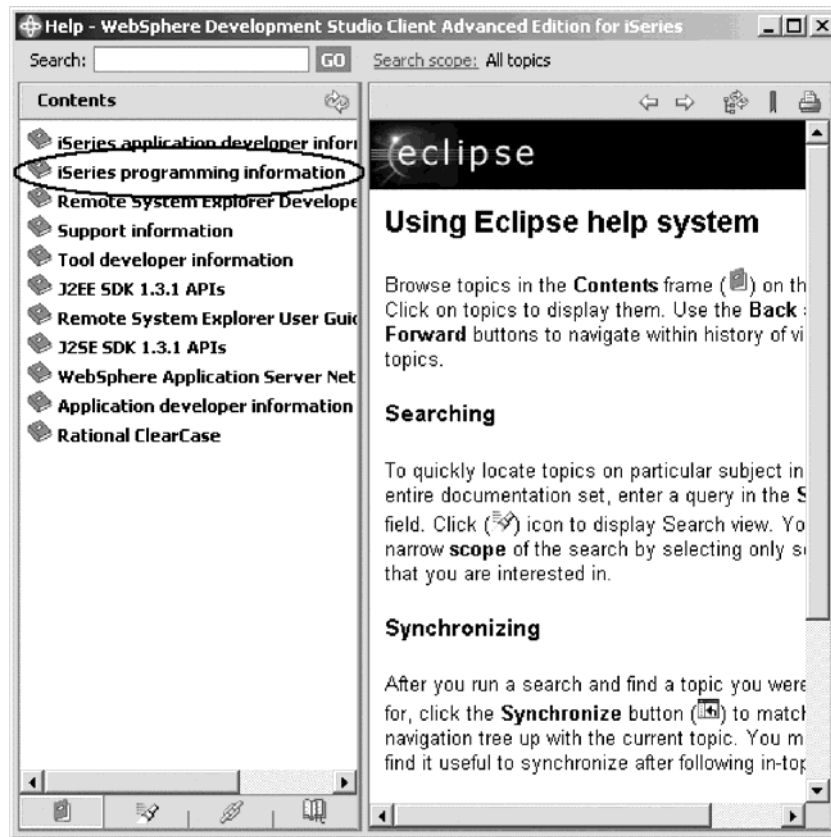
4. Click the **Show in Table of Contents** icon on the Help window toolbar.



This will synchronize the topics in the Contents pane on the left to the help topic you are viewing in the main help pane.

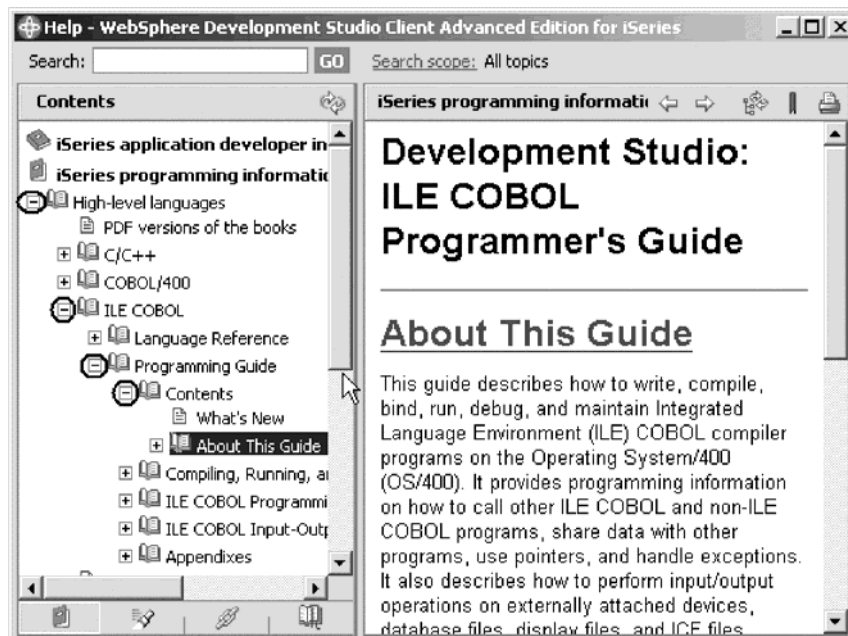
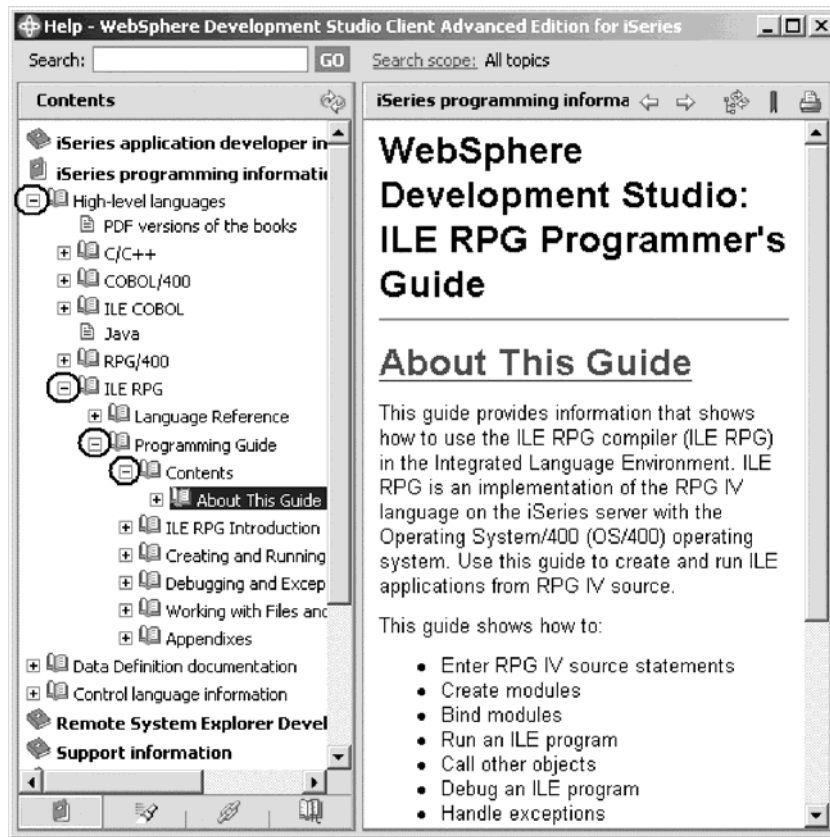
5. Play around in the Help window to see what else is available.
6. Minimize the Help window.
7. Select **Help > Help Contents** on the workbench menu to see a list of all help that is available in the product.

Here you will find the table of contents and you can select a topic of interest.



8. In the left pane of the Help window, click iSeries programming information.
9. Expand High level languages.
10. Expand ILE RPG or ILE COBOL.
11. Expand Programming Guide.
12. Expand Contents.

13. Click About This Guide.

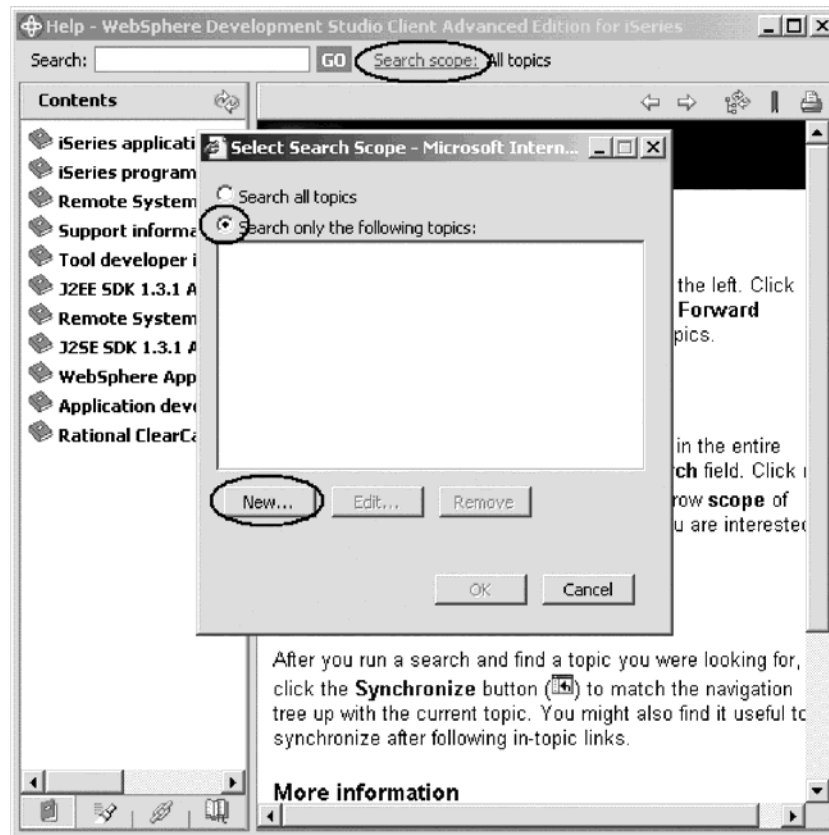


Having the latest version of the manuals at your fingertips will make it easier to find programming information. There is also the option to search the help by specifying a search string. By default, the complete help will be searched.

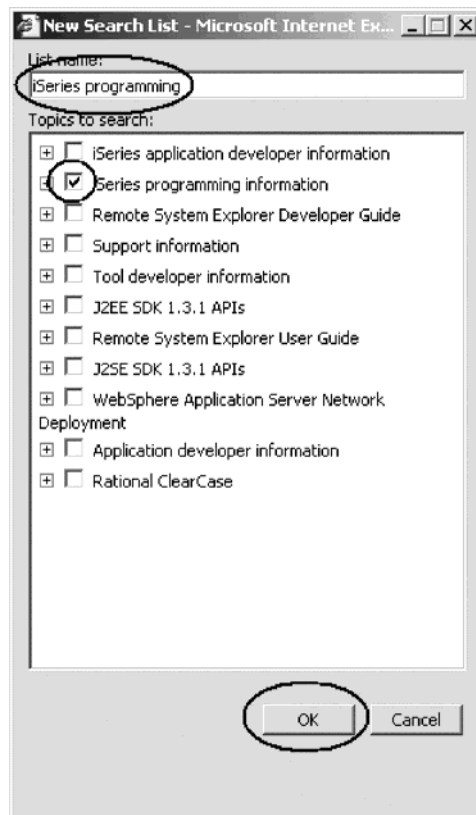
To limit the search to specific documents:

1. Click **Search scope**.

- The Select Search Scope dialog opens.
2. Click the **Search only the following topics** radio button.
 3. Click **New**.



The New Search List dialog opens:



4. In the **List name** field, type iSeries programming for example.
5. Select the **iSeries programming information** check box.
6. Click **OK**.
7. Click **OK** in the Select Search Scope dialog.

Now, if you wanted to do another search, you would only search in the iSeries programming information topics.

8. Minimize the Help window.

Prompting RPG language specifications

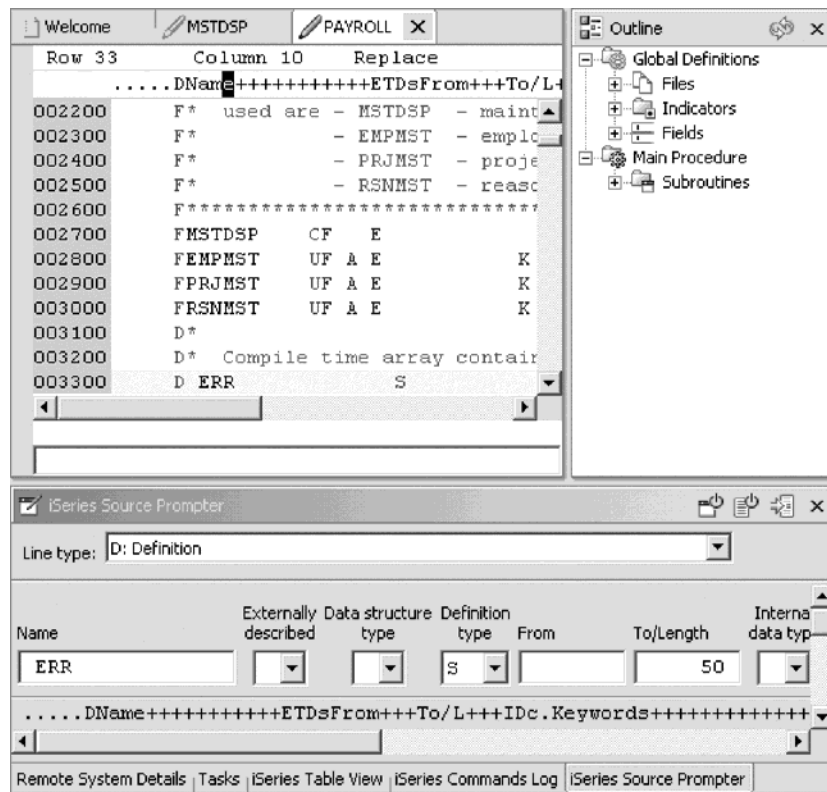
Instead of entering or changing code directly in the Editor window, you can use prompts. When you request a prompt for a specification line, a window appears where you can enter or change that line using entry fields.

To access prompts:

1. Return to the workbench. In the Editor window move your cursor to the D-spec on line 33.
2. Click **Source** from the workbench menu.
3. Click **Prompt** (or press **F4**).

The Editor window will reduce in size and allow you to see the iSeries Source Prompter at the bottom of the workbench. The iSeries Source Prompter shows

the specification line broken down into its individual fields.



On the iSeries Source Prompter toolbar you can use the three push buttons to: Disable source prompt view, Disable syntax checking, and Change to insert mode.

To display context sensitive help for any field in the iSeries Source Prompter:

1. Tab to the **Keywords** field.
2. Press **F1** to see help for this field.

The Help window with help for the D spec keywords opens. If it doesn't appear automatically, you might have to bring it to the foreground by clicking on its icon on the Windows task bar.

You will see words in the help that appear in a different color than the regular text. These are help links, and they show that there is additional help available on that word or phrase.

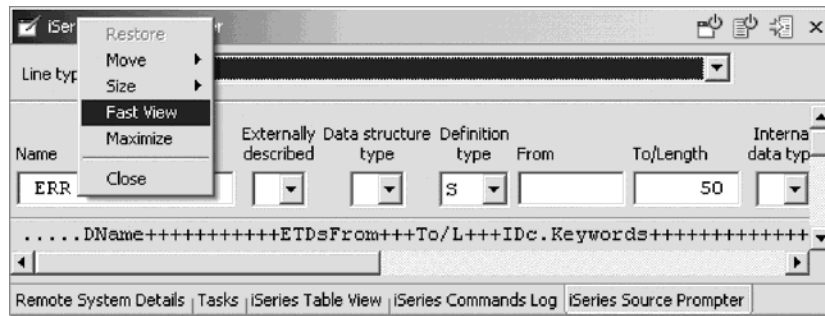
3. Click on any link to see specific help for that item.
4. Minimize the Help window.

To get to the iSeries Source Prompter from the maximized Editor window without bringing the size of the Editor window down, position the iSeries Source Prompter on the left task bar as a Fast view.

To create a fast view:

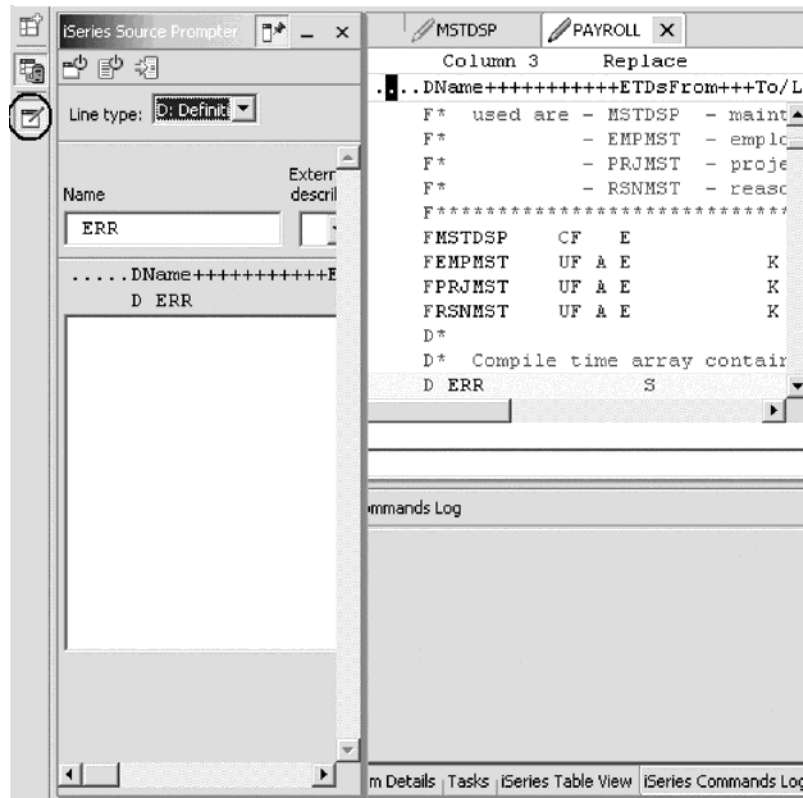
1. Right-click the iSeries Source Prompter title bar.

2. Click **Fast view** on the pop-up menu.



You will see the iSeries Source Prompter icon on the task bar on the left hand side of the workbench

3. Double-click the **PAYROLL** tab to maximize the Editor window.
4. Select a line in the Editor window and press **F4** to prompt for a line.
The iSeries Source Prompter will be placed on top of the Editor window.



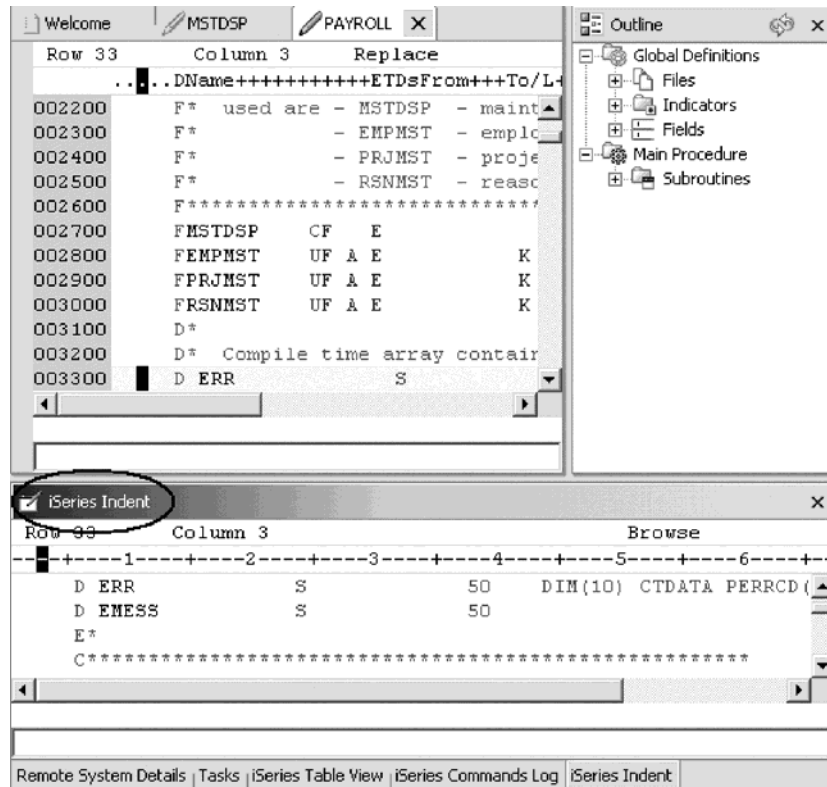
5. Click the **iSeries Source Prompter** icon on the task bar to minimize the iSeries Source Prompter.
6. Double-click the **PAYROLL** tab to return the Editor window to its original size.

Indenting RPG source

When editing ILE RPG source, it can be difficult to determine the beginning and ending of constructs. The indent option allows you to view your source with constructs in an indented mode. By default, the indent option will split the screen horizontally and show the indented view in the bottom pane.

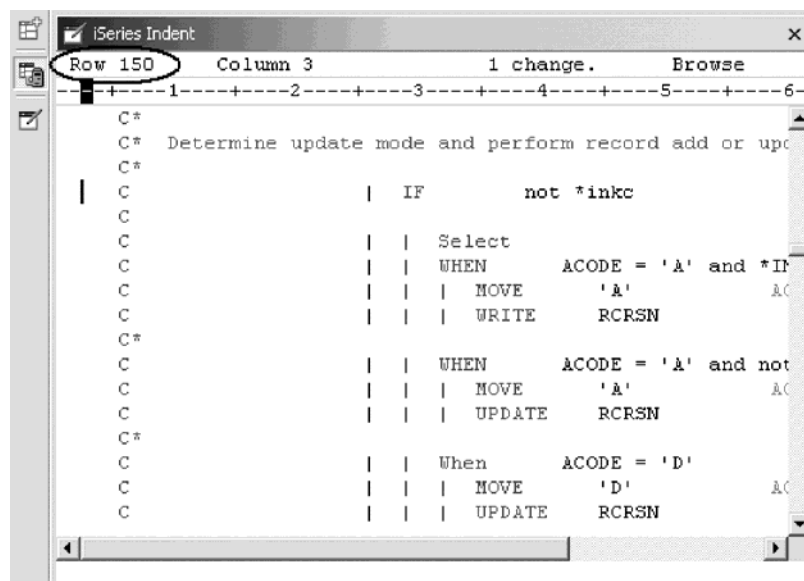
To indent source:

1. Click **Source > Show Indentation** from the workbench menu.
The iSeries Indent view opens at the bottom of the workbench.



You can display the iSeries Indent view as a full view.

2. Double-click the iSeries Indent view title bar.



3. Scroll down to line 150.

In this area you see some nested conditions with indented lines. As you will notice this helps to recognize the beginning and ending of these conditions. You can move this view as a Fast view to the left task bar as well.

Note: The Indented view is Browse mode only and cannot be edited.

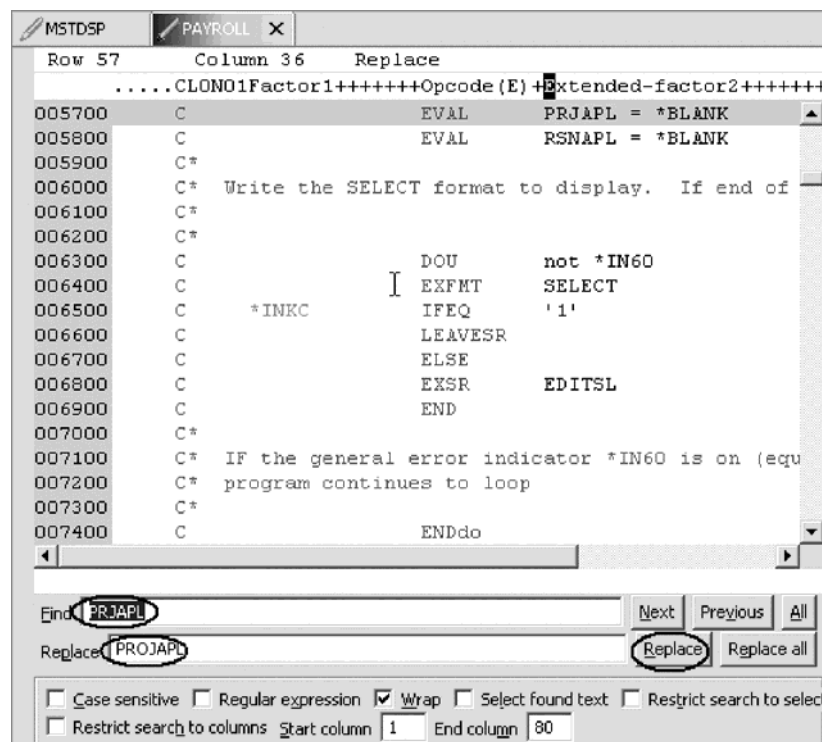
4. Click the X in the top right corner of the view to close the iSeries Indent view.
5. This returns you to the Editor window with the PAYROLL program.

Finding and replacing text

The LPEX Editor also has a powerful find and replace text feature. You use the Find and Replace window to search for an item. You can search for a word, a partial word, or a sequence of such. You can also enter a pattern you want to match, provided that the pattern follows the rules of regular expression. You can replace the found search item. If the entered text or pattern is found, the cursor moves to either the next or previous occurrence of the search item, according to your chosen search direction, and replaces the found text according to your selections.

To find and replace text:

1. Press **Ctrl+Home** to go to the top of the PAYROLL file or the PAYROLLC file.
Tip: When you press **Ctrl+Home** to get to the top or **Ctrl+End** to get to the bottom, a quick mark is set at your cursor position. This allows you to get back to that line by pressing **Alt+Q**. **Ctrl+Q** will set a quick mark.
2. Double-click the **PAYROLL** tab or **PAYROLLC** tab to maximize the Editor window.
3. Click **Edit > Find/Replace** from the workbench menu or press **Ctrl+F**.
The Find/Replace window opens at the bottom of the Editor window.



At the bottom of this window, you will notice that you have some options to select from, for example, search only in certain columns, etc. You want to find the first occurrence of PRJAPL and replace it by the word PROJAPL.

4. In the **Find** field, type PRJAPL.
5. Press the tab key to move to the **Replace** field and type PROJAPL.

The Editor moves the active line to line 57 in the RPG source or 194 in the COBOL source, which contains the first PRJAPL in the file.

6. Click **Replace** to replace PRJAPL with PROJAPL.
7. Click **Next** to go to the next location of PRJAPL in the file.
8. Click **Replace all** to replace all occurrences of PRJAPL with PROJAPL.
9. Double-click member **PAYROLL** tab or **PAYROLLC** tab in the Editor window to return the PAYROLL or PAYROLLC Editor window to its original size.
10. Close the PAYROLL or PAYROLLC window.
A window will appear asking you to save the latest changes.
11. Click **No**.
12. From the iSeries Projects Navigator, double-click PAYROLL to reload the RPG original source or PAYROLLC to reload the COBOL original source.

Filtering lines by string

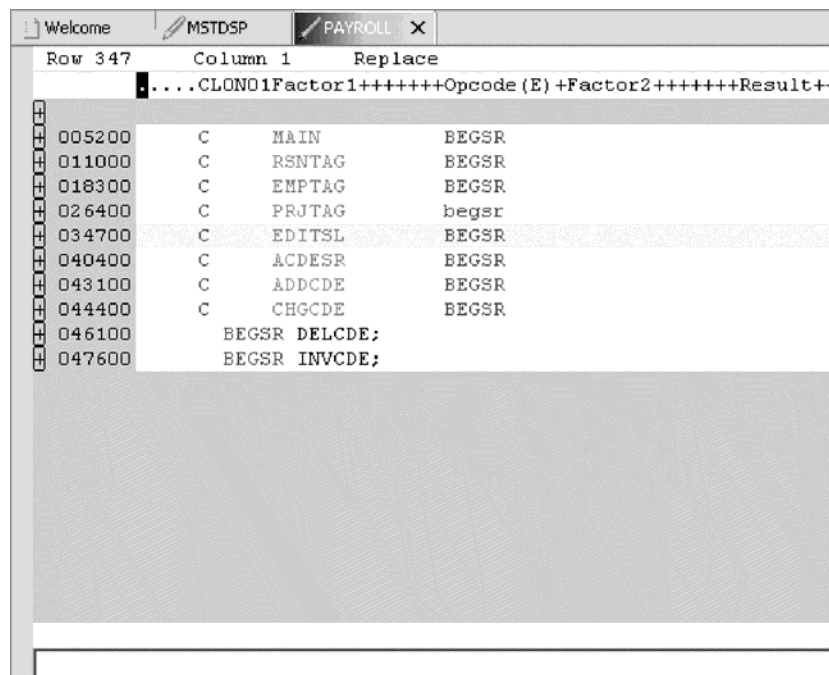
The editor allows you to filter or subset your source so that you see only lines containing a given string. Filtering lines makes it quick and easy to find lines without having to scroll through your source.

```

011000      C      RSNTAG      BEGSR
000029      * are: MSTDSP - maintenance display file
000030      *      EMPMST - employee master file
  
```

To filter source by string:

1. Double-click the BEGSR in PAYROLL or MSTDSP in PAYROLLC in the Edit window to select it.
2. Select **Edit > Selected > Filter Selection** from the workbench menu.



```

MSTDSP  PAYROLL X
Row 29   Column 14  Replace
-----+*A-1-B-+-----2-----3-----4-----5-----+
000029  * are: MSTDSP - maintenance display file
000037      SELECT MSTDSP-FILE
000038      ASSIGN          TO WORKSTATION-MSTDSP-S
000068      FD MSTDSP-FILE.
000069      01 MSTDSP-REC.
000070      COPY DDS-ALL-FORMATS OF MSTDSP.
000132      01 MSTDSP-IND-USAGE.
000154      OPEN I-O MSTDSP-FILE
000160      INITIALIZE MSTDSP-REC.
000167      CLOSE MSTDSP-FILE
000179      WRITE MSTDSP-REC FORMAT IS 'SELECT'
000183      READ MSTDSP-FILE FORMAT IS 'SELECT'
000220      INITIALIZE MSTDSP-REC
000294      WRITE MSTDSP-REC FORMAT IS 'EMPSEL'
000298      READ MSTDSP-FILE FORMAT IS 'EMPSEL'
000343      WRITE MSTDSP-REC FORMAT IS 'EMPMNT'
000347      READ MSTDSP-FILE FORMAT IS 'EMPMNT'
000394      WRITE MSTDSP-REC FORMAT IS 'PRJSEL'
000398      READ MSTDSP-FILE FORMAT IS 'PRJSEL'
000443      WRITE MSTDSP-REC FORMAT IS 'PRJMNT'
000447      READ MSTDSP-FILE FORMAT IS 'PRJMNT'
000494      WRITE MSTDSP-REC FORMAT IS 'RSNSEL'

```

3. Move the cursor down a few lines to line 347.
4. Click the plus sign beside line 347 to expand this section.

```

Welcome  MSTDSP  PAYROLL X
Row 347  Column 1  Replace
.....CLONO1Factor1+++++++Opcode(E)+Factor2+++++++Result++
005200  C    MAIN          BEGSR
011000  C    RSENTAG       BEGSR
018300  C    EMPTAG        BEGSR
026400  C    PRJTAG        begsr
034700  C    EDITSL        BEGSR
034800  C*
034900  C* Housekeeping, clear display fields and reset
035000  C*
035100  C          MOVE      *BLANKS      EMESS
035200  C          EVAL      *IN60 = *OFF
035300  C*
035400  C* The following IF AND OR combination checks the
035500  C* selection fields to ensure that only one appli
035600  C* selected.
035700  C*
035800  C    EMPAPL        IFEQ      'X'
035900  C    PRJAPL        ANDEQ      'X'
036000  C    EMPAPL        OREQ      'X'
036100  C    RSNAPL        ANDEQ      'X'
036200  C* THE BUG IS HERE

```



```

MSTDSP PAYROLLC X
Row 347 Column 1 Replace
---*A-1-B---2---3---4---5---
000160 INITIALIZE MSTDSP-REC.
000167 CLOSE MSTDSP-FILE
000179 WRITE MSTDSP-REC FORMAT IS 'SELECT'
000183 READ MSTDSP-FILE FORMAT IS 'SELECT'
000220 INITIALIZE MSTDSP-REC
000294 WRITE MSTDSP-REC FORMAT IS 'EMPSEL'
000298 READ MSTDSP-FILE FORMAT IS 'EMPSEL'
000343 WRITE MSTDSP-REC FORMAT IS 'EMPMT'
000347 READ MSTDSP-FILE FORMAT IS 'EMPMT'
000348 INDICATORS ARE IND-TABLE
000349 END-READ.
000350
000351 INITIALIZE RCEMP.
000352 MOVE CORR EMPMT-I TO RCEMP.
000353 MOVE WS-EMPNO TO EMPNO OF RCEMP.
000354 MOVE WS-ACREC TO ACREC OF RCEMP.
000355
000356 IF IND-OFF(IND-MAINT) AND IND-OFF(IND-EOJ)
000357 AND IND-OFF(IND-EMPS)
000358 EVALUATE WS-ACODE
000359 WHEN 'A'
000360 MOVE 'A' TO ACREC OF RCEMP
000361 IF WS-ACREC = 'D'

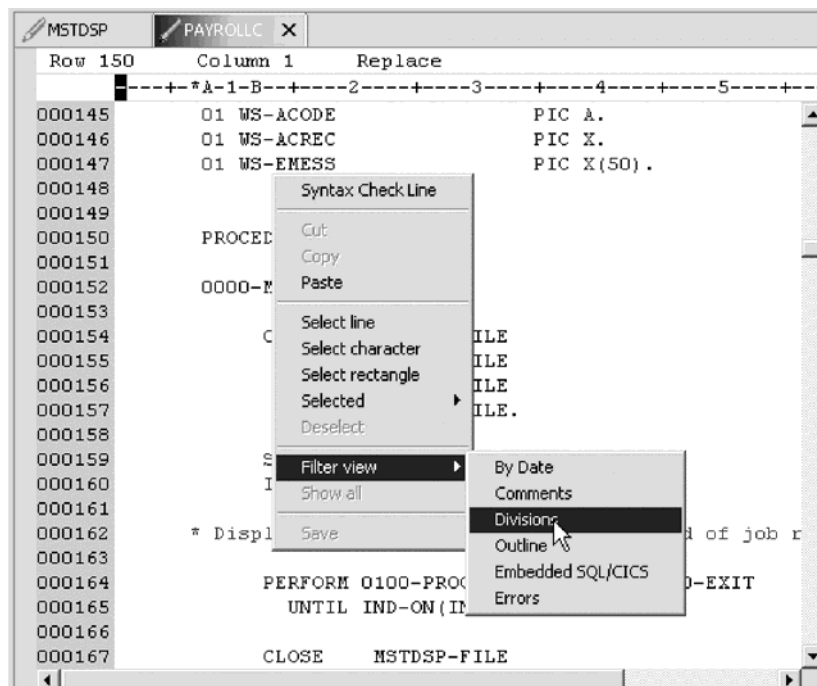
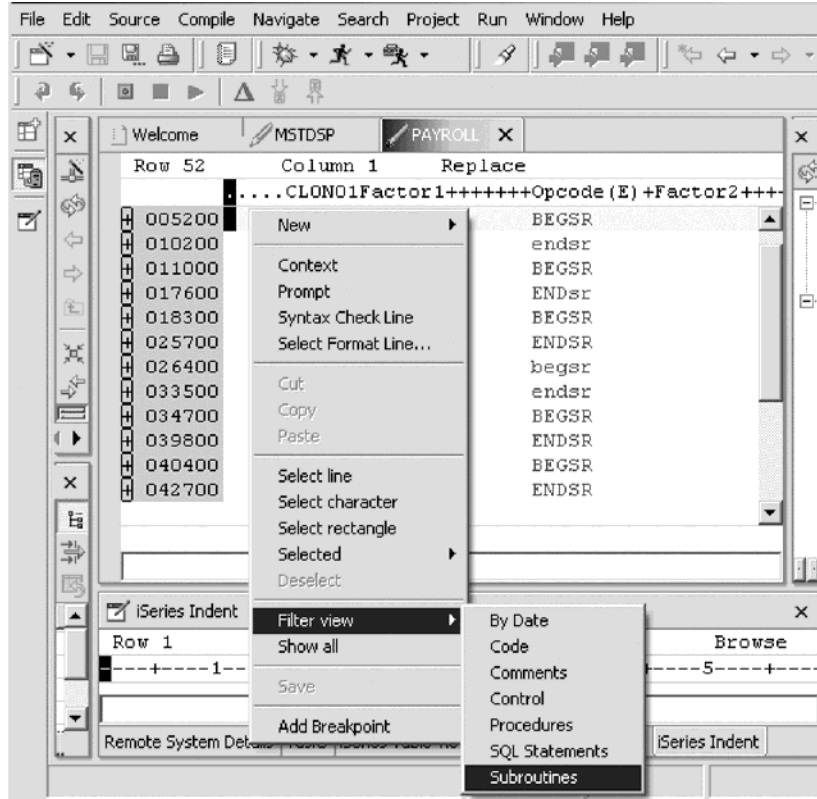
```

Now you want to show the entire source again.

5. Click **Edit > Show all** from the workbench menu or press **Ctrl+W**.
Your cursor is still positioned on the same line that you moved the cursor to, even though all lines are now showing.

Filtering lines by type

To help you navigate quickly through your ILE RPG or ILE COBOL source the Editor allows you to filter lines based on the line type. Imagine you want to see where all the subroutines are defined in your RPG source or where all the divisions are defined in your COBOL source.



To filter lines by type:

1. Right-click in the Editor window with the PAYROLL program or PAYROLLC program.
2. Click **Filter view > Subroutines** on the pop-up menu for PAYROLL or click **Filter view > Divisions** on the pop-up menu for PAYROLLC.

For PAYROLL all subroutines specifications are displayed allowing you to move quickly and easily to the area in your file where the desired subroutine is.

For PAYROLLC all divisions are displayed allowing you to move quickly and easily to the area in your file where the desired division is.

The screenshot shows the PAYROLL editor window with the following content:

```

Welcome | MSTDSP | PAYROLL X
Row 176 Column 39 Replace
.....CLON01Factor1+++++Opcode (E) +Factor2+++++
005200 C MAIN BEGSR
010200 C endsr
011000 C RSNTAG BEGSR
017600 C ENDSr
018300 C EMPTAG BEGSR
025700 C ENDSR
026400 C PRJTAG begsr
033500 C endsr
034700 C EDITSL BEGSR
039800 C ENDSR
040400 C ACDESR BEGSR
042700 C ENDSR
043100 C ADDCDE BEGSR
044000 C ENDSR
044400 C CHGCDE BEGSR
045400 C ENDSR
046100 BEGSR DELCDE;
047200 ENDSR;
047600 BEGSR INVCDE;
047900 ENDSR;
  
```

The screenshot shows the PAYROLLC editor window with the following content:

```

MSTDSP | PAYROLLC X
Row 150 Column 1 Replace
-----+*A-1-B-----2-----3-----4-----5-----+
000003 IDENTIFICATION DIVISION.
000005 PROGRAM-ID. PAYROLL.
000016 ENVIRONMENT DIVISION.
000064 DATA DIVISION.
000150 PROCEDURE DIVISION.
  
```

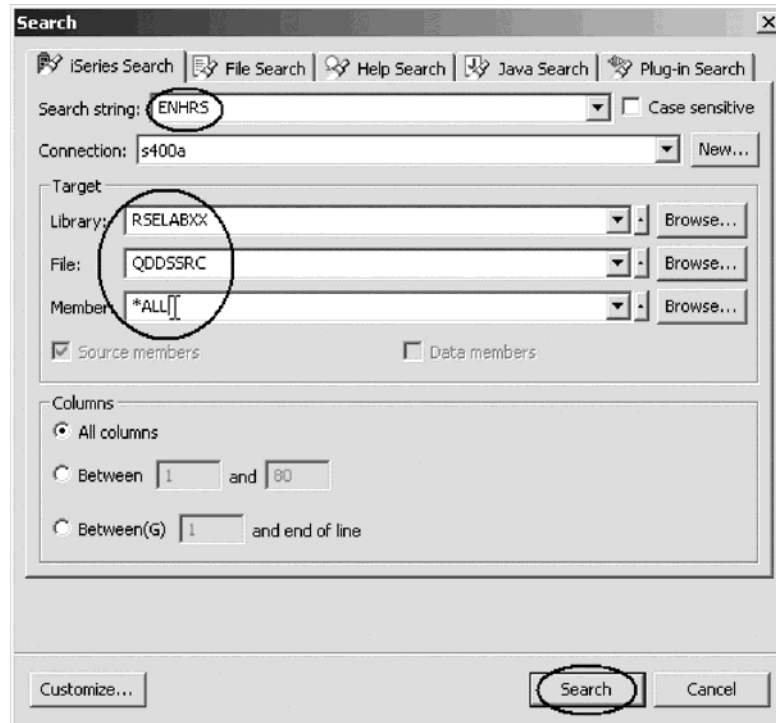
3. Move your cursor to the line with the subroutine declaration CHGCDE (line 444) in PAYROLL or the procedure division (line 150) in PAYROLLC.
4. Expand the declaration to show all lines in this subroutine or division.
Now you could work with the source inside this subroutine or division.
5. Right-click in the Editor window and click **Show All** on the pop-up menu.

Searching multiple files

If you would like to search through the members in a source physical file or through the files in a local directory, you can use the Search tool. The Multi-File Search utility allows you to search for a particular string of text in many members on the host. This function can also be used on local files.

To search multiple files:

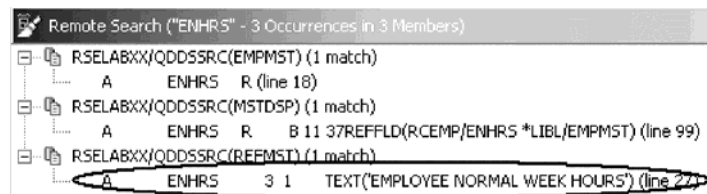
1. Click **Search > iSeries** from the workbench menu.
The Search window opens.
2. In the **Search string** field, type ENHRS.



The **Connection** field should contain your iSeries server name, otherwise enter it there.

3. Under **Target** in the **Library** field, type RSELABXX.
4. Under **Target** in the **File** field, type QDDSSRC to search all members in this source physical file.
5. Under **Target** in the **Member** field, select *ALL.
6. Click **Search**.

The Multi-File Search window lists all the lines in all the files that reference ENHRS.



7. Double-click the last line in the list.

```
A          ENHRS 3 1      TEXT('EMPLOYEE NORMAL WEEK HOURS')
```

The member REFMST is automatically loaded into the editor and the cursor is placed on the correct line.

8. Close REFMST.

Checking syntax

One of the powerful features that the LPEX Editor shares with SEU is its ability to syntax check your source. Syntax checking can be done either when the cursor leaves each line of source or all at once on either the currently selected source or on the entire file.

Now you will create a syntax error and watch for the prompt to correct it.

To syntax check the RPG file:

1. In the PAYROLL Editor window move the cursor to line 211 which contains EXSR ACDESR.

You might already be on that line but if not, type the line number in the sequence number column, or scroll down.

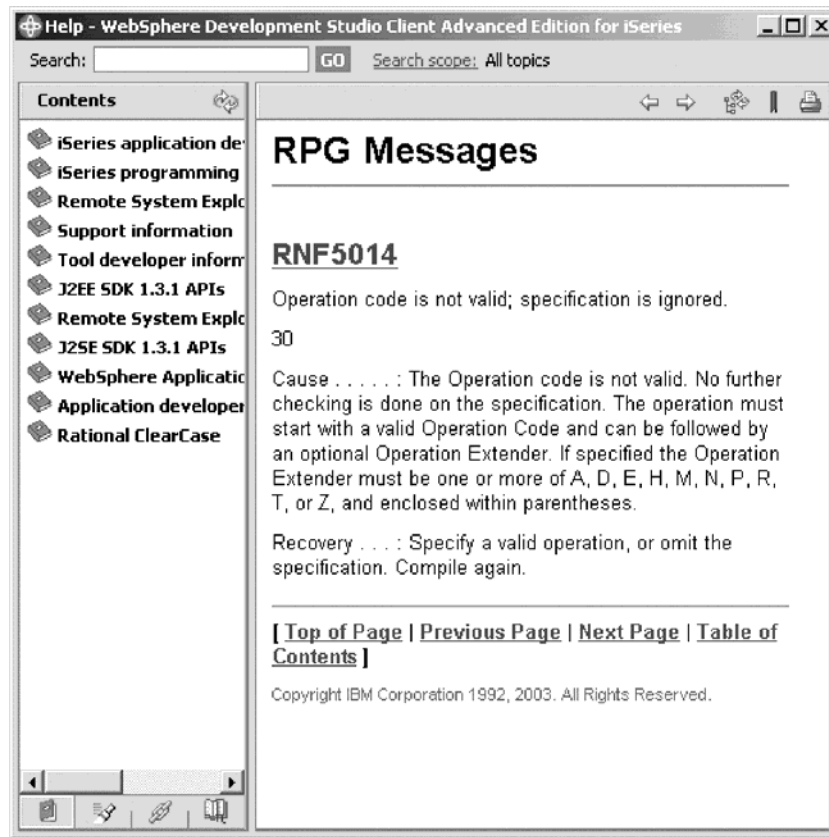
2. Append an X to the EXSR op-code to make it EXSRX.
3. Move the cursor off of the line.

An error message appears to draw attention to the error.

```
Row 211 Column 13 Replace 1 change.
.....1..+.2....3....4....5....
020300 C IF *INKD
020400 C leavesr
020500 C END
020600 C*
020700 C* Access employee master to validate action code req
020800 C*
020900 C IF NOT *INKC
021000 C EMPNO CHAIN EMPMST
021100 C EXSRX ACDESR
RNF5014E Operation code is not valid; specification is igno
021200 C ELSE
021300 C LEAVESR
```

4. Move the cursor onto the pink error message.

5. Press F1.



This opens a window with second level help for the error.

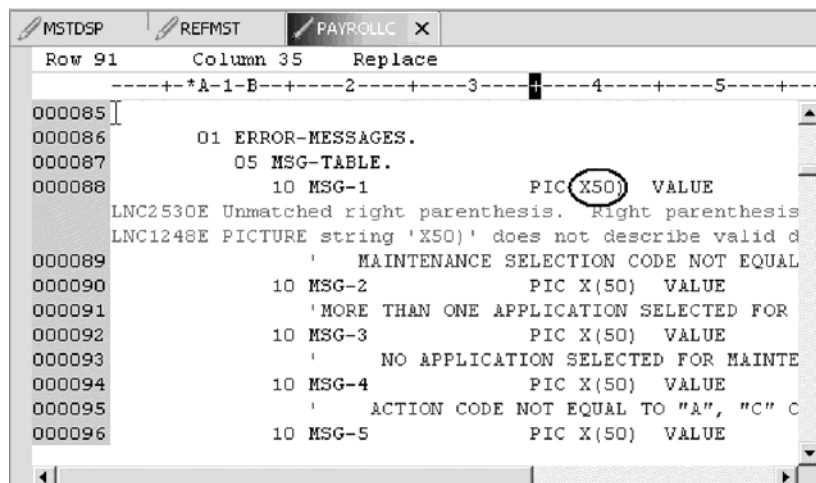
6. Minimize the Help window.
7. Change 'EXSRX' to 'EXSR' to correct the error.
8. Move the cursor off the line you just fixed.

The error message is automatically removed from the editor.

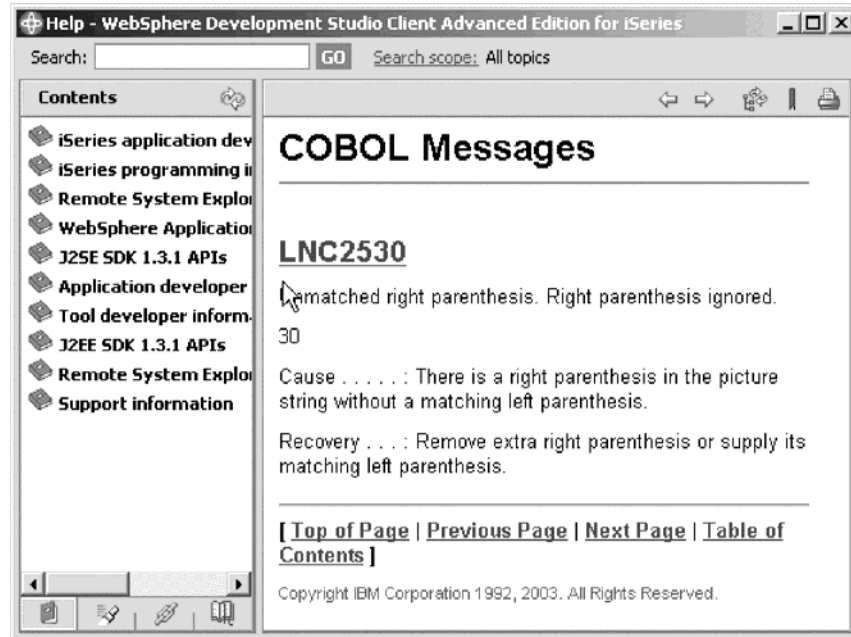
To syntax check the COBOL file:

1. Click the PAYROLLC Editor window, click **Source** and then click **Source > Syntax Check All** on the workbench menu.

Error messages appear to draw attention to the errors.



2. Move the cursor onto a pink error message.
3. Press F1.

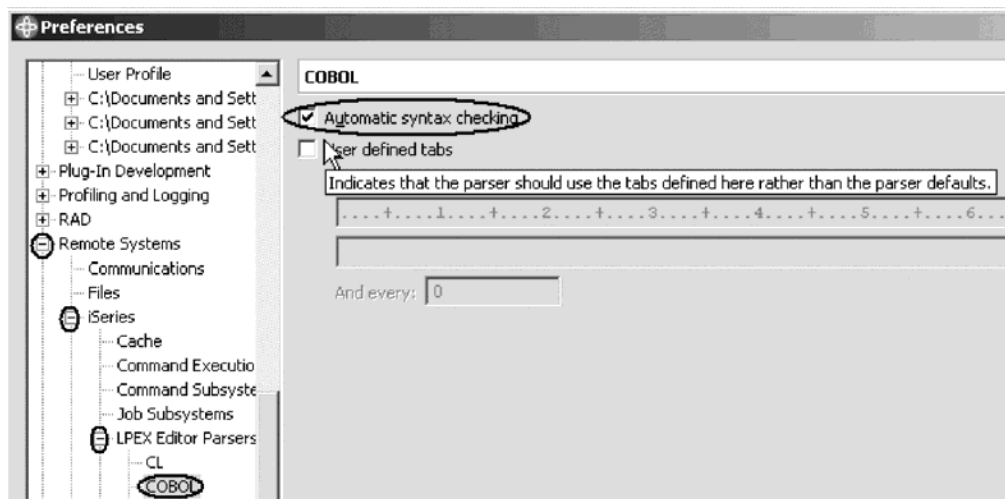
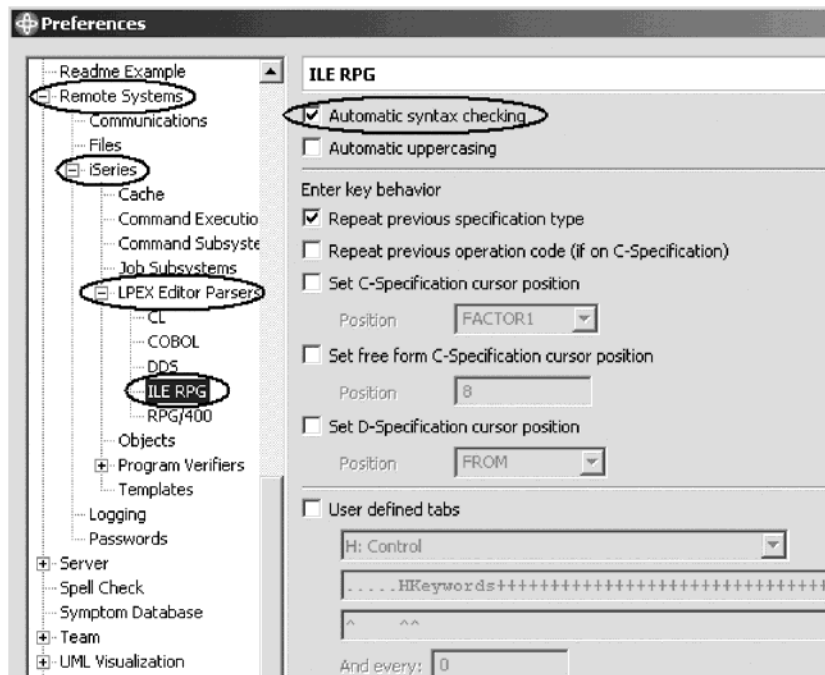


This opens a window with second level help for the error.

4. Minimize the Help window.
5. Add the required left parenthesis to correct the error.
6. Move the cursor off the line you just fixed.
The error message is automatically removed from the editor.
7. Close the file and save the changes.

Tip: You can toggle automatic syntax checking. Click **Window > Preferences** from the workbench menu and then expand Remote Systems, iSeries, LPEX Editor Parsers, ILE RPG or COBOL in the left pane of the Preferences window, select the

Automatic syntax checking check box, then click **OK**.



Checkpoint

Complete the checkpoint below to determine if you are ready to move on to the next module.

1. When column sensitive editing is selected:
 - a. Each column is considered a separate entry space
 - b. If you are inserting or deleting characters into a string that is in the Factor 2 entry, the result field entry does not move
 - c. The default editor preference is that column sensitive editing is off
 - d. All of the above
2. The LPEX Editor has predefined settings, but also has an associated preference page containing settings that you can define. (T, F)
3. LPEX Editor preferences are set in the:

- a. Preferences window
 - b. Editor window
 - c. New wizard
 - d. Remote Systems view
4. You can configure the LPEX Editor to adopt the keyboard and command personalities of many popular editors. (T, F)
5. If you want to undo a set of changes made to a file you must use the _____ operation. Name the operation.
- a. Insert
 - b. Replace
 - c. Redo
 - d. Undo
6. You can also cancel the effects of an undo operation by using the _____ operation. Name the operation.
- a. Insert
 - b. Replace
 - c. Redo
 - d. Undo
7. This help is invaluable if you cannot remember the order of fields in an RPG specification or the possible values for a variable field. Name the help. Choose the best answer.
- a. Context sensitive help
 - b. Language sensitive help
 - c. Display help
 - d. Field help
8. To receive language sensitive help, press ____ key in an Edit window. Name the key:
- a. F2
 - b. F3
 - c. F1
 - d. F4
9. If the cursor is _____ a field, you receive help for that field.
- a. Before
 - b. After
 - c. On
 - d. Off
10. Instead of entering or changing code directly in the Editor window, you can use _____.
- a. Prompts
 - b. Filters
 - c. SEU commands
 - d. Format line
 - e. All of the above
11. _____ views are hidden views, which can be quickly made visible. They work identical to normal views, the only difference being that when hidden they do not take up screen space on your workbench window.
- a. Remote Systems

- b. Navigator
 - c. Outline
 - d. Fast
12. The _____ option allows you to view your source with constructs in an indented mode. By default, the _____ option will split the screen horizontally and how show the indented view in the bottom pane.
- a. Fast view
 - b. Outdent
 - c. Indent
 - d. Edit
13. The indented view is browse mode only and cannot be edited. (T, F)
14. You use the _____ window to search for an item. Choose the best answer.
- a. Search
 - b. Find
 - c. Edit
 - d. Find and Replace
15. You can search for:
- a. A word
 - b. A partial word
 - c. A sequence of words
 - d. A pattern if it follows the rules of regular expression
 - e. All of the above
16. The LPEX Editor allows you to ____ or subset your source so that you see only lines containing a given string.
- a. Search
 - b. Find
 - c. Sort
 - d. Filter
17. To help you navigate quickly through your ILE RPG source the editor allows you to filter lines based on the _____. Choose the best answer.
- a. String
 - b. Line type
 - c. Line number
 - d. All of the above
18. If you would like to search through the members in a source physical file or through the files in a local directory, you can use the _____ tool. Choose the best answer.
- a. Compare
 - b. Search
 - c. Find
 - d. Edit
19. Syntax checking can be done either when the cursor leaves each line of source or all at once on either the currently selected source or on the entire file. (T, F)

More practice

Want more practice? Try this!

Given your experience in this exercise using the Remote Systems LPEX Editor, try these new tasks: Check out how token highlighting works in your ILE RPG source. Display a format line and use it to enter your source. Filter source by comments. Set auto-uppercase on. Use the Development Studio Client for iSeries online help to assist you in these tasks.

Recap

Congratulations! You have completed this module. You should now understand:

- The benefits of each language editing feature
- How to do column sensitive editing
- How to enter SEU commands
- How to undo and redo editing
- How to access help for language elements
- How to prompt on language elements
- How to indent source
- How to find and replace language elements
- How to filter the source by string and by line type
- How to search files
- How to compare files
- How to syntax check files

Now that you have mastered editing source, you can move on to verifying your source to ensure you have a clean compile on the iSeries system. This approach saves you iSeries cycles! Continue to the next module.

Chapter 7. Verifying source

In this module, you will learn how to verify source in the Remote Systems LPEX Editor. The program verifying and program compiling are the final steps in compiling a program or module. When errors are found by either, the iSeries Error List appears. The iSeries Error List is a powerful tool that manages errors found by verify and compile utilities in the Remote Systems LPEX Editor. You will become familiar with these tools, the various capabilities of the iSeries Error List and the program that you have created.

In order to verify source, there are several steps you will need to learn about and follow:

- Describe the purpose of the Program Verifier
- Invoke the Program Verifier
- Insert messages and checking that errors were fixed using the iSeries Error list
- Submit iSeries commands using the iSeries Table view

In order to accomplish these learning objectives, there are several steps that are involved, including:

- Invoking the Program Verifier
- Reviewing the iSeries Error List
- Fixing Errors

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 10 minutes to complete.

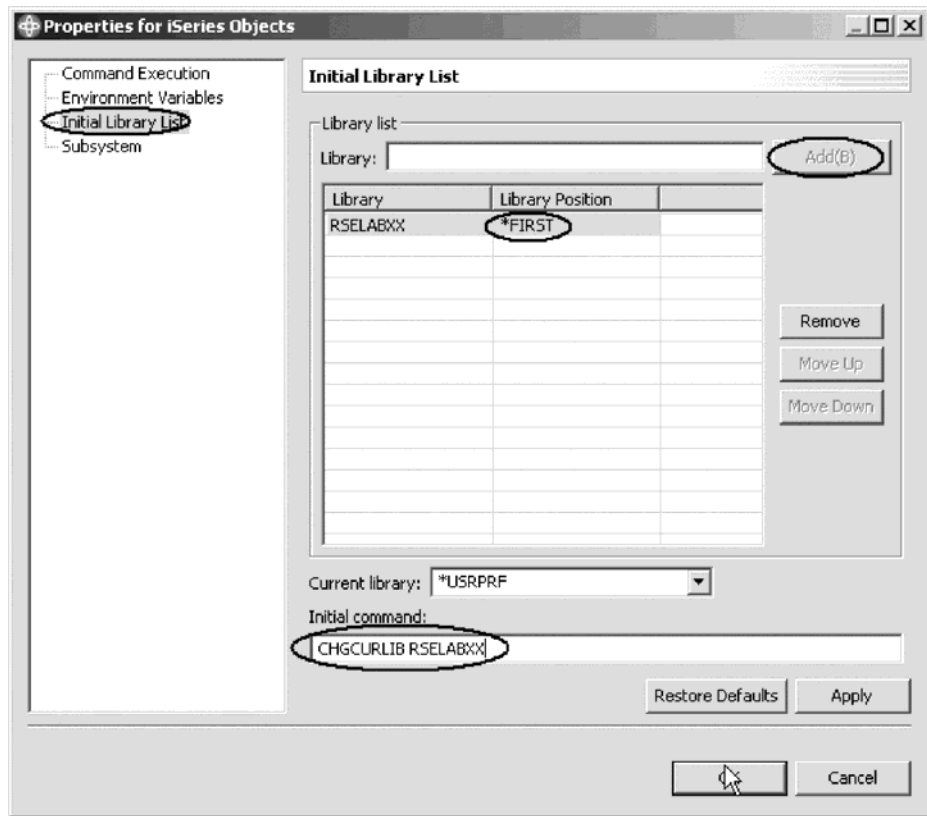
Verifying RPG or COBOL source

Now you get to play with one of the most powerful and unique features of the Development Studio Client — the Program Verifier.

Before you compile your code on an iSeries, you can make certain that there are no errors by invoking the Program Verifier. The verifier checks for semantic (compile) errors on your workstation so that you can guarantee a clean compile on the iSeries. Think of the host cycles you'll save. It is especially handy when you are writing code but you are disconnected from an iSeries. You can do this because Development Studio Client ported the parsing and checking code from the iSeries system compilers to the workstation. The iSeries Error List window lists the errors that are found and their severity, inserts the error messages directly into the source and helps you to navigate between the errors.

Note: Make sure that your user ID has been setup, so that your library has been added to the library list automatically. You can use the properties for iSeries Objects dialog to set connection information such as adding a library to a library list and changing the current library. From the Remote Systems view, you can right-click on iSeries Objects then click Properties to see this dialog.

You will need this setup to run jobs interactively from your workstation.



To invoke the verifier:

1. Click the **PAYROLL** tab to verify RPG source or **PAYROLLC2** tab (you will need to open the PAYROLLC2 file for edit first) to verify COBOL source.
2. Click **Source > Verify** from the workbench menu.

After a moment the verifier will display an iSeries Error List below the Editor window.

ID	Message	S...	L...	Location	Connection
RNF...	ENDSR operation is missin...	3...	1	RSELABXX/QRPG...	s400a
RNF...	The name or indicator EME...	3...	3...	RSELABXX/QRPG...	s400a
RNF...	The name or indicator RSN...	3...	9...	RSELABXX/QRPG...	s400a
RNF...	The operand RSNTAX of E...	3...	9...	RSELABXX/QRPG...	s400a
RNF...	Factor 2 must be '0' or '1' ...	3...	3...	RSELABXX/QRPG...	s400a
RNF...	Move operands ERR and E...	3...	3...	RSELABXX/QRPG...	s400a
RNF...	RPG provides Separate-In...	0	2...	RSELABXX/QRPG...	s400a

ID	Message	S...	Line	Location	Connection
LNC1904	Program PAYROLL syntax checked. Errors ...		40	1	RSELABXX/QCBLL... s400a
LNC1463	'EMPNO' is not unique in this context. Use ...		30	302	RSELABXX/QCBLL... s400a
LNC1326	'PRCD OF PRJSEL-I' not defined name. Sta...		30	402	RSELABXX/QCBLL... s400a
LNC1329	Subscript value '14' exceeds maximum occ...		30	606	RSELABXX/QCBLL... s400a
LNC0407	AT END phrase missing from sequential RE...		20	184	RSELABXX/QCBLL... s400a
LNC0407	AT END phrase missing from sequential RE...		20	299	RSELABXX/QCBLL... s400a
LNC0407	AT END phrase missing from sequential RE...		20	348	RSELABXX/QCBLL... s400a
LNC0407	AT END phrase missing from sequential RE...		20	399	RSELABXX/QCBLL... s400a
LNC0407	AT END phrase missing from sequential RE...		20	448	RSELABXX/QCBLL... s400a
LNC0407	AT END phrase missing from sequential RE...		20	499	RSELABXX/QCBLL... s400a
LNC0407	AT END phrase missing from sequential RE...		20	548	RSELABXX/QCBLL... s400a

The error list shows you:

- The error message itself
- The severity
- The line number
- The source location
- The connection name

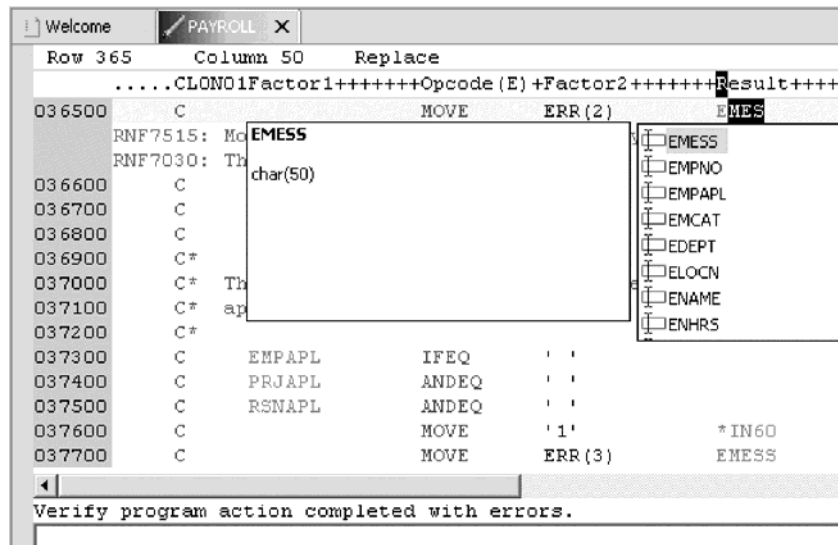
Fixing RPG errors

Next you fix the errors in your source.

To fix an error in your source go the error list:

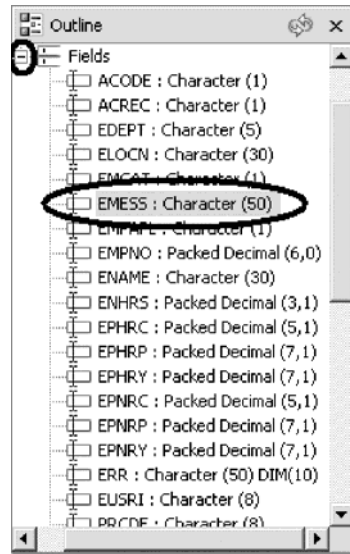
1. Double-click the error RNF7030.

You are automatically brought back into the Editor window to the line where the error occurred. The error on line 365 is a typo. The variable EMES is really EMESS. One good way of finding the correct name is the content assist.



2. Refresh the Outline view.
3. Select the misspelled variable and press **CRTL+spacebar**.
If the variable starts correctly the selection presented contains the correct name.
4. Double-click the variable EMESS in the list to correct the variable name.

Another way to find the variable name is to use the Outline view and see what variables are declared.



The next error is a RNF7030 as well.

5. Double-click RNF7030. Fix it in the editor.
6. RSNTAX should really be RSNTAG.

Make the appropriate change.

7. Go to the next error RNF5184.

The next error is actually RNF7018 but it is related to the first one and can be ignored. It shows the same line number, which is an indication that both errors are related.

8. Double-click RNF5184.

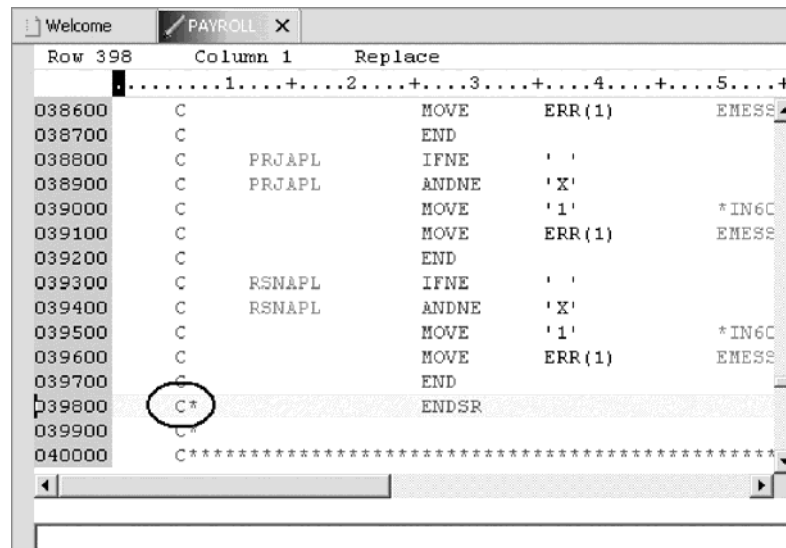
Certainly somebody didn't know their RPG and tried to assign a value 2 to an indicator.

9. Fix this by replacing the 2 with a 1.

Error RNF7515 is related to the first error you fixed. It has the same line number. You can ignore it. The only serious remaining error is RNF5178. This error is caused by a missing ENDSR.

Note: The verifier could not determine where the ENDSR is missing so the line number reported is 1, for this reason you can't just double click on the error message. You need to investigate where the missing statement belongs.

- Move to line 398 in the editor.



- Remove the asterisk (*) from the C-spec.
You can use the Tab key to quickly move to the appropriate column.
All the non-informational errors are now fixed. You can filter out different severities by using the filter menu.



- Click the arrow in the iSeries Error List title bar.
- Click **Show Severity** on the pop-up menu.
- Clear the severities you don't want to see in the list (Warning for example).

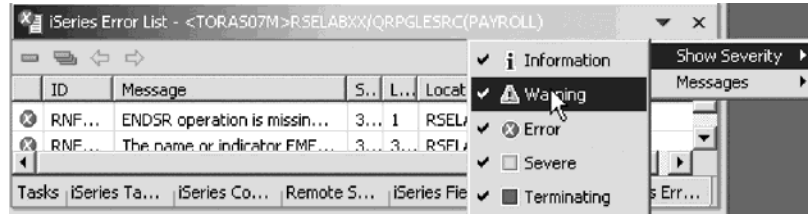
Fixing COBOL errors

Next you fix the errors in your source.

To fix an error in your source go the error list:

- Double-click the error LNC1463.
You are automatically brought back into the Editor window to the line where the error occurred. The error is caused by EMPNO not being uniquely defined. Go to line 302 where EMPNO is defined. The variable EMPNO should be EMPNO OF EMPSEL-I.
- Make the change.
The next error is LNC1326.
- Double-click LNC1326. Fix it in the editor.
- PRCD should really be PRCDE.
Make the appropriate change on line 402.
- Double-click LNC1329.
This error is because the array was declared with 4 elements. Go to line 606.

- Change the index of the array from 14 to 4.
The next errors are LNC0407. You can ignore these errors as they are severity 20.
All the severity 30 errors and above are now fixed. You can filter out different severities by using the filter menu.



- Click the arrow in the iSeries Error List title bar.
- Click **Show Severity** on the pop-up menu.
- Clear the severities you don't want to see in the list (Warning for example).

Saving the source and verifying source again

Now before you loose any of your changes, it's a good idea to save them. Make sure the PAYROLL member is selected. You then verify the source again to make sure that all the errors are fixed.

You can save the member using one of these ways:

- Click **File > Save** from the workbench menu.
- Click the Save icon in the workbench toolbar.
- Press **Ctrl+S**.
- Verify your source again; **Source > Verify**.

The screenshot shows the 'iSeries Error List' window for source '<TORA507M>RSELABXX/QRPGLESRC(PAYROLL)'. The table displays several error messages, all with a severity of 0. The messages are related to 'RPG provides Separate-Indicat...' and 'The name or indicator *IN03 is ...'.

ID	Message	Sev...	Line	Location
RNF7089	RPG provides Separate-Indicat...	0	27	RSELABXX/QRPGL...
RNF7031	The name or indicator *IN03 is ...	0	1	RSELABXX/QRPGL...
RNF7031	The name or indicator *IN04 is ...	0	1	RSELABXX/QRPGL...
RNF7031	The name or indicator *IN05 is ...	0	1	RSELABXX/QRPGL...
RNF7031	The name or indicator *IN06 is ...	0	1	RSELABXX/QRPGL...
RNF7031	The name or indicator *IN07 is ...	0	1	RSELABXX/QRPGL...

The screenshot shows the 'iSeries Error List' window for source '<TORA507M>RSELABXX/QCBLLSRC(PAYROLLC2)'. The table displays several 'LNC0407' error messages, all with a severity of 20. The messages are 'AT END phrase missing from sequential RE...'. The table includes an additional 'Connection' column.

ID	Message	S...	Line	Location	Connection
LNC0407	AT END phrase missing from sequential RE...	20	184	RSELABXX/QCBLL...	s400a
LNC0407	AT END phrase missing from sequential RE...	20	299	RSELABXX/QCBLL...	s400a
LNC0407	AT END phrase missing from sequential RE...	20	348	RSELABXX/QCBLL...	s400a
LNC0407	AT END phrase missing from sequential RE...	20	399	RSELABXX/QCBLL...	s400a
LNC0407	AT END phrase missing from sequential RE...	20	448	RSELABXX/QCBLL...	s400a
LNC0407	AT END phrase missing from sequential RE...	20	499	RSELABXX/QCBLL...	s400a
LNC0407	AT END phrase missing from sequential RE...	20	548	RSELABXX/QCBLL...	s400a

Everything should be ok. You are ready to compile the program.

Checkpoint

Complete the checkpoint below to determine if you are ready to move on to the next module.

1. The _____ tool checks for semantic (compile) errors on your workstation so that you can guarantee a clean compile on the iSeries.
 - a. Compile
 - b. LPEX Editor
 - c. Program Generator
 - d. Program Verifier
2. The _____ view identifies each error with an icon that identifies the severity level of the error, the ID of the error, the message, the severity, the line in the source member that caused the error, the location of the source member that produced the error, and the connection name.
 - a. Remote Systems
 - b. Outline
 - c. Navigator
 - d. iSeries Error List
3. You can sort the entries in the iSeries Error List view by:
 - a. ID
 - b. Message
 - c. Severity
 - d. Line
 - e. Location
 - f. Connection
 - g. All of the above
4. If you used the local program verifier, then your host compiles should be successful; no wasted iSeries cycles. (T, F)

More practice

Want more practice? Try this!

Given your experience in this exercise using the Program Verifier and that you have your own source on your own iSeries system try these new tasks: Check out Verify again on your source files. Assuming you receive errors in your source (add some errors into your source if you don't have any) when you verify your source, choose insert all error messages into the editor from the Error list. Use the Development Studio Client for iSeries online help to assist you in these tasks.

Recap

Congratulations! You have completed this module. You should now understand:

- The purpose of the Program Verifier
- The purpose of the iSeries Error List
- How to invoke the Program Verifier
- How to view and fix errors using the iSeries Error list
- How to save the fixed source

Now that you know how to verify source, you can move on to compiling the source. Continue to the next module.

Chapter 8. Building the iSeries Project

So now that the code has been edited locally and verified against any syntax errors, you are ready to perform a build (or compile) on the source members under a given iSeries project.

Associated with each iSeries project is a Build Style which basically determines how source members under that project will be pushed and compiled on the host. A build style is a set of actions that provide push and build operations for a given iSeries Project.

In this module, you will learn how to select a build style, compile a single file or compile an entire iSeries Project. You will also learn how to update files on your local machine and on the server automatically.

In order to build the iSeries Project, there are several steps you will need to learn about and follow:

- Describe the build styles
- Select the build style
- Compile a single file
- Compile an iSeries Project

In order to accomplish these learning objectives, there are several steps that are involved, including:

- Selecting the build style
- Submitting a build
- Running the program

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 10 minutes to complete.

Selecting the build style

There are three IBM-supplied build styles:

***NONE**

This build style contributes no actions and is useful if you want to disable the menu items associated with a build style. This style will always be available.

Command

This build style runs a single command in batch to compile all the members of the project. The command can be configured through the build style's configuration page. This build style contributes the following three actions to the Remote Actions menu found in the iSeries Projects Navigator view:

- **Push Changes** — Pushes any new or changed resources found in the selected project. An item is changed if it has been updated locally since the last time it was pushed, either by Push Selected or Push Changes.

The first time it is done, all resources are uploaded to the associated library. Each subsequent upload is incremental.

- **Push Selected** — This action uploads all selected resources and their children to their corresponding iSeries source files and members in the associated library. It creates any resources that do not exist. It will overwrite any changes that have been made on the host system only if confirmed by the user. Use this action to force the contents of the associated library to match the workspace.

Submit Build Command

Submits the command found in this build style configuration to the host.

CL Program

This build style uploads the COMPILE.CLLE and BIND.CLLE members from the source file that you designated in the build style configuration for this project. It then compiles and runs them to build this project on the host system. This build style contributes the following actions to the Remote Actions menu:

- **Push Changes and Push Selected** — These two actions are identical in behavior to the above build style.
- **Submit Build** — Submits a job to compile and run the iSeries Project on the host using the COMPILE and BIND programs from the source file you specify.

Each iSeries Project can have only one active build style. This can be configured through the properties page for that project (right click on the iSeries project and select Properties).

By default, when a new iSeries project is created it has the CL Program build style associated with it. This can be changed by going to Window > Preferences > iSeries Projects > iSeries Build Styles.

Once submitted, a build can be monitored through the iSeries Build Status View. This view can be set to update at regular intervals and monitors all iSeries Project build jobs that you have submitted. Also compile errors can be retrieved from that view by right clicking on the submitted build and selecting the Retrieve Errors action.

Submitting a build

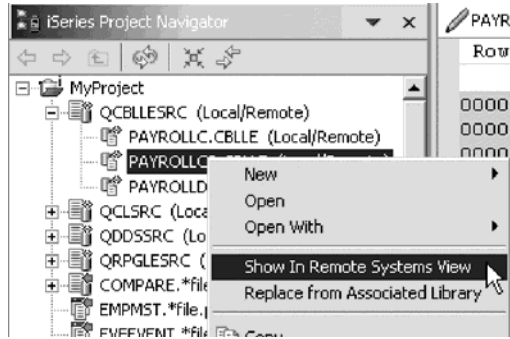
There are two ways by which you can compile your code changes. You can do a single member compile on an individual member basis. Or you can compile the full project. Compiling the full project depends on the Build Style associated with the project.

Note: Choose to do a single member compile or a full project build but not both.

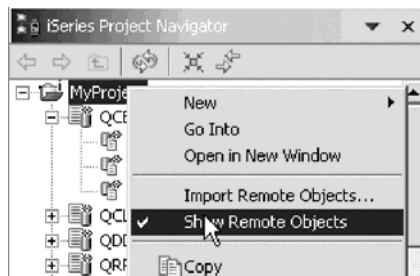
Submitting a single member compile

To do a single member compile:

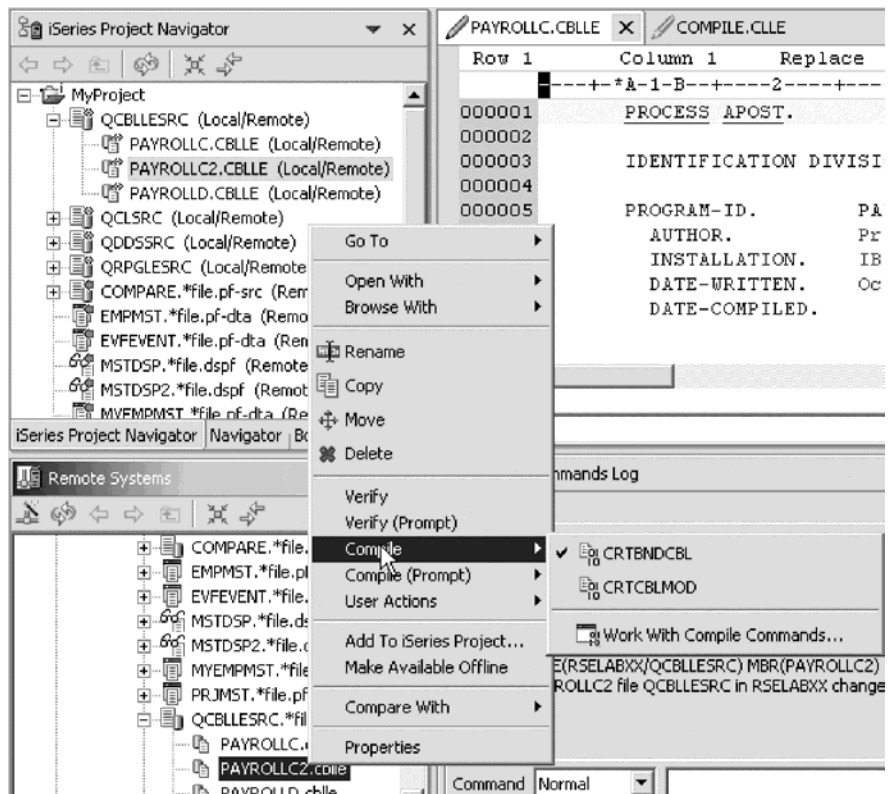
1. Push the member to the host: in the iSeries Project Navigator, right-click on the member and click **Remote Actions > Push Selected** on the pop-up menu.
2. Right-click on the member and select **Show in Remote Systems View**.

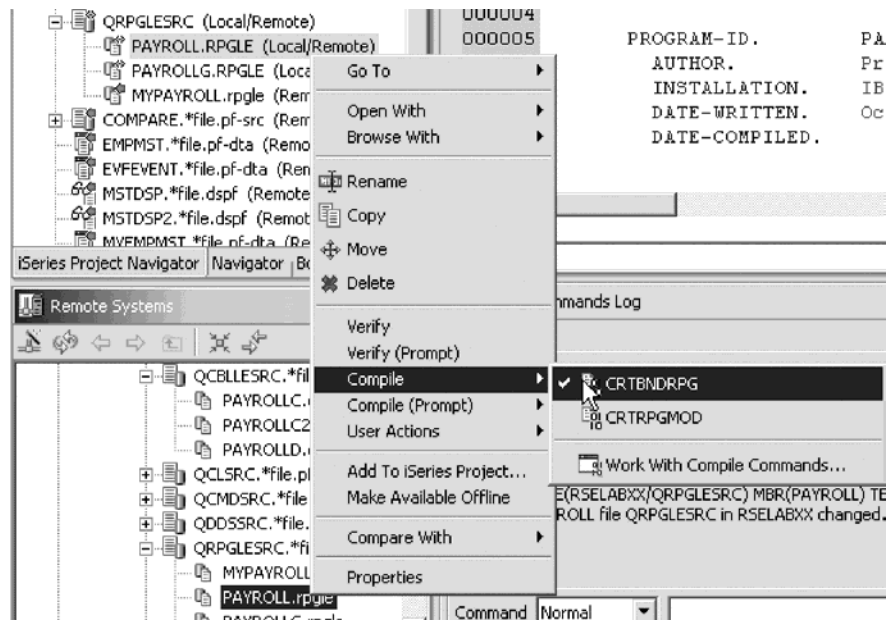


The Show in Remote Systems View menu option is enabled only if you have already selected to show remote objects for the iSeries Project.



3. In the Remote Systems view, right-click the selected member and select **Compile** to compile your member. .





This will compile your member and any errors will appear in the iSeries Error List.

Make sure you refresh your view to see the generated objects.

Tip: When you connect the host using a Remote System Explorer connection, the Library List is gathered from your profile at the host. You can override this and modify the library list of a specific connection. Right-click the connection in the Remote Systems view and click **Properties > Subsystems > iSeries Commands**.

Submitting a full project build

You can compile the project in full. The actual compile behavior depends on the Build Style associated with the project. The default build style for iSeries Projects is the CL Program Build Style.

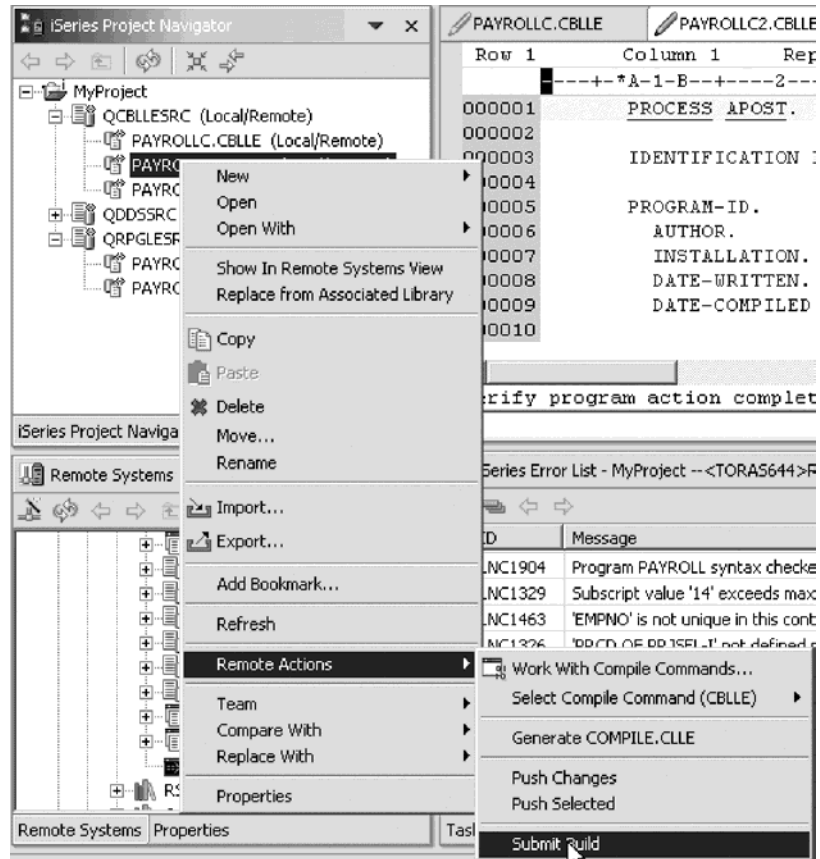
This build style will generate a COMPILE.CLLE member in a QCLSRC file that will contain a compile entry for each source member in the iSeries project.

You can verify or change the configuration of a build style. You can specify the name of the source file to hold the COMPILE.CLLE member and whether or not you want to automatically push changes and re-generate the COMPILE.CLLE member before a push.

For this exercise, all you have to do is simply submit the build.

To compile a project in full:

1. Right-click any object in the iSeries Project and click **Remote Actions > Submit Build**.



This action, with the default configuration, will perform all of the following:

- a. Generate the following COMPILE.CLLE member:

```

PAYROLLC.CBLLE  COMPILE.CLLE
Row 1          Column 1          Replace
-----+-----+-----+-----+
000100 PGM
000200 DCL  &FAILED TYPE(*DEC) LEN(10 0) VALUE(0)
000300 DCL  &FAILEDSTR TYPE(*CHAR) LEN(10)
000400
000500 CHGPF SRCFILE(RSELABXX/QDDSSRC) SRCMBR(EM
000600 MPMST)
000700 MONMSG MSGID(CPF0000) EXEC(DO)
000800  CHGVAR VAR(&FAILED) VALUE(&FAILED + 1)
000900 ENDDO
001000

```

- b. Display a Build Job entry in the iSeries Build Job Status View indicating that a build has been submitted. The entry will look like this:

Date/Time Submitted	Job	Project	Status
Feb 24, 2004 1:37:52 PM	154943/RICHIEYU/RICHI...	MyProject	Queued

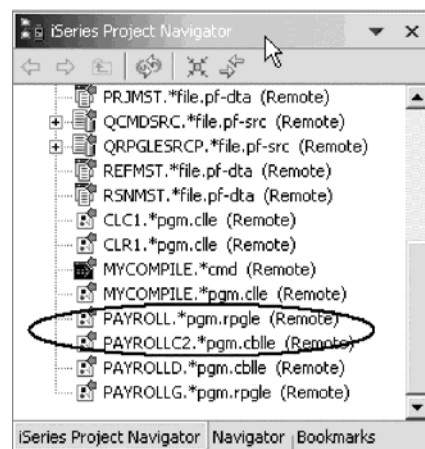
Refresh Interval: Never

Tasks | iSeries Commands Log | iSeries Build Job Status | iSeries Error List

- c. Push all project changes to the host, including the newly created COMPILE.CLLE member.
- d. Compile COMPILE.CLLE into a program in the QTEMP library.
- e. Run it against the source in the RSELABxx library.

This will generate the program.

You can refresh your library view and now you should see an RPG program object or a COBOL program object:



2. If there were any errors during the submitted build, after the job completes, refresh the iSeries Build Job Status View, then right-click on the entry in the iSeries Build Job Status View, and select Retrieve Errors.

This will open the iSeries Error list and you will be able to double-click the error to open the corresponding member.

Running the PAYROLL or PAYROLLC2 program

Communication between the iSeries and your workstation can be configured for:

1. The Remote System Explorer server job, the one that you are using currently.
2. A batch job.
3. An interactive job to test 5250 applications.

You will need an interactive communication link to the iSeries server and therefore you will need a 5250 emulator to start the interactive job on the iSeries. The communication link will be established through the emulation session by using an OS/400 command to initiate the session to your workstation.

To set up an interactive connection:

1. Start a 5250-emulation session.
2. Sign-on to the iSeries with a User ID and Password.

Note: Instead of the **Enter** key, you may have to use the **Ctrl** key in your 5250-emulation session.

3. Type STRRSESVR NAME (s400a) RMTLOCNAME(*RESOLVE) in the command line.

```
Selection or command  
==> STRRSESVR NAME (s400a) RMTLOCNAME (*RESOLVE)
```

The *RESOLVE keyword will get the IP address of your workstation and with this information the Remote System Explorer server will communicate with the Remote System Explorer daemon that runs on your workstation.

You should see a screen as shown:

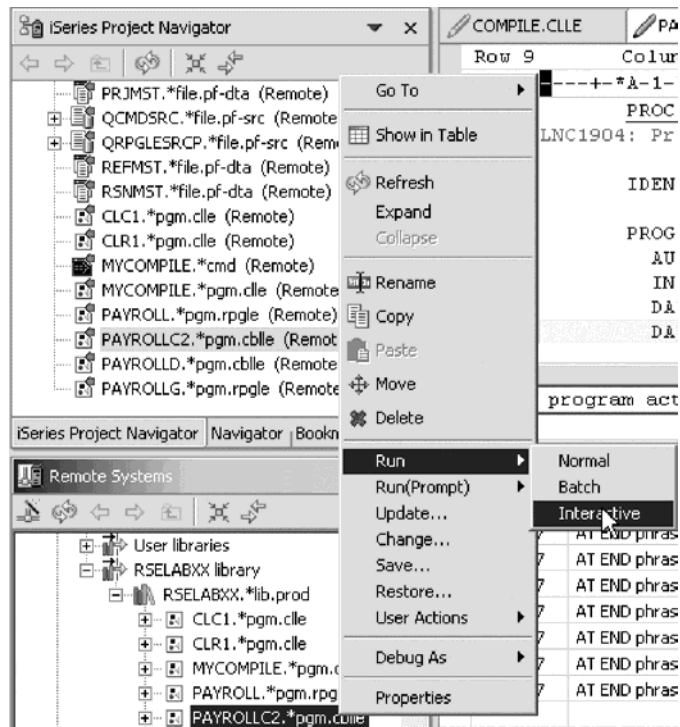
```
IBM RSE Communications Server  
  
Connection Name: s400a  
  
(c) Copyright IBM corp., 2001, 2003. All rights reserved.
```

Note: This screen will stay this way. Don't wait for it to finish, this session is the interactive session for interactive commands started from the Remote Systems view.

Next you will run the program that you just compiled earlier.

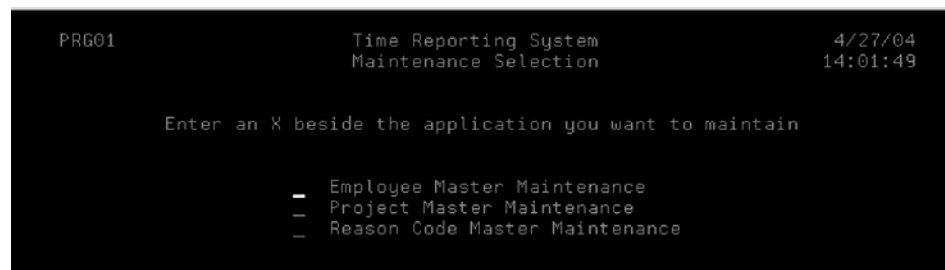
Select the program object in the iSeries Projects Navigator, right-click to see the pop-up menu and then click **Show in Remote Systems View**.

In the Remote Systems view, in the RSELABxx library:



1. Locate the PAYROLL program or PAYROLLC2 program that you created.
2. Right-click the PAYROLL program icon or PAYROLLC2 program icon in the Remote Systems view.
3. Click **Run > Interactive** on the pop-up menu.
4. Switch to your 5250-emulation session.

You will see the Start Menu of the payroll program.



5. Place an x beside Employee Master Maintenance.
6. Press the **Enter** key.
7. Type 456 for the Employee Number.
8. Type A for the Action Code to add employee 456.
9. Press the **Enter** key.
10. Type any information you like about the employee.
11. Press the **Enter** key.
12. Play in the application as much as you like.
13. Press **F3** to end the program.

Recap

Congratulations! You have completed this module. You should now understand:

- The concept of build styles
- How to select a build style
- The difference between a single member build and a full project build
- How to submit a build
- How to run an interactive application

Now that you have built your iSeries project, you can move on to designing screens. Continue to the next module.

Chapter 9. Designing screens

In this module, you will become familiar with the various aspects of the CODE Designer while modifying a display file to add a screen. You will step through each part of the CODE Designer tool interface and update some DDS as well. In the workbench, in the Remote System Explorer perspective you will use the connection that you used in the module before.

In order to design screens, there are several steps you will need to learn about and follow:

- Describe the features of the CODE Designer
- Start the CODE Designer
- Open, modify and save a display file
- Add a group
- Add a record
- Add, delete and modify various DDS fields
- Verify DDS
- Compile DDS

In order to accomplish these learning objectives, there are several steps that are involved, including:

- Opening a DDS member
- Viewing the DDS tree
- Selecting the DDS object
- Designing your DDS screen
- Creating groups from existing records
- Creating new screens
- Adding fields to the subfile record
- Switching between multiple records
- Adding field error handling
- Accessing field properties
- Adding new keywords
- Verifying your source changes
- Switching between design and editing your screen
- Compiling your source changes and closing CODE Designer

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 30 minutes to complete.

Opening a DDS member

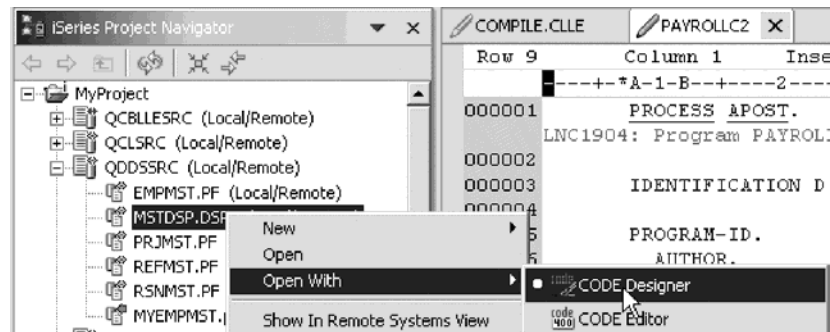
Using an editor to create and maintain DDS source for your display and printer files can be a frustrating and difficult task. What would be great is a graphical design tool that let's you design your screens and reports visually and then generate the DDS source for you. Well, that's exactly what CODE Designer does for you.

CODE Designer helps the novice DDS programmer create screens, reports and databases quickly and easily without worrying about the details of the DDS language, while at the same time letting the expert DDS programmer get access to all the features and power of the language.

Note: Make sure MSTDSP is closed from a previous LPEX Editor exercise.

To open a DDS file member:

1. In the iSeries Project Navigator, expand QDDSSRC.



2. Right-click MSTDSP member.
3. Click **Open With > CODE Designer** on the pop-up menu.

Viewing the DDS tree

What you are looking at now is basically an explorer view of the DDS. The DDS Tree view on the left-hand side of the Designer displays the DDS source in its file, record, field, and keyword hierarchy. It is a familiar and intuitive way to see the overall structure of the DDS source and to navigate through it quickly. Don't worry if you're not a DDS expert, we will explain everything you need to know.

The DDS Tree is located on the left-hand side of the CODE Designer window. This view presents the loaded DDS source as a tree structure, showing the hierarchy of files, records, fields, help specifications, keys, and keywords in each selected DDS object. The DDS Tree shows groups of records, which represent the screens or reports you are designing, as peers of the file in the tree hierarchy.

In this view, you can create groups, and copy or move keys, keywords, fields, and records. If any DDS object contains an error, the icon representing it displays a red X.

To open selection in the DDS tree to see file-level keywords and the record SELECT:

1. Expand the local folder.
2. Expand the File Keywords folder.
3. Expand the SELECT record.

4. Expand the Record Keywords folder.
5. Expand the EMESS field.

The DDS tree now shows you a summary of the file-level keywords and of the record SELECT.

Selecting the DDS object

In the upper right-hand side of the Designer is the Workbook with several different tabbed pages. The Workbook is the area of the CODE Designer where you design display files or printer files. You can view this notebook on the top right-hand side of the CODE Designer window. The top page is called Details and it provides a detailed view of the DDS objects selected by the DDS Tree. You can view this page in either details mode or list mode by selecting View > List.

In details mode, columns display information about each DDS object. You can use this mode if you want to know more about each DDS object (record, help specification, field, keyword, or keys).

In list mode, the DDS objects appear as columns of named icons. You can use this mode if you want to see more DDS objects within the page.

In the bottom right-hand side of the Designer is the Utility notebook. It lets you view specific elements of the DDS source such as errors and selected objects. The notebook contains several views: Selected DDS page, Error List page, Create keywords page, and Comments page. The Selected DDS page in the notebook shows the actual DDS source for the currently selected item.

To work with the DDS record SELECT:

1. In the DDS tree click the SELECT record.

The Details page lists all the fields in the record SELECT and summarizes some of their properties. The Selected DDS page shows the DDS for the SELECT record.

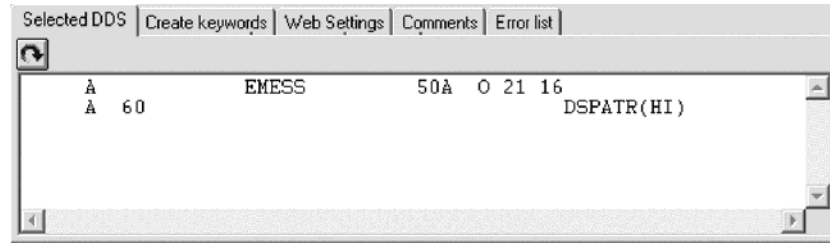
Record SELECT fields						
Field	Positi..	Len...	Type	Shift	Usa...	Sample
<input checked="" type="checkbox"/> 'PRG01'	2,5	5	Text const...			PRG01
<input checked="" type="checkbox"/> 'Time R...System'	2,30	21	Text const...			Time Reporting Syste
<input checked="" type="checkbox"/> 'DATE'	2,70	6	Date const...			MM/DD/YY
<input checked="" type="checkbox"/> 'Mainte...ection'	3,30	21	Text const...			Maintenance Selectic
<input checked="" type="checkbox"/> 'TIME'	3,70	6	Time const...			HH:MM:SS
<input checked="" type="checkbox"/> 'Enter ...intain'	6,14	54	Text const...			Enter an X beside the
<input type="checkbox"/> EMPAPL	9,25	1	Alphanumeric	A - Alphanum...	Both	B
<input checked="" type="checkbox"/> 'Employ...enance'	9,28	27	Text const...			Employee Master Mai
<input type="checkbox"/> PRJAPL	10,25	1	Alphanumeric	A - Alphanum...	Both	B
<input checked="" type="checkbox"/> 'Projec...enance'	10,28	26	Text const...			Project Master Mainte
<input type="checkbox"/> RSNAPL	11,25	1	Alphanumeric	A - Alphanum...	Both	B

2. In the DDS tree click Record keywords immediately below SELECT.

The Details page shows the current record-level keywords. The Selected DDS page still shows the DDS for the SELECT record.

3. In the DDS tree click the EMESS field.

The Details page shows its field-level keywords. The Selected DDS page now shows the DDS for the EMESS field.



Even this relatively small and simple DDS source member demonstrates how much easier it is to use the Designer to navigate through your DDS source. The syntax is being interpreted in intuitive graphical ways making it an ideal tool for learning DDS. But to get orders of magnitude improvement in your productivity what you really need is to work with your screens and reports in a WYSIWYG fashion, completely oblivious to the DDS required to make things appear the way they do. You need the Design Page.

Designing the DDS screen

You will spend most of your time creating, updating, and designing your DDS screens and reports in the Design page. The Design pages allow you to design your screens or reports visually using an intuitive graphical user interface. The Design page shows the DDS source as it would appear on either a screen (for display files) or a printed page (for printer files). It allows you to design your application's screens or reports by laying out records and fields in a graphical user interface.

On the Design page, you can easily create, edit, resize, and move DDS objects graphically. Create new records, fields, and constants directly on the Design page by using the palette push buttons to the left of the Design area or from the pop-up menus. The toolbar above the Design area allows quick access to many of the editing features as well as information about the currently selected object.

Click the MAIN_MENU tab in the workbook.



In order to understand where MAIN_MENU came from, we need to describe the concept of a group. A group is simply a collection of one or more DDS records that represent how a screen or report would be assembled at runtime. It allows you at development time to work with screens or reports as they would appear when they get assembled by your programs at runtime. To work with groups in CODE

designer you need to tell CODE designer which record formats make up a screen. In this case we have done this for the screen you see in the design page. We have created a group MAIN_Menu and CODE designer saved this information in the DDS source in comment lines. Any groups that you create are persisted as comment lines in the DDS so you can re-use these groups in subsequent CODE designer sessions.

The groups you create will appear in the tree view as well as in the workbook as a Design page tab for each group defined, to allow quick access to each group of records.

Creating groups from existing records

If you are working with existing DDS, you will want to create groups that will correspond to how the records are being used. In this example you will create a group for the next screen, where the user selects which employee in the payroll database to maintain. The screen is made up of record format EMPSEL.

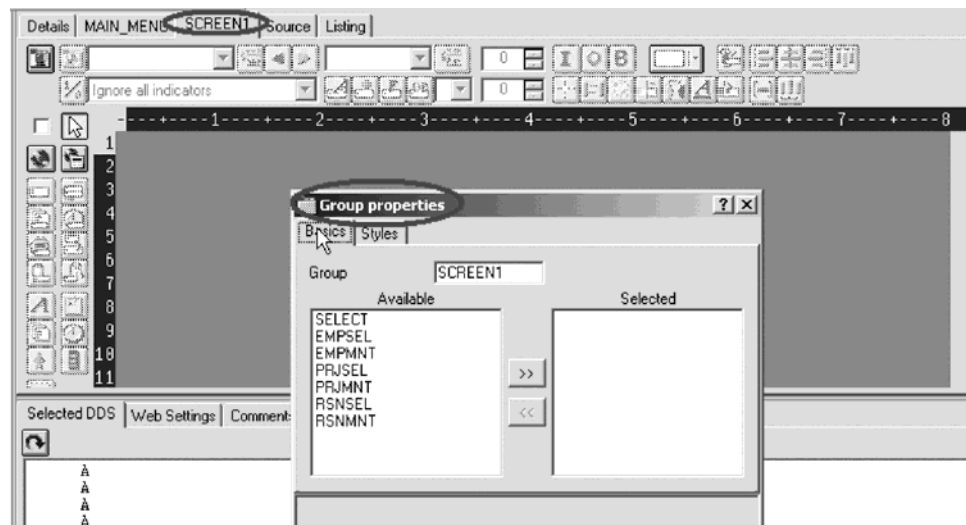
To create a new group:

1. Scroll to the bottom of the DDS tree and expand the MAIN_MENU group. The SELECT record appears as the only record in this group.



2. Right-click the MAIN-MENU group.
3. Click **Insert group** on the pop-up menu.

A Group Properties notebook opens and a blank Design page for the group SCREEN1 also opens.



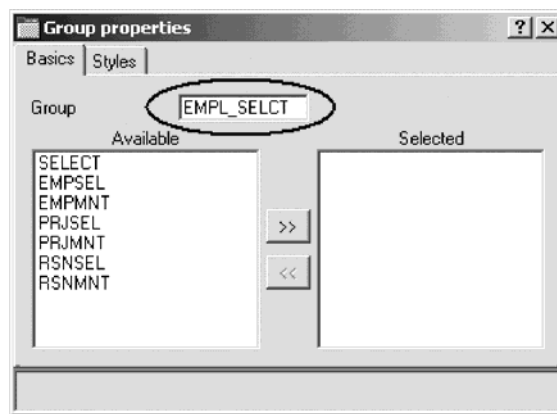
The Properties notebook lets you view and update the properties of the currently selected DDS object. You can open this notebook from any view, pop-up menu, or menu of the CODE Designer. The properties notebook is modeless. When you change an object's properties, the selected object changes immediately.

4. In the Group Properties notebook, select EMPSEL record from the **Available** list and click the **>>** button.

For simplicity this is the only record you will add for now. The Design page now shows us what the record EMPSEL looks like.



- In the group field, type EMPL_SELCT over SCREEN1 to rename the group.



- Close the Group properties notebook. Click the X in the top right corner of the Group Properties notebook.

You have finished creating a group. You could now work in the Design page with the record formats contained in this group. Now you'll create a new record format.

It appears that this is one of those unusable applications where you have to know the employee number ahead of time instead of being able to browse what is in the database. What we really need is a subfile. But aren't those difficult to code, you ask? Not with CODE Designer.

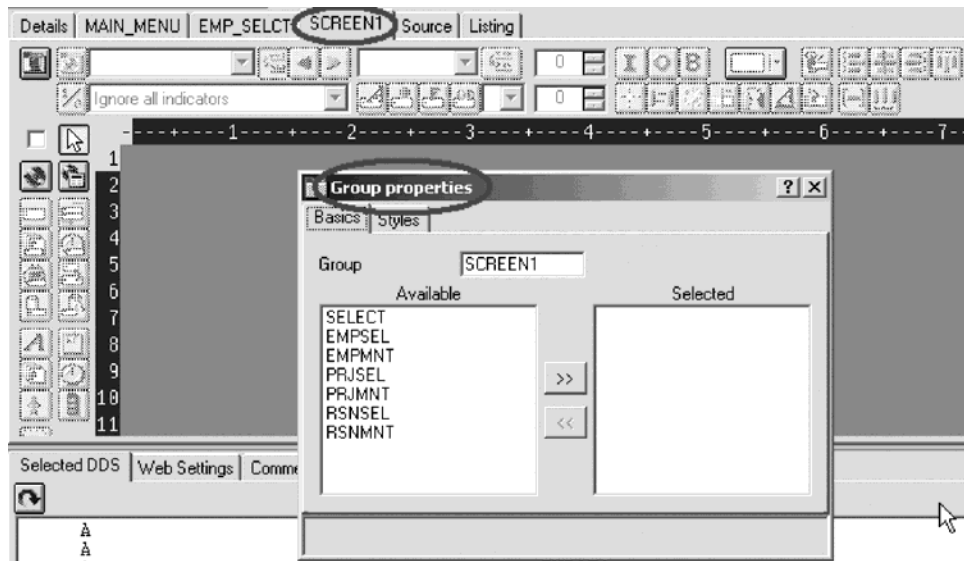
Creating new screens

To create a new record screen on the Design page you need to create a group that will create an empty page you can work with.

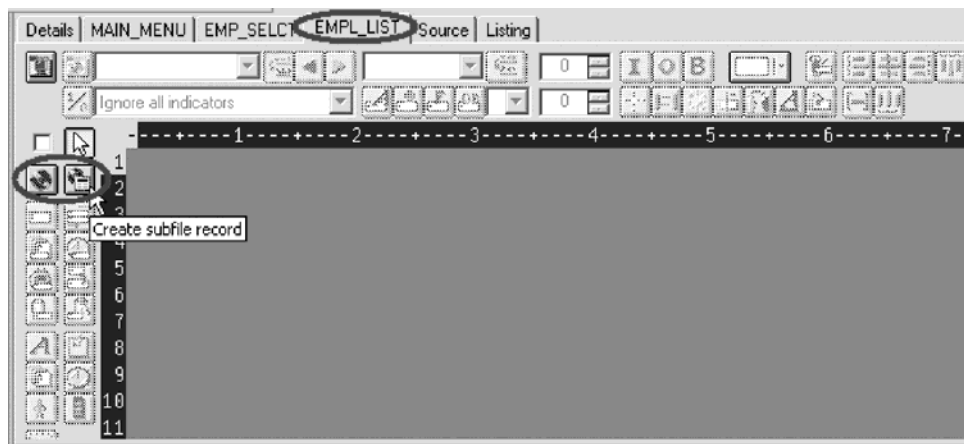
To create a new group:

- Right-click the new EMPL_SELCT group in the DDS tree.
- Click **Insert group** on the pop-up menu.

A Group Properties notebook appears and a blank Design page for the group SCREEN1 also appears.

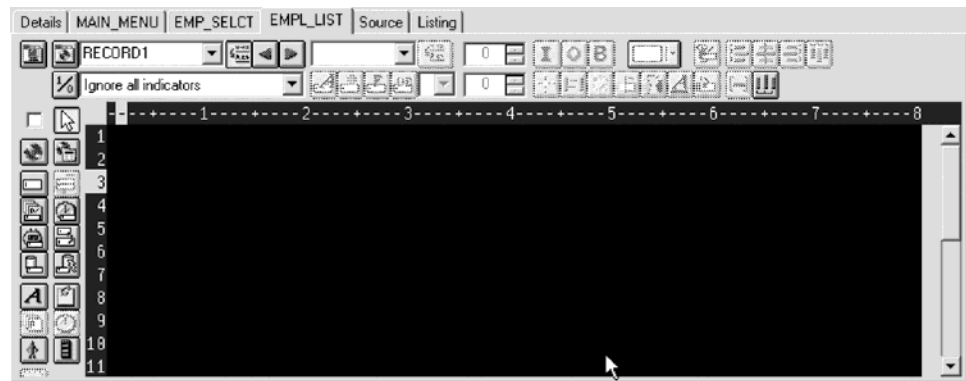


3. Rename the group to EMPL_LIST and close the Group Properties notebook.
4. You can create things on the Design page by selecting the appropriate tool from the palette on the left-hand side and then click on the Design page where you want it to be created. Right now, most things are disabled in the palette because there is no record in which to create fields. The only two tools available are **Create standard record** and **Create subfile record**. If you leave the mouse over a button for a second or two, flyover help will appear describing the indicated button.



5. Click the **Create subfile** record button and then click in the dark gray area.


A subfile and a subfile control record pair are created.



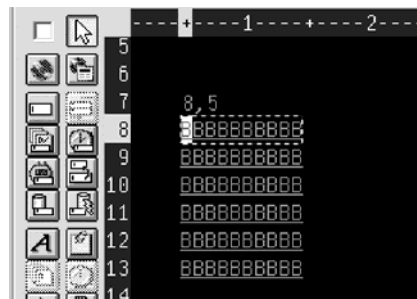
Adding fields to the subfile record

Now you add some columns to the subfile using the Design page. The subfile should be positioned on row eight. You use the cursor to specify the location of the part you want to put on the screen, in this case your subfile.

To add fields on the subfile:

1. Click **Create named field** button  and then **click** somewhere on **row 8**. Six fields appear in a vertical column. This is because the subfile you created, currently specified a SFLPAGE (visible list size) of six.
2. Click the top field and **hold** the mouse button down and **move** it to **row 8, column 5**.

Note the current row and column appear just above the field as you move it.




3. Move the cursor over to the **right edge** of the field. It turns into a double-headed arrow. Hold down the mouse button and **move** it to the **left**. The size of the field will be reduced. The current size will appear just above the field. When the size is **3**, let go of the mouse.

The toolbar at the top of the Design page is a very convenient place to monitor and manipulate the currently selected parts.

4. Rename the record from RECORD1 to EMPLSTSFL and the field from FIELD1 to OPCODE by typing over the text in each list.



5. Click the Color palette  button and select pink to change the color of the field.

To create an additional column:


1. Click the **I** button to change the usage of the field to input.
Now you will create an additional column in the subfile.
2. Position the cursor at **row 8, column 9**.

Note: The bottom right of the CODE Designer window shows the current cursor position 

If you can't see the field with the cursor position on your screen, click the **Maximize** button in the top right corner of the screen. You can use the cursor keys or the mouse to move the cursor.

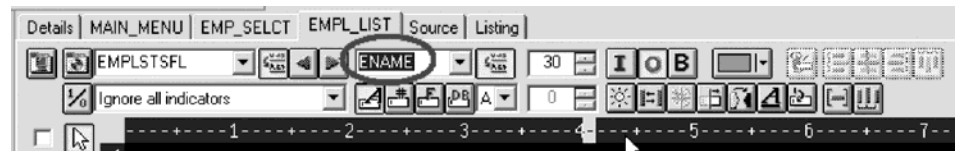
3. If you are creating a long field with an exact length, the SDA syntax can be easier. Type:
+0(30)

and then press the **back arrow** (not Backspace!) to select the text you created. Notice from the Selected DDS page that you have created a text constant containing +0(30).

4. Click **Convert string to field**  button on the toolbar or press **F11** to convert the SDA syntax into a character output field of length 30.



5. Rename the new field to ENAME using the toolbar. This will show the name of the employee.



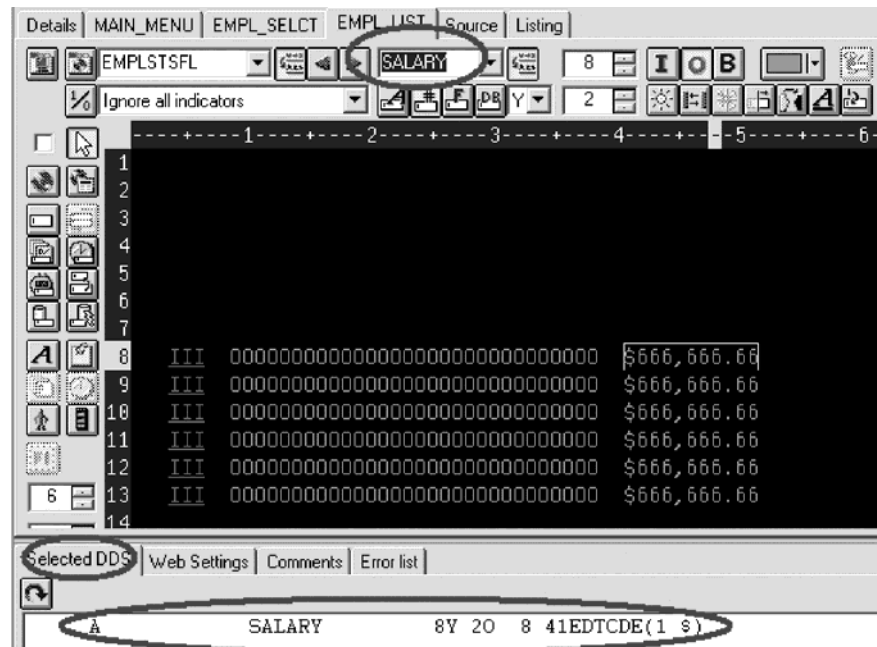
6. Position the cursor to **8, 41**.
7. Now you will add a field for the employee's salary. Type
\$666,666.66

and then press the back arrow.

Now wouldn't it be better if we could just tell the Designer what we wanted the number to look like and then have Designer generate all the cryptic EDTCDEs to make it happen?

8. Press **F11** to convert this field into an output numeric field with comma delimiters, two decimal positions, a currency symbol and no sign. Look at the

Selected DDS page to see what was generated for you. Impressive!

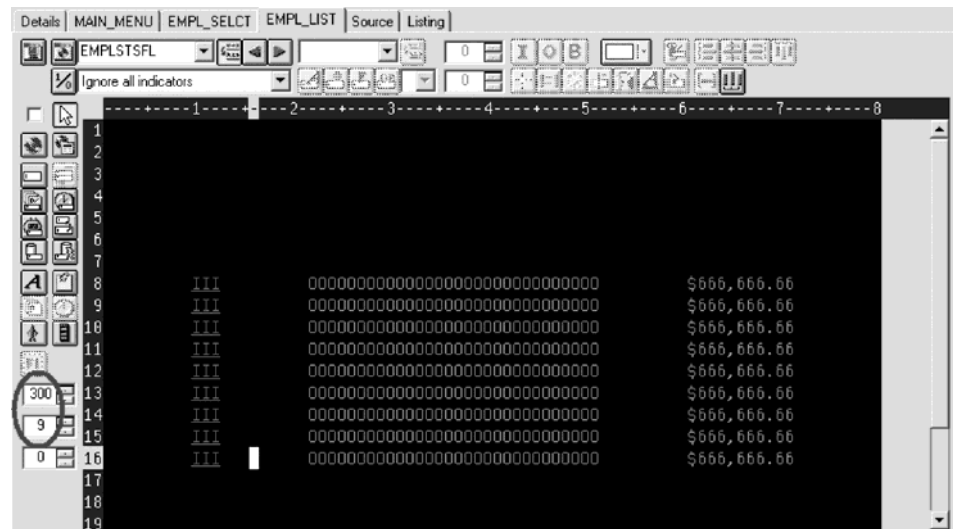


9. Rename the field to SALARY and change its color to yellow, using the toolbar.
10. The subfile seems compacted to the left. It would be better to space it out evenly. Just select the field and click the space horizontally button on the far right side of the toolbar. The other alignment buttons will align fields, left, right, center and top.



Just below the palette there are three spin buttons. The top one, **Subfile size**, specifies the total number of entries in the list that will be filled in by the application. The second one, **Subfile page size**, is how many entries appear on the screen.

11. In the **Subfile size** field, type 300.
12. In the **Subfile page size** field, type 9.




The Design page is updated accordingly.

Switching between multiple records

Now let's fix up the Subfile control record. The group you created contains 2 records. You can verify this by looking at the record list in the toolbar:

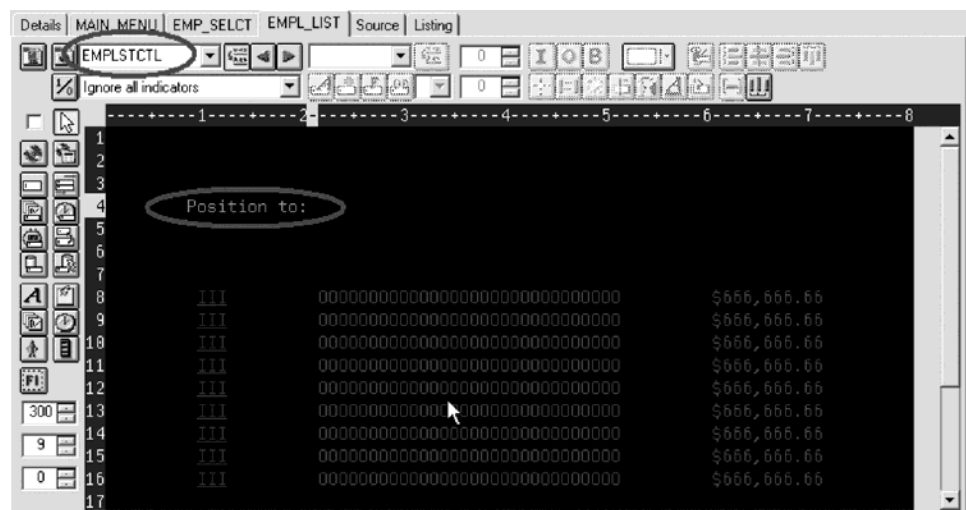





1. Change the current record by selecting RECORD1CTL from the record list or click next record  or press **Alt+End**.

The fields in the subfile still appear so that column heading can be lined up, but they appear at half-intensity so that they can be distinguished from the fields of the current record.

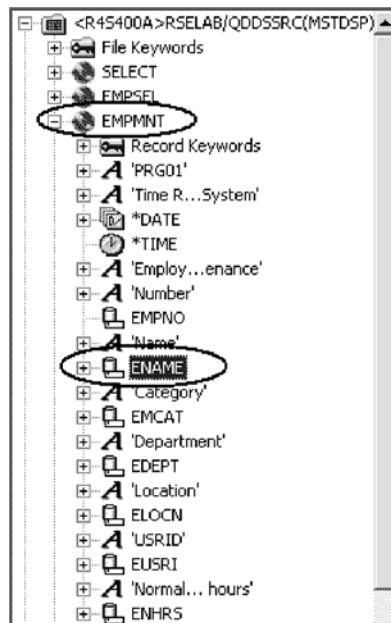
2. Rename the record to EMPLSTCTL using the toolbar. Let's provide a 'position to' entry in the subfile control header.
3. Position the cursor at 4, 9 and type:

Position to:



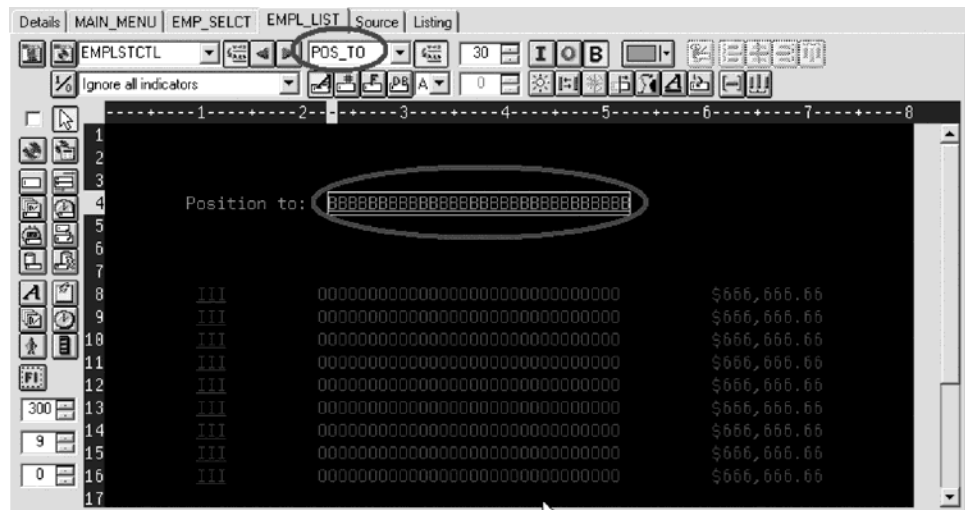
4. Now you need an employee name field.
You could create a named field with the right characteristics like you did in the subfile, or you could create a source reference using the Create source reference field  button in the palette or you could reference the original database field using one of the Create database reference field  Create database reference field(s) by selection  buttons. But there is an even simpler way. Use copy and paste!
5. In the DDS tree expand the EMPMNT record.

- Click the ENAME field and press **Ctrl+C**.



(The pop-up menu or Edit menu shows the Copy menu item as well).

- Position the cursor to 4, 23 and press **Ctrl+V**. Now that was easy!
- Rename the field to POS_T0.




Adding field error handling

Let's put in some error handling for the 'position to employee name' field. If the employee name is not found in the database, the program will turn on indicator 60. An indicator is a two digit variable (01, 02, 03, ... 98, 99) to signal whether or not certain events have occurred during processing. Using indicators enables program events to control screen displays. These indicators are set 'on' or 'off' in one part of the program while their status is referenced in another part of the program. By setting the indicators 'on' or 'off', you can associate fields with indicators to control whether or not a field will appear on the screen.

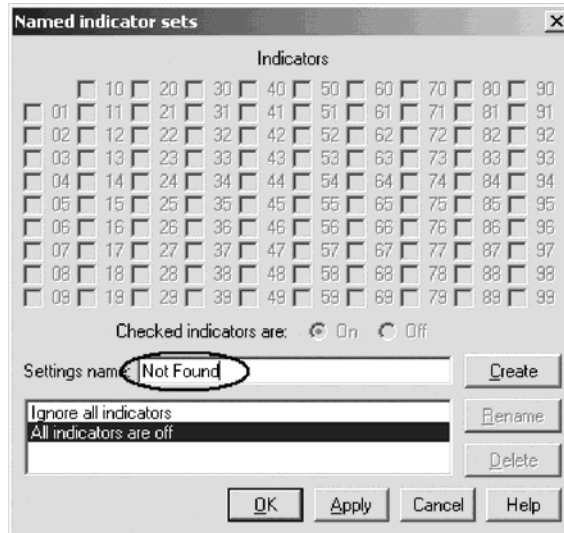
The screen should turn the field red, reverse image and position the cursor to it. Now wouldn't it be better if we could work something higher level and easier to remember than some arbitrary number from 1 to 99.

To set indicators:

1. Click the Changed named indicator sets  button on the Design page toolbar (or press F7).

The Named indicator sets window opens.

2. In the **Settings name** field, type: Not Found.
3. Click **Create**.



4. Select the check box next to **60** and click **OK**.

The Not found indicator set is now in effect. The Design area is shown as if indicator 60 was on and all other indicators were off. The Design page toolbar shows the current indicator set in the Select named indicator set list on the bottom left.

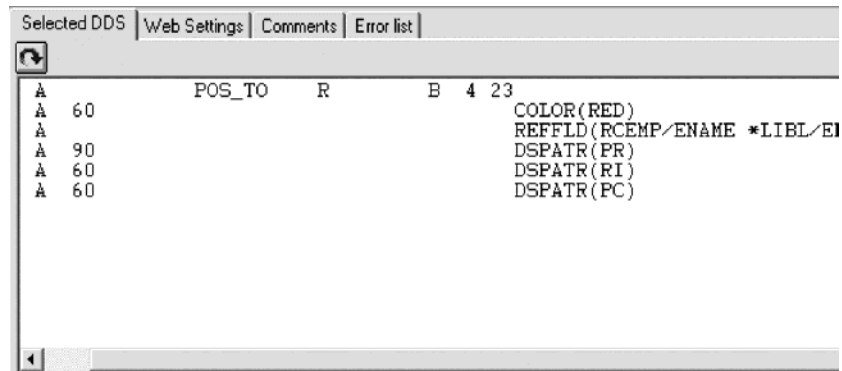


5. Now select the **POS_TO** field.
6. On the toolbar, select the color **red** and the display attributes **reverse image** and **position cursor**. (The set of toolbar buttons representing the current display attributes is found just below the color button).

The toolbar should look as follows:



- Examine the DDS generated in the Selected DDS page.



Notice that all the new keywords were created with a condition of 60. (The DSPATR(PR) was pasted with the field originally).

- Now let's try it out! From the **Select named indicator sets** list, select **All indicators are off**.



Wow! This really works!

- From the **Select named indicator sets** list, select **Not found**.
The field appears red and reverse imaged.

Accessing field properties

Second to the direct manipulation and the toolbar on the Design page, the easiest and quickest ways of getting access to the properties of a field, record, or entire file is a Properties notebook.

The Properties notebook lets you view and update the properties of the currently selected DDS object. You can open this notebook from any view, pop-up menu, or menu of the CODE Designer.

The Properties notebook is modeless. When you change an object's properties, the selected object changes immediately.

You can get to a Properties notebook from the **Selected** menu, by pressing **F4**, or double-click on anything in the DDS tree or the Details page or Design page.

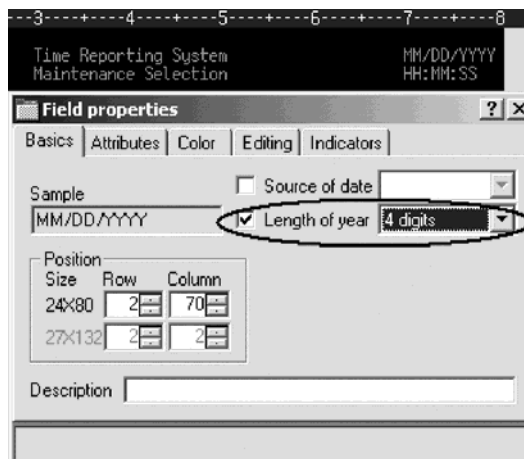
To open the Properties notebook:

1. In the DDS tree, click the record SELECT and press F4 to see the Record properties.



As you select different items, the Properties notebook will continuously update itself to show you the properties of the selected item.

2. Click the *DATE field in the SELECT record. (You may have to move the Properties notebook out of the way.) This field has a different set of pages describing its properties.
3. Change the year from 2 to 4 digits. Select the **Length of year** check box.
4. Select 4 digits from the list.

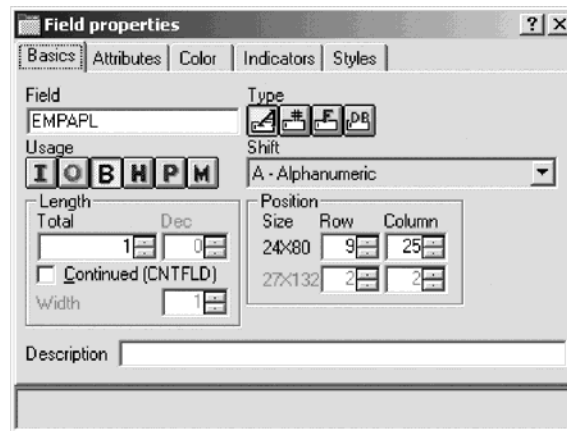


Notice how the sample is updated on the Properties notebook.

5. To test the Design page, click the **MAIN_MENU** tab in the workbook and look at the upper right corner of the screen. The year now has 4 digits.
6. Click the EMPAPL field in the SELECT record. On the Field properties notebook click the **Basics** tab.

On this page you can change the field's name, usage, length, type, and screen position. The other pages give you quick access to other properties for this

field.

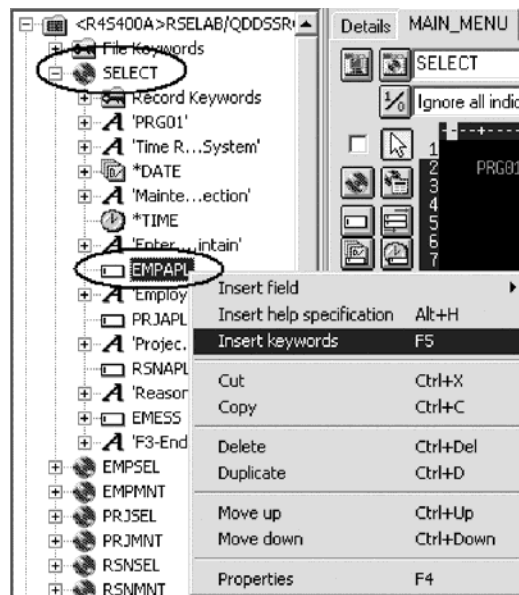


Adding new keywords

CODE Designer helps you manage the visual aspects of your displays and reports. But you also need to access the full power of DDS. You need to access keywords.

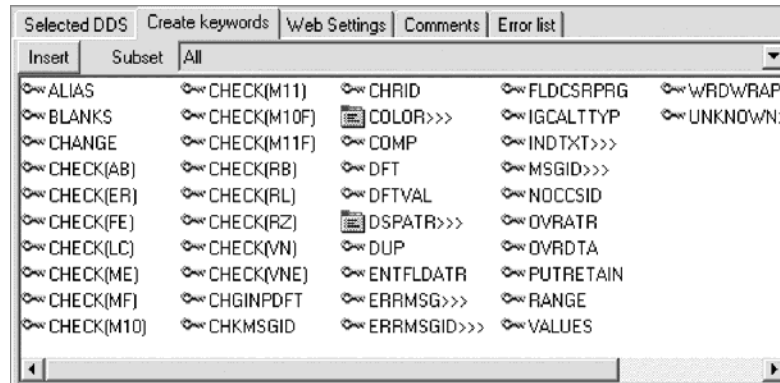
To add keywords:


1. Click EMPAPL field in the DDS tree.
2. Press F5 or right-click and click **Insert keywords** on the pop-up menu.

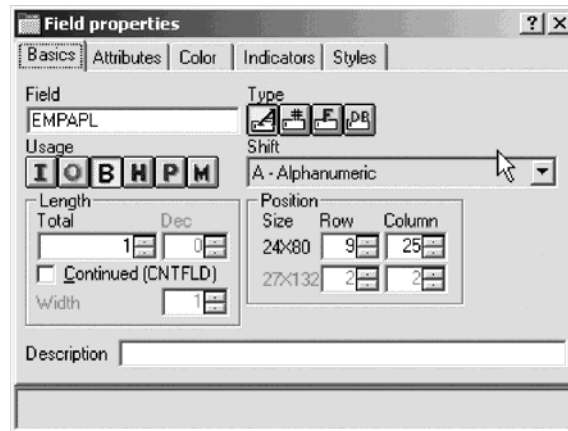


You see the Details page for the EMPAPL field and the **Create keywords** tab is selected in the Utilities notebook. This page shows you the subset of keywords that are allowed for the selected file, record or field and it takes into account the field's type, usage, shift and what record it is in. It is very powerful to know exactly what your options are. This information cannot be quickly


ascertained from the Reference manual.



3. With the EMPAPL Properties notebook at the **Basics** page, click the numeric field  button to change the field to numeric type.



Notice that the list of keywords in the Create keywords page has changed.

4. Click the  button to change the field back to alphanumeric. Notice that the list of keywords in the Create keywords page has changed.
5. Click the **ALIAS** keyword and press **F1**.

The DDS Reference help for the ALIAS keyword appears.

Tip: CODE Designer has lots of on-line help. Press F1 anywhere you want to see help for an item, icon or notebook. You will get help relevant to what you are currently trying to do. From the Help menu you can get quick access to the DDS Language Reference as well as several other useful sources of information.

6. Minimize the Help window.
7. Double-click the INDTXT keyword. (You may have to scroll to the right to find it).


The keyword is created with default values which can be changed when you want.

8. Double-click the INDTXT keyword again. The keyword is created with the same default values creating a conflict.
9. Close the Keyword Properties dialog.

Verifying the source changes

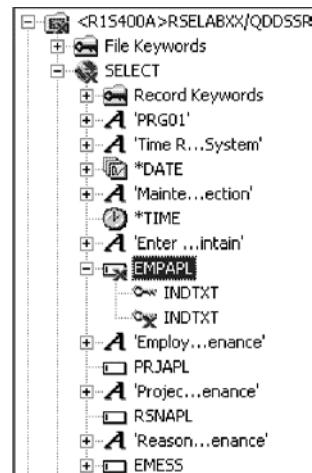
You have just added a new record and some new fields to our DDS source. Everything that the CODE Designer adds to your DDS source is certain to have the correct syntax. Now you need to make sure that there are no semantic errors. You just introduced one in the last section by creating two INDTXT keywords describing the same indicator.

To verify your source:

1. Click **Tools > Verify file** (or click the verify  button on the main toolbar) on the CODE Designer menu.

The DDS source is checked using the same verifier that the CODE Editor or LPEX Editor uses. A message appears on the status line at the bottom of the Designer stating that the verify process completed with errors.

2. In the DDS tree, there is a trail of red x's leading to the problem.



The file icon has a red x, as does the SELECT record, the EMPAPL field and finally the second INDTXT keyword.

3. Click the **MAIN_MENU** tab in the workbook.

The EMPAPL field is highlighted in red.

4. Click the **Listing** tab in the workbook.

This page shows you the listing generated by the most recent program verify. A warning message is buried somewhere in the listing but it's not easy to find.

5. If there are problems, they will show up in the Error list page in the Utility notebook. It behaves exactly like the Error list in the CODE Editor or LPEX Editor. Click the **Error list** tab.
6. Double-click the warning **DDS7861** in the Error list. (Press **F1** to see detailed help on the message).

The Source page appears and the cursor is placed exactly where the error is in the source. The Source page is a tokenized read-only view of the current state of the DDS source. Read-only? Wouldn't it be great if you could just clear the error right here. There are some things that are just plain faster in the editor and many others that are faster in the visual environment. It would be great to switch between the two modes at the push of a button. Well, let's just do that.

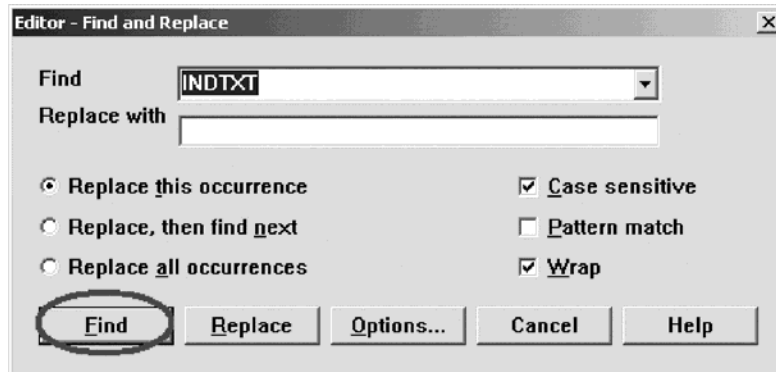
Switching between designing and editing the screen

To switch between the Design mode and the Edit mode:

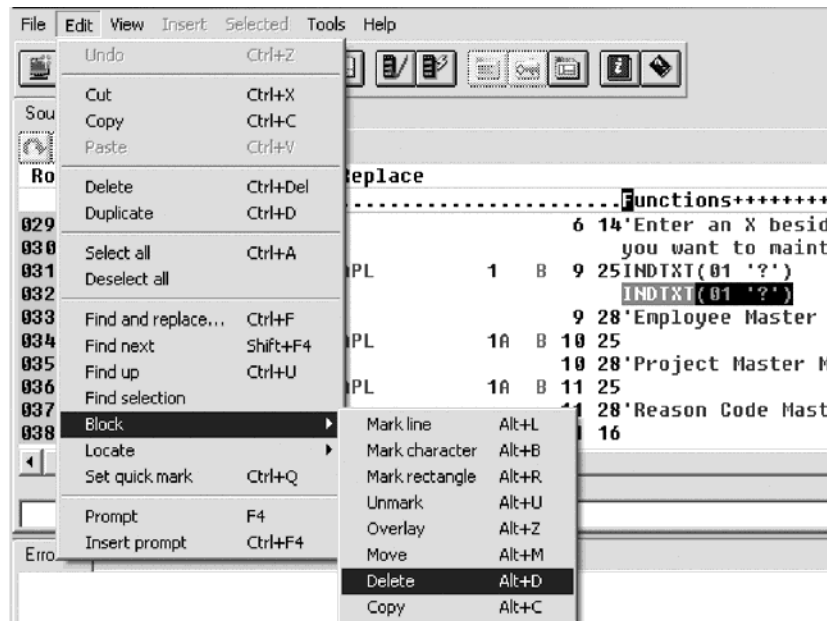
1. Click the Edit DDS source  button or select **File > Edit DDS Source** from the Editor menu.

You now have access to the full power of the editor.

2. Explore the **Edit** and **View** menu items.
3. Press **Ctrl-F** to open the Find/Replace window.
4. In the **Find** field, type **INDTXT** and click **Find**.




5. Press **Ctrl-N** to find the next occurrence.
6. Delete the second **INDTXT** line.



Compiling your source changes and closing the Designer

Now you will compile the source on the iSeries just as you did in the Remote Systems LPEX Editor and then close the designer.

To compile your source:

1. Click **File > Save** from the Designer menu to save your source to the iSeries.
2. Click **Tools > Compile** from the Designer menu and then click **No prompt** (or click the compile  button on the CODE Designer toolbar).

3. A message indicates when the compile is complete. Click **OK** in the Message window. If you run the PAYROLL program, you will see the 4 digit year change you made to the opening screen of the program.

To close the Designer:

1. Click **File > Exit** from the Designer menu.

Checkpoint

Complete the checkpoint below to determine if you are ready to move on to the next module.

1. There is a graphical design tool that let's you design your screens and reports visually and then generate the DDS source for you. This tool is named:
 - a. Page Designer
 - b. CODE Designer
 - c. Screen Design Aid
 - d. None of the above
2. Match the item with its correct description.
 - a. Workbook
 - b. Details page
 - c. Utility notebook
 - d. Design page
 - a. View specific elements of the DDS source such as errors and selected objects
 - b. Lists the contents of the currently selected item in the DDS tree
 - c. Contains several different tabbed pages
 - d. For visually designing screens and reports
3. The Utility notebook contains:
 - a. Selected DDS page
 - b. Error List page
 - c. Create keywords page
 - d. Comments page
 - e. All of the above
4. On the Design page, you can easily:
 - a. Create DDS objects
 - b. Edit DDS objects
 - c. Resize DDS objects
 - d. Move DDS objects
 - e. Create records
 - f. Create fields
 - g. Create constants
 - h. All of the above
5. Grouping records together allows you to work on one record while still seeing the related records in the background. (T, F)
6. The Properties notebook is modeless. When you change an object's properties, the selected object changes immediately. (T, F)
7. The DDS source is checked using the same verifier that the LPEX Editor or CODE Editor uses. (T, F)

8. You can switch between design mode and edit mode in CODE Designer. (T, F)
 9. You can compile sources on the iSeries just as you can in the LPEX Editor. (T, F)
-

More practice

Want more practice? Try this!

Given your experience in this exercise using the CODE Designer, try creating a printer report. You can use the physical file specification REFMST in member QDDSSRC in library RSELABXX. Take time to explore the fields and information for this physical file. You may want to refer back to this information as you create your report. When you are familiar with the file REFMST, you can create your printer file. Use the Development Studio Client for iSeries online help to assist you in this task.

Recap

Congratulations! You have completed this module. You should now understand:

- The purpose of a workbook, details page, utility notebook, design page, properties notebook, group and indicator
- How to modify a display file to add a screen
- How to add groups, records and fields
- How to save your DDS source
- How to verify your DDS source changes
- How to compile your DDS source changes

Now that you know how to design screens, you can learn how to debug and test the payroll application on an iSeries system. Continue with the next module.

Chapter 10. Debugging a program

In this module, you will review the Debugger features. You then learn how to start the debugger, set breakpoints, monitor variables, run and step into a program, view the call stack in the Debug view, remove a breakpoint, add a storage monitor, and set watch breakpoints and all from the Debug perspective.

In order to debug a program, there are several steps you will need to learn about and follow:

- Describe some of the features of the Debugger
- Start a Debug session
- Add and delete line breakpoints
- Display a variable
- Change a variable
- View the call stack
- Run, step and step into a program
- Switch between source and listing view
- Add a storage monitor
- Add a watch breakpoint

In order to accomplish these learning objectives, there are several steps that are involved, including:

- Debugging iSeries programs from the Debug perspective
- Starting the Integrated Debugger
- Setting breakpoints
- Monitoring variables
- Stepping into a program
- Listing call stack entries
- Setting breakpoints in PAYROLLG or PAYROLLD
- Removing a breakpoint in PAYROLLG or PAYROLLD
- Monitoring variables in PAYROLLG or PAYROLLD
- Adding a storage monitor
- Setting watch breakpoints
- Closing the debug session

The exercises within this module must be completed in order. Start with the first exercise when you are ready to begin.

Length of time:

This module will take approximately 20 minutes to complete.

Introducing the iSeries Integrated Debugger

The Integrated Debugger is a source-level debugger that enables you to debug and test an application that is running on an iSeries system. It provides a functionally rich interactive graphical interface that allows you to:

- View source code or compiler listings, while the program is running on the iSeries system.
- Set, change, delete, enable and disable line breakpoints in the application program. You can easily manage all your breakpoints using the Breakpoints view.
- Set watch breakpoints to make the program stop whenever a specified variable changes.
- View the call stack of your program in the Debug view. As you debug, the call stack gets updated dynamically. You can view the source of any debug program by clicking on its call stack entry.
- Step through your code one line at a time.
- Step into or step over program calls and ILE procedure calls.
- Display a variable and its value in the Monitors view. The value can easily be changed to see the effect on the program's execution.
- Locate procedure calls in a large program quickly and easily using the Modules/Programs view.
- Debug multithreaded applications, maintaining separate stacks for each thread with the ability to enable and disable any individual thread.
- Load source from the workstation instead of the iSeries – useful if you don't want the source code on a production machine.
- Debug client/server and distributed applications.

The Debugger supports RPG/400[®] and ILE RPG, COBOL and ILE COBOL, C, C++ and CL.

In the following exercise you will be given the opportunity to learn about some of the basic features of the Debugger. For the purpose of this exercise you will debug an ILE RPG/400 program. Don't worry if you don't know RPG.

Starting the integrated debugger

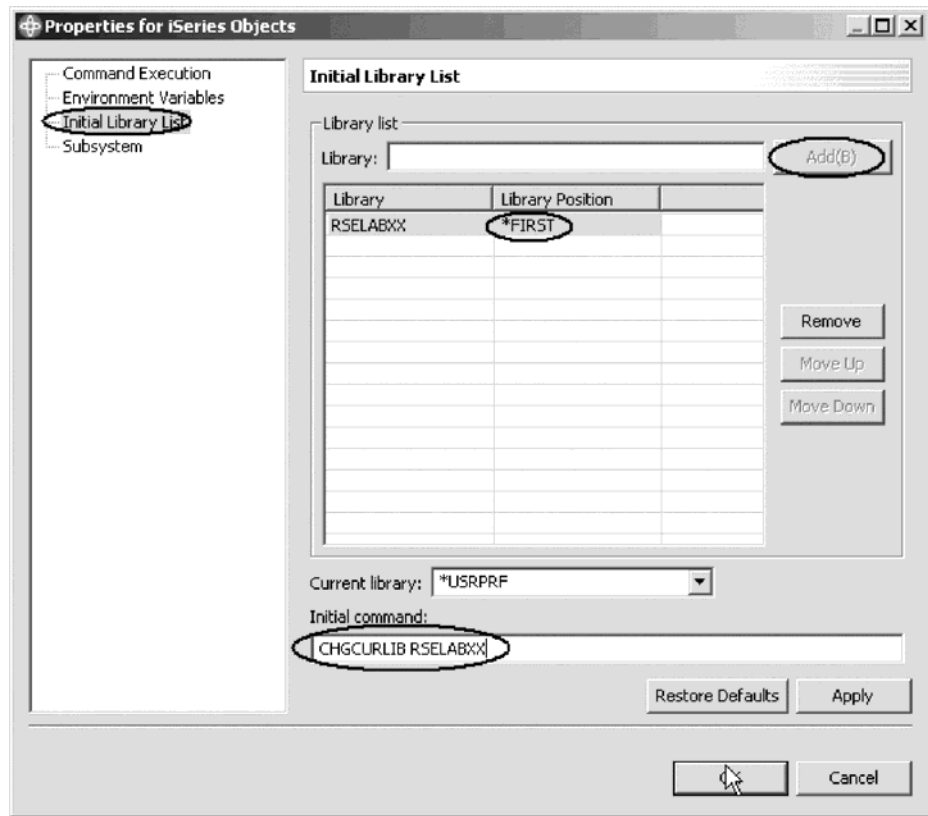
You will be working with the ILE RPG program PAYROLLG.

Note: For RPG programmers: PAYROLLG is the same RPG program as PAYROLL but without compile errors. You are using it instead of PAYROLL in this exercise, to accommodate anyone who decided to skip right to this exercise without completing the editor exercise.

Note: For COBOL programmers: PAYROLLD is the same COBOL program as PAYROLLC but without compile errors. You are using it instead of PAYROLLC in this exercise, to accommodate anyone who decided to skip right to this exercise without completing the editor exercise.

Note: Make sure that your user ID has been setup, so that your library has been added to the library list automatically. You can use the properties for iSeries Objects dialog to set connection information such as adding a library to a library list and changing the current library. You can right-click on iSeries Objects then click Properties to see this dialog. You will need this setup to

run jobs interactively from your workstation.



You can start the Debugger in several ways: directly from the pop-up menu of a program or service program in the Remote Systems view, or from the Launch Configurations window. Starting directly from the Remote Systems view doesn't allow you to specify parameters to be passed to the program. The Launch Configurations window allows you to modify how the program is invoked and to specify parameters.

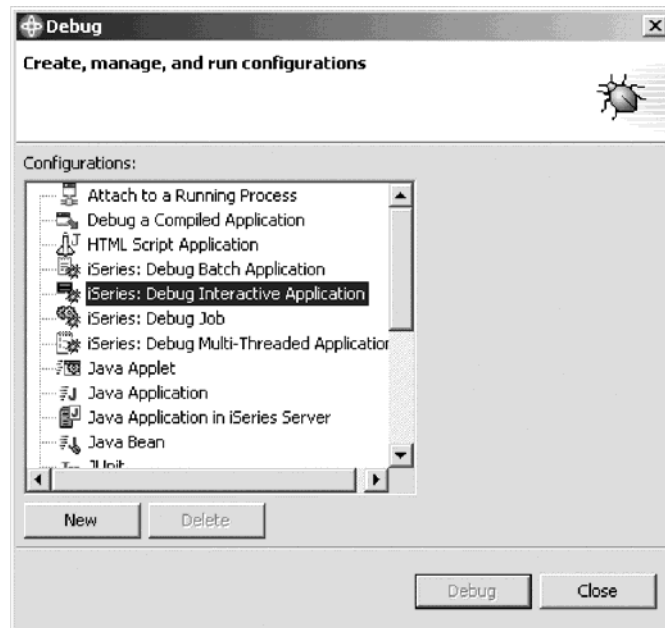
To make the exercise interesting you will use CL program CLR1 to call PAYROLLG and you will pass one parameter to CLR1 or you will use CL program CLC1 to call PAYROLLD and you will pass one parameter to CLC1. This means you will use the Launch Configurations window.

To start the debugger:

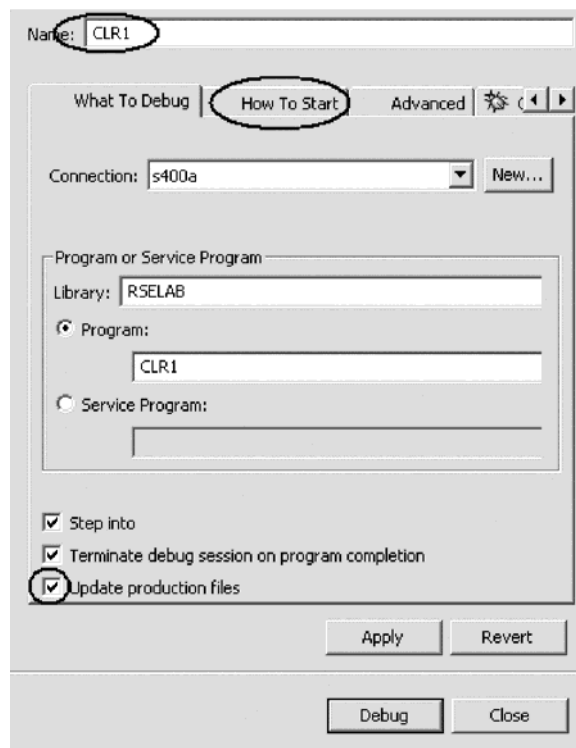
1. Expand QCLESRC in the iSeries Projects Navigator.
2. Select program CLR1 or CLC1.
3. Click the arrow beside the **DEBUG** icon  on the workbench toolbar.
4. Select **Debug** from the list.

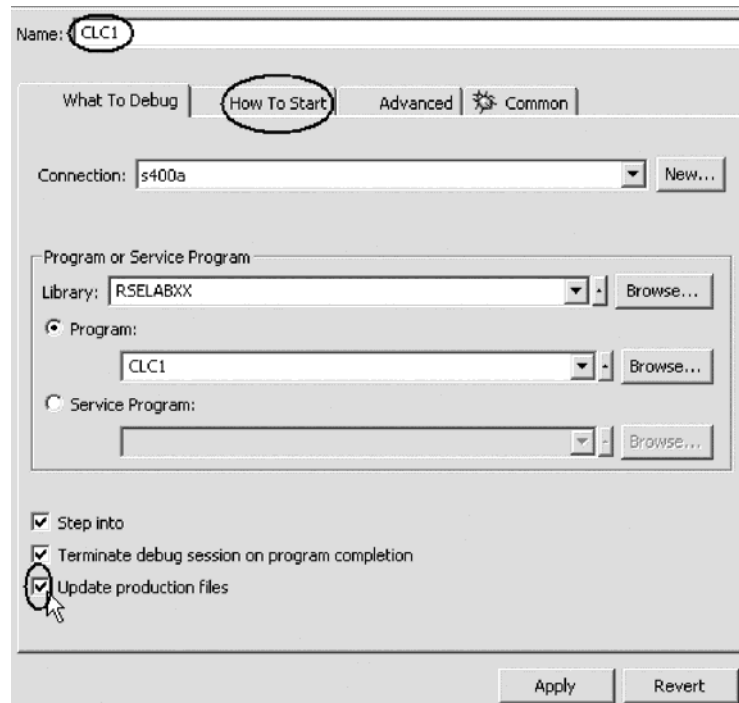
The Debug Launch Configurations window opens.

5. Select **iSeries: Debug Interactive Application** under the **Configurations** list.



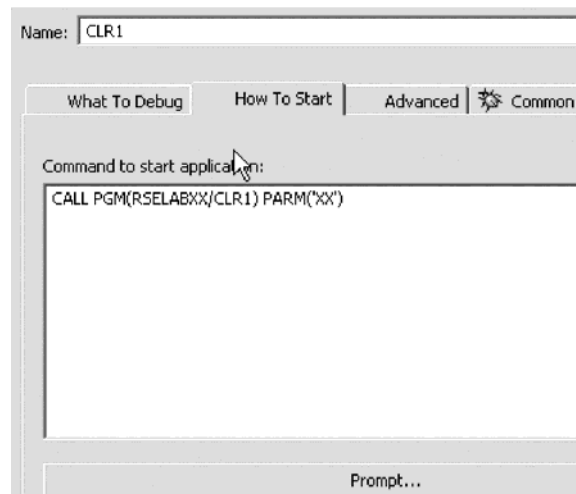
6. Click **New**.
The right pane of the Debug Launch Configurations window opens.

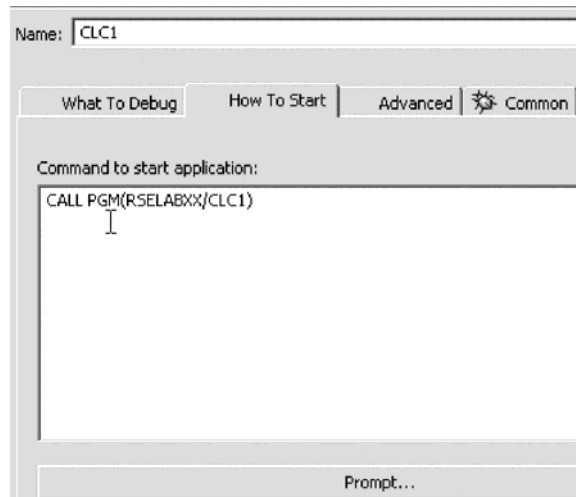




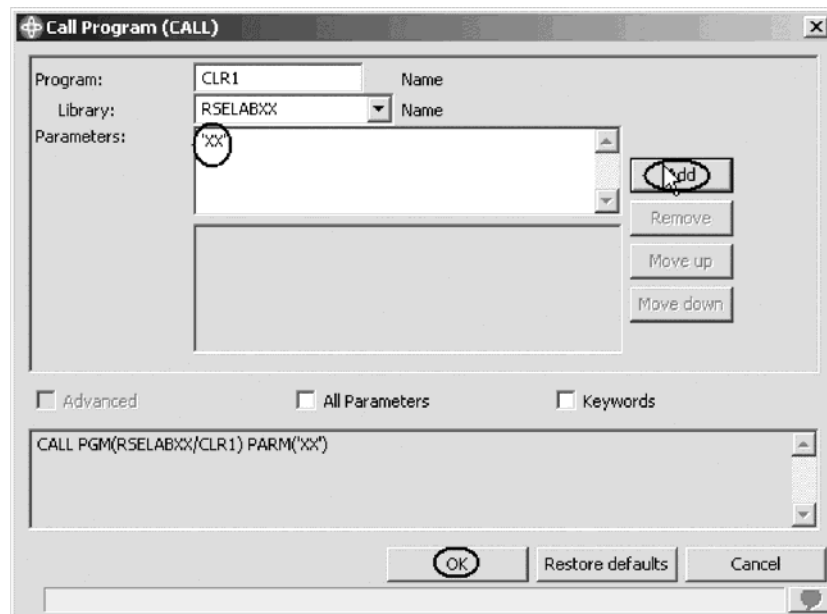
7. In the **Name** field, type the program name CLR1 or CLC1.
8. Select the **Update production files** check box.
9. Click the **How To Start** tab.

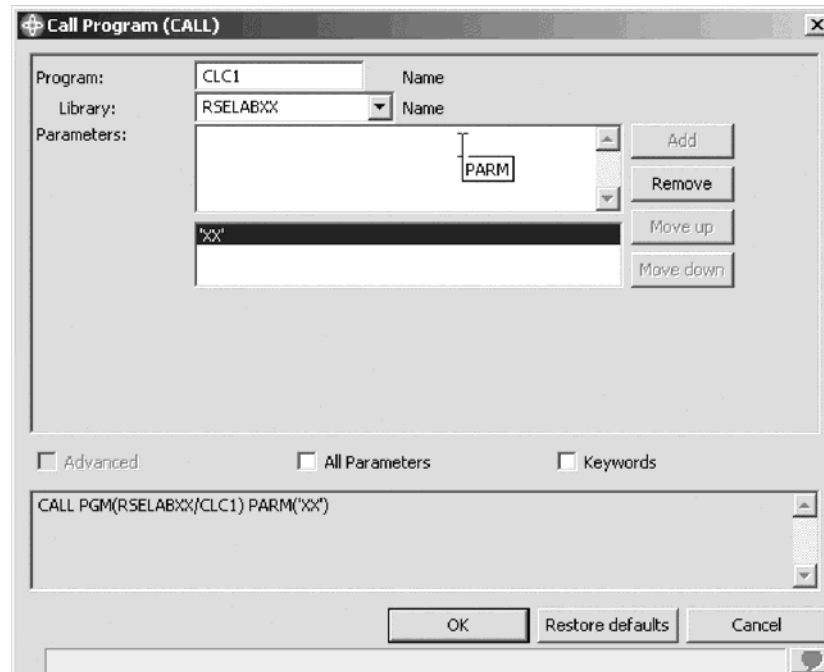
The How To Start page opens.





10. Click **Prompt**.
The Call Program (CALL) window opens.



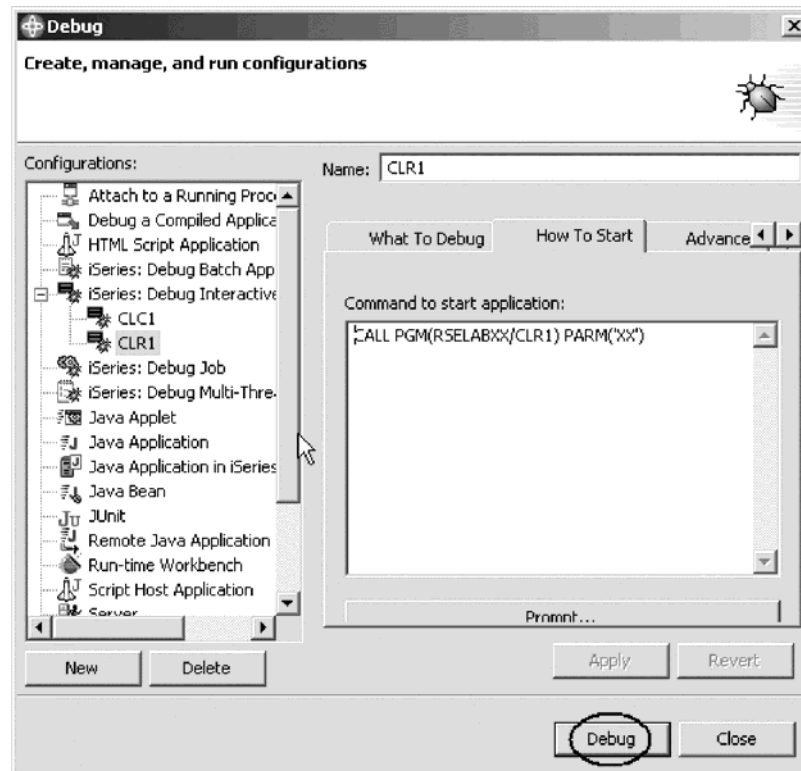


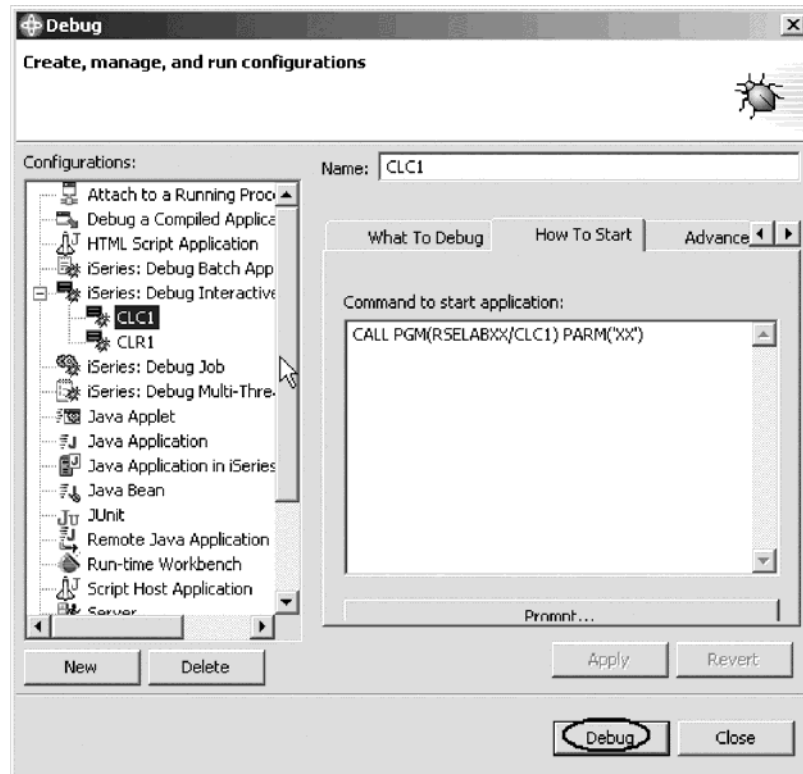
11. In the **Parameters** field, type 'XX'. Click **Add**.

The parameter value will appear in the lower list.

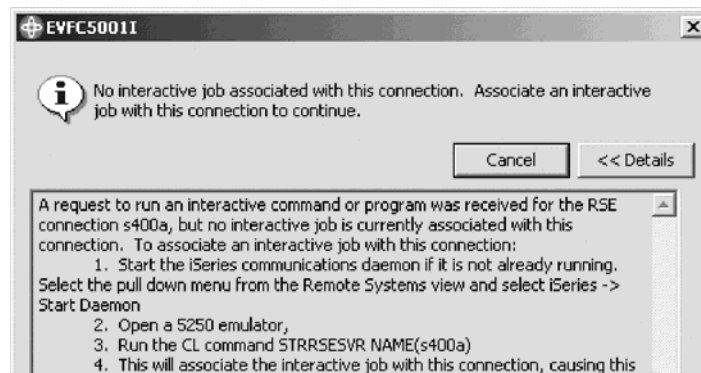
12. Click **OK**.

The complete start command for the program appears:





13. Click **Debug**.
The Debug perspective opens.
If not, you may see this error message:



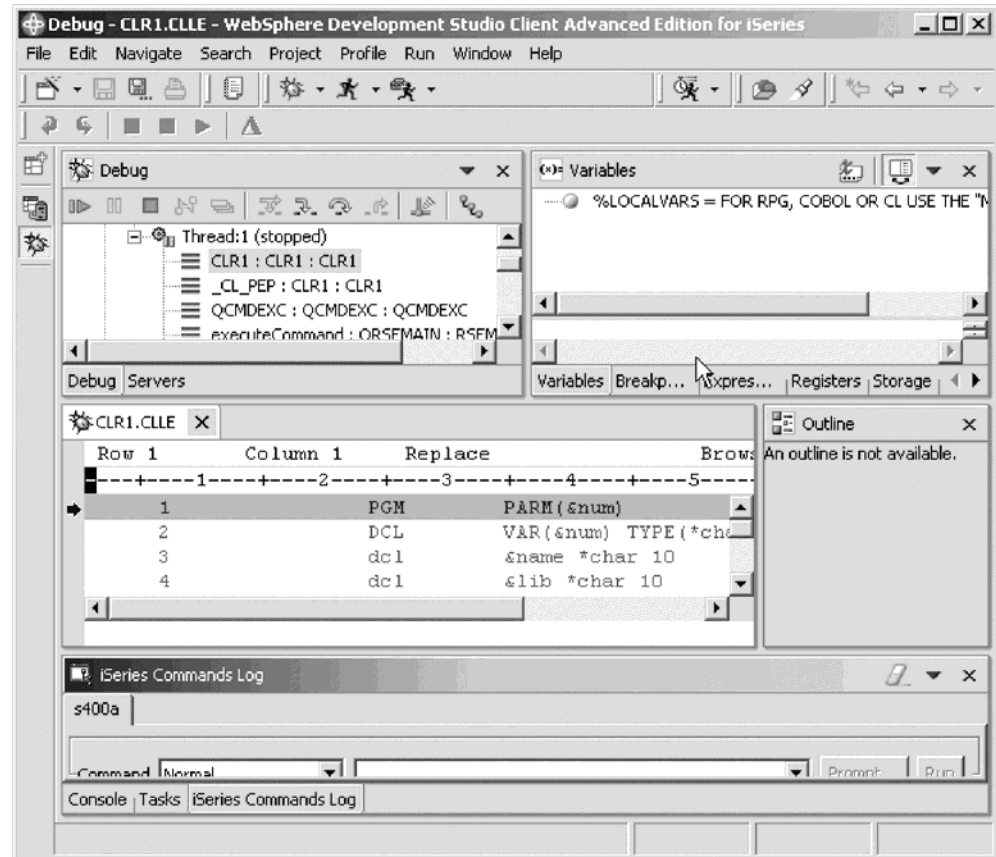
The Remote System Explorer communications server has been shut down in the meantime. Go to your 5250 emulator and restart the Remote System Explorer communications server following the instructions in the message. You don't have to cancel the message. It will be removed as soon as the connection between the Remote System Explorer communications server and the interactive session has been established. Now the Debug perspective is loaded in the workbench.

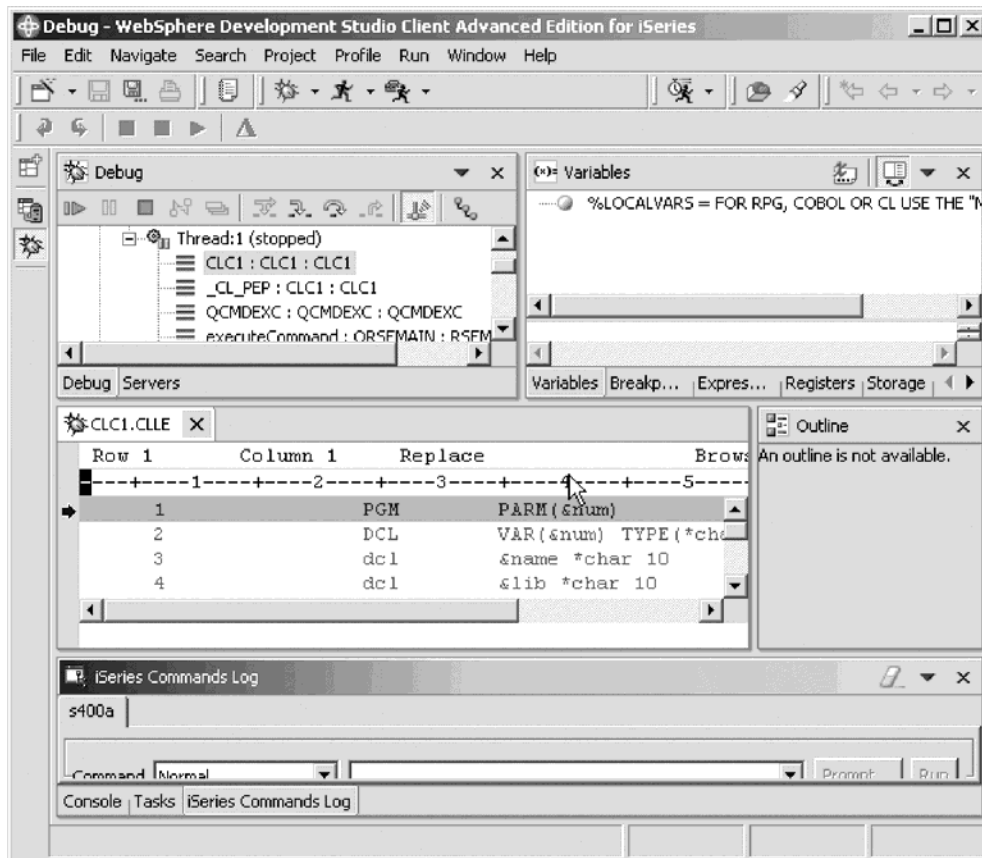
Now that the program is active on the iSeries and stopped at the first executable statement, the debugger displays the source.

Setting breakpoints

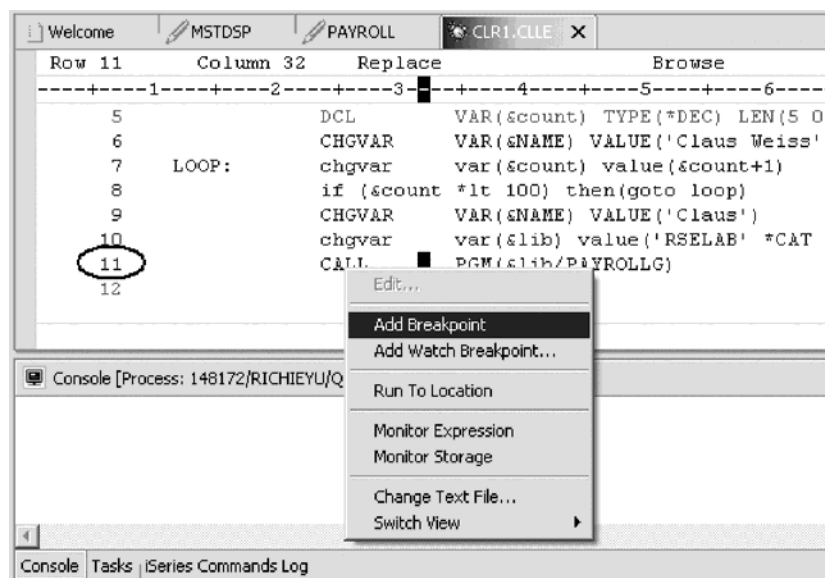
You can only set breakpoints at executable lines. All executable lines are displayed in blue. The easiest way to set a breakpoint is to right-click on the line in the Source view.

To set a breakpoint:





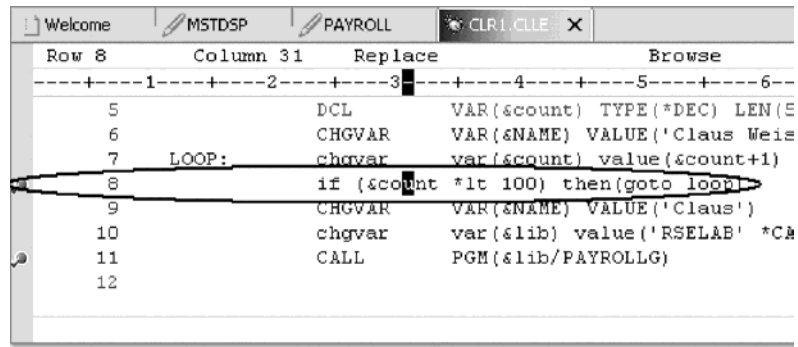
1. Scroll to line 11 then right-click anywhere on line 11.



2. Click **Add breakpoint** on the pop-up menu.

A dot with a checkmark in the prefix area indicates that a breakpoint has been set for that line. The prefix area is the small grey margin to the left of the source lines.

Now you add a conditional breakpoint in the loop when it loops the 99th time.

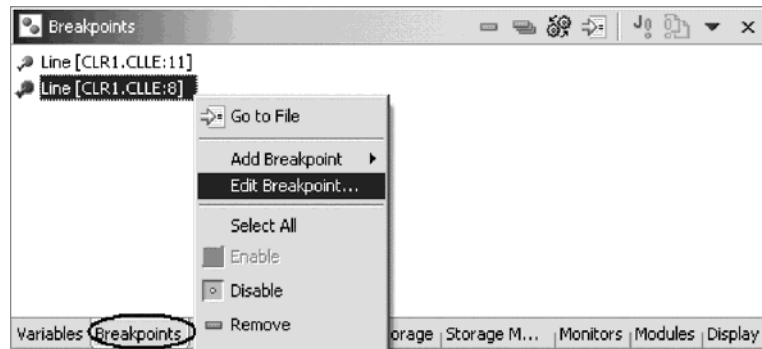


```
Row 8      Column 31  Replace      Browse
-----+-----+-----+-----+-----+-----
5          DCL          VAR(%count) TYPE(*DEC) LEN(8)
6          CHGVAR         VAR(%NAME) VALUE('Claus Weie
7          LOOP:        chgvar         var(%count) value(%count+1)
8          if (%count *lt 100) then(goto loop)
9          CHGVAR         VAR(%NAME) VALUE('Claus')
10         chgvar         var(%lib) value('RSELAB' *Ca
11         CALL          PGM(%lib/PAYROLLG)
12
```

To add a conditional breakpoint:

1. Scroll to line 8 then right-click on line 8.
2. Click **Add breakpoint** on the pop-up menu.
3. Click the **Breakpoints** tab.

The Breakpoints view opens:



4. In the **Breakpoints** view right-click the breakpoint for line 8.
5. Click **Edit Breakpoint** on the pop-up menu.

The Edit a Line Breakpoint window opens.

6. Under **Views**, click the ***LISTING** radio button.

Edit a Line Breakpoint

Required information
Sets a breakpoint to stop execution at a specific source line

Program: *PGM RSELABXX/CLR1

Module: CLR1

Views:
 *SOURCE
 *LISTING
 *STATEMENT

Source(optional): CLR1.LISTING

Line: 31

< Back Next > Finish Cancel

Edit a Line Breakpoint

Required information
Sets a breakpoint to stop execution at a specific source line

Program: *PGM RSELABXX/CLC1

Module: CLC1

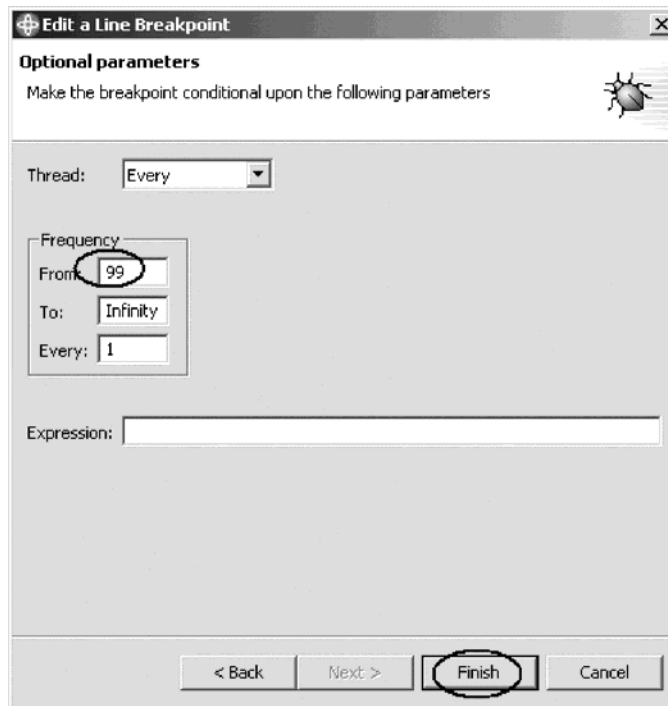
Views:
 *SOURCE
 *LISTING
 *STATEMENT

Source(optional): CLC1.LISTING

Line: 31

< Back Next > Finish Cancel

7. Click Next.



You only want to stop in the loop when it executes for the 99th time or more. You can do that by setting the From field of the Frequency group to 99.

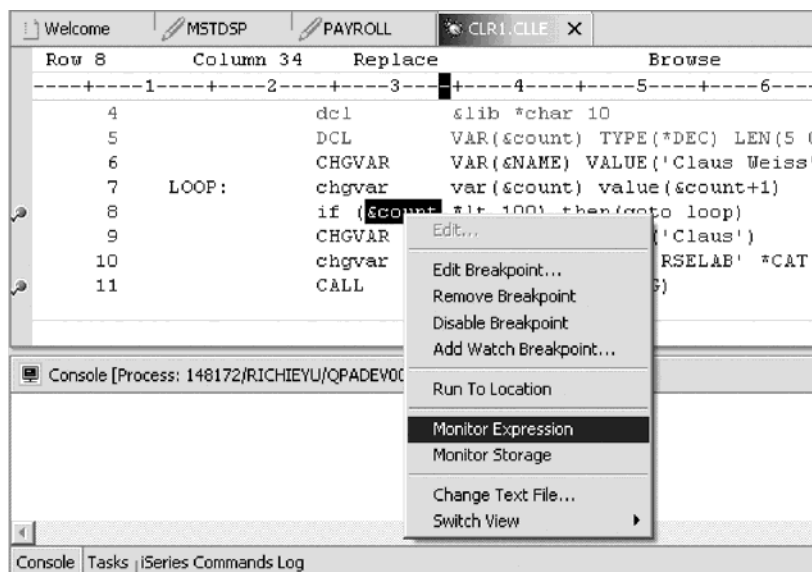
8. Under **Frequency**, in the **From** field, type 99.
9. Click **Finish**.

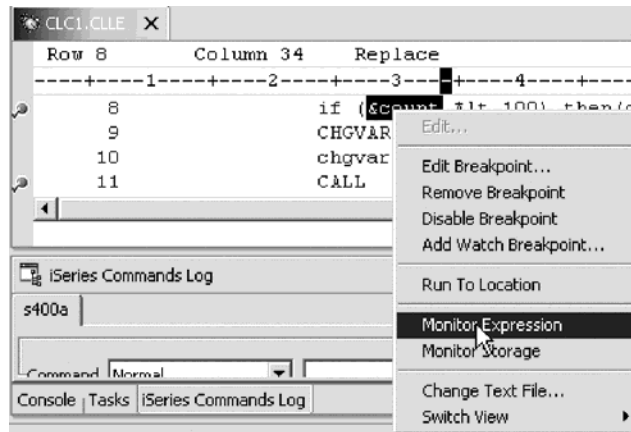
Monitoring variables

You can monitor variables in the Monitors view. Now you will monitor the variable &count.

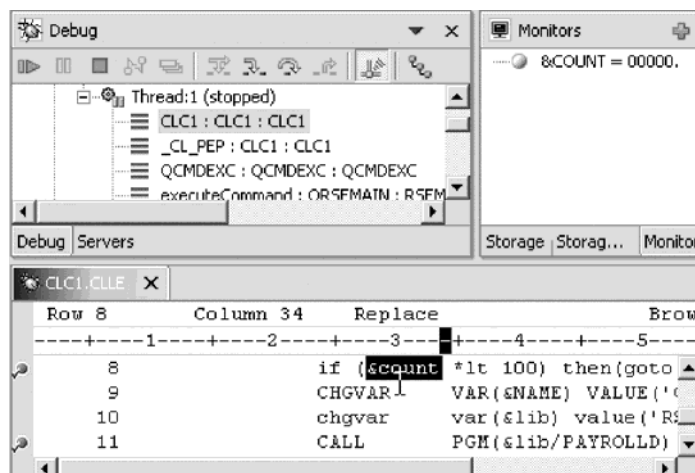
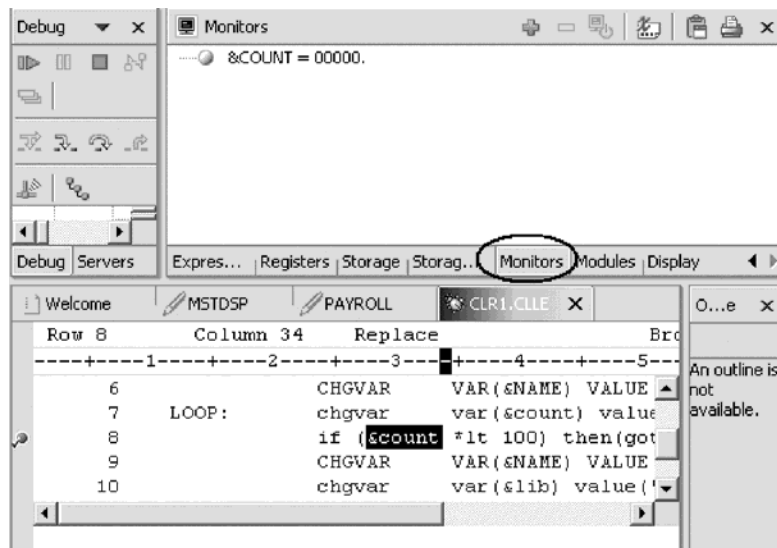
To monitor a variable:

1. In the Source view, double-click the variable &COUNT.





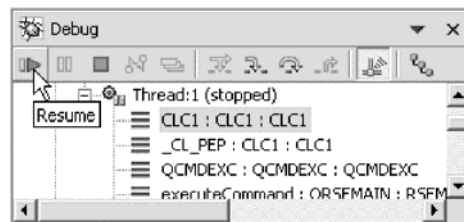
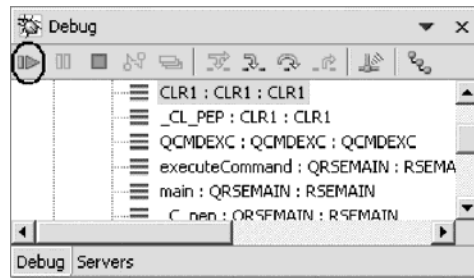
2. Right-click `&COUNT`.
 3. Click **Monitor Expression** on the pop-up menu.
- The Monitors view opens.



The variable appears in the Monitors view. Its current value is zero.

Tip: If you quickly want to see the value of a variable without adding it to the Monitor, leaving the mouse pointer on a variable for a second or so will display its value in a pop-up window.

Now that some breakpoints are set, you can start to run the application.



4. Click the **Resume**  icon from the Debug toolbar.

The program starts running and stops at the breakpoint at line 8. (Be patient, the Debugger has to stop 98 times but because of the condition continues to run until the 99th time.) Notice in the Monitors view, that `&count` now has the value 99.

5. Click the **Resume** icon again.

The program stops at the breakpoint at line 8 again and `&count` now has the value 100.

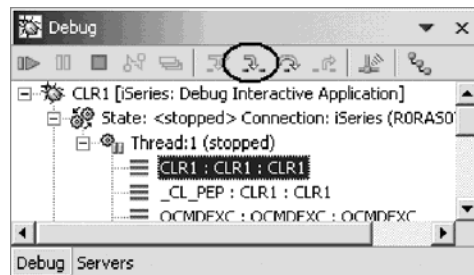
6. Click the **Resume** icon once more so that the program runs to the breakpoint at line 11.

Stepping into a program

The Debugger allows you to step over a program call or step into it. When you step over a program call, the called program runs and the Debugger stops at the next executable statement in the calling program. You are going to step into (Step into) the Payroll program.

To step into a program:

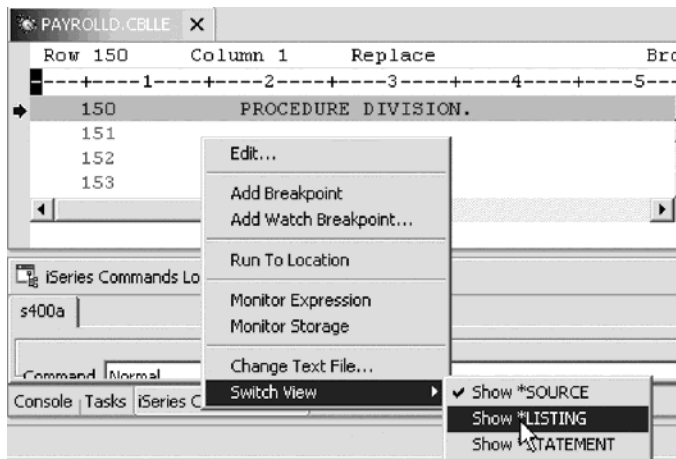
1. Click the **Step into** icon on the Debug toolbar.



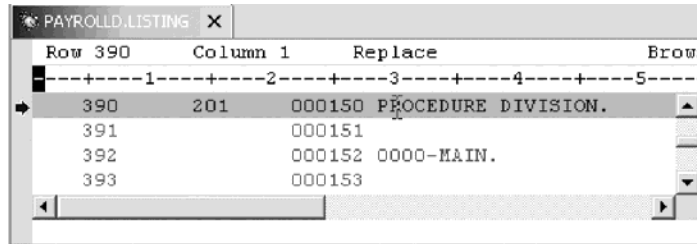
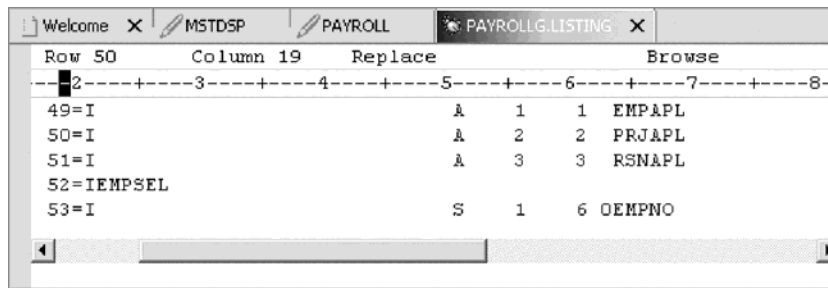


The source of PAYROLLG is displayed if you stepped into RPG or PAYROLLD if you stepped into COBOL. Depending on the option you used to compile the program (*SRCDBG or *LSTDBG for RPG or COBOL, or *SOURCE, *LIST, or *ALL for ILE RPG or ILE COBOL), this window displays either the Source or Listing View.

2. Right-click anywhere in the Source view.



- Click **Switch view > Show *LISTING** on the pop-up menu.

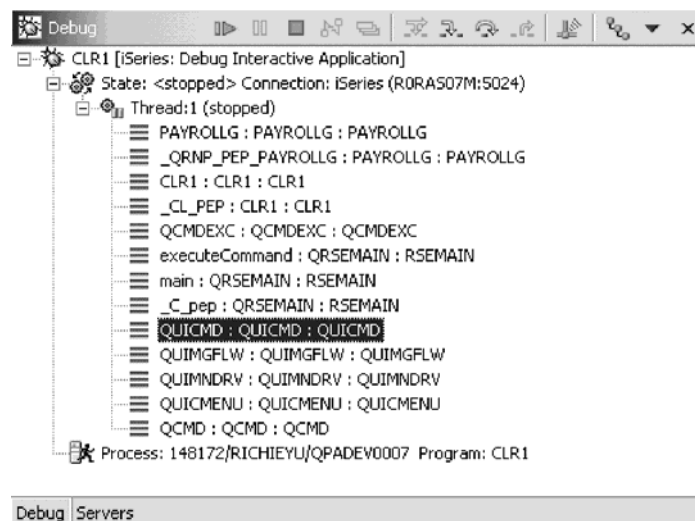


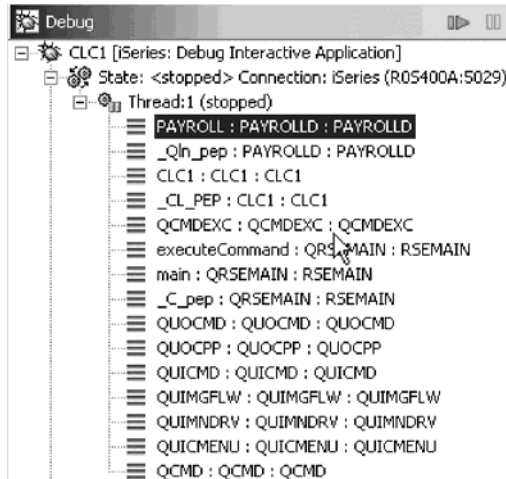
- Page down in the source and take a look at the expanded file descriptions. You don't have any /Copy member in your PAYROLL program but these would also be shown in a Listing view. Switch back to the Source view.
- Right-click anywhere in the Source view.
- Click **Switch view > Show *SOURCE** on the pop-up menu.

Listing call stack entries

The Debug view in the upper left pane, lists all call stack entries. It contains a tree view for each thread. The thread can be expanded to show every program, module, procedure and method that is on the stack at the current execution point. If you double click on a stack entry you will display the corresponding source if it is available. Otherwise the message No Debug data available appears in the Source view.

In the Debug view, expand the stack entry of Thread1 if it is not expanded already.





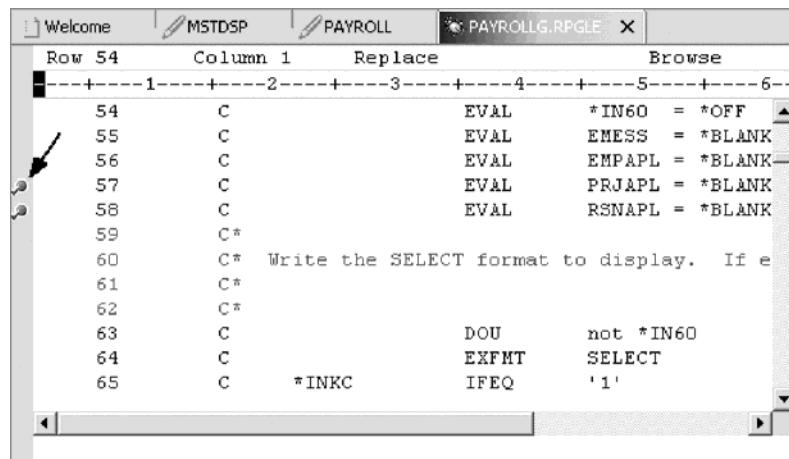
The stack entry allows you to work with and switch between different programs and/or ILE modules.

Setting breakpoints in PAYROLLG or PAYROLLD

Now you add some breakpoints in PAYROLLG or PAYROLLD.

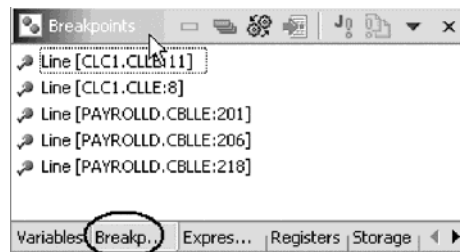
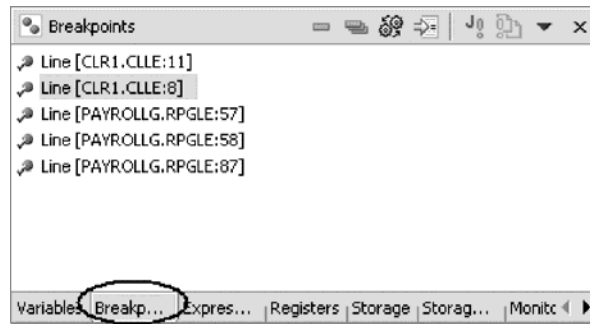
To add breakpoints:

1. Select PAYROLLG or PAYROLLD in Thread1.
2. Scroll to line 57 in PAYROLLG or 201 in PAYROLLD.
3. Double-click the prefix area of line 57 or double-click the prefix area of line 201.
A breakpoint icon is added to the prefix area of this line to indicate that a breakpoint is set.
4. Repeat the above step for line 58 in PAYROLLG or 206 in PAYROLLD.



5. Repeat the above step for line 87 in PAYROLLG or 218 in PAYROLLD.

To view all breakpoints, select the **Breakpoints** tab from the top left pane.



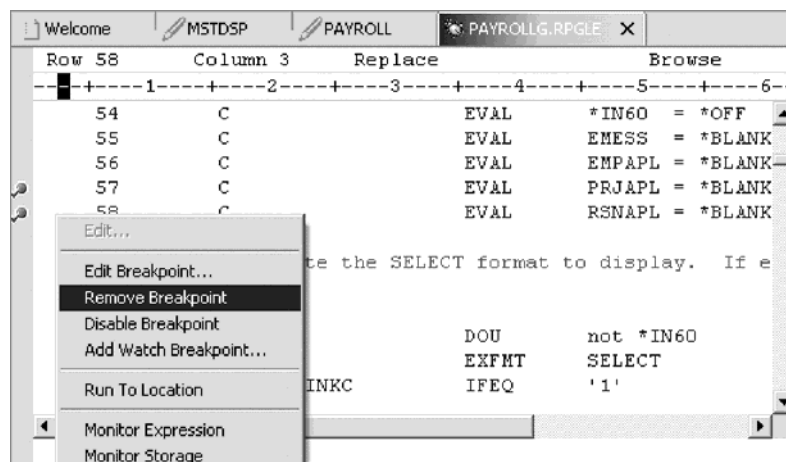
This view shows all breakpoints currently set in your Debug session. This is a convenient place to work with breakpoints. You can remove, disable/enable, add, or edit a breakpoint. These tasks are available from the pop-up menu when you right mouse click in the view area. Double-click any entry to show the source where the breakpoint is set.

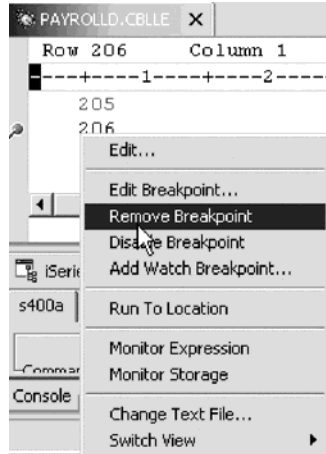
Removing a breakpoint in PAYROLLG or PAYROLLD

It is also easy to remove breakpoints from the Source view.

To remove a breakpoint:


1. Scroll to line 58 and then right-click line 58 in PAYROLLG or 206 in PAYROLLD.
2. Click **Remove Breakpoint** on the pop-up menu.





The icon is removed from the prefix area indicating that no breakpoint is set on that line.

Now you are ready to run the PAYROLLG program or PAYROLLD program.

3. Click the **Resume**  icon from the Debug toolbar.
4. The RPG program PAYROLLG starts running and runs to the breakpoint at line 57. The COBOL program PAYROLLD waits for 5250 input.
5. Click the **Resume** icon again for PAYROLLG.

The program waits for input from the 5250-emulation session.



6. Type an X beside the **Project Master Maintenance** option.
7. Press **Enter** in the emulation session.

The program runs to the breakpoint at line 87 for PAYROLLG or 201 for PAYROLLD.

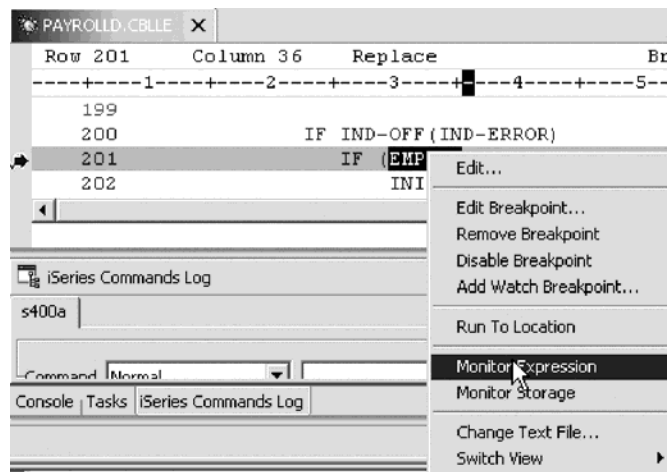
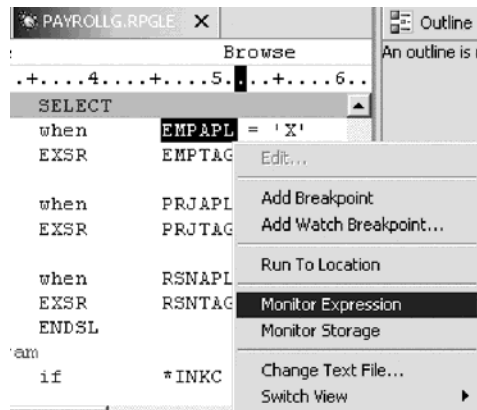
Monitoring variables in PAYROLLG or PAYROLLD

Now lets monitor variables and change them in PAYROLLG or PAYROLLD.

To monitor variables:

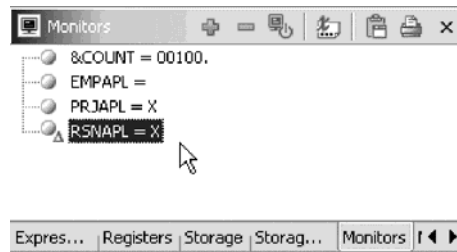
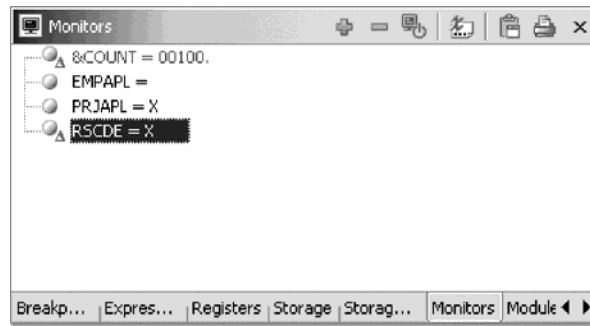
1. In the source view, double-click the variable EMPAPL on line 88 in PAYROLLG or 201 in PAYROLLD.

2. Right-click the variable.
3. Click **Monitor Expression** on the pop-up menu.



4. Click the **Monitors** tab in the upper right pane.
The variable appears in the **Monitors** view. Its value is blank because you did not select the **Employee Master Maintenance** option.
5. In the same way add the variables PRJAPL on line 91 and RSCDE on line 113 to the monitor for PAYROLLG or line 206 for variable PRJAPL and line 244 for variable RSNAPL for PAYROLLD.
Variable PRJAPL equals 'X' because you did select the **Project Master Maintenance** option.
6. In the Monitors view, double-click the variable RSCDE for RPG or RSNAPL for COBOL.
The value changes into an entry field.

- In the value field, type in the new value X for the variable.



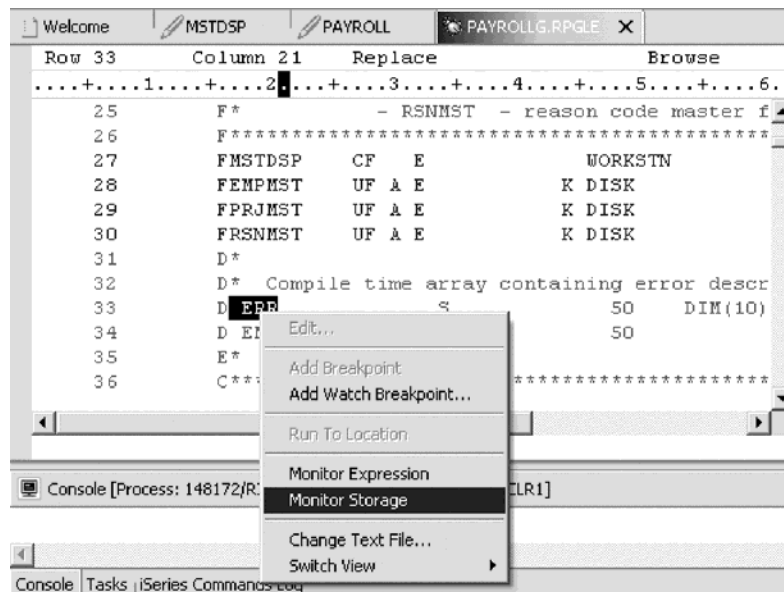
- Press **Enter**.
The variable is successfully changed.

Adding a storage monitor

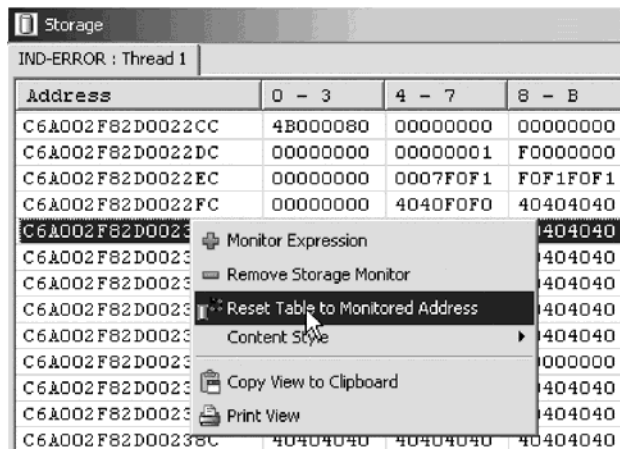
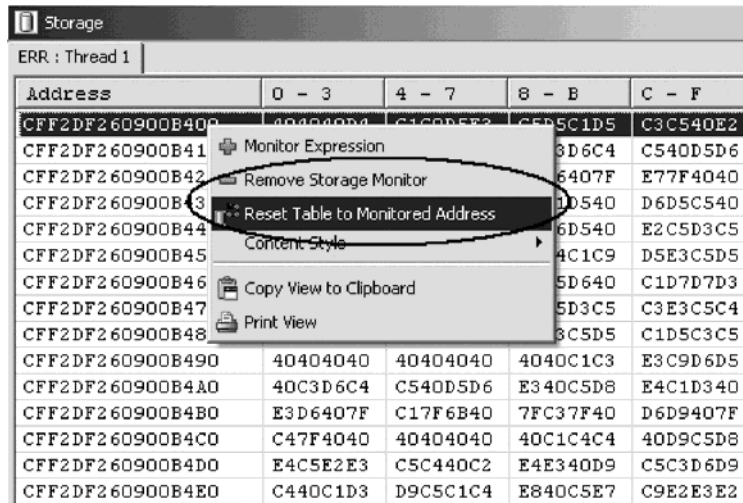
Adding a storage monitor for a variable allows you to view the storage starting with the address where the variable is located. The storage is displayed in hexadecimal and text format.

To add a storage monitor:

- In the Source view, double-click the variable ERR in line 33 for PAYROLLG or IND-ERROR in line 219 for PAYROLLD.
- Right-click and select **Monitor Storage** on the pop-up menu.



A new page is added to the Storage view. The tab shows the name of the variable.



- Use the scroll bar on the right of the Storage view to scroll down. You can see the current content of the memory.
- Right-click in the view area.
- Click **Reset Table to Monitored Address** on the pop-up menu to return to the starting address.
- Right-click the view area.
- Click **Remove Storage Monitor** on the pop-up menu to remove the storage monitor.

Setting watch breakpoints

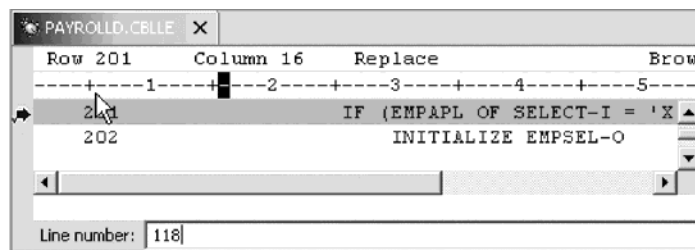
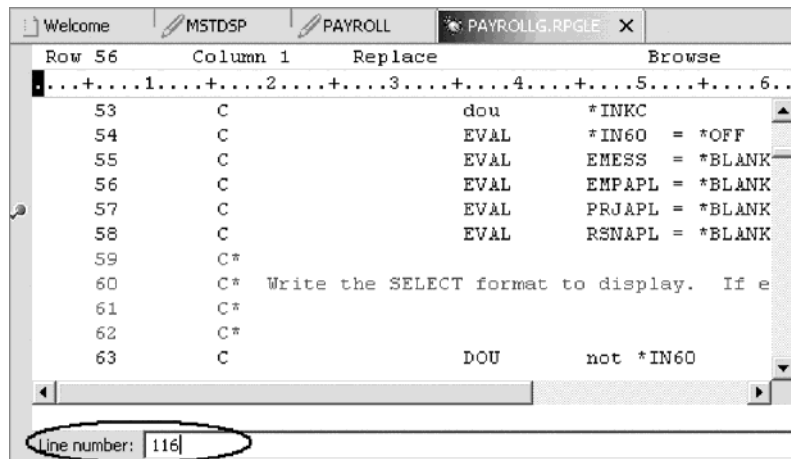
A watch breakpoint provides a notification to the user when a variable changes. It will suspend the execution of the program until an action is taken.

To set a watch breakpoint:

- Click somewhere in the Source view and press **Ctrl+L**.

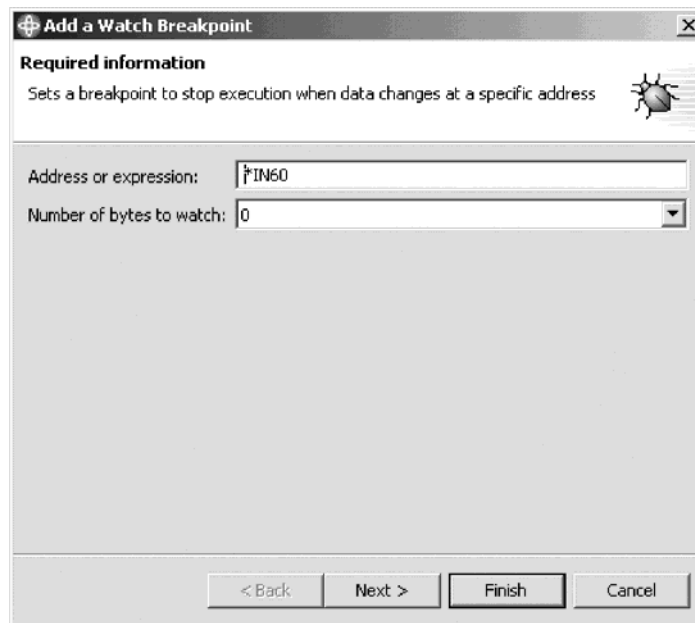
A **Line number** field is added to the bottom of the source area. In this field type 116 to go to that line in PAYROLLG or 118 to go to that line in

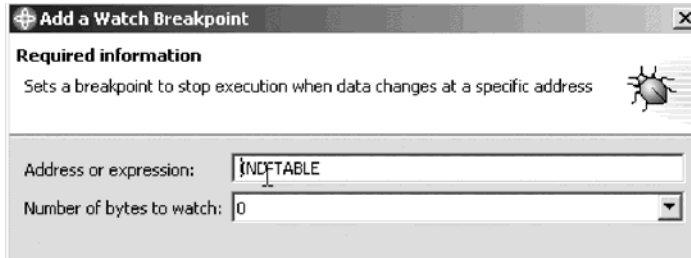
PAYROLLD.



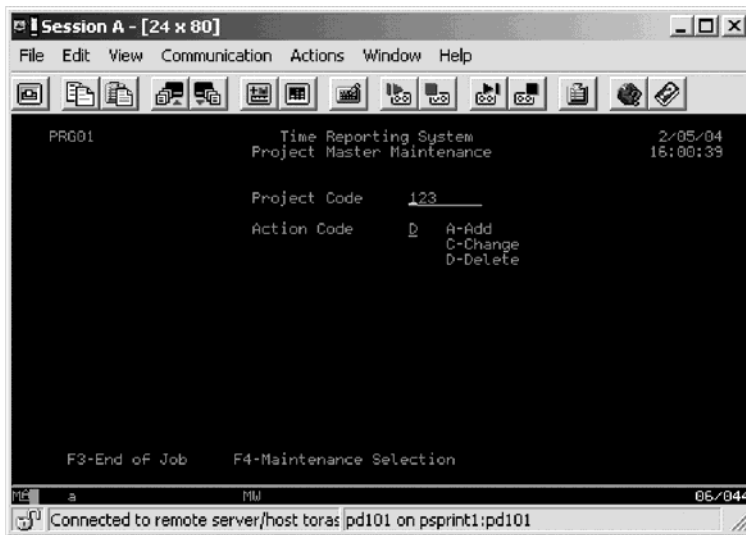
2. Double-click variable *IN60 in PAYROLLG or IND-TABLE in PAYROLLD to highlight it.
3. Right-click and click **Add Watch Breakpoint** on the pop-up menu.

The Add a Watch Breakpoint window opens. The **Expression** field is pre-filled with the highlighted variable *IN60 or IND-TABLE. By default the **Number of bytes to watch** field is set to zero, which means the variable will be watched in its defined length.

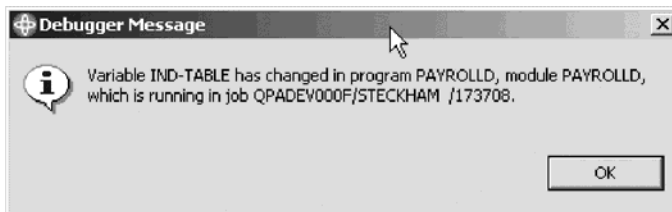
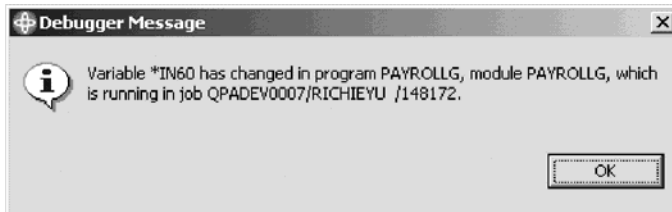




4. Click **Finish**.
The watch breakpoint is now set.
5. Click the **Resume** icon on the Debug toolbar.
The application waits for input from the 5250-emulation session.



6. In the 5250 emulation session, type 123 for **Project Code** and D (for delete) in the **Action Code** field.
7. Press **Enter**. A message is displayed indicating that the variable *IN60 or IND-TABLE has changed.



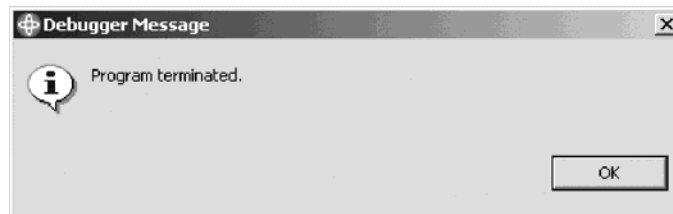
8. Click **OK**. The program stops at line 465 in PAYROLLG or 407 for PAYROLLD. This line is located immediately after the statement which caused the variable *IN60 or IND-TABLE to change.

Closing the debug session

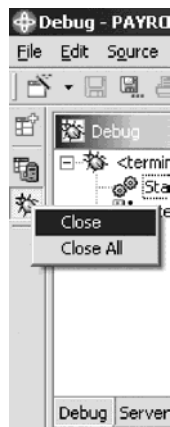
To close the debugger:

1. Click the **Resume** icon on the Debug toolbar.
The application waits for input from the 5250-emulation session.
2. Switch to the 5250 emulation session.
3. Press **F3** to end the job.

A message **Program terminated** appears:



4. Click **OK**.



5. Right-click the **Debug** icon on the left task bar of the workbench.
6. Click **Close** on the pop-up menu.

Checkpoint

Complete the checkpoint below to determine if you are ready to move on to the next module.

1. You can start the debugger:
 - a. From the Remote Systems view
 - b. Launch Configurations window
 - c. Both
2. You can only set breakpoints at executable lines. (T, F)
3. The easiest way to set a breakpoint is to:
 - a. Right-click on the line
 - b. Right-click after the line.
 - c. Right-click before the line
 - d. All of the above
4. You can change variables and indicators in the:
 - a. Remote Systems view

- b. Debug view
 - c. Monitors view
 - d. Storage view
 - e. All of the above
5. The debugger allows you to:
 - a. Step over a program call
 - b. Step into a program call C
 - c. Both
 6. The Debug view lists all call stack entries. It contains a tree view for each thread. (T, F)
 7. You can perform which actions on breakpoints:
 - a. Delete
 - b. Add
 - c. Disable
 - d. Enable
 - e. Edit
 - f. All of the above
 8. Adding a storage monitor for a variable allows you to view the storage starting with the address where the variable is located. (T, F) 9.
 9. The Storage monitor supports these display formats:
 - a. Hexadecimal and character
 - b. Character only
 - c. Decimal
 - d. All of the above
 - e. A and B
 10. A _____ breakpoint provides a notification to a user when a variable changes. It will suspend the execution of the program until an action is taken.
 - a. Watch
 - b. Support
 - c. Java Exception
 - d. Type

More practice

Want more practice? Try this!

Given your experience in working with the debugger features, in your own source, try setting, changing, deleting, enabling, disabling line breakpoints, setting watch breakpoints, displaying and changing variables and viewing the call stack as you debug your program. Use the Development Studio Client online help to assist you in these tasks.

Recap

Congratulations! You have completed this module. You should now understand:

- The purpose of the Debug view, the Monitors view, the Storage Monitor, the Call Stack and the roles of different types of breakpoints
- The actions you can perform on breakpoints

- How to start the debugger
- How to set breakpoints
- How to monitor variables
- How to run and step into a program
- How to view the call stack in the Debug view
- How to remove a breakpoint
- How to add a storage monitor
- How to set watch breakpoints

Chapter 11. Module checkpoint answers

2	3	4	6	7	9	10
1d	1b	1c	1d	1d	1b	1c
2e	2aa,bd,cb, ee	2e	2T	2d	2aa,bb,cd,dc	2T
		3f	3a	3g	3e	3e
		4c	4T	4T	4h	4c
		5T	5d		5T	5c
		6e	6c		6T	6T
		7e	7b		7T	7e
			8c		8T	8T
			9c		9T	9a
			10a			10a
			11d			
			12c			
			13F			
			14d			
			15e			
			16d			
			17d			
			18b			
			19T			

Appendix. Notices

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