IBM Host Access Transformation Services

Advanced Macro Guide

Version 9.5

SC27-5450-01

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Note:
Before using this information and the product it supports, read the information in Appendix B, "Notices," on page 203.

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Chapter 1. Introducing advanced macros

As a developer using Host Access Transformation Services (HATS) Toolkit, you can incorporate macros into your HATS application. The *HATS User's and Administrator's Guide* introduces the use of macros in HATS and describes how to create and modify basic macros. This document describes advanced macro functions that you can incorporate into your macro by using the Visual Macro Editor (VME) and the Advanced Macro Editor (AME). These tools provide graphical user interfaces that you can use to modify or add features to each screen interaction with the host application.

Use these editors to make any of these changes to your HATS macros:

- Add actions, such as new prompts, mouse clicks, or conditional actions.
- Edit and enhance the macro's screen recognition behavior and user input.
- Add more intelligent behavior to the macro, such as choosing between alternate paths through an application.

Note: Support for the Macro Editor and the Advanced Macro Editor is deprecated in HATS V9.5. While support continues for now, IBM reserves the right to remove these capabilities in a subsequent release of the product. This support is replaced by the Visual Macro Editor.

Adapting Host On-Demand macros for use in HATS

This document describes the Host On-Demand macro language and its use. It is extracted from the *Host On-Demand Macro Programming Guide Version 10*, with sections modified to match the implementation of macros and the use of the editors within HATS . This section explains how Host On-Demand macros are adapted for use within HATS.

The macros in a Host On-Demand environment typically run on the user's workstation. Although in a HATS rich client environment macros typically run on the user's workstation, in a HATS Web environment macros typically run on a centralized server. Because of this difference, prompting for data to use in a macro must be done differently in HATS. This document describes opening a prompt panel on the user's workstation, but this is not done in HATS. Instead, HATS retrieves the data for the macro prompt from a HATS global variable, user list, HATS Integration Object input property, or the user through an HTML entry form sent to the user's workstation. Similarly, data extracted from a host screen cannot be immediately displayed on the workstation of a HATS user. Instead, the data is copied into a HATS global variable, copied into a HATS Integration Object output property, or sent to the user's workstation in an HTML page. To help the HATS runtime's macro engine provide these additional macro interaction capabilities, the HATS Toolkit encapsulates each Host On-Demand macro script with another layer of XML that provides the HATS Toolkit and runtime with additional information about the macro script.

The Host On-Demand macro scripts described in this document begin with a <HAScript> tag and end with a </HAScript> tag. In HATS, each Host On-Demand macro script is wrapped within the HATS <macro> begin tag and the </macro> end tag. The <macro> tag contains 4 elements:

- The **<associatedConnections>** tag defines connection definitions to associate with this macro.
  - This helps the Toolkit when building drop-down lists of macro names as you build and configure HATS applications.
  - This element is ignored by the HATS runtime macro engine.
- The **<extracts>** tag defines to the HATS macro engine how to handle data extracted from a host screen while a macro is running. The information in this element is also used to indicate the size and type of Integration Object output properties to be created if the macro is used to create an Integration Object.
  - If the macro is played through a play macro action or a perform macro transaction action, this element controls whether extracted data is stored into a global variable or sent to the user's workstation with an HTML page.
  - If this macro is played outside the HATS runtime's macro engine, this element is ignored. For example, if the macro is run through a HATS Integration Object as a Web Service or as an EJB or a set of JSP pages, the extracted data is copied into output properties of the Integration Object and thus made available to the Web service, EJB Access Bean, or JSP pages, respectively.
  - Although the <extracts> tag is not used by an Integration Object at run time, the <extracts> tag is used to create an Integration Object from the HATS macro, should you choose to do so. In particular, the structure of an Integration Object's output properties is determined by this element. The information in the <extracts> element must agree with the actual <extract> actions found inside the Host On-Demand macro script itself. Otherwise, the data being extracted at run time will not fit correctly into the Integration Object's output properties, which might cause a loss of data. This is especially important when extracting tables of data, because the <extracts> tag will record the name, width, and number of elements in each column of data. The Host On-Demand macro's <extract> tag must indicate the same area so that parsing the data into the column output properties works correctly.
- The **<prompts>** tag describes for the HATS macro engine how to handle data required to complete running the macro. The information in this element also is used to indicate the size and type of Integration Object input properties to be created if the macro is used to create an Integration Object.
  - If the HATS macro engine is running the macro (using a Play macro or Perform macro transaction action) during a screen customization, this element controls whether the required data is obtained from a global variable, from a specified string literal, or is requested from the end user with an HTML page.
  - If this macro is played outside of the HATS runtime's macro engine, this element is ignored, and any required data is supplied by the environment running the macro (Web service, EJB, or Integration Object, for example).
  - Although the <prompts> tag is not used by an Integration Object at run time, the <prompts> tag is used if you choose to create an Integration Object from the HATS macro. In particular, the structure of an Integration Object's input properties is determined by this element. The information in the <prompts> element must agree with the actual <prompt> actions found inside the Host On-Demand macro script itself. Otherwise, the data being supplied by the Integration Object at run time will not satisfy the data required for the Host On-Demand macro's <prompt> actions, which can cause the macro to play incorrectly.
- The **<HAScript>** tag is the Host On-Demand macro script described in this document.

The following example shows the structure with a simple macro containing two prompts and a single extract:

```
<?xml version="1.0" encoding="UTF-8"?>
<macro>
    <associatedConnections default="main">
        <connection name="main"/>
    </associatedConnections>
    <extracts>
        <extract handler="default.jsp" index="-1" indexed="false"
            name="displayID" overwrite="true" save="true" separator=""
            showHandler="false" variableName="displayID"/>
    </extracts>
    <prompts>
        <prompt handler="default.jsp" name="password" separator=""
            source="handler" value="" variableIndex="0"
            variableIndexed="false" variableName="" welApplID="" welIsPassword="false"/>
        <prompt handler="default.jsp" name="userID" separator=""
            source="handler" value="" variableIndex="0"
            variableIndexed="false" variableName="" welApplID="" welIsPassword="false"/>
    </prompts>
    <HAScript author="" blockinput="false" creationdate=""
        delayifnotenhancedtn="0" description=""
        ignorepauseforenhancedtn="false" name="SignOn" pausetime="300"
        promptall="true" supressclearevents="false" timeout="60000" usevars="false">
        <screen entryscreen="true" exitscreen="false" name="Screen1" transient="false">
            <description uselogic="1 and 2">
                <oia invertmatch="false" optional="false" status="NOTINHIBITED"/>
                <string casesense="false" col="35" invertmatch="false"
                    optional="false" row="1" value=" Sign On "/>
            </description>
            <actions>
                <extract assigntovar="" continuous="false" ecol="79"
                    erow="4" name="displayID" planetype="TEXT_PLANE"
                    scol="70" srow="4" unwrap="false"/>
                <prompt assigntovar="" clearfield="false" col="53"
                    default="" description="" encrypted="false" len="10"
                    movecursor="true" name="userID" required="false"
                    row="6" title="" varupdateonly="false" xlatehostkeys="true"/>
                <mouseclick col="53" row="7"/>
                <prompt assigntovar="" clearfield="false" col="53"
                    default="" description="" encrypted="true" len="10"
                    movecursor="true" name="password" required="false"
                    row="7" title="" varupdateonly="false" xlatehostkeys="true"/>
                <input col="0" encrypted="false" movecursor="true"
                    row="0" value="[enter]" xlatehostkeys="true"/>
            </actions>
            <nextscreens timeout="0">
                <nextscreen name="Screen2"/>
            </nextscreens>
        </screen>
        <screen entryscreen="false" exitscreen="true" name="Screen2" transient="false">
            <description uselogic="1 and (2 and 3 and 4)">
                <oia invertmatch="false" optional="false" status="NOTINHIBITED"/>
                <cursor col="7" invertmatch="false" optional="false" row="20"/>
                <numinputfields invertmatch="false" number="1" optional="false"/>
                <string casesense="false" col="32" invertmatch="false"
                    optional="false" row="1" value=" i5/OS Main Menu " wrap="false"/>
            </description>
            <actions/>
            <nextscreens timeout="0"/>
        </screen>
    </HAScript>
</macro>
```

Figure 1. Simple macro structure

The example macro in Figure 1 on page 5 interacts with its environment differently depending on the engine playing the macro:

- If this macro is run by the runtime macro engine in the connect event as a play macro action, for example, the user is prompted by an HTML input form for user ID and password, and the 5250 workstation display ID is stored in the HATS global variable `displayID`. See *HATS User's and Administrator's Guide*, for more information on the Play macro action.
- If instead the macro is run by a HATS Integration Object using a JSP page, a Web service, an EJB Access Bean, or developer-supplied business logic, the macro fails if the Integration Object does not have the required values available in its `getUserID` and `getPassword` methods when the macro is run. This is because an Integration Object supplies its own macro engine where all prompts get data from Integration Object getters, and all extracts place data into Integration Object setters. The names and types of the Integration Object's input properties and the output property are determined by the data in the <prompts> element and the <extracts> element, respectively. See *HATS User's and Administrator's Guide*, for more information on Integration Objects.
- Also note that the above macro does not work as a connect macro associated with a HATS connection on the Connection Editor's Macros tab because connect and disconnect macros are special macros run automatically by the HATS connection management subsystem instead of the runtime macro engine. A connect macro can only use a user list for its prompts. See *HATS User's and Administrator's Guide*, for more information on connect and disconnect macros.

Working with macros in HATS

You can work with macros in several different ways within HATS Toolkit:

- You can record macros in the HATS Toolkit using the host terminal. After you record a macro, it is listed in the HATS Projects view, in the Macros folder. For more information, see the chapter, Macros and host terminal, in the HATS User's and Administrator's Guide.
- To edit a macro, double-click the macro name in the HATS Projects view to open the default editor for the macro. The default editor for HATS macros is the Visual Macro Editor. For more information, see Chapter 10, “Visual Macro Editor,” on page 107.
- To use the basic HATS Macro Editor, right-click the macro name and select **Open With > Macro Editor**. If you open the basic Macro Editor for a macro in this way, then it becomes the default editor for that macro. The tabs on the bottom of this editor enable you to work with the macro in different ways, including editing the XML source of the macro in the source view. For more information, see the chapter, Macros and host terminal, in the HATS User's and Administrator's Guide.
- On the Overview page of the basic HATS Macro Editor, click **Advanced Editor** to work with a macro using the Advanced Macro Editor.

Definitions of terms

Table 1 provides the definitions of a few terms that you will encounter in this book.

Table 1. Definitions of terms

Term	Definition
action	An action is an instruction that specifies some activity that the macro runtime is to perform when it plays back the macro (such as sending a sequence of keys to the host, displaying a prompt in a popup window, capturing a block of text from the screen, and other actions). See Chapter 7, "Macro actions," on page 55. **Note:** An action within a macro is not the same thing as an action triggered by a HATS event.
application screen	An application screen is a meaningful arrangement of characters displayed on the host terminal by a host application. See "Application screen" on page 11.
descriptor	A descriptor is an instruction that describes one characteristic of an application screen. Descriptors are also called screen recognition criteria. See Chapter 5, "Screen description," on page 35.
host terminal	A connection in HATS Toolkit to the host application where you record and run macros.
macro runtime	The macro runtime is the program module that plays back a macro when the macro is started. Specifically, the macro runtime reads the contents of the current macro script and generates the macro playback.
macro screen	A macro screen is a set of instructions that tells the macro runtime how to manage a particular visit to a particular application screen. See "Macro screen" on page 12.
macro script	A macro script is an XML script in which a macro is stored. When you play a macro, the macro runtime executes the instructions in the script. See "Macro script" on page 9.
source view	The source view shows the XML source of a macro.
valid next screen	A valid next screen is a macro screen that, during macro playback, is a valid candidate to be the next macro screen to be processed. See "Stages in processing a macro screen" on page 27.

Samples

You can create a new macro by copying a macro script from this document. This section assumes that you are copying an entire macro script, starting from the beginning designator <HAScript> and ending with the </HAScript> ending designator. To create a new macro in this way, perform the following steps:

1. In HATS Toolkit, select your HATS project and open the host terminal.
2. Record a simple macro to use as a holder for the script:
   a. Click the **Record Macro** icon. The **Record Macro** wizard opens.
   b. Click **Finish** to accept the default values. The **Define Screen Recognition Criteria** wizard opens.
   c. Click **Finish** to accept the default values. The title bar on the host terminal window should display `Recording...`.

d. Click the **Stop Macro** icon. The **Define Screen Recognition Criteria** wizard opens.
e. Click **Finish** to accept the default values.
f. Click the **Save Macro** icon.

3. Edit the macro that you just recorded.
   a. Double-click the name of the macro that you just recorded in the **Macros** folder in the HATS Project View.
   b. Click the **Source** tab at the bottom of the editor to open the source view.
   c. In the source view, delete the lines beginning with <HAScript> and ending with </HAScript>.
   d. Copy the entire text of a macro script from this document to the system clipboard.
   e. Paste the macro script into the source view.
   f. Click **File > Save** (or press Ctrl+S) to save the macro script.

You can edit the macro further using any of the HATS macro editors.

Note: Not all samples in this book are complete macro scripts. A complete macro script starts and ends with the element <HAScript> and does not contain ellipses (ellipses indicate missing information in the samples). Other samples are macro code snippets and need to be pasted into the appropriate location inside an existing, complete macro.

Chapter 2. Macro structure

This chapter describes the general structure of a macro as it can be seen in an XML macro script.

Macro script

A macro script is an XML script used to store a macro. You can view and edit the XML text of a macro script by using the source view of the VME or the basic Macro Editor.

Learning a little about the XML elements of the macro language will greatly increase your understanding of important topics, including the following:

- How to use the macro editors
- How macro playback works
- How to build effective macros

This book refers not only to the input fields, buttons, and list boxes provided by the macro editors, but also to the corresponding XML elements in which the same information is stored.

XML elements

To understand macro scripts you do not need to learn a great deal about XML, just the basics of the syntax. If your knowledge of XML syntax needs brushing up, you can learn more about it in “XML syntax in the Host On-Demand macro language” on page 167. However, almost all of what you need to know is covered in this subsection.

An XML script consists of a collection of XML elements, some of which contain other XML elements, in much the same way that some HTML elements contain other HTML elements. However, unlike HTML, XML allows a program developer to define new XML elements that reflect the structure of the information that the developer wishes to store. The Host On-Demand macro language contains approximately 35 different types of XML elements for storing the information needed to describe a macro. This macro language is described at length in Part 2, “The Host On-Demand macro language,” on page 165.

XML macro element names are enclosed in angle brackets. Examples: <HAScript> element, <screen> element.

Figure 2 shows an example of an XML element:

```
<SampleElement attribute1="value1" attribute2="value2">
...
</SampleElement>
```

Figure 2. Sample XML element

The element `<SampleElement>` shown in Figure 2 contains the key components of every macro element. The first line is the begin tag. It consists of a left angle bracket (<), followed by the name of the XML element (`SampleElement`), followed by attribute definitions, followed by a right angle bracket (>). The second line consists of an ellipsis (...) that is not part of XML syntax but is used in the figure above to indicate the possible presence of other elements inside the `<SampleElement>` element. The third line is the end tag. It contains the name of the element enclosed in angle brackets with a forward slash after the first angle bracket (`</Sample Element>`).

In the begin tag, the attributes are specified by using the attribute name (such as attribute1), followed by an equals sign (=), followed by an attribute value enclosed in quotation marks (such as `"value1"`). Any number of attributes can occur within the begin tag.

If the macro element does not contain other XML elements then it can be written in the shorthand fashion shown in Figure 3:

```
<SampleElement attribute1="value1" attribute2="value2"  />
```

Figure 3. Sample XML element written in the shorthand format

In Figure 3, the element <SampleElement> is written with a left angle bracket (<) followed by the name (`SampleElement`), followed by the attributes, followed by a forward slash and a right angle bracket (/>). Thus the entire XML element is written within a single pair of angle brackets.

Conceptual view of a macro script

A Host On-Demand macro script consists of a single <HAScript> element that can contain up to three major types of subelements:

- One <import> element (optional)
- One <vars> element (optional)
- One or more <screen> elements

Figure 4 shows a conceptual view of a sample macro script.

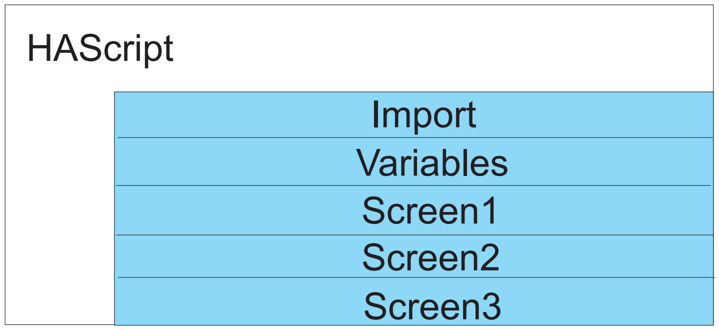


Figure 4. Conceptual view of a macro script

Figure 4 displays a <HAScript> element that contains instances of the major types of subelements: an <import> element (Import), a <vars> element (Variables), and three <screen> elements (Screen1, Screen2, and Screen3).

All macro scripts are structured like this, except that most have more screens. If there were 50 screens in the above macro, then Figure 4 would look much the same, except that after Screen3 there would be additional screens: Screen4, Screen5, and so on, up to Screen50. However, the order in which the screens are stored does not necessarily represent the order in which the screens are executed when the macro is played. See Chapter 4, “How the macro runtime processes a macro screen,” on page 25.

The <HAScript> element is the master element of a macro script. (HAScript stands for Host Access Script.) It encloses the entire macro and also contains, in its begin tag, attributes that contain information applicable to the entire macro, such as the macro's name. For an example of an <HAScript> element, see Figure 1 on page 5.

The <import> element is used to import Java™ classes and is optional. Importing Java classes is an advanced topic that is discussed in Chapter 9, “Variables and imported Java classes,” on page 87.

The <vars> element is used to declare and initialize variables belonging to one of the standard data types (boolean, integer, double, string, or field). Using standard variables is an advanced topic that is discussed in Chapter 9, “Variables and imported Java classes,” on page 87.

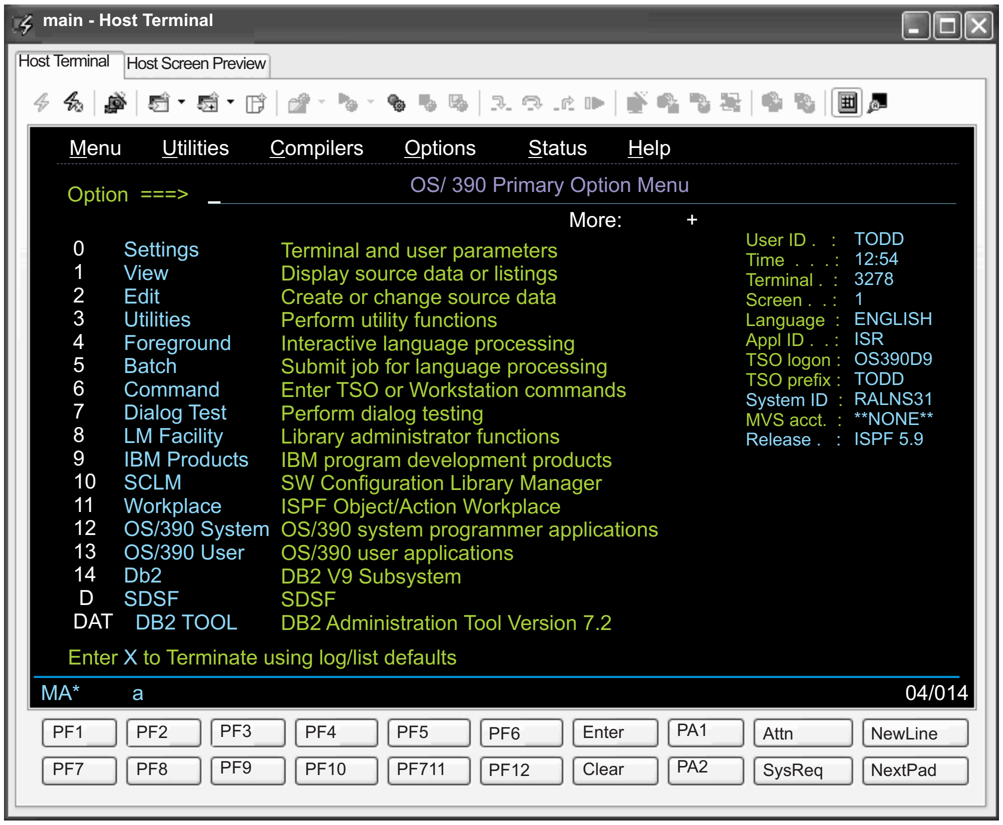
The <screen> element is used to define a macro screen. The <screen> element is the most important element that occurs inside the <HAScript> element. As you can see in Figure 4 on page 10, a macro script is composed mostly of <screen> elements (such as Screen1, Screen2, and Screen3 in the figure). Also, most of the other kinds of XML elements in a macro script occur somewhere inside a <screen> element.

The macro screen and its subcomponents

This section describes the macro screen and its major subcomponents. The definition of macro screen depends on another term, application screen.

Application screen

An application screen is a meaningful arrangement of characters displayed on the host terminal by a host application. An example of an application screen is the OS/390® ISPF Primary Option Menu, which is displayed in Figure 5 on page 12.



```
 Menu  Utilities  Compilers  Options   Status  Help
 ------------------------------------------------------------------
 Option ===> _           OS/ 390 Primary Option Menu
                                   More:     +
                                                    User ID . : TODD
 0   Settings      Terminal and user parameters     Time . . . : 12:54
 1   View          Display source data or listings  Terminal . : 3278
 2   Edit          Create or change source data     Screen . . : 1
 3   Utilities     Perform utility functions        Language : ENGLISH
 4   Foreground    Interactive language processing  Appl ID . . : ISR
 5   Batch         Submit job for language processing  TSO logon : OS390D9
 6   Command       Enter TSO or Workstation commands   TSO prefix : TODD
 7   Dialog Test   Perform dialog testing           System ID : RALNS31
 8   LM Facility   Library administrator functions  MVS acct. : **NONE**
 9   IBM Products  IBM program development products Release . : ISPF 5.9
 10  SCLM          SW Configuration Library Manager
 11  Workplace     ISPF Object/Action Workplace
 12  OS/390 System OS/390 system programmer applications
 13  OS/390 User   OS/390 user applications
 14  Db2           DB2 V9 Subsystem
  D  SDSF          SDSF
 DAT  DB2 TOOL     DB2 Administration Tool Version 7.2

 Enter X to Terminate using log/list defaults
 MA*      a                                              04/014
```

Figure 5. A sample application screen, the OS/390 ISPF Primary Option Menu

In Figure 5 you can see that this application screen has menu selections displayed in a row across the top (`Menu`, `Utilities`, `Compilers`, `Options`, and so on), a title near the top (`OS/390 Primary Option Menu`), a list of options along the left side (`0` through `DAT`), and an input field in which to type an option number or letter (`Option ===>`). When the user provides input, for example by typing a 3 (for `Utilities`) followed by the enter key, the ISPF application removes all these visible items from the host terminal and displays a different application screen.

Macro screen

A macro screen is a set of instructions that tell the macro runtime how to manage a visit to a particular application screen. A macro screen includes:

- A description of a particular application screen
- The actions to take when visiting this particular application screen
- A list of the macro screens that can validly occur after this particular macro screen

Although the concept is not very intuitive at this point, there might be within the same macro several macro screens that refer to the same application screen. Because of the way macro screens are linked to one another, the macro runtime might visit the same application screen several times during macro playback, processing a different macro screen at each visit.

Also, one macro screen might refer to more than one application screen. When several application screens are similar to each other, you might build a macro screen that handles all of the similar application screens.

Nevertheless, each macro screen corresponds to some application screen. When you record a macro, the Macro object creates and stores a macro screen for each application screen that you visit during the course of the recording. If you visit the same application screen more than once, the Macro object creates and stores a macro screen for each visit.

When you play back a recorded macro, the macro runtime processes one or more macro screens for each application screen that it visits during the course of the playback. Typically, a single macro screen runs for a given application screen. However, it is possible for a macro to be edited in such a way that the actions of the first macro screen do not cause the application screen to advance, and a second macro screen then matches the same application screen.

Conceptual view of a macro screen

A macro screen consists of a single <screen> element that contains three required subelements:

- One <description> element (required)
- One <actions> element (required)
- One <nextscreens> element (required, except in an Exit Screen)

Each of the subelements is required, and only one of each can occur.

Figure 6 shows a conceptual view of a <screen> element:

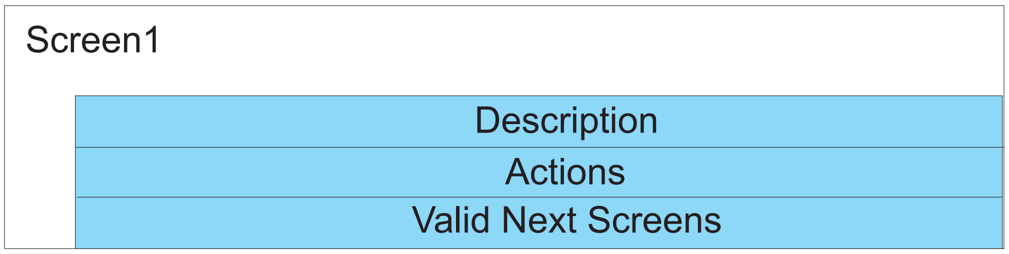


Figure 6. Conceptual view of a <screen> element

Figure 6 shows a <screen> element (Screen1) that contains the three required subelements: a <description> element (Description), an <actions> element (Actions), and a <nextscreens> element (Valid Next Screens).

All <screen> elements are structured in this way, with these three subelements. (A fourth and optional type of subelement, the <recolimit> element, is discussed later in this book.)

The <screen> element is the master element of a macro screen. It contains all the other elements that belong to that particular macro screen, and it also contains, in its begin tag, attributes that contain information applicable to the macro screen as a whole, such as the macro screen's name.

The <description> element contains descriptors that enable the macro runtime to recognize that the <screen> element to which the <description> element belongs is associated with a particular application screen. The descriptors and the <description> element are described in Chapter 5, “Screen description,” on page 35.

The <actions> element contains various actions that the macro runtime performs on the application screen, such as reading data from the application screen or entering keystrokes. The actions and the <actions> element are described in Chapter 7, “Macro actions,” on page 55.

The <nextscreens> element (Valid Next Screens in Figure 6 on page 13) contains a list of the screen names of all the <screen> elements that might validly occur after the current macro screen. The <nextscreens> element and the elements that it encloses are described in Chapter 6, “Screen recognition,” on page 49.

Chapter 3. Data types, operators, and expressions

Basic and advanced macro format

Your macro can be stored in either the basic macro format or the advanced macro format. When you record a macro using the host terminal, it is stored in the basic macro format. If you edit the macro and add support for variables and arithmetic expressions, your macro will be switched to the advanced macro format.

The basic macro format enables you to enter literal values, including integers, doubles, boolean (true or false), and strings.

In addition to the basic macro format functions, the advanced macro format offers these added functions:

- Allows string concatenation using the plus symbol (+) string operator.
- Allows arithmetic expressions.
- Allows conditional expressions.
- Allows variables.
- Allows imported Java variable types and methods.

Representation of strings and non-alphanumeric characters

You must write strings and the two special characters single quote (') and backslash (\) differently in the macro depending on whether you have chosen the basic macro format or the advanced macro format. Also, some characters that are ordinary characters in the basic macro format are used as operators in the advanced macro format, for example, the plus sign (+) and the greater than sign (>).

However, these rules affect only input fields located on editor tabs used to define screens (with the exception of the name), screen actions, and variables and types.

For other input fields, always use the rules for the basic macro format.

The following sections describe these differing rules.

Basic macro format rules

If you have chosen the basic macro format, use the following rules for input fields located on editor tabs used to define screens (with the exception of the name), screen actions, and variables and types:

- Strings must be written without being enclosed in single quotes. Examples:

  ```
  apple
  banana
  To be or not to be
  John Smith
  ```

- The single quote (') and the backslash (\) are represented by the characters themselves without a preceding backslash. Examples:

  ```
  New Year's Day
  c:\Documents and Settings\User
  ```

- The following characters or character sequences are not treated as operators: +, -, *, /, %, ==, !=, >, <, >=, <=, &&, ||, !.

Advanced macro format rules

If you have chosen the advanced macro format, use the following rules for input fields located on editor tabs used to define screens (with the exception of the name), screen actions, and variables and types:

- All strings must be written enclosed in single quotes. Examples:

```
'apple'
'banana'
'To be or not to be'
'John Smith'
```

- The single quote (') and the backslash (\) are represented by the characters themselves preceded by a backslash. Examples:

```
'New Year\'s Day'
c:\\Documents and Settings\\User
```

- The following characters or character sequences are treated as operators:
  - String concatenation operators: +
  - Arithmetic operators: +, -, *, /, %
  - Conditional operators: ==, !=, >, <, >=, <=
  - Logical operators: &&, ||, !

Converting your macro to a different format

Macros in either format, basic or advanced, can be converted to the other format. The conversion process is automated when converting from basic format to advanced, but must be done manually when converting from the advanced to the basic format. Both conversions are described below.

Converting your basic format macro to the advanced format

You can easily convert your macro from the basic macro format to the advanced macro format, by selecting the **Enable support for variables and arithmetic expressions** check box on the **Variables and Types** tab of the macro properties in the VME or the **Use Variables and Arithmetic Expressions in Macro** check box on the **Macro** tab of the AME. As a result the Macro object does the following:

- It enables all the advanced features for your macro.
- It automatically converts, in all input fields where conversion is required, all the strings in your macro and all occurrences of the two special characters single quote (') and backslash (\) from their basic representations to their advanced representations.

That is, the Macro object will find all the strings in your macro and surround them with single quotes, and the Macro object will change all occurrences of ' and \ to \' and \\. Also, any operator characters will be treated as operators.

Converting your advanced format macro to the basic format

Converting your macro from the advanced macro format to the basic macro format can be very difficult. There are no automatic conversions when you clear the option to use variables and arithmetic expressions. The only automatic result is that advanced features are disabled for the macro.

You must manually change, one at a time, all of the representations of strings and the two special characters back to the basic representations. You must also delete any instances where advanced features have been used in the macro. If you do not do so, you might encounter errors or unexpected results when you try to save or run the script. Any remaining advanced macro format operator characters will be treated as literal characters rather than as operators.

Standard data types

The Macro object supports the following standard data types:

- Boolean
- Integers
- Doubles
- Strings

These types are described in the following subsections.

Boolean data

The boolean values *true* and *false* can be written with any combination of uppercase and lower case letters (such as True, TRUE, FALSE, falsE, and so on).

Examples of fields that require a boolean value are the **Entry screen**, **Exit screen**, and **Transient screen** fields for a macro screen definition. Enter `true` to set the condition to true or `false` to set the condition to false.

Boolean values are not strings

Boolean values are not strings and are therefore never enclosed in single quotes. For example, whether you use the basic macro format or the advanced macro format, booleans are always written `true` and `false`, not `'true'` and `'false'`.

However, string values are converted to boolean values within a boolean context (see "Conversion to boolean" on page 21). Therefore with the advanced macro format you could enter the string `'true'` within a boolean field because the macro editor would convert the string `'true'` to the boolean value `true`.

Integers

Integers are written without commas or other delimiters. Examples:

```
10000
0
-140
```

Integer constants

The macro editor has a number of integer constants that are written using all uppercase characters. These values are treated as integers, not strings. Examples:

- NOTINHIBITED
- FIELD_PLANE
- COLOR_PLANE

Doubles

Doubles are written without commas or other delimiters. Examples:

```
3.1416
4.557e5
-119.0431
```

Strings

A string is any sequence of characters and can include leading, trailing, or intervening blank characters. Strings in some input fields must be represented differently, depending on whether the macro has been set to use the basic macro format or the advanced macro format. See "Representation of strings and non-alphanumeric characters" on page 15.

The following examples use the advanced macro format representation:

```
'apple'
'User4'
'Total number of users'
'   This string has 3 leading blanks.'
'This string has 3 trailing blanks.   '
```

Here are the same examples using the basic macro format representation:

```
apple
User4
Total number of users
   This string has 3 leading blanks.
This string has 3 trailing blanks.
```

Notice that with the basic macro format, trailing blanks are still allowed but are difficult to detect. If in doubt, see the representation of the string in the source view.

Fields

See "Field variables" on page 91.

The value null

The value *null* is a reserved word, not a string. When used in place of an object belonging to an imported Java class, it has the same meaning as it does in the Java language.

Do not use *null* to signify an empty string. To signify an empty string, use a pair of single quotes ('') in the advanced macro format, or nothing at all in the basic macro format. If you use the value *null* in a string context (for example, by assigning it to a string variable), then the macro editor or the macro runtime will convert the value *null* to the string `'null'`.

Arithmetic operators and expressions

In order to use arithmetic expressions you must first select the **Enable support for variables and arithmetic expressions** check box on the **Variables and Types** tab of the macro properties in the VME or select the **Use Variables and Arithmetic Expressions in Macro** check box on the **Macro** tab of the AME. For more information, see "Representation of strings and non-alphanumeric characters" on page 15).

The arithmetic operators are shown in Table 2.

Table 2. Arithmetic operators

Operator	**Operation**
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Modulo

In an arithmetic expression the terms are evaluated left to right. The order of precedence of the operators is: *, /, %, +, -. For example, the result of the following expression is 8:

```
4 * 2 + 16 / 8 - 1 * 2
```

You can use parentheses to indicate the order in which you want expressions to be evaluated:

```
(4 * 2) + (16 / 8) - (1 * 2)    evaluates to 8
but
4 * (( 2 + 16) / (8 - 1)) * 2   evaluates to 20.571
```

Using arithmetic expressions

You can use an arithmetic expression almost anywhere that you can use an arithmetic value. Examples:

- As a parameter for a screen, for example:
  - To specify a recognition limit for a screen
  - To specify a pause time for a screen
- As a parameter for a descriptor, for example:
  - To specify a row or column in cursor descriptor
  - To specify the number of fields in a numeric field count descriptor
  - To specify a row, column, or attribute value in an attribute descriptor
  - As a term in a conditional descriptor
- As a parameter in an action, for example:
  - To specify a row or column in a mouse click action
  - As the number of milliseconds in a pause action
  - To specify a value in a variable update action
  - As a term in a conditional action
- As an initial value for a variable

String concatenation operator (+)

You can use the string concatenation operator plus symbol (+) only if you use variables and arithmetic expressions in your macro. See “Basic and advanced macro format” on page 15.

You can write a string expression containing multiple concatenations. The following examples use the string representation required for the advanced format (see “Representation of strings and non-alphanumeric characters” on page 15).

```
Expression:               Evaluates to:

'Hello ' + 'Fred' + '!'   'Hello Fred!'
'Hi' 'There'              (Error, a + operator is required to concatenate strings)
'Hi' + 'There'            'HiThere'
```

Conditional and logical operators and expressions

The conditional operators are shown in Table 3.

Table 3. Conditional operators

Operator	Operation
==	Equal

Table 3. Conditional operators (continued)

Operator	Operation
!=	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal

The logical operators are shown in Table 4.

Table 4. Logical operators

Operator	Operation
&&	AND
||	OR
!	NOT

If you are entering && in an HTML or XML editor you might have to enter &amp;&amp;

In a conditional expression the terms are evaluated left to right. The order of precedence of the operators is the same order in which they are listed in the tables above. You can use parentheses to indicate the order in which you want expressions to be evaluated. Examples:

```
Expression:                 Evaluates to:

(4 > 3)                     true
!(4 > 3 )                   false
(4 > 3) && (8 > 10)         false
(4 > 3) || (8 > 10)         true
```

A conditional expression can contain arithmetic expressions, variables, and calls to methods of imported Java classes.

Conditional and logical operators can be used in only two contexts:
- The Condition field of a conditional descriptor
- The Condition field of a conditional action

Automatic data type conversion

Effect of context

If an item of data belongs to one standard data type (boolean, integer, double, or string) but the context requires a different standard data type, then when the data is evaluated (either when the macro editor saves the data or when the macro runtime plays the macro) it is automatically converted to the standard data type required by the context, if possible.

Examples of context are:
- The **Condition** field of a Condition descriptor (expects a boolean value)
- The **Value** field of a Variable update action when the variable is a field variable (expects a location string)
- The Row value of an Input action (expects an integer value)

However, if the data cannot be converted to the new data type (for example, the string `123apple` cannot be converted to an integer), then an error occurs. The macro editor displays an error message. The macro runtime stops the macro playback and displays an error message.

The following subsections discuss the conversions that can occur for each standard data type.

Conversion to boolean

The string `'true'` (or `'TRUE'`, `'True'`, and so on) in a boolean context is converted to boolean true. Any other string in a boolean context (including `'false'`, `'1'`, `'apple'`, and any other) is converted to boolean false.

```
'true' (in an input field that requires a boolean)  converts to true
'apple' (in an input field that requires a boolean)  converts to false
```

Conversion to integer

A string in valid integer format and occurring in an integer context converts to integer.

```
'4096'               converts to      4096
'-9'                 converts to      -9
```

Conversion to double

A string in valid double format occurring in a double context converts to double.

```
'148.3'               converts to 148.3
```

An integer combined with a double results in a double:

```
10 +  6.4            evaluates to 16.4
```

Conversion to string

A boolean, integer, or double in a string context converts to a string. (The boolean values true and false are not strings. See “Boolean data” on page 17.) The following values, when specified for an input field requiring a string value (such as the String field of an Input action), will evaluate to the specified result.

```
'The result is ' + true                        evaluates to 'The result is true'
FALSE (in an input field that requires a string) converts to 'false'
'The answer is ' + 15                          evaluates to 'The answer is 15'
22 (in an input field that requires a string)   converts to  '22'
14,52 (in an input field that requires a string) evaluates to'14,52'
```

Conversion errors

If the context requires a conversion but the format of the data is not valid for the conversion then the macro editor displays an error message. For example, typing '123apple' into the Row field of an Input action will cause an error message to be displayed and the previous value will be restored.

Equivalents

Any context that accepts an immediate value of a particular standard data type also accepts any entity of the same data type.

For example, if an input field accepts a string value, such as `'Standard Dialog'`, it also accepts:

- An expression that evaluates to a string

- A value that converts to a string
- A string variable
- A call to an imported method that returns a string

Similarly, if an input field accepts a boolean value (true or false), it also accepts:
- An expression that evaluates to a boolean value
- A value that converts to a boolean value
- A boolean variable
- A call to an imported method that returns a boolean

Recognizing this flexibility in the macro facility will help you write more powerful macros.

Significance of a negative value for a row or column

In the String descriptor and in several other descriptors and actions, a negative value for a row or column indicates an offset from the last row or the last column of the host terminal. The macro runtime calculates the row or column location as follows:

```
actual row    = (number of rows in text area)    + 1 + (negative row offset)
actual column = (number of columns in text area) + 1 + (negative column offset)
```

For example, if the host screen has 24 rows of text then a row coordinate of -1 indicates an actual row coordinate of 24 (calculated as: 24 + 1 - 1). Similarly if the host screen has 80 columns of text then a column coordinate of -1 indicates an actual column coordinate of 80 (calculated as 80 + 1 - 1).

The row calculation above ignores the OIA row. For example, if the host screen has 25 rows, it has only 24 rows of text.

The advantage of this convention is that if you want to specify a rectangle at the bottom of the host terminal, then this calculation gives the right result whether the host screen has 25, 43, or 50 rows. Similarly, if you want to specify a rectangle at the right side of the host terminal, then this calculation gives the right result whether the host screen has 80 columns or 132 columns.

Table 5 and Table 6 show the results for a few calculations:

Table 5. Negative value for row

Negative value for row:	Actual value in host terminal with 24 rows of text (OIA row is ignored):	Actual value in host terminal with 42 rows of text (OIA row is ignored):	Actual value in host terminal with 49 rows of text (OIA row is ignored):
-1	24	42	49
-2	23	41	48
-3	22	40	47

Table 6. Negative value for column

Negative value for column:	Actual value in host terminal with 80 columns:	Actual value in host terminal with 132 columns:
-1	80	132
-2	79	131

Table 6. Negative value for column (continued)

Negative value for column:	Actual value in host terminal with 80 columns:	Actual value in host terminal with 132 columns:
-3	78	130

Whether you use this convention or not, you should at least remember that a rectangular area with coordinates of (1,1) and (-1,-1) means the entire text area of the host terminal.

Chapter 4. How the macro runtime processes a macro screen

This section describes the activities that occur when the macro runtime processes a macro screen.

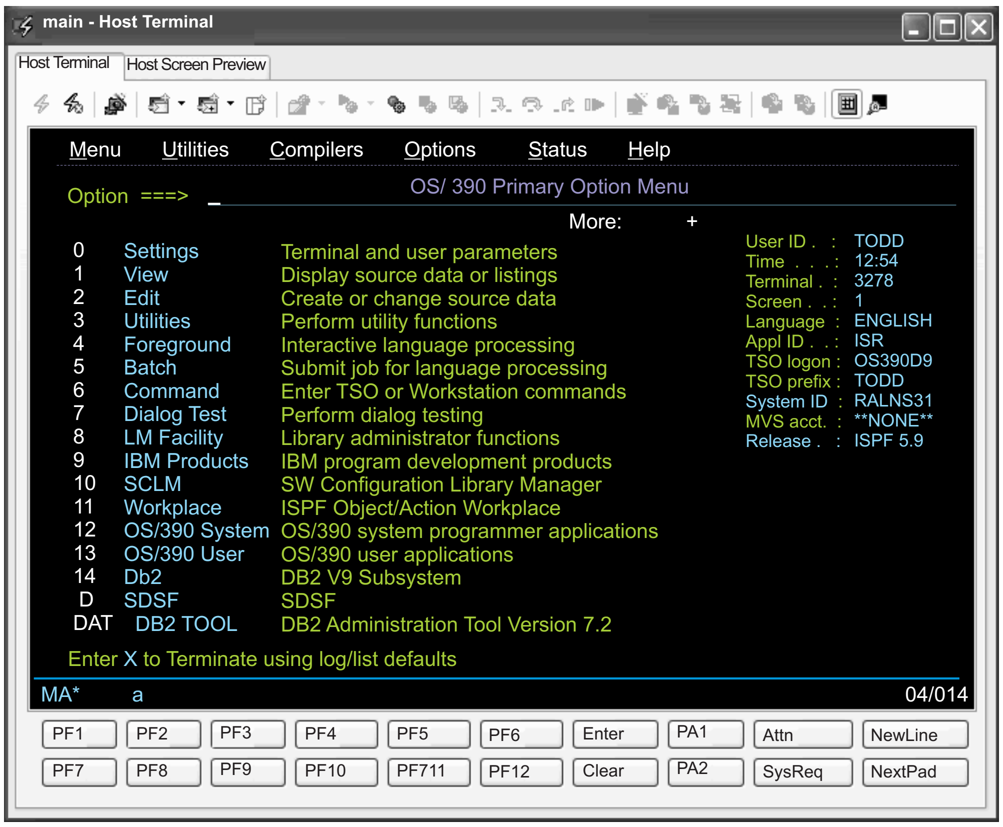
Overview of macro runtime processing

Scenario used as an example

As an example, this chapter uses a scenario from a macro. This macro contains only two macro screens, Screen1 and Screen2.

The scenario begins at the point at which the macro runtime has performed all the actions in Screen1 and is ready to search for the next macro screen to be processed.

Screen1 is the macro screen that handles the OS/390 ISPF Primary Option Menu (see Figure 7).



```
 Menu   Utilities   Compilers   Options   Status   Help

 Option ===> _              OS/ 390 Primary Option Menu
                                          More:     +
                                                          User ID .  :  TODD
 0   Settings      Terminal and user parameters            Time  . . . :  12:54
 1   View          Display source data or listings         Terminal .  :  3278
 2   Edit          Create or change source data            Screen . .  :  1
 3   Utilities     Perform utility functions               Language   :  ENGLISH
 4   Foreground    Interactive language processing         Appl ID . . :  ISR
 5   Batch         Submit job for language processing      TSO logon  :  OS390D9
 6   Command       Enter TSO or Workstation commands       TSO prefix :  TODD
 7   Dialog Test   Perform dialog testing                  System ID  :  RALNS31
 8   LM Facility   Library administrator functions         MVS acct.  :  **NONE**
 9   IBM Products  IBM program development products        Release .  :  ISPF 5.9
 10  SCLM          SW Configuration Library Manager
 11  Workplace     ISPF Object/Action Workplace
 12  OS/390 System OS/390 system programmer applications
 13  OS/390 User   OS/390 user applications
 14  Db2           DB2 V9 Subsystem
 D   SDSF          SDSF
 DAT  DB2 TOOL     DB2 Administration Tool Version 7.2

 Enter X to Terminate using log/list defaults
MA*     a                                                                04/014
```

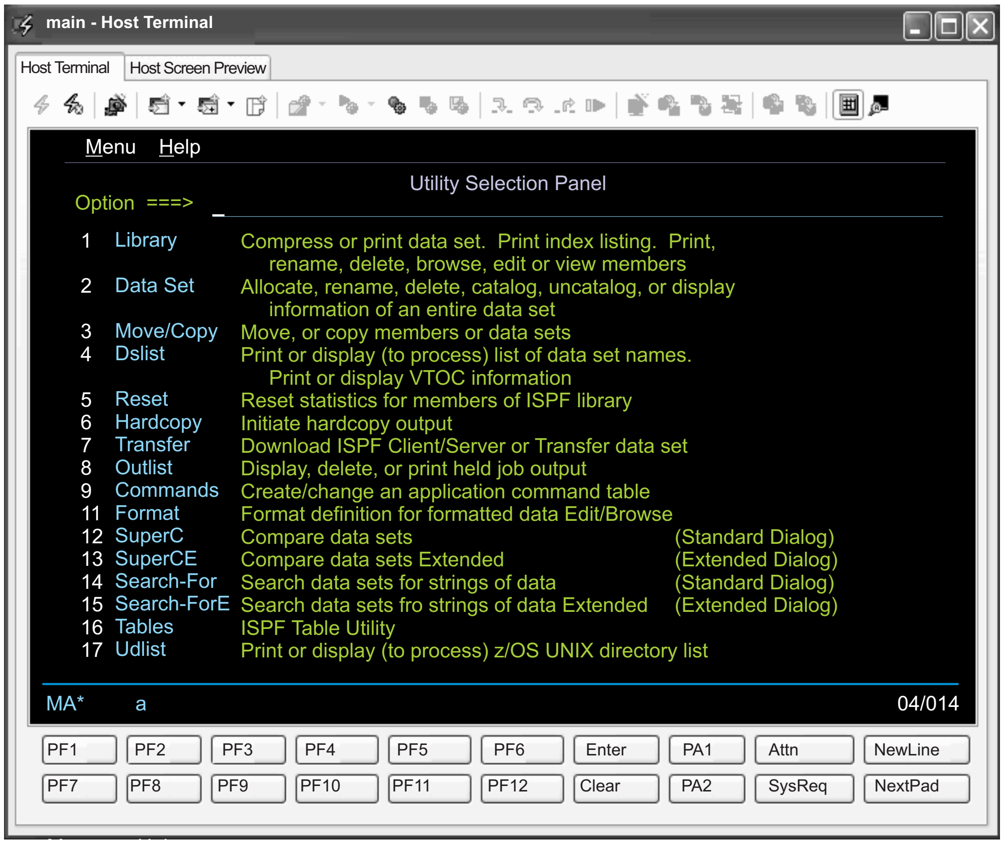
Figure 7. The OS/390 ISPF Primary Option Menu

Table 7 on page 26 shows a conceptual view of the contents of Screen1:

Table 7. Contents of macro screen Screen1

XML element contained in <screen> element Screen1:	Contents of XML element:
<description>	Descriptors: • The input inhibited indicator is cleared (input is not inhibited).
<actions>	Actions: 1. Move the text cursor to row 4 and column 14. 2. Type '3[enter]'.
<nextscreens>	Names of macro screens that can validly occur after this macro screen: • Screen2

Screen2 is the macro screen that handles the Utility Selection Panel (see Figure 8).



```
  Menu  Help
                          Utility Selection Panel
 Option  ===> _

  1  Library       Compress or print data set.  Print index listing.  Print,
                      rename, delete, browse, edit or view members
  2  Data Set      Allocate, rename, delete, catalog, uncatalog, or display
                      information of an entire data set
  3  Move/Copy     Move, or copy members or data sets
  4  Dslist        Print or display (to process) list of data set names.
                      Print or display VTOC information
  5  Reset         Reset statistics for members of ISPF library
  6  Hardcopy      Initiate hardcopy output
  7  Transfer      Download ISPF Client/Server or Transfer data set
  8  Outlist       Display, delete, or print held job output
  9  Commands      Create/change an application command table
 11  Format        Format definition for formatted data Edit/Browse
 12  SuperC        Compare data sets                          (Standard Dialog)
 13  SuperCE       Compare data sets Extended                 (Extended Dialog)
 14  Search-For    Search data sets for strings of data       (Standard Dialog)
 15  Search-ForE   Search data sets fro strings of data Extended  (Extended Dialog)
 16  Tables        ISPF Table Utility
 17  Udlist        Print or display (to process) z/OS UNIX directory list

MA*      a                                                                04/014
```

Figure 8. The Utility Selection Panel application screen

Table 8 on page 27 shows a conceptual view of the contents of Screen2:

Table 8. Contents of macro screen Screen2

XML element contained in <screen> element Screen2:	**Contents of XML element:**
<description>	Descriptors: • The input inhibited indicator is cleared (input is not inhibited). • There are 80 fields. • There are 3 input fields.
<actions>	Actions (the host application positions the text cursor in the correct input field): 1. Type '4[enter]'.
<nextscreens>	Names of macro screens that can validly occur after this macro screen: • (None. This is the last macro screen in the macro.)

Stages in processing a macro screen

During macro playback the macro runtime loops through the same three stages of activity again and again until the macro terminates, as summarized below. Notice that stage 1 has three steps within it.

1. Determine the next macro screen to be processed.
   - Step a. Add the names of candidate macro screens to the list of valid next screens.
   - Step b. Do screen recognition to match one of the candidate macro screens to the actual application screen that is currently displayed in the host terminal .
   - Step c. Remove the names of candidate macro screens from the list of valid next screens.
2. Make the selected macro screen the new current macro screen.
3. Perform the actions in the new current macro screen's <actions> element.

Stage 1

As noted above, stage 1 has three steps and, therefore, requires a more detailed explanation than stages 2 or 3. Each of these steps involves the list of valid next screens.

The list of valid next screens is just a list that can hold macro screen names. The macro runtime creates this list at the beginning of macro playback (before playing back the first macro screen), and discards this list after macro playback is complete. Initially the list is empty (except possibly for transient screens, which are described in “How the macro runtime selects the names of candidate macro screens” on page 29).

During macro playback, each time the macro runtime needs to determine the next macro screen to be processed, it performs the three steps 1(a), 1(b), and 1(c) using the list of valid next screens.

Overview of all 3 stages of the entire process

In stage 1 the macro runtime determines the next macro screen to be processed. As stated in the previous section, stage 1 includes three steps.

In step 1(a) the macro runtime collects the names of macro screens that can occur after the current macro screen, and adds these names to the list of valid next screens. There might be just one such screen in the list or several. In the example scenario, the macro runtime would look in the <nextscreens> element of Screen1, find one name (Screen2), and add that name to the list (see Table 7 on page 26).

In step 1(b), the macro runtime periodically checks each macro screen on the list to determine whether it matches the application screen.

Timing is a factor in this step. Because of an action that the macro runtime has just performed in the current macro screen (in Screen1, typing '3[enter]' as the last action of the <actions> element), the host application is in the process of changing the host terminal so that it displays the new application screen (the Utility Selection Panel) instead of the old application screen (ISPF Primary Option Menu). However, this change does not occur immediately or all at once. The change takes some hundreds of milliseconds and might require several packets of data from the host.

Therefore, during step 1(b), every time the OIA line or the host terminal's presentation space is updated, the macro runtime again checks the macro screen (or screens) named in the list of valid next screens to determine whether one of them matches the application screen in its current state.

Eventually the host terminal is updated to the extent that the macro runtime is able to match one of the macro screens on the list to the application screen.

In step 1(c), the macro runtime removes all the macro screen names from the list of valid next screens (except transient screens if any).

In stage 2, the macro runtime makes the selected macro screen, the one that matched the application screen in step 1(b), the new current macro screen.

Finally, in stage 3, the macro runtime performs the actions in the <actions> element of Screen2.

The remainder of this chapter provides detailed information about the stages and steps presented in the above overview.

Stage 1: Determining the next macro screen to be processed

As stated earlier, stage 1 contains three steps: adding macro screen names to the list of valid next screens, doing screen recognition, and removing the macro screen names from the list of valid next screens.

Step 1(a): Adding macro screen names to the list of valid next screens

In this step the macro runtime places the names of candidate macro screens on the list of valid next screens.

Valid next screens

When a host application has displayed an application screen in the host terminal, and a user input has occurred, then usually only a few application screens (frequently just one) can occur next.

In the example scenario, the current macro screen is Screen1, the current application screen is the ISPF Primary Option menu, and the input is `'3'` plus the enter key (see Table 7 on page 26). In this context, only one application screen can occur next, the Utility Selection Panel. Therefore the name of only one macro screen needs to be added to the list of valid next screens: Screen2.

This might seem at first to be counter-intuitive. After all, the ISPF Primary Option Menu has about 30 different possible inputs (15 options, 6 menu selections, and 8 function keys). There should be 30 names of macro screens on the list, not just 1, right?

The reason that the list of valid next screens usually has only one or a few names on it is that the macro is executing a series of instructions that are aimed at accomplishing some specific task. In Screen1, the instructions are aimed at getting from the ISPF Primary Option Menu to the Utility Selection Panel. The necessary actions have been performed to make this transition occur (`'3[enter]'`), and the macro screen is now just waiting for the expected application screen to appear.

How the macro runtime selects the names of candidate macro screens

This section describes how the macro runtime selects the macro screen names that it places on the list of valid next screens. There are two cases:

- For the very first macro screen to be played back, the macro runtime selects the name of any macro screen in the macro that is marked as an entry screen.
- For all subsequent macro screens being played back, the macro runtime uses the names that it finds in the <nextscreens> element of the current macro screen.

First macro screen: When macro playback begins, the list of valid next screens is empty (except possibly for transient screens, see "Transient screens" on page 30).

To get candidates for the first macro screen to be processed, the macro runtime searches the entire macro, finds each macro screen that is marked as an entry screen, and adds the names of these macro screens to the list.

The entry screen setting (an attribute of the <screen> element) exists for exactly this purpose, to mark macro screens that can occur as the first screen to be processed.

When a macro is recorded, the Macro object by default marks just the first macro screen to be recorded as an entry screen. After recording is complete, you can mark (or unmark) any macro screen as an entry screen, and there can be multiple entry screens.

Entry screens are described in more detail in "Entry screens" on page 49.

If no macro screen is marked as an entry screen, then the macro runtime uses all the macro screens in the macro as candidates for the first macro screen to be processed.

Subsequent macro screens: For subsequent macro screens (including the one immediately after the first macro screen), the macro runtime finds the names of the candidate macro screens listed in the <nextscreens> element of the current macro screen.

In the example scenario, Screen1 is the current macro screen, and its <nextscreens> element contains the name of one macro screen, Screen2 (see Table 7 on page 26). Therefore the macro runtime adds Screen2 to the list.

All of the macro screen names listed in the element are added to the list of valid next screens by the macro runtime.

During macro recording, when the Macro object begins to record a new macro screen, it stores the name of that new macro screen (such as Screen2) in the <nextscreens> element of the macro screen that it has just finished recording (such as Screen1). Therefore each macro screen (except the last) of a recorded macro has the name of one macro screen stored in its <nextscreens> element.

Subsequently you can add or delete the name of any macro screen in the macro to or from the <nextscreens> element of any macro screen.

The <nextscreens> element is described in more detail in "Recognizing valid next screens" on page 49.

Transient screens: A transient screen is a screen that can occur at any point in the macro, that occurs unpredictably, and that always needs to be cleared. An example of a transient screen is an error screen that appears in response to invalid input.

The Macro object does not mark any macro screen as a transient screen during macro recording. However, subsequently you can mark any macro screen as a transient screen.

When macro playback begins, the macro runtime searches the macro, finds each macro screen that is marked as a transient screen, and adds the name of each transient macro screen to the list of valid next screens. These names remain on the list for the duration of the macro playback.

For more information on transient screens see "Transient screens" on page 50.

Step 1(b): Screen recognition

In this step the macro runtime matches one of the macro screens named in the list of valid next screens to the current application screen.

This process is called screen recognition because the macro runtime recognizes one of the macro screens on the list as corresponding to the application screen that is currently displayed in the host terminal.

Overview of evaluation

The macro runtime evaluates the candidate macro screens in the order in which their names appear in the list of valid next screens.

If the macro runtime finds that one of the candidates matches the application screen, then the macro runtime immediately stops evaluating and goes on to the next step of removing the candidate names from the list, step 1(c). The matching screen becomes the next macro screen to be processed (stage 2).

However, if the macro runtime evaluates each macro screen named in the list without finding a match, then the macro runtime stops evaluating, temporarily, and does nothing further until the host terminal is updated.

Repeated screen evaluations

While the macro runtime is working on screen recognition, the host application is working on updating the host terminal with the new application screen. In the example scenario, the host application is updating the host terminal so that it displays the Utility Selection Panel. This process takes some hundreds of milliseconds and might require several packets of data from the host.

This situation explains why the macro runtime temporarily stops working on screen recognition until the screen is updated. If screen recognition has failed, the reason might be that the new application screen is incomplete. Therefore the macro runtime waits.

Each time that the OIA line is updated or the presentation space of the host terminal is updated, the macro runtime again makes a pass through the list of valid next screens, trying to find a match to the current application screen. If no match occurs then the macro runtime waits again.

The macro runtime might go through several cycles of waiting and evaluation before screen recognition succeeds.

Eventually, enough of the new application screen arrives so that the macro runtime can match one of the macro screens named in the list to the new application screen.

Determining whether a macro screen matches the application screen

The macro runtime determines whether a macro screen matches the current application screen by comparing individual descriptors in the macro screen to the current host terminal screen.

In the example scenario, the macro runtime finds the name Screen2 on the list of valid next screens, retrieves Screen2, looks at its descriptors, and compares the descriptors with the host terminal.

Each macro screen contains a <description> element that itself contains one or more descriptors. A descriptor is a statement of fact about the host terminal (application screen in its current state) that can be either true or false. In the example scenario, Screen2 contains three descriptors:

- The input inhibited indicator is cleared (input is not inhibited).
- There are 80 fields in the host terminal.
- There are 3 input fields in the host terminal.

When there are several descriptors in a <description> element, as here, the method that the macro runtime uses to evaluate the descriptors (as boolean true or false) and to combine their results into a single result (true or false) depends on some additional configuration information that is not described here. See "Evaluation of descriptors" on page 37 for the configuration information.

In the example scenario, Screen2 is configured in the default manner, so that the macro runtime evaluates each of the three descriptors in turn. If all three are true, then the macro runtime concludes that the overall result is true, and that Screen2 matches the current application screen.

For more information see "Evaluation of descriptors" on page 37.

Defining when to terminate recognition

Timeout setting for screen recognition: You can set a timeout value that causes the macro runtime to terminate the macro if screen recognition does not occur before the timer expires (see "Timeout settings for screen recognition" on page 51).

Recognition limit: You can set a recognition count that causes the macro runtime to terminate the macro, or to jump to a specified macro screen, if the macro runtime recognizes a macro screen, such as ScreenA, a number of times equal to the count (see "Recognition limit" on page 53).

Step 1(c): Removing the names of candidate macro screens from the list of valid next screens

After screen recognition has succeeded, the macro runtime immediately begins its next task, which is cleaning up the list of valid next screens (step 1(c)).

This is a simple step. The macro runtime removes the names of all the candidate macro screens, whether recognized or not, from the list of valid next screens.

If the list contains the names of transient screens, those names remain on the list (see "Transient screens" on page 50).

Stage 2: Making the successful candidate the new current macro screen

Stage 2 is simple. In stage 2, the macro runtime makes the successful candidate macro screen the new current macro screen.

In the example scenario, the macro runtime makes Screen2 the new current macro screen. The host terminal displays the new application screen, the Utility Selection Panel (see Table 7 on page 26 and Table 8 on page 27).

The macro runtime immediately begins stage 3.

Stage 3: Performing the actions in the new current macro screen

In stage 3, the macro runtime performs the actions in the new current macro screen's <actions> element. If the new current macro screen does not contain an <actions> element or if the <actions> element is empty, then the macro runtime skips this stage.

Each macro screen typically contains an <actions> element that contains one or more actions to be performed. An action is an instruction that causes some type of activity, such as sending a sequence of keys to the host, displaying a prompt in a popup window for the user, capturing a block of text from the screen, or some other activity.

In the example scenario, Screen2 contains only one action:
- Type 4 followed by the enter key.

Screen2 does not need an action to position the text cursor in the correct input field because the Utility Selection Panel automatically positions the text cursor there.

If the <actions> element contains multiple actions, the macro run time performs each macro action in turn in the order in which it occurs in the <actions> element.

For more information on actions see Chapter 7, "Macro actions," on page 55.

Inserting a delay after an action

Because the macro runtime executes actions much more quickly than a human user does, unforeseen problems can occur during macro playback that cause an action not to perform as expected, because of a dependency on a previous action.

To avoid this type of problem, the macro runtime, by default, inserts a delay of 150 milliseconds after every Input action or Prompt action in every macro screen, and a delay of 300 milliseconds after the last action of every macro screen (see "The pausetime attribute" on page 81).

You should leave this feature enabled, although you can disable it if you want. You can change the delays from 150 milliseconds and 300 milliseconds to other values.

If you want to change the duration of the delay for a particular macro screen, you can do so (see "The pause attribute" on page 81).

Also, for any particular action, you can increase the delay by adding a Pause action after the action (see "Pause action (<pause> element)" on page 66).

Repeating the processing cycle

After the macro runtime has performed all the actions in the <actions> element of the current macro screen, the macro runtime immediately begins the processing cycle again, starting with step 1(a), and using the candidate macro screens listed in the <nextscreens> element of the new current macro screen.

Terminating the macro

Whether or not there are next screens, the macro runtime terminates the macro when it finishes processing a macro screen that is marked as an exit screen.

In the example scenario Screen2 is marked as an exit screen (see Table 8 on page 27).

The exit screen setting, an attribute of the <screen> element, exists for exactly this purpose, to mark macro screens that terminate the macro.

When a macro is recorded, the Macro object, by default, marks the last recorded macro screen as an exit screen. After recording is complete, you can mark (or unmark) any macro screen as an exit screen, and there can be multiple exit screens.

Exit screens are described in more detail in "Exit screens" on page 50.

Chapter 5. Screen description

This chapter discusses:

- The terms descriptor, screen recognition, and screen description
- How the Macro Facility records a description of an application screen
- How to combine multiple descriptors
- The various types of descriptors

Screen description and screen recognition are related and intertwined topics. This chapter concentrates primarily on the process of describing screens so that they can then be recognized. It also contains enough information about screen recognition to give you a basic understanding of the relationship between the two functions. In-depth information about the screen recognition process is presented in Chapter 6, “Screen recognition,” on page 49

Definition of terms

Descriptor

An XML element that occurs in the <description> element of a macro screen and that states an identifying characteristic of the application screen to which the macro screen corresponds.

For example, a macro screen named ScreenB might contain a String descriptor (<string> element) that states that row 3 of the application screen contains the string `ISPF Primary Option Menu`. During macro playback, when the macro runtime is determining which macro screen to process next, and when ScreenB is a candidate, the macro runtime compares the descriptor in ScreenB with the actual application screen. If the descriptor matches the actual application screen (row 3 of the application screen really does contain the string), then the macro runtime selects ScreenB as the next macro screen to be processed.

Screen description

The process of adding descriptors to the <description> element of a macro screen. You engage in screen description when you use a macro editor to create or edit a descriptor for a macro screen (such as the String descriptor in the previous example). Likewise, the Macro object creates one or more descriptors for each new macro screen that it creates during macro recording (see “Recorded descriptions” on page 36).

Screen recognition

The process that the macro runtime performs when it attempts to match a candidate macro screen to the current application screen.

As detailed in Chapter 4, “How the macro runtime processes a macro screen,” on page 25, when the macro runtime needs to determine the next macro screen to be processed, the macro runtime places the names of candidate macro screens (usually found in the <nextscreens> element of the current macro screen) onto a list of valid next screens. Then, as the host application updates the host terminal with the new application screen, the macro runtime compares the descriptors of each macro screen on the list with the new application screen. Eventually the application screen is updated to the extent (for example, the string `ISPF Primary Option Menu` appears in row 3) that the macro runtime can match one of the macro screens on the list to the application screen. The matched macro screen becomes the next macro screen to be processed (see “Overview of all 3 stages of the entire process” on page 27).

For information about screen description using the VME, see “Screen Recognition tab” on page 115, and using the AME, see “Description tab” on page 138.

Recorded descriptions

During macro recording in the HATS host terminal, one or more descriptors is added to the new <description> element of each new macro screen that is created.

You must define the first macro screen of the macro being recorded. HATS automatically adds the OIA descriptor to the description of the first screen.

For every other application screen of the macro after the first application screen, you have the choice of defining the screen or allowing HATS to define it automatically. When HATS defines a screen, it creates three descriptors:

- The OIA descriptor is set to NOTINHIBITED.
- The Cursor descriptor is set to the actual cursor position of the application screen.
- The Number of Input Fields descriptor is set to the actual number of input fields in the application screen (can be 0).

Therefore, when the recorded macro is played back (without having been revised in any way), the macro runtime matches every macro screen after the first one to its corresponding application screen based on whether the input inhibited indicator is cleared, whether the cursor position matches the cursor position of the application screen, and whether the number of input fields in the macro screen's description matches the number of input fields in the application screen.

Why the recorded descriptions work

The recorded descriptions automatically created by HATS work well for at least three reasons.

First, the OIA descriptor, cursor position, and number of input fields can be applied to every possible application screen. That is, every application screen has some number of input fields (perhaps the number is 0), a starting cursor position, and an input inhibited indicator that is either set or cleared.

Second, the combination of the number of input fields and the cursor position provides a pretty reliable description of an application screen, because application screens typically contain many fields, but only a certain number of them are input fields. The cursor position is always in the first input field.

Third, and perhaps most important, during screen recognition the macro runtime compares the new application screen to a short list (usually a very short list) of macro screens called valid next screens (see “Stages in processing a macro screen” on page 27). Therefore a single macro screen need not be differentiated from every other macro screen in the macro, only from the other screens in the list of valid next screens. Frequently the list consists of a single macro screen.

Recorded descriptors provide a framework

For some macro screens, the recorded description might not be sufficient to allow the macro runtime to reliably distinguish one application screen from another similar application screen. Macro recording is still a very useful feature because it quickly provides a framework for your macro. From there you can improve the recorded description.

Often the most straightforward way to improve a recorded description is to add a String descriptor. For example, if the macro screen is for the Utility Selection Panel, then you might add a String descriptor specifying that the application screen contains the string `Utility Selection Panel` somewhere in row 3. Of course you are not limited to using a String descriptor. Some situations might require that you use one or more of the other descriptors to assure that the application screen is correctly recognized.

Evaluation of descriptors

This section describes in detail how the macro runtime determines whether a macro screen matches an application screen.

Keep the following in mind as you read through the following subsections:

- In most macro screens, the <description> element contains more than one descriptor.
- The default in the macro editors is that all descriptors are required (the Optional attribute of each descriptor is false) and that the default combining rule is used.
- The most common scenario that you will encounter is that all descriptors are required. That is, if you have defined three descriptors, you want all three of them to be true in order for the macro screen to be recognized. If you are facing this scenario, then you should use the default settings.
- If you are faced with a scenario that is more complicated than the default scenario, then you should use the uselogic method (see "The uselogic attribute" on page 39.)

Overview of the process

The following is an overview of the process.

1. The macro runtime evaluates each descriptor individually and arrives at a boolean result for that descriptor, either true or false.
2. The macro runtime then combines the boolean results of the individual descriptors to determine whether the description as a whole is true (the macro screen matches the application screen) or false. To combine the results of the individual descriptors the macro runtime uses either the default combining method or the uselogic method.
   - With the default combining method:
     a. The macro runtime inverts the boolean result of any descriptor that has the invertmatch attribute set to true (see "Invertmatch attribute" on page 38).
     b. The macro runtime combines the boolean results of the individual descriptors using:
        - The setting of the Optional attribute for each descriptor
        - The default rule for combining descriptors
   - In contrast, with the uselogic method:
     a. The macro runtime ignores the settings for the invertmatch and Optional attributes.
     b. The macro runtime combines the results of individual descriptors using a rule that you provide in the uselogic attribute.

Evaluation of individual descriptors

For each individual descriptor in the macro description, the macro runtime evaluates the descriptor and arrives at a boolean result of true or false.

For example, if the descriptor is a String descriptor, then the macro runtime looks in the application screen at the row and column that the descriptor specifies, and compares the string at that location with the string that the descriptor specifies. If the two strings match, then the macro runtime assigns a value of true to the String descriptor. If the two strings do not match then the macro assigns a value of false to the String descriptor.

Usually a macro screen contains more than one descriptor. However, if a macro screen contains only one descriptor (and assuming that the descriptor does not have the invertmatch attribute set to true) then if the single descriptor is true the entire description is true, and the macro runtime recognizes the macro screen as a match for the application screen. In contrast, if the single descriptor is false, then the entire description is false, and the macro screen is not recognized.

Default combining method

If you have more than one descriptor in a <description> element, then you must use either the default combining method described in this section or the uselogic attribute described in "The uselogic attribute" on page 39.

When to use the default combining method

The default combining method is appropriate for only two scenarios:

- You want the description as a whole to be true only if *all* the individual descriptors are true (this is the most common scenario).
- You want the description as a whole to be true if *at least one* of the individual descriptors is true.

You should not use the default method for any other scenario unless you thoroughly understand how the default combining method works.

The default combining method uses:

- The boolean result for each individual descriptor (see "Evaluation of individual descriptors")
- The value of the invertmatch attribute in each individual descriptor
- The value of the Optional attribute in each individual descriptor
- The default combining rule

Invertmatch attribute

Every descriptor has an invertmatch attribute.

By default this attribute is false, so that it has no effect on the evaluation of the descriptor.

If this setting is true, then the macro runtime inverts the boolean result that it obtains from evaluating the descriptor, changing true to false or false to true.

For example, if the macro runtime determines that a String descriptor is true (the string in the descriptor matches the screen in the application window), but the String descriptor has the invertmatch attribute set to true, then the macro runtime changes the String descriptor's result from true to false.

Optional attribute

Every descriptor has an Optional attribute that is set to either false (the default) or true.

The Optional attribute states how an individual descriptor's result is to be treated when the macro runtime uses the default combining rule to combine the boolean results of the descriptors. By default this attribute is set to false, signifying that the descriptor's result is required rather than optional.

Default combining rule

As stated earlier, the default combining rule is appropriate for only two scenarios:

- You want the description as a whole to be true only if *all* the individual descriptors are true (this is the most common scenario).
- You want the description as a whole to be true if *at least one* of the individual descriptors is true.

If you want the description as a whole to be true only if *all* the descriptors are true, then set the Optional attribute of all the descriptors in the description to false (the default setting).

In contrast, if you want the description as a whole to be true if *at least one* of the descriptors is true, then set the Optional attribute of all of the descriptors in the description to true.

You should not use the default combining rule in any other scenario where you have multiple descriptors in one macro screen, unless you understand the rule and its implications thoroughly. For more information see “Default rule for combining multiple descriptors in one macro screen” on page 199.

Also, you should not set the Optional attributes of multiple descriptors in one macro screen differently (some true, some false) unless you understand the rule and its implications thoroughly.

The uselogic attribute

The uselogic attribute of the <description> element allows you to define more complex logical relations among multiple descriptors than are available with the default combining method described in the previous section.

HATS adds a default uselogic attribute to the <description> tag when you record the macro. It will be regenerated if you edit the macro in the host terminal or in the macro editors. It will not be regenerated if you edit the macro in the source view.

Note: If you use the uselogic attribute, then the macro runtime ignores the invertmatch and Optional attributes in the individual descriptors.

The value of the uselogic attribute is a simplified logical expression whose terms are 1-based indexes of the descriptors that follow. Figure 9 on page 40 shows an example of a <description> element that contains a uselogic attribute (some of the attributes of the <string> element are omitted for clarity):

```
<description uselogic="(1 and 2) or (!1 and 3)" />
   <oia status="NOTINHIBITED" optional="false" invertmatch="false"/>
   <string value="&apos;Foreground&apos; row="5" col="8"/>
   <cursor row="18" col="19" optional="false" invertmatch="false"/>
</description>
```

Figure 9. Example of the uselogic attribute of the <description> element

In Figure 9, the value of the uselogic attribute is:

```
(1 and 2) or (!1 and 3)
```

This logical expression is not a regular logical expression (as described in "Conditional and logical operators and expressions" on page 19) but rather a simplified style of logical expression used only in the uselogic attribute. The rules for this style of logical expression are:

- The numerals 1, 2, 3, and so on stand for the boolean results of, respectively, the first, second, and third descriptors in the <description> element (<oia>, <string>, and <cursor> in the figure above). You can use any numeral for which a corresponding descriptor exists. For example, if a <description> element has seven descriptors, then you can use 7 to refer to the boolean result of the seventh descriptor, 6 to refer to the boolean result of the sixth descriptor, and so on.
- Only the following logical operators are allowed:

Table 9. Logical operators for the uselogic attribute

Operator:	**Meaning:**
and	Logical AND
or	Logical OR (inclusive)
!	Logical NOT (inversion)

- You can use parentheses () to group terms.
- The following entities are not allowed:
  - Arithmetic operators and expressions
  - Conditional operators and expressions
  - Variables
  - Calls to Java methods

In the example in Figure 9 the macro runtime will determine that the description as a whole is true if one of the following occurs:

- The result of the first descriptor is true and the result of the second descriptor is true (1 and 2)
- The result of the first descriptor is false and the result of the third descriptor is true (!1 and 3)

Remember that if you use the uselogic attribute, then the macro runtime ignores the invertmatch and the Optional attribute settings in the individual descriptors.

The descriptors

Each type of descriptor is stored as an individual XML element situated within the <description> element of one macro screen.

You do not have to understand all the types of descriptors at first. Instead you should begin by becoming familiar with just the following types:

- The OIA descriptor
- The Number of Fields descriptor
- The Number of Input Fields descriptor
- The String descriptor

These types of descriptors are sufficient to reliably describe many and perhaps even most application screens. However, if these types are not sufficient, then you should turn for help to one of the other types of descriptors.

Table 10 lists all the types of descriptors and shows the number of descriptors of each type that are allowed to exist in one macro screen (more specifically, in one <description> element belonging to one <screen> element):

Table 10. Types of descriptors, how many of each type allowed

Type of descriptor:	**Number of this type of descriptor allowed per macro screen:**
OIA	1 (required)
Number of Fields	0 or 1
Number of Input Fields	0 or 1
String descriptor	0 or more
Cursor descriptor	0 or 1
Attribute descriptor	0 or more
Condition descriptor	0 or more
Custom descriptor	0 or more

The following subsections describe each type of descriptor in detail.

OIA descriptor (<oia> element)

In almost all scenarios you can accept the default setting for this descriptor, which is `NOTINHIBITED`. Then, during screen recognition:

- If the input inhibited indicator in the host terminal is set (that is, input is inhibited), then the macro runtime will evaluate this descriptor as false.
- But if the input inhibited indicator is cleared (that is, input is not inhibited), then the macro runtime will evaluate this descriptor as true.

These are the results that you would want and expect. You typically do not want the macro runtime to recognize the macro screen and immediately start processing its actions while the input inhibited indicator is still set. (For more information about timing, see "Screen completion" on page 82). But no matter how you resolve that issue, you should almost always leave this descriptor at the default setting, which is `NOTINHIBITED`.

However, if you have a scenario in which you want the macro runtime to ignore the input inhibited condition, then set this descriptor to `DONTCARE`.

Number of Fields descriptor (<numfields> element)

The Number of Fields descriptor specifies a particular number of 3270, or 5250, fields. You can use an integer in the **Number of Fields** input field, or any entity that evaluates to an integer (such as a variable, an arithmetic expression, or a call to an external Java method).

During screen recognition the macro runtime:

1. Evaluates this descriptor and obtains an integer result.
2. Counts the number of fields in the application screen (in its current state).
3. Compares the two numbers.

If the two numbers are equal then the macro runtime evaluates this descriptor as true. Otherwise the macro runtime evaluates this descriptor as false.

When the macro runtime counts the fields in the host terminal it counts all types of 3270, or 5250, fields, including input fields.

If you do not want to use this descriptor then set the Number of Fields input field to blank.

Number of Input Fields descriptor (<numinputfields> element)

The Number of Input Fields descriptor is very similar to the Number of Fields descriptor described in the previous section. The difference is that the Number of Input Fields descriptor specifies a number of 3270, or 5250, input fields, whereas the Number of Fields descriptor specifies a number of fields of all types, including input fields.

You can use an integer in the **Number of Input Fields** field, or any entity that evaluates to an integer (such as a variable, an arithmetic expression, or a call to an external Java method).

During screen recognition, the macro runtime:

1. Evaluates this descriptor and obtains an integer result.
2. Counts the number of input fields in the application screen (in its current state).
3. Compares the two numbers.

If the two numbers are equal then the macro runtime evaluates this descriptor as true. Otherwise the macro runtime evaluates this descriptor as false.

If you do not want to use this descriptor then set the **Number of Input Fields** field to blank.

String descriptor (<string> element)

The String descriptor specifies the following information:

- A sequence of characters (the string)
- A rectangular area of text on the host terminal

The macro runtime searches inside the entire rectangular area of text for the string you specify. If the macro runtime finds the string inside the rectangular area of text, then it evaluates the string descriptor as true. If not, then it evaluates the string descriptor as false.

Specifying the rectangular area

You define the rectangular area of text by specifying the row and column coordinates of opposite corners. The default values for these coordinates are (1,1) and (-1,-1), indicating the entire text area of the host terminal. For the significance of negative values such as -1,-1, see “Significance of a negative value for a row or column” on page 22. You can use an integer or any entity that evaluates to an integer (such as a variable, an arithmetic expression, or a call to an external Java method).

The rectangular area can be just large enough to contain the string, or much larger than the string. For example, suppose that the application screen that you want to match to the macro screen has the string `'Terminal and user parameters'` in the rectangular area (6,20), (6,37). This rectangular area is exactly large enough to contain the string. If the application screen always has this string at this location, then you might specify the exact rectangular area.

However, suppose that the application screen that you want to match to the macro screen has the same string, `'Terminal and user parameters'`, located within it, but you cannot predict which row of the application screen will contain the string. In this case you could specify the rectangular area (1,1), (-1,-1), indicating that the macro runtime should search every row of the application screen for the identifying string.

For the string value you can use a string or any entity that evaluates to a string (such as a variable, an expression, or a call to an external Java method). The string must be in the form required by the macro format that you have chosen, either basic or advanced.

During screen recognition the macro runtime:

1. Evaluates the row and column values and obtains an integer result for each value.
2. Evaluates the string value and obtains a string result.
3. Looks for the string anywhere within the rectangular block of text in the application screen (in its current state) specified by the row and column values.

If the macro runtime finds the string within the rectangular block of text then the macro runtime evaluates this descriptor as true. Otherwise the macro runtime evaluates this descriptor as false.

How the macro runtime searches the rectangular area (Wrap attribute)

If the Wrap attribute is set to false (the default setting), then the macro runtime searches each row of the rectangular area separately. This method works well when the entire string is contained within one row. For example, if the string is `Utility Selection Panel` and the rectangular area is (1,1), (24,80), then the macro runtime searches for the string as follows:

1. Get the first row of the rectangular area. Determine whether the string occurs in the this row. If it does not, then search the next row.
2. Get the second row of the rectangular area. Determine whether the string occurs in this row. If it does not, then search the next row.
3. And so on.

In contrast, if the Wrap attribute is set to true then the macro runtime searches for the string as follows:

1. Get all the lines of the rectangular area and concatenate them in order.
2. Determine whether the string occurs in the concatenated string.

If the string you are searching for can wrap from one line to the next of the host terminal, then you should set the Wrap attribute to `true`. Do not confuse this attribute with the Unwrap attribute of the Extract action, which is based on fields rather than blocks of text (see “Unwrap attribute” on page 60).

The following description provides an example in which the Wrap attribute is set to `true`.

Figure 10 shows rows 14 through 18 of an application screen:

```
 6  Hardcopy    Initiate hardcopy output
 7  Transfer    Download ISPF Client/Server or Transfer data set
 8  Outlist     Display, delete, or print held job output
 9  Commands    Create/change an application command table
 *  Reserved    This option reserved for future expansion
```

Figure 10. Rows 14–18 of an application screen

In Figure 10, the first character of each row is a blank space. For example, in row 14, the first two characters are `' 6'`, that is, a blank space followed by the numeral 6. Suppose that you want to set up a String descriptor that checks for the following rectangular block of text on this application screen:

```
Hardcopy
Transfer
Outlist
Commands
Reserved
```

The steps in setting up the String descriptor for this multi-row block are as follows:

1. Create a new String descriptor.
2. Set the row and column location of the upper left corner of the text rectangle above to (14, 5) and the row and column location of the lower right corner to (18, 12).
3. Set the string value. The string value is:
   `'HardcopyTransferOutlist CommandsReserved'`
4. Set the Wrap attribute to true.
5. Leave all the other attributes set to the default.

Notice that in step 3 above the five rows are concatenated as a single string, without any filler characters added (such as a newline or space at the end). However, the string does contain a blank space after `'Outlist'` because that blank space does fall within the boundaries of the rectangle.

Using an extracted string in a String descriptor: If you use an Extract action to read text from the screen into a string variable (see "Extract action (<extract> element)" on page 58) then in a subsequent screen you can use the string variable in the **String** input field of a String descriptor.

For example, in ScreenA you might read a company name from the host terminal into a string variable named $strTmp$, using an Extract action. Then in ScreenB you could use $strTmp$ as the string to be searched for in a String descriptor.

You can do this when extracting multiple lines of text if you have the Wrap attribute set to true.

Multiple String descriptors in the same <description> element

You can create more than one String descriptor in the same <description> element. You should use as many String descriptors as you need in order to create a reliable description.

You can even define two different strings for the same rectangular block of text in the same <description> element. You might do this if the application screen corresponding to your macro screen displays different strings in the same location at different times. However, if you do define two different strings for the same rectangular block of text, you should be careful to indicate that both of the strings are not required (both are optional).

Cursor descriptor (<cursor> element)

The Cursor descriptor specifies a row and column location on the application screen, such as row 10 and column 50. For either the row value or the column value you can use an integer or any entity that evaluates to an integer (such as a variable, an arithmetic expression, or a call to an external Java method).

During screen recognition the macro runtime:

1. Evaluates the row value and obtains an integer result.
2. Evaluates the column value and obtains an integer result.
3. Looks at the row and column location of the text cursor in the application screen (in its current state).
4. Compares the row and column location in the descriptor with the row and column location of the text cursor in the application screen.

If the two locations are the same then the macro runtime evaluates this descriptor as true. Otherwise the macro runtime evaluates this descriptor as false.

Attribute descriptor (<attrib> element)

The attribute descriptor specifies a 3270, or 5250, attribute and a row and column location on the application window.

During screen recognition the macro runtime compares the specified attribute (such as 0x3) to the actual attribute at the row and column specified. If the attributes are the same, then the macro runtime evaluates the descriptor as true. Otherwise the macro runtime evaluates the descriptor as false.

This descriptor can be useful when you are trying to differentiate between two application screens that are very similar except for their attributes.

Condition descriptor (<condition> element)

The Condition descriptor specifies a conditional expression that the macro runtime evaluates during screen recognition, such as `$intNumVisits$ == 0`. For more information on conditional expressions see "Conditional and logical operators and expressions" on page 19.

During screen recognition the macro runtime evaluates the conditional expression and obtains a boolean result.

If the conditional expression evaluates to true then the macro runtime evaluates this descriptor as true. Otherwise the macro runtime evaluates this descriptor as false.

The Condition descriptor increases the flexibility and power of screen recognition by allowing the macro runtime to determine the next macro screen to be processed based on the value of one or more variables or on the result of a call to a Java method.

Custom descriptor (<customreco> element)

The Custom descriptor allows you to call custom description code.

To create a Custom descriptor you must use the source view to add a <customreco> element to the <description> element of the macro screen. For more information on this element, see "<customreco> element" on page 177.

Note: If you are using custom screen recognition in the screen descriptors of a HATS macro, and the macro is invoked through the <playmacro> action from within a separate macro, the custom screen recognition logic does not work.

HATS can only register as a listener for custom recognition events in the first macro of a chain. HATS cannot register as a listener for any of the subsequent macros in the chain.

To resolve this problem, use non-chained macros when using HATS custom screen recognition.

Variable update action (<varupdate> element)

The Variable update entry is not a descriptor at all. Instead, it is an action that the macro language allows to occur inside a <description> element.

The Variable update action in a <description> element performs the very same type of operation that it performs in an <actions> element, which is to store a specified value into a specified variable.

For information about creating a Variable update action see "Variable update action (<varupdate> element)" on page 73.

Processing a Variable update action in a description

You should be aware of how the macro runtime processes one or more Variable update actions when they occur in a <description> element:

1. The macro runtime performs all the Variable update actions immediately, as if they were first in sequence.
2. The macro runtime then evaluates the remaining items (descriptors) in the description as usual and arrives at an overall boolean result. The Variable update actions have no effect on the boolean result.

As you might remember, the macro runtime can go through the screen recognition process a number of times before matching a macro screen to an application screen (see "Repeated screen evaluations" on page 31). Therefore, if a <description> element contains one or more Variable update actions, then the macro runtime will perform the Variable update actions each time that it evaluates the <description> element.

For example, suppose that a macro is being played back, that the screen name ScreenB is on the list of valid next screens, and that ScreenB contains a <description> element like the one shown in Figure 11 on page 47:

```
<description>
   <oia status="NOTINHIBITED" optional="false" invertmatch="false" />
   <varupdate name="$intUpdate$" value="$intUpdate$+1" />
   <attrib value="0x4" row="1" col="1" plane="COLOR_PLANE" optional="false"
               invertmatch="false" />
</description>
```

Figure 11. The <description> element of ScreenB

Each time that the macro runtime tries to match ScreenB to the current application screen:

1. The macro runtime sees the <varupdate> action and performs it, incrementing the value of `$intUpdate$` by 1.
2. The macro runtime evaluates the <oia> descriptor and the <attrib> descriptor and arrives at a boolean result for the entire <description> element.

Variable update with the uselogic attribute

If you want the macro runtime to perform a Variable update action in a <description> element in some other sequence than first, you can change the order of execution by using the <description> element's uselogic attribute instead of the default combining rule (see "The uselogic attribute" on page 39).

When a Variable update action is used in a uselogic attribute:

- The macro runtime performs the Variable update action in the same order in which it occurs in the uselogic attribute.
- The macro runtime always evaluates the Variable update action to true.

Chapter 6. Screen recognition

Recognizing valid next screens

As described in Chapter 4, “How the macro runtime processes a macro screen,” on page 25, the macro runtime typically finds the names of macro screens that are candidates for becoming the next macro screen to be processed by looking in the <nextscreens> element of the current macro screen. That is, the macro screen contains within itself a list of the macro screens that can validly be processed next. Entry screens and transient screens are exceptions.

Entry screens, exit screens, and transient screens

You can use the entry screen, exit screen, and transient screen settings to mark macro screens that you want the macro runtime to treat in a special way. In the source view, these settings appear as attributes of the <screen> element.

In Figure 1 on page 5, you can see these three attributes in the <screen> element for Screen1: **entryscreen**, **exitscreen**, and **transient**.

For information about where these settings are made using the VME, see “General tab” on page 114, and using the AME, see “Screens tab” on page 136.

Entry screens

Mark a screen as an entry screen if you want the macro screen to be considered as one of the first macro screens to be processed when the macro is played back. You might have only one macro screen that you mark as a entry screen, or you might have several.

When the macro playback begins, the macro runtime searches through the macro script and finds all the macro screens that are designated as entry screens. Then the macro runtime adds the names of these entry macro screens to the runtime list of valid next screens. Finally the macro runtime tries in the usual way to match one of the screens on the list to the current host terminal.

When the macro runtime has matched one of the entry macro screens to the host terminal, that macro screen becomes the first macro screen to be processed. Before performing the actions in the first macro screen, the macro runtime removes the names of the entry macro screens from the runtime list of valid next screens.

Macro with several entry screens

The entry screens are evaluated in the order that they appear in the macro script. One of the situations in which you might have several entry screens in the same macro is when a host application begins with a series of application screens one after another, such as application screen A, followed by application screen B, followed by application screen C. For instance, screen A might be a logon screen, screen B a screen that starts several supporting processes, and screen C the first actual screen of the application.

In this situation, you might want the user to be able to run the macro whether the user was at application screen A, B, or C.

Entry screen as a normal screen

If you mark a screen as an entry screen, it can still participate in the macro as a normal screen and be listed in the <nextscreens> lists of other macro screens.

For example, you might have a host application that has a central application screen with a set of menu selections, so that each time you make a menu selection the application goes through several application screens of processing and then returns to the original central application screen.

In this situation, suppose that macro ScreenA is the macro screen corresponding to the central application screen. Both of the following would apply:

- ScreenA could be an entry screen, because the macro could start at the central application screen
- ScreenA could also appear in the <nextscreens> element of other macro screens, because after each task the application returns to the central application screen

Exit screens

Marking a macro screen as an exit screen causes the macro runtime to terminate the macro after it has performed the actions for that macro screen. That is, after the macro runtime performs the actions, and before going on to screen recognition, the macro runtime looks to see if the current macro screen has the exit screen indicator set to true. If so, then the macro runtime terminates the macro. (The macro runtime ignores the <nextscreens> element of an exit screen.)

You can have any number of exit screens for a macro. Here are some examples of situations in which there could be several exit screens.

- A macro might have one normal termination point and several abnormal termination points, which could be reached if an error occurred.
- A macro might allow you to stop at a certain point in the processing, or to keep going, so that there would be several normal termination points.

Transient screens

A transient macro screen is used to process an application screen that has the following characteristics:

- The application screen occurs unpredictably during the flow of the application. It might occur at several points or it might not occur at all.
- The only action that needs to occur for the application screen is that it needs to be cleared.

An example of such an application screen is an error screen that the application displays when the user enters invalid data. This error screen appears at unpredictable times (whenever the user enters invalid data) and as a macro developer the only action that you want to take for this error screen is to clear it and to get the macro back on track.

When the macro runtime prepares to play back a macro, at the point where the macro runtime adds the names of entry screens to the runtime list of valid next screens, the macro runtime also adds the names of all macro screens marked as transient screens (if any) to the end of the list.

Transient screens are considered for the entry screen without being marked as entry screens. If a transient screen is selected as the entry screen, its actions execute, and then the macro checks all of the entry screens and all of the transient screens to decide which screen to match next.

The names of these transient screens remain on the runtime list of valid next screens throughout the entire macro playback. Whenever the macro runtime adds the names of new candidate macro screens (from the <nextscreens> element of the current macro screen) to the list, the macro runtime adds these new candidate names ahead of the names of the transient screens, so that the names of the transient screens are always at the end of the list.

Whenever the macro runtime performs screen recognition, it evaluates the macro screens of all the names on the list in the usual way. If the macro runtime does not find a match to the application screen among the candidate macro screens whose names are on the list, then the macro runtime goes on down the list trying to match one of the transient macro screens named on the list to the application screen.

If the macro runtime matches one of the transient macro screens to the current application screen, then the macro runtime does not remove any names from the list. Instead, the macro runtime performs the actions in the transient macro screen (which should clear the unexpected application screen) and then goes back to the screen recognition process that it was pursuing when the unexpected application screen occurred.

Example of handling of transient screen

Suppose that the macro runtime is doing screen recognition and that it has the names of three macro screens on the list of valid next screens: ScreenB and ScreenD, which are the names of candidate screens, and ScreenR, which is the name of a transient screen. The macro runtime performs the following steps:

1. When the host terminal's presentation space is updated, the macro runtime evaluates the names on the list of valid next screens in the usual way.
2. Suppose that an unexpected application screen has occurred, so that neither ScreenB nor ScreenD matches the current application screen, but that ScreenR does match the current application screen.
3. Because a transient screen has been recognized, the macro runtime does not remove any names from the list of valid next screens.
4. The macro runtime makes ScreenR the current macro screen to be processed.
5. The macro runtime performs the actions in ScreenR. These actions clear the unexpected application screen.
6. The macro runtime ignores the <nextscreens> element, if any, in ScreenR.
7. The macro runtime returns to the previous task of screen recognition in step 1 above. The list of valid next screens has not changed. This time, suppose that an expected application screen is displayed and that the macro runtime finds that ScreenD matches it. Therefore:
   a. The macro runtime makes ScreenD the next macro screen to be processed.
   b. The macro runtime removes the names ScreenB and ScreenD from the list of valid next screens. The name ScreenR remains on the list.
   c. The macro runtime begins processing the actions in ScreenD.

Timeout settings for screen recognition

This section discusses the scenario in which the macro runtime cannot advance because it cannot match a screen on the list of valid next screens to the current application screen. There are two fields that let you set a timeout value that terminates the macro if screen recognition does not succeed before the timeout expires:

- The timeout attribute on the <HAScript> element.
- The timeout attribute on the <nextscreens> element.

Screen recognition

After the macro runtime has performed all the actions in the <actions> element of a macro screen, the macro runtime attempts to match one of the screens on the list of valid next screens to the new application screen (see Chapter 4, "How the macro runtime processes a macro screen," on page 25).

Sometimes, unforeseen circumstances make it impossible for the macro runtime to match any of the macro screens on the list of valid next screens to the application screen. For example, the user might type an input sequence that navigates to an unforeseen application screen. Or, a systems programmer might have changed the application screen so that it no longer matches the description in the <description> element of the corresponding macro screen.

When such a scenario occurs, the result is that the macro appears to hang while the macro runtime continually and unsuccessfully attempts to find a match.

Timeout attribute on the <HAScript> element

The timeout attribute on the <HAScript> element can be set using the **Timeout between screens** setting in the VME, see "General tab" on page 113, and in the AME, see Figure 61 on page 135. This attribute specifies a timeout value for screen recognition. By default, if specified the value applies to each and every macro screen in the macro. However, you can change the value for a particular macro screen by using the timeout attribute on the <nextscreens> element, see "Timeout attribute on the <nextscreens> element" on page 53).

Whenever the macro runtime starts to perform screen recognition, it checks to determine whether the timeout value is set for the entire macro or whether a timeout value is set for the macro screen's list of next screens. If a timeout value is set, then the macro runtime sets a timer to the number of milliseconds specified by the timeout value. If the timer expires before the macro runtime has completed screen recognition, then the macro runtime terminates the macro. An Error page is displayed in the browser, and a message such as the following is written to the server console:

```
Macro timed out: (Macro=ispf_ex2, Screen=screen_address_type)
```

Figure 12. Error message for screen recognition timeout

Notice that this message displays the name of the macro and the name of the screen that was being processed when the timeout occurred. For example, if the screen specified in this message is ScreenA, then the macro runtime had already performed all the actions in ScreenA and was trying to match a macro screen in the Valid Next Screens list for ScreenA to the application screen.

If the macro is playing in the host terminal, the following message is displayed:

```
The host terminal does not match any expected screens.
```

Figure 13. Error message shown for host terminal

When specified, the default timeout value is set to 60000 milliseconds (60 seconds).

Timeout attribute on the <nextscreens> element

The timeout attribute on the <nextscreens> element specifies a timeout value for screen recognition. It can be set using the Source tab in the VME and using the **Timeout** field in the AME, see Figure 73 on page 146. If this value is non-zero, then the macro runtime uses this value as a timeout value (in milliseconds) for screen recognition for macro screens on the current list of valid next screens, instead of using the value set in the timeout attribute on the <HAScript> element.

If the timer expires before the macro runtime has completed screen recognition, then the macro runtime displays the message in Figure 12 on page 52.

Recognition limit

The recognition limit allows you to take some sort of action if the macro runtime processes a particular macro screen too many times. If the macro runtime does process the same macro screen a large number of times (such as 100), then the reason is probably that an error has occurred in the macro and that the macro is stuck in an endless loop.

The recognition limit is not an attribute in the begin tag of the <screen> element, but rather a separate element (the <recolimit> element) that optionally can occur inside a <screen> element, on the same level as the <description>, <actions>, and <nextscreens> elements.

The <recolimit> element can be added using the **Set Recognition Limit** check box and the **Screens Before Error** input field both the VME and AME, see “Screens tab” on page 136.

When the recognition limit is reached, the macro runtime either terminates the macro with an error message (this is the default action) or starts processing another macro screen that you specify.

You should notice that the recognition limit applies to one particular screen and that by default it is not specified. You can specify a recognition limit for any macro screen, and you can specify the same or a different recognition limit value for each macro screen in which you include it.

Determining when the recognition limit is reached

The macro runtime keeps a recognition count for every macro screen that includes a <recolimit> element. When macro playback begins the recognition count is 0 for all macro screens.

Suppose that a macro includes a macro screen named ScreenB and that ScreenB contains a <recolimit> element with a recognition limit of 100. Each time the macro runtime recognizes ScreenB (that is, each time the macro runtime selects ScreenB as the next macro screen to be processed), the macro runtime performs the following steps:

1. The macro runtime detects the presence of the <recolimit> element inside ScreenB.
2. The macro runtime increments the recognition count for ScreenB.
3. The macro runtime compares the recognition count with the recognition limit.
4. If the recognition count is less than the recognition limit, then the macro runtime starts performing the action elements of ScreenB as usual.
5. However, if the recognition count is greater than or equal to the recognition limit, then the macro runtime performs the action specified by the <recolimit> element. In this case macro runtime does not process any of the action elements in ScreenB.

Action when the Recognition limit is reached

The default action when the recognition limit is reached is that the macro terminates and an Error page is displayed in the browser. The following error message is written to the server console:

```
Recolimit reached, but goto screen not provided, macro terminating.
```

If you want the macro runtime, as a recognition limit action, to go to another macro screen, you can set the**goto** attribute in the General screen properties panel. Use the **Goto Screen Name** input field and specify the name of the target macro screen as the value of the attribute (see "<recolimit> element" on page 190).

If you use the **goto** attribute, the macro runtime does not terminate the macro but instead starts processing the macro screen specified in the attribute.

You can use the target macro screen for any purpose. Some possible uses are:

- For debugging
- To display an informative message to the user before terminating the macro
- To continue processing the macro

Chapter 7. Macro actions

Actions by function

The following is a list of all the actions, grouped according to function.

- Interaction with the user:
  - Input (keystrokes and key-activated functions, such as copy to clipboard)
  - Mouse click
  - Prompt
- Getting data from the application
  - Extract
  - SQLQuery
  - Variable update
- Waits
  - Comm wait
  - Pause
- Programming
  - Conditional
  - Perform (call a Java method)
  - Play macro (chain to another macro)
  - Variable update
- Debug
  - Trace

How actions are performed

The runtime context

As you might remember from Chapter 4, "How the macro runtime processes a macro screen," on page 25, when the macro runtime has selected a new current macro screen, the macro runtime immediately begins to perform the actions in the <actions> element of that macro screen.

After the macro runtime has performed all the actions, it immediately goes on to the next step of determining the next macro screen to be processed.

The macro screen context

Within a single macro screen, the macro runtime performs the actions in the order in which they occur in the <actions> element. This is the same order in which you have ordered the actions in the Actions list.

You are not required to create any actions for a macro screen. If there is no <actions> element or if the <actions> element is empty, then the macro runtime goes straight to the next section of macro screen processing, which is selecting the next macro screen to be processed.

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Specifying parameters for actions

In specifying the parameters of an action, remember that, in general, any context that accepts an immediate value of a particular standard data type also accepts any entity of the same data type. For example, if an input field accepts a string value, then it also accepts an expression that evaluates to a string, a value that converts to a string, a string variable, or a call to an imported method that returns a string (see "Equivalents" on page 21).

However, there are a few fields in which you cannot use variables (see "Using the value that the variable holds" on page 91).

For information about specifying actions using the VME, see "Working with actions" on page 119, and using the AME, see "Actions tab" on page 143.

The actions

Comm wait action (<commwait> element)

The Comm wait action waits until the communication status of the session changes to some state that you have specified in the action. For example, you might create a Comm wait action to wait until the session is completely connected.

This action can be specified using the Source tab in the VME, and using the Actions tab in the AME, see "Comm wait action" on page 151.

How the action works

When the macro runtime starts to perform a Comm wait action, it looks at the communication status specified in the Comm wait action and compares it to the actual communication status of the session. If the two statuses match, then the macro runtime concludes that the Comm wait action is completed, and the macro runtime goes on to perform the next action.

However, if the two statuses do not match, then the macro runtime does no further processing, but just waits for the communication status that is specified in the Comm wait action to actually occur in the session.

You can specify in the Comm wait action a timeout value in milliseconds that causes the macro runtime to end the Comm wait action when the timeout value has expired. That is, the macro runtime terminates the action when the timeout value has expired, even if the communication status that the macro runtime has been looking for has not been reached.

After a Comm wait action, you probably want to use some other action, such as an Extract action, to check some characteristic of the application screen that indicates to you whether the session has actually reached the communication status that you wanted, or whether the Comm wait action ended because of a timeout.

Specify a communication status that is persistent

As the session connects or disconnects, the communication status typically moves quickly through some states (such as pending active, then active, then ready) until it reaches a particular state at which it remains stable for some time (such as CONNECTION_WORKSTATION_ID_READY). In most situations you want to specify that persistent, ending state in the Comm wait action.

If instead you specified some transitional state such as pending active, then the session might pass through that state and go on to the next state before the macro runtime gets a chance to perform your Comm wait action. Therefore when the macro runtime does perform your Comm wait action it will be waiting interminably for some state that has already occurred.

Examples

Figure 14 shows an example of specifying a communication state that will wait until a Telnet session negotiation has begun or until 10 seconds have elapsed without a Telnet negotiation session, whichever occurs first.

```
<commwait value="CONNECTION_READY" timeout="10000" />
```

Figure 14. Example of Comm wait action

For more information, see "<commwait> element" on page 174.

Conditional action (<if> element and <else> element)

The Conditional action contains the following items:

- A conditional expression that the macro runtime evaluates to true or false
- A list of actions that the macro runtime performs if the condition evaluates to true (Optional)
- A list of actions that the macro runtime performs if the condition evaluates to false (Optional)

The Conditional action provides the functions of an if-statement or of an if-else statement.

This action can be specified using the VME, see "Evaluate (If) action" on page 121, and using the AME, see "Conditional action" on page 152.

Conditional action not allowed within a Conditional action

The macro editor does not allow you to create a Conditional action inside another Conditional action. Therefore you cannot have the equivalent of an if-statement nested inside another if-statement, or of an if-statement nested inside an else-statement.

Example

The following code fragment prompts the user for input. If the input string is the string `true`, the code fragment writes the message `You typed TRUE` on the host screen. If the input string is any other string, the code fragment writes the message `You typed FALSE`. This example uses the following actions: Prompt action, Condition action, and Input action.

You can copy this code fragment from this document into the system clipboard, and then from the system clipboard into the source view. Because this code is a fragment, you must copy it into a macro screen in an existing macro script. You must also create a string variable named $strData$. To create the variable, add the follow lines after the <HAScript> begin tag and before the first <screen> element:

```
<vars>
   <create name="$strData$" type="string" value="" />
</vars>
```

After you save the script in the macro editor, you can edit it either with the macro editor or in the source view.

Notice the following facts about this example:

- The example consists of one code fragment containing an <actions> element and the actions inside it.
- The first action is a Prompt action that displays a message window and copies the user's input into the variable $strData$, without writing the input into an input field in the session window.
- The first part of the condition action (the <if> element) contains the condition, which is simply `$strData$`.
- Because $strData$ is a string variable in a boolean context, the macro runtime tries to convert the string to a boolean value (see "Automatic data type conversion" on page 20). If the user's input is the string `'true'` (in upper, lower, or mixed case), then the conversion is successful and the condition contains the boolean value true. If the user's input is any other string, then the conversion fails and the condition contains the boolean value false.
- If the condition is true, then the macro runtime performs the action inside the <if> element, which is an Input action writing the message `You typed TRUE` on the host screen. When all the actions inside the <if> element have been performed, the macro runtime skips over the <else> action and continues macro processing.
- If the condition is false, then the macro runtime skips over the actions in the <if> element and begins performing the actions in the <else> element, which includes one Input action that writes the message `You typed FALSE` on the host screen. After performing all the actions in the <else> action, the macro runtime continues macro processing.

```
<actions>
   <prompt name="'Type true or false'" description="" row="0" col="0"
               len="80" default="" clearfield="false" encrypted="false"
               movecursor="true" xlatehostkeys="true" assigntovar="$strData$"
               varupdateonly="true" />
   <if condition="$strData$" >
       <input value="'You typed TRUE'" row="0" col="0" movecursor="true" xlatehostkeys="true" encrypted="false"/>
   </if>
   <else>
       <input value="'You typed FALSE'" row="0" col="0" movecursor="true" xlatehostkeys="true" encrypted="false"/>
   </else>
</actions>
```

Figure 15. Sample code fragment showing a Condition action

For more information, see "<if> element" on page 182.

Extract action (<extract> element)

The Extract action captures data from the host terminal and optionally stores the data into a variable. This action is very useful and is the primary method that the Macro object provides for reading application data (instead of using programming APIs from the toolkit).

This action can be specified using the VME, see "Extract action" on page 122, and using the AME, see "Extract action" on page 152.

Treatment of nulls and other characters that do not display

Text captured from the TEXT_PLANE does not contain any nulls (0x00) or other characters that do not display. Any character cell on the display screen that appears to contain a blank space character will be captured as a blank space character.

Capturing a rectangular area of the host terminal

When the continuous attribute is false (this is the default value), the macro runtime treats the two pairs of row and column values as the upper left and lower right corners (inclusive) of a rectangular block of text. The rectangular block can be as small as one character or as large as the entire application window.

The macro runtime:

- Initializes the result string to an empty string
- Reads the rectangular block of text row by row, concatenating each row to the result string
- Stores the result string in the specified variable

As an example, suppose that the first 40 characters of rows 16, 17, and 18 of the host terminal are as follows:

```
.8..Outlist.....Display, delete, or prin
.9..Commands....Create/change an applica
.10.Reserved....This option reserved for
```

In addition, suppose that the macro runtime is about to perform an Extract action with the following settings:

- The continuous attribute is false.
- The row and column pairs are (16, 5) (the 'O' of Outlist) and (18, 12) (the 'd' of 'Reserved').
- The extraction name is 'Extract1'.
- The data plane is TEXT_PLANE.
- The string variable $strTmp$ is the variable in which the result string is to be stored.

Because the continuous attribute is false, the macro runtime treats the row and column pairs as marking a rectangular block of text, with the upper left corner at row 16 and column 5 and the lower right corner at row 18 and column 12.

The macro runtime initializes the result string to an empty string. Then the macro runtime reads the rectangular block of text one row at a time ('Outlist.', 'Commands', 'Reserved'), concatenating each row to the result string. Finally the macro runtime stores the entire result string into the result variable $strTmp$. The variable $strTmp$ now contains the following string:

```
'Outlist.CommandsReserved'
```

Capturing a sequence of text from the host terminal

When the continuous attribute is true, the macro runtime treats the two pairs of row and column values as the beginning and ending positions (inclusive) of a continuous sequence of text that wraps from line to line if necessary to get from the beginning position to the ending position. The sequence of text can be as small as one character or as large as the entire application window.

The macro runtime:

- Initializes the result string to an empty string

- Reads the continuous sequence of text from beginning to end, wrapping around from the end of one line to the beginning of the next line if necessary
- Stores the result string in the specified variable

For example, suppose that rows 21 and 22 of the host terminal contain the following text (each row is 80 characters):

```
........Enter / on the data set list command field for the command prompt pop-up
or ISPF line command............................................................
```

and suppose that the macro runtime is about to perform an Extract action with the following settings:

- The continuous attribute is true.
- The row and column pairs are (21, 9) (the 'E' of 'Enter') and (22, 20) (the 'd' of 'command').
- The extraction name is 'Extract1'.
- The data plane is TEXT_PLANE.
- The string variable $strTmp$ is the variable in which the result string is to be stored.

Because the continuous attribute is true, the macro runtime treats the row and column pairs as marking the beginning and end of a sequence of text, with the beginning position at (21, 9) and the ending at (22, 20).

The macro runtime initializes the result string to an empty string. Then the macro runtime reads the sequence of text from beginning to end, wrapping around from the last character of row 21 to the first character of row 22. Finally the macro runtime stores the entire result string into the result variable $strTmp$. The variable $strTmp$ now contains the following string of 92 characters (the following text is hyphenated to fit on the page of this document, but actually represents one string without a hyphen):

```
'Enter / on the data set list command field for the com-
mand prompt pop-up or ISPF line command'
```

In contrast, if the continuous attribute is set to false in this example, $strTmp$ would contain a string of 24 characters, `'Enter / on tline command'`.

Unwrap attribute

You can use this option with the continuous attribute set to either false or true.

When you set the unwrap attribute to true, the macro runtime uses not only the row and column pairs in the Extract window but also the field boundaries in the host terminal in determining the data to collect. The macro runtime returns an array of strings (if you are using the toolkit) or a single string of concatenated strings (if you are not using the toolkit).

Do not confuse the unwrap attribute with the wrap attribute of the String descriptor, which is based on a rectangular block of text rather than fields (see "How the macro runtime searches the rectangular area (Wrap attribute)" on page 43).

When unwrap is true and continuous is false: When the continuous attribute is false, the row and column pairs represent the corners of a rectangular block of text. When you set the unwrap attribute to true, the macro runtime reads each row of the rectangular block of text and processes each field in the row as follows:

- If the field begins outside the row and continues into the row, then the macro runtime ignores the field.
- If the field begins inside the row and ends inside the row, then the macro runtime includes the field's contents in the result.
- If the field begins inside the row and ends outside the row, then the macro runtime includes the contents of the entire field (including the part outside the rectangular block of text) in the result.

The intent of the unwrap attribute is to capture the entire contents of a field as one string even if the field wraps from one line to the next.

For example, suppose that the host terminal is 80 characters wide and that rows 9, 10, 11, and 12 of the host terminal are as follows:

```
.............................................Compress or print data set.......
............................................................Reset statistics..
............................................................Catalog or display
information of an entire data set.............................................
```

Suppose also that the following text areas in the lines above are fields:

```
Reset statistics
Catalog or display information of an entire data set
```

Finally, suppose that:
- The continuous attribute is false (this is the default setting).
- The unwrap attribute is true.
- The row and column pairs are (9,63) (the 'n' of 'print') and (11,73) (the ' ' after 'or').
- The extraction name is 'Extract1'.
- The data plane is TEXT_PLANE.

The macro runtime concatenates the individual strings and stores them as a single string into the variable that you specified in the Extract window. In this example the macro runtime stores the string `'Reset statisticsCatalog or display information of an entire data set'` into the variable.

When unwrap is true and continuous is true: When the continuous attribute is true, the row and column pairs represent the beginning and ending locations of a continuous sequence of text that wraps from line to line if necessary. When you then set the unwrap attribute to true, the macro runtime processes the continuous sequence of text as follows:
- If the field begins outside the sequence and continues into the sequence, then the macro runtime ignores the field.
- If the field begins inside the sequence and ends inside the sequence, then the macro runtime includes the field's contents in the result.
- If the field begins inside the sequence and ends outside the sequence, then the macro runtime includes the contents of the entire field (including the part outside the continuous sequence) in the result.

For more information, see “<extract> element” on page 179.

Input action (<input> element)

The Input action sends a sequence of keystrokes to the host terminal. The sequence can include keys that display a character (such as a, b, c, #, &, and so on) and also action keys (such as [enter] and others).

This action simulates keyboard input from an actual user.

This action can be specified using the VME, see "Input action" on page 126, and using the AME, see "Input action" on page 154.

Location at which typing begins

Use the row and column fields to specify the row and column location in the host terminal at which you want the input sequence to begin. For example, if you specify row 23 and column 17 in the Input action, and you specify `Hello world` as the String value of the Input action, then (assuming that the location you have specified lies within an input field) the macro runtime types the key sequence `Hello world` on the host terminal starting at row 23 and column 17.

If you specify a row or column location of 0, then the macro runtime will type the key sequence beginning at the actual row and column location of the text cursor on the host terminal when the Input action is performed. You should not specify a row or column of 0 unless the context is one in which the location of the text cursor does not matter or unless you can predict where the text cursor will be located (for example, if a Mouse click action has just moved the text cursor to a specific location, or if the application has positioned the text cursor as part of displaying the application screen).

Input errors

During macro playback, the host terminal reacts to a key input error in the same way as it would react if an actual user had typed the key.

For example, if an Input action sends a key that displays a character (such as a, b, c, #, & and so on) to the session when the text cursor is not located in a 3270 or 5250 input field, then the session responds by inhibiting the key input and displaying an error symbol in the Operator Information Area, just as it would with a keystroke typed by an actual user.

Translate host action keys (xlatehostkeys attribute)

The xlatehostkeys attribute indicates whether the macro runtime is to interpret action key names (such as [copy], [enter], [tab], and so on) in the input sequence as action keys or as literal sequences of characters. The default is true (interpret the action key names as action keys).

For example, suppose that the input key sequence is `'[up][up]Hello world'` and that the text cursor is at row 4, column 10. If the xlatehostkeys attribute is true, then in performing this input sequence the macro runtime moves the text cursor up two rows and then types `Hello world` beginning at row 2, column 10. In contrast, if the xlatehostkeys attribute is false, then the macro runtime types `[up][up]Hello world` beginning at row 4, column 10.

Move cursor to end of input (movecursor attribute)

When the movecursor attribute is true (the default), then the macro runtime moves the text cursor in the same way that it would be moved if an actual user were entering keyboard input. For example, if the key is a text character, such as 'a', then the macro runtime types the character on the host terminal and then moves the text cursor to the first character position after the 'a'. Similarly, if the key is [tab], then the macro runtime moves the text cursor to the next tab location.

In contrast, if the value of the movecursor attribute is false, then the macro runtime does not move the text cursor at all. The text cursor remains in the same position as it occupied before the macro runtime performed the Input action.

Encrypted attribute

You can use the encrypted attribute to encrypt the input key sequence contained in the value attribute (the String field). When you encrypt the contents of the value attribute, Host On-Demand stores only the encrypted version of the input key sequence into the macro script (in the <input> element) and does not retain the plain text (unencrypted) version of the input key sequence.

For example, Figure 16 shows an <input> element with an unencrypted input key sequence (`'myPassword'`):

```
input value="'myPassword'" row="20" col="16" movecursor="true"
         xlatehostkeys="true" encrypted="false" />
```

Figure 16. <input> element with unencrypted input key sequence

In contrast, Figure 17 shows the same <input> element with the input key sequence encrypted (`I7xae6rSVlVFF6qzhWRfKw==`). Notice that in this example the encrypted attribute of the <input> element is set to true:

```
input value="I7xae6rSVlVFF6qzhWRfKw==" row="20" col="16"
         movecursor="true" xlatehostkeys="true" encrypted="true" />
```

Figure 17. <input> element with encrypted input key sequence

In the macro editor, an encrypted input key sequence is displayed with asterisks (for example, the encrypted version of `'myPassword'` is displayed in the **String** field as `************************` rather than as `I7xae6rSVlVFF6qzhWRfKw==`).

Encryption allows you to include confidential data, such as a password, in an Input action without exposing the confidential data to casual view. An unauthorized person cannot discover the confidential data by viewing the macro script with a text editor, with the macro editor, or in the source view.

After you encrypt the input key sequence, Host On-Demand does not allow you or anyone else to use the macro editor or the source view to decrypt it. Host On-Demand does not decrypt an encrypted input key sequence of an Input action until the macro runtime processes the Input action during macro playback. When the macro runtime processes the Input action, the macro runtime decrypts the encrypted input key sequence and types the unencrypted version into the session window beginning at the specified row and column location.

Typically in a 3270 or a 5250 environment, for a confidential input key sequence such as a password, the host application creates a non-display input field as the destination of the input key sequence, so that blanks or asterisks (*) are displayed instead of the plain text.

However, a security exposure still exists if the macro script is exposed to more than casual view. A clever foe who gains access to a copy of the macro script can discover the original unencrypted input key sequence by editing the row and column fields of the Input action so that during macro playback the macro runtime types the decrypted input key sequence into a normal display field.

For greater security, you can use a Prompt action instead of an Input action. With a Prompt action, the input key sequence is not stored in the macro script, not even in encrypted form. Instead, during macro playback, when the macro runtime processes the Prompt action, the macro runtime pops up a window with an input field and a message prompting the end user to type an input key sequence. When the end user types the input key sequence and clicks **OK**, the macro runtime removes the popup window and directs the input key sequence into the session window at the specified row and column location.

Note: The default values for prompts are stored in macro files unencrypted. The default values display in the clear when you edit prompts in the macro editor. Therefore, while using a prompt to specify a password is an appropriate thing to do, for security reasons you should not specify a default value for the password.

Using an Input action does have this advantage, that the macro script runs automatically during macro playback without the end user having to intervene. However, if the confidential data changes (for example, if a password expires and a new and different password is required) then the Input action must be updated with the new input key sequence.

Automatic encryption during macro recording: During macro recording, for 3270 Display and 5250 Display sessions only, HATS automatically records a password input sequence as an Input action with an encrypted input key sequence.

Using the Encrypt string (VME) or Password (AME) check box: If the input key sequence was automatically encrypted during macro recording, when you look at the Input action in the macro editor, the Encrypt string (VME), or Password (AME), check box is selected, and the **String** field contains some number of asterisks (such as ******) representing the encrypted input key sequence.

In contrast, if the input key sequence was not automatically encrypted during macro recording (perhaps because the session was not a 3270 or 5250 display session, or perhaps because the input field was not a non-display input field) then the check box is cleared and the **String** field contains the unencrypted input key sequence.

If the input key sequence was not automatically encrypted during macro recording, you can encrypt it in the macro editor. Follow these steps to encrypt the input key sequence. Before you start, clear the check box if it is not already cleared.

1. If the input key sequence that you want is not already present in the **String** field, type the input key sequence into the **String** field.
   - The input key sequence appears normally in the **String** field (for example, `'myPassWord'`).
   - If you are using the advanced macro format, remember to enclose the input key sequence in single quotes (`'myPassWord'`).
2. Select the check box.
   - The macro editor encrypts the input key sequence and displays it in the **String** field using asterisks (**********************).

If you want to create an encrypted input key sequence, but you do not want the input key sequence to be displayed in unencrypted form as you type it into the **String** field, use the following method:

1. Clear the **String** field if it is not already empty.
2. Select the check box.
3. Type the input key sequence into the **String** field.
   - If you are using the advanced macro format, remember to enclose the input key sequence in single quotes (`'myPassWord'`).
   - As you type into the **String** field, the macro editor displays the characters using asterisks (`'myPassword'` is displayed as `************`).
   - When the input focus leaves the **String** field (that is, when you click some other field) then the macro editor encrypts the input key sequence.

After the input key sequence is encrypted, you might decide that you do not want it to be encrypted or that you want to revise it.

If the input key sequence is encrypted and you decide that you do not want it to be encrypted, then follow these steps:

1. Clear the check box.
   - The macro editor discards the encrypted string and clears the **String** field.
   - If for some reason the **String** field is not cleared, then delete the characters in it using the backspace key or the delete key.
2. Type the unencrypted input key sequence into the **String** field.

If the input key sequence is encrypted and you decide that you want to revise it, follow these steps:

1. Clear the **String** field using the backspace key or the delete key.
   - Delete the entire encrypted input key sequence, so that the field is empty.
2. Type the revised input key sequence into the **String** field.
   - If you are using the advanced macro format, remember to enclose the input key sequence in single quotes (`'myPassWord'`).
   - As you type into the **String** field, the macro editor displays the characters using asterisks (`'myPassword'` is displayed as `************`).
   - When the input focus leaves the **String** field (that is, when you click some other field) then the macro editor encrypts the input key sequence.

Do not try to revise an encrypted input key sequence by typing over or inserting characters into the string of asterisks in the **String** field (`*******`)! If you do, then you corrupt the encrypted input key sequence with your unencrypted revisions. Then the macro editor, believing that you have typed in an unencrypted string, re-encrypts the corrupted sequence. The result is that during macro playback, when the macro runtime processes the Input action, the decrypted sequence is not the input key sequence that you expected. (Also, if you are using the advanced macro format and you do not enclose the corrupted input key sequence with single quotes, the macro editor generates an error message).

Using the source view: The source view follows the same rules for encrypting an input key sequence as the macro editor.

The source view always allows you to do either of the following actions:

- Type into the editable text area a new <input> element that encrypts the input key sequence.

- Paste from the system clipboard into the editable text area an <input> element that encrypts the input key sequence.

You can also, while using the source view, change the value of the encrypted attribute (which activates or deactivates encryption) from true to false, or false to true.

However, if you want to use the source view to modify the value of the value attribute (which contains the encrypted or unencrypted input key sequence), and the encrypted attribute is set to true, then completely delete the encrypted input key sequence (so that it reads `value=""`), then type in the new input key sequence that you want encrypted.

Do not try to revise an encrypted input key sequence by typing over or inserting characters into an encrypted input key sequence in the value attribute! If you do, then you corrupt the encrypted input key sequence with your unencrypted revisions.

Encrypting a variable name: Although you can type a variable name (such as `$var1$`) into the **String** field in the macro editor (or into the value part of the value attribute in the source view) and encrypt the name of the variable (using the same steps that you would use to encrypt a normal input key sequence) this normally is not a useful thing to do. The reason is that when you encrypt a variable name only the characters making up the variable name are encrypted. The contents of the variable itself are not encrypted.

During macro playback, the macro runtime decrypts the encrypted text to get the plain text (such as `$var1$`), sees that the plain text is a variable name, and then evaluates the variable in the usual way.

For more information, see "<input> element" on page 184.

Mouse click action (<mouseclick> element)

The Mouse click action simulates a user mouse click on the host terminal. As with a real mouse click, the text cursor jumps to the row and column position where the mouse icon was pointing when the click occurred.

This action can be specified using the VME, see "Set cursor position action" on page 131, and using the AME, see "Mouse click action" on page 154.

For more information, see "<mouseclick> element" on page 185.

Pause action (<pause> element)

The Pause action waits for a specified number of milliseconds and then terminates.

More specifically, the macro runtime finds the <pause> element, reads the duration value, and waits for the specified number of milliseconds. Then the macro runtime goes on to perform the next item.

Uses for this action are:
- Any situation in which you want to insert a wait.
- Waiting for the host to update the host terminal. For more information see "Screen completion" on page 82.
- To add delay for debugging purposes.

This action can be specified using the VME, see “Pause action” on page 127, and using the AME, see “Pause action” on page 155.

For more information, see “<pause> element” on page 188.

Perform action (<perform> element)

The Perform action invokes a method belonging to a Java class that you have imported.

This action can be specified using the VME, see “Perform action” on page 127, and using the AME, see “Perform action” on page 155.

You can invoke a method in many other contexts besides the Perform action. However, the Perform action is useful in certain scenarios, for example, when you want to invoke a method that does not return a value.

Some of the contexts, other than the Perform action, in which you can invoke a method are as follows:

- You can invoke a method and assign the return value to a variable by using the Update variable action. The variable that receives the return value can be either a variable belonging to a standard type (boolean, integer, string, double) or a variable belonging to an imported type (for example, a variable named $objTmp$ that belongs to the imported type Object, based on the Java class Object).
- You can invoke a method and use the return value as a parameter in a macro action by specifying the method call in the field for the parameter. For example, in the Row parameter of an Extract action you can use a method call that returns an integer value. The macro runtime sees that the parameter is a method call , invokes the method, and uses the integer return value as the value of the Row parameter.
- You can invoke a method as part of any expression by using the method call as a term in the expression. When the macro runtime evaluates the expression, it sees that the term is a method call, invokes the method, and uses the value of the method (for example, a string) as the value of the term.
- You can invoke a method and use the return value as the initial value of a variable that you have just declared.

In general, outside the Perform action, you can invoke a method in any context in which the value returned by the method is valid.

Examples

The Figure 18 on page 68 shows how to invoke a method using the Perform action. Notice the following facts about these examples:

- In Example 1, the Perform action calls the update() method on the variable $importedVar$. Notice that:
  - The entire method call is enclosed in dollar signs ($).
  - In the context of a method call, the variable name itself (`importedVar`) is not enclosed in dollar signs ($).
  - A variable passed as a parameter to a method must be enclosed in dollar signs ($) as usual (`$str$`).
  - A string passed as a parameter to a method must be enclosed in single quotes as usual (`'Application'`).
- In Example 2, the Perform action calls a static method.

- In Example 3, the Perform action calls the close() method belonging to the class to which the variable belongs, such as java.io.FileInputStream.
- In Example 4, the Perform action calls the createZipEntry() method belonging to the class to which the variable belongs, such as java.util.zip.ZipInputStream.
- In Example 5, the Perform action calls the clear() method belonging to the class to which the variable belongs, such as java.util.Hashtable.

```
<actions>
   <!-- Example 1 -->
   <perform value="$importedVar.update( 5, 'Application', $str$)$" />

   <!-- Example 2 -->
   <perform value="$MyClass.myInit('all')$" />

   <!-- Example 3 -->
   <perform value="$fip.close()$" />

   <!-- Example 4 -->
   <perform value="$zis.createZipEntry( $name$ )$" />

   <!-- Example 5 -->
   <perform value="$ht.clear()$" />
</actions>
```

Figure 18. Example of the Perform action

For more information, see “<perform> element” on page 188.

PlayMacro action (<playmacro> element)

The PlayMacro action launches another macro.

This action can be specified using the VME, see “Play macro action” on page 127, and using the AME, see “Playmacro action” on page 155.

When the macro runtime performs a PlayMacro action, it terminates the current macro (the one in which the PlayMacro action occurs) and begins to process the specified macro screen of the target macro. This process is called chaining. The calling macro is said to "chain to" the target macro. There is no return to the calling macro.

You must specify in the PlayMacro action the name of the target macro and, optionally, the name of the macro screen in the target macro that you want the macro runtime to process first.

You can have the macro runtime transfer all of the variables with their contents from the calling macro to the target macro.

Adding a PlayMacro action

Outside a Condition element, you can add only one PlayMacro action to a macro screen, and that PlayMacro action must be the last action in the Actions list (<actions> element) of the macro screen.

Inside a Condition element:

- You can add one PlayMacro action to the true branch (<if> element), and that PlayMacro action must be the last action in the branch (<if> element).

- You can also add one PlayMacro action to the false branch (<else> element), and that PlayMacro action must be the last action in the branch (<else> element).

You can have as many Condition elements in the macro as you like, with each Condition element containing one PlayMacro action in its true branch and one PlayMacro action in its false branch.

The Macro Editor enforces these rules.

Using target macros with prompts

If a target macro requires a prompt value, prompt for the required value in the first macro of the chain. For example, if you chain from calling MacroA to target MacroB and MacroB needs an account number from the user, add the prompt action for the account number to MacroA. Assign the response to a macro variable using the assigntovar attribute of the <prompt> action. In the <playmacro> action in calling MacroA, specify that variables are transferred to the target macro by setting `transferVars="Transfer"`. In the target macro, use the macro variable in the place where you would have used the prompt action. For example, use an <input> action with the macro variable as the input value instead of a prompt action. If there are several macros in the chain, all prompts must occur in the first macro. For example, if you chain from MacroA to MacroB to MacroC and MacroC requires a prompt value, prompt for the MacroC value in MacroA and pass it along the chain.

Any time that you use macro variables with prompts in macros, you must specify a value of `promptall=true` in the <HAScript> tag of the macro. This is the default value for the attribute. Ensure that your calling macro, which contains all of the prompts for the chain, is using a value of true for `promptall`.

Transferring variables

You can have the macro runtime transfer to the target macro all the variables that belong to the calling macro, including the contents of those variables, by setting the transferVars attribute to `"Transfer"` (the default is `"No Transfer"`).

This transferring of variables and their contents allows you to use variables to pass parameters from the calling macro to the target macro.

After the target macro gets control, it can read from and write to the transferred variables in the same way that it reads from and writes to variables that it has declared itself.

For example, if MacroA currently has two integer variables named StartRow and StartCol, with values of 12 and 2, and then MacroA launches MacroB with a PlayMacro action, then MacroB starts out having variables StartRow and StartCol with values of 12 and 2.

Even if the transferred variable belongs to an imported type and contains a Java object, the target macro can still refer to the transferred variable and call methods on the Java object, or can write some other object into that transferred variable.

Requirements for transferring variables: The target macro must have selected the advanced macro format (see “Basic and advanced macro format” on page 15).

Restriction: The following restriction applies to all types of transferred variables: You cannot use the transferred variable in the **Initial Value** field of a variable defined in the target macro.

Additional information: If the target macro creates a variable with the same name and type as a transferred variable, then the macro runtime uses the created variable rather than the transferred variable.

When the target macro needs to import a type: In the target macro, if you want to use a transferred variable that belongs to an imported type, then you do not need to import that same type in the target macro. Examples of operations where you do not need to import the type are as follows:

- Using the transferred variable as the value of an attribute
- Calling a method on the transferred variable

However, in the target macro, if you want to use the name of an imported type, then you must import that type. Examples of operations where you must import the type:

- Declaring a new variable of the imported type
- Creating a new instance of the imported type
- Calling a static method of the imported type

The following example shows a PlayMacro action:

```
<actions>
   <playmacro name="TargetMacro" startscreen="*DEFAULT*"
            transferVars="Transfer" />
</actions>
```

Figure 19. Example of the PlayMacro action

For more information, see “<playmacro> element” on page 189

Prompt action (<prompt> element)

The Prompt action provides a powerful way to send immediate user keyboard input into the 3270 or 5250 application or into a variable.

This action can be specified using the VME, see “Prompt action” on page 128, and using the AME, see “Prompt action” on page 155.

The Prompt action displays on top of the host terminal a prompt window that contains a message, an input field, and three buttons (**OK**, **Cancel**, **Help**). After the user types text into the input field and clicks **OK**, the Prompt action uses the input in one or both of the following ways:

- The Prompt action types the input into an input field of the host terminal.
- The Prompt action interprets the input as a string and stores the input into a variable.

A typical use of this action, but by no means the only use, is to permit the user to provide a password. Many scenarios require that a macro log on to a host or start an application that requires a password for access. Because a password is sensitive data and also typically changes from time to time, you probably do not want to code the password as an immediate value into the macro.

With the Prompt action, you can display a message that prompts the user for a password and that lets the user type the password into the input field. After the user clicks **OK**, the macro runtime types the input into the host terminal at the row and column location that you specify. The input sequence can include action keys such as [enter], so that if the user types `MyPassword[enter]` the macro runtime not only can type the password into the password field but also can type the key that completes the logon or access action. (Or, you can put the action key into an Input action that immediately follows the Prompt action.)

Note: The default values for prompts are stored in macro files unencrypted. The default values display in the clear when you edit prompts in the macro editors. Therefore, while using a prompt to specify a password is an appropriate thing to do, for security reasons you should not specify a default value for the password.

The promptall attributes

You can have the macro runtime combine the popup windows from all <prompt> elements into one large prompt window and display this large prompt window at the beginning of the macro playback, by setting the promptall attribute of the <HAScript> element to true (see "<HAScript> element" on page 180).

The promptall attribute in the <actions> element works similarly (see "<actions> element" on page 172).

For more information, see "<prompt> element" on page 189.

SQLQuery action (<sqlquery> element)

The SQLQuery action is a very useful and powerful action that allows you to send an SQL statement to a host database, retrieve any data resulting from the SQL statement, and then write the data into a Host On-Demand macro variable.

This action can be specified using the Source tab in the VME, and using the Actions tab in the AME, see "SQLQuery action" on page 158.

You can use the SQLQuery action in any type of session that supports macros (3270 Display, 5250 Display, or VT Display).

The database server to which you connect can be on a different host than the host running your application session.

The SQLQuery action supports only SQL statements of type Select. It does not support SQL statements of type Insert, Update, or Delete.

The SQLQuery action requires a database driver that is accessible to both the HATS Toolkit environment and the specific HATS applications using the SQLQuery action. The database driver is specific to the database being accessed; obtain this driver from the database administrator.

For the SQL Wizard to function correctly within the HATS Toolkit, the database driver file should be placed in the lib\ext directory of the Java Runtime Environment (JRE) being used by the Rational® Software Delivery Platform (for example, RAD_INSTALL_DIR\jre\lib\ext). You must restart the Rational Software Delivery Platform (if it was active) after copying the database driver to the JRE location.

The HATS application must also have access to the database driver file when it is deployed. For HATS Web applications, the database driver file should be added to the EAR level. After the file is added to the EAR level, each WAR in the HATS application that uses the SQLQuery action must have its META-INF/

MANIFEST.MF file updated to include the database driver file. To ensure that the update to the MANIFEST.MF file is made correctly, edit it using the JAR Dependency Editor. For HATS rich-client applications, the database driver file should be added to the lib\ext directory of the JRE that is being used by the target deployment environment (Eclipse rich client, Lotus Notes®, or Lotus® Expeditor Client).

For more information, see "<sqlquery> element" on page 192.

Trace action (<trace> element)

The Trace action sends a trace message to a trace destination that you specify, such as the HATS Toolkit console or the WebSphere® console. In addition, HATS adds macro traces to the HATS runtime trace.

This action can be specified using the Source tab in the VME, and using the Actions tab in the AME, see "Trace action" on page 163.

Example

The example in Figure 20 on page 73 shows how to send trace messages to the HATS Toolkit console. This example uses the following action elements: Trace and Variable update.

You can copy the text of this macro script from this document into the system clipboard, and then from the system clipboard into the source view (see "Samples" on page 7). After you save this script in the macro editor, you can edit it.

Notice the following facts about this example:

- The example consists of one entire macro script named TRACE.
- The <create> element creates a string variable named `$strData$` and initializes it to an original value of `'Original value'`.
- The first action is a Trace action with the Trace Text set to `'The value is' + $strData$`.
- The second action is a Variable update action that sets the variable $strData$ to a new value of `'Updated value'`.
- The third action is another Trace action identical to the first Trace action.

```
<HAScript name="TRACE" description=" " timeout="60000" pausetime="300"
            promptall="true" author="" creationdate="" supressclearevents="false"
             usevars="true" ignorepauseforenhancedtn="false"
             delayifnotenhancedtn="0">
   <vars>
      <create name="$strData$" type="string" value="'Original value'" />
   </vars>
   <screen name="Screen1" entryscreen="true" exitscreen="false" transient="false">
      <description>
          <oia status="NOTINHIBITED" optional="false" invertmatch="false" />
      </description>
      <actions>
         <trace type="SYSOUT" value="'The value is '+$strData$"  />
         <varupdate name="$strData$" value="'Updated value'" />
         <trace type="SYSOUT" value="'The value is '+$strData$"  />
      </actions>
      <nextscreens timeout="0" >
      </nextscreens>
  </screen>
```

Figure 20. Sample code TRACE

This script in Figure 20 causes the macro runtime to send the following data:

```
The value is +{$strData$ = Original value}
The value is +{$strData$ = Updated value}
```

In the trace output above, notice that instead of just displaying the value of $strData$, the Debug action displays both the variable's name and its value inside braces.

For more information, see "<trace> element" on page 194.

Variable update action (<varupdate> element)

The <varupdate> element stores a value into a variable. During macro playback the macro runtime performs the action by storing the specified value into the specified variable.

You must specify:

- The name of a variable
- The value that you want to store into the variable

This action can be specified using the VME, see "Update macro variable action" on page 131, and using the AME, see "Variable update action" on page 163.

You can also use the Variable update action in a <description> element (see "Processing a Variable update action in a description" on page 46).

The value can be an arithmetic expression and can contain variables and calls to imported methods. If the value is an expression, then during macro playback the macro runtime evaluates the expression and stores the resulting value into the specified variable.

The Variable update action works like an assignment statement in a programming language. In a Java program you could write assignment statements such as:

```
boolVisitedThisScreen = true;
intVisitCount = intVisitCount + 1;
dblLength = 32.4;
strAddress ="123 Hampton Court";
```

With the Variable update action you type the left side of the equation (the variable) into the variable name field in the macro editor and type the right side of the equation (the value) into the value field. To create the equivalents of the Java assignment statements above, you would use the values shown in Table 11:

Table 11. Example of variable names and values

In the variable name field:	In the value field:
$boolVisitedThisScreen$	true
$intVisitCount$	$intVisitCount$+1
$dblLength$	32.4
$strAddress$	'123 Hampton Court'

The value that you provide must belong to the correct data type for the context or be convertible to that type (see "Automatic data type conversion" on page 20).

The Variable update action is useful because:
- The entity in the **Value** field can be an expression
- Expressions are not evaluated until the action is performed

For more information on expressions see Chapter 3, "Data types, operators, and expressions," on page 15.

Variable update action with a field variable

Using a Variable update action to update a field variable is a convenient way of reading the contents of a 3270 or 5250 field in the host terminal and storing the field's contents as a string into a variable.

A field variable is a type of string variable. A field variable is defined in the <vars> element of the macro script but does not take an initial value. The following contains an example of a field variable.

```
<vars>
<create name=$intUpdate$" type="integer" value="3"/>
<create name="$strData$" type="string" value="'hello'"/>
<create name="$fieldVar$" type="field" />
</vars>
```

A field variable contains a string, just as a string variable does, and you can use a field variable in any context in which a string variable is valid. However, a field variable differs from a string variable in the way in which a string is stored into the field variable. The string that a field variable contains is always a string that the macro runtime has read from a 3270 or 5250 field in the current host terminal.

When you use the Variable update action to update a string variable, you specify the following information:
- The name of the field variable, such as $fldTmp$.
- A location string, such as '5,11'. (A location string is a string containing two integers separated by a comma that represent a row and column location on the host terminal.)

When the macro runtime performs the Variable update action, the macro runtime:

1. Recognizes that the variable is a field variable.
2. Looks at the location string that is to be used to update the field variable.
3. Finds in the current host terminal the row and column location specified by the location string.
4. Finds in the current host terminal the 3270 or 5250 field in which the row and column location occurs.
5. Reads the entire contents of the 3270 or 5250 field, including any leading and trailing blanks.
6. Stores the entire contents of the field as a string into the field variable.

You can then use the field variable in any context in which a string is valid. For example, you can concatenate the field variable with another string, as in the following:

```
'The field\'s contents are'+ $fldPrintOption$
```

As an example, suppose that the host terminal contains a 3270 or 5250 field with the following characteristics:

- It begins at row 5, column 8
- It ends at row 5, column 32
- It contains the string `'Print VTOC information'`

You set up a Variable update action with the following values:

- In the variable name field you type the name of a field variable that you have just created, `$fldData$`.
- In the value field you type a location string, `'5,11'`. Notice that you have to specify only one row and column location, and that it can be any row and column location that lies within the field.

When the macro runtime performs this Variable update action, the macro runtime reads the entire contents of the field and stores the contents as a string into $fldData$. The field variable $fldData$ now contains the string `'Print VTOC information'`.

Reading part of a field: When you are using a field variable in a Variable update action, you can specify a location string that contains two locations. Use this feature if you want to read only part of the contents of a field.

Type the first and second locations into the value field with a colon (:) between them. For example, if the first location is 5,14 and the second location is 5,17, then you would type `'5,14:5,17'`.

When you specify two locations:

- The first location specifies the first position in the field to read from.
- The second location specifies the last position in the field to read from.

As an example, suppose that the host terminal contains a 3270 or 5250 field with the following characteristics:

- It begins at row 5, column 8
- It ends at row 5, column 32
- It contains the string `'Print VTOC information'`

In addition, suppose that you set up a Variable update action with the following values:

- In the variable name field you type the name of a field variable that you have just created, `$fldData$`.
- In the value field you type a location string, `'5,14:5,17'`. Here you are specifying both a beginning location and an ending location within the field.

When the macro runtime performs this Variable update action, the macro runtime reads the string `'VTOC'` from the field (beginning at the position specified by the first location string and continuing until the position specified by the second location string) and stores the string `'VTOC'` into $fldData$.

If the second location lies beyond the end of the field, the macro runtime reads the string beginning at the first location and continuing until the end of the field. The macro runtime then stores this string into the field variable.

For more information, see "<varupdate> element" on page 196.

Chapter 8. Timing issues

This chapter describes several timing issues involved in processing actions and the resources available for dealing with these issues.

Macro timing and delay characteristics

This section addresses HATS macro timing parameters from a macro script level. For example, while there are multiple ways to affect the timing of macro execution from various places in the HATS Toolkit graphical user interface (including the macro editors), the explanations here deal with the results of those actions as they are implemented in the XML script of the macro itself, not with the various ways (tabs in the macro editors, and so on) of causing them to be placed in the script.

There are several timing parameters that influence macro execution. Most timing parameters control delays in various parts of the macro's execution. This allows the macro to be resilient, robust, and successful in an environment where host response time and certain other variables might be unpredictable. The most common reason for adding delay in a macro is to allow the screen coming from the host to complete its arrival before it is processed by the macro. This delay can usually be reduced or totally avoided if enough additional description — for example, looking for strings of characters on various parts of the screen — is added to the screens that the delay addresses.

In a HATS macro, there are elements and there are attributes that modify elements (attributes are also referred to as parameters). Elements are framed by opening and closing angle bracket tags and attributes are normally included within an element's tags, such as in this example of the screen element with a modifying pause attribute:

```
<screen pause=15000>
```

The elements and attributes discussed in this chapter are:
- pausetime attribute of the <HAScript> element
- pause attribute of the <screen> element
- <pause> element, which can appear along with other actions inside the <actions> element
- ignorepauseforenhancedtn attribute of the <HAScript> element
- ignorepauseoverrideforenhancedtn attribute of the <pause> element
- delayifnotenhancedtn attribute of the <HAScript> element

What each element and attribute is for

The pausetime attribute of the <HAScript> element controls two things:
1. A delay of *pausetimevalue* /2 (in milliseconds) that occurs after most <prompt> and <insert> elements defined in a screen's actions, and
2. A one-time delay of *pausetimevalue* (in milliseconds) that occurs after all of a screen's actions have been executed (for most screens)

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Exactly where, and on which screens, delays of *pausetimevalue* /2 and *pausetimevalue* are executed is explained in more detail below. The default value for *pausetimevalue* (if no explicit pausetime attribute is defined) is 300 milliseconds.

The pause attribute (not to be confused with the <pause> element) overrides the pausetime attribute. To be more precise, if a pause attribute is defined within an element, it is used to override, for only that screen, the pausetime attribute defined (explicitly or by default) in the <HAScript> element for the macro. This means that when the pause attribute is defined for a screen, the pausetime attribute is ignored, and the value of that screen's pause attribute is used in calculating any pausetime-related delays that occur during that <screen> element's processing. The pause and pausetime attributes are not affected by, and do not affect, the processing of any <pause> elements.

The <pause> element is used to insert an explicit delay into the processing of a screen's actions. One or more <pause> elements can be placed before, in between, and after other actions defined in a screen's <actions> element. The pause and pausetime attributes are not affected by, and do not affect, the processing of any <pause> elements.

The ignorepauseforenhancedtn attribute of the <HAScript> element, when set to "true," causes the macro runtime to skip Pause actions (<pause> elements) during macro playback if the session is running in a contention resolution environment. See “ignorepauseforenhancedtn=true/false” on page 84 for additional information on the use of this attribute.

The ignorepauseoverrideforenhancedtn attribute of the <pause> element, when set to "true" in a particular <pause> element, causes the macro runtime to process that <pause> element (wait for the specified number of milliseconds) even if the ignorepauseforenhancedtn attribute is set to "true" in the <HAScript> element. See “ignorepauseoverrideforenhancedtn=true/false” on page 85 for additional information on the use of this attribute.

The delayifnotenhancedtn attribute of the <HAScript> element, when set to a non-zero value, causes the macro runtime to automatically pause the specified number of milliseconds whenever the macro runtime receives a notification that the Operator Information Area has changed. This attribute is useful for allowing the same macro to run successfully in both a contention resolution environment or a non-contention resolution environment. See “delayifnotenhancedtn=(milliseconds)” on page 85 for additional information on the use of this attribute.

How the HATS macro processing engine uses these timing elements and attributes

For non-exit screens (the exitscreen attribute is set to “false”), a delay of *pausetimevalue* is executed once after a screen's actions have all been executed, but before the registration or recognition of the next screen begins. If the pause attribute is defined for the screen, then the value of pause is used instead of the value of pausetime for the post-actions delay.

For macro screens defined as exit screens (the exitscreen attribute set to “true”), the pausetime attribute (and any pause attribute defined for that exit screen) is essentially ignored and there is no additional delay automatically executed after all of the screen's actions are completed. This keeps the macro engine from adding extra delays once it has navigated to the final screen of the macro.

In addition, for all macro screens, the macro sleeps for *pausetimevalue* /2 after each <prompt> or <insert> that is not the last action on the screen.

For example, if pausetime="1000" and no pause attribute is defined for the screen, as shown in Figure 21, the macro will sleep for 500 ms after the first action (a prompt), 500 ms after 4th action and (if the current screen is not an exit screen) 1000 ms after all the actions are played, for a total of 2000 ms.

```
<actions>
       <prompt...
       <extract...
       <extract...
       <prompt...
       <insert...
</actions>
```

Figure 21. Example 1 for pausetimevalue

In a macro, <pause> elements are executed inline wherever they are placed, and are not overridden by the pausetime attribute or pause attribute settings, but might be overridden by the ignorepauseforenhancedtn attribute of the <HAScript> element if it is set to "true".

To expand upon the above example, if pausetime="1000" and no pause attribute is defined for the screen, shown in Figure 22, the macro will sleep for 500 ms after the first action (a prompt), 500 ms after 4th action (a prompt), 500 ms after 5th action (an insert), 150 ms after the 6th action (the <pause> element), and (if the current screen is not an exit screen) 1000 ms after all the actions are played, for a total of 2650 ms.

```
<actions>
       <prompt...
       <extract...
       <extract...
       <prompt...
       <insert...
       <pause value="150"/>
</actions>
```

Figure 22. Example 2 for pausetimevalue

Note that if this were an exit screen, the total sleep time would be 1650 ms. Also note that the ignorepauseforenhancedtn attribute of the <HAScript> element, and the ignorepauseoverrideforenhancedtn attribute of the <pause> element, if set, will effect whether the explicit <pause> element in this example is executed or ignored.

What happens after a screen's actions have completed

In a macro, after all actions for a screen have been processed (including sleeping after all actions based on the pausetime or pause attribute value), the nextscreen is registered and a timer (timeout clock) is started. The macro attempts to recognize the screens at the time of registration and, if no screen is recognized, starts an iterative recognition process for the nextscreens, which is triggered by PSEVENTs and OIAEVENTs generated by data coming in from the host. Each time a PSEVENT or OIAEVENT arrives from the host, the macro tries to recognize the nextscreen again.

The screen recognition process continues to try to recognize the incoming screen data. It might fail several times before succeeding (messages are not logged for these failures). The timeout parameter for the macro sets an upper limit on how long each screen's recognition process (not the whole macro) will try to recognize the incoming screen. Note that the screen recognition engine is not in a "busy" loop. The engine waits to be triggered by incoming PSEVENT and OIAEVENT occurrences to do each additional comparison. If the timeout value is exceeded before the screen is recognized, screen recognition fails. The timer is stopped when a screen is recognized.

High-level, textual flow of macro engine processing

1. ScreenX is recognized.
2. ScreenX actions are completed. Note that there is the addition of pausetimevalue /2 (or pauseattributevalue /2) after each action if the action is a <prompt> or <insert> and is not the last action in the set of actions.
3. Macro play stops here if the current screen is an exit screen.
4. ScreenX *pausetimevalue* delay (set by the pausetime attribute or overridden by a local pause attribute for this screen) is completed.
5. Register nextscreens.
6. Start a timeout clock for nextscreens.
7. Recognition processing of nextscreens loops, doing a new recognition based on each PSEVENT or OIAEVENT, the arrival of which might be controlled or affected by contention resolution if it is active, until...
8. A nextscreen is recognized, in which case the timeout timer is stopped. The process returns to the top of the sequence and starts again, or the timeout timer (timeout attribute of the <HAScript> element) expires and the macro ends with a timeout error.

Pause after an action

This section discusses the scenario in which an action does not perform as expected because a previous action has side effects that have not completed.

There are two attributes that let you add a pause after actions during runtime:
- The pausetime attribute of the <HAScript> element.
- The pause attribute of the <Screen> element.

Speed of processing actions

Because the macro runtime executes actions much more quickly than a human user does, unforeseen problems can occur during macro playback that cause an action not to perform as expected, because of a dependency on a previous action.

One example is a keystroke that causes the application screen to change. If a subsequent action expects the application screen to have already changed, but in fact the application screen is still in the process of being updated, then the subsequent action can fail.

Timing-dependent errors between actions can occur in other situations, if the macro runtime performs each action immediately after the preceding action.

The pausetime attribute

The pausetime attribute of the <HAScript> element specifies a time period for the macro runtime to wait as follows:

- After performing an Input action or a Prompt action, to allow all the possible side effects of either of these two actions to complete
- After performing the last action in a macro screen, to allow any other side effects of action-processing to complete

Through HATS Version 5, the pausetime attribute was implemented as a pause after *every* type of action, not just after Input and Prompt actions. It is now implemented as follows:

- The macro runtime waits for the following:
  - An interval equal to 50% of the pause time after every Input action or Prompt action except the last one in a macro screen.
  - An interval equal to 100% of the pause time after the last action in a macro screen.
- The macro runtime does not wait for the following:
  - After the last Input action or Prompt action in a macro screen, unless it is the last action in the macro screen.
  - After any other type of action, unless it is the last action in the macro screen.

By default, the pausetime attribute is enabled and the timeout value is set to 300 milliseconds. Therefore by default the macro runtime:

- Waits 150 milliseconds after every Input action or Prompt action except the last one in a macro screen.
- Waits 300 milliseconds after the last action in a macro screen.

Notice that the pausetime attribute affects every macro screen. Therefore this one setting allows you avoid timing errors throughout the macro, without having to change each macro screen that might have a problem.

The pause attribute

If you want a longer or shorter pause between actions for a particular macro screen, or if you have only a few macro screens in which a pause between actions is important, then you can use the pause attribute of the <screen> element.

By default, this attribute is not specified.

If you specify this attribute for a macro screen, then the macro runtime uses the specified number of milliseconds for the pause between actions for this particular macro screen.

For example, if for ScreenA you set the pause attribute to 500 milliseconds, then the macro runtime waits 250 milliseconds after each Input action and Prompt action in ScreenA except the last one, and waits 500 milliseconds after the last action in ScreenA.

When the macro runtime processes a macro screen with the pause attribute of the <screen> element specified, it ignores the setting of the pausetime attribute of the <HAScript> element, and uses only the value in the pause attribute.

Adding a pause after a particular action

If you need an additional pause after one particular action in a macro screen, you can add a Pause action after the action. The wait that you specify in the Pause action is in addition to any wait that occurs because of a pausetime or pause attribute.

Screen completion

Recognizing the next macro screen too soon

Suppose that you have a macro screen, ScreenB, with the following bug: the macro runtime starts processing the actions in ScreenB before the host has completely finished displaying the new application screen. Although this timing peculiarity might not pose a problem for you in most situations, suppose that in this instance the first action in ScreenB is an Extract action that causes the macro runtime to read data from rows 15 and 16 of the application screen. Unfortunately the macro runtime performs this action before the host has had time to write all the new data into rows 15–16.

Analyzing this problem, you verify that:

- The session is a 3270 Display session using the default connectivity, TN3270.
- The following sequence of actions occurs:
  1. In processing the previous macro screen, the macro runtime performs an Input action that causes an enter key to be sent to the host.
  2. The host receives the enter key and sends the first block of commands and data for the new application screen.
  3. The client receives the first block and processes it, thereby updating some parts but not all of the host application screen. In particular, rows 15 and 16 of the application screen have not yet been updated.
  4. Meanwhile the macro runtime has started trying to recognize a valid next macro screen that matches the new application screen.
  5. As a result of the changes in the application screen from the first block of commands and data, the macro runtime recognizes macro ScreenB as the next macro screen to be processed.
  6. The macro runtime performs the first action element in ScreenB, which is an Extract action that reads data from rows 15 and 16 of the application screen.
  7. The client receives a second block of commands and data from the host and processes it, thereby updating other parts of the application screen, including rows 15 and 16.

In short, as a result of this timing problem the macro runtime has read rows 15 and 16 of the new application screen before the host could finish updating them.

The cause: Unenhanced TN3270 protocol

The reason for this problem is that the unenhanced TN3270 protocol does not include a way for a host to inform a client that the host application screen is complete. (TN3270 implements a screen-oriented protocol, 3270 Data Stream, over a character-oriented connection, Telnet). Therefore, the host cannot send several blocks of data to the client and then issue a message to indicate that the application screen is complete and the user can now enter data. Instead, each block arrives without any indication about whether it is the last block for this application screen. From the client's point of view, something like the following events occur:

1. A block of commands and data arrives. The client sets the input inhibit indicator, processes the block, and displays the new data on the specified parts of the host terminal. The client then clears the input inhibit indicator and waits.
2. 30 milliseconds pass.
3. Another block of commands and data arrives. The client processes the block as in step 1 above. This block causes a different part of the screen to be updated. The client waits.
4. 50 milliseconds pass.

This process continues until the host has completely displayed a new host application data screen. The client still waits, not knowing that the host application screen is complete. (For more information, see Chapter 4, “How the macro runtime processes a macro screen,” on page 25).

This process does not present problems for a human operator.

However, this process does present problems for the macro runtime during screen recognition. Recall that during screen recognition the macro runtime tries to match the application screen to one of the valid next macro screens every time the screen is updated and every time an OIA event occurs (see “Repeated screen evaluations” on page 31). Therefore the macro runtime might find a match before the screen is completely updated. For example, a String descriptor might state that recognition occurs if row 3 of the application screen contains the characters "ISPF Primary Option Menu". When the host has updated row 3 to contain these characters, then the macro runtime determines that a match has occurred, regardless of whether the host has finished updating the remainder of the application screen.

Solutions to early macro screen recognition

There are three approaches to solving this problem:
- Add more descriptors to the description.
- Insert a delay after the Input action that sends an enter key (see step 1 in “Recognizing the next macro screen too soon” on page 82).
- Use the contention-resolution feature of TN3270E.

The following subsections describe these solutions.

Add more descriptors: This approach works sometimes but can be awkward and unreliable. You add enough descriptors to the description part of ScreenB so that the macro runtime will not recognize the ScreenB until the critical portion of the application screen has been updated.

Insert a delay after the input action: Inserting a delay is the best solution if the session is an ordinary TN3270 session or if the session is a TN3270E session without contention-resolution. That is, after the Input action (in ScreenA in our example) that causes the host to send a new application screen, insert a pause of several hundred milliseconds or longer. This delay allows enough time for the host to update the application screen before the macro runtime starts processing the actions in the next macro screen (ScreenB).

In this scenario there are several ways to insert a pause after the Input action:
- Increase the delay specified by the pausetime attribute of the <HAScript> element.
- Increase the delay specified by the pause attribute of the <screen> element for ScreenA. This method is a good one. You are increasing the pause time only for ScreenA, so that only ScreenA is affected.

- Add a Pause action to ScreenA immediately after the Input action. This method is also good. You are inserting a pause exactly where it is needed.
- Add a Pause action as the first action of ScreenB. You might prefer this method in certain scenarios. However, using this method, if there are several macro screens that can occur after ScreenA (such as ScreenB, ScreenC, ScreenD), and if the screen completion problem occurs for each of these following macro screens, then you must to insert a Pause as the first action for each of these following macro screens. It is easier to use the method that inserts a Pause Action in one macro screen, ScreenA.

If your macro has to run both on ordinary TN3270 sessions and also on TN3270E sessions with contention-resolution enabled, the XML macro language has several attributes that can help you. See "Attributes that deal with screen completion."

Use the contention-resolution feature of TN3270E: TN3270E (Enhanced) is an enhanced form of the TN3270 protocol that allows users to specify an LU or LU pool to which the session will connect and that also supports the Network Virtual Terminal (NVT) protocol for connecting to servers in ASCII mode (for example, in order to log on to a firewall).

Contention-resolution mode is an optional feature of TN3270E, supported by some but not all TN3270E servers, that solves the client's problem of not knowing when the host has finished updating the application screen. If the client is running a TN3270E session and is connected to a server that supports contention-resolution, then the macro runtime does not recognize a new macro screen until the host has finished updating the application screen.

Attributes that deal with screen completion

Host On-Demand has three element attributes that address problems that the macro developer encounters when trying to support a single version of a macro to run on both the following environments:

- A non-contention-resolution environment (the macro is being run by clients connected to a TN3270 server or to a TN3270E server without contention resolution; consequently some macro screens might require a Pause action to allow time for the host to update the application screen).
- A content-resolution environment (the macro is being run by clients connected to a TN3270E server with contention resolution; consequently no macro screen requires a Pause action to allow time for the host to update the application screen).

You will have to add these attributes using the source view.

ignorepauseforenhancedtn=true/false

The ignorepauseforenhancedtn attribute of the <HAScript> element, when set to true, causes the macro runtime to skip Pause actions (<pause> elements) during macro playback if the session is running in a contention-resolution environment. You can use this attribute if you developed a macro to run in a non-contention-resolution environment (you inserted Pause actions) and you now want the macro to also run in a contention-resolution environment without unnecessary delays (you want the Pause actions to be ignored).

With this attribute set to true, the macro runtime processes Pause actions (waits the specified number of milliseconds) in a non-contention-resolution environment but ignores Pause actions in a contention-resolution environment.

Notice, however, that setting this attribute to true causes the macro runtime to skip all Pause actions (<pause> elements) in the macro, not just the pauses that have been inserted in order to time for the application screen to be updated. The next subsection addresses this secondary problem.

ignorepauseoverrideforenhancedtn=true/false

The ignorepauseoverrideforenhancedtn attribute of the <pause> element, when set to true in a particular <pause> element, causes the macro runtime to process that <pause> element (wait for the specified number of milliseconds) even if the ignorepauseforenhancedtn attribute is set to true in the <HAScript> element.

Set this attribute to true in a <pause> element if you want the <pause> element always to be performed, not skipped, even in a contention-resolution environment with the ignorepauseforenhancedtn attribute set to true in the <HAScript> element.

delayifnotenhancedtn=(milliseconds)

The delayifnotenhancedtn attribute of the <HAScript> element, when set to a non-zero value, causes the macro runtime to automatically pause the specified number of milliseconds whenever the macro runtime receives a notification that the OIA (Operator Information Area) has changed.

You can use this attribute if you developed a macro in a contention-resolution environment (you did not need to insert Pause actions) but you now want the macro to run also in a non-contention-resolution environment (some macro screens might need a Pause action to allow time for the application screen to be completed).

With this attribute set to true, then when the macro is run in a non-contention-resolution environment the macro runtime inserts a pause for the specified number of milliseconds each time it receives a notification that the OIA has changed. For example, if you specify a pause of 200 milliseconds then the macro runtime waits for 200 milliseconds every time the OIA changes.

The cumulative effect of the macro runtime pausing briefly after each notification of a change to the OIA is that the application screen is completed before the macro runtime begins processing the actions of the new macro screen. The macro runtime inserts these extra pauses only when it detects that the session is running in a non-contention-resolution environment.

A limitation of this attribute is that the macro runtime adds these extra pauses during every screen, not just during screens in which screen update is a problem. However, the additional time spent waiting is small. And more importantly, this attribute lets you quickly adapt the macro to a non-contention resolution environment, without having to test individual screens and insert a pause action in each screen with a screen update problem.

Chapter 9. Variables and imported Java classes

HATS variables

In HATS, there are two main types of variables: global variables and macro variables. The differences between them are outlined here.

Global variables

Global variables are variables created in HATS Toolkit and used by HATS projects. Global variables are stored outside of the macro script. They are maintained and updated by HATS runtime. There are two types of global variables:

Local
A local global variable is one that is created within a HATS project, and is only visible to the project.

Shared
A shared global variable is one that is visible to and can be used by all the HATS Web applications in an .ear file, or by all HATS rich client applications running in the same rich client environment.

Whether a global variable is considered local or shared depends on whether the shared check box in the GUI is checked when the global variable is created, or whether the value of the shared attribute of a `set`, `prompt`, or `extract` tag is specified as yes or no in the HATS .hma source file.

Macro variables

Unlike global variables, macro variables are used and stored within macros in the HATS .hma source file. The macro editors can be used to create macro variables. To create macro variables using the VME, see "Variables and Types tab" on page 113, and using the AME, see "Variables tab" on page 147. The macro variables are created, stored, and used by the macro engine, and listed in the macro script.

In a HATS macro (.hma) file source using HATS prompts and extracts for global variables, the prompts and extracts appear in the file before the macro script syntax. The macro script, which contains the macro variables, is enclosed by the begin <HAScript> and the end </HAScript> tags.

Introduction to macro variables and imported types

Macro variables help you to add programming intelligence to macros. With a variable you can store a value, save a result, keep a count, save a text string, remember an outcome, or do any number of other programming essentials.

You can create a variable that belongs to any of the standard data types (string, integer, double, boolean, and field).

You can also create a variable that belongs to an imported type representing a Java class. You can then create an instance of the class and call a method on the instance. This capability opens the door to the abundant variety of functionality available through Java class libraries, including libraries in the Java Runtime Environment (JRE) libraries, classes or libraries that you implement yourself, or Java classes and libraries from other sources.

Advanced macro format required

Using variables requires that you use the advanced macro format for your macro (see “Basic and advanced macro format” on page 15). Therefore, if you want to add variables to a macro that is in the basic macro format, you must decide whether to convert the macro to the advanced macro format. If you have an old macro in the basic macro format that many users rely on and that works perfectly, you might want to leave the macro as it is.

However, remember that all recorded macros are recorded in the basic macro format. So, if you have recently recorded a macro and are beginning to develop it further, then you might simply not have gotten around to switching to the advanced macro format.

The macro editors address both these situations by popping up a window with the following message when you start to define a variable in a macro that is still in the basic macro format:

```
You are attempting to use an advanced macro feature. If you choose to continue,
your macro will automatically be converted to advanced macro format. Would you
like to continue?
```

Figure 23. Reminder message

Click **Yes** if you are building a macro in which you plan to use variables, or **No** if you have a macro in the basic macro format that you do not want to convert.

Scope of variables

The scope of every variable is global with respect to the macro in which the variable is created. That is, every variable in a macro is accessible from any macro screen in the macro. All that an action or a descriptor in a macro screen has to do to access the variable is just to use the variable name.

For example, suppose that you have a variable named $intPartsComplete$ that you initialize to 0. You might use the variable in the following ways as the macro proceeds:

1. ScreenC completes Part 1 of a task and increments $intPartsComplete$ using a Variable update action.
2. ScreenG completes Part 2 of a task and increments $intPartsComplete$ using a Variable update action.
3. ScreenM has a Conditional action that tests whether 1 or 2 parts have been completed so far. Depending on the result, the macro expects either ScreenR or ScreenS as the next macro screen to be processed.
4. ScreenS completes Part 3 of a task and increments $intPartsComplete$ using a Variable update action.

In this example, actions in several different macro screens were able to read from or write to the variable $intPartsComplete$.

Creating a variable

In the Source view, you create a variable using a <create> element. There is a containing element called <vars> that contains all the variables in the macro script, and there is a <create> element for each variable. Figure 24 on page 89 shows a

<vars> element that contains five <create> elements:

```
<vars>
   <create name="$strAccountName$" type="string" value="" />
   <create name="$intAmount$" type="integer" value="0" />
   <create name="$dblDistance$" type="double" value="0.0" />
   <create name="$boolSignedUp$" type="boolean" value="false" />
   <create name="$fldFunction$" type="field" />
</vars>
```

Figure 24. Sample <vars> element

In Figure 24, the `<vars>` element creates one variable from each of the standard data types (string, integer, double, boolean, and field).

You must put all variable creations (<create> elements) inside the <vars> element. The <vars> element itself must appear after the <import> element, if any (see the next section), and before the first macro screen (<screen> element).

Creating an imported type for a Java class

In the Source view, you create an imported type using a <type> element. There is a containing element called <import> that contains all the imported types in the macro script, and there is a <type> element for each imported type. Figure 25 shows an <import> element that declares an imported type, followed by a <vars> element that creates and initializes a variable belonging to the imported type:

```
<import>
   <type class="java.util.Hashtable" name="Hashtable" />
</import>

<vars>
   <create name=$ht$ type="Hashtable" value="$new Hashtable(40)$" />
 </vars>
```

Figure 25. Imported type and variable of that type

In the figure above the <import> element contains one <type> element, which has a **class** attribute (containing the fully qualified class name, `java.util.Hashtable`) and a **name** attribute (containing the short name, `Hashtable`). The <vars> element contains one <create> element, which as usual specifies a name (`$ht$`), a type (`Hashtable`), and an initial value (which here is not `null` but rather is a call to a constructor that returns an instance of the class, `$new Hashtable(40)$`).

If you are using the source view, you must put all imported types (<type> elements) inside the <import> element. The <import> element itself must appear inside the <HAScript> element (see "<HAScript> element" on page 180) and before the <vars> element.

Common issues

Deploying Java libraries or classes

During macro playback, when the macro runtime processes a call to a Java method, the macro runtime searches all the available Java library files and class files for the class to which the method belongs. The search does not stop until it finds the class.

Deploying a Java library or class consists of placing the library file or class file containing the class in a location where the macro runtime can find it during macro playback. The following Java classes are automatically available for use and do not need to be deployed by you:

- Classes in the Java API. The Java archive files are already present in the HATS application and their locations are listed in the classpath that is specified when the HATS application is launched.
- Classes in the Host On-Demand Macro Utility Libraries. The HML libraries are stored with the HATS code (see "The Macro Utility Libraries (HML libraries)" on page 95).

All other Java classes containing methods invoked by a macro script must be deployed by you to a location where the macro runtime can find them. Depending on the environment, you can deploy the Java classes as class files or as libraries containing Java classes.

When using Java classes in a WebSphere Application Server runtime environment (not portal), be aware that the macro runtime is packaged in a Java EE Enterprise Application (.ear) file. If the Java classes are packaged in a HATS Web project, you must update the Web archive (WAR) class loader policy to **Single class loader for application** to ensure that the macro runtime can access them when the macro runs. If this configuration is not done, ClassNotFoundExceptions will occur when the macro invokes the Java classes. To learn how to configure the class loader policy, see **Configuring application class loaders** in the documentation for the version of WebSphere Application Server that you are using .

Variable names and type names

The rules for variable names are as follows:

- A variable name can contain only alphanumeric characters (a-z, A-Z, 0-9), underscore (_), or hyphen (-).
- Case is significant (for example, `strTmp` and `strtmp` are two different names).
- A variable name cannot be the same as the short name or the fully qualified class name of an imported type.

The rules for type names are as follows:

- A type name can contain only the alphanumeric characters, underscore (_), hyphen (-), or period (.).
- Type names are case sensitive.

Transferring variables from one macro to another

The PlayMacro action, in which one macro "chains to" another macro (a call without return), allows you to transfer all the variables and their values belonging to the calling macro to the target macro. The target macro has access both to its own variables and to the transferred variables (see "PlayMacro action (<playmacro> element)" on page 68).

Field variables

A field variable is a type of string variable. It holds a string, just as a string variable does, and you can use it in any context in which a string variable is valid.

However, a field variable differs from a string variable in the way in which a string is stored into the field variable. The string that a field variable contains is always a string that the macro runtime reads from a 3270 or 5250 field in the current host terminal. To get the macro runtime to read this string from the 3270 or 5250 field, you have to create a Variable update action that specifies:

1. The name of the field variable (such as $fldFilename$).
2. A location string (a string containing a pair of integers separated by a comma, such as `'5,11'`).

When the macro runtime performs the Variable update action it takes the following steps:

1. Looks in the host terminal at the row and column value specified by the location string.
2. Finds the 3270 or 5250 field in which the row and column value is located.
3. Reads the entire contents of the field.
4. Stores the entire contents of the field as a string into the field variable.

For more information, see "Variable update action with a field variable" on page 74.

Using variables

The macro runtime assigns initial values to variables at the start of the macro playback, before processing any macro screen. The sections that follow describe the usage of those initial values for both standard and imported variable types.

Using variables belonging to a standard type

Using the value that the variable holds

A variable that belongs to a standard type (string, integer, double, boolean) can be used in much the same way as an immediate value of the same type (such as `'Elm Street', 10, 4.6e-2, true`):

- Except for the restrictions listed later in this subsection, a variable of standard type can be used in any input field (in the macro editor) or attribute (in the source view) in which an immediate value of the same data type can be used. For example, if an input field (such as the String field on the Input action window) requires a string value, then the field likewise accepts a string variable. See "Equivalents" on page 21.
- Variables can be used with operators and expressions in the same ways that immediate values of the same types are used. See "Arithmetic operators and expressions" on page 18.
- The value of a variable occurring in a context different from the type of the variable is converted, if possible, to a value of the correct type, in the same way that an immediate value of the same type is converted. See "Automatic data type conversion" on page 20.

However, you cannot use a variable in certain contexts. In the AME, you cannot use a variable in the following contexts:

- Any field on the **General** tab
- The **Screen Name** field on the **Screens** tab
- The value of any field in the PlayMacro action window

In the source view, you cannot use a variable in the following contexts:

- The name of an attribute of any element
- The value of any attribute of an <HAScript> element
- The value of the name attribute of a <screen> element
- The value of the uselogic attribute of the <description> element
- The name of a macro screen in a <nextscreen> element
- The value of any attribute of a <playmacro> element

Writing a value into a variable belonging to a standard type

You can write a value into a variable belonging to a standard type in the following ways:

- Assign an initial value when you create the variable.
- Use a Variable update action to assign a value to the variable.
- Use the Prompt action to get user input and assign it to the variable.
- Use the Extract action to read data from the host terminal and assign it to the variable.
- Use an action that writes a return code value into a variable.

Restrictions: You cannot assign one of the following values to a variable of standard type:

- The value `null`. (Exception: If you assign the value `null` to a string variable, it is converted to the string 'null').
- A call to a void method.
- A call to a method that returns an array.

Writing a Java object into a variable of standard type: If you write a Java object into a variable of standard type, then the macro runtime calls the toString() method of the imported type and then attempts to assign the resulting string to the variable.

Using variables belonging to an imported type

Using the value that the variable holds

You can use the value contained in a variable belonging to an imported type in the following ways:

- You can assign the variable to another variable of the same type using the Variable update action.
- You can call a Java method on the variable (see “Calling Java methods” on page 94). If the Java method returns a value belonging to a standard type (string, integer, double, boolean), then you can use the result as you would use any value of that type.

Restrictions

You cannot assign the following types of data to a variable of imported type:

- A value or variable belonging to a standard type (string, integer, double, boolean, field).
- A instance of, or a variable belonging to, a different imported type (unless it is a superclass of the imported type).
- An array of instances of objects returned by a method called on a variable of imported type.

If your macro attempts to assign one of these invalid types of values to a variable of imported type, then the Macro runtime generates a runtime error and halts the macro.

Writing into the variable belonging to an imported type

You can write a value into a variable of imported type in the following ways:

- You can assign a value to the variable when you create it.
- You can assign a value to the variable using the Variable update action.

You can assign the following types of values to a variable belonging to an imported type:

- An instance of the same type. This instance can be either in a variable of the same type, or from a call to a method that returns an instance of the same type.
- The value null. To signify the value null, you can use one of the following:
  - The keyword `null`.
  - A blank input field (if you are using a macro editor), such as the **Initial Value** field when defining the variable, or the **Value** field in the Variable update action definition.
  - An empty attribute (if you are using the source view), as in the `value` attribute of the following <create> element:

    ```
    <create name=$ht$ type="Hashtable" value="" />
    ```

Comparing variables of the same imported type

In any conditional expression (for example, in the **Condition** field of a conditional action) in which you are comparing two variables of the same imported type, you should implement a comparison method (such as `equals()`) in the underlying class rather than using the variables themselves. For example,

```
$htUserData.equals($htPortData$)$
```

If instead, you compare the variables themselves (for example `$htUserData$ == $htPortData$`), then:

1. The macro runtime, for each variable, calls the toString() method of the underlying Java class and gets a string result
2. The macro runtime compares the two string results and gets a boolean result.
3. The macro runtime sets the result of the condition to the boolean result obtained in step 2.

This will probably not yield the outcome that you expect from comparing the two variables.

Calling Java methods

Where method calls can be used

You can call a method in any context in which the value returned by the method is valid. For example, in an Input action you can set the Row value to the integer value returned by a method, such as:

```
$importedVar.calculateRow()$
```

Also, you can use the Perform action to call a method when you do not need the return variable of the method or when the method has no return value (void) (see "Perform action (<perform> element)" on page 67).

Syntax of a method call

To call a method belonging to an imported class, use the same syntax that you would use in Java. However, in addition, you must also enclose a method call in dollar signs ($), just as you would a variable. Examples:

```
$new FileInputStream('filename')$
$fis.read()$
```

An immediate string value (such as `'Elm Street'`, or `'myFileName'` in the first example above) passed as a parameter to a method must be enclosed in single quotes, as usual (see "Advanced macro format rules" on page 16).

How the macro runtime searches for a called method

When you add a method call (such as `$prp.get('Group Name')$`) to a macro script, the macro editor does not verify that a called method or constructor exists in the class to which the variable belongs. That check is done by the macro runtime when the call occurs.

The method must be a *public* method of the underlying Java class.

When the macro runtime searches in the Java class for a method to match the method that you have called, the macro runtime maps macro data types (boolean, integer, string, field, double, imported type) to Java data types as shown in Table 12:

Table 12. How the macro runtime maps macro data types to Java data types

If the method parameter belongs to this macro data type:	Then the macro runtime looks for a Java method with a parameter of this Java data type:
boolean	boolean
integer	int
string	String
field	String
double	double
imported type	underlying class of the imported type

The macro runtime searches for a called method as follows:

1. The macro runtime searches for the class specified in the imported type definition (such as `java.util.Properties`).

2. The macro runtime searches in the class for a method with the same method signature (name, number of parameters, and types of parameters) as the called method.
3. If the search succeeds, then the macro runtime calls the method.
4. If the search fails, then the macro runtime searches in the class for a method with the same name and number of parameters (disregarding the types of the parameters) as the called method.
   a. If the macro runtime finds such a method, it calls the method with the specified parameters.
   b. If the call returns without an error, the macro runtime assumes that it has called the right method.
   c. If the call returns with an error, the macro runtime searches for another method.
   d. The search continues until all methods with the same name and number of parameters have been tried. If none was successful, then the macro runtime generates a runtime error.

The Macro Utility Libraries (HML libraries)

The Host On-Demand Macro Utility Libraries (HML libraries) are utility libraries that are packaged with the HATS code. You can invoke a method from one of these libraries without:
- Importing the underlying class; or
- Creating a variable to contain an instance of the class; or
- Creating an instance of the class.

In fact, you are not allowed to import a class contained in an HML Java library, or to create a variable belonging to an HML class, or to create an instance of an HML object.

The reason is that the macro runtime, during the initializing that goes on when macro playback is started:
- Imports all the HML classes.
- Creates one variable for each HML class to contain an instance of the class.
- Creates one instance of each HML class and stores it in the appropriate variable.

The following table shows for each HML variable the variable name and the types of methods in the underlying class.

Table 13. HML variables

HML variable:	**Description of methods:**
$HMLFormatUtil$	Methods for formatting strings.
$HMLPSUtil$	Methods that access the presentation space of the session window.
$HMLSessionUtil$	Methods that return session values.
$HMLSQLUtil$	Methods that return information about the results of the most recent SQLQuery action.

Invoking a method belonging to an HML library

To invoke a method belonging to an HML library, specify the variable name, method name, and input parameters in the usual way:

```
$HMLFormatUtil.numberToString(1.44)$
$HMLPSUtil.getCursorPos()$
$HMLSessionUtil.getHost()$
```

Figure 26. Example of invoking HML methods

Variable names beginning with HML are reserved

To prevent confusion between normal variables and HML variables, variable names beginning with `HML` are reserved. If you try to create a variable beginning with `HML`, Host On-Demand generates an error message.

$HMLFormatUtil$

The methods invoked with $HMLFormatUtil$ are formatting methods. Table 14 summarizes these methods:

Table 14. Method summary for $HMLFormatUtil$

METHOD SUMMARY: $HMLFormatUtil$	
`String`	**`numberToString(Object obj)`** Converts a number to a string formatted according to the currently configured locale. The input parameter can be of type integer or of type double.
`int or double`	**`stringToNumber(String str)`** Converts a numeric string in the local format (such as '1111.56', '1,111.56', or '1111,56') to a number. The number returned is either of type integer or of type double, depending on the input string.

Converting numbers to and from the format of the current locale

A locale is a set of formatting conventions associated with a particular national language and geographic area. For example, depending on the locale with which a client workstation is configured, a decimal value such as 1111.22 can be represented with any of the following strings:

```
'1111.22'
'1,111.22'
'1111,22'
```

As another example, a negative number such as -78 can be represented as:

```
'-78'
'78-'
```

The methods `numberToString()` and `stringToNumber()` perform conversions between a number (that is, a variable or immediate value of type integer or type double, such as 1111.22) and its representation in the current locale (a string, such as `'1111.22'`, `'1,111.22'`, or `'1111,22'`).

Method details

numberToString():

`public String` **`numberToString(Object obj)`**

This method converts a number (integer or double) to a string formatted according to the currently configured locale. The input parameter can be of type integer or of type double.

This method replaces the standalone method `$FormatNumberToString()$`, which is deprecated.

```
<input value="$HMLFormatUtil.numberToString(1111.44)$"
          row="20" col="16" movecursor="true"
          xlatehostkeys="true" encrypted="false" />
```

Figure 27. Example for numberToString()

stringToNumber():

```
public int stringToNumber(String str)
public double stringToNumber(String str)
```

This method converts a numeric string formatted according to the currently configured locale to a number. The number returned is either of type integer or of type double, depending on the input string.

This method replaces the standalone method `$FormatStringToNumber()$`, which is deprecated.

```
<value="'1111.33'" />
<extract name="'Extract'" planetype="TEXT_PLANE"
         srow="1" scol="1"
         erow="1" ecol="10" unwrap="false"
         assigntovar="$value$" />
<if condition="$HMLFormatUtil.stringToNumber($value$)$ < 0 "
   ...
</if>
```

Figure 28. Example for stringToNumber()

$HMLPSUtil$

The methods invoked with $HMLPSUtil$ affect the presentation space of the session window or return information about the presentation space of the session window. Table 15 summarizes these methods:

Table 15. Method summary for $HMLPSUtil$

METHOD SUMMARY: $HMLPSUtil$	
`int`	**`convertPosToCol(int pos)`** Returns the column number of the specified position in the presentation space.
`int`	**`convertPosToRow(int Pos)`** Returns the row number of the specified position in the presentation space.

Table 15. Method summary for $HMLPSUtil$ (continued)

METHOD SUMMARY: $HMLPSUtil$	
void	**enableRoundTrip(boolean flag)** For bidirectional languages, determines whether numerals preceded by bidirectional characters exchange places with the numerals.
int	**getCursorCol()** Returns the column number of the text cursor in the presentation space.
int	**getCursorPos()** Returns the position of the text cursor in the presentation space.
int	**getCursorRow()** Returns the row number of the text cursor in the presentation space.
int	**getSize()** Returns the size of the presentation space (number of character positions in the presentation space) .
int	**getSizeCols()** Returns the number of columns in the presentation space.
int	**getSizeRows()** Returns the number of rows in the presentation space.
String	**getString(int pos, int len)** Returns the text string beginning at the specified position in the presentation space and running for the specified length.
int	**searchString(String str)** Returns the position in the presentation space of the specified string (0 if the specified string is not found in the presentation space).

Presentation space

The presentation space is a data structure that contains an element for each row and column position in the session window (but not including the last row of the session window, which is used for the Operator Information Area). The size of the presentation space depends on the size of the session window. For example, if the session window has 24 rows and 80 columns, then the size of the presentation space is 24 * 80 = 1920.

The position of the elements in the presentation space corresponds serially to the row and column positions in the session window, reading from left to right, top to bottom. For example, if the session window has 80 rows and 25 columns, then row and column positions are as shown in Figure 29 on page 99:

```
Row of    Column of  Corresponds to
Session   Session    element at this
Window:   Window:    position in PS:
   1         1           1
   1         2           2
   1         3           3
 ...
   1        80          80
   2         1          81
   2         2          82
   2         3          83
 ...
  24        79        1919
  24        80        1920
```

Figure 29. Correspondence of row and column location in the presentation space

Host On-Demand uses the presentation space to store the characters that are to be displayed in the session window. Each element in the presentation space is used to store one character (and information about that character, such as intensity). For example, if the string `Message` appears at row 1 and column 1 of the session window, then rows and columns correspond to the positions shown in Figure 30:

```
Row of    Column of  Corresponds    Character
Session   Session    to element     stored in
Window:   Window:    at this pos-   this element:
                     ition in PS:
   1         1         1             M
   1         2         2             e
   1         3         3             s
   1         4         4             s
   1         5         5             a
   1         6         6             g
   1         7         7             e
```

Figure 30. Layout when 'Message' appears in row 1, column 1

Although you normally will not need to use them, Table 16 shows the formulas for calculating various values. The meanings of the symbols used in these formulas are as follows:

- `row` - A row location in the session window
- `col` - A column location in the session window
- `pos` - A position in the presentation space
- `NUMROWS` - The number of rows in the session window, *not* including the last row used for the Operator Information Area (OIA)
- `NUMCOLS` - The number of columns in the session window

Table 16. Formulas for calculating values related to presentation space

Value:	**Formula for calculating:**
Size of the PS	NUMROWS * NUMCOLS Example: 24 * 80 = 1920

Table 16. Formulas for calculating values related to presentation space (continued)

Value:	Formula for calculating:

row	`(pos + NUMCOLS - 1) / NUMCOLS`
	
	Example:
	`(81 + 80 - 1) / 80 = 2`

col	`pos - ((row - 1) * NUMCOLS)`
	
	Example:
	`1920 - ((24 - 1) * 80) = 80`

pos	`((row - 1) * NUMCOLS) + col`
	
	Example:
	`((24 - 1) * 80) + 1 = 1641`

Method details

convertPosToCol():

public int **convertPosToCol(int pos)**

This method returns the column number associated with the specified position in the presentation space.

```
<varupdate name="$cursor_col$ value="$HMLPSUtil.convertPosToCol($HMLPSUtil.getCursorPos()$) $" />
```

Figure 31. Example for convertPosToCol()

convertPosToRow():

public int **convertPosToRow(int pos)**

This method returns the row number associated with the specified position in the presentation space.

```
<varupdate name="$cursor_row$" value=$HMLPSUtil.convertPosToRow($HMLPSUtil.getCursorPos()$)$" />
```

Figure 32. Example for convertPosToRow()

enableRoundTrip():

public void **enableRoundTrip(boolean flag)**

This method is for bidirectional languages only (Arabic and Hebrew). Assume that `A`, `B`, and `C` are bidirectional characters. Normally, when a string contains a series of bidirectional characters followed by a series of numerals (for example, `ABC 123`), and the entire string is stored, the Host On-Demand client exchanges the positions of the bidirectional characters and the numerals. For example, normally, if you read the string `ABC 123` from the presentation space and store the string into a variable, and then subsequently write the value of the variable back into the presentation space, the Host On-Demand client writes `123 ABC` back into the presentation space.

To turn off this technique of forced reversal, call `enableRoundTrip()` with a value of true. To restore this technique of forced reversal, call `enableRoundTrip()` with a value of false.

```
<perform  value="$HMLPSUtil.enableRoundTrip(true)$" />
```

Figure 33. Example for enableRoundTrip()

getCursorCol():

`public int` **`getCursorCol()`**

This method returns the column location of the text cursor in the presentation space.

```
<input value="$HMLSessionUtil.getHost()$"
          row="$HMLPSUtil.getCursorRow()$"
          col="$HMLPSUtil.getCursorCol()$+2"
          movecursor="true" xlatehostkeys="true"
          encrypted="false" />
```

Figure 34. Example for getCursorCol()

getCursorPos():

`public int` **`getCursorPos()`**

This method returns the position of the text cursor in the presentation space.

```
<varupdate name="$cursor_pos$" value="$HMLPSUtil.getCursorPos()$" />
```

Figure 35. Example for getCursorPos()

getCursorRow():

`public int` **`getCursorRow()`**

This method returns the row location of the text cursor in the presentation space.

```
<input value="$HMLSessionUtil.getHost()$"
          row="$HMLPSUtil.getCursorRow()$"
          col="$HMLPSUtil.getCursorCol()$+2"
          movecursor="true" xlatehostkeys="true"
          encrypted="false" />
```

Figure 36. Example for getCursorRow()

getSize():

`public int` **`getSize()`**

This method returns the size of the presentation space, that is, the number of character positions in the presentation space. For example, if the session window has 25 rows and 80 columns, then the size of the presentation space is 24 * 80 = 1920.

```
<varupdate name="$size$" value="HMLPSUtil.getSize()$" />
```

Figure 37. Example for getSize()

getSizeCols():

`public int` **`getSizeCols()`**

This method returns the number of columns in the presentation space. The presentation space has the same number of columns as the session window. For example, if the session window has 25 rows and 80 columns, then the number of columns in the presentation space is 80.

```
<varupdate name="$size_cols$" value="$HMLPSUtil.getSizeCols()$" />
```

Figure 38. Example for getSizeCols()

getSizeRows():

`public int` **`getSizeRows()`**

This method returns the number of rows in the presentation space. The presentation space has one row less than the session window (because the last line of the session window, which contains the Operator Information Area, is not included in the presentation space). For example, if the session window has 25 rows and 80 columns, then the number of rows in the presentation space is 24.

```
<varupdate name="$size_rows$" value="$HMLPSUtil.getSizeRows()$" />
```

Figure 39. Example for getSizeRows()

getString():

`public String` **`getString(int pos, int len)`**

This method returns the text string beginning at the specified position in the presentation space and continuing for the specified number of characters.

```
<varupdate name="$text_of_row_18$"
          value="$HMLPSUtil.getString(
                    $HMLPSUtil.getSizeCols()$*17+1,
                    $HMLPSUtil.getSizeCols()$)$" />
```

Figure 40. Example for getString()

searchString():

`public int` **`searchString(String str)`**

This method returns the position in the presentation space of the specified string. This method returns 0 if the string is not found in the presentation space.

```
<varupdate name="$pos_ofIBM$" value="$HMLPSUtil.searchString('IBM')$" />
```

Figure 41. Example for searchString()

$HMLSessionUtil$

The methods invoked with $HMLSessionUtil$ return values associated with the session. Table 17 summarizes these methods:

Table 17. Method summary for $HMLSessionUtil$

METHOD SUMMARY: $HMLSessionUtil$	
`String`	**`getHost()`** Returns the text string specified in the `Destination Address` field of the session configuration.
`String`	**`getLabel()`** Returns the string specified in the **Session Name** field of the session configuration
`String`	**`getName()`** Returns the session instance identifier assigned to the session by the host.

Method details

getHost():

`public String` **`getHost()`**

This method returns the host name or the host address that you typed into the **Destination Address** field of the Connection section of the session configuration (such as `myhost.myloc.mycompany.com` or `9.27.63.45`).

```
<varupdate name="$host$" value="$HMLSessionUtil.getHost()$" />
```

Figure 42. Example for getHost()

getLabel():

`public String` **`getLabel()`**

This method returns the session name that you typed into the **Session Name** field of the Connection section of the session configuration (a name such as `3270 Display` or `5250 Display`).

```
<varupdate name="$label$" value="$HMLSessionUtil.getLabel()$" />
```

Figure 43. Example for getLabel()

getName():

`public String` **`getName()`**

This method returns the identifying name that the host assigns to the session (such as `A` , `B`, or `C`). When you start a session, the host assigns a name to the session to distinguish it from other instances of the same session that might be started.

```
<varupdate name="$name$" value="$HMLSessionUtil.getName()$" />
```

Figure 44. Example for getName()

$HMLSQLUtil$

The methods invoked on $HMLSQLUtil$ return information about the results of the most recent SQLQuery action. Table 18 summarizes these methods:

Table 18. Method summary for $HMLSQLUtil$

METHOD SUMMARY: $HMLSQLUtil$	
`int`	**`getColumnSize()`** Returns the number of columns of data.
`String`	**`getDataByIndex()`** Returns the entry located at the specified row index and column index.
`String`	**`getDataByName()`** Returns the entry located at the specified row index and column name (field name).
`int`	**`getRowSize()`** Returns the number of rows of data.

Format of the stored data

The results of the SQLQuery action are stored as a two-dimensional array that is one column wider and one row taller than the size of the block of data returned. Row 0 is used to store the names of the columns (the field names from the database), and Column 0 is used to store a zero-based index (see Table 19 on page 105 below). The entry at Row 0, Column 0 contains an empty string. The remainder of the array contains the actual data. All values are strings.

Table 19 shows as an example the results of a query, a 3 x 5 block of data, stored in a 4 x 6 array:

Table 19. Example of two-dimensional array containing results

(empty string)	TOPICID	EXMPLID	DESCRIPT
0	4	18	Create a toolbar with custom buttons.
1	9	54	Attach tables at startup.
2	11	74	Edit Products.
3	11	75	Enter or Edit Products
4	11	76	Find Customers

In the table above, the entry at Row 0, Column 0 contains an empty string. The remainder of Row 0 contains the field names from the database (TOPICID, EXMPLID, DESCRIPT). The remainder of Column 0 contains index numbers for the rows (0, 1, 2, 3, 4). The actual data is contained in the remainder of the array. All values are strings.

Method details

getColumnSize():

```
public int getColumnSize()
```

This method returns the actual number of columns of data in the array, including the added Column 0. For example, for the array in Table 19 this method returns 4.

```
<varupdate name="$col_size$" value="$HMLSessionUtil.getColumnSize()$" />
```

Figure 45. Example for getColumnSize()

getDataByIndex():

```
public int getDataByIndex(int row, int column)
```

This method returns the entry at the specified row and column index. The following list shows the values returned for the data shown in Table 19:

- getDataByIndex(0,0) returns an empty string.
- getDataByIndex(0,1) returns the string 'TOPICID'.
- getDataByIndex(0,2) returns the string 'EXMPLID'.
- getDataByIndex(1,1) returns the string '4'.
- getDataByIndex(2,2) returns the string '54'.
- getDataByIndex(3,3) returns the string 'Edit Products'.

```
<varupdate name="$data$" value="$HMLSessionUtil.getDataByIndex(3,3)$" />
```

Figure 46. Example for getDataByIndex()

getDataByName():

```
public int getDataByName(int row, String fieldName)
```

This method returns the entry at the specified row and field name. The following list shows the values returned for the data shown in Table 19 on page 105:

- getDataByIndex(1, TOPICID) returns the string '4'.
- getDataByIndex(2, EXMPLID) returns the string '54'.
- getDataByIndex(3, DESCRIPT) returns the string 'Edit Products'.

```
<varupdate name="$data$" value="$HMLSessionUtil.getDataByName(3,'DESCRIPT')$" />
```

Figure 47. Example for getDataByName()

getRowSize():

`public int` **`getRowSize()`**

This method returns the actual number of rows of data in the array, including the added Row 0. For example, for the array in Table 19 on page 105 this method returns 6.

```
<varupdate name="$row_size$" value="$HMLSessionUtil.getRowSize()$" />
```

Figure 48. Example for getRowSize()

FormatNumberToString() and FormatStringToNumber()

`$FormatNumberToString()$` is deprecated in favor of `$HMLFormatUtil.numberToString()$`. The former has the same input parameters and return type as the latter (see "numberToString()" on page 96).

`$FormatStringToNumber()$` is deprecated in favor of `$HMLFormatUtil.stringToNumber()$`. The former has the same input parameters and return type as the latter (see "stringToNumber()" on page 97).

Chapter 10. Visual Macro Editor

The Visual Macro Editor (VME) gives you the ability to visually develop HATS macros. The VME combines many of the features of the HATS host terminal, basic Macro Editor, and Advanced Macro Editor, and allows for offline development of macros. It also allows flows to be copied between macros and provides drag-and-drop support for adding new screens.

The VME is the default editor for HATS macros.

The Macro Editor can still be opened by right-clicking on the macro and selecting **Open With -> Macro Editor**. The Advanced Macro Editor can still be opened from the Macro Editor Overview page. Prompts and Extracts can also still be edited from the Macro Editor.

Note: Support for the Macro Editor and the Advanced Macro Editor is deprecated in HATS V9.5. While support continues for now, IBM reserves the right to remove these capabilities in a subsequent release of the product. This support is replaced by the Visual Macro Editor.

Creating a new macro

In addition to using the host terminal, you can use the VME to create a new macro using the New Macro wizard.

In the HATS perspective, use any of the following procedures to start the New Macro wizard:
- From the menu bar, click **File > New > Other > HATS > HATS Macro**.
- From the menu bar, click **HATS > New > Macro**.
- From the tool bar, click the **Create a HATS macro** icon.
- From the HATS Projects view, right-click a project and select **New HATS > Macro**.

The wizard includes one panel where you can:
- Provide a name and description for the macro.
- Select the project for the macro and the connection the macro will use.
- Select whether to connect the terminal when the macro is opened.

Using the editor

The VME is the default editor for HATS macros. When you double-click on a macro object (.hma file), the VME opens.

The VME is composed of the following parts:
1. Design tab
2. Palette view
3. Integrated terminal
4. Source tab

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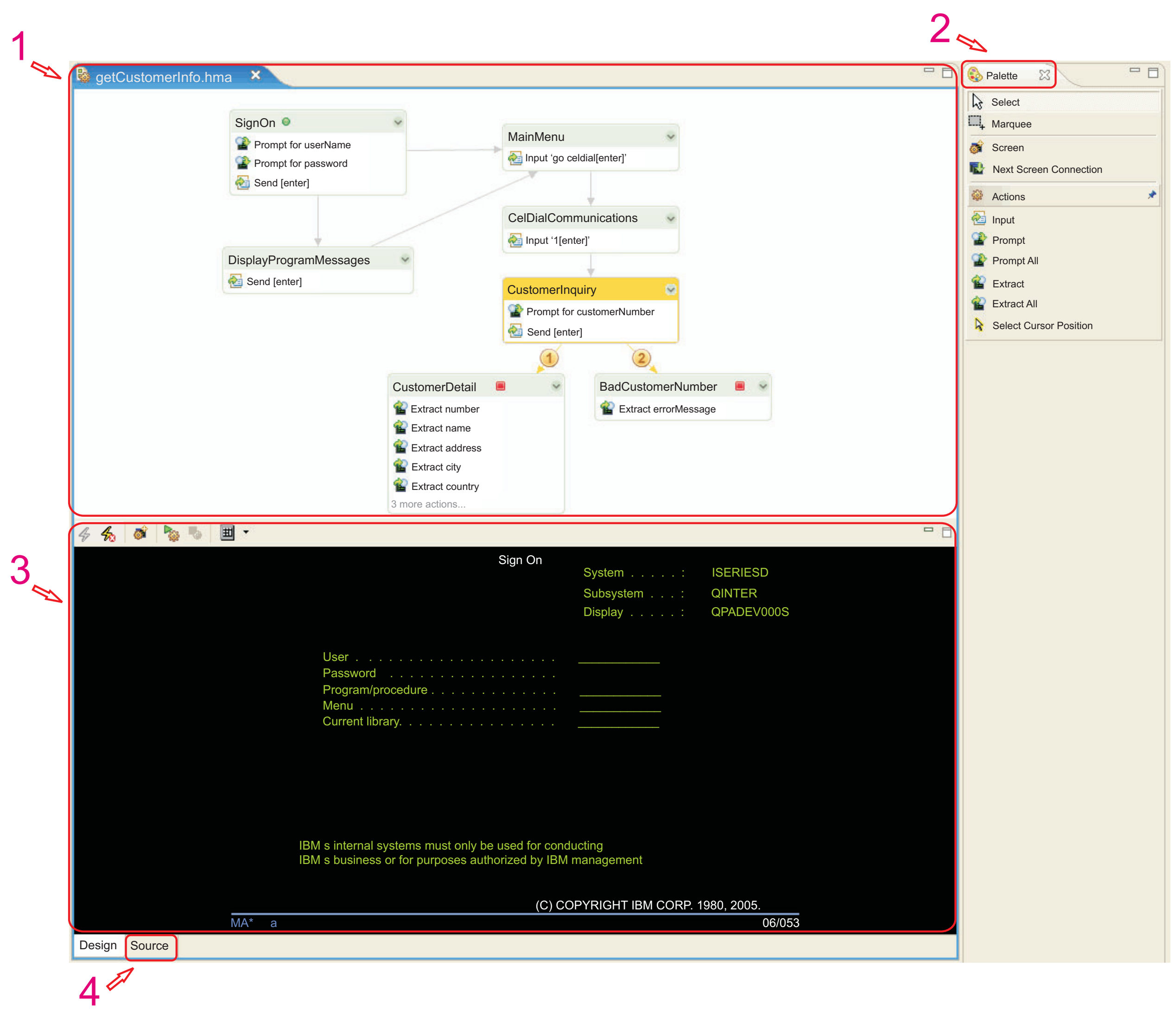

```
                                    Sign On
                                            System . . . . . :     ISERIESD
                                            Subsystem . . . :      QINTER
                                            Display . . . . . :    QPADEV000S

                 User . . . . . . . . . . . . . . . . . . .     ____________
                 Password . . . . . . . . . . . . . . . . .
                 Program/procedure . . . . . . . . . . . . .     ____________
                 Menu . . . . . . . . . . . . . . . . . . .     ____________
                 Current library. . . . . . . . . . . . . . .   ____________

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               IBM s business or for purposes authorized by IBM management

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          MA*   a                                                     06/053
```

Figure 49. Visual Macro Editor parts

Design tab

The design tab, or canvas, is the primary work area in the VME. It shows the macro objects graphically (macro screens, actions, and next screen connections) and allows you to make modifications to each object as well as change global macro properties.

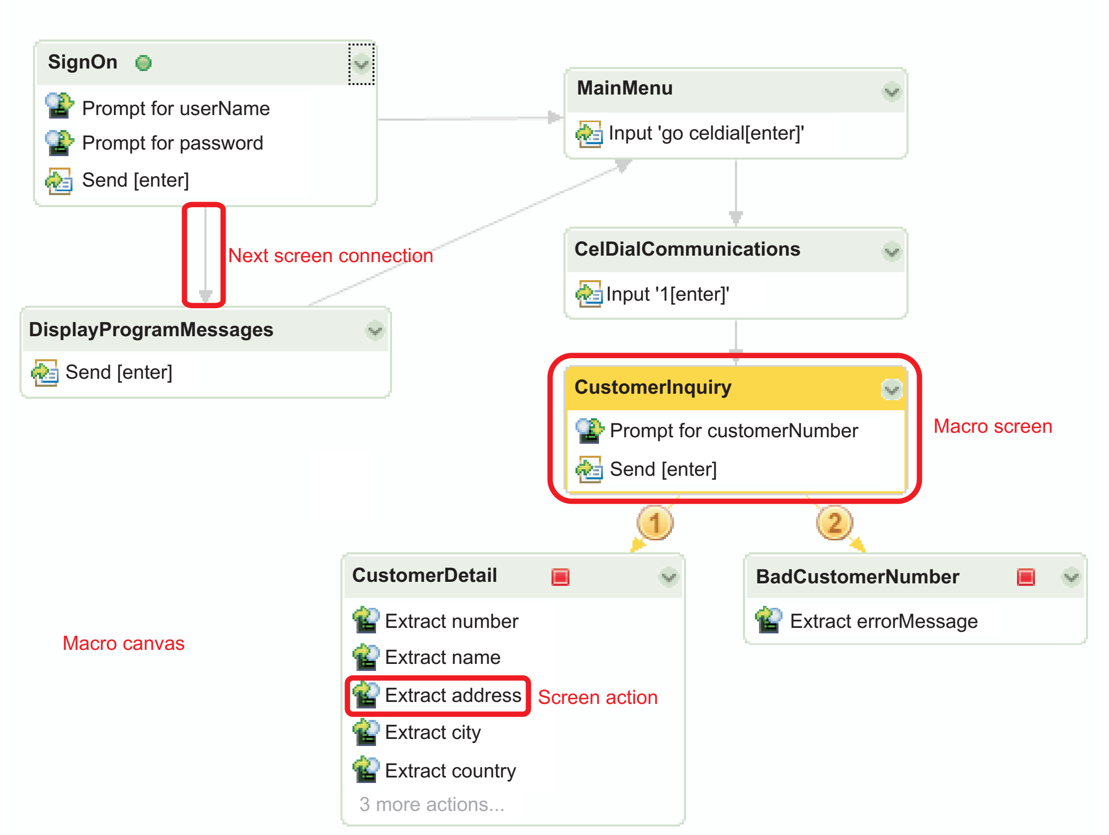


Figure 50. Visual Macro Editor design tab

For each object, different actions are enabled using the object's pop-up menu (right-click on the object). All actions can be undone by selecting **Undo** from the pop-up menu or from the Edit menu on the menu bar. All actions can be redone by selecting **Redo** from the pop-up menu or from the Edit menu. Once the macro is saved, changes cannot be undone. Once a change is made in the Source tab, previous actions made in the Design tab cannot be undone. Changes made on the Design tab are reflected in the Source tab and vice versa.

Macro menu

The following actions are enabled on the macro's pop-up menu (right-click on the white macro canvas):

Save Saves the macro to a file, disabling the **Undo** and **Redo** actions.

Copy As image
Copies the entire image of the macro to the system clipboard. This is useful for pasting the image of the macro into an email, or design document.

Paste Only enabled after a screen copy or cut.

Reset Layout
Resets the macro screens by attempting to minimize the number of crossed next screen connection lines. Entry screens are positioned at the top. Exit screens are positioned at the bottom. By default, the layout is reset when a screen is added using the integrated terminal. The layout of a macro created in a previous version of HATS is automatically set (using this same algorithm) when the macro is opened the first time in the VME.

Properties
Allows editing macro-level settings.

Screen menu

The following actions can be performed on a screen's pop-up menu (right-click a macro screen object):

Cut Deletes and copies the macro screen. For more information, see "Cut, delete, copy, and paste screens" on page 116.

Copy Copies the macro screen and allows pasting it into the same macro or another macro. For more information, see "Cut, delete, copy, and paste screens" on page 116.

Paste Only enabled after a screen copy or cut.

Delete Removes the macro screen from the macro. For more information, see "Cut, delete, copy, and paste screens" on page 116.

Rename
Allows renaming the macro screen. Disabled if more than one screen is selected.

Properties
Allows editing macro screen-level settings. Disabled if more than one screen is selected.

Action menu

The following actions can be performed on a screen action's pop-up menu (right-click a screen action):

Edit Allows editing the screen action. Only enabled if one action is selected. For more information, see"Adding and editing actions" on page 119.

Remove
Removes the action from the macro screen.

Move Up
Moves the action up in the list of screen actions. Disabled for the first action.

Move Down
Moves the action down in the list of screen actions. Disabled for the last action.

Next screen connection menu

The following actions can be performed on a next screen connection's pop-up menu (right-click a next screen connection object):

Delete Removes the next screen connection from the macro.

Reorder
Enabled on a next screen connection if there are other next screen connections originating from the same screen. Disabled when more than one next screen is selected. For more information, see "Reordering and changing next screen connections" on page 132.

Palette view

The Palette allows you to:

- Select an object using the **Select** tool.
- Select multiple objects on the canvas using the **Marquee** tool.

- Add a macro screen using the **Screen** tool. For more information, see "Adding a screen from the palette" on page 115.
- Add a next screen connection using the **Next Screen Connection** tool. For more information, see "Adding a next screen connection from the palette" on page 131.
- Add one of the actions listed in the **Actions** drawer. For more information, see "Adding an action to a screen from the palette" on page 120.

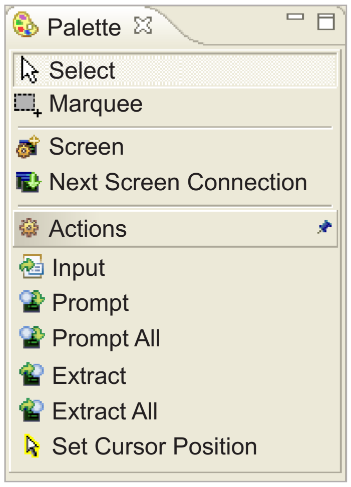


Figure 51. Visual Macro Editor Palette view

Integrated terminal

The integrated terminal toolbar allows for the following actions:

Connect
: Connect to the host.

Disconnect
: Disconnect from the host.

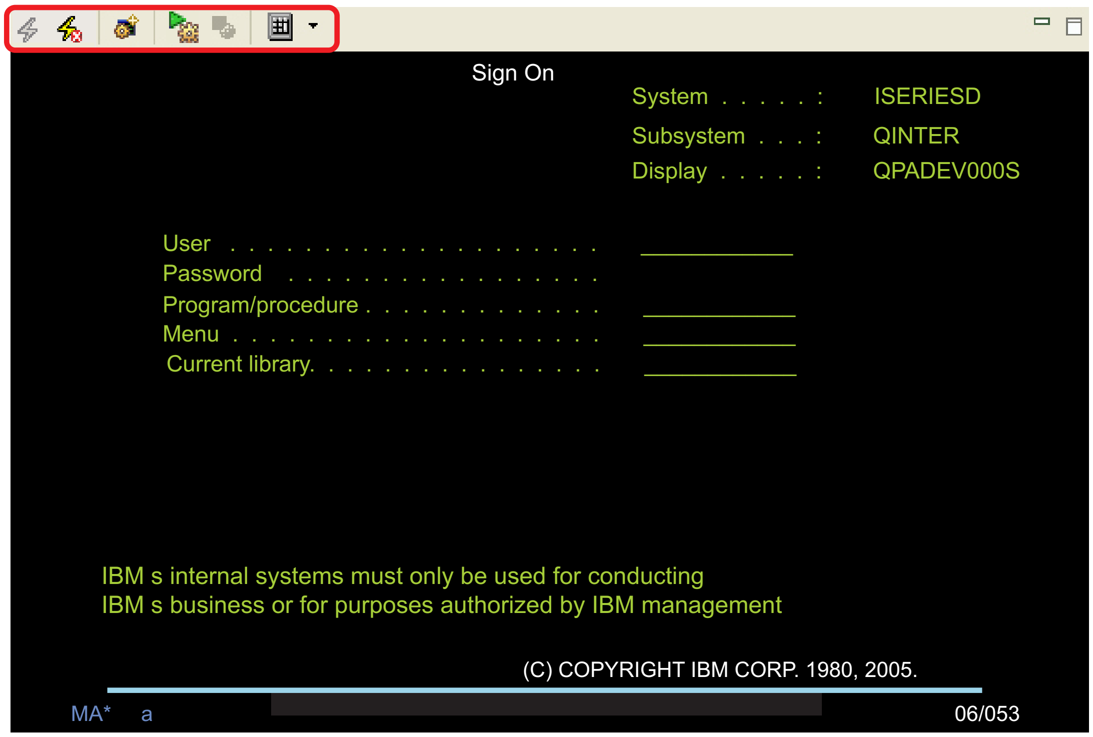
Add Screen
: See "Adding a screen from the integrated terminal" on page 115.

Play Macro
: See "Playing the macro" on page 114.

Stop Macro
: See "Playing the macro" on page 114.

Host keypad
: Interact with the host using the host keypad pull-down.

Note: In the integrated terminal, when navigating the host application, the F12 key is intercepted by IBM® Rational Software Delivery Platform (Rational SDP), which then moves the focus to the design pane of the VME. The F12 key is never sent to the host application. To work around this issue, and for other host keys as needed, use the host keypad pull-down from the toolbar.


```
                                   Sign On
                                                  System . . . . . :     ISERIESD
                                                  Subsystem . . . :      QINTER
                                                  Display . . . . . :    QPADEV000S

             User  . . . . . . . . . . . . . . . . . . . .     ____________
             Password  . . . . . . . . . . . . . . . . .
             Program/procedure . . . . . . . . . . . .     ____________
             Menu . . . . . . . . . . . . . . . . . . . .      ____________
             Current library. . . . . . . . . . . . . . .   ____________



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     MA*    a                                                              06/053
```

Figure 52. Visual Macro Editor integrated terminal

Source tab

The Source tab enables you to modify the macro XML source. It is required for advanced editing, such as adding custom screen recognition criteria.

The VME uses the Host On-Demand `<comment>` tag to keep information like location of the macro screen on the canvas and the associated screen capture.

The `<comment>` tag can also be used by developers to add a comment to a screen. Another way to add a comment is to use the format : `<!– this is a comment–>`. To avoid losing a developer's pre-existing comments, the VME converts text found in the `<comment>` tag that it does not recognize, for example, that does not contain any of the keywords like `visualinfo`, into a comment for the screen using the <!– –> format.

If there are syntax errors in the macro, then error markers appear when the macro is saved. Markers appear in the source and in the Problems view. Source errors prevent the macro canvas from showing, and an error message is displayed instead. If this occurs, switch to the Source tab and correct the errors.

By default, content assistance is enabled for all macros in the project. While editing a macro on the **Source** tab, press Crtl+Space to invoke content assistance. You can configure which macros in the project provide content assistance. For instructions, see Macro Content Assistance.

Working with macros

Editing macro properties

All macro-level settings are contained in the macro properties panel. To edit the macro-level properties, double-click on the macro canvas or right-click and select **Properties**.

The Properties panel includes a General tab and a Variables and Types tab.

General tab

The General tab allows you to view and modify the following macro properties:

Name Name of the macro (view only).

Description
Description of the macro. Optional.

Author
Author of the macro. Optional.

Creation date
Date and time when the macro was created. Optional.

Pause between actions
The amount of time (in milliseconds) the macro playback engine waits between executing actions in a macro screen.

Timeout between screens
The amount of time (in milliseconds) the macro playback engine waits for a next screen to appear.

Handle all prompts at start of macro
Specifies whether the user is prompted for all of the macro's prompts at the start of the macro.

Connection
The name of the connection in the project to use. For HATS projects with a single connection, the connection is typically named `main`. This setting is important if the macro is used in an Integration Object (IO) because this value is hardcoded in the generated IO when the IO is created and is used at runtime to select which connection to use.

Automatically connect terminal when the macro is opened
Specifies whether to automatically connect the integrated terminal when the macro is opened.

Variables and Types tab

The Variables and Types tab allows you to define macro variables and user-defined (imported) types.

The **Enable support for variables and arithmetic expressions** check box is cleared by default, can only be selected once, and is disabled afterwards. When the check box is selected, the macro is converted into the advanced macro format. Because this operation cannot be undone, a warning message is issued.

After the warning message is cleared by clicking **Yes**, the Variables and User-Defined Types tables are enabled and you can **Add**, **Edit**, and **Remove** items from the tables.

The VME does not require you to include the variable name between dollar signs ($). The editor adds the dollar signs ($) to the beginning and the end of the variable name in the macro source and removes them to display the variable name.

For more information, see Chapter 3, “Data types, operators, and expressions,” on page 15 and Chapter 9, “Variables and imported Java classes,” on page 87.

Playing the macro

The Play Macro button of the integrated terminal allows you to test the macro. As the macro is played in the terminal, the path is highlighted in the canvas. The macro is always started from the beginning regardless of the screen currently selected on the canvas.

Working with screens

Editing macro screen properties

To edit the properties of a macro screen, double-click on the object in the macro canvas or right-click and select **Properties**.

The Screen Properties panel includes a General tab, a Screen Recognition Tab, and an Actions Tab.

General tab

The General tab allows you to modify the following properties:

Name Name of the macro screen.

Screen capture
If a screen capture is associated with the macro screen, then a preview is shown in the screen capture area. If no screen capture is associated with the macro screen, then a message is displayed in the screen capture area.

You can use the **Browse** button to select a new screen capture and the **Clear** button to remove the association to a screen capture. For more information, see “Associating a macro screen with a screen capture” on page 116.

Entry screen
Specifies a screen on which the macro can begin.

Exit Specifies a screen on which the macro can end.

Transient screen
Specifies an unpredictable screen that may appear at anytime.

Set Recognition Limit

Specifies the number of times that the macro runtime recognizes the macro screen. When the macro runtime recognizes the macro screen by the specified times, the macro runtime does not process the actions of this macro screen, but instead performs the specified action.

By default the **Set Recognition limit** check box is cleared and the input field is disabled. If you select the check box, then the macro editor sets the default value of the **Screens Before Error** input field to 100. You can set the value to a larger or smaller quantity. For more information, see “Recognition limit” on page 53.

Set Pause Time
Specifies the time between actions for a particular macro screen.

Screen Recognition tab

The Screen Recognition tab is only enabled if a screen capture is associated with the macro screen. For more information about screen description in the macro facility, see Chapter 5, "Screen description," on page 35.

Actions tab

The Actions tab allows you to configure the actions to perform when the screen is recognized.

You can **Add**, **Edit**, **Remove**, and change the order of the actions using the **Up** and **Down** buttons. For more information, see "Adding and editing actions" on page 119.

Adding macro screens

Adding a screen by dragging a screen capture

A new screen can be added to the canvas by dragging a screen capture from any project.

When dragging from a project different than the one that contains the macro, you are prompted to select whether to import the screen capture file into the target project. If you click **Yes**, then the file is copied into the project's main Screen Capture folder, not the macro specific folder, and associated with the new macro screen on the canvas. If you click **No**, then the file is not imported, and no screen capture is associated with the new macro screen on the canvas.

If the default recognition criteria is defined, see "Default screen recognition criteria" on page 116, it is applied to the new screen's recognition criteria and adjusted to the selected screen capture.

You can double-click on the new screen to fully configure it and use the Next Screen Connection tool on the palette to wire it with the other screens in the macro.

Adding a screen from the integrated terminal

The Add Screen button of the integrated terminal allows you add the terminal's current screen to the macro and configure it appropriately.

The Add Screen wizard allows you to:
- Define screen attributes and screen relationships.
- Define screen recognition criteria, see "Screen Recognition tab."
- Add actions, see "Adding and editing actions" on page 119.

Adding a screen from the palette

The Screen tool of the palette allows you to add a new screen to the macro.

To add a screen, click **Screen** in the palette, then click on the canvas. This action will start the Add Screen wizard as described in "Adding a screen from the integrated terminal." The wizard forces you to select a screen capture using the Screen Capture panel described in "Associating a macro screen with a screen capture" on page 116 before proceeding to allow you to configure the screen.

Associating a macro screen with a screen capture

The **Browse** button on the General tab of the Screen Properties panel, see "Editing macro screen properties" on page 114, is used to select a screen capture from the project to associate with the macro screen. The Screen Capture panel displays a preview of all the screen captures in the project, inside or outside the screen capture macro folder.

The Screen Capture panel is also displayed when the user adds a screen from the Palette.

Screen preview

Hovering the mouse over a screen on the canvas shows a preview of the screen capture associated with it, if any.

Default screen recognition criteria

When the Add Screen wizard is used to add a screen to the macro, using the palette or the integrated terminal, you have the option to save the screen recognition criteria as the default recognition criteria for all screens added to the macro using the palette, the integrated terminal, or by dragging a screen capture. To specify this option, select the **Remember criteria for next time** check box on the Screen Recognition Criteria panel.

This feature is useful when many screens share the same recognition criteria. For example, if all your screens have a five character name or code at the upper left corner that uniquely identifies the screen, you can configure default recognition criteria so that every new screen recorded or added to the macro uses string recognition at that area of the screen. This saves time by not requiring you to configure recognition criteria on every screen.

There is only one default recognition criteria saved for the whole project, and it applies to all macros in the project.

The default recognition criteria is overridden by the last screen recognition criteria defined with the **Remember criteria for next time** check box selected.

When a default recognition criteria is defined, it is applied every time the Add Screen wizard is started and is also adjusted to the screen capture associated with the new screen.

Cut, delete, copy, and paste screens

One or more screens can be cut, or copied, and pasted in the same macro or another macro. The operation can be undone.

When one or more screens are selected and either **Cut** or **Delete** is executed, then all of the selected screens and incoming and outgoing next screen connections are removed from the macro canvas. This operation could force a reordering of the next screen connections originating from screens not removed. In the example below, the CelDialCommunications screen has next screen connections from the DisplayProgramMessages screen and to the MainMenu screen. It is also the second in order of next screen connections from the SignOn screen.

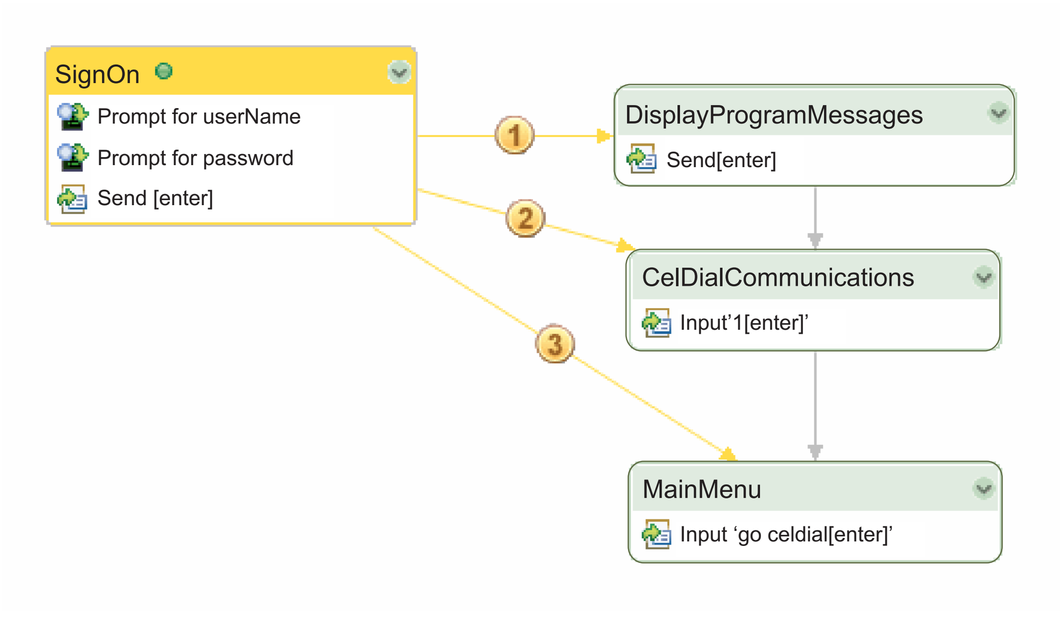


Figure 53. Delete screen example - before cut or delete

After cutting or deleting the CelDialCommunications screen, all of the next screen connections from and to it are removed, and the MainMenu screen becomes the second (instead of the third) in order of next screen connections from the SignOn screen.

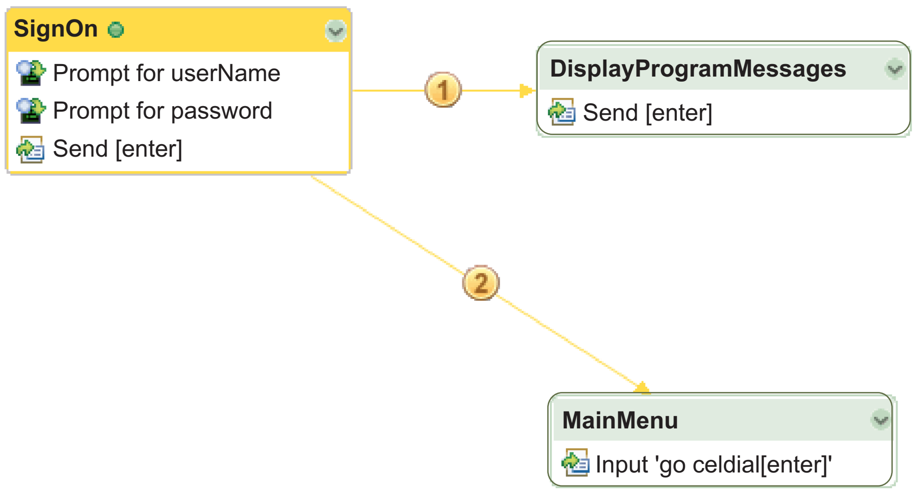


Figure 54. Delete screen example - after cut or delete

When **Paste** is executed, after a **Copy** or a **Cut**, then the internal next screen connections (next screen connections to other selected screens) are retained during the operation. In the example below the SignOn, DisplayProgramMessages, and MainMenu screens are selected to copy.

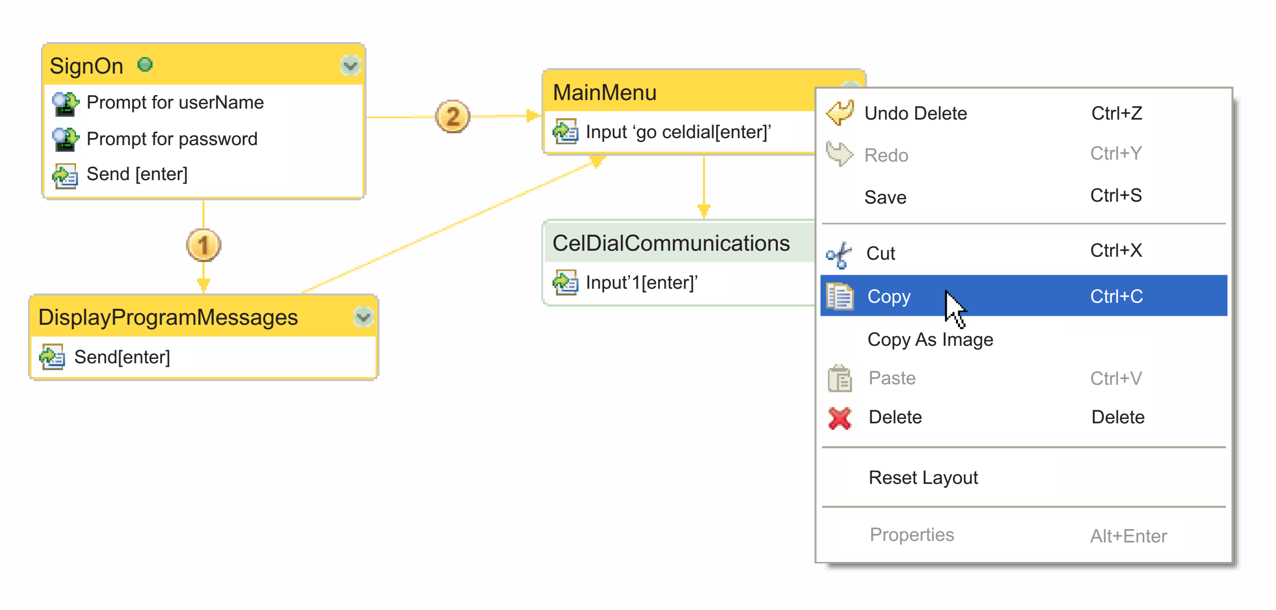


Figure 55. Copy screens example

After pasting the copied screens back onto the same macro canvas, notice that all of the next screen connections among the three selected screens are also copied. Only the next screen connection from the MainMenu screen to the CelDialCommunications screen is not copied.

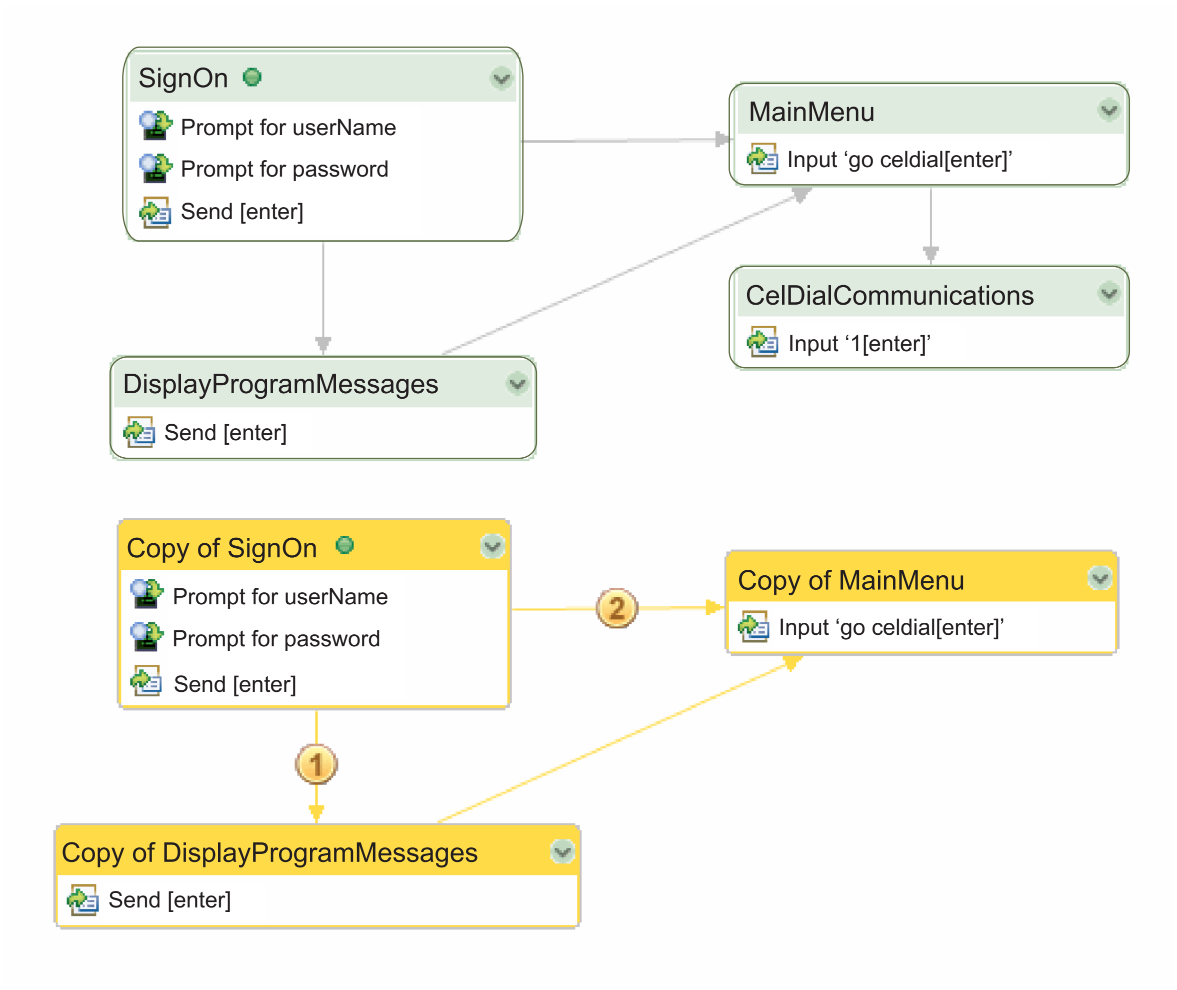


Figure 56. Paste screens example

Some considerations must be made when pasting one or more screens from or to a macro in advanced macro format.

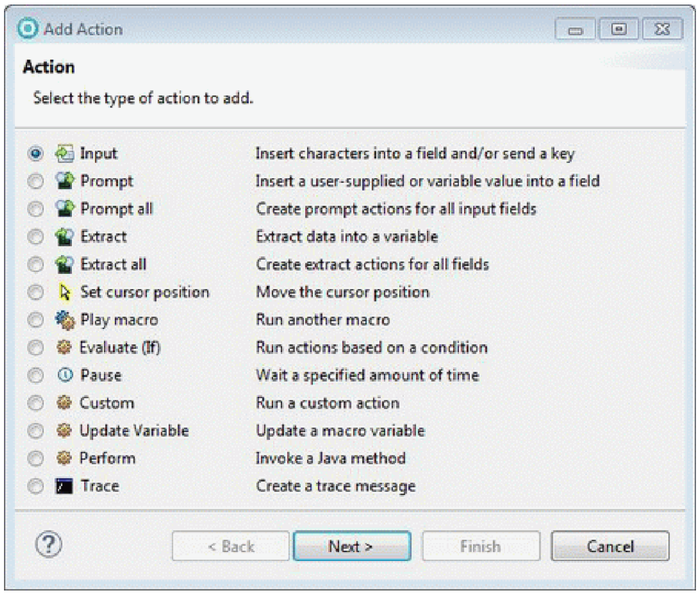
- When pasting screens from a macro that is not in advanced macro format to a macro in advanced format, then the screens being copied are converted to advance format.
- When pasting screens from a macro that is in advanced macro format to a macro that is not, a warning message is displayed, and you have the choice whether to convert the target macro.
- Variables and user-defined types used by screens being pasted are not copied.

Working with actions

Adding and editing actions

Adding and editing actions from the macro screen properties

Actions can be added to macro screens from the Actions tab of the macro screen properties, see "Editing macro screen properties" on page 114. The Add Action wizard shows the list of actions that can be added and edited for a macro screen.



Add Action

Action

Select the type of action to add.

● Input	Insert characters into a field and/or send a key
○ Prompt	Insert a user-supplied or variable value into a field
○ Prompt all	Create prompt actions for all input fields
○ Extract	Extract data into a variable
○ Extract all	Create extract actions for all fields
○ Set cursor position	Move the cursor position
○ Play macro	Run another macro
○ Evaluate (If)	Run actions based on a condition
○ Pause	Wait a specified amount of time
○ Custom	Run a custom action
○ Update Variable	Update a macro variable
○ Perform	Invoke a Java method
○ Trace	Create a trace message

Figure 57. Visual Macro Editor actions

Adding an action to a screen from the palette

The Actions tool of the palette allows you to add a new action to a macro screen.

To add an action, click the action in the palette, then click on the macro screen to add the action.

A panel, applicable to the selected action type, appears so you can edit the properties of the action.

Hiding and showing actions

Screen actions can be hidden or shown by clicking the toggle on the upper right corner of the screen figure.

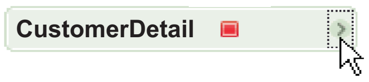


Figure 58. Hiding screen actions

If a screen has more actions than are permitted to be displayed, see "Working with VME preferences" on page 132, a line that reads `nnn more actions` is shown.

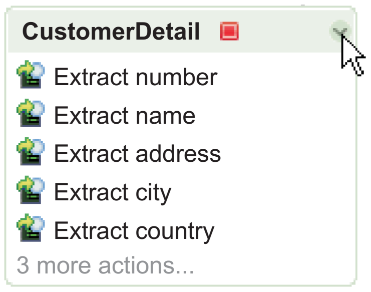


Figure 59. Showing screen actions

Actions

The following sections describe all the actions that can be added or edited using the VME. For more information about macro actions and more details about each action, see Chapter 7, “Macro actions,” on page 55.

Custom action

A Custom action allows you to invoke a Java program as a macro action and optionally pass arguments to the program.

The fields you can specify are:

ID An arbitrary string that identifies the Java program that you want to run.

Arguments
Optional. The arguments that you want to pass to the Java program.

For more information see “<custom> element” on page 176.

Evaluate (If) action

The Evaluate (If) action provides the functions of an if-statement or of an if-else statement.

Condition
Specify in the **Condition** field the conditional expression that you want the macro runtime to evaluate. The conditional expression can contain logical operators and conditional operators and can contain terms that include arithmetic expressions, immediate values, variables, and calls to Java methods. For more information, see “Conditional and logical operators and expressions” on page 19.

If True
Click this tab and click **Add** to add actions to perform for the case if the **Condition** is `true`.

If False
Click this tab and click **Add** to add actions to perform for the case if the **Condition** is `false`.

You can **Add**, **Edit**, **Remove**, move **Up,** or move **Down**, actions to perform for each case.

Note:
Even if many actions are defined for the **If True** and **If False** conditions, only the **Evaluate condition** is listed as an action on the screen object on the macro canvas.

For more information see "Conditional action (<if> element and <else> element)" on page 57.

Extract action

The Extract action captures data from the host terminal and optionally stores the data into a variable. This action is very useful and is the primary method that the Macro object provides for reading application data (instead of using programming APIs from the toolkit).

Name Specifies the name of the extract.

If an extract already exists with the same name, a warning message displays to notify you that proceeding will override the settings for the existing extract.

Use the **Region** section to specify the region of the host screen to extract.

Start row, Start column, End row, End Column
Specify the row and column coordinates of the area of the host screen to extract. When you use the mouse to mark the area on the host screen, these fields are filled for you.

Use the **Extraction Format** section to specify the format of the extracted data. Data extracted from the text plane is returned by storing a single string or lists of strings based on the extraction format chosen. Data extracted from the other (non-text) planes is returned in the form of a character array based on the extraction format chosen.

Extract this region as one string
When extracting from the text plane, specifies that the extracted text should be saved as a single horizontal string of characters. This option is supported for Integration Objects, macro handlers, global variables, and macro variables.

When extracting from the other (non-text) planes, specifies that the extracted data should be saved in a global variable as a single object in the form of a 2-dimensional character array. This option is supported only for global variables.

Extract this region as a list of strings
When extracting from the text plane, specifies that the extracted text should be saved as a vertical list of strings. This option is supported for macro handlers, global variables, and macro variables. For an Integration Object, a list of strings is treated as one continuous string.

When extracting from the other (non-text) planes, specifies that the data extracted as a 2-dimensional character array should be broken up into individual 1-dimensional arrays, each one representing a single row that was extracted, and each row stored in an index in the global variable. This option is supported only for global variables.

Extract this region as a table
When extracting from the text plane, specifies that the extracted text should be saved as a table of horizontal and vertical strings, with rows and

columns. This option is supported for Integration Objects, macro handlers, and macro variables. For a global variable, strings extracted as a table become one continuous string.

Note: When extracting from the other (non-text) planes, this option is disabled because this non-text data is not intended to be displayed directly to a user. Instead, it is meant for developers who need the extra data to determine how to display or handle certain host screens.

Click **Define** to define the table.

Table Extract Configuration

Use this page to format the columns of the table.

- **Column name**

  Use this field to change the heading of the selected column.
- **Expand column**

  Expanding a column moves characters between columns. When you highlight a column, the **Left** button moves the last character on each line of the column to the left of the highlighted column to become the first character on each line in the highlighted column. The **Right** button moves the first character from each line of the column to the right of the highlighted column to become the last character on each line in the highlighted column.
- **Reduce column**

  Reducing a column moves characters between columns. When you highlight a column, the **Left** button moves the first character from each line of the highlighted column to become the last character on each line in the column to the left of the highlighted column. The **Right** button moves the last character from each line of the highlighted column to become the first character on each line in the column to the right of the highlighted column.
- **Merge**

  Use this button to merge two highlighted columns into a single column. The characters in the highlighted columns are joined into one column.
- **Divide**

  Use this button to divide a highlighted column into two separate columns. The characters in the highlighted column are divided equally between the two new columns. If there are an uneven number of characters, the left column will contain one more character than the right column.

  Note:

  When you click **Divide**, HATS divides the selected column. If the column contains double-byte (DBCS) characters, the division can split a character between the two columns. In this case, the character will not appear in either column. If you see this happen while editing an extract action, use the **Right** and **Left** buttons to adjust the columns. The divided character will reappear when it is contained in a single column.

Use the **Handler** section to specify how text extracted from the text plane is processed.

Note: When extracting from the other (non-text) planes, this option is disabled because this non-text data is not intended to be displayed directly to a user. Instead, it is meant for developers who need the extra data to determine how to display or handle certain host screens.

Show handler

For HATS Web applications, you can select a .jsp file to display the extracted information to the user. A default macro handler is shipped with HATS, and it is named default.jsp. You can find this in the **HATS Projects** view, expanding the project name, and expanding **Web Content > Macro Event Handlers**. If you want to create your own handler, ensure that you return control to the HATS runtime.

Note: Integration Objects do not use this option. Instead, the output page will retrieve the extracted data from the Integration Object and display them.

For HATS rich client projects, you can specify a custom macro handler, or browse to select from the list of custom macro handlers defined in the rich client project, to prompt the user for the necessary information, and include a button for the user to submit the information. A default macro handler is shipped with HATS, and it is named DefaultMacroHandler. You can find this file in the **HATS Projects** view, expanding the project name, and expanding **Rich Content > Macro Event Handlers**. If you want to create your own handler, ensure that you return control to the HATS runtime by calling the createButtonArea() and createButtons() methods in the render() method of your custom macro handler. These methods are called in the default implementation of the RcpMacroHandler.render() method. For more information about RcpMacroHandler, see the HATS RCP API Reference section in the HATS Knowledge Center at http://www.ibm.com/support/knowledgecenter/SSXKAY_9.5.0?topic=/com.ibm.hats.doc/doc/rcpjavadoc/index.html.

Save as global variable

You can enter a name for the global variable in the **Name** field or select an existing variable using the drop-down menu. If you select an existing global variable in the **Name** field, click **Advanced** and specify how to handle the existing variable by selecting one of the following radio buttons:

- Overwrite the existing value with this new value.
- Overwrite the existing value with this new value, starting at the specific index.
- Append this new value to the end of the existing value.
- Insert this new value into the existing value, at the specific index.

You can also specify whether this variable is shared by selecting the **Shared** check box.

If you select to save the extract data as a global variable, the **Text** option of the **Planes to extract** setting is automatically selected.

Note: If you extract a value and assign it to a global variable set by an extract, and you plan to use the global variable value for a prompt, you should set the promptall attribute to `false`. When the promptall attribute is set to `true`, the extract action is not run before the prompt values are retrieved. Because of this, the global variable used by the prompt does not contain a value. Macros recorded in HATS default to `promptall=true`. For further information regarding the promptall attribute, see "The promptall attributes" on page 71.

Integration Objects do not directly extract to global variables. Instead, the output page for the Integration Object retrieves the data from the Integration Object after it has run, and then sets the global variables. Remember only shared global variables can be accessed by Integration Objects.

Save as macro variable

Select this box to specify a macro variable in which to save the extract data. This option is only displayed if macro variables are enabled for the macro.

If you select to save the extract data as a macro variable, the **Text** option of the **Planes to extract** setting is automatically selected. Only data from the text plane can be saved to a macro variable.

Variable

Select the variable in which to save the extract data. The drop-down menu is populated with all variables defined in the macro.

Use the **Advanced** section to set the following options:

Extract as one continuous region

Clear this box to capture a rectangular block of text. For more information, see "Capturing a rectangular area of the host terminal" on page 59. Select this box to capture a continuous sequence of text that wraps from line to line. For more information, see "Capturing a sequence of text from the host terminal" on page 59.

Unwrap

Select this box to capture the entire contents of any field that begins inside the specified extract area. For more information, see "Unwrap attribute" on page 60.

Planes to extract

Select the plane from which the data is to be extracted. The options are listed below. The default is **Text**.

- Text
- Color
- Field
- Extended field
- DBCS
- Grid

Data from any plane can be extracted and saved as a global variable. Only data from one plane can be extracted per Extract action. Only data from the text plane can be saved to a macro variable or used in an Integration Object.

Notes:

1. For information about the format and contents of the different data planes in the Host Access Class Library (HACL) presentation space

model, see Host Access Class Library Planes -- Format and Content at http://publib.boulder.ibm.com/infocenter/hodhelp/v11r0/index.jsp?topic=/com.ibm.hod.doc/doc/hacl/DWYL0M88.HTML.

2. For an example of how to use non-text plane data in an Integration Object see the section, Extracting data from non-text planes, in the *HATS Web Application Programmer's Guide*.

For more information see "Extract action (<extract> element)" on page 58. For considerations when using bidirectional language support, see Macro prompt and extract bidirectional options in the *HATS User's and Administrator's Guide*.

Extract All action

The Extract All action enables you to add multiple Extract actions, for all fields on the screen, at one time.

You can easily exclude single fields, all empty protected fields, or all input fields, and set names for the extracts.

If an extract already exists with the same name, a warning message displays to notify you that proceeding will override the settings for the existing extract.

If you select the **Save as global variable** option, you can also select whether to **Synchronize extract names and global variables names**. If you do, then the names are kept in sync. Otherwise, you can edit the global variable name to make it different than the name of the extract.

For information about the other VME settings for this action, see "Extract action" on page 122. For more general information see "Extract action (<extract> element)" on page 58.

Input action

The Input action simulates keyboard input from an actual user. The action sends a sequence of keystrokes to the host terminal. The sequence can include keys that display a character (such as a, b, c, #, &, and so on) and also action keys (such as [enter] and others).

Insert at current cursor position
Select this box to have the macro runtime insert the input at the current cursor position on the host terminal. Clear this box to set the cursor **Row** and **Column** fields yourself. Enter the cursor row and column at which to insert the input. If a screen capture is available, you can click on it to set the cursor row and column. You can also enter into the **Row** and **Column** fields a variable name in the form `$var$`.

String Enter into this field the string to send to the host terminal. You can enter an AID key into this field. For example, pressing `F12` on the keyboard will insert `[pf12]`. Other AID keys can be inserted using the drop-down menu next to the field. Since a `[tab]` will be inserted if the `TAB` key is pressed, the mouse must be used to exit the field.

Translate host action keys
Select this box, which is the default value, to have the macro runtime interpret an action key string (such as [enter]) as an action key rather than as a literal string.

Move cursor to end of input
Select this box to have the macro runtime move the text cursor to the end of the input

Encrypt string
Select this box to have the macro editor encrypt the sequence of keys contained in the **String** field.

For more information see "Input action (<input> element)" on page 62.

Pause action

The Pause action waits for a specified number of milliseconds and then terminates.

More specifically, the macro runtime finds the <pause> element, reads the duration value, and waits for the specified number of milliseconds. Then the macro runtime goes on to perform the next item.

Uses for this action are:
- Any situation in which you want to insert a wait.
- Waiting for the host to update the host terminal. For more information see "Screen completion" on page 82.
- To add delay for debugging purposes.

Duration (in milliseconds)

Specifies the number of milliseconds to wait. The default is **10000** milliseconds (10 seconds).

For more information, see "<pause> element" on page 188.

Perform action

The Perform action allows you to specify a Java method to run. This action can only be added for macros in advanced macro format.

The action invokes a method belonging to a Java class that you have imported as a user-defined type (see "Variables and Types tab" on page 113).

Java method
Specifies the method to run. You must enclose a method call in dollar signs ($), just as you would a variable (see "Syntax of a method call" on page 94). The macro runtime invokes the method. See also "How the macro runtime searches for a called method" on page 94.

For more information see "Perform action (<perform> element)" on page 67.

Play macro action

The Play macro action runs another macro.

Macro Select from this list box the macro to run. The list box is populated with all the macros in the project.

Start screen
Select from this list box the macro screen in the target macro that you want the macro runtime to process first. Select **(default)** to start the target macro at its usual start screen.

Transfer macro variables
Select this box to have the macro runtime transfer to the target macro all the variables that belong to the calling macro, including the contents of those variables.

For more information, see "PlayMacro action (<playmacro> element)" on page 68.

Prompt action

The Prompt action provides a powerful way to send immediate user keyboard input into the 3270 or 5250 application or into a variable.

Name Specifies the name of the prompt. This name is displayed in the prompt to the user, so you can use it to provide instructions related to the prompt field.

If a prompt already exists with the same name, a warning message displays to notify you that proceeding will override the settings for the existing prompt.

Default value
Specifies a default value to use for the prompt field.

Password protect input
Select this box to encrypt prompt input provided by the user.

Note: Default values that you specify for prompts are stored in macro files unencrypted. The default values display in the clear when you edit prompts using the macro editors. Therefore, while using a prompt to specify a password is an appropriate thing to do, for security reasons you should not specify a default value for the password.

Save value to macro variable
Select this box to specify a macro variable in which to save the prompt input. This option is only displayed if macro variables are enabled for the macro. The **Do not insert value into field** option is only enabled if **Save value to macro variable** is selected.

Variable
Select the variable in which to save the prompt input. The drop-down menu is populated with all variables defined in the macro.

Do not insert value into field
Select this box to have the macro runtime not display the prompt input in the input field. This field is enabled only when the **Save value to macro variable** box is selected.

Clear field before inserting value
Select this box to have the macro runtime clear the contents of the input field before typing begins.

Insert at current cursor position
Select this box to have the macro runtime insert the prompt input at the current cursor position on the host terminal. Clear this box to set the cursor **Row** and **Column** fields yourself. Enter the cursor row and column at which to insert the prompt input. If a screen capture is available, you can click on it to set the cursor row and column. You can also enter into the **Row** and **Column** fields a variable name in the form `$var$`.

Translate host action keys
Select this box, which is the default value, to have the macro runtime interpret an action key string (such as [enter]) as an action key rather than as a literal string.

Move cursor to end of input
Select this box to have the macro runtime move the text cursor to the end of the input

The **Handler** section enables you to determine how the prompt is processed. You can select one of the following radio buttons:

Show handler
For HATS Web projects, you can select a .jsp file to prompt the user for the necessary information, and include a button for the user to submit the information. A default macro handler, named default.jsp, is shipped with HATS. You can find this file by clicking the **HATS Projects** view of the Toolkit, expanding the project name, and expanding **Web Content > Macro Event Handlers**. If you want to create your own handler, ensure that you return control to the HATS runtime.

Note: Integration Objects ignore the selected .jsp handler. Instead, an input page is created for the Integration Object, and a prompt for the value is placed in that input page. The generated output page copies the value supplied by the input page into the Integration Object before the Integration Object is run.

For HATS rich client projects, you can specify a custom macro handler, or browse to select from the list of custom macro handlers defined in the rich client project, to prompt the user for the necessary information, and include a button for the user to submit the information. A default macro handler, named DefaultMacroHandler, is shipped with HATS. You can find this file in the **HATS Projects** view, expanding the project name, and expanding **Rich Client Content > Macro Event Handlers**. If you want to create your own handler, ensure that you return control to the HATS runtime by calling the createButtonArea() and createButtons() methods in the render() method of your custom macro handler. These methods are called in the default implementation of the RcpMacroHandler.render() method. For more information about RcpMacroHandler, see the HATS RCP API Reference section in the HATS Knowledge Center at http://www.ibm.com/support/knowledgecenter/SSXKAY_9.5.0?topic=/com.ibm.hats.doc/doc/rcpjavadoc/index.html.

Set prompt to string
If you know what value should be returned from a prompt, you can enter that string in the **String** field.

Set prompt to global variable
If you want the value of the prompt to be provided by a global variable, enter a name for the global variable in the **Name** field or select an existing variable using the drop-down menu next to the **Global variable** field. If you click the **Advanced** button, you can specify whether your variable is shared or indexed. If it is an indexed variable, you also need to specify whether to show all indexes or a single index. For more information about global variables, see the chapter, Interacting with global variables, in the HATS User's and Administrator's Guide.

Note:

If a prompt value is based on a global variable set by an extract, and the promptall attribute is set to `true`, the extract action is not run before the prompts values are retrieved. Because of this, the global variable used by the prompt does not contain a value. If you use global variables with extracts and prompts, you should set the promptall attribute to `false`. For further information regarding the promptall attribute, see "The promptall attributes" on page 71.

Integration Objects do not access global variables directly. Instead, the input and output pages for the Integration Object retrieve the global variable value, and set it into the Integration Object before it is run. Only shared global variables can be accessed by Integration Objects.

Set prompt to property from User List

If you want the prompt to access a user list, select the **User Profile** from the drop-down list. The user profile is the key as to determining whether to use the `userid` or password as the **User List property**. For more information about user lists, see the section, User List, in the HATS User's and Administrator's Guide.

Note: User list prompts can only be used in connect macros.

Use Web Express Logon

If you have configured your HATS application to use web express logon, enter the prompt type as either the user ID or password in the **Prompt type** drop-down list and enter the application ID in the **Application ID** field.

Note: The **Prompt type** should be prefilled with the correct value.

For more information see "Prompt action (<prompt> element)" on page 70. For considerations when using bidirectional language support, see Macro prompt and extract bidirectional options in the *HATS User's and Administrator's Guide*.

Prompt All action

The Prompt All action enables you to add multiple Prompt actions, for all fields on the screen, at one time.

You can easily exclude fields and set names for the prompts.

If a prompt already exists with the same name, a warning message displays to notify you that proceeding will override the settings for the existing prompt.

If you select the **Set prompt to global variable** option, you can also select whether to **Synchronize prompt names and global variables names**. If you do, then the names are kept in sync. Otherwise, you can edit the global variable name to make it different than the name of the prompt.

For information about the other VME settings for this action, see "Prompt action" on page 128. For more general information see "Prompt action (<prompt> element)" on page 70.

Set cursor position action

The Set cursor position action simulates a user mouse click on the host terminal. As with a real mouse click, the text cursor jumps to the row and column position where the mouse icon was pointing when the click occurred.

Specify the **Row** and **Column** location where you want the mouse click to occur. The screen capture is displayed if it is available. If so, you can click on it to set the **Row** and **Column** fields. You can also enter into the **Row** and **Column** fields a variable name in the form `$var$`.

For more information see “<mouseclick> element” on page 185.

Trace action

The Trace action sends a trace message to a trace destination that you specify, such as the HATS Toolkit console or the WebSphere console. In addition, HATS adds macro traces to the HATS runtime trace.

Trace specification

Use the Trace Handler list box to specify the destination to which you want the trace message sent:

- Select Host On-Demand trace facility to send the trace message to the Host On-Demand trace facility.
- Select User trace event to send the trace message to a user trace handler.
- Select Command line to send the message to the console.

Use the **Value** input field to specify the string that you want to send to the trace destination.

For more information, see “Trace action (<trace> element)” on page 72.

Update macro variable action

The Update macro variable action allows you to update the value of a macro variable. This action can only be added for macros in advanced macro format.

Variable
Select from this list box the name of the macro variable to update. The list box drop-down is populated with all the variables defined for the macro

Type Displays the type of the selected macro variable.

Value Specifies the value to assign to the macro variable. The value must be in the correct format for the type.

For more information see “Variable update action (<varupdate> element)” on page 73.

Working with next screen connections

Adding a next screen connection from the palette

The Next Screen Connection tool of the palette allows you to define a new next screen connection.

To add a next screen connection between two screens, click **Next Screen Connection** in the palette, click on the source screen and then click on the target screen.

If other connections originating from the same source screen exist, the new connection will have the highest order or priority. You can use the Reorder action on the next screen connection pop-up menu to change the order.

To create a loop, that is a next screen connection with the same source and target, click on the same screen twice. The loop is displayed as an arrow, if no other next screen connection is defined for the screen, or as a circle showing the order, if more next screen connections are defined for the screen.

Reordering and changing next screen connections

The Reorder action on the next screen connection pop-up menu allows the order (or priority) of the connection to be changed. This impacts the order of all the other next screen connections originating from the same screen.

The Reorder action works as an Up and Down. That is, if the connection with order 2 is changed to order 3 (down 1), then the connection with order 3 goes to order 2 (up 1).

The source or target of a next screen connection can be changed by dragging the appropriate end of the connection to a new source or target screen.

Working with VME preferences

To work with VME preferences, from the menu bar select **Window > Preferences > HATS > Visual Macro Editor**. You can modify the following preferences:

Show screen actions by default
: Select this preference to show actions on macro screen objects by default. Clear this preference to hide the actions by default. You can click the action toggle on the macro screen to show/hide the actions for the specific screen. This preference only affects macros opened in the VME for the first time. The default is selected.

Restrict number of screen actions shown
: Specifies the maximum number of actions displayed for a macro screen object. This is useful for complex macros where the interface is too complex if all actions are shown. The default is **5**.

Chapter 11. Advanced Macro Editor

The Advanced Macro Editor (AME) gives you the ability to set macro and screen-level attributes, edit screen descriptions; and add actions, links (next screen connections), and variables.

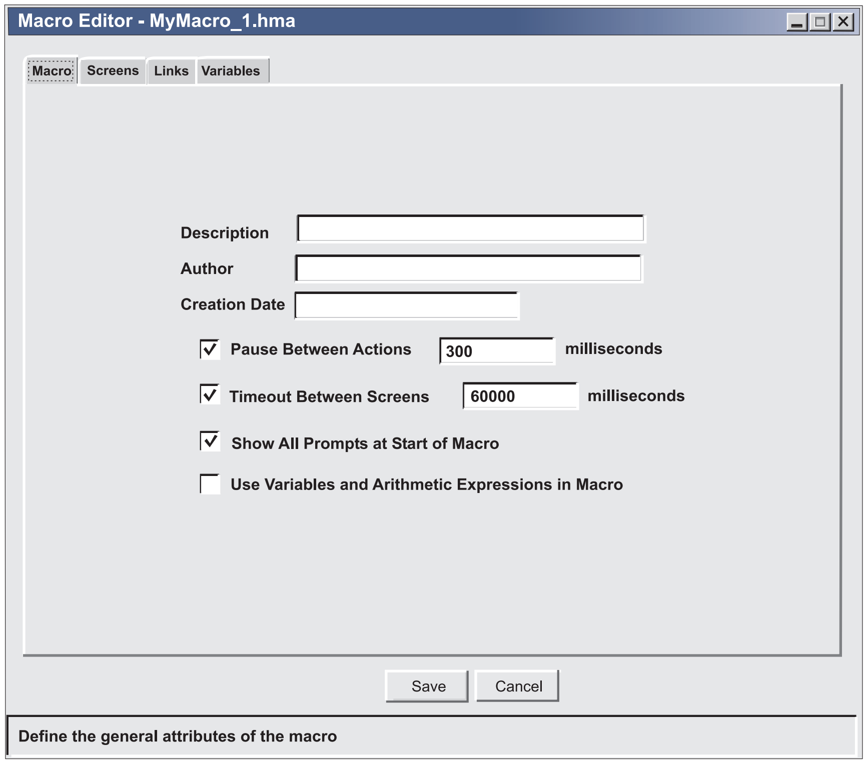
The basic Macro Editor can be opened by right-clicking on the macro and selecting **Open With -> Macro Editor**. The Advanced Macro Editor can then be opened from the Macro Editor Overview page. Prompts and Extracts can also still be edited from the Macro Editor.

If you open a macro with the Macro Editor, instead of with the VME, then the Macro Editor becomes the default editor for that macro (only that macro).

Note: Support for the Macro Editor and the Advanced Macro Editor is deprecated in HATS V9.5. While support continues for now, IBM reserves the right to remove these capabilities in a subsequent release of the product. This support is replaced by the Visual Macro Editor.

Using the editor

The Advanced Macro Editor is a graphical user interface (with buttons, input fields, list boxes, and so on) for editing the parts of a macro. Figure 60 shows the Advanced Macro Editor.



Description

Author

Creation Date

[✓] Pause Between Actions 300 milliseconds

[✓] Timeout Between Screens 60000 milliseconds

[✓] Show All Prompts at Start of Macro

[ ] Use Variables and Arithmetic Expressions in Macro

Define the general attributes of the macro

Figure 60. The Advanced Macro Editor

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Notes:

1. The AME is only aware of the <HAScript> element and its contents. This means any prompts or extracts you add or edit using the AME must be manually updated in the HATS <prompts> and <extracts> elements. This is important because a mismatch will cause Integration Objects to fail to run the macro properly, or will cause the macro to behave incorrectly when played with a Perform macro transaction or Play macro action. To minimize problems, we suggest that you use the HATS Macro Editor to define prompts and extracts, and use the AME for advanced logic within the macro as needed. See "Adapting Host On-Demand macros for use in HATS" on page 3 for more details on the HATS <prompts> and <extracts> elements.
2. The AME is not synchronized with the HATS Macro Editor. This means that when you make a change in the AME, it will not be reflected immediately in, for example, the source view. However, when you save and exit one editor, the changes will be reflected in the other.

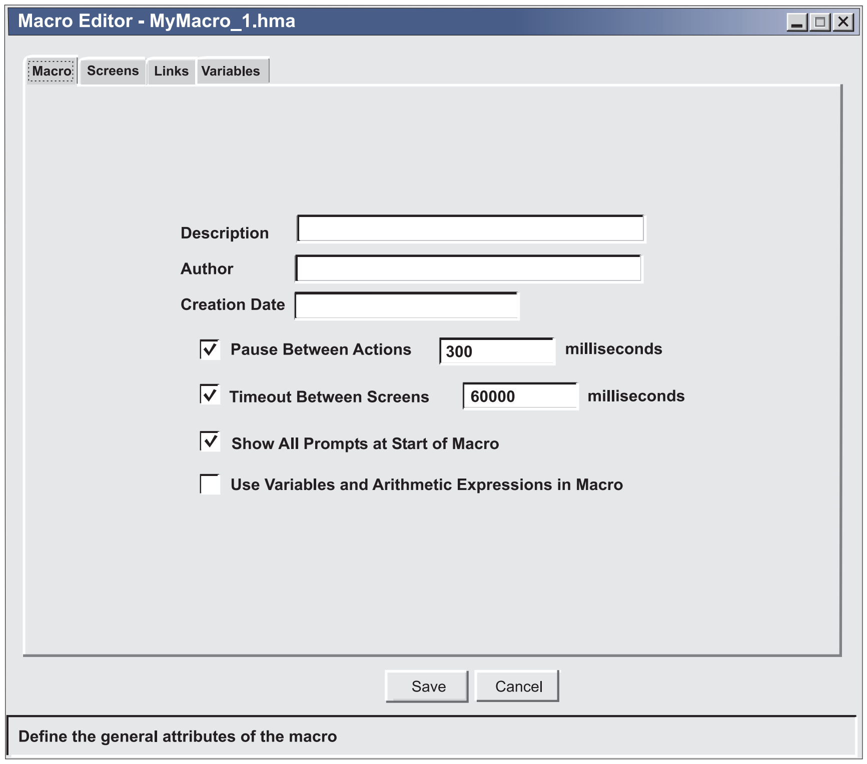
Macro tab

For the purpose of getting you acquainted with the AME, this section consists of a very simple comparison between the **Macro** tab of the AME and the <HAScript> element described in the previous section.

The AME has four tabs: **Macro**, **Screens**, **Links**, and **Variables**. The first tab, the **Macro** tab, corresponds very closely to the <HAScript> element. In fact, the **Macro** tab is the graphical user interface for some of the information that is stored in the attributes of the begin tag of the <HAScript> element.

Therefore, as the <HAScript> element is the master element of a macro script and contains in its attributes information that applies to the entire macro (such as the macro description), similarly the **Macro** tab is the first tab of the AME and provides access to some of the same global information.

Figure 61 on page 135 shows the AME with the **Macro** tab selected.


Macro Editor - MyMacro_1.hma

Description

Author

Creation Date

[✓] Pause Between Actions 300 milliseconds

[✓] Timeout Between Screens 60000 milliseconds

[✓] Show All Prompts at Start of Macro

[ ] Use Variables and Arithmetic Expressions in Macro

Define the general attributes of the macro

Figure 61. Macro tab of the AME

In Figure 61, the **Macro** tab has input fields for the macro description and other information, along with several check boxes. Also notice the following:

The **Macro Name** field contains the name that you assign to the macro. This is the same name that you will select when you want to edit the macro or run the macro. Macro names are case-sensitive. For example, `macro_1` is a different name than `Macro_1`, `MACRO_1`, and so on.

The **Use Variables and Arithmetic Expressions In Macro** check box determines whether the macro object uses the basic macro format or the advanced macro format for this macro. In the figure above this check box is not selected, indicating that the basic macro format will be used (see “Basic and advanced macro format” on page 15).

Figure 62 on page 136 shows a sample <HAScript> element that contains the same information as is shown on the **Macro** tab in Figure 61, as well as some additional information. In the source view, a <HAScript> element is written on a single line; here the element is written on multiple lines so that you can see the attributes.

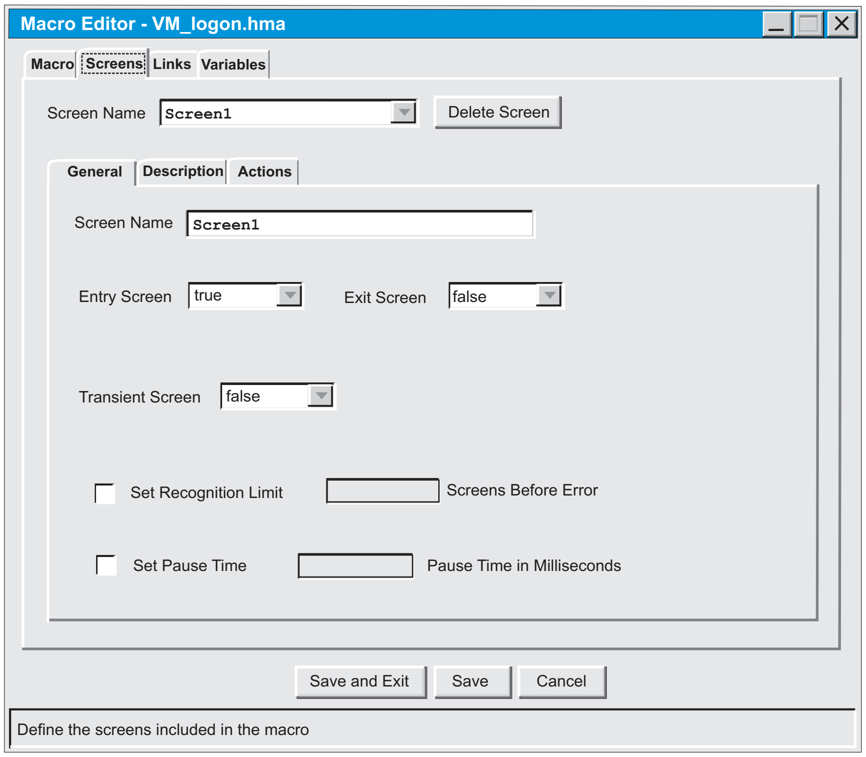
```
<HAScript
     name="macro_1"
     description=" "
     timeout="60000"
     pausetime="300"
     promptall="true"
     author=""
     creationdate=""
     supressclearevents="false"
     usevars="false"
     ignorepauseforenhancedtn="false"
     delayifnotenhancedtn="0">

...

</HAScript>
```

Figure 62. A sample <HAScript> element

In the <HAScript> element in Figure 62 there is an attribute corresponding to each input field of the **Macro** tab shown in Figure 61 on page 135. For example, the usevars attribute in the <HAScript> element (`usevars="false"`) corresponds to the **Use Variables and Arithmetic Expressions** check box on the **Macro** tab. Figure 62 has additional attributes that are not displayed in Figure 61 on page 135.

Screens tab

This section shows some of the ways in which the **Screens** tab of the AME is related to the XML <screen> element described in the previous section. Figure 63 shows the AME with the **Screens** tab selected:



Screen Name: Screen1

Screen Name: Screen1

Entry Screen: true

Exit Screen: false

Transient Screen: false

Set Recognition Limit ☐ Screens Before Error

Set Pause Time ☐ Pause Time in Milliseconds

Define the screens included in the macro

Figure 63. Screens tab

Notice that the **Screens** tab in Figure 63 on page 136 contains:
- A **Screen Name** list box at the top of the tab
- Three subordinate tabs, labeled **General**, **Description**, and **Actions**

Currently, the **General** tab is selected.

Notice that there are two **Screen Name** fields on the **Screens** tab:
- The **Screen Name** field at the top of the **Screens** tab is a list box that contains the names of all the macro screens in the macro.
- The **Screen Name** field at the top of the **General** subtab is an input field in which you can type the name that you want to assign to the currently selected screen.

In the **Screen Name** list box at the top of the **Screens** tab, you click the name of the macro screen that you want to work on (such as `Screen1`), and the AME displays in the subtabs the information belonging to that macro screen. For example, in Figure 63 on page 136 the list box displays the macro screen name `Screen1` and the subtabs display the information belonging to Screen1. If the user selected another macro screen name in the list box, perhaps `Screen10`, then the AME would display in the subtabs the information belonging to macro screen Screen10.

In the **Screen Name** input field under the **General** tab, you type the name that you want to assign to the currently selected macro screen. A screen name such as `Screen`*`x`*, where *x* stands for some integer (for example, Screen1), is a default name that the Macro object gives to the macro screen when it creates the macro screen. You can retain this name, or you can replace it with a more descriptive name that is easier to remember. (When all your macro screens have names such as Screen3, Screen10, Screen24, and so on, it is difficult to remember which macro screen does what.)

Notice that the subtabs **General**, **Description**, and **Actions** on the **Screens** tab correspond to the main parts of the XML <screen> element described in the previous section. Specifically:
- The **General** subtab presents the information stored in the attributes of a <screen> element.
- The **Description** subtab presents the information stored in the <description> subelement of a <screen> element.
- The **Actions** subtab presents the information stored in the <actions> subelement of a <screen> element.

But what about the <nextscreens> subelement? For usability reasons, the information belonging to the <nextscreens> element is presented in a higher-level tab, the **Links** tab. You can see the **Links** tab immediately to the right of the **Screens** tab in Figure 63 on page 136.

Figure 64 on page 138 shows the XML begin tag and end tag of a sample <screen> element named Screen1:

```
<screen name="Screen1" entryscreen="true" exitscreen="false" transient="false">
...
</screen>
```

Figure 64. Begin tag and end tag of a <screen> element

In Figure 64, the ellipsis (...) is not part of the XML text, but indicates that the required elements contained inside the <screen> element have been omitted for simplicity. Notice that the attributes in the begin tag correspond to fields on the **General** tab in Figure 63 on page 136. For example, the *name* attribute (`name="Screen1"`) corresponds to the **Screen Name** input field on the **General** tab, and the *entryscreen* attribute (`entryscreen="true"`) corresponds to the **Entry Screen** list box on the **General** tab.

Figure 65 shows the XML text for the entire <screen> element including the enclosed elements:

```
<screen name="Screen1" entryscreen="true" exitscreen="false" transient="false">
   <description>
      <oia status="NOTINHIBITED" optional="false" invertmatch="false" />
   </description>
   <actions>
      <mouseclick row="4" col="15" />
      <input value="3[enter]" row="0" col="0" movecursor="true"
               xlatehostkeys="true" encrypted="false" />
   </actions>
   <nextscreens timeout="0" >
      <nextscreen name="Screen2" />
   </nextscreens>
</screen>
```

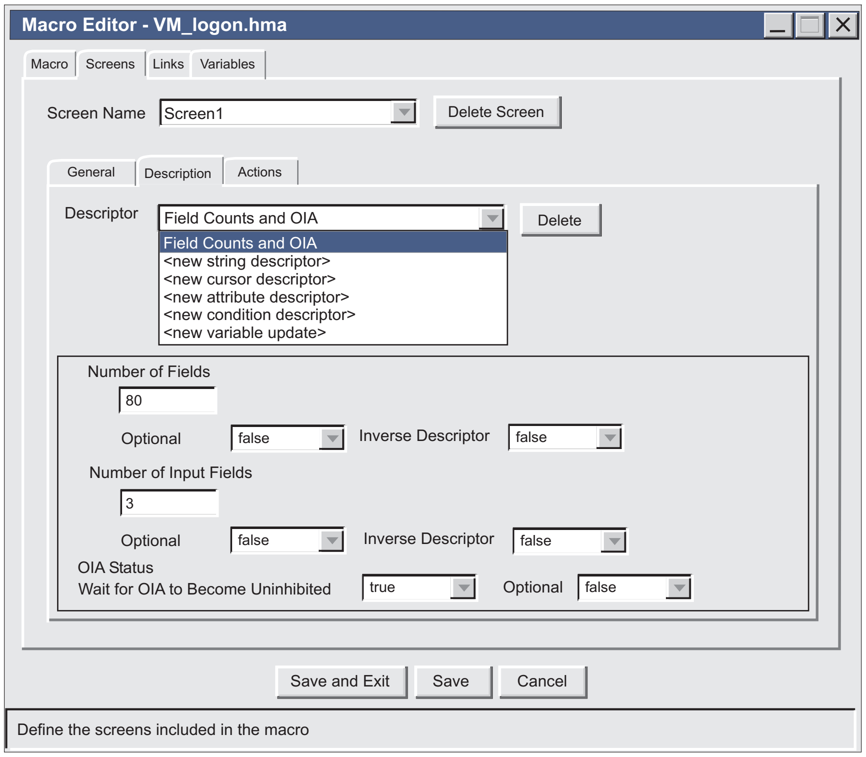
Figure 65. Sample XML <screen> element

In Figure 65, notice that the <screen> element contains the required <description>, <actions>, and <nextscreens> elements.

By default the **Set Recognition limit** check box is cleared and the input field is disabled. If you select the check box, then the macro editor sets the default value of the **Screens Before Error** input field to 100. You can set the value to a larger or smaller quantity. For more information, see “Recognition limit” on page 53.

Description tab

The **Description** tab on the **Screens** tab of the AME gives you access to the information stored inside the <description> element of a macro screen. Figure 66 on page 139 shows a sample **Description** tab:


Macro Editor - VM_logon.hma

Screen Name: Screen1

Descriptor: Field Counts and OIA

```
Field Counts and OIA
<new string descriptor>
<new cursor descriptor>
<new attribute descriptor>
<new condition descriptor>
<new variable update>
```

Number of Fields: 80

Optional: false   Inverse Descriptor: false

Number of Input Fields: 3

Optional: false   Inverse Descriptor: false

OIA Status

Wait for OIA to Become Uninhibited: true   Optional: false

Define the screens included in the macro

Figure 66. Description tab

In Figure 66, the **Screens** tab of the AME is selected. The name of the currently selected screen, Screen2, is displayed in the **Screen Name** field at the top of the **Screens** tab. Below the **Screen Name** field are the **General**, **Description**, and **Actions** subtabs. The **Description** tab is selected.

As you look at the **Description** tab in the figure above, you can see that it has an upper area and a lower area.

The upper area contains controls that operate on a single descriptor element considered as a whole. In particular, the **Descriptor** list box situated in the upper left corner of the **Description** tab contains the name of the currently selected descriptor. In the figure above, the currently selected descriptor is a Field Counts and OIA descriptor at the top of the list. (Descriptors do not have names. Field Counts and OIA is the type of the descriptor.)

The lower area of the **Description** tab displays the contents of the currently selected descriptor. Because the currently selected descriptor is a Fields Counts and OIA descriptor, the lower area of the **Description** tab presents the contents appropriate to that type of descriptor. If you created and selected another type of descriptor, such as a String descriptor, then the lower area would present the contents appropriate to a String descriptor.

Looking more closely at the lower area of the **Description** tab in Figure 66, you can see that the Field Counts and OIA descriptor contains three tests of identity:

- The screen contains 80 fields (the **Number of Fields** field is set to 80).
- The screen contains three input fields (the **Number of Input Fields** field is set to 3).
- The screen has the input inhibited indicator cleared (the **Wait for OIA to Become Uninhibited** list box is set to `true`).

The macro runtime will apply these three tests of identity when it tries to match this macro screen to an application screen.

Note: Although the AME presents the Fields Counts and OIA descriptor as a single descriptor containing three tests, in fact the macro language defines these three tests as three separate and independent descriptors. See "Field Counts and OIA descriptor" on page 141.

The lower area of the **Description** tab in Figure 66 on page 139 also displays, for each of these three tests in the Field Counts and OIA descriptor, a field labeled **Optional**. You can ignore this field for now. The Number of Fields and Number of Input Fields descriptors also have a field labeled Inverse Descriptor. You can ignore this field for now as well. These fields are described in the section "Default combining method" on page 38.

Creating a new descriptor: Looking again at the Descriptor list box in Figure 66 on page 139, notice that only the first entry is an actual descriptor. The remaining selections, which are all enclosed in angle brackets and all begin with the word `new`, are for creating new descriptors. Following is the list from Figure 66 on page 139:

```
Fields Counts and OIA
<new string descriptor>
<new cursor descriptor>
<new attribute descriptor>
<new condition descriptor>
<new variable update>
```

Figure 67. Contents of the Descriptor list box with one actual descriptor

For example, if you clicked <new string descriptor>, the Macro object would create a new String descriptor and place it at the start of the list. The lower area of the **Description** tab would allow you to fill out the various fields that belong to a String descriptor (such as a row and column location and a character string). The **Descriptor** list box would then look like this:

```
String descriptor(3, 29)
Fields Counts and OIA
<new string descriptor>
<new cursor descriptor>
<new attribute descriptor>
<new condition descriptor>
<new variable update>
```

Figure 68. Contents of the Descriptor list box with two actual descriptors

In Figure 68, the currently selected descriptor is now the String descriptor at the top of the list (the `3,29` stands for row 3, column 29). The Field Counts and OIA descriptor is now second on the list.

For information on how the macro runtime handles multiple descriptors, as in Figure 68, see "Evaluation of descriptors" on page 37.

Field Counts and OIA descriptor: The Field Counts and OIA descriptor is required and must be unique. That is, every **Description** tab must contain one and only one Field Counts and OIA descriptor.

This should not cause you any trouble in practice, for the following reasons:

- Although the Field Counts and OIA descriptor itself is required, only one of the three tests that it contains is required. Therefore the actual requirement is that every <description> element must contain one and only one OIA descriptor.
- The AME enforces these rules and will not let you mistakenly include more than one Field Counts and OIA descriptor in a **Description** tab. For example, the Delete button does not have any effect when you try to delete the Field Counts and OIA descriptor, and the Descriptor list box does not contain a <new> entry for the Field Counts and OIA descriptor.

How three separate and independent descriptors are presented as one: The AME presents the Field Counts and OIA descriptor as one descriptor (see Figure 66 on page 139). However, in fact each of the three parts of the Field Counts and OIA descriptor on the **Description** tab corresponds to a separate and independent descriptor in the underlying XML macro language. Specifically:

- The **Number of Fields** setting is stored as a <numfields> descriptor.
- The **Number of Input Fields** setting is stored as a <numinputfields> descriptor.
- The **Wait for OIA to Become Uninhibited** setting is stored as an <oia> descriptor.

Table 20 lists these three types of descriptors and shows how many of each can occur within a <description> element:

Table 20. Three types of <description> element descriptors

Type of descriptor:	Number of this type of descriptor allowed per macro screen (that is, per <description> element):
<oia>	1 (required)
<numfields>	1 (optional)
<numinputfields>	1 (optional)

As Table 20 shows, only one of each type of these descriptors can occur in a <description> element. The <oia> descriptor is required, but the <numfields> descriptor and the <numinputfields> descriptor are optional. The macro editor enforces these rules.

For example, look at a Field Counts and OIA descriptor first as it appears on the **Description** tab of the AME and then in the source view. Figure 66 on page 139 shows a Field Counts and OIA descriptor on the **Description** tab. The settings of the three parts of the Field Counts and OIA descriptor are set as follows:

```
Number of Fields:  80
Number of Input fields:  3
Wait for OIA to Become Uninhibited:  true
```

But if you look at the corresponding <description> element in the source view, you see the following:

```
<description>
   <oia status="NOTINHIBITED" optional="false" invertmatch="false" />
   <numfields number="80" optional="false" invertmatch="false" />
   <numinputfields number="3" optional="false" invertmatch="false" />
</description>
```

Figure 69. A <description> element with three descriptors

The XML code fragment in Figure 69 shows that the <description> element contains three separate and independent descriptors, each corresponding to one of the three parts of the Field Counts and OIA descriptor.

Suppose that you change the Field Counts and OIA descriptor settings to be as follows:

```
Number of Fields:  (blank)
Number of Input fields:  (blank)
Wait for OIA to Become Uninhibited:  true
```

Setting the first two fields to blank tells the AME that these items are not to be included in the script. If you look again at the corresponding <description> element in the source view you now see:

```
<description>
   <oia status="NOTINHIBITED" optional="false" invertmatch="false" />
</description>
```

The XML code fragment above shows that the <description> element now contains only one descriptor, an <oia> descriptor corresponding to the Wait for OIA to Become Uninhibited setting in the Field Counts and OIA descriptor.

Wait for OIA to Become Uninhibited descriptor: Table 21 shows:
- The three permissible settings for the **Wait for OIA to Become Uninhibited** list box
- The corresponding values used in the <oia> element
- How the macro runtime evaluates the setting

Table 21. Valid settings for the descriptor Wait for OIA to Become Uninhibited

Setting on the Description tab:	Value of the `status` attribute in the <oia> element:	Meaning:
`true`	NOTINHIBITED	If the input inhibited indicator in the host terminal is cleared (that is, input is not inhibited) then the macro runtime evaluates the descriptor as true. Otherwise the macro runtime evaluates the descriptor as false.
`false`	DONTCARE	The macro runtime always evaluates the descriptor as true.
`<Expression>`	'NOTINHIBITED', 'DONTCARE', or any expression that evaluates to one of these strings.	The macro runtime evaluates the expression and then interprets the resulting string.

Counting fields in the host terminal during macro development: If you want to view the **Number of Fields** field and the **Number of Input Fields** field, you can view the values and set the descriptors automatically to the values on the current screen.

To use this feature follow these steps:

1. Edit the macro in the host terminal. You can also use this feature while recording a macro.
2. In the host terminal, go to the application screen corresponding to the macro screen that you are working on. The values are always based on the screen shown in the host terminal.
3. In the tree view on the left, right-click the screen name and select **Edit** to bring up the **Define Screen Recognition Criteria** page.
4. The macro editor displays the total number of fields, the number of input fields, and the cursor position in the current application screen. Check the boxes for the criteria you want to use to recognize this screen.
5. To set the Number of Fields field and the Number of Input Fields field to the correct values, you can use the **Refresh** button beside each input field to count the fields in the application screen for you.
6. Click **Finish**.

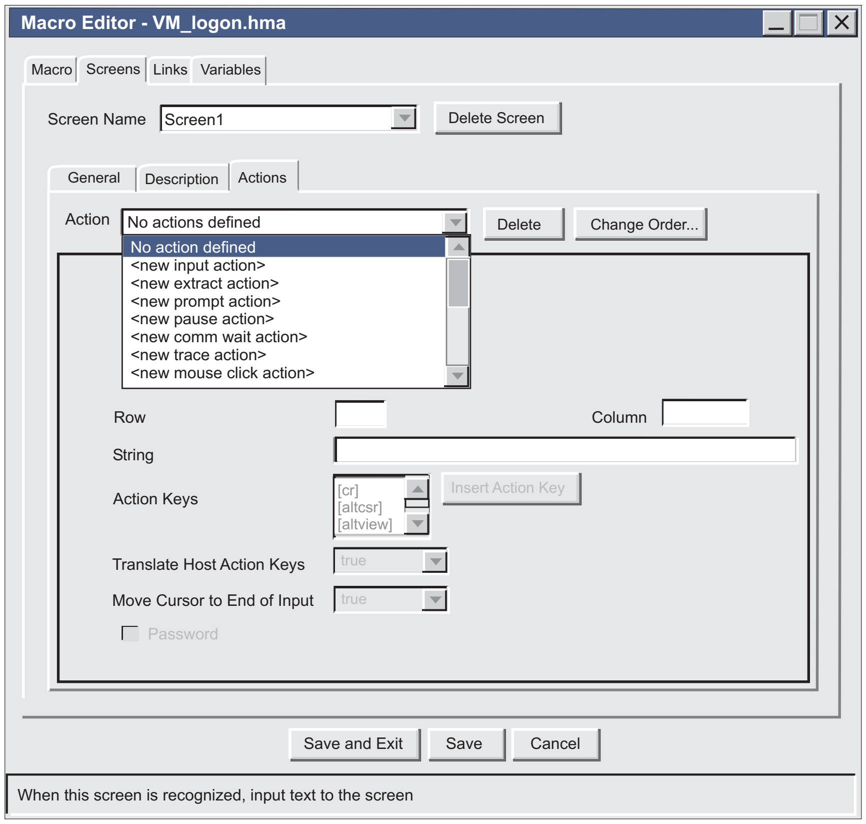
Treatment during screen recognition: During screen recognition, when the macro runtime evaluates individual descriptors and combines the boolean results, the macro runtime treats the <oia> descriptor, the <numfields> descriptor (if it is present), and the <numinputfields> descriptor (if it is present) each as a separate and independent descriptor, one like any other descriptor.

For more information about evaluating multiple descriptors see “Evaluation of descriptors” on page 37

The '*' string in a new String descriptor: When you create a new String descriptor the AME places the string `'*'` into the **String** input field as an initial, default value. Just erase this initial string and fill in the string that you want. The asterisk (*) does not mean anything or have any function. The initial string could say 'Default string value' and have the same effect.

Actions tab

The **Actions** tab on the **Screens** tab of the AME allows you to create and edit actions. When you create an action in the **Actions** tab, the AME inserts the new action into the <actions> element of the currently selected screen. Figure 70 on page 144 shows a sample **Actions** tab:



When this screen is recognized, input text to the screen

Figure 70. Actions tab

In Figure 70, the **Screens** tab of the AME is selected. The name of the currently selected screen, Screen1, is displayed in the **Screen Name** field at the top of the **Screens** tab. Below the **Screen Name** field are the **General**, **Description**, and **Actions** subtabs. The **Actions** tab is selected.

Like the **Description** tab, the **Actions** tab has an upper area and a lower area.

The upper area contains controls that operate on a single action element considered as a whole. In particular, the **Actions** list box situated in the upper left corner of the **Actions** tab contains the name of the currently selected action. In the figure above, there is no currently selected action, because no action has been created yet.

The lower area of the **Actions** tab displays the contents of the currently selected action, if any. If the currently selected action is an Input action, then the lower area of the **Actions** tab presents the contents appropriate to that type of action. If the user creates or selects another type of action, such as an Extract action, then the lower area presents the contents appropriate to an Extract action.

Creating a new action: Looking again at the **Actions** list box in Figure 70, you should notice that it does not yet contain any actions. The selections, which are all enclosed in angle brackets and all begin with the word `new`, are for creating new actions. As you can see in Figure 70, part of the **Actions** list box is not tall enough to show the whole list at once. Following is the entire list:

```
<new input action>
<new extract action>
<new prompt action>
<new pause action>
<new comm wait action>
<new trace action>
<new mouse click action>
<new variable update action>
<new play macro action>
<new perform action>
<new conditional action>
<new sql query action>
```

Figure 71. Contents of the list of an Actions list box with no actions created

For example, if you click **<new input action>**, the Macro object creates a new Input action and places it at the top of the list. The lower area of the **Actions** tab allows you to fill out the various fields that belong to an Input action (such as the input key sequence). The new Input item is in the selected area of the Actions list box, and the list part of the list box then looks like this:

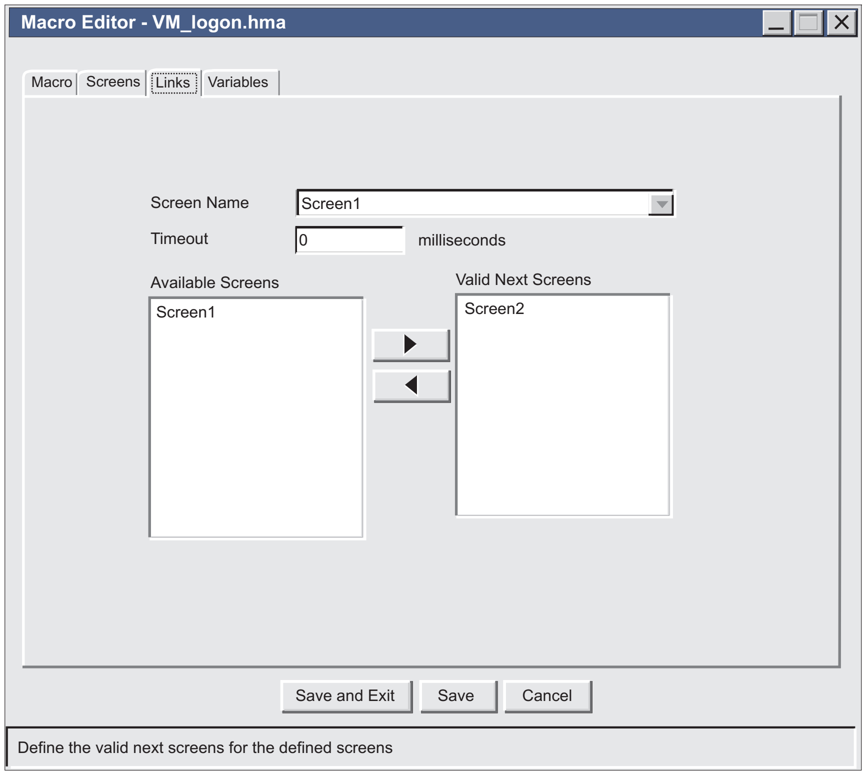
```
Input action1(0,0)
<new input action>
<new extract action>
<new prompt action>
<new pause action>
<new comm wait action>
<new trace action>
<new mouse click action>
<new variable update action>
<new play macro action>
<new perform action>
<new conditional action>
<new sql query action>
```

Figure 72. Contents of the list of an Actions list box with one actual action

When the macro runtime processes this macro screen, it performs the actions in the same order in which they are listed in the Actions list box. To change the order of the actual actions, click the Change Order button to the right of the Actions list box.

Links tab

In the AME, the **Links** tab provides the user interface for storing the names of candidate macro screens into the <nextscreens> element of a macro screen. Figure 73 on page 146 shows a sample **Links** tab:



Define the valid next screens for the defined screens

Figure 73. Links tab

In Figure 73, the **Screen Name** list box at the top of the tab contains a list of all the macro screens in the entire macro. The currently selected macro screen is Screen1. On the right, the **Valid Next Screens** list box contains a list of candidate macro screens for Screen1. (Do not confuse this list box, which contains the names in the <nextscreens> element of Screen1, with the list of valid next screens that the macro runtime uses when a macro is played back). On the left, the **Available Screens** list box contains a list of the names of all other macro screens.

Figure 73 shows only one screen in the **Available Screens** list because this figure is from a macro with only two macro screens in it, Screen1 and Screen2. However, imagine a macro of twenty screens, and suppose that you want to add macro screens to the <nextscreens> list of a new macro screen, ScreenR. You would follow these steps:

1. On the **Links** tab, expand the **Screen Name** list box and scroll down until you find ScreenR.
2. Select ScreenR.
3. Because ScreenR is a new screen, there are no macro screen names listed in the **Valid Next Screens** list on the right.
4. On the left, the **Available Next Screens** list box contains the names of all the macro screens in the macro.
5. Select a screen that you want to add to the list for ScreenR. Suppose that you select ScreenS.
6. After selecting ScreenS, click the right arrowhead button between the two list boxes. ScreenS is added to the list box on the right, and removed from the list box on the left.
7. In the same way, move the names of any other macro screens that you want to the **Valid Next Screens** list box for ScreenR.

8. Move a total of three screen names: ScreenS, ScreenG, and ScreenY.

When you are done, ScreenR, the currently selected macro screen, has the names of three macro screens in its list of valid next screens.

In the source view, you would see the names of the valid next macro screens, ScreenS, ScreenG, ScreenY, stored inside ScreenR as shown in Figure 74:
Figure 74 shows the <screen> element for ScreenR, with the `name` attribute set to

```
<screen name="ScreenR" entryscreen="true" exitscreen="false" transient="false">
   <description>
      ...
   </description>
   <actions>
      ...
   </actions>
   <nextscreens>
      <nextscreen name="ScreenS"/>
      <nextscreen name="ScreenG"/>
      <nextscreen name="ScreenY"/>
   </nextscreens>
</screen>
```

Figure 74. Macro screen ScreenR with <nextscreens> element

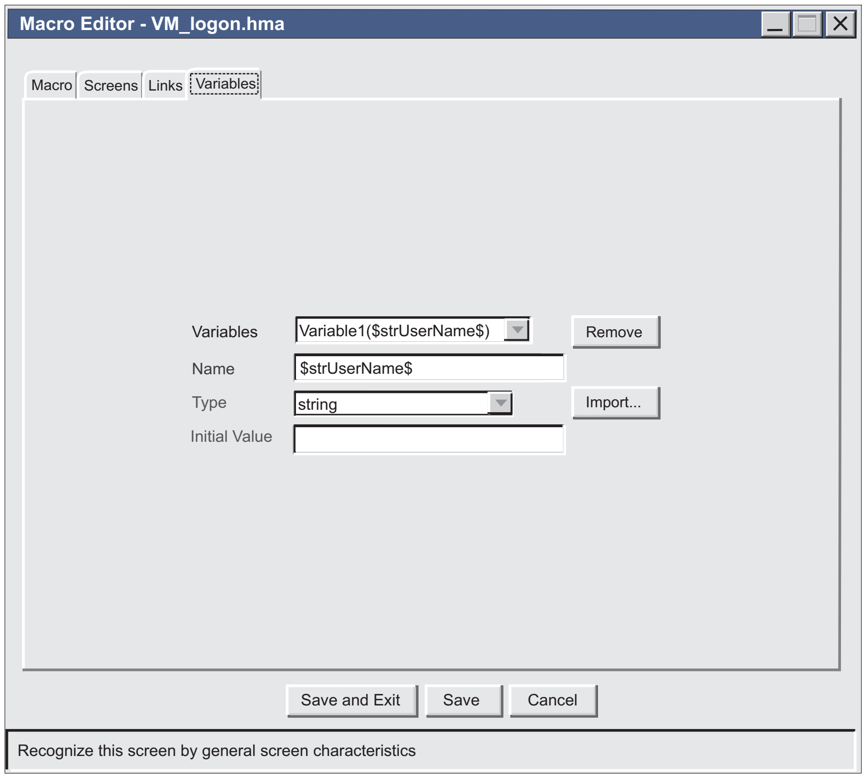
`"ScreenR"`. Inside are the three primary structural elements of a <screen> element: the <description> element, the <actions> element, and the <nextscreens> element. The contents of the <description> element and the <actions> element are not shown but are indicated with ellipses (...). The <nextscreens> element contains three <nextscreens> elements, and each <nextscreen> element contains the name of one of the valid next screens: `ScreenS`, `ScreenG`, and `ScreenY`.

For more information about runtime processing see Chapter 4, "How the macro runtime processes a macro screen," on page 25.

Variables tab

Because a variable belongs to the entire macro, and not to any one screen, there is a separate high-level tab for Variables. The **Variables** tab allows you to:
- Create a variable.
- Remove a variable.
- Import a Java class as a new variable type.

To create a variable belonging to a standard data type, use the **Variables** tab in the AME. Figure 75 on page 148 shows a sample **Variables** tab:



Variables: Variable1($strUserName$)
Name: $strUserName$
Type: string
Initial Value:

Recognize this screen by general screen characteristics

Figure 75. Variables tab

In Figure 75, the **Variables** tab of the AME is selected. The name of the currently selected variable, `$strUserName$`, is displayed in the Variables list box. Three other fields contain information that the macro runtime needs to create this variable: the **Name** input field, the **Type** list box, and the **Initial Value** input field.

The **Variables** list box contains the names of all the variables that have been created for this macro. It allows you to select a variable to edit or to remove, and it also contains a `<new variable>` entry for creating new variables.

Notice that the entry of the currently selected variable is contained in parentheses after another string:

```
Variable1($strUserName$)
```

The string `Variable1` is a setting that shows how many variables you have created. It is not saved in the macro script. The real name of the variable is `$strUserName$`, and you should use this name alone throughout the macro wherever you use the variable.

You have probably noticed that the variable name `$strUserName$` is enclosed in dollar signs ($). This is a requirement. You must enclose the variable name in dollar signs ($) wherever you use it in the macro.

The **Name** input field displays the name of the currently selected variable, `$strUserName$`. You can change the name of the variable by typing over the old name. Mostly you should use this field only for assigning a name to a newly created variable. Although you can come back later at any time and change the name of this variable (for example to `$strUserFirstName$`), remember that you might have already used the variable's old name elsewhere in the macro, in some action or descriptor. If you change the name here in the **Variables** tab, then you must also go back to every place in the macro where you have you used the variable and change the old variable name to the new variable name.

You can choose any variable name you like, although there are a few restrictions on the characters you can choose (see "Variable names and type names" on page 90). You do not have to choose names that begin with an abbreviated form of the data type (such as the `str` in the string variable `$strUserName$`), as this book does.

The Type list box lists the available types for variables and lets you select the type that you want to use for a new variable. The standard types are string, integer, double, boolean, and field. Also, whenever you import a Java class, such as `java.util.Hashtable`, as an imported type, the Type list box picks up this imported type and adds it to the list of available types, as shown in Figure 76:

```
string
integer
double
boolean
field
java.util.Hashtable
```

Figure 76. Contents of the Type list box after an imported type has been declared

You should use this list box for assigning a type to a newly created variable. You can come back later and change the variable's type to another type, but, as with variable names, remember that you might have already used the variable throughout the macro in contexts that require the type that you initially selected. If so, you must go to each of those places and make sure that the context in which you are using the variable is appropriate for its new type.

The **Initial Value** input field allows you to specify an initial value for the variable. The AME provides the following default values, depending on the type:

Table 22. Default initial values for variables

Type of variable:	**Default initial value:**
string	No string
integer	0
double	0.0
boolean	false
field	(No initial value)
(any imported type)	null

To specify a new initial value just type over the default value.

The Remove button removes the currently selected variable.

The Import button and the Import popup window are discussed in "Creating an imported type for a Java class" on page 150.

Creating a new variable

To create a new variable in the AME, first click the `<new variable>` entry at the end of the Variable list box. The AME creates a new variable and assigns to it some initial characteristics that you should modify to fit your needs. The initial values are:

1. An initial name (such as `$a1$`).
2. An initial type (`string`).
3. An initial value, which depends on the type (see Table 22 on page 149).

Note: If you create a string variable, you must enclose the initial value in single quotes. Otherwise you will see a message stating that the initial value is an invalid expression.

Now you should set the values that you want for the new variable. For example, if you are creating an integer variable that is for counting screens and that should have an initial value of 1, then you might set the initial values as follows:

1. In the **Name** input field, type the name `$intScreenCount$`.
2. In the **Type** list box, select the `integer` data type.
3. In the **Initial Value** field, type 1.

Besides the **Variables** tab, the AME provides access, in several convenient locations, to a popup window for creating new variables. For example, in the Variable update action, the **Name** list box contains not only all the names of variables that you have already created but also a `<New Variable>` entry. Click this entry to bring up the popup window for creating a new variable. Variables created using this popup window are equivalent to variables created in the **Variables** tab.

For information about creating a variable in the Source view, see "Creating a variable" on page 88.

Creating an imported type for a Java class

The way that a Host On-Demand macro imports a Java class is through an imported type. That is, you must first create an imported type and associate it with a particular Java class. You have to do this only once per Java class per macro. Follow these steps to create an imported type:

1. On the **Variables** tab, click the **Import** button. The Import popup window appears.
2. In the **Imported Types** list box, select the entry `<new imported type>`.
3. Type the Class name for the type, such as `java.util.Hashtable`. You must type the fully qualified class name, including the package name if any.
4. Type a Short Name, such as `Hashtable`. If you do not specify a short name then the AME uses the fully qualified class name as the short name. If you do specify a short name then you can use either the short name or the fully qualified class name when you refer to the imported type.
5. Click **OK**.

To create a variable belonging to this imported type, create the variable in the normal way, but select the imported type as the type of the variable. Follow these steps to create a variable of the imported type:

1. In the Variables list box, click the `<new variable>` entry at the end. The AME displays the default initial values in the usual way, including a name (such as `$a1$`), a type (`string`), and an initial value (blank).
2. In the **Name** input field, type the name that you want, such as `$ht$`.

3. In the **Type** list box, select the imported type, such as `Hashtable` (if you specified a short name when you imported the type) or `java.util.Hashtable` (if you accepted the default short name, which is the same as the fully qualified class name).
4. In the **Initial Value** field, you can either leave the field blank (which results in an initial value of `null`) or specify a method that returns an instance of the class, such as `$new Hashtable()$` (using the short name) or `$new java.util.Hashtable()$` (using the fully qualified class name).

Notice that the constructors are enclosed in dollar signs ($). You must use dollar signs around every call to a Java method, just as you must use dollar signs around the name of a variable. (The reason is that the enclosing dollar signs tell the macro runtime that it needs to evaluate the item.)

Going back to the Import popup window, the Imported **Types** list box allows you to create new types and to edit or delete the types that you have already created. To create a new type, click the `<new imported type>` entry at the end of the list. To edit a type, select the type in the **Imported Types** list box and modify the values in the **Class** and **Short Name** input fields. To remove a type, select the type and click **Remove**.

When you specify a short name, you can use any name, with certain restrictions (see "Variable names and type names" on page 90).

For information about creating an imported type in the Source view, see "Creating an imported type for a Java class" on page 89.

Working with actions

The following sections describe all the actions that can be added or edited using the AME. For more information about macro actions and more details about each action, see Chapter 7, "Macro actions," on page 55.

Comm wait action

Communication states

You can specify any of the states listed in the Connection Status list box. Table 23 lists the name and significance of each state:

Table 23. Communication states

Communication state:	**Significance:**
Connection Initiated	Initial state. Start Communications issued.
Connection Pending Active	Request socket connect.
Connection Active	Socket connected. Connection with host.
Connection Ready	Telnet negotiation has begun.
Connection Device Name Ready	Device name negotiated.
Connection Workstation ID Ready	Workstation ID negotiated.
Connection Pending Inactive	Stop Communications issued.
Connection Inactive	Socket closed. No connection with host.

The stable states (that is, the ones that usually persist for more than a few seconds) are:

- Connection Inactive - Here the session is completely disconnected
- Connection Workstation ID Ready - Here the session is completely connected

If you select **<Expression>** in the **Connection Status** list box, then you must specify an expression that resolves to one of the keywords that the macro runtime expects to find in the `value` attribute of the <commwait> element (see "<commwait> element" on page 174). For example, you might specify a variable named `$strCommState$`) that resolves to `CONNECTION_READY`.

For more information, see "Comm wait action (<commwait> element)" on page 56.

Conditional action

Specifying the condition

Specify in the **Condition** field the conditional expression that you want the macro runtime to evaluate. The conditional expression can contain logical operators and conditional operators and can contain terms that include arithmetic expressions, immediate values, variables, and calls to Java methods (see "Conditional and logical operators and expressions" on page 19).

Condition is True (<if> element)

Use the **Condition is True** tab to specify the actions that you want to be performed if the condition evaluates to true.

The **Condition is True** tab contains controls that are almost identical to the controls for the **Actions** tab. Specifically:

- The **Action** list box on the **Condition is True** tab allows you to create and edit actions in the same way that the **Action** list box on the **Actions** tab does.
- The **Delete** button and the **Change Order** button on the **Condition is True** tab allow you to delete or reorder actions in the same way that the **Delete** button and the **Change Order** button on the **Actions** tab do.
- The lower area of the **Condition is True** tab allows you to edit the values of the currently selected action in the same way that lower area of the **Actions** tab does.

Use these controls on the **Condition is True** tab to create and edit the actions that you want the macro runtime to perform if the condition is true.

Condition is False (<else> element)

Use the **Condition is False** tab to specify the actions that you want to be performed if the condition evaluates to false.

Like the **Condition is True** tab, the **Condition is False** tab contains controls that are almost identical to the controls for the **Actions** tab. Use these controls on the **Condition is False** tab to create and edit the actions that you want the macro runtime to perform if the condition is false.

For more information see "Conditional action (<if> element and <else> element)" on page 57.

Extract action

Capturing text

The most common use of the Extract action is to capture text that is being displayed in the host terminal.

Here is an overview of the steps to follow. Each step is described in more detail in the following subsections.

1. Set the Continuous Extract option, if necessary
2. Specify an area on the host terminal that you want to capture.
3. Specify an extraction name.
4. Specify TEXT_PLANE as the data plane.
5. Specify a variable in which you want the text to be stored.

Note: If you extract a value and assign it to a global variable set by an extract, and you plan to use the global variable value for a prompt, you should set the promptall attribute to `false`. When the promptall attribute is set to `true`, the extract action is not run before the prompts values are retrieved. Because of this, the global variable used by the prompt does not contain a value. Macros recorded in HATS default to `promptall=true`. For further information regarding the promptall attribute, see "The promptall attributes" on page 71.

Set the Continuous Extract option: If you want to capture a rectangular block of text, then set the Continuous Extract option to false (this is the default value). For more information, see "Capturing a rectangular area of the host terminal" on page 59.

In contrast, if you want to capture a continuous sequence of text that wraps from line to line, then set the Continuous Extract option to true. For more information, see "Capturing a sequence of text from the host terminal" on page 59.

Specify the area of the host terminal: To specify the area of the host screen that you want to capture, type the row and column coordinates of the text area into the **Row** and **Column** fields on the Extract action window.

The macro runtime interprets the values differently depending on whether the Continuous Extract option is set to false or true (see "Set the Continuous Extract option").

Type the first set of row and column coordinates into the first pair of Row and Column values (labeled Top Corner on the Extract action window) and type the second set of coordinates into the second pair of Row and Column values (labeled Bottom Corner). You can use the text cursor on the host screen as an aid to determine the coordinates that you want.

In the **Row (Bottom Corner)** input field you can enter `-1` to signify the last row of the data area on the host screen. This feature is helpful if your users work with host screens of different heights (such as 25, 43, 50) and you want to capture data down to the last row. Similarly for the **Column (Bottom Corner)** input field you can enter `-1` to signify the last column of the data on the host screen (see "Significance of a negative value for a row or column" on page 22).

Specify an extraction name: You must specify an extraction name, such as `'Extract1'`.

Specify TEXT_PLANE as the data plane: In the Data Plane list box click TEXT_PLANE. This is the default.

Specify the variable in which you want the text to be stored: Set the check box labeled Assign Text Plane to a Variable and enter the name of the variable into which you want the text to be stored. The text is returned as a string. In most cases you probably want to store the string in a string variable, so that some other action in your macro can process the string.

However, if you specify a variable of some other standard data type (boolean, integer, double) then the macro runtime converts the string to the format of the variable, if possible. For example, if the text on the screen is `1024` and the variable is an integer variable then the macro runtime will convert the string `1024` to the integer 1024 and store the value in the integer variable. If the format is not valid for converting the string to the data type of the variable then the macro runtime terminates the macro with a run time error. For more information about data conversion see “Automatic data type conversion” on page 20.

Input action

Input string

The **String** field is an input field in which you specify the key sequence that you want the action to perform.

To specify a key that causes a character to be displayed (such as a, b, c, #, &, and so on), type the key itself.

To specify a key from the Actions Keys list box, scroll the list to the key you want (such as `[backspace]`) and click Insert Action Key. The name of the key enclosed by square brackets appears at the next input position in the **String** field. Notice that the keys in the **Action Keys** list box are not listed alphabetically throughout. You might have to keep scrolling down the list to find the key you want.

Another way to specify an action key is just to type the name itself into the input field, surrounded by square brackets (for example, `[backspace]`).

The following copy/paste keys occur in the **Action Keys** list for a 3270 Display Session:

```
[copy]                  [mark right]
[copyappend]            [mark up]
[cut]                   [paste]
[mark down]             [pastenext]
[mark left]             [unmark]
```

These keys are not supported by HATS since HATS does not create a Display Session (Host On-Demand Terminal).

For other keys see “Mnemonic keywords for the Input action” on page 199.

For more information, see “Input action (<input> element)” on page 62.

Mouse click action

The Mouse click action simulates a user mouse click on the host terminal. As with a real mouse click, the text cursor jumps to the row and column position where the mouse icon was pointing when the click occurred.

Specifying row and column

In the lower area of the Actions window, specify the row and column location on the host terminal where you want the mouse click to occur. Or, you can click on the host terminal itself, and the macro editor updates the values in the **Row** and **Column** fields to reflect the new location of the text cursor.

For more information, see “<mouseclick> element” on page 185.

Pause action

The Pause action waits for a specified number of milliseconds and then terminates.

More specifically, the macro runtime finds the <pause> element, reads the duration value, and waits for the specified number of milliseconds. Then the macro runtime goes on to perform the next item.

Uses for this action are:
- Any situation in which you want to insert a wait.
- Waiting for the host to update the host terminal. For more information see “Screen completion” on page 82.
- To add delay for debugging purposes.

Type the number of milliseconds in the **Duration** input field. The default is **10000** milliseconds (10 seconds).

For more information, see “<pause> element” on page 188.

Perform action

The Perform action invokes a method belonging to a Java class that you have imported (see “Creating an imported type for a Java class” on page 150).

Invoking the method

Type the method call into the **Action to Perform** field. You must enclose a method call in dollar signs ($), just as you would a variable (see “Syntax of a method call” on page 94). The macro runtime invokes the method. See also “How the macro runtime searches for a called method” on page 94.

For more information see “Perform action (<perform> element)” on page 67.

Playmacro action

The PlayMacro action launches another macro.

Target macro file name and starting screen

Use the **Macro Name** field to specify the name of the target macro.

Use the **Start Screen Name** list box to select the macro screen in the target macro that you want the macro runtime to process first:
- If you want to start the target macro at its usual start screen, then select the ***DEFAULT*** entry in the **Start Screen Name** list box, or provide an expression that evaluates to the value *DEFAULT*.
- If you want to start the target macro at some other screen, then select the name of that screen in the **Start Screen Name** list box.

For more information, see “PlayMacro action (<playmacro> element)” on page 68.

Prompt action

The Prompt action provides a powerful way to send immediate user keyboard input into the 3270 or 5250 application or into a variable.

Displaying the prompt window

Parts of the prompt window: You should type the prompt text (such as `'Please type your password:'`) into the **Prompt Name** field, not into the **Prompt Text** field. (The **Prompt Text** field is an optional field than you can use to store a note containing details about the particular Prompt action.)

The macro runtime displays a prompt window with the following characteristics:
- The prompt window appears on top of the session window and is located in the center of the system's desktop window.
- The title of the prompt window is the value of the Prompt Title field unless that field is blank or there are multiple prompts in the macro and the macro is configured to show all prompts at the start of the macro. In those two instances, the title of the prompt window will be "Prompt".
- The message that you typed into the Prompt Name field is displayed in the center of the prompt window, followed by an input field.
- A button row across the bottom of the prompt window contains three buttons:
  - The **OK** button causes the macro runtime to process the contents of the input field.
  - The **Cancel** button halts the macro.
  - The **Help** button displays help text explaining how to use the prompt window.

Default Response: In the **Default Response** field, which is optional, you can type the text of a default response that you want to appear in the input field of the prompt window when the prompt window is displayed. If the user does not type any keyboard input into the input field of the prompt window, but rather just clicks **OK** to indicate that input is complete, then the macro runtime processes the default response that is contained in the input field.

For example, if the user normally uses ApplicationA but sometimes uses ApplicationB, you could type `ApplicationA` into the **Default Response** field. When the macro runtime performs the Prompt action, the prompt window appears with the text `ApplicationA` already displayed in the input field. The user either can click **OK** (in which case the macro processes `ApplicationA` as the contents of the input field) or else can type ApplicationB into the input field and then click **OK** (in which case the macro processes `ApplicationB` as the contents of the input field).

Password Response: If you select true in the Password Response list box (the default is false) then when the user types each key into the input field of the prompt window, the macro runtime displays an asterisk (*) instead of the character associated with the key.

For example, with the Password Response list box set to true (or resolving to true at runtime) then if the user types 'Romeo' the macro runtime displays `*****` in the input field.

Require Response: If you select true in the Require Response list box (the default is false) then:
- The macro runtime displays the text string `(required)` to the right of the input field, to indicate to the end user that input is required for this input field.
- The macro runtime disables the **OK** button of the prompt window until the input field of the prompt window contains text.

   – The input field can contain text either because you have specified a Default Response or because the user has typed text into the input field.
   – When **OK** is enabled, the end user can click either **OK** or **Cancel**, as usual:
      - Clicking **OK** causes the macro to process the Prompt action and continue processing the macro.
      - Clicking Cancel terminates the macro playback.
   – When **OK** is not enabled, the end user can click Cancel.
      - Clicking Cancel terminates the macro playback.

Thus, setting Require Response to true has the effects of reminding the end user (by displaying `(required)` to the right of the input field) that a response is required before proceeding, and of requiring the end user to enter text in the input field before clicking **OK** (by disabling **OK** until the input field contains text). However, if the Prompt action contains a Default Response, then **OK** is enabled and the default response is displayed in the input field.

If you select false in the **Require Response** list box then:
- The macro runtime does not display the text string `(required)`to the right of the input field.
- The macro runtime enables the **OK** button on the prompt window immediately as soon as the prompt window is displayed, whether or not the input field contains text.
   – The user can click **OK** or **Cancel**, as usual:
      - Clicking **OK** causes the macro runtime to process the Prompt action and then to continue processing the macro. In the Prompt action, if the input field is blank, the macro runtime does not send an input key sequence to session window.
      - Clicking **Cancel** terminates the macro playback.

Thus, setting Require Response to false has the effect of allowing the user to continue processing the macro by clicking **OK**, even if the input field of the prompt is blank.

If the promptall attribute of the <HAScript> element (or of the <actions> element) is set to true, and you have several prompt actions in the macro (or in the macro screen) with Require Response set to true, then at the start of macro playback (or at the start of the playback of the macro screen), when the macro runtime displays all the prompt input fields in a single prompt window, the macro runtime does not enable the **OK** button in the prompt window until all required input fields contain text (see “The promptall attributes” on page 71).

Note: If a prompt value is based on a global variable set by an extract, and the promptall attribute is set to `true`, the extract action is not run before the prompts values are retrieved. Because of this, the global variable used by the prompt does not contain a value. If you use global variables with extracts and prompts, you should set the promptall attribute to `false`. Macros recorded in HATS default to `promptall=true`.

Processing the contents of the input field

Response Length: The value in the **Response Length** field specifies not the size of the input field, but the number of characters that the macro runtime allows the user to type into the input field.

For example, if you set the **Response Length** field to 10, then the macro runtime allows the user to type only 10 characters into the input field.

Action keys and Translate Host Action Keys: Both you (in the **Default Response** input field) and the user (in the input field of the Prompt window) can use action keys (such as [enterreset], and so on) as you would in the String field of an Input action (see "Input string" on page 154).

The **Translate Host Action Keys** list box and its effect are exactly like the **Translate Host Action Keys** list box in the Input action (see "Translate host action keys (xlatehostkeys attribute)" on page 62). If you set this list box to true, which is the default value, then the macro runtime interprets an action key string (such as [enter]) as an action key rather than as a literal string.

Handling the input sequence in the host terminal

Use the **Row** and **Column** fields to specify the row and column position on the host terminal at which you want the macro runtime to start typing the input sequence. To have the macro runtime start typing the input sequence at the current position of the text cursor, you can set either or both of the **Row** and **Column** fields to 0. As with the Input action, the row and column position must lie within a 3270 or 5250 input field at runtime, or else the host terminal responds by inhibiting the input and displaying an error symbol in the Operator Information Area, just as it responds to keyboard input from an actual user.

You can have the macro runtime clear the contents of the input field before typing begins, by setting the **Clear Host Field** list box to true.

The **Move Cursor to End of Input** field has the same function and effects as the button of the same name in the Input action (see "Move cursor to end of input (movecursor attribute)" on page 62).

You can have the macro runtime not display the input sequence in the input field by setting the **Don't Write to Screen** list box to true. This field is enabled only when the **Assign to a Variable** check box is selected.

Assigning the input sequence to a variable

You can have macro runtime store the input sequence into a variable by checking the Assign to a Variable check box.

Create a new variable by clicking the `<New Variable>` entry in the list box. In the popup window for specifying a new variable, you can specify the name of a variable that the current macro inherits from another macro, or you can specify the name of a new variable that you want to create in the current macro. If you want to create a new variable in the current macro, select the `Create variable in this macro` check box and select the type of the new variable.

The macro runtime stores the input sequence as a string, and consequently you could specify a string variable as the variable to receive the input. However, if the variable is of some other type than string, then the macro runtime tries to convert the input to the data type of the target variable according to the usual rules (see "Automatic data type conversion" on page 20).

SQLQuery action

The SQLQuery action is a very useful and powerful action that allows you to send an SQL statement to a host database, retrieve any data resulting from the SQL statement, and then write the data into a Host On-Demand macro variable.

You can create an SQL statement manually or compose and test an SQL statement using the SQL Wizard.

The statement and results section

The SQLQuery action window has two main sections: a statement section and a result section.

The statement section occupies the upper area of the window and includes the following fields: **Database URL**, **Driver Identifier**, **Driver Class**, **User ID**, **Password**, and **Statement**. You can modify the information in this section in two ways:

- By creating an SQL statement in the SQL Wizard.
- By typing the information into the fields.

You can also edit any of the fields at any time by typing into the field.

The result section occupies the lower area of the window and includes the remaining field: **Output Result To (the $HMLSQLUtil$ macro variable)**.

Using the SQL Wizard

You can use the SQL Wizard to create an SQL statement and test it. The graphical user interface of the SQL Wizard makes it much easier to create an SQL statement, compared to typing in the entire text of the SQL statement into the **Statement** field of the AME. Also, in the SQL Wizard you can run an SQL statement that you are working on and view the results.

1. Click **SQL Wizard** to start the wizard.
   - If there is any information already in the fields of the statement section, then HATS uses this information to initialize the corresponding fields in the SQL Wizard.
2. Use the SQL Wizard to create an SQL statement and test it.
3. To close the SQL Wizard without changing your macro, click **Cancel**.
4. To save the SQL statement to your macro, do one of the following actions:
   - On the **Review** tab of the SQL Wizard, click **Save**.
   - On the **Results** tab of the SQL Wizard, click **Save SQL**.

   The AME writes the information that you created in the SQL Wizard into the appropriate fields of the statement section. Any already existing information in the fields of the statement section is overwritten. If the information that the AME writes into a field is a string (for example, the information written into the Database URL field), then the AME also automatically correctly formats the string depending on the underlying macro type. The following fields are updated
   - Fields in the statement section:
     - **Database URL**
     - **Driver Identifier**
     - **Driver Class**
     - **User ID**
     - **Password**
     - **Statement**
5. Click Cancel to close the SQL Wizard.

Using the fields in the statement section

Instead of creating an SQL statement with the SQL Wizard, you can type the information directly into the fields of the statement section. You can also type into any of the fields after you have created an SQL statement.

Database URL: In the **Database URL** field, type the database URL of the database server that provides access to the database. The format of the database URL depends on the type of Java Database Connectivity (JDBC) driver that you use to access the database (for more information on drivers see "Driver Identifier and Driver Class").

The remote server can be located on a host other than the host to which the application session is connected. For example, a SQLQuery action can specify an IBM i host, even though the same SQLQuery action is part of a macro that is running in a 3270 Display session connected to a System z® host.

Consult the documentation provided by the driver vendor for the proper format for the database URL.

Driver Identifier and Driver Class: The JDBC driver that the SQLQuery action uses to access the database is a Java client package used by the HATS application to communicate with a server program on a remote host. This server program on the remote host provides access to the database.

If you need a JDBC driver, contact the administrator of the remote database server to obtain the driver.

In the **Driver Identifier** list box of the SQLQuery action window in the macro editor, select `Other`.

When you select **Other** in the **Driver Identifier** list box, then you must type the fully qualified class name of the driver into the **Driver Class** field. If you do not know the fully qualified class name, contact the provider of the driver. When you type in the name, remember that case is significant (for example, `com` is different from `COM`).

User ID and Password: If the database connection requires a user ID and a password, then type the user ID into the **User ID** field and the password into the **Password** field.

HATS encrypts the key sequence that you type into the **Password** field. This encryption works exactly like the encryption used when the **Password** check box is selected in an Input action (see "Encrypted attribute" on page 63). Remember:

- When you type a password (such as `mypass`) into the **Password** field, the AME displays the password using asterisks (`******`).
- When you move the input focus to another input field, the AME:
  1. Generates an encrypted version of the password (such as `q0eqOskTUBQ=`).
  2. Displays the encrypted version of the password in the **Password** field using asterisks (`************`). (You can see the actual characters of the encrypted version of the password in the AME.)
- The password is a string. Therefore, if you are using the advanced macro format, remember to type the password enclosed in single quotes (for example, `'mypass'`). The AME encrypts the entire string, including the single quotes.
- If you need to modify the password after the AME has encrypted it, be sure to *completely delete all the characters in the field* before typing in the new password.

Note: The default values for prompts are stored in macro files unencrypted. The default values display in the clear when you edit prompts in the macro editors. Therefore, while using a prompt to specify a password is an appropriate thing to do, for security reasons you should not specify a default value for the password.

Statement: Type or paste an SQL statement into the **Statement** field. If the **Statement** field already contains an SQL statement, you can edit it (even if the SQL statement was created using the SQL Wizard).

The AME does not check the format of the SQL statement for validity. If the format is invalid, a run time error occurs when the macro runtime processes the SQLQuery action.

You can spread the SQL statement over several lines or write it all on one line. Figure 77 and Figure 78 show the same SQL statement written over several lines and written as one line. Either way is correct.

```
SELECT
   *
FROM
   SQLTEST.EX01
WHERE
   (
      ( SQLTEST.EX01.DESCRIPT is not null )
   )
```

Figure 77. SQL statement written on several lines

```
SELECT * FROM SQLTEST.EX01 WHERE((SQLTEST.EX01.DESCRIPT is not null))
```

Figure 78. Same SQL statement written on one line

Remember that if you are using the advanced macro format you must enclose the SQL statement in single quotes and follow the rules for special characters. Below, Figure 79 and Figure 80 show the same SQL statement written for the basic macro format and for the advanced macro format:

```
select * from hodtest.ex01 where
      ((hodtest.ex01.descript='Edit Products'))
```

Figure 79. SQL statement written for the basic macro format

```
'select * from hodtest.ex01 where
      ((hodtest.ex01.descript=\'Edit Products\'))'
```

Figure 80. Same SQL statement written for the advanced macro format

You can use either upper case or lower case for reserved words (such as `select`) and database names and fields (such as `hodtest.ex01.descript`), but you must use exact case for matching strings (such as `'Edit Products'`). Thus the two SQL statements in Figure 81 are equivalent:

```
select * from hodtest.ex01 where
      ((hodtest.ex01.descript='Edit Products'))
SELECT * FROM HODTEST.EX01 WHERE
      ((HODTEST.EX01.DESCRIPT='Edit Products'))
```

Figure 81. Example of equivalent upper case and lower case

Using the result section

The fields in the result section control how the SQLQuery action uses the data resulting from the SQL statement. You can write the data into a Host On-Demand macro variable.

Storing the data into a macro variable ($HMLSQLUtil$): The default destination for the data resulting from an SQLQuery action is the Host On-Demand macro variable $HMLSQLUtil$. The Host On-Demand runtime always updates this variable with the results of a successful SQLQuery action.

To store data into $HMLSQLUtil$, expand the Output Result To list box and click $HMLSQLUtil$.

To use the data stored in $HMLSQLUtil$ in a subsequent macro action, you must invoke methods from the Host On-Demand Macro Utility library (HML library) associated with $HMLSQLUtil$. See "$HMLSQLUtil$" on page 104.

Using the SQLQuery action with bidirectional languages

For bidirectional languages (Arabic and Hebrew), some specific properties must be set for SQLQuery to work correctly. An **Advanced** button appears in the AME to access the options. The **Advanced** button is visible only if your workstation is configured for a bidirectional language.

The additional properties are:

Host-File Type
: Specifies whether the host file should be saved in logical or visual format. The default is Visual.

Local-File Type
: Specifies whether local files are in logical or visual format. The default is Logical.

Host-File Orientation
: Specifies whether the host file should be saved in left-to-right or right-to-left format. The default is Left-to-Right.

Lam-Alef Expansion
: Specifies the behavior of the Lam-Alef characters. When receiving Arabic data from the host through the SQL wizard statement, the character Lam-Alef is expanded into two characters, if there is space after the Lam-Alef character: Lam followed by Alef.

Lam-Alef Compression
: Specifies the behavior of the Lam-Alef characters. When sending Arabic data to the host through the SQL wizard statement, the characters Lam followed by Alef are compressed into one character and space is added after the Lam-Alef character. This option is enabled for Arabic systems only. The default is on.

Numerals Shape
: Specifies the shape of the numeral on the host file at the SQL wizard statement; the numeral shape could be NOMINAL, NATIONAL or CONTEXTUAL. This option is enabled for Arabic systems only. The default is NOMINAL.

Round Trip
: Specifies the behavior of numerals, disabling the reversal of the numerals if preceded by Arabic/Hebrew characters. The default is on.

Symmetric Swapping
: Specifies the behavior of the symmetric characters, such as brackets; the inversion of the screen causes directional characters to be replaced by their counterparts. The default is on.

For more information, see “SQLQuery action (<sqlquery> element)” on page 71.

Trace action

The Trace action sends a trace message to a trace destination that you specify, such as the HATS Toolkit console or the WebSphere console. In addition, HATS adds macro traces to the HATS runtime trace.

Trace specification

Use the Trace Handler list box to specify the destination to which you want the trace message sent:

- Select Host On-Demand trace facility to send the trace message to the Host On-Demand trace facility.
- Select User trace event to send the trace message to a user trace handler.
- Select Command line to send the message to the console.

Use the **Trace Text** input field to specify the string that you want to send to the trace destination.

For more information, see “Trace action (<trace> element)” on page 72.

Variable update action

The Variable update action stores a value into a variable. During macro playback the macro runtime performs the action by storing the specified value into the specified variable.

You must specify:

- The name of a variable
- The value that you want to store into the variable

For more information, see “Variable update action (<varupdate> element)” on page 73.

Part 2. The Host On-Demand macro language

Chapter 12. Macro language features

This chapter describes the syntax, editing, hierarchy, commenting and debugging features of the Host On-Demand macro language.

Syntax and editing

XML syntax in the Host On-Demand macro language

A Host On-Demand macro is stored in an XML script using Host On-Demand macro language XML elements. This section describes some of the conventions of XML and gives examples from the Host On-Demand macro language:

- XML code is made up of elements. The Host On-Demand macro language contains about 35 XML elements.
- Element names in the macro language are not case-sensitive, except in the sense that you must write an element in the same combination of upper and lower case in both the begin tag and the end tag. All of the following are correct; the ellipses (...) are not part of the XML text but are meant to indicate that an element contains other elements:

  ```
  <screen>   ...      </screen>
  <Screen>   ...      </Screen>
  <scrEen>   ...      </scrEen>
  ```

  However, customarily the master element is spelled `HAScript` and the other elements are spelled with all lower case.
- Each XML element has a begin tag and an end tag, as shown in the examples below from the Host On-Demand macro language:

  ```
  <HAScript> ... </HAScript>
  <import> ... </import>
  <vars> ... </vars>
  <screen> ... </screen>
  ```
- Optionally you can combine the begin tag and end tag of an XML element into one tag. This option is useful when the XML element includes attributes but not other elements. For example,

  ```
  <oia ... />
  <numfields ...  />
  ```
- An element can contain attributes of the form *attribute_name="attribute_value"*. For example:

  ```
  <oia status="NOTINHIBITED" optional="false" invertmatch="false"/>
  <numfields number="80" optional="false" invertmatch="false"/>
  ```

  You can use a pair of empty double quote characters (that is, two double quote characters with nothing in between) to specify that the attribute is not set to a value.

  ```
  <HAScript name="ispf_ex1" description="" timeout="60000" ... author="" ...>
     ...
  </HAScript>
  ```
- An element can include other entire elements between its begin tag and end tag, in much the same way that HTML does. In the following example, a <description> element contains two elements: an <oia> element and a <numfields> element.

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```
<description>
   <oia status="NOTINHIBITED" optional="false" invertmatch="false">
   <numfields number="80" optional="false" invertmatch="false"/>
</description>
```

Source view editing

You can edit the XML text of a macro script directly in the source view.

You can cut and paste text between the source view and the system clipboard. This is a very important feature because it allows you to transfer text between the source view and other XML editors or text editors.

Hierarchy of the elements

Figure 82 lists the begin tags of all the XML elements in the Host On-Demand macro language supported in HATS. This list is not valid in terms of XML syntax and does not indicate where more than one element of the same type can occur. However, the indentation in this list does shows which XML elements occur inside other XML elements. For example, the first element in the list, the <HAScript> element, which is not indented at all, is the master element and contains all the other elements. The second element, the <import> element, occurs inside an <HAScript> element and contains a <type> element, and so on.

```
<HAScript>                Encloses all the other elements in the script.
   <import>               Container for <type> elements.
      <type>              Declares an imported data type (Java class).
   <vars>                 Container for <create> elements.
      <create>            Creates and initializes a variable.
   <screen>               Screen element, contains info about one macro screen.
      <description>       Container for descriptors.
         <attrib>         Describes a particular field attribute.
         <cursor>         Describes the location of the cursor.
         <customreco>     Refers to a custom recognition element.
         <numfields>      Describes the number of fields in the screen.
         <numinputfields> Describes the number of input fields in the screen.
         <string>         Describes a character string on the screen.
         <varupdate>      Assigns a value to a variable.
      <actions>           Container for actions.
         <commwait>       Waits for the specified communication status to occur.
         <custom>         Calls a custom action.
         <extract>        Copies data from the host application screen.
         <else>           Allows you to insert an else-condition.
         <if>             Allows you to insert an if-condition.
         <input>          Sends keystrokes to the host application.
         <mouseclick>     Simulates a mouse click.
         <pause>          Waits for the specified amount of time.
         <perform>        Calls a Java method that you provide.
         <playmacro>      Calls another macro.
         <prompt>         Prompts the user for information.
         <trace>          Writes out a trace record.
         <sqlquery>       Sends an SQL statement to a host database, retrieves
                          data, and writes it or displays it.
         <varupdate>      Assigns a value to a variable.
      <nextscreens>          Container for <nextscreen> elements.
         <nextscreen>        Contains the name of a valid next macro screen.
      <recolimit>            Takes action if recognition limit is reached.
```

Figure 82. Hierarchy of elements in the Host On-Demand macro language supported in HATS

The hierarchy of the elements and the corresponding structure of the macro script are discussed in numerous places in this document. In particular, see the following sections:

- For the <HAScript> element, see "Conceptual view of a macro script" on page 10.
- For the <screen> element, see "Conceptual view of a macro screen" on page 13.

For descriptions of individual elements, see Chapter 13, "Macro language elements," on page 171.

Inserting comments into a macro script

You can insert a comment anywhere inside an <HAScript> element by using XML-style comment brackets `<!-- -->` around the text of your comment.

Comments are useful for:

- Organizing a macro script by providing descriptive text
- Documenting a macro script by explaining complexities
- Debugging a macro script by commenting out executable elements in order to determine which remaining element is causing a problem

Comment errors

The source view will display an error message in the following situations:

- Nested comments
- A comment that comments out part of an executable element

Also, you cannot use comment brackets `<!-- -->` outside the <HAScript> element. If you do so then the source view will discard those comment brackets and the surrounded text when you save the script.

Examples of comments

Following are some examples of the use of comment brackets `<!-- -->` to insert comments:

```
<!--
A multi-line comment that comments on
the following <screen> element
-->
<screen name="Screen1" entryscreen="true" exitscreen="false" transient="false">

<!-- A comment on the following <description> element -->
<description>
   <oia status="NOTINHIBITED" optional="false" invertmatch="false" />
</description>

<!-- A comment on the following <actions> element -->
<actions>
   <mouseclick row="4" col="16" />
   <input value="3[enter]" row="0" col="0" movecursor="true"
            xlatehostkeys="true" />
</actions>
<!--
BEGIN
An accidental comment that surrounds part of
a <nextscreens> element,  thereby corrupting
the macro script.
You will get an error when you try to save
this macro script
```

```
<nextscreens timeout="0" >
   <nextscreen name="Screen2" />
END of accidental comment
-->
</nextscreens>
</screen>
```

Debugging macro scripts with the <trace> element

When you are debugging, you can use the <trace> element to send text and values to a trace output destination. In particular, if you include the name of a variable in the output, then the macro runtime will display both the name and the value of the variable in the output, enclosed in curly braces {}. Here is an example:

```
<vars>
<create name="$var1$" type="string" value="'original'" />
</vars>
.
.
<actions>
<trace type="SYSOUT" value="'Before update: '+$var1$" />
<varupdate name="$var1$" value="'updated'" />
<trace type="SYSOUT" value="'After update: '+$var1$" />
</actions>
```

Figure 83. Example of using the <trace> element

The code shown in the figure above prints the following text to the console:

```
Before update: +{$var1$ = original}
After update: +{$var1$ = updated}
```

Figure 84. Output from example of using the <trace> element

Notice that the <trace> action displays each variable in curly braces {} that contain both the variable name and the contents of the variable.

Chapter 13. Macro language elements

This chapter describes the Host On-Demand macro language elements and their attributes, and shows you how to use the macro language elements to create your macros.

Specifying the attributes

XML requirements

In the macro language the value of every attribute must be enclosed in double quotes. For example, in the following <mouseclick> element the values of the **row** and **col** attributes are enclosed in double quotes:

```
<mouseclick row="4" col="51" />
```

Advanced format in attribute values

As you might remember, even if a macro is in the advanced format, not all input fields in the macro editor expect a string to be placed in single quotes ('') (see “Representation of strings and non-alphanumeric characters” on page 15).

Similarly, in the macro language, when you provide a string value for an attribute that corresponds to one of these input fields that is affected by the advanced format, you must enter the string in the advanced format.

```
<input value="'3[enter]'" row="0" col="0" movecursor="true"
            xlatehostkeys="true" encrypted="false" />
```

However, if an attribute does not correspond to one of the input fields affected by the advanced format, then you should not write the value enclosed in single quotes, even if the macro is in the advanced format. For example, the **name** attribute of the <screen> element should never be enclosed in single quotes:

```
<screen name="Screen1" entryscreen="true" exitscreen="true" transient="false" >
   ...
</screen>
```

In the descriptions in this chapter of macro language elements, this book indicates such attributes (attributes that are unaffected by the advanced format) by not specifying a data type. For example, the description of the **name** attribute of the <screen> element is "Required" rather than as "Required string".

Typed data

Most attributes require a particular type of data: boolean, integer, string, double, or imported. For these attributes, the same rules apply as in the Macro Editor:

- The consequences of selecting the basic macro format or advanced macro format (see “Basic and advanced macro format” on page 15).
- The rules for representing strings and special characters, and for treating operator characters (see “Representation of strings and non-alphanumeric characters” on page 15).
- The rules for equivalent entities (see “Equivalents” on page 21).
- The rules for data type conversion (see “Automatic data type conversion” on page 20).

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- The rules for arithmetic operators and expressions (see “Arithmetic operators and expressions” on page 18).
- The rules for the string concatenation operator (see “String concatenation operator (+)” on page 19).
- The rules for conditional and logical operators and expressions (see “Conditional and logical operators and expressions” on page 19).
- The rules for representing variables (see “Introduction to macro variables and imported types” on page 87).
- The rules for calling methods on imported variables (see “Calling Java methods” on page 94).

<actions> element

The <actions> element, the <description> element, and <nextscreens> element are the three primary structural elements that occur inside the <screen> element (see “Conceptual view of a macro screen” on page 13).

The <actions> element contains elements called actions (such as simulating a keystroke, capturing data, and others) that the macro runtime performs during macro playback (see Chapter 7, “Macro actions,” on page 55).

Attributes

promptall

Optional boolean (the default is false). If this attribute is set to true then the macro runtime, before performing any of the actions inside the <actions> element, collects user input for any <prompt> elements inside the element. More specifically:

1. The macro runtime searches the <actions> element to find any <prompt> elements that occur within it.
2. The macro runtime displays the prompts for all the <prompt> elements immediately (all the prompts are combined into one popup).
3. The macro runtime collects the user input for all the popup windows.
4. The macro runtime now performs all the elements in the <actions> element as usual, in sequence.
5. When the macro runtime comes to a <prompt> action, it does not display the popup window for user input, but instead performs the <prompt> action using the input from step 3 above.

The promptall attribute of the <HAScript> element performs the same function for all the <prompt> elements in one macro (see “<HAScript> element” on page 180).

XML samples

```
<actions promptall="true">
   ...
</actions>
```

Figure 85. Example for the <actions> element

<attrib> element

The <attrib> element is a descriptor that states the row and column location and the value of a 3270 or 5250 attribute (see “Attribute descriptor (<attrib> element)” on page 45).

Attributes

plane Required. The data plane in which the attribute resides. The valid values are:
- FIELD_PLANE
- COLOR_PLANE
- DBCS_PLANE
- GRID_PLANE
- EXFIELD_PLANE
- Any expression that evaluates to one of the above.

value Required. A hexadecimal value in the format 0x37. The value of the attribute.

row Required integer. The row location of the attribute in the data plane.

col Required integer. The column location of the attribute in the data plane.

optional
Optional boolean (the default is false). See “Optional attribute” on page 39.

invertmatch
Optional boolean. See “Invertmatch attribute” on page 38.

XML samples

```
<attrib value="0x3" row="4" col="14" plane="COLOR_PLANE"
          optional="false" invertmatch="false" />
```

Figure 86. Example for the <attrib> element

<comment> element

The <comment> element inserts a text comment as a sub-element within a <screen> element. Limitations are:
- You cannot use a <comment> element outside a <screen> element.
- You cannot use more than one <comment> element inside the same <screen> element. If you do so then the source view will discard all the <comment> elements inside that <screen> element except the last one.
- No matter where in the <screen> element you place the <comment> element, the source view will move the comment up to be the first element within the <screen> element.

Attributes

None.

XML samples

```
<screen name="Screen2" entryscreen="false" exitscreen="true"
               transient="false">
   <comment>This comment provides information about this macro screen.
   </comment>
   ...
</screen>
```

Figure 87. Example for the <comment> element

Alternate method for inserting comments

An alternate method for inserting a comment is to use the XML-style comment brackets `<!-- -->`. See "Inserting comments into a macro script" on page 169.

<commwait> element

The <commwait> action waits for the communication status of the session to change to some specified value (see "Comm wait action (<commwait> element)" on page 56). You must specify a timeout value.

Attributes

value Required. The communication status to wait for. The value must be one of the following states:

- CONNECTION_INIT
- CONNECTION_PND_ACTIVE
- CONNECTION_ACTIVE
- CONNECTION_READY
- CONNECTION_DEVICE_NAME_READY
- CONNECTION_WORKSTATION_ID_READY
- CONNECTION_PND_INACTIVE
- CONNECTION_INACTIVE

timeout
Required integer. A timeout value in milliseconds. The macro runtime terminates the action if the timeout expires before the specified communication status occurs.

XML samples

```
<commwait value="CONNECTION_READY" timeout="10000" />
```

Figure 88. Example for the <commwait> element

<condition> element

The <condition> element specifies a conditional expression that the macro runtime evaluates during screen recognition. If the expression evaluates to true then the macro runtime evaluates the descriptor as true. If the expression evaluates to false then the macro runtime evaluates the descriptor as false (see "Condition descriptor (<condition> element)" on page 45).

For more information on conditional expressions see "Conditional and logical operators and expressions" on page 19.

Attributes

value
Required expression. The conditional expression that the macro runtime is to evaluate. This conditional expression can contain arithmetic expressions, variables, return values from Java method calls, and other conditional expressions.

optional
Optional boolean (the default is false). See "Optional attribute" on page 39.

invertmatch
Optional boolean. See "Invertmatch attribute" on page 38.

XML samples

```
<description>
   <!-- Check the value of a variable -->
   <condition value="$intPartsComplete$ == 4"
            optional="false" invertmatch="false" />

   <!-- Check the return value of a Java method -->
   <condition value="$htHashTable.size()$ != 0"$
            optional="false" invertmatch="false" />
</description>
```

Figure 89. Example for the <condition> element

<create> element

The <create> element creates and initializes a variable (see "Creating a variable" on page 88).

The <create> element must occur inside a <vars> element.

Attributes

name
Required. The name that you assign to the variable. There are a few restrictions on the spelling of variable names (see "Variable names and type names" on page 90).

type
Required. The type of the variable. The standard types are string, integer, double, boolean, field. You an also define an imported type representing a Java class (see "Creating an imported type for a Java class" on page 89).

value
Optional. The initial value for the variable. If you do not specify an initial value then the default initial value depends on the variable type.

XML samples

```
<HAScript ... usevars="true" ... >
   <import>
      <type class="java.util.Properties" name="Properties" />
   </import>

   <vars>
      <create name="$prp$" type="Properties" value="$new Properties()$" />
      <create name="$strAccountName$" type="string" value="" />
      <create name="$intAmount$" type="integer" value="0" />
      <create name="$dblDistance$" type="double" value="0.0" />
      <create name="$boolSignedUp$" type="boolean" value="false" />
      <create name="$fldFunction$" type="field" />
   </vars>
   ...
</HAScript>
```

Figure 90. Example for the <create> element

<cursor> element

The <cursor> element is a descriptor that states the row and column location of the text cursor on the host terminal (see "Cursor descriptor (<cursor> element)" on page 45).

Attributes

row Required integer. The row location of the text cursor.

col Required integer. The column location of the text cursor.

optional
Optional boolean (the default is false). See "Optional attribute" on page 39.

invertmatch
Optional boolean. See "Invertmatch attribute" on page 38.

XML samples

```
<cursor row="4" col="14" optional="false" invertmatch="false" />
```

Figure 91. Example for the <cursor> element

<custom> element

The <custom> element allows you to invoke a custom Java program from inside the <actions> element of a macro screen.

Here is an overview of the process:
1. Suppose that you have a Java program that you want to invoke as an action during the processing of a macro screen's <actions> element.
2. In the Macro Editor, add the following line to the <actions> element at the location at which you want to invoke the custom Java program:
   ```
   <custom id="'MyProgram1'" args="'arg1 arg2 arg3'"  />
   ```

3. Follow the instructions in the **MacroActionCustom** class. You will create a class that implements **MacroCustomActionListener**. The execute() method will be called with an event when the macro runtime performs the <custom> action in step 2.

Attributes

id Required. An arbitrary string that identifies the custom Java program that you want to run.

args Optional. The arguments that you want to pass to the custom Java program.

XML samples

```
<custom id="'MyProgram1'" args="'arg1 arg2 arg3'" />
<custom id="'MyProgram2'" args="'arg1 arg2'" />
```

Figure 92. Example for the <custom> element

<customreco> element

This <customreco> element allows you to call custom description code.

The steps for creating a custom descriptor are as follows:

1. Choose a string to identify the custom description, such as `MyCustomDescriptor01`. An identifier is required because you can have several types of custom descriptions.
2. Implement the **ECLCustomRecoListener** interface. In the **doReco()** method:
   a. Add code to check the identification string to verify that it is yours.
   b. Add your custom description code.
   c. Return true if the custom description is satisfied or false if it is not.
3. Use the source view to add a <customreco> element to the <description> element of the macro screen. The <customreco> element must specify the identifier you chose in step 2.

The macro runtime performs the <customreco> element after performing all the other descriptors.

Attributes

id Required string. The identifier that you have assigned to this custom description.

optional
Optional boolean (the default is false). See "Optional attribute" on page 39.

invertmatch
Optional boolean. See "Invertmatch attribute" on page 38.

XML samples

```
<customreco id="'MyCustomDescriptor01'" optional="false" invertmatch="false" />
```

Figure 93. Example for the <customreco> element

<description> element

The <actions> element, the <description> element, and the <nextscreens> element are the three primary structural elements that can occur inside the <screen> element (see "Conceptual view of a macro screen" on page 13).

The <description> element contains elements called descriptors, each of which states an identifying characteristic of an application screen (see Chapter 5, "Screen description," on page 35). The macro runtime uses the descriptors to match the macro screen to an application screen.

Attributes

uselogic
: Optional boolean. Allows you to define more complex logical relations among multiple descriptors than are available with the default combining method (see "The uselogic attribute" on page 39).

XML samples

```
<description uselogic="true">
   ...
</actions>
```

Figure 94. Example for the <description> element

<else> element

The <else> element contains a sequence of macro actions and must occur immediately after an <if> element. The macro runtime evaluates the conditional expression in the <if> element. Then:

- If the conditional expression is true:
  - The macro runtime performs the sequence of macro actions in the <if> element; and
  - The macro runtime skips the following <else> element if there is one.
- If the conditional expression is false:
  - The macro runtime skips the sequence of macro actions in the <if> element; and
  - The macro runtime performs the macro actions in the following <else> element if there is one.

The Macro object uses the <if> element, and if necessary the <else> element, to store a Conditional action (see "Conditional action (<if> element and <else> element)" on page 57).

Attributes

None.

XML samples

```
<if condition="($var_int$ > 10)">
   ...
</if>
<else>
   ...
</else>
```

Figure 95. Example for the <else> element

<extract> element

The <extract> element captures data from the host terminal (see "Extract action (<extract> element)" on page 58).

Attributes

For more information on the use of all these attributes see "Extract action (<extract> element)" on page 58.

name Required string. A name to be assigned to the extracted data.

planetype
Required. The plane from which the data is to be extracted. Valid values are:
- TEXT_PLANE
- FIELD_PLANE
- COLOR_PLANE
- EXFIELD_PLANE
- DBCS_PLANE
- GRID_PLANE

srow Required integer. The row of the first pair of row and column coordinates.

scol Required integer. The column of the first pair of row and column coordinates.

erow Required integer. The row of the second pair of row and column coordinates.

scol Required integer. The column of the second pair of row and column coordinates.

unwrap
Optional boolean. Setting this attribute to true causes the macro runtime to capture the entire contents of any field that begins inside the specified rectangle. See "Unwrap attribute" on page 60.

continuous
Optional boolean. Setting this attribute to true causes the macro runtime to interpret the row-column coordinates as the beginning and ending locations of a continuous sequence of data that wraps from line to line if necessary. If this attribute is set to false then the macro runtime interprets

the row-column coordinates as the upper left and lower right corners of a rectangular area of text. See “Capturing a sequence of text from the host terminal” on page 59.

assigntovar
: Optional variable name. Setting this attribute to a variable name causes the macro runtime to store the text plane data as a string value into the variable. If the variable is of some standard type other than string (that is, boolean, integer, or double) then the data is converted to that standard type, if possible. If the data cannot be converted then the macro terminates with a runtime error.

screenorientation
: Optional string. Use this attribute to define the host screen orientation to use for the extract during macro playback at runtime. Options are `LTR` and `RTL`.

XML samples

```
<extract name="'Get Data'" srow="1" scol="1" erow="11" ecol="11"
          assignto="$strText$" planetype="TEXT_PLANE" />
```

Figure 96. Example for the <extract> element

<HAScript> element

The <HAScript> element is the master element of a macro script. It contains the other elements and specifies global information about the macro (see “Conceptual view of a macro script” on page 10).

Attributes

name Required. The name of the macro.

description
: Optional. Descriptive text about this macro. You should include here any information that you want to remember about this macro.

timeout
: Optional integer. The number of milliseconds allowed for screen recognition. If this timeout value is specified and it is exceeded, then the macro runtime terminates the macro and displays a message (see “Timeout attribute on the <HAScript> element” on page 52). By default the Macro Editor sets this value to 60000 milliseconds (60 seconds).

pausetime
: Optional integer. The delay for the "pause between actions" (see “The pausetime attribute” on page 81). By default the Macro Editor sets this value to 300 milliseconds.

promptall
: Required boolean. If this attribute is set to true then the macro runtime, before performing any action in the first macro screen, collects user input for all the <prompt> elements inside the entire macro, combining the individual prompts into one large prompt. The **promptall** attribute of the <actions> element performs a similar function for all the <prompt> elements in one <actions> element (see “<actions> element” on page 172).

author Optional. The author or authors of this macro.

creationdate
Optional. Information about the dates and versions of this macro.

suppressclearevents
Optional boolean (default false). Advanced feature that determines whether the system should ignore screen events when a host application sends a clear screen command immediately followed by an end of record indicator in the data stream. You might want to set this value to true if you have screens in your application flow that have all blanks in them. If there is a valid blank screen in the macro and clear commands are not ignored, it is possible that a screen event with all blanks will be generated by clear commands coming from an ill-behaved host application. This will cause a screen recognition event to be processed and the valid blank screen will match when it shouldn't have matched.

usevars
Required boolean (default false). If this attribute is set to true then the macro uses the advanced macro format (see "Basic and advanced macro format" on page 15).

ignorepauseoverride
Optional. 3270 Display sessions only. If this attribute is set to true then the macro runtime skips all <pause> elements if the session is a TN3270E session running in contention-resolution mode (see "Attributes that deal with screen completion" on page 84). To re-enable a particular <pause> element see the **ignorepauseoverrideforenhancedtn** attribute of the <pause> element.

delayifnotenhancedtn
Optional. 3270 Display Sessions only. This attribute specifies a value in milliseconds and has an effect only when the session is *not* a TN3270E session running in contention-resolution mode. In that situation, this attribute causes the macro runtime to add a pause of the specified duration each time the macro runtime receives a notification that the OIA indicator has changed (see "Attributes that deal with screen completion" on page 84).

XML samples

```
<HAScript name="ispf_ex2" description="ISPF Sample2" timeout="60000"
           pausetime="300" promptall="true" author="Owner"
           creationdate="Sun Jun 08 12:04:26 PDT 2003"
           supressclearevents="false" usevars="true"
           ignorepauseforenhancedtn="false"
           delayifnotenhancedtn="0">
   ...
</HAScript>
```

Figure 97. Example for the <HAScript> element

<if> element

The <if> element contains a conditional expression and a sequence of macro actions. The macro runtime evaluates the conditional expression in the <if> element. Then:

- If the conditional expression is true:
  - The macro runtime performs the sequence of macro actions in the <if> element; and
  - The macro runtime skips the following <else> element if there is one.
- If the conditional expression is false:
  - The macro runtime skips the sequence of macro actions in the <if> element; and
  - The macro runtime performs the macro actions in the following <else> element if there is one.

The Macro object uses the <if> element, and if necessary the <else> element, to store a Conditional action (see "Conditional action (<if> element and <else> element)" on page 57).

Attributes

condition
Required. A conditional expression. The conditional expression can contain logical operators and conditional operators and can contain terms that include arithmetic expressions, immediate values, variables, and calls to Java methods (see "Conditional and logical operators and expressions" on page 19).

XML samples

```
<vars>
   <create name="$condition1$" type="string"/>
   <create name="$condition2$" type="boolean" value="false"/>
   <create name="$condition3$" type="integer"/>
</vars>
<screen>
   <description>
        ...
   </description>
   <actions promptall="true">
      <extract name="Get condition 1" srow="2" scol="1" erow="2"
               ecol="80" assigntovar="$condition1$"/>
      <extract name="Get condition 2" srow="3" scol="1" erow="3"
               ecol="80" assigntovar="$condition2$"/>
      <extract name="Get condition 3" srow="4" scol="1" erow="4"
               ecol="80" assigntovar="$condition3$"/>

      <if condition=
               "(($condition1$ !='')&&
               ($condition2$)||($condition3$ < 100))">
           ...
      </if>
      <else>
           ...
      </else>
   </actions>
</screen>
```

Figure 98. Example for the <if> element

<import> element

The <import> element, the <vars> element, and the <screen> element are the three primary structural elements that occur inside the <HAScript> element (see "Conceptual view of a macro script" on page 10).

The <import> element is optional. It contains <type> elements each of which declares an imported type based on a Java class (see "Creating an imported type for a Java class" on page 89).

The <import> element must occur after the <HAScript> begin tag and before the <vars> element.

Attributes

None.

XML samples

```
<HAScript .... >
   <import>
      <type class="java.util.Properties" name="Properties" />
   </import>

   <vars>
      <create name="$prp$" type="Properties" value="$new Properties()$" />
   </vars>
...
</HAScript>
```

Figure 99. Example for the <import> element

<input> element

The <input> element sends a sequence of keystrokes to the host terminal. The sequence can include keys that display a character (such as a, b, c, #, &, and so on) and also action keys (such as [enterreset], [copy], [paste], and others) (see “Input action (<input> element)” on page 62).

Attributes

value Required string. The sequence of keys to be sent to the host terminal.

row Optional integer (default is the current position of the text cursor). Row at which typing begins.

col Optional integer (default is the current position of the text cursor). Column at which typing begins.

movecursor
Optional boolean (default is true). Setting this attribute to true causes the macro runtime to move the text cursor to the end of the input (see “Move cursor to end of input (movecursor attribute)” on page 62).

xlatehostkeys
Optional boolean (default is true). Setting this attribute to true causes the macro runtime to interpret the name of an action key (such as `[enter]`) as an action key rather than as a character sequence (see “Translate host action keys (xlatehostkeys attribute)” on page 62).

encrypted
Optional boolean (default is false). Setting this attribute to true causes the Macro Editor to encrypt the sequence of keys contained in the **value** attribute when the Macro Editor is closed (see “Encrypted attribute” on page 63).

XML samples

```
<input value="'3[enter]'" row="4" column="14" movecursor="true"
           xlatehostkeys="true" encrypted="false" />
```

Figure 100. Example for the <input> element

<mouseclick> element

The <mouseclick> element simulates a mouse click on the host terminal by the user. As with a real mouse click, the text cursor jumps to the row and column position where the mouse icon was pointing when the click occurred.

Attributes

row Required integer. The row of the row and column location on the host terminal where the mouse click occurs.

col Required integer. The column of the row and column location on the host terminal where the mouse click occurs.

XML samples

```
<mouseclick row="20" col="16" />
```

Figure 101. Example for the <mouseclick> element

<nextscreen> element

The <nextscreen> element specifies the name of a <screen> element (macro screen) that the macro runtime should consider, among others, as a candidate to be the next macro screen to be processed (see "Recognizing valid next screens" on page 49).

The <nextscreen> element must occur within a <nextscreens> element.

Attributes

name Required. The name of the <screen> element that is a candidate to be the next macro screen to be processed.

XML samples

```
<!--
The effect of the following <nextscreens> element and its contents
is that when the macro runtime finishes performing the actions in
the current screen, it adds ScreenS and ScreenG to the runtime list of
valid next screens.
-->
<nextscreens>
   <nextscreen name="ScreenS">
   <nextscreen name="ScreenG">
</nextscreens>
```

Figure 102. Example for the <nextscreen> element

<nextscreens> element

The <actions> element, the <description> element, and the <nextscreens> element are the three primary structural elements that occur inside the <screen> element (see "Conceptual view of a macro screen" on page 13).

The <nextscreens> element contains <nextscreen> elements, each of which states the name of a macro screen that can validly occur after the current macro screen (see Chapter 6, “Screen recognition,” on page 49).

Attributes

timeout
: Optional integer. The value in milliseconds of the screen recognition timeout. The macro runtime terminates the macro if it cannot match a macro screen whose name is on the runtime list of valid next screens to the application screen before this timeout expires (see “Timeout settings for screen recognition” on page 51).

XML samples

```
<!--
The effect of the following <nextscreens> element and its contents
is that when the macro runtime finishes performing the actions in
the current screen, it will attempt to recognize ScreenS and ScreenG.
-->
<nextscreens>
   <nextscreen name="ScreenS">
   <nextscreen name="ScreenG">
</nextscreens>
```

Figure 103. Example for the <nextscreens> element

<numfields> element

The <numfields> element is a descriptor that states the number of 3270 or 5250 fields of all types that exist in the host terminal (see “Number of Fields descriptor (<numfields> element)” on page 41).

Attributes

number
: Required integer. The number of fields in the host terminal.

optional
: Optional boolean (the default is false). See “Optional attribute” on page 39.

invertmatch
: Optional boolean (the default is false). See “Invertmatch attribute” on page 38.

XML samples

```
<numfields number="10" optional="false" invertmatch="false" />
```

Figure 104. Example for the <numfields> element

<numinputfields> element

The <numinputfields> element is a descriptor that states the number of 3270 or 5250 input fields that exist in the host terminal (see “Number of Input Fields descriptor (<numinputfields> element)” on page 42).

Attributes

number
Required integer. The number of fields in the host terminal.

optional
Optional boolean (the default is false). See “Optional attribute” on page 39.

invertmatch
Optional boolean (the default is false). See “Invertmatch attribute” on page 38.

XML samples

```
<numinputfields number="10" optional="false" invertmatch="false" />
```

Figure 105. Example for the <numinputfields> element

<oia> element

The <oia> element is a descriptor that describes the state of the input inhibited indicator in the host terminal (see “OIA descriptor (<oia> element)” on page 41).

Attributes

status Required. The value can be:

- NOTINHIBITED

  The macro runtime evaluates the descriptor as true if the input inhibited indicator is cleared, or false if the input inhibited indicator is set.
- DONTCARE

  The macro runtime always evaluates the descriptor as true.
- An expression that evaluates to either NOTINHIBITED or DONTCARE

  The macro runtime evaluates the expression and then, depending on the result, evaluates the descriptor as usual.

optional
Optional boolean (the default is false). See “Optional attribute” on page 39.

invertmatch
Optional boolean. See “Invertmatch attribute” on page 38.

XML samples

```
<oia status="NOTINHIBITED" optional="false" invertmatch="false" />
```

Figure 106. Example for the <oia> element

<pause> element

The <pause> element waits for the specified number of milliseconds (see “Pause action (<pause> element)” on page 66).

Attributes

value Optional integer. The number of milliseconds to wait. If you do not specify this attribute then the Macro object will add the attribute "value=10000" (10 seconds) to the element when it saves the script.

ignorepauseoverride
Optional boolean (the default is false). For 3270 Display sessions only. Setting this attribute to true causes the macro runtime to process the <pause> element even if the **ignorepauseforenhancedtn** attribute of the <HAScript> element is set to true (see “Attributes that deal with screen completion” on page 84).

XML samples

```
<pause timeout="5000">
```

Figure 107. Example for the <pause> element

<perform> element

The <perform> element invokes a method belonging to a Java class that you have imported (see “Creating an imported type for a Java class” on page 89).

You can invoke a method in many other contexts besides the <perform> element. However, the <perform> element is useful when you want to invoke a method that does not return a value (see “Perform action (<perform> element)” on page 67).

Attributes

value Required. You must enclose a method call in dollar signs ($), just as you would a variable (see “Syntax of a method call” on page 94). You should specify the parameters, if any, of the method call in the same format that you would use if you were creating a Perform action in the Macro Editor.

XML samples

```
<!-- Call the update() method associated with the class to which
     importedVar belongs (such as mypackage.MyClass).
-->
<perform value="$importedVar.update( 5, 'Application', $str$)$" />
```

Figure 108. Example for the <perform> element

<playmacro> element

The <playmacro> element terminates the current macro and launches another macro (see "PlayMacro action (<playmacro> element)" on page 68. This process is called chaining macros.

There are restrictions on where in the <actions> element you can place a <playmacro> element (see "Adding a PlayMacro action" on page 68).

Attributes

name Required. The name of the target macro. The target macro must reside in the same location as the calling macro.

startscreen
Optional. The name of the macro screen (<screen> element) at which you want the macro runtime to start processing the target macro. Use the value *DEFAULT* or omit this parameter to have the macro runtime start at the usual starting screen of the target macro.

transfervars
Required. Setting this attribute to `Transfer` causes the macro runtime to transfer the variables belonging to the calling macro to the target macro (see "Transferring variables" on page 69). The default is `No Transfer`.

XML samples

```
<playmacro name="ispf_ex1.mac" startscreen="ScreenA"
                transfervars="Transfer" />
```

Figure 109. Example for the <playmacro> element

<prompt> element

The <prompt> element displays a popup window prompting the user for input, waits for the user to click **OK**, and then sends the input to the host terminal (see "Prompt action (<prompt> element)" on page 70).

Attributes

name Optional string. The text that is to be displayed in the popup window, such as `'Enter your response here:'.`

description
Optional string. A description of this action. This description is not displayed.

row Required integer. The row on the host terminal at which you want the macro runtime to start typing the input from the user.

col Required integer. The column on the host terminal at which you want the macro runtime to start typing the input from the user.

len Required integer. The number of characters that the user is allowed to enter into the prompt input field.

default
Optional string. The text to be displayed in the input field of the popup

window. If the user does not type any input into the input field but just clicks **OK**, the macro runtime will send this default input to the host terminal.

clearfield
: Optional boolean. Setting this attribute to true causes the macro runtime, before sending the input sequence to the host terminal, to clear the input field of the host terminal in which the row and column location occur.

encrypted
: Optional boolean. Setting this attribute to true causes the macro runtime, when the user types a key into the input field of the window, to display an asterisk (*) instead of the character associated with the key.

movecursor
: Optional boolean. Setting this attribute to true causes the macro runtime to move the cursor to the end of the input.

xlatehostkeys
: Optional boolean. Setting this attribute to true causes the macro runtime to interpret the names of action keys (such as `[enter]`) as action keys rather than as sequences of characters.

assigntovar
: Optional variable name. Setting this attribute to a variable name causes the macro runtime to store the input into the variable whose name you specify here.

varupdateonly
: Optional boolean. Setting this attribute to true causes the macro runtime to store the input into a variable and not to send it to the host terminal. This attribute takes effect only if the **assigntovar** attribute is set to true.

required
: Optional boolean. Setting this attribute to true causes the macro runtime to disable the **OK** button in the prompt window until the input field of the prompt window contains text. The input field can contain text either because you have specified a Default Response or because the user has typed text into the input field.

screenorientation
: Optional string. Use this attribute to define the host screen orientation to use for the prompt during macro playback at runtime. Options are `LTR` and `RTL`.

XML samples

```
<prompt name="'ID'" row="1" col="1" len="8" description="'ID for Logon'"
        default="'guest'" clearfield="true" encrypted="true"
        assigntovar="$userID$" varupdateonly="true" required="true"/>
```

Figure 110. Example for the <prompt> element

<recolimit> element

The <recolimit> element is an optional element that occurs within a <screen> element, at the same level as the <description>, <actions>, and <nextscreens> elements (see “Recognition limit” on page 53).

The <recolimit> element allows you to take action if the macro runtime processes the macro screen in which this element occurs more than some specified number of times.

Attributes

value Required integer. The recognition limit. If the macro runtime recognizes the macro screen this many times, then the macro runtime does not process the actions of this macro screen but instead performs the specified action.

goto Optional string (the default is for the macro runtime to display an error message and terminate the macro). The name of a macro screen that you want the macro runtime to start processing when the recognition limit is reached.

XML samples

```
<recolimit value="1" goto="RecoveryScreen1" />
```

Figure 111. Example for the <recolimit> element

<screen> element

The <screen> element, the <import> element, and the <vars> element are the three primary structural elements that occur inside the <HAScript> element (see “Conceptual view of a macro script” on page 10).

Multiple screen elements can occur inside a macro. One <screen> element contains all the information for one macro screen (see “The macro screen and its subcomponents” on page 11).

The <screen> element contains three primary structural elements: the <actions> element, the <description> element, and <nextscreens> (see “Conceptual view of a macro screen” on page 13).

Attributes

name Required. The name of this <screen> element (macro screen). The name must not be the same as the name of an already existing <screen> element.

entryscreen
Optional boolean (the default is false). Setting this attribute to true causes the macro runtime to treat this <screen> element as a valid beginning screen for the macro (see “Entry screens” on page 49).

exitscreen
Optional boolean (the default is false). Setting this attribute to true causes the macro runtime to treat this <screen> element as a valid ending screen for the macro (see “Exit screens” on page 50).

transient
Optional boolean (the default is false). Setting this attribute to true causes the macro runtime to treat this <screen> element as a screen that can appear at any time and that always needs to be cleared (see “Transient screens” on page 50).

pause Optional integer (the default is -1). Specifying a value in milliseconds for this attribute causes the macro runtime, for this <screen> element, to ignore the default delay for the "pause between actions" (set using the **pausetime** attribute of the <HAScript> element) and to use this value instead (see "The pause attribute" on page 81).

XML samples

```
<screen name="ScreenB" entryscreen="false" exitscreen="false"
           transient="false">
   <description>
      ...
   </description>
   <actions>
      ...
   </actions>
   <nextscreens>
      ...
   </nextscreens>
</screen>
```

Figure 112. Example for the <screen> element

<sqlquery> element

The <sqlquery> element sends an SQL statement to a database, retrieves the data resulting from the SQL statement, if any, and then stores the data into a macro variable (see "SQLQuery action (<sqlquery> element)" on page 71).

Attributes

url Required string. The database URL for the database server to which the SQL statement is sent, such as `jdbc:as400://myHost`.

driver Required string. The fully qualified package name of the driver used to connect with the database server, such as `COM.ibm.db2.jdbc.app.DB2DRIVER`. This package must be present on the client workstation.

userid Optional string. The user ID required to access the database, if one is required.

password
Optional string. The password required to access the database, if one is required.

statement
Required string. The SQL statement.

outputtype
Required integer. The destination where the data resulting from the SQL statement is to be directed. The valid value is: 0 - The data is stored in the macro variable $HMLSQLUtil$. You can retrieve the data by calling methods on the variable.

XML samples

```
<sqlquery url="'jdbc:as400://elcrtp06'"
   driver="'com.ibm.as400.access.AS400JDBCDriver'"
   userid="'myuser'"
   password="Ex0bRtrf73mPrwGrWMT+/g=="
   statement="'SELECT * FROM SQLTEST WHERE ((SQLTEST.DESCRIPT is not null))'"
   outputtype="0" />
```

Figure 113. Example for the <sqlquery> element

<string> element

The <string> element is a descriptor that specifies a sequence of characters and a rectangular area of the host terminal in which the sequence occurs (see "String descriptor (<string> element)" on page 42).

The sequence of characters can occur anywhere in the rectangular block.

Attributes

value Required string. The sequence of characters.

row Optional integer (the default is to search the entire screen). The row location of one corner of a rectangular block of text.

col Optional integer. The column location of one corner of a rectangular block of text.

erow Optional integer. The row location of the opposite corner of a rectangular block of text.

ecol Optional integer. The column location of the opposite corner of a rectangular block of text.

casesense
Optional boolean (the default is false). Setting this attribute to true causes the macro runtime to do a case-sensitive string compare.

wrap Optional boolean (the default is false).
- Setting this attribute to false causes the macro runtime to search for the sequence of characters in each separate row of the rectangular block of text. If the sequence of characters wraps from one row to the next, the macro runtime will not find it.
- Setting this attribute to true causes the macro runtime to check for the sequence of characters occurring in any row or wrapping from one row to the next of the rectangular block of text (see "How the macro runtime searches the rectangular area (Wrap attribute)" on page 43).

optional
Optional boolean (the default is false). See "Optional attribute" on page 39.

invertmatch
Optional boolean. See "Invertmatch attribute" on page 38.

XML samples

```
<!-- The string must occur in one specific area of a single row  -->
<string value="'Utility Selection Panel'" row="3" col="28"
            erow="3" ecol="51" casesense="false" wrap="false"
            optional="false" invertmatch="false" />

<!-- The string can occur in any single row of the session area -->
<string value="'Utility Selection Panel'" row="1" col="1"
            erow="-1" ecol="-1" casesense="false" wrap="false"
            optional="false" invertmatch="false" />
```

Figure 114. Example for the <string> element

<trace> element

The <trace> element sends a trace message to a trace destination that you specify, such as a console (see "Trace action (<trace> element)" on page 72).

Attributes

type Required. The destination for the trace data. The destination must be one of the following:

- HODTRACE: The Host On-Demand Trace Facility.
- USER: A user trace handler.
- SYSOUT: The WebSphere console.

value Required string. The string that is to be sent to the trace destination.

XML samples

```
<trace type="SYSOUT" value="'The value is '+$strData$" />
```

Figure 115. Example for the <trace> element

<type> element

The <type> element declares an imported type (such as `Properties`) that represents a Java class (such as `java.util.Properties`). After you have declared the type, you can create variables based on the type, create an instance of the Java class, and call methods on the instance (see "Creating an imported type for a Java class" on page 89).

A type can also be used for directly calling static methods (no need to instantiate).

The <type> element must occur inside a <import> element.

Attributes

class Required. The fully qualified class name of the class being imported, including the package name if any (such as `java.util.Properties`).

name Optional. A short name (such as `Properties`) that you can use elsewhere in the macro to refer to the imported type. If you do not specify a short name, then the short name is the same as the fully qualified class name. There are a few restrictions on the spelling of type names (see "Variable names and type names" on page 90).

XML samples

```
<import>
   <type class="java.util.Date" name="Date"/>
   <type class="java.io.FileInputStream"/>
   <type class="com.ibm.eNetwork.beans.HOD.HODBean" name="HODBean"/>
   <type class="myPackage.MyClass" name="MyClass"/>
</import>
```

Figure 116. Example for a <type> element

<vars> element

The <vars> element, the <import> element, and the <screen> element are the three primary structural elements that occur inside the <HAScript> element (see "Conceptual view of a macro script" on page 10).

The <vars> element is optional. It contains <create> elements, each of which declares and initializes a variable (see "Creating a variable" on page 88). The <vars> element must occur after the <import> element and before the first <screen> element.

To use variables, you must set the **usevars** element in <HAScript> to true.

Attributes

None.

XML samples

```
<HAScript ... usevars="true" .... >
   <import>
      <type class="java.util.Properties" name="Properties" />
   </import>

   <vars>
      <create name="$prp$" type="Properties" value="$new Properties()$" />
      <create name="$strAccountName$" type="string" value="" />
      <create name="$intAmount$" type="integer" value="0" />
      <create name="$dblDistance$" type="double" value="0.0" />
      <create name="$boolSignedUp$" type="boolean" value="false" />
      <create name="$fldFunction$" type="field" />
   </vars>
   ...
</HAScript>
```

Figure 117. Example for the <vars> element

<varupdate> element

The <varupdate> element causes the macro runtime to store a specified value into a specified variable. The value can be an immediate value, a variable, a call to a Java method, or an arithmetic expression that can contain any of these values. If the value is an expression, then during macro playback the macro runtime evaluates the expression and stores the resulting value into the specified variable (see “Variable update action (<varupdate> element)” on page 73).

You can also use the <varupdate> action in a <description> element (see “Variable update action (<varupdate> element)” on page 73).

For more information on variables see Chapter 9, “Variables and imported Java classes,” on page 87.

Attributes

name	Required. The name of the variable.
value	Required string. The value or expression to be assigned to the variable.

XML samples

```
<type>
   <type class="mypackage.MyClass" name="MyClass" />
   <type class="java.util.Hashtable" name="Hashtable" />
   <type class="java.lang.Object" name="Object" />
</type>

<vars>
   ...
</vars>

<screen>
   <description>
   ...
   </description>
   <actions>
      <varupdate name="$var_boolean1$"  value="false" />
      <varupdate name="$var_int1$"      value="5" />
      <varupdate name="$var_double1$"   value="5" />
      <varupdate name="$var_string1$"   value="'oak tree'" />
      <varupdate name="$var_field1$"    value="4,5" />

      <!-- null keyword -->
      <varupdate name="$var_importedMC1$"  value="null" />
      <!--  Equivalent to null keyword for an imported type  -->
      <varupdate name="$var_importedMC2$"  value="" />

      <varupdate name="$var_importedMC4$"
                 value="$new MyClass( 'myparam1', 'myparam2' )$" />
      <varupdate name="$var_importedMC5$"
                 value="$var_importedMC4$" />
      <varupdate name="$var_importedMC6$"
                 value="$MyClass.createInstance( 'mystringparam1' )$" />
      <varupdate name="$var_boolean2$"
                 value="$var_importedMC4.isEmpty()$" />
      <varupdate name="$var_int2$"
                 value="$($var_importedMC4.getHashtable()$).size()$" />
      <varupdate name="$var_double2$"
                 value="$var_importedMC4.getMeters()$" />
      <varupdate name="$var_string2$"
                 value="$var_importedMC4.toString()" />
   </actions>
</screen>
```

Figure 118. Example for the <varupdate> element

Appendix A. Additional information

Default rule for combining multiple descriptors in one macro screen

There is a default processing rule that applies when multiple descriptors are combined in one macro screen. It is called the *default combining rule* and it operates as follows:

1. Evaluate all the required descriptors (that is, descriptors for which the **Optional** field is set to `false`).
   a. If all are true, then the screen matches.
   b. Otherwise, go to step 2.
2. Start evaluating the optional descriptors (descriptors for which the **Optional** field is set to `true`).
   a. If any optional descriptor is true, then the screen matches.
   b. Otherwise, go to step 3.
3. If you reach here, then the macro screen does not match the application screen.

Mnemonic keywords for the Input action

This section contains the mnemonic keywords for the Input action and the type of session or sessions in which the mnemonic is supported. Session support for a given mnemonic is denoted by an X, along with any special notes that apply to the function.

Table 24. Keywords for the Input action

Function:	**Keyword:**	**3270:**	**5250:**	**VT:**
Attention	[attn]	x	x	
Alternate view	[altview]	x[3]	x[3]	
Backspace	[backspace]	x	x	x[1]
Backtab	[backtab]	x	x	
Beginning of Field	[bof]	x	x	
Clear	[clear]	x	x	x[1]
Cursor Down	[down]	x	x	x[1]
Cursor Left	[left]	x	x	x[1]
Cursor Right	[right]	x	x	x[1]
Cursor Select	[cursel]	x	x	x[1]
Cursor Up	[up]	x	x	x[1]
Delete Character	[delete]	x	x	x[1, 2]
Display SO/SI	[dspsosi]	x[3]	x[3]	
Dup Field	[dup]	x	x	
Enter	[enter]	x	x	x
End of Field	[eof]	x	x	x[1, 2]
Erase EOF	[eraseeof]	x	x	
Erase Field	[erasefld]	x	x	

Table 24. Keywords for the Input action (continued)

Function:	**Keyword:**	**3270:**	**5250:**	**VT:**
Erase Input	[erinp]	x	x	
Field Exit	[fldext]		x	
Field Mark	[fieldmark]	x	x	
Field Minus	[field-]		x	
Field Plus	[field+]		x	
F1	[pf1]	x	x	x
F2	[pf2]	x	x	x
F3	[pf3]	x	x	x
F4	[pf4]	x	x	x
F5	[pf5]	x	x	x
F6	[pf6]	x	x	x
F7	[pf7]	x	x	x
F8	[pf8]	x	x	x
F9	[pf9]	x	x	x
F10	[pf10]	x	x	x
F11	[pf11]	x	x	x
F12	[pf12]	x	x	x
F13	[pf13]	x	x	x
F14	[pf14]	x	x	x
F15	[pf15]	x	x	x
F16	[pf16]	x	x	x
F17	[pf17]	x	x	x
F18	[pf18]	x	x	x
F19	[pf19]	x	x	x
F20	[pf20]	x	x	x
F21	[pf21]	x		x
F22	[pf22]	x		x
F23	[pf23]	x		x
F24	[pf24]	x		x
Help	[help]		x	
Home	[home]	x	x	x[1, 2]
Insert	[insert]	x	x	x[1, 2]
Keypad 0	[keypad0]			x
Keypad 1	[keypad1]			x
Keypad 2	[keypad2]			x
Keypad 3	[keypad3]			x
Keypad 4	[keypad4]			x
Keypad 5	[keypad5]			x
Keypad 6	[keypad6]			x
Keypad 7	[keypad7]			x

Table 24. Keywords for the Input action (continued)

Function:	Keyword:	3270:	5250:	VT:
Keypad 8	[keypad8]			x
Keypad 9	[keypad9]			x
Keypad Dot	[keypad.]			x
Keypad Enter	[keypadenter]			x
Keypad Comma	[keypad,]			x
Keypad Minus	[keypad-]			x
New Line	[newline]	x	x	
PA1	[pa1]	x	x	
PA2	[pa2]	x	x	
PA3	[pa3]	x	x	
Page Up	[pageup]	x	x	x[1, 2]
Page Down	[pagedn]	x	x	x[1, 2]
Reset	[reset]	x	x	x
System Request	[sysreq]	x	x	
Tab Field	[tab]	x	x	x[1]
Test Request	[test]		x	

1. VT supports this function but it is up to the host application to act on it.
2. Supported in VT200 mode only.
3. The function is only available in a DBCS session.

The following table shows the bidirectional keywords for the Input action.

Table 25. Bidirectional keywords for the Input action

Function:	Keyword:	3270:	5250:	VT:
Auto Push	[autopush]	x		
Auto Reverse	[autorev]	x		x
Base	[base]	x	x	
BIDI Layer	[bidilayer]			
Close	[close]		x	
CSD	[csd]	x		
End Push	[endpush]	x		
Field Reverse	[fldrev]	x	x	
Field Shape	[fieldshape]	x		
Final	[final]	x		
Initial	[initial]	x		
Isolated	[isolated]	x		
Latin Layer	[latinlayer]	x	x	
Middle	[middle]	x		
Push	[push]	x		
Screen Reverse	[screenrev]	x	x	

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