Natural Screen Tester

Reference Guide

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1 Natural Screen Tester Eclipse Preferences

The Natural Screen Tester Eclipse preferences can be accessed via the **Windows > Preferences** menu in the Software AG node.

Remember passwords
Remembers the server passwords. When this check box is not selected the login pop-up is always displayed.

Always use the highest prioritized Screen Group (when creating Screens using Screen Creation Definitions)
When creating screens based on screen creation definitions which are defined within screen groups, you can determine to always use the highest prioritized screen group and not to ask the user every time which screen group to use. When this check box is not selected the dialog box requesting you to select the relevant screen group will always be displayed.

Switch to Natural Screen Tester perspective upon Natural Screen Tester wizards completion
When in an Eclipse perspective which is not the Natural Screen Tester perspective, and you run a wizard, once the wizard is completed, the perspective will change to be the Natural Screen Tester perspective.

Show Test Project Map on startup
Determines whether the Test Project view is displayed when opening a test project. By default the Test Project Map view is displayed.

Natural Screen Tester installation directory
Indicates the directory where Natural Screen Tester is installed.

JDK location
Indicates the directory where JDK is located.

Software AG Tomcat location
Indicates the directory where Software AG Tomcat is located.

2 Test Project Configuration Parameters

The test project properties dialog box can be accessed by right-clicking on the relevant test project and selecting **Properties**. Here you edit the basic properties as well as advanced properties:

See also **Host Configuration Parameters**.

General Test Project Parameters

This node is the first node of the test project properties and provides the most basic test project information. Right-click on an test project to access the general properties.

Test project name
: A unique name defined when first creating the test project. The test project name is read only here but can be changed by right-clicking on the test project and selecting **Rename...**.

Description
: A brief description of the test project.

Initialization mode

- **Automatic**
  Automatically loaded when the server is started.
- **When first accessed**
  Loaded when first accessed, in other words, when the code that initializes startup is first called (default).

Host Parameters

Host Parameters are described in detail in **Host Configuration Parameters**.

- General Host Parameters
- Offline
- Recording
- Send Options
- RPC
- Terminal Emulation Proxy

General Host Parameters

Host name
The name of the host that is to be connected to your test project (required field).

Address
The host's TCP/IP address (read only).

Port
The TCP/IP port to which the host is listening (read only).

Device Type
The device type of terminal that Natural Screen Tester emulates (read only).

Protocol
The protocol used to access the host (read only).

Model
The number of characters per column and per row, in the host's window (read only).

Code Page
The code page number of the required language for this test project (read only).

Activity

Non-activity timeout
Natural Screen Tester can be defined to disconnect after a certain period of non-activity. When selecting unlimited, the session will stay connected even when there is no activity.

Wait condition timeout
The default amount of time, in milliseconds, for which the test project waits to receive a screen from the host. For example, in paths, if the user defined a target screen, and it was not reached within this timeout, the user will get an exception. An additional example is in the frameworks, where the user will receive the last screen, and will continue waiting (as the host is still locked). Possible values are from 1000 to 999999 ms.

Flicker

An amount of time, defined in milliseconds, in which the test project waits for the host to send information. This is necessary, as information may be sent in a few chunks of data, before declaring that it has received the entire screen. This is a value defined for all the test project screens, and can be bypassed using the Wait Conditions. (By default, this value is set to 0). Possible values are from 0 to 10000 ms. Refer to Handling Flickering of Host Screens.

Blank screen timeout

The amount of time, defined in milliseconds, in which the test project waits after receiving a blank screen, giving the host the opportunity to continue sending the next screen before returning to the client. This is very similar to the flicker parameter, the difference being that the flicker feature waits the complete amount of time defined as oppose to the blank screen timeout which finishes once the screen stops being blank. In addition, this setting only applies to blank screens, and in this way, does not slow down the performance of the entire test project. (Default value: 500 ms). Possible values are from 0 to 10000 ms.

Offline

Work offline

Indicates whether to simulate a communication with the host by using a pre-recorded file. By default, this feature is not enabled.

Files on server

Lists the trace files which are on the server. Click and browse to copy a file from your local machine to the server.

Simulate host delay

Allows a session replayed by a GCT to simulate the host's communication delay or to predefine a time delay to wait before showing the information (this is because generally, the test project is faster when replayed). Available values: No delay, Simulate host, 500- 10000 ms (by default No delay is selected).

Recording

The Record Trace File feature enables creating a file, which will trace the connection communication (connection pool or user) between the Natural Screen Tester server and the host, for each connection. It is possible to define whether a single trace file will be created, replacing the previously saved file or if the data will be saved to a new file for every new connection or session. Identifying the separately saved files is possible by inserting identifying parameters in the file name (the session ID, connection time and/or connection ID).

Record display sessions (trace files)

Select this option to enable recording trace files.

Compress (create files in zip format)

Select this option to compress the file.

Encrypt (using server private key)
Select this option to encypt the file. In order to encrypt files, you must first define the encryption key (In the Server properties, General tab).

Suppress hidden fields
Conceals passwords and hidden fields in the trace file.

Note: The "Suppress hidden fields" option is not supported when recording using Terminal Emulation Proxy.

File name
The name of the trace file. You can create a separate **File for each** session, or connection and the name can include the session ID, creation time and/or connection ID.

%u will insert the session ID.

%t will insert the time stamp of the connection.

%c will insert the connection ID.

Location of folder
Browse and select the location of the folder where the files will be stored. Determine whether sub folders will be created for each year/month/day.

Open recordings folder
Opens the Windows Explorer and displays the location and list of existing trace files.

Send Options

The Send Options enable to configure how and whether a field is sent to the host when there are mismatches between the field and the host field.

Throw exception when field content does not match host field attributes
When the field does not match the host field attributes, for example, when the value to be entered is longer than the field length, or the field is not found, or the cursor position is not in an unprotected field, an error will occur.

When field content is longer than host field length...
When the field content is longer than the host field it is possible to select the option that this field will not be sent to the host, or that the contents of the field will be cut to match the host field size.

RPC

Available in test projects associated with AS/400 only.

In the RPC tab, connection parameters for the Natural Screen Tester **Program Calls**. This is enabled only for AS/400 hosts.

Enable connection pool
Selecting this check box indicates that the server should maintain a pool of connections.

Number of connections in pool
The minimum and maximum number of connections it is possible to have in the pool at one given time.

Minimum available connections
The minimal number of connections in the pool that are ready to serve a transaction. If the number of available connections in the pool falls below this number, new connections will be created until the minimum is reached.

Connections created when pool is increased
The number of connections created each time the pool size is increased.

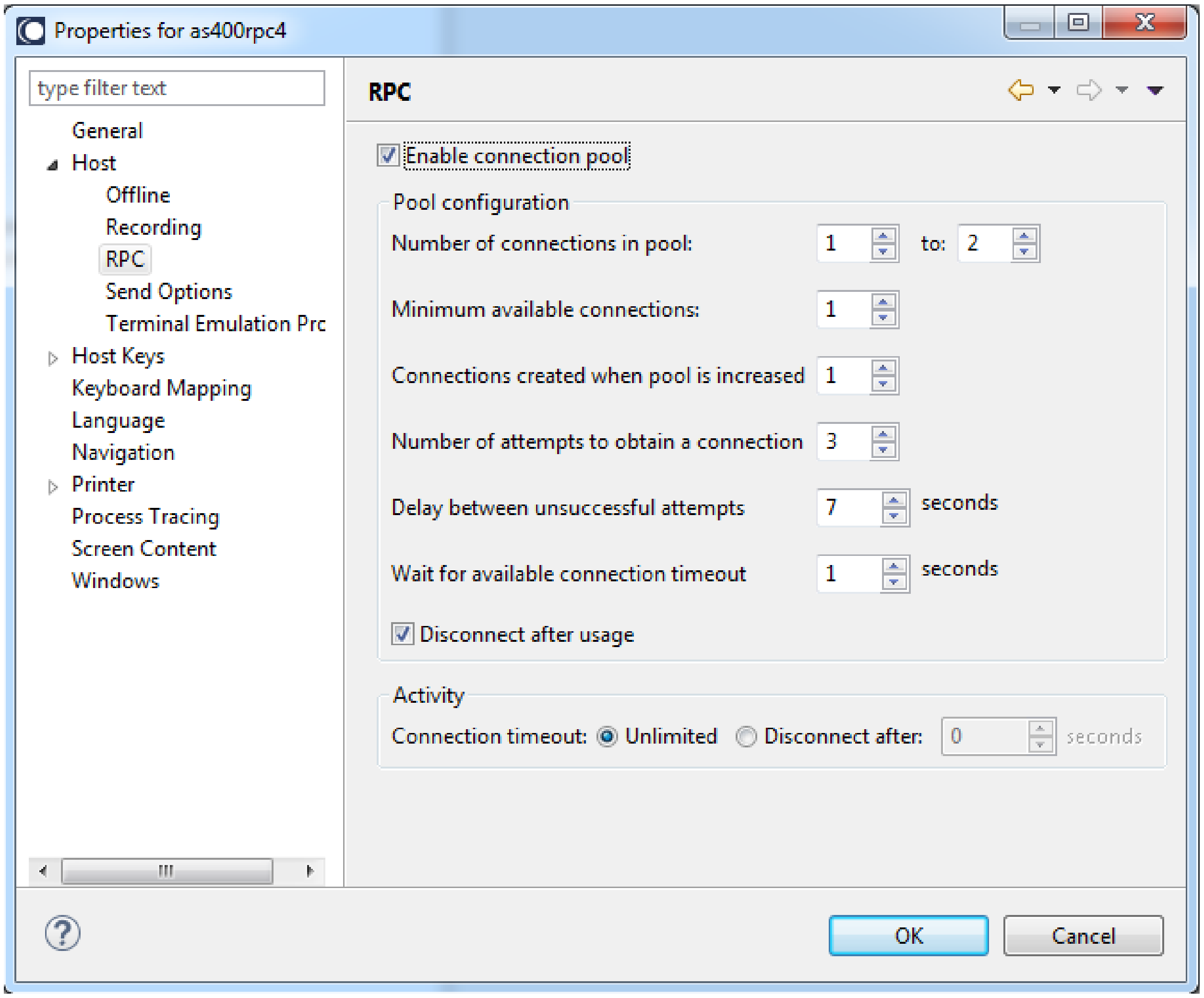
Number of attempts to obtain a connection
The number of attempts to create a connection.

Delay between unsuccessful attempts
The time, in milliseconds, before retrying to obtain a connection.

Wait for available connection timeout
If no connections are available in the connection pool, the length of time to wait for an available connection before a timeout message is sent.

Connection timeout
The total time, in minutes, that a connection can exist. Setting the value to "Unlimited" sets no timeout. After the set time elapses the connection is terminated.

Disconnect after usage
This checkbox determines whether to restart the connection once a user finishes using a connection or to terminate the connection when it is returned to the pool. When checked, the connection is terminated after usage.



RPC

[✓] Enable connection pool

Pool configuration

Number of connections in pool:	1	to:	2
Minimum available connections:	1		
Connections created when pool is increased	1		
Number of attempts to obtain a connection	3		
Delay between unsuccessful attempts	7	seconds	
Wait for available connection timeout	1	seconds	

[✓] Disconnect after usage

Activity

Connection timeout: [✓ Unlimited] Disconnect after: 0 seconds

Terminal Emulation Proxy

This feature enables redirecting emulation network traffic to pass through the port configured in this screen (only relevant for AS/400 and Mainframe hosts).

Use Terminal Emulation Proxy
Select this check box to use the Terminal Emulation Proxy option.

Note: When recording using Terminal Emulation Proxy, the "Suppress hidden fields" option is not supported.

Terminal Emulation Proxy port
Enter the port number through which you would like to redirect the emulation network traffic.

Keyboard Mappings

Use the Keyboard Mappings node to map host keys to keyboard keys.

Keyboard key/s
The combination of keyboard keys such as Shift+W. The values in this field are entered into the field as they are pressed on the keyboard.

Note: When using the keyboard keys within the web test project, the CTRL+N and CTRL+K keys are blocked by default as they cause multiple browser windows to use the same session (this can be manually set in the config/gx_keyboardMappings.xml file).

Command
Determines the host key that will be sent. The host key should be in square brackets and can be selected from the standard host keys list to the right of the Host key field.

Language

The Language node enables you to define the language used in the test project as well as direction settings, relevant mainly for right-to-left languages.

Language
The test project's language.

The following settings are relevant for right-to-left languages. The option you select is the default setting for all the screens, but can be changed for a specific screen in the relevant screen identification properties.

Screen direction
Relevant for mainframe hosts only. The screen direction of right-to-left languages differs according to the original host settings, and when incorrectly set, can cause the screen to be illegible. In order to correct this, define the suitable screen direction.

Typing direction
Right-to-left languages may display typed-in text in the client test project text fields, aligned to the left of the field. In order to display the text aligned to the right, select the right-to-left option. Numeric type fields typing direction will always be left-to-right.

Tab direction
When pressing the **Tab** button the cursor moves to the next consecutive field. The direction the cursor moves (moving to the next field to the left or moving to the next field to the right) must be correctly defined in order to preserve the screen logic.

Navigation

Enable map steps recording while navigating in session

Once selected, the test project map will record the navigation steps between the screens.

Exception path

An Exception path is initiated once a test case procedure that is being executed reaches a screen that is not defined as the To Screen of the step that was executed or as the From Screen of the next step to be executed. When such a screen is reached, Natural Screen Tester immediately searches (ignoring the wait condition timeout) for the Exception Path that has been defined. If an Exception path is found, it is executed. Natural Screen Tester will then try to continue the original path from the point before the Exception Path was initiated. The attempt to find and execute a suitable Exception path will be repeated as many as 30 times, after which the original path will fail to be executed.

Screen Content

Replace padding characters with space

Some hosts fill input fields with a character such as underscores or dots (following the actual content of the field). You may define that Natural Screen Tester replaces this character in the input field with spaces when the server sends the field's contents to the client. It is possible to define up to two padding characters.

The radio buttons enable applying this to all fields or only to input (unprotected) fields (input fields also include test project fields with "both" protection type - protected and unprotected).

Remove from both sides of text

This field determines whether the padding character will be removed from both sides of the field or just from one side (in LTR test projects the character will be removed from the right side, and in RTL test projects the character will be removed from the left side). In numeric type input fields, the characters are removed from both sides of the content (as it is clearly not a number).

Trim Fields

Some hosts fill input fields with spaces (following the actual content of the field). You may instruct Natural Screen Tester to remove the spaces from the content of the input field.

The radio buttons enable applying this to all fields or only to input (unprotected) fields or input fields and test project fields with "both" protection type - protected and unprotected).

Remove from both sides of text

This field determines whether the spaces will be removed from both sides of the field or just from one side (in LTR test projects the character will be removed from the right side, and in RTL test projects the character will be removed from the left side). In numeric type input fields, the characters are removed from both sides of the content (as it is clearly not a number).

Return Content of Hidden Fields
Some hosts have hidden fields in the screen. Usually these fields' visibility depends on the context of the screen. By default, Natural Screen Tester does not return the content of these fields because the user in an emulator cannot see them. However, sometimes their content can be important and one may want to access it (for example, hidden fields can be used as screen identifiers, or as a part of a test case procedure's logic). Check the **Return content of hidden fields** check box to return the content of all hidden fields in the test project.

Split fields when an attribute changes (color, blinking etc.)
This field determines whether when an attribute changes in the middle of a field, this field will be split.

Windows

In the Designer, you can describe the way a window is displayed in the host. The Window definitions are used to correctly identify screens and to open host windows as separate pop-up windows. Click the **Add** or **Delete** button to make any changes.

Note: When the host is a Natural UNIX host, this tab is disabled, as the windows' definitions are included in the Natural-Unix protocol and do not require being defined via Natural Screen Tester.

List of host windows
The list of host windows is displayed here. Add or remove windows by clicking on the relevant button. When adding a window you are required to select the type of modal windows the host sends. There are two types: Reversed Video or Frame. For test projects that have more than one level of windows (a window within a window), where each level is defined with a different Window Type, be sure to define the windows in the correct order.

Attributes

Frame is intensified
One of the parameters that assist in recognizing windows. This parameter determines whether the frame will be recognized as a window when the frame is intensified.

Frame with title
One of the parameters that assist in recognizing windows. This parameter determines whether the frame will be recognized as a window if the frame has a title.

Identify window even though unprotected fields exist outside window area
This field determines whether or not an area that seemingly could be identified as a window will be recognized as one, even though there are unprotected fields outside the window area. Note: When a window is identified within a screen, and working with modal windows, it is not possible to edit unprotected fields outside the window area.

Content

Remove window frame
Characters appear on the first line of the screen without the window frame. Suitable typically for Natural mapping test projects.

Display window title
Displays the window title in the window frame to be viewed.

Frame characters

Vertical
The character used for the host's modal window vertical lines. The character can be either typed in, or selected from the list of characters.

Horizontal
The character used for the host's modal window horizontal lines. The character can be either typed in, or selected from the list of characters.

Corners
The character used for the host's modal window corners. The character can be either typed in, or selected from the list of characters.

Synchronize corners
Defines that all four corners of the window frame are the same character (default). When selecting this option, define the character for each of the corners (upper-left, lower-left, upper-right and lower-right).

3 Host Configuration Parameters

See also **Test Project Configuration Parameters**

Host Configuration: Connectivity

Name/IP address
The host's TCP/IP address (IPv4 and IPv6 address formats are supported).

Port
The TCP/IP port to which the host is listening.

Device type
The device type of terminal.

Protocol
The protocol used to access the host.

Device Type	Protocol	Comment
Mainframe: IBM-3278, IBM-3279 (only supported via SNA servers that convert SNA to TN3270)	TN3270 TN3270E	
Natural-UNIX (Software AG)	Natural-APX, Natural-NSW	
BS2000	9750	
UNISYS-TD830 (UNISYS T27 EBCDIC), UNISYS-TD830-ASCII (UNISYS T27 ASCII)	TELNET	
TANDEM: TN6530-8	TN6530	Only block mode applications are supported in Web enablement.
FUJITSU-6680-00, FUJITSU-6680-02	TN6680	
AS/400: IBM-3179, IBM-3477-FC, IBM-5555	TN5250 TN5250E	
HITACHI	TN560	Supported only by Natural Screen Tester Servers installed on Win 32 platforms.

Model
The number of characters per column and per row, in the host's window.

Application
The name of the application on the BS2000, to which you want to connect (relevant only to BS2000). The name can be up to 8 characters long. $DIALOG is provided as the default name. The connection to the host will be established using an Open command, without any parameters.

Application script
The name of the shell script file required to start the Natural application (relevant Natural-UNIX).

Parameter file
This file contains the configuration parameters relevant for Natural-UNIX. Enter the parameter file name as it appears in Natural, without the file extension. For example: SYSTRANS.SAG should be written as SYSTRANS.

Connection timeout
The number of milliseconds the application will try to connect to the host, before it announces failure.

Code page
The code page number of the required language for this application.

Convert input to uppercase
Sends data to the host as uppercase (overrides default host configuration-backwards compatible).

Use 8-bit data
Determines whether to use an 8-bit ASCII table. When not selected, the 7-bit ASCII table is used by default.

RPC

Note: This tab is not displayed in Mainframe host applications.

Username
Insert a User ID to log into an AS/400 host.

Password
A password to log into an AS/400 host.

Library list
A list of libraries separated by spaces, in the AS/400 host called by programs that may reference them. If a program calls a library that is not recorded in the Library list, the program may not function properly.

Create debug log
Check this check box to save a debug log when running Natural Screen Tester programs.

File name
Specify the log file.

Security

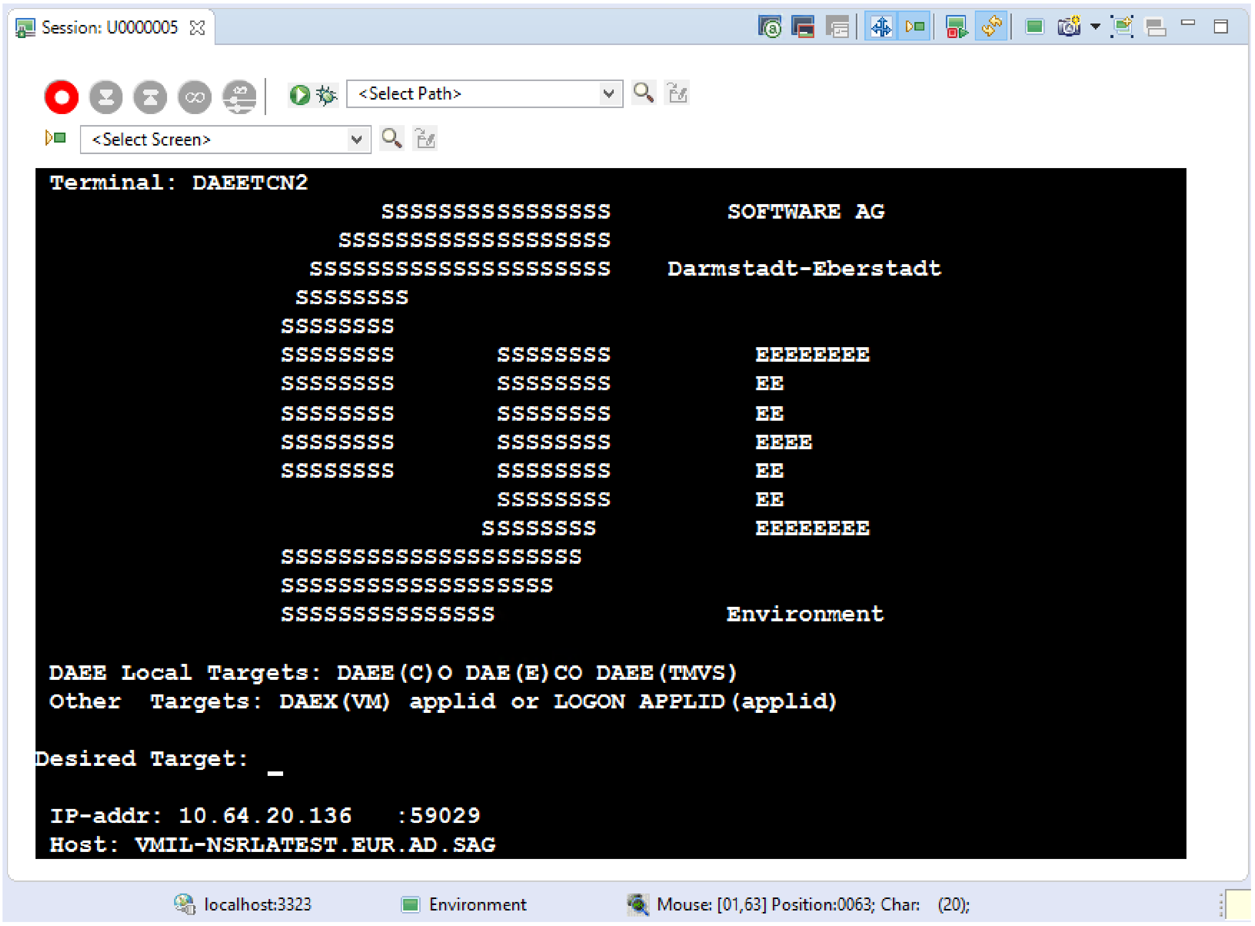
Connect using SSH
Enables connecting using the SSH connection between the Natural Screen Tester server and the host.

Use SSL connection to host
Enables using the SSL connection between the Natural Screen Tester server and the host.

Add and Remove icons
The Add icon enables adding a valid X509 certificate. Use the remove button to remove certificates not used.

Note: This can be used in any block mode host, however this has only been tested on a 3270 Mainframe host.

4 Session Properties and Toolbars



```
Terminal: DAEETCN2
                      SSSSSSSSSSSSSSSS        SOFTWARE AG
                   SSSSSSSSSSSSSSSSSS
                 SSSSSSSSSSSSSSSSSSSSS    Darmstadt-Eberstadt
                SSSSSSSS
               SSSSSSSS
               SSSSSSSS       SSSSSSSS          EEEEEEEE
               SSSSSSSS       SSSSSSSS          EE
               SSSSSSSS       SSSSSSSS          EE
               SSSSSSSS       SSSSSSSS          EEEE
               SSSSSSSS       SSSSSSSS          EE
                              SSSSSSSS          EE
                             SSSSSSSS           EEEEEEEE
               SSSSSSSSSSSSSSSSSSSSS
               SSSSSSSSSSSSSSSSSSS
               SSSSSSSSSSSSSSS                 Environment

DAEE Local Targets: DAEE(C)O DAE(E)CO DAEE(TMVS)
Other  Targets: DAEX(VM) applid or LOGON APPLID(applid)

Desired Target: _

IP-addr: 10.64.20.136   :59029
Host: VMIL-NSRLATEST.EUR.AD.SAG
```

localhost:3323   Environment   Mouse: [01,63] Position:0063; Char: (20);

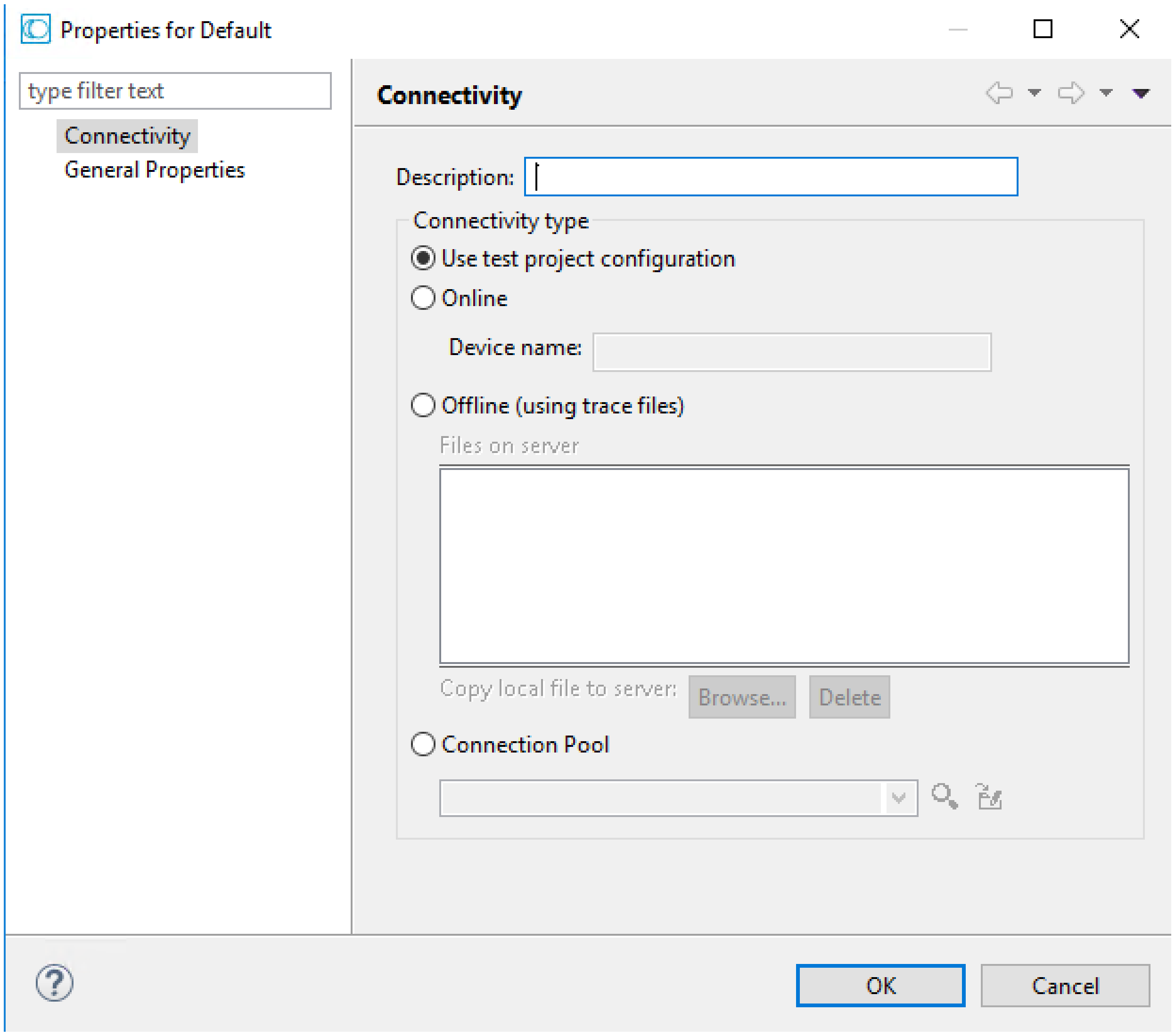
Display Session Properties

Refer to Creating a Display Session in the *Designing and Developing a Test Case* documentation. These definitions override the default connection configuration as defined in the test project properties.

- Connectivity Properties

- General Properties

Connectivity Properties


Properties for Default

type filter text

Connectivity
General Properties

Connectivity

Description:

Connectivity type

(● Use test project configuration)
○ Online
Device name:
○ Offline (using trace files)
Files on server
Copy local file to server: Browse... Delete
○ Connection Pool

OK Cancel

Description
A suitable description for the session.

Use test project configuration
Select Use test project configuration to implement the configuration as set in the test project properties.

Online
Select Online when you want to connect online to the configured host.

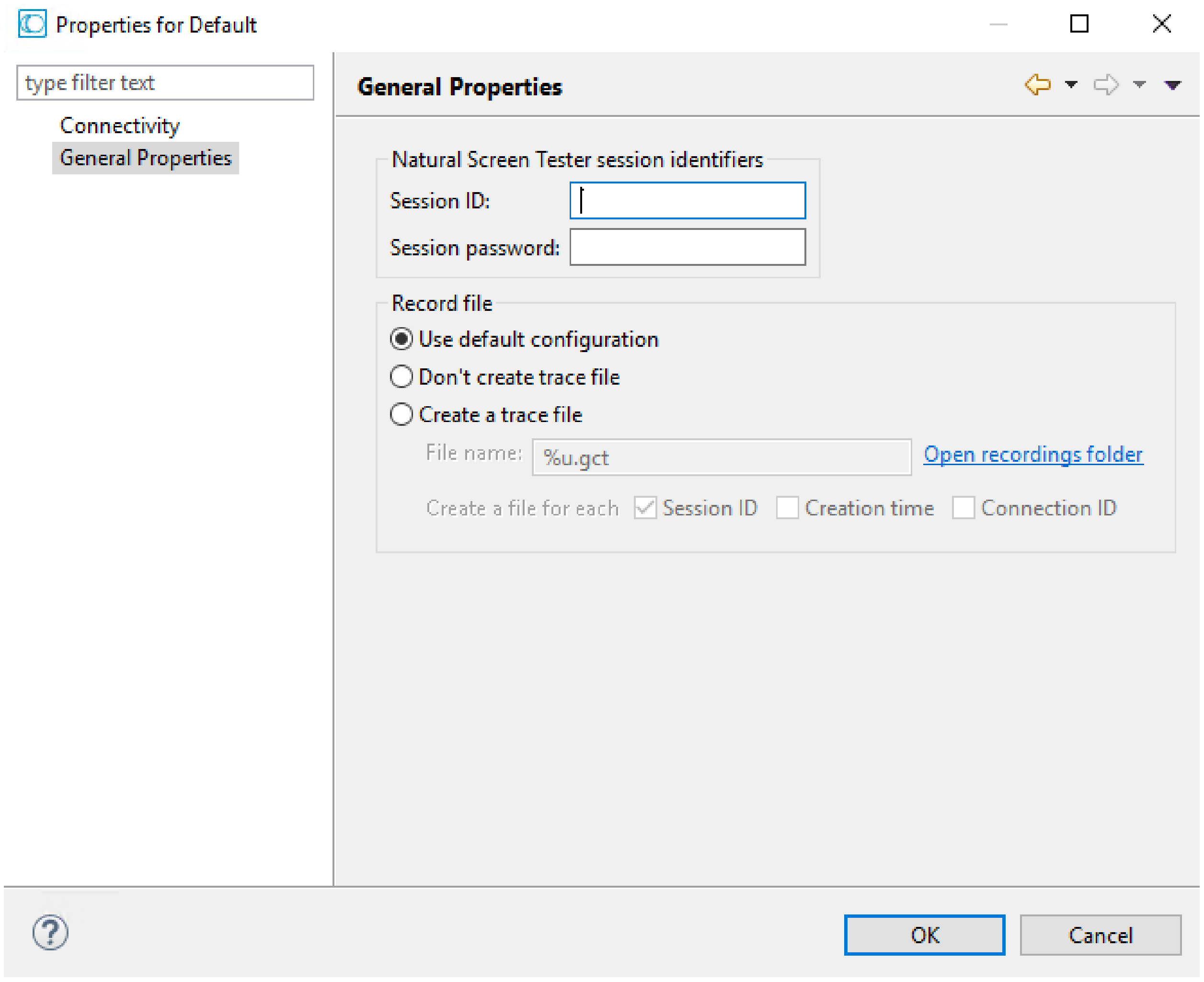
Offline (using trace files)

Indicate whether to simulate a communication with the host by using a pre-recorded file. Select Offline (using trace files) and then select the replay file from the list displayed in the **Files on server** list or browse and select a file from a folder.

Connection Pool

Select Connection Pool and choose one of the test project's Connection Pools.

General Properties



General Properties

Natural Screen Tester session identifiers

Session ID:

Session password:

Record file

● Use default configuration

○ Don't create trace file

○ Create a trace file

File name: %u.gct

Open recordings folder

Create a file for each ✓ Session ID ☐ Creation time ☐ Connection ID

Session ID
Custom session ID

Session password
Custom session password.

Use default configuration
Select **Use default configuration** to implement the Test Project Trace File configuration as set in the test project properties.

Don't create trace file
Select **Don't create trace file** if you do not want to create a trace file.

Create a trace file
Indicates whether to log the communication with the host into a file. Select **Create a trace file** and insert the trace file name. If you include %u or %t (or both) in the file name, you can create files for diverse users with different session ID and time information. Check **Session ID** if you

want to override the files of the same session ID. Check time to add a time stamp to the file name. This does not overwrite previous files. Check **Connection ID** to add full connection ID (test project, connection pool, connection) to the file name.

Session View Main Toolbar

	Show/hide attributes
	Show/hide input fields
	Window: will gray out or display in regular colors, the screen area outside the window. It is not possible to navigate outside the window.
	Test Case Toolbar
	Navigate to Screen Toolbar
	Restart Session
	Synch with host
	Character mode/Block mode
	Change screen direction
	Update Screen Image
	Edit the current screen
	Identify new screen/screen group
	Automatically identify unprotected screens
	Screen creation mode: automatic, semi-automatic or manual

Test Case Procedure Toolbar

The **Test Case Procedure** toolbar is used to record, run and debug a test case.

	Start recording
	Stop recording
	Mark possible input - marks the input (unprotected) fields of the current screen
	Mark possible output - marks the fields that will be used as assertions
	Loop

	Get loop condition text
	Run
	Debug

Test Project Toolbar

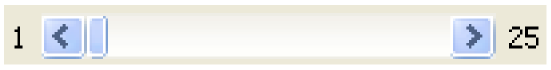
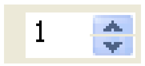
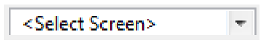
The Test Project toolbar is available to be used when developing a test project. Using the toolbar you can:

- Check that the test project definitions work as expected (by selecting a screen, and checking that Natural Screen Tester is able to navigate to this screen).
- Navigate to a specific screen to edit and make changes in the screen.

The Test Project toolbar is not displayed when working offline.

	Navigate to screen
	Open the entity's editor
🔍	Find entity

Navigation Toolbar

	Slider, indicates current location in the replay file.
	Screen number box, displays the current screen number.
	Displays a list of the available screens and screen groups.
	Open the entity's editor
🔍	Find entity
	When clicked, displays the screen number entered in the screen number box.
	Show User Input button displays the user input entered while the replay file was recorded. When the button is clicked, the contents of the input fields that were changed appear in red, a string representation of the host key sent appears in the Toolbar and the cursor is positioned in the position it was in when the screen was sent to the host.

Note: When replaying a file that has a Connection Pool, the Replay Navigator slider is not available for the Natural UNIX protocol.

5 Screens and Screen Groups

In the Screen Editor edit the screen definitions: the identifiers, fields, screen groups, tables and map steps. The Screen Editor can be accessed after creating a new screen or by editing an existing one. Refer to Screens in the *Designing and Developing a Test Case* documentation.

Identifiers Tab
Lists the identifying elements that identify the screen. Refer to Identifiers, Adding or Deleting an Identifier and Editing a Screen Identifier.

Identify entire screen (ignore window definition)
Selecting this check box indicates that the application's window definitions are ignored during the identification of this screen. Once the screen is identified, the full screen is used. This check box is only enabled when the screen has a window.

Select this check box:

- When the screen includes multiple windows and the window definition in this screen is ambiguous.
- To override general application window identification definitions in a specific screen.

Note: Changing the selection of this field will cause existing position dependant definitions in the screen (such as identifiers and fields) to be incorrect. It is therefore necessary to redefine identifiers and fields when selecting/clearing the check box. By default this field is not selected.

List of Identifiers
Lists the existing identifiers. There are several columns in this table:

Icon	Graphic indication of the type of identifier.
Type	Textual indication of the type of identifier
Content	Description of the identifier contents
Row	The position within the screen
Column	The position within the screen

Screen Fields Tab

Lists the screen's mappings. Enables adding new mappings, such as single, multiple or dynamic mappings. Next to each mapping, an icon indicates whether the mapping is inherited from a screen group, whether the mapping has been defined locally for the current screen, or whether the mapping was originally inherited from a screen group but has been overridden locally to suit the current screen. When selecting an inherited mapping, it is not possible to change the mapping properties. When selecting a local mapping, all properties can be changed. When selecting an overridden mapping, all properties can be changed, except for the name.

Icon	Description
▣	The mapping has been defined locally for the current screen.
↳	The mapping is inherited from a screen group.
▣	The mapping was originally inherited from a screen group but has been overridden locally to suit the current screen.
✖	Cancels overriding an inherited mapping.

Icon Legend

The Override/Cancel Override hyperlink (enabled when not selecting a local mapping) overrides an inherited mapping, or cancels overriding an inherited mapping (using the inherited values).

The Add Field Mapping hyperlink enables adding a new field mapping.

The Delete Field Mapping hyperlink (enabled on when selecting a local mapping) removes the mapping.

6 Procedures

A Natural Screen Tester procedure is a well-defined encapsulation of a complete process, and contains process input arguments, process output arguments and the process definition itself. A procedure group is a container of several procedures. The following procedure types are available:

- **Test Case Procedure**
  Encapsulates a process of navigation in host screens, collecting data or submitting data.
- **Flow Procedure**
  Encapsulates a complex process that can combine host sessions and other data sources: databases, host transactions (RPC), other web services.
- **Web Procedure**
  Encapsulates a process of navigating and selecting elements in the Web.
- **Program Procedure**
  Encapsulates a host transaction (in COBOL or RPG), invoked via RPC and not via the screens layer.
- **External Web Services**
  Encapsulates a web service that is external to Natural Screen Tester, invoked via SOAP.

This chapter covers the following topics:

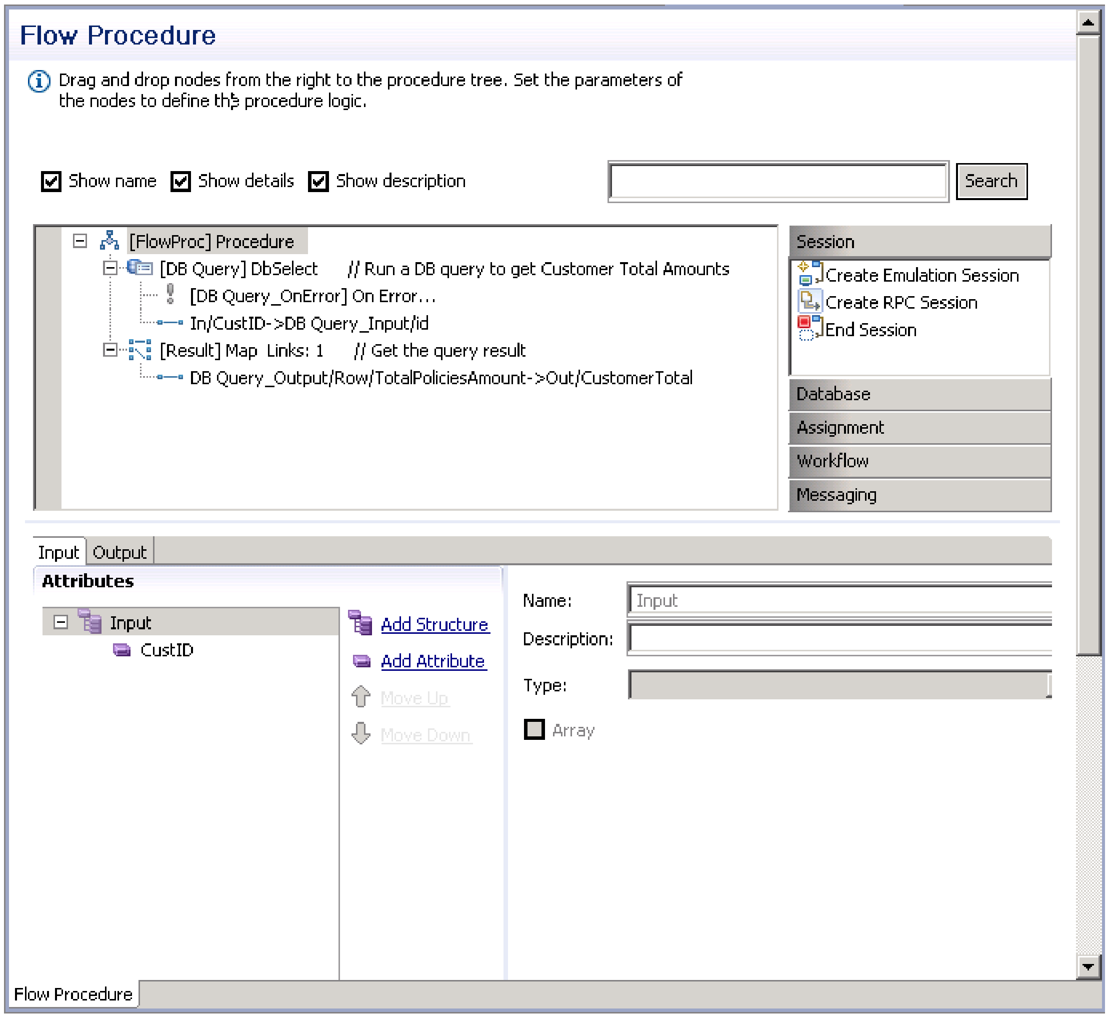
See also Procedures in the *Designing and Developing a Test Case* documentation.

Procedure Input and Output Attribute Types

- Text
- Long
- Boolean (True, False)
- Double
- Integer
- Float
- Byte
- Date: The format can be either 2001-07-04 12:08:56.235 or 2001-07-04T12:08:56.235 (this format should be used for Web Services only), or dd/MM/yyyy

See also Defining Procedure Inputs and Outputs in the *Designing and Developing a Test Case* documentation.

Flow Procedure Editor


Flow Procedure

Drag and drop nodes from the right to the procedure tree. Set the parameters of the nodes to define the procedure logic.

☑ Show name ☑ Show details ☑ Show description

```
[FlowProc] Procedure
  [DB Query] DbSelect     // Run a DB query to get Customer Total Amounts
    [DB Query_OnError] On Error...
    In/CustID->DB Query_Input/id
  [Result] Map  Links: 1     // Get the query result
    DB Query_Output/Row/TotalPoliciesAmount->Out/CustomerTotal
```

Name: Input

Description:

Type:

☐ Array

Show name

Includes the name of the node in the procedure details.

Show details

Includes details of the node in the procedure details.

Show description

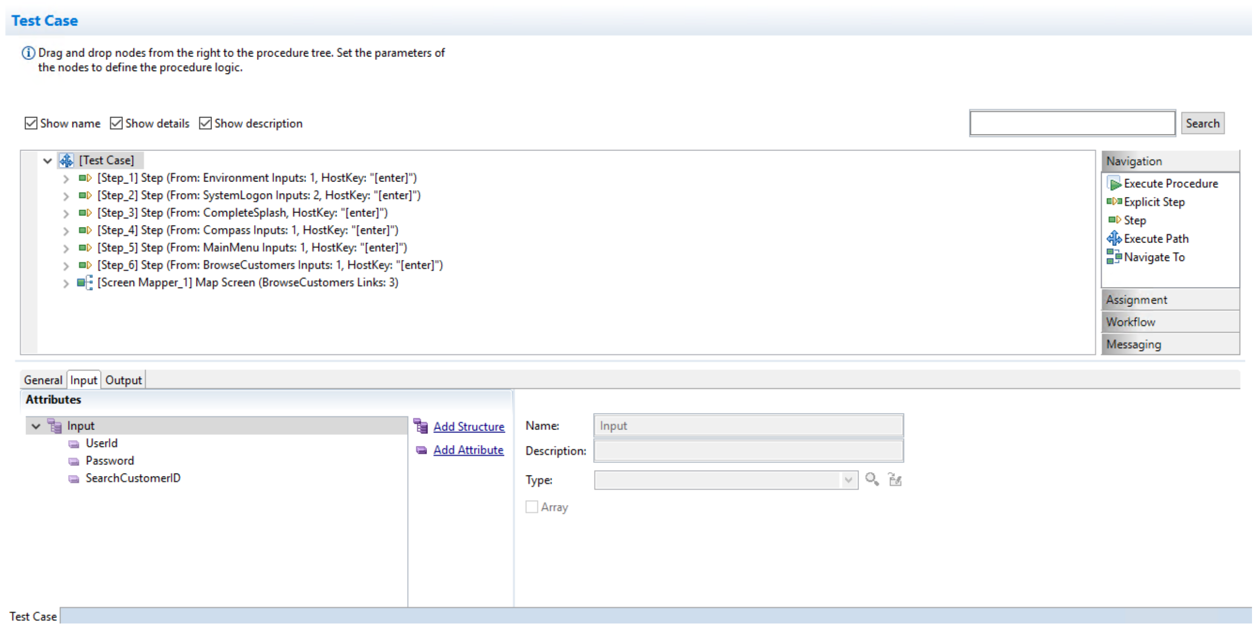
Includes a description of the node in the procedure details.

The procedure nodes are listed on the right, and can be placed within the procedure by dragging and dropping them to the relevant place within the procedure process. Clicking on one of the titles, such as Navigation, will display all the available nodes within navigation.

In the Procedure tree, right-clicking on a node will display the actions available for that node. These may include actions such as expanding or collapsing the node. The root node includes saving an image of the procedure to a file.

Test Case Procedure Editor

Test Case Procedure Panel


Test Case

Drag and drop nodes from the right to the procedure tree. Set the parameters of the nodes to define the procedure logic.

☑ Show name ☑ Show details ☑ Show description

```
[Test Case]
  [Step_1] Step (From: Environment Inputs: 1, HostKey: "[enter]")
  [Step_2] Step (From: SystemLogon Inputs: 2, HostKey: "[enter]")
  [Step_3] Step (From: CompleteSplash, HostKey: "[enter]")
  [Step_4] Step (From: Compass Inputs: 1, HostKey: "[enter]")
  [Step_5] Step (From: MainMenu Inputs: 1, HostKey: "[enter]")
  [Step_6] Step (From: BrowseCustomers Inputs: 1, HostKey: "[enter]")
  [Screen Mapper_1] Map Screen (BrowseCustomers Links: 3)
```

Attributes

```
Input
    UserId
    Password
    SearchCustomerID
```

Name: Input

Description:

Type:

☐ Array

Show name

Includes the name of the node in the procedure details.

Show details

Includes details of the node in the procedure details.

Show description

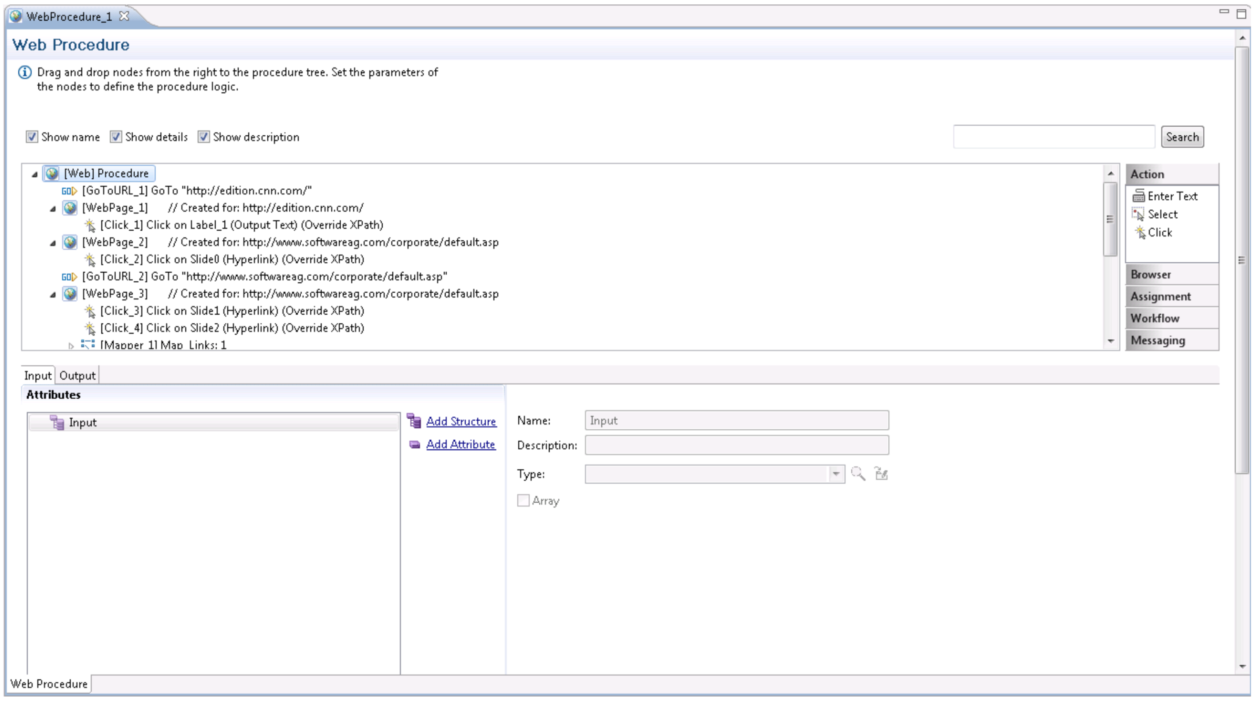
Includes a description of the node in the procedure details.

The procedure nodes are listed on the right, and can be placed within the procedure by dragging and dropping them to the relevant place within the procedure process. Clicking on one of the titles, such as Navigation, will display all the available nodes within navigation.

In the Procedure tree, right-clicking on a node will display the actions available for that node. These may include actions such as expanding or collapsing the node. The root node includes saving an image of the procedure to a file.

Web Procedures

Web Procedure Panel



Drag and drop nodes from the right to the procedure tree. Set the parameters of the nodes to define the procedure logic.

☑ Show name ☑ Show details ☑ Show description

```
[Web] Procedure
    [GoToURL_1] GoTo "http://edition.cnn.com/"
    [WebPage_1]     // Created for: http://edition.cnn.com/
        [Click_1] Click on Label_1 (Output Text) (Override XPath)
    [WebPage_2]     // Created for: http://www.softwareag.com/corporate/default.asp
        [Click_2] Click on Slide0 (Hyperlink) (Override XPath)
    [GoToURL_2] GoTo "http://www.softwareag.com/corporate/default.asp"
    [WebPage_3]     // Created for: http://www.softwareag.com/corporate/default.asp
        [Click_3] Click on Slide1 (Hyperlink) (Override XPath)
        [Click_4] Click on Slide2 (Hyperlink) (Override XPath)
      [Mapper_1] Map  Links: 1
```

Name: Input
Description:
Type:
☐ Array

Show name
: Includes the name of the node in the procedure details.

Show details
: Includes details of the node in the procedure details.

Show description
: Includes a description of the node in the procedure details.

The procedure nodes are listed on the right, and can be placed within the procedure by dragging and dropping them to the relevant place within the procedure process. Clicking on one of the titles, such as Navigation, will display all the available nodes within navigation.

In the Procedure tree, right-clicking on a node will display the actions available for that node. These may include actions such as expanding or collapsing the node. The root node includes saving an image of the procedure to a file.

Configuring the Proxy Settings

When your network requires defining a proxy, set the proxy Hostname, Port, Username and Password in the `WebProcedureConfig` section in the *<Natural Screen Tester installation>/config/gxconfig.xml* file:

```
<MainConfiguration>
        ...
        <ServerConfiguration>
        ...
           <webProcedureConfig>
              <proxyHostname></proxyHostname>
              <proxyPort></proxyPort>
              <proxyUsername></proxyUsername>
              <proxyPassword></proxyPassword>
           </webProcedureConfig>
        </ServerConfiguration>
</MainConfiguration>
```

What is an XPath?

Natural Screen Tester deciphers the Web page and finds elements using standard W3C technology called XPath. XPath, the XML Path Language, is a query language for selecting elements from an XML document. XPath was defined by the World Wide Web Consortium (W3C) and further details can be found at their site. When recording the Web procedure, and capturing an element, Natural Screen Tester finds the most suitable XPath that will locate the element in runtime. The XPath technology provides flexibility to locate a specific element using various XPaths. The format of an XPath can vary, for example, it can be of a format which only looks for a specific HTML attribute such as a name or ID within the Web page (recommended) or it can be a canonical XPath which provides the whole path, detailing the hierarchy of the tags which point to the element. If there is no name or ID, or if the name/ID is not generic enough, (i.e. if it is specific to a value that is likely to change in different instances of the page), alternative XPaths should be considered. The alternative suggestions by Natural Screen Tester are options which include various levels of hierarchy. The objective is to use an XPath which is based on a "solid" name/ID, with as few as possible levels of hierarchy as the fewer levels of hierarchy, the more stable the XPath is.

Handling Inline Frames

The suggested XPath has an additional level, and when there are inline frames, the XPath combines the web page and iframe's XPath into one XPath, to simplify the use within Natural Screen Tester.

For example:

The Web pages standard XPath (refers to the first iframe tag in the main document): `/html/body/iframe[1]`.

The IFrames standard XPath (refers to the second input tag under the first div tag, inside the iframe's document): `/html/body/div[1]/input[2]`.

The combined XPath used by Natural Screen Tester:
`/html/body/iframe[1]/html/body/div[1]/input[2]`.

Troubleshooting

What to do when the Web Procedure fails to run?

The Web Procedure can fail to run for a number of reasons such as an element cannot be found on the page or unexpected behavior when running JavaScripts. Some of these issues can be solved by adjusting parameters in the <*NSR-installation*>*/config/gxconfig.xml* file. Following is a list of possible problems with a recommendation as to what to do and when relevant, which parameter to configure. Below is a snipet of the code as it appears within the gxconfig.xml file.

Timeout error: When running the Web Procedure, sometimes an error message is displayed indicating that a timeout occurred, and that the procedure failed and did not run successfully. This can be for a number of reasons:

- A specific element used in the procedure was not found on the page. In this case, you should try the following:
  1. The XPath defined may not capture the correct element. Run the procedure from within the Designer and follow the output in the Console area.
  2. Refine the XPath to make it more robust. Refer to **What is an XPath?**
  3. Change the server log level to "trace" to help you understand where the problem may lie.
  4. If you know that this element is on the page, you should try to change the `waitElementTimeout` parameter and see if after extending this time the element is found.
- Required resources are not loaded on the page within a certain amount of time. You can confirm that this is your problem by setting the log level to "trace" and see that the actions/web element content retrieval is performed on the previous page. Change the `navigationTimeout` parameter to try and solve this.

Unexpected behavior when running JavaScript methods: If in a scenario which relies on the execution of a JavaScript method, the results are not as expected. Changing the `javascriptTimeout` may solve this.

CSS related problem: When there is a scenario that relies on the evaluation of CSS rules, and the results are not as expected, setting the `cssEnabled` parameter to enabled may solve this.

```
<MainConfiguration>
        ...
        <ServerConfiguration>
        ...
           <webProcedureConfig>
                <waitElementTimeout>30000</waitElementTimeout>
                <navigationTimeout>90000</navigationTimeout>
                <javascriptTimeout>30000</javascriptTimeout>
                <cssEnabled>false</cssEnabled>
           </webProcedureConfig>
        </ServerConfiguration>
</MainConfiguration>
```

General Nodes

Flow, Test Case and Web procedures may consist of a number of nodes. These nodes are defined by the user to perform logical operations and are arranged in the order that these operations are to be executed. Tree nodes have nested scopes, much like blocks in programming languages. Objects and values are available for mapping in the node in which they are defined and their child nodes, but not in the parent nodes.

The information in this section applies to flow, test case and web procedures and covers the following topics:

- Execute Procedure Node
- New Object Node
- Create Mappings Node
- Merge Arrays Node
- Throw Exception Node
- Log Message Node
- Send Mail Node
- Loop While Node
- For Each Node
- Test If Node
- Switch Node
- Try/Catch Node
- Exit Node
- Sleep Node

See separate sections for **Flow Procedure** | **Test Case Procedure** | **Web Procedure** nodes.

Execute Procedure Node

Used in procedures to execute a procedure and return the procedure's output. It contains a Mapper and defines Procedure Input, information about the session (for Test Case procedures and Program procedures) and Connection Properties (Program Procedures).

To Create an Execute Procedure Node

1. In the **Procedure** editor, drag and drop the **Execute Procedure** node (from within the Navigation divider) to the relevant position within the procedure.
2. In the bottom half of the screen, select the procedure.
3. Map necessary inputs from the source to the target. The target includes inputs, information about the session (for Test Case procedures and Program procedures) and Connection Properties (Program Procedures) such as user ID and password).

4 After the node is executed, the Procedure Output element, depending on the selected Procedure Output definition, is available at the procedure scope.

New Object Node

In the New Object node define temporary data structure which can be used within the context. Using the mapping tool, you can map values to parameters within the node, and later use the mapper to access the values of these parameters in other nodes within the context.

To create a New Object node

1 In the Procedure editor, drag and drop the New Object node (from within the Assignment divider) to the relevant position within the procedure.

2 The object can be defined as simple attribute, array, simple structure or array of structures. Click Add attribute or Add Structure as required. Enter a name and determine whether it is an array. It is also possible to provide a default value.

Create Mappings Node

This node enables you to create mappings between scope objects/variables or expression values to any output or object defined in the flow procedure's scope. Refer to using the mapper.

Merge Arrays Node

The Merge Array node is used to create an array of structured elements (objects) from a number of arrays of simple elements of the same size (such as inputs, or outputs from another procedure etc.). The iteration runs on one of the simple elements and therefore if the size of the arrays of all the simple elements is not the same, the results of the procedure may be lacking.

The following example will guide you through a basic example of the use of the Merge Arrays node in flow procedures. The source data is taken from three string array inputs (Name, Age and Address). The data received as a result of running the procedure will be placed in an array of a structure (in this case, a Business Entity (named Person), which includes Name, Age and Address attributes).

1. Create a Data Structure entity. In the Name field type Person and save the entity.
2. Open the entity in the Editor and add three attributes: Name, Age and Address (refer to Business Entity and Creating Business Entity Attributes). Save the Data Structure.
3. Create a flow procedure and add three array inputs: Name, Age and Address to the Flow Procedure node (refer to Defining Inputs and Outputs). Add an output called People. In this Output, add a structure. In the Type field select the data structure Person and select the Array check box.
4. In the Procedure editor, drag and drop the Merge Arrays node (from within the Assignment divider) to the relevant position within the procedure.

5. Click Select to select the object, where the data received as a result of running the procedure will be placed. The Modify Expression dialog box is displayed.
6. Double-click People to determine that the data will be mapped to the output called People. Click OK.
7. Click For Each Select Object to determine the input array that the procedure will run over. The Modify Expression dialog box is displayed.
8. Double-click In\Name to determine that the procedure will run over the array of names. Click OK.
9. In the bottom panel, expand In to view the list of inputs.
10. Click and drag In\Name to People\Name, creating a line between the two. In the same way, create a line between In\Age to Person\Age and between In\Address to Person\Address. When the procedure is run, an array of structures will be created (People).
11. Click Condition to filter some of the mappings. For example, to avoid mapping values from empty entities of the source arrays.
12. Click the Play icon in the debugger toolbar to test the procedure. Enter values for the input strings for three names, ages and addresses.
13. Click OK. The bottom panel displays the procedure inputs, outputs and status. The In node displays the string array data entered in the Get Flow Input dialog. The Out node displays structures of the Business Entity Person, which consists of the name, age and address of the string arrays, for all indexes in the array.

Throw Exception Node

Throws an exception with the message specified by the expression.

Log Message Node

Writes a log message specified by the expression. The expression also includes the level of the message: NORMAL, WARNING or ERROR.

Send Mail Node

The Send Mail node sends mail to the designated email addresses. Fill in the To and CC fields as well as a subject for the mail. In the From field enter the address which you would like to appear in the From field on the mail. When this field is left empty, the Default From address defined in the Server Configuration will be used.

Loop While Node

Executes its child nodes while a specified condition is true.

For Each Node

Executes the child nodes for each item of the specified array that matches the condition.

Test If Node

Behavior depends on the relational operator:

- With operator "greater than", "greater than or equal to", "less than", "less than or equal to" and one or both values are null: an exception is thrown.
- With operator "equal to" or "not equal to" and one or both values are null: if result is true, the Case True (container) child node is executed, otherwise the Case False (container) child node is executed.

Switch Node

A Switch Screen function, depending on the switch value (the current screen), selects one of several possible cases. Each case is defined to handle one or more screens. If the current screen isn't one of the screens specifically handled in one of the cases then the default case is used. There can't be more than one case that handles a specific screen.

To create a Switch Node

1. In the Procedure editor, drag and drop the Switch node (from within the Workflow divider) to the relevant position within the procedure.
2. Click on <expr> at the bottom of the screen, to define the value of the Switch function.
3. To add additional cases, right-click on the Switch node and select **Add Child > Case**. In the **Case Values** panel, click on the empty row and enter the value. Press **Enter** to confirm the value. It is possible to add multiple values to a single case node enabling the same case functionality to be used for a number of values.

Try/Catch Node

The Try node contains the sections of nodes that might potentially throw exceptions and the Catch node contains nodes that handle exceptions.

To create a Try/Catch Block Node

1 In the Procedure editor, drag and drop the Try/Catch node (from within the Workflow divider) to the relevant position within the procedure.

2 Right-click Try and define the nodes that are to be part of the Try Block and may potentially throw exceptions.

3 Right-click Catch and define the nodes that will handle the exceptions.

Exit Node

The Exit node is used to exit the procedure.

Sleep Node

The Sleep node causes the procedure to pause for the defined number of milliseconds.

To create a Sleep Node

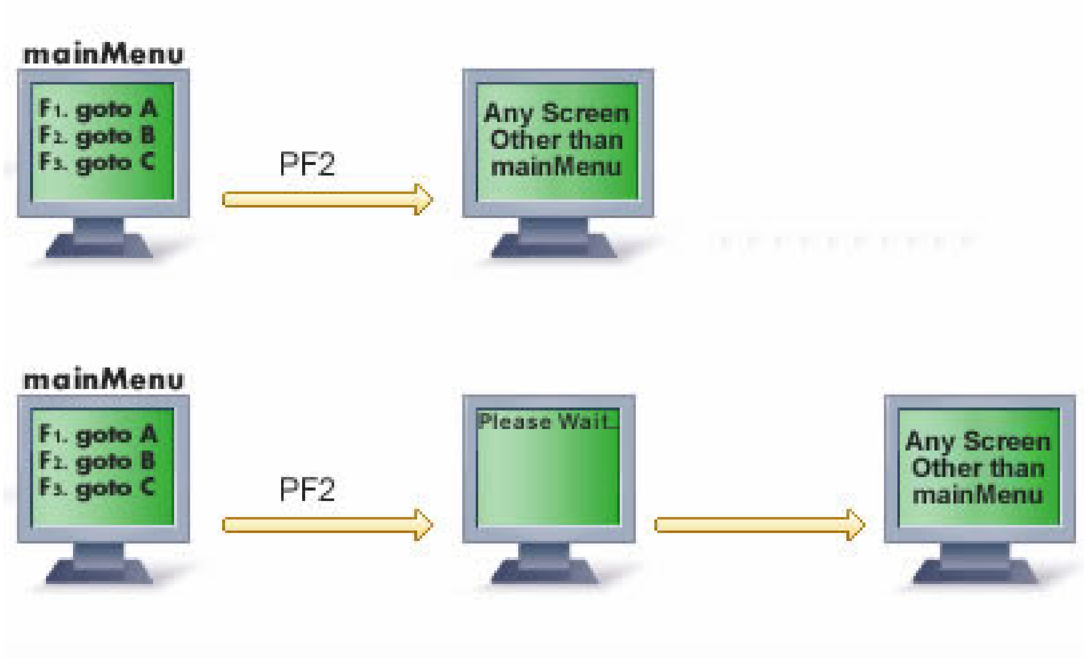
1 In the Procedure editor, drag and drop the Sleep node (from within the Workflow divider) to the relevant position within the procedure.

2 Click on the expression to determine the number of milliseconds the procedure should "sleep".

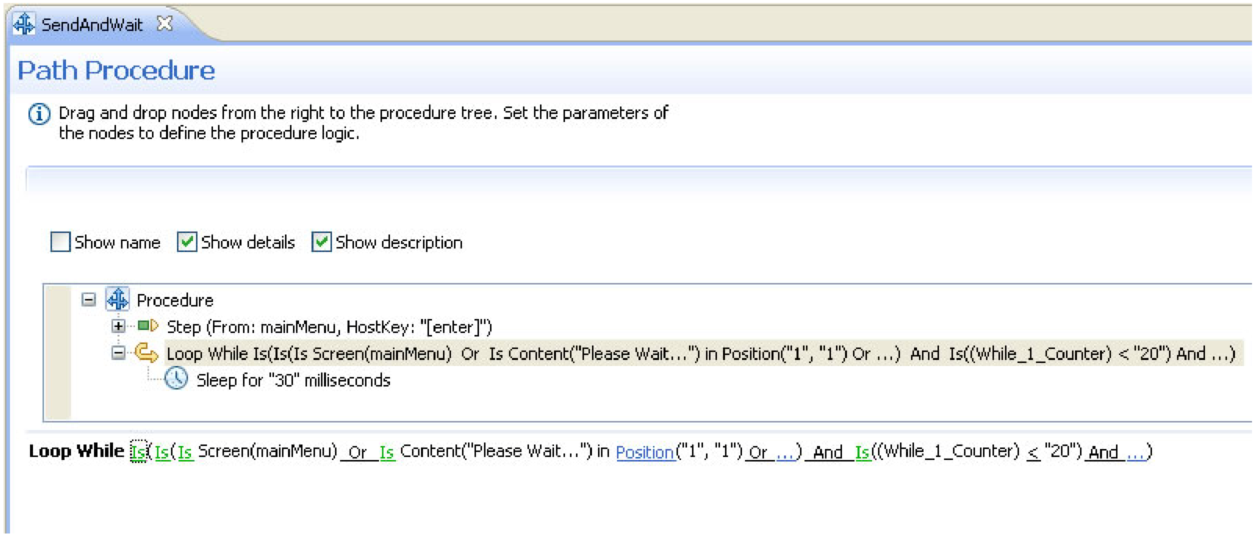
This node is typically used to create complicated customized wait conditions, where regular wait conditions cannot cover the complexity of the host behavior.

Implementation

Pressing PF2 when in a screen named "mainMenu" should take us to another screen right away, however, every now and then the host displays a blank screen with a "please wait" message at the top and only after a second or so displays the desired screen.



This example enables creating a Wait condition that pauses the procedure as long as the current screen is still "mainMenu" or as long as the "Please wait" message appears at the top of the screen. In addition it also prevents the procedure from hanging in an infinite loop from iterating more than 20 times. To accomplish this, a "Loop While" node with a complex condition, placing a Sleep Node inside the loop, should be used.



Drag and drop nodes from the right to the procedure tree. Set the parameters of the nodes to define the procedure logic.

☐ Show name ☑ Show details ☑ Show description

```
Procedure
    Step (From: mainMenu, HostKey: "[enter]")
    Loop While Is(Is(Is Screen(mainMenu)  Or  Is Content("Please Wait...") in Position("1", "1") Or ...)  And  Is((While_1_Counter) < "20") And ...)
        Sleep for "30" milliseconds
```

Loop While Is(Is(Is Screen(mainMenu) Or Is Content("Please Wait...") in Position("1", "1") Or ...) And Is((While_1_Counter) < "20") And ...)

Flow Procedure Nodes

Create Emulation Session Node

Used in procedures to create and initiate a new host session.

To create a create emulation session node

1 In the Procedure editor, drag and drop the Create Emulation Session node (from within the Session divider) to the relevant position within the procedure.

2 Select a connection pool from the list in order to create a new session to work with a connection of the selected connection pool. If you do not select a connection pool, a new session will be created against the host.

3 Refer to the Mapper for details on mapping.

Note: The Host user name and Host password fields enable you to establish an SSH connection. The Device name enables you to provide the host with the relevant device name.

4 Once the new session is created, its session ID and device are available as outputs of the Create Emulation Session node.

End Session Node

Used in procedures to end an existing Natural Screen Tester Host, RPC or Database session. To create an End Session Node: in the Procedure editor, drag and drop the End Session node (from within the Session divider) to the relevant position within the procedure. Refer to the Mapper for details on mapping.

Note: In the case of connection pools (RPC or emulation session), "end session" does not mean closing the session. The connection returns to the pool, and further action depends on how the pool has been configured. See **Connection Poosl** in this section and *Defining*

Natural Screen Tester RPC Application Parameters under *Developing a Natural Screen Tester Application*.

Create DB Session Node

This node is used in procedures to create and initiate a database session against a database in order to perform a transaction. A transaction is a number of statements, which together create a process against the database. When performing one or a number of separate, unconnected statements, use DbSelect and DbExecute, which open and close sessions independently.

To Create a DB Session Node

1 In the Procedure editor, drag and drop the Create Emulation DB Session node (from within the Database divider) to the relevant position within the procedure.

2 In the attributes area (the bottom half of the screen), select the database.

3 Select **Automatically commit** to automatically commit every execute statement as it is completed (in such a case it is not possible to rollback). If **Automatically commit** is not selected, you must use the commit node at the end of the transaction in order for the execute statements be saved to the database.

DbSelect Node

Executes an SQL statement that returns a single ResultSet object. Refer to DbExecute.

To create a DbSelect node

1 In the Procedure editor, drag and drop the DbSelect node (from within the Database divider) to the relevant position within the procedure.

2 In the attributes area (the bottom half of the screen), select the database.

3 In the **SQL statement** text box, write the statement that you want to execute. If the statement has parameters that should be provided at runtime, use the following syntax:

   - `$(varName)` for the variable you want to convert to the correct SQL format during the runtime (add an apostrophe before and after the variable).
   - `$(!varName)` for the variable that will be used "as is" (use it for table or field names).

   You will see the defined variables in the right panel of the mapper. You can map the elements from the left panel to those variables.

4 In the **Output parameter**'s panel, define the fields returned by the SQL statement (the order is important).

Use the refresh button to import the output parameters directly from the database (be sure the SQL statement is valid). After the node is executed the DbSelect output element, depending on the defined output parameters, is available at the procedure scope.

DbExecute Node

Executes an SQL `INSERT`, `UPDATE` or `DELETE` statement.

To create a DbExecute node

1. In the Procedure editor, drag and drop the DbExecute node (from within the Database divider) to the relevant position within the procedure.
2. From the database combo box, select the Natural Screen Tester database entity.
3. In the SQL statement text box, write the statement you want to execute. If the statement has parameters that should be provided at runtime, use the following syntax:

   - `$(varName)` for the variable you want to convert to the correct SQL format during the runtime (add an apostrophe before and after the variable).
   - `$(!varName)` for the variable that will be used "as is" (use it for table or field names).

   You will see the defined variables in the right panel of the mapper. You can map the elements from the left panel to those variables.

The DbExecute RecordCount element contains either the row count for `INSERT`, `UPDATE` or `DELETE` statements, or "0" for SQL statements that return nothing.

Rollback Node

Drops all changes made since the previous commit/rollback and releases any database locks currently held by the database session.

To create a Rollback node

1. In the Procedure editor, drag and drop the Rollback node (from within the Database divider) to the relevant position within the procedure.
2. The existing database session ID must be provided.

Commit Node

Ensures all changes made since the previous commit/rollback are permanent and releases any database locks currently held by the database session. The existing database session ID should be provided.

Parallel Actions Node

The Parallel Actions node will perform actions in parallel. The Parallel Actions node enables these actions to be performed at the same time rather than one after the other. Only certain types of nodes can be used as Parallel Actions:

- Send Mail
- Execute Procedure
- Create Emulation Session
- Create DB Session
- DbSelect
- DbExecute
- Rollback
- Commit
- Create RPC Session
- End Session

To create a Parallel Actions Node

1. In the Procedure editor, drag and drop the Parallel Actions node (from within the Workflow divider) to the relevant position within the procedure.
2. Right-click on the node and choose **Add Child** and then the relevant node.

Note: Failure of one action in the node will cause the node, together with all other actions, to fail. The error returned is always that of the first child node that failed.

Test Case Procedure Nodes

Explicit Step Node

Step is the basic building block of a test case. It defines a single act of navigation between a source screen/screen group and a target screen/screen group in the host. A step defines the data to set into fields of the source screen/screen group and the key to send (Enter, PF3...). It may define "wait" expressions, to make sure the host has enough time to process the input and reach the target screen\screen group. Once the target screen/screen group is reached, it may be collected (for response) or map values from its fields to the Procedure's output structures.

To Create an Explicit Step Node

1 In the Procedure editor, drag and drop the Step node (from within the Navigation divider) to the relevant position within the procedure.

2 Select the Source screen\screen group: The Source screen\screen group selection box allows the selection of the start screen\screen group of the step. This screen\screen group is used for validation at the beginning of the step, and to build the screen's schema for the input tab. Multiple Source screens/screen groups can be defined.

   The Target screen\screen group selection box allows the selection of the end screen or screens of the step. This screen\screen group is used for validation after sending data to the host, for execution of "wait for screen" expressions and to build the screen's schema for the output tab. Multiple Target screens can be defined.

3 The input tab uses the mapper component to map values into the source screen(s), to set the cursor, and to send host keys:

   Source screens - The mapping target shows the selected source screens and their mapped fields. If the screen is unknown, no fields are available.

   Cursor - The mapping target will show a Cursor node with row, column and field. Mapping is possible to either row and column or field. In order to position the cursor in a certain application field, map a string containing the field's name to the cursor. It is also possible to set the cursor position using multiple fields. Instead of just mapping the field name to the field part of the cursor schema, the string contains the required field index, for example:

"action[3]" or "action[$(index)]" where the token $(index) is mapped to another runtime value.

Send host keys - The mapping target shows a HostKeys node and default keys expression ([ENTER]). The keys expression is based on the Free Text expression, but it allows adding the key strings by selecting them from a predefined list.

4 Define the Wait conditions in the Wait tab: Wait conditions indicate to the Natural Screen Tester Server that a screen has fully arrived. A Wait condition is the condition by which the Natural Screen Tester Server decides that the host has finished sending screen data. The screen is then returned to the Natural Screen Tester Base Object. It uses the expression wizard mechanism to build wait conditions, whereby multiple conditions can be combined. Processing continues when all conditions are successfully met.

   Click on (<wait>) to define the wait expression. To define additional wait conditions, click on <...>.

   Note: When no wait conditions are defined, there is a default timeout of 10 seconds for each step.

   Character-mode hosts (for example UNIX hosts): As character-mode hosts are character stream based and never stop sending data, it is necessary to divide the data sent to screens, by defining Wait conditions.

5 Define outputs: The output tab contains a Screen Mapper node for each Target screen. The mapper area displays the output schema of the screen that is selected in the **Map from target screen** selection box. On the other side it displays the scope elements and input schema, allowing mapping values from the current screen, to other structures. When the test case procedure is executed using the ABO, the entire screen can be added to the response using the **Send to Base Object** checkbox.

6 Enter the repeat limit: The same step may repeat itself several times. In order to avoid infinite loops it is possible to set a limit to the number of times the step may be repeated during one execution. It is recommended to set this limitation using the flow logic, though it can also be done by setting a repeat limit.

Step Node

This node defines the data to set into the source screen and the key to send. It may define "wait" expressions, to make sure the host has enough time to process the input.

To create a Step node

1 In the Procedure editor, drag and drop the Step node (from within the Navigation divider) to the relevant position within the procedure.

2 Select the Source screen: The Source screen selection box allows the selection of the start screen of the step. This screen is used for validation at the beginning of the step, and to build the screen's schema for the input tab. Multiple Source screens can be defined.

3 Define the content of the current screen: This tab contains a Screen Mapper node for each Target screen. The mapper area displays the output schema of the screen that is selected in the "Source" selection box. On the other side it displays the scope elements and input schema, allowing mapping values from the current screen, to other structures. When the test case procedure is executed using the ABO, the entire screen can be added to the response using the "Send to Base Object" checkbox.

4 The input tab uses the mapper component to map values into the source screen(s), to set the cursor, and to send host keys:

Source screens - The mapping target shows the selected source screens and their mapped fields. If the screen is unknown, no fields are available.

Cursor - The mapping target will show a Cursor node with row, column and field. Mapping is possible to either row and column or field. In order to position the cursor in a certain application field, map a string containing the field's name to the cursor. It is also possible to set the cursor position using multiple fields. Instead of just mapping the field name to the field part of the cursor schema, the string contains the required field index, for example:

"action[3]" or "action[$(index)]" where the token $(index) is mapped to another runtime value.

Send host keys - The mapping target shows a HostKeys node and default keys expression ([ENTER]). The keys expression is based on the Free Text expression, but it allows adding the key strings by selecting them from a predefined list.

5 Define the Wait conditions in the Wait tab: Wait conditions indicate to the Natural Screen Tester Server that a screen has fully arrived. A Wait condition is the condition by which the Natural Screen Tester Server decides that the host has finished sending screen data. The screen is then returned to the Natural Screen Tester Base Object. It uses the expression wizard mechanism to build wait conditions, whereby multiple conditions can be combined. Processing continues when all conditions are successfully met.

Click on (<wait>) to define the wait expression. To define additional wait conditions, click on <...>.

Note: When no wait conditions are defined, there is a default timeout of 10 seconds for each step.

Character-mode hosts (for example UNIX hosts): As character-mode hosts are character stream based and never stop sending data, it is necessary to divide the data sent to screens, by defining Wait conditions.

6 Enter the repeat limit: The same step may repeat itself several times. In order to avoid infinite loops it is possible to set a limit to the number of times the step may be repeated during one execution. It is recommended to set this limitation using the flow logic, though it can also be done by setting a repeat limit.

Execute Test Case Node

This node calls another test case procedure or map. Just as in the Step node, you are required to define the source and target screens/screen groups. The mapper area shows the selected test case's input schema (screen fields and variables).

Nodes that are placed after the test case node in the same scope can access the path execution output schema using mappers.

To create an execute procedure node

1. In the Procedure editor, drag and drop the execute procedure node (from within the Navigation divider) to the relevant position within the procedure.
2. Select the procedure to execute.
3. Select the source and target screens/screen groups.
4. Map values to the fields and variables.
5. Properties Tab (optional). Enter the repeat limit: The same step may repeat itself several times. In order to avoid infinite loops it is possible to set a limit to the number of times the step may be repeated during one execution. It is recommended to set this limitation using the flow logic, though it can also be done by setting a repeat limit.

Navigate To Node

Use this node to use the Test Project Map to navigate to a specific screen.

To create a Navigate To node

1. In the Procedure editor, drag and drop the Navigate To node (from within the Navigation divider) to the relevant position within the procedure.
2. Select the required screen from the list of screens.

Screen Mapper Node

When the current screen matches the screen defined in the Screen Mapper node, the defined mappings are performed, allowing retrieving values from the host screen schema. The mapper area displays the output schema of the screen that is selected in the Map from current screen selection box. On the other side it displays the scope elements and the procedure's input schema, allowing mapping values from the current screen, to other structures. When the procedure is executed using the Natural Screen Tester Base Object, the entire screen can be added to the response using the **Send to Base Object** checkbox. The screen schema contains the following structures:

- Cursor - the cursor structure allows reading the current screen's cursor position (row, column). In addition, if the cursor is in a field, its name can be retrieved too.

- Screen Fields - the fields which are mapped to the screen are visible in the screen's schema, and their content can be retrieved using the mapper. For other field attributes, use expressions.
- Host Table - when the host screen contains a host table, it is reflected in the screen schema as an array of row objects, whose simple attributes are the table's columns. The screen fields that represent the columns will also appear as separate arrays outside the table's schema, providing more flexibility when mapping.

Switch Screen Node

A Switch Screen function, depending on the switch value (the current screen), selects one of several possible cases. Each case is defined to handle one or more screens. If the current screen isn't one of the screens specifically handled in one of the cases, then the default case is used. There can't be more than one case that handles a specific screen.

To create a Switch Screen node

1 In the Procedure editor, drag and drop the Switch Screen node (from within the Workflow divider) to the relevant position within the procedure.

2 To add cases, right-click on the **Switch...** node and choose **Add Child > Switch Screen Case**. In the **Case** panel, click on **Assign Screens** to view a list of the screens. It is possible to select and add multiple screens.

Web Procedure Nodes

GoTo URL Node

Used in the Web Procedure to navigate to a URL. This node reflects the URL entered in the Web Procedure Recorder. In the Editor, you can add navigation to other Web pages using this node (from within the Browser tab to the right of the procedure). It contains the URL and can be edited by right-clicking on the URL link and selecting **Open**. The URL passes parameters to the Web page. For example, in the following URL, the parameter `country` receives the value "US": *http://www.foo.com/bar?country=us*. Within the procedure Editor, you can edit the URL as as any **Free Text** expression and replace the value with a token: *http://www.foo.com/bar?country=$(country)*. This allows replacing the token dynamically, for example, using a Procedure Input attribute to set the value.

Web Page Node

For every page where an action was performed, a new Web Page node is created. This node includes all the actions performed on the page as child nodes. The child nodes of the Web Page can use all the elements on this page. When selecting the Web Page Node, you can see all the Web Elements defined in it. It is possible to add more elements to a Web Page by right-clicking on the root node of the Web Page. For each Web Element, you can copy its XPath or delete it.

Enter Text Node

This action node enables entering text within a specific input element within a Web Page. In the Editor you can add additional Enter Text nodes or edit existing ones. Note that when the action relates to an element within a list of elements, you must define an expression that specifies on which index within the list the action should be performed.

Value: The value that will be entered in this element when running the Web procedure. Click on the value link and use expressions to define the value.

Web Element: Select a web element from the list of elements of this type that have been captured in this Web Page. When editing an existing Enter Text node, you can use the override XPath option to change the element.

Select Node

This action node enables selecting a specific value that will be placed in the element of a Web Page when running the procedure. In the Editor you can add additional Select nodes or edit existing ones. Note that when the action relates to an element within a list of elements, you must define an expression that specifies on which index within the list the action should be performed.

Element Type: It is possible to toggle between the element types: Check Box, Drop-Down List and Radio Buttons and change the type.

Web Element: Select a web element from the list of elements of this type that have been captured in this Web Page. When editing an existing Enter Text node, you can use the override XPath option to change the element.

Value: You can determine the value to select in this element. For drop-down lists it is possible to determine that these values will be according to according to the value, according to the index or according to name. For Radio buttons, it is possible to determine that these values will be according to index or value.

For example (in a drop-down list of countries list) :

by name: "United States" - this is what the user see in the drop-down list options

by value: "USA" - this is the value that the drop-down list will send in the form to the web server by index: 5 - the country United States was the 5th option in the drop-down list

Click Node

This action simulates clicking on an element such as a button or hyperlink in a Web Page, when running the procedure. Note that when the action relates to an element within a list of elements, you must define an expression that specifies on which index within the list the action should be performed.

Web Element: Select a web element from the list of elements of this type that have been captured in this Web Page. Once a Web Element is selected, the type of element (such as hyperlink), and the Override XPath option enabling editing the XPath, also appear in the format.

General Expressions

The following expressions are relevant for flow, test case and web procedures. Expressions are used in nodes and child nodes of flow procedures to compute and assign values to variables and to help control the execution flow of a procedure. The object of an expression is to perform the computation indicated by the elements of the expression and to return a value that is the result of the computation. The expression types available vary according to the node you are defining.

- EmptyString, TRUE and FALSE Expressions
- Free Text
- Value Of
- Count Of
- Conditional Operator
- String Array
- Execute Procedure
- Now
- Create Date
- To Date
- Date Part
- Compare
- Logical And/Or
- Is Null
- Calculate
- Ceil
- Floor
- Round
- Absolute
- Concat
- Trim
- StrIn

- SubString
- Replace String
- Change Case
- StringLength
- Reverse
- FormatDate
- Format Number
- Extract Number
- Character

EmptyString, TRUE and FALSE Expressions

Standard fixed Natural Screen Tester syntax, used for these functions.

Free Text

In the **Free Text** dialog box, type in any text and add tokens in order to use values from the context. Click **Finish**. Click on the token link to define the variable. When previewing the text, line breaks are replaced with semicolons to simplify the display.

Example

Enter text and replaceable tokens in the **Free Text** tab: "Your account number is - $(var)"." $(var)" being a replaceable token. Click **Finish**. Use expressions to define a value for the token.

Refer to Mapper

Value Of

The **Value Of** expression returns the value of the selected object.

To define the Value Of expression

1 Select an item from the available scope.

2 Double-click to select this item as the expression's value.

Note: When selecting an expression which has a complex input or output structure which includes arrays, it is possible to select a specific index.

Count Of

The **Count Of** expression returns a count of an array item.

To define the Count Of expression

1. Select an array item.
2. Double-click to select this item as the expression's value.

Conditional Operator

The **Conditional Operator** expression is short-hand for an if-else statement. The Conditional Operator returns `<expr1>` if `<condition>` is true or returns `<expr2>` if `<condition>` is false.

Format

```
If <condition> Then <expr1> Else <expr2>
```

Implementation

Click on each `<expr>` and define the expression.

Example

```
If (( In/AccountNumber ) = 23453) Then TRUE Else FALSE
```

String Array

Returns a string array.

Format

```
StringArray (expr, ...)
```

Implementation

Use the `<expr>` link to define the first string. To define additional strings click the "..." link.

Execute Procedure

An expression that executes a Natural Screen Tester Procedure and returns its output.

Implementation

In the Input tab, select a procedure. Map values to the procedure's input using the mapper. In the Output tab, click the expression's output.

Now

Now expression returns the current date and time according to the setting of your computer system's date and time.

Create Date

Create Date returns a date for a specified year, month, day, hour, minutes and seconds.

Format

```
CreateDate (<year> , <month> , <day> , <hour> , <minute> , <second>)
```

Implementation

Click the links to define the expressions for the different parts of the date/time.

Example

`CreateDate (1982 , 07 , 19 , 09 , 20 , 13)` will return "1982-07-19 09:20:13:000"

To Date

To Date creates a date from a date/time string according to the given date format.

Format

```
ToDate (<datestring> , <format>)
```

Implementation

Click the links to define the expressions for the date string and format.

Example

`ToDate (19/07/1982 , dd/MM/yyyy)` will return" 1982-07-19 00:00:00:000"

Date Part

Date Part extracts a part of the date (year, month, hour etc.) from a date expression.

Format

```
YearOf(<date>)

MonthOf (<date>)

DayOf(<date>)

HourOf(<date>)

MinuteOf(<date>)

SecondOf(<date>)
```

Implementation

Select the date part: year, month, day, hour, minute or second. Click on the date expression and define the Date expression.

Example

`YearOf (Now)` will return "2004"

Compare

Compare expression compares the values of two numeric or textual expressions.

Note: When comparing two null expressions, the function will return "false".

Format

```
Is (<expr> = <expr>)

Is (<expr> > <expr>)

Is (<expr> < <expr>)

Is (<expr> >= <expr>)

Is (<expr> <= <expr>)
```

Implementation

Click `'Is'/'Is not'` to switch between the two options. Select the required comparison operator. Click the `<expr>` links to edit.

Logical And/Or

An expression that applies a logical AND or OR to several boolean expressions.

Format

```
Is (<expr> AND ...)

Is Not (<expr> AND ...)
```

Implementation

Click `'Is'/'Is not'` to switch between the two options. Click the `<expr>` or `"..."` links to add expressions. Select the required boolean operator (AND or OR).

Is Null

Is Null checks whether the selected object does not have an actual value during runtime.

To define the Is Null expression

1 Select an item from the available scope.
2 Click to select this item as the expression's value.

Calculate

Calculate returns a calculation and may include variables and arithmetic calculations.

Implementation
Type in the calculation formula using digits and operators. Click **Finish**. Click on the variable link to define an expression. A token representing this expression will appear in the calculation.

Ceil

Returns the smallest value that is not less than the argument and is equal to a mathematical integer. The value is displayed in double format.

Format
`Ceil(<expr>)`

Implementation
Click `<expr>` to define the relevant expression.

Example
`ceil(2.645);` will return "3.0"

Floor

Returns the largest value that is not greater than the argument and is equal to a mathematical integer. The value is displayed in double format.

Format
`Floor(<expr>)`

Implementation
Click `<expr>` to define the relevant expression.

Example
`floor(2.645);` will return "2.0".

Round

Returns the closest integer to the argument.

Format

`Round(<expr>)`

Implementation

Click `<expr>` to define the relevant expression.

Example

```
round(2.500); will return 3.

round(2.499); will return 2.
```

Absolute

Returns the absolute value of the argument. The value is displayed in double format.

Format

`Absolute(<expr>)`

Implementation

Click `<expr>` to define the relevant expression.

Example

```
Absolute(2.300); will return 2.0.
```

Concat

Returns a string value containing the concatenation of two or more supplied strings.

Format

`Concat("<expr>",...)`

Implementation

Use the <expr> link to define the first string. To define additional strings click the "..." link.

Example

`Concat("John", "Smith",...)` will return `"JohnSmith"`.

Trim

Trim expression returns a string containing a copy of a specified string with no leading or trailing spaces.

Format

`Trim(<expr>)`

Implementation

Click the `<expr>` to define the string expression to trim.

Example

`Trim(" John ")` will return "`John`".

StrIn

StrIn expression returns the position of the first occurrence of one string within another.

Format

`StrIn (<string> , <substring>, <case sensitive>)`

`StrIn (<string> , <substring>, <case insensitive>)`

Implementation

Click `<string> , <substring>` to define the string in which to search and the string to search for. The expression will search for the first occurrence of the second string within the first string. Toggle between **case insensitive** and **case sensitive** to determine case sensitivity.

Example

`StrIn ("Catwalk", "Cat")` will return "0"

`StrIn ("John", "Smith")` will return" -1 "

`StrIn ("Caterpillar", "pillar")` will return "6"

SubString

SubString expression returns a substring that begins at a specified location, and has a specified length.

Format

`SubString (<string> , <start> , <length>)`

Implementation

Click the links to define the original string, the start index and the required length of the substring.

Example

`SubString ("Caterpillar", 6, 6)` will return "pillar".

Replace String

Replaces either the first substring or all substrings in this string that match the given pattern, with the defined replacement.

Format

`ReplaceString( <string> , <patternToReplace> , <replacement>, <ReplaceFirst> )`

Implementation

Click the links to define the original string, the regular expression pattern to be replaced, the replacement string, and whether to replace just the first substring or the whole string.

Example

`ReplaceString("elephant", "e..a", "ega")` will yield the string "elegant".

Change Case

Change Case expression returns a string that has been converted to a specified case (lowercase or uppercase).

Format

`ToLowerCase (<expr>)`

`ToUpperCase (<expr>)`

Implementation

Select the relevant option to transform the expression to upper or lower case. Use the link to define the expression.

Example

`ToLowerCase ("JOHN")` will return "john" .

`ToUpperCase ("john")` will return "JOHN".

StringLength

StringLength expression returns the length of a string.

Format

`StrLen (<expr>)`

Implementation

Click the `<expr>` to define the string.

Example

`StrLen ("John")` will return "4".

Reverse

Reverse expression returns the reverse of a string expression.

Format

`Reverse (<expr> )`

Implementation

Click the `<expr>` to define the string expression.

Example

`Reverse ("caterpillar")` will return "rallipretac".

FormatDate

FormatDate expression converts a date/time object into a date/time string, according to the given date format.

Format

`FormatDate (<date> , <format>)`

Implementation

Click the links to define the expressions for the date/time object and format.

Example

`FormatDate (Now, "dd/MM/yyyy")`, Now expression being the current date and time, will return "19/07/1982".

Format Number

Formats a number according to the given format number.

Format

`FormatNumber( <number> , <format> )`

Implementation

Click the links to define the expressions for the number and format.

Example

For example if the number 18734573.07 is required as 18,734,573.07, use the format "#,##0.00". Refer to Number Format for further explanation about the format syntax.

Extract Number

Extract Number expression extracts a numeric value from a textual source number. When there is more than one number, it extracts the first number it locates. This expression may be used when needing to perform calculations on the source number.

Format

`ExtractNumber (<expr>, Decimal:dot)`

Implementation

Select the relevant decimal symbol: dot or comma. The separator that you do not select will be recognized as the thousand separator and will be removed. Click the link to define the source expression.

Example

When selecting the dot separator, `ExtractNumber ("1,000,876.321")` will return "1000876.321"
When selecting the comma separator, `ExtractNumber ("1.000.876,321")` will return "1000876.321"

Character

Character expression returns an ASCII or Unicode Character according to the decimal representation.

Implementation

Insert the character's ASCII code or Unicode value.

Example

Enter "13", the text in the **Value** field will display "carriage return" indicating the functionality.

Test Case Specific Expressions

- Wait Expression
- Test Screen Name
- Test Field Attribute
- Test Screen Content
- Is Member of Group
- Host Keys
- Position
- Screen Name
- Field Attributes
- Screen Properties
- Screen Buffer
- Field Content
- Find Field Index

- Field Occurrences

Wait Expression

The Wait expression is accessed from the Wait tab in the Step node of the test case procedure. The Wait tab lists expressions that represent the step waits. A Wait condition is the condition by which the Natural Screen Tester Server decides that the host has finished sending screen data, and returns the screen to the Natural Screen Tester Base Object. It uses the expression wizard mechanism to build wait conditions, whereby multiple conditions can be combined. Processing continues when all conditions are successfully met.

Select the Wait type and update the relevant attributes by clicking the expression links. You can use the session viewer for easy definition of strings and positions.

Wait type: For Host quiet

Waits for the host to stop sending data.

Format

Wait for host quiet (<timeout> , <flicker>)

Implementation

Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Wait type: For String

Waits for a specific string to be written in a specific place on the screen.

Format

Wait for string (<string> , <startPosition> , <endPosition> , <timeout> , <flicker>)

Implementation

Select the Case sensitive checkbox to determine that the specific string is case sensitive. Click <string> to define the specific string. Click <startPosition> and <endPosition> to define the start position and end position that determine the boundaries of a rectangle inside which it is possible for the string to appear. The start position is mandatory, and the end position is optional. Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Wait type: For cursor

Waits for the cursor to reach a certain position on the screen.

Format

Wait for cursor (<startPosition> , <endPosition> , <timeout> , <flicker>)

Implementation

Click <startPosition> and <endPosition> to define the start position and end position that determine the boundaries of a rectangle inside which it is possible for the string to appear. The start position is mandatory, and the end position is optional. Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Wait type: For Screen Id

Waits for a specific screen ID and all of the screen's identification strings to appear.

Format

Wait for screen (<all expected screens>, <timeout> , <flicker>)

Implementation

Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Wait type: While String

Natural Screen Tester Server waits while the screen displays the string of characters. The server realizes that all the data has arrived when the string is no longer displayed on the screen.

Format

Wait while string (<string> , <startPosition> , <endPosition> , <timeout> , <flicker>)

Implementation

Select the Case sensitive checkbox to determine that the specific string is case sensitive. Click <string> to define the specific string. Click <startPosition> and <endPosition> to define the start position and end position that determine the boundaries of a rectangle inside which it is possible for the string to appear. The start position is mandatory, and the end position is optional. Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester

Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Wait type: While Cursor

Natural Screen Tester Server waits while the screen displays the cursor in a particular position. The server realizes that all the data has arrived when the cursor is no longer displayed on the screen.

Format

Wait while cursor (<startPosition> , <endPosition> , <timeout> , <flicker>)

Implementation

Click <startPosition> and <endPosition> to define the start position and end position that determine the boundaries of a rectangle inside which it is possible for the string to appear. The start position is mandatory, and the end position is optional. Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Wait type: While Screen Id

The Natural Screen Tester Server waits while the screen is displayed. The server realizes that all the data has arrived when one of the screen's identification strings are no longer displayed.

Format

Wait while screen (<timeout> , <flicker>)

Implementation

Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Wait type: While dynamic string

Wait while dynamic string (<startPosition> , <endPosition> , <timeout> , <flicker>)

Implementation

Click <startPosition> and <endPosition> to define the start position and end position that determine the boundaries of a rectangle inside which it is possible for the dynamic string to appear. The start position is mandatory, and the end position is optional. Click <timeout> to determine the amount of time in milliseconds, that the Natural Screen Tester Server should wait for the screen to arrive. The initial need for Flicker arises when specific host screens are received 'split' between several buffers of data. Thus Natural Screen Tester Server needs to be informed to wait an additional amount of time for the complete screen to arrive. Click <flicker> to define this additional amount of time.

Test Screen Name

Checks whether the selected screen matches the current host screen.

Implementation

Select a screen to test.

Test Field Attribute

Boolean test of a selected attribute in the current screen/screen group, according to position or field.

Format

```
Is/Is not <Field Attribute> in Position (row, column)

Is/Is not <Field Attribute> in Field(<select field>)
```

Implementation

1. Click Is/Is not to define the condition.
2. Select an attribute: protected, hidden, intensified, reversed video, background color, foreground color, content, blinking or underlined.
3. Select whether to retrieve the attribute of a specific position (specify the row and column) or field (select a field).

Test Screen Content

Checks whether a certain text is within a defined rectangle or field in the current screen/screen group.

Format

```
Is/Is not Content(text) in Rectangle(Start Position:(row, column), End Position:
(row, column))

Is/Is not Content(text) in Position((row, column) (length))

Is/Is not Content(text) in Field(<select field>)
```

Implementation

1. Click Is/Is not to define the condition.
2. Click on `<text>` to define the relevant text.
3. Select whether the text is in a
   - rectangle (specify the start and end row and column)
   - specific position (specify the row, column and - optionally - length of the string)

     Note: If length is not specified, the default value is 1, so we recommend you provide a meaningful value.

   - field (select a field)

Is Member of Group

Determines whether the current screen is a member of a specific Screen Group.

Format

```
Is/Is not Screen member of (Screen Group).
```

Implementation

1. Select the relevant Screen Group.
2. Click Is/Is not to define the condition.

Host Keys

A free text editor that allows selecting host key constants.

Implementation

Select a host key and then add tokens to use values from the context. Use replaceable tokens, using the Natural Screen Tester format `$(<Replaceable Token Name>)`. Click **Finish**. Map the host key expression to the relevant output.

Example

Enter text and replaceable tokens:" Your account number is - $(number)". `$(number)` being a replaceable token.

Position

A row and column structure that defines a specific position.

Format

```
Position( <row> , <column> )
```

Implementation

Define the position by clicking the row and column expressions.

Screen Name

Returns the name of the current host screen.

Field Attributes

Returns the attributes of a position or field in the current screen/screen group.

Format

```
Get Attributes from Position(row, column)

Get Attributes from Field (<select field>)
```

Implementation

Select whether to retrieve attributes from a specific position (specify the row and column) or field (select a field).

The attributes that are retrieved are:

- Content - the content of the specific position (according to the defined length), or field.
- isProtected - True when protected, and False when unprotected.
- isIntensified - True when intensified, and False when not intensified.
- isHidden - True when hidden, and False when not hidden.
- isReversedVideo - True when reversed video, and False when not reversed video.

- isBlinking - True when blinking, and False when not blinking.
- isUnderlined - True when underlined, and False when not underlined.
- backgroundColor - returns the background color code and name (see list below).
- foregroundColor - returns the foreground color code and name (see list below).

Color	Code #		Color	Code #
None	-1		Gray	8
Black	0		Light blue	9
Blue	1		Light green	10
Green	2		Light aqua	11
Aqua	3		Light red	12
Red	4		Light purple	13
Purple	5		Yellow	14
Brown	6		Light white	15
White	7			

Note: These color codes are consistent with the codes that the Base Object fields return.

Screen Properties

Enables retrieving the following screen properties:

- The row, column and/or field where the cursor is positioned.
- The width and height of the screen.
- Indication whether the screen is a window or not.
- Retrieves the window title.

Screen Buffer

Retrieves the screen content as an array, where each index in the array is a row of the screen. Determine whether to retrieve the window content only or the whole screen.

Format

```
Get Screen Buffer(onlyWindowBuffer)
```

Implementation

Click onlyWindowBuffer to define a boolean expression which will determine whether to retrieve just the window content or the whole screen.

Field Content

Returns text from the current screen/screen group according to a position or field.

Format

```
Get Screen Content from Position(row, column)

Get Screen Content from Field (<select field>)
```

Implementation

Select whether to retrieve text from a specific position (specify the row and column) or field (select a field).

Find Field Index

Finds the index of the first occurrence, within a multiple field, that matches a specified criteria. Select the relevant multiple field and the type of attribute to search for, and then define the criteria.

Format

```
Find the index where(Is/Is not <field attribute>(<comparison type> <text>) in
Field (<select field>))
```

Implementation

1. Click Is/Is not to define the condition.
2. Select an attribute: protected, hidden, intensified, reversed video, background color, foreground color, content (define whether it is exact text or whether the field contains the text), blinking or underlined. According to the selected attribute, you may be required to determine further search parameters such as colors, the specific screen content etc.)
3. Select the relevant multiple field.

Field Occurrences

Returns the number of instances of a multiple field in the current screen\screen group.

Format

```
Count of Field(<select field>)
```

Implementation

Click on select field. Select a specific screen\screen group and then select a field from the list of fields.

Web Procedure Specific Expressions

Test Web Element Exists

Boolean test of a selected XPath in the current page. This function does not wait for all the elements of the page to be loaded and is carried out straight away.

Format

```
Is/Is not Web Element (<XPath>) exists
```

Implementation

1. Click Is/Is not to define the condition.
2. Click the XPath to open the Free Text dialog box and enter the XPath (you can copy-paste the XPath of an existing element by right-clicking an element and selecting Copy XPath to Clipboard).

Web Element Content

Returns the content of the element according to the selected XPath. If the element is not found after a certain amount of time (by default 30 seconds), this expression will timeout. This time can be changed in the <Natural Screen Tester installation>/config/gxconfig.xml file:

```
<MainConfiguration>
   ...
    <ServerConfiguration>
      ...
         <webProcedureConfig>
              <waitElementTimeout>30000</waitElementTimeout>
         </webProcedureConfig>
    </ServerConfiguration>
</MainConfiguration>
```

Format

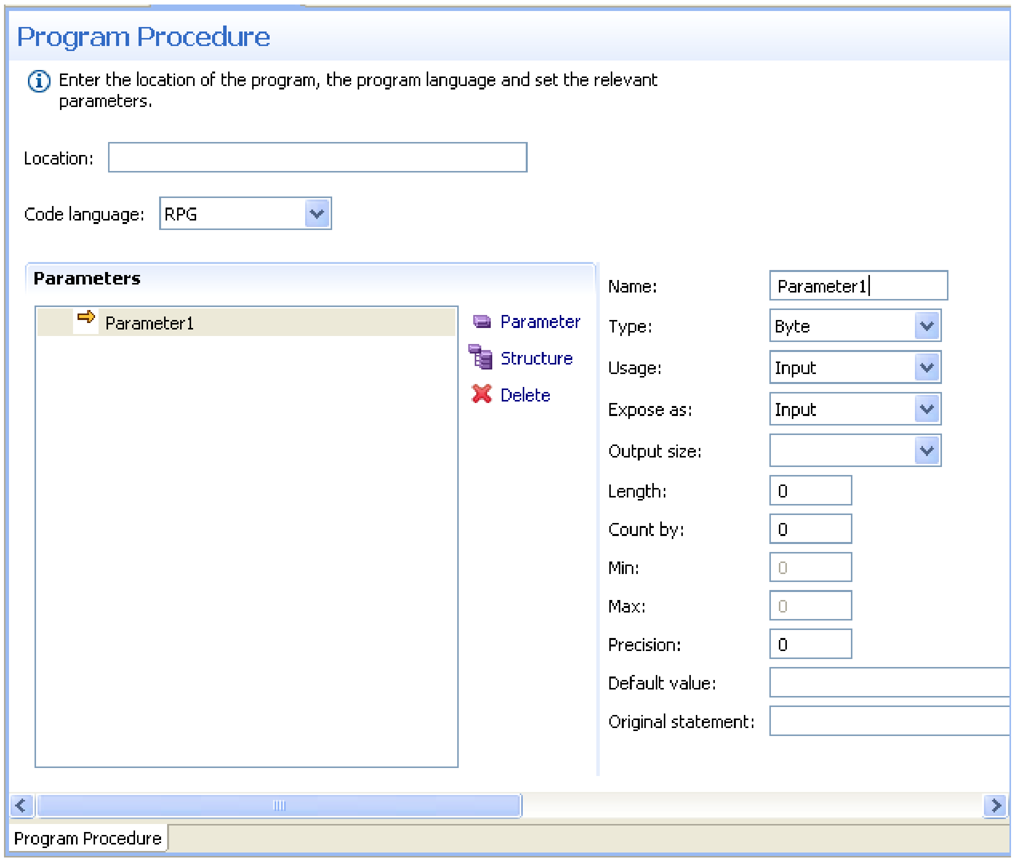
```
Get Content from Web Element (<XPath>)
```

Implementation

Select the XPath from which to retrieve the content.

Program Procedures

Double-click on the relevant Program Procedure from within the Repository. The Editor area displays the Procedure Program.



Enter the location of the program, the program language and set the relevant parameters.

Location:	
Code language:	RPG

Parameter1

Name:	Parameter1
Type:	Byte
Usage:	Input
Expose as:	Input
Output size:	
Length:	0
Count by:	0
Min:	0
Max:	0
Precision:	0
Default value:	
Original statement:	

Location

Fully qualified path of program in the host file system.

Code language

RPG or COBOL.

Name

Name of parameter

Type

Data type of parameter

Usage

Select the parameter usage: input, output, or input/output.

Expose as
Select which parameters are exposed to the end user. By default, a parameter is exposed according to its usage (input, output, etc.)

Length
Enter the parameter's length.

For RPG use only: You may either type a number or select from the drop-down list a reference to another numeric parameter.

Output size (optional)
For RPG use only: If the output size for this parameter is different from its length (array etc.), enter the expected output size. You may either type a number or select from the drop-down list a reference to another numeric parameter.

Count by (optional)
If this parameter is an array, enter the number of members in this array. Either type a number or select from the drop-down list a reference to another numeric parameter for dynamic arrays. For dynamic arrays you may also specify the minimum or maximum array boundaries.

Default value (optional)
Enter a default value for this parameter.

Precision (optional)
For numeric parameters, enter the number of digits that follow the decimal point.

Original Statement (optional)
If imported by the program wizard, this box will display the original statement from the program's source file for this parameter.

7 Connection Pools

A connection pool enables you to immediately get a host connection that is ready in a specific screen, the "initial screen". This saves the time of establishing the connection with the host and navigating to the relevant screen.

See also Connection Pools in the *Designing and Developing a Test Case* documentation.

General

Log level
It is possible to set a different detail of logging for each connection pool. The server logger should be set to **Info** log level at least, in order to see connection pool logs.

Initialization mode

Manual
An administrator manually initializes the connection pool.

When first accessed
Web applications or sessions that connect to the connection pool on the first call.

Automatic
Automatically initializes the connection pool when the test project is loaded.

Pool

Disconnect after usage
When the check box is selected, a connection will not be used again after it is returned to the pool. The termination path will be executed and then the connection will be disconnected. A new connection will be initialized if needed, according to the connection pool size definitions.

When the check box is not selected, the recycle path (it is recommended to define a recycle path when Disconnect after usage is not selected) is performed. The termination path will be executed once the connection pool stops. For more information see Defining a Termination Path.

User wait for connection timeout
The time, in milliseconds, that a user should wait to get a connection from the server before giving up. Leaving the box empty (or 0) sets no timeout at all.

Delay between connection attempts
The minimum delay time, in milliseconds, between any two consecutive connection creation attempts. Leaving the box empty (or 0) sets no delay at all.

Pool size type
Fixed: Constant number of connections (no pool size policy).

Limited: Number of connections is bound in a range.

Flexible: Number of connections is not bound by the pool.

Number of connections

When selecting Fixed as the size type, select the fixed number. When selecting Limited or Flexible enter the minimal and maximum number of connections in the pool as required.

Available connections

Not relevant when selecting Fixed as the size type. This field determines the pool size policy, see **Pool Size Control Policy Considerations**.

Minimal number of available connections in the pool. If the number of available connections in the pool falls below this number, new connections will be created until the minimum is reached.

Maximal number of available connections in the pool. If the number of available connections in the pool exceeds this number, some connections will be terminated until the maximum is reached.

Keep-alive

Path

A path that keeps the connection at the connection pool initial screen. Use the folder selection icon to select paths from different folders.

Interval

The time, in minutes, that an available connection may stay idle. When this time elapses, a keep-alive path is executed.

Connection Information Sets

A connection information set supplies a pool of possible connection parameters required for the initial connection to the host (such as the device type or host address) and for the execution of the connection pool initialization path when it exists (such as the required user name and password). See also Connection Information Sets in the *Designing and Developing a Test Case* documentation.

Select set

Select an existing **Connection Information Set**, or create a new one by selecting "<new set>" and pressing the button, labeled "New". To edit existing information set, select it in the combo box, and click the button (now labeled "Properties").

Delay after using a set

This delay takes place after a connection is terminated, and before a new connection can be initialized using the same parameter set. However, the delay will not occur if the connection information row has an unlimited repeat value (0). This feature is required for cases where the host can't initialize a new connection immediately after closing the current one, using the same parameters (user and password, device name, etc.).

Note: Changes to the pool's parameters will take place immediately, though the pool may take a while to fully adjust to the new configuration. Furthermore, changes will not cause the sudden disconnection of current active users.

Pool Size Control Policy Considerations

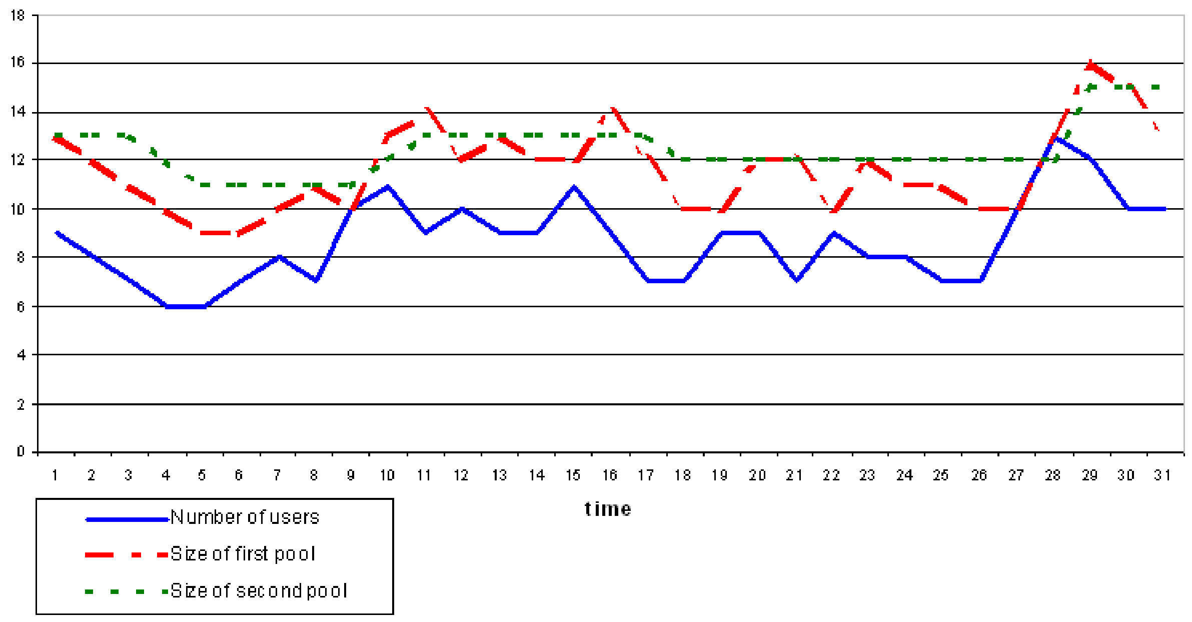
A simple (but not recommended) size control policy would be to set the minimal and maximal number of available connections with the same value. Under such a policy, the pool will try to always have a fixed number of available connections at hand. Therefore, when a client receives a connection, the number of available connections is reduced by one. The pool will initialize a new connection. When the client returns a connection, the pool recycles it and then it has one extra available connection. The pool will then terminate one of its connections to maintain the fixed number of available connections.

As far as the host server is concerned, every user that used the connection pool requires a new connection and initialization process (besides the constant set of "buffered" connections). However (unless working with a disconnect after usage policy), other pool size policies can diminish the amount of work required from the host server for the same amount of users.

Let n be the minimal, and n+k the maximal numbers of available connections. Usually there will be n to n+k available connections at hand. When a client receives a connection, a new connection will only be created if there were exactly n available connections. Similarly, a connection will be terminated after a connection is returned to the pool only when there are already n+k available connections in the pool.

Let d be the maximal absolute difference between the number of connections taken from the pool and the number of connections returned to it during every moment in a given period. As long as d < k no new connections to the host server are required, no matter how many users are served during that time.

The chart provides an example of the possible effect of pool size policy. The blue line represents the number of users connected at any moment. The first pool is configured to have three available connections at any given time. The second pool has a range of available connections: two (minimum) to five (maximum). The size of the first pool (red line) varies exactly according to the activity of the users. It requires the host to initialize and logoff 19 additional connections while serving 40 users. The second pool is more stable in size (green line), and requires only five additional connections and destroys only three, serving the same amount of users.



To conclude, we see that using a range of available connections (as opposed to holding a fixed size buffer) can dramatically reduce the number of connections and disconnections from the host server.

Note: This is true only when using a recycle path instead of disconnect after usage policy.

Connection Information Sets may affect the actual maximum size of the pool. For example when a limited number of users and passwords with a repeat limit of one is defined in the connection information set, the maximum number of possible connections will be the number of users defined in the connection information set even if the defined pool size is flexible. Refer to Connection Information Set for further details.

Navigation

Initialization

A path that can be executed on any new connection to the host that navigates the connection to one of the Initial Screens.

Initial Screen

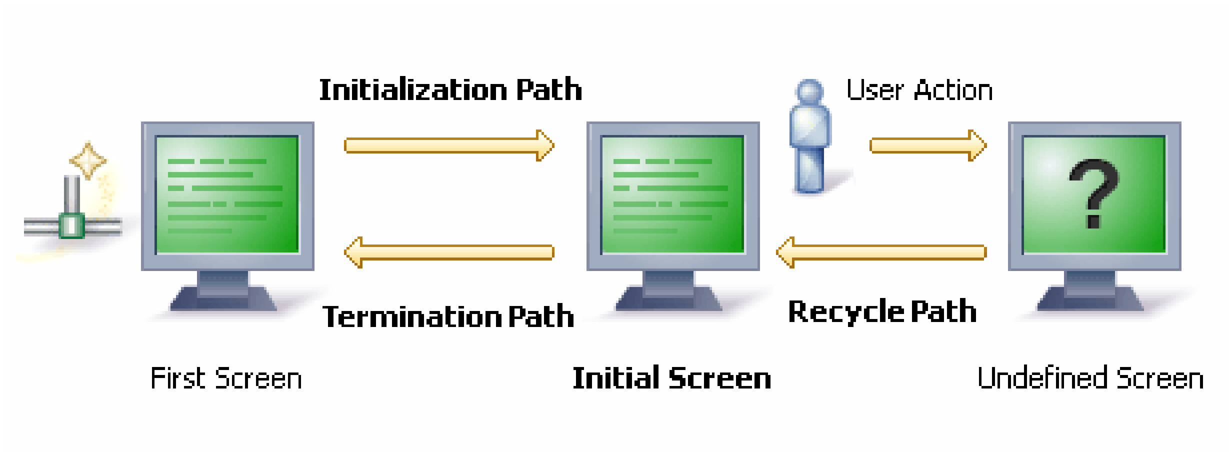
The initial screen is the first screen after the Initialization Path ends. The connection pool initial screen can be selected from the identified screens list. The Test Project Map can be used for this purpose.

Recycle

A path that can be executed on any used connection returned to the pool that navigates the connection to one of the Initial Screens.

Run recycle anyway
When checked, recycle path will always be performed after the connection has been used, even if the connection is in the initial screen.

Termination
A path that can be executed on any connection to the host (used or new) that should be performed before destroying a connection (for example, a host side logout procedure).



8 Connection Information Sets

A connection information set supplies a pool of possible connection parameters required for the initial connection to the host (such as the device type or host address) and for the execution of the connection pool initialization path when it exists (such as the required user name and password). See also Connection Information Sets in the *Designing and Developing a Test Case* documentation.

Table Area
There are two initial columns and one row in the table. The ID column indicates <default> for the initial row (cannot be deleted). Other rows are automatically assigned a numeric ID. The Repeat column can be edited (but cannot be deleted), and states the maximum number of host **connections** that can use the information row simultaneously. More columns and rows can be added to the table.

Add Record
Adds a new row to the table. Row ID is set automatically.

Delete Record
Deletes selected row or rows. The default row cannot be removed.

Define Columns
Enables defining a column in the table. The **Column Selection** dialog will open to allow you to select or remove columns.

In the column selection dialog box, entities can be added as table columns: connection parameters, fields and variables. Connection parameters are parameters that are required for initializing a session with the host such as the device name or host name. The parameters defined here override the general parameters defined in the test project configuration. Fields and variables provide the data required by the initialization path that is used in connection pools. Use fields or variables in accordance with the requirements and definitions of the relevant path. Many times one of the columns contains password information. It is recommended to protect such the values entered in this column by applying the Password column feature.

Set Password
Sets the column as a password column, making it protected.

Set Default Values

It is possible to set default values for the parameters/variables in the Connection Information Set. When clicking this link, a dialog box is displayed enabling you to enter default values for each of the columns.

9 Natural Screen Tester Log Files

Natural Screen Tester provides a number of different tools that can help to log, trace and analyze performance and functionality.

Server Log

The Server Log includes information as to the Server's activities and problems. The contents of the server log file are defined according to the settings configured in the Server Parameter>Log node. The Server Log can be accessed from Natural Screen Tester Designer or via an external browser. Administrators who do not have Natural Screen Tester Designer will access the Server Log from the Designer. Administrators who do not have Natural Screen Tester Designer will access the Server Log via an external browser.

There are several possible levels and each level includes the levels above it. For example, the Debug level also logs Normal, Warnings and Errors Only levels. See also Configuring the Server: Log | Viewing the Server Log in the *Getting Started* documentation.

Connection Pool Log

A log used for fine-tuning connection pool parameters or identifying problems of the different connection pools is written within the server log. The server log should be set to no less that the **Info** log level, in order to see connection pool logs. Once the project is in the production phase, **Error** level is the recommended level to use. It is possible to set a different detail of logging for each connection pool: None, Errors, Warnings, Information and Details.

See also Connection Pools: General Parameters.

Logging a Message from within a Procedure

As part of the procedure work flow definitions, it is possible to define that at some point in the procedure a message will be sent to the log. This is implemented using the Log Message Node (Refer to Working with Procedure Nodes and to General Nodes (Relevant for both Flow and Test Case Procedures), Test Case Procedure Nodes and Flow Procedure Nodes.

Test Case Procedure Failure Log

Natural Screen Tester enables generating a log that includes debug data regarding procedures that fail in runtime. The log includes a snapshot in ASCII characters of the screen that caused the failure.

To log data regarding procedures that fail in runtime

1 In the *<nsr_home>/config/log/gxlog_config.xml* file under the com.sabratec.util.flow.error_tracking category tag, change the <level value="off"/> line to be commented and uncomment the <!-level value="debug"/--> line.

2 Restart the Natural Screen Tester Server.

The log will be created in the *<nsr_home>/log* directory, and the file names will have the following format: debugging_error_in_%I_%t.log, %I being identifying information about the user and procedure name, and %t being the timestamp. The location and name of the file can be changed in the gxlog_config.xml file.

GCT Trace File

The GCT Trace File log enables recording a file, which traces the connection communication (connection pool or user) between the Natural Screen Tester server and the host, for each connection. It is possible to define whether a single trace file will be created, replacing the previously saved file or whether the data will be saved to a new file on every new connection or session. Identifying the separately saved files is possible by inserting identifying parameters in the file name (the session ID, creation time and/or connection ID). It is highly recommended to create a separate file for each session/connection or creation time. Note that trace files can be created from within the session definition overriding the application definition. This is recommended as it does not conflict with other existing sessions.

Refer to *Recording Trace Files* in the *Designing and Developing a Test Case* documentation for details regarding recording trace files.

Refer to the Session View in the *Designing and Developing a Test Case* documentation for details regarding overriding properties per session and also for details on navigating within a session in replay mode.

10 Database Entity

Folder
The folder where the database is located.

Username
The username required to connect to the database (optional).

Password

URL additional parameters
Additional parameters needed for the database connection (optional).

Driver
The connection driver used to access the database. You can choose a pre-defined driver using the combo box or supply a custom one. It may be required to supply the driver itself to Natural Screen Tester Server.

Database	Driver	Requires Driver Files
Apache Derby	org.apache.derby.jdbc.EmbeddedDriver	
SQL Server	com.Microsoft.jdbc.sqlserver.SQLServerDriver	Yes
Oracle	oracle.jdbc.driver.OracleDriver	Yes
MySQL	org.git.mm.mysql.Driver	Yes
DB2	COM.ibm.db2.jdbc.app.DB2Driver	Yes

URL
The connection prefix required to connect to the database. Choose a pre-defined prefix from the combo box or supply a custom one.

11 Troubleshooting

Test Project Map

An individual screen thumbnail within the Test Project Map can indicate problems or incompatibility between the defined identifiers and the screen image attached to the screen. Such problems are indicated by a red frame around the specific screen.

Possible problems:

- Incompatibility between the defined identifiers and the screen image attached to the screen. This can happen as a result of creating a screen and then manually changing an identifier.
- The screen suits the screen image, but there is a screen which is more suitable or identical to the screen image. Look at the name of the screen which is on the screen image and check that it suits the current screen. Note that the name which is on the screen image indicates how the server identified this screen image given all current screen definitions.

See Test Project Map in the *Designing and Developing a Test Case* documentation for more information.

Connection Pools

Symptom	Explanation	Possible Reasons	How to Check
All my connections are broken	Host sessions become *broken* if they cannot get to Ready state. Ready means that: 1. The connection is alive. 2. If an "initial screen" is defined by the pool, the session must get there.	Host is unavailable.	Try to connect to the host without the pool.
		Initialization path needs to be modified.	Create a connection outside the pool, run the initialization path and verify it gets to the "initial screen".
Connections disconnect after use but I want to reuse them	The pool may be configured to allow reusing a host connection that was used by a previous user. This would require returning the connection to the initial screen, either by implementing a robust navigation logic inside the invoked procedure or in the recycle path.	The **Disconnect after usage** option is checked.	Observe the state of the Disconnect after usage checkbox in pool tab of the connection pool.
		The logic of the user activity or the recycle path causes a disconnection from the host.	Capture a trace file for the user activity and recycle path. Observe that the host session is not terminated during the invocation of user activity or the recycle path.
		When a connection is returned to the pool and it	Capture a trace file for the user activity and recycle path. Observe that at the end of the user activity and

Symptom	Explanation	Possible Reasons	How to Check
		is not in the "initial screen", and there is no recycle path that successfully navigates to the initial screen.	the recycle path invocation, the connection is in the initial screen.
Connections remain Active after use	Upon finishing the user activity on a pool connection, the state of the connection would change according to the pool configuration and the state of the user session. The state of the connection would remain active if the session used by the pool has not ended.	A flow procedure creates an emulation session on a pool connection, but the "end session" node is not called on that session.	Verify the existence of an "end session" node in the flow procedure that creates the emulation session. Verify that the "end session" node is reached by capturing a trace file or by logging the invocation of the flow procedure.
Connections remain Terminating after use	A pool may be terminating a connection based on the pool's configuration, connection count and the status of the session. When doing so, the connection status would become "Terminating" and the termination path would run on the connection. After the termination path is completed, the connection is removed from the pool.	An exception in the termination path is causing the host connection to either get stuck or to terminate before completing the path.	Capture a trace file that includes the invocation of the termination path and observe that the path has completed successfully. Search for exceptions in the server logs that occurred during the invocation of the termination path.
A used connection is disconnecting while being used		The host is disconnecting the pool connection based on the user activity or due to the host state.	Capture a trace file for the user activity, observe the last packet transmissions between the server and the host. Look in the server log for an error indicating a socket close around this timestamp. Also ask the host administrator to inspect the host's log for disconnections.
		Another host connection is using the same host credentials/device name and hijacking the session.	When capturing trace files, you would notice a trace file created at the time when a previous trace file is closed. Both traces will include send sections containing the same credentials or device name.

Note: When recording trace files to capture the symptoms mentioned above, we recommend using the following variables in the trace file name: connection ID (`%c`), session ID (`%u`), creation time of file (`%t`). See *Recording Trace Files* for more information.

See Connection Pools in the *Designing and Developing a Test Case* documentation for more information.

Natural for UNIX APX Component

To troubleshoot problems in the APX component's functionality it is possible to define tracing its activity. The daemon and the Natural application with the APX lib can be traced separately. In order to determine which of the two components' activity should be traced follow these guidelines: when the problem seems to be to do with connecting the Natural Screen Tester Server to the APX daemon (including authentication problems), trace the daemon component. For any other problems trace the Natural application. Note that it is not recommended to use the trace file in the production environment on a regular basis.

To trace the APX daemon

1. Go to the $NATDIR/$APXNODE directory.
2. Edit the apxsrvd.sh file.

   Find EXECUTABLE=apxsrvd, and change it to EXECUTABLE=apxsrvd.tr
3. Define the following environment variables (the following is an example of how these should be defined in sh/bash):

   ```
   > PT_TRACELEV=i6000
   > SAGTMP=$HOME/tmp
   > export PT_TRACELEV
   > export SAGTMP
   ```

   The trace files are created in the $SAGTMP directory. In the example above this is $HOME/tmp.
4. Restart the daemon:

   ```
   > apxsrvd.sh servicename stop
   > apxsrvd.sh servicename start
   ```

   or

```
> apxsrvd.sh portnumber stop
> apxsrvd.sh portnumber start
```

To trace the Natural Application with the APX library

1. Go to the $NATDIR/$APXNODE directory.
2. Edit the apx.sh file.

   ```
   $NATDIR/$NATVERS/bin/natapx parm=$PARAMETERS etid=$$ >/dev/null 2>&1
   ```

   ```
   Change natapx to natapx.tr
   ```

   Uncomment (by removing the # from the beginning of the rows) the TRACE section.

The trace files are created in the $SAGTMP directory.

By default it is $HOME/tmp. It will take effect when next connecting to the daemon.

See **Setting up the APX Component** for more information.

Web Procedures

See **Web Procedures** for more information.

What to do when the Web Procedure Fails to Run

The Web Procedure can fail to run for a number of reasons such as an element cannot be found on the page or unexpected behavior when running JavaScripts. Some of these issues can be solved by adjusting parameters in the <`NSR-installation`>*/config/gxconfig.xml* file. Following is a list of possible problems with a recommendation as to what to do and when relevant, which parameter to configure. Below is a snipet of the code as it appears within the gxconfig.xml file.

Timeout error: When running the Web Procedure, sometimes an error message is displayed indicating that a timeout occurred, and that the procedure failed and did not run successfully. This can be for a number of reasons:

- A specific element used in the procedure was not found on the page. In this case, you should try the following:
  1. The XPath defined may not capture the correct element. Run the procedure from within the Designer and follow the output in the Console area.
  2. Refine the XPath to make it more robust. Refer to **What is an XPath?**
  3. Change the server log level to "trace" to help you understand where the problem may lie.

4. If you know that this element is on the page, you should try to change the `waitElementTimeout` parameter and see if after extending this time the element is found.

- Required resources are not loaded on the page within a certain amount of time. You can confirm that this is your problem by setting the log level to "trace" and see that the actions/web element content retrieval is performed on the previous page. Change the `navigationTimeout` parameter to try and solve this.

Unexpected behavior when running JavaScript methods: If in a scenario which relies on the execution of a JavaScript method, the results are not as expected. Changing the `javascriptTimeout` may solve this.

CSS related problem: When there is a scenario that relies on the evaluation of CSS rules, and the results are not as expected, setting the `cssEnabled` parameter to enabled may solve this.

```
<MainConfiguration>
        ...
        <ServerConfiguration>
        ...
           <webProcedureConfig>
                <waitElementTimeout>30000</waitElementTimeout>
                <navigationTimeout>90000</navigationTimeout>
                <javascriptTimeout>30000</javascriptTimeout>
                <cssEnabled>false</cssEnabled>
           </webProcedureConfig>
        </ServerConfiguration>
</MainConfiguration>
```

Error Messages

RC	Error Message	Explanation	Possible Reasons	What should I do?
5005	ERROR SOCKET	Error communicating with Natural Screen Tester Server	May occur as a result of incompatible client and server version.	Check the Natural Screen Tester Server version (see server log) and the client version (see client log) and make sure they are of the same version and build number.
		If the host decides to close the connection with the Natural Screen Tester Server, the session in the server will be disconnected and the client will receive a 5005 error, indicating that the Natural Screen Tester session is no longer active.	Host failure or network issue that made it offline. Probably more details in the host logs.	Catch this error in the client web application and act accordingly. Look into the host logs for more details.

RC	Error Message	Explanation	Possible Reasons	What should I do?
5002	ERROR CANNOT CONNECT TO HOST	When opening a Web application page we get the following error:	1. Missing or insufficient permissions 2. The host is offline. 3. Password expired (Natural under UNIX).	Check user credentials.
n/a	Error evaluating the expression	In earlier versions, NULL and empty string were almost the same. From version 9.8 they are not, and you should actively use options like `isNull()` or put in a default value to avoid these errors.	Usually these errors appear after migrating procedures, see the error message in the log for more details.	Look for "If" block with the empty string or look for inputs without the default value. The error log message should help you figure out where this is coming from.
n/a	The repository is not available	Usually happens due to a Java heap space problem.	The JVM's XMX parameter memory allocation is low.	Look into the server's launch config files (startup.bat / GXApplinXService.ini) and increase the -xmx value of the JVM.
n/a	General Javascript errors	The Framework's JavaScript engine encountered an error.	Could be caused by a host key not responding, or screen that wasn't refreshed after entering a value to an input field.	Open the browser's developer tools and use them to debug the scenario until you pinpoint the root cause.
5051	Procedure Exception: Cannot run procedure *`proc_name`*, error getting host connection, error code	Service fails to run on the local server. The error code should be "ERROR_SERVICE_NOT_ACTIVE".	Connection pool isn't active.	Check connection pool configuration. If it is set to "when first accessed", change it to "manual".
n/a	Replayer configuration doesn't match the current host configuration.	When running a trace file from the designer there should be a match between the Replayer to the current host configuration.	Replayer configuration doesn't match the current host configuration. For example, the Replayer Expected Model is 5 and the Host configuration Model is 2.	Open the Host configuration and change the host configuration according to the trace file.

12 List of Appendices

13 Appendix A: Reserved Words in Natural Screen Tester

The following words cannot be used as the name of an entity or test project:

- abstract
- addressof
- App_Code
- App_Data
- as
- asp
- aspx
- assert
- base
- bool
- boolean
- break
- byte
- case
- catch
- char
- checked
- class
- clear
- close
- config

- const
- context
- continue
- cs
- css
- date
- decimal
- default
- delegate
- delete
- dim
- do
- document
- double
- else
- end
- enum
- escape
- eval
- event
- exception
- explicit
- extends
- extern
- FALSE
- field
- final
- finally
- fixed
- float
- for
- foreach
- friend

- function
- get
- goto
- handles
- if
- images
- implements
- implicit
- import
- in
- index
- inherits
- instanceof
- int
- interface
- internal
- is
- java
- js
- jsp
- lock
- long
- me
- mustoverride
- mybase
- myclass
- namespace
- native
- new
- next
- nothing
- notoverridable
- null

- object
- open
- operator
- out
- overridable
- override
- overrides
- package
- page
- params
- private
- protected
- public
- put
- readonly
- redim
- ref
- return
- sbyte
- screen
- sealed
- shadowing
- short
- sizeof
- stackalloc
- static
- strictfp
- string
- struct
- sub
- substring
- super
- switch

- synchronized
- target
- this
- throw
- throws
- tostring
- transient
- TRUE
- try
- typeof
- uint
- ulong
- unchecked
- undefined
- unsafe
- until
- ushort
- using
- value
- var
- vb
- virtual
- void
- volatile
- while
- window
- withevents
- write

14 Appendix B: Security in Natural Screen Tester

End-To-End Security

Natural Screen Tester multi-tier architecture supports end-to-end security by utilizing encryption and industry-standard, secured protocols within each layer of communication. The following document details the security measures that are available for each layer, as well as additional security mechanisms available in other Natural Screen Tester components.

Natural Screen Tester server and clients support the ciphers defined at JVM level. See list of supported SSL cipher suites.

Host <> Natural Screen Tester Server

Communication between Natural Screen Tester Server and the host can be encrypted using SSL V3. Both client and server authentication are supported. SSL X509 certificate is stored using standard Keystore implementations (JCEKS).

This feature is available for any host that supports SSL V3 communication, however, this has only been tested on Mainframe hosts. It is also possible to use the secured protocol SSH V2.

To configure an SSL connection between the host and Natural Screen Tester server

- Refer to Configuring the SSL Connection.

Development Time

Natural Screen Tester allows managing password-protected users, groups and their permissions. It is possible to define certain permissions to a group, and then associate users with this group, giving the user the permissions defined for this group or to define specific users permissions. Each user/group can be assigned with read/write permissions at the application or folder level. The users' definitions are saved in an encrypted configuration file.

It is also possible to define users based on Integrated Windows Authentication (formerly NT Authentication).

Connection Pools

It is possible to specify passwords of host users as part of the connection information sets of connection pools (to enable connection pooling with automatic login to the host application). These passwords are encrypted and saved in the application's repository.

Running Natural Screen Tester Server with a Java Policy File

In order to run the Natural Screen Tester server with a Java security manager enabled, the following flags should be appended to the Start_Process_Parameters in the <Natural Screen Tester installation>\bin\start-gxserver.bat file, or to the JAVA_OPTS in the <Natural Screen Tester installation>\bin\start-gxserver.sh file or to the Start_Process_Parameters in the GXNatural Screen TesterService.ini file:

```
-Djava.security.manager -Djava.security.policy=./conf/catalina.policy
```

In the policy file (specified in the path above) the following permissions are set inside a grant section (if a different policy file is used, one should add the following manually):

```
permission java.net.SocketPermission "localhost:3323" , "listen,resolve,accept";
permission java.net.SocketPermission "localhost:*" , "resolve,accept";
permission java.net.SocketPermission "<host name>:<host port>" , "connect,resolve";
permission java.io.FilePermission "${com.sabratec.gxhome}/-", "read, write, delete";
permission java.io.FilePermission "${catalina.home}/-", "read";
permission java.io.FilePermission "${java.home}/../-", "read";
permission java.io.FilePermission "${java.io.tmpdir}/" , "read, delete, write";
permission java.io.FilePermission "${java.io.tmpdir}/-" , "read, delete, write";

//Natural Screen Tester Xstream usage. Used mostly by Natural Screen Tester ↩
configuration persist to XML
permission java.lang.RuntimePermission "accessClassInPackage.sun.misc";
permission java.lang.RuntimePermission "accessClassInPackage.sun.reflect";
permission java.lang.RuntimePermission "accessClassInPackage.sun.io";
permission java.lang.RuntimePermission "accessClassInPackage.sun.logging.*";
permission java.lang.RuntimePermission ↩
"defineClassInPackage.org.apache.jasper.runtime";
permission java.lang.RuntimePermission "accessDeclaredMembers";
permission java.lang.RuntimePermission "createClassLoader";
permission java.lang.reflect.ReflectPermission "suppressAccessChecks";
permission java.lang.RuntimePermission "reflectionFactoryAccess";
permission java.io.SerializablePermission "enableSubclassImplementation";
permission java.lang.RuntimePermission "getClassLoader";
// For using Log4J
permission java.lang.RuntimePermission "defineClassInPackage.java.lang";
```

```
// Used for showing the server icon in the system tray. Uncomment if needed.
// permission java.lang.RuntimePermission "loadLibrary.GXUtil";
// permission java.lang.RuntimePermission "modifyThreadGroup";

permission java.io.SerializablePermission "enableSubstitution";
permission java.sql.SQLPermission "setLog";
permission java.util.PropertyPermission "com.sabratec.*", "read,write";
permission java.util.PropertyPermission "com.softwareag.*", "read,write";
permission java.util.PropertyPermission "*", "read";
permission java.util.PropertyPermission "org.apache.adb.properties", "read,write";
permission java.util.PropertyPermission "javax.xml.registry.ConnectionFactoryClass", ↩
"write";
```

Note: lines with a close that starts with a single '<' character, should be edited according to the text inside the close.

When Natural Screen Tester is running with SSL support, the following should be added as well:

```
permission java.io.FilePermission "${java.home}/jre/bin/keytool" ,"execute";
```

15 Appendix C: Natural for UNIX Installation

Installing APX Component for Natural UNIX Protocol

When the host system on which you run your Natural applications is a UNIX system, additional software for the Natural UNIX protocol has to be installed on the host. The Natural UNIX protocol modules are shipped together with Natural for UNIX.

The protocol enables:

- The option to change the host password via the Natural Screen Tester Base Object.
- Support for a non standard screen size.
- User permissions are now received directly from the host. Note that currently it is not possible to log in to the host without providing a user name and password unless you use a customized User Exit authentication function.
- Host keys are automatically recognized by Natural Screen Tester and do not need to be identified according to their pattern.
- It is now possible to define the authentication method and authentication localization texts.
- The configuration has been improved. It is possible to specify the Natural parameter file in Natural Screen Tester Designer, using the same port for a number of applications in parallel, without making changes in the host.

Prerequisites

- **Supported Operating Systems**
  The same platforms as those supported by Natural for UNIX.
- **Other Software Products**
  Natural Version 6.3.2 or above for UNIX.
- **Linker**
  A linker (for example, lD or cc) and the command make must be available in the system.

Setting up the APX Component

Setting up APX on UNIX consists of the following steps

1 **Stop the NAT UNIX apxsrvd Daemons**

> **Note:** This step is only required for an upgrade installation. It is not required when you install Natural for UNIX for the first time.

Stop the apxsrvd process using one of the following commands: `apxsrvd.sh servicename stop`

or

```
apxsrvd.sh portnumber stop
```

Repeat this command for each service that has been started.

2 **Establish the Environment**

Ensure that the environment definitions, as described in setup.txt in the root directory of the Natural CD, are correct and set.

> **Note:** Special note for Red Hat Enterprise Linux AS: On Red Hat Enterprise Linux AS, only PAM authentication, working with local-machine users is supported (for example it is not possible to use PAM with WinBind for active directory authentication. Implement **UserExit1** to use PAM this way). Therefore you have to create a file */etc/pam.d/apxsrv* containing the following two lines:

```
#%PAM-1.0 auth required /lib/security/pam_unix.so nullok
```

3 **Install Natural with APX Component**

Natural Screen Tester Natural UNIX protocol is installed during the Natural installation.

> **Important:** The Natural installation provides a APX option which must be activated. For more details, see your Natural installation documentation.

When you install Natural with APX, the directory $NATDIR/$APXNODE is created. The template files located in $NATDIR/$NATVERS/apx/node-name are then copied to this new directory. The APX daemon $NATDIR/$NATVERS/apx/bin/apxsrvd requires a TCL shared library which is delivered in the $NATDIR/$NATVERS/lib directory. It is linked to the runpath /opt/softwareag/nat/$NATVERS/lib (for Natural Version 6.3) or /opt/softwareag/Natural/v`<version>`/lib (as of Natural Version 8.3), and is installed with permissions 6755 (s-bit). As the s-bit is used, $LD_LIBRARY_PATH is not searched. Therefore, ensure that the apxsrvd daemon can locate the TCL shared library. This can be done by installing Natural in /opt/softwareag and setting a symbolic link from /opt/softwareag to your current $SAG directory, or making the TCL shared library available from a system directory.

4 **Check the Environment Variables for APX**

The APX-specific settings are shown below:

Environment Variable	Description
Natural Screen Tester_ROOT	Home directory.
APXNODE	Name of the node on which APX is installed.
APXSERV	Name of the path to the apxservice file.
APXTIMEOUT	Number of seconds that the daemon waits for an input from the Natural Screen Tester server side (SO_TIMEOUT).

Directories

The following directories are created when Natural is installed together with Natural Screen Tester on a UNIX system:

Directory	Description
$NATDIR	Top-level Natural directory.
$NATDIR/$NATVERS	Directory with all components for the current Natural version.
$NATDIR/$NATVERS/apx	Directory with the APX components.
$NATDIR/$NATVERS/INSTALL	Shell scripts and environment files to required to install the product.
$NATDIR/$NATVERS/apx/bin	APX executable files.
$NATDIR/$NATVERS/apx/node-name	Contains the template files (services.dat, apxservice, etc.).
$NATDIR/$NATVERS/apx/samples/userexit	Contains the files for building the sample user exit.
$NATDIR/$NATVERS/bin/build	Contains the library (libapx.a) to link with Natural.
$NATDIR/$NATVERS/bin/build.tr	Contains the trace library (libapx.a) to link a trace version with Natural.
$NATDIR/$APXNODE	Contains the configuration files (services.dat, apxservice, etc.).

Note: The above table lists only the most important directories and files.

Configuration Files

When the APX installation finishes, the directory $NATDIR/$APXNODE will contain the following configuration files:

Configuration File	Description
apx.sh	Shell script to start the Natural application.
apxsrvd.sh	Shell script to start and to stop the daemon.
apxsrvd.conf	Contains the parameters required to configure the authentication method and the localization text.
Apxenv	Default environment script file for bash.
apxenv.csh	Default environment script file for cshell.

Working with the APX UNIX Component

Any Natural application can be used with Natural Screen Tester.

Starting a New Natural Application

To start a new Natural application, proceed as follows

1 Create a new parameter file using the Natural Configuration Utility (see the Natural documentation) and modify the STACK command as follows: `logon library; startprogram; fin`

2 Locate a service/port number which is not in use.

3 When necessary configure the apx.sh shell script. This script is called from the APX daemon in order to start a Natural session. It has the following content:

```
#!/bin/sh

# Extract the arguments
IP_ADDR=$1
CLIENT_ID=$2
PARAMETERS=$3
CUSTOM=$4

# Trace
#PT_TRACELEV=i6000
#SAGTMP=$HOME/tmp
#export PT_TRACELEV
#export SAGTMP

# Natural Data Transfer
NSWUCI_FD=$UNIUCI_FD
export NSWUCI_FD
```

```
#

$NATDIR/$NATVERS/bin/natapx parm=$PARAMETERS etid=$$ >/dev/null 2>&1
```

apx.sh Script Arguments

The shell script will receive the following arguments:

IP_ADDR
The client IP address from where the session is opened.

Note: If there is a proxy, this will not be the IP address of the Natural Screen Tester server workstation. Instead, it will be the IP address of the proxy.

CLIENT_ID
When connecting with the Natural Screen Tester server, the value of this argument will always be Natural Screen Tester.

PARAMETERS
The Natural parameters file as it appears in Natural, without the file extension. This file is passed to the parm argument in the Natural command line. The value of the PARAMETERS argument is taken from the Natural Screen Tester server configuration (as defined in the Natural Screen Tester Designer, in the Host Configuration dialog box).

CUSTOM
For future use.

4 When necessary configure the apxsrvd.conf file:

The configuration file apxsrvd.conf contains information that the user exits need for the APX daemon. It includes the following content:

```
[UserExits]
; UserExit1=/FS/sag/nat/apxexuex/userexit1/libapxuserexit1.so

[PasswdArguments]
Parameters=

[PasswdMessages]
EnterOldPassword=Enter existing login password:
NewPassword=New Password:
ReEnterNewPassword=Re-enter new Password:
PasswordSuccessful=passwd: password successfully changed for*
```

Sections in Configuration file

[UserExits]
The following user exit can be defined:

UserExit1

The library that is defined by UserExit1 contains the following function:

```
int apx_CheckUsernameAndPassword(const char *pUsername, const char *pPassword,
const char *pNewPassword, char *pErrorMessage)
```

If the key UserExit1 is defined in the configuration file, the function `apx_CheckUsernameAndPassword` is responsible for checking the user name and password. If a new password is received, user exit 1 is also responsible for changing the password.

When there is an error, the return code of the function must be "0"; in this case, the `pErrorMessage` is returned to the client. When the user name and password are correct, the return code must be a value other than "0".

[PasswdArguments]

The key Parameter is used to define any additional parameter(s) that have to be passed to the `passwd` command. For example:

```
passwd -r ldap
```

[PasswdMessages]

The keys in this section define the messages that are to be returned by the system (passwd command) when a user changes the password. If any of these messages are not identified by the daemon, an error will be returned to the client.

Password Mechanism

The password and new password are encrypted on the client side and decrypted on the UNIX side. A maximum of 8 characters is allowed.

When user exit 1 is active, the user name, password and new password parameters are passed to the user exit. When user exit 1 is not active, the daemon checks whether the user name and password are correct for the system. If a new password is sent, the daemon changes the password by calling the UNIX command passwd.

Starting and Stopping the Natural Screen Tester Daemon

The APX daemon is responsible for accepting new sessions. This daemon can be started and stopped using one of the following commands:

```
apxsrvd.sh servicename [start|stop]
```

```
apxsrvd.sh portnumber [start|stop]
```

Note: The daemon must be started on a service/port which is not yet in use.

Troubleshooting

To troubleshoot problems in the APX component's functionality it is possible to define tracing its activity. The daemon and the Natural application with the APX lib can be traced separately. In order to determine which of the two components' activity should be traced follow these guidelines: when the problem seems to be to do with connecting the Natural Screen Tester Server to the APX daemon (including authentication problems), trace the daemon component. For any other problems trace the Natural application. Note that it is not recommended to use the trace file in the production environment on a regular basis.

To trace the APX daemon

1 Go to the $NATDIR/$APXNODE directory.

2 Edit the apxsrvd.sh file.

Find EXECUTABLE=apxsrvd, and change it to EXECUTABLE=apxsrvd.tr

3 Define the following environment variables (the following is an example of how these should be defined in sh/bash):

```
> PT_TRACELEV=i6000
> SAGTMP=$HOME/tmp
> export PT_TRACELEV
> export SAGTMP
```

The trace files are created in the $SAGTMP directory. In the example above this is $HOME/tmp.

4 Restart the daemon:

```
> apxsrvd.sh servicename stop
> apxsrvd.sh servicename start
```

or

```
> apxsrvd.sh portnumber stop
> apxsrvd.sh portnumber start
```

To trace the Natural Application with the APX library

1 Go to the $NATDIR/$APXNODE directory.

2 Edit the apx.sh file.

```
$NATDIR/$NATVERS/bin/natapx parm=$PARAMETERS etid=$$ >/dev/null 2>&1
```

```
Change natapx to natapx.tr
```

Uncomment (by removing the # from the beginning of the rows) the TRACE section.

The trace files are created in the $SAGTMP directory.

By default it is $HOME/tmp. It will take effect when next connecting to the daemon.

Installing Natural for Natural Screen Tester on OpenVMS Hosts

If the host system on which you run your Natural applications is an OpenVMS system, additional software for Natural Screen Tester has to be installed on the host. The Natural Screen Tester OpenVMS modules are shipped on the Natural OpenVMS CD. In general, Natural Screen Tester uses the default system parameter values provided with the OpenVMS system.

Prerequisites

Supported Operating Systems: The same platforms as those supported by Natural for OpenVMS.

Other Software Products: Natural for OpenVMS 6.3.8 or above.

Setting Up the Natural Screen Tester Components

Setting up Natural Screen Tester on OpenVMS consists of the following steps:

1. Stop the Natural Screen Tester Daemons: This step is only required for an upgrade installation. It is not required when you install Natural Screen Tester for the first time.

   Stop the apxsrvd process using the following command:

   ```
   stop servicename
   ```

   Repeat this command for each Natural Screen Tester service that has been started.
2. Establish the Environment: Ensure that the environment definitions, as described in readme.txt in the root directory of the Natural CD, are correct and set.
3. Install Natural and Natural Screen Tester: Natural Screen Tester is automatically installed during the Natural installation. When you install Natural and Natural Screen Tester, the directory NATDIR:[apxnode] is created, where apxnode contains the system name. The template files located in NATDIR:[natvers.APX] are then copied to this new directory.
4. Check the Environment for Natural Screen Tester: Besides the logical names NATDIR and natvers as defined by Natural, Natural Screen Tester needs the following logical names which are created during the installation of Natural:

Logical Name	Description
apxnode	Contains the system name.
VAXC$PATH	Contains the physical device specification of NATDIR:[natvers.BIN]

Example:

Define VAXC$PATH="ALF9$DKB500:[NATURAL.V41212.BIN]"

In addition, the logical names NATOW and NATFE are redefined during the start of the daemon process to point to the Natural Screen Tester images NATAPXnatvers.EXE and NATFEAPXnatvers.EXE.

Optional. If function keys and message lines are to be displayed in their native format (i.e. as normal text), set the environment variable APX_PF_MSG_LINES_NATIVE_FORMAT to "YES":

Define APX_PF_MSG_LINES_NATIVE_FORMAT="YES"

If APX_PF_MSG_LINES_NATIVE_FORMAT is not set or if its value is not "YES", function keys and message lines are detected automatically (default). If they are to be treated in a special way, you have to define the basic rules Function Keys and Message Line in the same way as for a mainframe screen.

5. Check the OpenVMS UAF Parameters: Check the OpenVMS UAF (user authorization file) parameters listed in the table below and, if necessary, modify them. The size values of these parameters for the APXSRVD daemon are important. The sizes depend on the number of sessions that are started by the daemon. Natural error messages will occur if the size limits are reached or if no more quotas are available. In these cases, you have to increase the values so that they meet your needs.

Parameter	Recommended Value
Fillm	Approximately 50 for each session with Natural Screen Tester.
Prclm	50
Bytlm	Approximately 30000 for each session with Natural Screen Tester.
BIOlm	10000

6. Define the TCP Port Number: The UCX service with the TCP port number must be defined in the system as follows:

$ UCX SET SERVICE APXDEMO /PORT=22370 /FILE="" /USER="" /PROC=""

Instead of APXDEMO and the above port number, you can also specify other values. For example, you can create or define the TCP service name APXAPPL1 with the port number 25000.

Directories

The following directories are created when Natural is installed together with Natural Screen Tester on an OpenVMS system:

Directory	Description
NATDIR	Top-level Natural directory.
NATDIR:[natvers]	Directory with all components for the current Natural version.
NATDIR:[natvers.INSTALL]	Shell scripts and environment files to install the Natural product.
NATDIR:[natvers.BIN]	Natural Screen Tester executable files NATFEAPXnatvers.EXE, NATAPXnatvers.EXE and APXSRVDnatvers.EXE.
NATDIR:[natvers.FNAT]	Contains the old Natural demo application SYSEXAPX for Natural Screen Tester.
NATDIR:[apxnode]	Contains the configuration files APXSRVD_servicename.COM, APXSRVD_servicename.LOG, SERVICES.DAT and START_APXSRVD.COM.

The files APXSRVD_servicename.COM and APXSRVD_servicename.LOG are created when the Natural Screen Tester daemon APXSRVDnatvers.EXE is started with the procedure START_APXSRVD.COM.

servicename is the UCX service as defined in the file SERVICES.DAT.

natvers indicates the version number and patch level of the corresponding Natural version.

Configuration File

The configuration file SERVICES.DAT is located in the directory NATDIR:[apxnode], where the apxnode contains the node name (for example, NATDIR:[ALF9]SERVICES.DAT).

The content of this configuration file is one line for each defined TCP service:

servicename username natural parm1 ... parmn

servicename	Must be the same name as used in the TCP port number definition (see above).
username	Not used.
natural	This is the program name which must not be changed.
parm1 … parmn	Dynamic Natural parameters.

Example:

```
apxdemo sag natural parm=mypar bp=bp1
apxapp1 sag natural parm=app1 bp=bp1
apxapp2 sag natural parm=app2 bp=bp2
```

Note: If the APXSRVDnatvers daemon does not detect Natural's dynamic parameter ETID, the daemon automatically adds the ETID to the list of the dynamic parameters to be passed to Natural. The ETID added by the daemon has the format ETID=number_ username. It is truncated if the string exceeds 8 characters.

Setting Up and Activating the APXSRVD Daemon

The BYPASS privilege must be authorized for the account to start the Natural Screen Tester daemon. The BYPASS privilege must also be set for the daemon process.

When TCP port number and service have been defined (UCX) and the SERVICES.DAT template file has been modified according to your requirements, you can start the APXSRVD daemon to use Natural Screen Tester.

To start the daemon, invoke the DCL procedure START_APXSRVD.COM as follows:

@START_APXSRVD.COM service natvers

service contains the name of the service as defined with UCX.

natvers defines the Natural version and patch level.

If both parameters service and natvers are omitted, the defaults APXDEMO and the current Natural version are used. The command procedure creates the temporary file APXSRVD_ servicename.COM which sets up the environment and creates all logicals for Natural Screen Tester and starts the daemon.

Once the daemon has been started, the file APXSRVD_ servicename.LOG is created. This file contains information (including the errors) about the daemon.

APXSRVD_ servicename.COM and APXSRVD_servicename.LOG are located in the directory NATDIR:[apxnode].

Note: The account which starts the daemon must hold the privilege IMPERSONATE as the default privilege. It is not sufficient to have an authorized privilege.

Closing the Natural Application and Natural in Error Situations

There are error situations in Natural Screen Tester which force the termination of the Natural session. For example, when the user chooses the close button in the upper right corner of the Natural Screen Tester window, the communication with the Natural application is disconnected immediately. Then also the Natural process finishes execution immediately without running through the normal close down code of the application. This may lead to inconsistencies in the system, for example, if the corresponding entry for the Natural process remains in the database user queue.

Natural Screen Tester returns error codes to Natural which can be used in a Natural error handling routine. To make sure that the close down code of your application is always executed, write an error handling routine which identifies the Natural Screen Tester fatal errors or add this code to your existing error handling routine. For critical errors, move the command FIN to the top of the Natural stack in order to finish and close everything correctly.

The Natural Screen Tester critical errors are:

6296	Fatal error in the communication. The communication will be disconnected immediately.
6297	Fatal error allocating memory.

Example: Application Program

This Natural program reads the employees file stored in Adabas. The program moves ERRGEN to *ERROR-TA to check any Natural error.

```
DEFINE DATA LOCAL
1 VIS VIEW OF EMP
   2 AA-1                                                                                    ↩

END-DEFINE
MOVE "ERRGEN" TO *ERROR-TA
READ VIS
  DISPLAY AA-1
END-READ
END
```

Example: Error Handling Routine ERRGEN

This Natural program with the name ERRGEN checks the Natural error number. If the error number is 6296 (fatal error in the communication), the program stacks the command FIN on top of the Natural stack. The Natural execution finishes immediately and all databases are closed.

```
DEFINE DATA LOCAL
1 ERRNUMBER (N4)
1 LINENUMBER (N4)
1 STATUS (A1)
1 LEVEL (A2)
1 GNPGACTU (A8)
END-DEFINE
INPUT (SG=OFF) ERRNUMBER LINENUMBER STATUS GNPGACTU LEVEL
IF ERRNUMBER=6296
  STACK TOP COMMAND "FIN"
END-IF
END
```

Restrictions

There are several restrictions when using the presentation clients with Natural applications on UNIX hosts:

- **Runtime errors in Natural applications**

  Runtime errors in Natural UNIX applications are handled by the default NSWUCIET error transaction. The user can define another error transaction by setting the *ERROR-TA Natural system variable. See the Natural documentation for details. Sample Natural error transaction:

  ```
  DEFINE DATA
  LOCAL
  1 ERR_INFO
    2 ERR_NR(N5)
    2 ERR_LINE(N4)
    2 ERR_STAT(A1)
    2 ERR_PNAM(A8)
    2 ERR_LEVEL(N2)
  END-DEFINE
  INPUT ERR_INFO
  DISPLAY ERR_INFO
  STACK TOP COMMAND 'E'
  END
  ```

  Starting with Natural 6.1, a default error transaction named NSWUCIET will be used if Natural is running with Natural Screen Tester and an error transaction has not been set by the user.

- **Return to the Natural main screen**

  You cannot use Natural applications that return to the Natural main screen. This always leads to wrong screen display and a loss of the session.

- **Natural editors and utilities**

  You cannot use the Natural utilities such as SYSMAIN, SYSDDM and editors such as NATEDIT. This always leads to wrong screen display and a loss of the session.

- **Natural system commands**

  You cannot use any Natural system command such as CATALL, FIND, GLOBALS, HELP, KEY, LIST, SCAN or XREF. This always leads to wrong screen display and a loss of the session.

- **Natural commands SETUP and RETURN**

  You should not use the Natural commands SETUP and RETURN as this may lead to a loss of the session. • Terminal commands Terminal (%) commands are not supported. They do not work when entered in a presentation client.

- **Internal REINPUT**

  The error messages of an internal REINPUT are not displayed in the presentation clients (for example, if you enter the number 500 into a I1 field: NAT1142). Examples of such messages:

NAT1142	Input results in integer value overflow.
NAT1125	Too many significant digits in numeric input value.
NAT1143	Input does not correspond to input edit mask.
NAT1011	Requested function key not allocated.

- **Natural system variable *INIT-ID**

  When using the presentation clients with Natural applications on UNIX hosts, the Natural system variable *INIT-ID will not be filled with a value for the terminal type. Instead, it will contain the value notty.

16 Appendix E: SSL Cipher Suites Supported by Natural Screen Tester

Following is a list of the SSL cipher suites supported when connecting to the host. These are relevant when running Oracle's JVM. It is possible to use any JSSE provider, including IBM.

```
TLS_RSA_WITH_AES_128_CBC_SHA

TLS_RSA_WITH_AES_256_CBC_SHA

TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA

TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA

TLS_ECDH_RSA_WITH_AES_128_CBC_SHA

TLS_ECDH_RSA_WITH_AES_256_CBC_SHA

TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA

TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA

TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA

TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA

TLS_DHE_RSA_WITH_AES_128_CBC_SHA

TLS_DHE_RSA_WITH_AES_256_CBC_SHA

TLS_DHE_DSS_WITH_AES_128_CBC_SHA

TLS_DHE_DSS_WITH_AES_256_CBC_SHA

SSL_RSA_WITH_3DES_EDE_CBC_SHA
```

```
TLS_ECDH_ECDSA_WITH_3DES_EDE_CBC_SHA

TLS_ECDH_RSA_WITH_3DES_EDE_CBC_SHA

TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA

TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA

SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA

SSL_DHE_DSS_WITH_3DES_EDE_CBC_SHA

SSL_RSA_WITH_DES_CBC_SHA

SSL_DHE_RSA_WITH_DES_CBC_SHA

SSL_DHE_DSS_WITH_DES_CBC_SHA

SSL_RSA_EXPORT_WITH_DES40_CBC_SHA

SSL_DHE_RSA_EXPORT_WITH_DES40_CBC_SHA

SSL_DHE_DSS_EXPORT_WITH_DES40_CBC_SHA

SSL_RSA_WITH_NULL_MD5

SSL_RSA_WITH_NULL_SHA

TLS_ECDH_ECDSA_WITH_NULL_SHA

TLS_ECDH_RSA_WITH_NULL_SHA

TLS_ECDHE_ECDSA_WITH_NULL_SHA

TLS_ECDHE_RSA_WITH_NULL_SHA

TLS_DH_anon_WITH_AES_128_CBC_SHA

TLS_DH_anon_WITH_AES_256_CBC_SHA

SSL_DH_anon_WITH_3DES_EDE_CBC_SHA

SSL_DH_anon_WITH_DES_CBC_SHA

TLS_ECDH_anon_WITH_AES_128_CBC_SHA

TLS_ECDH_anon_WITH_AES_256_CBC_SHA

TLS_ECDH_anon_WITH_3DES_EDE_CBC_SHA

SSL_DH_anon_EXPORT_WITH_DES40_CBC_SHA
```

```
TLS_ECDH_anon_WITH_NULL_SHA

TLS_KRB5_WITH_3DES_EDE_CBC_SHA

TLS_KRB5_WITH_3DES_EDE_CBC_MD5

TLS_KRB5_WITH_DES_CBC_SHA

TLS_KRB5_WITH_DES_CBC_MD5

TLS_KRB5_EXPORT_WITH_DES_CBC_40_SHA

TLS_KRB5_EXPORT_WITH_DES_CBC_40_MD5
```

17 Appendix F: Syntax and Format Reference

Regular Expression Syntax

Several transformation patterns allow using Regular Expressions to define the textual pattern we want to find in the host screen.

General Examples

Expression	Search for
Just some text	Specific text, find only "Just some text"
.*\.txt	Text files, like "Readme.txt"
Gr[ae]y	Only "Gray" or "Grey"
Colou?r	Only "Color" or "Colour"
\b[1-9][0-9]{2,4}\b	A number between 100 and 99999
\b[A-Z0-9._%-]+@ [A-Z0-9.-]+\.[A-Z]{2,4}\b	Email address, like "help@softwareag.com"

Host Specific Examples

Search for	Use...	Expression
"1 more >" or "2 more >"	To convert the text "1 more >" or "2 more >" etc. to a button that sends PF11	[1-9] more >
"(x-y)", "(January-march)", etc.	To erase any text with this pattern	\(.*-.*\)

General Rules

- [\|] separates alternatives.
- Expressions within parentheses are matched as subpattern groups and saved for further use.
- By default, a quantified subpattern matches as many times as possible without causing the rest of the pattern not to match. To change the quantifiers to match the minimum number of times possible, without causing the rest of the pattern not to match, use a [?] right after the quantifier.

Regular Expression Matching

Expression	Matches
{n,m}	At least n but not more than m times
{n,}	At least n times
{n}	Exactly n times
*	0 or more times
+	1 or more times
?	0 or 1 time
.	Everything except \n in a regular expression within parentheses
^	A null token matching the beginning of a string or line (i.e., the position right after a new line or right before the beginning of a string) in a regular expression within parentheses
$	A null token matching the end of a string or line (that is, the position right before a new line or right after the end of a string) in a regular expression within parentheses
\b	Backspace inside a character class ([abcd])
\b	Null token matching a word boundary (\w on one side and \W on the other)
\B	Null token matching a boundary that isn't a word boundary
\A	Only at the beginning of a string
\Z	Only at the end of a string (or before a new line at the end)
\	New line
\r	Carriage return
\t	Tab
\f	Form feed
\d	Digit [0-9]
\D	Non-digit [^0-9]
\w	Word character [0-9a-z_A-Z]
\W	Non-word character [^0-9a-z_A-Z]
\s	A white space character [\t\n\r\f]
\S	A non-white space character [^ \t\n\r\f]
\xnn	The hexadecimal representation of character nn
\cD	The corresponding control character
\nn or \nnn	The octal representation of character nn unless a back reference.
\1, \2, \3 ...	Whatever the first, second, third, and so on, parenthesized group matched. This is called a back reference. If there is no corresponding group, the number is interpreted as an octal representation of a character.
\0	The null character. Any other back-slashed character matches itself.
*?	0 or more times
+?	1 or more times

Expression	Matches
??	0 or 1 time
{n}?	Exactly n times
{n,}?	At least n times
{n,m}?	At least n but not more than m times

18 Appendix G: ASCII Character Table

Decimal	Octal	Hex	Binary	Value	
000	000	000	00000000	NUL	(Null char.)
001	001	001	00000001	SOH	(Start of Header)
002	002	002	00000010	STX	(Start of Text)
003	003	003	00000011	ETX	(End of Text)
004	004	004	00000100	EOT	(End of Transmission)
005	005	005	00000101	ENQ	(Enquiry)
006	006	006	00000110	ACK	(Acknowledgment)
007	007	007	00000111	BEL	(Bell)
008	010	008	00001000	BS	(Backspace)
009	011	009	00001001	HT	(Horizontal Tab)
010	012	00A	00001010	LF	(Line Feed)
011	013	00B	00001011	VT	(Vertical Tab)
012	014	00C	00001100	FF	(Form Feed)
013	015	00D	00001101	CR	(Carriage Return)
014	016	00E	00001110	SO	(Shift Out)
015	017	00F	00001111	SI	(Shift In)
016	020	010	00010000	DLE	(Data Link Escape)
017	021	011	00010001	DC1 (XON)	(Device Control 1)
018	022	012	00010010	DC2	(Device Control 2)
019	023	013	00010011	DC3 (XOFF)	(Device Control 3)
020	024	014	00010100	DC4	(Device Control 4)
021	025	015	00010101	NAK	(Negative Acknowledgment)
022	026	016	00010110	SYN	(Synchronous Idle)
023	027	017	00010111	ETB	(End of Trans. Block)

Decimal	Octal	Hex	Binary	Value	
024	030	018	00011000	CAN	(Cancel)
025	031	019	00011001	EM	(End of Medium)
026	032	01A	00011010	SUB	(Substitute)
027	033	01B	00011011	ESC	(Escape)
028	034	01C	00011100	FS	(File Separator)
029	035	01D	00011101	GS	(Group Separator)
030	036	01E	00011110	RS	(Request to Send)(Record Separator)
031	037	01F	00011111	US	(Unit Separator)
032	040	020	00100000	SP	(Space)
033	041	021	00100001	!	(exclamation mark)
034	042	022	00100010	"	(double quote)
035	043	023	00100011	#	(number sign)
036	044	024	00100100	$	(dollar sign)
037	045	025	00100101	%	(percent)
038	046	026	00100110	&	(ampersand)
039	047	027	00100111	'	(single quote)
040	050	028	00101000	(	(left/opening parenthesis)
041	051	029	00101001	)	(right/closing parenthesis)
042	052	02A	00101010	*	(asterisk)
043	053	02B	00101011	+	(plus)
044	054	02C	00101100	,	(comma)
045	055	02D	00101101	-	(minus or dash)
046	056	02E	00101110	.	(dot)
047	057	02F	00101111	/	(forward slash)
048	060	030	00110000	0	
049	061	031	00110001	1	
050	062	032	00110010	2	
051	063	033	00110011	3	
052	064	034	00110100	4	
053	065	035	00110101	5	
054	066	036	00110110	6	
055	067	037	00110111	7	
056	070	038	00111000	8	
057	071	039	00111001	9	
058	072	03A	00111010	:	(colon)
059	073	03B	00111011	;	(semi-colon)

Decimal	Octal	Hex	Binary	Value	
060	074	03C	00111100	<	(less than)
061	075	03D	00111101	=	(equal sign)
062	076	03E	00111110	>	(greater than)
063	077	03F	00111111	?	(question mark)
064	100	040	01000000	@	(AT symbol)
065	101	041	01000001	A	
066	102	042	01000010	B	
067	103	043	01000011	C	
068	104	044	01000100	D	
069	105	045	01000101	E	
070	106	046	01000110	F	
071	107	047	01000111	G	
072	110	048	01001000	H	
073	111	049	01001001	I	
074	112	04A	01001010	J	
075	113	04B	01001011	K	
076	114	04C	01001100	L	
077	115	04D	01001101	M	
078	116	04E	01001110	N	
079	117	04F	01001111	O	
080	120	050	01010000	P	
081	121	051	01010001	Q	
082	122	052	01010010	R	
083	123	053	01010011	S	
084	124	054	01010100	T	
085	125	055	01010101	U	
086	126	056	01010110	V	
087	127	057	01010111	W	
088	130	058	01011000	X	
089	131	059	01011001	Y	
090	132	05A	01011010	Z	
091	133	05B	01011011	[	(left/opening bracket)
092	134	05C	01011100	\	(back slash)
093	135	05D	01011101	]	(right/closing bracket)
094	136	05E	01011110	^	(caret/cirumflex)
095	137	05F	01011111	_	(underscore)

Decimal	Octal	Hex	Binary	Value	
096	140	060	01100000	`	
097	141	061	01100001	a	
098	142	062	01100010	b	
099	143	063	01100011	c	
100	144	064	01100100	d	
101	145	065	01100101	e	
102	146	066	01100110	f	
103	147	067	01100111	g	
104	150	068	01101000	h	
105	151	069	01101001	I	
106	152	06A	01101010	j	
107	153	06B	01101011	k	
108	154	06C	01101100	l	
109	155	06D	01101101	m	
110	156	06E	01101110	n	
111	157	06F	01101111	o	
112	160	070	01110000	p	
113	161	071	01110001	q	
114	162	072	01110010	r	
115	163	073	01110011	s	
116	164	074	01110100	t	
117	165	075	01110101	u	
118	166	076	01110110	v	
119	167	077	01110111	w	
120	170	078	01111000	x	
121	171	079	01111001	y	
122	172	07A	01111010	z	
123	173	07B	01111011	{	(left/opening brace)
124	174	07C	01111100	|	(vertical bar)
125	175	07D	01111101	}	(right/closing brace)
126	176	07E	01111110	~	(tilde)
127	177	07F	01111111	DEL	(delete)

19 Appendix H: SDFX File Format Definition

Introduction

SDFX (Screen Definition Format) is a proprietary generic format used for describing a host screen. In addition to standard formats like BMS, MFS and Natural maps, Natural Screen Tester supports this generic format. If your host screen maps are not supported in Natural Screen Tester you can convert them to the SDFX format and then import them into your Natural Screen Tester repository.

SDFX is based on the XML structure. Each SDFX file is composed of one mapset, and must have the ".SDFX" extension. A mapset contains one or more smaller units called maps. Each map currently corresponds to one host screen. A map is made up of identifiers, fields, and map steps. Mapsets, maps, and fields are identified by name. Natural Screen Tester uses the map name to create a screen entity with the same name.

Mapset File Structure

The following details the mapset file structure, where all the map and field details are placed within the Map tag and are detailed in **Defining Maps** and **Defining Fields**.

```
<Mapset>
    <Name>mapsetname</Name>
    <Version>1</Version>
    <Type>SIMPLE</Type>
    <Map>
       ...
    <Map>
    <Map>
       ...
    <Map>
<Mapset>
```

Mapset Parameters

`<Name>mapsetname</Name>`
: The name of the mapset (mandatory).

`<Version>1</Version>`
: This line contains the SDFX format version (currently, always 1).

`<Type>SIMPLE</Type>`
: This line contains the type of SDFX used. Currently the only type available is "SIMPLE".

`<Map> ... <Map>`
: Refer to **Defining Maps**. A number of maps can be added to the same file.

Defining Maps

Each map represents a single screen and contains the screen properties such as the screen name, screen position, screen width and height etc.

```
<Map>
    <Name>MapName</Name>
    <PosX>1</PosX>
    <PosY>1</PosY>
    <Width>80</Width>
    <Height>24</Height>
    <IsPopup>false</IsPopup>
    <Field class="SimpleField">
      ...
    </Field>
    <Field class="ListField">
      ...
    </Field>
    <LoopField>
      ...
    </LoopField>
</Map>
```

Map Parameters

`<Name>MapName</Name>`
The name of the map (mandatory).

`<PosX>1</PosX>`
The map's horizontal position (the X coordinate of the rectangle's top-left character, can be from 1 to the width of the screen). When not specified, the default is 1.

`<PosY>1</PosY>`
The map's vertical position (the Y coordinate of the rectangle's top-left character, can be from 1 to the height of the screen). When not specified, the default is 1.

`<Width>80</Width>`
The map's width (optional, default is 80).

`<Height>24</Height>`
The map's height (optional, default is 24).

`<IsPopup>false</IsPopup>`
True indicates that this map is used as a pop-up on the host (optional, default is false).

`<Field class="SimpleField"> ... </Field>`
Refer to Defining Fields. A number of fields can be added to the same map.

Defining Identifiers

Use SDFX identifiers to create Natural Screen Tester identifiers (refer to Defining Identifiers).

Parameters to use for a Text identifier

The identifier is recognized if its text matches (or does not match) the host screen text in the defined position.

`Text`
: The string to try and match.

`IsMatch`
: Boolean (true \ false), default value is true. When set to false, then the identifier is recognized only if the host screen's text \ attribute in that position does not match the identifier's text \ attribute.

`IsCaseSensitive`
: Boolean (true \ false). When set to true, then the text will be case sensitive.

`ScreenArea`
: Represents the screen area within in which to search for the identifier. Possible values:

`Anywhere`
: Any position on the screen is a valid position.

For example

```
<ScreenArea class="Anywhere"/>
```

`Position`
: Defines a position on the screen. `StartPos` determines the first position within the screen.

For example:

```
<ScreenArea class="Position">
   <StartPos>
     <PosX>40</PosX>
     <PosY>23</PosY>
   </StartPos>
 </ScreenArea>
```

`PositionLength`
: Defines the first position within the screen and the length of the area.

For example:

```
<ScreenArea class="PositionLength">
  <StartPos>
    <PosX>40</PosX>
    <PosY>23</PosY>
  </StartPos>
  <Length>15</Length>
</ScreenArea>
```

`Rectangle`

Defines a rectangle on the screen. `StartPos` determines the top left position and `EndPos` determines the bottom right position. Together these create a rectangle.

For example:

```
<ScreenArea class="Rectangle">
  <StartPos>
    <PosX>10</PosX>
    <PosY>1</PosY>
  </StartPos>
  <EndPos>
    <PosX>30</PosX>
    <PosY>24</PosY>
  </EndPos>
</ScreenArea>
```

The following example is sample code used for a text identifier, using the type "Anywhere".

```
<Identifier class="Text">
      <Text>TextToMatch</Text>
      <IsMatch>true</IsMatch>
      <IsCaseSensitive>true</IsCaseSensitive>
      <ScreenArea class="Anywhere"/>
 </Identifier>
```

Parameters to use for an Attribute identifier

The identifier is recognized if its attribute matches the attribute that applies for the host screen in the defined position. The position does not necessarily has to be the position of the attribute character.

`Attribute`

The attribute to search for. Possible values: PROTECTED, HIDDEN, INTENSIFIED, and REVERSED_VIDEO.

`ScreenArea: Position`

Defines a position on the screen where the attribute should be checked.

For example:

```
<ScreenArea class="Position">
   <StartPos>
     <PosX>40</PosX>
     <PosY>23</PosY>
   </StartPos>
 </ScreenArea>
```

The following example is sample code used for an attribute identifier (defines an "Unprotected" attribute).

```
<Identifier class="Attribute">
     <Attribute>PROTECTED</Attribute>
     <IsMatch>false</IsMatch>
     <ScreenArea class="Position">
       <StartPos>
         <PosX>40</PosX>
         <PosY>23</PosY>
       </StartPos>
     </ScreenArea>
 </Identifier>
```

Defining Fields

- **Definitions of a Simple Field**: Simple fields can be protected, unprotected or static fields.
- **Definitions of a List Field**: A List Field is a field which contains a repetitive pattern of simple fields (a "table" of similar cells).
- **Definition of a Loop Field**: A loop field describes a repetitive element of the host screen, which is not a list.

Definitions of a Simple Field

A simple field may be a protected, unprotected or status field. A field for which no name is given, will be considered by Natural Screen Tester to be an identifier. A simple field can also be used as a static identifier.

```
<Field class="SimpleField">
    <Type>SIMPLE</Type>
    <Name>DFHM001</Name>
    <PosX>2</PosX>
    <PosY>1</PosY>
    <Length>4</Length>
    <Text>string</Text>
    <Attribute>PROTECTED</Attribute>
    <DataType>DATA_TYPE_ALPHANUMERIC</DataType>
    <Bright>NORM</Bright>
    <ForegroundColor>WHITE</ForegroundColor>
```

```
      <BackgroundColor>DEFAULT</BackgroundColor>
      <HighlightBlink>false</HighlightBlink>
      <HighlightReverse>false</HighlightReverse>
      <HighlightUnderline>false</HighlightUnderline>

  </Field>
```

Note: A field which does not have a name tag but has a text tag, will be used as a screen identifier.

Simple Field Parameters

`<Field class="SimpleField">`
: Indicates that this field is a simple field (a field's class can be SimpleField or ListField).

`<Type>SIMPLE</Type>`
: Indicates that it is a simple field (optional, since SIMPLE is the default field type).

`<Name>DFHM001</Name>`
: The name of the field (optional). A field for which no name is given will be considered by Natural Screen Tester to be an identifier (a static area on the screen).

`<PosX>2</PosX>`
: The field's horizontal position (the X coordinate of the position of the attribute character, can be from 1 to the width of the screen), relative to the original map.

`<PosY>1</PosY>`
: The field's vertical position (the Y coordinate of the position of the attribute character, can be from 1 to the height of the screen), relative to the original map.

`<Length>4</Length>`
: The field's length (not including the attribute character).

`<Text>string</Text>`
: The initial value of the field (optional). This should match the field's length and will be truncated or space-padded as needed.

`<Attribute>PROTECTED</Attribute>`
: The field's attribute. Possible values are: "UNPROTECTED" or "PROTECTED". The default value is "PROTECTED".

`<DataType>DATA_TYPE_ALPHANUMERIC</DataType>`
: Determines whether the field can receive numeric or alpha numeric data. Possible values: "DATA_TYPE_ALPHANUMERIC" or "DATA_TYPE_NUMERIC". The default value is "DATA_TYPE_ALPHANUMERIC".

`<Bright>NORM</Bright>`
: The field's attribute (brightness) (optional). Possible values: "BRT", "NORM" or "DRK". The default value is "NORM".

`<ForegroundColor>WHITE</ForegroundColor>`
Indicates the foreground color of the field (optional). The default color is white. The color must be written in capital letters. Possible values include: WHITE, BLACK, AQUA, BLUE, BROWN, GRAY, GREEN, LIGHT_AQUA, LIGHT_BLUE, LIGHT_GREEN, LIGHT_PURPLE, LIGHT_RED, LIGHT_WHITE, PURPLE, RED, YELLOW, NONE, DEFAULT.

`<BackgroundColor>DEFAULT</BackgroundColor>`
Indicates the foreground color of the field (optional). The default color is black. The color must be written in capital letters. Possible values include: WHITE, BLACK, AQUA, BLUE, BROWN_YELLOW, GREEN, PURPLE, RED, NONE, DEFAULT.

`<HighlightBlink>false</HighlightBlink>`
BLINK highlighting (optional, default is false).

`<HighlightReverse>false</HighlightReverse>`
REVERSE highlighting (optional, default is false).

`<HighlightUnderline>false</HighlightUnderline>`
UNDERLINE highlighting (optional, default is false).

Definitions of a List Field

A List Field is a field which contains a repetitive pattern of simple fields. Since this repetition can expand vertically to the right (not only downward), a list can be seen as a "table" of similar cells (Natural Screen Tester multiple fields \ tables). Each cell in the list is called a record and can contain several fields. You are required to define the first record (cell) and it must consist of Simple fields only.

```
<Field class="ListField">
      <Type>LIST</Type>
      <Name>DFHM002</Name>
      <PosX>1</PosX>
      <PosY>1</PosY>
      <Direction>HORIZONTAL_FIRST</Direction>
      <RecordWidth>1</RecordWidth>
      <RecordHeight>1</RecordHeight>
      <RecordsNum>4</RecordsNum>
      <Field>
       ...
      </Field>
      <Field>
       ...
      </Field>
</Field>
```

List Field Parameters

`<Field class="ListField">`
Indicates that this field is a list field (a field's class can be SimpleField or ListField).

`<Type>LIST</Type>`
: Indicates that it is a list field.

`<Name>DFHM002</Name>`
: The name of the list (optional).

`<PosX>1</PosX>`
: The list's horizontal position (the X coordinate of its top-left corner, can be from 1 to the width of the screen). Note that the corner of the list's area isn't necessarily the corner of the top-left cell (unless the cell's position is 1,1).

`<PosY>1</PosY>`
: The list's vertical position (the Y coordinate of its top-left corner, can be from 1 to the height of the screen).

`<Direction>HORIZONTAL_FIRST</Direction>`
: The direction in which records are inserted into the list (optional). Possible values are: "VERTICAL_FIRST" or "HORIZONTAL_FIRST" (default: VERTICAL_FIRST).

`<RecordWidth>1</RecordWidth>`
: The width (in characters) of a single list record (i.e. cell). The default value is "1". For example, when wanting to repeat an occurrence every twenty characters (counting from the beginning of the previous record), enter 20 for this parameter and 0 for the value of the RecordHeight.

`<RecordHeight>1</RecordHeight>;`
: The height (in characters) of a single list record (i.e. cell). Possible values can be in the range 1-99. The default value is "1". For example, when wanting to repeat an occurrence every two rows (counting from the first row of the previous occurrence), enter 2 for this parameter.

`<RecordsNum>4</RecordsNum>`
: The total number of records to produce. Possible values can be in the range 1-99. The default value is "1".

Definition of a Loop Field

A loop field describes a repetitive element of the host screen, which is not a list. The most common example being the drawing of a frame of some sort which consists of simple (static) fields one below the other. Each simple field inside the loop field is repeated (cloned) either along the x-axis, y-axis or both ("table"). The distance between adjacent cloned fields is controllable, and it is the user's responsibility to make sure cloned fields are kept within the map's bounds.

```
<LoopField>
   <HorizontalClonesNum>1</HorizontalClonesNum>
   <HorizontalOffset>1</HorizontalOffset>
   <VerticalClonesNum>1</VerticalClonesNum>
   <VerticalOffset>1</VerticalOffset>
   <Field>
     ...
   </Field>
   <Field>
```

```
      ...
    </Field>
 </LoopField>
```

Loop Field Parameters

`<HorizontalClonesNum>1</HorizontalClonesNum>`
The number of cloned fields (including the field itself) to be created in each row (optional, default is 1).

`<HorizontalOffset>1</HorizontalOffset>`
The number of columns between adjacent cloned fields (optional, default is 1 which means that there are no blank columns between cloned fields, just attributes).

`<VerticalClonesNum>1</VerticalClonesNum>`
The number of cloned fields (including the field itself) to be created in each column (optional, default is 1).

`<VerticalOffset>1</VerticalOffset>`
The number of rows between adjacent cloned fields (optional, default is 1 which means that there are no blank rows between cloned fields).

Defining Map Steps

The Map Steps defined here can be used in the Test Project Map.

```
<MapStep>
   <SendKeys>[ENTER]</SendKeys>
   <TargetScreen>ScreenName</TargetScreen>
   <CursorPos>
     <PosX>10</PosX>
     <PosY>5</PosY>
   </CursorPos>
   <InputField>
     <StartPos>
       <PosX>10</PosX>
       <PosY>5</PosY>
     </StartPos>
     <Text>input</Text>
   </InputField>
   <InputField>
     <StartPos>
       <PosX>10</PosX>
       <PosY>7</PosY>
     </StartPos>
     <GlobalVariableName>variableName</GlobalVariableName>
     <Text>prefix</Text>
   </InputField>
   <InputField>
```

```
    ...
  </InputField>
  <InputField>
    ...
  </InputField>
</Mapstep>
```

Note:

1. It is only possible to place one map step from one specific screen to another specific target screen. When defining more than one, only the first one defined in the file will be displayed (e.g. if you can get from screen A to screen B both by sending the [enter] key or by sending the [PF5] key, the first map step defined is the one Natural Screen Tester uses).
2. It is not possible to define a map step from a screen to itself. Such map steps, if defined in the SDFX file, will be ignored.
3. Map step must contain a "SendKeys" element and a "TargetScreen" element. If one of them is missing, then the map step will not be added (a warning will be added to the server log).

Map Step Parameters

`SendKeys`

The host key. Ensure that the host key you define is listed in the list of host keys which is displayed in the test project properties, in the Keyboard Mapping tab, in the Host Key column.

For Example:

```
<SendKeys>[attn]</SendKeys>
```

`CursorPos`

The position of the cursor. For example there may be several map steps with the same [help] host key, each with a different target screen (the specific help menu) as long as they also have different cursor locations (the field for which the user wanted the help menu).

`PosX`

The column of the cursor position.

`PosY`

The row of the cursor position.

`TargetScreen`

The name of the destination screen, as defined in the destination screen's map definition in the same SDFX file.

`InputField`

Optional. Each map step can have zero or more input fields, each field represents input the user entered to a specific field when performing the map step.

`StartPos`

Determines the position on screen where the first character was entered.

`PosX`
The column of the cursor position.

`PosY`
The row of the cursor position.

`GlobalVariableName`
Optional. The name of the global variable whose value should be used as the text.

`Text`
The text entered.

Example of an SDFX File

```
<Mapset>
  <Name>Example</Name>
  <Version>1</Version>
  <Type>SIMPLE</Type>
  <Map>
    <Name>Example</Name>
    <PosX>1</PosX>
    <PosY>1</PosY>
    <Width>80</Width>
    <Height>24</Height>
    <CursorPosX>1</CursorPosX>
    <CursorPosY>1</CursorPosY>
    <IsPopup>false</IsPopup>
 <Field class="SimpleField">
      <Length>10</Length>
      <Attribute>PROTECTED</Attribute>
      <DataType>DATA_TYPE_ALPHANUMERIC</DataType>
      <Bright>NORM</Bright>
      <ForegroundColor>GREEN</ForegroundColor>
      <BackgroundColor>DEFAULT</BackgroundColor>
      <DbcsMode>NONE</DbcsMode>
      <HighlightBlink>false</HighlightBlink>
      <HighlightReverse>false</HighlightReverse>
      <HighlightUnderline>false</HighlightUnderline>
      <OffsetFromLeft>0</OffsetFromLeft>
      <OffsetFromRight>0</OffsetFromRight>
      <OffsetFromTop>0</OffsetFromTop>
      <OffsetFromBottom>0</OffsetFromBottom>
      <Type>SIMPLE</Type>
   <Text>First Name</Text>
      <PosX>8</PosX>
      <PosY>3</PosY>
    </Field>
 <Field class="SimpleField">
      <Length>10</Length>
      <Attribute>PROTECTED</Attribute>
      <DataType>DATA_TYPE_ALPHANUMERIC</DataType>
      <Bright>NORM</Bright>
      <ForegroundColor>WHITE</ForegroundColor>
      <BackgroundColor>DEFAULT</BackgroundColor>
      <Type>SIMPLE</Type>
   <Text>----------</Text>
      <PosX>8</PosX>
      <PosY>4</PosY>
    </Field>
 <Field class="SimpleField">
      <Length>10</Length>
      <Attribute>PROTECTED</Attribute>
      <DataType>DATA_TYPE_ALPHANUMERIC</DataType>
      <Bright>NORM</Bright>
      <ForegroundColor>WHITE</ForegroundColor>
      <BackgroundColor>DEFAULT</BackgroundColor>
      <OffsetFromLeft>0</OffsetFromLeft>
      <OffsetFromRight>0</OffsetFromRight>
      <OffsetFromTop>0</OffsetFromTop>
      <OffsetFromBottom>0</OffsetFromBottom>
      <Type>SIMPLE</Type>
   <Text>----------</Text>
      <PosX>20</PosX>
      <PosY>4</PosY>
    </Field>
 <Field class="SimpleField">
      <Length>10</Length>
      <Attribute>PROTECTED</Attribute>
      <DataType>DATA_TYPE_ALPHANUMERIC</DataType>
      <Bright>NORM</Bright>
      <ForegroundColor>BLUE</ForegroundColor>
      <BackgroundColor>DEFAULT</BackgroundColor>
      <DbcsMode>NONE</DbcsMode>
      <HighlightBlink>false</HighlightBlink>
      <HighlightReverse>false</HighlightReverse>
      <HighlightUnderline>false</HighlightUnderline>
      <OffsetFromLeft>0</OffsetFromLeft>
      <OffsetFromRight>0</OffsetFromRight>
      <OffsetFromTop>0</OffsetFromTop>
      <OffsetFromBottom>0</OffsetFromBottom>
      <Type>SIMPLE</Type>
   <Text>Last Name</Text>
      <PosX>20</PosX>
      <PosY>3</PosY>
    </Field>
    <Field class="ListField">
      <Direction>HORIZONTAL_FIRST</Direction>
      <RecordWidth>1</RecordWidth>
      <RecordHeight>1</RecordHeight>
      <RecordsNum>15</RecordsNum>
      <Field>
```

```
     <Name>firstName</Name>
        <Length>10</Length>
        <Attribute>PROTECTED</Attribute>
        <DataType>DATA_TYPE_ALPHANUMERIC</DataType>
        <Bright>BRT</Bright>
        <DbcsMode>NONE</DbcsMode>
        <Type>SIMPLE</Type>
        <PosX>8</PosX>
        <PosY>6</PosY>
      </Field>
      <Field>
     <Name>lastName</Name>
        <Length>10</Length>
        <Attribute>UNPROTECTED</Attribute>
        <DataType>DATA_TYPE_NUMERIC</DataType>
        <Bright>NORM</Bright>
        <ForegroundColor>WHITE</ForegroundColor>
        <BackgroundColor>DEFAULT</BackgroundColor>
        <Type>SIMPLE</Type>
        <PosX>20</PosX>
        <PosY>6</PosY>
      </Field>
      <Type>LIST</Type>
      <PosX>1</PosX>
      <PosY>1</PosY>
    </Field>
    <LoopField>
      <HorizontalClonesNum>1</HorizontalClonesNum>
      <HorizontalOffset>1</HorizontalOffset>
      <VerticalClonesNum>1</VerticalClonesNum>
      <VerticalOffset>1</VerticalOffset>
    </LoopField>
  </Map>
</Mapset>
```

20 Appendix I: Dynamic Field Mapping Limitations

In some screens, the position of a field may vary. It is therefore necessary to map some fields in such a way, that even if they appear in a different position, they will still be recognized and mapped. This is possible by defining the label near the field (the label must be to the left of the field) and identifying the field according to this label. This mapping type is called "Single Dynamic" as the mapping position changes dynamically according to the leading label. Refer to Map Fields section for further details as to how to map test project fields according to their leading label.

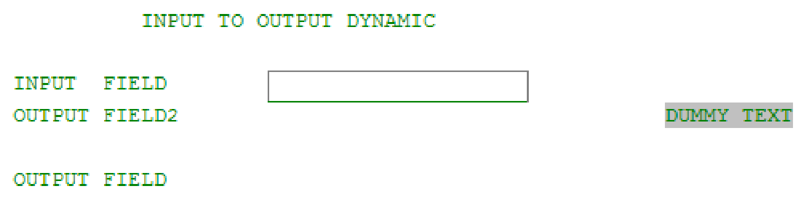
Following are some limitations:

There is no specific identifier on the host screen which distinguishes between protected fields and static text which cannot change in runtime. This implies the following limitations:

- If a field does not have a distinctive label exactly to its left, it cannot be defined as a dynamic field.
- This feature is disabled for test projects that are defined with a right to left language (a new dynamic field mapping can't be created).
- Static and Dynamic field mappings should not be set to match the same fields.

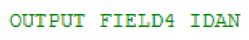
Specific use cases

- When the protected field is blank, any text to the right of the field is matched as the protected field area.



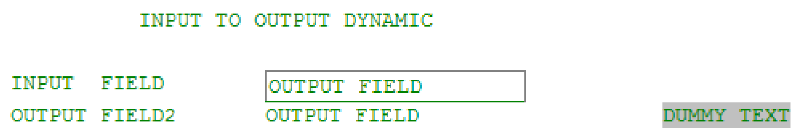
```
          INPUT TO OUTPUT DYNAMIC

INPUT  FIELD
OUTPUT FIELD2                              DUMMY TEXT

OUTPUT FIELD
```

- When a label and field are separated by a single white space, the protected field won't be matched, unless the "field search area" and "label search area" do not overlap.



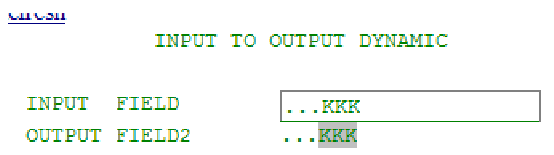
```
OUTPUT FIELD4 IDAN
```

- When arbitrary text in a protected field, matches the label search criteria it is wrongly matched as a field label, and the text to the right of it may be wrongly marked as a protected field.



```
                INPUT TO OUTPUT DYNAMIC

 INPUT   FIELD          OUTPUT FIELD
 OUTPUT FIELD2          OUTPUT FIELD                DUMMY TEXT
```

- When the text of the protected field starts with white spaces or separator characters, such as a dot or colon this text won't be considered as part of the field.



```
               INPUT TO OUTPUT DYNAMIC

 INPUT   FIELD          ...KKK
 OUTPUT FIELD2          ...KKK
```

- If two white spaces or separator characters appear as a sequence inside a protected field, they will be considered as a field boundary. For example, a row part containing the text "Hello, world" will be identified as a protected field with the text "Hello" only. In addition, when a leading label is defined as a part of a protected field's actual label and the actual label contains two or more separator characters (after the given leading label), the rest of the actual label might be falsely marked as the protected field. Note that these limitations are data dependant, they may only surface when specific data is sent from the host and therefore may not be identified during desgin time but only in runtime.

21 Appendix K: Host Supported Code Pages

Code	Language
037	US, Belgium, Brazil, Canada, Netherlands, Portugal
273	Germany, Austria
274	Belgium Old
275	Brazil Old
277	Denmark, Norway
278	Finland, Sweden
280	Italy
284	Spain, Latin America
285	UK
297	France
420	Arabic
424	Hebrew New Code
500	Multilingual
803	Hebrew Old Code
838	Thai
870	Latin 2 (EBCDIC Multilingual)
875	Greece
905	Turkish-Extended Code Page
930	Japan Katakana Ex
933	Korean
935	Simplified Chinese
937	Traditional Chinese
939	Japan English Ex
1025	1025 - Cyrillic

Code	Language
1026	Turkish
1130	Vietnamese
1155	Turkish - Euro support
1097	Farsi
1500	Multilingual Swiss
VT configurations	
SJIS	Japanese SJIS
EUC	Japanese EUC
874	Thai
916	Hebrew
932	Japanese ISO
1011	German
1024	Portuguese
1090	Decimal Special Graphics
1100	Multi
1134	Hebrew 7-bit
3000	Line Drawing
4001	International
4002	Multilingual
4040	Session 3151 Initial
4041	Session 3151
4090	ANSI Special Graphics
8000	ISO-8859-1