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Silk Test 15.5

Silk4NET User Guide

Micro Focus
575 Anton Blvd., Suite 510
Costa Mesa, CA 92626

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Licensing Information

Unless you are using a trial version, Silk Test requires a license.

The licensing model is based on the client that you are using and the applications that you want to be able to test. The available licensing modes support the following application types:

Licensing Mode	Application Type
Web	Web applications, including Java-Applets.
Web plus Flex	Web applications, including the following: • Apache Flex • Java-Applets

Full	• Web applications, including the following:
	  • Apache Flex
	  • Java-Applets
	• Mobile Web applications.
	  • Android
	  • iOS
	• Apache Flex
	• Java AWT/Swing
	• Java SWT and Eclipse RCP
	• .NET, including Windows Forms and Windows Presentation Foundation (WPF)
	• Rumba
	• Windows API-Based
	Note: To upgrade your license to a Full license, visit *www.borland.com*.

Premium	All application types that are supported with a *Full* license, plus SAP applications. **Note:** To upgrade your license to a Premium license, visit *www.borland.com*.

Silk4NET

Silk4NET is the Silk Test plug-in for Microsoft Visual Studio. Silk4NET enables you to efficiently create and manage functional, regression, and localization tests directly in Visual Studio. With Silk4NET, you can perform the following tasks within Visual studio:

- Develop tests using Visual Basic .NET.
- Develop tests using C#.
- Run tests as a part of a test plan in the Microsoft test environment.
- Run tests as a part of as a part of your build process.
- View test results.

Silk4NET supports the testing of a broad set of application technologies. Designed for realizing automation benefits even when applied to complex tests, Silk4NET brings true test automation capability directly to the developer's preferred environment and lets you easily cope with changes made in the test application.

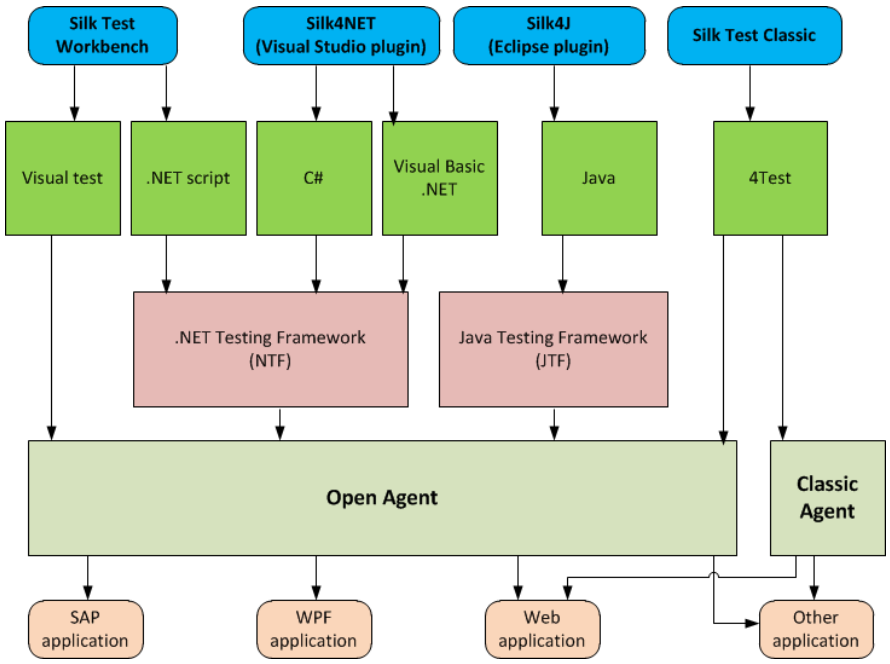
Additionally, the powerful testing framework of Silk4NET enables high reusability of tests across multiple test projects, which further increases the achievable Return On Investment (ROI). With less time spent on building and maintaining testing suites, your QA staff can expand test coverage and optimize application quality.

Silk Test Product Suite

Silk Test is an automated testing tool for fast and reliable functional and regression testing. Silk Test helps development teams, quality teams, and business analysts to deliver software faster, and with high quality. With Silk Test you can record and replay tests across multiple platforms and devices to ensure that your applications work exactly as intended.

The Silk Test product suite includes the following components:

- Silk Test Workbench – Silk Test Workbench is the quality testing environment that offers .NET scripting for power users and easy to use visual tests to make testing more accessible to a broader audience.
- Silk4NET – The Silk4NET Visual Studio plug-in enables you to create Visual Basic or C# test scripts directly in Visual Studio.
- Silk4J – The Silk4J Eclipse plug-in enables you to create Java-based test scripts directly in your Eclipse environment.
- Silk Test Classic – Silk Test Classic is the traditional, 4Test Silk Test product.
- Silk Test Agents – The Silk Test Agent is the software process that translates the commands in your tests into GUI-specific commands. In other words, the Agent drives and monitors the application you are testing. One Agent can run locally on the host machine. In a networked environment, any number of Agents can run on remote machines.



The product suite that you install determines which components are available. To install all components, choose the complete install option. To install all components with the exception of Silk Test Classic, choose the standard install option.

Product Notification Service

The product notification service is an application that runs in your system tray and allows you to find out if updates are available for Silk Test. It also provides a link for you to click to navigate to the updates.

Running the Service

In the system tray, click the update notification icon and the Product Notification Service application opens.

Installed Version	Provides the version number of the currently installed Silk Test application.
Update Version	Provides a link and the version number of the next minor update, if one is available.
New Version	Provides a link and the version number of the next full release, if one is available.
Settings	Click the **Settings** button to open the **Settings** window. Select if and how often you want the notification service to check for updates.

Contacting Micro Focus

Micro Focus is committed to providing world-class technical support and consulting services. Micro Focus provides worldwide support, delivering timely, reliable service to ensure every customer's business success.

All customers who are under a maintenance and support contract, as well as prospective customers who are evaluating products, are eligible for customer support. Our highly trained staff respond to your requests as quickly and professionally as possible.

Visit *http://supportline.microfocus.com/assistedservices.asp* to communicate directly with Micro Focus SupportLine to resolve your issues, or email supportline@microfocus.com.

Visit Micro Focus SupportLine at *http://supportline.microfocus.com* for up-to-date support news and access to other support information. First time users may be required to register to the site.

Information Needed by Micro Focus SupportLine

When contacting Micro Focus SupportLine, please include the following information if possible. The more information you can give, the better Micro Focus SupportLine can help you.

- The name and version number of all products that you think might be causing an issue.
- Your computer make and model.
- System information such as operating system name and version, processors, and memory details.
- Any detailed description of the issue, including steps to reproduce the issue.
- Exact wording of any error messages involved.
- Your serial number.

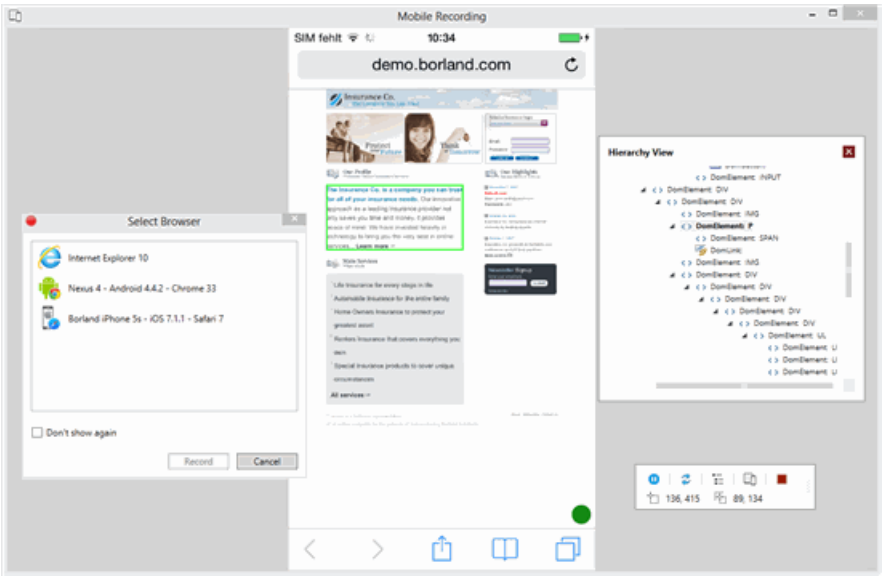
To find out these numbers, look in the subject line and body of your Electronic Product Delivery Notice email that you received from Micro Focus.

What's New in Silk4NET

Silk4NET supports the following new features:

Testing Apple Safari in iOS

By introducing support for testing against Apple Safari in iOS, Silk4NET now provides broad coverage of browsers for cross-browser testing. You can simply run your existing scripts against Apple Safari in iOS or you can create new scripts against iOS to ensure that your Web application fulfills all quality requirements. Silk4NET performs all testing against genuine versions of all supported browsers, instead of simply simulating the browser behavior.



Enhanced Mobile Browser Support

Silk4NET provides the easiest way of interacting with a mobile Web application:

- Silk4NET now supports image recognition for testing mobile Web applications on all supported mobile browsers. With image recognition, you can create cross-browser tests that include actions like verifying an image, clicking on an image, or waiting for an image to display.
- Silk4NET is now able to capture swipe gestures during recording.
- You do not need to manually calculate any coordinates for cross-browser testing, this calculation is done automatically to ensure that your test scripts are reliable and stable across multiple devices and browsers.

Usability Enhancements

This section lists usability enhancements that have been made in Silk Test 15.5.

Enhanced Custom Control Support

You can now also create custom classes for Java applications. With a few clicks, the new custom class is created and can be used during recording and replay. This class is used instead of the standard Silk Test class in all future tests. This is very helpful when handling complex or unusual interactions with the controls of your applications.

Easy interaction with multiple applications

You can now easily switch between applications within a single script. Silk Test now enables you to select the application with which you want to currently interact at any given time. You do no longer need to define the application that you want to test before the actual test.

Enhanced image verification

You can now click **Verify** to verify an image asset within the image asset UI.

Unicode character support for TypeKeys

When testing mobile Web applications, you can now use Unicode characters for the `TypeKeys` method.

Using an existing browser instance for recording

When recording against a Web application, you can now choose to record against a Web page currently open in an existing browser instance.

Text recognition in Internet Explorer 11

You can now use the following text recognition methods in Internet Explorer 11:

- `TextCapture`
- `TextExists`
- `TextRectangle`

Run base state

You can now use **Run Base State** to execute the base state from the menu and return your applications under test to their initial state before recording.

Stopping the Open Agent out of a script

You can now use the new `ShutDown` method of the `Agent` class to stop the Open Agent out of a script. This ensures that the agent does not continue running after test execution has ended.

Working with multiple console windows

You can now test multiple open console windows with Silk Test. For example, you can now use the new `CloseAll` method of the `ConsoleWindow` class to close all open console windows, or all console windows that have a specific caption.

Technology Updates

This section lists the significant technology updates for Silk Test 15.5.

Mozilla Firefox Support

Silk Test now includes playback support for applications running in:

- Mozilla Firefox 26
- Mozilla Firefox 27
- Mozilla Firefox 28
- Mozilla Firefox 29

Google Chrome Support

Silk Test now includes playback support for applications running in:

- Google Chrome 32
- Google Chrome 33
- Google Chrome 34
- Google Chrome 35

API Enhancements

Lists API enhancements that have been made in Silk Test 15.5.

Handling checked items in list views

When a list view displays check boxes on items, the `ListView` class now includes new methods and properties that enable you to verify whether these check boxes are checked and to check and uncheck the check boxes.

Interacting with multiple open command windows

You can now interact with multiple open command windows at the same time. The methods of the `ConsoleWindow` class are now overloaded to accept the index or the fully qualified identifier of the console window as an additional input parameter.

Saving captured bitmaps in the PNG format

When capturing a bitmap with the `CaptureBitmap` method, you can now specify that you want to save the bitmap as a PNG file.

Defining the exact position of a text click

The `TextClick` method now takes the position to click at as an additional optional parameter. The position is relative to the upper left corner of the text.

Defining whether to match a text exactly or not

The `TextClick`, `TextExists`, and `TextCapture` methods now accept an additional `exactMatch` parameter, which allows you to define whether you want to click, verify, or capture only exact matches of the text or you will also accept partial matching texts.

Shutting down the agent after test execution

You can now use the new `Shutdown` method to shut down the agent after test execution.

Silk Test Open Agent

The Silk Test Open Agent is the software process that translates the commands in your scripts into GUI-specific commands. In other words, the Open Agent drives and monitors the application that you are testing.

One Agent can run locally on the host machine. In a networked environment, any number of Agents can replay tests on remote machines. However, you can record only on a local machine.

Starting the Silk Test Open Agent

Before you can create a test or run a sample script, the Silk Test Open Agent must be running. Typically, the Agent starts when you launch the product. If you must manually start the Open Agent, perform this step.

Click **Start** > **Programs** > **Silk** > **Silk Test** > **Tools** > **Silk Test Open Agent** . The Silk Test Open Agent icon displays in the system tray.

Open Agent Port Numbers

When the Open Agent starts, a random, available port is assigned to Silk Test Workbench, Silk Test Classic, Silk Test Recorder, Silk4J, Silk4NET, and the application that you are testing. The port numbers are registered on the information service. Silk Test Workbench, Silk Test Classic, Silk Test Recorder, Silk4NET, or Silk4J contact the information service to determine the port to use to connect to the Open Agent. The information service communicates the appropriate port, and Silk Test Workbench, Silk Test Classic, Silk Test Recorder, Silk4NET, or Silk4J connects to that port. Communication runs directly between Silk Test Workbench, Silk Test Classic, Silk Test Recorder, Silk4NET, or Silk4J and the Agent.

By default, the Open Agent communicates with the information service on port 22901. You can configure additional ports for the information service as alternate ports that work when the default port is not available. By default, the information service uses ports 2966, 11998, and 11999 as alternate ports.

Typically, you do not have to configure port numbers manually. However, if you have a port number conflict or an issue with a firewall, you must configure the port number for that machine or for the information service. You can use a different port number for a single machine or you can use the same available port number for all your machines.

Configuring the Port that Clients Use to Connect to the Information Service

Before you begin this task, stop the Silk Test Open Agent.

Typically, you do not have to configure port numbers manually. The information service handles port configuration automatically. Use the default port of the information service to connect to the Agent. Then, the information service forwards communication to the port that the Agent uses.

The default port of the information service is 22901. When you can use the default port, you can type `hostname` without the port number for ease of use. If you do specify a port number, ensure that it matches the value for the default port of the information service or one of the additional information service ports. Otherwise, communication will fail.

If necessary, you can change the port number that all clients use to connect to the information service.

1. Navigate to the `infoservice.properties.sample` file and open it.

   This file is located in `C:\Documents and Settings\All Users\Application Data\Silk\Silk Test\conf`, where "`C:\Documents and Settings\All Users`" is equivalent to the content of the ALLUSERSPROFILE environment variable, which is set by default on Windows systems.

   This file contains commented text and sample alternate port settings.
2. Change the value for the appropriate port.

   Typically, you configure the information service port settings to avoid problems with a firewall by forcing communication on a specific port.

   Port numbers can be any number from 1 to 65535.

   - `infoservice.default.port` – The default port where the information service runs. By default, this port is set to 22901.
   - `infoservice.additional.ports` – A comma separated list of ports on which the information service runs if the default port is not available. By default, ports 2966, 11998, and 11999 are set as alternate ports.
3. Save the file as `infoservice.properties`.
4. Restart the Open Agent, the Silk Test client, and the application that you want to test.

Configuring the Port that the Silk Test Client or the Test Application Uses to Connect to the Open Agent

Before you begin this task, stop the Silk Test Open Agent.

Typically, you do not have to configure port numbers manually. The information service handles port configuration automatically. Use the default port of the information service to connect to the Agent. Then, the information service forwards communication to the port that the Agent uses.

If necessary, change the port number that the Silk Test client or the application that you want to test uses to connect to the Open Agent.

1. Navigate to the `agent.properties.sample` file and open it.

   By default, this file is located at: `%APPDATA%\Silk\Silk Test\conf`, which is typically `C:\Documents and Settings\<user name>\Application Data\Silk\Silk Test\conf` where *<user name>* equals the current user name.
2. Change the value for the appropriate port.

   Typically, you configure port settings to resolve a port conflict.

   Note: Each port number must be unique. Ensure that the port numbers for the Agent differ from the information service port settings.

   Port numbers can be any number from 1 to 65535.

   Port settings include:

   - `agent.vtadapter.port` – Controls communication between Silk Test Workbench and the Open Agent when running tests.
   - `agent.xpmodule.port` – Controls communication between Silk Test Classic and the Agent when running tests.
   - `agent.autcommunication.port` – Controls communication between the Open Agent and the application that you are testing.
   - `agent.rmi.port` – Controls communication with the Open Agent and Silk4J.
   - `agent.ntfadapter.port` – Controls communication with the Open Agent and Silk4NET.

Note: The ports for Apache Flex testing are not controlled by this configuration file. The assigned port for Flex application testing is 6000 and increases by 1 for each Flex application that is tested. You cannot configure the starting port for Flex testing.

3. Save the file as `agent.properties`.
4. Restart the Open Agent, the Silk Test client, and the application that you want to test.

Configuring the Port that the Silk Test Client Uses to Connect to Silk Test Recorder

Before you begin this task, stop the Silk Test Open Agent.

Typically, you do not have to configure port numbers manually. The information service handles port configuration automatically. Use the default port of the information service to connect to the Agent. Then, the information service forwards communication to the port that the Agent uses.

If necessary, change the port number that Silk Test Classic, Silk4J, or Silk4NET uses to connect to Silk Test Recorder.

1. Navigate to the `recorder.properties.sample` file and open it.

   By default, this file is located at: `%APPDATA%\Silk\Silk Test\conf`, which is typically `C:\Documents and Settings\<user name>\Application Data\Silk\Silk Test\conf` where <*user name*> equals the current user name.
2. Change the `recorder.api.rmi.port` to the port that you want to use.

   Port numbers can be any number from 1 to 65535.

   Note: Each port number must be unique. Ensure that the port numbers for the Agent settings differ from the recorder and the information service port settings.
3. Save the file as `recorder.properties`.
4. Restart the Open Agent, the Silk Test client, and the application that you want to test.

Configuring the Open Agent to Run Remotely in a Network Address Translation (NAT) Environment

To remotely run the Open Agent in a network address translation (NAT) environment, such as on a Lab Manager virtual machine (VM), configure the Agent to include a VM argument.

1. Navigate to the `agent.properties.sample` file and open it.

   By default, this file is located at: `%APPDATA%\Silk\SilkTest\conf`, which is typically `C:\Documents and Settings\<user name>\Application Data\Silk\SilkTest\conf.`
2. Add the following property:

   ```
   java.rmi.server.hostname=<external IP of VM>
   ```
3. Save the file as `agent.properties` .

Desktop Class

The Desktop class is the entry point for accessing the application that you are testing and the Open Agent.

The Desktop class represents a desktop of a specific machine. Therefore, the desktop is associated with one agent, which runs on that machine.

Getting Started with Silk4NET

Perform the following actions to use Silk4NET:

1. Create a Silk4NET project.
2. Add Silk4NET tests to your project. A project can include any combination of recorded tests and manually scripted tests.
3. Execute the tests.
4. Analyze the test results.

Base State

An application's base state is the known, stable state that you expect the application to be in before each test case begins execution, and the state the application can be returned to after each test case has ended execution. This state may be the state of an application when it is first started.

When you create a class for an application, Silk4NET automatically creates a base state.

Base states are important because they ensure the integrity of your tests. By guaranteeing that each test case can start from a stable base state, you can be assured that an error in one test case does not cause subsequent test cases to fail.

Silk4NET automatically ensures that your application is at its base state during the following stages:

- Before a test runs
- During the execution of a test
- After a test completes successfully

Note: Silk4NET stores the base state and any Silk4NET options in the `config.silk4net` configuration file. Silk4NET creates such a file for each Silk4NET project.

Modifying the Base State

You can change the executable location, working directory, locator, or URL of the base state if necessary. For example, if you want to launch tests from a production Web site that were previously tested on a testing Web site, change the base state URL and the tests will run in the new environment.

1. Click **Silk4NET** and choose **Edit Application Configurations**. The **Edit Application Configurations** dialog box opens and lists the existing application configurations.
2. Click **Edit**.
3. In the **Executable Pattern** text box, type the executable name and file path of the desktop application that you want to test.
   For example, you might type `C:\Program Files\Internet Explorer\IEXPLORE.EXE` to specify Internet Explorer.
4. If you are testing a desktop application and you want to use a command line pattern in combination with the executable file, type the command line pattern into the **Command Line Pattern** text box.
5. If you are testing a Web site, in the **Url to navigate** text box, type the Web address for the Web page to launch when a test begins.
6. Click **OK**.

Running the Base State

Before starting to record a test against an application, you can execute the base state to bring all applications, against which you want to record, to the appropriate state for recording.

Depending on the type of the application, the following actions are performed:

- The application configurations of all applications, for which an application configuration is defined in the current project, are executed.
- For Web applications, the Web application is opened in the default browser and to the default URL.

To run the base state:

Click **Silk4NET** > **Run Base State**.

The base state is executed.

Application Configuration

An application configuration defines how Silk4NET connects to the application that you want to test. Silk4NET automatically creates an application configuration when you create the base state. However, at times, you might need to modify, remove, or add an additional application configuration. For example, if you are testing an application that modifies a database and you use a database viewer tool to verify the database contents, you must add an additional application configuration for the database viewer tool.

- For a Windows application, an application configuration includes the following:
  - Executable pattern

    All processes that match this pattern are enabled for testing. For example, the executable pattern for Internet Explorer is `*\IEXPLORE.EXE`. All processes whose executable is named `IEXPLORE.EXE` and that are located in any arbitrary directory are enabled.
  - Command line pattern

    The command line pattern is an additional pattern that is used to constrain the process that is enabled for testing by matching parts of the command line arguments (the part after the executable name). An application configuration that contains a command line pattern enables only processes for testing that match both the executable pattern and the command line pattern. If no command-line pattern is defined, all processes with the specified executable pattern are enabled. Using the command line is especially useful for Java applications because most Java programs run by using `javaw.exe`. This means that when you create an application configuration for a typical Java application, the executable pattern, `*\javaw.exe` is used, which matches any Java process. Use the command line pattern in such cases to ensure that only the application that you want is enabled for testing. For example, if the command line of the application ends with **com.example.MyMainClass** you might want to use ***com.example.MyMainClass** as the command line pattern.
- For a Web application in a desktop browser, an application configuration includes only the browser type.
- For a Web application in a mobile browser, an application configuration includes the following:
  - Browser type.
  - Mobile Device Name.

Modifying an Application Configuration

An application configuration defines how Silk4NET connects to the application that you want to test. Silk4NET automatically creates an application configuration when you create the base state. However, at times, you might need to modify, remove, or add an additional application configuration. For example, if you are testing an application that modifies a database and you use a database viewer tool to verify the database contents, you must add an additional application configuration for the database viewer tool.

1. Click **Silk4NET** and choose **Edit Application Configurations**. The **Edit Application Configurations** dialog box opens and lists the existing application configurations.
2. To add an additional application configuration, click **Add application configuration**. The **Select Application** dialog box opens. Select the tab and then the application that you want to test and click **OK**.
3. To remove an application configuration, click **Remove** next to the appropriate application configuration.
4. To edit an application configuration, click **Edit**.
5. Click **OK**.

Select Application Dialog Box

Use the **Select Application** dialog box to select the application that you want to test, to associate an application with an object map, or to add an application configuration to a test. Application types are listed in tabs on the dialog box. Select the tab for the application type you want to use.

Windows Lists all Microsoft Windows applications that are running on the system. Select an item from the list and click **OK**.

Use the **Hide processes without caption** check box to filter out applications that have no caption.

Web Lists all available browsers, including mobile browsers on any connected mobile devices. Specify the Web page to open in the **Enter URL to navigate** text box. If an instance of the selected browser is already running, you can click **Use URL from running browser** to record against the URL currently displayed in the running browser instance.

Restriction: If you are recording a test for a Web application, you can only record with Internet Explorer. However, you can play back Web tests with other supported browsers and you can record mobile Web applications on any supported mobile browser.

Application Configuration Errors

When the program cannot attach to an application, the following error message opens:
Failed to attach to application <Application Name>. For additional information, refer to the Help.

In this case, one or more of the issues listed in the following table may have caused the failure:

Issue	Reason	Solution
Time out	• The system is too slow. • The size of the memory of the system is too small.	Use a faster system or try to reduce the memory usage on your current system.
User Account Control (UAC) fails	You have no administrator rights on the system.	Log in with a user account that has administrator rights.
Command-line pattern	The command-line pattern is too specific. This issue occurs especially for Java. The replay may not work as intended.	Remove ambiguous commands from the pattern.

Working with Silk4NET Projects

This section describes how you can use Silk4NET projects.

A Silk4NET project contains all the resources needed to test the functionality of your applications by using Silk4NET.

Creating a Silk4NET Project

1. Click **Silk4NET** > **New Project** or **File** > **New Project** . The **New Project** dialog box displays.
2. Under **Installed** > **Templates**, click **Visual Basic** or **Visual C#**, select **Test** and then select **Silk4NET Project**.
3. Type a name for the project into the **Name** field.
4. *Optional:* Type a name for the solution into the **Solution** field.
5. Click **OK**. The **Create a Silk4NET Test** dialog box opens.
6. Select how you want to create your Silk4NET test by clicking one of the following option buttons:

Record a Silk4NET test	Record actions and verifications against your application under test and generate a new test containing the recorded automation statements.
Create an empty Silk4NET test	Create an empty test that can be filled with automation statements later on.

7. Click **OK**. If you have selected to create an empty Silk4NET test, a new solution containing the Silk4NET project is created. Additionally, a Silk4NET test is created in the project with the following language-specific file name:
   - `UnitTest1.vb`
   - `UnitTest1.cs`
8. If you have selected to record a new Silk4NET test, the **Select Application** dialog box opens. Select the type of application that you want to test by clicking on a tab and then selecting the application in the list.
9. To test a Web application, specify the URL of the Web application.

   Specify the Web page to open in the **Enter URL to navigate** text box. If an instance of the selected browser is already running, you can click **Use URL from running browser** to record against the URL currently displayed in the running browser instance.
10. Click **OK**. If you have selected an existing instance of Google Chrome on which you want to replay a test method, Silk4NET checks whether the automation support is included. If the automation support is not included, Silk4NET informs you that Google Chrome has to be restarted. The application and the **Recording** dialog box or the **Mobile Recording** dialog box open.

Note: You can also use the context menu in the **Solution Explorer** to add Silk4NET projects to an existing solution.

Working with Silk4NET Tests

Describes how you can use Silk4NET tests.

You can create new Silk4NET tests by recording user actions made against your AUT or by manually scripting your test classes and methods in Visual Basic or Visual C#.

Adding a Silk4NET Test to a Project

You can only add Silk4NET tests to an existing Silk4NET or Test project. If no Silk4NET or Test project exists, create a Silk4NET or Test project before you try to create a Silk4NET test.

1. Click **Silk4NET** > **New Test** or **Project** > **Add New Item** .

   Note: If your solution contains more than one Silk4NET projects, select the project to which you want to add the new test from the list in the **Project Selector**.

   The **Add New Item** dialog box opens.
2. Under **Installed**, click one of the following:
   - If your project is a Visual Basic project, click **Common Items** > **Silk4NET Test**.
   - If your project is a Visual C# project, click **Visual C# Items** > **Silk4NET Test**.
3. Type a name for the test into the **Name** field and click **Add**. The **Create a Silk4NET Test** dialog box opens.
4. Select how you want to create your Silk4NET test by clicking one of the following option buttons:

Record a Silk4NET test	Record actions and verifications against your application under test and generate a new test containing the recorded automation statements.
Create an empty Silk4NET test	Create an empty test that can be filled with automation statements later on.

5. Click **OK**. If you have selected to create an empty Silk4NET test, a new solution containing the Silk4NET project is created. Additionally, a Silk4NET test is created in the project with the following language-specific file name:
   - `UnitTest1.vb`
   - `UnitTest1.cs`
6. If you have selected to record a new Silk4NET test, the **Select Application** dialog box opens. Select the type of application that you want to test by clicking on a tab and then selecting the application in the list.
7. To test a Web application, specify the URL of the Web application.

   Specify the Web page to open in the **Enter URL to navigate** text box. If an instance of the selected browser is already running, you can click **Use URL from running browser** to record against the URL currently displayed in the running browser instance.
8. Click **OK**. If you have selected an existing instance of Google Chrome on which you want to replay a test method, Silk4NET checks whether the automation support is included. If the automation support is not included, Silk4NET informs you that Google Chrome has to be restarted. The application and the **Recording** dialog box or the **Mobile Recording** dialog box open.

If you have selected to record the test, the recorded test is added to your project. If you have selected to add an empty test, an empty Silk4NET test is added to your project.

Note: You can also use the context menu in the **Solution Explorer** to add Silk4NET tests to your Silk4NET or Test project.

Recording a Silk4NET Test

1. Click **Silk4NET** > **New Test** or **Project** > **Add New Item** .

   Note: If your solution contains more than one Silk4NET projects, select the project to which you want to add the new test from the list in the **Project Selector**.

   The **Add New Item** dialog box opens.
2. Under **Installed**, click one of the following:
   - If your project is a Visual Basic project, click **Common Items** > **Silk4NET Test**.
   - If your project is a Visual C# project, click **Visual C# Items** > **Silk4NET Test**.
3. Type a name for the test into the **Name** field and click **Add**. The **Create a Silk4NET Test** dialog box opens.
4. Select **Record a Silk4NET test** and click **OK**.
5. Select the tab that corresponds to the type of application that you are testing:
   - If you are testing a standard application that does not run in a browser, select the **Windows** tab.
   - If you are testing a Web application or a mobile Web application, select the **Web** tab.
6. To test a standard application, select the application from the list.
7. To test a Web application or a mobile Web application, select one of the installed browsers or mobile browsers from the list.

   Specify the Web page to open in the **Enter URL to navigate** text box. If an instance of the selected browser is already running, you can click **Use URL from running browser** to record against the URL currently displayed in the running browser instance. For the tutorial, select **Internet Explorer** and specify *http://demo.borland.com/InsuranceWebExtJS/* in the **Browse to URL** text box.
8. Click **OK**. If you have selected an existing instance of Google Chrome on which you want to replay a test method, Silk4NET checks whether the automation support is included. If the automation support is not included, Silk4NET informs you that Google Chrome has to be restarted. The application and the **Recording** dialog box or the **Mobile Recording** dialog box open.
9. Perform the interactions, which you want to record, with your application under test.

   For additional information about recording a mobile Web application, see *Recording Mobile Web Applications*. For additional information about recording an action against a mobile device, see *Interacting with a Mobile Device*.
10. When you are finished with recording, click **Stop Recording**. The **Recording Complete** dialog box opens. From this dialog box, you can click **Playback** to replay the recorded test.
    - If you are using Visual Studio 2010, you can also access the **Test View** in Visual Studio, where you can replay and manage your tests.
    - If you are using Visual Studio 2012, you can also access the **Test Explorer** in Visual Studio, where you can replay and manage your tests.

The recorded interactions are added as a file to your project. The default file name of the generated file is `UnitTest<Index>.cs` or `UnitTest<Index>.vb`, depending on the default programming language of your project. For example, if you are recording the first test for a Visual Basic project, the name of the generated file is `UnitTest1.vb`

Note: You can also create a new project and record the new test into the new project.

Characters Excluded from Recording and Replaying

The following characters are ignored by Silk Test during recording and replay:

Characters	Control
...	`MenuItem`
tab	`MenuItem`
&	All controls. The ampersand (&) is used as an accelerator and therefore not recorded.

Manually Creating a Silk4NET Test

1. Add a Silk4NET test to your project.
2. *Optional:* To add support for controls of a specific application technology, you must include an import statement at the beginning of the test that references the application technology namespace, as shown in the following examples:

```
'Visual Basic .NET
Imports SilkTest.Ntf.Wpf
Imports SilkTest.Ntf.XBrowser
Imports SilkTest.Ntf.Win32
```

```
//C#
using SilkTest.Ntf.Wpf;
using SilkTest.Ntf.XBrowser;
using SilkTest.Ntf.Win32;
```

3. Configure the base state of the test application. For example:

```
'Visual Basic .NET
Dim baseState = New BrowserBaseState(BrowserType.InternetExplorer,
"www.borland.com")
baseState.Execute()
```

```
//C#
BrowserBaseState baseState = new
BrowserBaseState(BrowserType.InternetExplorer, "www.borland.com");
baseState.Execute();
```

   Note: The base state makes sure that the application that you want to test is running and in the foreground. This ensures that tests will always start with the same application state, which makes them more reliable. In order to use the base state, it is necessary to specify what the main window looks like and how to launch the application that you want to test if it is not running. Creating a base state is optional. However, it is recommended as a best practice.

4. Add test classes and methods that test the desired functionality of the test application.

Adding a Verification to a Script while Recording

Do the following to add a verification to a script during recording:

1. Begin recording.
2. Move the mouse cursor over the object that you want to verify and press **Ctrl+Alt**.

   When you are recording a mobile Web application, you can also click on the object and click **Add Verification**.

   This option temporarily suspends recording and displays the **Select Verification Type** dialog box.

3. Select **Verify properties of the TestObject**.

   For information about adding an image verification to a script, see *Adding an Image Verification During Recording*.
4. Click **OK**. The **Verify Properties** dialog box opens.
5. To select the property that you want to verify, check the corresponding check box.
6. Click **OK**. Silk4NET adds the verification to the recorded script and you can continue recording.

Adding a Locator or an Object Map Item to a Test Method Using the Locator Spy

Manually capture a locator or an object map item using the **Locator Spy** and copy the locator or the object map item to the test method. For instance, you can identify the caption or the XPath locator string for GUI objects using the **Locator Spy**. Then, copy the relevant locator strings and attributes into the test methods in your scripts.

1. Open the test class that you want to modify.
2. Click **Silk4NET** > **Locator Spy**. The **Locator Spy** and the application under test open. If you are testing a mobile application, a recording window opens, representing the screen of the mobile device. You cannot perform actions in the recording window, but you can perform actions on the mobile device or emulator and then refresh the recording window.
3. *Optional:* To display locators in the **Locator** column instead of object map items, uncheck the **Show object map identifiers** check box.

   Object map item names associate a logical name (an alias) with a control or a window, rather than the control or window's locator. By default, object map item names are displayed.

   Note: When you check or uncheck the check box, the change is not automatically reflected in the locator details. To update an entry in the **Locator Details** table, you have to click on the entry.
4. Position the mouse over the object that you want to record. The related locator string or object map item shows in the **Selected Locator** text box.
5. Press **Ctrl+Alt** to capture the object.

   Note: Press **Ctrl+Shift** to capture the object if you specified the alternative record break key sequence on the **General Recording Options** page of the **Script Options** dialog box.
6. *Optional:* Click **Show additional locator attributes** to display any related attributes in the **Locator Attribute** table.
7. *Optional:* You can replace a recorded locator attribute with another locator attribute from the **Locator Attribute** table.

   For example, your recorded locator might look like the following:

   ```
   /BrowserApplication//BrowserWindow//input[@id='loginButton']
   ```

   If you have a `textContents Login` listed in the **Locator Attribute** table, you can manually change the locator to the following:

   ```
   /BrowserApplication//BrowserWindow//input[@textContents='Login']
   ```

   The new locator displays in the **Selected Locator** text box.
8. To copy the locator, click **Copy Locator to Clipboard**.

   In the **Selected Locator** text box, you can also mark the portion of the locator string that you want to copy, and then you can right-click the marked text and click **Copy**.
9. In the script, position your cursor to the location to which you want to paste the recorded locator.

   For example, position your cursor in the appropriate parameter of a `Find` method in the script.

   The test method, into which you want to paste the locator, must use a method that can take a locator as a parameter. Using the **Locator Spy** ensures that the locator is valid.

10. Copy the locator or the object map item to the test case or to the Clipboard.
11. Click **Close**.

Running Silk4NET Tests

This topic describes how you can run your Silk4NET tests in Visual Studio.

1. To view all the tests that are available in the selected project or solution:
   - In Visual Studio 2010, click **Test** > **Windows** > **Test View**.
   - In Visual Studio 2012, click **Test** > **Windows** > **Test Explorer**.
2. In the **Test View** or the **Test Explorer**, depending on which version of Visual Studio you are using, select the tests that you want to execute.
3. Right-click on your selection and click one of the following:
   - In Visual Studio 2010, click **Run Selection**.
   - In Visual Studio 2012, click **Run Selected Tests**.

   To run all tests in the selected project or solution, click **Run All** in the **Test View** or the **Test Explorer**, depending on which version of Visual Studio you are using.
4. If you are testing a Web application and multiple browsers that are supported for replay are installed on the machine, the **Select Browser** dialog box opens. Select the browser and click **Run**.

   Note: If multiple applications are configured for the current project, the **Select Browser** dialog box is not displayed.
5. When the test execution is complete, the **Playback Complete** dialog box opens. Click **Explore Results** to examine the results of the tests with TrueLog or click **OK** to close the dialog box.

Note: When you execute your tests, and Visual Studio starts the components that are needed for the execution of the tests, Visual Studio will clean up everything when the test execution is finished, terminating the Open Agent and all open browser windows.

Analyzing Test Results

After running a test, you can review the test results and analyze the success or failure of the test run.

1. Run a Silk4NET test. When the execution is finished, the **Playback Complete** dialog box opens.
2. Click **Explore Results** to examine the results of the tests with TrueLog. Silk TrueLog Explorer opens.
3. Click through the results in Silk TrueLog Explorer.

   Silk TrueLog Explorer captures a screenshot whenever a test fails.

Visual Execution Logs with TrueLog

TrueLog is a powerful technology that simplifies root cause analysis of test case failures through visual verification. The results of test runs can be examined in TrueLog Explorer. When an error occurs during a test run, TrueLog enables you to easily locate the line in your script that generated the error so that the issue can be resolved.

Note: TrueLog is supported only for one local or remote agent in a script. When you use multiple agents, for example when testing an application on one machine, and that application writes data to a database on another machine, a TrueLog is written only for the first agent that was used in the script. When you are using a remote agent, the TrueLog file is also written on the remote machine.

For additional information about TrueLog Explorer, refer to the *Silk TrueLog Explorer User Guide*, located in **Start** > **Programs** > **Silk** > **Silk Test** > **Documentation**.

You can enable TrueLog in Silk4NET to create visual execution logs during the execution of Silk4NET tests. The TrueLog file is created in the working directory of the process that executed the Silk4NET tests.

The default setting is that screenshots are only created when an error occurs in the script, and only test cases with errors are logged.

Enabling TrueLog

For new Silk4NET scripts, TrueLog is enabled by default. To enable TrueLog for existing Silk4NET scripts, which are using the Visual Studio Unit Testing Framework, you have to replace the `TestClass` attribute of all test classes in the script with the `SilkTestClass` attribute.

To enable TrueLog:

1. Open the script that contains the test class for you want to enable TrueLog.
2. Add the `SilkTestClass` attribute to the test class.

The TrueLog is created in the `TestResults` sub-directory of the directory, in which the Visual Studio solution file and the results of the Visual Studio Unit Testing Framework are located. The Visual Studio solution file is the file in which the Silk4NET scripts are located. When the Silk4NET test execution is complete, a dialog box opens, and you can click **Explore Results** to review the TrueLog for the completed test.

Examples

To enable TrueLog for a class in a Visual Basic script, use the following code:

```
<SilkTestClass()> Public Class MyTestClass
  <TestMethod()> Public Sub MyTest()
    ' my test code
  End Sub
End Sub
```

To enable TrueLog for a class in a C# script, use the following code:

```
[SilkTestClass]
public class MyTestClass {
  [TestMethod]
  public void MyTest() {
    // my test code
  }
}
```

Why is TrueLog Not Displaying Non-ASCII Characters Correctly?

TrueLog Explorer is a MBCS-based application, meaning that to be displayed correctly, every string must be encoded in MBCS format. When TrueLog Explorer visualizes and customizes data, many string conversion operations may be involved before the data is displayed.

Sometimes when testing UTF-8 encoded Web sites, data containing characters cannot be converted to the active Windows system code page. In such cases, TrueLog Explorer will replace the non-convertible characters, which are the non-ASCII characters, with a configurable replacement character, which usually is '?'.

To enable TrueLog Explorer to accurately display non-ASCII characters, set the system code page to the appropriate language, for example Japanese.

Using Silk4NET with Team Foundation Server

This section describes how you can use Visual Studio Team Foundation Server (TFS) to execute Silk4NET tests.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Executing Silk4NET Tests in TFS

Note: For detailed information on the steps in this task that describe functionality of TFS or Visual Studio, refer to the documentation of these products.

You can use a TFS to execute Silk4NET tests:

1. In Visual Studio, open the **Team Explorer View** and click **Connect to Team Project** to connect to the TFS.
2. In the **Team Explorer View**, add your Silk4NET project to the TFS.
3. *Optional:* Add additional Silk4NET tests to your Silk4NET project.
4. In the **Team Explorer View**, check in the tests into the TFS.
5. Right-click on the solution that includes your Silk4NET project and click **Add** > **New Item** > **Test** > **Test Settings File** to create a new test settings file.
6. Double click on the new test settings file to edit it.
7. In the test settings file, select **Data and diagnostics**.
8. Check **Enable Silk4NET TrueLog** to enable the Silk4NET TrueLog data collector.
9. *Optional:* Under **Roles** in the test settings file, you can configure the test controller that you would like to use to execute the tests.
10. In the **Team Explorer View**, create a new build definition.
11. Add your test settings file to the build definition.
12. Configure the build definition so that automated tests for your Silk4NET test project assembly are run after the build.
13. Follow the instructions in *How to: Set Up Your Test Agent to Run Tests that Interact with the Desktop* to enable the interaction between Silk4NET and the AUT.
14. In the **Team Explorer View**, run the build definition to execute the Silk4NET tests.
15. *Optional:* Analyze the TrueLog files.

Locating TrueLog Files for Silk4NET Tests Executed with TFS

When you execute Silk4NET tests with TFS, the **Playback Complete** dialog box is not displayed after the execution is finished, and the TrueLog files for the tests are not written on your local machine. Locate the generated TrueLog files to analyze the results of the Silk4NET tests that you have executed with TFS.

If you have enabled the Silk4NET TrueLog data collector, you can perform the following steps to locate the TrueLog files:

1. In the **Team Explorer**, right-click on the build for which you want to locate the TrueLog file.
2. Click **Test run passed**. Under **Collected files** you can see the TrueLog file
3. Double-click on the TrueLog file to download it.

For information on enabling the Silk4NET TrueLog data collector, see *Executing Silk4NET Tests in TFS*.

Setting Script Options

Specify script options for recording, browser and custom attributes, classes to ignore, synchronization, and the replay mode.

Note: For each Silk4NET project, Silk4NET creates the `config.Silk4net` configuration file. Silk4NET stores the base state of the application under test and all options in this file. The options are then used during replay.

Setting TrueLog Options

Enable TrueLogs to capture bitmaps and to log information for Silk4NET.

Logging bitmaps and controls in TrueLogs may adversely affect the performance of Silk4NET. Because capturing bitmaps and logging information can result in large TrueLog files, you may want to log test cases with errors only and then adjust the TrueLog options for test cases where more information is needed.

The results of test runs can be examined in TrueLog Explorer. For additional information about TrueLog Explorer, refer to the *Silk TrueLog Explorer User Guide*, located in **Start** > **Programs** > **Silk** > **Silk Test** > **Documentation**.

To enable TrueLog and customize the information that the TrueLog collects for Silk4NET, perform the following steps:

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **TrueLog** tab.
3. Select the **Screenshot mode**.

   Default is **None**.
4. *Optional:* Set the **Delay**.

   This delay gives Windows time to draw the application window before a bitmap is taken. You can try to add a delay if your application is not drawn properly in the captured bitmaps.
5. Click **OK**.

Setting Recording Preferences

Set the shortcut key combination to pause recording and specify whether absolute values and mouse move actions are recorded.

Note: All the following settings are optional. Change these settings if they will improve the quality of your test methods.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **Recording** tab.
3. To set `Ctrl+Shift` as the shortcut key combination to use to pause recording, check the **OPT_ALTERNATE_RECORD_BREAK** check box.

   By default, `Ctrl+Alt` is the shortcut key combination.
4. To record absolute values for scroll events, check the **OPT_RECORD_SCROLLBAR_ABSOLUT** check box.
5. To record mouse move actions for Web application, Win32 applications, and Windows forms applications, check the **OPT_RECORD_MOUSEMOVES** check box. You cannot record mouse move

actions for child technology domains of the xBrowser technology domain, for example Apache Flex and Swing.

6. If you record mouse move actions, in the **OPT_RECORD_MOUSEMOVE_DELAY** text box, specify how many milliseconds the mouse has to be motionless before a `MouseMove` is recorded

   By default this value is set to 200.
7. To record text clicks instead of `Click` actions on objects where `TextClick` actions usually are preferable to `Click` actions, check the **OPT_RECORD_TEXT_CLICK** check box.
8. To record image clicks instead of `Click` actions on objects where `ImageClick` actions usually are preferable to `Click` actions, check the **OPT_RECORD_IMAGE_CLICK** check box.
9. To record object maps, check the **OPT_RECORD_OBJECTMAPS** check box.
10. To use additional attributes of the element when merging object maps during locator recording, check the **OPT_OBJECTMAPS_SMART_MERGE** check box.

    If the check box is unchecked, only the XPath is used for merging and any additional attributes, which might lead to ambiguous usage of object map IDs in a recorded script, are not used to map locators to existing object map entries.
11. Click **OK**.

Setting Browser Recording Options

Specify browser attributes to ignore while recording and whether to record native user input instead of DOM functions.

Note: All the following settings are optional. Change these settings if they will improve the quality of your test methods.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **Browser** tab.
3. In the **Locator attribute name exclude list** grid, type the attribute names to ignore while recording. For example, if you do not want to record attributes named `height`, add the `height` attribute name to the grid.

   Separate attribute names with a comma.
4. In the **Locator attribute value exclude list** grid, type the attribute values to ignore while recording. For example, if you do not want to record attributes assigned the value of `x-auto`, add `x-auto` to the grid.

   Separate attribute values with a comma.
5. To record native user input instead of DOM functions, check the **OPT_XBROWSER_RECORD_LOWLEVEL** check box.

   For example, to record `Click` instead of `DomClick` and `TypeKeys` instead of `SetText`, check this check box.

   If your application uses a plug-in or AJAX, use native user input. If your application does not use a plug-in or AJAX, we recommend using high-level DOM functions, which do not require the browser to be focused or active during playback. As a result, tests that use DOM functions are faster and more reliable.
6. To set the maximum length for locator attribute values, type the length into the field in the **Maximum attribute value length** section.

   If the actual length exceeds that limit the value is truncated and a wild card (*) is appended. By default this value is set to 20 characters.
7. To automatically search for an unobstructed click spot on the specified target element, check the **OPT_XBROWSER_ENABLE_SMART_CLICK_POSITION** check box.
8. Click **OK**.

Setting Custom Attributes

Silk4NET includes a sophisticated locator generator mechanism that guarantees locators are unique at the time of recording and are easy to maintain. Depending on your application and the frameworks that you use, you might want to modify the default settings to achieve the best results. You can use any property that is available in the respective technology as a custom attribute given that they are either numbers (integers, doubles), strings, item identifiers, or enumeration values.

A well-defined locator relies on attributes that change infrequently and therefore requires less maintenance. Using a custom attribute is more reliable than other attributes like caption or index, since a caption will change when you translate the application into another language, and the index might change when another object is added.

For the technology domains listed in the list box on the **Custom Attributes** tab, you can also retrieve arbitrary properties (such as a WPFButton that defines *myCustomProperty*) and then use those properties as custom attributes. To achieve optimal results, add a custom automation ID to the elements that you want to interact with in your test. In Web applications, you can add an attribute to the element that you want to interact with, such as `<div myAutomationId= "my unique element name" />`. Or, in Java SWT, the developer implementing the GUI can define an attribute (for example `testAutomationId`) for a widget that uniquely identifies the widget in the application. A tester can then add that attribute to the list of custom attributes (in this case, `testAutomationId`), and can identify controls by that unique ID. This approach can eliminate the maintenance associated with locator changes.

If multiple objects share the same attribute value, such as a caption, Silk4NET tries to make the locator unique by combining multiple available attributes with the "and" operation and thus further narrowing down the list of matching objects to a single object. Should that fail, an index is appended. Meaning the locator looks for the *nth* control with the caption *xyz*.

If more than one object is assigned the same custom attribute value, all the objects with that value will return when you call the custom attribute. For example, if you assign the unique ID, `loginName` to two different text fields, both fields will return when you call the `loginName` attribute.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **Custom Attributes** tab.
3. From the **Select a tech domain** list box, select the technology domain for the application that you are testing.

   Note: You cannot set custom attributes for Flex or Windows API-based client/server (Win32) applications.
4. Add the attributes that you want to use to the list.

   If custom attributes are available, the locator generator uses these attributes before any other attribute. The order of the list also represents the priority in which the attributes are used by the locator generator. If the attributes that you specify are not available for the objects that you select, Silk4NET uses the default attributes for the application that you are testing.

   Separate attribute names with a comma.

   Note: To include custom attributes in a Web application, add them to the html tag. For example type, `<input type='button' bcauid='abc' value='click me' />` to add an attribute called `bcauid`.

   Note: To include custom attributes in a Java SWT control, use the `org.swt.widgets.Widget.setData(String key, Object value)` method.

   Note: To include custom attributes in a Swing control, use the `SetClientProperty("propertyName", "propertyValue")` method.
5. Click **OK**.

Setting Classes to Ignore

Specify the names of any classes that you want to ignore during recording and playback.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **Transparent Classes** tab.
3. In the **Transparent classes** grid, type the name of the class that you want to ignore during recording and playback.

   Separate class names with a comma.
4. Click **OK**.

Setting WPF Classes to Expose During Recording and Playback

Specify the names of any WPF classes that you want to expose during recording and playback. For example, if a custom class called *MyGrid* derives from the WPF `Grid` class, the objects of the *MyGrid* custom class are not available for recording and playback. `Grid` objects are not available for recording and playback because the `Grid` class is not relevant for functional testing since it exists only for layout purposes. As a result, `Grid` objects are not exposed by default. In order to use custom classes that are based on classes that are not relevant to functional testing, add the custom class, in this case *MyGrid*, to the **OPT_WPF_CUSTOM_CLASSES** option. Then you can record, playback, find, verify properties, and perform any other supported actions for the specified classes.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **WPF** tab.
3. In the **Custom WPF class names** grid, type the name of the class that you want to expose during recording and playback.

   Separate class names with a comma.
4. Click **OK**.

Setting Synchronization Options

Specify the synchronization and timeout values for Web applications.

Note: All the following settings are optional. Change these settings if they will improve the quality of your test methods.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **Synchronization** tab.
3. To specify the synchronization algorithm for the ready state of a web application, from the **OPT_XBROWSER_SYNC_MODE** list box, choose an option.

   The synchronization algorithm configures the waiting period for the ready state of an invoke call. By default, this value is set to **AJAX**.
4. In the **Synchronization exclude list** text box, type the entire URL or a fragment of the URL for any service or Web page that you want to exclude.

   Some AJAX frameworks or browser applications use special HTTP requests, which are permanently open in order to retrieve asynchronous data from the server. These requests may let the synchronization hang until the specified synchronization timeout expires. To prevent this situation,

either use the HTML synchronization mode or specify the URL of the problematic request in the **Synchronization exclude list** setting.

For example, if your Web application uses a widget that displays the server time by polling data from the client, permanent traffic is sent to the server for this widget. To exclude this service from the synchronization, determine what the service URL is and enter it in the exclusion list.

For example, you might type:

- http://example.com/syncsample/timeService
- timeService
- UICallBackServiceHandler

Separate multiple entries with a comma.

Note: If your application uses only one service, and you want to disable that service for testing, you must use the HTML synchronization mode rather than adding the service URL to the exclusion list.

5. To specify the maximum time, in milliseconds, to wait for an object to be ready, type a value in the **OPT_SYNC_TIMEOUT** text box.

   By default, this value is set to **300000**.
6. To specify the time, in milliseconds, to wait for an object to be resolved during replay, type a value in the **OPT_WAIT_RESOLVE_OBJDEF** text box.

   By default, this value is set to **5000**.
7. To specify the time, in milliseconds, to wait before the agent attempts to resolve an object again, type a value in the **OPT_WAIT_RESOLVE_OBJDEF_RETRY** text box.

   By default, this value is set to **500**.
8. Click **OK**.

Setting Replay Options

Specify whether you want to ensure that the object that you want to test is active and whether to override the default replay mode. The replay mode defines whether controls are replayed with the mouse and keyboard or with the API. Use the default mode to deliver the most reliable results. When you select another mode, all controls use the selected mode.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **Replay** tab. The **Replay Options** page displays.
3. From the **OPT_REPLAY_MODE** list box, select one of the following options:
   - **Default** – Use this mode for the most reliable results. By default, each control uses either the mouse and keyboard (low level) or API (high level) modes. With the default mode, each control uses the best method for the control type.
   - **High level** – Use this mode to replay each control using the API of the target technology. For example for Rumba controls, the Rumba RDE API is used to replay the controls.
   - **Low level** – Use this mode to replay each control using the mouse and keyboard.
4. To ensure that the object that you want to test is active, check the **OPT_ENSURE_ACTIVE_OBJDEF** check box.
5. To change the time to wait for an object to become enabled during playback, type the new time into the field in the **Object enabled timeout** section.

   The time is specified in milliseconds. The default value is 1000.
6. Click **OK**.

Setting Advanced Options

Specify whether you want to enable Windows Accessibility, whether the focus should be removed from the window during text capture, and whether locator attribute names should be case sensitive.

1. Click **Silk4NET** and choose **Edit Options**. The **Script Options** dialog box opens.
2. Click the **Advanced** tab. The **Advanced Options** page displays.
3. Check the **OPT_ENABLE_ACCESSIBILITY** check box to enable Microsoft Accessibility in addition to the normal Win32 control recognition.
4. Check the **OPT_REMOVE_FOCUS_ON_CAPTURE_TEXT** check box to remove the focus from the window before capturing a text.

   A text capture is performed during recording and replay by the following methods:

   - `TextClick`
   - `TextCapture`
   - `TextExists`
   - `TextRect`
5. Check the **OPT_LOCATOR_ATTRIBUTES_CASE_SENSITIVE** check box to set locator attribute names to be case sensitive. The names of locator attributes for mobile Web applications are always case insensitive, and this option is ignored when recording or replaying mobile Web applications.
6. Set the default accuracy level for new image assets by selecting a value from 1 (low accuracy) to 10 (high accuracy) from the **OPT_IMAGE_ASSET_DEFAULT_ACCURACY** list box.
7. Set the default accuracy level for new image verification assets by selecting a value from 1 (low accuracy) to 10 (high accuracy) from the **OPT_IMAGE_VERIFICATION_DEFAULT_ACCURACY** list box.
8. Click **OK**.

Silk4NET Sample Tests

The Silk4NET sample tests are packaged in a Visual Studio solution which you can open and view as well as run against the Silk Test sample applications.

To open the sample projects, click **Open sample projects** in the *Silk4NET Start Page*, or click **FILE** > **Open Project** in Visual Studio and browse to `\Users\Public\Documents\SilkTest\samples\Silk4NET`. Select the folder that corresponds to the Visual Studio version that you are using and select the samples solution file. Then click **Open**.

In addition to the installed Silk4NET sample applications, the set of Silk4NET sample tests includes several tests for the following Silk Test Web-based sample applications:

Insurance Co. Web site	*http://demo.borland.com/InsuranceWebExtJS/*
Green Mountain Outpost Web	*http://demo.borland.com/gmopost/*

Object Recognition

Silk4NET enables you to easily identify the objects in your application under test.

Within Silk4NET, literal references to identified objects are referred to as *locators*. Silk4NET uses locators to find and identify objects in the application under test (AUT). Locators are a subset of the XPath query language, which is a common XML-based language defined by the World Wide Web Consortium, W3C.

Locator Basic Concepts

Silk4NET supports a subset of the XPath query language. For additional information about XPath, see *http://www.w3.org/TR/xpath20/*.

XPath expressions rely on the current context, the position of the object in the hierarchy on which the `Find` method was invoked. All XPath expressions depend on this position, much like a file system. For example:

- "//Shell" finds all shells in any hierarchy starting from the current context.
- "Shell" finds all shells that are direct children of the current context.

Additionally, some XPath expressions are context sensitive. For example, myWindow.find(xPath) makes myWindow the current context.

Dynamic object recognition uses a `Find` or `FindAll` functions to identify an object in a test case. Silk Test Classic provides an alternative to using `Find` or `FindAll` functions in scripts that use XPath queries. You can use locator keywords in an INC file to create scripts that use dynamic object recognition and window declarations.

Object Type and Search Scope

A locator typically contains the type of object to identify and a search scope. The search scope is one of the following:

- //
- /

Locators rely on the current object, which is the object for which the locator is specified. The current object is located in the object hierarchy of the application's UI. All locators depend on the position of the current object in this hierarchy, much like a file system.

XPath expressions rely on the *current context*, which is the position of the object in the hierarchy on which the `Find` method was invoked. All XPath expressions depend on this position, much like a file system.

Note:

The object type in a locator for an HTML element is either the HTML tag name or the class name that Silk4NET uses for this object. For example, the locators `//a` and `//DomLink`, where `DomLink` is the name for hyperlinks in Silk4NET, are equivalent. For all non-HTML based technologies only the Silk4NET class name can be used.

Example

- `//a` identifies hyperlink objects in any hierarchy relative to the current object.
- `/a` identifies hyperlink objects that are direct children of the current object.

Note: <*a*> is the HTML tag for hyperlinks on a Web page.

Example

The following code sample identifies the first hyperlink in a browser. This example assumes that a variable with the name *browserWindow* exists in the script that refers to a running browser instance. Here the type is "a" and the current object is *browserWindow*.

VB

```
Dim link As DomLink = browserWindow.DomLink("//a")
```

C#

```
DomLink link = browserWindow.DomLink("//a");
```

Using Attributes to Identify an Object

To identify an object based on its properties, you can use locator attributes. The locator attributes are specified in square brackets after the type of the object.

Example

The following sample uses the `textContents` attribute to identify a hyperlink with the text *Home*. If there are multiple hyperlinks with the same text, the locator identifies the first one.

VB

```
 Dim link as DomLink = browserWindow.DomLink("//
a[@textContents='Home']")
```

C#

```
DomLink link = browserWindow.DomLink("//
a[@textContents='Home']");
```

Locator Syntax

Silk4NET supports a subset of the XPath query language to locate UI controls.

The following table lists the constructs that Silk4NET supports.

Note: <*a*> is the HTML tag for hyperlinks on a Web page.

Supported Locator Construct	Sample	Description
//	`//a`	Identifies objects that are descendants of the current object. The example identifies hyperlinks on a Web page.
/	`/a`	Identifies objects that are direct children of the current object. Objects located on lower hierarchy levels are not recognized.

Supported Locator Construct	Sample	Description
		The example identifies hyperlinks on a Web page that are direct children of the current object.
Attribute	`//a[@textContents='Home']`	Identifies objects by a specific attribute. The example identifies hyperlinks with the text *Home*.
Index	Example 1: `//a[3]` Example 2: `//a[@textContents='Home'][2]`	Identifies a specific occurrence of an object if there are multiple ones. Indices are 1-based in locators. Example 1 identifies the third hyperlink and Example 2 identifies the second hyperlink with the text *Home*.
Logical Operators: and, or, not, =, !=	Example 1: `//a[@textContents='Remove' or @textContents='Delete']` Example 2: `//a[@textContents!='Remove']` Example 3: `//a[not(@textContents='Delete' or @id='lnkDelete') and @href='*/delete']`	Identifies objects by using logical operators to combine attributes. Example 1 identifies hyperlinks that either have the caption *Remove* or *Delete*, Example 2 identifies hyperlinks with a text that is not *Remove*, and Example 3 shows how to combine different logical operators.
..	Example 1: `//a[@textContents='Edit']/..` Example 2: `//a[@textContents='Edit']/..//a[@textContents='Delete']`	Identifies the parent of an object. Example 1 identifies the parent of the hyperlink with the text *Edit* and Example 2 identifies a hyperlink with the text *Delete* that has a sibling hyperlink with the text *Edit*.
*	Example 1: `//*[@textContents='Home']` Example 2: `/*/a`	Identifies objects without considering their types, like hyperlink, text field, or button. Example 1 identifies objects with the given text content, regardless of their type, and Example 2 identifies hyperlinks that are second-level descendants of the current object.

The following table lists the locator constructs that Silk4NET does not support.

Unsupported Locator Construct	Example
Comparing two attributes with each other.	`//a[@textContents = @id]`

Unsupported Locator Construct	Example
An attribute name on the right side is not supported. An attribute name must be on the left side.	`//a['abc' = @id]`
Combining multiple locators with `and` or `or`.	`//a[@id = 'abc'] or ..//Checkbox`
More than one set of attribute brackets.	`//a[@id = 'abc'] [@textContents = '123']` (use `//a [@id = 'abc' and @textContents = '123']` instead)
More than one set of index brackets.	`//a[1][2]`

Any construct that does not explicitly specify a class or the class wildcard, such as including a wildcard as part of a class name.	`//[@id = 'abc']`
	(use `//*[@id = 'abc']` instead)
	`"//*//a[@id='abc']"`

Using Locators

Within Silk4NET, literal references to identified objects are referred to as *locators*. For convenience, you can use shortened forms for the locator strings in scripts. Silk4NET automatically expands the syntax to use full locator strings when you playback a script. When you manually code a script, you can omit the following parts in the following order:

- The search scope, `//`.
- The object type name. Silk4NET defaults to the class name.
- The surrounding square brackets of the attributes, `[ ]`.

When you manually code a script, we recommend that you use the shortest form available.

Note: When you identify an object, the full locator string is captured by default.

The following locators are equivalent:

- The first example uses the full locator string.

  VB
  ```
  _desktop.DomLink("//BrowserApplication//BrowserWindow//
  a[@textContents='Home']").Select()
  ```

  C#
  ```
  _desktop.DomLink("//BrowserApplication//BrowserWindow//
  a[@textContents='Home']").Select();
  ```

  To confirm the full locator string, use the **Locator Spy** dialog box.
- The second example works when the browser window already exists.

  VB
  ```
  browserWindow.DomLink("//a[@textContents='Home']").Select()
  ```

  C#
  ```
  browserWindow.DomLink("//a[@textContents='Home']").Select();
  ```

  Alternatively, you can use the shortened form.

  VB
  ```
  browserWindow.DomLink("@textContents='Home'").Select()
  ```

C#

```
browserWindow.DomLink("@textContents='Home'").Select();
```

To find an object that has no real attributes for identification, use the index. For instance, to select the second hyperlink on a Web page, you can type:

VB

```
browserWindow.DomLink("[2]").Select()
```

C#

```
browserWindow.DomLink("[2]").Select();
```

Additionally, to find the first object of its kind, which might be useful if the object has no real attributes, you can type:

VB

```
browserWindow.DomLink().Select()
```

C#

```
browserWindow.DomLink().Select();
```

Using the Find Method

Instead of using methods like `.DomLink`, you can use the `Find` method to identify a single object with a locator.

Note: The `Find` method can only use full locators, the shortened locator form is not supported.

Instead of typing:

VB

```
_desktop.DomLink("//a[@textContents='Home']").Select()
```

C#

```
_desktop.DomLink("//a[@textContents='Home']").Select();
```

you can type:

VB

```
_desktop.Find(Of DomLink)("//a[@textContents='Home']").Select()
```

C#

```
_desktop.Find<DomLink>("//a[@textContents='Home']").Select();
```

The `.DomLink` method also uses the `Find` method internally. Prefer using the `.DomLink` method, because it is more concise than the `Find` method.

Using Locators to Check if an Object Exists

You can use the `Exists` method to determine if an object exists in the application under test.

The following code checks if a hyperlink with the text *Log out* exists on a Web page:

VB

```
If (browserWindow.Exists( "//a[@textContents='Log out']" )) Then
  ' do something
End If
```

C#

```
if (browserWindow.Exists( "//a[@textContents='Log out']" )){
  // do something
}
```

Using the Find method

You can use the `Find` method and the `FindOptions` method to check if an object, which you want to use later, exists.

The following code searches for a window and closes the window if the window is found:

VB

```
Dim mainWindow As Window
mainWindow = _desktop.Find("//Window[@caption='My Window']", New
FindOptions(False))
If (mainWindow IsNot Nothing) Then
   mainWindow.CloseSynchron()
End If
```

C#

```
Window mainWindow = _desktop.Find<Window>("//Window[@caption='My Window']",
new FindOptions(false));
if (mainWindow != null){
  mainWindow.CloseSynchron();
}
```

Identifying Multiple Objects with One Locator

You can use the `FindAll` method to identify all objects that match a locator rather that only identifying the first object that matches the locator.

Example

The following code example uses the `FindAll` method to retrieve all hyperlinks of a Web page:

VB

```
Dim links As IList(Of DomLink) = browserWindow.FindAll(Of
DomLink)("//a")
```

C#

```
IList<DomLink> links = browserWindow.FindAll<DomLink>("//a");
```

Locator Customization

This section describes how you can create stable locators that enable Silk4NET to reliably recognize the controls in your application under test (AUT).

Silk4NET relies on the identifiers that the AUT exposes for its UI controls and is very flexible and powerful in regards to identifying UI controls. Silk4NET can use any declared properties for any UI control class and can also create locators by using the hierarchy of UI controls. From the hierarchy, Silk4NET chooses the most appropriate items and properties to identify each UI control.

Silk4NET can exclude dynamic numbers of controls along the UI control hierarchy, which makes the object recognition in Silk4NET very robust against changes in the AUT. Intermediate grouping controls that

change the hierarchy of the UI control tree, like formatting elements in Web pages, can be excluded from the object recognition.

Some UI controls do not expose meaningful properties, based on which they can be identified uniquely. Applications which include such controls are described as applications with *bad testability*. Hierarchies, and especially dynamic hierarchies, provide a good means to create unique locators for such applications. Applications with *good testability* should always provide a simple mechanism to identify UI controls uniquely.

One of the simplest and most effective practices to make your AUT easier to test is to introduce stable identifiers for controls and to expose these stable identifiers through the existing interfaces of the application.

Stable Identifiers

A *stable identifier* for a UI control is an identifier that does not change between invocations of the control and between different versions of the application, in which the UI control exists. A stable identifier needs to be unique in the context of its usage, meaning that no other control with the same identifier is accessible at the same time. This does not necessarily mean that you need to use GUID-style identifiers that are unique in a global context. Identifiers for controls should be readable and provide meaningful names. Naming conventions for these identifiers will make it much easier to associate the identifier to the actual control.

Example: Is the caption a good identifier for a control?

Very often test tools are using the *caption* as the default identifier for UI controls. The caption is the text in the UI that is associated with the control. However, using the caption to identify a UI control has the following drawbacks:

- The caption is not stable. Captions can change frequently during the development process. For example, the UI of the AUT might be reviewed at the end of the development process. This prevents introducing UI testing early in the development process because the UI is not stable.
- The caption is not unique. For example, an application might include multiple buttons with the caption **OK**.
- Many controls are not exposing a caption, so you need to use another property for identification.
- Using captions for testing localized applications is cumbersome, as you need to maintain a caption for a control in each language and you also have to maintain a complex script logic where you dynamically can assign the appropriate caption for each language.

Creating Stable Locators

One of the main advantages of Silk4NET is the flexible and powerful object-recognition mechanism. By using XPath notation to locate UI controls, Silk4NET can reliably identify UI controls that do not have any suitable attributes, as long as there are UI elements near the element of interest that have suitable attributes. The XPath locators in Silk4NET can use the entire UI control hierarchy or parts of it for identifying UI controls. Especially modern AJAX toolkits, which dynamically generate very complex Document Object Models (DOMs), do not provide suitable control attributes that can be used for locating UI controls.

In such a case, test tools that do not provide intelligent object-recognition mechanisms often need to use index-based recognition techniques to identity UI controls. For example, identify the n-th control with icon *Expand*. This often results in test scripts that are hard to maintain, as even minor changes in the application can break the test script.

A good strategy to create stable locators for UI controls that do not provide useful attributes is to look for an anchor element with a stable locator somewhere in the hierarchy. From that anchor element you can then work your way to the element for which you want to create the locator.

Silk4NET uses this strategy when creating locators, however there might be situations in which you have to manually create a stable locator for a control.

Example: Locating the Expand Icon in a Dynamic GWT Tree

The Google Widget Toolkit (GWT) is a very popular and powerful toolkit, which is hard to test. The dynamic tree control is a very commonly used UI control in GWT. To expand the tree, we need to identify the **Expand** icon element.

You can find a sample dynamic GWT tree at *http://gwt.google.com/samples/Showcase/Showcase.html#!CwTree*.

The default locator generated by Silk4NET is the following:

```
/BrowserApplication//BrowserWindow//DIV[@id='gwt-debug-cwTree-dynamicTree-root-child0']/DIV/DIV[1]//IMG[@border='0']
```

For the following reasons, this default locator is no reliable locator for identifying the **Expand** icon for the control **Item 0.0**:

- The locator is complex and built on multiple hierarchies. A small change in the DOM structure, which is dynamic with AJAX, can break the locator.
- The locator contains an index for some of the controls along the hierarchy. Index based locators are generally weak as they find controls by their occurrence, for example finding the sixth expand icon in a tree does not define the control well. An exception to that rule would be if the index is used to express different data sets that you want to identify, for example the sixth data row in a grid.

Often a good strategy for finding better locators is to search for siblings of elements that you need to locate. If you find siblings with better locators, XPath allows you to construct the locator by identifying those siblings. In this case, the tree item **Item 0.0** provides a better locator than the **Expand** icon. The locator of the tree item **Item 0.0** is a stable and simple locator as it uses the `@textContents` property of the control.

By default, Silk4NET uses the property `@id`, but in GWT the `@id` is often not a stable property, because it contains a value like `='gwt-uid-<nnn>'`, where `<nnn>` changes frequently, even for the same element between different calls.

You can manually change the locator to use the `@textContents` property instead of the `@id`.

Original Locator:

```
/BrowserApplication//BrowserWindow//DIV[@id='gwt-uid-109']
```

Alternate Locator:

```
/BrowserApplication//BrowserWindow//DIV[@textContents='Item 0.0']
```

Or you can instruct Silk4NET to avoid using `@id='gwt-uid-<nnn>'`. In this case Silk4NET will automatically record the stable locator. You can do this by adding the text pattern that is used in `@id` properties to the locator attribute value blacklist. In this case, add `gwt-uid*` to the blacklist.

When inspecting the hierarchy of elements, you can see that the control **Item 0.0** and the **Expand** icon control have a joint root node, which is a `DomTableRow` control.

To build a stable locator for the **Expand** icon, you first need to locate **Icon 0.0** with the following locator:

```
/BrowserApplication//BrowserWindow//DIV[@textContent='Item 0.0']
```

Then you need to go up two levels in the element hierarchy to the `DomTableRow` element. You express this with XPath by adding `/../..` to the locator. Finally you need to search from `DomTableRow` for the **Expand** icon. This is easy as the **Expand** icon is the only IMG control in the sub-tree. You express this

with XPath by adding `//IMG` to the locator. The final stable locator for the **Expand** icon looks like the following:

```
/BrowserApplication//BrowserWindow//DIV[@textContent='Item 0.0']/../..//IMG
```

You can also use the sibling approach to identify text fields. Text fields often do not provide any meaningful attributes that can be used in locators. By using the label of a text field, you could create a meaningful locator for the text field, because the label is the best identifier for the text field from the perspective of a tester. You can easily use the label as a part of the locator for a test field by using the sibling approach.

Custom Attributes

Many UI technologies provide a mechanism that allows them to extend the set of predefined attributes of UI controls with custom attributes. These custom attributes can be used by the application developer to introduce stable identifiers that uniquely identify the control. Silk4NET can access custom attributes of UI controls and can also use these custom attributes to identify UI controls.

Using special automation for the identification of UI controls has several advantages compared to using the defined attributes like `caption`. Being able to establish stable identifiers in the application code and to expose these identifiers through either custom attributes or defined automation properties leads to understandable and maintainable test-automation scripts, allowing you to start with your test automation early in the development process.

You can configure the attributes used for identification by using the flexible locator strategy of Silk4NET.

Custom Attributes for Apache Flex Applications

Apache Flex applications use the predefined property `automationName` to specify a stable identifier for the Apache Flex control as follows:

```
<?xml version="1.0" encoding="utf-8"?>
  <s:Group xmlns:fx="http://ns.adobe.com/mxml/2009"
      xmlns:s="library://ns.adobe.com/flex/spark"
      xmlns:mx="library://ns.adobe.com/flex/mx" width="400" height="300">
    <fx:Script>
    …
    </fx:Script>
    <s:Button x="247" y="81" label="Button" id="button1" enabled="true"
click="button1_clickHandler(event)"
        automationName="AID_buttonRepeat"/>
    <s:Label x="128" y="123" width="315" height="18" id="label1"
verticalAlign="middle"
        text="awaiting your click" textAlign="center"/>
  </s:Group>
```

Apache Flex application locators look like the following:

```
…//SparkApplication//SparkButton[@caption='AID_buttonRepeat'
```

Attention: For Apache Flex applications, the *automationName* is always mapped to the locator attribute `caption` in Silk4NET. If the *automationName* attribute is not specified, Silk4NET maps the property `ID` to the locator attribute `caption`.

Java SWT Custom Attributes

You can add custom attributes to a test application to make a test more stable. For example, in Java SWT, the developer implementing the GUI can define an attribute (for example, `'silkTestAutomationId'`) for a widget that uniquely identifies the widget in the application. A tester using Silk4NET can then add that attribute to the list of custom attributes (in this case, `'silkTestAutomationId'`), and can identify controls by that unique ID. Using a custom attribute is more reliable than other attributes like caption or index, since a caption will change when you translate the application into another language, and the index will change whenever another widget is added before the one you have defined already.

If more than one object is assigned the same custom attribute value, all the objects with that value will return when you call the custom attribute. For example, if you assign the unique ID, `'loginName'` to two different text fields, both fields will return when you call the `'loginName'` attribute.

Java SWT Example

If you create a button in the application that you want to test using the following code:

```
Button myButton = Button(parent, SWT.NONE);

myButton.setData("SilkTestAutomationId", "myButtonId");
```

To add the attribute to your XPath query string in your test, you can use the following query:

```
Dim button =
desktop.PushButton("@SilkTestAutomationId='myButton'")
```

To enable a Java SWT application for testing custom attributes, the developers must include custom attributes in the application. Include the attributes using the `org.swt.widgets.Widget.setData(String key, Object value)` method.

Custom Attributes for Web Applications

HTML defines a common attribute `ID` that can represent a stable identifier. By definition, the ID uniquely identifies an element within a document. Only one element with a specific ID can exist in a document.

However, in many cases, and especially with AJAX applications, the ID is used to dynamically identify the associated server handler for the HTML element, meaning that the ID changes with each creation of the Web document. In such a case the ID is not a stable identifier and is not suitable to identify UI controls in a Web application.

A better alternative for Web applications is to introduce a new custom HTML attribute that is exclusively used to expose UI control information to Silk4NET.

Custom HTML attributes are ignored by browsers and by that do not change the behavior of the AUT. They are accessible through the DOM of the browser. Silk4NET allows you to configure the attribute that you want to use as the default attribute for identification, even if the attribute is a custom attribute of the control class. To set the custom attribute as the default identification attribute for a specific technology domain, click **Silk4NET** > **Edit Options** > **Custom Attributes** and select the technology domain.

The application developer just needs to add the additional HTML attribute to the Web element.

Original HTML code:

```
<A HREF="http://abc.com/control=4543772788784322..." <IMG
src="http://abc.com/xxx.gif" width=16 height=16> </A>
```

HTML code with the new custom HTML attribute *AUTOMATION_ID*:

```
<A HREF="http://abc.com/control=4543772788784322..."
AUTOMATION_ID = "AID_Login" <IMG src="http://abc.com/xxx.gif"
width=16 height=16> </A>
```

When configuring the custom attributes, Silk4NET uses the custom attribute to construct a unique locator whenever possible. Web locators look like the following:

```
…//DomLink[@AUTOMATION_ID='AID_Login'
```

Example: Changing ID

One example of a changing ID is the Google Widget Toolkit (GWT), where the ID often holds a dynamic value which changes with every creation of the Web document:

```
ID = 'gwt-uid-<nnn>'
```

In this case <nnn> changes frequently.

Custom Attributes for Windows Forms Applications

Windows Forms applications use the predefined automation property `automationId` to specify a stable identifier for the Windows forms control.

Silk4NET automatically will use this property for identification in the locator. Windows Forms application locators look like the following:

```
/FormsWindow//PushButton[@automationId='btnBasicControls']
```

Custom Attributes for WPF Applications

WPF applications use the predefined automation property `AutomationProperties.AutomationId` to specify a stable identifier for the WPF control as follows:

```
<Window x:Class="Test.MainWindow"
    xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
    xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
    Title="MainWindow" Height="350" Width="525">
  <Grid>
    <Button AutomationProperties.AutomationId="AID_buttonA">The
Button</Button>
  </Grid>
</Window>
```

Silk4NET automatically uses this property for identification in the locator. WPF application locators look like the following:

```
/WPFWindow[@caption='MainWindow']//WPFButton[@automationId='AID_buttonA']
```

Troubleshooting Performance Issues for XPath

When testing applications with a complex object structure, for example complex web applications, you may encounter performance issues, or issues related to the reliability of your scripts. This topic describes how you can improve the performance of your scripts by using different locators than the ones that Silk4NET has automatically generated during recording.

Note: In general, we do not recommend using complex locators. Using complex locators might lead to a loss of reliability for your tests. Small changes in the structure of the tested application can break such a complex locator. Nevertheless, when the performance of your scripts is not satisfying, using more specific locators might result in tests with better performance.

The following is a sample element tree for the application MyApplication:

```
Root
  Node id=1
    Leaf id=2
    Leaf id=3
    Leaf id=4
    Leaf id=5
  Node id=6
    Node id=7
      Leaf id=8
      Leaf id=9
    Node id=9
      Leaf id=10
```

You can use one or more of the following optimizations to improve the performance of your scripts:

- If you want to locate an element in a complex object structure , search for the element in a specific part of the object structure, not in the entire object structure. For example, to find the element with the

identifier 4 in the sample tree, if you have a query like `Root.Find("//Leaf[@id='4']")`, replace it with a query like `Root.Find("/Node[@id='1']/Leaf[@id='4']")`. The first query searches the entire element tree of the application for leafs with the identifier 4. The first leaf found is then returned. The second query searches only the first level nodes, which are the node with the identifier 1 and the node with the identifier 6, for the node with the identifier 1, and then searches in the subtree of the node with the identifier 1 for all leafs with the identifier 4.

- When you want to locate multiple items in the same hierarchy, first locate the hierarchy, and then locate the items in a loop. If you have a query like `Root.FindAll("/Node[@id='1']/Leaf")`, replace it with a loop like the following:

```
Public Sub Main()
  Dim node As TestObject

  node = _desktop.Find("//Node[@id='1']")
  For i As Integer = 1 To 4 Step 1
    node.Find("/Leaf[@id='"+i+"']")
  Next

End Sub
```

Locator Spy

Use the **Locator Spy** to identify the caption or the XPath locator string for GUI objects. You can copy the relevant XPath locator strings and attributes into methods in your scripts. Additionally, you can manually edit the attributes of the XPath locator strings in your test scripts and validate the changes in the **Locator Spy**. Using the **Locator Spy** ensures that the XPath query string is valid.

The object tree in the locator spy lists all the objects that are available in the current application or Web page. You can use the object tree to inspect the available objects and the object structure of the application or Web page.

Note: The locator attributes table of the **Locator Spy** displays all attributes that you can use in the locator. For Web applications, the table also includes any attributes that you have defined to be ignored during recording.

Object Maps

An object map is a test asset that contains items that associate a logical name (an alias) with a control or a window, rather than the control or window's locator. Once a control is registered in an object map asset, all references to it in scripts are made by its alias, rather than by its actual locator name.

You can use object maps to store objects that you are using often in multiple scripts. Multiple tests can reference a single object map item definition, which enables you to update that object map definition once and have Silk4NET update it in all tests that reference the object map definition.

In your scripts, you can mix object map identifiers and locators. This feature enables you to keep your object maps relatively small and easier to manage. You can simply store the commonly used objects in your object maps, and use locators to reference objects that are rarely used.

Tip: To optimally use the functionality that object maps provide, create an individual project in Silk4NET for each application that you want to test.

Example for object maps

The following construct shows a definition for a `BrowserWindow` where the locator is used:

```
_desktop.BrowserApplication("cnn_com").BrowserWindow("//
BrowserWindow[1]")
```

The name of the object map asset is *cnn_com*. The locator that can be substituted by an alias in the object map is the following:

```
"//BrowserWindow[1]"
```

The object map entry for the `BrowserWindow` is *BrowserWindow*.

The resulting definition of the `BrowserWindow` in the script is the following:

```
_desktop.BrowserApplication("cnn_com").BrowserWindow("BrowserWin
dow")
```

If the index in the locator changes, you can just change the alias in the object map, instead of having to change every appearance of the locator in your test script. Silk4NET will update all tests that reference the object map definition.

Example for mixing object map identifiers and locators

The following sample code shows how you can mix object map identifiers and locators to specify a rarely used child object of an object stored in an object map:

```
// VB
Window window = _desktop.Window("MyApplication") // object map
id - the application window is used often
MenuItem aboutMenuItem =
_desktop.MenuItem("@caption='About'") // locator - the About
dialog is only used once
aboutMenuItem.Select()
```

```
// C#
Window window = _desktop.Window("MyApplication"); // object map
id - the application window is used often
MenuItem aboutMenuItem =
_desktop.MenuItem("@caption='About'"); // locator - the About
dialog is only used once-
aboutMenuItem.Select();
```

The following sample code shows how you can mix object map identifiers and locators to specify an often used child object of a rarely used object.

```
// VB
MobileDevice device = _desktop.MobileDevice("@deviceName='Nexus
7'") // locator - the device name should be script-specific
MobileTextView textView =
device.MobileTextView("MyTextView") // object map id - this
textView is not depending on the device
```

```
// C#
MobileDevice device = _desktop.MobileDevice("@deviceName='Nexus
7'"); // locator - the device name should be script-specific
MobileTextView textView =
device.MobileTextView("MyTextView"); // object map id - this
textView is not depending on the device
```

Advantages of Using Object Maps

Object maps have the following advantages:

- They simplify test maintenance by applying changes made to a locator for an object map item to all tests that include the corresponding object map item.
- They ease the handling of locators in a large scale functional testing environment.
- They can be managed independent of individual scripts.
- They substitute complex locator names with descriptive names, which can make scripts easier to read.
- They eliminate dependence on locators, which may change if the test application is modified.

Turning Object Maps Off and On

You can configure Silk4NET to use the locator name or the alias from the object map during recording.

To use the alias from the object map during recording:

1. Click **Silk4NET** > **Edit Options**.
2. Click **Recording**.
3. Check the **Record object maps** setting.

   By default, Silk4NET records the alias from the object map during recording. If you set the **Record object maps** setting unchecked, Silk4NET records the locator name during recording. You can turn the **Record object maps** setting off and on as you find necessary. However, when a test is recorded with locators, you must re-record it in order to use object map items.

Note: In addition to the XPath attributes, Silk4NET uses additional attributes of the element when merging object maps during locator recording. However, attributes that might lead to ambiguous usage of object map IDs in a recorded script are not used to map locators to existing object map entries.

Note: When you enable the **Record object maps** setting, object map item names display in place of locators throughout Silk4NET. For instance, if you view the **Application Configurations** category in the **Properties** pane, you will notice that the **Locator** box shows the object map item name rather than the locator name.

Using Assets in Multiple Projects

In Silk4NET, image assets, image verifications, and object maps are referred to as *assets*. If you want to use assets outside of the scope of the project in which they are located, you need to add a direct project

reference from the project in which you want to use the assets to the project in which the assets are located.

During replay, when an asset is used, Silk4NET firstly searches in the *current project* for the asset. The current project is the directory which contains the test code that is currently executed. If Silk4NET does not find the asset in the current project, Silk4NET additionally searches the projects to which the current project has a project reference. If the asset is still not found, Silk4NET throws an error.

Note: When the code of a project, which you have added as a dependency to another project, is not referenced in the code of the dependent project, Visual Studio will remove the project dependency when you build the dependent project. To use assets that are located in a project dependency, you have to add a code reference from the dependent project to a member of the project in which the assets are located. By adding such a code reference, you ensure that Visual Studio will not remove the project dependency when you are building the dependent project. For example, you could add a class or a constant to the project dependency, and then call the class or constant in the code of the dependent project.

If assets with the same name exist in more than one project, and you do not want to use the asset that is included in the current project, you can define which specific asset you want to use in any method that uses the asset. To define which asset you want to use, add the assembly name as a prefix to the asset name when calling the method. The assembly name defaults to the project name.

Example: Adding a project reference

If the project *ProjectA* contains a test that calls the following code:

```
'VB code
window.ImageClick("imageAsset")
```

and the image asset *imageAsset* is located in project *ProjectB*, you need to add a direct project reference from *ProjectA* to *ProjectB*.

Example: Calling a specific asset

If *ProjectA* and *ProjectB* both contain an image asset with the name *anotherImageAsset*, and you explicitly want to click the image asset from *ProjectB*, use the following code:

```
'VB code
window.ImageClick("ProjectB:anotherImageAsset")
```

Merging Object Maps During Action Recording

When you record actions with Silk4NET, Silk4NET checks if existing object map entries can be reused. Silk4NET checks this directly during recording, when a new locator is generated. Silk4NET checks if the object that is currently recorded in the application under test exactly matches an existing object map entry, and if yes, Silk4NET reuses the object map identifier from the object map.

This behavior has the following benefits:

- Silk4NET correctly reuses an object map identifier during recording, even if the locator in the object map has changed.
- A recorded script cannot contain wrong object map identifiers, and therefore will never fail to play back because of a wrong object map identifier.
- If you restructure your object map, for example by adding an additional level of hierarchy, the object map identifiers are still reused.

Example

Silk4NET records the following script when you click on the **Products** link in the Borland website, *http://www.borland.com*.

```
With _desktop.BrowserApplication( "borland_com" )
  With .BrowserWindow( "BrowserWindow" )
    .DomLink( "Products" ).Click( MouseButton .Left, New Point
(47, 18))
  End With
End With
```

The recorded object map looks like this:

```
borland_com                                  //BrowserApplication
  BrowserWindow                                      //BrowserWindow
    Products                                           //
A[@textContents='Products']
```

You could now manually restructure the object map to include the header section of the Borland website:

```
borland_com                                  //BrowserApplication
  BrowserWindow                                      //BrowserWindow
    header                                             //
HEADER[@role='banner']
      Products                                           //
A[@textContents='Products']
```

When you now record a click on the **Products** link the object map is reused correctly, and the following script is recorded:

```
With _desktop.BrowserApplication( "borland_com" )
  With .BrowserWindow( "BrowserWindow" )
    .DomElement("header").DomLink( "Products" ).Click( MouseButt
on .Left, New Point (47, 18))
  End With
End With
```

Note: When you record another object in the header section of the Borland website, for example the **About** link, Silk4NET adds the **About** object map entry as a child of **BrowserWindow**, and not of **header**.

Using Object Maps with Web Applications

By default, when you record actions against a Web application, Silk4NET creates an object map with the name *WebBrowser* for native browser controls and an object map asset for every Web domain.

For common browser controls which are not specific for a Web domain, like the main window or the dialog boxes for printing or settings, an additional object map is generated in the current project with the name *WebBrowser*.

In the object map, you can edit the URL pattern by which the object map entries are grouped. When you edit the pattern, Silk4NET performs a syntactical validation of the pattern. You can use the wildcards * and ? in the pattern.

Example

When you record some actions on *http://www.borland.com* and *http://www.microfocus.com* and then open the printer dialog, the following three new object map assets are added to the **Asset Browser**:

- WebBrowser
- borland_com
- microfocus_com

Note: Silk4NET generates the new object map assets only for projects without an object map. If you record actions against a Web application for which Silk4NET already includes an object map that was generated with a version of Silk4NET prior to version 14.0, the additionally recorded entries are stored into the existing object map, and there are no additional object map assets generated for the Web domains.

Renaming an Object Map Item

You can manually rename items and locators in an object map.

Warning: Renaming an object map item affects every script that uses that item. For example, if you rename the **Cancel** button object map item from **CancelMe** to **Cancel**, every script that uses **CancelMe** must be changed manually to use **Cancel**.

Object map items must be unique. If you try to add a duplicate object map item, Silk4NET notifies you that the object must be unique.

If you use an invalid character or locator, the item name or locator text displays in red and a tooltip explains the error. Invalid characters for object map items include: \, /, <, >, ", :, *, ?, |, =, ., @, [,]. Invalid locator paths include: empty or incomplete locator paths.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:
   - Double-click the object map that includes the object map item that you want to rename.
   - Right-click the object map that includes the object map item that you want to rename and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. Navigate to the object map item that you want to rename.
   For example, you might need to expand a node to locate the item that you want to rename.
4. Click the object that you want to rename and then click the object again.
5. Type the item name that you want to use and then press `Enter`.

   If you use an invalid character, the item name displays in red.

   The new name displays in the **Item name** list.
6. Press **CTRL+S** to save your changes

If any existing scripts use the item name that you changed, you must manually change the scripts to use the new item name.

Note: All child nodes of any node in the object map tree are sorted alphabetically when you save the object map.

Modifying Object Maps

An existing object map is able to reuse existing object map identifiers during recording, even if you have added additional structural elements to the object map.

Example: Adding a DIV to an existing object map

Let us suppose you want to add a DIV element to bundle the email and login fields in the following simple object map:

```
demo_borland_com                                    //
BrowserApplication
  BrowserWindow                                              //
BrowserWindow
    login-form email                                         //
INPUT[@id='login-form:email']
    login-form login                                         //
INPUT[@id='login-form:login']
```

You can change the structure of the object map by adding the new DIV *loginArea* and the object map will still be able to correctly reuse the object map identifiers during recording.

```
demo_borland_com                                    //
BrowserApplication
  BrowserWindow                                              //
BrowserWindow

loginArea                                                 //'DIV[@id='
login']
      login-form email                                       //
INPUT[@id='login-form:email']
      login-form login                                       //
INPUT[@id='login-form:login']
```

Modifying a Locator in an Object Map

Locators are automatically associated with an object map item when you record a script. However, you might want to modify a locator path to make it more generic. For example, if your test application automatically assigns the date or time to a specific control, you might want to modify the locator for that control to use a wildcard. Using a wildcard enables you to use the same locator for each test even though each test inserts a different date or time.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:
   - Double-click the object map that includes the locator that you want to modify.
   - Right-click the object map that includes the locator that you want to modify and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. Navigate to the locator that you want to modify.
   For example, you might need to expand a node to locate the locator that you want to modify.
4. Click the locator path that you want to modify and then click the locator path again.
5. If you have a valid locator path, you can type the item name and locator path that you want to use and then press `Enter`. To determine a valid locator path, use the **Locator Spy** dialog box as described in the following steps:
   a) Click **Silk4NET** > **Locator Spy**.
   b) Position the mouse over the object that you want to record and press **CTRL+ALT**. Silk4NET displays the locator string in the **Locator** text field.
   c) Select the locator that you want to use in the **Locator Details** table.

d) Copy and paste the locator into the object map.

6. If necessary, modify the item name or locator text to meet your needs.

   If you use an invalid character or locator, the item name or locator text displays in red and a tooltip explains the error.

   Invalid characters for object map items include: \, /, <, >, ", :, *, ?, |, =, ., @, [,].

   Invalid locator paths include: empty or incomplete locator paths.

7. Press **CTRL+S** to save your changes

If any existing scripts use the locator path that you modified, you must manually change the visual tests or scripts to use the new locator path.

Updating Object Maps from the Test Application

If items in the test application change, you can use the **Object Map** UI to update the locators for these items.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:
   - Double-click the object map that you want to use.
   - Right-click the object map that you want to use and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. Click **Update Locator**. The **Locator Spy** displays and Silk4NET opens the test application.
4. Position the mouse cursor over the object that you want to record and press **CTRL+ALT**. Silk4NET displays the locator string in the **Locator** text field.
5. Select the locator that you want to use in the **Locator Details** table.
6. Remove any attributes that you do not want to use from the locator that is displayed in the **Locator** text field.
7. Click **Validate Locator** to validate that the locator works.
8. Click **Paste Locator to Editor** to update the locator in the object map.
9. Save the changed object map.

When you update an object map item from the AUT, you can change only the XPath representations of leaf nodes in the object map tree. You cannot change the XPath representations of any parent nodes. When the XPath representations of higher-level nodesin the object map tree are not consistent after the update, an error message displays.

Example

For example, suppose you have an object map item with an object map ID that has the following three hierarchy levels:

```
WebBrowser.Dialog.Cancel
```

The corresponding XPath representation of these hierarchy levels is the following:

```
/BrowserApplication//Dialog//PushButton[@caption='Cancel']
```

- First hierarchy level: `/BrowserApplication`
- Second hierarchy level: `//Dialog`
- Third hierarchy level: `//PushButton[@caption='Cancel']`

You can use the following locator to update the object map item:

```
/BrowserApplication//Dialog//PushButton[@id='123']
```

- First hierarchy level: `/BrowserApplication`
- Second hierarchy level: `//Dialog`
- Third hierarchy level: `//PushButton[@id='123']`

You cannot use the following locator cannot to update the object map item, because the second level hierarchy nodes do not match:

```
/BrowserApplication//BrowserWindow//PushButton[@id='9999999']
```

- First hierarchy level: `/BrowserApplication`
- Second hierarchy level: `//BrowserWindow`
- Third hierarchy level: `//PushButton[@id='9999999']`

Copying an Object Map Item

You can copy and paste object map entries within or between object maps. For example, if the same functionality exists in two separate test applications, you might copy a portion of one object map into another object map.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:
   - Double-click the object map that includes the object map item that you want to copy.
   - Right-click the object map that includes the object map item that you want to copy and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. Navigate to the object map item that you want to copy.
   For example, you might need to expand a node to locate the item that you want to copy.
4. Choose one of the following:
   - Right-click the object map item that you want to copy and choose **Copy tree**.
   - Click the object map item that you want to copy and then press `Ctrl+C`.
5. In the object map hierarchy, navigate to the position where you want to paste the item that you copied.

   For instance, to include an item on the first level of the hierarchy, click the first item name in the item list. To position the copied item a level below a specific item, click the item that you want to position the copied item below.

   To copy and paste between object maps, you must exit the map where you copied the object map item and open and edit the object map where you want to paste the object map item.
6. Choose one of the following:
   - Right-click the position in the object map where you want to paste the copied object map item and choose **Paste**.
   - Click the position in the object map where you want to paste the copied object map item and then press `Ctrl+V`.

   The object map item displays in its new position in the hierarchy.
7. Press **CTRL+S** to save your changes

If any existing scripts use the object map item name that you moved, you must manually change the scripts to use the new position in the hierarchy.

Adding an Object Map Item

Object map items are automatically created when you record a script. Occasionally, you might want to manually add an object map item.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:
   - Double-click the object map that includes the object map item that you want to rename.
   - Right-click the object map that includes the object map item that you want to rename and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. In the object map hierarchy, right-click on the item below which you want to add the new object map item.

   For instance, to include an item on the first level of the hierarchy, right-click on the first item name in the item list. To position the new item a level below a specific item, right-click on the item below which you want to position the new item.
4. Click **Insert new**. A new item is added to the hierarchy.
5. If you have a valid locator path, you can type the item name and locator path that you want to use and then press `Enter`. To determine a valid locator path, use the **Locator Spy** dialog box as described in the following steps:
   a) Click **Silk4NET** > **Locator Spy**.
   b) Position the mouse over the object that you want to record and press **CTRL+ALT**. Silk4NET displays the locator string in the **Locator** text field.
   c) Select the locator that you want to use in the **Locator Details** table.
   d) Copy and paste the locator into the object map.
6. If necessary, modify the item name or locator text to meet your needs.

   If you use an invalid character or locator, the item name or locator text displays in red and a tooltip explains the error.

   Invalid characters for object map items include: \, /, <, >, ", :, *, ?, |, =, ., @, [,].

   Invalid locator paths include: empty or incomplete locator paths.
7. Press **CTRL+S** to save your changes

Note: All child nodes of any node in the object map tree are sorted alphabetically when you save the object map.

Opening an Object Map from a Script

When you are editing a script, you can open an object map by right clicking on an object map entry in the script and selecting **Open Silk4NET Asset.** This will open the object map in the GUI.

Example

```
// VB .NET code
<TestMethod()> Public Sub TestMethod1()
  With _desktop.Window("Untitled -
Notepad").TextField("TextField").TypeKeys("hello")
```

```
  End With
End Sub
```

```
// C# code
[TestMethod]
public void TestMethod1()
{
  Window untitledNotepad = _desktop.Window("Untitled -
Notepad");
  untitledNotepad.TextField("TextField").TypeKeys("hello");
}
```

In the previous code sample, right-click `Untitled - Notepad` to open the entry `Untitled - Notepad` in the object map, or right-click `TextField` to open the entry `Untitled - Notepad.TextField` in the object map.

Highlighting an Object Map Item in the Test Application

After you add or record an object map item, you can click **Highlight** to highlight the item in the test application. You might want to highlight an item to confirm that it's the item that you want to modify in the object map.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:
   - Double-click the object map that you want to use.
   - Right-click the object map that you want to use and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. In the object map hierarchy, select the object map item that you want to highlight in the test application.

   Note: Ensure that only one instance of the test application is running. Running multiple instances of the test application will cause an error because multiple objects will match the locator.
4. Click **Highlight**.

   The **Select Application** dialog box might open if the test application has not been associated with the object map. If this happens, select the application that you want to test and then click **OK**.

   Silk4NET opens the test application and displays a green box around the control that the object map item represents.

Navigating from a Locator to an Object Map Entry in a Script

If you want to see more than the **ID** of an object map entry, you can easily see the raw locator that will be used by the Open Agent when the command is executed by doing the following:

1. Open a script.
2. Place your cursor within a string in a line of the script that you want to identify.
3. Right click and select **Open Silk4NET Asset**.

   Note:

   If the cursor is in a string that does not represent an object map entry, Silk4NET will still assume that it is an object map entry and you may not get the results that you expect.

   The **Object Map** window opens with the proper item selected in the tree view.

Finding Errors in an Object Map

If you use an invalid character or locator, the item name or locator text displays in red and a tooltip explains the error. Use the toolbar in the **Object Map** window to navigate to any errors.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:

   - Double-click the object map that you want to troubleshoot.
   - Right-click the object map that you want to troubleshoot and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. Look for any item name or locator text displayed in red.
4. If necessary, modify the item name or locator text to meet your needs.

   If you use an invalid character or locator, the item name or locator text displays in red and a tooltip explains the error.

   Invalid characters for object map items include: \, /, <, >, ", :, *, ?, |, =, ., @, [,].

   Invalid locator paths include: empty or incomplete locator paths.
5. Press **CTRL+S** to save your changes

Deleting an Object Map Item

You might want to delete an item from an object map if it no longer exists in the test application or for some other reason.

1. In the **Solution Explorer**, click on the **Object Maps** folder of the project in which the object map that you want to change is located.
2. Choose one of the following:

   - Double-click the object map that includes the object map item that you want to delete.
   - Right-click the object map that includes the object map item that you want to delete and choose **Open**.

   The object map displays a hierarchy of the object map items and the locator associated with each item.
3. Navigate to the object map item that you want to delete.
   For example, you might need to expand a node to locate the object map item that you want to delete.
4. Choose one of the following:

   - Right-click the object map item that you want to delete and choose **Delete**, or choose **Delete tree** to additionally delete all child items of the object map item.
   - Click the object map item that you want to delete and then press **DEL**, or press **CTRL+DEL** to additionally delete all child items of the object map item.
5. Press **CTRL+S** to save your changes

If any existing scripts use the object map item or its children that you deleted, you must manually change any references to that object map item in the scripts.

Initially Filling Object Maps

As a best practice, we recommend that you fill your object map and then review all object map items before you record your tests.

To initially fill your object map with all available items in the AUT, you might create a test that clicks every object and opens every window and dialog box in your test application. Then, you can review the object map item for each object and make any necessary modifications before you record your functional tests. After you have reviewed and modified the object map items you can delete the test that you have created to fill the object map.

Tip: You can use the arrow keys to navigate between items in an object map.

Image Recognition Support

You can use image recognition in the following situations:

- To conveniently interact with test applications that contain highly customized controls, which cannot be identified using object recognition. You can use *image clicks* instead of coordinate-based clicks to click on a specified image.
- To test graphical objects in the application under test, for example charts.
- To perform a check of the visible UI of the application under test.

If you want to click on a control that is otherwise not recognizable, you can use the `ImageClick` method with an image asset. If you want to verify that an otherwise not recognizable control exists in your application under test, you can use the `VerifyAsset` method with an image verification.

Image recognition methods are supported for all technology domains that are supported by Silk4NET.

Image Click Recording

Image click recording is disabled by default in favor of coordinate-based click recording, because image click recording might generate a confusingly large number of images. To enable image click recording, you can perform one of the following:

- In the **Recording** dialog box, check **Record image clicks**.
- Click **Silk4NET** > **Edit Options**, select the **Recording** tab, and check the check box in the **Record image clicks** section.

Note: When recording on a mobile browser, you do not have to enable image click recording.

When image click recording is enabled, Silk4NET records `ImageClick` methods when object recognition or text recognition is not possible. You can insert image clicks in your script for any control, even if the image clicks are not recorded.

If you do not whish to record an `ImageClick` action, you can turn off image click recording and record normal clicks or text clicks.

Note: The recorded images are not reused. Silk4NET creates a new image asset for each image click that you record.

Note: Image click recording is not supported for applications or applets that use the Java AWT/Swing controls.

Image Recognition Methods

Silk4NET provides the following methods for image recognition:

Method	Description
`ImageClick`	Clicks in the middle of the image that is specified in an asset. Waits until the image is found or the *Object resolve timeout*, which you can define in the synchronization options, is over.
`ImageExists`	Returns whether the image that is specified in an asset exists.

Method	Description
`ImageRectangle`	Returns the object-relative rectangle of the image that is specified in an asset.
`ImageClickFile`	Clicks on the image that is specified in a file.
`ImageExistsFile`	Returns whether the image that is specified in a file exists.
`ImageRectangleFile`	Returns the object-relative rectangle of the image that is specified in a file.
`VerifyAsset`	Executes a verification asset. Throws a VerificationFailedException if the verification does not pass.
`TryVerifyAsset`	Executes a verification asset and returns whether the verification passed.

Image Assets

You can use image assets in the following situations:

- To conveniently interact with test applications that contain highly customized controls, which cannot be identified using object recognition. You can use *image clicks* instead of coordinate-based clicks to click on a specified image.
- To test graphical objects in the application under test, for example charts.

Image assets consist of an image with some additional information that is required by Silk4NET to work with the asset.

Silk4NET provides the following methods for image assets:

Method	Description
`ImageClick`	Clicks in the middle of the specified image asset. Waits until the image is found or the *Object resolve timeout*, which you can define in the synchronization options, is over.
`ImageExists`	Returns whether the specified image asset exists.
`ImageRectangle`	Returns the object-relative rectangle of the specified image asset.

Image assets must be located in the `Image Assets` folder of the project. The `.imageasset` files must be embedded resources.

Creating an Image Asset

You can create image assets in one of the following ways:

- By inserting a new image asset into an existing script.
- During recording.
- From the menu.

To create a new image asset from the menu, perform the following steps:

1. In the menu, click **Silk4NET** > **New Image Asset**.
2. Type a useful name for the asset into the **Name** field and double-click **Silk4NET Image Asset**. The image asset UI opens.
3. Select how you want to add an image to the asset.
    - If you want to use an existing image, click **Browse** and select the image file.

- If you want to capture a new image from the UI of the application under test, click **Capture**. If you are testing a Web application, you can select the browser on which you want to capture the image from the **Select Browser** window.

4. If you have selected to capture a new image, select the area of the screen that you want to capture and click **Capture Selection**.
5. *Optional:* Click **Verify** to check if Silk4NET can find the image asset in the UI of the AUT.

   If you are testing a Web application, you can select the browser on which you want to capture the image from the **Select Browser** window.
6. *Optional:* You can set the option **Client Area Only** to define that only the part of the image that is actually part of the AUT is considered when Silk4NET compares the image verification to the UI of the AUT.
7. Specify the **Accuracy Level**.

   The accuracy level defines how much the image to be verified is allowed to be different to the image in the application under test, before Silk4NET declares the images as different. This is helpful if you are testing multiple systems or browsers with different screen resolutions. We recommend to choose a high level of accuracy in order to prevent false positives. You can change the default accuracy level in the options.

   Note: When you set the **Accuracy Level** to less than five, the actual colors of the images are no longer considered for the comparison. Only the grayscale representations of the images are compared.
8. Save the image asset.

The new image asset is listed under the current project in the **Solution Explorer**, and you can use it to perform image clicks.

You can add multiple images to the same image asset.

Note: To add an image click while recording against a mobile browser, you can right-click in the **Mobile Recording** window and select **ImageClick** from the action list.

Adding Multiple Images to the Same Image Asset

During testing, you will often need to test functionality on multiple environments and with different testing configurations. In a different environment, the actual image might differ in such a degree from the image that you have captured in the image asset, that image clicks might fail, although the image is existing. In such a case, you can add multiple images to the same image asset.

To add an additional image to an image asset:

1. Double-click on the image asset to which you want to add an additional image. The image asset UI opens.
2. Click on the plus sign in the lower part of the UI to add a new image to the image asset.
3. Save the image asset.

The new image is added to the asset. Each time an image click is called, and until a match is achieved, Silk4NET will compare the images in the asset with the images in the UI of the application under test. By default, Silk4NET compares the images in the order in which they have been added to the asset.

Note: To change the order in which Silk4NET compares the images, click on an image in the lower part of the image asset UI and drag the image to the position that you want. The order lowers from left to right. The image that is compared first is the image in the left-most position.

Opening an Asset from a Script

When you are editing a script, you can open an asset by right clicking it and selecting **Open Silk4NET Asset.** This will open the asset in the GUI.

If the asset is a reference to a file on the system, for example, referenced by `ImageClickFile`, the file will be opened by your system's default editor.

Image Verifications

You can use an *Image Verification* to check if an image exists in the UI of the application under test (AUT) or not.

Image verifications consist of an image with some additional information that is required by Silk4NET to work with the asset.

To execute an image verification, use the `VerifyAsset` method.

Image verification assets must be located in the `Verifications` folder of the project.
The `.verification` files must be embedded resources.

An image verification fails when Silk4NET cannot find the image in the AUT. In this case the script breaks execution and throws a VerificationFailedException. To avoid this behavior, use the `TryVerifyAsset` method.

If the locator for the image verification is not found in the AUT, Silk4NET throws an `ObjectNotFoundException`.

You can open a successful image verification in TrueLog Explorer by clicking **Open Verification** in the **Info** tab of the verification step. You can open a failed image verification in TrueLog Explorer by clicking **Show Differences** in the **Info** tab of the verification step. If a failed image verification would have been successful if a lower accuracy level had been used, the accuracy level that would have succeeded is suggested.

Creating an Image Verification

You can create image verifications in one of the following ways:

- By using the menu.
- During recording.

To create a new image verification in the menu, perform the following steps:

1. Click **Silk4NET** > **New Image Verification**.
2. Type a useful name for the asset into the **Name** field and double-click **Silk4NET Image Verification**. The image verification UI opens.
3. Click **Identify** to identify the image that you want to verify in the application under test.
4. *Optional:* If you want to recapture the same image from the application under test, because there is a change in comparison to the image that you had initially captured, click **Recapture**.

   If you are testing a Web application, you can select the browser on which you want to capture the image from the **Select Browser** window.
5. *Optional:* You can click **Verify** to test if the image verification works.

   If you are testing a Web application, you can select the browser on which you want to capture the image from the **Select Browser** window.

   Silk4NET searches for the image in the UI of the AUT, top-down and left to right, and highlights the first matching image.
6. *Optional:* You can add an exclusion area to the image verification, which will not be considered when Silk4NET compares the image verification to the UI of the application under test (AUT).
7. *Optional:* You can set the option **Client Area Only** to define that only the part of the image that is actually part of the AUT is considered when Silk4NET compares the image verification to the UI of the AUT.

8. Specify the **Accuracy Level**.

   The accuracy level defines how much the image to be verified is allowed to be different to the image in the application under test, before Silk4NET declares the images as different. This is helpful if you are testing multiple systems or browsers with different screen resolutions. We recommend to choose a high level of accuracy in order to prevent false positives. You can change the default accuracy level in the options.

   Note: When you set the **Accuracy Level** to less than five, the actual colors of the images are no longer considered for the comparison. Only the grayscale representations of the images are compared.
9. Save the image verification.

The new image verification is listed in the **Solution Explorer**, and you can use it to check if the image exists in the UI of your application under test.

Adding an Image Verification During Recording

You can add image verifications to your scripts to check if controls which are otherwise not recognizable exist in the UI of the application under test. To add an image verification during the recording of a script, perform the following steps:

1. Begin recording.
2. Move the mouse cursor over the image that you want to verify and click **Ctrl + Alt**. Silk4NET asks you if you want to verify a property or an image.
3. Select **Create or Insert an Image Verification**.
4. Perform one of the following steps:
   - To create a new image verification in the image verification UI, select **New** from the list box.
   - To insert an existing image verification asset, select the image verification asset from the list box.
5. Click **OK**.
   - If you have chosen to create a new image verification, the image verification UI opens.
   - If you have chosen to use an existing image verification, the image verification is added to your script. You can skip the remaining steps in this topic.
6. To create a new image verification, click **Verify** in the image verification UI.
7. Move the mouse cursor over the image in the AUT and click **CTRL+ALT.** The image verification UI displays the new image verification.
8. Click **OK**. The new image verification is added to the current project.
9. Continue recording.

Using Assets in Multiple Projects

In Silk4NET, image assets, image verifications, and object maps are referred to as *assets*. If you want to use assets outside of the scope of the project in which they are located, you need to add a direct project reference from the project in which you want to use the assets to the project in which the assets are located.

During replay, when an asset is used, Silk4NET firstly searches in the *current project* for the asset. The current project is the directory which contains the test code that is currently executed. If Silk4NET does not find the asset in the current project, Silk4NET additionally searches the projects to which the current project has a project reference. If the asset is still not found, Silk4NET throws an error.

Note: When the code of a project, which you have added as a dependency to another project, is not referenced in the code of the dependent project, Visual Studio will remove the project dependency

when you build the dependent project. To use assets that are located in a project dependency, you have to add a code reference from the dependent project to a member of the project in which the assets are located. By adding such a code reference, you ensure that Visual Studio will not remove the project dependency when you are building the dependent project. For example, you could add a class or a constant to the project dependency, and then call the class or constant in the code of the dependent project.

If assets with the same name exist in more than one project, and you do not want to use the asset that is included in the current project, you can define which specific asset you want to use in any method that uses the asset. To define which asset you want to use, add the assembly name as a prefix to the asset name when calling the method. The assembly name defaults to the project name.

Example: Adding a project reference

If the project *ProjectA* contains a test that calls the following code:

```
'VB code
window.ImageClick("imageAsset")
```

and the image asset *imageAsset* is located in project *ProjectB*, you need to add a direct project reference from *ProjectA* to *ProjectB*.

Example: Calling a specific asset

If *ProjectA* and *ProjectB* both contain an image asset with the name *anotherImageAsset*, and you explicitly want to click the image asset from *ProjectB*, use the following code:

```
'VB code
window.ImageClick("ProjectB:anotherImageAsset")
```

Enhancing Tests

This section describes how you can enhance a test.

Recording Additional Actions Into an Existing Test

This functionality is supported only if you are using the Open Agent.

Once a test is created, you can open the test and record additional actions to any point in the test. This allows you to update an existing test with additional actions.

1. Open an existing test script.
2. Select the location in the test script into which you want to record additional actions.

   Note: Recorded actions are inserted after the selected location. The application under test (AUT) does not return to the base state. Instead, the AUT opens to the scope in which the preceding actions in the test script were recorded.
3. Click **Silk4NET** > **Record Actions**.

   Silk4NET minimizes and the **Recording** window or the **Mobile Recording** window opens.
4. Record the additional actions that you want to perform against the AUT.
5. To stop recording, click **Stop Recording** in the **Recording** window or the **Mobile Recording** window.

Calling Windows DLLs

This section describes how you can call DLLs. You can call a DLL either within the process of the Open Agent or in the application under test (AUT). This allows the reuse of existing native DLLs in test scripts.

DLL calls in the Open Agent are typically used to call global functions that do not interact with UI controls in the AUT.

DLL calls in the AUT are typically used to call functions that interact with UI controls of the application. This allows Silk4NET to automatically synchronize the DLL call during playback.

Note: In 32-bit applications, you can call 32-bit DLLs, while in 64-bit applications you can call 64-bit DLLs. The Open Agent can execute both 32-bit and 64-bit DLLs.

Note: The .NET framework also provides built-in support for DLL calling, which is called P/Invoke. P/Invoke can be used in Visual Basic scripts to call DLL functions within the process that executes the script. However, in contrast to calling DLL functions with Silk Test Workbench in the application under test, there is no automatic synchronization.

Note: You can only call DLLs with a C interface. If you want to call .NET assemblies, which also have the file extension .dll, do not use the DLL calling feature but instead just add a reference to the assembly in your .NET script.

Calling a Windows DLL from Within a Script

A declaration for a DLL starts with an interface that has a Dll attribute. The syntax of the declaration is the following:

```
<Dll("dllname.dll")> Public Interface DllInterfaceName
  FunctionDeclaration
  [FunctionDeclaration]…
End Interface
```

dllname The name of or the full path to the DLL file that contains the functions you want to call from your scripts. Environment variables in the DLL path are automatically resolved. You do not have to use double backslashes (\\) in the path, single backslashes (\) are sufficient.

DllInterfaceName The identifier that is used to interact with the DLL in a script.

FunctionDeclaration A function declaration of a DLL function you want to call.

DLL Function Declaration Syntax

A function declaration for a DLL typically has the following form:

For functions that do not have a return value, the declaration has the following form:

return-type The data type of the return value.

function-name The name of the function.

arg-list A list of the arguments that are passed to the function.

The list is specified as follows:

data-type The data type of the argument.

identifier The name of the argument.

Passing Arguments to DLL Functions

DLL functions are written in C, so the arguments that you pass to these functions must have the appropriate C data types. The following data types are supported:

Use this data type for arguments or return values with the following data types:

- int
- INT
- long
- LONG
- DWORD
- BOOL
- WPARAM
- HWND

The type works for all DLL arguments that have a 4-byte value.

Use this data type for arguments or return values with the C data types long and int64. The type works for all DLL arguments that have an 8-byte value.

Use this data type for arguments or return values with the C data types short and WORD. The type works for all DLL arguments that have a 2-byte value.

Use this data type for arguments or return values with the C data type bool.

String Use this for arguments or return values that are Strings in C.

Use this for arguments or return values with the C data type double.

Use this for arguments with the C data type RECT. cannot be used as a return value.

Use this for arguments with the C data type POINT. Point cannot be used as a return value.

Use this for arguments with the C data type HWND. TestObject cannot be used as a return value, however you can declare DLL functions that return a HWND with an Integer as the return type.

Note: The passed TestObject must implement the interface so that Silk4NET is able to determine the window handle for the TestObject that should be passed into the DLL function. Otherwise an exception is thrown when calling the DLL function.

List Use this for arrays for user defined C structs. Lists cannot be used as a return value.

Note: When you use a List as an parameter, the list that is passed in must be large enough to hold the returned contents.

Note: A C struct can be represented by a List, where every list element corresponds to a struct member. The first struct member is represented by the first element in the list, the second struct members is represented by the second element in the list, and so on.

Note: Any argument that you pass to a DLL function must have one of the preceding data types.

Passing String Arguments to DLL Functions

Strings that are passing into a DLL function or that are returned by a DLL function are treated by default as Unicode Strings. If your DLL function requires ANSI String arguments, use the `CharacterSet` property of the `DllFunctionOptions` attribute.

Example

```
<Dll( "user32.dll" )> Public Interface IUserDll32Functions
  <DllFunctionOptions(CharacterSet:=CharacterSet.Ansi)>
Function SendMessageA( _
    ByVal obj As TestObject, ByVal message As Integer , ByVal
wParam As Integer , ByRef lParam As String ) As Integer
End Interface
```

Passing a String back from a DLL call as a ByRef argument works per default if the String's size does not exceed 256 characters length. If the String that should be passed back is longer than 256 characters, you need to pass a Visual Basic String in that is long enough to hold the resulting String.

Example

Use the following code to create a String with 1024 blank characters:

```
Dim longEmptyString = New String ( " "c , 1024 )
```

Pass this String as a ByRef argument into a DLL function and the DLL function will pass back Strings of up to 1024 characters of length.

When passing a String back from a DLL call as a function return value, the DLL should implement a DLL function called `FreeDllMemory` that accepts the C String pointer returned by the DLL function and that frees the previously allocated memory. If no such function exists the memory will be leaked.

Aliasing a DLL Name

If a DLL function has the same name as a reserved word in Visual Basic, or the function does not have a name but an ordinal number, you need to rename the function within your declaration and use the alias statement to map the declared name to the actual name.

Example

For example, the `Exit` statement is reserved by the Visual Basic compiler. Therefore, to call a function named `exit`, you need to declare it with another name, and add an alias statement, as shown here:

```
<Dll("mydll.dll")> Public Interface IMyDllFunctions
  <DllFunctionOptions(Alias:="exit")> Sub MyExit()
End Interface
```

Conventions for Calling DLL Functions

The following calling conventions are supported when calling DLL functions:

- __stdcall
- __cdecl

The __*stdcall* calling convention is used by default when calling DLL functions. This calling convention is used by all Windows API DLL functions.

You can change the calling convention for a DLL function by using the `CallingConvention` property of the `DllFunctionOptions` attribute.

Example

The following code example declares a DLL function with the __*decl* calling convention:

```
<Dll("msvcrt.dll")> Public Interface IMsVisualCRuntime

<DllFunctionOptions(CallingConvention:=CallingConvention.Cdecl)>
 Function cos(ByVal input As Double) As Double
End Interface
```

Custom Controls

Silk4NET provides the following features to support you when you are working with custom controls:

- The *dynamic invoke* functionality of Silk4NET enables you to directly call methods, retrieve properties, or set properties on an actual instance of a control in the application under test (AUT).
- For Win32-based applications, the *class mapping* functionality enables you to map the name of a custom control class to the name of a standard Silk Test class. You can then use the functionality that is supported for the standard Silk Test class in your test.
- The **Manage Custom Controls** dialog box enables you to specify a name for a custom control that can be used in a locator and also enables you to write reusable code for the interaction with the custom control.

Note: For custom controls, you can only record methods like `Click`,`TextClick`, and `TypeKeys` with Silk4NET. You cannot record custom methods for custom controls except when you are testing Apache Flex applications.

Dynamic Invoke

Dynamic invoke enables you to directly call methods, retrieve properties, or set properties, on an actual instance of a control in the application under test. You can also call methods and properties that are not available in the Silk4NET API for this control. Dynamic invoke is especially useful when you are working with custom controls, where the required functionality for interacting with the control is not exposed through the Silk4NET API.

Call dynamic methods on objects with the `Invoke` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Call multiple dynamic methods on objects with the `InvokeMethods` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.

For example, to call a method named `SetTitle`, which requires the title to be set as an input parameter of type string, on an actual instance of a control in the application under test, type the following:

```
control.Invoke("SetTitle", "my new title")
```

Note: Typically, most properties are read-only and cannot be set.

Note: Reflection is used in most technology domains to call methods and retrieve properties.

Note: You cannot dynamically invoke methods for DOM elements.

Frequently Asked Questions About Dynamic Invoke

This section includes a collection of questions that you might encounter when you are dynamically invoking methods to test custom controls.

Which Methods Can I Call With the Invoke Method?

To get a list of all the methods that you can call with the `Invoke` method for a specific test object, you can use the `GetDynamicMethodList`. To view the list, you can for example print it to the console or view it in the debugger.

Why Does an Invoke Call Return a Simple String when the Expected Return is a Complex Object?

The `Invoke` method can only return simple data types. Complex types are returned as string. Silk4NET uses the `ToString` method to retrieve the string representation of the return value. To call the individual methods and read properties of the complex object that is returned by the first method invocation, use `InvokeMethods` instead of `Invoke`.

How Can I Simplify My Scripts When I Use Many Calls To InvokeMethods?

When you extensively use `InvokeMethods` in your scripts, the scripts might become complex because you have to pass all method names as strings and all parameters as lists. To simplify such complex scripts, create a static method that interacts with the actual control in the AUT instead of interacting with the control through `InvokeMethods`. For additional information, see *Adding Code to the Application Under Test to Test Custom Controls*.

Adding Code to the Application Under Test to Test Custom Controls

When you are testing Windows Forms applications or WPF applications, and you want to test complex custom controls or custom controls that you cannot test by simply using the `Invoke` and `InvokeMethods` methods, you can create a static method that interacts with the actual control in the application under test (AUT) and you can add this code to the AUT.

The benefit for you from adding code to the AUT is that the code in the AUT can use regular method calls for interacting with the control, instead of using the reflection-like style of calling methods with the dynamic invoke methods. Therefore you can use code completion and IntelliSense when you are writing you code.

You can then call the code in the AUT with a simple invoke call, where you pass the control of interest as a parameter.

You can add code to the AUT in the following ways:

- Compile the code into the AUT. The implementation is simple, but you will be changing the AUT, which you might not want to do.
- Inject code to the AUT at runtime by using the `LoadAssembly` method in a test script. This requires more effort than compiling the code into the AUT, but the injected code will be located close to the test code. The `LoadAssembly` method is available for the classes `WPFWindow` and `FormsWindow`.

Example: Testing the UltraGrid Infragistics control

This example demonstrates how you can retrieve the content of an `UltraGrid` control. The `UltraGrid` control is included in the `NETAdvantage for Windows Forms` library which is provided by Infragistics. You can download a trial of the library from *http://www.infragistics.com/products/windows-forms/downloads*.

To create the `UltraGridUtil` class, perform the following actions:

1. Create a new class library project in C# or VB .NET. Call the new project `AUTExtensions`.

   Note: The class library should use the same .NET version as the AUT.
2. Add references to the required dependencies to the project. For example, for Infragistics version 12.2 you need to reference the following assemblies:

   - Infragistics4.Shared.v12.2
   - Infragistics4.Win.UltraWinGrid.v12.2
   - Infragistics4.Win.v12.2

   If you are not sure which version of Infragistics is used in your AUT you can use the **Process Explorer** tool from Microsoft to see which assemblies are loaded in your AUT.

   a. In the `AUTExtensions` project, create the new class UltraGridUtil with the following content:

```
' VB code
Public Class UltraGridUtil

  Public Shared Function GetContents(ultraGrid As
Infragistics.Win.UltraWinGrid.UltraGrid) As List(Of List(Of
String))
    Dim contents = New List(Of List(Of String))
    For Each row In ultraGrid.Rows
      Dim rowContents = New List(Of String)
      For Each cell In row.Cells
        rowContents.Add(cell.Text)
      Next
      contents.Add(rowContents)
    Next
    Return contents
  End Function

End Class
```

```
// C# code
using System.Collections.Generic;

namespace AUTExtensions {
```

```
  public class UltraGridUtil {

    public static List<List<string>>
GetContents(Infragistics.Win.UltraWinGrid.UltraGrid grid) {
      var result = new List<List<string>>();
      foreach (var row in grid.Rows) {
        var rowContent = new List<string>();
        foreach (var cell in row.Cells) {
          rowContent.Add(cell.Text);
        }
        result.Add(rowContent);
      }
      return result;
    }

  }

}
```

Note: The `Shared` modifier makes the `GetContents` method a static method.

3. Build the `AUTExtensions` project.
4. Load the assembly into the AUT during playback.
   - Open an existing test script or create a new test script in a Silk4NET project.
   - Add the AUTExtensions project as a reference to the Silk4NET project.
   - Add the following code to your test script:

```
' VB code
mainWindow.LoadAssembly(GetType(UltraGridUtil).Assembly.Loca
tion)
```

```
// C# code
mainWindow.LoadAssembly(typeof(UltraGridUtil).Assembly.Locat
ion);
```

5. Call the static method of the injected code in order to get the contents of the `UltraGrid`:

```
'VB code
Dim ultraGrid = mainWindow.Control("@automationId='my grid'")
Dim contents As IList =
mainWindow.Invoke("AUTExtensions.UltraGridUtil.GetContents",
ultraGrid)
```

```
// C# code
Dim ultraGrid = mainWindow.Control("@automationId='my grid'");
Dim contents As IList =
mainWindow.Invoke("AUTExtensions.UltraGridUtil.GetContents",
ultraGrid);
```

Frequently Asked Questions About Adding Code to the AUT

This section includes a collection of questions that you might encounter when you are adding code to the AUT to test custom controls.

Why is Code That I Have Injected Into the AUT With the LoadAssembly Method Not Updated in the AUT?

If code in the AUT is not replaced by code that you have injected with the `LoadAssembly` method into the AUT, the assembly might already be loaded in your AUT. Assemblies cannot be unloaded, so you have to close and re-start your AUT.

Why Do the Input Argument Types Not Match When I Invoke a Method?

If you invoke a method and you get an error that says that the input argument types do not match, the method that you want to invoke was found but the arguments are not correct. Make sure that you use the correct data types in your script.

If you use the `LoadAssembly` method in your script to load an assembly into the AUT, another reason for this error might be that your assembly is built against a different version of the third-party library than the version that is used by the AUT. To fix this problem, change the referenced assembly in your project. If you are not sure which version of the third-party library is used in your AUT, you can use the **Process Explorer** tool from Microsoft.

How Do I Fix the Compile Error when an Assembly Can Not Be Copied?

When you have tried to add code to the AUT with the `LoadAssembly` method, you might get the following compile error:
Could not copy '<assembly_name>.dll' to '<assembly_name>.dll'. The process cannot access the file.
The reason for this compile error is that the assembly is already loaded in the AUT and cannot be overwritten.

To fix this compile error, close the AUT and compile your script again.

Testing Apache Flex Custom Controls

Silk4NET supports testing Flex custom controls. By default, Silk4NET provides record and playback support for the individual subcontrols of the custom control.

For testing custom controls, the following options exist:

- Basic support

  With basic support, you use dynamic invoke to interact with the custom control during replay. Use this low-effort approach when you want to access properties and methods of the custom control in the test application that Silk4NET does not expose. The developer of the custom control can also add methods and properties to the custom control specifically for making the control easier to test. A user can then call those methods or properties using the dynamic invoke feature.

  The advantages of basic support include:

  - Dynamic invoke requires no code changes in the test application.
  - Using dynamic invoke is sufficient for most testing needs.

  The disadvantages of basic support include:

  - No specific class name is included in the locator (for example, Silk4NET records “//FlexBox” rather than “//FlexSpinner”)
  - Only limited recording support
  - Silk4NET cannot replay events.

  For more details about dynamic invoke, including an example, see *Dynamically Invoking Apache Flex Methods*.
- Advanced support

  With advanced support, you create specific automation support for the custom control. This additional automation support provides recording support and more powerful play-back support. The advantages of advanced support include:

  - High-level recording and playback support, including the recording and replaying of events.
  - Silk4NET treats the custom control exactly the same as any other built-in Flex control.
  - Seamless integration into Silk4NET API
  - Silk4NET uses the specific class name in the locator (for example, Silk4NET records “//FlexSpinner”)

The disadvantages of advanced support include:

- Implementation effort is required. The test application must be modified and the Open Agent must be extended.

Managing Custom Controls

You can create custom classes for custom controls for which Silk4NET does not offer any dedicated support. Creating custom classes offers the following advantages:

- Better locators for scripts.
- An easy way to write reusable code for the interaction with the custom control.

Example: Testing the UltraGrid Infragistics control

Suppose that a custom grid control is recognized by Silk4NET as the generic class `Control`. Using the custom control support of Silk4NET has the following advantages:

Better object recognition because the custom control class name can be used in a locator.

Many objects might be recognized as `Control`. The locator requires an index to identify the specific object. For example, the object might be identified by the locator `//Control[13]`. When you create a custom class for this control, for example the class `UltraGrid`, you can use the locator `//UltraGrid`. By creating the custom class, you do not require the high index, which would be a fragile object identifier if the application under test changed.

You can implement reusable playback actions for the control in scripts.

When you are using custom classes, you can encapsulate the behavior for getting the contents of a grid into a method by adding the following code to your custom class, which is the class that gets generated when you specify the custom control in the user interface.

Typically, you can implement the methods in a custom control class in one of the following ways:

- You can use methods like `Click`, `TypeKeys`, `TextClick`, and `TextCapture`.
- You can dynamically invoke methods on the object in the AUT.
- You can dynamically invoke methods that you have added to the AUT. This is the approach that is described in this example.

You can use the following code to call the static method that is defined in the example in *Adding Code to the Application Under Test to Test Custom Controls*. The method `GetContents` is added into the generated class `UltraGrid`.

```
' VB code
Partial Public Class UltraGrid

  Public Function GetContents() As
IList
    Return
```

```
Invoke("AUTExtensions.UltraGridUtil.
GetContents", Me)
  End Function

End Class
```

```
// C# code
public partial class UltraGrid {

  public System.Collections.IList
GetContents() {
    return
(System.Collections.IList)
Invoke("AUTExtensions.UltraGridUtil.
GetContents", this);
  }

}
```

When you define a class as a custom control, you can use the class in the same way in which you can use any built-in class, for example the `Dialog` class.

```
' VB code
Dim ultraGrid As UltraGrid =
mainWindow.UltraGrid("@automationId=
'my grid'")
Dim contents =
ultraGrid.GetContents()
```

```
// C# code
UltraGrid ultraGrid =
mainWindow.UltraGrid("@automationId=
'my grid'");
IList contents =
ultraGrid.GetContents();
```

Supporting a Custom Control

Silk4NET supports managing custom controls over the UI for the following technology domains:

- Win32
- Windows Presentation Foundation (WPF)
- Windows Forms
- Java AWT/Swing
- Java SWT

To create a custom class for a custom control for which Silk4NET does not offer any dedicated support.

1. Click **Silk4NET** > **Manage Custom Controls**. The **Manage Custom Controls** dialog box opens.
2. In the **Silk4NET Custom Controls Output Directory** field, type in a name or click **Browse** to select the script that will contain the custom control.
3. Click on the tab of the technology domain for which you want to create a new custom class.
4. Click **Add**.
5. Click one of the following:

   - Click **Identify new custom control** to directly select a custom control in your application with the **Identify Object** dialog box.

- Click **Add new custom control** to manually add a custom control to the list.

A new row is added to the list of custom controls.

6. If you have chosen to manually add a custom control to the list:
   a) In the **Silk Test base class** column, select an existing base class from which your class will derive.
      This class should be the closest match to your type of custom control.
   b) In the **Silk Test class** column, enter the name to use to refer to the class.
      This is what will be seen in locators. For example: `//UltraGrid` instead of `//Control[13]`.

      Note: After you add a valid class, it will become available in the **Silk Test base class** list. You can then reuse it as a base class.
   c) In the **Custom control class name** column, enter the fully qualified class name of the class that is being mapped.
      For example: `Infragistics.Win.UltraWinGrid.UltraGrid`. For Win32 applications, you can use the wildcards *?* and * in the class name.
7. *Only for Win32 applications:* In the **Use class declaration** column, set the value to **False** to simply map the name of a custom control class to the name of a standard Silk Test class.
   When you map the custom control class to the standard Silk Test class, you can use the functionality supported for the standard Silk Test class in your test. Set the value to **True** to additionally use the class declaration of the custom control class.
8. Click **OK**.
9. *Only for scripts:*
   a) Add custom methods and properties to your class for the custom control.
   b) Use the custom methods and properties of your new class in your script.

      Note: The custom methods and properties are not recorded.

Note: Do not rename the custom class or the base class in the script file. Changing the generated classes in the script might result in unexpected behavior. Use the script only to add properties and methods to your custom classes. Use the **Manage Custom Controls** dialog box to make any other changes to the custom classes.

Custom Controls Options

Silk4NET > **Manage Custom Controls**.

Silk4NET supports managing custom controls over the UI for the following technology domains:

- Win32
- Windows Presentation Foundation (WPF)
- Windows Forms
- Java AWT/Swing
- Java SWT

In the **Silk4NET Custom Controls Output Directory**, define the script file into which the new custom classes should be generated.

When you map a custom control class to a standard Silk Test class, you can use the functionality supported for the standard Silk Test class in your test. The following **Custom Controls** options are available:

Option	Description
Silk Test base class	Select an existing base class to use that your class will derive from. This class should be the closest match to your type of custom control.

Option	Description
Silk Test class	Enter the name to use to refer to the class. This is what will be seen in locators.
Custom control class name	Enter the fully qualified class name of the class that is being mapped. You can use the wildcards *?* and * in the class name.
Use class declaration	This option is available only for Win32 applications. By default `False`, which means the name of the custom control class is mapped to the name of the standard Silk Test class. Set this setting to `True` to additionally use the class declaration of the custom control class.

Note: After you add a valid class, it will become available in the **Silk Test base class** list. You can then reuse it as a base class.

Example: Setting the options for the UltraGrid Infragistics control

To support the `UltraGrid` Infragistics control, use the following values:

Option	Value
Silk Test base class	`Control`
Silk Test class	`UltraGrid`
Custom control class name	`Infragistics.Win.UltraWinGrid.UltraGrid`

Improving Object Recognition with Microsoft Accessibility

You can use Microsoft Accessibility (Accessibility) to ease the recognition of objects at the class level. There are several objects in Internet Explorer and in Microsoft applications that Silk4NET can better recognize if you enable Accessibility. For example, without enabling Accessibility Silk4NET records only basic information about the menu bar in Microsoft Word and the tabs that appear. However, with Accessibility enabled, Silk4NET fully recognizes those objects.

Example

Without using Accessibility, Silk4NET cannot fully recognize a `DirectUIHwnd` control, because there is no public information about this control. Internet Explorer uses two `DirectUIHwnd` controls, one of which is a popup at the bottom of the browser window. This popup usually shows the following:

- The dialog box asking if you want to make Internet Explorer your default browser.
- The download options **Open**, **Save**, and **Cancel**.

When you start a project in Silk4NET and record locators against the `DirectUIHwnd` popup, with accessibility disabled, you will see only a single control. If you enable Accessibility you will get full recognition of the `DirectUIHwnd` control.

Using Accessibility

Win32 uses the Accessibility support for controls that are recognized as generic controls. When Win32 locates a control, it tries to get the accessible object along with all accessible children of the control.

Objects returned by Accessibility are either of the class `AccessibleControl`, `Button` or `CheckBox`. `Button` and `Checkbox` are treated specifically because they support the normal set of methods and

properties defined for those classes. For all generic objects returned by Accessibility the class is `AccessibleControl`.

Example

If an application has the following control hierarchy before Accessibility is enabled:

- Control
  - Control
- Button

When Accessibility is enabled, the hierarchy changes to the following:

- Control
  - Control
    - Accessible Control
    - Accessible Control
      - Button
- Button

Enabling Accessibility

If you are testing a Win32 application and cannot recognize objects, you should first enable Accessibility. Accessibility is designed to enhance object recognition at the class level.

To enable Accessibility:

1. Click . The dialog box opens.
2. Click **Advanced**.
3. Select the **Use Microsoft Accessibility** option. Accessibility is turned on.

Overview of Silk4NET Support of Unicode Content

The Open Agent is Unicode-enabled, which means that the Open Agent is able to recognize double-byte (wide) languages.

With Silk4NET you can test applications that contain content in double-byte languages such as Chinese, Korean, or Japanese (Kanji) characters, or any combination of these.

The Open Agent supports the following:

- Localized versions of Windows.
- International keyboards and native language Input Method Editors (IME).
- Passing international strings as parameters to test cases, methods, and so on, and comparing strings.
- Reading and writing text files in multiple formats: ANSI, Unicode, and UTF-8.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Before testing double-byte characters with Silk4NET

Testing an internationalized application, particularly one that contains double-byte characters, is more complicated than testing an application that contains strictly English single-byte characters. Testing an internationalized application requires that you understand a variety of issues, from operating system support, to language packs, to fonts, to working with IMEs and complex languages.

Before you begin testing your application using Silk4NET, you must do the following:

- Meet the needs of your application under test (AUT) for any necessary localized OS, regional settings, and required language packs.
- Install the fonts necessary to display your AUT.
- If you are testing an application that requires an IME for data input, install the appropriate IME.

Text Recognition Support

Text recognition methods enable you to conveniently interact with test applications that contain highly customized controls, which cannot be identified using object recognition. You can use *text clicks* instead of coordinate-based clicks to click on a specified text string within a control.

For example, you can simulate selecting the first cell in the second row of the following table:

CustomerName	FirstOrder	ID	IsActive	CreditCard
Bob Villa	01.01.2008	0	☑	MasterCard
Brian Miller	02.01.2008	1	☐	Visa
Caral Rudd	03.01.2008	2	☑	American Ex...
Dan Rundgren	04.01.2008	3	☐	MasterCard
Devie Yingstein	05.01.2008	4	☑	Visa

Specifying the text of the cell results in the following code line:

Text recognition methods are supported for the following technology domains:

- Win32.
- WPF.
- Windows Forms.
- Java SWT and Eclipse.
- Java AWT/Swing.

  Note: For Java Applets, and for Swing applications with Java versions prior to version 1.6.10, text recognition is supported out-of-the-box. For Swing applications with Java version 1.6.10 or later, you have to add the following command-line element when starting the application:

  ```
  -Dsun.java2d.d3d=false
  ```

  For example:

  ```
  javaw.exe -Dsun.java2d.d3d=false -jar mySwingApplication.jar
  ```
- xBrowser.

Text recognition methods

The following methods enable you to interact with the text of a control:

`TextCapture`	Returns the text that is within a control. Also returns text from child controls.
`TextClick`	Clicks on a specified text within a control. Waits until the text is found or the *Object resolve timeout*, which you can define in the synchronization options, is over.
`TextRectangle`	Returns the rectangle of a certain text within a control or a region of a control.
`TextExists`	Determines whether a given text exists within a control or a region of a control.

Text click recording

When text click recording is enabled, records `TextClick` methods instead of clicks with relative coordinates. Use this approach for controls where `TextClick` recording produces better results than normal coordinate-based clicks. You can insert text clicks in your script for any control, even if the text clicks are not recorded.

If you do not whish to record a `TextClick` action, you can turn off text click recording and record normal clicks.

The text recognition methods prefer whole word matches over partially matched words. recognizes occurrences of whole words previously than partially matched words, even if the partially matched words are displayed before the whole word matches on the screen. If there is no whole word found, the partly matched words will be used in the order in which they are displayed on the screen.

Example

The user interface displays the text *the hostname is the name of the host*. The following code clicks on *host* instead of *hostname*, although *hostname* is displayed before *host* on the screen: The following code clicks on the substring *host* in the word *hostname* by specifying the second occurrence:

Debugging Scripts

Run-time errors encountered during playback can be caused by a variety of factors, such as changes in the test application, script coding mistakes, or environmental changes. Quickly diagnosing and fixing these errors by debugging scripts minimizes script maintenance efforts and facilitates a more efficient team testing effort.

Script debugging lets you temporary suspend script playback in the development environment to manage, examine, reset, step through, or continue script playback.

Script Reliability

Application testing reveals errors in the application being tested. When testing software applications, these errors can cause scripts to not execute to completion.

The ability of scripts to reliably play back to completion is essential to successful testing. Synchronization issues, and expected and unexpected application errors may cause scripts to fail before playing back to completion. Silk4NET provides built-in option settings and scripting features that allow scripts to adjust to synchronization and application issues and play back reliably in any testing environment.

When playing back scripts, some errors are the result of slow application response time, which causes the application to lose synchronization with the scripts that test it. These errors can be handled by adjusting Silk4NET option settings that optimize synchronization between the scripts and the application being tested.

Stepping Through a Script in Debug Mode

You can play back scripts to execute one line at a time while in debug mode. Known as *stepping*, this allows a tester to trace through code during playback to see the order in which statements execute, which aids in debugging.

Stepping enables you to walk through a script in debug mode to closely examine its execution.

In debug mode, control playback execution by using the following commands:

Step Into (F11)	Executes the script one statement at a time. **Step Into** is useful to trace through each line in the code and steps into functions or embedded scripts. Each function or embedded script is also executed one code line at a time. **Step Into** is useful for detailed analysis of a test, and lets you see the effect of each statement on variable usage and test application interaction.
Step Over (F10)	Executes each procedure as if it were a single statement. Use this instead of Step Into to go directly into a function, without stepping through the individual lines that make up the function.
Step Out (Shift + F11)	Executes all remaining code in a procedure as if it were a single statement, and exits to the next statement in the procedure that caused the procedure to be initially called.
Set Run Pointer/ Next Statement	Continues execution with the statement at which the pointer is currently located, without executing any intermediate statements. Drag the pointer to the statement and click **F5** to execute it.

Stepping commands are accessed from the **DEBUG** menu.

Stepping Through Script Playback from a Selected Point

During debugging, you can execute the script from where playback was suspended by a breakpoint.

1. Set a breakpoint at a specific line in the script.
2. Press F5 to playback the script. Playback executes to the breakpoint, suspends and enters debug mode.
3. Press F5 to playback the script to the next breakpoint.

   If the code executes successfully, playback re-enters debug mode and the next code to be played back is highlighted in yellow. If the code does not playback successfully, the **Playback Error** dialog box opens.
4. Press F5 to step through playback of the remaining code in the script. Playback executes to the set breakpoint. The script displays in debug mode where you can step through the playback execution, control the step playback execution, or playback to/from certain points in the script.

Controlling Line Execution During Script Debugging

While debugging a script, you can control flow to aid in error recognition and to reduce the time needed to diagnose and fix errors.

The **Step Over** command sets the execution point to the line in your script that you choose. This feature is only available while at a breakpoint during debugging.

Use the **Step Over** command when you want to re-run a statement within the current procedure or to skip over statements in your script you do not want to play back. While debugging a script, this feature lets you control flow to aid in error recognition and reduce the time needed to diagnose and fix errors.

1. While debugging or at a breakpoint during playback, perform one of the following steps:
   - Drag the yellow arrow to the code line to be played back next.
   - Click to position the cursor on the next line to be played back and then choose **DEBUG** > **Step Over**.
2. Press F5 to resume playback at the selected line. After the selected line executes, playback suspends, and Silk4NET returns to debug mode. The execution point goes to the next sequential line.

Stopping Script Playback at Selected Points

You can configure scripts to suspend at set points during playback and enter debug mode. The points at which you set a script to stop on playback are called *breakpoints*. Breakpoints let you manage playback to facilitate debugging, and can help isolate where a script fails. Breakpoints help to analyze how a script plays back even if there are no errors in the script. When you set a breakpoint, playback stops at the breakpoint and enters debug mode.

Setting breakpoints enables a script to play back to any specific point of interest. Place breakpoints at specific lines where you want to stop playback. Playback executes to the first breakpoint and suspends until you tell the script to proceed.

1. Open the script in which you want to set a breakpoint.
2. Click the line where playback is to be suspended.
3. Click **DEBUG** > **Toggle Breakpoint**. A breakpoint icon appears in the column next to the line. Playback executes to the set breakpoint. When playback suspends at a breakpoint, the script highlights the breakpoint line in yellow with a yellow arrow pointing to the line.

During debugging, you can control line execution during playback. You can also configure scripts to playback to or from a specific line.

Tip: Select a line with a breakpoint and press `F9` to delete the breakpoint from the selected line. Press `Ctrl+Shift+F9` to delete all breakpoints from a script.

Testing Specific Environments

Silk4NET supports testing several types of environments.

Apache Flex Support

Silk4NET provides built-in support for testing Apache Flex applications using Internet Explorer, Mozilla Firefox, and the Standalone Flash Player, and Adobe AIR applications built with Apache Flex 4 or later.

Silk4NET also supports multiple application domains in Apache Flex 3.x and 4.x applications, which enables you to test sub-applications. Silk4NET recognizes each sub-application in the locator hierarchy tree as an application tree with the relevant application domain context. At the root level in the locator attribute table, Apache Flex 4.x sub-applications use the `SparkApplication` class. Apache Flex 3.x sub-applications use the `FlexApplication` class.

Supported Controls

For a complete list of the record and playback controls available for Apache Flex testing, see the *Flex Class Reference*.

Note: The Silk Test Flex Automation SDK is based on the Automation API for Apache Flex. The Silk Test Automation SDK supports the same components in the same manner that the Automation API for Apache Flex supports them. For instance, the `typekey` statement in the Flex Automation API does not support all keys. You can use the input text statement to resolve this issue. For more information about using the Flex Automation API, see the *Apache Flex Release Notes*.

Configuring Flex Applications to Run in Adobe Flash Player

To run an Apache Flex application in Flash Player, one or both of the following must be true:

- The developer who creates the Flex application must compile the application as an EXE file. When a user launches the application, it will open in Flash Player. Install Windows Flash Player from *http://www.adobe.com/support/flashplayer/downloads.html*.
- The user must have Windows Flash Player Projector installed. When a user opens a Flex .SWF file, he can configure it to open in Flash Player. Windows Flash Projector is not installed when Flash Player is installed unless you install the Apache Flex developer suite. Install Windows Flash Projector from *http://www.adobe.com/support/flashplayer/downloads.html*.

1. For Microsoft Windows 7 and Microsoft Windows Server 2008 R2, configure Flash Player to run as administrator. Perform the following steps:
   a) Right-click the Adobe Flash Player program shortcut or the `FlashPlayer.exe` file, then click **Properties**.
   b) In the **Properties** dialog box, click the **Compatibility** tab.
   c) Check the **Run this program as an administrator** check box and then click **OK**.
2. Start the .SWF file in Flash Player from the command prompt (cmd.exe) by typing:
   `"<Application_Install_Directory>\ApplicationName.swf"`
   By default, the *<SilkTest_Install_Directory>* is located at `Program Files\Silk\Silk Test`.

Launching the Component Explorer

Silk Test provides a sample Apache Flex application, the Component Explorer. Compiled with the Adobe Automation SDK and the Silk Test specific automation implementation, the Component Explorer is pre-configured for testing.

In Internet Explorer, open *http://demo.borland.com/flex/SilkTest15.5/index.html*. The application launches in your default browser.

Testing Apache Flex Applications

Silk Test provides built-in support for testing Apache Flex applications. Silk Test also provides several sample Apache Flex applications. You can access the sample applications at *http://demo.borland.com/flex/SilkTest15.5/index.html*.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Before you can test your own Apache Flex application, your Apache Flex developers must perform the following steps:

- Enabling your Apache Flex application for testing
- Creating testable Apache Flex applications
- Coding Apache Flex containers
- Implementing automation support for custom controls

To test your own Apache Flex application, follow these steps:

- Configuring security settings for your local Flash Player
- Recording a test
- Playing back a test
- Customizing Apache Flex scripts
- Testing a custom Apache Flex control

Note: Loading an Apache Flex application and initializing the Flex automation framework may take some time depending on the machine on which you are testing and the complexity of your Apache Flex application. Set the Window timeout value to a higher value to enable your application to fully load.

Testing Apache Flex Custom Controls

Silk4NET supports testing Flex custom controls. By default, Silk4NET provides record and playback support for the individual subcontrols of the custom control.

For testing custom controls, the following options exist:

- Basic support

  With basic support, you use dynamic invoke to interact with the custom control during replay. Use this low-effort approach when you want to access properties and methods of the custom control in the test application that Silk4NET does not expose. The developer of the custom control can also add methods and properties to the custom control specifically for making the control easier to test. A user can then call those methods or properties using the dynamic invoke feature.

  The advantages of basic support include:

  - Dynamic invoke requires no code changes in the test application.
  - Using dynamic invoke is sufficient for most testing needs.

  The disadvantages of basic support include:

- No specific class name is included in the locator (for example, Silk4NET records “//FlexBox” rather than “//FlexSpinner”)
- Only limited recording support
- Silk4NET cannot replay events.

For more details about dynamic invoke, including an example, see *Dynamically Invoking Apache Flex Methods*.

- Advanced support

  With advanced support, you create specific automation support for the custom control. This additional automation support provides recording support and more powerful play-back support. The advantages of advanced support include:

  - High-level recording and playback support, including the recording and replaying of events.
  - Silk4NET treats the custom control exactly the same as any other built-in Flex control.
  - Seamless integration into Silk4NET API
  - Silk4NET uses the specific class name in the locator (for example, Silk4NET records “//FlexSpinner”)

  The disadvantages of advanced support include:

  - Implementation effort is required. The test application must be modified and the Open Agent must be extended.

Dynamically Invoking Flex Methods

You can call methods, retrieve properties, and set properties on controls that Silk4NET does not expose by using the dynamic invoke feature. This feature is useful for working with custom controls and for working with controls that Silk4NET supports without customization.

Note: Typically, most properties are read-only and cannot be set.

Supported Methods and Properties

The following methods and properties can be called:

- Methods and properties that Silk4NET supports for the control.
- All public methods that the Flex API defines
- If the control is a custom control that is derived from a standard control, all methods and properties from the standard control can be called.

Supported Parameter Types

The following parameter types are supported:

- All built-in Silk4NET types

  Silk4NET types includes primitive types (such as boolean, int, string), lists, and other types (such as Point)

Returned Values

The following values are returned for properties and methods that have a return value:

- The correct value for all built-in Silk4NET types. These types are listed in the *Supported Parameter Types* section.
- All methods that have no return value return `null` in C# or `Nothing` in VB.

Defining a Custom Control in the Test Application

Typically, the test application already contains custom controls, which were added during development of the application. If your test application already includes custom controls, you can proceed to *Testing a Flex Custom Control Using Dynamic Invoke* or to *Testing a Custom Control Using Automation Support*.

This procedure shows how a Flex application developer can create a spinner custom control in Flex. The spinner custom control that we create in this topic is used in several topics to illustrate the process of implementing and testing a custom control.

The spinner custom control includes two buttons and a textfield, as shown in the following graphic.

The user can click **Down** to decrement the value that is displayed in the textfield and click **Up** to increment the value in the textfield.

The custom control offers a public "CurrentValue" property that can be set and retrieved.

1. In the test application, define the layout of the control.
   For example, for the spinner control type:

```
<?xml version="1.0" encoding="utf-8"?>
<customcontrols:SpinnerClass xmlns:mx="http://www.adobe.com/2006/mxml"
xmlns:controls="mx.controls.*" xmlns:customcontrols="customcontrols.*">
    <controls:Button id="downButton" label="Down" />
    <controls:TextInput id="text" enabled="false" />
    <controls:Button id="upButton" label="Up"/>
</customcontrols:SpinnerClass>
```

2. Define the implementation of the custom control.
   For example, for the spinner control type:

```
package customcontrols
{
    import flash.events.MouseEvent;

    import mx.containers.HBox;
    import mx.controls.Button;
    import mx.controls.TextInput;
    import mx.core.UIComponent;
    import mx.events.FlexEvent;

    [Event(name="increment",     type="customcontrols.SpinnerEvent")]
    [Event(name="decrement",     type="customcontrols.SpinnerEvent")]

    public class SpinnerClass extends HBox
    {
        public var downButton : Button;
        public var upButton : Button;
        public var text : TextInput;
        public var ssss: SpinnerAutomationDelegate;
        private var _lowerBound : int = 0;
        private var _upperBound : int = 5;

        private var _value : int = 0;
        private var _stepSize : int = 1;


        public function SpinnerClass() {
            addEventListener(FlexEvent.CREATION_COMPLETE,
creationCompleteHandler);
        }
```

```
        private function creationCompleteHandler(event:FlexEvent) : void {
            downButton.addEventListener(MouseEvent.CLICK,
downButtonClickHandler);
            upButton.addEventListener(MouseEvent.CLICK,
upButtonClickHandler);
            updateText();
        }

        private function downButtonClickHandler(event : MouseEvent) : void {
            if(currentValue - stepSize >= lowerBound) {
                currentValue = currentValue - stepSize;
            }
            else {
                currentValue = upperBound - stepSize + currentValue -
lowerBound + 1;
            }

            var spinnerEvent : SpinnerEvent = new
SpinnerEvent(SpinnerEvent.DECREMENT);
            spinnerEvent.steps = _stepSize;
            dispatchEvent(spinnerEvent);
        }

        private function upButtonClickHandler(event : MouseEvent) : void {
            if(currentValue <= upperBound - stepSize) {
                currentValue = currentValue + stepSize;
            }
            else {
                currentValue = lowerBound + currentValue + stepSize -
upperBound - 1;
            }

            var spinnerEvent : SpinnerEvent = new
SpinnerEvent(SpinnerEvent.INCREMENT);
            spinnerEvent.steps = _stepSize;
            dispatchEvent(spinnerEvent);
        }

        private function updateText() : void {
            if(text != null) {
                text.text = _value.toString();
            }
        }

        public function get currentValue() : int {
            return _value;
        }

        public function set currentValue(v : int) : void {
            _value = v;
            if(v < lowerBound) {
                _value = lowerBound;
            }
            else if(v > upperBound) {
                _value = upperBound;
            }
            updateText();

        }

        public function get stepSize() : int {
            return _stepSize;
        }
```

```
        public function set stepSize(v : int) : void {
            _stepSize = v;
        }

        public function get lowerBound() : int {
            return _lowerBound;
        }

        public function set lowerBound(v : int) : void {
            _lowerBound = v;
            if(currentValue < lowerBound) {
                currentValue = lowerBound;
            }
        }

        public function get upperBound() : int {
            return _upperBound;
        }

        public function set upperBound(v : int) : void {
            _upperBound = v;
            if(currentValue > upperBound) {
                currentValue = upperBound;
            }
        }
    }
}
```

3. Define the events that the control uses.
   For example, for the spinner control type:

```
package customcontrols
{
    import flash.events.Event;

    public class SpinnerEvent extends Event
    {
        public static const INCREMENT : String = "increment";
        public static const DECREMENT : String = "decrement";

        private var _steps : int;

        public function SpinnerEvent(eventName : String) {
            super(eventName);
        }

        public function set steps(value:int) : void {
            _steps = value;
        }

        public function get steps() : int {
            return _steps;
        }

    }
}
```

The next step is to implement automation support for the test application.

Testing a Flex Custom Control Using Dynamic Invoke

Silk4NET provides record and playback support for custom controls using dynamic invoke to interact with the custom control during replay. Use this low-effort approach when you want to access properties and methods of the custom control in the test application that Silk4NET does not expose. The developer of the

custom control can also add methods and properties to the custom control specifically for making the control easier to test.

1. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.
2. Call dynamic methods on objects with the `Invoke` method.
3. Call multiple dynamic methods on objects with the `InvokeMethods` method.
4. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.
5. Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method.

Example

The following example tests a spinner custom control that includes two buttons and a textfield, as shown in the following graphic.

The user can click **Down** to decrement the value that is displayed in the textfield and click **Up** to increment the value in the textfield.

The custom control offers a public "CurrentValue" property that can be set and retrieved.

To set the spinner's value to 4, type the following:

```
Dim spinner = Desktop.Find("//
FlexBox[@className=customcontrols.Spinner]")
spinner.SetProperty("CurrentValue", 4)
```

Testing a Custom Control Using Automation Support

You can create specific automation support for the custom control. This additional automation support provides recording support and more powerful play-back support. To create automation support, the test application must be modified and the Open Agent must be extended.

Before you can test a custom control in Silk4NET, perform the following steps:

- Define the custom control in the test application
- Implement automation support

After the test application has been modified and includes automation support, perform the following steps:

For scripts, record the script and make manual modifications to fit the custom control.
For example, the following code shows how to increment the spinner's value by 3 by using the "Increment" method that has been implemented in the automation delegate:

```
_desktop.TestObject("//FlexSpinner[@caption='index:
1']").Invoke("Increment", 3)
```

The following example shows how to set the value of the spinner to 3.

```
_desktop.TestObject("//FlexSpinner[@caption='index:
1']").SetProperty("CurrentValue", 3)
```

Implementing Automation Support for a Custom Control

Before you can test a custom control, implement automation support (the automation delegate) in ActionScript for the custom control and compile that into the test application.

The following procedure uses a custom Flex spinner control to demonstrate how to implement automation support for a custom control. The spinner custom control includes two buttons and a textfield, as shown in the following graphic.

The user can click **Down** to decrement the value that is displayed in the textfield and click **Up** to increment the value in the textfield.

The custom control offers a public "CurrentValue" property that can be set and retrieved.

1. Implement automation support (the automation delegate) in ActionScript for the custom control.
   For further information about implementing an automation delegate, see the Adobe Live Documentation at *http://livedocs.adobe.com/flex/3/html/help.html?content=functest_components2_14.html*.
   In this example, the automation delegate adds support for the methods "increment", "decrement". The example code for the automation delegate looks like this:

```
package customcontrols
{
    import flash.display.DisplayObject;
    import mx.automation.Automation;
    import customcontrols.SpinnerEvent;
    import mx.automation.delegates.containers.BoxAutomationImpl;
    import flash.events.Event;
    import mx.automation.IAutomationObjectHelper;
    import mx.events.FlexEvent;
    import flash.events.IEventDispatcher;
    import mx.preloaders.DownloadProgressBar;
    import flash.events.MouseEvent;
    import mx.core.EventPriority;

    [Mixin]
    public class SpinnerAutomationDelegate extends BoxAutomationImpl
    {

        public static function init(root:DisplayObject) : void {
            // register delegate for the automation
            Automation.registerDelegateClass(Spinner,
SpinnerAutomationDelegate);
        }

        public function SpinnerAutomationDelegate(obj:Spinner) {
            super(obj);
            // listen to the events of interest (for recording)
            obj.addEventListener(SpinnerEvent.DECREMENT, decrementHandler);
            obj.addEventListener(SpinnerEvent.INCREMENT, incrementHandler);
        }

        protected function decrementHandler(event : SpinnerEvent) : void {
            recordAutomatableEvent(event);
        }

        protected function incrementHandler(event : SpinnerEvent) : void {
            recordAutomatableEvent(event);
        }

        protected function get spinner() : Spinner {
```

```
            return uiComponent as Spinner;
        }

        //----------------------------------
        //  override functions
        //----------------------------------

        override public function get automationValue():Array {
            return [ spinner.currentValue.toString() ];
        }

        private function replayClicks(button : IEventDispatcher, steps :
int) : Boolean {
            var helper : IAutomationObjectHelper =
Automation.automationObjectHelper;
            var result : Boolean;
            for(var i:int; i < steps; i++) {
                helper.replayClick(button);
            }
            return result;
        }

        override public function
replayAutomatableEvent(event:Event):Boolean {

            if(event is SpinnerEvent) {
                var spinnerEvent : SpinnerEvent = event as SpinnerEvent;
                if(event.type == SpinnerEvent.INCREMENT) {
                    return replayClicks(spinner.upButton,
spinnerEvent.steps);
                }
                else if(event.type == SpinnerEvent.DECREMENT) {
                    return replayClicks(spinner.downButton,
spinnerEvent.steps);
                }
                else {
                    return false;
                }

            }
            else {
                return super.replayAutomatableEvent(event);
            }
        }

        // do not expose the child controls (i.e the buttons and the
textfield) as individual controls
        override public function get numAutomationChildren():int {
            return 0;
        }

    }
}
```

2. To introduce the automation delegate to the Open Agent, create an XML file that describes the custom control.

   The class definition file contains information about all instrumented Flex components. This file (or files) provides information about the components that can send events during recording and accept events for replay. The class definition file also includes the definitions for the supported properties.

   The XML file for the spinner custom control looks like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<TypeInformation>
    <ClassInfo Name="FlexSpinner" Extends="FlexBox">
```

```
        <Implementation
            Class="customcontrols.Spinner" />
        <Events>
            <Event Name="Decrement">
                <Implementation
                    Class="customcontrols.SpinnerEvent"
                    Type="decrement" />
                <Property Name="steps">
                    <PropertyType Type="integer" />
                </Property>
            </Event>
            <Event Name="Increment">
                <Implementation
                    Class="customcontrols.SpinnerEvent"
                    Type="increment" />
                <Property Name="steps">
                    <PropertyType Type="integer" />
                </Property>
            </Event>
        </Events>
        <Properties>
            <Property Name="lowerBound" accessType="read">
                <PropertyType Type="integer" />
            </Property>
            <Property Name="upperBound" accessType="read">
                <PropertyType Type="integer" />
            </Property>
            <!-- expose read and write access for the currentValue property
-->
            <Property Name="currentValue" accessType="both">
                <PropertyType Type="integer" />
            </Property>
            <Property Name="stepSize" accessType="read">
                <PropertyType Type="integer" />
            </Property>
        </Properties>
    </ClassInfo>
</TypeInformation>
```

3. Include the XML file for the custom control in the folder that includes all the XML files that describe all classes and their methods and properties for the supported Flex controls.

   Silk Test contains several XML files that describe all classes and their methods and properties for the supported Flex controls. Those XML files are located in the `<<Silk Test_install_directory>\ng\agent\plugins\com.borland.fastxd.techdomain.flex.agent_<version>\config\automationEnvironment` folder.

   If you provide your own XML file, you must copy your XML file into this folder. When the Open Agent starts and initializes support for Apache Flex, it reads the contents of this directory.

   To test the Flex Spinner sample control, you must copy the CustomControls.xml file into this folder. If the Open Agent is currently running, restart it after you copy the file into the folder.

Flex Class Definition File

The class definition file contains information about all instrumented Flex components. This file (or files) provides information about the components that can send events during recording and accept events for replay. The class definition file also includes the definitions for the supported properties.

Silk Test contains several XML files that describe all classes/events/properties for the common Flex common and specialized controls. Those XML files are located in the `<Silk Test_install_directory>\ng\agent\plugins\com.borland.fastxd.techdomain.flex.agent_<`*`version`*`>\config\automationEnvironment` folder.

If you provide your own XML file, you must copy your XML file into this folder. When the Silk Test agent starts and initializes support for Apache Flex, it reads the contents of this directory.

The XML file has the following basic structure:

```
<TypeInformation>
<ClassInfo>
<Implementation />
<Events>
<Event />
…
</Events>
<Properties>
<Property />
…
</Properties>
</ClassInfo>
</TypeInformation>
```

Customizing Apache Flex Scripts

You can manually customize your Flex scripts. You can insert verifications manually using the `Verify` function on Flex object properties. Each Flex object has a list of properties that you can verify. For a list of the properties available for verification, review the *Flex Class Reference*.

1. Record a test for your Flex application.
2. Open the script file that you want to customize.
3. Manually type the code that you want to add.

Testing Multiple Flex Applications on the Same Web Page

When multiple Flex applications exist on the same Web page, Silk4NET uses the Flex application ID or the application size property to determine which application to test. If multiple applications exist on the same page, but they are different sizes, Silk4NET uses the size property to determine on which application to perform any actions and no additional steps are necessary.

Silk4NET uses JavaScript to find the Flex application ID to determine on which application to perform any actions if:

- Multiple Flex applications exist on a single Web page
- Those applications are the same size

Note: In this situation, if JavaScript is not enabled on the browser machine, an error occurs when a script runs.

1. Enable JavaScript.

2. In Internet Explorer, perform the following steps:
   a) Choose **Tools** > **Internet Options**.
   b) Click the **Security** tab.
   c) Click **Custom level**.
   d) In the **Scripting** section, under **Active Scripting**, click **Enable** and click **OK**.
3. Follow the steps in *Testing Apache Flex Applications*.

Note: If a frame exists on the Web page and the applications are the same size, this method will not work.

Adobe AIR Support

Silk4NET supports testing with Adobe AIR for applications that are compiled with the Flex 4 compiler. For details about supported versions, check the *Release Notes* for the latest information.

Silk Test provides a sample Adobe AIR application. You can access the sample application at *http://demo.borland.com/flex/SilkTest15.5/index.html* and then click the Adobe AIR application that you want to use. You can select the application with or without automation. In order to execute the AIR application, you must install the Adobe AIR Runtime.

Overview of the Flex Select Method Using Name or Index

You can record Flex `Select` methods using the `Name` or `Index` of the control that you select. By default, Silk4NET records `Select` methods using the name of the control. However, you can change your environment to record `Select` events using the index for the control, or you can switch between the name and index for recording.

You can record `Select` events using the index for the following controls:

- `FlexList`
- `FlexTree`
- `FlexDataGrid`
- `FlexAdvancedDataGrid`
- `FlexOLAPDataGrid`
- `FlexComboBox`

The default setting is ItemBasedSelection (Select event), which uses the name control. To use the index, you must adapt the AutomationEnvironment to use the IndexBasedSelection (SelectIndex event). To change the behavior for one of these classes, you must modify the FlexCommonControls.xml, AdvancedDataGrid.xml, or OLAPDataGrid.xml file using the following code. Those XML files are located in the `<Silk Test_install_directory>\ng\agent\plugins \com.borland.fastxd.techdomain.flex.agent_< version>\config \automationEnvironment` folder. Make the following adaptations in the corresponding xml file.

```
<ClassInfo Extends="FlexList" Name="FlexControlName"
EnableIndexBasedSelection=”true” >

…

</ClassInfo>
```

With this adaption the IndexBasedSelection is used for recording `FlexList::SelectIndex` events. Setting the `EnableIndexBasedSelection=` to `false` in the code or removing the Boolean returns recording to using the name (`FlexList::Select` events).

Note: You must re-start your application, which automatically re-starts the Silk Test Agent, in order for these changes to become active.

Selecting an Item in the FlexDataGrid Control

Select an item in the FlexDataGrid control using the index value or the content value.

1. To select an item in the FlexDataGrid control using the index value, use the `SelectIndex` method. For example, type `FlexDataGrid.SelectIndex(1)`.
2. To select an item in the FlexDataGrid control using the content value, use the `Select` method.

   Identify the row that you want to select with the required formatted string. Items must be separated by a pipe (" | "). At least one Item must be enclosed by two stars ("*"). This identifies the item where the click will be performed.

   The syntax is: `FlexDataGrid.Select("*Item1* | Item2 | Item3")`

Enabling Your Flex Application for Testing

To enable your Flex application for testing, your Apache Flex developers must include the following components in the Flex application:

- Apache Flex Automation Package
- Silk Test Automation Package

Apache Flex Automation Package

The Flex automation package provides developers with the ability to create Flex applications that use the Automation API. You can download the Flex automation package from Adobe's website, *http://www.adobe.com*. The package includes:

- Automation libraries – the automation.swc and automation_agent.swc libraries are the implementations of the delegates for the Flex framework components. The automation_agent.swc file and its associated resource bundle are the generic agent mechanism. An agent, such as the Silk Test Agent, builds on top of these libraries.
- Samples

Note: The Silk Test Flex Automation SDK is based on the Automation API for Flex. The Silk Test Automation SDK supports the same components in the same manner that the Automation API for Flex supports them. For instance, the `typekey` statement in the Flex Automation API does not support all keys. You can use the input text statement to resolve this issue. For more information about using the Flex Automation API, see the *Apache Flex Release Notes*.

Silk Test Automation Package

Silk Test's Open Agent uses the Apache Flex automation agent libraries. The FlexTechDomain.swc file contains the Silk Test specific implementation.

You can enable your application for testing using either of the following methods:

- Linking automation packages to your Flex application
- Run-time loading

Linking Automation Packages to Your Flex Application

You must precompile Flex applications that you plan to test. The functional testing classes are embedded in the application at compile time, and the application has no external dependencies for automated testing at run time.

When you embed functional testing classes in your application SWF file at compile time, the size of the SWF file increases. If the size of the SWF file is not important, use the same SWF file for functional testing

and deployment. If the size of the SWF file is important, generate two SWF files, one with functional testing classes embedded and one without. Use the SWF file that does not include the embedded testing classes for deployment.

When you precompile the Flex application for testing, in the include-libraries compiler option, reference the following files:

- automation.swc
- automation_agent.swc
- FlexTechDomain.swc
- automation_charts.swc (include only if your application uses charts and Flex 2.0)
- automation_dmv.swc (include if your application uses charts and Flex > 3.x)
- automation_flasflexkit.swc (include if your application uses embedded flash content)
- automation_spark.swc (include if your application uses the new Flex 4.x controls)
- automation_air.swc (include if your application is an AIR application)
- automation_airspark.swc (include if your application is an AIR application and uses new Flex 4.x controls)

When you create the final release version of your Flex application, you recompile the application without the references to these SWC files. For more information about using the automation SWC files, see the *Apache Flex Release Notes*.

If you do not deploy your application to a server, but instead request it by using the file protocol or run it from within Apache Flex Builder, you must include each SWF file in the local-trusted sandbox. This requires additional configuration information. Add the additional configuration information by modifying the compiler's configuration file or using a command-line option.

Note: The Silk Test Flex Automation SDK is based on the Automation API for Flex. The Silk Test Automation SDK supports the same components in the same manner that the Automation API for Flex supports them. For instance, when an application is compiled with automation code and successive SWF files are loaded, a memory leak occurs and the application runs out of memory eventually. The Flex Control Explorer sample application is affected by this issue. The workaround is to not compile the application SWF files that Explorer loads with automation libraries. For example, compile only the Explorer main application with automation libraries. Another alternative is to use the module loader instead of swfloader. For more information about using the Flex Automation API, see the *Apache FlexRelease Notes*.

Precompiling the Flex Application for Testing

You can enable your application for testing by precompiling your application for testing or by using run-time loading.

1. Include the automation.swc, automation_agent.swc, and FlexTechDomain.swc libraries in the compiler's configuration file by adding the following code to the configuration file:

```
<include-libraries>

...

<library>/libs/automation.swc</library>

<library>/libs/automation_agent.swc</library>

<library>pathinfo/FlexTechDomain.swc</library>

</include-libraries>
```

Note: If your application uses charts, you must also add the automation_charts.swc file.

2. Specify the location of the automation.swc, automation_agent.swc, and FlexTechDomain.swc libraries using the include-libraries compiler option with the command-line compiler.

   The configuration files are located at:

   Apache Flex 2 SDK – <flex_installation_directory>/frameworks/flex-config.xml

   Apache Flex Data Services – <flex_installation_directory>/flex/WEB-INF/flex/flex-config.xml

   The following example adds the automation.swc and automation_agent.swc files to the application:

```
mxmlc -include-libraries+=../frameworks/libs/automation.swc;../frameworks/
libs/
automation_agent.swc;pathinfo/FlexTechDomain.swc MyApp.mxml
```

   Note: Explicitly setting the include-libraries option on the command line overwrites, rather than appends, the existing libraries. If you add the automation.swc and automation_agent.swc files using the include-libraries option on the command line, ensure that you use the += operator. This appends rather than overwrites the existing libraries that are included.

   Note: The Silk Test Flex Automation SDK is based on the Automation API for Flex. The Silk Test Automation SDK supports the same components in the same manner that the Automation API for Flex supports them. For instance, when an application is compiled with automation code and successive SWF files are loaded, a memory leak occurs and the application runs out of memory eventually. The Flex Control Explorer sample application is affected by this issue. The workaround is to not compile the application SWF files that Explorer loads with automation libraries. For example, compile only the Explorer main application with automation libraries. Another alternative is to use the module loader instead of swfloader. For more information about using the Flex Automation API, see the *Apache FlexRelease Notes*.

Run-Time Loading

You can load Flex automation support at run time using the Silk Test Flex Automation Launcher. This application is compiled with the automation libraries and loads your application with the SWFLoader class. This automatically enables your application for testing without compiling automation libraries into your SWF file. The Silk Test Flex Automation Launcher is available in HTML and SWF file formats.

Limitations

- The Flex Automation Launcher Application automatically becomes the root application. If your application must be the root application, you cannot load automation support with the Silk Test Flex Automation Launcher.
- Testing applications that load external libraries – Applications that load other SWF file libraries require a special setting for automated testing. A library that is loaded at run time (including run-time shared libraries (RSLs) must be loaded into the ApplicationDomain of the loading application. If the SWF file used in the application is loaded in a different application domain, automated testing record and playback will not function properly. The following example shows a library that is loaded into the same ApplicationDomain:

```
import flash.display.*;

import flash.net.URLRequest;

import flash.system.ApplicationDomain;

import flash.system.LoaderContext;


var ldr:Loader = new Loader();


var urlReq:URLRequest = new URLRequest("RuntimeClasses.swf");
```

```
var context:LoaderContext = new LoaderContext();

context.applicationDomain = ApplicationDomain.currentDomain;

loader.load(request, context);
```

Run-Time Loading

1. Copy the content of the `Silk\Silk Test\ng\AutomationSDK\Flex\<version>\FlexAutomationLauncher` directory into the directory of the Flex application that you are testing.
2. Open `FlexAutomationLauncher.html` in Windows Explorer and add the following parameter as a suffix to the file path:
   ```
   ?automationurl=YourApplication.swf
   ```
   where *YourApplication.swf* is the name of the SWF file for your Flex application.
3. Add `file:///` as a prefix to the file path.
   For example, if your file URL includes a parameter, such as: `?automationurl=explorer.swf`, type: .
   ```
   file:///C:/Program%20Files/Silk/Silk Test/ng/sampleapplications/Flex/3.2/
   FlexControlExplorer32/FlexAutomationLauncher.html?automationurl=explorer.swf
   ```

Using the Command Line to Add Configuration Information

To specify the location of the automation.swc, automation_agent.swc, and FlexTechDomain.swc libraries using the command-line compiler, use the include-libraries compiler option.

The following example adds the `automation.swc` and `automation_agent.swc` files to the application:

```
mxmlc -include-libraries+=../frameworks/libs/automation.swc;../frameworks/
libs/
automation_agent.swc;pathinfo/FlexTechDomain.swc MyApp.mxml
```

Note: If your application uses charts, you must also add the `automation_charts.swc` file to the include-libraries compiler option.

Explicitly setting the include-libraries option on the command line overwrites, rather than appends, the existing libraries. If you add the `automation.swc` and `automation_agent.swc` files using the include-libraries option on the command line, ensure that you use the += operator. This appends rather than overwrites the existing libraries that are included.

To add automated testing support to a Flex Builder project, you must also add the `automation.swc` and `automation_agent.swc` files to the include-libraries compiler option.

Passing Parameters into a Flex Application

You can pass parameters into a Flex application using the following procedures.

Passing Parameters into a Flex Application Before Runtime

You can pass parameters into a Flex application before runtime using automation libraries.

1. Compile your application with the appropriate automation libraries.
2. Use the standard Flex mechanism for the parameter as you typically would.

Passing Parameters into a Flex Application at Runtime Using the Flex Automation Launcher

Before you begin this task, prepare your application for run-time loading.

1. Open the `FlexAutomationLauncher.html` file or create a file using `FlexAutomationLauncher.html` as an example.
2. Navigate to the following section:

```
<script language="JavaScript" type="text/javascript">

                AC_FL_RunContent(eef

                   "src", "FlexAutomationLauncher",

                   "width", "100%",

                   "height", "100%",

                   "align", "middle",

                   "id", "FlexAutomationLauncher",

                   "quality", "high",

                   "bgcolor", "white",

                   "name", "FlexAutomationLauncher",

                   "allowScriptAccess","sameDomain",

                   "type", "application/x-shockwave-flash",

                   "pluginspage", "http://www.adobe.com/go/getflashplayer",

                   "flashvars", "yourParameter=yourParameterValue"+
"&automationurl=YourApplication.swf"



                );

        </script>
```

   Note: Do not change the "`FlexAutomationLauncher`" value for "`src`", "`id`", or "`name`."

3. Add your own parameter to "*yourParameter=yourParameterValue*".
4. Pass the name of the Flex application that you want to test as value for the "*&automationurl=YourApplication.swf*" value.
5. Save the file.

Creating Testable Flex Applications

As a Flex developer, you can employ techniques to make Flex applications as "test friendly" as possible. These include:

- Providing Meaningful Identification of Objects
- Avoiding Duplication of Objects

Providing Meaningful Identification of Objects

To create "test friendly" applications, ensure that objects are identifiable in scripts. You can set the value of the ID property for all controls that are tested, and ensure that you use a meaningful string for that ID property.

To provide meaningful identification of objects:

- Give all testable MXML components an ID to ensure that the test script has a unique identifier to use when referring to that Flex control.
- Make these identifiers as human-readable as possible to make it easier for the user to identify that object in the testing script. For example, set the id property of a Panel container inside a TabNavigator to `submit_panel` rather than `panel1` or `p1`.

When working with Silk4NET, an object is automatically given a name depending on certain tags, for instance, id, childIndex. If there is no value for the id property, Silk4NET uses other properties, such as the childIndex property. Assigning a value to the id property makes the testing scripts easier to read.

Avoiding Duplication of Objects

Automation agents rely on the fact that some properties of object instances will not be changed during run time. If you change the Flex component property that is used by Silk4NET as the object name at run time, unexpected results can occur. For example, if you create a Button control without an `automationName` property, and you do not initially set the value of its label property, and then later set the value of the `label` property, problems might occur. In this case, Silk4NET uses the value of the label property of Button controls to identify an object if the automationName property is not set. If you later set the value of the `label` property, or change the value of an existing label, Silk4NET identifies the object as a new object and does not reference the existing object.

To avoid duplicating objects:

- Understand what properties are used to identify objects in the agent and avoid changing those properties at run time.
- Set unique, human-readable id or `automationName` properties for all objects that are included in the recorded script.

Custom Attributes for Apache Flex Applications

Apache Flex applications use the predefined property `automationName` to specify a stable identifier for the Apache Flex control as follows:

```
<?xml version="1.0" encoding="utf-8"?>
  <s:Group xmlns:fx="http://ns.adobe.com/mxml/2009"
      xmlns:s="library://ns.adobe.com/flex/spark"
      xmlns:mx="library://ns.adobe.com/flex/mx" width="400" height="300">
    <fx:Script>
    …
    </fx:Script>
    <s:Button x="247" y="81" label="Button" id="button1" enabled="true"
click="button1_clickHandler(event)"
        automationName="AID_buttonRepeat"/>
    <s:Label x="128" y="123" width="315" height="18" id="label1"
verticalAlign="middle"
        text="awaiting your click" textAlign="center"/>
  </s:Group>
```

Apache Flex application locators look like the following:

```
…//SparkApplication//SparkButton[@caption='AID_buttonRepeat'
```

Attention: For Apache Flex applications, the *automationName* is always mapped to the locator attribute `caption` in Silk4NET. If the *automationName* attribute is not specified, Silk4NET maps the property `ID` to the locator attribute `caption`.

Flex AutomationName and AutomationIndex Properties

The Flex Automation API introduces the `automationName` and `automationIndex` properties. If you provide the `automationName`, Silk4NET uses this value for the recorded window declaration's name. Providing a meaningful name makes it easier for Silk4NET to identify that object. As a best practice, set the value of the `automationName` property for all objects that are part of the application's test.

Use the `automationIndex` property to assign a unique index value to an object. For instance, if two objects share the same name, assign an index value to distinguish between the two objects.

Note: The Silk Test Flex Automation SDK is based on the Automation API for Flex. The Silk Test Automation SDK supports the same components in the same manner that the Automation API for Flex supports them. For instance, when an application is compiled with automation code and successive SWF files are loaded, a memory leak occurs and the application runs out of memory eventually. The Flex Control Explorer sample application is affected by this issue. The workaround is to not compile the application SWF files that Explorer loads with automation libraries. For example, compile only the Explorer main application with automation libraries. Another alternative is to use the module loader instead of swfloader. For more information about using the Flex Automation API, see the *Apache Flex Release Notes*.

Flex Class Definition File

The class definition file contains information about all instrumented Flex components. This file (or files) provides information about the components that can send events during recording and accept events for replay. The class definition file also includes the definitions for the supported properties.

Silk Test contains several XML files that describe all classes/events/properties for the common Flex common and specialized controls. Those XML files are located in the `<Silk Test_install_directory>\ng\agent\plugins \com.borland.fastxd.techdomain.flex.agent_<version>\config \automationEnvironment` folder.

If you provide your own XML file, you must copy your XML file into this folder. When the Silk Test agent starts and initializes support for Apache Flex, it reads the contents of this directory.

The XML file has the following basic structure:

```
<TypeInformation>
<ClassInfo>
<Implementation />
<Events>
<Event />
…
</Events>
<Properties>
<Property />
…
</Properties>
</ClassInfo>
</TypeInformation>
```

Setting the Flex automationName Property

The `automationName` property defines the name of a component as it appears in tests. The default value of this property varies depending on the type of component. For example, the `automationName` for a Button control is the label of the Button control. Sometimes, the `automationName` is the same as the `id` property for the control, but this is not always the case.

For some components, Flex sets the value of the `automationName` property to a recognizable attribute of that component. This helps testers recognize the component in their tests. Because testers typically do not have access to the underlying source code of the application, having a control's visible property define that control can be useful. For example, a Button labeled "Process Form Now" appears in the test as `FlexButton("Process Form Now")`.

If you implement a new component, or derive from an existing component, you might want to override the default value of the `automationName` property. For example, UIComponent sets the value of the `automationName` to the component's `id` property by default. However, some components use their own methods for setting the value. For example, in the Flex Store sample application, containers are used to create the product thumbnails. A container's default `automationName` would not be very useful because it is the same as the container's `id` property. So, in Flex Store, the custom component that generates a product thumbnail explicitly sets the `automationName` to the product name to make testing the application easier.

Example

The following example from the CatalogPanel.mxml custom component sets the value of the `automationName` property to the name of the item as it appears in the catalog. This is more recognizable than the default automation name.

```
thumbs[i].automationName = catalog[i].name;
```

Example

The following example sets the `automationName` property of the ComboBox control to "Credit Card List"; rather than using the `id` property, the testing tool typically uses "Credit Card List" to identify the ComboBox in its scripts:

```
<?xml version="1.0"?>
<!-- at/SimpleComboBox.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
  <mx:Script>
    <![CDATA[
      [Bindable]
      public var cards: Array = [
        {label:"Visa", data:1},
        {label:"MasterCard", data:2},
        {label:"American Express", data:3}
      ];

      [Bindable]
      public var selectedItem:Object;
      ]
   ]>
  </mx:Script>
  <mx:Panel title="ComboBox Control Example">
    <mx:ComboBox id="cb1" dataProvider="{cards}"
      width="150"
      close="selectedItem=ComboBox(event.target).selectedItem"
      automationName="Credit Card List"
    />
    <mx:VBox width="250">
      <mx:Text width="200" color="blue" text="Select a type of
credit card." />
      <mx:Label text="You selected: {selectedItem.label}"/>
      <mx:Label text="Data: {selectedItem.data}"/>
    </mx:VBox>
  </mx:Panel>
</mx:Application>
```

Setting the value of the `automationName` property ensures that the object name will not change at run time. This helps to eliminate unexpected results.

If you set the value of the `automationName` property, tests use that value rather than the default value. For example, by default, Silk4NET uses a Button control's label property as the name of the Button in the script. If the label changes, the script can break. You can prevent this from happening by explicitly setting the value of the `automationName` property.

Buttons that have no label, but have an icon, are recorded by their index number. In this case, ensure that you set the `automationName` property to something meaningful so that the tester can recognize the Button in the script. After the value of the `automationName` property is set, do not change the value during the component's life cycle. For item renderers, use the `automationValue` property rather than the `automationName` property. To use the `automationValue` property, override the `createAutomationIDPart()` method and return a new value that you assign to the `automationName` property, as the following example shows:

```
<mx:List xmlns:mx="http://www.adobe.com/2006/mxml">
  <mx:Script>
    <![CDATA[
      import mx.automation.IAutomationObject;
      override public function
      createAutomationIDPart(item:IAutomationObject):Object {
        var id:Object = super.createAutomationIDPart(item);
        id["automationName"] = id["automationIndex"];
        return id;
      }
    ]]>
  </mx:Script>
</mx:List>
```

Use this technique to add index values to the children of any container or list-like control. There is no method for a child to specify an index for itself.

Setting the Flex Select Method to Use Name or Index

You can record Flex `Select` methods using the `Name` or `Index` of the control that you select. By default, Silk Test records `Select` methods using the name of the control. However, you can change your environment to record `Select` events using the index for the control, or you can switch between the name and index for recording.

1. Determine which class you want to modify to use the Index.

   You can record `Select` events using the index for the following controls:

   - `FlexList`
   - `FlexTree`
   - `FlexDataGrid`
   - `FlexOLAPDataGrid`
   - `FlexComboBox`
   - `FlexAdvancedDataGrid`
2. Determine which XML file is related to the class that you want to modify.

   The XML files related to the preceding controls include: `FlexCommonControls.xml`, `AdvancedDataGrid.xml`, or `OLAPDataGrid.xml`.
3. Navigate to the XML files that are related to the class that you want to modify.

   The XML files are located in the `<Silk Test_install_directory>\ng\agent\plugins\com.borland.fastxd.techdomain.flex.agent_<version>\config\automationEnvironment` folder.

4. Make the following adaptations in the corresponding XML file.

```
<ClassInfo Extends="FlexList" Name="FlexControlName"
EnableIndexBasedSelection=”true” >

…

</ClassInfo>
```

   For instance, you might use "`FlexList`" as the " `FlexControlName`" and modify the `FlexCommonControls.xml` file.

   With this adaption the IndexBasedSelection is used for recording `FlexList::SelectIndex` events.

   Note: Setting the `EnableIndexBasedSelection=` to `false` in the code or removing the boolean returns recording to using the name (`FlexList::Select` events).

5. Re-start your Flex application and the Open Agent in order for these changes to become active.

Coding Flex Containers

Containers differ from other kinds of controls because they are used both to record user interactions (such as when a user moves to the next pane in an Accordion container) and to provide unique locations for controls in the testing scripts.

Adding and Removing Containers from the Automation Hierarchy

In general, the automated testing feature reduces the amount of detail about nested containers in its scripts. It removes containers that have no impact on the results of the test or on the identification of the controls from the script. This applies to containers that are used exclusively for layout, such as the HBox, VBox, and Canvas containers, except when they are being used in multiple-view navigator containers, such as the ViewStack, TabNavigator, or Accordion containers. In these cases, they are added to the automation hierarchy to provide navigation.

Many composite components use containers, such as Canvas or VBox, to organize their children. These containers do not have any visible impact on the application. As a result, you typically exclude these containers from testing because there is no user interaction and no visual need for their operations to be recordable. By excluding a container from testing, the related test script is less cluttered and easier to read.

To exclude a container from being recorded (but not exclude its children), set the container's `showInAutomationHierarchy` property to false. This property is defined by the `UIComponent` class, so all containers that are a subclass of `UIComponent` have this property. Children of containers that are not visible in the hierarchy appear as children of the next highest visible parent.

The default value of the `showInAutomationHierarchy` property depends on the type of container. For containers such as Panel, Accordion, Application, DividedBox, and Form, the default value is `true`; for other containers, such as Canvas, HBox, VBox, and FormItem, the default value is `false`.

The following example forces the VBox containers to be included in the test script's hierarchy:

```
<?xml version="1.0"?>
<!-- at/NestedButton.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
<mx:Panel title="ComboBox Control Example">
<mx:HBox id="hb">
<mx:VBox id="vb1" showInAutomationHierarchy="true">
<mx:Canvas id="c1">
<mx:Button id="b1" automationName="Nested Button 1" label="Click Me" />
</mx:Canvas>
</mx:VBox>
<mx:VBox id="vb2" showInAutomationHierarchy="true">
<mx:Canvas id="c2">
<mx:Button id="b2" automationName="Nested Button 2" label="Click Me 2" />
</mx:Canvas>
</mx:VBox>
```

```
</mx:HBox>
</mx:Panel>
</mx:Application>
```

Multiview Containers

Avoid using the same label on multiple tabs in multiview containers, such as the TabNavigator and Accordion containers. Although it is possible to use the same labels, this is generally not an acceptable UI design practice and can cause problems with control identification in your testing environment.

Flex Automation Testing Workflow

The Silk4NET workflow for testing Flex applications includes:

- Automated Testing Initialization
- Automated Testing Recording
- Automated Testing Playback

Flex Automated Testing Initialization

When the user launches the Flex application, the following initialization events occur:

1. The automation initialization code associates component delegate classes with component classes.
2. The component delegate classes implement the IAutomationObject interface.
3. An instance for the AutomationManager is created in the mixin `init()` method. (The AutomationManager is a mixin.)
4. The SystemManager initializes the application. Component instances and their corresponding delegate instances are created. Delegate instances add event listeners for events of interest.
5. The Silk4NET FlexTechDomain is a mixin. In the FlexTechDomain `init()` method, the FlexTechDomain registers for the `SystemManager.APPLICATION_COMPLETE` event. When the event is received, it creates a FlexTechDomain instance.
6. The FlexTechDomain instance connects via a TCP/IP socket to the Silk Test Agent on the same machine that registers for record/playback functionality.
7. The FlexTechDomain requests information about the automation environment. This information is stored in XML files and is forwarded from the Silk Test Agent to the FlexTechDomain.

Flex Automated Testing Recording

When the user records a new test in Silk4NET for a Flex application, the following events occur:

1. Silk4NET calls the Silk Test Agent to start recording. The Agent forwards this command to the FlexTechDomain instance.
2. FlexTechDomain notifies AutomationManager to start recording by calling `beginRecording()`. The AutomationManager adds a listener for the AutomationRecordEvent.RECORD event from the SystemManager.
3. The user interacts with the application. For example, suppose the user clicks a Button control.
4. The `ButtonDelegate.clickEventHandler()` method dispatches an AutomationRecordEvent event with the click event and Button instance as properties.
5. The AutomationManager record event handler determines which properties of the click event to store based on the XML environment information. It converts the values into proper type or format. It dispatches the record event.
6. The FlexTechDomain event handler receives the event. It calls the `AutomationManager.createID()` method to create the AutomationID object of the button. This object provides a structure for object identification. The AutomationID structure is an array of AutomationIDParts. An AutomationIDPart is created by using IAutomationObject. (The UIComponent.id, automationName, automationValue, childIndex, and label properties of the Button control are read and stored in the object. The label property is used because the XML information specifies that this property can be used for identification for the Button.)

7. FlexTechDomain uses the `AutomationManager.getParent()` method to get the logical parent of Button. The AutomationIDPart objects of parent controls are collected at each level up to the application level.
8. All the AutomationIDParts are included as part of the AutomationID object.
9. The FlexTechDomain sends the information in a call to Silk4NET.
10. When the user stops recording, the `FlexTechDomain.endRecording()` method is called.

Flex Automated Testing Playback

When the user clicks the **Playback** button in Silk4NET, the following events occur:

1. For each script call, Silk4NET contacts the Silk Test Agent and sends the information for the script call to be executed. This information includes the complete window declaration, the event name, and parameters.
2. The Silk Test Agent forwards that information to the FlexTechDomain.
3. The FlexTechDomain uses `AutomaionManager.resolveIDToSingleObject` with the window declaration information. The AutomationManager returns the resolved object based on the descriptive information (automationName, automationIndex, id, and so on).
4. Once the Flex control is resolved, FlexTechDomain calls `AutomationManager.replayAutomatableEvent()` to replay the event.
5. The `AutomationManager.replayAutomatableEvent()` method invokes the `IAutomationObject.replayAutomatableEvent()` method on the delegate class. The delegate uses the `IAutomationObjectHelper.replayMouseEvent()` method (or one of the other replay methods, such as `replayKeyboardEvent()`) to play back the event.
6. If there are verifications in your script, FlexTechDomain invokes `AutomationManager.getProperties()` to access the values that must be verified.

Styles in Apache Flex Applications

For applications developed in Apache Flex 3.x, Silk4NET does not distinguish between styles and properties. As a result, styles are exposed as properties. However, with Apache Flex 4.x, all new Flex controls, which are prefixed with `Spark`, such as `SparkButton`, do not expose styles as properties. As a result, the `GetProperty()` and `GetPropertyList()` methods for Flex 4.x controls do not return styles, such as `color` or `fontSize`, but only properties, such as `text` and `name`.

The `GetStyle(string styleName)` method returns values of styles as a string. To find out which styles exist, refer to the Adobe help located at: *http://help.adobe.com/en_US/FlashPlatform/reference/actionscript/3/package-detail.html*.

If the style is not set, a `StyleNotSetException` occurs during playback.

For the Flex 3.x controls, such as `FlexTree`, you can use `GetProperty()` to retrieve styles. Or, you can use `GetStyle()`. Both the `GetProperty()` and `GetStyle()` methods work with Flex 3.x controls.

Calculating the Color Style

In Flex, the color is represented as number. It can be calculated using the following formula:

```
red*65536 + green*256 + blue
```

Example

In the following example, the script verifies whether the buttonBar in the Spark application uses font size 12.

```
 Imports SilkTest.Ntf.Flex

Public Module Main
    Dim _desktop As Desktop = Agent.Desktop
```

```
    Public Sub Main()
        Dim Application As SparkApplication
        Dim ButtonBar As SparkButtonBar
        Application = _desktop.Find( "/BrowserApplication//
BrowserWindow//
            SparkApplication" )
        ButtonBar = Application.SparkButtonBar()

        Workbench.Verify(ButtonBar.GetStyle( "fontSize" ),
"12" )
    End Sub
End Module
```

Configuring Flex Applications for Adobe Flash Player Security Restrictions

The security model in Adobe Flash Player 10 has changed from earlier versions. When you record tests that use Flash Player, recording works as expected. However, when you play back tests, unexpected results occur when high-level clicks are used in certain situations. For instance, a **File Reference** dialog box cannot be opened programmatically and when you attempt to play back this scenario, the test fails because of security restrictions.

To work around the security restrictions, you can perform a low-level click on the button that opens the dialog box. To create a low-level click, add a parameter to the `Click` method.

For example, instead of using `SparkButton::Click()`, use `SparkButton::Click(MouseButton.Left)`. A `Click()` without parameters is a high-level click and a click with parameters (such as the button) is replayed as a low-level click.

1. Record the steps that use Flash Player.
2. Navigate to the `Click` method and add a parameter.
   For example, to open the **Open File** dialog box, specify:
   ```
   SparkButton("@caption='Open File Dialog…'").Click(MouseButton.Left)
   ```
   When you play back the test, it works as expected.

Attributes for Apache Flex Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Flex applications include:

- automationName
- caption (similar to automationName)
- automationClassName (e.g. `FlexButton`)
- className (the full qualified name of the implementation class, e.g. `mx.controls.Button`)
- automationIndex (the index of the control in the view of the FlexAutomation, e.g. `index:1`)
- index (similar to automationIndex but without the prefix, e.g. `1`)
- id (the id of the control)
- windowId (similar to id)
- label (the label of the control)
- All dynamic locator attributes

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

Java AWT/Swing Support

Silk4NET provides built-in support for testing applications or applets that use the Java AWT/Swing controls. When you configure an application or applet that uses Java AWT/Swing, Silk4NET automatically provides support for testing standard AWT/Swing controls.

Note: You can also test Java SWT controls embedded in Java AWT/Swing applications or applets as well as Java AWT/Swing controls embedded in Java SWT applications.

Note: Image click recording is not supported for applications or applets that use the Java AWT/Swing controls.

Sample Applications

Silk Test provides a sample Swing test application. Download and install the sample applications from *http://supportline.microfocus.com/websync/SilkTest.aspx*. After you have installed the sample applications, click **Start** > **Programs** > **Silk** > **Silk Test** > **Sample Applications** > **Java Swing** > **Swing Test Application**.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Supported Controls

For a complete list of the controls available for Java AWT/Swing testing, see *Java Swing Class Reference*.

Attributes for Java AWT/Swing Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Java AWT/Swing include:

- caption
- priorlabel: Helps to identify text input fields by the text of its adjacent label field. Every input field of a form usually has a label that explains the purpose of the input. For controls that do not have a caption, the attribute **priorlabel** is automatically used in the locator. For the **priorlabel** value of a control, for example a text input field, the caption of the closest label at the left side or above the control is used.
- name
- accessibleName
- *Swing only*: All custom object definition attributes set in the widget with `SetClientProperty("propertyName", "propertyValue")`

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Dynamically Invoking Java Methods

Dynamic invoke enables you to directly call methods, retrieve properties, or set properties, on an actual instance of a control in the application under test. You can also call methods and properties that are not

available in the Silk4NET API for this control. Dynamic invoke is especially useful when you are working with custom controls, where the required functionality for interacting with the control is not exposed through the Silk4NET API.

Call dynamic methods on objects with the `Invoke` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Call multiple dynamic methods on objects with the `InvokeMethods` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.

For example, to call a method named `SetTitle`, which requires the title to be set as an input parameter of type string, on an actual instance of a control in the application under test, type the following:

```
control.Invoke("SetTitle", "my new title")
```

Note: Typically, most properties are read-only and cannot be set.

Note: Reflection is used in most technology domains to call methods and retrieve properties.

Supported Methods and Properties

The following methods and properties can be called:

- Methods and properties that Silk4NET supports for the control.
- All public methods of the SWT, AWT, or Swing widget
- If the control is a custom control that is derived from a standard control, all methods and properties from the standard control can be called.

Supported Parameter Types

The following parameter types are supported:

- Primitive types (boolean, integer, long, double, string)

  Both primitive types, such as `int`, and object types, such as `java.lang.Integer` are supported. Primitive types are widened if necessary, allowing, for example, to pass an `int` where a `long` is expected.
- Enum types

  Enum parameters must be passed as string. The string must match the name of an enum value. For example, if the method expects a parameter of the enum type, `java.sql.ClientInfoStatus` you can use the string values of `REASON_UNKNOWN`, `REASON_UNKNOWN_PROPERTY`, `REASON_VALUE_INVALID`, or `REASON_VALUE_TRUNCATED`
- Lists

  Allows calling methods with list, array, or var-arg parameters. Conversion to an array type is done automatically, provided the elements of the list are assignable to the target array type.
- Other controls

  Control parameters can be passed or returned as TestObject.

Returned Values

The following values are returned for properties and methods that have a return value:

- The correct value for all built-in Silk4NET types. These types are listed in the *Supported Parameter Types* section.

- All methods that have no return value return `null` in C# or `Nothing` in VB.

Determining the priorLabel in the Java AWT/Swing Technology Domain

To determine the priorLabel in the Java AWT/Swing technology domain, all labels and groups in the same window as the target control are considered. The decision is then made based upon the following criteria:

- Only labels either above or to the left of the control, and groups surrounding the control, are considered as candidates for a priorLabel.
- If a parent of the control is a `JViewPort` or a `ScrollPane`, the algorithm works as if the parent is the window that contains the control, and nothing outside is considered relevant.
- In the simplest case, the label closest to the control is used as the priorLabel.
- If two labels have the same distance to the control, and one is to the left and the other above the control, the left one is preferred.
- If no label is eligible, the caption of the closest group is used.

Java SWT and Eclipse RCP Support

Silk Test provides built-in support for testing applications that use widgets from the Standard Widget Toolkit (SWT) controls. When you configure a Java SWT/RCP application, Silk Test automatically provides support for testing standard Java SWT/RCP controls.

Silk Test supports:

- Testing Java SWT controls embedded in Java AWT/Swing applications as well as Java AWT/Swing controls embedded in Java SWT applications.
- Testing Java SWT applications.
- Any Eclipse-based application that uses SWT widgets for rendering. Silk Test supports both Eclipse IDE-based applications and RCP-based applications.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Supported Controls

For a complete list of the widgets available for SWT testing, see *Java SWT Class Reference*.

Java SWT Class Reference

When you configure a Java SWT application, Silk4NET automatically provides built-in support for testing standard Java SWT controls.

Java SWT Custom Attributes

You can add custom attributes to a test application to make a test more stable. For example, in Java SWT, the developer implementing the GUI can define an attribute (for example, `'silkTestAutomationId'`) for a widget that uniquely identifies the widget in the application. A tester using Silk4NET can then add that attribute to the list of custom attributes (in this case, `'silkTestAutomationId'`), and can identify controls by that unique ID. Using a custom attribute is more reliable than other attributes like caption or index, since a caption will change when you translate the application into another language, and the index will change whenever another widget is added before the one you have defined already.

If more than one object is assigned the same custom attribute value, all the objects with that value will return when you call the custom attribute. For example, if you assign the unique ID, `'loginName'` to two different text fields, both fields will return when you call the `'loginName'` attribute.

Java SWT Example

If you create a button in the application that you want to test using the following code:

```
Button myButton = Button(parent, SWT.NONE);

myButton.setData("SilkTestAutomationId", "myButtonId");
```

To add the attribute to your XPath query string in your test, you can use the following query:

```
Dim button =
desktop.PushButton("@SilkTestAutomationId='myButton'")
```

To enable a Java SWT application for testing custom attributes, the developers must include custom attributes in the application. Include the attributes using the `org.swt.widgets.Widget.setData(String key, Object value)` method.

Attributes for Java SWT Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Java SWT include:

- caption
- all custom object definition attributes

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Dynamically Invoking Java Methods

Dynamic invoke enables you to directly call methods, retrieve properties, or set properties, on an actual instance of a control in the application under test. You can also call methods and properties that are not available in the Silk4NET API for this control. Dynamic invoke is especially useful when you are working with custom controls, where the required functionality for interacting with the control is not exposed through the Silk4NET API.

Call dynamic methods on objects with the `Invoke` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Call multiple dynamic methods on objects with the `InvokeMethods` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.

For example, to call a method named `SetTitle`, which requires the title to be set as an input parameter of type string, on an actual instance of a control in the application under test, type the following:

```
control.Invoke("SetTitle", "my new title")
```

Note: Typically, most properties are read-only and cannot be set.

Note: Reflection is used in most technology domains to call methods and retrieve properties.

Supported Methods and Properties

The following methods and properties can be called:

- Methods and properties that Silk4NET supports for the control.
- All public methods of the SWT, AWT, or Swing widget
- If the control is a custom control that is derived from a standard control, all methods and properties from the standard control can be called.

Supported Parameter Types

The following parameter types are supported:

- Primitive types (boolean, integer, long, double, string)

  Both primitive types, such as `int`, and object types, such as `java.lang.Integer` are supported. Primitive types are widened if necessary, allowing, for example, to pass an `int` where a `long` is expected.
- Enum types

  Enum parameters must be passed as string. The string must match the name of an enum value. For example, if the method expects a parameter of the enum type, `java.sql.ClientInfoStatus` you can use the string values of `REASON_UNKNOWN`, `REASON_UNKNOWN_PROPERTY`, `REASON_VALUE_INVALID`, or `REASON_VALUE_TRUNCATED`
- Lists

  Allows calling methods with list, array, or var-arg parameters. Conversion to an array type is done automatically, provided the elements of the list are assignable to the target array type.
- Other controls

  Control parameters can be passed or returned as TestObject.

Returned Values

The following values are returned for properties and methods that have a return value:

- The correct value for all built-in Silk4NET types. These types are listed in the *Supported Parameter Types* section.
- All methods that have no return value return `null` in C# or `Nothing` in VB.

Testing Mobile Web Applications

Silk4NET enables you to automatically test your mobile Web applications. Automated testing with Silk4NET provides the following benefits:

- It can significantly reduce the testing time of your mobile Web applications.
- You can create your tests once and then test your mobile Web applications on a large number of different devices and platforms.
- You can ensure the reliability and performance that is required for enterprise mobile Web applications.
- It can increase the efficiency of QA team members and mobile Web application developers.
- Manual testing might not efficient enough for an agile-focused development environment, given the large number of mobile devices and platforms on which a mobile Web application needs to function.

Testing Mobile Web Applications on Android

Silk4NET enables you to test a mobile Web application on an Android device or an Android emulator.

Testing Mobile Web Applications on a Physical Android device

To test a mobile Web application on a physical Android device, perform the following tasks:

1. Connect the device to the machine on which Silk4NET is installed.
2. If you are testing this Android device for the first time on this machine, install the appropriate Android USB Driver on the machine.

   For additional information, see *Installing a USB Driver*.
3. Enable USB-debugging on the Android device.

   For additional information, see *Enabling USB Debugging*.
4. Ensure that the Open Agent is running on the machine to which the Android device is connected.

   When testing a mobile Web application, the Open Agent is automatically used as a proxy for the Android device.

   Note: A network connection needs to be active on the Android device.
5. If the proxy is not set automatically, set the proxy.
6. Type `localhost` into the **Proxy** or **Proxy hostname** field.
7. Type `9999` into the **Port** field.
8. Click **OK**.
9. Silk4NET installs the **Silk Test Web Tunneler** app on the Android device to enable the USB connection between the Open Agent and the device.
10. To test a secure mobile Web application over HTTPS, Silk4NET copies a root certificate to the device or emulator during hooking. If the certificate is not installed, the **Silk Test Web Tunneler** app displays a message box, stating that the root certificate is not installed. Click on the message box to install the certificate.

    Note: If the certificate is not installed automatically during hooking, see *Troubleshooting when Testing Mobile Web Applications* or *Manually Adding a Root Certificate to Test a Secure Web Application*.
11. Close and restart all browsers.
12. Create a Silk4NET project for your mobile Web application.
13. Create a test for your mobile Web application.
14. Use the **Mobile Recording** feature to record the test against the mobile Web application.
15. Replay the test.

    The Android device should not lock the screen during testing. To keep the device awake while it is connected to a machine, open the settings and tap **Developer Options**. Then check **Stay awake** or **Stay awake while charging**.
16. Analyze the test results.

Testing Mobile Web Applications on an Android Emulator

To test a mobile Web application on an Android emulator, perform the following tasks:

1. Configure the emulator settings for Silk4NET.

   For additional information, see *Configuring the Android Emulator for Silk4NET*.
2. Start the Android emulator.

3. To test a mobile Web application, set the Open Agent as a proxy for the Android emulator.

   Note: Ensure that the Open Agent is running on the machine on which the emulator is installed.

   For additional information, see *Manually Setting the Open Agent as a Proxy for an Android Device or Emulator*.
4. To test a secure mobile Web application over HTTPS, Silk4NET copies a root certificate to the device or emulator during hooking. If the certificate is not installed, the **Silk Test Web Tunneler** app displays a message box, stating that the root certificate is not installed. Click on the message box to install the certificate.

   Note: If the certificate is not automatically copied to the device during hooking, see *Troubleshooting when Testing Mobile Web Applications* or *Installing the Root Certificate to Test a Secure Web Application*.
5. Close and restart all browsers.
6. Create a Silk4NET project for your mobile Web application.
7. Create a test for your mobile Web application.
8. Use the **Mobile Recording** feature to record the test against the mobile Web application.
9. Replay the test.

   The Android device should not lock the screen during testing. To keep the device awake while it is connected to a machine, open the settings and tap **Developer Options**. Then check **Stay awake** or **Stay awake while charging**.
10. Analyze the test results.

Installing a USB Driver

To connect an Android device for the first time to your local machine to test your mobile Web applications, you need to install the appropriate USB driver.

The device manufacturer might provide an EXE with all the necessary drivers for the device. In this case you can just install the EXE on your local machine. If the manufacturer does not provide such an EXE, you can install a single USB driver for the device on the machine.

To install the Android USB driver on Microsoft Windows 7:

1. Find the appropriate driver for your device.

   For information on finding and installing a USB driver, see *http://developer.android.com/tools/extras/oem-usb.html*.
2. Connect your Android device to a USB port on your local machine.
3. From your desktop or **Windows Explorer**, right-click **Computer** and select **Manage**.
4. In the left pane, select **Device Manager**.
5. In the right pane, locate and expand **Other device**.
6. Right-click the device name, for example *Nexus S*, and select **Update Driver Software**. The **Hardware Update Wizard** opens.
7. Select **Browse my computer for driver software** and click **Next**.
8. Click **Browse** and locate the USB driver folder.

   By default, the Google USB Driver is located in `<sdk>\extras\google\usb_driver\`.
9. Click **Next** to install the driver.

For information on upgrading an existing USB driver or installing a USB driver on another operating system, see *http://developer.android.com/tools/extras/oem-usb.html*.

Enabling USB-Debugging

To communicate with an Android device over the Android Debug Bridge (adb), enable USB debugging on the device.

1. On the Android device, open the settings.
2. Tap **Developer Settings**.

   If the developer settings are not included in the settings menu of the device:

   a) Depending on whether the device is a phone or a pad, scroll down and tap **About phone** or **About Pad**.

   b) Scroll down again and tap **Build Number** seven times.
3. In the **Developer settings** window, check **USB-Debugging**.
4. Set the USB mode of the device to **Media device (MTP)**, which is the default setting.

   For additional information, refer to the documentation of the device.

Manually Setting the Open Agent as a Proxy for an Android Emulator

To set the Open Agent as a proxy for your Android emulator, install the Open Agent on the machine from which you want to test the emulator and enable USB debugging on the emulator.

1. On the Android emulator, open the settings.
2. In the **WIRELESS & MORE** section, click **More**.
3. Select **Mobile Networks** > **Access Point Names**.
4. Select an existing access point to edit it or create a new access point.
5. Type the IP-address of the machine on which the Open Agent is installed into the **Proxy** or **Proxy hostname** field.
6. Click **Port**.
7. Type the port for the Open Agent into the **Port** field. By default, the port number is 9999. To change the port number, use the configuration setting **ext.http.proxy.port** in the file `AppData\Roaming\Silk\SilkTest\conf\silkproxy.properties.sample` to set a permanent port number. For example, to set the port number to *9999*, set `ext.http.proxy.port=9999`. Then type the port number into the **Port** field and rename the file `silkproxy.properties.sample` to `silkproxy.properties`.
8. Click **OK**.

The Open Agent is now set as a proxy for your Android device or Android emulator. For additional information on configuring a proxy for your Android device or Android emulator, refer to the documentation of the device or the emulator.

Note: As long as the Open Agent is running, you can use the Internet connection on the mobile device that uses the Open Agent as a proxy. If the Open Agent is not running, the connection will no longer work, and you have to use another connection to connect to the Internet from your mobile device. If you remove the wireless network connection while the device or emulator is still running, the connection to the Open Agent persists until you shut down the device or emulator.

Recommended Settings for Android Devices

To optimize testing with Silk4NET, configure the following settings on the Android device that you want to test:

- Enable USB-debugging on the Android device. For additional information, see *Enabling USB-Debugging*
- Set a pattern or a PIN to lock the screen of the Android device.

- The Android device should not lock the screen during testing. To keep the device awake while it is connected to a machine, open the settings and tap **Developer Options**. Then check **Stay awake** or **Stay awake while charging**.

Configuring the Android Emulator for Silk4NET

When you want to test mobile Web applications on an Android emulator with Silk4NET, you have to configure the emulator for testing:

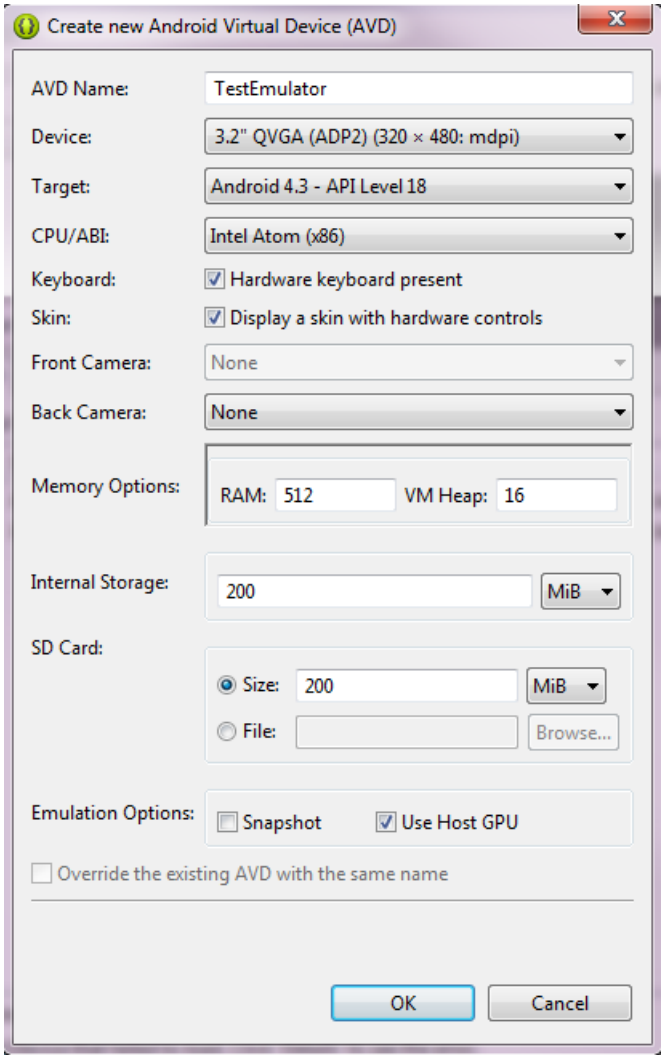
1. Install the Android emulator.

   For information on how to install and configure an Android emulator, see *Get the Android SDK*.
2. From Eclipse, click **Window** > **Android SDK Manager** to start the **Android SDK Manager**.
3. For all Android versions that you want to test with the emulator, expand the version node and check the check box next to **Intel x86 Atom System Image**.
4. Click **Install** to install the selected packages.
5. Expand the **Extras** node and check the check box next to **Intel x86 Emulator Accelerator (HAXM)**.
6. Click **Install** to install the selected packages.
7. Review the *Intel Corporation license agreement*. If you accept the terms, select **Accept** and click **Install.** The **Android SDK Manager** will download the installer to the `extras` directory, under the main SDK directory. Even though the **Android SDK Manager** says `Installed` it actually means that the Intel HAXM executable was downloaded. You will still need to run the installer from the extras directory to get it installed.
8. Extract the installer inside the `extras` directory and follow the installation instructions for your platform.
9. In Eclipse, click **Window** > **Android Virtual Device Manager** to add a new Android Virtual Device (AVD).
10. Select the **Android Virtual Devices** tab.
11. Click **New**.
12. Configure the virtual device according to your requirements.
13. Set the RAM size used by the emulator to an amount that is manageable by your machine.

    For example, set the RAM size for the emulator to `512`.
14. Set a size for the SD card.

    Note: If you do not set a size for the SD card, you need to set the value of the internal storage to 50 MB or more, otherwise you cannot copy the certificate file to the emulator.
15. To enhance the speed of the transactions on the emulator, select the **Intel Atom (x86)** CPU in the **CPU/ABI** field.
16. *Optional:* To enhance the speed of the transactions on the emulator, you can also check the **Use Host GPU** check box in the emulation options.

    Note: By setting **Use Host GPU**, you can no longer capture screenshots and would see a black image in the **Mobile Recording** dialog box. However, you could still highlight controls within the **Mobile Recording** dialog box. For additional information, see *https://code.google.com/p/android/issues/detail?id=58724*.



17. Click **OK**.

Testing Mobile Web Applications on iOS

Silk4NET enables you to test a mobile Web application on an iOS device.

Testing Mobile Web Applications on a Physical iOS Device

To test a mobile Web application on a physical iOS device, perform the following tasks:

1. If you are testing a mobile Web application on an iOS device for the first time on this machine, install iTunes on the machine.

   iTunes is required because it contains the device drivers that are needed to test on an iOS device.
2. Install the Silk Test application on the iOS device. For additional information, see *Installing the Silk Test Application on an iOS Device*.
3. Set `localhost:9999` as a proxy for your iOS device.

   For additional information on setting the proxy for an iOS device, see *Setting the Proxy for an iOS Device*.
4. Connect the device to the machine on which Silk4NET is installed.
5. Run a simple test to ensure that the Open Agent is running on the machine to which the iOS device is connected.

6. Open the Silk Test application on the iOS device.
7. To test a secure mobile Web application over HTTPS, install a root certificate for the mobile Web application by using the Silk Test application.
8. Close and restart all browsers.
9. Create a Silk4NET project for your mobile Web application.
10. Create a test for your mobile Web application.
11. Use the **Mobile Recording** feature to record the test against the mobile Web application.
12. Replay the test.

    The iOS device should not fall into sleep mode during testing. To turn the screen lock and password off, select **Settings** > **General** > **Passcode Lock**. In iOS 7, select **Settings** > **Passcode**.
13. Analyze the test results.

Installing the Silk Test Application on an iOS Device

Install the Silk Test application on an iOS device to enable the USB connection between the Open Agent and the iOS device.

1. Register the UDID of the iOS device in the developer program of your company.
2. Download Xcode, for example from *https://developer.apple.com/xcode/downloads/*, and install it on a Mac.

   The Mac is only required to install the Silk Test application on an iOS device, and does not have to be very fast. For example, a Mac Mini with minimal configuration would be sufficient.
3. Connect the iOS device to the Mac.
4. When a dialog box opens on the iOS device, click **Trust**. You can now use the device in combination with Xcode. After you launch an App for the first time, a Provisioning Profile which matches the developer profile of your company is installed on the device.
5. Copy the archive `SilkTestiOS.zip`, which is located by default under `C:\Program Files (x86)\Silk\SilkTest\ng\iOS` on the Windows machine on which the Open Agent is installed, to the Mac and unpack the archive.

   Note: To retrieve the password for unpacking the archive, log in to our *SupportLine site* and report an incident with the subject `iOS Password`.
6. Click **File** > **Open** to import the project to Xcode or click the `.xcodeproj` file to open the project.
7. In Xcode, select your device as the target instead of the iOS Simulator, which is set as the target by default.
8. In the project settings, select the developer program of your company.
9. Click on the arrow in the upper left corner or select **Product** > **Run**.
10. To automatically install the Silk Test application on additional iOS devices used in your company, see *Automatically Installing the Silk Test Application on an iOS Device*.
11. The Silk Test application on the iOS device is started for the first time.

    Note: As soon as the Silk Test application has been successfully started on the iOS device, you can simply tap the icon of the application on the iOS device to start the application.

Automatically Installing the Silk Test Application on an iOS Device

Generate an IPA file and distribute it to enable users in your company to install the Silk Test application automatically on iOS devices.

Note: To test an iOS device with Silk Test, the UDID of the iOS device must be registered in the Apple Developer Account of your company.

1. Download Xcode, for example from *https://developer.apple.com/xcode/downloads/*, and install it on a Mac.

The Mac is only required to install the Silk Test application on an iOS device, and does not have to be very fast. For example, a Mac Mini with minimal configuration would be sufficient.

2. Connect the iOS device to the Mac.
3. When a dialog box opens on the iOS device, click **Trust**. You can now use the device in combination with Xcode. After you launch an App for the first time, a Provisioning Profile which matches the developer profile of your company is installed on the device.
4. In Xcode, compile the Silk Test application.
5. Click **Products** > **Archive** and generate the IPA file for the Silk Test application.
6. Copy the generated IPA file and a developer disk image for every iOS version that you want to test into the distribution folder that you want to use.
   a) The developer disk image is located by default in the Xcode installation folder under `xCode/Contents/Developer/Platforms/IPhoneOS.platform/DeviceSupport/<iOS_version_number>/`, where *iOS_version_number* is the iOS version of the device that you want to test.
   b) You need to copy two files for the developer disk image, `DeveloperDiskImage.dmg` and `DeveloperDiskImage.dmg.signature`.
7. On every machine from which you want to test an iOS device, open the folder `%APPDATA%\Silk\SilkTest\Conf`.
8. Rename the file `iosApp.properties.sample` to `iosApp.properties`.
9. Open the `iosApp.properties` file and change the file locations to the distribution folder to which you have copied the IPA file and the developer disk image.

When you select an iOS device, with an iOS version for which you have copied a developer disk image, from the **Select Application** dialog, the Silk Test application is installed on the iOS device.

Setting the Proxy for an iOS Device

To set the *localhost* as a proxy for your iOS device, install the Open Agent on the machine from which you want to test the device.

1. On the iOS device, click **Settings** > **WiFi**.
2. Click on the information button (**i**) of the active wireless network.
3. In the **Proxy** section, select **Manual**.
4. Type `localhost` into the hostname field.
5. Type `9999` into the port field.

For additional information on configuring a proxy for your iOS device, refer to the documentation of the device.

Note: As long as the Open Agent is running, you can use the Internet connection on the mobile device. If the Open Agent is not running, the connection will no longer work, and you have to use another connection to connect to the Internet from your mobile device. If you remove the wireless network connection while the device is still running, the connection to the Open Agent persists until you shut down the device.

Recommended Settings for iOS Devices

To optimize testing with Silk4NET, configure the following settings on the iOS device that you want to test:

- Ensure that the iOS device is running with Xcode and in developer mode.
- To ensure that Apple Safari starts correctly, tap **Settings** > **Safari** and select **Clear Cookies and Data**.
- To make the testing reflect the actions an actual user would perform, disable AutoFill and remembering passwords for Apple Safari. Tap **Settings** > **Safari** > **Passwords & AutoFill** and turn off the **Names and Passwords** setting.

- The iOS device should not fall into sleep mode during testing. To turn the screen lock and password off, select **Settings** > **General** > **Passcode Lock**. In iOS 7, select **Settings** > **Passcode**.

Recording Mobile Web Applications

Note: Some low-level methods and classes are not supported for mobile Web applications. To be able to correctly replay a test recorded against a mobile Web application, uncheck the **Record native user input** option in the Browser options of Silk4NET before recording against the mobile Web application. For additional information, see *Limitations for Testing Mobile Web Applications*.

Once you have established the connection between Silk4NET and a mobile device or an emulator, you can record the actions that are performed on a mobile browser on the device to create tests. To record mobile Web applications, Silk4NET uses the **Mobile Recording** feature, which provides additional functionality compared to the recorder that is used for standard or Web applications.

The **Mobile Recording** feature displays the screen of the mobile device or emulator which you are testing.

Note: If no mobile device is connected to the machine and no emulator is started, the **Mobile Recording** window displays an error message. Connect your mobile device to the machine or start the emulator and then click **Refresh** in the **Mobile Recording** window.

When you perform an action in the **Mobile Recording** feature, the same action is performed on the mobile device.

When you interact with a control on the screen, the **Mobile Recording** feature preselects the default action. A list of all the available actions against the control displays, and you can select the action that you want to perform or simply accept the preselected action by clicking **OK**. You can type values for the parameters of the selected action into the parameter fields. Silk4NET automatically validates the parameters.

When you cannot directly interact with a control, for example because other controls are hiding the control, you can click **Toggle Object Hierarchy** in the **Mobile Recording** feature to select the control from the control hierarchy tree.

When you pause the recording, you can perform actions in the screen which are not recorded to bring the device into a state from which you want to continue recording.

When you stop recording, a script is generated with your recorded actions, and you can proceed with replaying the test.

Interacting with a Mobile Device

To interact with a mobile device and to perform an action like a swipe in the application under test:

1. In the **Mobile Recording** window, click **Show Mobile Device Actions**. All the actions that you can perform against the mobile device are listed.
2. Select the action that you want to perform from the list.
3. To record a swipe on an Android device or emulator, move the mouse while clicking the left mouse button.
4. Continue with the recording of your test.

Troubleshooting when Testing Mobile Web Applications

Why does the Select Application dialog box not display my mobile browsers?

Silk4NET might not recognize a mobile device or emulator for one of the following reasons:

Reason	Solution
The mobile device is not connected to the local machine.	Connect the mobile device to the local machine.
The emulator is not running.	Start the emulator.
The Android Debug Bridge (adb) does not recognize the mobile device.	To check if the mobile device is recognized by adb: 1. Navigate to `C:\Program Files (x86)\Silk\SilkTest\ng\agent\plugins\com.microfocus.silktest.adb_15.0.0.6733\bin`. 2. Hold **Shift** and right-click into the **File Explorer** window. 3. Select **Open command window here**. 4. In the command window, type `adb devices` to get a list of all attached devices. 5. If your device is not listed, check if USB-debugging is enabled on the device.
The version of the operating system of the device is not supported by Silk4NET.	For information on the supported mobile operating system versions, refer to the *Release Notes*.
The USB driver for the device is not installed on the local machine.	Install the USB driver for the device on the local machine. For additional information, see *Installing a USB Driver*.
USB-debugging is not enabled on the device.	Enable USB-debugging on the device. For additional information, see *Enabling USB-Debugging*.

Why can my mobile device or emulator no longer connect to the Internet?

If you have configured a proxy for every network connection on your mobile device or emulator, and you are currently not recording or replaying any tests, the mobile device or emulator cannot connect to the Internet. For a physical mobile device you can check the connection status in the **Silk Test Web Tunneler** application.

If the mobile device is connected and the Open Agent is running, and the mobile device still cannot connect to the Internet, check if the proxy settings are correct.

To be able to connect to the Internet when the Open Agent is not running, you can temporarily disable the proxy.

Why does Silk4NET search for a URL in Chrome for Android instead of navigating to the URL?

Chrome for Android might in some cases interpret typing an URL into the address bar as a search. As a workaround you can manually add a command to your script to navigate to the URL.

Why can I not record on an Android emulator with Android 4.3?

To record on an Android emulator with Android version 4.3, uncheck the **Use Host GPU** check box in the emulator settings.

Why do mobile applications no longer work when I configure the proxy?

Some mobile applications do not use the global proxy that you can set for the WiFi connection. Browsers and some applications like Gmail use the proxy settings, but most other mobile applications ignore the proxy settings and therefore cannot connect to the Internet while the proxy is set.

What do I do if the adb server does not start correctly?

When the Android Debug Bridge (adb) server starts, it binds to local TCP port 5037 and listens for commands sent from adb clients. All adb clients use port 5037 to communicate with the adb server. The adb server locates emulator and device instances by scanning odd-numbered ports in the range 5555 to 5585, which is the range used by emulators and devices. Adb does not allow changing those ports. If you encounter a problem while starting adb, check if one of the ports in this range is already in use by another program.

For additional information, see *http://developer.android.com/tools/help/adb.html*.

Why do I get the error: `Failed to allocate memory: 8`?

This error displays if you are trying to start up the emulator and the system cannot allocate enough memory. You can try the following:

1. Lower the RAM size in the memory options of the emulator.
2. Lower the RAM size of Intel HAXM. To lower the RAM size, run the `IntelHaxm.exe` again and choose **change**.
3. Open the **Task Manager** and check if there is enough free memory available. If not, try to free up additional memory by closing a few programs.

Why can I not work with a secure website?

If you cannot test a secure website (HTTPS) on a physical mobile device, try the following:

1. Open the **Silk Test Web Tunneler** application on the mobile device to check the following:
   - A certificate is installed for the secure website.
   - The certificate matches the root certificate of the machine on which the Open Agent is installed.

   If no certificate is installed or the certificate does not match the root certificate of the machine on which the Open Agent is installed, a yellow warning message is displayed.
2. Click on the warning and select **Ok** to install the certificate. Installing a certificate requires to set a password or a screen lock for the mobile device. If no password or screen lock is set you are prompted to set one during this step.
3. If the certificate is not found on the device the installation fails and an error message displays. Check if the file `root.crt` exists under `sdcard/silk/certs/`.
4. If the file `root.crt` does not exist, copy the file manually by using the **File Explorer**. The certificate might be missing if you have no write permissions on the mobile device.
5. After you have copied the certificate to the device, you can install the certificate by using the **Silk Test Web Tunneler** application or by clicking on the certificate in the file system.

If you cannot test a secure website (HTTPS) on an emulator, manually add the root certificate of the website. For additional information, see *Manually Adding a Root Certificate to Test a Secure Web Application*.

Manually Adding a Root Certificate to Test a Secure Web Application

If you are testing an Android emulator with Android version 4.4 or later, you cannot follow the process described in this topic. For information on how to add a root certificate to test a secure Web application on an Android emulator with Android version 4.4 or later, see *Retrieving the Root Certificate of a Secure Web Application*.

Note: To perform the steps described in this topic, you must have configured the Open Agent as a proxy for the Android device or Android emulator.

When you are testing a mobile Web application which uses HTTPS on an Android device or Android emulator, each request to open a specific site will automatically generate a certificate for this site on the machine on which the Open Agent is installed. This new certificate is issued to the same domain as the original certificate, replacing the original certificate to enable testing over the SSL connection.

The first certificate that is generated is the root certificate for the mobile Web application.

To be able to test the application with Silk4NET, the root certificate needs to be installed on the Android device or Android emulator. By default, the root certificate is copied to the device during hooking. However, if the root certificate is not automatically installed, manually install the root certificate once for each mobile Web application that you want to test.

1. If you are testing a mobile Web application on an Android emulator with Android 4.4 or later, perform the following steps:
   a) From the Android device or Android emulator, open the mobile Web application that you want to test.
   b) For example, open *www.borland.com*.
   c) Append the following extension to the URL: `/_st_/dynamic/certificate`. For example, the new URL for www.borland.com in the mobile browser is the following: *www.borland.com/_st_/dynamic/certificate*.
2. Open the mobile Web application that you want to test. If it is the first time that you open the mobile Web application, the Open Agent generates the modified root certificate for the application.
3. On the machine on which the Open Agent is installed, go to the folder where the root certificate is located.

   By default, this is the folder `%Appdata%\Silk\SilkTest\certs\authority`.
4. Copy the root certificate file `root.crt`.
5. Paste the root certificate file to the root folder in the storage of your Android device.

   If you are testing on an Android emulator, the Open Agent automatically copies the certificate to the root directory of the emulator.

   Note: To enable the Open Agent to copy the certificate to the emulator, configure a size for the SD card in the emulator settings.
6. If you are testing on a physical Android device, install the certificate from the storage into your Android device.

   For additional information about how to install a certificate from the storage, refer to the documentation of your Android device or Android emulator.
7. If you are testing on an Android emulator:
   a) Navigate to **Settings** > **Security** > **Install from SD card** on the emulator.
   b) Click **OK** to install the certificate.
   c) *Optional:* Navigate to **Settings** > **Security** > **Trusted credentials** > **USER** to verify that the certificate is installed on the emulator.
8. Close and restart all browsers.

Installing the Root Certificate to Test a Secure Web Application

Note: If you are testing a physical Android device, or an Android emulator with an Android version prior to 4.4, see *Manually Adding a Root Certificate to Test a Secure Web Application*.

Note: To perform the steps described in this topic, you must have configured the Open Agent as a proxy for the Android device or Android emulator.

When you are testing a mobile Web application which uses HTTPS on an Android device or Android emulator, each request to open a specific site will automatically generate a certificate for this site on the machine on which the Open Agent is installed. This new certificate is issued to the same domain as the original certificate, replacing the original certificate to enable testing over the SSL connection.

The first certificate that is generated is the root certificate for the mobile Web application.

To be able to test the application with Silk4NET, the root certificate needs to be installed on the Android device or Android emulator. By default, the root certificate is copied to the device during hooking. However, if the root certificate is not automatically installed, manually install the root certificate once for each mobile Web application that you want to test.

1. From the Android emulator, open the mobile Web application that you want to test.

   For example, open *www.borland.com*.
2. Append `/_st_/dynamic/certificate` to the URL and go to the new URL.

   For example, the URL for www.borland.com in the mobile browser is the following: *www.borland.com/_st_/dynamic/certificate*.
3. Type a name for the certificate into the **Certificate name** field in the certificate download dialog box.
4. Leave the default setting, **VPN and apps**, in the **Credential use** list box.
5. Click **OK**. The certificate is installed on the emulator.
6. Close and restart all browsers.

Limitations for Testing Mobile Web Applications

The support for playing back tests and recording locators on mobile browsers is not as complete as the support for the other supported browsers and native mobile applications. The following list lists the known limitations for playing back tests and recording locators on mobile browsers:

- The following classes, interfaces, methods, and properties are currently not supported for mobile Web applications:
  - `BrowserApplication` class.
    - `CloseOtherTabs` method
    - `CloseTab` method
    - `ExistsTab` method
    - `GetActiveTab` method
    - `GetSelectedTab` method
    - `GetSelectedTabIndex` method
    - `GetSelectedTabName` method
    - `GetTabCount` method
    - `OpenTab` method
    - `SelectTab` method
  - `DomElement` class.
    - `DomDoubleClick` method
    - `DomMouseMove` method
    - `GetDomAttributeList` method
  - `DomForm` class. All methods and properties in this class are not supported for mobile Web applications.
  - `DomRadioButton` class.
    - `RadioListItemCount` property
    - `RadioListItems` property
    - `RadioListSelectedIndex` property
    - `RadioListSelectedItem` property
  - `DomTable` class. All methods and properties in this class are not supported for mobile Web applications.
  - `DomTableRow` class. All methods and properties in this class are not supported for mobile Web applications.
  - `IClickable` interface.
    - `Click` method. You can use clicks on Web applications running on an Android device, but not on an iOS device.

    - `DoubleClick` method
    - `PressMouse` method
    - `ReleaseMouse` method
  - `IKeyable` interface. All methods and properties in this interface are not supported for mobile Web applications.
  - Image recognition is not supported for iOS. When you are testing a Web application on an iOS device, you can only use image verifications.
- XPath logical operators are supported only for standard HTML attributes, and are not supported for properties and custom Silk Test attributes. For example, the logical operators are not supported for the `textContents` attribute and the `innerText` attribute. Expressions built with these operators are always case-sensitive, independent of the Silk Test setting.
- XPath logical operators are not supported on stock Android browser on Android versions prior to version 4.4.
- Recording in landscape mode is not supported for emulators that include virtual buttons in the system bar. Such emulators do not correctly detect rotation and render the system bar in landscape mode to the right of the screen, instead of the lower part of the screen. However, you can record against such an emulator in portrait mode.

Clicking on Objects in a Mobile Website

When clicking on an object during the recording and replay of an automated test, a mobile website presents the following challenges in comparison to a desktop website:

- Varying zoom factors and device pixel ratios.
- Varying screen sizes for different mobile devices.
- Varying font and graphic sizes between mobile devices, usually smaller in comparison to a website in a desktop browser.
- Varying pixel size and resolution for different mobile devices.

Silk4NET enables you to surpass these challenges and to click the appropriate object on a mobile website.

When recording a test on a mobile device, Silk4NET does not record coordinates when recording a `Click`. However, for cross-browser testing, coordinates are allowed during replay. You can also manually add coordinates to a `Click`. Silk4NET interprets these coordinates as the HTML coordinates of the object. To click on the appropriate object inside the `BrowserWindow`, during the replay of a test on a mobile device, Silk4NET applies the current zoom factor to the HTML coordinates of the object. The device pixel coordinates are the HTML coordinates of the object, multiplied with the current zoom factor.

If the object is not visible in the currently displayed section of the mobile website, Silk4NET scrolls to the appropriate location in the website.

Example

The following code shows how you can test a `DomButton` with a fixed size of 100 x 20 px in your HTML page.

C#

```
DomButton domButton = _desktop.Find<DomButton>("locator for the
button");
domButton.Click(MouseButton.LEFT, new Point(50, 10));
```

VB

```
DomButton domButton = _desktop.Find(Of DomButton)("locator for
the button");
domButton.Click(MouseButton.LEFT, new Point(50, 10));
```

During replay on a different mobile device or with a different zoom factor, the `DomButton` might for example have an actual width of 10px on the device screen.

Silk4NET clicks in the middle of the element when using the code above, independent of the current zoom factor, because Silk4NET interprets the coordinates as HTML coordinates and applies the current zoom factor.

.NET Support

Silk Test provides built-in support for testing .NET applications including:

- Windows Forms (Win Forms) applications
- Windows Presentation Foundation (WPF) applications
- Microsoft Silverlight applications

For details about supported versions, click **Start** > **Programs** > **Silk** > **Silk Test** > **Release Notes** to view the *Release Notes*.

Windows Forms Support

Silk4NET provides built-in support for testing .NET standalone and No-Touch Windows Forms (Win Forms) applications. However, side-by-side execution is supported only on standalone applications. Silk4NET can record and play back controls embedded in:

- Framework version 2.0
- Framework version 3.0
- Framework version 3.5

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Object Recognition

The name that was given to an element in the application is used as `automationId` attribute for the locator if available. As a result, most objects can be uniquely identified using only this attribute.

Supported Controls

For a complete list of the record and replay controls available for Win Forms testing, see *Windows Forms Class Reference*.

Windows Forms Class Reference

When you configure a Windows Forms application, Silk4NET automatically provides built-in support for testing standard Windows Forms controls.

Attributes for Windows Forms Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Windows Forms applications include:

- automationid
- caption
- windowid
- priorlabel (For controls that do not have a caption, the priorlabel is used as the caption automatically. For controls with a caption, it may be easier to use the caption.)

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Custom Attributes for Windows Forms Applications

Windows Forms applications use the predefined automation property `automationId` to specify a stable identifier for the Windows forms control.

Silk4NET automatically will use this property for identification in the locator. Windows Forms application locators look like the following:

```
/FormsWindow//PushButton[@automationId='btnBasicControls']
```

Dynamically Invoking Windows Forms Methods

Dynamic invoke enables you to directly call methods, retrieve properties, or set properties, on an actual instance of a control in the application under test. You can also call methods and properties that are not available in the Silk4NET API for this control. Dynamic invoke is especially useful when you are working with custom controls, where the required functionality for interacting with the control is not exposed through the Silk4NET API.

Call dynamic methods on objects with the `Invoke` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Call multiple dynamic methods on objects with the `InvokeMethods` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.

For example, to call a method named `SetTitle`, which requires the title to be set as an input parameter of type string, on an actual instance of a control in the application under test, type the following:

```
control.Invoke("SetTitle", "my new title")
```

Note: Typically, most properties are read-only and cannot be set.

Note: Reflection is used in most technology domains to call methods and retrieve properties.

The Invoke Method

For a Windows Forms or a WPF control, you can use the `Invoke` method to call the following methods:

- Public methods that the MSDN defines for the control.
- Public static methods that the MSDN defines.
- User-defined public static methods of any type.

First Example for the Invoke Method

For an object of the Silk4NET type `DataGrid`, you can call all methods that MSDN defines for the type `System.Windows.Forms.DataGrid`.

To call the method `IsExpanded` of the `System.Windows.Forms.DataGrid` class, use the following code:

```
//VB .NET code
Dim isExpanded As Boolean = dataGrid.Invoke("IsExpanded", 3)
```

```
//C# code
bool isExpanded = (bool) dataGrid.Invoke("IsExpanded", 3);
```

Second Example for the Invoke Method

To invoke the static method `String.Compare(String s1, String s2)` inside the AUT, use the following code:

```
//VB .NET code
Dim result as Integer = (Integer)
mainWindow.Invoke("System.String.Compare", "a", "b")
```

```
//C# code
int result = (int) mainWindow.Invoke("System.String.Compare",
"a", "b");
```

Third Example for the Invoke Method

This example shows how you can dynamically invoke the user-generated method `GetContents`.

You can write code which you can use to interact with a control in the application under test (AUT), in this example an `UltraGrid`. Instead of creating complex dynamic invoke calls to retrieve the contents of the `UltraGrid`, you can generate a new method `GetContents` and then just dynamically invoke the new method.

In Visual Studio, the following code in the AUT defines the `GetContents` method as a method of the `UltraGridUtil` class:

```
//C# code, because this is code in the AUT
namespace UltraGridExtensions {
  public class UltraGridUtil {
    /// <summary>
    /// Retrieves the contents of an UltraGrid as nested list
    /// </summary>
    /// <param name="grid"></param>
    /// <returns></returns>
    public static List<List<string>>
GetContents(Infragistics.Win.UltraWinGrid.UltraGrid grid) {
      var result = new List<List<string>>();
      foreach (var row in grid.Rows) {
        var rowContent = new List<string>();
        foreach (var cell in row.Cells) {
          rowContent.Add(cell.Text);
        }
        result.Add(rowContent);
      }
      return result;
    }
  }
}
```

The code for the `UltraGridUtil` class needs to be added to the AUT. You can do this in the following ways:

- The application developer can compile the code for the class into the AUT. The assembly needs to be already loaded.
- You can create a new assembly that is loaded into the AUT during test execution.

To load the assembly, you can use the following code:

```
FormsWindow.LoadAssembly(String assemblyFileName)
```

You can load the assembly by using the full path, for example:

```
mainWindow.LoadAssembly("C:/temp/ultraGridExtensions.dll")
```

You can also find the location of the assembly by using the `Location` method:

```
//VB.NET code
Dim assemblyLocation =
GetType(UltraGridExtensions.UltraGridUtil).Assembly.Location
mainWindow.LoadAssembly(assemblyLocation)
```

```
//C# code
string assemblyLocation =
typeof(UltraGridExtensions.UltraGridUtil).Assembly.Location;
mainWindow.LoadAssembly(assemblyLocation);
```

When the code for the UltraGridUtil class is in the AUT, you can add the following code to your test script to invoke the `GetContents` method:

```
var contents = (IList)
mainWindow.Invoke("UltraGridExtensions.UltraGridUtil.GetContents
", ultraGrid);
```

The `mainWindow` object, on which the `Invoke` method is called, only identifies the AUT and can be replaced by any other object in the AUT.

The InvokeMethods Method

For a Windows Forms or a WPF control, you can use the `InvokeMethods` method to invoke a sequence of nested methods. You can call the following methods:

- Public methods that the MSDN defines for the control.
- Public static methods that the MSDN defines.
- User-defined public static methods of any type.

Supported Methods and Properties

The following methods and properties can be called:

- Methods and properties that Silk4NET supports for the control.
- All public methods and properties that the MSDN defines for the control.
- If the control is a custom control that is derived from a standard control, all methods and properties from the standard control can be called.

Supported Parameter Types

The following parameter types are supported:

- All built-in Silk4NET types

  Silk4NET types includes primitive types (such as boolean, int, string), lists, and other types (such as Point and Rect).
- Enum types

  Enum parameters must be passed as string. The string must match the name of an enum value. For example, if the method expects a parameter of the .NET enum type `System.Windows.Visiblity` you can use the string values of `Visible`, `Hidden`, or `Collapsed`.
- .NET structs and objects

  .NET struct and object parameters must be passed as a list. The elements in the list must match one constructor for the .NET object in the test application. For example, if the method expects a parameter of the .NET type `System.Windows.Vector`, you can pass a list with two integers. This works because the `System.Windows.Vector` type has a constructor with two integer arguments.
- Other controls

  Control parameters can be passed or returned as TestObject.

Returned Values

The following values are returned for properties and methods that have a return value:

- The correct value for all built-in Silk4NET types. These types are listed in the *Supported Parameter Types* section.
- All methods that have no return value return `null` in C# or `Nothing` in VB.

Windows Presentation Foundation (WPF) Support

Silk4NET provides built-in support for testing Windows Presentation Foundation (WPF) applications. Silk4NET supports standalone WPF applications and can record and play back controls embedded in .NET version 3.5 or later.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Supported Controls

For a complete list of the controls available for WPF testing, see *WPF Class Reference*.

All supported WPF classes for Silk4NET WPF support start with the prefix *WPF*, such as `WPFWindow` and `WPFListBox`.

Supported methods and properties for WPF controls depend on the actual implementation and runtime state. The methods and properties may differ from the list that is defined for the corresponding class. To determine the methods and properties that are supported in a specific situation, use the following code:

- `GetPropertyList()`
- `GetDynamicMethodList()`

For additional information abut WPF, refer to *MSDN*.

WPF Class Reference

When you configure a WPF application, Silk4NET automatically provides built-in support for testing standard WPF controls.

Attributes for Windows Presentation Foundation (WPF) Applications

Supported attributes for WPF applications include:

- *automationId*
- *caption*
- *className*
- *name*
- All dynamic locator attributes.

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

Object Recognition

To identify components within WPF scripts, you can specify the *automationId*, *caption*, *className*, or *name*. The name that is given to an element in the application is used as the *automationId* attribute for the locator if available. As a result, most objects can be uniquely identified using only this attribute. For example, a locator with an *automationId* might look like: `//WPFButton[@automationId='okButton']`".

If you define an *automationId* and any other attribute, only the *automationId* is used during replay. If there is no *automationId* defined, the *name* is used to resolve the component. If neither a *name* nor an *automationId* are defined, the *caption* value is used. If no caption is defined, the *className* is used. We recommend using the *automationId* because it is the most useful property.

Attribute Type	Description	Example
automationId	An ID that was provided by the developer of the test application.	`//WPFButton[@automationId='okButton']"`
name	The name of a control. The Visual Studio designer automatically assigns a name to every control that is created with the designer. The application developer uses this name to identify the control in the application code.	`//WPFButton[@name='okButton']"`
caption	The text that the control displays. When testing a localized application in multiple languages, use the automationId or name attribute instead of the caption.	`//WPFButton[@automationId='Ok']"`
className	The simple .NET class name (without namespace) of the WPF control. Using the class name attribute can help to identify a custom control that is derived from a standard WPF control that Silk4NET recognizes.	`//WPFButton[@className='MyCustomButton']"`

During recording, Silk4NET creates a locator for a WPF control by using the *automationId*, *name*, *caption*, or *className* attributes in the order that they are listed in the preceding table. For example, if a control has a *automationId* and a *name*, Silk4NET uses the *automationId* when creating the locator.

The following example shows how an application developer can define a *name* and an *automationId* for a WPF button in the XAML code of the application:

```
<Button Name="okButton" AutomationProperties.AutomationId="okButton"
Click="okButton_Click">Ok</Button>
```

Custom Attributes for WPF Applications

WPF applications use the predefined automation property `AutomationProperties.AutomationId` to specify a stable identifier for the WPF control as follows:

```
<Window x:Class="Test.MainWindow"
    xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
    xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
    Title="MainWindow" Height="350" Width="525">
  <Grid>
    <Button AutomationProperties.AutomationId="AID_buttonA">The
Button</Button>
  </Grid>
</Window>
```

Silk4NET automatically uses this property for identification in the locator. WPF application locators look like the following:

```
/WPFWindow[@caption='MainWindow']//WPFButton[@automationId='AID_buttonA']
```

Classes that Derive from the WPFItemsControl Class

Silk4NET can interact with classes that derive from `WPFItemsControl`, such as `WPFListBox`, `WPFTreeView`, and `WPFMenu`, in two ways:

- Working with the control

  Most controls contain methods and properties for typical use cases. The items are identified by text or index.
- Working with individual items, such as `WPFListBoxItem`, `WPFTreeViewItem`, or `WPFMenuItem`

  For advanced use cases, use individual items. For example, use individual items for opening the context menu on a specific item in a list box, or clicking a certain position relative to an item.

Custom WPF Controls

Generally, Silk4NET provides record and playback support for all standard WPF controls.

Silk4NET handles custom controls based on the way the custom control is implemented. You can implement custom controls by using the following approaches:

- Deriving classes from `UserControl`

  This is a typical way to create compound controls. Silk4NET recognizes these user controls as `WPFUserControl` and provides full support for the contained controls.
- Deriving classes from standard WPF controls, such as `ListBox`

  Silk4NET treats these controls as an instance of the standard WPF control that they derive from. Record, playback, and recognition of children may not work if the user control behavior differs significantly from its base class implementation.
- Using standard controls that use templates to change their visual appearance

  Low-level replay might not work in certain cases. Switch to high-level playback mode in such cases.

Silk4NET filters out certain controls that are typically not relevant for functional testing. For example, controls that are used for layout purposes are not included. However, if a custom control derives from an excluded class, specify the name of the related WPF class to expose the filtered controls during recording and playback.

Dynamically Invoking WPF Methods

Dynamic invoke enables you to directly call methods, retrieve properties, or set properties, on an actual instance of a control in the application under test. You can also call methods and properties that are not available in the Silk4NET API for this control. Dynamic invoke is especially useful when you are working with custom controls, where the required functionality for interacting with the control is not exposed through the Silk4NET API.

Call dynamic methods on objects with the `Invoke` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Call multiple dynamic methods on objects with the `InvokeMethods` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.

For example, to call a method named `SetTitle`, which requires the title to be set as an input parameter of type string, on an actual instance of a control in the application under test, type the following:

```
control.Invoke("SetTitle", "my new title")
```

Note: Typically, most properties are read-only and cannot be set.

Note: Reflection is used in most technology domains to call methods and retrieve properties.

The Invoke Method

For a Windows Forms or a WPF control, you can use the `Invoke` method to call the following methods:

- Public methods that the MSDN defines for the control.
- Public static methods that the MSDN defines.
- User-defined public static methods of any type.

First Example for the Invoke Method

For an object of the Silk4NET type `DataGrid`, you can call all methods that MSDN defines for the type `System.Windows.Forms.DataGrid`.

To call the method `IsExpanded` of the `System.Windows.Forms.DataGrid` class, use the following code:

```
//VB .NET code
Dim isExpanded As Boolean = dataGrid.Invoke("IsExpanded", 3)
```

```
//C# code
bool isExpanded = (bool) dataGrid.Invoke("IsExpanded", 3);
```

Second Example for the Invoke Method

To invoke the static method `String.Compare(String s1, String s2)` inside the AUT, use the following code:

```
//VB .NET code
Dim result as Integer = (Integer)
mainWindow.Invoke("System.String.Compare", "a", "b")
```

```
//C# code
int result = (int) mainWindow.Invoke("System.String.Compare",
"a", "b");
```

Third Example for the Invoke Method

This example shows how you can dynamically invoke the user-generated method `GetContents`.

You can write code which you can use to interact with a control in the application under test (AUT), in this example an `UltraGrid`. Instead of creating complex dynamic invoke calls to retrieve the contents of the `UltraGrid`, you can generate a new method `GetContents` and then just dynamically invoke the new method.

In Visual Studio, the following code in the AUT defines the `GetContents` method as a method of the `UltraGridUtil` class:

```
//C# code, because this is code in the AUT
namespace UltraGridExtensions {
  public class UltraGridUtil {
    /// <summary>
    /// Retrieves the contents of an UltraGrid as nested list
```

```
    /// </summary>
    /// <param name="grid"></param>
    /// <returns></returns>
    public static List<List<string>>
GetContents(Infragistics.Win.UltraWinGrid.UltraGrid grid) {
      var result = new List<List<string>>();
      foreach (var row in grid.Rows) {
        var rowContent = new List<string>();
        foreach (var cell in row.Cells) {
          rowContent.Add(cell.Text);
        }
        result.Add(rowContent);
      }
      return result;
    }
  }
}
```

The code for the `UltraGridUtil` class needs to be added to the AUT. You can do this in the following ways:

- The application developer can compile the code for the class into the AUT. The assembly needs to be already loaded.
- You can create a new assembly that is loaded into the AUT during test execution.

To load the assembly, you can use the following code:

```
FormsWindow.LoadAssembly(String assemblyFileName)
```

You can load the assembly by using the full path, for example:

```
mainWindow.LoadAssembly("C:/temp/ultraGridExtensions.dll")
```

You can also find the location of the assembly by using the `Location` method:

```
//VB.NET code
Dim assemblyLocation =
GetType(UltraGridExtensions.UltraGridUtil).Assembly.Location
mainWindow.LoadAssembly(assemblyLocation)
```

```
//C# code
string assemblyLocation =
typeof(UltraGridExtensions.UltraGridUtil).Assembly.Location;
mainWindow.LoadAssembly(assemblyLocation);
```

When the code for the UltraGridUtil class is in the AUT, you can add the following code to your test script to invoke the `GetContents` method:

```
var contents = (IList)
mainWindow.Invoke("UltraGridExtensions.UltraGridUtil.GetContents
", ultraGrid);
```

The `mainWindow` object, on which the `Invoke` method is called, only identifies the AUT and can be replaced by any other object in the AUT.

The InvokeMethods Method

For a Windows Forms or a WPF control, you can use the `InvokeMethods` method to invoke a sequence of nested methods. You can call the following methods:

- Public methods that the MSDN defines for the control.
- Public static methods that the MSDN defines.
- User-defined public static methods of any type.

Supported Methods and Properties

The following methods and properties can be called:

- Methods and properties that Silk4NET supports for the control.
- All public methods and properties that the MSDN defines for the control.
- If the control is a custom control that is derived from a standard control, all methods and properties from the standard control can be called.

Supported Parameter Types

The following parameter types are supported:

- All built-in Silk4NET types

  Silk4NET types includes primitive types (such as boolean, int, string), lists, and other types (such as Point and Rect).
- Enum types

  Enum parameters must be passed as string. The string must match the name of an enum value. For example, if the method expects a parameter of the .NET enum type `System.Windows.Visiblity` you can use the string values of `Visible`, `Hidden`, or `Collapsed`.
- .NET structs and objects

  .NET struct and object parameters must be passed as a list. The elements in the list must match one constructor for the .NET object in the test application. For example, if the method expects a parameter of the .NET type `System.Windows.Vector`, you can pass a list with two integers. This works because the `System.Windows.Vector` type has a constructor with two integer arguments.
- WPF controls

  WPF control parameters can be passed as `TestObject`.

Returned Values

The following values are returned for properties and methods that have a return value:

- The correct value for all built-in Silk4NET types. These types are listed in the *Supported Parameter Types* section.
- All methods that have no return value return `null` in C# or `Nothing` in VB.
- A string for all other types

  Call `ToString` on returned .NET objects to retrieve the string representation

Example

For example, when an application developer creates a custom calculator control that offers the following methods and the following property:

```
public void Reset()
public int Add(int number1, int number2)
public System.Windows.Vector StrechVector(System.Windows.Vector
vector, double
factor)
public String Description { get;}
```

The tester can call the methods directly from his test. For example:

```
customControl.Invoke("Reset")
Dim sum as Integer = customControl.Invoke("Add", 1, 2)
' the vector can be passed as list of integer
Dim vector = New List(Of Integer)
vector.Add(3)
vector.Add(4)
' returns "6;8" because this is the string representation of
```

```
the .NET object
Dim strechedVector As String =
customControl.Invoke("StrechVector", vector, 2.0)
Dim description As String =
customControl.GetProperty("Description")
```

Setting WPF Classes to Expose During Recording and Playback

Silk4NET filters out certain controls that are typically not relevant for functional testing. For example, controls that are used for layout purposes are not included. However, if a custom control derives from an excluded class, specify the name of the related WPF class to expose the filtered controls during recording and playback.

Specify the names of any WPF classes that you want to expose during recording and playback. For example, if a custom class called *MyGrid* derives from the WPF `Grid` class, the objects of the *MyGrid* custom class are not available for recording and playback. `Grid` objects are not available for recording and playback because the `Grid` class is not relevant for functional testing since it exists only for layout purposes. As a result, `Grid` objects are not exposed by default. In order to use custom classes that are based on classes that are not relevant to functional testing, add the custom class, in this case *MyGrid*, to the **OPT_WPF_CUSTOM_CLASSES** option. Then you can record, playback, find, verify properties, and perform any other supported actions for the specified classes.

1. Click **Silk4NET** > **Edit Options**.
2. Click the plus sign (+) next to **Record** in the **Options** menu tree. The **Record** options display in the right side panel.
3. Click **WPF**.
4. In the **Custom WPF class names** grid, type the name of the class that you want to expose during recording and playback.

   Separate class names with a comma.
5. Click **OK**.

Silverlight Application Support

Microsoft Silverlight (Silverlight) is an application framework for writing and running rich internet applications, with features and purposes similar to those of Adobe Flash. The run-time environment for Silverlight is available as a plug-in for most web browsers.

Silk4NET provides built-in support for testing Silverlight applications. Silk4NET supports Silverlight applications that run in a browser as well as out-of-browser and can record and play back controls in .NET version 3.5 or later.

The following applications, that are based on Silverlight, are supported:

- Silverlight applications that run in Internet Explorer.
- Silverlight applications that run in Mozilla Firefox.
- Out-of-Browser Silverlight applications.

Supported Controls

Silk4NET includes record and replay support for Silverlight controls.

For a complete list of the controls available for Silverlight testing, see the *Silverlight Class Reference*.

Note: With Silk Test 14.0 or later, Silk4NET recognizes only Silverlight controls that are available for interaction and visible on the screen. This change might change the behavior of tests that were recorded with a Silk Test version prior to Silk Test 14.0. To run such tests with Silk Test 14.0 or later, remove all invisible or not yet available Silverlight controls from the tests.

Prerequisites

The support for testing Silverlight applications in Microsoft Windows XP requires the installation of Service Pack 3 and the Update for Windows XP with the Microsoft User Interface Automation that is provided in Windows 7. You can download the update from *http://www.microsoft.com/download/en/details.aspx?id=13821*.

Note: The Microsoft User Interface Automation needs to be installed for the Silverlight support. If you are using a Windows operating system and the Silverlight support does not work, you can install the update with the Microsoft User Interface Automation, which is appropriate for your operating system, from *http://support.microsoft.com/kb/971513*.

Silverlight Class Reference

When you configure a Silverlight application, Silk4NET automatically provides built-in support for testing standard Silverlight controls.

Locator Attributes for Identifying Silverlight Controls

Supported locator attributes for Silverlight controls include:

- *automationId*
- *caption*
- *className*
- *name*
- All dynamic locator attributes

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

To identify components within Silverlight scripts, you can specify the *automationId*, *caption*, *className*, *name* or any dynamic locator attribute. The *automationId* can be set by the application developer. For example, a locator with an *automationId* might look like `//SLButton[@automationId="okButton"]`.

We recommend using the *automationId* because it is typically the most useful and stable attribute.

Attribute Type	Description	Example
automationId	An identifier that is provided by the developer of the application under test. The Visual Studio designer automatically assigns an *automationId* to every control that is created with the designer. The application developer uses this ID to identify the control in the application code.	`//SLButton[@automationId="okButton"]`
caption	The text that the control displays. When testing a localized application in multiple languages, use the *automationId* or *name* attribute instead of the *caption*.	`//SLButton[@caption="Ok"]`
className	The simple .NET class name (without namespace) of the Silverlight control. Using the *className* attribute can help to identify a custom control that is derived from a standard Silverlight control that Silk4NET recognizes.	`//SLButton[@className='MyCustomButton']`
name	The name of a control. Can be provided by the developer of the application under test.	`//SLButton[@name="okButton"]`

Attention: The *name* attribute in XAML code maps to the locator attribute *automationId*, not to the locator attribute *name*.

During recording, Silk4NET creates a locator for a Silverlight control by using the *automationId*, *name*, *caption*, or *className* attributes in the order that they are listed in the preceding table. For example, if a

control has an *automationId* and a *name*, Silk4NET uses the *automationId*, if it is unique, when creating the locator.

The following table shows how an application developer can define a Silverlight button with the text "Ok" in the XAML code of the application:

XAML Code for the Object	Locator to Find the Object from Silk Test
`<Button>Ok</Button>`	`//SLButton[@caption="Ok"]`
`<Button Name="okButton">Ok</Button>`	`//SLButton[@automationId="okButton"]`
`<Button AutomationProperties.AutomationId="okButton">Ok</Button>`	`//SLButton[@automationId="okButton"]`
`<Button AutomationProperties.Name="okButton">Ok</Button>`	`//SLButton[@name="okButton"]`

Dynamically Invoking Silverlight Methods

Dynamic invoke enables you to directly call methods, retrieve properties, or set properties, on an actual instance of a control in the application under test. You can also call methods and properties that are not available in the Silk4NET API for this control. Dynamic invoke is especially useful when you are working with custom controls, where the required functionality for interacting with the control is not exposed through the Silk4NET API.

Call dynamic methods on objects with the `Invoke` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Call multiple dynamic methods on objects with the `InvokeMethods` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.

For example, to call a method named `SetTitle`, which requires the title to be set as an input parameter of type string, on an actual instance of a control in the application under test, type the following:

```
control.Invoke("SetTitle", "my new title")
```

Note: Typically, most properties are read-only and cannot be set.

Note: Reflection is used in most technology domains to call methods and retrieve properties.

Supported Parameter Types

The following parameter types are supported:

- All built-in Silk4NET types.

  Silk4NET types include primitive types, for example boolean, int, and string, lists, and other types, for example Point and Rect.
- Enum types.

  Enum parameters must be passed as string. The string must match the name of an enum value. For example, if the method expects a parameter of the .NET enum type `System.Windows.Visiblity` you can use the string values of `Visible`, `Hidden`, or `Collapsed`.
- .NET structs and objects.

  Pass .NET struct and object parameters as a list. The elements in the list must match one constructor for the .NET object in the test application. For example, if the method expects a parameter of the .NET

type `System.Windows.Vector`, you can pass a list with two integers. This works because the `System.Windows.Vector` type has a constructor with two integer arguments.

- Other controls.

  Control parameters can be passed as `TestObject`.

Supported Methods and Properties

The following methods and properties can be called:

- All public methods and properties that the MSDN defines for the `AutomationElement` class. For additional information, see *http://msdn.microsoft.com/en-us/library/system.windows.automation.automationelement.aspx*.
- All methods and properties that MSUIA exposes. The available methods and properties are grouped in "patterns". Pattern is a MSUIA specific term. Every control implements certain patterns. For an overview of patterns in general and all available patterns see *http://msdn.microsoft.com/en-us/library/ms752362.aspx*. A custom control developer can provide testing support for the custom control by implementing a set of MSUIA patterns.

Returned Values

The following values are returned for properties and methods that have a return value:

- The correct value for all built-in Silk4NET types.
- All methods that have no return value return `null` in C# or `Nothing` in VB.
- A string for all other types.

  To retrieve this string representation, call the `ToString` method on returned .NET objects in the application under test.

Example

A `TabItem` in Silverlight, which is an item in a `TabControl`.

```
tabItem.Invoke("SelectionItemPattern.Select")
mySilverligtObject.GetProperty("IsPassword")
```

Scrolling in Silverlight

Silk4NET provides two different sets of scrolling-related methods and properties, depending on the Silverlight control.

- The first type of controls includes controls that can scroll by themselves and therefore do not expose the scrollbars explicitly as children. For example combo boxes, panes, list boxes, tree controls, data grids, auto complete boxes, and others.
- The second type of controls includes controls that cannot scroll by themselves but expose scrollbars as children for scrolling. For example text fields.

This distinction in Silk4NET exists because the controls in Silk4NET implement scrolling in those two ways.

Controls that support scrolling

In this case, scrolling-related methods and property are available for the control that contains the scrollbars. Therefore, Silk4NET does not expose scrollbar objects.

Examples

The following command scrolls a list box to the bottom:

```
listBox.SetVerticalScrollPercent(100)
```

The following command scrolls the list box down by one unit:

```
listBox.ScrollVertical(ScrollAmount.SmallIncrement)
```

Controls that do not support scrolling

In this case the scrollbars are exposed. No scrolling-related methods and properties are available for the control itself. The horizontal and vertical scrollbar objects enable you to scroll in the control by specifying the increment or decrement, or the final position, as a parameter in the corresponding API functions. The increment or decrement can take the values of the ScrollAmount enumeration. For additional information, refer to the Silverlight documentation. The final position is related to the position of the object, which is defined by the application designer.

Examples

The following command scrolls a vertical scrollbar within a text box to position 15:

```
textBox.SLVerticalScrollBar().ScrollToPosition(15)
```

The following command scrolls a vertical scrollbar within a text box to the bottom:

```
textBox.SLVerticalScrollBar().ScrollToMaximum()
```

Troubleshooting when Testing Silverlight Applications

Silk4NET cannot see inside the Silverlight application and no green rectangles are drawn during recording

The following reasons may cause Silk4NET to be unable to see inside the Silverlight application:

Reason	Solution
You use a Mozilla Firefox version prior to 4.0.	Use Mozilla Firefox 4.0 or later.
You use a Silverlight version prior to 3.	Use Silverlight 3 (Silverlight Runtime 4) or Silverlight 4 (Silverlight Runtime 4).

Your Silverlight application is running in windowless mode.	Silk4NET does not support Silverlight applications that run in windowless mode. To test such an application, you need to change the Web site where your Silverlight application is running. Therefore you need to set the `windowless` parameter in the object tag of the HTML or ASPX file, in which the Silverlight application is hosted, to `false`.
	The following sample code sets the `windowless` parameter to `false`:
	`<object ...>`
	`  <param name="windowless"`
	`value="false"/>`
	`  ...`
	`</object>`

Rumba Support

Rumba is the world's premier Windows desktop terminal emulation solution. Silk Test provides built-in support for recording and replaying Rumba.

When testing with Rumba, please consider the following:

- The Rumba version must be compatible to the Silk Test version. Versions of Rumba prior to version 8.1 are not supported.
- All controls that surround the green screen in Rumba are using basic WPF functionality (or Win32).
- The supported Rumba desktop types are:
  - Mainframe Display
  - AS400 Display
  - Unix Display

For a complete list of the record and replay controls available for Rumba testing, see the *Rumba Class Reference*.

Rumba Class Reference

When you configure a Rumba application, Silk4NET automatically provides built-in support for testing standard Rumba controls.

Enabling and Disabling Rumba

Rumba is the world's premier Windows desktop terminal emulation solution. Rumba provides connectivity solutions to mainframes, mid-range, UNIX, Linux, and HP servers.

Enabling Support

Before you can record and replay Rumba scripts, you need to enable support:

1. Install Rumba desktop client software version 8.1 or later.
2. Click **Start** > **Programs** > **Silk** > **Silk Test** > **Administration** > **Rumba plugin** > **Enable Silk Test Rumba plugin**.

Disabling Support

Click **Start** > **Programs** > **Silk** > **Silk Test** > **Administration** > **Rumba plugin** > **Disable Silk Test Rumba plugin**.

Locator Attributes for Identifying Rumba Controls

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests. Supported attributes include:

caption	The text that the control displays.
priorlabel	Since input fields on a form normally have a label explaining the purpose of the input, the intention of **priorlabel** is to identify the text input field, **RumbaTextField**, by the text of its adjacent label field, **RumbaLabel**. If no preceding label is found in the same line of the text field, or if the label at the right side is closer to the text field than the left one, a label on the right side of the text field is used.
StartRow	This attribute is not recorded, but you can manually add it to the locator. Use **StartRow** to identify the text input field, **RumbaTextField**, that starts at this row.
StartColumn	This attribute is not recorded, but you can manually add it to the locator. Use **StartColumn** to identify the text input field, **RumbaTextField**, that starts at this column.

All dynamic locator attributes.	For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Using Screen Verifications with Rumba

To automatically insert screen verifications in Rumba, turn on the following option in the **Options** dialog box: **Record** > **General** > **Record Screen Verifications**.

To manually insert screen verifications:

1. In your test, click the **Create Verification Type Logic** button to open the **Test Logic Designer - Verification**.
2. Click **Next**.
3. Select **The Contents of a Screen**.

   Any excluded objects as identified in **Tools** > **Options** > **Record** > **Rumba** > **Excluded Objects** will be used. You can customize these further in the **Properties** window of the test after you finish performing this procedure.
4. Click **Next**.
5. Click the **Identify** button.
6. Select the control on the Rumba Screen that you want to identify. The whole screen will be captured.
7. Click **Next**.
8. Click **Finish**.

Testing a Unix Display

For Unix displays, Silk4NET can only record the interactions with the main **RUMBA screen** control, because the underlying structure of the Unix display differs to the structure of the AS/400 and Mainframe displays.

SAP Support

Silk4NET provides built-in support for testing SAP client/server applications based on the Windows-based GUI module.

Note: You can only test SAP applications with Silk4NET if you have a Premium license for Silk4NET. For additional information on the licensing modes, see *Licensing Information*.

Note: If you use SAP NetWeaver with Internet Explorer or Firefox, Silk4NET tests the application using the xBrowser technology domain.

Note: Check the Release Notes for the latest version information and known issues.

Supported Controls

For a complete list of the record and replay controls available for SAP testing, see the *SAP Class Reference*.

For a list of supported attributes, see *Attributes for SAP Applications*.

SAP Class Reference

When you configure a SAP application, Silk4NET automatically provides built-in support for testing standard SAP controls.

The classes included in the SAP class reference, along with all included properties and methods, are part of the SAP Automation module that is directly accessible through Silk4NET.

Note: The interface, including the underlying algorithms and the behavior of the interface is not under the control of Silk4NET.

Attributes for SAP Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for SAP include:

- automationId
- caption

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Dynamically Invoking SAP Methods

Dynamic invoke enables you to directly call methods, retrieve properties, or set properties, on an actual instance of a control in the application under test. You can also call methods and properties that are not available in the Silk4NET API for this control. Dynamic invoke is especially useful when you are working with custom controls, where the required functionality for interacting with the control is not exposed through the Silk4NET API.

Call dynamic methods on objects with the `Invoke` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Call multiple dynamic methods on objects with the `InvokeMethods` method. To retrieve a list of supported dynamic methods for a control, use the `GetDynamicMethodList` method.

Retrieve dynamic properties with the `GetProperty` method and set dynamic properties with the `SetProperty` method. To retrieve a list of supported dynamic properties for a control, use the `GetPropertyList` method.

For example, to call a method named `SetTitle`, which requires the title to be set as an input parameter of type string, on an actual instance of a control in the application under test, type the following:

```
control.Invoke("SetTitle", "my new title")
```

Note: Typically, most properties are read-only and cannot be set.

Note: Reflection is used in most technology domains to call methods and retrieve properties.

Supported Methods and Properties

The following methods and properties can be called:

- Methods and properties that Silk4NET supports for the control.

- All public methods that the SAP automation interface defines
- If the control is a custom control that is derived from a standard control, all methods and properties from the standard control can be called.

Supported Parameter Types

The following parameter types are supported:

- All built-in Silk4NET types

  Silk4NET types includes primitive types (such as boolean, int, string), lists, and other types (such as Point and Rect).
- UI controls

  UI controls can be passed or returned as `TestObject`.

Returned Values

The following values are returned for properties and methods that have a return value:

- The correct value for all built-in Silk4NET types. These types are listed in the *Supported Parameter Types* section.
- All methods that have no return value return `null` in C# or `Nothing` in VB.

Dynamically Invoking Methods on SAP Controls

When Silk4NET cannot record actions against an SAP control, you can record the actions with the recorder that is available in SAP and then dynamically invoke the recorded methods in a Silk4NET script. By doing so, you can replay actions against SAP controls that you cannot record.

1. To record the actions that you want to perform against the control, use the **SAP GUI Scripting** tool that is available in SAP.

   For additional information on the **SAP GUI Scripting** tool, refer to the SAP documentation.
2. Open the recorded actions from the location to which the **SAP GUI Scripting** tool has saved them and see what methods were recorded.
3. In Silk4NET, dynamically invoke the recorded methods from your script.

Examples

For example, if you want to replay pressing a special control in the SAP UI, which is labeled *Test* and which is a combination of a button and a list box, and selecting the sub-menu *subsub2* of the control, you can record the action with the recorder that is available in SAP. The resulting code will look like the following:

```
session.findById("wnd[0]/usr/cntlCONTAINER/shellcont/
shell").pressContextButton "TEST"
session.findById("wnd[0]/usr/cntlCONTAINER/shellcont/
shell").selectContextMenuItem "subsub2"
```

Now you can use the following code to dynamically invoke the methods `pressContextButton` and `selectContextMenuItem` in your script in Silk4NET:

```
.SapToolbarControl("shell
ToolbarControl").Invoke("pressContextButton", "TEST")
.SapToolbarControl("shell
ToolbarControl").Invoke("selectContextMenuItem", "subsub2")
```

Replaying this code will press the control in the SAP UI and select the sub-menu.

Configuring Automation Security Settings for SAP

Before you launch an SAP application, you must configure the security warning settings. Otherwise, a security warning, `A script is trying to attach to the GUI`, displays each time a test plays back an SAP application.

1. In **Windows Control Panel**, choose **SAP Configuration**. The **SAP Configuration** dialog box opens.
2. In the **Design Selection** tab, uncheck the **Notify When a Script Attaches to a Running SAP GUI**.

Windows API-Based Application Support

Silk4NET provides built-in support for testing Microsoft Windows API-based applications. Several objects exist in Microsoft applications that Silk4NET can better recognize if you enable Accessibility. For example, without enabling Accessibility Silk4NET records only basic information about the menu bar in Microsoft Word and the tabs that appear in Internet Explorer versions later than version 7.0. However, with Accessibility enabled, Silk4NET fully recognizes those objects. You can also improve Silk4NET object recognition by defining a new window, if necessary.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Supported Controls

For a complete list of the record and replay controls available for Windows-based testing, see *Win32 Class Reference*.

Win32 Class Reference

When you configure a Win32 application, Silk4NET automatically provides built-in support for testing standard Windows API-based controls.

Attributes for Windows API-based Client/Server Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Windows API-based client/server applications include:

- caption
- windowid
- priorlabel: Helps to identify text input fields by the text of its adjacent label field. Every input field of a form usually has a label that explains the purpose of the input. For controls that do not have a caption, the attribute **priorlabel** is automatically used in the locator. For the **priorlabel** value of a control, for example a text box, the caption of the closest label at the left side or above the control is used.

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Determining the priorLabel in the Win32 Technology Domain

To determine the priorLabel in the Win32 technology domain, all labels and groups in the same window as the target control are considered. The decision is then made based upon the following criteria:

- Only labels either above or to the left of the control, and groups surrounding the control, are considered as candidates for a priorLabel.
- In the simplest case, the label closest to the control is used as the priorLabel.
- If two labels have the same distance to the control, the priorLabel is determined based upon the following criteria:
  - If one label is to the left and the other above the control, the left one is preferred.
  - If both levels are to the left of the control, the upper one is preferred.
  - If both levels are above the control, the left one is preferred.
- If the closest control is a group control, first all labels within the group are considered according to the rules specified above. If no labels within the group are eligible, then the caption of the group is used as the priorLabel.

xBrowser Support

Use the xBrowser technology domain to test Web applications that use:

- Internet Explorer
- Mozilla Firefox
- Google Chrome
- Embedded browser controls

The xBrowser technology domain supports the testing of plain HTML pages as well as AJAX pages. AJAX pages require additional, sophisticated strategies for object recognition and synchronization.

Note: You must record tests for Web applications using Internet Explorer. To create tests that use another supported browser, record them with Internet Explorer and play them back with the other browser. Or, you can manually create tests for the other browser using the **Identify Objects** dialog box to identify the locators in the supported browser that you want to use.

Note: Before you record or playback Web applications, disable all browser add-ons that are installed in your system. To disable add-ons in Internet Explorer, click **Tools** > **Internet Options**, click the **Programs** tab, click **Manage add-ons**, select an add-on and then click **Disable**.

For information about supported versions, any known issues, and workarounds, refer to the *Release Notes*.

Sample Applications

To access the Silk Test sample Web applications, go to:

- *http://demo.borland.com/InsuranceWebExtJS/*
- *http://demo.borland.com/gmopost*

Selecting the Browser for Test Replay

You can define the browser that is used for the replay of a test in the following ways:

- If you execute a test from the UI of Silk4NET and the **Select Browser** dialog box displays, the browser selected in the dialog box is used, and Silk4NET ignores which browser is set in the test script.

- If the **Select Browser** dialog box is disabled, because the **Don't show again** is unchecked, the application configurations in the individual test scripts determine the browser that is used to execute the tests.
- If you execute a script from the command line, the application configurations of the individual scripts are used.

Test Objects for xBrowser

Silk4NET uses the following classes to model a Web application:

Class	Description
`BrowserApplication`	Exposes the main window of a Web browser and provides methods for tabbing.
`BrowserWindow`	Provides access to tabs and embedded browser controls and provides methods for navigating to different pages.
`DomElement`	Exposes the DOM tree of a Web application (including frames) and provides access to all DOM attributes. Specialized classes are available for several DOM elements.

Object Recognition for xBrowser Objects

The xBrowser technology domain supports dynamic object recognition.

Test cases use locator strings to find and identify objects. A typical locator includes a locator name and at least one locator attribute, such as `"//LocatorName[@locatorAttribute='value']"`.

Locator Names

With other technology types, such as Java SWT, locator names are created using the class name of the test object. With xBrowser, the tag name of the DOM element can also be used as locator name. The following locators describe the same element:

1. Using the tag name: `"//a[@href='http://www.microfocus.com']"`
2. Using the class name: `"//DomLink[@href='http://www.microfocus.com']"`

To optimize replay speed, use tag names rather than class names.

Locator Attributes

All DOM attributes can be used as locator string attributes. For example, the element `<button automationid='123'>Click Me</button>` can be identified using the locator `"//button[@automationid='123']"`.

Recording Locators

Silk4NET uses a built-in locator generator when recording test cases and using the **Identify Object** dialog box. You can configure the locator generator to improve the results for a specific application.

Page Synchronization for xBrowser

Synchronization is performed automatically before and after every method call. A method call is not started and does not end until the synchronization criteria is met.

Note: Any property access is not synchronized.

Synchronization Modes

Silk4NET includes synchronization modes for HTML and AJAX.

Using the HTML mode ensures that all HTML documents are in an interactive state. With this mode, you can test simple Web pages. If more complex scenarios with Java script are used, it might be necessary to manually script synchronization functions, such as:

- `WaitForObject`
- `WaitForProperty`
- `WaitForDisappearance`
- `WaitForChildDisappearance`

The AJAX mode synchronization waits for the browser to be in a kind of idle state, which is especially useful for AJAX applications or pages that contain AJAX components. Using the AJAX mode eliminates the need to manually script synchronization functions (such as wait for objects to appear or disappear, wait for a specific property value, and so on), which eases the script creation process dramatically. This automatic synchronization is also the base for a successful record and playback approach without manual script adoptions.

Troubleshooting

Because of the true asynchronous nature of AJAX, generally there is no real idle state of the browser. Therefore, in rare situations, Silk4NET will not recognize an end of the invoked method call and throws a timeout error after the specified timeout period. In these situations, it is necessary to set the synchronization mode to HTML at least for the problematic call.

Note: Regardless of the page synchronization method that you use, in tests where a Flash object retrieves data from a server and then performs calculations to render the data, you must manually add a synchronization method to your test. Otherwise, Silk4J does not wait for the Flash object to complete its calculations. For example, you might use `Thread.sleep(millisecs)`.

Some AJAX frameworks or browser applications use special HTTP requests, which are permanently open in order to retrieve asynchronous data from the server. These requests may let the synchronization hang until the specified synchronization timeout expires. To prevent this situation, either use the HTML synchronization mode or specify the URL of the problematic request in the **Synchronization exclude list** setting.

Use a monitoring tool to determine if playback errors occur because of a synchronization issue. For instance, you can use FindBugs, *http://findbugs.sourceforge.net/*, to determine if an AJAX call is affecting playback. Then, add the problematic service to the **Synchronization exclude list**.

Note: If you exclude a URL, synchronization is turned off for each call that targets the URL that you specified. Any synchronization that is needed for that URL must be called manually. For example, you might need to manually add `WaitForObject` to a test. To avoid numerous manual calls, exclude URLs for a concrete target, rather than for a top-level URL, if possible.

Configuring Page Synchronization Settings

You can configure page synchronization settings for each individual test or you can set global options that apply to all tests in the **Script Options** dialog box.

To add the URL to the exclusion filter, specify the URL in the **Synchronization exclude list** in the **Script Options** dialog box.

To configure individual settings for tests, record the test and then insert code to override the global playback value. For example, to exclude the time service, you might type:

```
desktop.setOption(CommonOptions.OPT_XBROWSER_SYNC_EXCLUDE_URLS,
    Arrays.asList("timeService"));
```

Comparing API Playback and Native Playback for xBrowser

Silk4NET supports API playback and native playback for Web applications. If your application uses a plug-in or AJAX, use native user input. If your application does not use a plug-in or AJAX, we recommend using API playback.

Advantages of native playback include:

- With native playback, the agent emulates user input by moving the mouse pointer over elements and pressing the corresponding elements. As a result, playback works with most applications without any modifications.
- Native playback supports plug-ins, such as Flash and Java applets, and applications that use AJAX, while high-level API recordings do not.

Advantages of API playback include:

- With API playback, the Web page is driven directly by DOM events, such as `onmouseover` or `onclick`.
- Scripts that use API playback do not require that the browser be in the foreground.
- Scripts that use API playback do not need to scroll an element into view before clicking it.
- Generally API scripts are more reliable since high-level user input is insensitive to pop-up windows and user interaction during playback.
- API playback is faster than native playback.

Differences Between API and Native Playback Functions

The `DomElement` class provides different functions for API playback and native playback.

The following table describes which functions use API playback and which use native playback.

	API Playback	Native Playback
Mouse Actions	`DomClick`	`Click`
	`DomDoubleClick`	`DoubleClick`
	`DomMouseMove`	`MoveMouse`
		`PressMouse`
		`ReleaseMouse`
Keyboard Actions	not available	`TypeKeys`
Specialized Functions	`Select`	not available
	`SetText`	
	etc.	

Setting Browser Recording Options

Specify custom attributes, browser attributes to ignore while recording, and whether to record native user input instead of DOM functions.

Silk4NET includes a sophisticated locator generator mechanism that guarantees locators are unique at the time of recording and are easy to maintain. Depending on your application and the frameworks that you use, you might want to modify the default settings to achieve the best results. You can use any property that is available in the respective technology as a custom attribute given that they are either numbers (integers, doubles), strings, item identifiers, or enumeration values.

In xBrowser applications, you can also retrieve arbitrary properties and then use those properties as custom attributes. To achieve optimal results, add a custom automation ID to the elements that you want to interact with in your test.

1. Click **Silk4NET** > **Edit Options**.
2. Click the plus sign (+) next to **Record** in the **Options** menu tree. The **Record** options display in the right side panel.
3. Click **xBrowser**.

4. To add a custom attribute for a Web application, in the **Custom attributes** text box, type the attributes that you want to use.

   Using a custom attribute is more reliable than other attributes like caption or index, since a caption will change when you translate the application into another language, and the index might change whenever another object is added before one you have defined already.

   Note: To include custom attributes in a Web application, add them to the html tag. For example type, `<input type='button' MyAutomationID='abc' value='click me' />` to add an attribute called `MyAutomationID`.

   If more than one object is assigned the same custom attribute value, all the objects with that value will return when you call the custom attribute. For example, if you assign the unique ID, `loginName` to two different text fields, both fields will return when you call the `loginName` attribute.

   Note: There is a 62 character limit to attribute names.

5. In the **Locator attribute name exclude list** text box, type the attribute names to ignore while recording.

   Use this list to specify attributes that change frequently, such as size, width, height, and style. You can include the wildcards '*' and '?' in the **Locator attribute name exclude list**.

   For example, if you do not want to record attributes named `height`, add the `height` attribute name to the list.

   Separate attribute names with a comma.

6. In the **Locator attribute value exclude list** text box, type the attribute values to ignore while recording. For example, if you do not want to record attributes assigned the value of `x-auto`, add the `x-auto` attribute value to the list.

   Some AJAX frameworks generate attribute values that change every time the page is reloaded. Use this list to ignore such values. You can also use wildcards in this list.

   Separate attribute names with a comma.

7. To record native user input instead of DOM functions, from the **Record native user input** list box, select **Yes**.

   For example, to record `Click` instead of `DomClick` and `TypeKeys` instead of `SetText`, select **Yes**.

   If your application uses a plug-in or AJAX, specify **Yes** to use native user input. If your application does not use a plug-in or AJAX, we recommend using high-level DOM functions, which do not require the browser to be focused or active during playback. As a result, tests that use DOM functions are faster and more reliable.

8. Click **OK**.

Setting Mouse Move Preferences

Specify whether mouse move actions are recorded for Web applications, Win32 applications, and Windows Forms applications that use mouse move events. You cannot record mouse move events for child domains of the xBrowser technology domain, for example Apache Flex and Swing.

1. Click **Silk4NET** > **Edit Options**.
2. Click the plus sign (+) next to **Record** in the **Options** menu tree. The **Record** options display in the right side panel.
3. Click **Recording**.
4. To record mouse move actions, check the OPT_RECORD_MOUSEMOVES option..

   Silk4NET will only record mouse move events that cause changes to the hovered element or its parent in order to keep scripts short.

5. If you record mouse move actions, in the **Record mouse move delay** text box, specify how many milliseconds the mouse has to be motionless before a `MoveMouse` action is recorded

   By default this value is set to 200.

Mouse move actions are only recorded if the mouse stands still for this time. A shorter delay will result in more unexpected move mouse actions, a longer delay will require you to keep the mouse still to record an action.

6. Click **OK**.

Browser Configuration Settings for xBrowser

Several browser settings help to sustain stable test executions. Although Silk4NET works without changing any settings, there are several reasons that you might want to change the browser settings.

Increase replay speed	Use `about:blank` as home page instead of a slowly loading Web page.
Avoid unexpected behavior of the browser	• Disable pop up windows and warning dialog boxes. • Disable auto-complete features. • Disable password wizards.
Prevent malfunction of the browser	Disable unnecessary third-party plugins.

The following sections describe where these settings are located in the corresponding browser.

Internet Explorer

The browser settings are located at **Tools** > **Internet Options**. The following table lists options that you might want to adjust.

Tab	Option	Configuration	Comments
General	Home page	Set to `about:blank`.	Minimize start up time of new tabs.
General	Tabs	• Disable warning when closing multiple tabs. • Enable to switch to new tabs when they are created.	• Avoid unexpected dialog boxes. • Links that open new tabs might not replay correctly otherwise.
Privacy	Pop-up blocker	Disable pop up blocker.	Make sure your Web site can open new windows.
Content	AutoComplete	Turn off completely	• Avoid unexpected dialog boxes. • Avoid unexpected behavior when typing keys.
Programs	Manage add-ons	Only enable add-ons that are absolutely required.	• Third-party add-ons might contain bugs. • Possibly not compatible to Silk4NET.
Advanced	Settings	• Disable **Automatically check for Internet Explorer updates**. • Enable **Disable script debugging (Internet Explorer)**. • Enable **Disable script debugging (Other)**. • Disable **Enable automatic crash recovery**. • Disable **Display notification about every script error**.	Avoid unexpected dialog boxes.

Tab	Option	Configuration	Comments
		• Disable all **Warn ...** settings	

Note: Recording a Web application in Internet Explorer with a zoom level different to 100% might not work as expected. Before recording actions against a Web application in Internet Explorer, set the zoom level to 100%.

Mozilla Firefox

In Mozilla Firefox, you can edit all settings by navigating a tab to `about:config`. The following table lists options that you might want to adjust. If any of the options do not exist, you can create them by right-clicking the table and choosing **New**.

Option	Value	Comments
app.update.auto	false	Avoid unexpected behavior (disable auto update).
app.update.enabled	false	Avoid unexpected behavior (disable updates in general).
app.update.mode	0	Avoid unexpected dialog boxes (do not prompt for new updates).
app.update.silent	true	Avoid unexpected dialog boxes (do not prompt for new updates).
browser.sessionstore.resume_from_crash	false	Avoid unexpected dialog boxes (warning after a browser crash).
browser.sessionstore.max_tabs_undo	0	Enhance performance. Controls how many closed tabs are kept track of through the Session Restore service.
browser.sessionstore.max_windows_undo	0	Enhance performance. Controls how many closed windows are kept track of through the Session Restore service.
browser.sessionstore.resume_session_once	false	Avoid unexpected dialog boxes. Controls whether the last saved session is restored once the next time the browser starts.
browser.shell.checkDefaultBrowser	false	Avoid unexpected dialog boxes. Checks if Mozilla Firefox is the default browser.
browser.startup.homepage	"about:blank"	Minimize start up time of new tabs.
browser.startup.page	0	Minimize browser startup time (no start page in initial tab).
browser.tabs.warnOnClose	false	Avoid unexpected dialog boxes (warning when closing multiple tabs).
browser.tabs.warnOnCloseOtherTabs	false	Avoid unexpected dialog boxes (warning when closing other tabs).
browser.tabs.warnOnOpen	false	Avoid unexpected dialog boxes (warning when opening multiple tabs).
dom.max_chrome_script_run_time	180	Avoid unexpected dialog boxes (warning when XUL code takes too long to execute, timeout in seconds).
dom.max_script_run_time	600	Avoid unexpected dialog boxes (warning when script code takes too long to execute, timeout in seconds).
dom.successive_dialog_time_limit	0	Avoid unexpected **Prevent page from creating additional dialogs** dialog box.
extensions.update.enabled	false	Avoid unexpected dialog boxes. Disables automatic extension update.

Google Chrome

You do not have to change browser settings for Google Chrome. Silk4NET automatically starts Google Chrome with the appropriate command-line parameters.

Configuring the Locator Generator for xBrowser

The Open Agent includes a sophisticated locator generator mechanism that guarantees locators are unique at the time of recording and are easy to maintain. Depending on your application and the frameworks that you use, you might want to modify the default settings to achieve the best results.

A well-defined locator relies on attributes that change infrequently and therefore requires less maintenance. Using a custom attribute is more reliable than other attributes like caption or index, since a caption will change when you translate the application into another language, and the index might change when another object is added.

To achieve optimal results, add a custom automation ID to the elements that you want to interact with in your test. In Web applications, you can add an attribute to the element that you want to interact with, such as `<div myAutomationId=”my unique element name” />`. This approach can eliminate the maintenance associated with locator changes.

1. Click **Silk4NET** > **Edit Options** and then click the **Custom Attributes** tab.
2. If you use custom automation IDs, from the **Select a TechDomain** list box, select **xBrowser** and then add the IDs to the list.

   The custom attributes list contains attributes that are suitable for locators. If custom attributes are available, the locator generator uses these attributes before any other attribute. The order of the list also represents the priority in which the attributes are used by the locator generator. If the attributes that you specify are not available for the objects that you select, Silk4NET uses the default attributes for xBrowser.
3. Click the **Browser** tab.
4. In the **Locator attribute name exclude list** grid, type the attribute names to ignore while recording.

   For example, use this list to specify attributes that change frequently, such as size, width, height, and style. You can include the wildcards ‘*’ and ‘?’ in the Locator attribute name blacklist.

   Separate attribute names with a comma.
5. In the **Locator attribute value exclude list** grid, type the attribute values to ignore while recording.

   Some AJAX frameworks generate attribute values that change every time the page is reloaded. Use this list to ignore such values. You can also use wildcards in this list.

   Separate attribute values with a comma.
6. Click **OK**.

   You can now record or manually create a test case.

Prerequisites for Replaying Tests with Google Chrome

Command-line parameters

When you use Google Chrome to replay a test or to record locators, Google Chrome is started with the following command:

```
%LOCALAPPDATA%\Google\Chrome\Application\chrome.exe
  --enable-logging
  --log-level=1
  --disable-web-security
  --disable-hang-monitor
  --disable-prompt-on-repost
  --dom-automation
```

```
--full-memory-crash-report
--no-default-browser-check
--no-first-run
--homepage=about:blank
--disable-web-resources
--disable-preconnect
--enable-logging
--log-level=1
--safebrowsing-disable-auto-update
--test-type=ui
--noerrdialogs
--metrics-recording-only
--allow-file-access-from-files
--disable-tab-closeable-state-watcher
--allow-file-access
--disable-sync
--testing-channel=NamedTestingInterface:st_42
```

When you use the wizard to hook on to an application, these command-line parameters are automatically added to the base state. If an instance of Google Chrome is already running when you start testing, without the appropriate command-line parameters, closes Google Chrome and tries to restart the browser with the command-line parameters. If the browser cannot be restarted, an error message displays.

Note: The command-line parameter `disable-web-security` is required when you want to record or replay cross-domain documents.

Limitations for Testing with Google Chrome

The support for playing back tests and recording locators with Google Chrome is not as complete as the support for the other supported browsers. The following list lists the known limitations for playing back tests and recording locators with Google Chrome:

- Silk Test does not support testing child technology domains of the xBrowser domain with Google Chrome. For example Apache Flex or Microsoft Silverlight are not supported with Google Chrome.
- Silk Test does not provide native support for Google Chrome. You cannot test internal Google Chrome functionality. For example, in a test, you cannot change the currently displayed Web page by adding text to the navigation bar through Win32. As a workaround, you can use API calls to navigate between Web pages. Silk Test supports handling alerts and similar dialog boxes.
- The page synchronization for Google Chrome is not as advanced as for the other supported browsers. Changing the synchronization mode has no impact on the synchronization for Google Chrome.
- Silk Test does not support the methods `TextClick` and `TextSelect` when testing applications with Google Chrome.
- Silk Test does not recognize the **Log In** and **Cancel** buttons in the authentication dialog box of Google Chrome. Use one of the following solutions to work around this limitation:
  - Specify the username and the password in the URL of the website that you want to test. For example, to log in to the website *www.example.com/loginrequired.html*, use the following code:
    ```
    http://myusername:mypassword@example.com/loginrequired.html
    ```
  - Use `TypeKeys` to enter the username and password in the dialog box. For example, use the following code:
    ```
     desktop.find("//Window[@caption='Authentication Required']/
    Control[2]").TypeKeys("myusername")
    desktop.find("//Window[@caption='Authentication Required']/
    Control[1]").TypeKeys("mypassword<Enter>")
    ```

    Note: `Control[2]` is the username field, and `Control[1]` is the password field. The `<Enter>` key at the end of the second `TypeKeys` confirms the entries in the dialog box.
- Silk Test does not recognize opening the **Print** dialog box in Google Chrome by using the Google Chrome menu. To add opening this dialog box in Google Chrome to a test, you have to send **Ctrl+Shift**

+P using the `TypeKeys` method. Internet Explorer does not recognize this shortcut, so you have to first record your test in Internet Explorer, and then manually add pressing **Ctrl+Shift+P** to your test.

- When two Google Chrome windows are open at the same time and the second window is detached from the first one, Silk Test does not recognize the elements on the detached Google Chrome window. For example, start Google Chrome and open two tabs. Then detach the second tab from the first one. Silk Test does no longer recognize the elements on the second tab. To recognize elements with Silk Test on multiple Google Chrome windows, use **CTRL+N** to open a new Google Chrome window.
- When you want to test a Web application with Google Chrome and the **Continue running background apps when Google Chrome is closed** check box is checked, Silk Test cannot restart Google Chrome to load the automation support.

xBrowser Frequently Asked Questions

This section includes a collection of questions that you might encounter when testing your Web application.

How do I Verify the Font Type Used for the Text of an Element?

You can access all attributes of the `currentStyle` attribute of a DOM element by separating the attribute name with a `":"`.

Internet Explorer 8 or earlier	`wDomElement.GetProperty("currentStyle:fontName")`
All other browsers, for example Internet Explorer 9 or later and Mozilla Firefox	`wDomElement.GetProperty("currentStyle:font-name")`

What is the Difference Between textContents, innerText, and innerHtml?

- `textContents` is all text contained by an element and all its children that are for formatting purposes only.
- `innerText` returns all text contained by an element and all its child elements.
- `innerHtml` returns all text, including html tags, that is contained by an element.

Consider the following html code.

```
<div id="mylinks">
  This is my <b>link collection</b>:
  <ul>
    <li><a href="www.borland.com">Bye bye <b>Borland</b> </a></li>
    <li><a href="www.microfocus.com">Welcome to <b>Micro Focus</b></a></li>
  </ul>
</div>
```

The following table details the different properties that return.

Code	Returned Value
`browser.DomElement("//div[@id='mylinks']").GetProperty("textContents")`	`This is my link collection:`
`browser.DomElement("//div[@id='mylinks']").GetProperty("innerText")`	`This is my link collection:Bye bye Borland Welcome to Micro Focus`

Code	Returned Value

`browser.DomElement("//div[@id='mylinks']").GetProperty("innerHtml")`	`This is my <b>link collection</b>:`
	`<ul>`
	`  <li><a href="www.borland.com">Bye bye`
	`<b>Borland</b></a></li>`
	`  <li><a href="www.microfocus.com">Welcome to`
	`<b>Micro Focus</b></a></li>`
	`</ul>`

Note: In Silk Test 13.5 or later, whitespace in texts, which are retrieved through the `textContents` property of an element, is trimmed consistently across all supported browsers. For some browser versions, this whitespace handling differs to Silk Test versions prior to Silk Test 13.5. You can re-enable the old behavior by setting the OPT_COMPATIBILITY option to a version lower than 13.5.0.

I Configured innerText as a Custom Class Attribute, but it Is Not Used in Locators

A maximum length for attributes used in locator strings exists. `InnerText` tends to be lengthy, so it might not be used in the locator. If possible, use `textContents` instead.

What Should I Take Care Of When Creating Cross-Browser Scripts?

When you are creating cross-browser scripts, you might encounter one or more of the following issues:

- Different attribute values. For example, colors in Internet Explorer are returned as `"# FF0000"` and in Mozilla Firefox as `"rgb(255,0,0)"`.
- Different attribute names. For example, the font size attribute is called `"fontSize"` in Internet Explorer 8 or earlier and is called `"font-size"` in all other browsers, for example Internet Explorer 9 or later and Mozilla Firefox.
- Some frameworks may render different DOM trees.

How Can I See Which Browser I Am Currently Using?

The `BrowserApplication` class provides a property `"browsertype"` that returns the type of the browser. You can add this property to a locator in order to define which browser it matches.

For information about new features, supported platforms and versions, known issues, and work-arounds, refer to the *Release Notes*.

Examples

To get the browser type, type the following into the locator:

```
browserApplication.GetProperty("browsertype")
```

Additionally, the `BrowserWindow` provides a method `GetUserAgent` that returns the user agent string of the current window.

Which Locators are Best Suited for Stable Cross-Browser Testing?

The built in locator generator attempts to create stable locators. However, it is difficult to generate quality locators if no information is available. In this case, the locator generator uses hierarchical information and indices, which results in fragile locators that are suitable for direct record and replay but ill-suited for stable, daily execution. Furthermore, with cross-browser testing, several AJAX frameworks might render different DOM hierarchies for different browsers.

To avoid this issue, use custom IDs for the UI elements of your application.

Logging Output of My Application Contains Wrong Timestamps

This might be a side effect of the synchronization. To avoid this problem, specify the HTML synchronization mode.

My Test Script Hangs After Navigating to a New Page

This can happen if an AJAX application keeps the browser busy (open connections for Server Push / ActiveX components). Try to set the HTML synchronization mode. Check the *Page Synchronization for xBrowser* topic for other troubleshooting hints.

Recorded an Incorrect Locator

The attributes for the element might change if the mouse hovers over the element. Silk4NET tries to track this scenario, but it fails occasionally. Try to identify the affected attributes and configure Silk4NET to ignore them.

Rectangles Around Elements in Internet Explorer are Misplaced

- Make sure the zoom factor is set to 100%. Otherwise, the rectangles are not placed correctly.
- Ensure that there is no notification bar displayed above the browser window. Silk4NET cannot handle notification bars.

Link.Select Does Not Set the Focus for a Newly Opened Window in Internet Explorer

This is a limitation that can be fixed by changing the Browser Configuration Settings. Set the option to always activate a newly opened window.

DomClick(x, y) Is Not Working Like Click(x, y)

If your application uses the `onclick` event and requires coordinates, the `DomClick` method does not work. Try to use `Click` instead.

FileInputField.DomClick() Will Not Open the Dialog

Try to use `Click` instead.

The Move Mouse Setting Is Turned On but All Moves Are Not Recorded. Why Not?

In order to not pollute the script with a lot of useless `MoveMouse` actions, Silk4NET does the following:

- Only records a `MoveMouse` action if the mouse stands still for a specific time.
- Only records `MoveMouse` actions if it observes activity going on after an element was hovered over. In some situations, you might need to add some manual actions to your script.
- Silk4NET supports recording mouse moves only for Web applications, Win32 applications, and Windows Forms applications. Silk4NET does not support recording mouse moves for child technology domains of the xBrowser technology domain, for example Apache Flex and Swing.

I Need Some Functionality that Is Not Exposed by the xBrowser API. What Can I Do?

You can use `ExecuteJavaScript()` to execute JavaScript code directly in your Web application. This way you can build a workaround for nearly everything.

Why Are the Class and the Style Attributes Not Used in the Locator?

These attributes are on the ignore list because they might change frequently in AJAX applications and therefore result in unstable locators. However, in many situations these attributes can be used to identify objects, so it might make sense to use them in your application.

Dialog is Not Recognized During Replay

When recording a script, Silk4NET recognizes some windows as `Dialog`. If you want to use such a script as a cross-browser script, you have to replace `Dialog` with `Window`, because some browsers do not recognize `Dialog`.

For example, the script might include the following line:

```
/BrowserApplication//Dialog//PushButton[@caption='OK']
```

Rewrite the line to enable cross-browser testing to:

```
/BrowserApplication//Window//PushButton[@caption='OK']
```

Why Do I Get an Invalidated-Handle Error?

This topic describes what you can do when you test a Web application and Silk4NET displays the following error message: `The handle for this object has been invalidated.`

This message indicates that something caused the object on which you called a method, for example `WaitForProperty`, to disappear. For example, if something causes the browser to navigate to a new page, during a method call in a Web application, all objects on the previous page are automatically invalidated.

Sometimes the reason for this problem is the built-in synchronization. For example, suppose that the application under test includes a shopping cart, and you have added an item to this shopping cart. You are waiting for the next page to be loaded and for the shopping cart to change its status to `contains items`. If the action, which adds the item, returns too soon, the shopping cart on the first page will be waiting for the status to change while the new page is loaded, causing the shopping cart of the first page to be invalidated. This behavior will result in an invalidated-handle error.

As a workaround, you should wait for an object that is only available on the second page before you verify the status of the shopping cart. As soon as the object is available, you can verify the status of the shopping cart, which is then correctly verified on the second page.

Why Are Clicks Recorded Differently in Internet Explorer 10?

When you record a `Click` on a `DomElement` in Internet Explorer 10 and the `DomElement` is dismissed after the `Click`, then the recording behavior might not be as expected. If another `DomElement` is located beneath the initial `DomElement`, Silk Test records a `Click`, a `MouseMove`, and a `ReleaseMouse`, instead of recording a single `Click`.

A possible workaround for this unexpected recording behavior depends on the application under test. Usually it is sufficient to delete the unnecessary `MouseMove` and `ReleaseMouse` events from the recorded script.

Attributes for Web Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Web applications include:

- caption (supports wildcards *?* and *)
- all DOM attributes (supports wildcards *?* and *)

Note: Empty spaces are handled differently by each browser. As a result, the `textContent` and `innerText` attributes have been normalized. Empty spaces are skipped or replaced by a single space if an empty space is followed by another empty space. Empty spaces are detected spaces, carriage returns, line feeds, and tabs. The matching of such values is normalized also. For example:

```
<a>abc
abc</a>
```

Uses the following locator:

```
//A[@innerText='abc abc']
```

Custom Attributes for Web Applications

HTML defines a common attribute `ID` that can represent a stable identifier. By definition, the ID uniquely identifies an element within a document. Only one element with a specific ID can exist in a document.

However, in many cases, and especially with AJAX applications, the ID is used to dynamically identify the associated server handler for the HTML element, meaning that the ID changes with each creation of the Web document. In such a case the ID is not a stable identifier and is not suitable to identify UI controls in a Web application.

A better alternative for Web applications is to introduce a new custom HTML attribute that is exclusively used to expose UI control information to Silk4NET.

Custom HTML attributes are ignored by browsers and by that do not change the behavior of the AUT. They are accessible through the DOM of the browser. Silk4NET allows you to configure the attribute that you want to use as the default attribute for identification, even if the attribute is a custom attribute of the control class. To set the custom attribute as the default identification attribute for a specific technology domain, click **Silk4NET** > **Edit Options** > **Custom Attributes** and select the technology domain.

The application developer just needs to add the additional HTML attribute to the Web element.

Original HTML code:

```
<A HREF="http://abc.com/control=4543772788784322..." <IMG
src="http://abc.com/xxx.gif" width=16 height=16> </A>
```

HTML code with the new custom HTML attribute *AUTOMATION_ID*:

```
<A HREF="http://abc.com/control=4543772788784322..."
AUTOMATION_ID = "AID_Login" <IMG src="http://abc.com/xxx.gif"
width=16 height=16> </A>
```

When configuring the custom attributes, Silk4NET uses the custom attribute to construct a unique locator whenever possible. Web locators look like the following:

```
…//DomLink[@AUTOMATION_ID='AID_Login'
```

Example: Changing ID

One example of a changing ID is the Google Widget Toolkit (GWT), where the ID often holds a dynamic value which changes with every creation of the Web document:

```
ID = 'gwt-uid-<nnn>'
```

In this case <nnn> changes frequently.

xBrowser Class Reference

When you configure an xBrowser application, Silk4NET automatically provides built-in support for testing standard xBrowser controls.

64-bit Application Support

Silk4NET supports testing 64-bit applications for the following technology types:

- Windows Forms
- Windows Presentation Foundation (WPF)
- Microsoft Windows API-based
- Java AWT/Swing
- Java SWT

Check the *Release Notes* for the most up-to-date information about supported versions, any known issues, and workarounds.

Supported Attribute Types

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests. If necessary, you can change the attribute type in one of the following ways:

- Manually typing another attribute type and value.
- Specifying another preference for the default attribute type by changing the **Preferred attribute list** values.

Attributes for Apache Flex Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Flex applications include:

- automationName
- caption (similar to automationName)
- automationClassName (e.g. `FlexButton`)
- className (the full qualified name of the implementation class, e.g. `mx.controls.Button`)
- automationIndex (the index of the control in the view of the FlexAutomation, e.g. `index:1`)
- index (similar to automationIndex but without the prefix, e.g. `1`)
- id (the id of the control)
- windowId (similar to id)
- label (the label of the control)
- All dynamic locator attributes

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards `?` and `*`.

For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

Attributes for Java AWT/Swing Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Java AWT/Swing include:

- caption
- priorlabel: Helps to identify text input fields by the text of its adjacent label field. Every input field of a form usually has a label that explains the purpose of the input. For controls that do not have a caption, the attribute **priorlabel** is automatically used in the locator. For the **priorlabel** value of a control, for example a text input field, the caption of the closest label at the left side or above the control is used.
- name
- accessibleName
- *Swing only*: All custom object definition attributes set in the widget with `SetClientProperty("propertyName", "propertyValue")`

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Attributes for Java SWT Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Java SWT include:

- caption
- all custom object definition attributes

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Attributes for SAP Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for SAP include:

- automationId
- caption

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Locator Attributes for Identifying Silverlight Controls

Supported locator attributes for Silverlight controls include:

- *automationId*

- *caption*
- *className*
- *name*
- All dynamic locator attributes

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

To identify components within Silverlight scripts, you can specify the *automationId*, *caption*, *className*, *name* or any dynamic locator attribute. The *automationId* can be set by the application developer. For example, a locator with an *automationId* might look like `//SLButton[@automationId="okButton"]`.

We recommend using the *automationId* because it is typically the most useful and stable attribute.

Attribute Type	Description	Example
automationId	An identifier that is provided by the developer of the application under test. The Visual Studio designer automatically assigns an *automationId* to every control that is created with the designer. The application developer uses this ID to identify the control in the application code.	`//SLButton[@automationId="okButton"]`
caption	The text that the control displays. When testing a localized application in multiple languages, use the *automationId* or *name* attribute instead of the *caption*.	`//SLButton[@caption="Ok"]`
className	The simple .NET class name (without namespace) of the Silverlight control. Using the *className* attribute can help to identify a custom control that is derived from a standard Silverlight control that Silk4NET recognizes.	`//SLButton[@className='MyCustomButton']`
name	The name of a control. Can be provided by the developer of the application under test.	`//SLButton[@name="okButton"]`

Attention: The *name* attribute in XAML code maps to the locator attribute *automationId*, not to the locator attribute *name*.

During recording, Silk4NET creates a locator for a Silverlight control by using the *automationId*, *name*, *caption*, or *className* attributes in the order that they are listed in the preceding table. For example, if a control has an *automationId* and a *name*, Silk4NET uses the *automationId*, if it is unique, when creating the locator.

The following table shows how an application developer can define a Silverlight button with the text "Ok" in the XAML code of the application:

XAML Code for the Object	Locator to Find the Object from Silk Test
`<Button>Ok</Button>`	`//SLButton[@caption="Ok"]`
`<Button Name="okButton">Ok</Button>`	`//SLButton[@automationId="okButton"]`
`<Button AutomationProperties.AutomationId="okButton">Ok</Button>`	`//SLButton[@automationId="okButton"]`
`<Button AutomationProperties.Name="okButton">Ok</Button>`	`//SLButton[@name="okButton"]`

Locator Attributes for Identifying Rumba Controls

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests. Supported attributes include:

caption	The text that the control displays.
priorlabel	Since input fields on a form normally have a label explaining the purpose of the input, the intention of **priorlabel** is to identify the text input field, **RumbaTextField**, by the text of its adjacent label field, **RumbaLabel**. If no preceding label is found in the same line of the text field, or if the label at the right side is closer to the text field than the left one, a label on the right side of the text field is used.
StartRow	This attribute is not recorded, but you can manually add it to the locator. Use **StartRow** to identify the text input field, **RumbaTextField**, that starts at this row.
StartColumn	This attribute is not recorded, but you can manually add it to the locator. Use **StartColumn** to identify the text input field, **RumbaTextField**, that starts at this column.
All dynamic locator attributes.	For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Attributes for Web Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Web applications include:

- caption (supports wildcards *?* and *)
- all DOM attributes (supports wildcards *?* and *)

Note: Empty spaces are handled differently by each browser. As a result, the `textContent` and `innerText` attributes have been normalized. Empty spaces are skipped or replaced by a single space if an empty space is followed by another empty space. Empty spaces are detected spaces, carriage returns, line feeds, and tabs. The matching of such values is normalized also. For example:

```
<a>abc
abc</a>
```

Uses the following locator:

```
//A[@innerText='abc abc']
```

Attributes for Windows Forms Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Windows Forms applications include:

- automationid

- caption
- windowid
- priorlabel (For controls that do not have a caption, the priorlabel is used as the caption automatically. For controls with a caption, it may be easier to use the caption.)

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Attributes for Windows Presentation Foundation (WPF) Applications

Supported attributes for WPF applications include:

- *automationId*
- *caption*
- *className*
- *name*
- All dynamic locator attributes.

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

For additional information on dynamic locator attributes, see *Dynamic Locator Attributes*.

Object Recognition

To identify components within WPF scripts, you can specify the *automationId*, *caption*, *className*, or *name*. The name that is given to an element in the application is used as the *automationId* attribute for the locator if available. As a result, most objects can be uniquely identified using only this attribute. For example, a locator with an *automationId* might look like: `//WPFButton[@automationId='okButton']`.

If you define an *automationId* and any other attribute, only the *automationId* is used during replay. If there is no *automationId* defined, the *name* is used to resolve the component. If neither a *name* nor an *automationId* are defined, the *caption* value is used. If no caption is defined, the *className* is used. We recommend using the *automationId* because it is the most useful property.

Attribute Type	Description	Example
automationId	An ID that was provided by the developer of the test application.	`//WPFButton[@automationId='okButton']`
name	The name of a control. The Visual Studio designer automatically assigns a name to every control that is created with the designer. The application developer uses this name to identify the control in the application code.	`//WPFButton[@name='okButton']`
caption	The text that the control displays. When testing a	`//WPFButton[@automationId='Ok']`

Attribute Type	Description	Example
	localized application in multiple languages, use the automationId or name attribute instead of the caption.	
className	The simple .NET class name (without namespace) of the WPF control. Using the class name attribute can help to identify a custom control that is derived from a standard WPF control that Silk4NET recognizes.	`//WPFButton[@className='MyCustomButton']"`

During recording, Silk4NET creates a locator for a WPF control by using the *automationId*, *name*, *caption*, or *className* attributes in the order that they are listed in the preceding table. For example, if a control has a *automationId* and a *name*, Silk4NET uses the *automationId* when creating the locator.

The following example shows how an application developer can define a *name* and an *automationId* for a WPF button in the XAML code of the application:

```
<Button Name="okButton" AutomationProperties.AutomationId="okButton"
Click="okButton_Click">Ok</Button>
```

Attributes for Windows API-based Client/Server Applications

When a locator is constructed, the attribute type is automatically assigned based on the technology domain that your application uses. The attribute type and value determines how the locator identifies objects within your tests.

Supported attributes for Windows API-based client/server applications include:

- caption
- windowid
- priorlabel: Helps to identify text input fields by the text of its adjacent label field. Every input field of a form usually has a label that explains the purpose of the input. For controls that do not have a caption, the attribute **priorlabel** is automatically used in the locator. For the **priorlabel** value of a control, for example a text box, the caption of the closest label at the left side or above the control is used.

Note: Attribute names are case sensitive, except for mobile applications, where the attribute names are case insensitive. Attribute values are by default case insensitive, but you can change the default setting like any other option. The locator attributes support the wildcards ? and *.

Dynamic Locator Attributes

In a locator for identifying a control during replay you can use a pre-defined set of locator attributes, for example *caption* and *automationId*, which depend on the technology domain. But you can also use every property, including dynamic properties, of a control as locator attribute. A list of available properties for a certain control can be retrieved with the `GetPropertyList` method. All returned properties can be used for identifying a control with a locator.

Note: You can use the `GetProperty` method to retrieve the actual value for a certain property of interest. You can then use this value in your locator.

Example

If you want to identify the button that has the user input focus in a Silverlight application, you can type:

```
browser.Find("//SLButton[@IsKeyboardFocused=true]")
```

or alternatively

```
Dim button = dialog.SLButton("@IsKeyboardFocused=true")
```

This works because Silk4NET exposes a property called `IsDefault` for the Silverlight button control.

Example

If you want to identify a button in a Silverlight application with the font size 12 you can type:

```
Dim button = browser.Find("//SLButton[@FontSize=12]")
```

or alternatively

```
Dim button = browser.SLButton("@FontSize=12")
```

This works because the underlying control in the application under test, in this case the Silverlight button, has a property called `FontSize`.

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