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Developing Flex Components and Themes in Flash Authoring

Acknowledgments

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CHAPTER 1
Working with Flash MX 2004

This chapter describes how to set up and work in the Macromedia Flash environment when creating components for Macromedia Flex. It helps familiarize you with setting the classpath in Flash, working with symbols, and exporting component SWC files.

If you are an experienced Flash developer, you may be able to skip this chapter.

For a set of simple examples that illustrate the basics of component development, see Chapter 2, "Creating Basic Components in Flash MX 2004," on page 23. For a more in-depth look at programming the ActionScript class files for components, see Chapter 3, "Creating Advanced Components in Flash MX 2004," on page 45.

Contents

About creating components

You can create a new component for Flex in several ways. Depending on what kind of component you want to create, you use different tools. To extend the class of an existing component and add a new method, for example, you can write just a single ActionScript class file. To create a new tag in MXML, you can create a component in MXML using a combination of MXML tags and ActionScript. Or, to create a new component with new behaviors, graphics, and other interactive elements, you can use the Flash MX 2004 Integrated Development Environment (IDE).

This section describes how to create a new component for Flex using the Flash environment. You do this when you want to accomplish the following tasks:

- Generate SWC files. SWC files are component archive files that you add to your Flex environment. They provide easy portability among Flash and Flex developers. This chapter includes instructions on how to create and use a SWC file.
- Change the appearance of Flex components. By editing a component's visual assets on the Flash Stage, you can change a component's appearance from styles and skins to the shape and size.

- Create components that feature complex user interaction, such as the Data Grid. You can make the component respond to different user input, such as adding keyboard event listeners.
- Take advantage of the Flash tools, such as font and drawing tools, to create complex graphics. Flash comes with a rich set of tools to edit graphics, sounds, and video when building a new component.

You would *not* use the instructions in this section to accomplish the following:

- Change the theme of your components or only their appearance and not their behavior. Although it is possible to re-theme all of your components using the instructions in this section, the process of theming is designed to be easier than what this section describes.
- Add functionality to code-only or faceless components that have no user interaction. You can extend existing components more easily by writing an ActionScript class. For more information, see *Developing Flex Applications*.
- Create components with fairly simple graphics. You can create a new component that employs a simple set of graphics using the drawing API available in MXML and ActionScript to output vector graphics.

Introduction to components

A component can provide any functionality that its creator can imagine. It lets developers create functionality that designers can use in applications. Developers can encapsulate frequently used functionality into components, and designers can customize the look and behavior of components by adding methods and events to the components.

A *component* can be a simple user interface control, such as a Radio Button or a CheckBox, or it can contain content, such as a Canvas or Data Grid; a component can also be nonvisual, like the FocusManager that lets you control which object receives focus in a Flex application.

Flex components are built on Version 2 of the Macromedia Component Architecture, which lets you easily and quickly build robust applications with a consistent appearance and behavior. This architecture includes classes on which all components are based, style and skin mechanisms that let you customize component appearance, a broadcaster-listener event model, depth and focus management, and an accessibility implementation.

Components enable the separation of coding and design. All components are subclasses of the UIObject and UIComponent classes and inherit all properties, methods, and events from those classes. Components also let you reuse code, either in components that you create, or by downloading and installing components created by other developers.

Many components are also subclasses of other components. All components also use the same event model, CSS-based styles, and built-in skinning mechanism.

Component classes are written in ActionScript 2.0. Each component is a class and each class is in an ActionScript package. For example, a Radio Button component is an instance of the RadioButton class whose package name is `mx.controls`.

About component types

Flex uses the following types of components:

UI controls UI controls are visual components that represent discrete elements of a user interface (Checkbox, ComboBox, TextInput components, and so on) and are the interface between application data and the user.

Containers Containers are shells for different types of content. For example, Panel is a container. The mx.containers.Container class is the base class for containers. You generally would not use the instructions in this chapter to create new containers because they are nonvisual.

Data components Data components are nonvisual components that connect, contain, and process content. Use data components with UI controls. The process for connecting them is called *data binding*, where a change in data in one component forces an event to occur in other dependent components. Examples of data components are the WebServiceConnector, DataSet, and the Validator. A typical application contains multiple instances of a data component. You generally would not use the instructions in this chapter to create new data components because they are nonvisual.

Managers Managers are nonvisual components that are responsible for managing some type of system resource. Examples of managers include the FocusManager and the DepthManager. A typical application contains only one instance of a manager, and these managers are normally instantiated if they are needed by components that rely on them. You generally would not use the instructions in this chapter to create new managers because they are nonvisual.

Working in the Flash environment

The Macromedia Flash MX 2004 and Flash MX Professional 2004 environments are set up to make the structure of classes and components logical. You must take the following steps to prepare your Flash environment for extending or creating new components for Flex:

1. Import Flex components into Flash, and make Flex classes available to Flash.
2. Set the Flash classpath to point to the Flex classes.

If you have not created a component before, you should also familiarize yourself with the asset types (such as graphics, symbols, class files, and FLA files) that you will be working with.

The following sections describe these steps and component assets in detail.

About component assets

When creating a new visual component for Flex in Flash MX 2004, you start with a FLA file and add or change the skins, graphics, ActionScript class files, and other assets. You then export the files as SWC files, which are then used by Flex as components.

This section describes the types of assets that you work with to create your component in Flash.

Symbols and MovieClips

In Flash, most assets are also known as *symbols*, and each symbol must have a unique name. You can store symbols anywhere in the FLA file, because Flex accesses the assets by the symbol name rather than by the Timeline or Stage.

A symbol is a graphic, button, or movie clip that you create in Flash MX 2004. You create the symbol only once; you can then reuse it throughout your document or in other documents. Any symbol that you create automatically becomes part of the Library for the current document.

Each symbol has its own Timeline. You can add frames, keyframes, and layers to a symbol Timeline, just as you can to the main Timeline. Movie clips are symbols that can play animation in a Flash application. If the symbol is a movie clip or a button, you can control the symbol with ActionScript. Flex abstracts the idea of the MovieClip, so you may not be familiar with them. However, they are the foundation of the Flash environment, and you use them when creating components for Flex in Flash.

Compiled clips

Symbols can be compiled in Flash and converted into a compiled clip symbol. The compiled clip symbol behaves just like the movie clip symbol from which it was compiled, but compiled clips appear and publish much faster than regular movie clip symbols. Compiled clips cannot be edited, but they do have properties that appear in the Property Inspector and in the Component Inspector panel and they include a live preview.

The components included with Flash MX 2004 have already been converted to compiled clips.

Classes

The ActionScript class file specifies the properties, methods, and events for the component, and defines which, if any, classes that your component inherits from. It also includes other class files and packages that your component uses.

You must use the .as file naming convention for ActionScript source code, and name the source code file after the component itself. For example, the MyComponent.as file contains the source code for the MyComponent component.

The FLA file includes a reference to the ActionScript class file for the component. This is known as binding the component to the class file. The binding is also known as a linkage identifier.

Class files can reside at the top level of the directory structure, or you can create a directory structure that mirrors your ActionScript class file's package name and store the ActionScript class file there.

Adding Flex classes and components to the Flash IDE

The Flex components and the Flash components share the same names and most of the same functionality. However, Flex has enhanced and upgraded the Flash component set. Therefore, you must add the Flex components to the Flash environment using the instructions in this section in order to compile new components for Flex.

To compile a new component's SWC file in Flash for use in Flex, you must add the Flex SWC files and ActionScript class files to your local FLA file's classpath. These files are included in the FlexforFlash.zip file, which is included in the Flex installation process. After you extract the contents of the FlexforFlash.zip file, you must add them to your classpath.

To add Flex components to the Flash environment:

1. Close the Flash IDE if it is open.
2. Find the *Flex_install_dir*/resources/flexforflash/FlexforFlash.zip file. This file was included in the installation with the other Flex files.

   The default location in Windows is C:\Program Files\Macromedia\Flex\resources\flexforflash\FlexforFlash.zip.
3. Extract the contents of the FlexForFlash.zip file to the Flash First Run directory.

   The default location is C:/Program Files/Macromedia/Flash MX 2004/en/First Run. This file creates the Components/Flex Components directory and copies the Flex SWC files to that directory. In addition, it creates the Flex Classes directory, which contains the ActionScript source files for the Flex classes.
4. Open the Flash IDE.

   The Flex Components list appears in the Components panel with the other component lists.
5. In each new FLA file that you create, add the following classpath entry to the top of the local classpath listing:

   ```
   $(LocalData)/Flex Classes
   ```

   Note: You must add the Flex Classes entry to the top of the classpath list.

   For more information on editing your FLA file's classpath settings, see "Changing the Flash classpath" on page 10.

About the Flash MX 2004 classpath

The classpath is an ordered list of directories that Flash searches for class files when you export a component as a SWC file. The order of the classpath entries is important because Flash uses the classes on a first-come, first-served basis. At export time, classes found on the classpath that match linkage identifiers in the FLA file are imported into the FLA file and registered with their symbols.

There are two types of classpaths in Flash MX 2004: global and local. The *global classpath* is used by all FLA files generated with the Flash IDE. A *local classpath* applies only to the current FLA file. When you make changes to the classpath, you should change only the *local* classpath.

Before you can create components for Flex in Flash, you must edit the FLA file's local classpath settings to include the /Flex Classes directory and the dot (.).

Relative values in the Flash classpath are relative to the location of the FLA file.

About the default classpath

The default local classpath is empty. The default global classpath consists of the following paths:

- . (the dot)
- $(LocalData)/Classes

The dot (.) indicates the current working directory. Flash searches the FLA file's current directory for the ActionScript classes it needs.

The $(LocalData)/Classes path indicates the per-user configuration directory. This directory points to the following physical locations:

- On Windows 2000 or Windows XP, this directory is C:\Documents and Settings*username*\Local Settings\Application Data\ Macromedia\Flash MX 2004\en\Configuration\Classes.
- On the Macintosh, this directory is *volume*:Users:*username*:Library:Application Support:Macromedia:Flash MX 2004:en:configuration:classes.

The user configuration directories mirror the directories located in *Flash_root*/en/Configuration. However, the classpath does not directly include those directories.

By default, Flash MX 2004 does not include the Flex classes in its environment. You must download and install a separate set of files, and then add them to your classpath settings. For more information, see "Adding Flex classes and components to the Flash IDE" on page 8.

Changing the Flash classpath

This section describes how to change the global and local classpaths. Macromedia recommends changing only the local classpath and adding the following entries to your local classpath:

- $(LocalData)/Flex Classes
- . (the dot)

The $(LocalData)/Flex Classes classpath entry points to the classes that you extracted in "Adding Flex classes and components to the Flash IDE" on page 8. The dot (.) indicates the current working directory in Flash. This is the directory in which you store your FLA file.

Note: To edit the local classpath, you must have a FLA file open.

To change the local classpath:

1. Create a new FLA file or open an existing FLA file in Flash.
2. Select File > Publish Settings.

   The Publish Settings dialog box appears.
3. Select the Flash tab.
4. Click the Settings button.

   The ActionScript Settings dialog box appears.
5. Add, remove, or edit entries in the Classpath dialog box.
6. Click OK to save your changes.
7. Save the FLA file.

To change the global classpath:

1. Select Edit > Preferences.

   The Preferences dialog box appears.

2. Select the ActionScript tab.
3. Click the ActionScript 2.0 Settings button.

   The Classpath dialog box appears.

4. Add, remove, or edit entries in the Classpath dialog box.
5. Click OK to save your changes.

About importing classes

Flash imports all files referenced in ActionScript classes with `import` statements.

For example, if your component extends the UIObject class and makes use of assets found in the SimpleButton and TextInput controls, you import the following classes in your class file:

```
import mx.core.UIObject;
import mx.controls.SimpleButton;
import mx.controls.TextInput;
```

When importing classes, you can use a wildcard to import all classes in a particular package; for example:

```
import mx.controls.*;
```

Flash only imports the necessary classes when compiling the component.

Flash finds classes that you import by searching the directories in the classpath. For most situations, your local Flash classpath must consist of at least the following entries:

- $(LocalData)/Flex Classes
- . (the dot)

The $(LocalData)/Flex Classes points to the classes that you extracted in "Adding Flex classes and components to the Flash IDE" on page 8. The dot (.) indicates the current working directory in Flash. This is the directory in which you store your FLA file.

To import a custom class or package of classes, you can store the file or the directory structure in the same directory as the FLA file so that Flash will find them with these classpath settings.

Working with component symbols

All components are MovieClip objects, which are a type of symbol. This section describes how to create new symbols, edit existing symbols, and convert symbols to components.

Adding new symbols

To create a new component, you must insert a new symbol into a new FLA file. You then convert the symbol to a component so that you can link the component to a class file.

To add a new component symbol:

1. In Flash, create a blank Flash document.
2. Select Insert > New Symbol.

   The Create New Symbol dialog box appears.
3. In the Name field, enter the fully qualified symbol name. You should use package names and avoid simple names such as Button or List, to avoid naming conflicts with existing components.

   The symbol name will be the component name, including the package (if any) that it resides in. A good convention to use is to name the component by capitalizing the first letter of each word in the component (for example, myPackage.MyComponent or MyComponent).
4. Select the Movie Clip option for the behavior.

   Note: A MovieClip object has its own multiframe Timeline that plays independently of the main Timeline.
5. Click the Advanced button.

   The advanced settings appear in the dialog box.
6. In the Identifier field, enter a fully qualified linkage identifier (for example, myPackage.MyComponent).

   The identifier is used as symbol name and linkage name, and as the associated class name. It should be the same as the symbol name.
7. In the AS 2.0 Class field, enter the fully qualified path to the component's ActionScript 2.0 class file, relative to your classpath settings. If the ActionScript file is in a package, you must include the package name (for example, myPackage.MyComponent).

   Note: Do not include the filename's extension; the AS 2.0 Class text box points to the packaged location of the class and not the file system's name for the file. This field's value should be the same as the Identifier.
8. Select Export for ActionScript. This tells Flash to package the component by default with any Flash content that is used by the component.
9. Deselect Export in First Frame (it is selected by default).
10. Click OK.

    Flash adds the new symbol to the Library and switches to Edit Symbols mode. In this mode, the name of the symbol appears above the upper left corner of the Stage, and a cross-hair pointer indicates the symbol's registration point.

    You can edit the linkage identifier and ActionScript class for the new symbol by right-clicking on the symbol in the Library and selecting Properties.

Editing symbols

Each symbol has its own Timeline. You can add frames, keyframes, and layers to a symbol's Timeline, just as you can to the main Timeline. On these layers and in these frames you store the graphical assets for the symbol.

To edit the symbol's linkage information:

- Right-click the symbol in the Flash Library, and select Linkage.

When creating components, you often start with a single symbol. Flash provides the following ways for you to edit symbols:

- Edit the symbol in the context of the other objects on the Stage by selecting the Edit in Place command. Other objects are dimmed to distinguish them from the symbol that you are editing. The name of the symbol you are editing appears in an edit bar at the top of the Stage, to the right of the current scene name.
- Edit the symbol in a separate window by selecting the Edit in New Window command. Editing a symbol in a separate window lets you see the symbol and the main Timeline at the same time. The name of the symbol that you are editing appears in the edit bar at the top of the Stage.
- Edit the symbol by changing the window from the Stage view to a view of only the symbol, using Edit Symbols mode. To enter Edit Symbols mode, select the symbol's instance from the Edit Symbols drop-down icon. The name of the symbol that you are editing appears in the edit bar at the top of the Stage, to the right of the current scene name:

Editing symbol layers

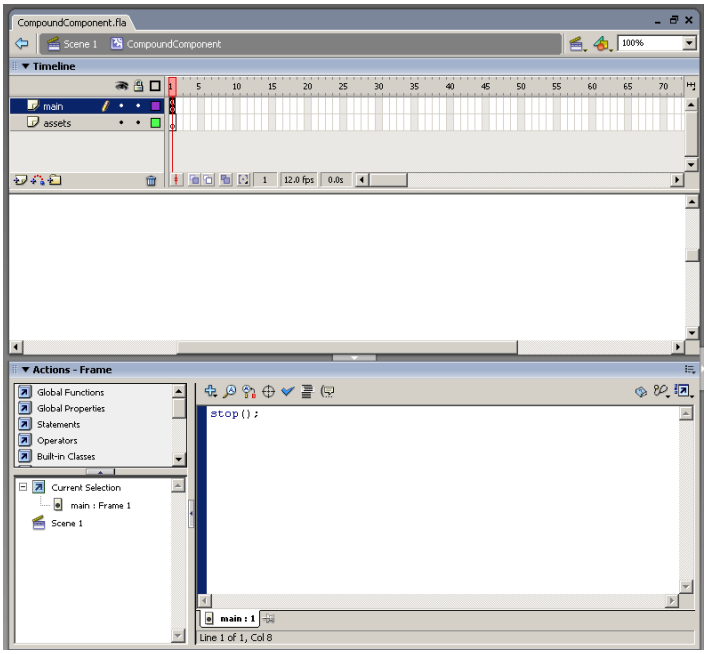
After you add a new symbol and define the linkages for it, you can define the component's assets in the symbol's Timeline.

A component's symbol should have two layers. The first layer is the main layer, in which you invoke the `stop()` action so that the player does not play the entire movie that the component comprises. The second layer contains all the skins and graphical symbols used by the component.

This section describes what layers to insert and what to add to those layers.

To edit symbol layers:

1. Enter Edit Symbols mode.
2. Rename an empty layer, or create a layer called **main**. You can use any name for the main layer; however, this document refers to this layer as the main layer.
3. In the first frame of the main layer, add a `stop()` action in the Actions panel, as the following figure shows:



   Do not add any graphical assets to this layer.

4. Rename an empty layer, or create a layer called **assets**. You can use any name for the assets layer; however, this document refers to this layer as the assets layer.

   The assets layer includes all the graphical assets used by this component.

5. Insert a blank Keyframe on the assets layer. You should now have two frames on the assets layer.
6. Add any graphical assets used by this component on the second frame of your component's assets layer. For example, if you are creating a custom button, add the graphics that represent the button's states (up, down, and so on).
7. Drag dependent components onto the Stage of the component symbol's assets layer, if necessary. For more information, see "Adding dependent components" on page 15.
8. When you have finished creating the symbol content, do one of the following to return to document-editing mode:
   - Click the Back button at the left side of the edit bar above the Stage.
   - Select Edit > Edit Document.
   - Click the scene name in the edit bar above the Stage.

Adding dependent components

You can create new components based on existing Flex components, such as Button, CheckBox, UIObject, and UIComponent. In many cases your new component combines the functionality and symbols of existing visual Flex components. You must add the component symbols (or compiled clips) of the components on which your new component depends to the component FLA file's Library.

After you add symbols to the Library, Flash can include the assets in the SWC file when you export your new component. For example, to create a custom text area component, you must first add the TextArea component and its assets to the Library.

Also, when you build a compound component (a component that is built from multiple components, such as a ComboBox), you must add each of the subcomponents to the Library.

If you add a dependent component that is not in Flash but *is* in the Flex architecture, you must take special steps to produce a SWC file. For more information, see "Using the SWCRepair utility" on page 19.

To add a dependent component to your component's Library:

1. Enter Edit Symbols mode for your component symbol.
2. Select the second frame of the assets layer.
3. Select the dependent component's symbol from the Flex Components drop-down list in the Components panel. If you do not have a list of Flex Components in your Components panel, see "Adding Flex classes and components to the Flash IDE" on page 8.
4. Drag the component onto the Stage in the second frame of your new component's assets layer.

   Flash adds the component to the Library.

Converting symbols into components

After you add a symbol to your FLA file, add its assets, and link it to the ActionScript class file, you must convert it to a component. You can inspect and edit a component with the Component Definition panel, and you also can export it as a SWC file.

To tell the difference between a symbol and a component, look at the icon in the Library. The following table shows the symbol icon and the default component icon:

Symbol	Component
	

Each built-in Flash component has a distinct icon. For example, the Button control has its own icon that looks like a button. You can add your own icon for your new component to the Flash environment, or use one of the Flash component icons. The latter practice is not recommended, because it might cause confusion. The default icon is adequate to indicate a generic component. For more information, see "Adding an icon" on page 71.

You must create the class file before turning the symbol into a component. If Flash does not convert your symbol into a component, it most likely cannot find the ActionScript class. Another possibility is that the class file is not in the Flash classpath.

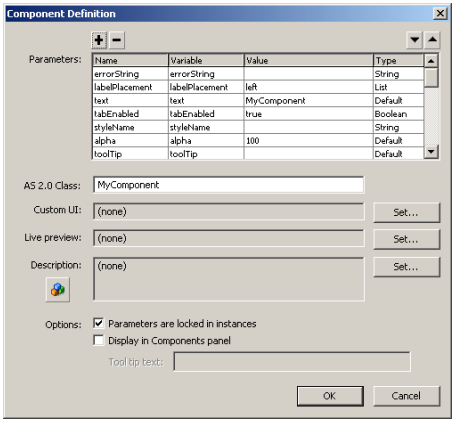
To convert a symbol into a component:

1. Create an ActionScript class file and save it with an .as filename extension.

   For more information on creating ActionScript class files, see the examples in Chapter 2, "Creating Basic Components in Flash MX 2004," on page 23.
2. Save the FLA file that you are working in. If you do not save the document, Flash does not try to establish a link between the FLA file and the class file.
3. Right-click the custom component's symbol name in the Library.
4. Select Component Definition.

   The Component Definition panel appears.
5. Enter the class name in the AS 2.0 Class text box. You must enter the fully qualified class name, if the class is in a package. Do not include the filename extension. For example, if the classname is MyComponent.as, enter **MyComponent**.
6. Click OK.

   Flash transforms the symbol into a component and populates the Parameters box with the component properties that are available in the class file and the classes from which your class inherits, as the following figure shows:



Exporting components

Flash MX 2004 exports components as component packages (SWC files). A SWC file contains all the code, SWF files, images, and metadata associated with the component, so you can easily add it to your Flex environment. When you distribute a component, you only need to give your users the SWC file.

SWC files are usually copied into a single directory for use in Flex or Flash, so each component must have a unique filename to prevent conflicts.

This section describes a SWC file and explains how to import and export SWC files in Flash.

About component files

When you create a new component with Flash MX 2004, you have a minimum of four files, as follows:

***.fla file** The Flash source file that contains the symbols and skins used by the component.

***.as file** The ActionScript source class file that defines the methods and properties of the component.

***.swc file** The compiled component file used by Flex.

***.mxml file** The Flex application file from which you invoke the component.

You must be sure to store the *.as and *.fla files in a separate directory from the *.swc and *.mxml files. The *.as and *.fla files should not be accessible by your users, and their presence in the same directory as the *.mxml file can cause problems with the ActionScript classpath.

About SWC files

A SWC file is a zip-like file that is generated by the Flash authoring tool, and packaged and expanded with the PKZip archive format. It contains everything that a component needs to run in the Flash or Flex environment.

The following table describes the contents of a SWC file:

File	Description
catalog.xml	(Required) Lists the contents of the component package and its individual components, and serves as a directory to the other files in the SWC file.
Source code	Contains one or more ActionScript files that contain a class declaration for the component. The source code is used only for type-checking when extending components, and is not compiled by the authoring tool because the compiled bytecode is already in the implementing SWF file. The source code might contain intrinsic class definitions that contain no function bodies and are provided only for type-checking.
Implementing SWF files	(Required) Implements the components. One or more components can be defined in a single SWF file. If the component is created with Flash MX 2004, only one component is exported per SWF file.
Live Preview SWF files	(Optional) Supports Live Preview in the authoring tool. If omitted, the implementing SWF files are used for Live Preview instead. You can omit the Live Preview SWF file in nearly all cases; include the file only if the component's appearance depends on dynamic data (for example, a text box that shows the result of a web service call).
Debug info	(Optional) Includes a SWD file corresponding to the implementing SWF file. The filename is always the same as that of the SWF file, but with the extension .swd. If it is included in the SWC file, debugging of the component is allowed. For more information, see "Including debugging information" on page 21.

File	Description
Icon	(Optional) Contains the 18 x 18, 8-bit-per-pixel icon used to display a component in the authoring tool user interface(s). If you don't supply an icon, a default icon appears (see "Adding an icon" on page 71). The icon must be a PNG file.
Property inspector	(Optional) Supports a custom Property inspector in the authoring tool. If omitted, the default Property inspector is displayed to the user.

Flex includes a single SWC file that contains all the built-in components. This SWC file is located in the *flex_app_root*/WEB-INF/flex/frameworks directory. In addition, you expanded a ZIP file containing all of the individual SWC files when you prepared the Flash environment in "Adding Flex classes and components to the Flash IDE" on page 8.

Viewing and changing SWC file contents

To view the contents of a SWC file, you can open it using any compression utility that supports PKZip format (including WinZip).

You can optionally include other files in the SWC file, after you generate it from the Flash environment. For example, you might want to include a Read Me file, usage instructions, or the FLA file, if you want users to have access to the component's source code.

Using SWC files

This section describes how to create and import SWC files. You should give instructions for importing SWC files to your component users, either as a separate set of instructions or as a Read Me file inside the SWC file.

Creating SWC files

Flash MX 2004 and Flash MX Professional 2004 create SWC files by exporting a component. When creating a SWC file, Flash reports compile-time errors as if you were testing a Flash application. This means that once a component is compiled as a SWC file, you can be reasonably certain that you will not encounter runtime errors, such as type mismatches.

Note: After you create a SWC file, you can rename the file, but the tag name you use in your MXML file must match the Linkage Identifier in the original FLA file (or the symbolName in the class file).

To export a SWC file:

1. Select a component in the Flash Library.
2. Right-click the item and select Export SWC File.
3. Save the SWC file.
4. (Optional) Postprocess the SWC file with the SWCRepair utility. This step is necessary only if your new custom component is a subclass of a component that was not included in Flash, but is included in Flex. For more information, see "Using the SWCRepair utility" on page 19.

Using the SWCRepair utility

If your new component extends a component that is not native to the Flash environment (but is instead in the Flex Components list), you must run the SWCRepair utility against the SWC file when you finish exporting it from Flash and before you use it in Flex. This applies mostly to containers, since they are not normally used in Flash.

The SWCRepair utility updates a Flash SWC file for use in Flex; the FlexforFlash.zip file includes the SWCRepair utility. This file is described in "Adding Flex classes and components to the Flash IDE" on page 8.

When you expand the FlexforFlash.zip file, the SWCRepair utility is expanded to *Flash_root*/en/First Run/SWCRepair/bin/. The default location is C:/Program Files/Macromedia/Flash MX 2004/en/First Run/SWCRepair/bin/SWCRepair.exe.

The SWCRepair utility has the following syntax:

```
SWCRepair SWC_filename [Flash_root/en/First Run/Components/Flex Components]
```

For example:

```
C:/Program Files/Macromedia/Flash MX 2004/en/First Run/SWCRepair/bin/
  SWCRepair.exe C:/myProjects/myComponent.SWC
```

The SWCRepair utility assumes that Flash is installed in C:/Program Files/Macromedia/Flash MX 2004. If this is not the actual path, a second argument to the program specifies the Flex Components directory. For example, if Flash is installed in D:/MM/Flash, you would run the SWCRepair utility as the following example shows:

```
D:/MM/Flash/en/First Run/SWCRepair/bin/SWCRepair.exe C:/myProjects/foo.swc
  "D:/MM/Flash/en/First Run/Components/Flex Components"
```

After you run the SWCRepair utility against a SWC file, check whether a log file was created. The log file name is the same as the SWC filename and appears in the same directory as the SWC file. For example, if the SWC file is C:/myProjects/foo.swc, the log file is C:/myProjects/foo.log.

If the SWCRepair utility does not generate a log file, check the program arguments and rerun the utility.

Adding SWC files to Flex

After you generate a SWC file, you must store it in a location that Flex can access so you can use the SWC file in your Flex applications.

To use a SWC file in your Flex application, save it to a directory defined by the `<compiler>` tag's `<lib-path>` child tag in the flex-config.xml file. The following example from the flex-config.xml file adds the /WEB-INF/flex/myswcs directory to the `<lib-path>` setting, in addition to the user_classes and frameworks directories:

```
<compiler>
  ...
  <lib-path>
    <path-element>/WEB-INF/flex/myswcs</path-element>
    <path-element>/WEB-INF/flex/user_classes</path-element>
    <path-element>/WEB-INF/flex/frameworks</path-element>
  </lib-path>
<compiler>
```

Note: You should not store custom SWC files in the /WEB-INF/flex/frameworks directory.

SWC files must be at the top level of the directory. You cannot put them in subdirectories, unless you explicitly define those subdirectories with the `<lib-path>` setting. The package information for the classes in the SWC file is internalized by the SWC file, so you are not required to mirror that package when referring to the SWC file.

You can also store your SWC file in the *flex_app_root*/WEB-INF/flex/user_classes directories.

If you export a new version of a SWC file from Flash to Flex, you do not have to restart Flex or close your browser. The Flex application recognizes that the SWC file was added or changed based on its timestamp, and reloads it in the client when the application refreshes the page.

To determine if a SWC is reloading properly, you can add the following arguments to the Flex J2EE server Java arguments. If you are using JRun, add these entries to the jvm.config file located in the *flex_root*/jrun4/bin directory.

```
-Dtrace.cache -Dtrace.swc
```

After restarting the Flex server, you see notifications from FileWatcherService as you modify your SWC file and then reload the MXML. The logging information indicates where the SWC file that Flex is loading is located on the Flex server's hard disk.

You can also verify that Flex is not loading older versions of SWC files from an unexpected location by setting the `<create-compile-report>` option to `true` in the flex-config.xml file, as the following example shows:

```
<debugging>
  <create-compile-report>true</create-compile-report>
  ...
</debugging>
```

Flex generates a file named *your_app*-report.xml in the same directory as your MXML file. This file contains the source location and timestamp of every symbol definition that went into the final SWF file.

Instantiating components in Flex

To use your component in your Flex applications, at a minimum you must declare a namespace and use a tag that matches the name of the component, as the following example shows:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns:my="*">
  <my:ModalText />
</mx:Application>
```

If you store the component in the same directory as the application, you can specify a global namespace and forego the tag prefix, as the following example shows:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*">
  <ModalText />
</mx:Application>
```

If the component's ActionScript classes are in a package, you must specify a namespace that points to that package in your MXML file, as the following example shows:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml"
  xmlns:myp="myPackage.*" >

  <myp:myComponent />

</mx:Application>
```

For more information on using namespaces for Flex components, see *Developing Flex Applications*.

To pass properties to the component, add them as tag properties, as the following example shows:

```
<ModalText labelPlacement="left"/>
```

You can instantiate a custom component by creating the component's class in ActionScript using the `createClassObject()` method:

```
<mx:Script>
<![CDATA[
  createClassObject(MyComponent, "myComp", 0, {myName:"Ted"});
]]>
</mx:Script>
```

The previous example is equivalent to the following MXML statement:

```
<MyComponent id="myComp" myName="Ted" />
```

Including debugging information

The SWD file contains debugging information for the SWF file. You must use SWD files to use the Debug Flash Player to debug your component. By default, Flash does not include debugging information when exporting the SWC file.

When you export a SWC file, you can include the SWD file in the SWC file by selecting Debugging Permitted in the Publish Settings dialog box. As with all settings in the Publish Settings dialog box, you must make this change for every FLA file. It is not a global setting.

Note: You should not include debugging information in your SWC file if the SWC file is used in a production environment. It increases the size of the SWC file and also makes debugging information available to users.

To include the SWD file in your SWC file:

1. Open your FLA file.
2. In the Flash environment, select File > Publish Settings.

   The Publish Settings dialog box appears.
3. Select the Debugging Permitted check box.
4. Click OK.
5. Save the FLA file.
6. Export the SWC file as described in "Creating SWC files" on page 18.

   Flash includes the SWD file with the other files in your SWC file.

Importing SWC files into the Flash IDE

SWC files are a convenient way to share components among Flash developers. After you create a SWC file, you can give that SWC component to anyone else with Flash and they can use your component in their applications. Flash authors can use custom SWC components as they would any other component in the Flash Library.

Note: After you create a SWC file, you can rename the file, but the tag name you use in your MXML file must match the Linkage Identifier in the original FLA file (or the symbolName in the class file).

When you distribute your components to other developers, you can include the following instructions so that they can install and use them immediately.

To use a SWC file in the Flash authoring environment:

1. Copy the SWC file into the *Flash_root*/en/First Run/Components directory.
2. Start the Flash authoring environment or reload the Components panel if it was already running. To reload the component list on the Components panel, click the menu button and select Reload.

   The component's icon appears in the Components panel. You can now use the component as if it were any of the built-in components.

CHAPTER 2
Creating Basic Components in Flash MX 2004

This chapter includes a set of simple examples that illustrate the basics of component development. The first part of the chapter introduces the Green Square, Orange Circle, and Blue Button components, which illustrate simple component construction and usage. The latter part of the chapter expands on the simple components and describes how to use event handling, styling, skinning, and other techniques when creating your components.

If you are unfamiliar with working in the Macromedia Flash environment, see Chapter 1, "Working with Flash MX 2004," on page 5. For more advanced information on creating components, see Chapter 3, "Creating Advanced Components in Flash MX 2004," on page 45.

Contents

Creating simple components

This section describes how to create simple components in Macromedia Flash for Macromedia Flex. As with creating any Hello World–style example, these procedures ignore some practices to help new component developers quickly achieve success and begin creating components.

This section describes how to create the following components:

Green Square Create a component that exists in a flat namespace. This component's ActionScript class file is not part of a package.

Orange Circle Create a component that exists in a package. By developing this component, you learn how to work in a namespace that uses packaged classes.

Blue Button Create a component that extends an existing visual component.

These components illustrate the basic concepts of component creation. Building the components also shows you the minimum requirements for creating a custom visual component in Flash for use in Flex. For detailed information about building more complex components, see Chapter 3, "Creating Advanced Components in Flash MX 2004," on page 45.

Creating the Green Square

Creating the Green Square is similar to creating a Hello World component, but because this is Flash, the simplest example creates a visual component rather than printing the words "Hello World".

The Green Square component prints a shape on the screen. The shape is green and square.

To create the Green Square:

1. Set up the Flash environment by adding the Flex components and class files. For more information, see "Adding Flex classes and components to the Flash IDE" on page 8.
2. In Flash, create a new FLA file.
3. Edit the FLA file's local classpath settings to include the following two classpath entries:
   - $(LocalData)/Flex Classes
   - . (the dot)

   For more information, see "Changing the Flash classpath" on page 10.
4. Draw a green square on the Stage. Make sure that the origin indicator (or registration point) is at the top left corner.
5. Save the FLA file as greensquare.fla.
6. Open a text editor and create a file called greensquare.as. Save the ActionScript file in the same directory as the greensquare.fla file. This should be a directory that is not in the web application's directory structure, since these are source files for your eventual component. Furthermore, it cannot be the same directory into which you deploy the SWC file and the MXML file.
7. Add the following code to the greensquare.as file:

```
class greensquare extends mx.core.UIObject {

  static var symbolName:String="greensquare";

  static var symbolOwner:Object = greensquare;

  var className:String = "greensquare";

  function greensquare() { //empty constructor
  }

  function init() {
```

```
        super.init();
        invalidate(); // Required call so that Flex draws the component.
    }

}
```

8. Return to the Flash environment. Right-click the square and select Convert to Symbol.

   The Convert To Symbol dialog box appears.

9. In the Convert to Symbol dialog box, set the Name, Identifier, and AS 2.0 Class fields to **greensquare**. To access the Identifier and AS 2.0 Class fields, you must select the Export for ActionScript check box.

10. Click OK.

    Flash adds the greensquare symbol to the Library as a Movie Clip.

11. Convert the symbol to a component by right-clicking the symbol in the Flash Library and selecting Component Definition.

12. In the Component Definition dialog box, set the AS 2.0 Class field to **greensquare**.

13. Right-click the symbol in the Flash Library and select Export SWC File.

    The Export File dialog box appears.

14. Save the new SWC file as greensquare.swc.

15. In a text editor, create a new MXML file that contains the following code:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*">

  <greensquare/>

</mx:Application>
```

16. Save the MXML file as greentest.mxml. You cannot name the file greensquare.mxml. You must give it a name that is different from the component's name, such as greentest.mxml.

17. Copy the SWC component you created (greensquare.swc) to the same directory as the MXML file. This should not be the same directory into which you saved the ActionScript and FLA files. This directory must be in the web application's directory structure so that Flex can compile a SWF from the MXML file.

18. Request the MXML file in your browser or a stand-alone Flash Player. A green square should appear.

Creating the Orange Circle

This section describes how to create the Orange Circle component. This component is different from the Green Square because its ActionScript class file exists in a package. As a result, there are additional steps that you must take to build it in Flash, and then refer to it in your MXML file.

The Orange Circle component prints a shape on the screen. The shape is orange and circular.

To create the Orange Circle:

1. Set up the Flash environment by adding the Flex components and class files. For more information, see "Adding Flex classes and components to the Flash IDE" on page 8.
2. In Flash, create a new FLA file.
3. Edit the FLA file's local classpath settings to include the following two classpath entries:
   - $(LocalData)/Flex Classes
   - . (the dot)

   For more information, see "Changing the Flash classpath" on page 10.
4. Draw an orange circle on the Flash Stage and save the FLA file as orangecircle.fla.
5. Create a file in a text editor and add the following code to it:

```
class myPackage.orangecircle extends mx.core.UIObject {

  static var symbolName:String="myPackage.orangecircle";

  static var symbolOwner:Object = myPackage.orangecircle;

  var className:String="orangecircle";

  function orangecircle() { // Empty constructor.
  }

  function init() {
    super.init();
    invalidate(); // Required call so that Flex draws the component.
  }

}
```

6. Save the text file as orangecircle.as in the myPackage subdirectory, below the directory in which the FLA file is stored. This should be a directory that is not in the web application's directory structure, since these are source files for your eventual component. Furthermore, it cannot be the same directory into which you deploy the SWC file and the MXML file.

   The files you are using now should be in the following locations:

```
../orangecircle.fla
../myPackage/orangecircle.as
```

7. Return to the Flash environment. Right-click the circle on the Stage, and select Convert to Symbol.
8. In the Convert to Symbol dialog box, set the Name field to **orangecircle**.
9. Enter **myPackage.orangecircle** in the AS 2.0 Class and Identifier text boxes.
10. Click OK.

    Flash adds the orange circle symbol to the Library.
11. Convert the symbol to a component by right-clicking the symbol in the Flash Library and selecting Component Definition.
12. In the Component Definition dialog box, set the AS2.0 Class field to **myPackage.orangecircle**.

13. Right-click the symbol in the Flash Library and select Export SWC File.
14. Save the new SWC file as orangecircle.swc.
15. In a text editor, create an MXML file that contains the following code:

```
<?xml version="1.0"?>

<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml"
  xmlns:myp="myPackage.*" >

  <myp:orangecircle />

</mx:Application>
```

    You must add a namespace declaration that includes the package whenever you access a component that uses ActionScript files in packages.

    You cannot name the file orangecircle.mxml. You must give it a name that is different from the component's name, such as oc.mxml.
16. Save the MXML file.
17. Copy the SWC file that you created (orangecircle.swc) to the same directory as the MXML file. This should not be the same directory in which you saved the ActionScript and FLA file. This directory must be in the web application's directory structure, so that Flex can compile a SWF from the MXML file.
18. Request the MXML file in your browser or a stand-alone Flash Player. An orange circle should appear.

Creating the Blue Button

This procedure shows you how to extend an existing Flex control. In this example, it is a button. The button's border and text are blue. When you insert the Blue Button component into your Flex application, it inherits all of the events, behaviors, and capabilities of a standard Button control, but it has a customized style.

To create the Blue Button:

1. Set up the Flash environment by adding the Flex components and class files. For more information, see "Adding Flex classes and components to the Flash IDE" on page 8.
2. In Flash, create a FLA file.
3. Edit the FLA file's local classpath settings to include the following two classpath entries:
    - $(LocalData)/Flex Classes
    - . (the dot)

    For more information, see "Changing the Flash classpath" on page 10.
4. Select Insert > New Symbol.

    The Create New Symbol dialog box appears.

    Rather than convert existing graphical assets to a symbol, you create a symbol and add dependent components to it as assets.

5. In the Create New Symbol dialog box, perform the following steps:
   a. Enter **BlueButton** in the Name field.
   b. Enter **BlueButton** in the Identifier field.
   c. Enter **BlueButton** in the AS2.0 Class field.

   To access the Identifier and AS 2.0 Class field, you must select the Export for ActionScript check box.
6. Click OK.
7. Save the FLA file as BlueButton.fla.
8. Open a text editor and create a file called BlueButton.as. Save the ActionScript file in the same directory as the BlueButton.fla file. This should be a directory that is not in the web application's directory structure, since these are source files for your eventual component. Furthermore, it cannot be the same directory into which you deploy the SWC file and the MXML file.
9. Add the following code to the BlueButton.as file:

```
class BlueButton extends mx.controls.Button {
  static var symbolName:String="BlueButton";
  static var symbolOwner:Object = BlueButton;
  var className:String = "BlueButton";

  function BlueButton() {
  }

  function init() {
    //Set the label text to blue.
    setStyle("color", 0x6666CC);

    super.init();
    invalidate();
  }
}
```

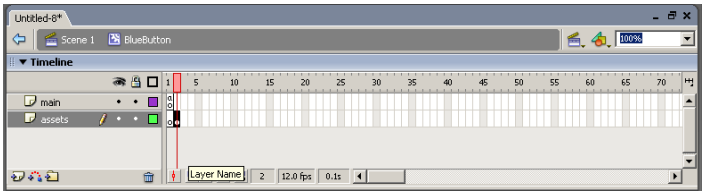
   This script extends the mx.controls.Button class rather than the base classes (UIObject or UIComponent). As a result, it inherits all the skins, styles, behaviors, and events of the Button control.

   It also calls the UIObject `setStyle()` method and sets the values of the `color` property to a hexadecimal equivalent of the color blue. When setting colors in `setStyle()` method calls, you must use the hexadecimal values for the value and surround the property name with quotation marks.
10. Return to the Flash environment and enter Edit Symbols mode to edit the BlueButton symbol.
11. Rename the existing layer **main**.
12. Add the following line to the main layer's first frame:

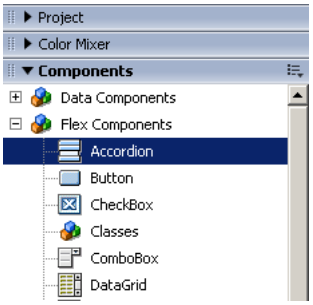
```
stop();
```

13. Add a new layer called **assets**.

14. Insert a blank keyframe in the second frame of the assets layer by selecting the frame, and then selecting Insert > Timeline > Blank Keyframe. The following figure shows the layers for the BlueButton symbol:



15. Find the Button control in the Flex Components list:



If you do not see the Flex Components listed in the Components panel, see "Adding Flex classes and components to the Flash IDE" on page 8.

16. Drag the Button control from the Flex Components list onto the second frame of the assets layer.

Flash adds the Button to the Library as a Compiled Clip asset.

17. Right-click the BlueButton movie clip in the Library and select Component Definition.
18. In the Component Definition dialog box, set the AS2.0 Class field to **BlueButton**.
19. Click OK.

Flash converts the symbol to a component.

20. Right-click the component in the Flash Library and select Export SWC File.
21. Save the new SWC file as BlueButton.swc.
22. In a text editor, create a new MXML file that contains the following code:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*">

  <BlueButton label="Blue Button" />

</mx:Application>
```

23. Copy the SWC file that you created (BlueButton.swc) to the same directory as the MXML file. This should not be the same directory into which you saved the ActionScript and FLA file. This directory must be in the web application's directory structure so that Flex can compile a SWF from the MXML file.
24. Request the MXML file in your browser or a stand-alone Flash Player. The blue button should appear.

Working with component properties

Most components have instance properties that the Flex author can set while adding the component to the application. To make this possible, you add properties to the class definition. You can set all component properties as properties in MXML and in ActionScript, unless they are explicitly marked private.

You can expose component properties by doing the following:

- Creating an instance variable
- Defining getters and setters

These methods are described in the following sections.

Creating an instance variable

Creating instance variables is simple. In the component's ActionScript class file, you declare a variable:

```
var myName:String;
```

If the variable declaration does not specify a default value, your code must either take into account that *myName* might be `undefined`, or the user could encounter unexpected results.

In MXML, you set that property using a tag property:

```
<MyComponent myName="Ted" />
```

As a result, you should define a default value for most regular properties, as the following example shows:

```
var myName:String = "Fred";
```

You can use the Inspectable keyword to set the default value of a property and to limit the available values for the property; for example:

```
[Inspectable(defaultValue="left", enumeration="left, right")]
function set labelPlacement(p:String)
...
```

In this example, the `labelPlacement` property is limited to the values `left` or `right`, and the default value is `left`. For more information on using the Inspectable keyword, see "Inspectable" on page 63. The ModalText example class file shows the use of the Inspectable keyword. For more information, see "Using the ModalText example" on page 73.

Defining getters and setters

The recommended way of exposing properties in your class file is with a pair of getters and setters. These functions must be public. The advantage of getters and setters is that you can calculate the return value in a single place and trigger events when the variable changes.

You define getter and setter functions using the get and set method properties within a class definition block.

The following example declares a getter and setter for the `myName` variable:

```
private var _myName:String = "Fred";

public function get myName():String {
  return _myName;
}
public function set myName(name:String) {
  _myName = name;
}
```

The local value of `_myName` is private, while the getter and setter methods are public.

In getters and setters, you cannot use the same name of the property in the function name. As a result, you should use some convention, such as prefixing the member name with an underscore character (_).

Binding properties to a custom component

Most properties should be bindable so that developers can use the contents of your component as parameters to a web service call or to update the UI. The simplest form of binding is to use the curly braces ({ }) syntax that binds a property of a control to another control's property. In the component's ActionScript class, you can declare a variable as follows:

```
var myName:String = "Fred";
```

In your MXML file, you then bind the value of a control's property to the component's property, as the following example shows:

```
<MyComponent id="myComp1" name="Fred" />
<mx:TextArea text="{myComp1.myName}" />
```

Although it is sometimes useful, this simple binding technique does not fully take advantage of the capabilities of binding. If the user changes the value of the MyComponent `myName` property, the TextArea component is not notified. To keep the two synchronized, the MXML author must write code that stores and periodically compares the two values.

With a little modification, the component's class file can support dynamic binding so that whenever the component's property changes, the Flex control reflects that change.

To be dynamically bindable, a property must dispatch an event when it is changed. The main property of a component often dispatches either a `change` or `click` event when it is accessed, but you can use any event.

Add the ChangeEvent metadata keyword to the getter, and a `dispatchEvent()` method call inside the setter. When the property's value is set, the component dispatches the `change` event. Since the getter is bound to the ChangeEvent `change`, the binding subsystem knows what to listen for when that property changes.

At the top of the class file, you must also add the Event metadata keyword to identify `change` as an event that this component emits.

The following ActionScript class file shows how to bind a property to an event:

```
[Event("change")]
class BindChar extends mx.core.UIComponent {
  static var symbolName:String="BindChar";
  static var symbolOwner:Object = BindChar;
  var className:String = "BindChar";

  function BindChar() {
  }

  // This example uses a TextField to store and display the character.
  var myCharField:TextField;

  function init() {
    super.init();
    tabEnabled = true;
    invalidate();
  }

  function keyDown(evt:Object):Void {
    //Triggers the setter on every keystroke.
    char = String.fromCharCode(evt.ascii);
  }

  [ChangeEvent("change")]
  public function get char():String {
    return myCharField.text;
  }

  public function set char(c:String) {
    myCharField.text = c;
    dispatchEvent({ type: "change" });
  }
}
```

The following MXML file binds the component's `char` property to the TextArea control's `text` property:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*" >

  <BindChar id="myComp1" char="F" />

  <mx:TextArea id="ta1" text="{myComp1.char}" />

</mx:Application>
```

If your custom SWC file has properties typed Array, do not use data binding to supply initial values for array properties. For example, if your custom SWC file has a `labels` property that is typed Array, do not use data binding in the MXML as the following example shows:

```
<yourSWC labels={myArray}/>

<mx:Script>
<![CDATA[
  var myArray=["cat", "dog", "bird"];
]]>
</mx:Script>
```

The problem is that Flex instantiates the SWC file before data binding occurs. Instead, you define the array using the `<mx:Array>` tag, as the following example shows:

```
<yourSWC>
  <labels>
  <mx:Array>
    <mx:String>cat</mx:String>
    <mx:String>dog</mx:String>
    <mx:String>bird</mx:String>
  </mx:Array>
  </labels>
</yourSWC>
```

Adding events to custom components

All visual controls inherit a large set of events from the base classes, UIObject and UIComponent. From the UIComponent class, components inherit events such as `focusIn`, `focusOut`, `keyDown`, and `keyUp`. From the UIObject class, components inherit events such as `mouseDown`, `mouseUp`, `mouseOver`, and `mouseOut`. For a complete list of UIObject and UIComponent events, see *Developing Flex Applications*.

Components can emit and consume events. In most cases, you want your component to emit an event and the MXML application to consume and handle it.

Custom components that extend existing Flex classes inherit those events. For example, if you extend the mx.controls.Button class, you have the set of click-related events at your disposal, in addition to the events that all controls inherit, such as `mouseOver` and `mouseDown`.

This section describes how to add event handling and emitting functionality to your custom components.

Handling the initialize event

When Flex finishes creating a component, it emits the component's `initialize` event. This event is used by MXML developers to populate data, debug, or perform some other function before the user starts interacting with the application.

Because nearly all classes extend the UIObject class, the `initialize` event is already supported in custom components. To define a handler for it, you add the `initialize` property to the component's MXML tag, and then add ActionScript code that processes the event, as the following example shows:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*">

  <mx:Script>
  <![CDATA[
  function myInit() {
    trace('init greensquare');
  }
  ]]>
  </mx:Script>

  <greensquare initialize="myInit();" />

</mx:Application>
```

Handling mouse events

All visual components that inherit from the UIObject class support a number of navigational mouse events, including the following:

- `mouseOver`
- `mouseOut`
- `mouseDown`
- `mouseUp`

These events do not include the `click` event. For a complete list of events supported by visual components, see the information about the control in *Developing Flex Applications*.

To use the common mouse events, you point to a handler in your MXML file. You do not need to add any additional code to the component source code.

The following example changes the alpha (transparency) of the Green Square component when the mouse moves over the component, and again when the mouse moves away from the component:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*">
  <mx:Script>
  <![CDATA[
  var startAlpha:Number = 40;

  function myInit() {
    myGS.alpha=startAlpha;
  }

  function changeAlpha(curAlpha:Number) {
    myGS.alpha=curAlpha;
  }
```

```
    ]]>
    </mx:Script>

    <greensquare id="myGS" mouseOver="changeAlpha(100);"
    mouseOut="changeAlpha(startAlpha);" />

</mx:Application>
```

To handle an event that is not supported by the current parent class, such as a `click` event on a UIObject, you must edit the component class file. However, to add a `click` event to your component, it is sometimes easier to extend the Button or SimpleButton class than it is to write the code to support a `click` event.

For information on defining new events and event handlers for your custom component, see "Emitting events" next.

Emitting events

You can define an event that is not inherited from the component's parent class, such as a click for a control that is not a subclass of the Button class. In the following example, Flex throws an error because the Green Square component does not emit a `click` event:

```
<greensquare id="myGS" click="changeAlpha(0);" />
```

If you try to use a click handler in the MXML file, you get an error similar to the following:

```
Error: unknown attribute 'click' on greensquare
```

This means that you have to go back to the component's ActionScript class and tell the component to emit a `click` event. You do this by adding a call to `dispatchEvent()` in the component's ActionScript class file. You must also include the Event metadata keyword so that Flex recognizes the dispatched event. For more information on the `dispatchEvent()` method, see *Developing Flex Applications*.

The following example adds a metadata keyword identifying `click` as an event that this component can emit, and then dispatches the `click` event when the `onRelease()` method is triggered. In this case, the `click` event causes a change in the instance's `alpha` property.

```
[Event("click")]
class greensquare extends mx.core.UIObject {

  static var symbolName:String="greensquare";
  static var symbolOwner:Object = greensquare;
  var className:String = "greensquare";

  function greensquare() {
  }

  function init() {
    super.init();
    invalidate();
  }

  function onRelease(Void):Void {
    dispatchEvent({ type: "click" });
```

```
  }
}
```

The following MXML file handles the `click` event within an `<mx:Script>` block:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*"
  initialize="createListener();" >

  <mx:Script>
  <![CDATA[
  var startAlpha:Number = 40;
  var curState:Number = 100;

  function myInit() {
    myGS.alpha=startAlpha;
  }

  function modAlpha(curAlpha:Number) {
    gs.alpha=curAlpha;
    if (curState==100) {
      curState=40;
    } else {
      curState=100;
    }
  }
  ]]>
  </mx:Script>

  <greensquare id="gs" initialize="myInit();" click="modAlpha(curState);" />

</mx:Application>
```

For an example of a custom component that emits and handles its events, see "Creating compound components" on page 42.

Handling keyboard events

Keyboard events are emitted by all components that extend the UIComponent class. To make use of keyboard events in your MXML files, you should capture the keys and include the value of the key in your event object, and then dispatch the keyboard event with the event object.

The following component class emits the `keyDown` event so that the Flex application can handle it. It builds an event object, adding the ASCII value of the key that the user pressed as the `myKey` property of the event object. The class extends the UIComponent class but not the UIObject class, which does not handle this event.

```
[Event("mykeydown")]
class greensquare extends mx.core.UIComponent {
  static var symbolName:String="greensquare";
  static var symbolOwner:Object = greensquare;
  var className:String = "greensquare";

  function greensquare() {
  }
```

```
  function init() {
    super.init();
    tabEnabled = true;
    invalidate();
  }

  function keyDown(Void):Void {
    var k = Key.getCode();
    trace("key: " + k);
    dispatchEvent({type:"mykeydown", myKey:k});
  }
}
```

The following MXML file handles the keyboard event that the class file emits. The MXML file inspects the event object's `myKey` property to determine which key the user pressed.

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*">

  <mx:Script>
  <![CDATA[
  function handleKeyDown(evt) {
    if (evt.myKey == 8) {  // backspace
      ta1.text = "";
    } else {
      ta1.text='pressed: ' + evt.myKey;
    }
  }
  ]]>
  </mx:Script>

  <greensquare id="myGS" mykeydown="handleKeyDown(event);" />

  <mx:TextArea id="ta1" text="" />

</mx:Application>
```

Setting default sizes

You can set the default size of a custom component by setting the values of the `_measuredPreferredWidth` and `_measuredPreferredHeight` properties in the `measure()` method. These values will be used if no explicit width and height are specified in the component's MXML tag. Your measure function should not set the `preferredWidth` and `preferredHeight` properties.

The following class sets the default size of the BlueButton control to 500 by 200 pixels, and uses the `setStyle()` method to define the default `fontSize` property for the button's label:

```
class BlueButton extends mx.controls.Button {
  static var symbolName:String="BlueButton";
  static var symbolOwner:Object = BlueButton;
  var className:String = "BlueButton";

  function BlueButton() {
```

```
  }

  function init() {
    setStyle("fontSize", 24);
    super.init();
    invalidate();
  }

  function measure() {
    _measuredPreferredWidth=500;
    _measuredPreferredHeight=200;
  }
}
```

The following MXML file instantiates the BlueButton control. All instances of this BlueButton control have a default size of 500 by 200 pixels, with a label `fontSize` of 24.

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns=”*” >

<BlueButton label="My Big Button" />

</mx:Application>
```

You can override custom style settings in the MXML file, as the following example shows:

```
<BlueButton label="My Big Button" fontSize="12" />
```

Styling custom components

Style properties define the look of a component, from the size of the fonts used to the color of the background. To change style properties in custom components, use the `setStyle()` method in the component's `init()` function. This applies the same style to all instances of the component, but Flex application authors can override the settings of the `setStyle()` method in their MXML tags. Any style properties that are not explicitly set in the component's class file are inherited from the component's superclass.

This section includes a class file that extends an existing control. For more information on setting up the Flash environment and exporting this custom component as a SWC file, see “Creating the Blue Button” on page 27.

The following ActionScript class file sets the `color` and `themeColor` styles of the BlueButton control:

```
class BlueButton extends mx.controls.Button {
  static var symbolName:String="BlueButton";
  static var symbolOwner:Object = BlueButton;
  var className:String = "BlueButton";

  function BlueButton() {
  }

  function init() {

    // Set the label text to blue.
```

```
        setStyle("color", 0x6666CC);

        // Set the background and border to blue when mouse hovers over control.
        setStyle("themeColor", 0x6666CC);

          super.init();
          invalidate();
        }
}
```

The following MXML file instantiates the BlueButton control without overriding the default styles set in the component's class file:

```
<?xml version="1.0"?>

<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*" >

  <BlueButton label="Blue Button" />

</mx:Application>
```

In addition to setting the color property, you can set the font face, font size, and other style properties. For more information on the available style properties, see *Developing Flex Applications*.

Skinning custom components

When you extend an existing visual control, you can include additional graphics inside the SWC file and instruct the new control to use these graphical assets to represent its appearance. The process of changing the appearance of a control is called *skinning*. Skins can be any kind of graphic that Flash supports, from a simple line drawing to a multipart SWF file.

To skin a component, you start with a FLA file, just as you would when creating any new component. However, you add a new symbol to the FLA file that defines the skin in addition to the component's symbol itself.

The following table describes the general structure of a FLA file that includes new skins for the component:

Name	Frame	Description
Main	Layer 1 Frame 1	The top level of the FLA file, which contains a single blank frame.
Symbol: custom component	Layer 1 Frame 1	First layer, named main, with an ActionScript `stop()` statement.
	Layer 2 Frame 1	Empty.
	Layer 2 Frame 2	Second layer, named assets, which contains the skin symbol plus any additional graphical assets used by this component.
Symbol: skin graphics	Layer 1 Frame 1-x	The new symbol, which contains as many frames as are necessary to represent the new skin. For a simple, static graphic, you can draw the new skin on a single frame.

In the component's class file, you must also override the name of the skin. Macromedia recommends that you apply the skin to your component as a clip parameter in the `constructObject2()` method rather than rely on the timing of the instantiation process. This is especially true when the component creates child components that rely on the positioning of the skin.

You can override some or all of the control's skins. For example, the Button control has the following basic skins, each representing a state of the control:

- `falseUpSkin`
- `falseDownSkin`
- `falseOverSkin`
- `falseDisabledSkin`
- `trueUpSkin`
- `trueDownSkin`
- `trueOverSkin`
- `trueDisabledSkin`

Each state is represented as a variable in the class file, or is an inherited variable. By setting the value of one of these variables, you instruct Flex to apply a new skin, using the symbol name to find the skin.

When you add a new skin, it should respond to resizing and drawing methods of the component. For a list of what skins are used by what controls, see each control's entry in *Developing Flex Applications*.

This section describes a simple method for changing the skin for one of the states of the standard Button control. You can use the steps in this procedure to change the skin for any visual control in Flex.

To create a custom component with a different skin:

1. In the Flash environment, create a FLA file and set the classpath settings to include the Flex classes and the local directory. For more information, see "Changing the Flash classpath" on page 10.
2. Insert a new symbol by selecting Insert > New Symbol. The Create New Symbol dialog box appears. This new symbol will be the new component.
3. In the Create New Symbol dialog box, do the following:
   a. Select the MovieClip for Behavior option (the default).
   b. Select the Export for ActionScript check box.
   c. Enter the appropriate name, identifier, and class file in the Name, Identifier, and AS 2.0 Class fields.
   d. Clear the Export in First Frame check box.
4. In Edit Symbols mode for the new symbol, rename the Timeline's first layer to **main**, and add a `stop()` action in the Actions Frame.

5. Add a second layer called **assets**, and add a second blank keyframe to this layer.
6. Return to the main FLA file.
7. Insert a new symbol by selecting Insert > New Symbol. The Create New Symbol dialog box appears. This new symbol will be the new skin.
8. In the Create New Symbol dialog box, do the following:
   a. Select the MovieClip for Behavior option (the default).
   b. Select the Export for ActionScript check box.
   c. Enter a symbol Name.

      Do not specify an AS 2.0 Class name or an Identifier for this symbol. For more information on creating a new symbol, see "Adding new symbols" on page 12.
   d. Clear the Export in First Frame check box.
9. Draw the new skin on the second symbol's Stage in Edit Symbols mode. The new skin can be a simple graphic or a composite of MovieClips.
10. Return to Edit Symbols mode and edit the component's symbol (the first symbol you created).
11. Drag the skin symbol you created onto the second frame of the component's assets layer.
12. Create a new ActionScript class file. In this file, extend the existing control, set the value of the skin to the new skin name, and apply the skin as a clip parameter in the `constructObject2()` method.

    The following example overrides the `falseUpSkin` skin with the symbol named redbox in a new Button control called SkinnedButton:

```
class SkinnedButton extends mx.controls.Button {

  // Set the value of the falseUpSkin state to the new skin.
  var falseUpSkin:String = "redbox";

  static var symbolName:String="SkinnedButton";
  static var symbolOwner:Object = SkinnedButton;
  var className:String = "SkinnedButton";

  function SkinnedButton() {
  }

  function init() {
    super.init();
    invalidate();
  }

  static var clipParameters:Object = { redbox:1 };

  function constructObject2(o:Object):Void {
    super.constructObject2(o);
    applyProperties(o, SkinnedButton.clipParameters);
  }
}
```

13. Right-click the component's symbol in the Library and select Component Definition. In the AS 2.0 Class field, enter the class name.
14. Export the SWC file. For more information, see "Creating SWC files" on page 18.
15. Add the new component to an MXML file and request that file to see the new skin.

    If the skin is not positioned properly on the Stage, you can rearrange it by returning to the FLA file and editing the skin's symbol.

Creating compound components

Compound components are components that include the assets of multiple controls inside them. They might be graphical assets or a combination of graphical assets and classes. For example, you can create a component that includes a button and a text field, or a component that includes a button, a text field, and a validator.

When you create compound components, you should instantiate the controls inside the component's class file. Assuming that some of these controls have graphical assets, you must plan the layout of the controls that you are including, and set properties such as default values in your class file. You must also ensure that you import all the necessary classes that the compound component uses.

Since the class extends one of the base classes, such as mx.core.UIComponent, and not a controls class like mx.controls.Button, you must instantiate each of the controls as children of the custom component and arrange them on the screen.

Properties of the individual controls are not accessible from the MXML author's environment unless you design your class to allow this. For example, if you create a new component that extends the UIComponent class and uses a Button and a TextArea component, you cannot set the label text in the MXML tag because you do not directly extend the Button class.

To instantiate controls inside your compound component, use the `createClassObject()` method inside the `createChildren()` method. For more information, see "Implementing the createChildren() method" on page 54.

This section uses an example component, called CompoundComponent, that combines a Button control and a TextArea control. It handles the `click` event of the Button control and writes a message to the TextArea control.

Since this component handles events (and doesn't just emit them), it includes an event listener and an event handler in the class file.

The `layoutChildren()` method handles the layout of the controls inside the component. This method calls the control's `move()` method to arrange the Button control centered below the TextArea control. The values passed to the `move()` method are relative to the registration point in the FLA file. This appears in the Flash Stage as a "+".

Another example of a compound component is ModalText, which uses a TextInput control and a SimpleButton control. For more information, see "Using the ModalText example" on page 73.

The following ActionScript class file creates a component that instantiates TextArea and Button controls:

```
// Import all necessary classes.
import mx.core.UIComponent;
import mx.controls.Button;
import mx.controls.TextArea;

[Event("click")]
class CompoundComponent extends UIComponent {
  static var symbolName:String="CompoundComponent";
  static var symbolOwner:Object = CompoundComponent;
  var className:String = "CompoundComponent";

  function CompoundComponent() {
  }

  function init() {
    super.init();
    invalidate();
  }

  // Declare two children member variables.
  var text_mc:TextArea;
  var mode_mc:Button;

  function createChildren():Void {
    if (mode_mc == undefined)
      createClassObject(Button, "mode_mc", 1, { });
    if (text_mc == undefined)
      createClassObject(TextArea, "text_mc", 0, { preferredWidth: 150,
  editable: false });

    mode_mc.addEventListener("click", this);
    mode_mc.label = "Click Me";
  }

  function layoutChildren():Void {
    mode_mc.move(text_mc.width/2-5, 50);
  }

  // Handle events that are dispatched by the children.
  function handleEvent(evt:Object):Void {
    if (evt.type == "click")
      text_mc.text = "the button was clicked";
  }
}
```

CHAPTER 3
Creating Advanced Components in Flash MX 2004

This chapter describes the details of creating visual, interactive components in the Macromedia Flash MX 2004 workspace for use in Macromedia Flex applications. The majority of the work is in writing the ActionScript class file, which derives from Flex existing classes, and adding your own custom functionality.

For a set of simple examples that show the basics of component development, see Chapter 2, "Creating Basic Components in Flash MX 2004," on page 23. If you are unfamiliar with working in the Flash environment, see Chapter 1, "Working with Flash MX 2004," on page 5.

Contents

About Creating components

This section describes the general process for creating a component that extends an existing Flash MX 2004 class. If you want to create a component that is based on the Button control, for example, you can subclass the mx.controls.Button class. However, if you want to invent your own component, you will likely extend either the mx.core.UIComponent or mx.core.UIObject class. Choosing one of these base classes is discussed later, but Macromedia recommends that most custom components extend the UIComponent class rather than the UIObject class.

The *process of* creating a Flex component in Flash is different from the one for creating general-use Flash components. It is possible, and even desirable, to create components that operate in both environments; however, there are certain optimizations available to Flex applications that require that components behave in a more sophisticated manner.

Flex components are different from Flash components in that Flex does not expose the Timeline, which means that the infrastructure can have more control over how components are instantiated. In addition, Flex does not have a Stage with objects.

Use the following general process for creating a new Flex component in Flash:

1. Create a symbol and add assets in the FLA file.
   a. Insert a new symbol onto the Flash Stage and convert it to a component.
   b. Add dependent components to the new symbol.
2. Create an ActionScript class file.
   a. Extend one of the base classes (UIObject or UIComponent) or another component.
   b. Specify `symbolName`, `symbolOwner`, and `className`.
   c. Specify properties that can be set using an MXML tag property (clip parameters).
   d. Implement the `constructObject2()` method.
   e. Implement the `init()` method.
   f. Implement the `createChildren()` method.
   g. Implement the `measure()` method.
   h. Implement the `layoutChildren()` method.
   i. Implement the `draw()` method.
   j. Add properties, methods, and metadata.
3. Link the class file to the FLA file.
4. Generate a SWC file.

Writing the component's ActionScript code

Most components include some ActionScript code. When you create a component symbol that derives from a parent class, you link the symbol to an external ActionScript 2.0 class file. (For information on defining this file, see "Working with component symbols" on page 12.)

The external ActionScript class extends another class, adds methods, adds getters and setters, and defines events and event handlers for the component. When you extend an existing component class, you can inherit from only one class. ActionScript 2.0 does not allow multiple inheritance.

To edit ActionScript class files, you can use Flash, any text editor, or an Integrated Development Environment (IDE).

Simple example of a class file

The following is a simple example of a class file called MyComponent.as. If you were creating this component, you would link this file to the component in the Flash IDE.

This example contains a minimal set of imports, methods, and declarations for a component that inherits from the UIObject class.

```
//Import packages.
import mx.core.UIObject;

//Declare the class and extend from the parent class.
class myPackage.MyComponent extends UIObject {

  // Identify the symbol name that this class is bound to.
  static var symbolName:String = "myPackage.MyComponent";

  // Identify the fully qualified package name of the symbol owner.
  static var symbolOwner:Object = Object(myPackage.MyComponent);

  // Provide the className variable.
  var className:String = "MyComponent";

  // Define an empty constructor.
  function MyComponent() {
  }

  // Override the init method, and call the parent's init method.
  function init(Void):Void {
    super.init();

    // Call invalidate() to display graphics.
    invalidate();
  }

}
```

General process for writing a class file

Use the following general process when you write a component's ActionScript class file. Depending on the type of component that you create, whether you override any of the superclass's methods is optional. For the simplest form of component, you are not required to implement any of these methods.

To write the ActionScript file for a component:

1. Select and extend a parent class.
2. Define the `symbolName`, `symbolOwner`, and `className` properties.
3. Write an empty class constructor.
4. Specify properties that can be set using an MXML tag property (clip parameters).
5. Implement the `constructObject2()` method.
6. Implement the `init()` method.

7. Implement the `createChildren()` method.
8. Implement the `measure()` method.
9. Implement the `layoutChildren()` method.
10. Implement the `draw()` method.
11. Add properties, methods, and metadata.

The ordering of methods that you implement in this process mirrors that in the component instantiation life cycle. By understanding which methods are called and in what order, you can better understand how you write a component's class file. For more information, see "About the component instantiation life cycle" on page 51.

Each of the steps in this process is covered in more detail in the remainder of this chapter.

Selecting a parent class

Most components share some common behavior and functionality. Flash includes two base classes to supply this commonality: UIObject and UIComponent. By extending these classes, your components have a basic set of methods, properties, and events.

Note: Macromedia recommends that you base your components on the UIComponent class rather than the UIObject class. The UIComponent class provides more built-in functionality, but maintains the flexibility of extending the UIObject class.

UIObject and UIComponent are the base classes of the component architecture. Understanding the principles at work in these two classes is important for building components.

The following table briefly describes the two base classes:

Class	Extends	Description
mx.core.UIComponent	UIObject	UIComponent is the base class for all Flex components. It can participate in tabbing, accept low-level events such as keyboard and mouse input, and be disabled so it does not receive mouse and keyboard input. The UIComponent class lets you perform the following tasks: • Create focus navigation • Enable and disable components • Resize components Macromedia recommends using the UIComponent class rather than the UIObject class as the base class for your custom components.
mx.core.UIObject	MovieClip	UIObject is the base class for all graphical objects. It can have shape, draw itself, and be invisible. The UIObject class lets you perform the following tasks: • Edit styles • Handle events • Resize by scaling Macromedia does not recommend using the UIObject class rather than the UIComponent class as the base class for your custom components.

About the UIObject and UIComponent classes

Components based on version 2 of the Macromedia Component Architecture descend from the UIObject class, which wraps the MovieClip class. The MovieClip class is the base class for the classes in Flash that can draw on the screen. By providing a wrapper around its methods and properties, Flex makes the UIObject syntax more intuitive and improves the conceptual management of representing graphic objects.

Many MovieClip properties and methods are related to the Timeline. The UIObject class abstracts many of those details. Subclasses of the MovieClip class do not use unnecessary MovieClip properties and methods. However, you can access these properties and methods, if you want.

The UIObject (mx.core.UIObject) class hides the mouse handling and frame handling in the MovieClip class. The UIObject class also defines the styles, skins, and event aspects of the component architecture. The UIObject class and its subclasses broadcast their events just before drawing. If you are familiar with Flash, this event is analogous to the `enterFrame()` MovieClip event. The UIObject class posts events to its listeners just before drawing when loading and unloading, and when its layout changes (`move`, `resize`).

A UIObject class or UIObject subclass resizes itself by scaling. When you change its size using the `setSize()` method, the new dimensions are handed to the `_width` and `_height` properties of the MovieClip class, which scale the subclass.

The UIComponent (mx.core.UIComponent) class is a subclass of the UIObject class. It defines high-level behaviors that are specific to a graphical object. The UIComponent class handles end-user interactions (such as clicking and focus) and component enabling and disabling. The UIComponent class inherits all the methods, properties, and events of the UIObject class.

The UIComponent class also handles dragging, but you should not override the `startDrag()` method when defining custom components.

Extending other classes

You can extend any component class to create a new component class. For example, if you want to create a component that behaves almost the same as a Button component does, you can extend the Button class instead of recreating all the functionality of the Button class from the base classes.

To make component construction easier, you can extend a subclass for any class in the component architecture; you do not need to extend the UIObject or UIComponent class directly. If you extend any other component's class, you extend these base classes by default, because all components are subclasses of the UIComponent class, which is a subclass of the UIObject class.

When you add dependent components, you should override the `createChildren()` and `layoutChildren()` methods to instantiate, position, and resize the components properly.

Accessing application scope

Every class that extends the UIObject class has an `application` property that stores a reference to the Application object. You can use this property to access data or methods at the application level. Because the event handlers and the bindings of a component execute in the context of that component, using the Application object gives you access to the application scope.

To access the Application object, you must import the Application package in your class file, as the following example shows:

```
import mx.core.Application;
```

Some nonvisual components, such as Validator, do not inherit from the UIObject class. As a result, some components do not have an `application` property. For these components, you can access the application by using the static property `Application.application`.

In the following example, the component calls the `getName()` method on the Application object. Assume that the method is written in the MXML file or some dependent class that uses your component.

```
var name:String = application.getName();
```

Identifying the class, symbol, and owner names

To help Flash find the proper ActionScript classes and packages, and to preserve the component's naming, you must set the `symbolName`, `symbolOwner`, and `className` variables in your component's ActionScript class file.

The following table describes these variables:

Property	Type	Description
`symbolName`	String	Symbol name for the object (name of the ActionScript class). The symbol name must be the fully qualified class name (for example, myPackage.MyComponent). This name must match the Linkage Identifier and ActionScript 2.0 Class fields in the Create New Symbol dialog box described in "Adding new symbols" on page 12. You must declare this variable as static.
`symbolOwner`	Object	Class used in the internal call to the `createClassObject()` method. The symbol owner must be the fully qualified class name (for example, myPackage.MyComponent). Do not use quotation marks around the `symbolOwner` value, since it is of type Object. This name must match the Linkage Identifier and ActionScript 2.0 Class fields in the Create New Symbol dialog box described in "Adding new symbols" on page 12. You must declare this variable as static.
`className`	String	Name of the component class. This does not include the package name and has no corresponding setting in the Flash development environment. You can use the value of this variable when setting style properties.

The following example adds the `symbolName`, `symbolOwner`, and `className` properties to the MyButton class:

```
class MyButton extends mx.controls.Button {
  static var symbolName:String = "myPackage.MyButton";
  static var symbolOwner = myPackage.MyButton;
  var className:String = "MyButton";
  ...
}
```

About the component instantiation life cycle

When you instantiate a new component, Flex calls a number of methods, and those methods call other methods that you can override. Instantiating a new control in your application triggers the following method calls by Flex:

1. Class constructor

   After the class constructor is called, Flex calls the `constructObject2()` method.

2. The `constructObject2()` method

   When you implement the `constructObject2()` method, you must call the `super.constructObject2()` method or make manual calls to the `init()` and `createChildren()` methods.

3. The `init()` method

   Flex calls the `init()` method from the parent class's `constructObject2()` method.

4. The `createChildren()` method

   Flex calls the `createChildren()` method from the parent class's `constructObject2()` method.

5. The `measure()` method

   Flex calls the `measure()` method.

6. The `layoutChildren()` method

   Flex calls the `layoutChildren()` method.

7. The `draw()` method

   Flex calls the `draw()` method.

Each of the `measure()`, `layoutChildren()`, and `draw()` methods has a corresponding invalidate function. For more information, see "About invalidation" on page 68.

The remaining sections describe each of these methods. For the purposes of initialization, you do not need to add any explicit calls to these methods, because Flex initiates each call. However, you might be required to explicitly call some of these methods to refresh the object's state after it has been created and displayed.

Writing the constructor

Generally, component constructors should be empty so that the object can be customized with its properties interface. For example, the following code shows a constructor for MyComponent:

```
function MyComponent() {
}
```

In this example, when a new component is instantiated, the `MyComponent()` constructor is called. Setting properties in the constructor can lead to overwriting default values, depending on the ordering of initialization calls.

The empty constructor is not the only method necessary to instantiate the object with property values. You can also override the `constructObject2()` method. This happens because the constructor is called too early in the life cycle of the object to support the proper construction of it and its children. As a result, Flex finally instantiates the object when the `constructObject2()` method is called. For more information, see "Implementing the constructObject2() method" on page 54.

Each class can contain only one constructor function; overloaded constructor functions are not supported in ActionScript 2.0.

Specifying clip parameters

Clip parameters define the instance properties that you can set as an MXML tag's property. The values of these are stored in the initObject so that Flex can apply them to the component during instantiation. Clip parameters mirror the set of properties in the Flash UI Property inspector. They are used in Flex as a list of properties to be applied during the construction of the object. Clip parameters are roughly equivalent to constructor parameters in Java or C++, although they are not set in the constructor call, but later, in the `constructObject2()` method.

Clip parameters are not meant to set default values, but rather to apply tag attributes to the component when it is created.

You define clip parameters and then apply them to the object using the `UIObject.applyProperties()` method inside the `constructObject2()` method. You use the `applyProperties()` method to apply the clip parameters, based on values set by the user in the MXML tag.

When playing a standard Flash SWF file, Flash Player applies clip parameters before the object's constructor is called (which calls the `constructObject()` method, which calls the `init()` method).

In Flex, Flash Player no longer applies clip parameters by default. This lets you control when they are applied, which should be in the `constructObject2()` method. If you do not apply the clip parameters explicitly in the `constructObject2()` method, Flex applies them after the constructor finishes.

In an MXML file, you might have a tag that defines a foo property, as the following example shows:

```
<MyComponent foo="myvalue" />
```

When it instantiates the component, the Flex framework creates an initialization object (`{foo: "myvalue"}`) and passes it to the `constructObject2()` method. The `constructObject2()` method sets this property.

Clip parameters can take any number of comma-separated arguments. Flex stores the clip parameters as an array. Every argument in the clip parameter definition must have a ":1" after it in order for Flex to let you use it.

The following example creates the clip parameters `text`, `html`, and `autoSize`, and then calls the `applyProperties()` method from within the `constructObject2()` method:

```
var clipParameters:Object = { text: 1, html: 1, autoSize: 1};

function constructObject2(obj:Object):Void {
  ...
  applyProperties(obj, Label.prototype.clipParameters);
}
```

The `applyProperties()` method has the following signature:

```
applyProperties(Object, Object):Void
```

Thus, when you have a component like the following:

```
class MyComponent extends UIComponent {
  ...
  private var clipParameters:Object = {someProperty: 1};

  private static var mergedClipParameters =
  mx.core.UIObject.mergeClipParameters(MyComponent.prototype.
  clipParameters,UIComponent.prototype.clipParameters);

  public var someProperty:String;
  ...
}
```

You can do this:

```
function constuctObject2(initObj:Object) {
  super.constructObject2(initObj);
  this.applyProperties(initObj, clipParameters);
}
```

This example uses the bracket notation to get around type-checking. If it runs in Flash, the `constructObject2()` method is never called and UIObject.init takes care of all property initialization. If it runs in Flex, it calls the `constructObject2()` method and this function applies properties as required.

You can dynamically create a list of clip parameters using the `mergeClipParameters()` method. This method creates the list of clip parameters using ActionScript shorthand; for example:

```
static function mergeClipParameters(obj, par):Boolean {
  for (var i in par) {
    obj[i] = par[i];
  }
  return true;
}
```

Implementing the constructObject2() method

The `constructObject2()` method is effectively the constructor for your class. The `UIObject.constructObject2()` method calls the `init()` and `createChildren()` methods. It should apply any properties in the initObj that are needed by `init()` and `createChildren()`, and then call `super.constructObject2()`.

The `constructObject2()` method has the following signature:

```
constructObject2(initObj:Object):Void
```

In addition, if you use clip parameters, you should add a call to the `applyProperties()` method at the end of the `constructObject2()` method; for example:

```
function constructObject2(o:Object):Void {
  super.constructObject2(o);
  applyProperties(o, Label.prototype.clipParameters);
}
```

If you override the `constructObject2()` method, you must at least call the `super.constructObject2()` method.

The initObj contains all the component instance's properties that are set in the MXML tag (and stored as clip parameters). Flex creates this object implicitly during instantiation of the component.

Implementing the init() method

Flash calls the `init()` method when the class is created. At a minimum, the `init()` method should call the superclass's `init()` method. The `width`, `height`, and `clip` parameters are not properly set until after this method is called.

```
function init(Void):Void {
  super.init();
}
```

The implicit init object (initObj) contains everything passed in through the `initObj` argument to the `createClassObject()` method. You can access it in the `init()` method.

Note: Do not create child objects in the `init()` method. `You` should use it only for setting up initial properties.

Implementing the createChildren() method

Components implement the `createChildren()` method to create subobjects (such as other components) in the component. Rather than calling the subobject's constructor in the `createChildren()` method, call the `createClassObject()` method to instantiate a subobject of your component.

The `createClassObject()` method has the following signature:

```
createClassObject(className, instanceName, depth, initObject)
```

The following table describes the arguments:

Argument	Type	Description
`className`	Object	The name of the class.
`instanceName`	String	The name of the instance.
`depth`	Number	The depth for the instance.
`initObject`	Object	The object that contains the initialization properties.

To call the `createClassObject()` method, you must know what those children are (for example, a border or a button that you always need), because you must specify the name and type of the object, plus any initialization parameters in the call to `createClassObject()`.

The following example calls the `createClassObject()` method to create a new Label object for use inside a component:

```
up_mc.createClassObject(Label, "label_mc", 1); // Create a label in the holder
```

You set properties in the call to the `createClassObject()` method by adding them as part of the `initObject` argument. The following example sets the value of the `label` property:

```
form.createClassObject(CheckBox, "cb", 0, {label:"Check this"});
```

The following example creates TextInput and SimpleButton components:

```
function createChildren():Void {
  if (text_mc == undefined)
    createClassObject(TextInput, "text_mc", 0, { preferredWidth: 80,
  editable:false });
    text_mc.addEventListener("change", this);
    text_mc.addEventListener("focusOut", this);

  if (mode_mc == undefined)
    createClassObject(SimpleButton, "mode_mc", 1, { falseUpSkin:
  modeUpSkinName, falseOverSkin: modeOverSkinName, falseDownSkin:
  modeDownSkinName });
  mode_mc.addEventListener("click", this);
}
```

If your component is a container, and you do not know exactly which children it contains, call the `createComponents()` method. This method creates all child objects. For more information on using the `createComponents()` method, see *Developing Flex Applications*.

At the end of the `createChildren()` method, call the necessary invalidate methods (`invalidate()`, `invalidateSize()`, or `invalidateLayout()`) to refresh the screen. For more information, see "About invalidation" on page 68.

Implementing the commitProperties() method

Flex calls the `commitProperties()` method before it calls the `measure()` method. It provides a chance to set variables that are used by the `measure()` method after the constructor has finished and MXML attributes have been applied.

Flex only calls the `commitProperties()` method after it calls the `invalidateProperties()` method.

For example, the ViewStack container uses the `commitProperties()` method to maximize performance. When you set the `ViewStack.selectedIndex` property, the ViewStack container doesn't update to a new page right away. Instead, it privately stores a `pendingSelectedIndex` property. When it is time for Flash Player to update the screen, Flex calls the `commitProperties()`, `measure()`, `layoutChildren()`, and `draw()` methods. In the `commitProperties()` method, the ViewStack container checks to see whether the `pendingSelectedIndex` property is set, and it updates the selected index at that time.

The motivation to use the `commitProperties()` method is to delay processing until the last minute, so that Flash Player avoids doing computationally expensive, redundant work. For example, if a script changes the `ViewStack.selectedIndex` property 15 times, you would want to minimize the number of times the display of the ViewStack container updates when the `selectedIndex` property changes. By using the `commitProperties()` method, you can update the `pendingSelectedIndex` property 15 times, and then only do the rendering once.

This is most useful for properties that are computationally expensive to update. If setting a property is inexpensive, you can avoid using the `commitProperties()` method.

Implementing the measure() method

Generally, the `measure()` method is only called once when the component is instantiated. The component's container sets the initial size and Flex calculates the preferred minimum and maximum sizes. You can use the `measure()` method to explicitly set the size of the component, although Macromedia does not recommend doing this when developing components.

You can set the following properties in the `measure()` method. Flex calculates them, but you can override them:

- `_measuredMinWidth`
- `_measuredMaxWidth`
- `_measuredMinHeight`
- `_measuredMaxHeight`
- `_measuredWidthFlex`
- `_measuredHeightFlex`
- `_measuredPreferredWidth`
- `_measuredPreferredHeight`

The Flex properties (those that end with the word Flex) define limits for when the object is resized. These *measured* properties are used for layout in containers if your component doesn't explicitly set a `preferredWidth` or `preferredHeight` attribute.

Controls calculate the values of these based on runtime properties. For example, the Button control's `measure()` method examines how wide its label is in order to compute the value of the `_measuredPreferredWidth` property.

By default, Flex sets the values of _measuredPreferredWidth and _measuredPreferredHeight to the values of the current height and width, but you should override them. The following example of the measure() method from the Label component sets a default width and height if the label text field is empty:

```
function measure(Void):Void {
  var myTF = _getTextFormat();
  var txt = text;

  if (txt == undefined || txt.length < 2) {
    txt = "Wj";
  }
  var textExt = myTF.getTextExtent2(txt);
  var textW = textExt.width + 4;
  var textH = textExt.height + 4;

  if (textW == undefined) {
    textW = 20;
  }

  if (textH == undefined) {
    textH = 8;
  }

  trace("Label:  " + textW + " " + textH);

  _measuredPreferredWidth = textW;
  _measuredPreferredHeight = textH;
}
```

Implementing the layoutChildren() method

The layoutChildren() method positions subobjects within the confines set by the layoutWidth and layoutHeight properties of your component. Each component should implement this method. The layoutChildren() method deprecates the size() method, which is used primarily by Flash designers to perform the same function.

Use the width and height properties of the child controls when changing the size of the children. These properties are scaled for use inside the component. Use the layoutWidth and layoutHeight properties when changing the size of the component itself. These properties are not scaled because the component is at the top level.

The layoutChildren() method does not update the screen unless you call an invalidation method. Flex only calls the layoutChildren() method if the invalidateLayout() method was previously called. For more information, see "About invalidation" on page 68.

The following example checks for the value of the labelPlacement property and lays out the mode_mc object accordingly:

```
function layoutChildren():Void {

  text_mc.setSize(layoutWidth - mode_mc.width, layoutHeight);

  if (labelPlacement == "left")
```

```
    {
      mode_mc.move(layoutWidth - mode_mc.width, 0);
      text_mc.move(0, 0);
    }
    else {
      mode_mc.move(0, 0);
      text_mc.move(mode_mc.width, 0);
    }

}
```

Implementing the draw() method

The `draw()` method displays objects on the screen. Whenever the component needs to draw an interface element, it calls a `draw()` method. You use the `draw()` method to create or modify elements that are subject-to-change.

Everything is made visible in the `draw()` method. A border does not actually call the drawing API until its `draw()` method is called. Any graphical assets that you bring in for the purposes of measuring are invisible until the `draw()` method is called.

You should not call the `draw()` method directly. Instead, call one of the invalidation methods, and that method calls the `draw()` method. Flex also calls the `draw()` method from the `redraw()` method. However, Flex calls the `redraw()` method only if the object is invalidated, so you should actually call an invalidation method if you want Flex to invoke the `draw()` or `redraw()` method. If you do not call an invalidation method, the component remains invisible unless you set its visibility property to `true` in MXML. For more information, see "About invalidation" on page 68.

Flex also calls the `draw()` method after the `layoutChildren()` method.

Inside the `draw()` method, you can use calls to the Flash drawing API to draw borders, rules, and other graphical elements. You can also call the `clear()` method, which removes the visible objects. In general, to set lengths in the `draw()` method, you should use `this.layoutWidth` and `this.layoutHeight` instead of `width` and `height`.

The following example clears the component and then draws a border around the component:

```
function draw():Void {
  clear();
  if (bTextChanged) {
    bTextChanged = false;
    text_mc.text = text;
  }
  // Draw a border around everything.
  drawRect(0, 0, this.layoutWidth, this.layoutHeight);

}
```

Defining getters and setters

Getters and setters provide visibility to component properties and control access to those properties by other objects.

To define getter and setter methods, precede the method name with `get` or `set`, followed by a space and the property name. Macromedia recommends that you use initial capital letters for the second word and each word that follows. For example:

```
public function get initialColorStyle(): Number
```

The variable that stores the property's value cannot have the same name as the getter or setter. By convention, precede the name of the getter and setter variables with two underscores (__). In addition, Macromedia recommends that you declare the variable as private.

The following example shows the declaration of `initialColor`, and getter and setter methods that get and set the value of this property:

```
...
private var __initialColor:Color = 42;
...
public function get initialColor():Number {
  return __initialColor;
}
public function set initialColor(newColor:Number) {
  __initialColor = newColor;
}
```

You commonly use getters and setters in conjunction with metadata keywords to define properties that are visible, are bindable, and have other properties. For more information, see "Component metadata" on page 59.

Component metadata

The Flash compiler recognizes component metadata statements in your external ActionScript class files. The metadata tags define component attributes, data binding properties, events, and other properties of the component. Flash interprets these statements during compilation; they are never interpreted during runtime in Flex or Flash.

Using metadata keywords

Metadata statements are associated with a class declaration or an individual data field. They are bound to the next line in the ActionScript file. When defining a component property, add the metadata tag on the line before the property declaration. When defining component events or other aspects of a component that affect more than a single property, add the metadata tag outside the class definition so that the metadata is bound to the entire class.

In the following example, the `Inspectable` metadata keywords apply to the `flavorStr`, `colorStr`, and `shapeStr` properties:

```
[Inspectable(defaultValue="strawberry")]
public var flavorStr:String;

[Inspectable(defaultValue="blue")]
public var colorStr:String;

[Inspectable(defaultValue="circular")]
public var shapeStr:String;
```

Metadata tags

The following table describes the metadata tags that you can use in ActionScript class files:

Tag	Description
Bindable	Reveals a property in the Bindings tab of the Component inspector. For more information, see "Bindable" on page 60.
ChangeEvent	Identifies events that cause data binding to occur. For more information, see "ChangeEvent" on page 61.
Effect	Defines the valid property name for the tag's effect. For more information, see "Effect" on page 62.
Embed	Imports JPEG, GIF, PNG, SVG, and SWF files at compile time. Also imports image assets from SWC files. This is functionally equivalent to the MXML `@Embed` syntax, as described in *Developing Flex Applications*.
Event	Describes the events that the component emits. For more information, see "Event" on page 62.
IconFile	Identifies the filename for the icon that represents the component in the Flash Components panel. For more information, see "Adding an icon" on page 71.
Inspectable	Defines an attribute exposed to component users in the Component inspector. Also limits allowable values of the property. For more information, see "Inspectable" on page 63.
InspectableList	Identifies which subset of inspectable parameters should be listed in the Flash MX 2004 Property inspector. If you don't add an InspectableList property to your component's class, all inspectable parameters appear in the Property inspector. For more information, see "InspectableList" on page 64.
NonCommittingChangeEvent	Identifies an event as an interim trigger. For more information, see "NonCommittingChangeEvent" on page 65.
Style	Describes a style property allowed on the component. For more information on using the `Style` metadata keyword, see "Style" on page 66.

The following sections describe the component metadata tags in more detail.

Bindable

Data binding connects components to each other. You achieve visual data binding through the Bindings tab in the Component inspector. From there, you add, view, and remove bindings for a component.

Although data binding works with any component, its main purpose is to connect user-interface components to external data sources, such as web services and XML documents. These data sources are available as components with properties, which you can bind to other component properties. The Component inspector is the main tool used in Flash MX Professional 2004 to do data binding.

Use the `Bindable` metadata keyword to make properties and getter and setter functions in your ActionScript classes appear on the Bindings tab in the Component inspector.

The `Bindable` metadata keyword has the following syntax:

```
[Bindable[readonly|writeonly[,type="datatype"]]]
```

The `Bindable` keyword must precede a property, a getter or setter function, or other metadata keyword that precedes a property or getter or setter function.

The following example defines the property `flavorStr` as a public, inspectable variable that is also accessible on the Bindings tab in the Component inspector:

```
[Bindable]
[Inspectable(defaultValue="strawberry")]
public var flavorStr:String = "strawberry";
```

The `Bindable` metadata keyword takes three options that specify the type of access to the property, as well as the data type of that property. The following table describes these options:

Option	Description
`readonly`	Instructs Flash to allow the property to be only the source of a binding, as this example shows: `[Bindable("readonly")]`
`writeonly`	Instructs Flash to allow the property to be only the destination of a binding, as this example shows: `[Bindable("writeonly")]`
`type="datatype"`	Specifies the data type of the property that is being bound. If you do not specify this option, data binding uses the property's data type as declared in the ActionScript code. If *`datatype`* is a registered data type, you can use the functionality in the Schema tab's Data Type pop-up menu. The following example sets the data type of the property to String: `[Bindable(type="String")]`

You can combine the access option and the data type option, as the following example shows:

```
[Bindable(param1="writeonly",type="DataProvider")]
```

The `Bindable` keyword is required when you use the `ChangeEvent` metadata keyword. For more information, see "ChangeEvent" on page 61.

ChangeEvent

Use the `ChangeEvent` metadata keyword to generate one or more component events when changes are made to properties.

The `ChangeEvent` metadata keyword has the following syntax:

```
[ChangeEvent("event_name"[,...)]
property_declaration or get/set function
```

You can use this keyword only with variable declarations or getter or setter functions, although it is not required.

The `Bindable` keyword is required when you use the `ChangeEvent` metadata keyword. For more information, see "Bindable" on page 60.

In the following example, the component generates the `change` event when the value of the `flavorStr` property changes:

```
[ChangeEvent("change")]
public var flavorStr:String;
```

When the event specified in the metadata occurs, Flash informs whatever is bound to the property that the property has changed.

You can also instruct your component to generate an event when a getter or setter function is called, as the following example shows:

```
[ChangeEvent("change")]
function get selectedDate():Date
```

In most cases, you set the `change` event on the getter function, and dispatch the event on the setter function.

You can register multiple `change` events in the metadata so that more than one event is generated when the property changes, as the following example shows:

```
[ChangeEvent("change1")]
[ChangeEvent("change2")]
[ChangeEvent("change3")]
```

Any one of those events indicates a change to the variable. They do not all have to occur to indicate a change.

Effect

The `Effect` metadata keyword defines the name of the property that you can assign to an effect for the MXML tag.

The `Effect` metadata keyword has the following syntax:

```
[Effect("effect_name")]
```

The *effect_name* generally matches the *event_name* listed in the `Effect` metadata plus the word *Effect*. The following example means that a tag may have a `resizeEffect` property assigned to the effect to play when the resize event triggers:

```
[Effect("resizeEffect")]
```

Event

Use the `Event` metadata keyword to define events dispatched by this component. Add the Event statements outside the class definition in the ActionScript file so that they are bound to the class and not a particular member of the class.

The `Event` metadata keyword has the following syntax:

```
[Event("event_name")]
```

The following example identifies the `myClickEvent` event as an event that the component can dispatch:

```
[Event("myClickEvent")]
```

If you do not identify an event in the class file with the `Event` metadata keyword, the compiler ignores the event during compilation, and Flex ignores this event triggered by the component during runtime. The metadata for events is inherited from the parent class, however, so you do not need to tag events that are already tagged with the `Event` metadata keyword in the parent class.

The following example shows the `Event` metadata for the UIObject class, which handles the `resize`, `move`, and `draw` events:

```
...

[Event("resize")]
[Event("move")]
[Event("draw")]

class mx.core.UIObject extends MovieClip {
  ...
}
```

Inspectable

You specify the user-editable (or *inspectable*) parameters of a component in the class definition for the component using the `Inspectable` metadata keyword. If you tag a property as inspectable, it appears in the Component inspector of the Flash user interface.

Prior to the availability of this metadata keyword, you had to define the property in the ActionScript class file *and* in the Component inspector, which introduced the possibility of errors because the property was defined in multiple locations. Now, you define the property only once.

The `Inspectable` metadata statement must immediately precede the property's variable declaration to be bound to that property.

The `Inspectable` metadata keyword has the following syntax:

```
[Inspectable(value_type=value[,option=value,...])]
property_declaration name:type;
```

The following table describes the options of the `Inspectable` metadata keyword:

Option	Type	Description
`category`	String	(Optional) Groups the property into a specific subcategory in the Property inspector of the Flash user interface.
`defaultValue`	String or Number	(Required) Defines the default value for the inspectable property. This property is required if used in a getter or setter function. The default value is determined from the property definition.
`enumeration`	String	(Optional) Specifies a comma-delimited list of legal values for the property. Only these values are allowed; for example, `item1`, `item2`, `item3`.

Option	Type	Description
environment	String	(Optional) Notes which inspectable properties should not be allowed (none), which are used only for Flash (Flash), and which are used only by Flex and not Flash (MXML).
format	String	(Optional) Indicates that the property holds a value with a file path.
listOffset	Number	(Optional) Defines the default index of a List value. Added for backward compatibility with Flash MX components.
name	String	(Optional) Defines a display name for the property; for example, Font Width. If not specified, use the property's name, such as _fontWidth.
type	String	(Optional) Specifies the type. If omitted, use the property's type. The following values are acceptable: • Array • Object • List • String • Number • Boolean • Font Name • Color If the property is an array, you must list the valid values for the array.
variable	String	(Optional) Specifies the variable to which this parameter is bound. Added for backward compatibility with Flash MX components.
verbose	Number	(Optional) Indicates that this inspectable property should be displayed in the Flash user interface only when the user indicates that verbose properties should be included. If this property is not specified, Flash assumes that the property should be displayed.

The following example defines the enabled parameter as inspectable:

```
[Inspectable(defaultValue=true, verbose=1, category="Other")]
var enabled:Boolean;
```

The Inspectable keyword supports loosely typed properties, as the following example shows:

```
[Inspectable("danger", 1, true, maybe)]
```

InspectableList

Use the InspectableList metadata keyword to specify exactly which subset of inspectable parameters should appear in the Property Inspector or Component definition panels in the Flash MX 2004 user interface.

The InspectableList metadata keyword eliminates inheritance of inspectable properties in the base class. Only the properties in this list are marked as inspectable. Use the InspectableList keyword in combination with the Inspectable keyword to hide inherited attributes for subclassed components.

If you do not add an InspectableList metadata keyword to your component's class, all inspectable parameters, including those of the component's parent classes, appear in the Flash Property inspector.

The `InspectableList` metadata keyword has the following syntax:

```
[InspectableList("attribute1"[,...])]
```

The `InspectableList` keyword must immediately precede the class definition because it applies to the entire class and not individual members of the class.

The following example allows the `flavorStr` and `colorStr` properties to be displayed in the Property inspector, but excludes other inspectable properties (such as `flavorAge`) from the DotParent class:

```
[InspectableList("flavorStr","colorStr")]
class BlackDot extends DotParent {

  [Inspectable(defaultValue="strawberry")]
  public var flavorStr:String;

  [Inspectable(defaultValue="blue")]
  public var colorStr:String;

  [Inspectable(defaultValue="10")]
  public var flavorAge:String;

  ...
}
```

NonCommittingChangeEvent

The `NonCommittingChangeEvent` metadata keyword identifies an event as an interim trigger. You use this keyword for properties that might change often, but for which you do not want validation to occur on every change.

An example of this is if you tied a validator function to the text property of a TextInput control. The text property changes on every keystroke, but you do not want to validate the property until the user presses the Enter key or changes focus away from the field. The `NonCommittingChangeEvent` keyword lets you trigger validation when the user is done editing the text field.

The `NonCommittingChangeEvent` metadata keyword has the following syntax:

```
[NonCommittingChangeEvent("event_name")]
```

In the following example, the component is aware that the property has changed if the change is triggered; however, that change is not final. There is another `ChangeEvent` keyword that probably triggers when the change is final.

```
[Event("change")]
...
[ChangeEvent("valueCommitted")]
[NonCommittingChangeEvent("change")]
function get text():String {
  return getText();
}

function set text(t):Void {
  setText(t);
}
```

Style

The `Style` metadata keyword describes a style property allowed for the component. The `Style` metadata keyword has the following syntax:

```
[Style(name=style_name[,option=value,...])]
```

The following table describes the options for the `Style` metadata keyword:

Option	Type	Description
`name`	String	(Required) The name of the style.
`type`	String	The type of data.
`format`	String	Units of the property.
`inherit`	String	Whether the property is inheriting. Valid values are `yes` and `no`.

The following example shows the `textSelectedColor` property:

```
[Style(name="textSelectedColor",type="Number",format="Color",inherit="yes")]
```

Defining component parameters

When building a component, you can add parameters that define its appearance and behavior. The most commonly used properties appear as authoring parameters in the Component inspector. You define these properties by using the `Inspectable` keyword (see "Inspectable" on page 63). You can also set all inspectable parameters with ActionScript. Setting a parameter with ActionScript in your MXML application overrides any value set during component authoring.

The following examples set several component parameters and expose them with the `Inspectable` metadata keyword in the Component inspector:

```
// A string parameter.
[Inspectable(defaultValue="strawberry")]
public var flavorStr:String;

// A string list parameter.
[Inspectable(enumeration="sour,sweet,juicy,rotten",defaultValue="sweet")]
public var flavorType:String;

// An array parameter.
[Inspectable(name="Flavors", defaultValue="strawberry,grape,orange",
  verbose=1, category="Fruits")]
var flavorList:Array;

// An object parameter.
[Inspectable(defaultValue="belly:flop,jelly:drop")]
public var jellyObject:Object;

// A color parameter.
[Inspectable(defaultValue="#ffffff")]
public var jellyColor:Color;
```

```
// A setter.
[Inspectable(defaultValue="default text")]
function set text(t:String)
```

Parameters can be any of the following supported types:

- Array
- Object
- List
- String
- Number
- Boolean
- Font Name
- Color

Handling events

The event model is a dispatcher-listener model based on the DOM Level 3 proposal for event architectures. Every component in the architecture emits events in a standard format, as defined by the convention. Those events vary across components, depending on the functionality that the component provides.

Components generate and dispatch events and consume (listen to) other events. An object that wants to know about another object's events registers with that object. When an event occurs, the object dispatches the event to all registered listeners by calling a function requested during registration. To receive multiple events from the same object, you must register for each event.

Although every component can define unique events, events are inherited from the core classes of the architecture, mx.core.UIObject and mx.core.UIComponent. These classes define low-level component events, such as `draw`, `resize`, `move`, `load`, and others that are fundamental to all components. Subclasses of these classes inherit and broadcast these events.

Dispatching events

In the body of your component's ActionScript class file, you broadcast events using the `dispatchEvent()` method. The `dispatchEvent()` method has the following signature:

```
dispatchEvent(eventObj)
```

The `eventObj` argument is the event object that describes the event. You can explicitly build an event object before dispatching the event, as the following example shows:

```
var eventObj = new Object();
eventObj.type = "myEvent";
dispatchEvent(eventObj);
```

You can also use the following shortcut syntax that sets the value of the `type` property for the event object and dispatches the event in a single line:

```
dispatchEvent({type:"myEvent"});
```

The event object has an implicit property, `target`, that is a reference to the object that triggered the event.

For more information on events, see *Developing Flex Applications*.

Defining event handlers

You define the event handler object or event handler function that listens for your component's events in your application's ActionScript. The following example handles the `change`, `focusOut`, and `click` events of the children of the component:

```
function handleEvent(evt:Object):Void {
  if (evt.type == "change") {
    dispatchEvent({ type: "change" });
  } else if (evt.type == "focusOut") {
    text_mc.editable = false;
  } else if (evt.type = "click") {
    text_mc.editable = !text_mc.editable;
  }
}
```

Using the Event metadata

Add Event metadata in your ActionScript class file for each event listener. The value of the `Event` keyword becomes the first argument in calls to the `addEventListener()` method, as the following example shows:

```
[Event("click")] // Event declaration.
...
class FCheckBox{
  function addEventListener(eventName:String, eventHandler:Object) {
    ... // eventName is String
  }
}
```

Event metadata describes the events that this component emits, not the ones it consumes. For more information on the `Event` metadata keyword, see "Event" on page 62.

About invalidation

Macromedia recommends that a component not update itself immediately in most cases, but instead save a copy of the new property value, set a flag indicating what is changed, and call one of the three invalidation methods.

The following are the invalidation methods:

invalidateSize() Indicates that one of the `_measured` properties may have changed. This results in a call to the `measure()` method. If the `measure()` method changes the value of one of the `_measured` properties, it calls the `layoutChildren()` method.

invalidateLayout() Indicates that the position and/or size of one of the subobjects may have changed, but the `_measured` properties have not been affected. This results in a call to the `layoutChildren()` method. If you change a subobject in the `layoutChildren()` method, you should call the `invalidate()` method.

invalidate() Indicates that just the visuals for the object have changed, but size and position of subobjects have not changed. This method calls the `draw()` method.

invalidateProperties() Indicates that you have changed properties. This method calls the `commitProperties()` method.

You should call the `invalidateSize()` method infrequently because it measures and redraws everything on the screen, and this can be an expensive action. Sometimes you need to call more than one of these methods to force a layout, even though the computed sizes did not change.

You must call an invalidation method at least once during the instantiation of your component. The most common place for you to do this is in the `createChildren()` or `layoutChildren()` method.

Skinning custom controls

A user-interface control is composed entirely of attached MovieClip objects or symbols that are stored inside a SWF file. All assets for a user-interface control can be external to the user-interface control, so they can also be used by other components. For example, if your component needs button functionality, you can reuse the existing Button component assets.

The Button control uses a separate symbol to represent each of its states (FalseDown, FalseUp, Disabled, Selected, and so on). However, you can associate your custom symbols—called *skins*—with these states. At runtime, the old and new symbols are exported in the SWF file. The old states become invisible to give way to the new symbols. This ability to change skins during author-time as well as runtime is called *skinning*.

To use skinning in components, create a variable for every skin element or linkage used in the component in your ActionScript class file. This lets someone set a different skin element just by changing a parameter in the component, as the following example shows:

```
var falseUpSkin = "mySkin";
```

The name mySkin is subsequently used as the linkage name of the symbol to display the `FalseUpSkin`.

The following example shows the skin variables for the various states of the Button component:

```
var falseUpSkin:String  = "ButtonSkin";
var falseDownSkin:String  = "ButtonSkin";
var falseOverSkin:String = "ButtonSkin"
var falseDisabledSkin:String = "ButtonSkin";
var trueUpSkin:String = "ButtonSkin";
var trueDownSkin:String = "ButtonSkin";
var trueOverSkin:String = "ButtonSkin";
var trueDisabledSkin:String = "ButtonSkin";
var falseUpIcon:String = "";
var falseDownIcon:String = "";
var falseOverIcon:String = "";
var falseDisabledIcon:String = "";
var trueUpIcon:String = "";
var trueDownIcon:String = "";
var trueOverIcon:String = "";
var trueDisabledIcon:String = "";
```

In some cases, you must call the `invalidate()` method after changing skin properties. This depends on where you set the skin. If you set it prior to the `layoutChildren()` method, the `invalidate()` call in that method takes care of it for you. But if you set skin properties late in the component instantiation life cycle, you might have to call the `invalidate()` method again to have Flash draw the new skins.

Adding styles

Adding styles is the process of registering all the graphic elements in your component with a class and letting that class control the graphics at runtime. Flex gathers style information from style sheets and external files, and builds a styleDeclaration object that stores this information.

When the component checks a style property, it queries its own style properties (and therefore the properties of its ancestors). If it cannot find the style property, it checks to see if it has a styleDeclaration object assigned to it.

If it does, it returns the corresponding property in the styleDeclaration object. If not, and the property is not inherited, the value of the style is `undefined`. If the property is inherited, it checks the style property of its parent component. The parent component returns the property if it has it or checks *its* parent. When the last parent is queried and no style has been found, Flex checks for a global style object.

To set or get styles on an instance of an object, you access the UIObject `getStyle()` or `setStyle()` methods. The following example sets the color on a button instance:

```
myButton.setStyle("color", 0xFF00FF);
```

You cannot access style properties as "*.propertyName*". Instead, you must use the `getStyle()` or `setStyle()` methods. This abstracts the code that handles inheriting styles and updating of a component after a style change.

The `getStyle()` and `setStyle()` methods have the following signatures:

```
getStyle(styleName:String);
setStyle(styleName:String, value):Void;
```

The `getStyle()` method returns a string, number, or object representing the *styleName*. It returns `undefined` if the style does not exist.

The `setStyle()` method sets a style on the object (and children if it is a cascading style).

You do not need to implement code in your component to support styles and style inheritance, because it is implemented in the base classes. For more information about styles, see *Developing Flex Applications*.

Making components accessible

A growing requirement for web content is that it should be accessible to people who have disabilities. Visually impaired people can use the visual content in Flash applications by means of screen reader software, which provides an audio description of the material on the screen.

When you create a component, you can include ActionScript that enables the component and a screen reader to communicate. Then, when developers use your component to build an application in Flash, they use the Accessibility panel to configure each component instance.

Flash MX 2004 includes the following accessibility features:

- Custom focus navigation
- Custom keyboard shortcuts
- Screen-based documents and the screen authoring environment
- An Accessibility class

To enable accessibility in your component, add the following line to your component's class file:

```
mx.accessibility.ComponentName.enableAccessibility();
```

For example, the following line enables accessibility for the MyButton component:

```
mx.accessibility.MyButton.enableAccessibility();
```

When developers add the MyButton component to an application, they can use the Accessibility panel to make it available to screen readers.

Improving component usability

After you create the component and prepare it for packaging, you can make it easier for your users to use. This section describes some techniques for adding usability to your component.

Adding an icon

You can add an icon that represents your component in the Components panel of the Flash authoring environment.

To add an icon for your component:

1. Create an image with the following specifications:
   - 18 pixels x 18 pixels
   - Saved in PNG format
   - 8-bit with alpha transparency
   - A transparent upper-left pixel, to support masking
2. Add the following definition to your component's ActionScript class file before the class definition:

   ```
   [IconFile("component_name.png")]
   ```
3. Add the image to the same directory as the FLA file.

   When you export the SWC file, Flash includes the image at the root level of the archive.

Adding ToolTips

ToolTips appear when a user rolls the mouse over your component name or icon in the Components panel of the Flash authoring environment.

To add a ToolTip to your component, use the `tiptext` keyword outside the class definition in the component's ActionScript class file. You must comment out this keyword using an asterisk (*), and precede it with an at sign (@) for the compiler to properly recognize it.

The following example shows the tooltip for the CheckBox component:

```
* @tiptext Basic CheckBox component. Extends Button.
```

Adding versioning

When releasing components, you should define a version number. This lets developers know whether they should upgrade, and helps with technical support issues. When you set a component's version number, use the static variable `version`, as the following example shows:

```
static var version:String = "1.0.0.42";
```

If you create many components as part of a component package, you can include the version number in an external file. Thus, you update the version number in only one place. For example, the following code imports the contents of an external file that stores the version number in one place:

```
#include "../myPackage/ComponentVersion.as"
```

The contents of the ComponentVersion.as file are identical to the previous variable declaration, as the following example shows:

```
static var version:String = "1.0.0.42";
```

Best practices when designing a component

Use the following practices when designing a component:

- Keep the file size as small as possible.
- Make your component as reusable as possible by generalizing functionality.
- Use the Border class rather than graphical elements to draw borders around objects.
- Use tag-based skinning.
- Assume an initial state. Because style properties are on the object, you can set initial settings for styles and properties so your initialization code does not have to set them when the object is constructed, unless the user overrides the default state.
- When defining the symbol, do not select the Export in First Frame option unless it is absolutely necessary. Flash loads the component just before it is used in your Flash application, so if you select this option, Flash preloads the component in the first frame of its parent. The reason you typically do not preload the component in the first frame is for considerations on the web: the component loads before your preloader begins, defeating the purpose of the preloader.
- Avoid multiple frame MovieClips (except for the two-frame trick for assets).

- Always implement an `init()` method and call the `super.init()` method, but otherwise keep the component as lightweight as possible.
- Use the `invalidate()` and `invalidateStyle()` methods to invoke the `draw()` method instead of calling the `draw()` method explicitly.

Using the ModalText example

The following code example implements the class definition for the ModalText component. This is a sample custom component that is included in the Flex installation in the *flex_install_dir*/resources/flexforflash directory. The ModalText.zip file contains ModalText.fla, a file that defines the symbols for the ModalText component necessary to generate the SWC file. This ZIP file also contains ModalText.as, which is also provided here.

The ModalText component is a text input whose default is the noneditable mode, but you can switch to editable mode by clicking its button.

Save the following code to the file ModalText.as, and then generate the SWC file using the FLA file:

```
// Import all necessary classes.
import mx.core.UIComponent;
import mx.controls.SimpleButton;
import mx.controls.TextInput;

// Modal text sends a change event when the text is changed.
[Event("change")]

/*** a) Extend UIComponent. ***/
class ModalText extends UIComponent {

  /*** b) Specify symbolName, symbolOwner, className. ***/
  static var symbolName:String = "ModalText";
  static var symbolOwner:Object = ModalText;
  // className is optional and used for determining default styles.
  var className:String = "ModalText";

  /*** c) Specify clipParameters, which are the properties you want to set
       before the call to init() and createChildren() ***/
  static var clipParameters = { text:1, labelPlacement: 1 };

  /***d) Implement constructObject2(), which is effectively the constructor
       for this class. ***/

  function constructObject2(o:Object):Void
  {
    super.constructObject2(o);
    applyProperties(o, ModalText.clipParameters);
  }

  /*** e) Implement init(). ***/
  function init():Void
  {
    // Set up initial values based on clipParameters, if any (there are none
```

```
  // in this example).
  super.init();
}

/*** f) Implement createChildren(). ***/

// Declare two children member variables.
var text_mc:TextInput;
var mode_mc:SimpleButton;

// Declare default skin names for the button states.
// This is optional if you do not want to allow skinning.
var modeUpSkinName:String = "ModalUpSkin";
var modeOverSkinName:String = "ModalOverSkin";
var modeDownSkinName:String = "ModalDownSkin";

// Note that we test for the existence of the children before creating them.
// This is optional, but we do this so a subclass can create a different
// child instead.
function createChildren():Void
{
  if (text_mc == undefined)
    createClassObject(TextInput, "text_mc", 0, { preferredWidth: 80,
      editable:false });
  text_mc.addEventListener("change", this);
  text_mc.addEventListener("focusOut", this);

  if (mode_mc == undefined)
    createClassObject(SimpleButton, "mode_mc", 1,
             { falseUpSkin: modeUpSkinName,
             falseOverSkin: modeOverSkinName,
             falseDownSkin: modeDownSkinName });
  mode_mc.addEventListener("click", this);

}

/*** g) implement measure  ***/
// The default width is the size of the text plus the button.
// The height is dictated by the button.
function measure():Void
{
  _measuredPreferredWidth = text_mc.preferredWidth +
    mode_mc.preferredWidth;
  _measuredPreferredHeight = mode_mc.preferredHeight;
}

/*** h) implement layoutChildren   ***/
// Place the button depending on labelPlacement and fit the text in the
// remaining area.
function layoutChildren():Void
{
  text_mc.setSize(width - mode_mc.width, height);
  if (labelPlacement == "left")
  {
    mode_mc.move(width - mode_mc.width, 0);
```

```
    text_mc.move(0, 0);
  }
  else
  {
    mode_mc.move(0, 0);
    text_mc.move(mode_mc.width, 0);
  }
}

/*** i) implement draw  ***/

// Set flags when things change so we only do what we have to.
private var bTextChanged:Boolean = true;

// Set text if it changed, and draw a border.
function draw():Void
{
  clear();
  if (bTextChanged)
  {
    bTextChanged = false;
    text_mc.text = text;
  }
  // Draw a simple border around everything.
  drawRect(0, 0, width, height);
}

/*** j) add methods, properties, metadata ***/

// The general pattern for properties is to specify a private
// holder variable.
private var __labelPlacement:String = "left";

// Create a getter/setter pair so you know when it changes.
[Inspectable(defaultValue="left", enumeration="left, right")]
function set labelPlacement(p:String)
{
  // Store the new value.
  __labelPlacement = p;
  // Add invalidateSize(), invalidateLayout(), or invalidate(), depending on
  // what changed.  You may call more than one if you need to.
  invalidateLayout();
}

function get labelPlacement():String
{
  return __labelPlacement;
}

var __text:String = "ModalText";

[Inspectable(defaultValue="ModalText")]
function set text(t:String)
{
  __text = t;
```

```
      bTextChanged = true;
      invalidate();
    }

    function get text():String
    {
      if (bTextChanged)
        return __text;

      return text_mc.text;
    }

    // Handle events that are dispatched by the children.
    function handleEvent(evt:Object):Void
    {
      if (evt.type == "change")
      {
        dispatchEvent({ type: "change" });
      }
      else if (evt.type == "focusOut")
      {
        text_mc.editable = false;
      }
      else if (evt.type = "click")
      {
        text_mc.editable = !text_mc.editable;
      }
    }
}
```

The following is an example MXML file that instantiates the ModalText control and sets the `labelPlacement` property to `"left"`:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*"
  width="800" height="400">
  <ModalText labelPlacement="left"/>
</mx:Application>
```

Troubleshooting

This section describes some common problems and their solutions when creating components for Flex in Flash.

I get an error "don't know how to parse ..." when I try to use the component from MXML.

This means that the compiler could not find the SWC file, or the contents of the SWC file did not list the component. The MXML tag must match the `symbolName` for the component. Also, ensure that the SWC file is in a directory that Flex searches, and ensure that your `xmlns` property is pointing to the right place. Try moving the SWC file to the same directory as the MXML file and setting the namespace to "*" as the following example shows:

```
<mx:Application xmlns:mx="http://www.macromedia.com/2003/mxml" xmlns="*">
```

For more information, see “Using SWC files” on page 18.

I get an error "xxx is not a valid attribute ..." when I try to use the component from MXML.

Ensure that the attribute is spelled correctly and is marked as `Inspectable` in the metadata. The metadata syntax is not checked, so ensure that there are no misspellings or syntax errors. Also be sure that it is not private.

For more information, see "Inspectable" on page 63.

I don't get any errors, but nothing shows up.

Verify that the component was instantiated. One way to do this is to put a Button control and a TextArea control in the MXML application and set the `.text` property to the ID for the component when the button is clicked.

```
<!-- This verifies whether a component was instantiated. -->
<zz:mycomponent id="foo" xmlns:zz="zz.custom.mycomponents" />
<mx:TextArea id="output" />
<mx:Button label="Print Output" click="output.text = foo" />
```

I tried the verification test and I got nothing or "undefined" in the output.

This means that one of your dependent classes was either not loaded or was loaded too late. Print various classes to the output to see whether they are being created. Any components created with the `createClassObject()` method as subcomponents of your component must be placed in your component symbol.

For more information, see "Adding dependent components" on page 15.

A good practice is to create a hidden frame and place components on that frame. Then put a `stop()` action in the preceding frame, so the hidden frame never gets played. As an example, the ModalText symbol has a layer called assets and the `stop()` action on the main layer.

The component is instantiated properly but does not show up (#1)

In some cases, helper classes are not ready by the time your component requires them. Flex adds classes to the application in the order that they need to be initialized (base classes, and then child classes). However, if you have a static method that gets called as part of the initialization of a class, and that static method has class dependencies, Flex does not know to place that dependent class before the other class because it does not know when that method is going to be called.

One possible remedy is to add a static variable dependency to the class definition. Flex knows that all static variable dependencies must be ready before the class is initialized, so it orders the class loading correctly.

The following example adds a static variable to tell the linker that class A must be initialized before class B:

```
class mx.example.A {

  static function foo():Number
  {
    return 5;
  }
}
class mx.example.B
{
```

```
  static function bar():Number

  {
    return mx.example.A.foo();
  }

  static var z = B.bar();
  // Dependency
  static var ADependency = mx.example.A;
}
```

The component is instantiated properly but does not show up (#2)

Verify that the `_measuredPreferredWidth` and `_measuredPreferredHeight` properties are nonzero. If they are zero, ensure that you implemented the `measure()` method correctly. Sometimes you have to ensure that subobjects are created in order to get the correct measurements.

You can also check the values of the `preferredWidth` and `preferredHeight` properties. Other code might have set those values to 0. If so, set a breakpoint in the setters for the `width`, `height`, `preferredWidth`, and `preferredHeight` properties to see what is setting them.

You can also verify that the `visible` property and the `_visible` property are set to `true`. The `_visible` property is an internal property used by Flash Player. If `visible=true` and `_visible=false`, ensure that your component called the `invalidate()` method in its `measure()` or `layoutChildren()` methods.

The system does not call the `invalidate()` method unless you explicitly do so. All components must call the `invalidate()` method at least once, because their layout changes as they are given their correct size during the layout process.

The component is instantiated properly but does not show up (#3)

It is possible that there is another class or SWC file that overrides your custom class or the symbols used in your component. Check the ActionScript classes and SWC files in the *flex_app_root*/WEB-INF/flex/user_classes directory to ensure that there are no naming conflicts.

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