ADOBE® FLEX® 3
BUILDING AND DEPLOYING ADOBE FLEX 3 APPLICATIONS

Fx

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Building and Deploying Adobe Flex® 3 Applications

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Part 1: Application Design

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Chapter 1: Application Development Phases

It is difficult to define the exact process that all Adobe® Flex™ developers use to build and deploy applications. However, the process typically involves five distinct phases: design, configure, build, deploy, and secure.

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Design phase

In the design phase, you make basic decisions about how to write code for reusability, how your application interacts with its environment, how your application accesses application resources, and many other decisions. In the design phase, also define your development and deployment environments, including the directory structure of your application.

Although these design decisions specify how your application interacts with its environment, you also have architectural issues to decide. For example, you might choose to develop your application based on a particular design pattern, such as Model-View-Controller (MVC).

About design patterns

One common starting point of the design phase is to identify one or more design patterns relevant for your application. A design pattern describes a solution to a common programming problem or scenario. Although the design pattern might give you insight into how to approach an application design, it does not necessarily define how to write code for that solution.

Many types of design patterns have been catalogued and documented. For example, the Functional design pattern specifies that each module of your application performs a single action, with little or no side effects for the other modules in your application. The design pattern does not specify what a module is, commonly though it corresponds to a class or method.

About MVC

The goal of the Model-View-Controller (MVC) architecture is that by creating components with a well-defined and limited scope in your application, you increase the reusability of the components and improve the maintainability of the overall system. Using the MVC architecture, you can partition your system into three categories of components:

Model components Encapsulates data and behaviors related to the data processed by the application. The model might represent an address, the contents of a shopping cart, or the description of a product.

View components Defines your application's user interface, and the user's view of application data. The view might contain a form for entering an address, a DataGrid control for showing the contents of a shopping cart, or an image of a product.

Controller components Handles data interconnectivity in your application. The Controller provides application management and the business logic of the application. The Controller does not necessarily have any knowledge of the View or the Model.

For example, with the MVC design, you could implement a data-entry form that has three distinct pieces:

- The model consists of XML data files or the remote data service calls to hold the form data.
- The view is the presentation of any data and display of all user interface elements.
- The controller contains logic that manipulates the model and sends the model to the view.

The promise of the MVC architecture is that by creating components with a well-defined and limited scope, you increase the reusability of these components and improve the maintainability of the overall system. In addition, you can modify components without affecting the entire system.

Although you can consider a Flex application as part of the View in a distributed MVC architecture, you can use Flex to implement the entire MVC architecture on the client. A Flex application has its own view components that define the user interface, model components that represent data, and controller components that communicate with back-end systems.

About Struts

Struts is an open-source framework that facilitates the development of web applications based on Java servlets and other related technologies. Because it provides a solution to many of the common problems that developers face when building these applications, Struts has been widely adopted in a large variety of development efforts, from small projects to large-scale enterprise applications.

Struts is based on a Model-View-Controller (MVC) architecture, with a focus on the controller part of the MVC architecture. In addition, it provides JSP tag libraries to help you create the view in a traditional JSP/HTML environment.

Configure phase

Before you write your first line of application code, or before you deploy an application, you must ensure that you configure your environment correctly. Configuration is a broad term and encompasses several different tasks.

For example, you must configure your development and deployment environments to ensure that your application can access the required resources and data services. If your application requires access to a web service, ensure that your application has the correct access rights to the web service. If you application runs outside a firewall, ensure that it can access resources inside the firewall.

The following sections contain an overview of configuration tasks.

About run-time configuration

Most run-time configuration has to do with configuring access to remote data services, such as web services. For example, during application development, you run your application behind a firewall, where the application has access to all necessary resources and data services. However, when you deploy the application, you must ensure that an executing application can still access the necessary resources when the application runs outside of the firewall.

One configuration issue for Flex SDK applications is the placement of a crossdomain.xml file. For security, by default Flash Player does not allow an application to access a remote data service from a domain other than the domain from which the application was served. Therefore, a server that hosts a data service must be in the same domain as the server hosting your application, or the remote server must define a crossdomain.xml file. A crossdomain.xml file is an XML file that provides a way for a server to indicate that its data and documents are available to SWF files served from specific domains, or from all domains. By default, place the crossdomain.xml at the root directory of the server that is serving the data.

Flex SDK does not include a server-side proxy for handling data service requests. Therefore, you must ensure that you configure data services for direct access by your application, or make data service requests through your own proxy server.

Build phase

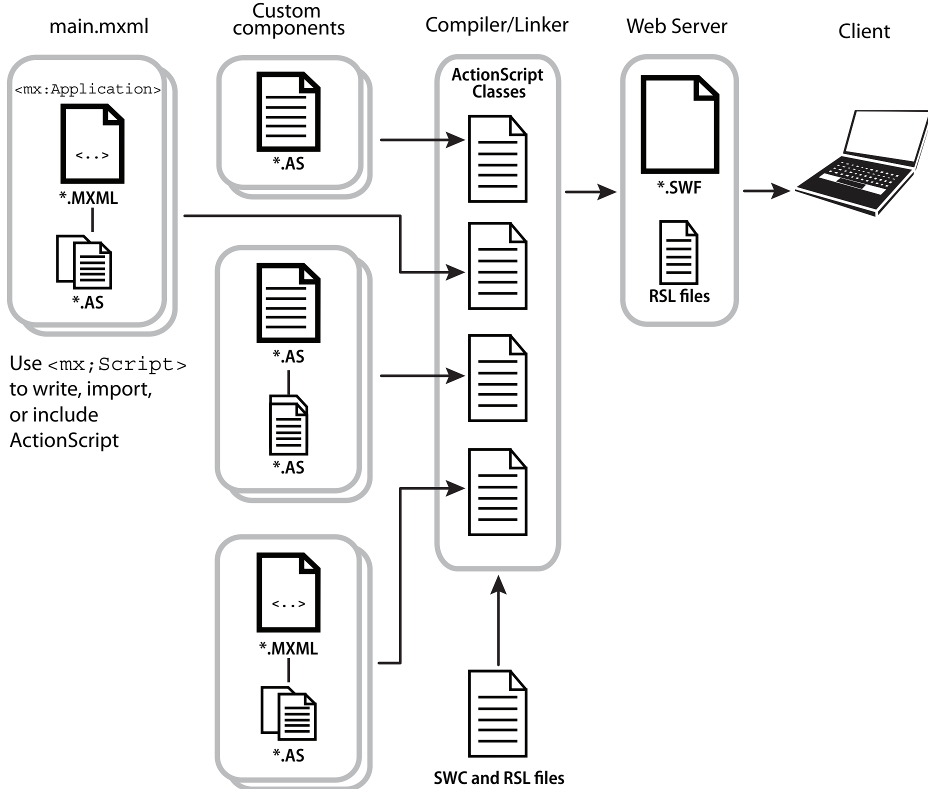
Building your application is an iterative process that includes three main tasks:

1. Compile
2. Debug
3. Test

About compiling

Compiling your application converts your application files and assets into a single SWF file. During compilation, you set compiler options to enable accessibility, enable debug information in the output, set library paths, and set other options. You can configure the compiler as part of configuring your project in Flex Builder, by using command-line arguments to the compiler, or by setting options in a configuration file.

When you compile your application, the Flex compiler creates a single SWF file from all of the application files (Adobe® MXML™, AS, RSL, SWC, and asset files), as the following example shows:



Flex provides two compilers: mxmlc and compc. You can use the compc and mxmlc compilers from within Flex Builder or from a command line.

You use mxmlc to compile MXML, ActionScript, SWC, and RSL files into a single SWF file. After your application is compiled and deployed on your web or application server, a user can make an HTTP request to download and play the SWF file on their computer.

You use compc to create resources that you use to create the application. For example, you can compile components, classes, and other files into SWC files or into RSLs, and then statically or dynamically link these libraries to your application.

For more information, see “Using the Flex Compilers” on page 125.

About debugging an application

Flex provides several tools that you use to debug your application, including the following:

AIR Debug Launcher (ADL) A command line version of the Adobe® AIR™ debugger that you can use outside of Adobe® Flex™ Builder™.

Flash Player You can run Flex applications in two different versions of Adobe® Flash® Player: the standard version, which the general public uses, and the debugger version, which application developers use to debug their applications during the development process.

Flex Builder visual debugger The Flex Builder debugger allows you to run and debug applications. You can use the debugger to set and manage breakpoints; control application execution by suspending, resuming, and terminating the application; step into and over the code; watch variables; evaluate expressions; and so on.

Flex Command-line debugger A command line version of the debugger that you can use outside of Flex Builder.

For more information, see “Using the Command-Line Debugger” on page 245.

About testing an application

Due to the size, complexity, and large amounts of data handled by applications, maintaining the quality of a large software application can be difficult. To help with this task, you can use automated testing tools that test and validate application behavior without human intervention.

The Flex Automation Package provides developers with the ability to create Flex applications that use the Automation API. You can use this API to create automation agents or to ensure that your applications are ready for testing. In addition, the Flex Automation Package includes support for Mercury QuickTest Professional (QTP) automation tool. for more information, see “Creating Applications for Testing” on page 356.

Deploy phase

When you deploy your application, you make it available to customers. Typically, you deploy the application as a SWF file on a web server so that users can access it by using an HTTP request to the SWF file.

When you deploy the application’s SWF file, you must also deploy all of the assets required by the application. For example, if the application requires access to video or image files, or to XML data files, you must make sure to deploy those assets as well. If the application uses an RSL, you must also deploy the RSL.

Deploying assets may not necessarily be as simple as copying the assets to a location on your web server. Flash Player has built-in security features that controls the access of application assets at run time.

This section contains an overview of the deployment phase. For more information, see “Deploying Flex Applications” on page 299.

What happens during a request to a SWF file

When a customer requests the SWF file, the web server or application server returns the SWF file to the client computer. The SWF file then runs locally on the client.

In some cases, a request to a Flex SWF file can cause multiple requests to multiple SWF files. For example, if your application uses Runtime Shared Libraries (RSLs), the web server or application server returns an RSL as a SWC file to the client along with the application SWF file.

Server-side caching

Your web server or application server typically caches the SWF file on the first request, and then serves the cached file on subsequent requests. You configure server-side caching by using the options available in your web server or application server.

Client-side caching

The SWF file returned to the client is typically cached by the customer's browser on first request. Depending on the browser configuration, the SWF file typically remains in the cache until the browser closes. When the browser reopens, the next request to the SWF file must reload it from the server.

Integrating Flex applications with your web application

To incorporate a Flex application into a website, you typically embed the SWF file in an HTML, JSP, Adobe® ColdFusion®, or other type of web page. The page that embeds the SWF file is known as the *wrapper*.

A wrapper consists of an `<object>` tag and an `<embed>` tag that format the SWF file on the page, define data object locations, and pass run-time variables to the SWF file. In addition, the wrapper can include support for deep linking and Flash Player version detection and deployment.

When you compile an application with Flex Builder, it automatically creates a wrapper file for you in the bin directory associated with the Flex Builder project. You can copy the contents of the wrapper file into your HTML pages to reference the SWF file.

You can edit the wrapper to manipulate how Flex appears in the browser. You can also add JavaScript or other logic in the page to communicate with Flex or generate customized pages.

When using the mxmlc command-line compiler, you must write the wrapper yourself. For more information, see "Creating a Wrapper" on page 311.

Secure phase

Security is not necessarily a phase of the application development process, but is an issue that you should take into consideration during the entire development process. That is, you do not configure, build, test, and deploy an application, and then define the security issues. Rather, you take security into consideration during all phases.

Building security into your application often takes the following main efforts:

- Using the security features built into Flash Player
- Building security into your application

Flash Player has several security features built into it, including sandbox security, that you can take advantage of because you are building applications for Flash Player.

But, Flash Player security is not enough for many application requirements. For example, your application may require the user to log in, or perform authentication in some other way, before accessing data services. When you must handle security issues beyond those built into Flash Player, design them into your application from the initial design phase, test them during the compile phase, and verify them during the deploy phase.

For more information on security, see "Applying Flex Security" on page 29.

About the security model

The Flex security model protects both the client and the server. Consider the following general aspects of security when you deploy Flex applications:

- Flash Player operating in a sandbox on the client
- Authorizing and authenticating users who access a server's resources

Flash Player runs inside a security sandbox that prevents the client from being hijacked by malicious application code. This sandbox prevents a user from running a Flex application that can access system files and perform other tasks.

Flash Player security

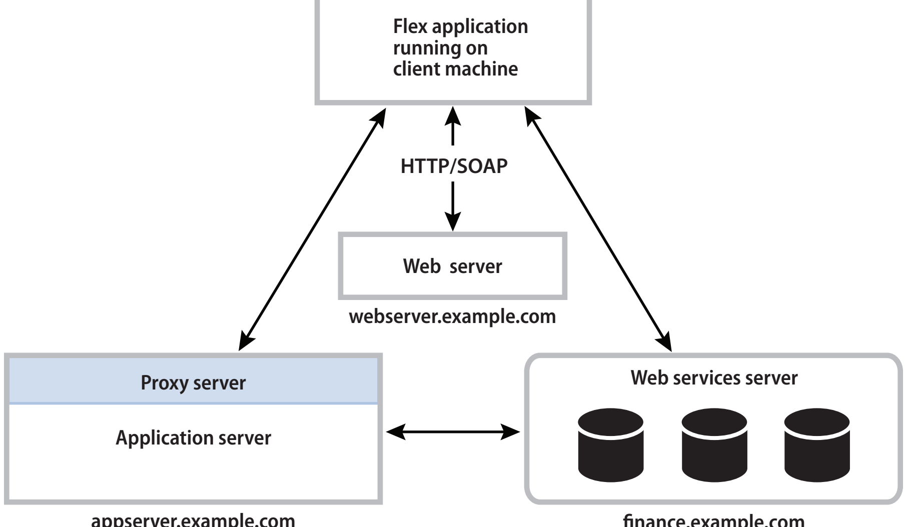
Flash Player has an extensive list of features that ensure Flash content is secure, including the following:

- Uses the encryption capabilities of SSL in the browser to encrypt all communications between a Flash application and the server
- Includes an extensive sandbox security system that limits transfer of information that might pose a risk to security or privacy
- Does not allow applications to read data from the local drive, except for SharedObjects that were created by that domain
- Does not allow writing any data to the disk except for data that is encapsulated in SharedObjects

- Does not allow web content to read any data from a server that is not from the same domain, unless that server explicitly allows access
- Enables the user to disable the storage of information for any domain
- Does not allow data to be sent from a camera or microphone unless the user gives permission

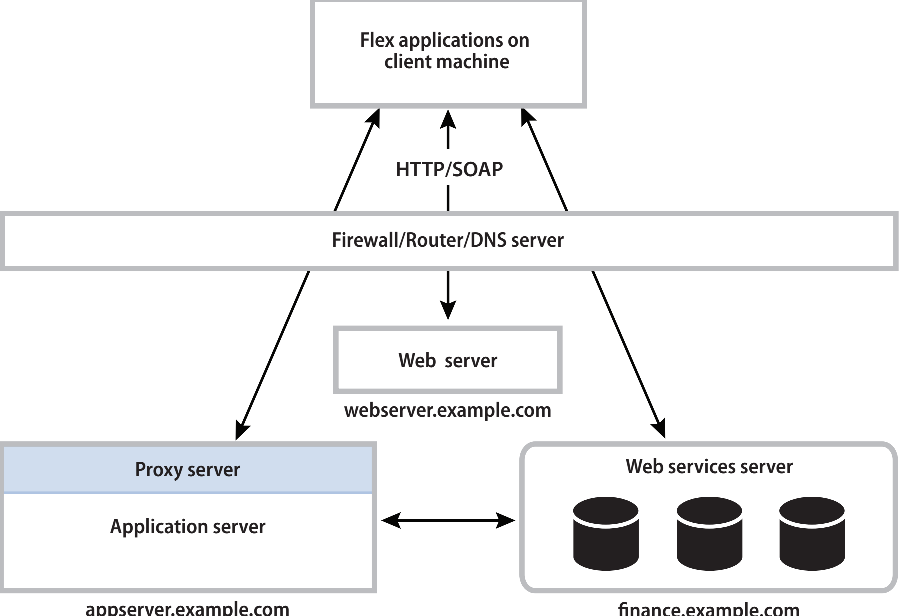
Application Development in Flex SDK

The following example shows a typical development environment for a Flex SDK application:



In this example, application development happens in an environment that is behind a firewall, and you deploy your application SWF file on webserver.example.com. To run the application, you make a request to it from a computer that is also within the firewall. The executing SWF file can access resources on any other server as necessary. In the development environment, the SWF file can directly access web services, or it can access them through a proxy server.

The following example shows a typical deployment environment for a Flex SDK application:



In this example, the customer requests the application SWF file from webserver.example.com, the server returns the SWF file to the customer, and the SWF file plays. The executing SWF file must be able to access the necessary resources from outside the firewall.

Design phase

With Flex SDK, one of your first design decisions might be to choose a design pattern that fits your application requirements. That design pattern might have implications on how you structure your development environment, determine the external data services that your application must access, and define how you integrate your Flex application into a larger web application.

Configure phase

For run-time configuration, you ensure that your executing SWF file can access the necessary resources including asset files (such as image files) and external data services. If you access a resource on a domain other than the domain from which the SWF file is served, you must define a crossdomain.xml file on the target server, or make the request through a proxy server.

Build phase

To build an application for Flex SDK, you define a directory structure on your development system for application files, and define the location of application assets. You then compile, debug, and test your application.

The compile-time configuration for a Flex SDK application is primarily a process of setting compiler options to define the location of SWC and RSLs, to create a SWF file with debug information, or to set additional compiler options. When compiling applications, you compile your application into a single SWF file, and then deploy the SWF file to a web server or application server for testing.

Deploy phase

With Flex SDK, you deploy your application SWF file on your web server or application server. Users then access the deployed SWF file by making an HTTP request in the form:

```
http://hostname/path/filename.swf
```

If you embed your SWF file in an HTML or other type of web page using a wrapper, users request the wrapper page. The request to the wrapper page causes the web server or application server to return the SWF file along with the wrapper page.

Secure phase

Security issues for Flex SDK applications often have to do with how the application accesses external resources. For example, you might require a user to log in to access resources, or you might want the application to be able to access external data services that implement some other form of access control.

Chapter 2: Flex Application Structure

One of your first tasks when developing an Adobe® Flex™ application is to set up your development directory structure. As part of setting up this directory structure, you must decide how to organize your application assets, how to share assets across applications, and how to configure the compiler to create your application SWF file.

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Installation directory structure

Before you can begin to set up your application development environment, be familiar with the Flex installation directory structure for the following products:

- Flex SDK
- Adobe ® Flex® Builder™

Flex SDK installation directory structure

When you install Flex SDK, the installer creates the following directory structure under the installation directory:

Directory	Description
/ant	Contains the Flex Ant tasks, which provide a convenient way to build your Flex projects.
/asdoc	Contains ASDoc, a command-line tool that you can use to create API language reference documentation as HTML pages from the classes in your Flex application.
/bin	Contains the executable files, such as the mxmlc and compc compilers.
/frameworks	Contains configuration files, such as flex-config.xml and default.css.
/frameworks/libs	Contains the library SWC files. You use the files to compile your application.
/frameworks/locale	Contains the localization resource files.

Directory	Description
/frameworks/projects	Contains the Flex framework source code.
/frameworks/rsls	Contains the RSL for the Flex framework.
/frameworks/themes	Contains the theme files that define the basic look and feel of all Flex components.
/lib	Contains JAR files.
/runtimes	Contains the standard and debugger versions of Adobe ® Flash® Player and the Adobe® AIR™ components.
/samples	Contains sample applications.
/templates	Contains template HTML wrapper files.

Flex Builder installation directory structure

When you install Flex Builder, you install Flex SDK plus Flex Builder. The installer creates the following directory structure:

Directory	Description
Flex Builder 3	The top-level directory for Flex Builder.
/configuration	A standard Eclipse folder that contains the config.ini file and error logs.
/features	A standard Eclipse folder that contains the plug-ins corresponding to features of Flex Builder.
/jre	Contains the Java Runtime Environment installed with Flex Builder used by default when you run the stand-alone version of Flex Builder.
/Player	Contains the different versions of Flash Player—the standard version and the debugger version.
/plugins	Contains the Eclipse plugins used by Flex Builder.
/sdks	Contains the different Flex SDKs. For a directory description, see "Flex SDK installation directory structure" on page 15.

Development directory structure

As part of the process of setting up the directory structure of your development environment, you define the directory location for application-specific assets, assets shared across applications, and the location of other application files and assets.

Flex file types

A Flex application consists of many different file types. Consider the following options when you decide where to place each type of file.

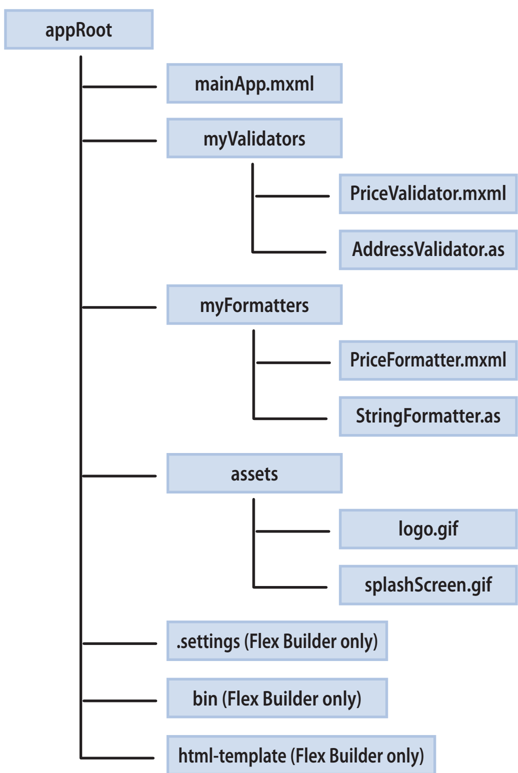
The following table describes the different Flex file types:

File format	Extension	Description
MXML	.mxml	Your application typically has one main application MXML file that contains the `<mx:Application>` tag, and one or more MXML files that implement your custom MXML components.
ActionScript	.as	A utility class, Flex custom component class, or other logic implemented as an ActionScript file.
SWC	.swc	A custom library file, or a custom component implemented as an MXML or ActionScript file, then packaged as a SWC file. A SWC file contains components that you package and reuse among multiple applications. The SWC file is then statically linked into your application at compile time when you create the application's SWF file.
RSL	.swc	A custom library implemented as an MXML or ActionScript file, and then deployed as a Runtime Shared Library (RSL). An RSL is a stand-alone SWC file that is downloaded separately from your application's SWF file, cached on the client computer for use with multiple application SWF files, and dynamically linked to your application.
CSS file	.css	A text file template for creating a Cascading Style Sheets file.
Assets	.flv, .mp3, .jpg, .gif, .swf, .png, .svg, .xml, other	The assets required by your application, including image, skin, sound, and video files.

Flex SDK directory structure

A typical Flex application consists of a main MXML file (the file that contains the `<mx:Application>` tag), one or more MXML files that implement custom MXML components, one or more ActionScript files that contains custom components and custom logic, and asset files.

The following example shows an example of the directory structure of a simple Flex application:



This application consists of a root application directory and directories for different types of files. Everything required to compile and run the application is contained in the directory structure of the application.

Flex Builder adds additional directories to the application that are not present for Flex SDK applications:

.settings Contains the preference settings for your Flex Builder project

bin-debug Contains the debug SWF and debug wrapper files

bin-release Contains the generated SWF file and wrapper file, created by Flex Builder when you select File > Export > Release Version

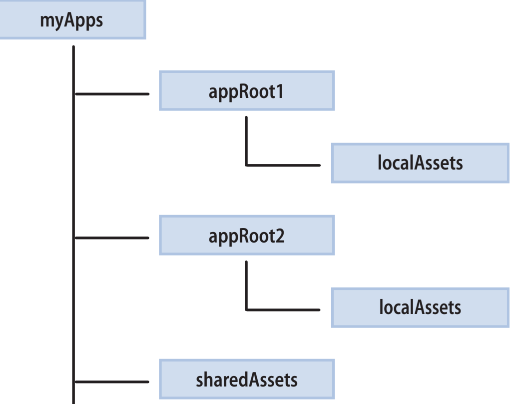
html-template Contains additional files used by specific Flex features, such as deep linking or Player detection. Flex Builder uses these files to generate an HTML wrapper for your SWF file.

There are no inherent restrictions in Flex for the location of the root directory of your application, so you can put it almost anywhere in the file system of your computer. If you are using Flex Builder, the default location of the application root directory in Microsoft Windows is My Documents\Flex Builder 3*project_name* (for example, C:\Documents and Settings*userName*\My Documents\Flex Builder 3\myFlexApp).

Sharing assets among applications

Typically, you do not develop a single application in isolation from all other applications. Your application shares files and assets with other applications.

The following example shows two Flex applications, appRoot1 and appRoot2. Each application has a directory for local assets, and can access shared assets from a directory outside of the application's directory structure:



The location of the shared assets does not have to be at the same level as the root directories of the Flex applications. It only needs to be somewhere accessible by the applications at compile time.

In the following example, you use the Image control in an MXML file in the appRoot1 directory to access an asset from the shared assets directory:

```
<?xml version="1.0"?>
<!-- apparch/EmbedExample.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
  <mx:Image id="loader1" source="@Embed(source='../assets/butterfly.gif')"/>
</mx:Application>
```

Consideration for accessing application assets

One of the decisions that you must make when you create a Flex application is whether to load your assets at run time, or to embed the assets within the application's SWF file.

When you embed an asset, you compile it into your application's SWF file. The advantage to embedding an asset is that it is included in the SWF file, and can be accessed faster than having to load it from a remote location at run time. The disadvantage of embedding is that your SWF file is larger than if you load the asset at run time.

If you decide to access an asset at run time, you can load it from the local file system of the computer on which the SWF file runs, or you can access a remote asset, typically though an HTTP request over a network.

A SWF file can access one type of external asset: local or over a network; the SWF file cannot access both types. You determine the type of access allowed by the SWF file by using the `use-network` flag when you compile your application. When you set the `use-network` flag to `false`, you can access assets in the local file system, but not over the network. The default value is `true`, which lets you access assets over the network, but not in the local file system.

For more information on the `use-network` flag, see "Using the Flex Compilers" on page 125. For more information on embedding application assets, see "Embedding Assets" on page 965 in the *Adobe Flex 3 Developer Guide*.

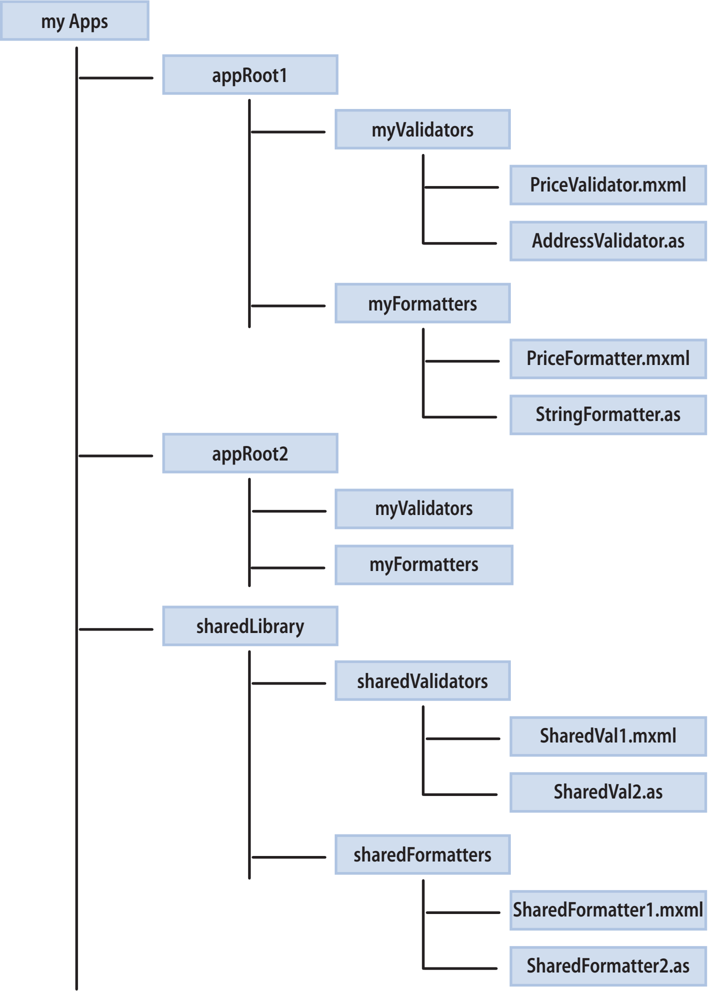
Sharing MXML and ActionScript files among applications

You can build an entire Flex application in a single MXML file that contains both your MXML code and any supporting ActionScript code. As your application gets larger, your single file also grows in size and complexity. This type of application would soon become difficult to understand and debug, and very difficult for multiple developers to work on simultaneously.

Flex supports a component-based development model. You use the predefined components included with Flex to build your applications, and create components for your specific application requirements. You can create custom components using MXML or ActionScript.

Defining your own components has several benefits. One advantage is that components let you divide your applications into modules that you can develop and maintain separately. By implementing commonly used logic within custom components, you can also build a suite of reusable components that you can share among multiple Flex applications.

The following example shows two Flex applications, appRoot1 and appRoot2. Each application has a subdirectory for local MXML and ActionScript components, and can also reference a library of shared components:



The Flex compiler uses the source path to determine the directories where it searches for MXML and ActionScript files. By default, the root directory of the application is included in the source path; therefore, a Flex application can access any MXML and ActionScript files in its main directory, or in a subdirectory.

For shared MXML and ActionScript files that are outside of the application's directory structure, you modify the source path to include the directories that the compiler searches for MXML and ActionScript files. The component search order in the source path is based on the order of the directories listed in the source path.

You can set the source path as part of configuring your project in Flex Builder, in the flex-config.xml file, or set it when you open the command-line compiler. In this example, you set the source path to:

```
C:\myApps\sharedLibrary
```

To access a component in an MXML file, you specify a namespace definition that defines the directory location of the component relative to the source path. In the following example, an MXML file in the appRoot1 directory accesses an MXML component in the local directory structure, and in the directory containing the shared library of components:

```
<?xml version="1.0"?>
<!-- apparch/ComponentNamespaces.mxml -->
<mx:Application
  xmlns:mx="http://www.adobe.com/2006/mxml"
  xmlns:MyLocalComps="myFormatters.*"
  xmlns:MySharedComps="sharedFormatters.*"
>

  <MyLocalComps:PriceFormatter/>

  <MySharedComps:SharedFormatter2/>

</mx:Application>
```

The MXML tag name for a custom component is composed of two parts: the namespace prefix, in this example MyLocalComps and MySharedComps, and the tag name. The namespace prefix tells Flex the directory in the source path that contains the file that implements the custom component. The tag name corresponds to the filename of the component, in this example PriceFormatter.mxml and SharedFormatter2.mxml.

Using a SWC file in a Flex SDK application

A SWC file is a Flex library file that contains one or more components implemented in MXML or ActionScript. All Flex library files are shipped as SWC files in the frameworks/libs directory. This includes the following SWC files:

- framework.swc
- playerglobal.swc
- rpc.swc

You can also create SWC files that you package and reuse among multiple applications. You typically use static linking with SWC files, which means the compiler includes all components, classes, and their dependencies in the application SWF file when you compile the application. For more information on static linking, see "About linking" on page 196.

By default, the Flex compiler includes all SWC files in the frameworks/libs directory when it compiles your application. For your custom SWC files, you use the `library-path` option of the mxmlc compiler, or set the library path in Flex Builder, to specify the location of the SWC file.

Using an RSL in a Flex SDK application

One way to reduce the size of your application's SWF file is by externalizing shared assets into stand-alone files that can be separately downloaded and cached on the client. These shared assets are loaded by any number of applications at run time, but must be transferred to the client only once. These shared files are known as Runtime Shared Libraries or RSLs.

An RSL is a stand-alone file that the client downloads separately from your application's SWF file, and caches on the client computer for use with multiple application SWF files. Using an RSL reduces the resulting file size for your applications. The benefits increase as the number of applications that use the RSL increases. If you only have one application, putting components into RSLs does not reduce the aggregate download size, and might increase it.

You create an RSL as a SWC file that you package and reuse among multiple applications. To reference an RSL, you use the `runtime-shared-libraries` option for the command-line compiler, or Flex Builder. You typically use dynamic linking with RSLs, which means that the classes in the RSL are left in an external file that is loaded at run time.

Every Flex application uses some aspects of the Flex framework, which is a relatively large set of ActionScript classes that define the infrastructure of a Flex application. If a client loads two different Flex applications, the application will likely load overlapping class definitions. To further reduce the SWF file size, you can use *framework* RSLs. Framework RSLs let you externalize the framework libraries and can be used with any Flex application.

For more information on RSLs, framework RSLs, and dynamic linking, see "Using Runtime Shared Libraries" on page 195.

Using modules in a Flex SDK application

Modules are SWF files that can be loaded and unloaded by an application. They cannot be run independently of an application, but any number of applications can share the modules.

Modules let you split your application into several separate SWF files. The main application, or shell, can dynamically load other SWF files that it requires, when it needs them. It does not have to load all modules when it starts, nor does it have to load any modules if the user does not interact with them. When the application no longer needs a module, it can unload the module to free up memory and resources.

For more information, see "Creating Modular Applications" on page 981.

Compiling an application

Compiling your application converts your application files and assets into a single SWF file. During compilation, you set compiler options to enable accessibility, enable debug information in the output, set library paths, and set other options. You can configure the compiler as part of configuring your project in Flex Builder, by using command-line arguments to the compiler, or by setting options in a configuration file.

For more information on compiling applications, see "Using the Flex Compilers" on page 125.

About case sensitivity during a compile

The Flex compilers use a case-sensitive file lookup on all file systems. On case-insensitive file systems, such as the Macintosh and Windows file systems, the Flex compiler generates a case-mismatch error when you use a component with the incorrect case. On case-sensitive file systems, such as the UNIX file system, the Flex compiler generates a component-not-found error when you use a component with the incorrect case.

Compiling a Flex SDK application

Flex SDK includes two compilers, mxmlc and compc. You use mxmlc to compile MXML files, ActionScript files, SWC files, and RSLs into a single SWF file. After your application is compiled and deployed on your web or application server, a user can make an HTTP request to download and play the SWF file on their computer. You use the compc compiler to compile components, classes, and other files into SWC files or RSLs.

To compile an application with Flex SDK, you use the mxmlc compiler in the bin directory of your Flex SDK directory. The most basic mxmlc example is one in which the MXML file for your application has no external dependencies (such as components in a SWC file or ActionScript classes). In this case, you open mxmlc from the command line and point it to your MXML file, as the following example shows:

```
$ mxmlc c:/myFiles/app.mxml
```

The mxmlc compiler has many options that you can specify on the command line, or that you can set in the flex-config.xml file. For example, to disable warning messages, you set the `warnings` options to `false`, as the following example shows:

```
$ mxmlc -warnings=false c:/myFiles/app.mxml
```

You only specify the main application file, the file that contains the `<mx:Application>` tag, to the compiler. The compiler searches the default source path for any MXML and ActionScript files that your application references. If your application references MXML and ActionScript files in directories that are not included in the default source path, you can use the `source-path` option to add a directory to the source path, as the following example shows:

```
$ mxmlc -source-path path1 path2 path3 c:/myFiles/app.mxml
```

In this example, you specify a list of directories, separated by spaces, and terminate that list with `--`.

Compiling an application that uses SWC files

Often, you use SWC files when compiling MXML files. You specify the SWC files in the compiler by using the `library-path` option.

The following example adds two SWC files to the `library-path` when it compiles your application:

```
$ mxmlc -library-path+=/myLibraries/MyRotateEffect.swc;/myLibraries/MyButtonSwc.swc
c:/myFiles/app.mxml
```

Compiling an application that uses RSLs

To use an RSL in your application, use the `runtime-shared-library-path` compiler option. The following example compiles an application with an RSL at the command line:

```
$ mxmlc -runtime-shared-library-path=../lib/mylib.swc,../bin/library.swf Main.mxml
```

Compiling an application that uses modules

The way you compile modules is similar to the way you compile Flex applications. On the command line, you use the mxmlc command-line compiler. The result is a SWF file that you load into your application as a module.

You cannot run the module-based SWF file as a stand-alone application or load it into a browser window. It must be programmatically loaded by an application as a module.

For more information on compiling modules on the command line, see “Creating Modular Applications” on page 981

Compiling a Flex Builder application

When you compile a project with Flex Builder, you open the Flex compilers from within Flex Builder itself, not from the command line. You can build your projects manually or let Flex Builder automatically compile them for you. In either case, the Flex Builder compiler creates the SWF application files, generates a wrapper, places the output files in the proper location, and alerts you to any errors encountered during compilation. You then run and debug your applications as needed.

If you must modify the default build settings, you have several options for controlling how your projects are built into applications. For example, you can set build preferences on individual projects or on all the projects in your workspace, modify the build output path, change the build order, and so on. You can also create custom build instructions using third-party tools, such as Apache Ant.

When your projects are built, automatically or manually, Flex Builder places the SWF file in the project output folder along with the wrapper. By default, this is the debug version of your application. It contains debugging information and, therefore, is used when you debug your application. A wrapper file embeds the application SWF file and is used to run or debug your application in a web browser. The standard version of your application SWF files, which you generate through Export Release Version, does not include the additional debugging information and is smaller.

Compiling an application that uses modules

In Flex Builder, you create modules as applications and compile them by either building the project or running the application. The result is a SWF file that you load into your application as a module.

You cannot run the module-based SWF file as a stand-alone Flex application or load it into a browser window. It must be loaded by an application as a module. When you run it in Flex Builder to compile it, you should close the Player or browser Window and ignore any errors. Modules should not be requested by the Player or through a browser directly.

For information on compiling modules in Flex Builder, see “Creating Modular Applications” on page 981

Deployment directory structure

When you deploy an application, ensure that the directory structure of the deployed application is correct.

When you deploy your application, must be aware of how your application accesses its assets. If you embedded all of your application assets into the SWF file, you can deploy the application as a stand-alone SWF file.

However, if your application accesses assets at run time, the application requests assets during execution. You must ensure that you deploy all of the necessary assets, in the correct location, so that you can run the application correctly.

Assets that you deploy at run time include:

- HTML wrapper
- Deep linking files
- Express Install files
- RSLs
- Modules
- Compiled CSS SWF files
- Resource modules (for localization)
- Images, sound files, and other binary assets that are not embedded
- Data files

In some cases, the deployed locations of these files must match the locations of the files during development. For example, if you load modules from the same directory as your main application, then you must deploy these modules to that directory, unless you programmatically handle alternative locations to load the modules from.

In other cases, the deployed locations of these files is specified. For example, the deep linking files history.css, historyFrame.html, and history.js must all reside in a /history subdirectory that is located relative to the application's SWF file.

And in other cases, you specify the eventual deployed location of these assets when you compile your application. For example, if you compiled your application using an RSL, you must ensure that the RSL is also deployed to your web server, along with your application's SWF file. The directory location of the RSL must match the directory location that you specified at compile time using the `runtime-shared-libraries` or `runtime-shared-library-path` options for the compiler.

For more information about what assets to deploy with your application, see "Deployment checklist" on page 304.

Chapter 3: Applying Flex Security

Developers (including programmers and other authors) who design and publish Flex applications can control the security aspects of the applications they develop by using Flex.

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Introduction

Adobe® Flash® Player runs applications built with Flash. (These applications are also referred to as SWF files). Content is delivered as a series of instructions in binary format to Flash Player over web protocols in the precisely described SWF (.swf) file format. The SWF files themselves are typically hosted on a server and then downloaded to, and displayed on, the client computer when requested. Most of the content consists of binary ActionScript instructions. ActionScript is the ECMA standards-based scripting language that Flash uses that features APIs designed to allow the creation and manipulation of client-side user interface elements and for working with data.

The Flex security model protects both client and the server. Consider the following two general aspects to security:

- Authorization and authentication of users accessing a server's resources
- Flash Player operating in a sandbox on the client

Flex supports working with the web application security of any J2EE application server. In addition, precompiled Flex applications can integrate with the authentication and authorization scheme of any underlying server technology to prevent users from accessing your applications. The Flex framework also includes several built-in security mechanisms that let you control access to web services, HTTP services, and server-based resources such as EJBs.

Flash Player runs inside a security sandbox that prevents the client from being hijacked by malicious application code.

***Note:** SWF content running in the Adobe® AIR™ follows different security rules than content running in the browser. For details, see the "AIR Security" section in* Developing AIR Applications with Adobe Flex 3.

Declarative compared to programmatic security

The two common approaches to security are declarative and programmatic. Often, declarative security is server based. Using the server's configuration, you provide protection to a resource or set of resources. You use the container's authentication and authorization schemes to protect that resource from unauthorized access.

The declarative approach to security casts a wide net. Declarative security is implemented as a separate layer from the web components that it works with. You set up a security system, such as a set of file permissions or users, groups, and roles, and then you plug your application's authentication mechanism into that layer.

With declarative security, either a user gains access to the resource or they do not. Usually the content cannot be customized based on roles. In an HTML-based application, the result is that users are denied access to certain pages. However, in a Flex environment, the typical result of declarative security is that the user is denied access to the entire application, since the application is seen as a single resource to the container.

Declarative security lets programmers who write web applications ignore the environment in which they write. Declarative security is typically set up and maintained by the deployer and not the developer of the application. Also, updates to the web application do not generally require a refactoring of the security model.

Programmatic security gives the developer of the application more control over access to the application and its resources. Programmatic security can be much more detailed than declarative security. For example, a developer using programmatic security can allow or deny a user access to a particular component inside the application.

Although programmatic security is typically configured by the developer of the application, it usually interacts with the same systems as declarative security, so the relationship between developer and deployer of the application must be cooperative when implementing programmatic security.

Declarative security is recommended over programmatic security for most applications because the design promotes code reuse, making it more maintainable. Furthermore, declarative security puts the responsibility of security into the hands of the people who specialize in its implementation; application programmers can concentrate on writing applications and people who deploy the applications in a specific environment can concentrate on enforcing security policies and take advantage of that context.

Client security overview

When considering security issues, you cannot think of Flex applications as traditional web applications. Flex applications often consist of a single monolithic SWF file that is loaded by the client once, or a series of SWF files loaded as modules or RSLs. Web applications, on the other hand, usually consist of many individual pages that are loaded one at a time.

Most web applications access resources such as web services that are outside of the client. When a Flex application accesses an external resource, two factors apply:

- Is the user authorized to access this resource?
- Can the client load the resource, or is it prevented from loading the resource, because of its sandbox limitations?

The following basic security rules always apply by default:

- Resources in the same security sandbox can always access each other.
- SWF files in a remote sandbox can never access local files and data.

You should consider the following security issues related to the client architecture that affect Flex applications.

Flash Player security features

Much of Flash Player security is based on the domain of origin for loaded SWF files, media, and other assets. A SWF file from a specific Internet domain, such as www.example.com, can always access all data from that domain. These assets are put in the same security grouping, known as a security sandbox. For example, a SWF file can load SWF files, bitmaps, audio, text files, and any other asset from its own domain. Also, cross-scripting between two SWF files from the same domain is permitted, as long as both files are written using ActionScript 3.0. Cross-scripting is the ability of one SWF file to use ActionScript to access the properties, methods, and objects in another SWF file. Cross-scripting is not supported between SWF files written using ActionScript 3.0 and files using previous versions of ActionScript; however, these files can communicate by using the LocalConnection class.

Memory usage and disk storage protections

Flash Player includes security protections for disk data and memory usage on the client computer.

The only type of persistent storage is through the SharedObject class, which is embodied as a file in a directory whose name is related to that of the owning SWF file. A Flex application cannot typically write, modify, or delete any files on the client computer other than SharedObject data files, and it can only access SharedObject data files under the established settings per domain.

Flash Player helps limit potential denial-of-service attacks involving disk space (and system memory) through its monitoring of the usage of SharedObject classes. Disk space is conserved through limits automatically set by Flash Player (the default is 100K of disk space for each domain). The author can set the application to prompt the user for more disk space, or Flash Player automatically prompts the user if an attempt is made to store data that exceeds the limit. In either case, the disk space limit is enforced by Flash Player until the user gives explicit permission for an increased allotment for that domain.

Flash Player contains memory and processor safeguards that help prevent applications from taking control of excess system resources for an indefinite period of time. For example, Flash Player can detect an application that is in an infinite loop and select it for termination by prompting the user. The resources that the application uses are immediately released when the application closes.

Flash Player uses a garbage collector engine. The processing of new allocation requests always first ensures that memory is cleared so that the new usage always obtains only clean memory and cannot view any previous data.

Privacy

Privacy is an important aspect of overall security. Adobe products, including Flash Player, provide very little information that would reveal anything about a user (or their computer). Flash Player does not provide personal information about users (such as names, e-mail addresses, and phone numbers), or provide access to other sensitive information (such as credit card numbers or account information).

What Flash Player does provide is basically standardized hardware and software configuration information that authors might use to enhance the user experiences in the environment encountered. The same information is often available already from the operating system or web browser.

Information about the client environment that is available to the Flex application includes:

- User agent string, which typically identifies the embedding browser type and operating system of the client
- System capabilities such as the language or the presence of an MP3 decoder (see the Capabilities class)
- Presence of a camera and microphone
- Keyboard and mouse input

ActionScript also includes the ability to replace the contents of the client's Clipboard by using the `setClipboard()` method of the System class. This method does not have a corresponding `getClipboard()` method, so protected data that might be stored in the Clipboard already is not accessible to Flash Player.

About sandboxes

The sandbox type indicates the type of security zone in which the SWF file is operating. In Flash Player, all SWF files (and HTML files, for the purposes of SWF-to-HTML scripting) are placed into one of four types of sandbox:

remote All files from non-local URLs are placed in a remote sandbox. There are many such sandboxes, one for each Internet (or intranet) domain from which files are loaded.

local-with-filesystem The default sandbox for local files. SWF files in this sandbox may not contact the Internet (or any servers) in any way—they may not access network endpoints with addresses such as HTTP URLs.

local-with-networking SWF file in this sandbox may communicate over the network but may not read from local file systems.

local-trusted This sandbox is not restricted. Any local file can be placed in this sandbox if given authorization by the end user. This authorization can come in two forms: interactively through the Settings Manager or noninteractively through an executable installer that creates Flash Player configuration files on the user's computer.

You can determine the current sandbox type by using the `sandboxType` property of the Security class, as the following example shows:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- security/DetectCurrentSandbox.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" creationComplete="initApp()">
    <mx:Script><![CDATA[
        [Bindable]
        private var l_sandboxType:String;

        private function initApp():void {
            l_sandboxType = String(Security.sandboxType);
        }
    ]]></mx:Script>

    <mx:Form>
        <mx:FormItem id="fi1" label="Security.sandboxType">
            <mx:Label id="l1" text="{l_sandboxType}"/>
        </mx:FormItem>
    </mx:Form>

</mx:Application>
```

When you compile a Flex application, you have some control over which sandbox the application is in. This determination is a combination of the value of the `use-network` compiler option (the default is `true`) and whether the SWF file was loaded by the client over a network connection or as a local file.

The following table shows how the sandbox type is determined:

use-network	Loaded	Sandbox type
false	locally	local-with-filesystem
true	locally	local-with-network
true	network	remote
false	network	n/a (causes an error)

Browser security

Flash Player clients can be one of the following four types:

- Embedded Flash Player
- Debugger version of embedded Flash Player
- Stand-alone Flash Player
- Debugger version of stand-alone Flash Player

The stand-alone Flash Player runs on the desktop. It is typically used by people who are running applications that are installed and maintained by an IT department that has access to the desktop on which the application runs.

The embedded Flash Player is run within a browser. Anyone with Internet access can run applications from anywhere with this player. For Internet Explorer, the embedded player is loaded as an ActiveX control inside the browser. For Netscape-based browsers (including Firefox), it is loaded as a plug-in inside the browser. Using an embedded player lets the developer use browser-based technologies such as FORM and BASIC authentication as well as SSL.

Browser APIs

Applications hosting the Flash Player ActiveX control or Flash Player plug-in can use the EnforceLocalSecurity and DisableLocalSecurity API calls to control security settings. If DisableLocalSecurity is opened, the application does not benefit from the local-with-networking and local-with-file-system sandboxes. All files loaded from the local file system are placed into the local-trusted sandbox. The default behavior for an ActiveX control hosted in a client application is DisableLocalSecurity.

If EnforceLocalSecurity is opened, the application can use all three local sandboxes. The default behavior for the browser plug-in is EnforceLocalSecurity.

Cross-scripting

Cross-scripting is when a SWF file communicates directly with another SWF file. This communication includes calling methods and setting properties of the other SWF file.

SWF file loading and cross-scripting are always permitted between SWF files that reside in the same sandbox. For example, any local-with-filesystem SWF file can load and cross-script any other local-with-filesystem SWF file; any local-with-networking SWF file can load and cross-script any other local-with-networking SWF file; and so on. The restrictions appear when two SWF files from different sandboxes or two remote SWF files with different domains attempt to cooperate.

For SWF files in the remote sandbox, if two SWF files were loaded from the same domain, they can cross-script without any restrictions. If both SWF files were loaded from a network, but from different domains, you must provide permissions to allow them to cross-script.

To enable cross-scripting between SWF files, use the Security class's `allowDomain()` and `allowInsecureDomain()` methods.

You call these methods from the called SWF file and specify the calling SWF file's domain. For example, if SWF1 in domainA.com calls a method in SWF2 in domainB, SWF2 must call the `allowDomain()` method and specifically allow SWF files from domainA.com to cross-script the method, as the following example shows:

```
import flash.system.Security;
Security.allowDomain("domainA.com");
```

If the SWF files are in different sandboxes (for example, if one SWF file was loaded from the local file system and the other from a network) they must adhere to the following set of rules:

- Remote SWF files (those served over HTTP and other non-local protocols) can never load local SWF files.
- Local-with-networking SWF files can never load local-with-filesystem SWF files, or vice versa.
- Local-with-filesystem SWF files can never load remote SWF files.
- Local-trusted SWF files can load SWF files from any sandbox.

To facilitate SWF-to-SWF communication, you can also use the LocalConnection class. For more information, see "Using the LocalConnection class" on page 46.

ExternalInterface

You use the ExternalInterface API to let your Flex application call scripts in the wrapper and to allow the wrapper to call functions in your Flex application. The ExternalInterface API consists primarily of the `call()` and `addCallback()` methods in the flash.net package.

This communication relies on the domain-based security restrictions that the `allowScriptAccess` and `allowNetworking` properties define. You set the values of the `allowScriptAccess` and `allowNetworking` properties in the SWF file's wrapper. For more information, see "About the object and embed tags" on page 321.

By default, the Flex application and the HTML page it is calling must be in the same domain for the `call()` method to succeed. For more information, see "Communicating with the Wrapper" on page 1035 in the *Adobe Flex 3 Developer Guide*.

The navigateToURL() method

The `navigateToURL()` method opens or replaces a window in the Flash Player's container application. You typically use it to launch a new browser window, although you can also embed script in the method's call to perform other actions.

This usage of the `navigateToURL()` method relies on the domain-based security restrictions that the `allowScriptAccess` and `allowNetworking` parameters define. You set the values of the `allowScriptAccess` and `allowNetworking` parameters in the SWF file's wrapper. For more information, see "About the object and embed tags" on page 321.

Caching

Flex applications reside entirely on the client. If the browser loads the application, the application SWF file, plus externally loaded images and other media files, are stored locally on the client in the browser's cache. These files reside in the cache until cleared.

Storing a SWF file in the browser's cache can potentially expose the file to people who would not otherwise be able to see it. The following table shows some example locations of the browser's cache files:

Browser or operating system	Cache location
Internet Explorer on Windows XP	C:\Documents and Settings*username*\Local Settings\Temporary Internet Files
Firefox on Windows XP	C:\Documents and Settings*username*\Application Data\Mozilla\Firefox\Profiles*user-name*.default\Cache
UNIX	$HOME/.mozilla/firefox/*username*.default/Cache/

These files can remain in the cache even after the browser is closed.

To prevent client browsers from caching the SWF file, try setting the following HTTP headers in the wrapper that returns the Flex application's SWF file:

```
Cache-control: no-cache, no-store, must-revalidate, max-age=-1
Pragma: no-cache, no-store
Expires: -1
```

Trusted sites and directories

The browser security model includes levels of trust applied to specific websites. Flash Player interacts with this model by assigning a sandbox based on whether the browser declared the site of the SWF file's origin trusted.

If Flash Player loads a SWF file from a trusted website, the SWF file is put in the local-trusted sandbox. The SWF file can read from local data sources and communicate with the Internet.

You can also assign a SWF file to be in the local-trusted sandbox when you load it from the local file system. To do this, you configure a directory as trusted by Flash Player (which results in the SWF file being put in the local-trusted sandbox) by adding a FlashPlayerTrust configuration file that specifies the directory to trust. This requires administrator access privileges to the client system, so it is typically used in controlled environments. Users can also define a directory as trusted by using the Flash Player User Settings Manager. For more information, see Flash Player documentation.

Deploying secure applications

When you deploy an application, you make the application accessible to your users. The process of deploying an application is dependent on your application, your application requirements, and your deployment environment. You can employ some of the following strategies to ensure that the application you deploy is secure.

Deploying local SWF files versus network SWF files

Client computers can obtain individual SWF files from a number of sources, such as from an external website or a local file system. When SWF files are loaded into Flash Player, they are individually assigned to security sandboxes based on their origin.

Flash Player classifies SWF files downloaded from the network (such as from external websites) in separate sandboxes that correspond to their website origin domains. By default, these files are authorized to access additional network resources that come from the specific (exact domain name match) site. Network SWF files can be allowed to access additional data from other domains by explicit website and author permissions.

A local SWF file describes any file referenced by using the “file:\\” protocol or a UNC path, which does not include an IP address or a qualifying domain. For example, “\\test\test.swf” and “file:\\test.swf” are considered local files, while “\\test.com\test.swf” and “\\192.168.0.1\test.swf” are not considered local files.

Local SWF files from local origins, such as local file systems or UNC network paths, are placed into one of three sandboxes: local-with-networking, local-with-filesystem, and local-trusted.

When you compile the Flex application, if you set the `use-network` compiler option to `false`, local SWF files are placed in the local-with-filesystem sandbox. If you set the `use-network` compiler option to `true`, local SWF files are placed in the local-with-networking sandbox.

Local SWF files that are registered as trusted (by users or by installer programs) are placed in the local-trusted sandbox. Users can also reassign (move) a local SWF file to or from the local-trusted sandbox based on their security considerations.

Deploy checklist

Before you deploy your application, ensure that your proxy servers, firewalls, and assets are configured properly. Adobe provides a deployment checklist that you can follow. For more information, see "Deployment checklist" on page 304.

Remove wildcards

If your application relies on assets loaded from another domain, and that domain has a crossdomain.xml file on it, remove wildcards from that file if possible. For example, change the following:

```
<cross-domain-policy>
    <allow-access-from domain="*" to-ports="*"/>
</cross-domain-policy>
```

to this:

```
<cross-domain-policy>
    <allow-access-from domain="*.myserver.com" to-ports="80,443,8100,8080" />
</cross-domain-policy>
```

Also, set the value of the `to-ports` attribute of the `allow-access-from` tag to ensure that you are only allowing necessary ports access to the resources.

Check your application for calls to the `allowDomain()` and `allowInsecureDomain()` methods. During development, you might pass these methods a wildcard character (*), but now restrict those methods to allowing requests only from the necessary domains.

Deploy assets to WEB-INF

In some deployments, you want to make assets such as data files accessible to the application, but not accessible to anyone requesting the file. If you are using a J2EE-based server, you can deploy those files to a subdirectory within the WEB-INF directory. Based on J2EE security constraints, no J2EE server can return a resource from the WEB-INF directory to any client request. The only way to access files in this directory is with server-side code.

Precompiling source code

If you are using the Flex module for Apache and IIS, precompile MXML files, JSP files, and class files. After you precompile your MXML and JSP files, remove the source files from the public-facing server. You should not be using the Flex module for Apache and IIS to compile MXML file in a production environment.

To precompile MXML files, use the mxmlc compiler utility in the bin directory. For more information on using the utility, see "About the command-line compilers" on page 131.

To precompile JSP files on JRun, for example, you use the jspc precompiler utility located in the JRun bin directory. For information on precompiling JSP files on your application server, see your application server documentation.

Loading assets

The most common task that developers perform that requires an understanding of security is loading external assets.

Data compared to content

The Flash Player security model makes a distinction between loading content and accessing or loading data. Content is defined as media: visual media that Flash Player can display, such as audio, video, or a SWF file that includes displayed media. Data is defined as something that you can manipulate only with ActionScript code.

You can load data in one of two ways: by extracting data from loaded media content, or by directly loading data from an external file (such as an XML file) or socket connection. You can extract data from loaded media by using the `BitmapData.draw()` method, the `Sound.id3` property, or the `SoundMixer.computeSpectrum()` method. You can load data by using classes such as the SWFLoader, URLStream, URLLoader, Socket, and XMLSocket classes.

The Flash Player security model defines different rules for loading content and accessing data. Loading content has fewer restrictions than accessing data. In general, content such as SWF files, bitmaps, MP3 files, and videos can be loaded from anywhere, but if the content is from a domain other than that of the loading SWF file, it will be partitioned in a separate security sandbox.

Loading remote assets

Loading remote or network assets relies on three factors:

- Type of asset. If the target asset is a content asset, such as an image file, you do not need any specific permissions from the target domain to load its assets into your Flex application. If the target asset is a data asset, such as an XML file, you must have the target domain's permission to access this asset. For more information on the types of assets, see "Data compared to content" on page 39.
- Target domain. If you are loading data assets from a different domain, the target domain must provide a cross-domain.xml policy file. This file contains a list of URLs and URL patterns that it allows access from. The calling domain must match one of the URLs or URL patterns in that list. For more information about the cross-domain.xml file, see "Using cross-domain policy files" on page 40. If the target asset is a SWF file, you can also provide permissions by calling the `loadPolicyFile()` method and loading an alternative policy file inside that target SWF file. For more information, see "Using cross-domain policy files" on page 40.

- Loading SWF file's sandbox. To load an asset from a network address, you must ensure that your SWF file is in either the remote or local-with-networking sandbox. To ensure that a SWF file can load assets over the network, you must set the `use-network` compiler option to `true` when you compile the Flex application. This is the default. If the application was loaded from the local file system with `use-network` set to `false`, the application is put in the local-with-filesystem sandbox and it cannot load remote SWF files.

Loading assets from a remote location that you do not control can potentially expose your users to risks. For example, the remote website B contains a SWF file that is loaded by your website A. This SWF file normally displays an advertisement. However, if website B is compromised and its SWF file is replaced with one that asks for a username and password, some users might disclose their login information. To prevent data submission, the loader has a property called `allowNetworking` with a default value of `never`.

Using cross-domain policy files

To make data available to SWF files in different domains, use a *cross-domain policy file*. A cross-domain policy file is an XML file that provides a way for the server to indicate that its data and documents are available to SWF files served from other domains. Any SWF file that is served from a domain that the server's policy file specifies is permitted to access data or assets from that server.

When a Flash document attempts to access data from another domain, Flash Player attempts to load a policy file from that domain. If the domain of the Flash document that is attempting to access the data is included in the policy file, the data is automatically accessible.

The default policy file is named crossdomain.xml and resides at the root directory of the server that is serving the data. The following example policy file permits access to Flash documents that originate from foo.com, friend-OfFoo.com, *.foo.com, and 105.216.0.40:

```
<?xml version="1.0"?>
<!-- http://www.foo.com/crossdomain.xml -->
<cross-domain-policy>
    <allow-access-from domain="www.friendOfFoo.com"/>
    <allow-access-from domain="*.foo.com"/>
    <allow-access-from domain="105.216.0.40"/>
</cross-domain-policy>
```

You can also configure ports in the crossdomain.xml file. For more information about crossdomain.xml policy files, see *Programming ActionScript 3.0*.

You can use the `loadPolicyFile()` method to access a nondefault policy file.

Loading local assets

In some cases, your SWF file might load assets that reside on the client's local file system. This typically happens when the Flex application is embedded on the client device and loaded from a network. If the application is allowed to access local assets, it cannot access network assets.

To ensure that a Flex application can access assets in the local sandbox, the application must be in the local-with-filesystem or local-trusted sandbox. To ensure this, you set the `use-network` compiler option to `false` when you compile the application. The default value of this option is `true`.

When you load another SWF file that is in the local file system into your application with a class such as SWFLoader, and you want to call methods or access properties of that SWF file, you do not need to explicitly enable cross-scripting.

If the SWF files are in different sandboxes (for example, you loaded the main SWF file into the local-with-network sandbox, but loaded the asset SWF file from the network), you cannot cross-script because they are in different sandboxes. Remote SWF files cannot load local SWF files, and vice versa.

Using J2EE authentication

Flex applications integrates well with any server environment, including J2EE. To effectively implement secure web applications in a J2EE environment, you should understand the following concepts:

Authentication The process of gathering user credentials (user name and password) and validating them in the system. This requires checking the credentials against a user repository such as a database, flat file, or LDAP implementation, and authenticating that the user is who they say they are.

Authorization The process of making sure that the authenticated user is allowed to view or access a given resource. If a user is not authorized to view a resource, the container does not allow access.

Using container-based authentication

J2EE uses the Java Authentication and Authorization Service (JAAS), Java security manager, and policy files to enforce access controls on users and ties this enforcement to web server roles. The authenticating mechanism is role based. That is, all users who access a web application are assigned to one or more roles. Example roles are manager, developer, and customer.

Application developers can assign usage roles to a web application, or to individual resources that make up the application. Before a user is granted access to a web application resource, the container ensures that the user is identified (logged in) and that the user is assigned to a role that has access to the resource. Any unauthorized access of a web application results in an HTTP 401 (Unauthorized) status code.

Authentication requires a website to store information about users. This information includes the role or roles assigned to each user. In addition, websites that authenticate user access typically implement a login mechanism that forces verification of each user's identity by using a password. After the website validates the user, the website can then determine the user's roles.

This logic is typically implemented in one of the following forms:

- JDBC Login Module
- LDAP Login Module
- Windows Login Module
- Custom JAAS Login Module

Authentication occurs on a per-request basis. The container typically checks every request to a web application and authenticates it.

Authentication requires that the roles that the application developer defines for a web application be enforced by the server that hosts the application.

As part of developing and deploying an application, you must configure the following application authentication settings:

- Access roles to applications
- Resource protection
- Application server validation method

The web application's deployment descriptor, web.xml, contains the settings for controlling application authentication. This file is stored in the web application's WEB-INF directory.

Using authentication to control access to Flex applications

To use authentication to prevent unauthorized access to your Flex application, you typically use the container to set up constraints on resources. You then challenge the user who then submits credentials. These credentials determine the success or failure of the user's login attempt, as the container's authentication logic determines.

For example, you can protect the page that the Flex application is returned with, or protect the SWF file itself. You do this in the web.xml file by defining specific URL patterns, as the following example shows:

```
<web-app>
    <security-constraint>
        <web-resource-collection>
            <web-resource-name>Payroll Application</web-resource-name>
                <url-pattern>/payroll/*</url-pattern>
                <http-method>GET</http-method>
                <http-method>POST</http-method>
            </web-resource-collection>
```

```
        <auth-constraint>
            <role-name>manager</role-name>
        </auth-constraint>
    </security-constraint>
</web-app>
```

When the browser tries to load a resource that is secured by constraints in the web.xml file, the browser either challenges the user (if you are using BASIC authentication) or forwards the user to a login page (with FORM authentication).

With BASIC authentication, the user enters a username and password in a popup box that the browser creates. To specify that an application uses BASIC authentication, you use the `login-config` element and its `auth-method` subelement in the web application's web.xml file, as the following example shows:

```
<web-app>
    <login-config>
        <auth-method>BASIC</auth-method>
        <realm-name>Managers</realm-name>
    </login-config>
    ...
</web-app>
```

With FORM authentication, you must code the page that accepts the username and password, and submit them as FORM variables named `j_username` and `j_password`. This form can be implemented in HTML or as a Flex application or anything that can submit a form.

When you configure FORM authentication, you can specify both a login form and an error form in the web.xml file, as the following example shows:

```
<web-app>
    <login-config>
        <auth-method>FORM</auth-method>
        <form-login-config>
            <form-login-page>/login.htm</form-login-page>
            <form-error-page>/loginerror.htm</form-error-page>
        </form-login-config>
    </login-config>
</web-app>
```

You submit the results of the form validation to the `j_security_check` action. The server executing the application recognizes this action and processes the form.

A simple HTML-based form might appears as follows:

```
<form method="POST" action="j_security_check">
    <table>
        <tr><td>User</td><td><input type=text name="j_username"></tr>
        <tr><td>Password</td><td><input type=password name="j_password"></tr>
```

```
    </table>
    <input type=submit>
</form>
```

The results are submitted to the container's JAAS system with base-64 encoding, which means they can be read by anyone that can view the TCP/IP traffic. Use encryption to prevent these so-called "man-in-the-middle" attacks. In both BASIC and FORM authentication, if the user accessed the resource through SSL, the username and password submission are encrypted, as is all traffic during that exchange.

After it is complete, the container populates the browser's security context and provides or denies access to the resource. Flash Player inherits the security context of the underlying browser. As a result, when you make a data service call, the established credentials are used.

When a user fails an authentication attempt with invalid credentials, be sure not to return information about which item was incorrect. Instead, use a generic message such as "Your login information was invalid."

Using RPC services

You can use the RPC services classes—RemoteObject, HTTPService, and WebService—not only to control access to the data that goes into an MXML page, but also to control the data and actions that flow out of it. You can also use service authentication to allow only certain users to perform certain actions. For example, if you have an application that allows employee data to be modified through a RemoteObject call, use RemoteObject authentication to make sure that only managers can change the employee data.

A service-based architecture makes it easy to implement several different security models for your Flex application. You can use programmatic security to limit access to services, or you can apply declarative security constraints to entire services.

When accessing RPC services with Flex tags such as the `<mx:WebService>` and `<mx:HTTPService>` tags, your Flex application's SWF file must connect to the service directly, which means that it can encounter security-based limitations.

Destinations must be configured entirely in the Flex application; the component must communicate directly with the RPC service.

In addition, you must set the `use-proxy` compiler option to `false` when you compile the application.

When `use-proxy` is `false`, one of the following must be `true`:

- The RPC is in the same domain as the Flex application that calls it.
- The RPC's host system has a crossdomain.xml file that explicitly allows access from the Flex application's domain.

Using secured services

Secured services are services that are protected by resource constraints. The service itself behaves as a resource that needs authentication and the container defines its URL pattern as requiring authorization.

You might have a protected Flex application that calls a protected resource. In this case, with BASIC authentication and a proxied destination, the user's credentials are passed through to the service. The user only has to log on once when they first start the Flex application, and not when the application attempts to access the service.

Without a proxy, the user is challenged to enter their credentials a second time when the application attempts to access the service.

When you use secured services, keep the following in mind:

- If possible, use HTTPS for your services when you use authentication. In BASIC and custom authentication, user names and passwords are sent in a base-64 encoding. Using base-64 encoding hides the data only from plain view; HTTPS actually encrypts the data. You can use HTTPS in these cases by making sure HTTPS is set up on your server and by adding a protocol attribute with the value `https` on the service, and by adding a cross-domain.xml file.
- To ensure that the WebService and HTTPService endpoints are secure, use a browser window to access the URL you are trying to secure. This should always bring up a BASIC authentication prompt.
- If the BASIC or custom login box appears but you can't log in, make sure that the users and roles were added correctly to your application server. This is often an error-prone task that is overlooked as the source of the problem.

Making other connections

Flash Player can connect to servers, services, and load data from sources other than RPC services. Some of these sources have security issues that you should consider.

Using RTMP

Flash Player uses the Real-Time Messaging Protocol (RTMP) for client-server communication. This is a TCP/IP protocol designed for high-performance transmission of audio, video, and data messages. RTMP sends unencrypted data, including authentication information (such as a name and a password).

Although RTMP in and of itself does not offer security features, Flash communications applications can perform secure transactions and secure authentication through an SSL-enabled web server.

Flash Player also provides support for versions of RTMP that are tunneled through HTTP and HTTPS. RTMP refers to RTMP transmitted within an HTTP wrapper, and RTMPS is RTMP transmitted within an HTTPS wrapper.

Using sockets

Sockets let you read and write raw binary or XML data with a connected server. Sockets transmit over TCP. Because of this, Flash Player cannot take advantage of the built-in encryption capabilities of the browser. However, you can use encryption algorithms written in ActionScript to protect the data that is being communicated.

Cross-domain access to socket and XML socket connections is disabled by default. Access to socket connections in the same domain of the SWF file on ports lower than 1024 is also disabled by default. You can permit access to these connections by serving a cross-domain policy file from any of the following locations:

- The same port as the main socket connection
- A different port
- The HTTP server on port 80 in the same domain as the socket server

For more information, see the Socket and XMLSocket classes in *Flash ActionScript Language Reference*.

Using the LocalConnection class

The LocalConnection class lets you develop SWF files that can send instructions to each other. LocalConnection objects can communicate only among SWF files that are running on the same client computer, but they can be running in different applications—for example, a SWF file running in a browser and a SWF file running in a projector. (A projector is a SWF file saved in a format that can run as a stand-alone application—that is, the projector doesn't require Flash Player to be installed since it is embedded inside the executable file.)

For every LocalConnection communication, there is a sender SWF file and a listener SWF file. The simplest way to use a LocalConnection object is to allow communication only between LocalConnection objects located in the same domain because you won't have security issues.

Applications served from different domains that need to be able to make LocalConnection calls to each other must be granted cross-domain LocalConnection permissions. To do this, the listener must allow the sender permission by using the `LocalConnection.allowDomain()` or `LocalConnection.allowInsecureDomain()` methods.

Adobe does not recommend using the `LocalConnection.allowInsecureDomain()` method because allowing non-HTTPS documents to access HTTPS documents compromises the security offered by HTTPS. It is best that all Flash SWF files that make LocalConnection calls to HTTPS SWF files are served over HTTPS.

For more information about using the LocalConnection class, see *Programming ActionScript 3.0*.

To facilitate SWF-to-SWF communication, you can also use cross-scripting. For more information, see "Cross-scripting" on page 34.

Using SSL

A SWF file playing in a browser has many of the same security concerns as an HTML page being displayed in a browser. This includes the security of the SWF file while it is being loaded into the browser, as well as the security of communication between Flash and the server after the SWF file has loaded and is playing in the browser. In particular, data communication between the browser and the server is susceptible to being intercepted by third parties. The solution to this issue in HTML is to encrypt the communication between the client and server to make any data captured by third parties undecipherable and thus unusable. This encryption is done by using an SSL-enabled browser and server.

Because a SWF file running within a browser uses the browser for almost all of its communication with the server, it can take advantage of the browser's built-in SSL support. This lets communication between the SWF file and the server be encrypted. Furthermore, the actual bytes of the SWF file are encrypted while they are being loaded into the browser. Thus, by playing a SWF file within an SSL-enabled browser through an HTTPS connection with the server, you can ensure that the communication between Flash Player and the server is encrypted and secure.

The one exception to this security is the way Flash Player uses persistent sockets (through the ActionScript XMLSocket object), which does not use the browser to communicate with the server. Because of this, SWF files that use sockets cannot take advantage of the built-in encryption capabilities of the browser. However, you can use one-way encryption algorithms written in ActionScript to encrypt the data being communicated.

MD5 is a one-way encryption algorithm described in RFC 1321. This algorithm has been ported to ActionScript, which enables developers to secure one-way data by using the MD5 algorithm before it is sent from the SWF file to the server. For more information about RFC 1321, see www.faqs.org/rfcs/rfc1321.html or www.rsasecurity.com/rsalabs/faq/3-6-6.html.

Using secure endpoints

To access HTTP services or web services through HTTPS, you can specify the protocols using "https" in the `wsdl` or `url` properties; for example:

```
<mx:WebService url="https://myservice.com" .../>
<mx:HTTPService wsdl="https://myservice.com" .../>
```

By default, a SWF file served over an unsecure protocol, such as HTTP, cannot access other documents served over the secure HTTPS protocol, even when those documents come from the same domain. As a result, if you loaded the SWF file over HTTP but want to connect to the service through HTTPS, you must add `secure="false"` in the crossdomain.xml file on the services's server, as the following example shows:

```
<cross-domain-policy>
    <allow-access-from domain="*.mydomain.com" secure="false"/>
</cross-domain-policy>
```

If you loaded the SWF file over HTTPS, you do not have to make any changes.

Writing secure Flex applications

When you code a Flex application, keep the following topics in mind to ensure that the application you write is as secure as possible.

MXML tags with security restrictions

Some MXML tags trigger operations that require security settings. Operations that trigger security checks include:

- Referencing a URL that is outside the exact domain of the application that makes a request.
- Referencing an HTTPS URL when the application that makes the request is not served over HTTPS.
- Referencing a resource that is in a different sandbox.

In these cases, access rights must be granted through one of the permission-granting mechanisms such as the `allowDomain()` method or a crossdomain.xml file.

MXML tags that can trigger security checks include:

- Any class that extends the Channel class.
- RPC-related tags that use channels such as `<mx:WebService>`, `<mx:RemoteObject>`, and `<mx:HTTPService>`.
- Messaging tags such as `<mx:Producer>` and `<mx:Consumer>`.
- The `<mx:DataService>` tag.
- Tags that load SWF files such as `<mx:SWFLoader>`.

In addition to these tags and their underlying classes, many Flash classes trigger security checks including ExternalInterface, Loader, NetStream, SoundMixer, URLLoader, and URLRequest.

Disabling viewSourceURL

If you enabled the view source feature by setting the value of the `viewSourceURL` property on the `<mx:Application>` tag, you must be sure to remove it before you put your application into production.

This functionality applies only to Flex Builder users.

Remove sensitive information from SWF files

Applications built with Flash share many of the same concerns and issues as web pages when it comes to protecting the security of data. Because the SWF file format is an open format, you can extract data and algorithms contained within a SWF file. This is similar to how HTML and JavaScript code can be easily viewed by users. However, SWF files make viewing the code more difficult. A SWF file is compiled and is not human-readable like HTML or JavaScript.

But security is not obtained through obscurity. A number of third-party tools can extract data from compiled SWF files. As a result, do not consider that any data, variables, or ActionScript code compiled into an application are secure. You can use a number of techniques to secure sensitive information and still make it available for use in your SWF files.

To help ensure a secure environment, use the following general guidelines:

- Do not include sensitive information, such as user names, passwords, or SQL statements in SWF files.
- Do not use client-side username and password checks for authentication.
- Remove debug code, unused code, and comments from code before compiling to minimize the amount of information about your application that is available to someone with a decompiler or a debugger version of Flash Player.
- If your SWF file needs access to sensitive information, load the information into the SWF file from the server at run time. The data will not be part of the compiled SWF file and thus cannot be extracted by decompiling the SWF file. Use a secure transfer mechanism, such as SSL, when you load the data.
- Implement sensitive algorithms on the server instead of in ActionScript.
- Use SSL whenever possible.
- Only deploy your web applications from a trusted server. Otherwise, the server-side aspect of your application could be compromised.

Input validation

Input validation means ensuring that input is what it says it is or is what it is supposed to be. If your application is expecting name and address information, but it gets SQL commands, have a validation mechanism in your application that checks for and filters out SQL-specific characters and strings before passing the data to the execute method.

In many cases, you want users to provide input in TextInput, TextArea, and other controls that accept user input. If you use the input from these controls in operations inside the application, make sure that the input is free of possible malicious characters or code.

One approach to enforcing input validation is to use the Flex validator classes by using the <mx:Validator> tag or the tag for the appropriate validator type. Validators ensure that the input conforms to a predetermined pattern. For example, the NumberValidator class ensures that a string represents a valid number. This validator can ensure that the input falls within a given range (specified by the minValue and maxValue properties), is an integer (specified by the domain property), is non-negative (specified by the allowNegative property), and does not exceed the specified precision.

In typical client-server environments, data validation occurs on the server after data is submitted to it from the client. One advantage of using Flex validators is that they execute on the client, which lets you validate input data before transmitting it to the server. By using Flex validators, you eliminate the need to transmit data to and receive error messages back from the server, which improves the overall responsiveness of your application.

You can also write your own ActionScript filters that remove potentially harmful code from input. Common approaches include stripping out dollar sign ($), quotation mark ("), semi-colon (;) and apostrophe (') characters because they have special meaning in most programming languages. Because Flex also renders HTML in some controls, also filter out characters that can be used to inject script into HTML, such as the left and right angle brackets (“<” and “>”), by converting these characters to their HTML entities “<” and “>”. Also filter out the left and right parentheses (“(”and “)”) by translating them to “(” and “)”, and the pound sign (“#”) and ampersand (“&”) by translating them to “#” (#) and “&” (&).

Another approach to enforcing input validation is to use strongly-typed, parameterized queries in your SQL code. This way, if someone tries to inject malicious SQL code into text that is used in a query, the SQL server will reject the query.

For more information on potentially harmful characters and conversion processes, see http://www.cert.org/tech_tips/malicious_code_mitigation.html.

For more information about validators, see “Validating Data” on page 1263 in the *Adobe Flex 3 Developer Guide*.

ActionScript

Use some of the following techniques to try to make your use of ActionScript more secure.

Handling errors

The SecurityError exception is thrown when some type of security violation takes place. Security errors include:

- An unauthorized property access or method call was made across a security sandbox boundary.
- An attempt was made to access a URL not permitted by the security sandbox.
- A socket connection was attempted to an unauthorized port number, for example, a port below 1024, without a policy file present.
- An attempt was made to access the user's camera or microphone, and the request to access the device was denied by the user.

Flash Player dispatches SecurityErrorEvent objects to report the occurrence of a security error. Security error events are the final events dispatched for any target object. This means that any other events, including generic error events, are not dispatched for a target object that experiences a security error.

Your event listener can access the SecurityErrorEvent object's `text` property to determine what operation was attempted and any URLs that were involved, as the following example shows:

```
<?xml version="1.0"?>
<!-- security/SecurityErrorExample.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" creationComplete="initApp()">
    <mx:Script><![CDATA[
        import flash.net.URLLoader;
        import flash.net.URLRequest;
        import flash.events.SecurityErrorEvent;
        import mx.controls.Alert;

        private var loader:URLLoader = new URLLoader();

        private function initApp():void {
            loader.addEventListener(SecurityErrorEvent.SECURITY_ERROR,
securityErrorHandler);
        }

        private function triggerSecurityError():void {
            // This URL is purposefully broken so that it will trigger a
            // security error.
            var request:URLRequest = new URLRequest("http://www.[yourDomain].com");

            // Triggers a security error.
            loader.load(request);
        }

        private function securityErrorHandler(event:SecurityErrorEvent):void {
          Alert.show("A security error occurred! Check trace logs for details.");
            trace("securityErrorHandler: " + event.text);
```

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

    <mx:Button id="b1" label="Click Me To Trigger Security Error"
click="triggerSecurityError()"/>

</mx:Application>
```

If no event listeners are present, the debugger version of Flash Player automatically displays an error message that contains the contents of the text property.

In general, try to wrap methods that might trigger a security error in a try/catch block. This prevents users from seeing information about destinations or other properties that you might not want to be visible.

Suppressing debug output

Flash Player writes debug output from a `trace()` method or the Logging API to a log file on the client. Any client can be running the debugger version of Flash Player. As a result, remove calls to the `trace()` method and Logging API calls that produce debugging output so that clients cannot view your logged information.

If you use the Logging API in your custom components and classes, set the value of the LogEventLevel to `NONE` before compilation, as the following example shows:

```
myTraceTarget.level = LogEventLevel.NONE;
```

For more information about the Logging API, see "Using the logging API" on page 233.

Using host-based authentication

IP addresses and HTTP headers are sometimes used to perform host-based authentication. For example, you might check the Referer header or the client IP address to ensure that a request comes from a trusted source.

However, request headers such as Referer can be spoofed easily. This means that clients can pretend to be something they are not by settings headers or faking IP addresses. The solution to the problem of client spoofing is to not use HTTP header data as an authentication mechanism.

Using passwords

Using passwords in your Flex application is a common way to protect resources from unauthorized access. Test the validity of the password on the server rather than the client, because the client has access to all the logic in the local SWF file.

Never store passwords locally. For example, do not store username and password combinations in local SharedObjects. These are stored in plain-text and unencrypted, just as cookie files are. Anyone with access to the user's computer can access the information inside a SharedObject.

To ensure that passwords are transmitted from the client to the server safely, enforce the use of SSL or some other secure transport-level protocol.

When you ask for a password in a TextArea or TextInput control, set the `displayAsPassword` property to `true`. This displays the password as asterisks as it is typed.

Storing persistent data with the SharedObject class

Flash Player supports persistent shared objects through the SharedObject class. The SharedObject class stores data on users' computers. This data is usually local, meaning that it was obtained with the `SharedObject.getLocal()` method. You can also create persistent remote data with the SharedObject class; this requires Flash Media Server (formerly Flash Communication Server).

Each remote sandbox has an associated store of persistent SharedObject directory on the client. For example, when any SWF from domain1.com reads or writes data with the SharedObject class, Flash Player reads or writes that object in the domain1.com object store. Likewise for a SWF from domain2.com, Flash Player uses the domain2.com store. To avoid name collisions, the directory path defaults to the full path in the URL of the creating SWF file. This process can be shortened by using the `localPath` parameter of the `SharedObject.getLocal()` method, which allows other SWF files from the same domain to access a shared object after it is created.

Every domain has a maximum amount of data that a SharedObject class can save in the object store. This is an allocation of the user's disk space in which applications from that domain can store persistent data. Users can change the quota for a domain at any time by choosing Settings from the Flash Player context menu. When an application tries to store data with a SharedObject class that causes Flash Player to exceed its domain's quota, a dialog box appears, asking the user whether to increase the domain quota.

Configuring client security settings

Some security control features in Flash Player target user choices, and some target the modern corporate and enterprise environments, such as when the IT department would like to install Flash Player across the enterprise but has concerns about IT security and privacy. To help address these types of requirements, Flash Player provides various installation-time configuration choices. For example, some corporations do not want Flash Player to have access to the computer's audio and video hardware; other environments do not want Flash Player to have any read or write access to the local file system.

Three groups can make security choices: the application author (using developer controls), the administrative user (using administrator controls), and the local user (with user controls).

About the mm.cfg file

You configure the debugger version of Flash Player by using the settings in the mm.cfg text file. You must create this file when you first configure the debugger version of Flash Player.

The settings in this file let you enable or disable `trace()` logging, set the location of the `trace()` file's output, and configure client-side error and warning logging.

For more information, see "Configuring the debugger version of Flash Player" on page 229.

About the mms.cfg file

The primary purpose for the Macromedia® Security Configuration file (mms.cfg) is to support the corporate and enterprise environments where the IT department wants to install Flash Player across the enterprise, while enforcing some common global security and privacy settings (supported with installation-time configuration choices).

On operating systems that support the concept of user security levels, the file is flagged as requiring system administrator (or root) permissions to modify or delete it. The following table shows the location of the mms.cfg, depending on the operating system:

Operating System	Location of mms.cfg file
Macintosh OS X	/Library/Application Support/Macromedia
Windows XP/Vista	C:\WINDOWS\system32\Macromed\Flash
Windows 2000	C:\WINNT\System32\Macromed\Flash
Windows 95/98/ME	C:\WINDOWS\System\Macromed\Flash
Linux	/etc/adobe

You can use this file to configure security settings that deal with data loading, privacy, and local file access. The settings include:

- `FileDownloadDisable`
- `FileUploadDisable`
- `LocalStorageLimit`
- `AVHardwareDisable`

For a complete list of options and their descriptions, see http://www.adobe.com/devnet/flashplayer/articles/flash_player_8_security.pdf.

About FlashPlayerTrust files

Flash Player provides a way for administrative users to register certain local files so that they are always loaded into the local-trusted sandbox. Often an installer for a native application or an application that includes many SWF files will do this. Depending on whether Flash Player will be embedded in a nonbrowser application, one of two strategies can be appropriate: register SWF files and HTML files to be trusted, or register applications to be trusted. Only applications that embed the browser plug-ins can be trusted—the stand-alone players and standard browsers do not check to see if they were trusted.

The installer creates files in a directory called FlashPlayerTrust. These files list paths of trusted files. This directory, known as the Global Flash Player Trust directory, is alongside the mms.cfg file, in the following location, which requires administrator access:

- Windows: system\Macromed\Flash\FlashPlayerTrust (for example, C:\winnt\system32\Macromed\Flash\FlashPlayerTrust)
- OS X: app support/Macromedia/FlashPlayerTrust (for example, /Library/Application Support/Macromedia/FlashPlayerTrust)

These settings affect all users of the computer. If an installer is installing an application for all users, the installer can register its SWF files as trusted for all users.

For more information about FlashPlayerTrust files, see http://www.adobe.com/devnet/flashplayer/articles/flash_player_8_security.pdf.

About the Settings Manager

The Settings Manager allows the individual user to specify various security, privacy, and resource usage settings for applications executing on their client computer. For example, the user can control application access to select facilities (such as their camera and microphone), or control the amount of disk space allotted to a SWF file's domain. The settings it manages are persistent and controlled by the user.

The user can indicate their personal choices for their Flash Player settings in a number of areas, either globally (for Flash Player itself and all applications built with Flash) or specifically (applying to specific domains only). To designate choices, the user can select from the six tab categories along the top of the Settings Manager dialog box:

- Global Privacy Settings
- Global Storage Settings
- Global Security Settings
- Flash Player Update Settings
- Privacy Settings for Individual Websites
- Storage Settings for Individual Websites

Access the Settings Manager for your Flash Player

1. Open an application in Flash Player.
2. Right-click and select Settings.

   The Adobe Flash Player Settings dialog box appears.
3. Select the Privacy tab (on the far left).
4. Click the Advanced button.

   Flash Player launches a new browser window and loads the Settings Manager help page.

Other resources

The following table lists resources that are useful in understanding the Flash Player security model and implementing security in your Flex applications:

Resource name	Location
Security Topic Center	http://www.adobe.com/devnet/security
Security Bulletins and Advisories	http://www.adobe.com/support/security
Flash Player Security & Privacy	http://www.adobe.com/products/flashplayer/security
Security Resource Center	http://www.adobe.com/resources/security
Flash Player 9 Security white paper	http://www.adobe.com/go/fp9_0_security
"Flash Player Security" in *Programming ActionScript 3.0*	http://www.adobe.com/go/progAS3_security
"Networking and Communications" in *Programming ActionScript 3.0*.	http://www.adobe.com/go/AS3_networking_and_communications
Security Changes in Flash Player 8	http://www.adobe.com/devnet/flash/articles/fplayer8_security.html
Security Changes in Flash Player 7	http://www.adobe.com/devnet/flash/articles/fplayer_security.html
Understanding Service Authentication	http://www.adobe.com/devnet/flex/articles/security_framework_print.html
Settings Manager	http://www.adobe.com/support/flashplayer/help/settings/

Chapter 4: Optimizing Flex Applications

After you have a working application, you can explore ways to make that application download faster and perform better.

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Improving client-side performance

Tuning software to achieve maximum performance is not an easy task. You must commit to producing efficient implementations and monitor software performance continuously during the software development process.

Employ the following general guidelines when you test applications for performance, such as using the `getTimer()` method and checking initialization time.

Before you begin actual testing, you should understand some of the influences that client settings can have on performance testing. For more information, see "Configuring the client environment" on page 62.

In addition to these techniques, you should also consider using the Adobe® Flex® profiler in Adobe® Flex® Builder™. For more information, see "Profiling Flex applications" on page 155 in *Using Adobe Flex Builder 3*.

General guidelines

You can use the following general guidelines when you improve your application and the environment in which it runs:

- Set performance targets early in the software design stage. If possible, try to estimate an acceptable performance target early in the application development cycle. Certain usage scenarios dictate the performance requirements. It would be disappointing to fully implement a product feature and then find out that it is too slow to be useful.
- Understand performance characteristics of the application framework, and employ the strategies that maximize the efficiency of components and operations.
- Understand performance characteristics of the application code. In medium-sized or large-sized projects, it is common for a product feature to use codes or components written by other developers or by third-party vendors. Knowing what is slow and what is fast in dependent components and code is essential in getting the design right.

- Do not attempt to test a large application's performance all at once. Rather, test small pieces of the application so that you can focus on the relevant results instead of being overwhelmed by data.
- Test the performance of your application early and often. It is always best to identify problem areas early and resolve them in an iterative manner, rather then trying to shove performance enhancements into existing, poorly performing code at the end of your application development cycle.
- Avoid optimizing code too early. Even though early testing can highlight performance hot spots, refrain from fixing them while you are still developing those areas of the application; doing so might unexpectedly delay the implementation schedule. Instead, document the issues and prioritize all the performance issues as soon as your team finishes the feature implementation.

Testing applications for performance

You can use various techniques to test start-up and run-time performance of your Flex applications, such as monitoring memory consumption, timing application initialization, and timing events. The Flex profiler provides this type of information without requiring you to write any additional code. If you are using Flex Builder, you should use the profiler for testing your application's performance. For more information, see "Profiling Flex applications" on page 155 in *Using Adobe Flex Builder 3*.

Calculating application initialization time

One approach to performance profiling is to use code to gauge the start-up time of your application. This can help identify bottlenecks in the initialization process, and reveal deficiencies in your application design, such as too many components or too much reliance on nested containers.

The `getTimer()` method in flash.utils returns the number of milliseconds that have elapsed since Adobe® Flash® Player or Adobe AIR™ was initialized. This indicates the amount of time since the application began playing. The Timer class provides a set of methods and properties that you can use to determine how long it takes to execute an operation.

Before each update of the screen, Flash Player calls the set of functions that are scheduled for the update. Sometimes, a function should be called in the next update to allow the rest of the code scheduled for the current update to execute. You can instruct Flash Player or AIR to call a function in the next update by using the `callLater()` method. This method accepts a function pointer as an argument. The method then puts the function pointer on a queue, so that the function is called the next time the player dispatches either a `render` event or an `enterFrame` event.

The following example records the time it takes the Application object to create, measure, lay out, and draw all of its children. This example does not include the time to download the SWF file to the client, or to perform any of the server-side processing, such as checking the Flash Player version, checking the SWF file cache, and so on.

```
<?xml version="1.0"?>
<!-- optimize/ShowInitializationTime.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="callLater(showInitTime)">
    <mx:Script><![CDATA[
        import flash.utils.Timer;

        [Bindable]
        public var t:String;
        private function showInitTime():void {
            // Record the number of ms since the player was initialized.
            t = "App startup: " + getTimer() + " ms";
        }
    ]]></mx:Script>
    <mx:Label id="l1" text="{t}"/>
</mx:Application>
```

This example uses the `callLater()` method to delay the recording of the startup time until after the application finishes and the first screen updates. The reason that the `showInitTime` function pointer is passed to the `callLater()` method is to make sure that the application finishes initializing itself before calling the `getTimer()` method.

For more information on using the `callLater()` method, see "Using the callLater() method" on page 107.

Calculating elapsed time

Some operations take longer than others. Whether these operations are related to data loading, instantiation, effects, or some other factor, it's important for you to know how long each aspect of your application takes.

You can calculate elapsed time from application startup by using the `getTimer()` method. The following example calculates the elapsed times for the `preinitialize` and `creationComplete` events for all the form elements. You can modify this example to show individual times for the initialization and creation of each form element.

```
<?xml version="1.0" encoding="iso-8859-1"?>
<!-- optimize/ShowElapsedTime.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
initialize="init()">
    <mx:Script><![CDATA[
        [Bindable]
        public var dp:Array = [
            {food:"apple", type:"fruit", color:"red"},
            {food:"potato", type:"vegetable", color:"brown"},
            {food:"pear", type:"fruit", color:"green"},
            {food:"orange", type:"fruit", color:"orange"},
            {food:"spinach", type:"vegetable", color:"green"},
            {food:"beet", type:"vegetable", color:"red"}
        ];
```

```
        public var sTime:Number;
        public var eTime:Number;
        public var pTime:Number;

        private function init():void {
            f1.addEventListener("preinitialize", logPreInitTime, true);
            f1.addEventListener("creationComplete", logCreationCompTime, true);
        }

        private var isFirst:Boolean = true;

        private function logPreInitTime(e:Event):void {
            // Get the time when the preinitialize event is dispatched.
            sTime = getTimer();

          trace("Preinitialize time for " + e.target + ": " + sTime.toString());
        }

        private function logCreationCompTime(e:Event):void {
            // Get the time when the creationComplete event is dispatched.
            eTime = getTimer();

            // Use target rather than currentTarget because these events are
            // triggered by each child of the Form control during the capture
            // phase.
            trace("CreationComplete time for " + e.target + ": " + eTime.toString());
        }

    ]]></mx:Script>

    <mx:Form id="f1">
        <mx:FormHeading label="Sample Form" id="fh1"/>
        <mx:FormItem label="List Control" id="fi1">
            <mx:List dataProvider="{dp}" labelField="food" id="list1"/>
        </mx:FormItem>
        <mx:FormItem label="DataGrid control" id="fi2">
            <mx:DataGrid width="200" dataProvider="{dp}" id="dg1"/>
        </mx:FormItem>
        <mx:FormItem label="Date controls" id="fi3">
            <mx:DateChooser id="dc"/>
            <mx:DateField id="df"/>
        </mx:FormItem>
    </mx:Form>
</mx:Application>
```

Calculating memory usage

You use the `totalMemory` property in the System class to find out how much memory has been allocated to Flash Player or AIR on the client. The `totalMemory` property represents all the memory allocated to Flash Player or AIR, not necessarily the memory being used by objects. Depending on the operating system, Flash Player or AIR will be allocated more or less resources and will allocate memory with what is provided.

You can record the value of `totalMemory` over time by using a Timer class to set up a recurring interval for the timer event, and then listening for that event.

The following example displays the total amount of memory allocated (totmem) to Flash Player at 1-second intervals. This value will increase and decrease. In addition, this example shows the maximum amount of memory that had been allocated (maxmem) since the application started. This value will only increase.

```
<?xml version="1.0"?>
<!-- optimize/ShowTotalMemory.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" initialize="initTimer()">
    <mx:Script><![CDATA[
        import flash.utils.Timer;
        import flash.events.TimerEvent;

        [Bindable]
        public var time:Number = 0;
        [Bindable]
        public var totmem:Number = 0;
        [Bindable]
        public var maxmem:Number = 0;



        public function initTimer():void {
            // The first parameter is the interval (in milliseconds). The
            // second parameter is number of times to run (0 means infinity).
            var myTimer:Timer = new Timer(1000, 0);
            myTimer.addEventListener("timer", timerHandler);
            myTimer.start();
        }

        public function timerHandler(event:TimerEvent):void {
            time = getTimer()
            totmem = flash.system.System.totalMemory;
            maxmem = Math.max(maxmem, totmem);
        }
    ]]></mx:Script>
    <mx:Form>
        <mx:FormItem label="Time:">
            <mx:Label text="{time} ms"/>
```

```
        </mx:FormItem>
        <mx:FormItem label="totalMemory:">
            <mx:Label text="{totmem} bytes"/>
        </mx:FormItem>
        <mx:FormItem label="Max. Memory:">
            <mx:Label text="{maxmem} bytes"/>
        </mx:FormItem>
    </mx:Form>
</mx:Application>
```

Configuring the client environment

When testing applications for performance, it is important to configure the client properly.

Choosing the version of Flash Player

When you test your applications for performance, use the standard version of Adobe® Flash® Player or AIR rather than the debugger version of Flash Player or ADL, if possible. The debugger version of Player provides support for the `trace()` method and the Logging API. Using logging or the `trace()` method can significantly slow player performance, because the player must write log entries to disk while running the application.

If you do use the debugger version of Flash Player, you can disable logging and the `trace()` method by setting the `TraceOutputFileEnable` property to 0 in your mm.cfg file. You can keep `trace()` logging working, but disable the Logging API that you might be using in your application, by setting the logging level of the TraceTarget logging target to `NONE`, as the following example shows:

```
myLogger.log(LogEventLevel.NONE, s);
```

For performance testing, consider writing run-time test results to text components in the application rather than calling the `trace()` method so that you can use the standard version of Flash Player and not the debugger version of Flash Player.

For more information about configuring `trace()` method output and logging, see “Logging” on page 227.

Disabling SpeedStep

If you are running performance tests on a Windows laptop computer, disable Intel SpeedStep functionality. SpeedStep toggles the speed of the CPU to maximize battery life. SpeedStep can toggle the CPU at unpredictable times, which makes the results of a performance test less accurate than they would otherwise be.

1 Select Start > Settings > Control Panel.
2 Double-click the Power Settings icon.

   The Power Options Properties dialog box displays.

3 Select the Power Schemes tab.

4 Select High System Performance from the Power Schemes drop-down box.

5 Click OK.

Changing timeout length

When you test your application, be aware of the `scriptTimeLimit` property. If an application takes too long to initialize, Flash Player warns users that a script is causing Flash Player to run slowly and prompts the user to abort the application. If this is the situation, you can set the `scriptTimeLimit` property of the `<mx:Application>` tag to a longer time so that the Flex application has enough time to initialize.

However, the default value of the `scriptTimeLimit` property is 60 seconds, which is also the maximum, so you can only increase the value if you have previously set it to a lower value. You rarely need to change this value.

The following example sets the `scriptTimeLimit` property to 30:

```
<?xml version="1.0"?>
<!-- optimize/ChangeScriptTimeLimit.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" scriptTimeLimit="30">
    <!-- Empty application -->
</mx:Application>
```

Preventing client-side caching

When you test performance, ensure that you are not serving files from the local cache to Flash Player. Otherwise, this can give false results about download times. Also, during development and testing, you might want to change aspects of the application such as embedded images, but the browser continues to use the old images from your cache.

If the date and time in the If-Modified-Since request header matches the date and time in the Last-Modified response header, the browser loads the SWF file from its cache. Then the server returns the 304 Not Modified message. If the Last-Modified header is more recent, the server returns the SWF file.

You can use the following techniques to disable client-side caching:

- Delete the Flex files from the browser's cache after each interaction with your application. Browsers typically store the SWF file and other remote assets in their cache. On Microsoft Internet Explorer in Windows XP, for example, you can delete all the files in c:\Documents and Settings\username\Local Settings\Temporary Internet Files to force a refresh of the files on the next request. For more information, see "Caching" on page 36.
- Set the HTTP headers for the SWF file request in the HTML wrapper to prevent caching of the SWF file on the client. The following example shows how to set headers that prevent caching in JSP:

```
// Set Cache-Control to no-cache.
response.setHeader("Cache-Control", "no-cache");
// Prevent proxy caching.
response.setHeader("Pragma", "no-cache");
```

```
// Set expiration date to a date in the past.
response.setDateHeader("Expires", 946080000000L); //Approx Jan 1, 2000
// Force always modified.
response.header("Last-Modified", new Date());
```

Reducing SWF file sizes

You can improve initial user experience by reducing the time it takes to start an application. Part of this time is determined by the download process, where the SWF file is returned from the server to the client. The smaller the SWF file, the shorter the download wait. In addition, reducing the size of the SWF file also results in a shorter application initialization time. Larger SWF files take longer to unpack in Flash Player.

The mxmlc compiler includes several options that can help reduce SWF file size.

Using the bytecode optimizer

The bytecode optimizer can reduce the size of the Flex application's SWF file by using bytecode merging and peephole optimization. Peephole optimization removes redundant instructions from the bytecode.

If you are using Flex Builder or the mxmlc command-line compiler, you can set the `optimize` compiler option to `true`, as the following example shows:

```
mxmlc -optimize=true MyApp.mxml
```

The default value of the `optimize` option is `true`.

Disabling debugging

Disabling debugging can make your SWF files smaller. When debugging is enabled, the Flex compilers include line numbers and other navigational information in the SWF file that are only used in a debugging environment. Disabling debugging reduces functionality of the fdb command-line debugger and the debugger built into Flex Builder.

To disable debugging, set the `debug` compiler option to `false`. The default value for the mxmlc compiler is `false`. The default value for the compc compiler is `true`.

For more information about debugging, see "Using the Command-Line Debugger" on page 245.

Using strict mode

When you set the `strict` compiler option to `true`, the compiler verifies that definitions and package names in `import` statements are used in the application. If the imported classes are not used, the compiler reports an error.

The following example shows some examples of when strict mode throws a compiler error:

```
package {
    import flash.utils.Timer; // Error. This class is not used.
```

```
    import flash.printing.* // Error. This class is not used.
    import mx.controls.Button; // Error. This class is not used.
    import mx.core.Application; // No error. This class is used.

    public class Foo extends Application {
    }

}
```

The `strict` option also performs compile-time type checking, which provides a small optimization increase in the application at run time.

The default value of the `strict` compiler option is `true`.

Examining linker dependencies

To find ways to reduce SWF file sizes, you can look at the list of ActionScript classes that are linked into your SWF file.

You can generate a report of linker dependencies by setting the `link-report` compiler option to `true`. The output of this compiler option is a report that shows linker dependencies in an XML format.

The following example shows the dependencies for the ProgrammaticSkin script as it appears in the linker report:

```
<script name="C:\flex3sdk\frameworks\libs\framework.swc(mx/skins/ProgrammaticSkin)"
mod="1141055632000" size="5807">
    <def id="mx.skins:ProgrammaticSkin"/>
    <pre id="mx.core:IFlexDisplayObject"/>
    <pre id="mx.styles:IStyleable"/>
    <pre id="mx.managers:ILayoutClient"/>
    <pre id="flash.display:Shape"/>
    <dep id="String"/>
    <dep id="flash.geom:Matrix"/>
    <dep id="mx.core:mx_internal"/>
    <dep id="uint"/>
    <dep id="mx.core:UIComponent"/>
    <dep id="int"/>
    <dep id="Math"/>
    <dep id="Object"/>
    <dep id="Array"/>
    <dep id="mx.core:IStyleClient"/>
    <dep id="Boolean"/>
    <dep id="Number"/>
    <dep id="flash.display:Graphics"/>
</script>
```

The following table describes the tags used in this file:

Tag	Description
`<script>`	Indicates the name of a compilation unit used in the creation of the application SWF file. Compilation units must contain at least one public definition, such as a class, function, or namespace. The `name` attribute shows the origin of the script, either from a source file or from a SWC file (for example, frameworks.swc). If you set `keep-generated=true` on the command line, all classes in the generated folder are listed as scripts in this file. The `size` attribute shows the class' size, in bytes. The `mod` attribute shows the time stamp when the script was created.
`<def>`	Indicates the name of a definition. A definition, like a script, can be a class, function, or namespace.
`<pre>`	Indicates a definition that must be linked in to the SWF file before the current definition is linked in. This tag means *prerequisite*. For class definitions, this tag shows the direct parent class (for example, flash.events:Event), plus all implemented interfaces (for example, mx.core:IFlexDisplayObject and mx.managers:ILayoutClient) of the class.
`<dep>`	Indicates other definitions that this definition depends on (for example, String, _ScrollBarStyle, and mx.core:IChildList). This is a reference to a definition that the current script requires. Some script definitions have no dependencies, so the `<script>` tag might have no `<dep>` child tags.
`<ext>`	Indicates a dependency to an asset that was not linked in. These dependencies show up in the linker report when you use the `external-library-path`, `externs`, or `load-externs` compiler options to add assets to the SWF file.

You can examine the list of prerequisites and dependencies for your application definition. You do this by searching for your application's root MXML file by its name; for example, MyApp.mxml. You might discover that you are linking in some classes inadvertently. When writing code, it is common to make a reference to a class but not actually require that class in your application. That reference causes the referenced class to be linked in, and it also links in all the classes on which the referenced class depends.

If you look through the linker report, you might find that you are linking in a class that is not needed. If you do find an unneeded class, try to identify the linker dependency that is causing the class to be linked in, and try to find a way to rewrite the code to eliminate that dependency.

Avoiding initializing unused classes

Some common ways to avoid unnecessary references include avoiding initializing classes you do not use and performing type-checking with the `getQualifiedClassName()` method.

The following example checks if the class is a Button control. This example forces the compiler to include a Button in the SWF file, even if the child is not a Button control and the entire application has no Button controls.

```
<?xml version="1.0"?>
<!-- optimize/UnusedClasses.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="checkChildType()">
    <mx:Script><![CDATA[
    import mx.controls.Button;

    public function checkChildType():void {
        var child:DisplayObject = getChildAt(0);
        var childIsButton:Boolean = child is mx.controls.Button;
        trace("child is mx.controls.Button: " + childIsButton); // False.
    }
    ]]></mx:Script>

    <!-- This control is here so that the getChildAt() method succeeds. -->
    <mx:DataGrid/>

</mx:Application>
```

You can use the `getQualifiedClassName()` method to accomplish the same task as the previous example. This method returns a String that you can compare to the name of a class without causing that class to be linked into the SWF.

The following example does not create a linker dependency on the Button control:

```
<?xml version="1.0"?>
<!-- optimize/GetQualifiedClassNameExample.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
        creationComplete="checkChildType()">
    <mx:Script><![CDATA[
    public function checkChildType():void {
        var child:DisplayObject = getChildAt(0);
        var childClassName:String = getQualifiedClassName(child);
        var childIsButton:Boolean = childClassName == "mx.controls::Button"
        trace("child class name = Button " + childIsButton);
    }
    ]]></mx:Script>

    <!-- This control is here so that the getChildAt() method succeeds. -->
    <mx:DataGrid/>

</mx:Application>
```

Externalizing assets

There are various methods of externalizing assets used by your Flex applications; these include:

- Using modules

- Using run-time stylesheets
- Using Runtime Shared Libraries (RSLs)
- Loading assets at run time rather than embedding them

This section describes loading assets at run time. For information about modules and run-time stylesheets, see the *Adobe Flex 3 Developer Guide*. For information about RSLs, see “Using RSLs to reduce SWF file size” on page 70.

One method of reducing the SWF file size is to externalize assets; that is, to load the assets at run time rather than embed them at compile time. You can do this with assets such as images, SWF files, and sound files.

Embedded assets load immediately, because they are already part of the Flex SWF file. However, they add to the size of your application and slow down the application initialization process. Embedded assets also require you to recompile your applications whenever your asset changes.

The following example embeds the shapes.swf file into the Flex application at compile time:

```
<?xml version="1.0"?>
<!-- optimize/EmbedAtCompileTime.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Image source="@Embed(source='../assets/butterfly.gif')"/>
</mx:Application>
```

The following example loads the shapes.swf file into the Flex application at run time:

```
<?xml version="1.0"?>
<!-- optimize/EmbedAtRunTime.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Image source="../assets/butterfly.gif"/>
</mx:Application>
```

The only supported image type that you cannot load at run time is SVG. Flash Player and AIR require that the compiler transcodes that file type at compile time. The player and AIR runtime cannot transcode that file type at run time.

When you load SWF files from domains that are not the same as the loading SWF file, you must use a cross-domain.xml file or other mechanism to enable the proper permissions. For more information on using the cross-domain.xml file, see “Using cross-domain policy files” on page 40.

An alternative to reducing SWF file sizes by externalizing assets is to increase the SWF file size by embedding assets. By embedding assets such as images, sounds, and SWF files, you can reduce the network bandwidth and connections. The SWF file size increases, but the application requires fewer network connections to the server.

For information on loading assets, see “Embedding Assets” on page 965 in the *Adobe Flex 3 Developer Guide.*

Using character ranges for embedded fonts

By specifying a range of symbols that compose the face of an embedded font, you reduce the size of an embedded font. Each character in a font must be described; if you remove some of these characters, it reduces the overall size of the description information that Flex must include for each embedded font.

You can set the range of glyphs in the flex-config.xml file or in the `font-face` declaration in each MXML file. You specify individual characters or ranges of characters using the Unicode values for the characters, and you can set multiple ranges for each font declaration.

In CSS, you can set the Unicode range with the `unicodeRange` property, as the following example shows:

```
@font-face {
    src:url("../assets/MyriadWebPro.ttf");
    fontFamily: myFontFamily;
    unicodeRange:
        U+0041-U+005A, /* Upper-Case [A..Z] */
        U+0061-U+007A, /* Lower-Case a-z */
        U+0030-U+0039, /* Numbers [0..9] */
        U+002E-U+002E; /* Period [.] */
}
```

In the flex-config.xml file, you can set the Unicode range with the `<language-range>` block, as the following example shows:

```
<language-range>
    <lang>Latin I</lang>
    <range>U+0020,U+00A1-U+00FF,U+2000-U+206F,U+20A0-U+20CF,U+2100-U+2183</range>
</language-range>
```

For more information, see “Using Fonts” on page 653 in the *Adobe Flex 3 Developer Guide*.

Using multiple SWF files

One way to reduce the size of an application’s file is to break the application up into logical parts that can be sent to the client and loaded over a series of requests rather than all at once. By breaking a monolithic application into smaller applications, users can interact with your application more quickly, but possibly experience some delays while the application is running.

One approach is to use the SWFLoader control. This technique can work with SWF files that add graphics or animations to an application, or SWF files that act as stand-alone applications inside the main application. If you import SWF files that require a large amount of user interaction, however, consider building them as custom components. SWF files produced with earlier versions of Flex or ActionScript may not work properly when loaded with the SWFLoader control.

Rather than loading SWF files into the main application with the SWFLoader control, consider having the SWF files communicate with each other as separate applications. You can do this with local SharedObjects, LocalConnection objects, or with the ExternalInterface API.

Another approach to loading multiple small SWF files rather than one large one is to use the HTML wrapper to provide a framework for loading the SWF files.

Comparing dynamic and static linking

Most large applications use libraries of ActionScript classes and components. You must decide whether to use static or dynamic linking when using these libraries in your Flex applications.

When you use *static linking*, the compiler includes all components, classes, and their dependencies in the application SWF file when you compile the application. The result is a larger SWF file that takes longer to download but loads and runs quickly because all the code is in the SWF file. To compile your application that uses libraries and to statically link those definitions into your application, you use the `library-path` and `include-libraries` options to specify the locations of SWC files.

Dynamic linking is when some classes used by an application are left in an external file that is loaded at run time. The result is a smaller SWF file size for the main application, but the application relies on external files that are loaded during run time.

To dynamically link classes and components, you compile a library. You then instruct the compiler to exclude that library's contents from the application SWF file. You must still provide link-checking at compile time even though the classes are not going to be included in the final SWF file.

You use dynamic linking by creating component libraries and compiling them with your application by using the `external-library-path`, `externs`, or `load-externs` compiler options. These options instruct the compiler to exclude resources defined by their arguments from inclusion in the application, but to check links against them and prepare to load them at run time. The `external-library-path` option specifies SWC files or directories for dynamic linking. The `externs` option specifies individual classes or symbols for dynamic linking. The `load-externs` option specifies an XML file that describes which classes to use for dynamic linking. This XML file has the same syntax as the file produced by the `link-report` compiler option.

For more information about linking, see "About linking" on page 196. For more information about compiler options, see "Using the Flex Compilers" on page 125.

Using RSLs to reduce SWF file size

One way to reduce the size of your application's SWF file is by externalizing shared assets into stand-alone files that can be separately downloaded and cached on the client. These shared assets are loaded by any number of applications at run time, but must be transferred only once to the client. These shared files are known as *Runtime Shared Libraries* (RSLs).

If you have multiple applications but those applications share a core set of components or classes, your users will be required to download those assets only once as an RSL. The applications that share the assets in the RSL use the same cached RSL as the source for the libraries as long as they are in the same domain. The resulting file size for your applications can be reduced. The benefits increase as the number of applications that use the RSL increases.

When you create an RSL, be sure to optimize it prior to deployment. This removes debugging information as well as unnecessary metadata from the RSL, which can dramatically reduce its size.

For more information, see "Using Runtime Shared Libraries" on page 195.

Application coding

The MXML language provides a rich set of controls and classes that you can use to create interactive applications. This richness sometimes can reduce performance. However, there are some techniques that a Flex developer can use to improve the run-time performance of the Flex application.

To measure the effects of the following techniques, you should use the Flex profiler. For more information, see "Profiling Flex applications" on page 155 in *Using Adobe Flex Builder 3*.

Object creation and destruction

Object creation is the task of instantiating all the objects in your application. These objects include controls, components, and objects that contain data and other dynamic information. Optimizing the process of object creation and destruction can result in significant performance gains. *Object destruction* is the act of reallocating memory for objects after all references to those objects have been removed. This task is carried out by the garbage collector at regular intervals. You can improve the frequency that Flash Player and AIR destroy objects by removing references to objects.

No single task during application initialization takes up the most time. The best way to improve performance is to create fewer objects. You can do this by deferring the instantiation of objects, or changing the order in which they are created to improve perceived performance.

Using ordered creation

You can improve *perceived* startup time of your Flex application by ordering the creation of containers in the initial view. The default behavior of Flex is to create all containers and their children in the initial view, and then display everything at once. The user cannot interact with the application or see meaningful data until all the containers and their children are created.

In some cases, you can improve the user's initial experience by displaying the components in one container before creating the components in the next container. This process is called ordered creation.

To use ordered creation, you set the `creationPolicy` property of a container to `queued`, as the following example shows:

```
<?xml version="1.0"?>
<!-- optimize/QueuedPanels.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Panel id="panel1" creationPolicy="queued" width="100%" height="33%">
        <mx:Button id="button1a"/>
        <mx:Button id="button1b"/>
    </mx:Panel>

    <mx:Panel id="panel2" creationPolicy="queued" width="100%" height="33%">
        <mx:Button id="button2a"/>
        <mx:Button id="button2b"/>
    </mx:Panel>

    <mx:Panel id="panel3" creationPolicy="queued" width="100%" height="33%">
        <mx:Button id="button3a"/>
        <mx:Button id="button3b"/>
    </mx:Panel>
</mx:Application>
```

This adds the container's children to a queue. Flash Player instantiates and displays all of the children within the first container in the queue before instantiating the children in the next container in the queue.

For more information on ordered creation, see "Using ordered creation" on page 101.

Using deferred creation

To improve the start-up time of your application, minimize the number of objects that are created when the application is first loaded. If a user-interface component is not initially visible at start up, create that component only when you need it. This is called deferred creation. Containers that have multiple views, such as an Accordion, provide built-in support for this behavior. You can use ActionScript to customize the creation order of multiple-view containers or defer the creation of other containers and controls.

To use deferred creation, you set the value of a component's `creationPolicy` property to `all`, `auto`, or `none`. If you set it to `none`, Flex does not instantiate a control's children immediately, but waits until you instruct Flex to do so. In the following example, the children of the VBox container are not be instantiated when the application is first loaded, but only after the user clicks the button:

```
<?xml version="1.0"?>
<!-- optimize/CreationPolicyNone.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[

        private function createButtons(e:Event):void {
            myVBox.createComponentsFromDescriptors();
```

```
        }

    ]]></mx:Script>

    <mx:Panel title="VBox with Repeater">
        <mx:VBox id="myVBox" height="100" width="125" creationPolicy="none">
            <mx:Button id="b1" label="Hurley"/>
            <mx:Button id="b2" label="Jack"/>
            <mx:Button id="b3" label="Sawyer"/>
        </mx:VBox>
    </mx:Panel>

    <mx:Button id="myButton" click="createButtons(event)" label="Create Buttons"/>

</mx:Application>
```

You call methods such as `createComponentFromDescriptor()` and `createComponentsFromDescriptor()` on the container to instantiate its children at run time. For more information on using deferred instantiation, see "Using deferred creation" on page 94.

Destroying unused objects

Flash Player provides built-in garbage collection that frees up memory by destroying objects that are no longer used. To ensure that the garbage collector destroys your unused objects, remove all references to that object, including the parent's reference to the child.

For more information about garbage collection, see "About garbage collection" on page 178 in *Using Adobe Flex Builder 3*.

On containers, you can call the `removeChild()` or `removeChildAt()` method to remove references to child controls that are no longer needed. The following example removes references to button instances from the myVBox control:

```
<?xml version="1.0"?>
<!-- optimize/DestroyObjects.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[
        private function destroyButtons(e:Event):void {
            myVBox.removeChild(b1);
            myVBox.removeChild(b2);
            myVBox.removeChild(b3);
        }
    ]]></mx:Script>

    <mx:Panel title="VBox with Repeater">
        <mx:VBox id="myVBox" height="100" width="125">
            <mx:Button id="b1" label="Hurley"/>
```

```
            <mx:Button id="b2" label="Jack"/>
            <mx:Button id="b3" label="Sawyer"/>
        </mx:VBox>
    </mx:Panel>

    <mx:Button id="myButton2" click="destroyButtons(event)" label="Destroy Buttons"/>

</mx:Application>
```

You can clear references to unused variables by setting them to `null` in your ActionScript; for example:

```
myDataProvider = null
```

To ensure that destroyed objects are garbage collected, you must also remove event listeners on them by using the `removeEventListener()` method, as the following example shows:

```
<?xml version="1.0"?>
<!-- optimize/RemoveListeners.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="initApp(event)">
    <mx:Script><![CDATA[
        private function initApp(e:Event):void {
            b1.addEventListener("click",myClickHandler);
            b2.addEventListener("click",myClickHandler);
            b3.addEventListener("click",myClickHandler);
        }

        private function destroyButtons(e:Event):void {
            b1.removeEventListener("click",myClickHandler);
            b2.removeEventListener("click",myClickHandler);
            b3.removeEventListener("click",myClickHandler);

            myVBox.removeChild(b1);
            myVBox.removeChild(b2);
            myVBox.removeChild(b3);
        }

        private function myClickHandler(e:Event):void {
            // Do something here.
        }
    ]]></mx:Script>

    <mx:Panel title="VBox with Repeater">
        <mx:VBox id="myVBox" height="100" width="125">
            <mx:Button id="b1" label="Hurley"/>
            <mx:Button id="b2" label="Jack"/>
            <mx:Button id="b3" label="Sawyer"/>
        </mx:VBox>
```

```
    </mx:Panel>

    <mx:Button id="myButton" click="destroyButtons(event)" label="Destroy Buttons"/>

</mx:Application>
```

You cannot call the `removeEventListener()` method on an event handler that you added inline. In the following example, you cannot call `removeEventListener()` on b1's `click` event handler, but you can call it on b2's and b3's event handlers:

```
<?xml version="1.0"?>
<!-- optimize/RemoveSomeListeners.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="initApp(event)">
    <mx:Script><![CDATA[
        private function initApp(e:Event):void {
            b2.addEventListener("click",myClickHandler);
            b3.addEventListener("click",myClickHandler);
        }

        private function destroyButtons(e:Event):void {
            b2.removeEventListener("click",myClickHandler);
            b3.removeEventListener("click",myClickHandler);

            myVBox.removeChild(b1);
            myVBox.removeChild(b2);
            myVBox.removeChild(b3);
        }

        private function myClickHandler(e:Event):void {
            // Do something here.
        }
    ]]></mx:Script>

    <mx:Panel title="VBox with Repeater">
        <mx:VBox id="myVBox" height="100" width="125">
            <mx:Button id="b1" label="Hurley" click="myClickHandler(event)"/>
            <mx:Button id="b2" label="Jack"/>
            <mx:Button id="b3" label="Sawyer"/>
        </mx:VBox>
    </mx:Panel>

    <mx:Button id="myButton" click="destroyButtons(event)" label="Destroy Buttons"/>

</mx:Application>
```

The *weakRef* parameter to the addEventListener() method provides you with some control over memory resources for listeners. A strong reference (when weakRef is false) prevents the listener from being garbage collected. A weak reference (when weakRef is true) does not. The default is false.

For more information about the removeEventListener() method, see "Using Events" on page 61 in the *Adobe Flex 3 Developer Guide*.

Using styles

You use styles to define the look and feel of your Flex applications. You can use them to change the appearance of a single component, or apply them globally. Be aware that some methods of applying styles are more expensive than others. You can increase your application's performance by changing the way you apply styles.

For more information about using styles, see "Using Styles and Themes" on page 589 in the *Adobe Flex 3 Developer Guide*.

Loading stylesheets at run time

You can load stylesheets at run time by using the StyleManager. These style sheets take the form of SWF files that are dynamically loaded while your Flex application runs.

By loading style sheets at run time, you can load images (for graphical skins), fonts, type and class selectors, and programmatic skins into your Flex application without embedding them at compile time. This lets skins and fonts be partitioned into separate SWF files, away from the main application. As a result, the application's SWF file size is smaller, which reduces the initial download time. However, the first time a run-time style sheet is used, it takes longer for the styles and skins to be applied because Flex must download the necessary CSS-based SWF file.

For more information, see the *Adobe Flex 3 Developer Guide*.

Reducing calls to the setStyle() method

Run-time cascading styles are very powerful, but use them sparingly and in the correct context. Calling the setStyle() method can be an expensive operation because the call requires notifying all the children of the newly-styled object. The resulting tree of children that must be notified can be quite large.

A common mistake that impacts performance is overusing or unnecessarily using the setStyle() method. In general, you only use the setStyle() method when you change styles on existing objects. Do not use it when you set up styles for an object for the first time. Instead, set styles in an <mx:Style> block, as style properties on the MXML tag, through an external CSS style sheet, or as global styles.

Some applications must call the `setStyle()` method during the application or object instantiation. If this is the case, call the `setStyle()` method early in the instantiation phase. Early in the instantiation phase means setting styles from the component or application's `preinitialize` event, instead of the `initialize` or `creationComplete` event. By setting the styles as early as possible during initialization, you avoid unnecessary style notification and lookup.

If you programmatically create a component and want to set styles on that component, call the `setStyle()` method before you attach it to the display list with a call to the `addChild()` method, as the following example shows:

```
<?xml version="1.0"?>
<!-- optimize/CreateStyledButton.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="initApp(event)">
    <mx:Script><![CDATA[
        import mx.controls.Button;

        public function initApp(e:Event):void {
            var b:Button = new Button();
            b.label="Click Me";
            b.setStyle("color", 0x00CCFF);
            panel1.addChild(b);
        }
    ]]></mx:Script>

    <mx:Panel id="panel1"/>

</mx:Application>
```

Setting global styles

Changing global styles (changing a CSS ruleset that is associated with a class or type selector) at run time is an expensive operation. Any time you change a global style, Flash Player must perform the following actions:

- Traverse the entire application looking for instances of that control.
- Check all the control's children if the style is inheriting.
- Redraw that control.

The following example globally changes the Button control's color style property:

```
<?xml version="1.0"?>
<!-- optimize/ApplyGlobalStyles.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="initApp(event)">
    <mx:Script><![CDATA[
        public function initApp(e:Event):void {
```

```
            StyleManager.getStyleDeclaration("Button").setStyle("color", 0x00CCFF);
        }
    ]]></mx:Script>

    <mx:Panel id="panel1">
        <mx:Button id="b1" label="Click Me"/>
        <mx:Button id="b2" label="Click Me"/>
        <mx:Button id="b3" label="Click Me"/>
    </mx:Panel>

</mx:Application>
```

If possible, set global styles at authoring time by using CSS. If you must set them at run time, try to set styles by using the techniques described in "Reducing calls to the setStyle() method" on page 76.

Calling the setStyleDeclaration() and loadStyleDeclarations() methods

The `setStyleDeclaration()` method is computationally expensive. You can prevent Flash Player from applying or clearing the new styles immediately by setting the `update` parameter to `false`.

The following example sets new class selectors on different targets, but does not trigger the update until the last style declaration is applied:

```
<?xml version="1.0"?>
<!-- styles/SetStyleDeclarationExample.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" creationComplete="initApp()">
  <mx:Script><![CDATA[
        import mx.styles.StyleManager;

        private var myButtonStyle:CSSStyleDeclaration = new
CSSStyleDeclaration('myButtonStyle');
        private var myLabelStyle:CSSStyleDeclaration = new
CSSStyleDeclaration('myLabelStyle');
        private var myTextAreaStyle:CSSStyleDeclaration = new
CSSStyleDeclaration('myTextAreaStyle');

        private function initApp():void {
            myButtonStyle.setStyle('color', 'blue');
            myLabelStyle.setStyle('color', 'blue');
            myTextAreaStyle.setStyle('color', 'blue');
        }

        private function applyStyles():void {
            StyleManager.setStyleDeclaration("Button", myButtonStyle, false);
            StyleManager.setStyleDeclaration("Label", myLabelStyle, false);
            StyleManager.setStyleDeclaration("TextArea", myTextAreaStyle, true);
        }
```

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

    <mx:Button id="myButton" label="Click Me" click="applyStyles()"/>
    <mx:Label id="myLabel" text="This is a label"/>
    <mx:TextArea id="myTextArea" text="This is a TextArea"/>

</mx:Application>
```

When you pass `false` for the `update` parameter, Flash Player stores the selector but does not apply the style. When you pass `true` for the `update` parameter, Flash Player recomputes the styles for every visual component in the application.

The `loadStyleDeclarations()` method is similarly computationally expensive. When you load a new style sheet, this method triggers an update to the display list by default. You can prevent Flash Player from applying or clearing the new style sheets immediately by setting the `update` parameter to `false`. When you chain calls to `loadStyleDeclarations()` methods, set the update parameter to `false` for all calls except the last one.

Working with containers

Containers provide a hierarchical structure that lets you control the layout characteristics of container children. You can use containers to control child sizing and positioning, or to control navigation among multiple child containers.

When you develop your Flex application, try to minimize the number of containers that you use. This is because most containers provide relative sizing and positioning, which can be resource-intensive operations, especially when an application first starts.

One common mistake is to create a container that contains a single child. Sometimes having a single child in a container is necessary, such as when you use the container’s padding to position the child. But try to identify and remove containers such as these that provide no real functionality. Also keep in mind that the root of an MXML component does not need to be a container.

Another sign of possibly too many containers is when you have a container nested inside another container, where both the parent and child containers have the same type (for example, HBoxes).

Minimizing container nesting

It is good practice to avoid deeply nested layouts when possible. For simple applications, if you have nested containers more than three levels deep, you can probably produce the same layout with fewer levels of containers. Deep nesting can lead to performance problems. For larger applications, deeper nesting might be unavoidable.

When you nest containers, each container instance runs measuring and sizing algorithms on its children (some of which are containers themselves, so this measuring procedure can be recursive). When the layout algorithms have processed, and the relative layout values have been calculated, Flash Player draws the complex collection of objects comprising the view. By eliminating unnecessary work at object creation time, you can improve the performance of your application.

Using Grid containers

A Grid container is useful for aligning multiple objects. When you use Grid containers, however, you introduce additional levels of containers with the GridItem and GridRow controls. In many cases, you can achieve the same results by using the VBox and HBox containers, and these containers use fewer levels of nesting.

Using layout containers

You can sometimes improve application start-up time by using Canvas containers, which perform absolute positioning, instead of relative layout containers, such as the Form, HBox, VBox, Grid, and Tile containers.

Canvas containers are the only containers that let you specify the location of their child controls by default. All other containers are relative containers by default, which means that they lay everything out relative to other components in the container. You can make Application and Panel containers do absolute positioning.

Canvas containers eliminate the layout logic that other containers use to perform automatic positioning of their children at startup, and replace it with explicit pixel-based positioning. When you use a Canvas container, you must remember to set the *x* and *y* positions of all of its children. If you do not set the *x* and *y* positions, the Canvas container's children lay out on top of each other at the default *x*, *y* coordinates (0,0).

The canvas container is not always more efficient than other containers, however, because it must measure itself to make sure that it is large enough to contain its children. Applications that use canvases typically contain a much flatter containment hierarchy. As a result, using canvas containers can lead to less nesting and fewer overall containers, which improves performance.

Canvas containers support constraints, which means that if the container changes size, the children inside the container move with it.

Using absolute sizing

Writing object widths and heights into the code can save time because the Flex layout containers do not have to calculate the size of the object at run time. By specifying container or control widths or heights, you lighten the relative layout container's processing load and subsequently decrease the creation time for the container or control. This technique works with any container or control.

Improving effect performance

Effects let you add animation and motion to your application in response to user or programmatic action. For example, you can use effects to cause a dialog box to bounce slightly when it receives focus, or to slowly fade in when it becomes visible.

Effects can be one of the most processor-intensive tasks performed by a Flex application. Use the techniques described in this section to improve the performance of effects. For more information, see "Using Behaviors" on page 545 in the *Adobe Flex 3 Developer Guide*.

Increasing effect duration

Increase the duration of your effect with the `duration` property. Doing this spreads the distinct, choppy stages over a longer period of time, which lets the human eye fill in the difference for a smoother effect.

Hiding parts of the target view

Make parts of the target view invisible when the effect starts, play the effect, and then make those parts visible when the effect has completed. To do this, you add logic in the `effectStart` and `effectEnd` event handlers that controls what is visible before and after the effect.

When you apply a Resize effect to a Panel container, for example, the measurement and layout algorithm for the effect executes repeatedly over the duration of the effect. When a Panel container has many children, the animation can be jerky because Flex cannot update the screen quickly enough. Also, resizing one Panel container often causes other Panel containers in the same view to resize.

To solve this problem, you can use the Resize effect's `hideChildrenTargets` property to hide the children of Panel containers while the Resize effect is playing. The value of the `hideChildrenTargets` property is an Array of Panel containers that should include the Panel containers that resize during the animation. When the `hideChildrenTargets` property is `true`, and before the Resize effect plays, Flex iterates through the Array and hides the children of each of the specified Panel containers.

Avoiding bitmap-based backgrounds

Designers often give their views background images that are solid colors with gradients, slight patterns, and so forth. To ease what Flash Player redraws during an effect, try using a solid background color for your background image. Or, if you want a slight gradient instead of a solid color, use a background image that is a SWF or SVG file. These are easier for Flash Player to redraw than standard JPG or PNG files.

Suspending background processing

To improve the performance of effects, you can disable background processing in your application for the duration of the effect by setting the `suspendBackgroundProcessing` property of the Effect to `true`. The background processing that is blocked includes component measurement and layout, and responses to data services for the duration of the effect.

Using the cachePolicy property

An effect can use bitmap caching in Flash Player to speed up animations. An effect typically uses bitmap caching when the target component's drawing does not change while the effect is playing.

The `cachePolicy` property of UIComponents controls the caching operation of a component during an effect. The `cachePolicy` property can have the following values:

CachePolicy.ON Specifies that the effect target is always cached.

CachePolicy.OFF Specifies that the effect target is never cached.

CachePolicy.AUTO Specifies that Flex determines whether the effect target should be cached. This is the default value.

The `cachePolicy` property is useful when an object is included in a redraw region but the object does not change. For more information about redraw regions, see "Understanding redraw regions" on page 83.

The `cachePolicy` property provides a wrapper for the `cacheAsBitmap` property. For more information, see "Using the cacheAsBitmap property" on page 83.

Improving rendering speed

The actual rendering of objects on the screen can take a significant amount of time. Improving the rendering times can dramatically improve your application's performance. Use the techniques in this section to help improve rendering speed. In addition, use the techniques described in the previous section, "Improving effect performance" on page 81, to improve effect rendering speed.

Setting movie quality

You can use the `quality` property of the wrapper's `<object>` and `<embed>` tags to change the rendering of your Flex application in Flash Player. Valid values for the `quality` property are `low`, `medium`, `high`, `autolow`, `autohigh`, and `best`. The default value is `best`.

The `low` setting favors playback speed over appearance and never uses anti-aliasing. The `autolow` setting emphasizes speed at first but improves appearance whenever possible. The `autohigh` setting emphasizes playback speed and appearance equally at first, but sacrifices appearance for playback speed if necessary. The `medium` setting applies some anti-aliasing and does not smooth bitmaps. The `high` setting favors appearance over playback speed and always applies anti-aliasing. The `best` setting provides the best display quality and does not consider playback speed. All output is anti-aliased and all bitmaps are smoothed.

For information on these settings, see "About the object and embed tags" on page 321.

Understanding redraw regions

A *redraw region* is the region around an object that must be redrawn when that object changes. Everything in a redraw region is redrawn during the next rendering phase after an object changes. The area that Flash Player redraws includes the object, and any objects that overlap with the redraw region, such as the background or the object's container.

You can see redraw regions at run time in the debugger version of Flash Player by selecting View > Show Redraw Regions in the player's menu. When you select this option, the debugger version of Flash Player draws red rectangles around each redraw region while the application runs.

By looking at the redraw regions, you can get a sense of what is changing and how much rendering is occurring while your application runs. Flash Player sometimes combines the redraw regions of several objects into a single region that it redraws. As a result, if your objects are spaced close enough together, they might be redrawn as part of one region, which is better than if they are redrawn separately. If the number of regions is too large, Flash Player might redraw the entire screen.

Using the cacheAsBitmap property

To improve rendering speeds, make careful use of the `cacheAsBitmap` property. You can set this property on any UIComponent.

When you set the `cacheAsBitmap` property to `true`, Flash Player stores a copy of the initial bitmap image of an object in memory. If you later need that object, and the object's properties have not changed, Flash Player uses the cached version to redraw the object. This can be faster than using the vectors that make up the object.

Setting the `cacheAsBitmap` property to `true` can be especially useful if you use animations or other effects that move objects on the screen. Instead of redrawing the object in each frame during the animation, Flash Player can use the cached bitmap.

The downside is that changing the properties of objects that are cached as bitmaps is more computationally expensive. Each time you change a property that affects the cached object's appearance, Flash Player must remove the old bitmap and store a new bitmap in the cache. As a result, only set the `cacheAsBitmap` property to `true` for objects that do not change much.

Enable bitmap caching only when you need it, such as during the duration of an animation, and only on a few objects at a time because it can be a memory-intensive operation. The best approach might be to change this property at various times during the object's life cycle, rather than setting it once.

Using filters

To improve rendering speeds, do not overuse filters such as DropShadowFilter. The expense of the filter is proportional to the number of pixels in the object that you are applying the filter to. As a result, it is best to use filters on smaller objects.

Using device text

Mixing device text and vector graphics can slow rendering speeds. For example, a DataGrid control that contains both text and graphics inside a cell will be much slower to redraw than a DataGrid that contains just text.

Using clip masks

Using the `scrollRect` and `mask` properties of an object are expensive operations. Try to minimize the number of times you use these properties.

Using large data sets

You can minimize overhead when working with large data sets.

Paging

When you use a DataService class to get your remote data, you might have a collection that does not initially load all of its data on the client. You can prevent large amounts of data from traveling over the network and slowing down your application while that data is processed using paging. The data that you get incrementally is referred to as *paged* data, and the data that has not yet been received is *pending* data.

Paging data using the DataService class provides the following benefits:

- Maximum message size on the destination can be configured.
- If size exceeds the maximum value, multiple message batches are used.
- Client reassembles separate messages.
- Asynchronous data paging across the network.
- User interface elements can display portions of the collection without waiting for the entire collection to load.

For more information, see "Using Data Providers and Collections" on page 137 in the *Adobe Flex 3 Developer Guide*.

Disabling live scrolling

Using a DataGrid control with large data sets might make it slow to scroll when using the scrollbar. When the DataGrid displays newly visible data, it calls the `getItemAt()` method on the data provider.

The default behavior of a DataGrid is to continuously update data when the user is scrolling through it. As a result, performance can degrade if you just simply scroll through the data on a DataGrid because the DataGrid is continuously calling the `getItemAt()` method. This can be a computationally expensive method to call.

You can disable this *live scrolling* so that the view is only updated when the scrolling stops by setting the `liveScrolling` property to false.

The default value of the `liveScrolling` property is true. All subclasses of ScrollControlBase, including TextArea, HorizontalList, TileList, and DataGrid, have this property.

Dynamically repeating components

There are relative benefits of using List-based controls (rather than the Repeater control) to dynamically repeat components. If you must use the Repeater, however, there are techniques for improving the performance of that control.

Comparing List-based controls to the Repeater control

To dynamically repeat components, you can choose between the Repeater or List-based controls, such as HorizontalList, TileList, or List. To achieve better performance, you can often replace layouts you created with a Repeater with the combination of a HorizontalList or TileList and an item renderer.

The Repeater object is useful for repeating a small set of simple user interface components, such as RadioButton controls and other controls typically used in Form containers. You can use the HorizontalList, TileList, or List control when you display more than a few repeated objects.

The HorizontalList control displays data horizontally, similar to the HBox container. The HorizontalList control always displays items from left to right. The TileList control displays data in a tile layout, similar to the Tile container. The TileList control provides a direction property that determines if the next item is down or to the right. The List control displays data in a single vertical column.

Unlike the Repeater object, which instantiates all objects that are repeated, the HorizontalList, TileList, and List controls only instantiate what is visible in the list. The Repeater control takes a data provider (typically an Array) that creates a new copy of its children for each entry in the Array. If you put the Repeater control's children inside a container that does not use deferred instantiation, your Repeater control might create many objects that are not initially visible.

For example, a VBox container creates all objects within itself when it is first created. In the following example, the Repeater control creates all the objects whether or not they are initially visible:

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

```
<!-- optimize/VBoxRepeater.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">

    <mx:Script><![CDATA[
        import mx.collections.ArrayCollection;

        [Bindable]
        public var imgList:ArrayCollection = new ArrayCollection([
            {img:"../assets/butterfly.gif"},
            {img:"../assets/butterfly-gray.gif"},
            {img:"../assets/butterfly-silly.gif"}
        ]);

    ]]></mx:Script>

    <mx:Panel title="VBox with Repeater">
        <mx:VBox height="150" width="250">
            <mx:Repeater id="r" dataProvider="{imgList}">
                <mx:Image source="../assets/{r.currentItem.img}"/>
            </mx:Repeater>
        </mx:VBox>
    </mx:Panel>

</mx:Application>
```

If you use a List-based control, however, Flex only creates those controls in the list that are initially visible. The following example uses the List control to create only the image needed for rendering:

```
<?xml version="1.0"?>
<!-- optimize/ListItems.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
   <mx:Script><![CDATA[
        import mx.collections.ArrayCollection;

        private static var birdList:Array =
["../assets/butterfly.gif","../assets/butterfly-gray.gif","../assets/butterfly-
silly.gif"];
        [Bindable]
        private var birdListAC:ArrayCollection = new ArrayCollection(birdList);

        private function initCatalog():void {
            birdlist.dataProvider = birdListAC;
        }

    ]]></mx:Script>

    <mx:Panel title="List">
```

```
        <mx:List id="birdlist" rowHeight="150" width="250" rowCount="1"
itemRenderer="mx.controls.Image" creationComplete="initCatalog()">
        </mx:List>
    </mx:Panel>
</mx:Application>
```

Using the Repeater control

When using a Repeater control, keep the following techniques in mind:

- Avoid repeating objects that have clip masks because using clip masks is a resource- intensive process.
- Ensure that the containers used as the children of the Repeater control do not have unnecessary container nesting and are as small as possible. If a single instance of the repeated view takes a noticeable amount of time to instantiate, repeating makes it worse. For example, multiple Grid containers in a Repeater object do not perform well because Grid containers themselves are resource-intensive containers to instantiate.
- Set the `recycleChildren` property to `true`. The `recycleChildren` property is a Boolean value that, when set to `true`, binds new data items into existing Repeater children, incrementally creates children if there are more data items, and destroys extra children that are no longer required.

  The default value of the `recycleChildren` property is `false` to ensure that you do not leave stale state information in a repeated instance. For example, suppose you use a Repeater object to display photo images and each Image control has an associated NumericStepper control for how many prints you want to order. Some of the state information, such as the image, comes from the `dataProvider` property. Other state information, such as the print count, is set by user interaction. If you set the `recycleChildren` property to `true` and page through the photos by incrementing the Repeater object's `startingIndex` value, the Image controls bind to the new images, but the NumericStepper control maintains the old information. Use `recycleChildren="false"` only if it is too cumbersome to reset the state information manually, or if you are confident that modifying your `dataProvider` property should not trigger a recreation of the Repeater object's children.

  Keep in mind that the `recycleChildren` property has no effect on a Repeater object's speed when the Repeater object loads the first time. The `recycleChildren` property improves performance only for subsequent changes to the Repeater control's data provider. If you know that your Repeater object creates children only once, you do not have to use the `recycleChildren` property or worry about the stale state situation.

Improving charting component performance

You can use various techniques to improve the performance of charting controls.

Avoiding filtering series data

When possible, set the `filterData` property to `false`. In the transformation from data to screen coordinates, the various series types filter the incoming data to remove any missing values that are outside the range of the chart; missing values would render incorrectly if drawn to the screen. For example, a chart that represents vacation time for each week in 2003 might not have a value for the July fourth weekend because the company was closed. If you know your data model will not have any missing values at run time, or values that fall outside the chart's data range, you can instruct a series to explicitly skip the filtering step by setting its `filterData` property to `false`.

Coding the LinearAxis object

If possible, do not let a LinearAxis object autocalculate its range. A LinearAxis control calculating its numeric range can be a resource-intensive calculation. If you know reasonable minimum and maximum values for the range of your LinearAxis, specify them to help your charts render more quickly.

In addition to specifying the range for a LinearAxis, specify an interval (the numeric distance between label values along the axis) value. Otherwise, the chart control must calculate this value.

Coding the CategoryAxis object

Modifying a CategoryAxis object's data provider is more resource intensive than modifying a Series object's data provider. If the data bound to your chart is going to change, but the categories in your chart will stay static, have the CategoryAxis' data provider and Series' data provider refer to different objects. This prevents the CategoryAxis from reevaluating its data provider, which is a resource-intensive computation.

Styling AxisRenderer objects

Improve the rendering time of your AxisRenderers objects by setting particular styles. The AxisRenderers perform many calculations to ensure that they render correctly in all situations. The more help you can give them in restricting their options, the faster they render. Setting the `labelRotation` and `canStagger` styles on the AxisRenderer improve performance. You can set these styles within the tag or in CSS.

Specifying gutter styles

Specify gutter styles when possible. The gutter area of a Cartesian chart is the area between the margins and the actual axis lines. With default values, the chart adjusts the gutter values to accommodate axis decorations. Calculating these gutter values can be resource intensive. By explicitly setting the values of the `gutterLeft`, `gutterRight`, `gutterTop`, and `gutterBottom` style properties, your charts draw quicker and more efficiently.

Using drop shadows

To improve performance, do not use drop-shadows on your series items unless they are necessary. You can selectively add shadows to individual chart series by using renderers such as the ShadowBoxItemRenderer and ShadowLineRenderer classes.

Shadows are implemented as filters in charting controls. As a result, you must remove these shadows by setting the chart control's `seriesFilters` property to an empty Array. The following example removes the shadows from all series, but then changes the renderer for the third series to be a shadow renderer:

```
<?xml version="1.0"?>
<!-- optimize/RemoveShadowsColumnChart.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[
        import mx.collections.ArrayCollection;
        [Bindable]
        public var expenses:ArrayCollection = new ArrayCollection([
            {Month: "Jan", Income: 2000, Expenses: 1500, Profit: 500},
            {Month: "Feb", Income: 1000, Expenses: 200, Profit: 800},
            {Month: "Mar", Income: 1500, Expenses: 500, Profit: 1000}
        ]);
    ]]></mx:Script>
    <mx:Panel title="Column Chart">
        <mx:ColumnChart id="myChart" dataProvider="{expenses}">
            <mx:seriesFilters>
                <mx:Array/>
            </mx:seriesFilters>
            <mx:horizontalAxis>
                <mx:CategoryAxis dataProvider="{expenses}" categoryField="Month"/>
            </mx:horizontalAxis>
            <mx:series>
                <mx:ColumnSeries xField="Month" yField="Income" displayName="Income"/>
               <mx:ColumnSeries xField="Month" yField="Expenses" displayName="Expenses"/>
                <mx:ColumnSeries xField="Month" yField="Profit" displayName="Profit"
itemRenderer="mx.charts.renderers.ShadowBoxItemRenderer"/>
            </mx:series>
        </mx:ColumnChart>
        <mx:Legend dataProvider="{myChart}"/>
```

```
    </mx:Panel>
</mx:Application>
```

Chapter 5: Improving Startup Performance

Adobe® Flex® helps you improve the actual and perceived startup times of your Flex applications. You can do this by deferring the creation of certain controls until a later time, or customize the order in which containers are created and displayed in your applications.

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About startup performance

You could increase the startup time and decrease performance of your applications if you create too many objects or put too many objects into a single view. To improve startup time, minimize the number of objects that are created when the application is first loaded. If a user-interface component is not initially visible at startup, avoid creating that component until you need it. This is called deferred creation. Containers that have multiple views, such as an Accordion container, provide built-in support for this behavior. You can use ActionScript to customize the creation order of multiple-view containers or defer the creation of other containers and controls.

After you improve the *actual* startup time of your application as much as possible, you can improve *perceived* startup time by ordering the creation of containers in the initial view. The default behavior of Flex is to create all containers and their children in the initial view, and then display everything at one time. The user will not be able to interact with the application or see meaningful data until all the containers and their children are created. In some cases, you can improve the user's initial experience by displaying the components in one container before creating the components in the next container. This process is called *ordered creation*.

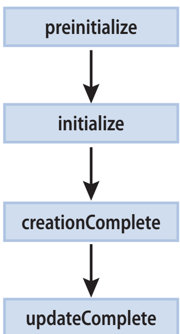
The remaining sections of this topic describe how to use deferred creation to reduce overall application startup time and ordered creation to make the initial startup time appear as short as possible to the user. But before you can fully understand ordered creation and deferred creation, you must also understand the differences between single-view and multiple-view containers, the order of events in a component's startup life cycle, and how to manually instantiate controls from their child descriptors.

About startup order

All Flex components trigger a number of events during their startup procedure. These events indicate when the component is first created, plotted internally, and drawn on the screen. The events also indicate when the component is finished being created and, in the case of containers, when its children are created.

Components are instantiated, added or linked to a parent, and then sized and laid out inside their container. The component creation order is as follows:

The following example shows the major events that are dispatched during a component's creation life cycle:



The creation order is different for containers and components because containers can be the parent of other components or containers. Components within the containers must also go through the creation order. If a container is the parent of another container, the inner container's children must also go through the creation order.

The following example shows the major events that are dispatched during a container's creation life cycle:

Container
Component
preinitialize
preinitialize
initialize
childAdd
initialize
creationComplete
updateComplete
creationComplete
updateComplete

After all components are created and drawn, the Application object dispatches an `applicationComplete` event. This is the last event dispatched during an application startup.

The creation order of multiview containers (navigators) is different from standard containers. By default, all top-level views of the navigator are instantiated. However, Flex creates only the children of the initially visible view. When the user navigates to the other views of the navigator, Flex creates those views' children. For more information on the deferred creation of children of multiview containers, see "Using deferred creation" on page 94.

For a detailed description of the component creation life cycle, see "About creating advanced components" on page 129 in *Creating and Extending Adobe Flex 3 Components*.

Using deferred creation

By default, containers create only the controls that initially appear to the user. Flex creates the container's other descendants if the user navigates to them. Containers with a single view, such as Box, Form, and Grid containers, create all of their descendants during the container's instantiation because these containers display all of their descendants immediately.

Containers with multiple views, called navigator containers, only create and display the descendants that are visible at any given time. These containers are the ViewStack, Accordion, and TabNavigator containers.

When navigator containers are created, they do not immediately create all of their descendants, but only those descendants that are initially visible. Flex defers the creation of descendants that are not initially visible until the user navigates to a view that contains them.

The result of this deferred creation is that an MXML application with navigator containers loads more quickly, but the user experiences brief pauses when he or she moves from one view to another when interacting with the application.

You can instruct each container to create their children or defer the creation of their children at application startup by using the container's `creationPolicy` property. This can improve the user experience after the application loads. For more information, see "About the creationPolicy property" on page 94.

You can also create individual components whose instantiation is deferred by using the `createComponentsFromDescriptors()` method. For more information, see "Creating deferred components" on page 98.

About the creationPolicy property

To defer the creation of any component, container, or child of a container, you use the `creationPolicy` property. Every container has a `creationPolicy` property that determines how the container decides whether to create its descendants when the container is created. You can change the policy of a container using MXML or ActionScript.

The valid values for the `creationPolicy` property are `auto`, `all`, `none`, and `queued`. The meaning of these settings depends on whether the container is a navigator container (multiple-view container) or a single-view container. For information on the meaning of these values see "Single-view containers" on page 95 and "Multiple-view containers" on page 95.

The `creationPolicy` property is not inheritable. This means that if you set the value of the `creationPolicy` property to `none` on an outer container, all containers within that container have the default value of the `creationPolicy` property, unless otherwise set. They do not inherit the value of `none` for their `creationPolicy`. Also, if you have two containers at the same level (of the same type) and you set the `creationPolicy` of one of them, the other container has the default value of the `creationPolicy` property unless you explicitly set it.

Single-view containers

Single-view containers by default create all their children when the application first starts. You can use the `creationPolicy` property to change this behavior. The following table describes the values of the `creationPolicy` property when you use it with single-view containers:

Value	Description
`all`, `auto`	Creates all controls inside the single-view container. The default value is `auto`, but `all` results in the same behavior.
`none`	Instructs Flex to not instantiate any component within the container until you manually instantiate the controls. When the value of the `creationPolicy` property is `none`, explicitly set a width and height for that container. Normally, Flex scales the container to fit the children that are inside it, but because no children are created, proper scaling is not possible. If you do not explicitly resize the container, it grows to accommodate the children when they are created. To manually instantiate controls, you use the `createComponentsFromDescriptors()` method. For more information, see "Creating deferred components" on page 98.
`queued`	Has no effect on deferred creation. For more information on using the `queued` value of the `creationPolicy` property, see "Using ordered creation" on page 101.

The following example sets the value of a VBox container's `creationPolicy` property to `auto`, the default value:

```
<?xml version="1.0"?>
<!-- layoutperformance/AutoCreationPolicy.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:VBox id="myVBox" creationPolicy="auto">
        <mx:Button id="b1" label="Get Weather"/>
    </mx:VBox>
</mx:Application>
```

The default behavior of all single-view containers is that they and their children are entirely instantiated when the application starts. If you set the `creationPolicy` property to `none`, however, you can selectively instantiate controls within the containers by using the techniques described in "Creating deferred components" on page 98.

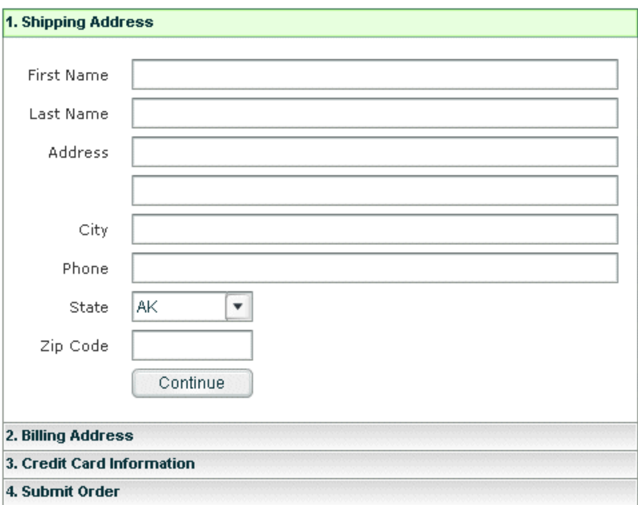
Multiple-view containers

Containers with multiple views, such as the ViewStack and Accordion, do not immediately create all of their descendants, but only those descendants that are visible in the initial view. Flex defers the instantiation of descendants that are not initially visible until the user navigates to a view that contains them. The following containers have multiple views and, so, are defined as navigator containers:

- ViewStack
- TabNavigator
- Accordion

When you instantiate a navigator container, Flex creates all of the top-level children. For example, creating an Accordion container triggers the creation of each of its views, but not the controls within those views. The `creationPolicy` property determines the creation of the child controls inside each view.

When you set the `creationPolicy` property to `auto` (the default value), navigator containers instantiate only the controls and their children that appear in the initial view. The first view of the Accordion container is the initial pane, as the following example shows:



When the user navigates to another panel in the Accordion container, the navigator container creates the next set of controls, and recursively creates the new view's controls and their descendants. You can use the Accordion container's `creationPolicy` property to modify this behavior. The following table describes the values of the `creationPolicy` property when you use it with navigator containers:

Value	Description
`all`	Creates all controls in all views of the navigator container. This setting causes a delay in application startup time, but results in quicker response time for user navigation.
`auto`	Creates all controls only in the initial view of the navigator container. This setting causes a faster startup time for the application, but results in slower response time for user navigation. This setting is the default for multiple-view containers.
`none`	Instructs Flex to not instantiate any component within the navigator container or any of the navigator container's panels until you manually instantiate the controls. To manually instantiate controls, you use the `createComponentsFromDescriptors()` method. For more information, see "Creating deferred components" on page 98.
`queued`	This property has no effect on deferred creation. For more information on using the `queued` value of the `creationPolicy` property, see "Using ordered creation" on page 101.

The following example sets the `creationPolicy` property of an Accordion container to `all`, which instructs the container to instantiate all controls for every panel in the navigator container when the application starts:

```
<?xml version="1.0"?>
<!-- layoutperformance/AllCreationPolicy.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Panel title="Accordion">
        <mx:Accordion id="myAccordion" creationPolicy="all">
            <mx:VBox label="Accordion Button for Panel 1">
                <mx:Label text="Accordion container panel 1"/>
                <mx:Button label="Click Me"/>
            </mx:VBox>
            <mx:VBox label="Accordion Button for Panel 2">
                <mx:Label text="Accordion container panel 2"/>
                <mx:Button label="Click Me"/>
            </mx:VBox>
            <mx:VBox label="Accordion Button for Panel 3">
                <mx:Label text="Accordion container panel 3"/>
                <mx:Button label="Click Me"/>
            </mx:VBox>
        </mx:Accordion>
    </mx:Panel>
</mx:Application>
```

Creating deferred components

When you set a container's `creationPolicy` property to `none`, components declared as MXML tags inside that container are not created. Instead, objects that describe those components are added to an Array. These objects are called descriptors. You can use the `createComponentsFromDescriptors()` method to manually instantiate those components. This method is defined on the Container base class.

Using the createComponentsFromDescriptors() method

You use the `createComponentsFromDescriptors()` method of a container to create all the children of a container at one time.

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

```
container.createComponentsFromDescriptors(recurse:Boolean):Boolean
```

The *`recurse`* argument determines whether Flex should recursively instantiate children of the components. Set the parameter to `true` to instantiate children of the components, or `false` to not instantiate the children. The default value is `false`.

On a single-view container, calling the `createComponentsFromDescriptors()` method instantiates all controls in that container, regardless of the value of the `creationPolicy` property.

In navigator containers, if you set the `creationPolicy` property to `all`, you do not have to call the `createComponentsFromDescriptors()` method, because the container creates all controls in all views of the container. If you set the `creationPolicy` property to `none` or `auto`, calling the `createComponentsFromDescriptors()` method creates only the current view's controls and their descendents.

Another common usage is to set the navigator container's `creationPolicy` property to `auto`. You can then call *`navigator`*`.getChildAt(n).createComponentsFromDescriptors()` to explicitly create the children of the *n*-th view.

The following example does not instantiate any of the buttons in the HBox container when the application starts up, but does when the user changes the value of the `creationPolicy` property. The user initiates this change by selecting *all* from the drop-down list.

```
<?xml version="1.0"?>
<!-- layoutPerformance/ChangePolicy.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" creationComplete="appInit()">
    <mx:Script><![CDATA[
        [Bindable]
        public var p:String;

        private function appInit():void {
```

```
            p = policy.selectedItem.toString();
        }

        private function changePolicy():void {
            var polType:String = policy.value.toString();
            hb.creationPolicy = polType;
            if (polType == "none") {
                // do nothing
            } else if (polType == "all") {
                hb.createComponentsFromDescriptors();
            }
        }
    ]]></mx:Script>
    <mx:ComboBox id="policy" close="p=String(policy.selectedItem);changePolicy();">
        <mx:dataProvider>
            <mx:Array>
                <mx:String>none</mx:String>
                <mx:String>all</mx:String>
            </mx:Array>
        </mx:dataProvider>
    </mx:ComboBox>

    <mx:Panel title="Creation Policy" id="hb" creationPolicy="none">
        <mx:Button label="B1" width="50" y="0" x="0"/>
        <mx:Button label="B2" width="50" y="0" x="75"/>
        <mx:Button label="B3" width="50" y="0" x="150"/>
    </mx:Panel>

    <mx:Label text="CreationPolicy: {p}"/>

</mx:Application>
```

Using the childDescriptors property

When a Flex application starts, Flex creates an object of type Object that describes each MXML component. These objects contain information about the component's name, type, and properties set in the object's MXML tag. Flex adds these objects to an Array that each container maintains. For example, applications with two Canvas containers have an Array with objects that describe the Canvas containers. Those containers, in turn, have an Array with objects that describe their children.

Each object in the Array is an object of type ComponentDescriptor. You can access this Array by using a container's `childDescriptors` property, and use a zero-indexed value to identify the descriptor. All containers have a `childDescriptors` property.

Depending on the value of the `creationPolicy` property, Flex immediately begins instantiating controls inside the containers or it defers their instantiation. If instantiation is deferred, you can use the properties of this Array to access the ComponentDescriptor of each component and create that object at a specified time.

The `childDescriptors` property points to an Array of objects, so you can use Array functions, such as `length`, to iterate over the children, as the following example shows:

```
<?xml version="1.0"?>
<!-- layoutperformance/AccessChildDescriptors.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[
        import mx.core.ComponentDescriptor;
        import flash.utils.*;

        public function iterateOverChildren():void {
            // Get the number of descriptors.
            var n:int = tile.childDescriptors.length;
            for (var i:int = 0; i < n; i++) {
                var c:ComponentDescriptor = tile.childDescriptors[i];
                var d:Object = c.properties;

                // Log ids and types of objects in the Array.
                ta1.text += c.id + " is of type " + c.type + "\n";

                // Log the properties added in the MXML tag of the object.
                for (var p:String in d) {
                    ta1.text += "Property: " + p + " : " + d[p] + "\n";
                }
            }
        }

    ]]></mx:Script>

    <mx:Tile id="tile" creationComplete="iterateOverChildren();">
        <mx:TextInput id="myInput" text="Enter text here"/>
        <mx:Button id="myButton" label="OK" width="150"/>
    </mx:Tile>

    <mx:TextArea id="ta1" height="150" width="250"/>

</mx:Application>
```

Properties of the ComponentDescriptor include `id`, `type`, and `properties`. The `properties` property points to an object that contains the properties that were explicitly added in the MXML tag. This object does not store properties such as styles and events.

Destroying components

After you create a component, it continues to exist until the user quits the application or you detach it from its parent and the garbage collector destroys it.

To detach a component from its parent container, you can use the `removeChild()` or `removeChildAt()` methods. You can also use the `removeAllChildren()` method to remove all child controls from a container. Calling these methods does not immediately delete the objects from memory. If you do not have any other references to the child, Adobe® Flash® Player garbage collects it at some future point. But if you have stored a reference to that child on some other object, the child is not removed from memory.

For more information on using these methods, see the View class in the *Adobe Flex Language Reference*.

Using ordered creation

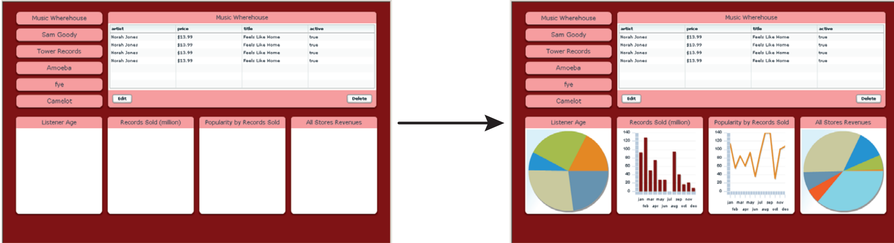
By default, Flex displays the Loading progress bar while it initializes an application. Only after all of the components in the application are initialized and laid out does Flex display any portion of the application. Using ordered creation, you can customize this experience and change the user's perception of how quickly the application starts.

During initialization, Flex first creates all the containers, and then fills in each container with its children and data. Finally, Flex displays the application in its entirety. This causes the user to wait for the entire application to load before beginning to interact with it.

However, you can instruct Flex to display the children of each container as its children are created rather than waiting for the entire application to finish loading. You do this using a technique called ordered creation.

The following example shows a complex application that contains a single container at the top, and four containers across the bottom. This application implements ordered creation so that the contents of each container become visible before the entire application is finished loading.

In this example, the image on the left shows the application after the first container is populated with its children and data, but before the remaining four containers are populated. The image on the right shows the final state of the application.



If this application did not use ordered creation, Flex would not display anything until all components in all five of the containers were created, resulting in a longer perceived start-up time.

To gradually display children of each container, you add them to an instantiation queue. The “Adding containers to the queue” on page 102 section describes how to add containers to the queue so that you can improve perceived layout performance of your Flex applications.

Adding containers to the queue

You can add any number of containers to the instantiation queue so that their contents are displayed in queue order. To add a container to the instantiation queue, you set the value of the container’s `creationPolicy` property to `queued`. Unless you specify a queue order, containers are instantiated and displayed in the order in which they appear in the application source code.

In the following example, the Panel containers and their child controls are added to the instantiation queue. To the user, each Panel container appears one at a time during the application startup. The perceived startup time of the application is greatly reduced. The panels are created in the order that they appear in the source code (panel1, panel2, panel3):

```
<?xml version="1.0"?>
<!-- layoutperformance/QueuedCreationPolicy.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Panel id="panel1" creationPolicy="queued" width="100%" height="33%">
        <mx:Button id="button1a" label="Button 1A"/>
        <mx:Button id="button1b" label="Button 1B"/>
    </mx:Panel>

    <mx:Panel id="panel2" creationPolicy="queued" width="100%" height="33%">
        <mx:Button id="button2a" label="Button 2A"/>
```

```
        <mx:Button id="button2b" label="Button 2B"/>
    </mx:Panel>

    <mx:Panel id="panel3" creationPolicy="queued" width="100%" height="33%">
        <mx:Button id="button3a" label="Button 3A"/>
        <mx:Button id="button3b" label="Button 3B"/>
    </mx:Panel>
</mx:Application>
```

Flex first creates all the panels. Flex then instantiates and displays all the children in the first panel in the queue before moving on to instantiate the children in the next panel in the queue.

To specify an order for the containers in the instantiation queue, you use the `creationIndex` property. For more information on using the `creationIndex` property, see "Setting queue order" on page 103.

Setting queue order

When you use ordered creation, the order in which containers appear in the instantiation queue determines in what order Flex displays the container and its children on the screen.

You can set the order in which containers are queued by using the container's `creationIndex` property, in conjunction with setting the `creationPolicy` property to `queued`. Flex creates the containers in their `creationIndex` order until all containers in the initial view are created. Flex then revisits each container and creates its children in the same order. After creating all the children in a container that is in the queue, Flex displays that container before starting to create the children in the next container.

All containers support a `creationIndex` property.

If you set a `creationIndex` property on a container, but do not set the `creationPolicy` property to `queued`, Flex ignores the `creationIndex` property and uses `auto`, the default value, for the `creationPolicy` property.

The following example sets the `creationIndex` property so that the contents of the panel3 container are shown first, then the contents of panel2, and finally the contents of panel1:

```
<?xml version="1.0"?>
<!-- layoutperformance/QueueOrder.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[
        private function logCreationOrder(e:Event):void {
            ta1.text += e.currentTarget.id + " created\n";
        }
    ]]></mx:Script>

    <mx:Fade id="SlowFade" duration="4000"/>

    <mx:HBox>
```

```
        <mx:Panel id="panel1" title="Panel 1 (index:2)" creationPolicy="queued"
creationIndex="2"  creationComplete="logCreationOrder(event)"
creationCompleteEffect="{SlowFade}">
            <mx:Button id="button1a" label="Button 1A"
creationComplete="logCreationOrder(event)"/>
            <mx:Button id="button1b" label="Button 1B"
creationComplete="logCreationOrder(event)"/>
        </mx:Panel>

        <mx:Panel id="panel2" title="Panel 2 (index:1)" creationPolicy="queued"
creationIndex="1"  creationComplete="logCreationOrder(event)"
creationCompleteEffect="{SlowFade}">
            <mx:Button id="button2a" label="Button 2A"
creationComplete="logCreationOrder(event)"/>
            <mx:Button id="button2b" label="Button 2B"
creationComplete="logCreationOrder(event)"/>
        </mx:Panel>

        <mx:Panel id="panel3" title="Panel 3 (index:0)" creationPolicy="queued"
creationIndex="0" creationComplete="logCreationOrder(event)"
creationCompleteEffect="{SlowFade}">
            <mx:Button id="button3a" label="Button 3A"
creationComplete="logCreationOrder(event)"/>
            <mx:Button id="button3b" label="Button 3B"
creationComplete="logCreationOrder(event)"/>
        </mx:Panel>
    </mx:HBox>

    <mx:TextArea id="ta1" height="200" width="350"/>

</mx:Application>
```

This example uses the inherited `creationCompleteEffect` effect to play an effect just as the container finishes creation. The result is that the panels fade in slow enough that you can see the order of creation. After a container is initialized and displayed, Flex waits for all effects to finish playing before initializing the next container.

If you set the same value of the `creationIndex` property for two queued containers, Flex creates and displays their contents in the order in which they are defined in the application's source code. The value of the `creationIndex` property can be any valid Number, including 0 and negative values.

Dynamically adding containers to the queue

You can dynamically add containers to the instantiation queue by using the Application class's `addToCreationQueue()` method. The `addToCreationQueue()` method has the following signature:

`addToCreationQueue(`*`id`*`:Object, `*`preferredIndex`*`:int, `*`callbackFunction`*`:Function,`
`parent``:IFlexDisplayObject):void`

The following table describes the `addToCreationQueue()` method's arguments:

Argument	Description
`id`	Specifies the name of the container that you want to add to the queue.
`preferredIndex`	(Optional) Specifies the container's position in the queue. By default, Flex places the container at the end of the queue, but this value lets you explicitly choose the queue order for the container.p
`callbackFunction`	This parameter is currently ignored.
`parent`	This parameter is currently ignored.

Only use the `addToCreationQueue()` method to add containers to the queue whose `creationPolicy` property is set to `none`. Containers whose `creationPolicy` property is set to `auto` or `all` will probably created their children during the application initialization. Containers whose `creationPolicy` property is set to `queued` are already in the queue.

After it is added to the queue, the container that is to be created with the `addToCreationQueue()` method then competes with containers whose `creationPolicy` is set to `queued`, depending on their position in the queue. Flex creates containers whose `preferredIndex` property is lowest.

The following example uses the `addToCreationQueue()` method to create the children of the HBox containers when the user clicks the Create Later button. The calls to the `addToCreationQueue()` method specify a `preferredIndex` for each box, which causes the boxes and their children to be created in a different order from the order in which they are defined in the application's source code (in this example, box1, box3, box2, and then box4).

```
<?xml version="1.0"?>
<!-- layoutPerformance/AddToCreationQueueExample.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[
        public function doCreate():void {
             addToCreationQueue('box1', 0);
             addToCreationQueue('box2', 2);
             addToCreationQueue('box3', 1);
             addToCreationQueue('box4', 3);
        }
    ]]></mx:Script>

    <mx:HBox backgroundColor="#CCCCFF" horizontalAlign="center">
        <mx:Label text="addToCreationQueue()" fontWeight="bold"/>
    </mx:HBox>
```

```
    <mx:Form>
        <mx:FormItem label="first:">
            <mx:HBox id="box1" creationPolicy="none" width="200" height="50"
                    borderStyle="solid" backgroundColor="#CCCCFF">
                <mx:Button label="Button 1"/>
                <mx:Button label="Button 2"/>
            </mx:HBox>
        </mx:FormItem>
        <mx:FormItem label="fourth:">
            <mx:HBox id="box2" creationPolicy="none" width="200" height="50"
                    borderStyle="solid" backgroundColor="#CCCCFF">
                <mx:Button label="Button 3"/>
                <mx:Button label="Button 4"/>
            </mx:HBox>
        </mx:FormItem>
        <mx:FormItem label="second:">
            <mx:HBox id="box3" creationPolicy="none" width="200" height="50"
                    borderStyle="solid" backgroundColor="#CCCCFF">
                <mx:Button label="Button 5"/>
                <mx:Button label="Button 6"/>
            </mx:HBox>
        </mx:FormItem>
        <mx:FormItem label="third:">
            <mx:HBox id="box4" creationPolicy="none" width="200" height="50"
                    borderStyle="solid" backgroundColor="#CCCCFF">
                <mx:Button label="Button 7"/>
                <mx:Button label="Button 8"/>
            </mx:HBox>
        </mx:FormItem>
    </mx:Form>
    <mx:Button label="Create Later" click="doCreate();"/>
</mx:Application>
```

In some cases, the `addToCreationQueue()` method does not act as you might expect. The reason is that if the instantiation queue is empty, the first container to be put in that queue triggers the creation process of its children. Other containers might subsequently be added to the queue, but the instantiation of the first container added has already been triggered, regardless of the value of its `preferredIndex` property. The result is that an item might not have the lowest `preferredIndex` value, but because no other containers are in the queue, Flex begins creating that container. Flex cannot stop instantiating the first container once it starts.

In the following example, although the redBox container has the highest `preferredIndex`, Flex creates its children first because the queue was empty when Flex encountered this line in the code. By the time redBox is complete, the other containers will be in the queue, and Flex proceeds with the next lowest item in the queue; in this case, the whiteBox container, followed by blueBox and, finally, greenBox.

```
function doCreate():void {
```

```
    addToCreationQueue('redBox', 4);
    addToCreationQueue('blueBox', 2);
    addToCreationQueue('whiteBox', 1);
    addToCreationQueue('greenBox', 3);
}
```

Combining containers with different creationPolicy settings

You can mix containers with different `creationPolicy` settings and change the order in which they are created and their children are displayed. Flex creates outer containers before inner containers, regardless of their `creationIndex`. This is because Flex does not create the children of a queued container until all containers at that level are created.

Setting a container's `creationPolicy` property does not override the policies of the containers within that container. For example, if you queue an outer container, but set the inner container's `creationPolicy` to `none`, Flex creates the inner container, but not any child controls of that inner container.

In the following example, the button1 control is never created because its container specifies a `creationPolicy` of `none`, even though the outer container sets the `creationPolicy` property to `all`:

```
<?xml version="1.0"?>
<!-- layoutperformance/TwoCreationPolicies.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:HBox label="HBox1" creationPolicy="all" creationIndex="0">
        <mx:HBox label="HBox1" creationPolicy="none">
            <mx:Button id="button1" label="Click Me"/>
        </mx:HBox>
    </mx:HBox>
</mx:Application>
```

Using the callLater() method

The `callLater()` method queues an operation to be performed for the next screen refresh, rather than in the current update. Without the `callLater()` method, you might try to access a property of a component that is not yet available. The `callLater()` method is most commonly used with the `creationComplete` event to ensure that a component has finished being created before Flex proceeds with a specified method call on that component.

All objects that inherit from the UIComponent class can open the `callLater()` method. It has the following signature:

```
callLater(method:Function, args:Array):void
```

The *method* argument is the function to call on the object. The *args* argument is an optional Array of arguments that you can pass to that function.

The following example defers the invocation of the `doSomething()` method, but when it is opened, Flex passes the Event object and the "Product Description" String in an Array to that function:

```
callLater(doSomething, [event, "Product Description"]);
...
function doSomething(event:Event, title:String):void {
    ...
}
```

The following example uses a call to the `callLater()` method to ensure that new data is added to a DataGrid before Flex tries to put focus on the new row. Without the `callLater()` method, Flex might try to focus on a cell that does not exist and throw an error:

```
<?xml version="1.0"?>
<!-- layoutperformance/CallLaterAddItem.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" initialize="initData()">
    <mx:Script><![CDATA[
        import mx.collections.*;
        private var DGArray:Array = [
            {Artist:'Pavement', Album:'Slanted and Enchanted', Price:11.99},
            {Artist:'Pavement', Album:'Brighten the Corners', Price:11.99}];

        [Bindable]
        public var initDG:ArrayCollection;
        //Initialize initDG ArrayCollection variable from the Array.
        public function initData():void {
            initDG=new ArrayCollection(DGArray);
        }

        public function addNewItem():void {
            var o:Object;
            o = {Artist:'Pavement', Album:'Nipped and Tucked', Price:11.99};
            initDG.addItem(o);
            callLater(focusNewRow);
        }

        public function focusNewRow():void {
            myGrid.editedItemPosition = {
                columnIndex:0,rowIndex:myGrid.dataProvider.length-1
            };
        }

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

```
    <mx:DataGrid id="myGrid" width="350" height="200" dataProvider="{initDG}"
editable="true">
        <mx:columns>
            <mx:Array>
                <mx:DataGridColumn dataField="Album" />
                <mx:DataGridColumn dataField="Price" />
            </mx:Array>
        </mx:columns>
    </mx:DataGrid>

    <mx:Button id="b1" label="Add New Item" click="addNewItem()"/>

</mx:Application>
```

Another use of the `callLater()` method is to create a recursive method. Because the function is called only after the next screen refresh (or frame), the `callLater()` method can be used to create animations or scroll text with methods that reference themselves.

The following example scrolls ticker symbols across the screen and lets users adjust the speed with an HSlider control:

```
<?xml version="1.0"?>
<!-- layoutperformance/CallLaterTicker.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[
    [Bindable]
    public var text:String = "SLAR:95.5....TIBA:42....RTF:34.15....AST:23.42";
    [Bindable]
    public var speed:Number = 5;

    public function initTicker():void {
        theText.move( this.width+10, 0 ); // Start the text on the right side.
        callLater(moveText);
    }

    public function moveText():void {
        var xpos:Number = theText.x;
        if( xpos-speed+theText.width < 0 ) {
            xpos = this.width+10; // Start the text on the right side.
        }
        xpos -= speed;
        theText.move(xpos,0);
        callLater(moveText);
    }

    public function changeSpeed():void {
        speed = speedSelector.value;
```

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

    <mx:Panel title="Ticker Sample" width="400" height="200">
        <mx:Canvas creationComplete="initTicker()"
                horizontalScrollPolicy="off" backgroundColor="red" color="white"
                width="100%">
            <mx:Label id="theText" text="{text}" y="0"/>
        </mx:Canvas>
        <mx:HBox>
            <mx:Label text="Speed:"/>
            <mx:HSlider minimum="1" maximum="10" value="{speed}"
                id="speedSelector" snapInterval="1" tickInterval="1"
                change="changeSpeed()"/>
        </mx:HBox>
    </mx:Panel>
</mx:Application>
```

Chapter 6: Building Overview

Typical Adobe® Flex™ development environment include similar tools and asset types that you work with to create Flex applications.

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About the Flex development tools

Configuration files

Be familiar with the ways to configure your development environment. Adobe Flex Software Development Kit (SDK) primarily provide XML files that you use to configure the settings. The flex-config.xml file defines the default compiler options for the compilers.

In addition to server and compiler configuration settings, you can also modify the messaging and data management settings, the JVM heap size, Adobe® Flash® Player settings, and logging and caching settings.

For more information about configuring your Flex SDK environment, see “Flex SDK Configuration” on page 119.

Compilers

Flex includes application compilers and component compilers. You use the application compilers to compile SWF files from MXML and other source files. You use the component compilers to compile SWC files from component files. You can then use SWC files as dynamic or static libraries with your Flex applications.

The application compilers take the following forms:

- Adobe® Flex™ Builder™ project compiler. The Flex Builder application compiler is opened by Flex Builder for Flex Projects and ActionScript Projects.
- mxmlc command-line compiler. You open the mxlmc compiler from the command line to create a SWF file that you then deploy to a website.

- Web-tier compiler. The Flex module for Apache and IIS compiler provides web-tier compilation of MXML files on Apache and IIS web servers. This lets you rapidly compile, test, and deploy an application: instead of compiling your MXML file into a SWF file and then deploying it and its wrapper files on a web server, you can just refresh the MXML file in your browser. For more information, see "Using the Flex Module for Apache and IIS" on page 341.

The component compilers take the following forms:

- Flex Builder library project compiler. The Flex Builder component compiler is opened by Flex Builder for Flex library projects.
- compc command-line compiler. You open the compc compiler from the command line to create SWC files. You can use these SWC files as static component libraries, themes, or runtime shared libraries (RSLs).

For information on using the compilers, see "Using the Flex Compilers" on page 125.

Debugger

To test your applications, you run the application SWF files in a web browser or the stand-alone Flash Player. If you encounter errors in your applications, you can use the debugging tools to set and manage breakpoints in your code; control application execution by suspending, resuming, and terminating the application; step into and over the code statements; select critical variables to watch; evaluate watch expressions while the application is running; and so on.

Flex provides the following debugging tools:

Flex Builder debugger he Flex Builder Debugging perspective provides all of the debugging tools you expect from a robust, full-featured development tool. You can set and manage breakpoints; control application execution by suspending, resuming, and terminating the application; step into and over the code; watch variables; evaluate expressions; and so on. For more information, see *Using Adobe Flex Builder 3*.

The fdb command-line debugger The fdb command-line debugger provides a command-line interface to the debugging experience. With fdb, you can step into code, add breakpoints, check variables, and perform many of the same tasks you can with the Flex Builder visual debugger. For more information, see "Using the Command-Line Debugger" on page 245.

AIR Debug Launcher (ADL) ADL is a command line debugger for Adobe® AIR™ applications that you can use outside of Flex Builder. For details, see "Using the AIR development tools" of *Developing AIR Applications with Adobe Flex 3*.

Loggers

You can log messages at several different points in a Flex application's life cycle. You can log messages when you compile the application, when you deploy it to a web application server, or when a client runs it. You can log messages on the server or on the client. These messages are useful for informational, diagnostic, and debugging activities.

Flex includes the following logging mechanisms that you use when working with Flex applications.

Client-side logging When you use the debugger version of Flash Player or start your AIR application using AIR Debug Launcher, you can use the `trace()` global method to write out messages or configure a TraceTarget to customize log levels of applications for data services-based applications. For more information, see "Client-side logging and debugging" on page 232.

Compiler logging When compiling your Flex applications from the command line and in Flex Builder, you can view deprecation and warning messages, and sources of fatal errors. For more information, see "Compiler logging" on page 243.

About application files

Flex applications can use many types of application files such as classes, component libraries, theme files, and Runtime Shared Libraries (RSLs).

Component classes

You can use any number of component classes in your Flex applications. These classes can be MXML or Action-Script files. You can use classes to extend existing components or define new ones.

Component classes can take the form of MXML, ActionScript files, or as SWC files. In MXML or ActionScript files, the components are not compiled but reside in a directory structure that is part of your compiler's source path. SWC files are described in "SWC files" on page 114.

Component libraries are not dynamically linked unless they are used in a Runtime Shared Library (RSL). Component classes are statically linked at compile time, which means that they must be in the compiler's source path. For information about creating and using custom component classes, see *Creating and Extending Adobe Flex 3 Components*.

SWC files

A *SWC* file is an archive file for Flex components and other assets. SWC files contain a SWF file and a catalog.xml file. The SWF file inside the SWC file implements the compiled component or group of components and includes embedded resources as symbols. Flex applications extract the SWF file from a SWC file, and use the SWF file's contents when the application refers to resources in that SWC file. The catalog.xml file lists of the contents of the component package and its individual components.

You compile SWC files by using the component compilers. These include the compc command-line compiler and the Flex Builder Library Project compiler. SWC files can be component libraries, RSLs, theme files, and resource bundles.

To include a SWC file in your application at compile time, it must be located in the library path. For more information about SWC files, see "About SWC files" on page 174.

Component libraries

A component library is a SWC file that contains classes and other assets that your Flex application uses. The component library's file structure defines the package system that the components are in.

Typically, component libraries are statically linked into your application, which means that the compiler compiles it into the SWF file before the user downloads that file.

To build a component library SWC file, you use the `include-classes`, `include-namespaces`, and `include-sources` component compiler options. For more information on building component libraries, see "Using compc, the component compiler" on page 161.

Runtime Shared Libraries

You can use shared assets that can be separately downloaded and cached on the client in Flex. These shared assets are loaded by multiple applications at run time, but must be transferred only once to the client. These shared files are known as *Runtime Shared Libraries* or *RSLs*.

RSLs are the only kind of application asset that is dynamically linked into your Flex application. When you compile your application, the RSL source files must be available to the compiler so that it can perform proper link checking. The assets themselves are not included in the application SWF file, but are only referenced at run time.

To create an RSL SWC file, you add files to a library by using the `include-classes` and `include-namespaces` component compiler options. To use RSLs when compiling your application, you use the `external-library-path`, `externs`, `load-externs`, and `runtime-shared-libraries` application compiler options. The `external-library-path`, `externs`, and `load-externs` options provide the compile-time location of the libraries. The `runtime-shared-libraries` option provides the run-time location of the shared library. The compiler requires this for dynamic linking.

For more information, see "Using Runtime Shared Libraries" on page 195.

Themes

A *theme* defines the look and feel of a Flex application. A theme can define something as simple as the color scheme or common font for an application, or it can be a complete reskinning of all the components used by the application.

Themes usually take the form of a SWC file. However, themes can also be composed of a CSS file and embedded graphical resources, such as symbols from a SWF file.

Theme files must be available to the compiler at compile-time. You build a theme file by using the `include-file` and `include-classes` component compiler options to add skin files and style sheets to a SWC file. You then reference the theme SWC file when you compile the main Flex application by using the `theme` application compiler option.

For more information about themes, see "Using Styles and Themes" on page 589 in the *Adobe Flex 3 Developer Guide*.

Resource bundles

You can package libraries of localized properties files and ActionScript classes into a SWC file. The application compiler can then statically use this SWC file as a resource bundle. For more information about creating and using resource bundles, see "Localizing Flex Applications" on page 1101 in the *Adobe Flex 3 Developer Guide*.

Other assets

Other application assets include images, fonts, movies, and sound files. You can embed these assets at compile time or access them at run time.

When you embed an asset, you compile it into your application's SWF file. The advantage of embedding an asset is that it is included in the SWF file, and can be accessed faster than when the application has to load it from a remote location at run time. The disadvantage of embedding an asset is that your SWF file is larger than if you load the resource at run time.

The alternative to embedding an asset is to load the asset at run time. You can load an asset from the local file system in which the SWF file runs, or you can access a remote asset, typically though an HTTP request over a network.

Embedded assets load immediately, because they are already part of the Flex SWF file. However, they add to the size of your application and slow down the application initialization process. Embedded assets also require you to recompile your applications whenever your asset files change.

For more information, see “Embedding Assets” on page 965 in the *Adobe Flex 3 Developer Guide*.

Part 2: Application Development

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Chapter 7: Flex SDK Configuration

Use the configuration files included with Adobe® Flex® SDK to configure the compilers and other aspects of Flex. For information about how to configure Adobe® Flex® Builder™, see *Using Adobe Flex Builder 3*.

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About configuration files

The various compilers and servers use the configuration files differently.

Applying license keys

You typically add a license key if you want to unlock the source code for the data visualization packages, or if you want to remove the watermark from your applications that use the charting and AdvancedDataGrid components.

There are several methods to set the license key for your Flex compiler. You can set your license key in the following ways:

- Use the license manager in Flex Builder
- Edit the license.properties file
- Edit the flex-config.xml file
- Use the `license` command line compiler option
- Use the `Configuration.setLicense()` method (compiler API only)

Use the license manager in Flex Builder

To enter your license key in Flex Builder, select Help > Manage Flex Licenses.

Edit the license.properties file

You can manually add your license key to the license.properties file. You add the license key to the value of the `flexbuilder3` key, as the following example shows:

```
flexbuilder3=00000000000000000000
```

The location of the license.properties file is operating system-dependent. It is located in the following directories:

Operating System	Location
Windows XP	C:\Documents and Settings\All Users\Application Data\Adobe\Flex\license.properties
Windows Vista	C:\ProgramData\Adobe\Flex\license.properties
Mac OSX	/Library/Application Support/Adobe/Flex/license.properties
Linux	~/.adobe/Flex/license.properties

Edit the flex-config.xml file

You can edit your config.xml file to add a license key. You add it to the `<licenses>` child tag of the `<flex-config>` tag, as the following example shows:

```
<flex-config>
    <licenses>
        <license>
            <product>flexbuilder3</product>
            <serial-number>0000-0000-0000-0000-0000-0000</serial-number>
        </license>
    </licenses>
    ...
</flex-config>
```

Use the `license` command-line compiler option

You can pass your license key as an option to the mxmlc and compc command-line compilers. To do this, you use the `license` option, and pass it a product name and the key. The product name must be "flexbuilder3". The following example shows how to do this:

```
mxmlc -license=flexbuilder3,000000000000000000000 MyApp.mxml
```

In Flex Builder, you can pass the license key with the `license` compiler option by adding it to the Additional Compiler Arguments field in the Flex Compiler properties panel.

Use the `Configuration.setLicense()` method

If you are using the Flex compiler API to build your Flex applications, you can call the Configuration class's `setLicense()` method. For more information, see the documentation included with the compiler API.

Root variables

For Flex SDK, the *flex_install_dir* variable is the top-level directory where you installed the SDK. Under this directory are the bin, frameworks, lib, and samples directories. The *flex_app_root* directory is the top level location for many files.

Configuration files layout

The layout of the configuration files for Flex SDK is simple. It includes a jvm.config file, fdb command-line debugger shell script, and the mxmlc and compc command-line compiler shell scripts for configuring the JVM that the compiler uses. It also includes the flex-config.xml file that sets the compiler options, as well as executable files for fdb, mxmlc, and compc.

The layout of the configuration files for Flex SDK is as follows:

```
sdk_install_dir/
        bin/jvm.config
        bin/mxmlc
        bin/mxmlc.exe
        bin/compc
        bin/compc.exe
        bin/fdb
        bin/fdb.exe
        frameworks/flex-config.xml
```

Flex SDK configuration

Flex SDK includes the mxmlc and compc command-line compilers. You use mxmlc to compile Flex applications from MXML, ActionScript, and other source files. You use the compc compiler to compile component libraries, Runtime Shared Libraries (RSLs), and theme files.

The compilers are located in the *sdk_install_dir*/bin directory. You configure the compiler options with the flex-config.xml file. The compilers use the Java JRE. As a result, you can also configure settings such as memory allocation and source path with the JVM arguments.

Command-line compiler configuration

The flex-config.xml file defines the default compiler options for the compc and mxmlc command-line compilers. You can use this file to set options such as debugging, SWF file metadata, and themes to apply to your application. For a complete list of compiler options, see “Using mxmlc, the application compiler” on page 139 and “Using compc, the component compiler” on page 161.

The flex-config.xml file is located in the *sdk_install_dir*/frameworks directory. If you change the location of this file relative to the location of the command-line compilers, you can use the `load-config` compiler option to point to its new location.

You can also use a local configuration file that overrides the compiler options of the flex-config.xml file. You give this local configuration file the same name as the MXML file, plus -config.xml" and store it in the same directory. When you compile your MXML file, the compiler looks for a local configuration file first, then the flex-config.xml file.

For more information on compiler configuration files, see "About configuration files" on page 134.

JVM configuration

The Flex compilers use the Java JRE. Configuring the JVM can result in faster and more efficient compilations. Without a JVM, you cannot use the mxmlc and compc command-line compilers. You can configure JVM settings such as the Java source path, Java library path, and memory settings.

On Windows, you use the compc.exe and mxmlc.exe executable files in the bin directory to compile Flex applications and component libraries. You use the fdb.exe executable file in the bin directory to debug applications. The executable files use the jvm.config file to set JVM arguments. The jvm.config file is in the same directory as the executable files. If you move it or the executable files to another directory, they use their default settings and not the settings defined in the jvm.config file.

The fdb, compc, and mxmlc shell scripts (for UNIX, Linux, or Windows systems running a UNIX-shell emulator such as Cygwin) do not take a configuration file. You set the JVM arguments inside the shell script file.

Locating the jvm.config file

The location of the jvm.config file depends on which Flex product you use. The following table shows the location and use of the product-specific jvm.config files:

Product	Location of jvm.config	Description
Flex SDK	*sdk_install_dir*/bin	Used by the Java process opened by the mxmlc and compc command-line executable files.

Changing the JVM heap size

The most common JVM configuration is to set the size of the Java heap. The Java heap is the amount of memory reserved for the JVM. The actual size of the heap during run time varies as classes are loaded and unloaded. If the heap requires more memory than the maximum amount allocated, performance will suffer as the JVM performs garbage collection to maintain enough free memory for the applications to run.

You can set the initial heap size (or minimum) and the maximum heap size on most JVMs. By providing a larger heap size, you give the JVM more memory with which to defer garbage collection. However, you must not assign all of the system's memory to the Java heap so that other processes can run optimally.

To set the initial heap size on the Sun HotSpot JVM, change the value of the `Xms` property. To change the maximum heap size, change the value of the `Xmx` property. The following example sets the initial heap size to 256M and the maximum heap size to 512M:

```
java.args=-Xms256m -Xmx512m -Dsun.io.useCanonCaches=false
```

In addition to increasing your JVM's heap size, you can tune the JVM in other ways. Some JVMs provide more granular control over garbage collecting, threading, and logging. For more information, consult your JVM documentation or view the options on the command line. If you are using the Sun HotSpot JVM, for example, you can enter `java -X` or `java -D` on the command line to see a list of configuration options.

In many cases, you can also use a different JVM. Benchmark your Flex application and the application server on several different JVMs. Choose the JVM that provides you with the best performance.

Setting the `useCanonCaches` argument to `false` is required to support Windows file names.

```
<?xml version="1.0"?>
<!-- config/ContextRootTest.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="l1.text='url='+s1.url">
    <mx:HTTPService id="s1" url="@ContextRoot()/service.jsp"/>
    <mx:Label id="l1"/>
</mx:Application>
```

Flash Player configuration

You can use the standard version or the debugger version of Adobe® Flash® Player as clients for your Flex applications. The debugger version of Flash Player can log output from the `trace()` global method as well as data services messages and custom log events.

You enable and disable logging and configure the location of the output file in the mm.cfg file. For more information on locating and editing the mm.cfg file, see "Configuring the debugger version of Flash Player" on page 229.

You can configure the standard version and the debugger version of Flash Player auto-update and other settings by using the mms.cfg file. This file is in the same directory as the mm.cfg file. For more information on auto-update, see the Flash Player documentation.

Chapter 8: Using the Flex Compilers

Adobe® Flex® application and component compilers can be opened on the command line, in Adobe® Flex® Builder™, and at run time in the Flex web application. Use the Flex compilers to compile applications, component libraries, themes, and run-time shared libraries (RSLs).

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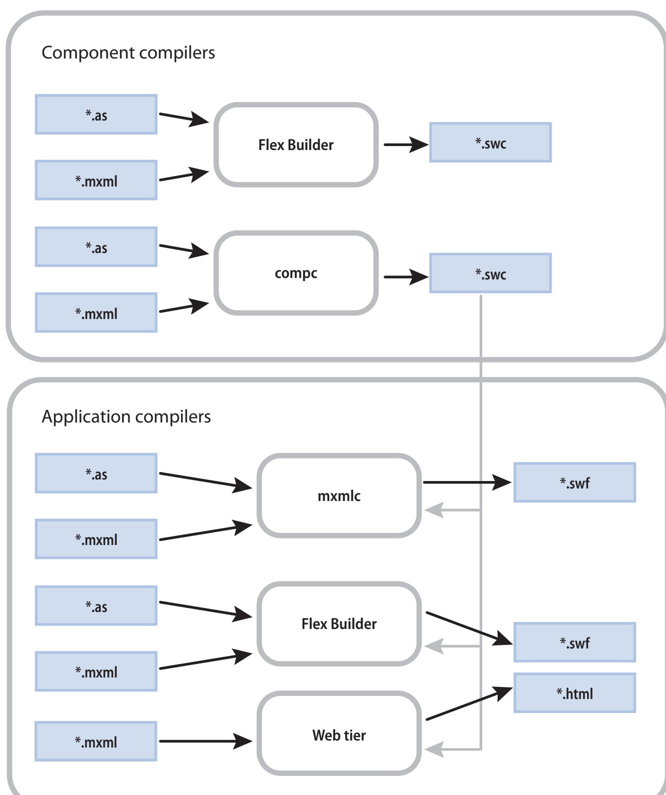
About the Flex compilers

Flex includes the following application and component compilers:

- Application compilers. The application compilers create SWF files from MXML, ActionScript, and other assets such as images, SWF files, and SWC files.
- Component compilers. The component compilers create SWC files from the same kinds of files. The application compilers then use the SWC files as component libraries, themes, or RSLs.

The following example shows the input and output of the Flex compilers:



You open the application compiler with the mxmlc command-line tool, the Flex Builder Build Project option, or with the run-time web-tier compiler. You open the component compiler with the Flex Builder Build Project option for a Library Project or with the compc command-line tool.

About the application compilers

The application compilers create SWF files that are run in an Adobe™ Flash® Player client or in an Adobe AIR™ application. The client can be a stand-alone Flash Player or a Flash Player in a browser, which takes the form of an ActiveX control for Microsoft Internet Explorer or a plug-in for Netscape-based browsers.

Flex Builder project compiler. The Flex Builder application compiler is opened by Flex Builder for Flex Projects and ActionScript Projects. (The component compiler is used for Library Projects.) It is similar in functionality to the mxmlc command-line compiler, although the way you set options is different. You use this compiler to compile Flex Builder projects that you will later deploy. For more information, see "Using the Flex Builder application compiler" on page 127.

The mxmlc command-line compiler. You open the mxlmc compiler from the command line to create a SWF file that you then deploy to a website. Typically, you pass the name of the application's root MXML file to the compiler. The output is a SWF file. For more information, see "Using the mxmlc application compiler" on page 128.

Web-tier compiler. The Flex module for Apache and IIS compiler provides web-tier compilation of MXML files on Apache and IIS web servers. This lets you rapidly compile, test, and deploy an application: instead of compiling your MXML file into a SWF file and then deploying it and its wrapper files on a web server, you can just refresh the MXML file in your browser. For more information, see "Using the Flex Module for Apache and IIS" on page 341.

The Flex Builder compiler and mxmlc compiler have similar sets of options. These are described in "About the application compiler options" on page 139.

You can compile applications that are written entirely in ActionScript and contain no MXML. You can compile these "ActionScript-only" applications with the Flex Builder and mxmlc compilers. You cannot compile ActionScript-only applications with the web-tier compiler. This compiler requires that there be at least a root application MXML file.

Using the Flex Builder application compiler

You use the Flex Builder application compiler to create SWF files from MXML, ActionScript, and other source files. You use this compiler to precompile SWF files that you deploy later, or you can deploy them immediately to a server running the Flex web application.

To open the Flex Builder application compiler, you select Project > Build. The Flex Builder application compiler is opened by Flex Builder for Flex Projects and ActionScript Projects. (You use the component compiler for Library Projects.)

To edit the compiler settings, use the settings on the Project > Properties > Flex Compiler dialog box. For information on the compiler options, see "About the application compiler options" on page 139.

The Flex Builder compiler has the same options as the mxmlc compiler. Some options are implemented with GUI controls in the Flex Compiler dialog box. To set the source path and library options, select Project > Properties > Flex Build Path and use the Flex Build Path dialog box.

You can set the values of most options in the Additional Compiler Arguments field by using the same syntax as on the command line. For information about the syntax for setting options in the Flex Compiler dialog box, see "About the command-line compilers" on page 131.

By default, Flex Builder exposes the compilation options through the project properties. If you want to use a configuration file, you can create your own and pass it to the compiler by using the `load-config` option. For more information on setting compiler options with configuration files, see "About configuration files" on page 134.

In addition to generating SWF files, the Flex Builder compiler also generates an HTML wrapper that you can use when you deploy the new Flex application. The HTML wrapper includes the `<object>` and `<embed>` tags that reference the new SWF file, as well as scripts that support history management and player version detection. For more information about the HTML wrapper, see "Creating a Wrapper" on page 311.

The Flex Builder application compiler uses incremental compilation by default. For more information on incremental compilation, see "About incremental compilation" on page 157.

Using the mxmlc application compiler

You use the mxmlc command-line compiler to create SWF files from MXML, AS, and other source files. You can open it as a shell script and executable file for use on Windows and UNIX systems. You use this compiler to precompile Flex applications that you deploy later.

The command-line compiler is installed with Flex SDK. It is in the *flex_install_dir*/bin directory in Flex SDK. The compiler is also included in the default Flex Builder installation, in the *flex_builder_install_dir*/sdks/*sdk_version*/bin directory.

To use the mxmlc utility, you should understand its syntax and how to use configuration files. For more information, see "About the command-line compilers" on page 131.

The basic syntax of the mxmlc utility is as follows:

```
mxmlc [options] target_file
```

The default option is the target file to compile into a SWF file, and it is required to have a value. If you use a space-separated list as part of the options, you can terminate the list with a double hyphen before adding the target file; for example:

```
mxmlc -option arg1 arg2 arg3 -- target_file.mxml
```

To see a list of options for mxmlc, you can use the `help list` option, as the following example shows:

```
mxmlc -help list
```

To see a list of all options available for mxmlc, including advanced options, you use the following command:

```
mxmlc -help list advanced
```

The default output of mxmlc is *filename*.swf, where *filename* is the name of the root application file. The default output location is in the same directory as the target, unless you specify an output file and location with the `output` option.

The mxmlc command-line compiler does not generate an HTML wrapper. You must create your own wrapper to deploy a SWF file that the mxmlc compiler produced. The wrapper is used to embed the SWF object in the HTML tag. It includes the `<object>` and `<embed>` tags, as well as scripts that support Flash Player version detection and history management. For information about creating an HTML wrapper, see "Creating a Wrapper" on page 311.

The mxmlc utility uses the default compiler settings in the flex-config.xml file. This file is in the *flex_sdk_dir*/frameworks/ directory. You can change the settings in this file or use another custom configuration file. For more information on using configuration files, see "About configuration files" on page 134.

The mxmlc compiler is highly customizable with a large set of options. For information on the compiler options, see "About the application compiler options" on page 139.

You can also open the mxmlc compiler with the `java` command on the command line. For more information, see "Invoking the command-line compilers with Java" on page 133.

About the component compiler

You use the component compiler to generate a SWC file from component source files and other asset files such as images and style sheets. A SWC file is an archive of Flex components and other assets. For more information about SWC files, see "About SWC files" on page 174.

In some ways, the component compiler is similar to the application compiler. The application compiler produces a SWF file from one or more MXML and ActionScript files; the component compiler produces a SWC file from its input files. SWC files are compressed files that contain a SWF file (library.swf), asset files, and a catalog.xml file.

You use the component compiler to create the following kinds of assets:

Component libraries. Component libraries are SWC files that contain one or more components that are used by applications. SWC files also contain the namespace information that describe the contents of the SWC file. For more information about component libraries, see "About SWC files" on page 174.

Run-time shared libraries (RSLs). RSLs are external shared assets that can be separately downloaded and cached on the client. These shared assets are loaded by any number of applications at run time. For more information on RSLs, see "Using Runtime Shared Libraries" on page 195.

Themes. Themes are a combination of graphical and programmatic skins, and Cascading Style Sheets (CSS). You use themes to define the look and feel of a Flex application. For more information on themes, see "Using Styles and Themes" on page 589 in *Adobe Flex 3 Developer Guide*.

You open the component compiler in the following ways:

Flex Builder Library Project compiler. Flex Builder uses the component compiler when you create a Library Project. (The application compiler is used for Flex Projects and ActionScript Projects). For more information, see "Using the Flex Builder component compiler" on page 130.

The compc command-line compiler. You open the compc compiler from the command line to create a SWC file. For more information, see “Using the compc component compiler” on page 130.

The component compiler has many of the same options as the application compilers, as described in “About the application compiler options” on page 139. The component compiler has additional options as described in “About the component compiler options” on page 161.

Like the application compiler, you can use the `load-config` option to point the component compiler to a configuration file, rather than specify command-line options or set the options in the Flex Library Compiler dialog box.

When you compile a SWC file, store the new file in a location that is not the same as the source files. If both sets of files are accessible by Flex when you compile your application, unexpected behavior can occur.

The SWC files that are produced by the component compilers do not require an HTML wrapper because they are used as themes, RSLs, or component libraries that are input to other compilers to create Flex applications. You never deploy a SWC file that users can request directly.

Using the Flex Builder component compiler

You use the component compiler in Flex Builder to create SWC files. You do this by setting up a Flex Library Project using the New Library Project command. You add MXML and ActionScript components, style sheets, SWF files, and other assets to the project.

To open the Flex Builder component compiler, select Project > Build Project for your Flex Library Project.

You edit the compiler settings by using the settings on the Project > Properties > Flex Library Compiler dialog box. Using the Additional Compiler Arguments field in this dialog box, you can set compiler options as if you were using the command-line compiler. For information about the syntax for setting options in the Flex Library Compiler dialog box, see “About the command-line compilers” on page 131.

You can set the value of some options using the GUI controls. To set the resource options in the Flex Library Build Path dialog box, select Project > Properties > Flex Library Build Path.

Flex Builder does not expose a default configuration file to set compiler options but you can create your own and pass it to the compiler with the `load-config` option. For more information on setting compiler options with configuration files, see “About configuration files” on page 134.

Using the compc component compiler

You use the compc command-line compiler to compile SWC files from MXML, ActionScript, and other source files such as style sheets, images, and SWF files.

You can open the compc compiler as a shell script and executable file for use on Windows and UNIX systems. It is in the *flex_install_dir*/bin directory in Flex SDK.

To use the compc compiler, you should understand how to pass options and use configuration files. For more information, see "About the command-line compilers" on page 131.

The syntax of the compc compiler is as follows:

```
compc [options] -include-classes class [...]
```

The default option for compc is `include-classes`. At least one of the "include-" options is required.

To see a list of supported options for compc, you can use the `help list` option, as the following example shows:

```
compc -help list
```

The compc compiler uses the default compiler settings in the flex-config.xml file. Like the application compiler, you can change these settings or use another custom configuration file. Unlike the application compiler, however, the component compiler does not support the use of default configuration files.

You cannot use the compc compiler to create a SWC file from a FLA file or other file created in the Adobe® Flash® authoring environment.

You can also open the compc compiler with the `java` command on the command line. For more information, see "Invoking the command-line compilers with Java" on page 133.

About the command-line compilers

You use the mxmlc and compc command-line compilers to compile your MXML and AS files into SWF and SWC files. You can use the utilities to precompile Flex applications that you want to deploy on another server or to automate compilation in a testing environment.

To use the command-line compilers, you must have a Java run-time environment in your system path.

For Flex SDK, the command-line compilers are located in the *flex_install_dir*/bin directory. For Flex Builder, the compilers are located in the *flex_builder_install_dir*/sdks/*sdk_version*/bin directory.

When using mxmlc and compc on the command line, you can also use a configuration file to store your options rather than list them on the command line. You can store command-line options as XML blocks in a configuration file. For more information, see "About configuration files" on page 134.

Command-line syntax

The mxmlc and compc compilers take many options. The options are listed in the help which you can view with the `help` option, as the following example shows:

```
mxmlc -help
```

This displays a menu of choices for getting help. The most common choice is to list the basic configuration options:

```
mxmlc -help list
```

To see advanced options, use the `list advanced` option, as the following example shows:

```
mxmlc -help list advanced
```

To see a list of entries whose names or descriptions include a particular String, use the following syntax:

```
mxmlc -help pattern
```

The following example returns descriptions for the `external-library-path`, `library-path`, and `runtime-shared-libraries` options:

```
mxmlc -help list library
```

For a complete description of mxmlc options, see "About the application compiler options" on page 139. For a complete description of compc options, see "About the component compiler options" on page 161.

Many command-line options, such as `show-actionscript-warnings` and `accessible`, have `true` and `false` values. You specify these values by using the following syntax:

```
mxmlc -accessible=true -show-actionscript-warnings=true
```

Some options, such as `source-path`, take a list of one or more options. You can see which options take a list by examining the help output. Square brackets (`[ ]`) that surround options indicate that the option can take a list of one or more parameters.

You can separate each entry in a list with a space or a comma. The syntax is as follows:

```
-var val1 val2
```

or

```
-var=val1, val2
```

If you do not use commas to separate entries, you terminate a list by using a double hyphen, as the following example shows:

```
-var val1 val2 -- -next_option
```

If you use commas to separate entries, you terminate a list by not using a comma after the last entry, as the following example shows:

```
-var=val1, val2 -next_option
```

You can append values to an option using the += operator. This adds the new entry to the end of the list of existing entries rather than replacing the existing entries. The following example adds the c:/myfiles directory to the `library-path` option:

```
mxmlc -library-path+=c:/myfiles
```

Using abbreviated option names

In some cases, the command-line help shows an option with dot-notation syntax; for example, `source-path` is shown as `compiler.source-path`. This notation indicates how you would set this option in a configuration file. On the command line, you can specify the option with only the final node, `source-path`, as long as that node is unique, as the following example shows:

```
mxmlc -source-path . c:/myclasses/ -- foo.mxml
```

For more information about using configuration files to store command-line options, see "About configuration files" on page 134.

Some compiler options have aliases. *Aliases* provide shortened variations of the option name to make command lines more readable and less verbose. For example, the alias for the `output` option is `o`. You can view a list of options by their aliases by using the following command:

```
mxmlc -help list aliases
```

or

```
mxmlc -help list advanced aliases
```

You can also see the aliases in the verbose help output by using the following command:

```
mxmlc -help list details
```

Invoking the command-line compilers with Java

Flex provides a simple interface to the command-line compilers. For UNIX users, there is a shell script. For Windows users, there is an executable file. These files are located in the bin directory. You can also invoke the compilers using Java. This lets you integrate the compilers into Java-based projects (such as Ant) or other utilities.

The shell scripts and executable files for the command-line compilers wrap calls to the mxmlc.jar and compc.jar JAR files. To invoke the compilers from Java, you call the JAR files directly. For Flex SDK, the JAR files are located in the *flex_install_dir*/lib directory. For Flex Builder, they are located in the *flex_builder_install_dir*/sdks/*sdk_version*/lib.

To invoke a command in a JAR file, use the `java` command from the command line and specify the JAR file you want to execute with the `jar` option. You must also specify the value of the `+flexlib` option. This advanced option lets you set the root directory that is used by the compiler to locate the flex-config.xml file, among other files. You typically point it to your frameworks directory. From there, the compiler can detect the location of other configuration files.

The following example compiles MyApp.mxml into a SWF file using the JAR file to invoke the mxmlc compiler:

```
java -jar ../lib/mxmlc.jar +flexlib c:/flex_3_sdk/frameworks c:/flex3/MyApp.mxml
```

You pass all other options as you would when you open the command-line compilers. The following example sets the locale and source path when compiling MyApp:

```
java -jar ../lib/mxmlc.jar +flexlib c:/flex_3_sdk/frameworks -locale en_US -source-path
locale/{locale} c:/flex3/MyApp.mxml
```

About configuration files

Configuration files can be used by the command-line utilities and Flex Builder compilers.

Flex includes a default configuration file named flex-config.xml. This configuration file contains most of the default compiler settings for the application and component compilers. You can customize this file or create your own custom configuration file.

Flex SDK includes the flex-config.xml file in the *flex_install_dir*/frameworks directory.

The Flex Builder compilers do not use a flex-config.xml file by default. The default settings are stored internally. You can, however, create a custom configuration file and pass it to the Flex Builder compilers by using the `load-config` option. Flex Builder includes a copy of the flex-config.xml file that you can use as a template for your custom configuration file. This file located in the *flex_builder_install_dir*/sdks/*sdk_version*/frameworks directory.

You can generate a configuration file with the current settings by using the `dump-config` option, as the following example shows:

```
mxmlc -dump-config myapp-config.xml
```

Locating configuration files

You can specify the location of a configuration file by using the `load-config` option. The target configuration file can be the default flex-config.xml file, or it can be a custom configuration file. The following example loads a custom configuration file:

```
compc -load-config=myconfig.xml
```

If you specify the filename with the `+=` operator, your loaded configuration file is used *in addition to* and not instead of the flex-config.xml file:

```
compc -load-config+=myconfig.xml
```

With the mxmlc compiler, you can also use a local configuration file. A *local configuration file* does not require you to point to it on the command line. Rather, Flex examines the same directory as the target MXML file for a configuration file with the same name (one that matches the *filename*-config.xml filename). If it finds a file, it uses it in conjunction with the flex-config.xml file. You can also specify a configuration file by using the `load-config` option with the `+=` operator.

For example, if your application's top-level file is called MyApp.mxml, the compiler first checks for a MyApp-config.xml file for configuration settings. With this feature, you can easily compile multiple applications using different configuration options without changing your command-line options or your flex-config.xml file.

Options in the local configuration file take precedence over options set in the flex-config.xml file. Options set in a configuration file that the `load-config` option specify take precedence over the local configuration file. Command-line settings take precedence over all configuration file settings. For more information on the precedence of compiler options, see "About option precedence" on page 138.

Configuration file syntax

You store values in a configuration file in XML blocks, which follow a specific syntax. In general, the tags you use match the command-line options.

About the root tag

The root tag of the default configuration file, flex-config.xml, is `<flex-config>`. If you write a custom configuration file, it must also have this root tag. Compiler configuration files must also have an XML declaration tag, as the following example shows:

```
<?xml version="1.0"?>
<flex-config xmlns="http://www.adobe.com/2006/flex-config">
```

You must close the `<flex-config>` tag as you would any other XML tag. All compiler configuration files must be closed with the following tag:

```
</flex-config>
```

In general, the second tag in a configuration file is the `<compiler>` tag. This tag wraps most compiler options. However, not all compiler options are set in the `<compiler>` block of the configuration file.

Tags that you must wrap in the compiler block are prefixed by `compiler` in the help output (for example, `compiler.services`). If the option uses no dot-notation in the help output (for example, `include-file`), it is a tag at the root level of the configuration file, and the entry appears as follows:

```
<compiler>
...
</compiler>
<include-file>
    <name>logo.gif</name>
    <path>c:/images/logo/logo1.gif</path>
</include-file>
```

In some cases, options have multiple parent tags, as with the fonts options, such as `compiler.fonts.managers` and `compiler.fonts.languages.language`. Other options that require parent tags when added to a configuration file include the `frames.frame` option and the metadata options. The following sections describe methods for determining the syntax.

Getting the configuration file tags

Use the `help list` option of the command-line compilers to get the configuration file syntax of the compiler options; for example:

```
mxmlc -help list advanced
```

The following is the entry for the `source-path` option:

```
-compiler.source-path [path-element][...]
```

This indicates that in the configuration file, you can have one or more `<path-element>` child tags of the `<source-path>` tag, and that `<source-path>` is a child of the `<compiler>` tag. The following example shows how this should appear in the configuration file:

```
<compiler>
    <source-path>
        <path-element>.</path-element>
        <path-element>c:/myclasses/</path-element>
    </source-path>
</compiler>
```

Understanding leaf nodes

The help output uses dot-notation to separate child tags from parent tags, with the right-most entry being known as the *leaf node*. For example, `-tag1.tag2` indicates that `<tag2>` should be a child tag of `<tag1>`.

Angle brackets (`< >`) or square brackets (`[ ]`) that surround an option indicate that the option is a leaf node.

Square brackets indicate that there can be a list of one or more parameters for that option.

If the leaf node of a tag in the angle bracket is unique, you do not have to specify the parent tags in the configuration file. For example, the help usage shows the following:

```
compiler.fonts.managers [manager-class][...]
```

You can specify the value of this option in the configuration file, as the following example shows:

```
<compiler>
    <fonts>
        <managers>
            <manager-class>flash.fonts.JREFontManager</manager-class>
        </managers>
    </fonts>
```

```
</compiler>
```

However, the `<manager-class>` leaf node is unique, so you can set the value without specifying the `<fonts>` and `<managers>` parent tags, as the following example shows:

```
<compiler>
    <manager-class>flash.fonts.JREFontManager</manager-class>
</compiler>
```

If the help output shows multiple options listed in angle brackets, you set the values of these options at the same level inside the configuration file and do not make them child tags of each other. For example, the usage for default-size (`default-size <width> <height>`) indicates that the default size of the application is set in a configuration file, as the following example shows:

```
<default-size>
    <height>height_value</height>
    <width>width_value</width>
</default-size>
```

Using tokens

You can pass custom token values to the compiler using the following syntax:

```
+token_name=value
```

In the configuration file, you reference that value using the following syntax:

```
${token_name}
```

You can use the `@Context` token in your configuration files to represent the context root of the application. You can also use the `${flexlib}` token to represent the frameworks directory. This is useful if you set up your own configuration and are not using the default `library-path` settings.

The default value of the `${flexlib}` token is *`application_home`*`\frameworks`.

Appending values

In a configuration file, you can specify the `append` attribute of any tag that takes a list of arguments. Set this attribute to `true` to indicate that the values should be appended to the option rather than replace it. The default value is `false`.

Setting the `append` attribute to `true` lets you compound the values of options with multiple configuration files. The following example appends two entries to the `library-path` option:

```
<library-path append="true">
    <path-element>/mylibs</path-element>
    <path-element>/myotherlibs</path-element>
</library-path>
```

About option precedence

You can set the same options in multiple places and the Flex compilers use the value from the source that has the highest precedence.

If you do not specify an option on the command line, the compilers check for a `load-config` option and get the value from that file.

When using the mxmlc compiler, Flex checks to see if there is an *app_name*-config.xml file in the same directory as the target MXML file. This is known as the local configuration file and is described in "Locating configuration files" on page 134. The syntax and structure of local configuration files are the same as with the flex-config.xml file.

If no `load-config` option is specified, the compilers check for the flex-config.xml file. The compilers look for the flex-config.xml file in the /frameworks directory. The following location is the default:

```
{flex_root}/frameworks
```

Most options have a default value that the compilers use if the option is not set in any of the other ways.

The following table shows the possible sources of options for each compiler. The table also shows the order of precedence for each option. The options set using the method described in a lower row take precedence over the options set using the methods described in a higher row.

Compiler options	**Flex Builder**	**mxmlc**	**compc**
Default settings	Yes	No	No
flex-config.xml	No	Yes	Yes
Local configuration file	No	Yes	No
Configuration file specified by load-config option	Yes	Yes	Yes
Command-line option	No	Yes	Yes
Options panel	Yes	No	No

The web-tier compiler uses its own set of configuration files.

You can mix and match the source of the compiler options. For example, you can specify a custom configuration file with the `load-config` option, and also set additional options on the command line.

You can also use multiple configuration files. You can chain them by using the `+=` operator with the `load-config` option. If you specify a configuration file with this option, the compilers also look for the flex-config.xml and local (*appname*-config.xml) configuration files.

Using mxmlc, the application compiler

You use the application compiler to compile SWF files from your ActionScript and MXML source files.

The application compiler's options let you define settings such as the library path and whether to include debug information in the resulting SWF file. Also, you can set application-specific settings such as the frame rate at which the SWF file should play and its height and width.

To invoke the application compiler with Flex SDK, you use the mxmlc command-line utility. In Flex Builder, you use the application compiler by building a new Flex Project. Some of the Flex SDK command-line options have equivalents in the Flex Builder environment. For example, you can use the tabs in the Flex Build Path dialog box to add classes and libraries to your project.

The following set of examples use the application compiler.

About the application compiler options

The following table describes the application compiler options. You invoke the application compiler with the mxmlc command-line utility or when building a project in Flex Builder.

Option	Description
`accessible=true|false`	Enables accessibility features when compiling the Flex application or SWC file. The default value is `false`. For more information on using the Flex accessibility features, see "Creating Accessible Applications" on page 1139 in *Adobe Flex 3 Developer Guide*.
`actionscript-file-encoding` *`string`*	Sets the file encoding for ActionScript files. For more information, see "Setting the file encoding" on page 156.
`advanced`	Lists advanced help options when used with the help option, as the following example shows: `mxmlc -help advanced` This is an advanced option.
`allow-source-path-overlap=true|false`	Checks if a `source-path` entry is a subdirectory of another `source-path` entry. It helps make the package names of MXML components unambiguous. This is an advanced option.

Option	Description
`as3=true|false`	Use the ActionScript 3.0 class-based object model for greater performance and better error reporting. In the class-based object model, most built-in functions are implemented as fixed methods of classes. The default value is `true`. If you set this value to `false`, you must set the `es` option to `true`. This is an advanced option.
`benchmark=true|false`	Prints detailed compile times to the standard output. The default value is `true`.
`context-root` *`context-path`*	Sets the value of the `{context.root}` token, which is often used in channel definitions in the flex-services.xml file and other settings in the flex-config.xml file. The default value is null.
`contributor` *`name`*	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.
`creator` *`name`*	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.
`date` *`text`*	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.
`debug=true|false`	Generates a debug SWF file. This file includes line numbers and filenames of all the source files. When a run-time error occurs, the stacktrace shows these line numbers and filenames. This information is used by the command-line debugger and the Flex Builder debugger. Enabling the `debug` option generates larger SWF files. For the mxmlc compiler, the default value is `false`. For the compc compiler, the default value is `true`. For Flex Builder, the default value is `true`. If you export an application by using the Export Release Build feature, the Flex Builder compiler excludes the debugging information, which is the equivalent of setting the value of this option to `false`. When generating SWC files, if `debug` is set to `true`, then the library.swf file inside the SWC file contains debug information. If you are generating a SWC file for distribution, set this value to `false`. For information about the command-line debugger, see "Using the Command-Line Debugger" on page 245. If you set this option to `true`, Flex also sets the `verbose-stacktraces` option to `true`
`debug-password` *`string`*	Lets you engage in remote debugging sessions with the Flash IDE. This is an advanced option.

Option	Description
`default-background-color` *`int`*	Sets the application's background color. You use the 0x notation to set the color, as the following example shows: `-default-background-color=0xCCCCFF` The default value is null. The default background of a Flex application is an image of a gray gradient. You must override this image for the value of the `default-background-color` option to be visible. For more information, see "Editing application settings" on page 156. This is an advanced option.
`default-frame-rate` *`int`*	Sets the application's frame rate. The default value is 24. This is an advanced option.
`default-script-limits` *`max-recursion-depth`* *`max-execution-time`*	Defines the application's script execution limits. The `max-recursion-depth` value specifies the maximum depth of Adobe Flash Player call stack before Flash Player stops. This is essentially the stack overflow limit. The default value is 1000. The `max-execution-time` value specifies the maximum duration, in seconds, that an ActionScript event handler can execute before Flash Player assumes that it is hung, and aborts it. The default value is 60 seconds. You cannot set this value above 60 seconds. You can override these settings in the application. This is an advanced option.
`default-size` *`width height`*	Defines the default application size, in pixels. This is an advanced option.
`defaults-css-files` *`filename`* `[, ...]`	Inserts CSS files into the output the same way that a per-SWC defaults.css file works, but without having to re-archive the SWC file to test each change. CSS files included in the output with this option have a higher precedence than default CSS files in existing SWCs. For example, a CSS file included with this option overrides definitions in framework.swc's defaults.css file, but it has the same overall precedence as other included CSS files inside the SWC file. This option does not actually insert the CSS file into the SWC file; it simulates it. When you finish developing the CSS file, you should rebuild the SWC file with the new integrated CSS file. This option takes one or more files. The precedence for multiple CSS files included with this option is from first to last. This is an advanced option.

<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td><code>defaults-css-url string</code></td><td>Defines the location of the default style sheet. Setting this option overrides the implicit use of the defaults.css style sheet in the framework.swc file.

For more information on the defaults.css file, see “Using Styles and Themes” on page 589 in Adobe Flex 3 Developer Guide.

This is an advanced option.</td></tr>
<tr><td><code>define=NAMESPACE::variable,value</code></td><td>Defines a global constant. The value is evaluated at compile time and exists as a constant within the application. A common use of inline constants is to set values that are used to include or exclude blocks of code, such as debugging or instrumentation code. This is known as conditional compilation.

The following example defines the constant <code>debugging</code> in the <code>CONFIG</code> namespace:

<code>-define=CONFIG::debugging,true</code>

In ActionScript, you can use this value to conditionalize statements; for example:

<code>CONFIG::debugging {
  // Execute debugging code here.
}</code>

To set multiple conditionals on the command-line, use the <code>define</code> option more than once.

For more information, see “Using conditional compilation” on page 158.</td></tr>
<tr><td><code>description text</code></td><td>Sets metadata in the resulting SWF file. For more information, see “Adding metadata to SWF files” on page 155.</td></tr>
<tr><td><code>dump-config filename</code></td><td>Outputs the compiler options in the flex-config.xml file to the target path; for example:

<code>mxmlc -dump-config myapp-config.xml</code>

This is an advanced option.</td></tr>
</table>

Option	Description
`es=true|false`	Instructs the compiler to use the ECMAScript edition 3 prototype-based object model to allow dynamic overriding of prototype properties. In the prototype-based object model, built-in functions are implemented as dynamic properties of prototype objects. The default value is `false`. Using the ECMAScript edition 3 prototype-based object model lets you use untyped properties and functions in your application code. As a result, if you set the value of the `es` compiler option to `true`, you must set the `strict` compiler option to `false`. Otherwise, the compiler will throw errors. If you set this option to `true`, you must also set the value of the `as3` compiler option to `false`. This is an advanced option.
`externs` *`class_name [...]`*	Sets a list of classes to exclude from linking when compiling a SWF file. This option provides compile-time link checking for external references that are dynamically linked. For more information about dynamic linking, see "About linking" on page 196. This is an advanced option.
`external-library-path` *`path-element [...]`*	Specifies a list of SWC files or directories to exclude from linking when compiling a SWF file. This option provides compile-time link checking for external components that are dynamically linked. By default, the libs/player/playerglobal.swc file is linked as an external library. This library is built into Flash Player. For more information about dynamic linking, see "About linking" on page 196. You can use the += operator to append the new SWC file to the list of external libraries.
`fonts.advanced-anti-aliasing=true|false`	Sets the default value that determines whether embedded fonts use advanced anti-aliasing information when rendering the font. Setting the value of the `advanced-anti-aliasing` property in a style sheet overrides this value. The default value is `false`. For more information about using advanced anti-aliasing, see "Using Fonts" on page 653 in *Adobe Flex 3 Developer Guide*.

Option	Description
`fonts.languages.language-range` *`lang range`*	Specifies the range of Unicode settings for that language. For more information, see "Using Styles and Themes" on page 589 in *Adobe Flex 3 Developer Guide*. This is an advanced option.
`fonts.local-fonts-snapshot` *`path_to_file`*	Sets the location of the local font snapshot file. The file contains system font data. This is an advanced option.
`fonts.managers` *`manager-class [...]`*	Defines the font manager. The default is flash.fonts.JREFontManager. You can also use the flash.fonts.BatikFontManager. For more information, see "Using Styles and Themes" on page 589 in *Adobe Flex 3 Developer Guide*. This is an advanced option.
`fonts.max-cached-fonts` *`string`*	Sets the maximum number of fonts to keep in the server cache.
`fonts.max-glyphs-per-face` *`string`*	Sets the maximum number of character glyph-outlines to keep in the server cache for each font face. This is an advanced option.
`frames.frame` *`label class_name`* `[...]`	Specifies a SWF file frame label with a sequence of class names that are linked onto the frame. This option lets you add asset factories that stream in after the application that then publish their interfaces with the ModuleManager class. The advantage to doing this is that the application starts faster than it would have if the assets had been included in the code, but does not require moving the assets to an external SWF file. This is an advanced option.
`generate-frame-loader=true|false`	Toggles the generation of an IFlexBootstrap-derived loader class. This is an advanced option.
`headless-server=true|false`	Enables the headless implementation of the Flex compiler. This sets the following: `System.setProperty("java.awt.headless", "true")` The headless setting (java.awt.headless=true) is required to use fonts and SVG on UNIX systems without X Windows. This is an advanced option.
`help [-list [advanced]]`	Prints usage information to the standard output. For more information, see "Command-line syntax" on page 131.

Option	Description
`include-libraries` *`library [...]`*	Links all classes inside a SWC file to the resulting application SWF file, regardless of whether or not they are used. Contrast this option with the `library-path` option that includes only those classes that are referenced at compile time. To link one or more classes whether or not they are used and not an entire SWC file, use the `includes` option. This option is commonly used to specify resource bundles.
`include-resource-bundles` *`bundle [...]`*	Specifies the resource bundles to link into a resource module. All resource bundles specified with this option must be in the compiler's source path. You specify this using the `source-path` compiler option. For more information on using resource bundles, see "Localizing Flex Applications" on page 1101 in *Adobe Flex 3 Developer Guide*.
`includes` *`class [...]`*	Links one or more classes to the resulting application SWF file, whether or not those classes are required at compile time. To link an entire SWC file rather than individual classes, use the `include-libraries` option.
`incremental=true|false`	Enables incremental compilation. For more information, see "About incremental compilation" on page 157. This option is `true` by default for the Flex Builder application compiler. For the command-line compiler, the default is `false`. The web-tier compiler uses incremental compilation by default.
`keep-as3-metadata=`*`class_name`* `[...]`	Specifies custom metadata that you want to keep. By default, the compiler keeps the following metadata: • Bindable • Managed • ChangeEvent • NonCommittingChangeEvent • Transient If you want to preserve the default metadata, you should use the += operator to append your custom metadata, rather than the = operator which replaces the default metadata. This is an advanced option. For more information, see "About metadata tags" on page 33 in *Creating and Extending Adobe Flex 3 Components*.

Option	Description
`keep-all-type-selectors=true|false`	Instructs the compiler to keep a style sheet's type selector in a SWF file, even if that type (the class) is not used in the application. This is useful when you have a modular application that loads other applications. For example, the loading SWF file might define a type selector for a type used in the loaded (or, target) SWF file. If you set this option to `true` when compiling the loading SWF file, then the target SWF file will have access to that type selector when it is loaded. If you set this option to `false`, the compiler will not include that type selector in the loading SWF file at compile time. As a result, the styles will not be available to the target SWF file. This is an advanced option.
`keep-generated-actionscript=true|false`	Determines whether to keep the generated ActionScript class files. The generated class files include stubs and classes that are generated by the compiler and used to build the SWF file. When using the application compiler, the default location of the files is the /generated subdirectory, which is directly below the target MXML file. If the /generated directory does not exist, the compiler creates one. When using the compc component compiler, the default location of the /generated directory is relative to the output of the SWC file. When using Flex Builder, the default location of the generated files is the /bin/generated directory. The default names of the primary generated class files are *filename*-generated.as and *filename*-interface.as. The default value is `false`. This is an advanced option.
`language` *code*	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.

Option	Description
`library-path` *`path-element [...]`*	Links SWC files to the resulting application SWF file. The compiler only links in those classes for the SWC file that are required. You can specify a directory or individual SWC files. The default value of the `library-path` option includes all SWC files in the libs and libs/player directories, plus the current locale directory. These are required. To point to individual classes or packages rather than entire SWC files, use the `source-path` option. If you set the value of the `library-path` as an option of the command-line compiler, you must also explicitly add the framework.swc and locale SWC files. Your new entry is not appended to the `library-path` but replaces it, unless you use the += operator. On the command line, you use the += operator to append the new argument to the list of existing SWC files. In a configuration file, you can set the `append` attribute of the `library-path` tag to `true` to indicate that the values should be appended to the library path rather than replace existing default entries.
`license` *`product_name license_key`*	Defines the license key to use when compiling. Valid values for *`product_name`* include `flexbuilder3`.

`link-report` *`filename`*	Prints linking information to the specified output file. This file is an XML file that contains `<def>`, `<pre>`, and `<ext>` symbols showing linker dependencies in the final SWF file.
	
	The file format output by this command can be used to write a file for input to the `load-externs` option.
	
	For more information on the report, see "Examining linker dependencies" on page 65.
	
	This is an advanced option.

`load-config` *`filename`*	Specifies the location of the configuration file that defines compiler options. If you specify a configuration file, you can override individual options by setting them on the command line. All relative paths in the configuration file are relative to the location of the configuration file itself. Use the `+=` operator to chain this configuration file to other configuration files. For more information on using configuration files to provide options to the command-line compilers, see "About configuration files" on page 134.

Option	Description

`load-externs filename [...]`	Specifies the location of an XML file that contains `<def>`, `<pre>`, and `<ext>` symbols to omit from linking when compiling a SWF file. The XML file uses the same syntax as the one produced by the `link-report` option. For more information on the report, see "Examining linker dependencies" on page 65.
	
	This option provides compile-time link checking for external components that are dynamically linked.
	
	For more information about dynamic linking, see "About linking" on page 196.
	
	This is an advanced option.

`locale string`	Specifies one or more locales to be compiled into the SWF file. If you do not specify a locale, then the compiler uses the default locale from the flex-config.xml file. The default value is en_US. You can append additional locales to the default locale by using the += operator. If you remove the default locale from the flex-config.xml file, and do not specify one on the command line, then the compiler will use the machine's locale. For more information, see "Localizing Flex Applications" on page 1101in *Adobe Flex 3 Developer Guide*.
`localized-description text lang`	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.
`localized-title text lang`	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.
`mxml.compatibility-version=version`	Specifies the version of the Flex compiler that the output should be compatible with. This option affects some behavior such as the layout rules, padding and gaps, skins, and other style settings. In addition, it affects the rules for parsing properties files. The currently-supported values are `3` and `2.0.1`. The default value is `3`. The following example instructs the application to compile with the 2.0.1 rules for these behaviors: `-compatibility-version=2.0.1` For more information on using the option, see "Backward compatibility" on page 286.
`namespaces.namespace uri manifest`	Specifies a namespace for the MXML file. You must include a URI and the location of the manifest file that defines the contents of this namespace. This path is relative to the MXML file. For more information about manifest files, see "About manifest files" on page 175.

Option	Description
`optimize=true|false`	Enables the ActionScript optimizer. This optimizer reduces file size and increases performance by optimizing the SWF file's bytecode. The default value is `true`.
`output` *`filename`*	Specifies the output path and filename for the resulting file. If you omit this option, the compiler saves the SWF file to the directory where the target file is located. The default SWF filename matches the target filename, but with a SWF file extension. If you use a relative path to define the *filename*, it is always relative to the current working directory, not the target MXML application root. The compiler creates extra directories based on the specified filename if those directories are not present. When using this option with the component compiler, the output is a SWC file rather than a SWF file, unless you set the `directory` option to `true`. In that case, the output is a directory with the contents of the SWC file. The name of the directory is that value of the `ouput` option.
`publisher` *`name`*	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.
`raw-metadata` *`XML_string`*	Defines the metadata for the resulting SWF file. The value of this option overrides any metadata.* compiler options (such as `contributor`, `creator`, `date`, and `description`). This is an advanced option.
`resource-bundle-list` *`filename`*	Prints a list of resource bundles that are used by the current application to a file named with the *`filename`* argument. You then use this list as input that you specify with the `include-resource-bundles` option to create a resource module. For more information, see "Localizing Flex Applications" on page 1101 in *Adobe Flex 3 Developer Guide*.
`runtime-shared-libraries rsl-`*`url [...]`*	Specifies a list of runtime shared libraries (RSLs) to use for this application. RSLs are dynamically-linked at run time. The compiler externalizes the contents of the application that you are compiling that overlap with the RSL. You specify the location of the SWF file relative to the deployment location of the application. For example, if you store a file named library.swf file in the *web_root*/libraries directory on the web server, and the application in the web root, you specify libraries/library.swf. For more information about RSLs, see "Using Runtime Shared Libraries" on page 195.

Option	Description
`runtime-shared-library-path=`*`path-element,rsl-url[,policy-file-url,failover-url,...]`*	Specifies the location of a runtime shared library (RSL). The compiler externalizes the contents of the application that you are compiling that overlap with the RSL. The `path-element` argument is the location of the SWC file or open directory to compile against. For example, c:\flexsdk\frameworks\libs\framework.swc. This is the equivalent of the using the `external-library-path` option when compiling against an RSL using the `runtime-shared-libraries` option. The `rsl-url` argument is the URL of the RSL that will be used to load the RSL at runtime. The compiler does not verify the existence of the SWF file at this location at compile time. It does store this string in the application, however, and uses it at run time. As a result, the SWF file must be available at run time but necessarily not at compile time. The `policy-file-url` is the location of the crossdomain.xml file that gives permission to read the RSL from the server. This might be necessary because the RSL can be on a separate server as the application. For example, http://www.mydomain.com/rsls/crossdomain.xml. The `failover-url` and second `policy-file-url` arguments specify the location of the secondary RSL and crossdomain.xml file if the first RSL cannot be loaded. This most commonly happens when the client Player version does not support cross-domain RSLs. You can add any number of failover RSLs, but must include a policy file URL for each one. Do not include spaces between the comma-separated values. The following example shows how to use this option: `mxmlc -o=../lib/app.swf -runtime-shared-library-path=../lib/mylib.swc,../bin/myrsl.swf Main.mxml` You can specify more than one library file to be used as an RSL. You do this by adding additional `runtime-shared-library-path` options. You can also use the `runtime-shared-libraries` command to use RSLs with your Flex applications. However, the `runtime-shared-library-path` option lets you also specify the location of the policy file and failover RSL. For more information about RSLs, see “Using Runtime Shared Libraries” on page 195.
`services` *`filename`*	Specifies the location of the services-config.xml file. This file is used by LiveCycle Data Services ES.

Option	Description
`show-actionscript-warnings=true|false`	Shows warnings for ActionScript classes. The default value is `true`. For more information about viewing warnings and errors, see "Viewing warnings and errors" on page 172.
`show-binding-warnings=true|false`	Shows a warning when Flash Player cannot detect changes to a bound property. The default value is `true`. For more information about viewing warnings and errors, see "Viewing warnings and errors" on page 172.
`show-shadowed-device-font-warnings=true|false`	Shows warnings when you try to embed a font with a family name that is the same as the operating system font name. The compiler normally warns you that you are shadowing a system font. Set this option to `false` to disable the warnings. The default value is `true`. For more information about viewing warnings and errors, see "Viewing warnings and errors" on page 172.
`show-unused-type-selector-warnings=true|false`	Shows warnings when a type selector in a style sheet or `<mx:Style>` block is not used by any components in the application. The default value is `true`. For more information about viewing warnings and errors, see "Viewing warnings and errors" on page 172.

Option	Description
`source-path` *`path-element [...]`*	Adds directories or files to the source path. The Flex compiler searches directories in the source path for MXML, AS, or CSS source files that are used in your Flex applications and includes those that are required at compile time. You can use wildcards to include all files and subdirectories of a directory. To link an entire library SWC file and not individual classes or directories, use the `library-path` option. The source path is also used as the search path for the component compiler's `include-classes` and `include-resource-bundles` options. You can also use the += operator to append the new argument to the list of existing source path entries. This option has the following default behavior: • If `source-path` is empty, the target file's directory will be added to source-path. • If `source-path` is not empty and if the target file's directory is a subdirectory of one of the directories in `source-path`, `source-path` remains unchanged. • If `source-path` is not empty and if the target file's directory is not a subdirectory of any one of the directories in `source-path`, the target file's directory is prepended to `source-path`.
`static-link-runtime-shared-libraries=true|false`	Determines whether to compile against libraries statically or use RSLs. Set this option to true to ignore the RSLs specified by the `runtime-shared-library-path` option. Set this option to false to use the RSLs. The default value is true. This option is useful so that you can quickly switch between a statically and dynamically linked application without having to change the `runtime-shared-library-path` option, which can be verbose, or edit the configuration files. For more information about RSLs, see "Using Runtime Shared Libraries" on page 195.
`strict=true|false`	Prints undefined property and function calls; also performs compile-time type checking on assignments and options supplied to method calls. The default value is `true`. For more information about viewing warnings and errors, see "Viewing warnings and errors" on page 172.

Option	Description
`target-player=`*`player_version`*	Specifies the version of Flash Player that you want to target with the application. Features requiring a later version of Flash Player are not compiled into the application. The *`player_version`* parameter has the following format: *`major_version.minor_version.revision`* The *`major_version`* is required while *`minor_version`* and *`revision`* are optional. The minimum value is 9.0.0. If you do not specify the *`minor_version`* or *`revision`*, then the compiler uses zero. If you do not explicitly set the value of this option, the compiler uses the default from the flex-config.xml file. The value in flex-config.xml is the version of Flash Player that shipped with the SDK. This option is useful if your application's audience has a specific player and cannot upgrade. You can use this to "downgrade" your application for that audience. This option is commonly used in conjunction with framework RSLs. For more information, see "Targeting Flash Player versions" on page 295.
`theme `*`filename [...]`*	Specifies a list of theme files to use with this application. Theme files can be SWC files with CSS files inside them or CSS files. For information on compiling a SWC theme file, see "Using Styles and Themes" on page 589 in *Adobe Flex 3 Developer Guide*.
`title `*`text`*	Sets metadata in the resulting SWF file. For more information, see "Adding metadata to SWF files" on page 155.
`use-network=true|false`	Specifies that the current application uses network services. The default value is `true`. When the `use-network` property is set to `false`, the application can access the local filesystem (for example, use the `XML.load()` method with *file:* URLs) but not network services. In most circumstances, the value of this property should be `true`. For more information about the `use-network` property, see "Applying Flex Security" on page 29.
`use-resource-bundle-metadata=true|false`	Enables resource bundles. Set to `true` to instruct the compiler to process the contents of the `[ResourceBundle]` metadata tag. The default value is `true`. For more information, see "Localizing Flex Applications" on page 1101 in *Adobe Flex 3 Developer Guide*. This is an advanced option.

Option	Description
verbose-stacktraces=true|false	Generates source code that includes line numbers. When a run-time error occurs, the stacktrace shows these line numbers. Enabling this option generates larger SWF files. Enabling this option does not generate a debug SWF file. To do that, you must set the debug option to true. The default value is false.
verify-digests=true|false	Instructs the application to check the digest of the RSL SWF file against the digest that was compiled into the application at compile time. This is a security measure that lets you load RSLs from remote domains or different sub-domains. It also lets you enforce versioning of your RSLs by forcing an application's digest to match the RSL's digest. If the digests are out of sync, you must recompile your application or load a different RSL SWF file. For more information about RSLs, see "Using Runtime Shared Libraries" on page 195.
version	Returns the version number of the MXML compiler. If you are using a trial or Beta version of Flex, the version option also returns the number of days remaining in the trial period and the expiration date.
warn-*warning_type*=true|false	Enables specified warnings. For more information, see "Viewing warnings and errors" on page 172.
warnings=true|false	Enables all warnings. Set to false to disable all warnings. This option overrides the warn-*warning_type* options. The default value is true.

The following sections provide examples of using the mxmlc application compiler options on the command line. You can also use these techniques with the application compilers in the Flex Builder and web-tier environments.

Basic example of using mxmlc

The most basic example is one in which the MXML file has no external dependencies (such as components in a SWC file or ActionScript classes) and no special options. In this case, you invoke the mxmlc compiler and point it to your MXML file as the following example shows:

```
mxmlc c:/myfiles/app.mxml
```

The default option is the target file to compile into a SWF file, and it is required to have a value. If you use a space-separated list as part of the options, you can terminate the list with a double hyphen before adding the target file; for example:

```
mxmlc -option arg1 arg2 arg3 -- target_file.mxml
```

Adding metadata to SWF files

The application compilers support adding metadata to SWF files. This metadata can be used by search engines and other utilities to gather information about the SWF file. This metadata represents a subset of the Dublin Core schema.

You can set the following values:

- `contributor`
- `creator`
- `date`
- `description`
- `language`
- `localized-description`
- `localized-title`
- `publisher`
- `title`

For the mxmlc command-line compiler, the default metadata settings in the flex-config.xml file are as follows:

```
<metadata>
    <title>Adobe Flex 2 Application</title>
    <description>http://www.adobe.com/flex</description>
    <publisher>unknown</publisher>
    <creator>unknown</creator>
    <language>EN</language>
</metadata>
```

You can also set the metadata values as command-line options. The following example sets some of the metadata values:

```
mxmlc -language+=klingon -title "checkintest!" -localized-description "it r0x0rs" en-us -
localized-description "c'est magnifique!" fr-fr -creator "Flexy Frank" -publisher "Franks
Beans" flexstore.mxml
```

In this example, the following values are compiled into the resulting SWF file:

```
<rdf:RDF xmlns:rdf='http://www.w3.org/1999/02/22-rdf-syntax-ns#'>
    <rdf:Description rdf:about='' xmlns:dc='http://purl.org/dc/elements/1.1'>
        <dc:format>application/x-shockwave-flash</dc:format>
        <dc:title>checkintest!</dc:title>
        <dc:description>
            <rdf:Alt>
                <rdf:li xml:lang='fr-fr'>c'est magnifique!</rdf:li>
                <rdf:li xml:lang='x-default'>http://www.adobe.com/flex<
```

```
                    /rdf:li>
                <rdf:li xml:lang='en-us'>it r0x0rs</rdf:li>
            </rdf:Alt>
        </dc:description>
        <dc:publisher>Franks Beans</dc:publisher>
        <dc:creator>Flexy Frank</dc:creator>
        <dc:language>EN</dc:language>
        <dc:language>klingon</dc:language>
        <dc:date>Dec 16, 2005</dc:date>
    </rdf:Description>
</rdf:RDF>
```

For information on the SWF file format, see the Flash File Format Specification, which is available through the Player Licensing program.

Setting the file encoding

You use the `actionscript-file-encoding` option to set the file encoding so that the application compiler correctly interprets ActionScript files. This tag does not affect MXML files because they are XML files that contain an encoding specification in the `xml` tag.

You use the `actionscript-file-encoding` option when your ActionScript files do not contain a Byte Order Mark (BOM), and the files use an encoding that is different from the default encoding of your computer. If your ActionScript files contain a BOM, the compiler uses the information in the BOM to determine the file encoding.

For example, if your ActionScript files use Shift_JIS encoding, have no BOM, and your computer uses ISO-8859-1 as the default encoding, you use the `actionscript-file-encoding` option, as the following example shows:

```
actionscript-file-encoding=Shift_JIS
```

Editing application settings

The mxmlc compiler includes options to set the application's frame rate, size, script limits, and background color. By setting them when you compile your application, you do not need to edit the HTML wrapper or the application's MXML file. You can override these settings by using properties of the `<mx:Application>` tag or properties of the `<object>` and `<embed>` tags in the HTML wrapper.

The following command-line example sets default application properties:

```
mxmlc -default-size 240 240 -default-frame-rate=24 -default-background-color=0xCCCCFF -
default-script-limits 5000 10 -- c:/myfiles/flex2/misc/MainApp.mxml
```

To successfully apply the value of the `default-background-color` option to your Flex application, you must set the default background *image* to an empty string. Otherwise, this image of a gray gradient covers the background color. For more information, see "Application Container" on page 451 in *Adobe Flex 3 Developer Guide*.

For more information about the HTML wrapper, see "Creating a Wrapper" on page 311.

Using SWC files

Often, you use SWC files when compiling MXML files. SWC files can provide themes, components, or other helper files. You typically specify SWC files used by the application by using the `library-path` option.

The following example compiles the RotationApplication.mxml file into the RotationApplication.swf file:

```
mxmlc -library-path+=c:/mylibraries/MyButtonSwc.swc
c:/myfiles/comptest/testRotation.mxml
```

In a configuration file, this appears as the following example shows:

```
<compiler>
    <library-path>
        <path-element>c:/flexdeploy/frameworks/libs/framework.swc</path-element>
        <path-element>c:/flexdeploy/frameworks/locale/{locale}/framework_rb.swc</path-
element>
        <path-element>c:/mylibraries/MyButtonSwc.swc</path-element>
    </library-path>
</compiler>
```

About incremental compilation

You can use incremental compilation to decrease the time it takes to compile an application or component library with the Flex application compilers. When incremental compilation is enabled, the compiler inspects changes to the bytecode between revisions and only recompiles the section of bytecode that has changed. These sections of bytecode are also referred to as *compilation units*.

You enable incremental compilation by setting the `incremental` option to `true`, as the following example shows:

```
mxmlc -incremental=true MyApp.mxml
```

Incremental compilation means that the compiler inspects your code, determines which parts of the application are affected by your changes, and only recompiles the newer classes and assets. The Flex compilers generate many compilation units that do not change between compilation cycles. It is possible that when you change one part of your application, the change might not have any effect on the bytecode of another.

As part of the incremental compilation process, the compiler generates a cache file that lists the compilation units of your application and information on your application's structure. This file is located in the same directory as the file that you are compiling. For example, if my application is called MyApp.mxml, the cache file is called MyApp_*n*.cache, where *n* represents a checksum generated by the compiler based on compiler configuration. This file helps the compiler determine which parts of your application must be recompiled. One way to force a complete recompile is to delete the cache file from the directory.

Incremental compilation can help reduce compile time on small applications, but you achieve the biggest gains on larger applications.

The default value of the `incremental` compiler option is `true` for the Flex Builder application compiler. For the mxmlc command-line compiler, the default is `false`.

Using conditional compilation

To include or exclude blocks of code for certain builds, you can use conditional compilation. The mxmlc compiler lets you pass the values of constants to the application at compile time. Commonly, you pass a Boolean that is used to include or exclude a block of code such as debugging or instrumentation code. The following example conditionalizes a block of code by using an inline constant Boolean:

```
CONFIG::debugging {
    // Execute debugging code here.
}
```

To pass constants, you use the `compiler.define` compiler option. The constant can be a Boolean, String, or Number, or an expression that can be evaluated in ActionScript at compile time. This constant is then accessible within the application source code as a global constant.

To use the `define` option, you define a configuration namespace for the constant, a variable name, and a value using the following syntax:

```
-define=namespace::variable_name,value
```

The configuration namespace can be anything you want. The following example defines the constant `debugging` with a value of `true` in the `CONFIG` namespace:

```
-define=CONFIG::debugging,true
```

To set the values of multiple constants on the command-line, use the `define` option more than once; for example:

```
mxmlc -define=CONFIG::debugging,true -define=CONFIG::release,false MyApp.mxml
```

To set the value of these constants in the flex-config.xml file, rather than on the command line, you write this as the following example shows:

```
<compiler>
    <define>
        <name>CONFIG::debugging</name>
        <value>true</value>
    </define>
    <define>
        <name>CONFIG::release</name>
        <value>false</value>
    </define>
</compiler>
```

In a Flex Ant task, you can set constants with a `define` element, as the following example shows:

```
<mxmlc ... >
    <define name="CONFIG::debugging" value="true"/>
    <define name="CONFIG::release" value="false"/>
</mxmlc>
```

Using inline constants

You can use inline constants in ActionScript. Boolean values can be used to conditionalize top-level definitions of functions, classes, and variables, in much the same way you would use an `#IFDEF` preprocessor command in C or C++. You cannot use constant Boolean values to conditionalize metadata or `import` statements.

The following example conditionalizes which class definition the compiler uses when compiling the application:

```
// compilers/MyButton.as
package  {
    import mx.controls.Button;

    CONFIG::debugging
    public class MyButton extends Button {
        public function MyButton() {
            super();
            // Set the label text to blue.
            setStyle("color", 0x0000FF);
        }
    }

    CONFIG::release
    public class MyButton extends Button {
        public function MyButton() {
            super();
            // Set the label text to red.
            setStyle("color", 0xFF0000);
        }
    }
}
```

You can also pass Strings and Numbers to the application and use them as inline constants, in the same way you might use a `#define` directive in C or C++. For example, if you pass a value named `NAMES::Company`, you replace it with a constant in your application by using an ActionScript statement like the following example shows:

```
private static const companyName:String = NAMES::Company;
```

Passing expressions

You can pass expressions that can be evaluated at compile time as the value of the constant. The following example evaluates to false:

```
-define+=CONFIG::myConst,"1 > 2"
```

The following example evaluates to 3:

```
-define+=CONFIG::myConst,"4 - 1"
```

Expressions can contain constants and other configuration values; for example:

```
-define+=CONFIG::bool2,false -define+=CONFIG::and1,"CONFIG::bool2 && false"
```

In general, you should wrap all constants with double quotes, so that the mxmlc compiler correctly parses them as a single argument.

Passing Strings

When passing Strings, you must add extra quotes to ensure that the compiler parses them correctly.

To define Strings on the command-line, you must surround them with double-quotes, *and* either escape-quote them (`"\"Adobe Systems\""` or `"\'Adobe Systems\'"`) or single-quote them (`"'Adobe Systems'"`).

The following example shows both methods of including Strings on the command line:

```
-define+=NAMES::Company,"'Adobe Systems'" -define+=NAMES::Ticker,"\"ADBE\""
```

To define Strings in configuration files, you must surround them with single or double quotes; for example:

```
<define>
    <name>NAMES::Company</name>
    <value>'Adobe Systems'</value>
</define>
<define>
    <name>NAMES::Ticker</name>
    <value>"ADBE"</value>
</define>
```

To pass empty Strings on the command line, use single quotes surrounded by double quotes, as the following example shows:

```
-define+=CONFIG::debugging,"''"
```

To pass empty Strings in configuration files, use double quotes (`""`) or single quotes (`''`).

Using compc, the component compiler

You use the component compiler to generate a SWC file from component source files and other asset files such as images and style sheets.

To use the component compiler with Flex SDK, you use the compc command-line utility. In Flex Builder, you use the compc component compiler by building a new Flex Library Project. Some of the Flex SDK command-line options have equivalents in the Flex Builder environment. You use the tabs in the Flex Library Build Path dialog box to add classes, libraries, and other resources to the SWC file.

The following examples show component compiler usage.

About the component compiler options

The component compiler options let you define settings such as the classes, resources, and namespaces to include in the resulting SWC file.

The component compiler can take most of the application compiler options, and the options described in this section. For a description of the application compiler options, see "About the application compiler options" on page 139. Application compiler options that do not apply to the component compiler include the metadata options (such as `contributor`, `title`, and `date`), default application options (such as `default-background-color` and `default-frame-rate`), `locale`, `debug-password`, and `theme`.

The component compiler has compiler options that the application compilers do not have. The following table describes the component compiler options that are not used by the application compilers:

Option	Description
`compute-digest=true|false`	Writes a digest to the catalog.xml of a library. Use this when the library will be used as a cross-domain RSL or when you want to enforce the versioning of RSLs. The default value is true. For more information about RSLs, see "Using Runtime Shared Libraries" on page 195.
`directory=false|true`	Outputs the SWC file in an open directory format rather than a SWC file. You use this option with the `output` option to specify a destination directory, as the following example shows: `compc -directory=true -output=destination_directory` You typically use this option when you create RSLs because you must extract the library.swf file from the SWC file before deployment. For more information, see "Using Runtime Shared Libraries" on page 195. The default value is false.
`include-classes class [...]`	Specifies classes to include in the SWC file. You provide the class name (for example, MyClass) rather than the file name (for example, MyClass.as) to the file for this option. As a result, all classes specified with this option must be in the compiler's source path. You specify this by using the `source-path` compiler option. You can use packaged and unpackaged classes. To use components in namespaces, use the `include-namespaces` option. If the components are in packages, ensure that you use dot-notation rather than slashes to separate package levels. This is the default option for the component compiler.

Option	Description
`include-file` *`name path [...]`*	Adds the file to the SWC file. This option does not embed files inside the library.swf file. This is useful for adding graphics files, where you want to add non-compiled files that can be referenced in a style sheet or embedded as assets in MXML files. If you add a stylesheet that references compiled resources such as programmatic skins, use the `include-stylesheet` option. If you use the `[Embed]` syntax to add a resource to your application, you are not required to use this option to also link it into the SWC file. For more information, see "Adding nonsource classes" on page 171.
`include-lookup-only=false|true`	If `true`, only manifest entries with `lookupOnly=true` are included in the SWC catalog. The default value is `false`. This is an advanced option.
`include-namespaces` *`uri [...]`*	Specifies namespace-style components in the SWC file. You specify a list of URIs to include in the SWC file. The *`uri`* argument must already be defined with the `namespace` option. To use components in packages, use the `include-classes` option.
`include-sources` *`path-element`*	Specifies classes or directories to add to the SWC file. When specifying classes, you specify the path to the class file (for example, MyClass.as) rather than the class name itself (for example, MyClass). This lets you add classes to the SWC file that are not in the source path. In general, though, use the `include-classes` option, which lets you add classes that are in the source path. If you specify a directory, this option includes all files with an MXML or AS extension, and ignores all other files.
`include-stylesheet` *`name path [...]`*	Specifies stylesheets to add to the SWC file. This option compiles classes that are referenced by the stylesheet before including the stylesheet in the SWC file. You do not need to use this option for all stylesheets; only stylesheets that reference assets that need to be compiled such as programmatic skins or other class files. If your stylesheet does not reference compiled assets, you can use the `include-file` option. This option does not compile the stylesheet into a SWF file before including it in the SWC file. You compile a CSS file into a SWF file when you want to load it at run time.

On the command line, you cannot point the compc utility to a single directory and have it compile all components and source files in that directory. You must specify each source file to compile.

If you have a large set of components in a namespace to include in a SWC file, you can use a manifest file to avoid having to type an unwieldy compc command. For information on creating manifest files, see "About manifest files" on page 175.

The following sections describe common scenarios where you could use the compc command-line compiler. You can apply the techniques described here to compiling SWC files in Flex Builder with the Flex Library Compiler.

Compiling stand-alone components and classes

In many cases, you have one or more components that you use in your Flex applications, but you do not have them in a package structure. You want to be able to use them in the generic namespace ("*") inside your Flex applications. In these cases, you use the `include-classes` option to add the components to your SWC file.

The following command-line example compiles two MXML components, Rotation.as and RotationInstance.as, into a single SWC file:

```
compc -source-path .
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/RotationClasses.swc
    -include-classes rotationClasses.Rotation rotationClasses.RotationInstance
```

The rotationClasses directory is a subdirectory of the current directory, which is in the source path. The SWC file is output to the user_classes directory, so the new components require no additional configuration to be used in a server environment.

You use the `include-classes` option to add components to the SWC file. You use just the class name of the component and not the full filename (for example, MyComponent rather than MyComponent.as). Use dot-notation to specify the location of the component in the package structure.

You also set the `source-path` to the current directory or a directory from which the component directory can be determined.

You can also add the framework.swc and framework_rb.swc files to the `library-path` option. This addition is not always required if the compiler can determine the location of these SWC files on its own. However, if you move the compiler utility out of the default location relative to the frameworks files, you must add it to the library path.

The previous command-line example appears in a configuration file as follows:

```
<compiler>
    <source-path>
        <path-element>.</path-element>
    </source-path>
    <output>
        c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/RotationClasses.swc
    </output>
</compiler>
<include-classes>
    <class>rotationClasses.Rotation</class>
    <class>rotationClasses.RotationInstance</class>
</include-classes>
```

To use components that are not in a package in a Flex application, you must declare a namespace that includes the directory structure of the components. The following example declares a namespace for the components compiled in the previous example:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
xmln:local="rotationclasses.*">
    ...
    <local:Rotation id="Rotate75" angleFrom="0" angleTo="75" duration="100"/>
    ...
</mx:Application>
```

To use the generic namespace of "*" rather than a namespace that includes a component's directory structure, you can include the directory in the `source-path` as the following command-line example shows:

```
compc -source-path . c:/flexdeploy/comps/rotationClasses
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/RotationComps.swc
    -include-classes Rotation RotationInstance
```

Then, you can specify the namespace in your application as:

```
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" xmln:local="*">
```

You are not required to use the directory name in the `include-classes` option if you add the directory to the source path.

These options appear in a configuration file, as the following example shows:

```
<compiler>
    <source-path>
        <path-element>.</path-element>
        <path-element>c:/flexdeploy/comps/rotationClasses</path-element>
    </source-path>
    <output>c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/
RotationComps.swc</output>
</compiler>
<include-classes>
    <class>Rotation</class>
    <class>RotationInstance</class>
<include-classes>
```

This example assumes that the components are not in a named package. For information about compiling packaged components, see "Compiling components in packages" on page 166.

Compiling components in packages

Some components are created inside packages or directory structures so that they can be logically grouped and separated from application code. As a result, packaged components can have a namespace declaration that includes the package name or a unique namespace identifier that references their location within a package.

You compile packaged components similarly to how you compile components that are not in packages. The only difference is that you must use the package name in the namespace declaration, regardless of how you compiled the SWC file, and that package name uses dot-notation instead of slashes. You must be sure to specify the location of the classes in the `source-path`.

In the following command-line example, the MyButton component is in the mypackage package:

```
compc -source-path . c:/flexdeploy/comps/mypackage/
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MyButtonComp.swc
    -include-classes mypackage.MyButton
```

These options appear in a configuration file, as the following example shows:

```
<compiler>
    <source-path>
        <path-element>.</path-element>
        <path-element>c:/flexdeploy/comps/mypackage/</path-element>
    </source-path>
    <output>
        c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MyButtonComp.swc
    </output>
</compiler>
<include-classes>
    <class>mypackage.MyButton</class>
<include-classes>
```

To access the MyButton class in your application, you must declare a namespace that includes its package; for example:

```
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" xmlns:mine="mypackage.*">
```

You can use the compc compiler to compile components from multiple packages into a single SWC file. In the following command-line example, the MyButton control is in the mypackage package, and the CustomComboBox control is in the acme package:

```
compc -source-path .
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/CustomComps.swc
    -include-classes mypackage.MyButton
    acme.CustomComboBox
```

You then define each package as a separate namespace in your MXML application:

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

```
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" xmlns:mine="mypackage.*"
xmlns:acme="acme.*">
    <mine:MyButton/>
    <acme:CustomComboBox/>
</mx:Application>
```

Compiling components using namespaces

When you have many components in one or more packages that you want to add to a SWC file and want to reference from an MXML file through a custom namespace, you can list them in a manifest file, then reference that manifest file on the command line. Also, you can specify a namespace for that component or define multiple manifest files and, therefore, specify multiple namespaces to compile into a single SWC file.

When you use manifest files to define the components in your SWC file, you specify the namespace that the components use in your Flex applications. You can compile all the components from one or more packages into a single SWC file. If you have more than one package, you can set it up so that all packages use a single namespace or so that each package has an individual namespace.

Components in a single namespace

In the manifest file, you define which components are in a namespace. The following sample manifest file defines two components to be included in the namespace:

```
<?xml version="1.0"?>
<!-- SimpleManifest.xml -->
<componentPackage>
    <component id="MyButton" class="MyButton"/>
    <component id="MyOtherButton" class="MyOtherButton"/>
</componentPackage>
```

The manifest file can contain references to any number of components in a namespace. The `class` option is the full class name (including package) of the class. The `id` property is optional, but you can use it to define the MXML tag interface that you use in your Flex applications. If the compiler cannot find one or more files listed in the manifest, it throws an error. For more information on using manifest files, see “About manifest files” on page 175.

On the command line, you define the namespace with the `namespace` option; for example:

```
-namespace http://mynamespace SimpleManifest.xml
```

Next, you target the defined namespace for inclusion in the SWC file with the `include-namespaces` option; for example:

```
-include-namespaces http://mynamespace
```

The `namespace` option matches a namespace (such as “http://www.adobe.com/2006/mxml”) with a manifest file. The `include-namespaces` option instructs compc to include all the components listed in that namespace’s manifest file in the SWC file.

After you define the manifest file, you can compile the SWC file. The following command-line example compiles the components into the “http://mynamespace” namespace:

```
compc -source-path .
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MyButtons.swc
    -namespace http://mynamespace SimpleManifest.xml
    -include-namespaces http://mynamespace
```

In a configuration file, these options appear as the following example shows:

```
<compiler>
    <source-path>
        <path-element>.</path-element>
    </source-path>
    <output>c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MyButtons.swc</output>
    <namespaces>
        <namespace>
            <uri>http://mynamespace</uri>
            <manifest>SimpleManifest.xml</manifest>
        </namespace>
    </namespaces>
</compiler>
<include-namespaces>
    <uri>http://mynamespace</uri>
<include-namespaces>
```

In your Flex application, you can access the components by defining the new namespace in the `<mx:Application>` tag, as the following example shows:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" xmlns:a="http://mynamespace">
    <a:MyButton/>
    <a:MyOtherButton/>
</mx:Application>
```

Components in multiple namespaces

You can use the compc compiler to compile components that use multiple namespaces into a SWC file. Each namespace must have its own manifest file.

The following command-line example compiles components defined in the AcmeManifest.xml and SimpleManifest.xml manifest files:

```
compc -source-path .
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MyButtons.swc
    -namespace http://acme2006AcmeManifest.xml
    -namespace http://mynamespace SimpleManifest.xml
    -include-namespaces http://acme2006 http://mynamespace
```

In this case, all components in both the http://mynamespace and http://acme2006 namespaces are targeted and included in the output SWC file.

In a configuration file, these options appear as the following example shows:

```
<compiler>
    <source-path>
        <path-element>.</path-element>
    </source-path>
    <output>c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MyButtons.swc</output>
    <namespaces>
        <namespace>
            <uri>http://acme2006</uri>
            <manifest>AcmeManifest.xml</manifest>
        </namespace>
        <namespace>
            <uri>http://mynamespace</uri>
            <manifest>SimpleManifest.xml</manifest>
        </namespace>
    </namespaces>
</compiler>
<include-namespaces>
    <uri>http://acme2006</uri>
    <uri>http://mynamespace</uri>
<include-namespaces>
```

In your MXML application, you define both namespaces separately:

```
<?xml version="1.0"?>
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
xmlns:simple="http://mynamespace" xmlns:acme="http://acme2006">
    <simple:SimpleComponent/>
    <acme:AcmeComponent/>
</mx:Application>
```

You are not required to include all namespaces that you define as target namespaces. You can define multiple namespaces, but use only one target namespace. You might do this if some components use other components that are not directly exposed as MXML tags. You cannot then directly access the components in the unused namespace, however.

The following command line example defines two namespaces, http://acme2006 and http://mynamespace, but only includes one as a namespace target:

```
compc -source-path .
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MyButtons.swc
    -namespace http://acme2006AcmeManifest.xml
    -namespace http://mynamespace SimpleManifest.xml
    -include-namespaces http://mynamespace
```

Adding utility classes

You can add any classes that you want to use in your Flex applications to a SWC file. These classes do not have to be components, but are often files that components use. They are classes that might be used at run time and, therefore, are not checked by the compiler. For example, your components might use a library of classes that perform mathematical functions, or use a custom logging utility. This documentation refers to these classes as *utility classes*. Utility classes are not exposed as MXML tags.

To add utility classes to a SWC file, you use the `include-sources` option. This option lets you specify a path to a class file rather than the class name, or specify an entire directory of classes.

The following command-line example adds the FV_calc.as and FV_format.as utility classes to the SWC file:

```
compc -source-path .
    -output c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MySwc.swc
    -include-sources FV_classes/FV_format.as FV_classes/FV_calc.as
    -include-classes asbutton.MyButton
```

In a configuration file, these options appear as the following example shows:

```
<compiler>
    <source-path>
        <path-element>.</path-element>
    </source-path>
    <output>c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/MySwc.swc</output>
</compiler>
<include-classes>
    <class>asbutton.MyButton</class>
</include-classes>
<include-sources>
    <path-element>FV_classes/FV_format.as</path-element>
    <path-element>FV_classes/FV_calc.as</path-element>
<include-sources>
```

When specifying files with the `include-sources` option, you must give the full filename (for example, FV_calc.as instead of FV_calc) because the file is not a component.

You can also provide a directory name to the `include-sources` option. In this case, the compiler includes all files with an MXML or AS extension, and ignores all other files.

Classes that you add with the `include-sources` option can be accessed from the generic namespace in your Flex applications. To use them, you need to add the following code in your Flex application tag:

```
xmlns:local="*"
```

You can then use them as tags; for example:

```
<local:FV_calc id="calc" rate=".0125" nper="12" pmt="100" pv="0" type="1"/>
```

Adding nonsource classes

You often include noncompiled (or nonsource) files with your applications. A *nonsource* file is a class or resource (such as a style sheet or graphic) that is not compiled but is included in the SWC file for other classes to use. For example, a font file that you embed or a set of images that you use as graphical skins in a component's style sheet should not be compiled but should be included in the SWC file. These are classes that you typically do not use the `[Embed]` syntax to link in to your application.

Use the `include-file` option to define nonsource files in a SWC file.

The syntax for the `include-file` option is as follows:

```
-include-file name path
```

The *`name`* argument is the name used to reference the embedded file in your Flex applications. The *`path`* argument is the current path to the file in the file system.

When you use the `include-file` option, you specify both a name and a filepath, as the following example shows:

```
compc -include-file logo.gif c:/images/logo/logo1.gif ...
```

In a configuration file, these options appear as the following example shows:

```
<compiler>
    <output>c:/jrun4/servers/flex2/flex/WEB-INF/flex/user_classes/Combo.swc</output>
</compiler>
<include-file>
    <name>logo.gif</name>
    <path>c:/images/logo/logo1.gif</path>
</include-file>
<include-classes>
    <class>asbutton.MyButton</class>
<include-classes>
```

Each name that you assign to a resource must be unique because the name becomes a global variable.

You cannot specify a list of files with the `include-file` option. So, you must add a separate `include-file` option for each file that you include, as the following command-line example shows:

```
compc -include-file file1.jpg ../images/file1.jpg -include-file file2.jpg
../images/file2.jpg -- -output MyFile.swc
```

If you want to add many resources to the SWC file, consider using a configuration file rather than listing all the resources on the command line. For an example of a configuration file that includes multiple resources in a SWC file, see "Using Styles and Themes" on page 589 in *Adobe Flex 3 Developer Guide*.

In general, specify a file extension for files that you include with the `include-file` option. In some cases, omitting the file extension can lead to a loss of functionality. For example, if you include a CSS file in a theme SWC file, you must set the name to be *.css. When Flex examines the SWC file, it applies all CSS files in that SWC file to the application. CSS files without the CSS extension are ignored.

Creating themes

You can use the `include-file` and `include-classes` options to add skin files and style sheets to a SWC file. The SWC file can then be used as a theme. For more information about using themes in Flex applications, see "Using Styles and Themes" on page 589 in *Adobe Flex 3 Developer Guide*.

Viewing errors and warnings

You can use the compiler options to specify what level of warnings and errors to view. Also, you can set levels of logging with the compiler options.

Viewing warnings and errors

There are several options that let you customize the level of warnings and errors that are displayed by the Flex compilers, including the following:

- `show-binding-warnings`
- `show-actionscript-warnings`
- `show-shadowed-device-font-warnings`
- `strict`
- `warnings`

To disable all warnings, set the `warnings` option to `false`.

The `show-actionscript-warnings` option displays compiler warnings for the following situations:

1 Situations that are probably not what the developer intended, but are still legal; for example:

```
if (a = 10)                 // Did you really want '==' instead of '='?
if (b == NaN)               // Any comparison with NaN is always false.
var b;                      // Missing type declaration.
```

- Usage of deprecated or removed ActionScript 2.0 APIs.
- Situations where APIs behave differently in ActionScript 2.0 than in ActionScript 3.0.

You can customize the types of warnings displayed by using options that begin with *warn* (for example, `warn-constructor-return-values` and `warn-bad-type-cast`). A complete list of warnings are available in the advanced command-line help or in the flex-config.xml file.

The `strict` option enforces typing and reports run-time verifier errors at compile time. This option assumes that definitions are not dynamically redefined at run time, so these checks can be made at compile time. It displays errors for conditions such as undefined references, const and private violations, argument mismatches, and type checking.

The `show-binding-warnings` option displays warnings when Flash Player cannot detect changes to bound properties.

About deprecation

The command-line compilers express deprecation warnings by default. In some cases, Flex functionality has been deprecated. Deprecated features and properties have the following characteristics:

- Generate compilation warnings that Flex displays in the HTML wrapper for the application.
- Continue to work in Flex 2 and 2.0.1.
- Will be removed from the product in a future major release.

You can suppress deprecation warnings by setting the `show-deprecated-warnings` option to `false`.

There is a `[Deprecated]` metadata tag that you can use to deprecate your own classes and class elements. For more information, see “Deprecated metadata tag” on page 41 in *Creating and Extending Adobe Flex 3 Components*.

About logging

Errors and warnings are reported differently, depending on which compiler you are using.

The mxmlc and compc command-line compilers send error and warning messages to the standard output. You can redirect this output by using the redirector (>).

Flex Builder displays error and warning messages in the Problems tab.

The web-tier compiler displays error and warning messages in the requesting browser by default. The web-tier compiler also stores error and warning messages in a log file. For more information on configuring logging for the web-tier compiler, see “Using the web-tier compiler log files” on page 351.

About SWC files

A *SWC* file is an archive file, sometimes also referred to as a class library, for Flex components and other assets. SWC files contain a SWF file and a catalog.xml file, in addition to properties files and other uncompiled assets such as CSS files. The SWF file implements the compiled component or group of components and includes embedded resources as symbols. Flex applications extract the SWF file from a SWC file and use the SWF file's contents when the application refers to resources in that SWC file. The catalog.xml file lists of the contents of the component package and its individual components.

In most cases, the symbols defined in the SWF file that are referenced by the application are embedded in the Flex application at compile-time. This is known as static linking. The application compiler only includes those classes that are used by your application, and dependent classes, in the final SWF file.

You can also dynamically link the contents of SWC files. Dynamic linking is when the entire SWF file is loaded at run time. To achieve dynamic linking of the SWF file, you must use the SWC file as a Runtime Shared Library, or RSL. For more information, see "Using Runtime Shared Libraries" on page 195.

SWC files make it easy to exchange components and other assets among Flex developers. You need only exchange a single file, rather than the MXML or ActionScript files and images and other resource files. The SWF file in a SWC file is compiled, which means that the code is loaded efficiently and it is hidden from casual view. Also, compiling a component as a SWC file can make namespace allocation an easier process.

You can package and expand SWC files with tools that support the PKZip archive format, such as WinZip or jar. However, do not manually change the contents of a SWC file, and do not try to run the SWF file that is in a SWC file in Flash Player.

You typically create SWC files by using compc, the command-line component compiler. You can also save SWC files as open directories rather than archived files. This give you easier access to the contents of the SWC file. You create an open directory SWC by setting the `directory` option to `true`. This is typically only used when you create an RSL because RSLs require that you deploy the SWF file with your application.

The properties files inside SWC files are uncompiled text files in UTF-8 format. They are used as resource bundles for localization of Flex applications. Within the SWC file, they are stored in the /locale/*locale_string* directory, where `locale_string` is something like en_US or fr_FR. For more information, see "Localizing Flex Applications" on page 1101 in *Adobe Flex 3 Developer Guide*.

Distributing SWC files

After you generate a SWC file, you can use it in your Flex applications.

You can also copy SWC files to a directory specified by the `library-path` compiler option. You must store SWC files at the top level of the user_classes directory or the directory specified by the `library-path`. You cannot store SWC files in subdirectories.

To use a SWC file when compiling components or applications from the command line or from within Flex Builder, you specify the location of the SWC file with the `library-path` compiler option.

Note: *Do not store custom components or classes in the flex_root/WEB-INF/flex/libs directory. This directory is for Adobe classes and components.*

Using components in SWC files

If a component in a SWC file does not have a namespace, you can add a generic namespace identifier in your `<mx:Application>` tag to use the component, as the following example shows:

```
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" xmlns:a="*">
```

If the component has a package name as part of its namespace, you must do one of the following:

1 Add the package name to the namespace declaration in the `<mx:Application>` tag; for example:

```
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" xmlns:but="mycomponents.*">
```

2 Create a manifest file and recompile the SWC file. You pass the manifest file to the compc compiler by using the `namespace` option. In the `<mx:Application>` tag, you specify only the unique namespace URI that you used with compc. For more information on specifying a namespace for the component, see “Compiling components using namespaces” on page 167.

About manifest files

Manifest files map a component namespace to class names. They define the package names that the components used before being compiled into a SWC file. They are not required when compiling SWC files, but they can help keep your source files organized.

Manifest files use the following syntax:

```
<?xml version="1.0"?>
<componentPackage>
    <component id="component_name" class="component_class"/>
    [...]
</componentPackage>
```

For example:

```
<?xml version="1.0"?>
<componentPackage>
    <component id="MyButton" class="package1.MyButton"/>
    <component id="MyOtherButton" class="package2.MyOtherButton"/>
</componentPackage>
```

In a manifest file, the `id` property of each `<component>` tag must be unique. It is the name you use for the tag in your Flex applications. For example, you define the `id` as `MyButton` in the manifest file:

```
<component id="MyButton" class="asbutton.MyButton"/>
```

In your Flex application, you use `MyButton` as the tag name:

```
<local:MyButton label="Click Me"/>
```

The `id` property in the manifest file entry is optional. If you omit it, you can use the class name as the tag. This is useful if you have two classes with the same name in different packages. In this case, you use the manifest to define the tags, as the following example shows:

```
<?xml version="1.0"?>
<componentPackage>
    <component id="BoringButton" class="boring.MyButton"/>
    <component id="GreatButton" class="great.MyButton"/>
</componentPackage>
```

Some SWC files consist of multiple components from different packages, so compc includes a manifest file with your SWC file in those cases to prevent compiler errors.

When compiling the SWC file, you specify the manifest file by using the `namespace` and the `include-namespaces` options. You define the namespace and its contents with the namespace option:

```
-namespace http://mynamespace mymanifest.xml
```

Then you identify that namespace's contents for inclusion in the SWC file:

```
-include-namespaces http://mynamespace
```

Using fcsh, the Flex compiler shell

The fcsh (Flex Compiler Shell) utility provides a shell environment that you use to compile Flex applications, modules, and component libraries. It works very similarly to the mxmlc and compc command line compilers, but it compiles faster than the mxmlc and compc command-line compilers. One reason is that by keeping everything in memory, fcsh eliminates the overhead of launching the JVM and loading the compiler classes. Another reason is that compilation results (for example, type information) can be kept in memory for subsequent compilations.

This utility is intended to improve the experience of users of the command-line compilers. If you are using Flex Builder, you do not need to use fcsh. The Flex Builder tool already uses the optimizations provided by fcsh.

For simple applications, fcsh might not be necessary. But for more complex applications that you compile frequently, you should experience a significant performance improvement over using the mxmlc and compc command-line compilers.

When you first compile an application with fcsh, you will not typically notice any difference in speed between the fcsh and the command-line compilers. This is because fcsh must load the application model and custom libraries into memory, just as the command-line compilers would. After that, however, each subsequent compilation uses the libraries in memory to compile. This reduces the amount of disk access that the compilers need to perform and should result in shorter compile times.

The fcsh tool is in the bin directory. For Unix and Mac OS, it is a shell script called fcsh. For Windows, it is fcsh.exe. You invoke it only from the command line. The Java settings are managed by the jvm.config file in the bin directory.

Using fcsh

You invoke fcsh from the command line. You can launch the utility either as an executable (Windows) or shell command (Unix/Linux/Mac).

1 Open a command prompt.

2 Navigate to the {*SDK_root*}/bin directory.

3 Enter `fcsh` at the command line. Your commands will now be executed within the fcsh environment. You will know this if the (fcsh).

Typically, you compile a simple application when you first launch fcsh; for example:

```
(fcsh) mxmlc c:/myfiles/MyApp.mxml
```

The fcsh utility returns a target id:

```
fcsh: Assigned 1 as the compile target id.
```

You then refer to the target ids when using subsequent commands inside the fcsh utility. For example, to compile the application with incremental compilation:

```
(fcsh) compile 1
```

You can enter `help` in the fcsh shell to see a list of available options; for example:

```
(fcsh) help
```

You can enter `quit` in the fcsh shell to exit fcsh and return to the command prompt; for example:

```
(fcsh) quit
```

The following example shows that fcsh dramatically reduces compilation time when compiling the same application multiple times:

```
(fcsh) mxmlc -benchmark=true flexstore.mxml
    Total time: 8885ms
    Peak memory usage: 84 MB (Heap: 58, Non-Heap: 26)
(fcsh) mxmlc -benchmark=true flexstore.mxml
    Total time: 5140ms
    Peak memory usage: 84 MB (Heap: 57, Non-Heap: 27)
```

Then, the second full compilation of the same application is much faster:

```
> touch flexstore.mxml

(fcsh) compile 1
    Files changed: 1 Files affected: 0
    Total time: 933ms
    Peak memory usage: 88 MB (Heap: 62, Non-Heap: 26)
    flexstore.swf (522456 bytes)
    Total time: 1102ms
    Peak memory usage: 77 MB (Heap: 51, Non-Heap: 26)
(fcsh)
```

About fcsh options

The following table describes the available fcsh options:

Option	Description
`clear [`*id*`]`	Removes the target id(s) from memory but saves the target's *.cache file. If you enter this command without specifying an id argument, fcsh clears all target ids. For information about cache files, see "About incremental compilation" on page 157.
`compile` *id*	Uses incremental compilation (without linking) to compile the specified id. If you try to compile a target that has not changed, fcsh skips that target.
`compc` *arg1* `[...]`	Compiles SWC files from the specified sources. This command returns a target id that you can then pass to other fcsh options. The target ids are incremented by 1 for each new compilation. If you quit fcsh and then relaunch it, all targets are cleared and the ids start at 1 again.
`info [`*id*`]`	Displays compiler target information such as the source files and cache file name. If you do not specify a target id, fcsh prints information for all targets in reverse id order.

Option	Description
`mxmlc` *arg1* `[...]`	Compiles and optimizes the target Flex application or module using the mxmlc command-line compiler. This command returns a target id that you can then pass to other fcsh options. The target ids are incremented by 1 for each new compilation. If you quit fcsh and then relaunch it, all targets are cleared and the ids start at 1 again.
`quit`	Exits the fcsh utility. All data stored in memory is destroyed. When you relaunch fcsh, you cannot access any targets that you created in a previous session.

Chapter 9: Using Flex Ant Tasks

The Adobe® Flex® Ant tasks provide a convenient way to build your Flex projects using an industry-standard build management tool. If you are already using Ant projects to build Flex applications, you can use the Flex Ant tasks to replace your `exec` or `java` commands that invoke the mxmlc and compc compilers. If you are not yet using Ant to build your Flex applications, you can take advantage of these custom tasks to quickly and easily set up complex build processes for your Flex applications.

The Flex Ant tasks feature includes two compiler tasks, `mxmlc` and `compc`. You can use these to compile Flex applications, modules, and component libraries. In addition, the Flex Ant tasks include the `html-wrapper` task that lets you generate custom HTML wrappers and the supporting files for those wrappers.

The `mxmlc` and `compc` Flex Ant tasks extend the `java` Ant task. As a result, you can use all the available attributes of the `java` Ant task in those Flex Ant tasks. This includes `fork`, `maxmemory`, and `classpath`.

For more information on using Ant, see the Ant project web site at http://ant.apache.org.

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Installation

Installing the Flex Ant tasks is a simple process. You copy a single JAR file from the Flex SDK ant directory to a target directory. For Adobe® Flex® Builder™, the Flex Ant directory is located at *flex_builder_install*/sdks/3.0.0/ant. For the SDK, the ant directory is located at *sdk_install*/ant.

Copy the *flex_ant*/lib/flexTasks.jar file to Ant's lib directory ({*ant_root*}/lib). If you do not copy this file to the lib directory, you must specify it by using Ant's `-lib` option on the command line when you make a project.

The Flex Ant directory also includes the source code for the Flex Ant tasks.

Using Flex Ant tasks

You can use the Flex Ant tasks in your existing projects or create new Ant projects that use them. There are three tasks that you can use in your Ant projects:

- `mxmlc` — Invokes the application compiler. You use this compiler to compile Flex applications, modules, resource modules, and CSS SWF files.
- `compc` — Invokes the component compiler. You use this compiler to compile SWC files and Runtime Shared Libraries (RSLs).
- `html-wrapper` — Generates the HTML wrapper and supporting files for your Flex application. By using this task, you can select the type of wrapper (with and without deep linking support, with and without express install, and with and without player detection), as well as specify application settings such as the height, width, and background color.

To use the custom Flex Ant tasks in your Ant projects, you must add the flexTasks.jar file to your project's lib directory, and then point to that JAR file in the `taskdef` task. A `taskdef` task adds a new set of task definitions to your current project. You use it to add task definitions that are not part of the default Ant installation. In this case, you use the `taskdef` task to add the `mxmlc`, `compc`, and `html-wrapper` task definitions to your Ant installation. In addition, for most projects you set the value of the `FLEX_HOME` variable so that Ant can find your flex-config.xml file and so that you can add the frameworks directory to your source path.

Use the Flex tasks in Ant:

1 Add a new `taskdef` task to your project. In this task, specify the flexTasks.tasks file as the resource, and point to the flexTasks.jar file for the classpath. For example:

```
<taskdef resource="flexTasks.tasks"
classpath="${basedir}/flexTasks/lib/flexTasks.jar" />
```

2 Define the `FLEX_HOME` and `APP_ROOT` properties. Use these properties to point to your Flex SDK's root directory and application's root directory. Although not required, creating properties for these directories is a common practice because you will probably use them several times in your Ant tasks, for example:

```
<property name="FLEX_HOME" value="C:/flex/sdk"/>
<property name="APP_ROOT" value="myApps"/>
```

3 Write a target that uses the Flex Ant tasks. The following example defines the `main` target that uses the `mxmlc` task to compile the Main.mxml file:

```
<target name="main">
    <mxmlc file="${APP_ROOT}/Main.mxml" keep-generated-actionscript="true">
        <load-config filename="${FLEX_HOME}/frameworks/flex-config.xml"/>
```

```
        <source-path path-element="${FLEX_HOME}/frameworks"/>
    </mxmlc>
</target>
```

The following shows the complete example:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- mySimpleBuild.xml -->
<project name="My App Builder" basedir=".">
    <taskdef resource="flexTasks.tasks"
        classpath="${basedir}/flexTasks/lib/flexTasks.jar"/>
    <property name="FLEX_HOME" value="C:/flex/sdk"/>
    <property name="APP_ROOT" value="myApp"/>
    <target name="main">
        <mxmlc file="${APP_ROOT}/Main.mxml" keep-generated-actionscript="true">
            <load-config filename="${FLEX_HOME}/frameworks/flex-config.xml"/>
            <source-path path-element="${FLEX_HOME}/frameworks"/>
        </mxmlc>
    </target>
</project>
```

This example shows how to use different types of options for the `mxmlc` task. You can specify the value of the `keep-generated-actionscript` option as an attribute of the `mxmlc` task's tag because it does not take any child tags. To specify the values of the `load-config` and `source-path` options, you create child tags of the `mxmlc` task's tag. For more information on using options, see "Working with compiler options" on page 184.

4 Execute the Ant project, as shown in the following example:

```
> ant -buildfile mySimpleBuild.xml main
```

If you did not copy the flexTasks.jar file to Ant's lib directory as described in "Installation" on page 181, you must include the JAR file by using Ant's `-lib` option. For example:

```
> ant -lib c:/ant/lib/flexTasks.jar -buildfile mySimpleBuild.xml main
```

The output of these commands should be similar to the following:

```
Buildfile: mySimpleBuild.xml
main:
    [mxmlc] Loading configuration file C:\flex\sdk\frameworks\flex-config.xml
    [mxmlc] C:\myfiles\flex2\ant_tests\apps\Main.swf (150035 bytes)
BUILD SUCCESSFUL
Total time: 10 seconds
>
```

Working with compiler options

The compc and mxmlc compilers share a very similar set of options. As a result, the behavior of the `mxmlc` and `compc` Ant tasks are similar as well. T

You can specify options for the `mxmlc` and `compc` Flex tasks in a number of ways:

- Task attributes
- Single argument options
- Multiple argument options
- Nested elements
- Implicit FileSets

Task attributes

The simplest method of specifying options for the Flex Ant tasks is to specify the name and value of command-line options as a task attribute. In the following example, the `file` and `keep-generated-actionscript` options are specified as attributes of the `mxmlc` task:

```
<mxmlc file="${APP_ROOT}/Main.mxml" keep-generated-actionscript="true">
```

Many mxmlc and compc options have aliases (alternative shorter names). The Flex Ant tasks support all documented aliases for these options.

Single argument options

Many compiler options specify the value of a single parameter. For example, the `load-config` option takes a parameter named `filename`. You set these types of options by including an attribute in the task element whose name is the option name and whose value is the value of the option.

The following example sets the values of the `load-config` and `source-path` options:

```
<mxmlc ... >
    <load-config filename="${FLEX_HOME}/frameworks/flex-config.xml"/>
    <source-path path-element="${FLEX_HOME}/frameworks"/>
</mxmlc>
```

The `source-path` option can take more than one `path-element` parameter. For more information, see “Repeatable options” on page 185.

Multiple argument options

Some compiler options, such as the `default-size` option, take more than one argument. The `default-size` option takes a `height` and a `width` argument. You set the values of options that take multiple arguments by using a nested element of the same name, with the attributes of the element corresponding to the arguments of the option as shown in the command-line compiler's online help.

For example, the online help for mxmlc shows the following syntax for the `default-size` option:

```
-default-size <width> <height>
```

To pass the option `-default-size 800 600` to the `mxmlc` task, use the following syntax:

```
<mxmlc ...>
    <default-size width="800" height="600"/>
</mxmlc>
```

Repeatable options

Some compiler options are repeatable. The online help shows their arguments in square brackets, followed by a bracketed ellipses, like this:

```
-compiler.source-path [path-element] [...]
```

You set the value of repeatable options by using multiple nested elements of the same name as the option, along with attributes of the same name as they appear in the online help.

The following example sets two values for the `compiler.source-path` option:

```
<mxmlc ...>
    <compiler.source-path path-element="src"/>
    <compiler.source-path path-element="../bar/src"/>
</mxmlc>
```

Nested elements

In some situations, options that are closely related are grouped together in a nested element of the main task element. For example, the command-line compiler options with the `compiler.fonts` and `metadata` prefixes can be grouped into nested elements. The `compiler.fonts` options use the element name `fonts` and the `metadata` options use the element name `metadata`.

The following example shows how to use the `metadata` nested element:

```
<mxmlc ...>
    <metadata description="foo app">
        <contributor name="Joe" />
        <contributor name="Nick" />
    </metadata>
</mxmlc>
```

In this example, you drop the `metadata` prefix when setting the `description` and `contributor` options as a nested element.

This is a uniformly applied rule with one exception: the `compiler.fonts.languages.language-range` option is set using a nested element with the name `language-range`, rather than `languages.language-range`.

Implicit FileSets

There are many examples in the Apache Ant project where tasks behave as implicit FileSets. For example, the `delete` task, while supporting additional attributes, supports all of the attributes (such as `dir` and `includes`) and nested elements (such as `include` and `exclude`) of a FileSet to specific the files to be deleted.

Some Flex Ant tasks allow nested attributes that are implicit FileSets. These nested attributes support all the attributes and nested elements of an Ant FileSet while adding additional functionality. These elements are usually used to specify repeatable arguments that take a filename as an argument.

The following example uses the implicit FileSet syntax with the `include-sources` nested element:

```
<include-sources dir="player/avmplus/core" includes="builtin.as, Date.as, Error.as,
Math.as, RegExp.as, XML.as"/>
```

When a nested element in a Flex Ant task is an implicit FileSet, it supports one additional attribute: `append`. The reason for this is that some repeatable options for the Flex compilers have default values. When setting these options in a command line, you can append new values to the default value of the option, or replace the default value with the specified values. Setting the `append` value to `true` adds the new option to the list of existing options. Setting the `append` value to `false` replaces the existing options with the new option. By default, the value of the `append` attribute is `false` in implicit FileSets.

The following example sets the value of the `append` attribute to `true` and uses the Ant `include` element of an implicit FileSet to add multiple SWC files to the `include-libraries` option:

```
<compiler.include-libraries dir="${swf.output}" append="true">
    <include name="MyComponents.swc" />
    <include name="AcmeComponents.swc" />
    <include name="DharmaComponents.swc" />
</compiler.include-libraries>
```

The following options are implemented as implicit FileSets:

```
compiler.external-library-path
compiler.include-libraries
compiler.library-path
compiler.theme
compiler.include-sources (compc only)
```

The Flex Ant task's implicit FileSets are also different from the Ant project's implicit FileSets in that they support being empty, as in the following example:

```
<external-library-path/>
```

This is equivalent to using `external-library-path=` on the command line.

Using the mxmlc task

You use the `mxmlc` Flex Ant task to compile applications, modules, resource modules, and Cascading Style Sheets (CSS) SWF files. This task supports most mxmlc command-line compiler options, including aliases.

For more information on using the mxmlc command-line compiler, see "Using mxmlc, the application compiler" on page 139.

Required attributes

The `mxmlc` task requires the `file` attribute. The `file` attribute specifies the MXML file to compile. This attribute does not have a command-line equivalent because it is the default option on the command line.

Unsupported options

The following mxmlc command-line compiler options are not supported by the `mxmlc` task:

- `help`
- `version`

Example

The following example `mxmlc` task explicitly defines the `source-path` and `library-path` options, in addition to other properties such as `incremental` and `keep-generated-actionscript`. This example also specifies an output location for the resulting SWF file. This example defines two targets: main and clean. The main target compiles the Main.mxml file into a SWF file. The clean target deletes the output of the main target.

```
<?xml version="1.0" encoding="utf-8"?>
<!-- myMXMLCBuild.xml -->
<project name="My App Builder" basedir=".">
    <taskdef resource="flexTasks.tasks"
classpath="${basedir}/flexTasks/lib/flexTasks.jar" />
    <property name="FLEX_HOME" value="C:/flex/sdk"/>
    <property name="APP_ROOT" value="apps"/>
    <property name="DEPLOY_DIR" value="c:/jrun4/servers/default/default-war"/>
    <target name="main">
        <mxmlc
            file="${APP_ROOT}/Main.mxml"
            output="${DEPLOY_DIR}/Main.swf"
            actionscript-file-encoding="UTF-8"
            keep-generated-actionscript="true"
            incremental="true"
        >
            <!-- Get default compiler options. -->
            <load-config filename="${FLEX_HOME}/frameworks/flex-config.xml"/>

            <!-- List of path elements that form the roots of ActionScript
            class hierarchies. -->
            <source-path path-element="${FLEX_HOME}/frameworks"/>

            <!-- List of SWC files or directories that contain SWC files. -->
            <compiler.library-path dir="${FLEX_HOME}/frameworks" append="true">
                <include name="libs" />
                <include name="../bundles/{locale}" />
            </compiler.library-path>

            <!-- Set size of output SWF file. -->
            <default-size width="500" height="600" />
        </mxmlc>
    </target>
    <target name="clean">
        <delete dir="${APP_ROOT}/generated"/>
        <delete>
            <fileset dir="${DEPLOY_DIR}" includes="Main.swf"/>
        </delete>
    </target>
</project>
```

Using the compc task

You use the `compc` Flex Ant task to compile component SWC files. This task supports most compc command-line compiler options, including aliases. For more information on using the compc command-line compiler, see "Using compc, the component compiler" on page 161.

Required attributes

The only required attribute for the `compc` task is the `output` attribute, which specifies the name of the SWC file that the `compc` task creates.

Special attributes

The `include-classes` attribute takes a space-delimited list of class names. For example:

```
<compc include-classes="custom.MyPanel custom.MyButton" ... >
    ...
</compc>
```

When using the `include-resource-bundles` attribute, you should not specify them as a comma or space-delimited list in a single entry. Instead, add a separate nested tag for each resource bundle that you want to include, as the following example shows:

```
<compc output="${swf.output}/compc_rb.swc" locale="en_US">
    <include-resource-bundles bundle="ErrorLog"/>
    <include-resource-bundles bundle="LabelResource"/>
    <sp path-element="locale/{locale}" />
</compc>
```

Unsupported options

The following compc command-line compiler options are not supported by the `compc` task:

- `help`
- `version`

Example

The following example `compc` task builds a new SWC file that contains two custom components and other assets. The components are added to the SWC file by using the `include-classes` attribute. The source files for the components are in a subdirectory called components. The other assets, including four images and a CSS file, are added to the SWC file by using the `include-file` element. This example defines two targets: main and clean. The main target compiles the MyComps.swc file. The clean target deletes the output of the main target.

```
<?xml version="1.0" encoding="utf-8"?>
<project name="My Component Builder" basedir=".">
    <taskdef resource="flexTasks.tasks"
classpath="${basedir}/flexTasks/lib/flexTasks.jar" />
    <property name="FLEX_HOME" value="C:/flex/sdk"/>
    <property name="DEPLOY_DIR" value="c:/jrun4/servers/default/default-war"/>
    <property name="COMPONENT_ROOT" value="components"/>
    <target name="main">
        <compc
            output="${DEPLOY_DIR}/MyComps.swc"
            include-classes="custom.MyButton custom.MyLabel">
            <source-path path-element="${basedir}/components"/>
            <include-file name="f1-1.jpg" path="assets/images/f1-1.jpg"/>
            <include-file name="f1-2.jpg" path="assets/images/f1-2.jpg"/>
            <include-file name="f1-3.jpg" path="assets/images/f1-3.jpg"/>
            <include-file name="f1-4.jpg" path="assets/images/f1-4.jpg"/>
            <include-file name="main.css" path="assets/css/main.css"/>
        </compc>
    </target>
    <target name="clean">
        <delete>
            <fileset dir="${DEPLOY_DIR}" includes="MyComps.swc"/>
        </delete>
    </target>
</project>
```

Using the html-wrapper task

The `html-wrapper` Flex Ant task generates files that you deploy with your Flex applications. In its simplest form, an HTML wrapper consists of an `<object>` and an `<embed>` tag that embed the SWF file in an HTML page.

The `html-wrapper` task outputs the index.html and AC_OETags.js files for your Flex application. If you enable deep linking support, the `html-wrapper` task also outputs the deep linking files such as historyFrame.html, history.css, and history.js. If you enable express installation, the `html-wrapper` task also outputs the playerProductInstall.swf file.

You typically deploy these files, along with your application's SWF file, to a web server. Users request the HTML wrapper, which embeds the SWF file. You can customize the output of the wrapper and its supporting files after it is generated by Ant.

For more information on the HTML wrapper, see "Creating a Wrapper" on page 311.

About the templates

There are six types of HTML wrapper templates that you can generate with the `html-wrapper` Flex Ant task:

- Client-side detection only — Provides scripts that detect the version of the client's player and return alternative content if the client's player does not meet the minimum required version.
- Client-side detection with history — Provides the same scripts as those in the client-side-detection template, but adds deep linking support.
- Express installation — Provides scripts that support Express Install.
- Express installation with history — Provides scripts that support Express Install and deep linking support.
- No player detection — Provides a basic wrapper.
- No player detection with history — Provides a basic wrapper with deep linking support.

You determine which template is used by using a combination of the history and template attributes of the `html-wrapper` task.

Supported attributes

The attributes of the `html-wrapper` task correspond to some of the attributes and parameters of the `<object>` and `<embed>` tags in the HTML wrapper. The task also supports some attributes that specify the output location and the type of wrapper to generate. For a complete list of the attributes and parameters of the `<object>` and `<embed>` tags in the HTML wrapper, see "About the object and embed tags" on page 321.

The following table describes the supported attributes of the `html-wrapper` task:

Attribute	Description
`application`	The name of the SWF object in the HTML wrapper. You use this name to refer to the SWF object in JavaScript or when using the ExternalInterface API. This value should not contain any spaces or special characters. This attribute sets the value of the `<embed>` tag's `name` attribute and the `<object>` tag's `id` attribute.
`bgcolor`	Specifies the background color of the application. Use this property to override the background color setting specified in the SWF file. This property does not affect the background color of the HTML page. This attribute sets the value of the `<embed>` tag's `bgcolor` attribute and the `<object>` tag's `bgcolor` parameter. The default value is `white`.
`file`	Sets the file name of the HTML output file. The default value is "index.html".
`height`	Defines the height, in pixels, of the SWF file. Adobe® Flash® Player makes a best guess to determine the height of the application if none is provided. This attribute sets the value of the `<embed>` tag's `height` attribute and the `<object>` tag's `height` attribute. The default value is 400.
`history`	Set to `true` to include deep linking support (also referred to as *history management*) in the HTML wrapper. Set to `false` to exclude deep linking from the wrapper. Use this attribute in combination with the `template` attribute to determine which template is used. The default value is `false`. For more information on deep linking, see "Deep Linking" on page 1065 in *Adobe Flex 3 Developer Guide*.
`output`	Sets the directory that Ant writes the generated files to.
`swf`	Sets the name of the SWF file that the HTML wrapper embeds (for example, Main). Do not include the *.swf extension; the extension is appended to the name for you. This attribute sets the value of the `<embed>` tag's `src` attribute and the `<object>` tag's `movie` parameter. This SWF file does not have to exist when you generate the HTML wrapper. It is used by the `<object>` and `<embed>` tags to point to the location of the SWF file at deployment time.
`template`	The type of template to output. The value of this attribute must be one of the following: • `client-side-detection` • `express-installation` • `no-player-detection` Use this attribute in combination with the `history` attribute to determine which template is used. The default value is `express-installation`.
`title`	Sets the value of the `<title>` tag in the head of the HTML page. The default value is `Flex Application`.
`version-major`	Sets the value of the `requiredMajorVersion` global JavaScript variable in the HTML wrapper. The default value is 9. The value of this attribute only matters if you include version detection in your wrapper by setting the `template` attribute to `express-installation` or `client-side-detection`.
`version-minor`	Sets the value of the `requiredMinorVersion` global JavaScript variable in the HTML wrapper. The default value is 0. The value of this attribute only matters if you include version detection in your wrapper by setting the `template` attribute to `express-installation` or `client-side-detection`.

Attribute	Description
`version-revision`	Sets the value of the `requiredRevision` global JavaScript variable in the HTML wrapper. The default value is 0. The value of this attribute only matters if you include version detection in your wrapper by setting the `template` attribute to `express-installation` or `client-side-detection`.
`width`	Defines the width, in pixels, of the SWF file. Flash Player makes a best guess to determine the width of the application if none is provided. This attribute sets the value of the `<embed>` tag's `width` attribute and the `<object>` tag's `width` attribute. The default value is 400.

Required attributes

The `html-wrapper` task requires the `swf` attribute. In addition, if you specify only the `swf` attribute, the default wrapper will have the following default settings:

```
height="400"
width="400"
template="express-installation"
bgcolor="white"
history="false"
title="Flex Application"
```

Be sure to use only the filename and not the filename and extension when specifying the value of the `swf` attribute. The `html-wrapper` task appends `.swf` to the end of its value.

For example, do this:

```
swf="Main"
```

Do not do this:

```
swf="Main.swf"
```

Unsupported options

You cannot set all the available `<object>` and `<embed>` tag parameters using the `html-wrapper` task. Parameters you cannot set include `quality`, `allowScriptAccess`, `classid`, `pluginspage`, and `type`.

Example

The following example project includes a wrapper target that uses the `html-wrapper` task to generate a wrapper with deep linking and player detection logic. This target also sets the height and width of the SWF file. The project also includes a clean target that deletes all the files generated by the wrapper target.

```
<?xml version="1.0" encoding="utf-8"?>
<!-- myWrapperBuild.xml -->
<project name="My Wrapper Builder" basedir=".">
```

```
    <taskdef resource="flexTasks.tasks" classpath="${basedir}/lib/flexTasks.jar"/>
    <property name="FLEX_HOME" value="C:/flex3/sdk"/>
    <property name="APP_ROOT" value="apps"/>
    <target name="wrapper">
        <html-wrapper
            title="Welcome to My Flex App"
            file="index.html"
            height="300"
            width="400"
            bgcolor="red"
            application="app"
            swf="Main"
            version-major="9"
            version-minor="0"
            version-revision="0"
            history="true"
            template="express-installation"
            output="${APP_ROOT}"/>
    </target>
    <target name="clean">
        <delete>
            <!-- Deletes playerProductInstall.swf -->
            <fileset dir="${APP_ROOT}"
                includes="playerProductInstall.swf"
                defaultexcludes="false"/>
            <!-- Deletes index.html and historyFrame.html -->
            <fileset dir="${APP_ROOT}" includes="*.html" defaultexcludes="false"/>
            <!-- Deletes history.css -->
            <fileset dir="${APP_ROOT}" includes="*.css" defaultexcludes="false"/>
            <!-- Deletes history.js and AC_OETags.js -->
            <fileset dir="${APP_ROOT}" includes="*.js" defaultexcludes="false"/>
        </delete>
    </target>
</project>
```

Chapter 10: Using Runtime Shared Libraries

Adobe® Flex® supports Runtime Shared Libraries (RSLs), which you can configure.

Topics

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Introduction to RSLs

One way to reduce the size of your applications' SWF files is by externalizing shared assets into stand-alone files that can be separately downloaded and cached on the client. These shared assets can be loaded and used by any number of applications at run time, but must be transferred only once to the client. These shared files are known as *Runtime Shared Libraries* or *RSLs*.

If you have multiple applications but those applications share a core set of components or classes, clients can download those assets only once as an RSL rather than once for each application. The RSLs are persisted on the client disk so that they do not need to be transferred across the network a second time. The resulting file size for the applications can be reduced. The benefits increase as the number of applications that use the RSL increases.

Flex applications support the following types of RSLs:

- Standard RSLs — A library of custom classes created by you to use across applications that are in the same domain. Standard RSLs are stored in the browser's cache. For more information, see "About standard RSLs" on page 203.
- Cross-domain RSLs — A library of custom classes, like standard RSLs, with the difference being that they can be loaded by applications in different domains and sub-domains. Cross-domain RSLs are stored in the browser's cache. For more information, see "About cross-domain RSLs" on page 204.
- Framework RSLs — Precompiled libraries of Flex components and framework classes that all applications can share. Framework RSLs are precompiled for you. For more information, see "Using the framework RSLs" on page 216.

You can create your own RSLs from custom libraries. You do this by using either the Adobe® Flex® Builder's™ Build Project option for your Flex Library Project or the compc command-line compiler.

About linking

Understanding linking can help you understand how RSLs work and how you can most benefit from their use. The Flex compilers support static linking and dynamic linking. Static linking is the most common type of linking when compiling a Flex application. However, dynamic linking lets you take advantage of RSLs to achieve a reduction of the final SWF file size and, therefore, a reduction in the application download time.

When you use *static linking*, the compiler includes all referenced classes and their dependencies in the application SWF file. The end result is a larger file that takes longer to download than a dynamically-linked application, but loads and runs quickly because all the code is in the SWF file.

To statically link a library's definitions into your application, you use the `library-path` and `include-libraries` compiler options to specify locations of SWC files.

When you use the `library-path` option, the compiler includes only those classes required at compile time in the SWF file, so the entire contents of a library are not necessarily compiled into the SWF file. The `include-libraries` option includes the entire contents of the library, regardless of which classes are required. You can also use the `source-path` and `includes` options to embed individual classes in your SWF file.

In Flex Builder, you use the Project > Properties > Flex Builder Path > Library Path dialog to add libraries to your project. To statically link a library at compile time, you select Merged Into Code for the library's Link Type. This includes only those classes that are used in the application, so it is the equivalent of the `library-path` compiler option.

If you statically link any part of a library into your application, you cannot use that library as an RSL.

Dynamic linking is when some classes used by an application are left in an external file that is loaded at run time. The result is a smaller SWF file size for the main application, but the application relies on external files that are loaded at run time. Dynamic linking is used by modules, runtime stylesheets, and RSLs.

When you want to use a dynamically-linked library, you instruct the compiler to exclude that library's contents from the application SWF file when you compile the application. You must provide link-checking at compile time even though the classes are not going to be included in the final SWF file. At run time, the application loads the entire library into the application SWF file, which can result in slower startup times and greater memory usage.

You can use the `runtime-shared-library-path` and `runtime-shared-libraries` options to specify the location of dynamically-linked libraries.

You can also use the `external-library-path`, `externs`, or `load-externs` compiler options to specify the files to dynamically link into an application. These options instruct the compiler to exclude classes and libraries from the application, but to check links against them and prepare to load them at run time. The `external-library-path` option specifies SWC files or directories for dynamic linking. The `externs` option specifies individual classes or symbols for dynamic linking. The `load-externs` option specifies an XML file that describes what classes to use for dynamic linking. These options are most often used when externalizing assets from modules so that the module and the application do not contain overlapping class definitions. The `runtime-shared-library-path` option provides all the arguments to use external libraries as RSLs.

In Flex Builder, to use dynamically-linked libraries, you specify either RSL or External as the Link Type in the Library Path dialog for the library.

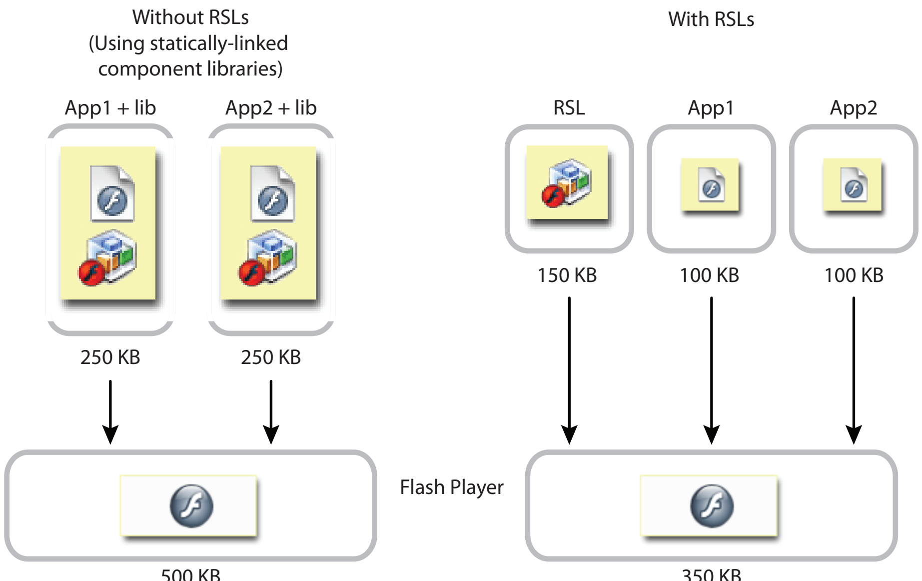
You can view the linking information for your application by using the `link-report` compiler option. This generates a report that has the same syntax as the file that you load with the `load-externs` option, so you can use it as an argument to that option without changing it. For more information about this report, see "Examining linker dependencies" on page 65.

For more general information about the command-line compiler options, see "Using the Flex Compilers" on page 125.

RSL benefits

The following example shows the possible benefit of separating shared components into an RSL. In this example, the library's size is 150 KB (kilobytes) and the compiled application's size is 100 KB. Without RSLs, you merge the library into both applications for an aggregate download size of 500 KB. If you add a third or fourth application, the aggregate download size increases by 250 KB for each additional application.

With RSLs, the RSL needs to be downloaded once only. For two applications that use the same RSL, the result is an aggregate download size of 350 KB, or a 30% reduction. If you add a third or fourth application, the aggregate download size increases by 100 KB instead of 250KB for each additional application. In this example, the benefits of using an RSL increase with each new application.



In this example, the applications with statically-linked libraries run only after Adobe® Flash® Player loads the 250 KB for each application. With dynamically linked RSLs, however, only the first application must load the entire 250 KB (the combined size of the application and the RSL). The second application runs when just 100 KB loads because the RSL is cached.

The illustrated scenario shows one possible outcome. If your applications do not use all of the components in the RSL, the size difference (and, as a result, the savings in download time) might not be as great. Suppose that each application only uses half of the components in the RSL. If you statically link the library, only those classes that are used are included; the output, as a result, is 100 KB + 75 KB for the first application and the library and 100 KB + 75 KB for the second application and the library, or an aggregate download size of 350 KB. When you use a library as an RSL, its entire SWF file must be transferred across the network and loaded by the application at run time, regardless of how much of that library is actually used. In this second case, the combined download size when using RSLs and when not using RSLs is the same.

In general, the more Flex applications that use a common RSL, the greater the benefit.

RSL considerations

RSLs are not necessarily beneficial for all applications. You should try to test both the download time and startup time of your application with and without RSLs.

Standard RSLs can not be shared across domains. If a client runs an application in domain1.com and uses an RSL, and then launches an application in domain2.com that uses the same RSL, the client downloads the RSL twice even though the RSL is the same. You can overcome this limitation of standard RSLs by using cross-domain RSLs.

Cross-domain RSLs can be loaded by any application, even if that application is not in the same domain. They do, however, require that you create and check a digest when the RSL is loaded. This can increase startup time of the application by a small amount.

Framework RSLs can also be loaded by any application. To take advantage of the fact that framework RSLs can be cached in the Player cache, the client must be running a recent version of Flash Player. Not all clients necessarily have the latest Player, so loading a framework RSL might fail. In these cases, you can specify a failover RSL.

An RSL usually increases the startup time of an application. This is because the entire library is loaded into a Flex application regardless of how much of the RSL is actually used. For this reason, make your RSLs as small as possible. This contrasts with how statically-linked libraries are used. When you compile a Flex application, the compiler extracts just the components it needs from those component libraries.

If you have several applications that share several libraries, it might be tempting to merge the libraries into a single library that you use as an RSL. However, if the individual applications generally do not use more than one or two libraries each, the penalty for having to load a single, large RSL might be higher than it would be to have the applications load multiple smaller RSLs.

In this case, test your application with both a single large RSL and multiple smaller RSLs, because the gains are largely application specific. It might be better to build one RSL that has some extra classes than to build two RSLs, if most users will load both of them anyway.

If you have overlapping classes in multiple RSLs, be sure to synchronize the versions so that the wrong class is never loaded.

You cannot use RSLs in ActionScript-only projects if the base class is Sprite or MovieClip. RSLs require that the application's base class, such as Application or SimpleApplication, understand RSL loading.

About caching

RSLs are cached when they are first used. When they are needed by another application, they can be loaded from the cache rather than across the network. Caching is one of the benefits of RSLs, because disk access is much faster than network access.

The type of caching used by an RSL is based on the type of RSL. Standard or cross-domain RSLs are stored in the browser's cache. If the user clears their cache, the RSLs are removed and must be downloaded again the next time they are needed. Unsigned framework RSLs are also stored in the browser's cache.

Signed framework RSLs are stored in the Player cache. This is a special cache that is maintained by Flash Player. To clear this cache, clients must invoke the Settings Manager. RSLs stored in this cache are signed and therefore can be used by any Flex application without the need for a cross-domain policy file.

For more information about the framework cache, see "About the Player cache" on page 218.

Creating libraries

To use standard or cross-domain RSLs, you must first create the library that will be used as an RSL. If you want to use framework RSLs, the libraries are already created for you. In that case, all you need to do is compile against them and then deploy the SWZ or SWF file with your Flex application.

A standard or cross-domain RSL is a library of custom components, classes, and other assets that you create. You can create a library using either Flex Builder or the compc command-line compiler. A library is a SWC file or open directory that contains a library.swf file and a catalog.xml file, as well as properties files and other embedded assets. You can use any library as an RSL, but libraries do not need to be used as RSLs.

Creating libraries in Flex Builder

In Flex Builder, you create a new library by selecting File > New > Flex Library Project. You add resources to a library by using the Flex Library Build Path dialog box. When you select Build Library or Build All, Flex Builder creates a SWC file. This SWC file contains the library.swf file.

Creating libraries on the command line

On the command line, you create a library by using the compc compiler. You add files to a library by using the `include-classes` and `include-namespaces` options when you compile the SWC file.

The following command-line example creates a library called CustomCellRenderer.swc with the compc compiler:

```
compc -source-path ../mycomponents/components/local
    -include-classes CustomCellRendererComponent
    -directory=true
    -debug=false
    -output ../libraries/CustomCellRenderer
```

The options on the command line can also be represented by settings in the flex-config.xml file, as the following example shows:

```
<?xml version="1.0">
<flex-config>
    <compiler>
        <source-path>
            <path-element>../mycomponents/components/local</path-element>
        </source-path>
    </compiler>
    <output>../libraries/CustomCellRenderer</output>
    <directory>true</directory>
    <debug>false</false>
    <include-classes>
        <class>CustomCellRendererComponent</class>
    </include-classes>
</flex-config>
```

All classes and components must be statically linked into the resulting library. When you use the compc compiler to create the library, do not use the `include-file` option to add files to the library, because this option does not statically link files into the library.

Optimizing libraries

Optimizing libraries means to remove debugging and other code from the library prior to deployment. For normal libraries that you are not using as RSLs, you do not need to optimize. This is because you will likely want to debug against the library during development, so you will need the debug code inside the library. And, when you compile the release version of your Flex application, the compiler will exclude debug information as it links the classes from the library.

When you compile a library for production use as an RSL, however, you can set the `debug` compiler option to `false`. The default value is `true` for compc, which means that the compiler, by default, includes extra information in the SWC file to make it debuggable. You should avoid creating a debuggable library that you intend to use in production so that the RSL's files are as small as possible. If you set the value of the `debug` option to `false`, however, you will not be able to debug against the RSL for testing.

If you do include debugging information, you can still optimize the RSL after compiling it, which removes the debugging information as well as unnecessary metadata. For more information, see "Optimizing RSL SWF files" on page 212.

Before you deploy an RSL, you extract the SWF file that is inside the library SWC file and optimize it. The default name of this SWF file is library.swf. After you extract it from the SWC file, you can rename it to anything you want. When you deploy the RSL, you deploy the SWF file so that the application can load it at run time.

On the command line, you typically specify that the output of compiling a library be an open directory rather than a SWC file by using the `directory` option and the `output` option. The output is an open directory that contains the following files:

- catalog.xml
- library.swf

In addition, the library contains properties files and any images or other embedded assets that are used by the library.

If you do not specify that the output be an open directory, you must manually extract the library.swf file from the SWC file with a compression utility, such as PKZip.

In Flex Builder, you can instruct the compiler to automatically extract the SWF file for you when you add the RSL SWC file to the project. Doing this does not optimize the SWF file, so the library will be bigger than if you extract it yourself and optimize it.

To manually extract an RSL SWF file from its SWC file in Flex Builder, add the `output` and `directory` options to the Additional Compiler Arguments field in the Flex Compiler dialog box. In both cases, you specify the deployment location of the SWF file when you add the SWC file to your project as an RSL.

When creating a library, you need to know if you will be using the library as a standard RSL or as a cross-domain RSL. If you are using it as a cross-domain RSL, you must include the digest information in the library. For more information, see "About cross-domain RSLs" on page 204.

After you create the library, you then compile your application against the SWC file and specify the library's SWF file's location for use at run time. For more information, see "Compiling applications with standard and cross-domain RSLs" on page 206.

For more information on using the compc compiler options, see "Using the Flex Compilers" on page 125.

Using standard and cross-domain RSLs

Standard and cross-domain RSLs are RSLs that you create from your custom component libraries. These RSLs are different from signed framework RSLs in that they are unsigned and can only be stored in the browser's cache. They are never stored in the Player cache.

To use standard or cross-domain RSLs, you perform the following tasks:

- **Create a library** An RSL is created from a library of custom classes and other assets. You can create a library with either the Flex Builder Library Project or the compc command-line compiler. You can output the library as a SWC file or an open directory. The library includes a library.swf file and a catalog.xml file; the library.swf file is deployed as the RSL. For more information, see "Creating libraries" on page 200.

- **Compile your application against the library** When you compile your Flex application, you externalize assets from your application that are defined in the RSL. They can then be linked at run time rather than at compile time. You do this when you compile the application by passing the compile-time location of the library SWC file as well as the run-time location of the library's SWF file. For more information, see "Compiling applications with standard and cross-domain RSLs" on page 206.
- **Optimize the RSL** After you generate a library and compile your application against it, you should run the optimizer against the library's SWF file. The optimizer reduces the SWF file by removing debugging code and unneeded metadata from it. While this step is optional, it is best practice to optimize a library SWF file before deploying it. For more information, see "Optimizing RSL SWF files" on page 212.
- **Deploy the RSL** After you have compiled and optionally optimized your RSL, you deploy the library.swf file with your application so that it is accessible at run time. If the RSL is a cross-domain RSL, then you might also be required to deploy a crossdomain.xml file.

About standard RSLs

Standard RSLs can only be used by applications that are in the same domain as the RSL. You can benefit from using standard RSLs if you meet all of the following conditions:

- You host multiple applications in the same domain.
- You have custom component libraries.
- More than one application uses those custom component libraries.

Not all applications can benefit from standard RSLs. Applications that are in different domains or that do not use component libraries will not benefit from standard RSLs.

Standard RSLs can benefit from digests. While they do not require digests, you can use them to ensure that your application loads the latest RSL. For more information, see "About RSL digests" on page 204.

The following is a list of typical applications that can benefit from standard RSLs:

- Large applications that load multiple smaller applications that use a common component library. The top-level application and all the subordinate applications can share components that are stored in a common RSL.
- A family of applications on a server built with a common component library. When the user accesses the first application, they download an application SWF file and the RSL. When they access the second application, they download only the application SWF file (the client has already downloaded the RSL, and the components in the RSL are used by the two applications).
- A single monolithic application that changes frequently, but has a large set of components that rarely change. In this case, the components are downloaded once, while the application itself might be downloaded many times. This might be the case with charting components, where you might have an application that uses you change frequently, but the charting components themselves remain fairly static.

About cross-domain RSLs

Cross-domain RSLs can be used by applications in any domain or sub-domain. The benefits of cross-domain RSLs are the same as standard RSLs, but they are not restricted to being in the same domain as the application that loads them. This lets you use the same RSL in multiple applications that are in different domains.

To use a cross-domain RSL that is located on a remote server, the remote server must have a crossdomain.xml file that allows access from the application's domain. The easiest way to do this is to add a crossdomain.xml file to the server's root. To ensure that applications from any domain can access the RSL SWF file, you can use an open cross-domain.xml file such as the following:

```
<cross-domain-policy>
    <allow-access-from domain="*" to-ports="*"/>
</cross-domain-policy>
```

This is not a best practice, however, because it allows requests from any domain to load the RSL, and other assets, from your server. You should instead restrict requests to only those domains that you trust by narrowing the entries in the `domain` attribute. For more information, see "Using cross-domain policy files" on page 40.

You can store the crossdomain.xml file anywhere on the target server. When you compile a cross-domain RSL, you can specify the location of the crossdomain.xml file, and the application will look to that location to get permission to load the RSL. If you do not specify the location of the crossdomain.xml file when you compile your application, the application looks in the server's root directory by default.

Cross-domain RSLs can fail to load into a Flex application under the following conditions:

- The server on which the RSL is located fails
- The network fails, so remote files cannot be loaded
- The digest of the RSL when the application was compiled does not match the digest of the RSL when it is loaded
- The crossdomain.xml file is absent from the RSL's server

Cross-domain RSLs support a backup mechanism where a failover RSL can be loaded in the case of a server failure. If the server on which the main RSL fails, Flash Player will try to load a failover RSL whose location you specify when you compile the application.

About RSL digests

To ensure that the cross-domain RSL is coming from the trusted party, Flash Player reads the bytes of the incoming RSL and computes a one-way hash, or *digest*. The digest must match the digest that was stored in the application at compile time when the application was linked to the cross-domain RSL. If the RSL's digest matches the known digest, then Flash Player loads the cross-domain RSL. If the digests do not match, Flash Player displays an error message and does not load the RSL.

You can also use digests for standard RSLs. This is useful if you update your RSLs frequently, and want to ensure that the application loads the latest RSL.

To create a digest while compiling a library, you set the `compute-digest` compiler option to `true`. You can set this value in the flex-config.xml file, as the following example shows:

```
<compute-digest>true</compute-digest>
```

The default value of the `compute-digest` option is `true`.

In Flex Builder, to disable digests, you must add the following to the Additional Compiler Arguments field in the Flex Library Compiler dialog box:

```
-compute-digest=false
```

The compiler writes the digest inside the `swc/library/libraries/digests` element of the RSL's catalog.xml file. The following example shows the structure of `digest` elements, which are optional children of the `digests` element in the catalog.xml file:

```
<digests>
    <digest type="SHA-256" signed="true"
        value="d604d909d8d6d358097cf2f4ebf4707faf330469ed6b41dcdc5aaf6f4dd3bea9"   />
    <digest type="SHA-256" signed="false"
        value="d604d909d8d6d358097cf2f4ebf4707faf330469ed6b41dcdc5aaf6f4dd3bea9"   />
</digests>
```

The following table describes the tag and its attributes:

Option	Description
`digest`	Optional child of `digests` element.
`signed`	Whether the library is signed or not. This value is `true` if the digest is of a signed library and `false` otherwise. Only Adobe can create signed libraries. This attribute is required.
`type`	The kind of hash used to create the digest. The only currently-supported value is "SHA-256". This attribute is required.
`value`	The hash of the specified type. This is the digest of the RSL associated with the catalog.xml. This attribute is required.

When you compile your production application with an RSL that uses a digest for verification, set the `verify-digests` compiler option to `true` to indicate that the application must check the digest before using the RSL. The default value of this option is `true`.

If you have multiple RSLs, such as a main RSL plus a failover RSL, the compiler stores multiple digests inside the application.

The Flex compiler uses the SHA-256 digest algorithm from the java.security libraries to generate the digest.

About failover

The failover feature is used for two reasons:

- If the Flash Player is not at least version 9.0.115 and it tries to load a signed RSL, it will attempt to load the failover RSL
- If a network or server failure occurs while loading the main RSL, Flash Player will attempt to load the failover RSL

For framework RSLs, you typically specify a signed RSL as the main RSL, and an unsigned RSL as the failover RSL. When loading an application that uses signed framework RSLs, older versions of Flash Player skip the signed RSL and attempt to load the failover RSL, which is typically an unsigned RSL.

For all RSLs, the failover RSL provides a mechanism to load an RSL if the primary server is unavailable.

You can specify the location of the RSL and a failover RSL in your flex-config.xml file or on the command line as parameters to the `runtime-shared-library-path` option. The default failover RSL is framework_3.0.${build.number}.swf. In Flex Builder, you can add failover RSLs by adding them to the Deployment Paths in the Library Path Item Options dialog box.

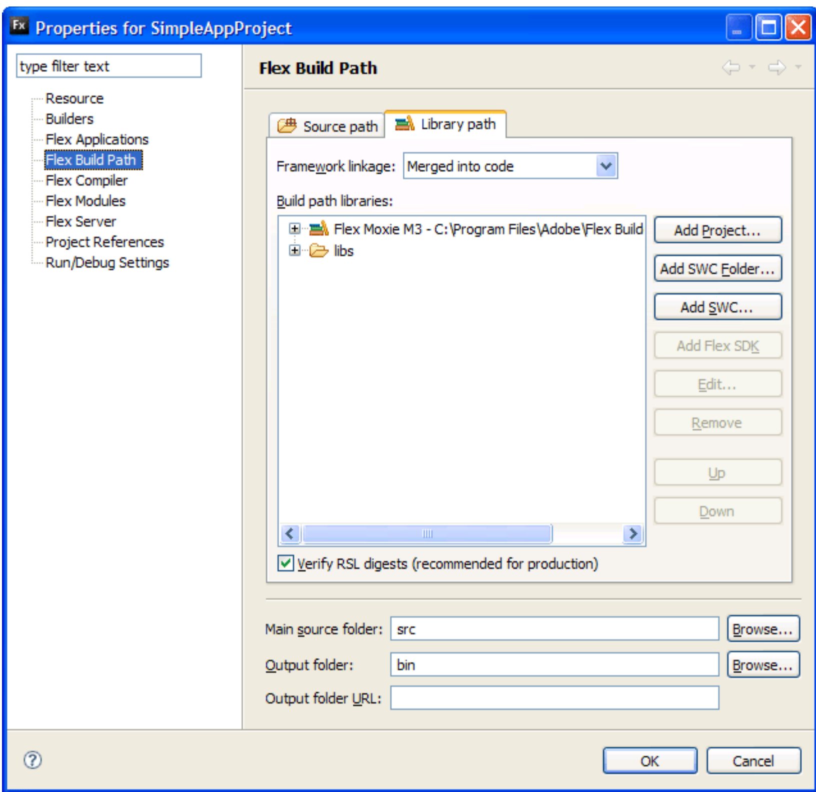
Compiling applications with standard and cross-domain RSLs

Compiling your application with standard or cross-domain RSLs is easier to do in Flex Builder than it is on the command line. Flex Builder can automatically extract the RSL SWF file for you during the compilation process, and use that SWF to compile your application against. If you use the command-line compiler, then you must extract this file from the SWC file yourself prior to deployment. In either case, when you deploy the RSL SWF file, you should optimize it as described in “Optimizing RSL SWF files” on page 212.

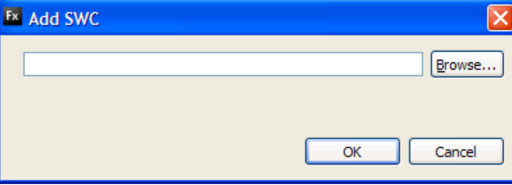
Compile with standard or cross-domain RSLs in Flex Builder

1. Open your Flex application’s project.
2. Select Project > Properties.
3. Select Flex Build Path in the option list. The Flex Build Path settings appear.

4 Select the Library Path tab:



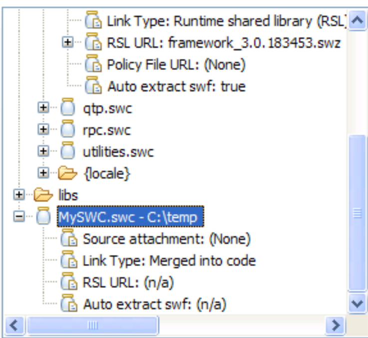
5 Click the Add SWC button. The Add SWC dialog box appears.



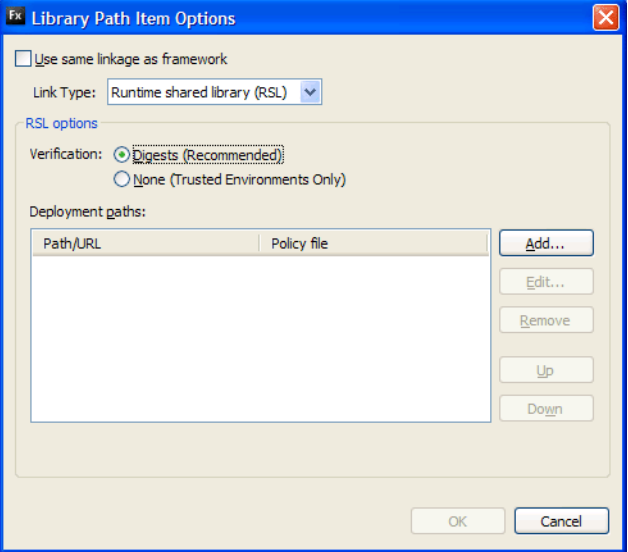
6 Enter the path to the SWC file or click the Browse button to find the SWC file.

7 Click OK to add the SWC file to your project's library path. Flex Builder adds the new SWC file to the list of SWC files in the Library Path tree.

8 Expand the SWC file in the Build Path Libraries tree by clicking the + next to it. The following example shows an expanded SWC named MySWC:

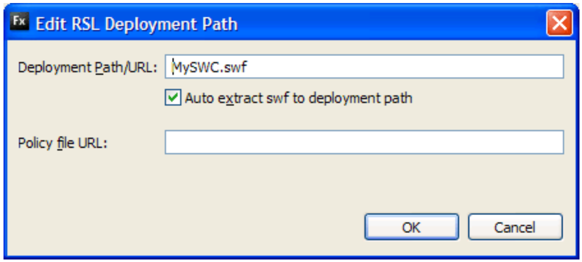


9 Change the Link Type to "Runtime shared library (RSL)". You do this by selecting the Link Type and clicking the Edit button. When you change the Link Type to an RSL, Flex Builder displays additional options in the Library Path Item Options dialog box.



10 For Verification, select Digests if you are using a cross-domain RSL or if you are using a standard RSL that you want to verify at run time with a digest.

Click the Add button to add the deployment path of the RSL SWF file. The Edit RSL Deployment Path dialog box appears.



In the Deployment Path/URL field, enter the location that you will deploy the RSL's SWF file to. This path is relative to the main application's SWF file. The default is to deploy the RSL in the same directory as the main application.

(Cross-domain RSLs only) Add a policy file URL if the application and the RSL will be on separate domains, and the crossdomain.xml file is not at the root of the RSL's server.

You can have Flex Builder extract the RSL's SWF file from the SWC file automatically or you can do it manually. Deselect the Auto Extract swf to Deployment Path option if you want to extract the RSL's SWF file from the SWC file manually. Otherwise, Flex Builder will extract the SWF file for you. In general, you should manually extract the SWF file and optimize it before deploying it. Otherwise, the library.swf file will be larger than necessary. For more information on optimizing the RSL, see "Optimizing RSL SWF files" on page 212.

Click OK to save your changes.

11 Select None for Verification if you are using a standard RSL that does not use a digest. In this case, the RSL is assumed to not be cross-domain, and you therefore cannot specify a policy file URL. This is because standard RSLs must be deployed in the same domain as the main application, so policy files are not necessary. The deployment path of the RSL can also only be a local path that is relative to the location of the main application's SWF file.

12 Click OK to save your Library Path Item Options.

13 If the RSL is a cross-domain RSL, ensure that the Verify RSL Digests option is selected in the Library Path tab. If the RSL is standard and you do not want to use a digest, deselect this option. This option is overridden by the Verification setting in the Library Path Item Options dialog box.

14 Click OK to save your changes to the Flex Build Path settings.

Compile with standard or cross-domain RSLs on the command line

To use standard or cross-domain RSLs in your application on the command line, you use the `runtime-shared-library-path` application compiler option. This option has the following syntax:

```
-runtime-shared-library-path=path-element,rsl-url[,policy-file-url,failover-url,...]
```

The following table describes the `runtime-shared-library-path` arguments:

Argument	Description
`path-element`	Specifies the location of the SWC file or open directory to compile against. For example, c:\flexsdk\frameworks\libs\framework.swc. The compiler provides compile-time link checking by using the library specified by this option. This argument is required.
`rsl-url`	Specifies the location of the RSL SWF file that will be loaded by the application at run time. The compiler does not verify the existence of the SWF file at this location at compile time. It does store this string in the application, however, and uses it at run time. As a result, the SWF file must be available at run time but not necessarily at compile time. You specify the location of the SWF file relative to the deployment location of the application. For example, if you store the library.swf file in the *web_root*/libraries directory on the web server, and the application in the web root, you specify libraries/library.swf for the RSL SWF file. This argument is required. You must know the deployment location of the RSL SWF file relative to the application when you compile it. You do not have to know the deployment structure when you create the library SWC file, though, because components and classes are compiled into a SWC file and can be used by any application at compile time. The value of the `rsl-url` argument can be a relative URL, such as "../libraries/library.swf", or an absolute URL, such as "http://www.mydomain.com/libraries/library.swf". If it is on a different server, it must be a cross-domain or framework RSL. Standard RSLs can only be loaded from the same domain as the application. The default name of the RSL SWF file is library.swf, but you can change it to any name you want after you extract it from the SWC file. If you change it, then you must change the name you specify in the `rsl-url` option.

Argument	Description
`policy-file-url`	Specifies the location of the policy file (crossdomain.xml) that gives permission to load the RSL from the server. For example, http://www.mydomain.com/rsls/crossdomain.xml. This is only necessary if the RSL and the application that uses it are on different domains. If you are serving the application and the RSL SWF file from the same domain, then you do not need to specify a policy file URL. This argument is optional. If you do not provide a value, then Flash Player looks at the root of the target web server for the crossdomain.xml file. For more information on using RSLs in different domains, see "About cross-domain RSLs" on page 204.
`failover-url`	Specifies the location of a secondary RSL if the first RSL cannot be loaded. This is most commonly used to ensure that an unsigned framework RSL will be used if the signed framework RSL fails to load. If the version of Flash Player is earlier than 9.0.115, it cannot load signed RSLs, so it must load an unsigned RSL. While this argument is used primarily to ensure that the framework RSL is loaded, it can also be used by cross-domain RSLs to ensure that a secondary RSL is available in case of network or server failure. This argument is optional. If you specify a second `policy-file-url`, then Flash Player will look to that location for the crossdomain.xml file for the failover RSL.

The following example shows how to use the `runtime-shared-library-path` option when compiling your application on the command line:

```
mxmlc -runtime-shared-library-path=../lib/mylib.swc,../bin/library.swf Main.mxml
```

Do not include spaces between the comma-separated arguments of the `runtime-shared-library-path` option on the command line.

Your Flex application can use any number of RSLs. In Flex Builder, you add a list of RSLs on the Library Path tab. When using the command line, you add additional `runtime-shared-library-path` options. In both cases, the order of the RSLs is significant because base classes must be loaded before the classes that use them.

You can also use a configuration file to use RSLs, as the following example shows:

```
<runtime-shared-library-path>
    <path-element>../lib/mylib.swc</path-element>
    <rsl-url>../bin/library.swf</rsl-url>
</runtime-shared-library-path>
```

In the previous example, the file structure at compile time looks like this:

```
c:/Main.mxml
c:/lib/CustomDataGrid.swc
```

The deployed files are structured like this:

```
web_root/Main.swf
web_root/bin/library.swf
```

If you are using a cross-domain RSL, you can also specify the location of the crossdomain.xml file, and the location of one or more RSLs to be used as a failover RSL. The following example specifies a full URL for the location of the RSL, and the locations of a crossdomain.xml file and failover RSL on the command line:

```
mxmlc -runtime-shared-library-path=
    ../lib/mylib.swc,
    http://www.my-domain.com/rsls/library.swf,
    http://www.my-domain.com/rsls/crossdomain.xml,
    http://www.my-other-domain.com/rsls/library.swf,
    http://www.my-other-domain.com/rsls/crossdomain.xml
    Main.mxml
```

In the configuration file, this would be represented as follows:

```
<runtime-shared-library-path>
    <path-element>../lib/mylib.swc</path-element>
    <rsl-url>http://www.my-domain.com/rsls/library.swf</rsl-url>
    <policy-file-url>http://www.my-domain.com/rsls/crossdomain.xml</rsl-url>
    <rsl-url>http://www.my-other-domain.com/rsls/library.swf</rsl-url>
    <policy-file-url>http://www.my-other-domain.com/rsls/crossdomain.xml</rsl-url>
</runtime-shared-library-path>
```

Toggling RSLs on the command line

When compiling an application that uses RSLs, the command-line compiler options can be unwieldy and difficult to read. It is generally easier to define RSLs in your configuration files. However, when you do that, it is not very easy to enable or disable them as you develop your application because you have to edit the configuration file any time you want to change the way the RSLs are compiled.

To disable the use of RSLs without editing the configuration file, set the value of `static-link-runtime-shared-libraries` to `false`. By doing this, you can toggle the use of RSLs from the command line without having to edit the configuration file or enter long sets of command-line options. The default value of this option is `true`.

While you typically set the value of the `static-link-runtime-shared-libraries` option on the command line, you can also set it in the configuration file. If you set any RSL values on the command line, then the value of the `static-link-runtime-shared-libraries` option in the configuration file is ignored.

Optimizing RSL SWF files

The default SWF file in your SWC files includes debugging code and metadata that increase the file size. The debugging code is necessary for the compiler to run, but is not necessary at run time unless you want to debug the RSL. You can remove the debug code and unnecessary metadata by using the optimizer tool.

If you use the optimizer tool, you must keep track of two separate library files: one for compiling (the larger, pre-optimized one) and one for deploying (the smaller one, optimized one). You compile your main application against the non-optimized library but then deploy the optimized library so that it can be loaded at run time.

The optimizer tool is in the bin directory. For Unix and Mac OS, it is a shell script called optimizer. For Windows, it is optimizer.exe. You invoke it only from the command line. The Java settings are managed by the jvm.config file in the bin directory.

The syntax for the optimizer tool is as follows:

```
optimizer -keep-as3-metadata="Bindable,Managed,ChangeEvent,
NonCommittingChangeEvent,Transient" -input input_swf -output output_swf
```

You must specify the `keep-as3-metadata` option and pass it the required metadata. At a minimum, you should specify the Bindable, Managed, ChangeEvent, NonCommittingChangeEvent, and Transient metadata names. You can also specify custom metadata that you want to remain in the optimized SWF file.

You can specify the configuration file that the optimizer tool uses by using the `load-config` option.

To get help while using the optimizer tool, enter the `-help` option:

```
c:\flex\bin> optimizer -help
```

By default, the optimizer tool saves an optimized version of the SWF file in the current directory, with the name output.swf. This file should be smaller than the library.swf because it does not contain the debugging code.

Use optimized RSLs

1 Create an RSL by compiling a library project in Flex Builder or building a SWC file with the compc command line tool.

2 Compile your main application and reference the RSL.

3 Extract the library.swf file from your RSL's SWC file, if you haven't done so already.

4 Run the optimizer against the library.swf file, for example:

```
c:\bin> optimimzer -keep-as3-metadata="Bindable,Managed,ChangeEvent,
NonCommittingChangeEvent,Transient" -input c:\rsls\library.swf -output
c:\rsls\output\output.swf
```

5 Deploy the optimized library (in this case, output.swf) with the application so that the application uses it at run time.

Example of creating and using a standard and cross-domain RSL

This example walks you through the process of creating a library and then using that library as a standard and a cross-domain RSL with an application. It uses the command-line compilers, but you can apply the same process to create and use RSLs with a Flex Builder project. This example first shows you how to use a standard RSL, and then how to use that same RSL as a cross-domain RSL.

Keep in mind that a SWC file is a library that contains a SWF file that contains run-time definitions and additional metadata that is used by the compiler for dependency tracking, among other things. You can open SWC files with any archive tool, such as WinZip, and examine the contents.

Before you use an RSL, first learn how to statically link a SWC file. To do this, you build a SWC file and then set up your application to use that SWC file.

In this example you have an application named app.mxml that uses the ProductConfigurator.as and ProductView.as classes. The structure of this example includes the following files and directories:

```
project/src/app.mxml
project/libsrc/ProductConfigurator.as
project/libsrc/ProductView.as
project/lib/
project/bin/
```

To compile this application without using libraries, you can link the classes in the /libsrc directory using the `source-path` option, as the following example shows:

```
cd project/src
mxmlc -o=../bin/app.swf -source-path+=../libsrc app.mxml
```

This command adds the ProductConfigurator and ProductView classes to the SWF file.

To use a library rather than standalone classes, you first create a library from the classes. You use the compc compiler to create a SWC file that contains the ProductConfigurator and ProductView classes, as the following command shows:

```
cd project
compc -source-path+=libsrc -debug=false -o=lib/mylib.swc ProductConfigurator ProductView
```

This compiles the mylib.swc file in the lib directory. This SWC file contains the implementations of the Product-Configurator and ProductView classes.

To recompile your application with the new library, you add the library with the `library-path` option, as the following example shows:

```
cd project/src
mxmlc -o=../bin/app.swf -library-path+=../lib/mylib.swc app.mxml
```

This links the library at compile time, which does not result in any benefits of externalization. The library is not yet being used as an RSL. If you use the new library as an RSL, the resulting SWF file will be smaller, and the library can be shared across multiple applications.

Now you can recompile the application to use the library as an external RSL rather than as a library linked at compile time.

The first step is to compile your application with the `runtime-shared-library-path` option. This option instructs the compiler to specifically exclude the classes in your library from being compiled into your application, and provides a run time location of the RSL SWF file.

```
cd project/src
mxmlc -o=../bin/app.swf -runtime-shared-library-path=../lib/mylib.swc,myrsl.swf app.mxml
```

The next step is to prepare the RSL so that it can be found at run time. To do this, you extract the library.swf file from the SWC file with any archive tool, such as WinZip or jar.

The following example extracts the SWF file by using the unzip utility on the command line:

```
cd project/lib
unzip mylib.swc library.swf
mv library.swf ../bin/myrsl.swf
```

This example renames the library.swf file to myrsl.swf and moves it to the same directory as the application SWF file.

The next step is to optimize the library.swf file so that it does not contain any debug code or unnecessary metadata. The following example optimizes the SWF file by using the optimizer tool:

```
optimimzer -keep-as3-metadata="Bindable,Managed,ChangeEvent,NonCommittingChangeEvent,
Transient" -input bin/myrsl.swf -output bin/myrsl.swf
```

You now deploy the main application and the RSL. In this example, they must be in the same directory. If you want to deploy the myrsl.swf file to a different directory, you specify a different path in the `runtime-shared-library-path` option.

You can optionally run the optimizer tool on the myrsl.swf file to make it smaller before deploying it. For more information, see "Optimizing RSL SWF files" on page 212.

To use the RSL as a cross-domain RSL, you add a crossdomain.xml file, a failover RSL, and its crossdomain.xml file to the option, as the following example shows:

```
cd project/src
mxmlc -o=../bin/app.swf -runtime-shared-library-path=../lib/mylib.swc,
    http://www.my-remote-domain.com/rsls/myrsl.swf,
    http://www.my-remote-domain.com/rsls/crossdomain.xml,
    http://www.my-other-remote-domain.com/rsls/myrsl.swf,
    http://www.my-other-remote-domain.com/rsls/crossdomain.xml,
    Main.mxml
```

Next, you create a crossdomain.xml file. If the domain that are you running the Flex application on is my-local-domain.com, then you can create a crossdomain.xml file that looks like the following:

```
<cross-domain-policy>
    <allow-access-from domain="*.my-local-domain.com" to-ports="*"/>
</cross-domain-policy>
```

You now deploy the main application and the RSL. This time, however, the RSL is deployed on a remote server in the /rsls directory. You must also ensure that the crossdomain.xml file is in that directory. Finally, you must ensure that the failover RSL and its crossdomain.xm l file are deployed to the other remote domain.

Using the framework RSLs

Every Flex application uses some aspects of the Flex framework, which is a relatively large set of ActionScript classes that define the infrastructure of a Flex application. If a client loads two different Flex applications, the application will likely load overlapping class definitions. This can be a problem for users who are on dialup or slow network connections. It also leads to the perception that Flex applications load more slowly than HTML-based applications.

To overcome these limitations, you can use framework RSLs with your Flex applications. These libraries are comprised of the Flex class libraries and can be used with any Flex application. Framework RSLs come in two versions: signed and unsigned. *Signed framework RSLs* are cached in a special Player cache rather than the browser cache. They can be accessed by any application regardless of that application's originating domain. They only need to be downloaded to the client once, and they are not cleared from the client's disk when the browser's cache is cleared. *Unsigned framework RSLs* are cached in the browser cache and can only be used by applications that have access to the RSL's domain.

Flash Player 9.0.115 and later support loading signed framework RSLs. These RSLs can be loaded by applications in different domains. The framework RSLs are signed and have the extension SWZ. Only Adobe can create signed RSLs, and only signed RSLs can be stored in the Player cache. If you create an RSL that contains a custom library, it will be unsigned. You cannot sign it. If a Player with a version earlier than 9.0.115 attempts to load a framework RSL, then Flash Player skips it and loads a failover RSL, if one was specified when the application was compiled.

Only applications compiled with the Flex 3 compilers can use signed framework RSLs. Applications compiled earlier versions of the compilers cannot use signed framework RSLs.

Included framework RSLs

The framework RSLs are located in the *flex_sdk_dir*/frameworks/rsls directory. For Flex Builder, the framework RSLs are located in the *flex_builder_dir*/sdks/3.0.0/frameworks/rsls directory. The naming convention includes the version number of Flex, plus the build number of the compiler that you currently use. The following framework RSLs are included with the Flex products:

- framework_3.0.*build_number*.swz (signed framework RSL)
- framework_3.0.*build_number*.swf (unsigned framework RSL)
- rpc_3.0.*build_number*.swz (signed data services RSL)
- rpc_3.0.*build_number*.swf (unsigned data services RSL)
- (Flex Builder only) datavisualization_3.0.*build_number*.swz (signed data visualization RSL)
- (Flex Builder only) datavisualization_3.0.*build_number*.swf (unsigned data visualization RSL)

The signed and unsigned framework RSLs are optimized, as described in "Optimizing RSL SWF files" on page 212.

Flex also includes a number of SWC files that you can use as standard or cross-domain RSLs. These libraries are unsigned and not optimized. These SWC files are located in the frameworks/libs directory. They include automation.swc (for automation classes) and qtp.swc (for Mercury QuickTest Pro agent classes).

Framework RSL digests

After the framework RSLs are transferred across the network, Flash Player generates a digest of the framework RSL and compares that digest to the digest that was stored in the Flex application when it was compiled. If the digests match, then the RSL is loaded. If not, then Flash Player throws an error and attempts to load a failover RSL.

Using a framework RSL

To use the framework RSL in your Flex applications, you compile against the framework.swc file in your /frameworks/libs directory with the `runtime-shared-library-path` option on the command line. You can optionally add a policy file URL if necessary, plus one or more failover RSLs and their policy file URLs.

The following example compiles SimpleApp with the framework RSL:

```
mxmlc -runtime-shared-library-path=libs/framework.swc,
    framework_3.0.183453.swz,,framework_3.0.183453.swf
    SimpleApp.mxml
```

This example sets the signed framework RSL (*.swz) as the primary RSL, and then the unsigned framework RSL (*.swf) as the secondary RSL. This example does not specify a location for the policy file, so it is assumed that either the RSLs and the application are in the same domain or the policy file is at the root of the target server.

The following example shows the configuration file that loads a framework RSL:

```
<runtime-shared-library-path>
    <path-element>libs/framework.swc</path-element>
    <rsl-url>framework_3.0.${build.number}.swz</rsl-url>
    <policy-file-url></policy-file-url>
    <rsl-url>framework_3.0.${build.number}.swf</rsl-url>
</runtime-shared-library-path>
```

The configuration file uses a `{build.number}` token in the name of the RSLs. The compiler replaces this with a build number during compilation. The name of the framework RSL depends on the build number of Flex that you are using.

You can specify a signed SWZ file as the framework RSL and not specify an unsigned SWF file as a failover RSL. In this case, the application will not work in any Flash Player of version earlier than 9.0.115. The compiler will throw a warning, though, unless you set the `target-player` compiler option to 9.0.115 or later. This instructs the compiler to ignore the fact that there is no failover that will work with older Players. You can detect and upgrade users to the newest Player in the HTML wrapper by using the Express Install feature. For more information, see “Using Express Install” on page 333.

When you deploy your application, you must be sure to deploy the SWZ file to the location you specified on the command line. You must also be sure that the crossdomain.xml file is in place at the RSL’s domain. To ensure that your Flex application can support older versions of Flash Player, you should also deploy the unsigned framework RSL SWF file (in addition to the signed SWZ file), and specify that file as a failover RSL.

About the Player cache

The Player cache stores signed RSLs, such as the framework RSLs. You can manage the settings of the Player cache with the Settings Manager. The use of the RSLs in the Player cache is secure; no third party can inject code that will be executed. Only Adobe can sign RSLs; therefore, only Adobe RSLs can be stored in the Player cache.

The default size of the framework cache is 20MB. When the aggregate size of the cached RSLs in this directory meets or exceeds 20MB, Flash Player purges the cache. Files are purged on a least-recently-used basis. Less-used files are purged before files that have been used more recently. Purging continues until the cache size is below 60% of the maximum size. By default, this is 12MB.

The Global Storage Settings panel in the Settings Manager lets the user turn off the caching feature and increase or decrease its size. The Settings Manager is a special control panel that runs on your local computer but is displayed within and accessed from the Adobe website. If the user disables the Player cache, then Flash Player will not load SWZ files. Flash Player will load failover RSLs instead.

The following table shows the locations of the Player cache on various platforms:

Platform	Location
Windows 95/98/ME/2000/XP	C:\Documents and Settings*user_name*\Application Data\Adobe\Flash Player\AssetCache\
Windows Vista	C:\Users*user_name*\AppData\Roaming\Adobe\Flash Player\AssetCache\
Linux	/home/*user_name*/.adobe/Flash_Player/AssetCache/
Mac OSX	/Users/*user_name*/Library/Cache/Adobe/Flash Player/AssetCache/

Using the framework RSLs in Flex Builder

You can use Flex Builder to organize your RSLs and decide which SWC files to use as RSLs and which to use as statically-linked libraries. You can also use Flex Builder to configure the deployment locations, digests, and other properties of RSLs. The signed and unsigned framework RSLs have already been created for you and optimized. All you have to do is compile your application against the RSLs and deploy them to the location that you specified at compile time.

You can set each SWC file that your project uses to use one of the following linkage types:

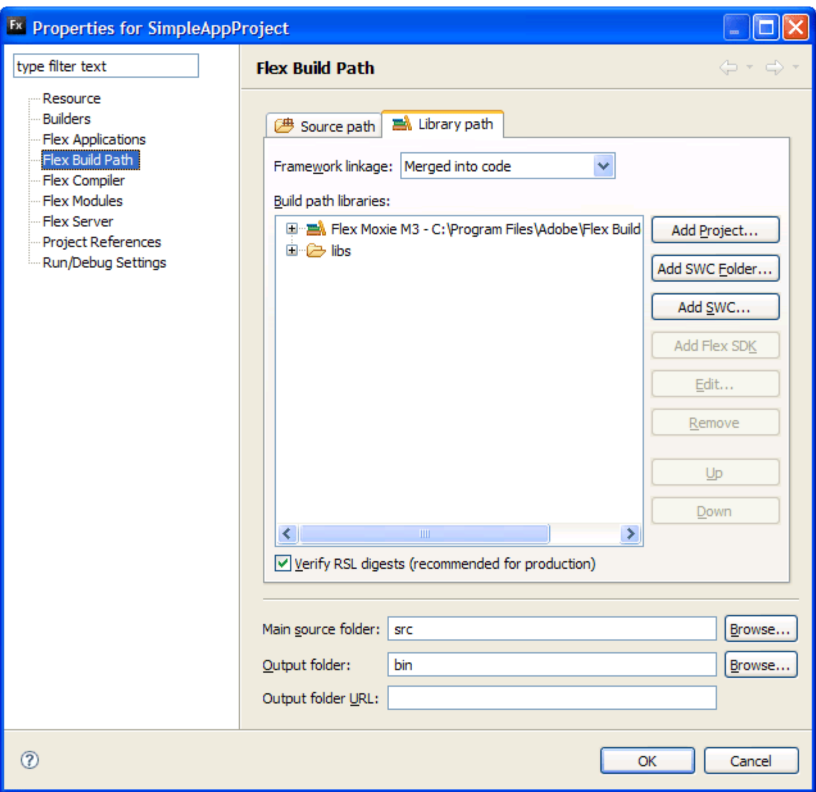
- Merged Into Code —Indicates that classes and their dependencies from this library are added to the SWF file at compile time. They are not loaded at run time. The result is a larger SWF file, but no external dependencies. This is the default selection for the framework.
- RSL — Indicates that this library will be used as an RSL. When you compile your application, the classes and their dependencies in this library are externalized, but you compile against them. You must then make them available as an RSL at run time.
- External — Indicates that this library will be externalized from the application, but it will not be used as an RSL. This excludes all the definitions in a library from an application but provides compile time link checking. Typically, only playerglobal.swc has this setting in an application project, but you might also use it to externalize assets that are used as modules or dynamically-loaded SWF files.

By default, all SWC files in the library path use the same linkage as the framework.

Use the framework.swc file as an RSL in Flex Builder

1. Open your Flex project in Flex Builder.
2. Select the project in the Navigator and select Project > Properties.
3. Select the Flex Build Path option in the resource list at the left. The Flex Build Path dialog box appears.

4 Select the Library Path tab:



5 Select Runtime Shared Library (RSL) from the Framework Linkage drop-down list. This instructs the application compiler to use the framework.swc file as an RSL. Flex Builder assumes that you will deploy the framework RSLs to the same directory as the main application's SWF file.

6 Click OK to save your changes.

When you export the release build of your project, the main application's SWF file should be smaller. In addition, in the release output directory, Flex Builder includes the framework's SWF and SWZ files for you to deploy.

You can view the settings of the SWC files that are included with Flex but whose classes are not included in the framework RSLs by expanding the list of libraries used by Flex in the Library Path tab. This list includes the automation.swc and qtp.swc files. You might want to compile your application against these SWC files as RSLs if your application will benefit from doing so. These SWC files are not optimized, so before you use them as RSLs, you should optimize them as described in “Optimizing RSL SWF files” on page 212.

Use other Adobe SWC files as RSLs in Flex Builder

1 On the Library Path tab, click the + to expand the list of SWC files.

2 Select the SWC file that you want to use as an RSL and click the + to show its properties. For example, click the + next to the automation.swc file.

3 Click the Link Type property and click the Edit button. The default link type is “Merged into code”, which means that the library is statically linked to your application by default.

4 If you are already using the framework.swc file as an RSL, you can select the Use Same Linkage As Framework option. This option lets you toggle the RSL’s status on and off by changing only the framework.swc file’s linkage status. Otherwise, select Runtime Shared Library (RSL) from the Link Type drop-down list.

The RSL Options field is enabled.

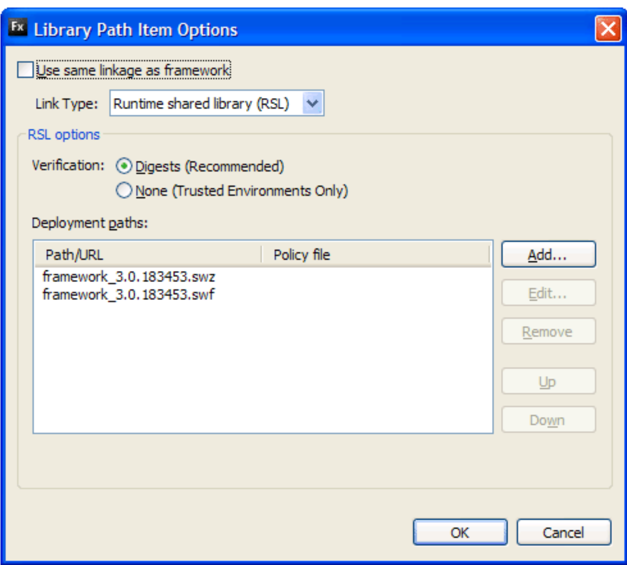
5 Select the Verification type and the deployment locations of the RSL as described in “Compiling applications with standard and cross-domain RSLs” on page 206.

6 Click OK to save your changes.

In some cases, you might not want to deploy the framework RSLs in the same directory as your main application. You might have a central server where these RSLs are stored, and need to share them across multiple applications.

Customize the deployment location of the framework RSLs

1 Edit the framework.swc file's settings in the Library Path Item Options dialog box.

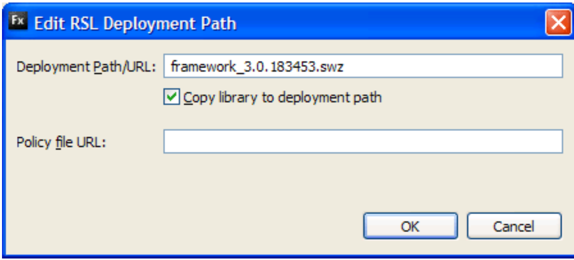


2 Select the Digests radio button, if it is not already selected.

Notice the two default entries in the Deployment paths field: an SWZ file and an SWF file. The SWZ file is the signed RSL that can be stored in the framework cache. The SWF file is an unsigned SWF file that is a failover if the SWZ file cannot be loaded.

By default, the framework RSLs are deployed to the same directory as your main application.

3 To change the deployment location of the framework RSLs, click the SWZ file and then click the Edit button. The Edit RSL Deployment Path dialog box appears:



In the Deployment Path/URL field, enter the location of the SWZ file. For example, “http://www.remote-server.com/rsls/framework_3.0.183453.swc”. The application tries to load the RSL from this location at run time. The location can be relative to the application’s SWF file, or a full URL to a remote server. If the RSL is on a remote server, you might also be required to point to the policy file. In the Policy file URL field, enter the location of the crossdomain.xml file, if there is no crossdomain.xml file at the target server’s root. You do not need to enter anything in this field if the application’s SWF file and the RSLs are served from the same domain, or if the crossdomain.xml file is at the target server’s root.

4 Click OK to save your changes in the Edit RSL Deployment Path dialog box.

5 Repeat the previous two steps for the SWF file, if you are also deploying the unsigned framework RSL with your application. If you do not deploy the failover SWF file, then users with Flash Player versions earlier than 9.0.115 will not be able to use your application.

6 Click OK to save your changes to the Library Path Item Options dialog box.

7 Ensure that the Verify RSL Digests option on the Library Path tab is selected.

8 Click OK to save your changes to the Flex Build Path settings.

When you deploy your application, you must manually copy the framework RSLs to the path that you specified on the remote server.

Using the framework RSLs on the command line

The following example application shows how to use the framework RSLs on the command line.

You first create an application that uses at least one visual Flex component. For example, the following application uses a Button control:

```
<?xml version="1.0"?>
<!-- rsls/SimpleRSLApp.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Button label="Submit"/>
</mx:Application>
```

Save this file as SimpleApp.mxml and store it in the project/src directory.

After you create the application, determine the size of the application’s compiled SWF file before you use the framework RSL. This will give you an idea of how much memory you are saving by using the framework RSL.

Compile this application as you normally would, with one exception. Add the `static-link-runtime-shared-libraries=true` option; this ensures that you are not using the framework RSL when compiling the application, regardless of the settings in your configuration files. Instead, you are compiling the framework classes into your SWF file.

With the mxmlc command-line compiler, use the following command to compile the application:

```
cd project
mxmlc -static-link-runtime-shared-libraries=true bin/SimpleApp.mxml
```

Examine the output size of the SWF file. Even though the application contains only a Button control, the size of the SWF file should be around 140KB. That is because it not only includes component and application framework classes, but it also includes all classes that those classes inherit from plus other framework dependencies. For visual controls such as a Button, the list of dependencies can be lengthy. If you added several more controls to the application, you will notice that the application does not get much larger. That is because there is a great deal of overlap among all the visual controls.

Run the application in a browser either from the file system or from a server. You can also run the application in the standalone player.

Next, compile the application again, but this time add the signed framework RSL as an RSL and the unsigned framework RSL as a failover RSL. For example:

```
mxmlc -runtime-shared-library-path=c:/p4/flex/flex/sdk/frameworks/libs/framework.swc,
    framework_3.0.183453.swz,,framework_3.0.183453.swf rsls/SimpleApp.mxml
```

The result is a SWF file that should be significantly smaller than the previous SWF file.

This command includes a blank entry for the policy file URL. In this example, the crossdomain.xml file is not needed because you will deploy the RSLs and the application to the same domain, into the same directory.

In addition, the `runtime-shared-library-path` option includes an unsigned failover RSL as its final parameter. This is a standard framework RSL SWF file that is provided to support older versions of Flash Player that do not support signed RSLs. It is not cross domain, and if used by the client, it is stored in the browser's cache, not the framework cache.

You must now deploy the application and the framework RSLs to a server. You cannot request the SimpleApp.swf file from the file system because it loads network resources (the framework RSLs) and this will cause a security sandbox violation unless it is loaded from a server. You deploy the SimpleApp.swf, framework_3.0.183453.swz, and framework_3.0.183453.swf files to the same directory on your web server.

Request the application in the browser or create a wrapper for the application and request that file.

To verify that the signed framework RSL was loaded by your Flex application, you can look for an SWZ file in your framework cache. For more information, see "About the Player cache" on page 218.

After the client downloads the signed framework RSL, they will not have to download that RSL again for any Flex application that uses signed framework RSLs, unless a new version of the framework is released or the RSL's SWZ file is purged from the Player cache.

Troubleshooting RSLs

RSLs can be complicated to create, use, and deploy. The following table describes common errors and techniques to resolve them:

Error	Resolution
`#1001`	This error indicates that the digest of a library does not match the RSL SWF file. When you compile an application that uses an RSL, you specify the library SWC file that the application uses for link checking at compile time and an RSL SWF file that the application loads at run time. The digest in the library's catalog.xml file must match the digest of the RSL SWF file or you will get this error. If this error persists, recompile the application against the library SWC file again and redeploy the application's SWF file. If you are using framework RSLs, then the SWZ file is a different version than what the application was compiled against. Check whether this is the case by adding a failover RSL SWF file and recompiling. If the error does not recur, then the SWZ file is out of sync.
`#2032`	This error indicates that the SWZ or SWF file is not being found. For example, if you specified only "mylib.swf" as the value of the `rsl-url` parameter to the `runtime-shared-library-path` option, but the SWF file is actually in a sub-directory such as /rsls, then you must either recompile your application and update the value of the `rsl-url` parameter to "rsls/mylib.swf", or move mylib.swf to the same directory as the application's SWF file.
`#2046`	This error indicates that the loaded RSL was not signed properly. In the case of framework RSLs, the framework's SWZ file that the application attempted to load at run time was not a properly signed SWZ file. You must ensure that you deploy an Adobe-signed RSL.

`#2048`	The cause of this error is that you do not have a crossdomain.xml file on the server that is returning the RSL. You should add a file to that server. For more information, see "Using cross-domain policy files" on page 40.
	
	If you put the crossdomain.xml file at the server's root, you do not have to recompile your Flex application. This is because the application will look for that file at the server's root by default, so there is no need to explicitly define its location.
	
	If you cannot store a crossdomain.xml file at the remote server's root, but can put it in another location on that server, you must specify the file's location when you compile the application. On the command line, you do this by setting the value of the `policy-file-url` argument of the `runtime-shared-library-path` option.
	
	In the following example, the RSL SWF file is located in the /rsls directory on www.domain.com. The crossdomain.xml file is located in the same directory, which is not the server's root, so it must therefore be explicitly specified:
	
	`mxmlc -runtime-shared-library-path=`
	`../lib/mylib.swc,`
	`http://www.mydomain.com/rsls/myrsl.swf,`
	`http://www.mydomain.com/rsls/crossdomain.xml`
	`Main.mxml`

Error	Resolution
`#2148`	This error occurs when you try to open an application that uses RSLs in the standalone player or in the browser by using the file system and not a server. It means that you are violating the security sandbox of Flash Player by trying to load file resources. You must deploy your application and RSLs to a network location, and request the application with a network request so that Flash Player will load the RSL. If you are testing the application locally, you can add the directory to your Player trust file to avoid this error.
`Requested resource not found`	You might find this error in your web server logs. If you deploy the RSL SWF file to a location other than that specified when you compiled the application, then you will get an error similar to this when the application tries to run. The solution is to either recompile your Flex application and correct the deployment location of the RSL SWF file or to move the RSL SWF file to the location that the application expects.

Chapter 11: Logging

You can log messages at several different points in an Adobe® Flex® application's life cycle. You can log messages when you compile the application, when you deploy it to a web application server, or when a client runs it. You can log messages on the server or on the client. These messages are useful for informational, diagnostic, and debugging activities.

Topics

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About logging

When you encounter a problem with your application, whether during compilation or at run time, the first step is to gather diagnostic information to locate the cause of the problem. The source of a problem typically is in one of two places: the server web application, or the client application.

***Note:** For detailed information on debugging Adobe® AIR™ applications, see "Using the AIR development tools" in* Developing AIR Applications with Adobe Flex 3.

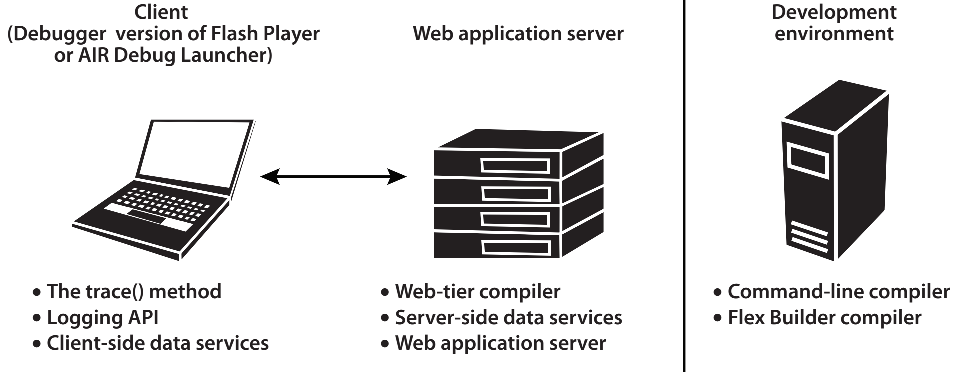
Flex includes several different logging and error reporting mechanisms that you can use to track down failures:

Client-side logging and debugging With the debugger version of Adobe® Flash® Player, or with an AIR application that you debug using ADL, you can use the global `trace()` method to write out messages or configure a TraceTarget to customize log levels of applications for data services-based applications. For more information, see "Client-side logging and debugging" on page 232.

Compiler logging When compiling your Flex applications from the command line and in Adobe® Flex® Builder®, you can view deprecation and warning messages, and sources of fatal errors. For more information, see "Compiler logging" on page 243.

Web-tier logging The Flex module for Apache and IIS compiler has its own logging facilities. For more information, see "Using the web-tier compiler log files" on page 351.

The following example shows the types of logging you can do in the appropriate environment:



To use client-side debugging utilities such as the `trace()` global method and client-side data services logging, you must install and configure the debugger version of Flash Player. This is described in "Using the debugger version of Flash Player" on page 228. The debugger version of Flash Player is not required to log compiler messages or web-tier compiler messages.

Using the debugger version of Flash Player

The debugger version of Flash Player is a tool for development and testing. Like the standard version of Adobe Flash Player 9, it runs SWF files in a browser or on the desktop in a stand-alone player. Unlike Flash Player, the debugger version of Flash Player enables you to do the following:

- Output statements and application errors to the debugger version of the Flash Player local log file by using the `trace()` method.
- Write data services log messages to the local log file of the debugger version of Flash Player.
- View run-time errors (RTEs).
- Use the fdb command-line debugger.
- Use the Flex Builder debugging tool.
- Use the Flex Builder profiling tool.

Note: *Any client running the debugger version of Flash Player can view your application's* `trace()` *statements and other log messages unless you disable them. For more information, see* *"Suppressing debug output" on page 52*.

The debugger version of Flash Player lets you take advantage of the client-side logging utilities such as the `trace()` method and the logging API. You are not required to run the debugger version of Flash Player to log compiler and web-tier messages because these logging mechanisms do not require a player.

***Note:** ADL logs `trace()` output from AIR applications, based on the setting in mm.cfg (the same setting used by the debug version of Flash Player)."*

In nearly all respects, the debugger version of Flash Player appears to be the same as the standard version of Flash Player. To determine whether or not you are running the debugger version of Flash Player, use the instructions in "Determining Flash Player version in Flex" on page 231.

The debugger version of Flash Player comes in ActiveX, Plug-in, and stand-alone versions for Microsoft Internet Explorer, Netscape-based browsers, and desktop applications, respectively. You can find the debugger version of Flash Player installers in the following locations:

- Flex Builder: *install_dir*/Player/*os_version*
- Flex SDK: *install_dir*/runtimes/player/*os_version*/

Uninstall your current Flash Player before you install the debugger version of Flash Player. For information on installing the debugger version of Flash Player, see the Flex installation instructions.

You can enable or disable trace logging and perform other configuration tasks for the debugger version of Flash Player. For more information, see "Configuring the debugger version of Flash Player" on page 229.

Configuring the debugger version of Flash Player

You use the settings in the mm.cfg text file to configure the debugger version of Flash Player. These settings also affect logging of `trace()` output in AIR applications running in the ADL debugger. If this file does not exist, you can create it when you first configure the debugger version of Flash Player. The location of this file depends on your operating system.

The following table shows where to create the mm.cfg file for several operating systems:

Operating system	**Create file in ...**
Macintosh OS X	`/Library/Application Support/Macromedia`
Windows 95/98/ME	`%HOMEDRIVE%\%HOMEPATH%`
Windows 2000/XP	`C:\Documents and Settings\`*`username`*
Windows Vista	`C:\Users\`*`username`*
Linux	`/home/`*`username`*

On Microsoft Windows XP, the default location was \Documents and Settings\user_name. On Microsoft Windows 2000, the default location was \. For earlier versions of Flash Player on Windows XP and 2000, the location of the mm.cfg file was determined by the `HOMEDRIVE` and `HOMEPATH` environment variables.

The following table lists the properties that you can set in the mm.cfg file:

Property	Description
`ErrorReportingEnable`	Enables the logging of error messages. Set the `ErrorReportingEnable` property to 1 to enable the debugger version of Flash Player to write error messages to the log file. To disable logging of error messages, set the `ErrorReportingEnable` property to 0. The default value is 0.
`MaxWarnings`	Sets the number of warnings to log before stopping. The default value of the `MaxWarnings` property is 100. After 100 messages, the debugger version of Flash Player writes a message to the file stating that further error messages will be suppressed. Set the `MaxWarnings` property to override the default message limit. For example, you can set it to 500 to capture 500 error messages. Set the `MaxWarnings` property to 0 to remove the limit so that all error messages are recorded.
`TraceOutputFileEnable`	Enables trace logging. Set `TraceOutputFileEnable` to 1 to enable the debugger version of Flash Player to write trace messages to the log file. Disable trace logging by setting the `TraceOutputFileEnable` property to 0. The default value is 0.
`TraceOutputFileName`	**Note**: Beginning with the Flash Player 9 Update, Flash Player ignores the `TraceOutputFileName` property and stores the flashlog.txt file in a hard-coded location based on operating system. For more information, see "Log file location" on page 231. Sets the location of the log file. By default, the debugger version of Flash Player writes error messages to a file named flashlog.txt, located in the same directory in which the mm.cfg file is located. Set `TraceOutputFileName` to override the default name and location of the log file by specifying a new location and name in the following form: On Macintosh OS X, you should use colons to separate directories in the TraceOutputFileName path rather than slashes. `TraceOutputFileName=<fully qualified path/filename>`

The following sample mm.cfg file enables error reporting and trace logging:

```
ErrorReportingEnable=1
TraceOutputFileEnable=1
```

Log file location

The default log file location changed between the initial Flash Player 9 release and the Flash Player 9 Update. In the initial Flash Player 9 release, the default location was the same directory as the mm.cfg file and you could update the log file location and name through the `TraceOutputFileName` property.

Beginning with the Flash Player 9 Update, you cannot modify the log file location or name. The filename is flashlog.txt, and its location is hard-coded, depending on your operating system. The following table shows the flashlog.txt file location:

Operating System	Log file location
Windows 95/98/ME/2000/XP	`C:\Documents and Settings\`*`username`*`\Application Data\Macromedia\Flash Player\Logs`
Windows Vista	`C:\Users\`*`username`*`\AppData\Roaming\Macromedia\Flash Player\Logs`
Macintosh OS X	`/Users/`*`username`*`/Library/Preferences/Macromedia/Flash Player/Logs/`
Linux	`/home/`*`username`*`/.macromedia/Flash_Player/Logs/`

Determining Flash Player version in Flex

To determine which version of Flash Player you are currently using—the standard version or the debugger version—you can use the Capabilities class. This class contains information about Flash Player and the system that it is currently operating on. To determine if you are using the debugger version of Flash Player, you can use the `isDebugger` property of that class. This property returns a Boolean value: the value is `true` if the current player is the debugger version of Flash Player and `false` if it is not.

The following example uses the `playerType`, `version`, and `isDebugger` properties of the Capabilities class to display information about the Player:

```
<?xml version="1.0"?>
<!-- logging/CheckDebugger.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:Script><![CDATA[
        import flash.system.Capabilities;

        private function reportVersion():String {
            if (Capabilities.isDebugger) {
                return "Debugger version of Flash Player";
            } else {
                return "Flash Player";
            }
        }
        private function reportType():String {
            return Capabilities.playerType + " (" + Capabilities.version + ")";
```

```
        }
    ]]></mx:Script>
    <mx:Label text="{reportVersion()}"/>
    <mx:Label text="{reportType()}"/>
</mx:Application>
```

Other properties of the Capabilities class include `hasPrinting`, `os`, and `language`.

Client-side logging and debugging

Often, you use the `trace()` method when you debug applications to write a checkpoint message on the client, which signals that your application reached a specific line of code, or to output the value of a variable.

The debugger version of Flash Player has two primary methods of writing messages that use `trace()`:

- The global `trace()` method. The global `trace()` method prints Strings to a specified output log file. For more information, see "Using the global trace() method" on page 232.
- Logging API. The logging API provides a layer of functionality on top of the `trace()` method that you can use with your custom classes or with the data service APIs. For more information, see "Using the logging API" on page 233.

Configuring the debugger version of Flash Player to record trace() output

To record messages on the client, you must use the debugger version of Flash Player. You must also set `TraceOutputFileEnable` to 1 in your mm.cfg file. For more information on editing the mm.cfg file, see "Configuring the debugger version of Flash Player" on page 229.

The debugger version of Flash Player sends output from the `trace()` method to the flashlog.txt file. The location of this file is determined by the operating system. For more information, see "Log file location" on page 231.

Using the global trace() method

You can use the debugger version of Flash Player to capture output from the global `trace()` method and write that output to the client log file. You can use `trace()` statements in any ActionScript or MXML file in your application. Because it is a global function, you are not required to import any ActionScript classes packages to use the `trace()` method.

The following example defines a function that logs the various stages of the Button control's startup life cycle:

```
<?xml version="1.0"?>
<!-- logging/ButtonLifeCycle.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
```

```
    <mx:Script><![CDATA[
        private function traceEvent(event:Event):void {
            trace(event.currentTarget + ":" + event.type);
        }
    ]]></mx:Script>

    <mx:Button id="b1" label="Click Me"
        preinitialize="traceEvent(event)"
        initialize="traceEvent(event)"
        creationComplete="traceEvent(event)"
        updateComplete="traceEvent(event)"
    />

</mx:Application>
```

The following example shows the output of this simple application:

```
TraceLifecycle_3.b1:Button:preinitialize
TraceLifecycle_3.b1:Button:initialize
TraceLifecycle_3.b1:Button:creationComplete
TraceLifecycle_3.b1:Button:updateComplete
TraceLifecycle_3.b1:Button:updateComplete
TraceLifecycle_3.b1:Button:updateComplete
```

Messages that you log by using the `trace()` method should be Strings. If the output is not a String, use the `String(...)` String conversion function, or use the object's `toString()` method, if one is available, before you call the `trace()` method.

To enable tracing, you must configure the debugger version of Flash Player as described in "Configuring the debugger version of Flash Player to record trace() output" on page 232.

Using the logging API

The logging API lets an application capture and write messages to a target's configured output. Typically the output is equivalent to the global `trace()` method, but it can be anything that an active target supports.

The logging API consists of the following parts:

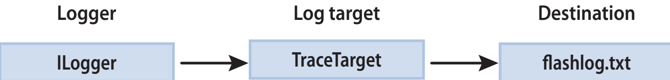
Logger The logger provides an interface for sending a message to an active target. Loggers implement the ILogger interface and call methods on the Log class. The two classes of information used to filter a message are category and level. Each logger operates under a category. A *category* is a string used to filter all messages sent from that logger. For example, a logger can be acquired with the category "orange". Any message sent using the "orange" logger only reaches those targets that are listening for the "orange" category. In contrast to the category that is applied to all messages sent with a logger, the *level* provides additional filtering on a per-message basis. For example, to indicate that an error occurred within the "orange" subsystem, you can use the error level when logging the message. The supported levels are defined by the LogEventLevel class. The Flex framework classes that use the logging API set the category to the fully qualified class name as a convention.

Log target The log target defines where log messages are written. Flex predefines a single log target: TraceTarget, which is the most commonly used log target. This log target connects the logging API to the trace system so that log messages are sent to the same location as the output of the `trace()` method. For more information on the `trace()` method, see "Using the global trace() method" on page 232.

You can also write your own custom log target. For more information, see "Implementing a custom logger with the logging API" on page 238.

Destination The destination is where the log message is written. Typically, this is a file, but it can also be a console or something else, such as an in-memory object. The default destination for TraceTarget is the flashlog.txt file. You configure this destination on the client.

The following example shows a sample relationship between a logger, a log target, and a destination:



You can also use the logging API to send messages from custom code you write. You can do this when you create a set of custom APIs or components or when you extend the Flex framework classes and you want users to be able to customize their logging. For more information, see "Implementing a custom logger with the logging API" on page 238.

The following packages within the Flex framework are the only ones that use the logging API:

- mx.rpc.*
- mx.messaging.*
- mx.data.*

To configure client-side logging in MXML or ActionScript, create a TraceTarget object to log messages. The TraceTarget object logs messages to the same location as the output of the `trace()` statements. You can also use the TraceTarget to specify which classes to log messages for, and what level of messages to log.

The levels of logging messages are defined as constants of the LogEventLevel class. The following table lists the log level constants and their numeric equivalents, and describes each message level:

Logging level constant (int)	Description
`ALL (0)`	Designates that messages of all logging levels should be logged.
`DEBUG (2)`	Logs internal Flex activities. This is most useful when debugging an application. Select the `DEBUG` logging level to include `DEBUG`, `INFO`, `WARN`, `ERROR`, and `FATAL` messages in your log files.
`INFO (4)`	Logs general information. Select the `INFO` logging level to include `INFO`, `WARN`, `ERROR`, and `FATAL` messages in your log files.
`WARN (6)`	Logs a message when the application encounters a problem. These problems do not cause the application to stop running, but could lead to further errors. Select the `WARN` logging level to include `WARN`, `ERROR`, and `FATAL` messages in your log files.
`ERROR (8)`	Logs a message when a critical service is not available or a situation has occurred that restricts the use of the application. Select the `ERROR` logging level to include `ERROR` and `FATAL` messages in your log files.
`FATAL (1000)`	Logs a message when an event occurs that results in the failure of the application. Select the `FATAL` logging level to include only `FATAL` messages in your log files.

The log level lets you restrict the amount of messages sent to any running targets. Whatever log level you specify, all “lower” levels of messages are written to the log. For example, if you set the log level to `DEBUG`, all log levels are included. If you set the log level to `WARNING`, only `WARNING`, `ERROR`, and `FATAL` messages are logged. If you set the log level to the lowest level of message, `FATAL`, only `FATAL` messages are logged.

Using the logging API with data services

The data services classes are designed to use the logging API to log client-side and server-side messages.

Enable the logging API with data services

1 Create a TraceTarget logging target and set the value of one or more filter properties to include the classes whose messages you want to log. You can filter the log messages to a specific class or package. You can use wildcards (*) when defining a filter.

2 Set the log level by using the `level` property of the log target. You can also add detail to the log file output, such as the date and time that the event occurred, by using properties of the log target.

3 When you create a target within ActionScript, call the Log class's `addTarget()` method to add the new target to the logging system. Calling the `addTarget()` method is not required when you create a target in MXML. As long as the client is using the debugger version of Flash Player and meets the requirements described in "Configuring the debugger version of Flash Player to record trace() output" on page 232, the messages are logged.

The following example configures a TraceTarget logging target in ActionScript:

```
<?xml version="1.0"?>
<!-- charts/ActionScriptTraceTarget.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
creationComplete="initLogging();">

    <mx:Script><![CDATA[
        import mx.collections.ArrayCollection;
        import mx.logging.targets.*;
        import mx.logging.*;

        [Bindable]
        public var myData:ArrayCollection;

        private function initLogging():void {
            // Create a target.
            var logTarget:TraceTarget = new TraceTarget();

            // Log only messages for the classes in the mx.rpc.* and
            // mx.messaging packages.
            logTarget.filters=["mx.rpc.*","mx.messaging.*"];

            // Log all log levels.
            logTarget.level = LogEventLevel.ALL;

            // Add date, time, category, and log level to the output.
            logTarget.includeDate = true;
            logTarget.includeTime = true;
            logTarget.includeCategory = true;
            logTarget.includeLevel = true;

            // Begin logging.
            Log.addTarget(logTarget);
        }
    ]]></mx:Script>

    <!-- HTTPService is in the mx.rpc.http.* package -->
    <mx:HTTPService
        id="srv"
        url="../assets/trace_example_data.xml"
```

```
        useProxy="false"
        result="myData=ArrayCollection(srv.lastResult.data.result)"
    />

    <mx:LineChart id="chart" dataProvider="{myData}" showDataTips="true">
        <mx:horizontalAxis>
            <mx:CategoryAxis categoryField="month"/>
        </mx:horizontalAxis>
        <mx:series>
            <mx:LineSeries yField="apple" name="Apple"/>
            <mx:LineSeries yField="orange" name="Orange"/>
            <mx:LineSeries yField="banana" name="Banana"/>
        </mx:series>
    </mx:LineChart>

    <mx:Button id="b1" click="srv.send();" label="Load Data"/>

</mx:Application>
```

In the preceding example, the `filters` property is set to log messages for all classes in the mx.rpc and mx.messaging packages. In this case, it logs messages for the HTTPService class, which is in the mx.rpc.http.* package.

You can also configure a log target in MXML. When you do this, though, you must be sure to use an appropriate number (such as 2) rather than a constant (such as `DEBUG`). The following example sets the values of the filters for a TraceTarget logging target by using MXML syntax:

```
<?xml version="1.0"?>
<!-- charts/MXMLTraceTarget.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" creationComplete="initApp();">

    <mx:Script><![CDATA[
        import mx.collections.ArrayCollection;
        import mx.logging.Log;

        [Bindable]
        public var myData:ArrayCollection;

        private function initApp():void {
            Log.addTarget(logTarget);
        }

    ]]></mx:Script>

    <mx:TraceTarget id="logTarget"
        includeDate="true"
        includeTime="true"
```

```
        includeCategory="true"
        includeLevel="true"
    >
        <mx:filters>
            <mx:Array>
                <mx:String>mx.rpc.*</mx:String>
                <mx:String>mx.messaging.*</mx:String>
            </mx:Array>
        </mx:filters>
        <!-- 0 is represents the LogEventLevel.ALL constant. -->
        <mx:level>0</mx:level>
    </mx:TraceTarget>

    <!-- HTTPService is in the mx.rpc.http.* package -->
    <mx:HTTPService
        id="srv"
        url="../assets/trace_example_data.xml"
        useProxy="false"
        result="myData=ArrayCollection(srv.lastResult.data.result)"
    />

    <mx:LineChart id="chart" dataProvider="{myData}" showDataTips="true">
        <mx:horizontalAxis>
            <mx:CategoryAxis categoryField="month"/>
        </mx:horizontalAxis>
        <mx:series>
            <mx:LineSeries yField="apple" name="Apple"/>
            <mx:LineSeries yField="orange" name="Orange"/>
            <mx:LineSeries yField="banana" name="Banana"/>
        </mx:series>
    </mx:LineChart>

    <mx:Button id="b1" click="srv.send();" label="Load Data"/>

</mx:Application>
```

Implementing a custom logger with the logging API

If you write custom components or an ActionScript API, you can use the logging API to access the trace system in the debugger version of Flash Player. You do this by defining your log target as a TraceTarget, and then calling methods on your logger when you log messages.

The following example extends a Button control. It writes log messages for the startup life cycle events, such as `initialize` and `creationComplete`, and the common UI events, such as `click` and `mouseOver`.

```
package { // The empty package.
    import mx.controls.Button;
    import flash.events.*;
    import mx.logging.*;
    import mx.logging.targets.*;

    public class MyCustomLogger extends Button {

        private var myLogger:ILogger;

        public function MyCustomLogger() {
            super();
            initListeners();
            initLogger();
        }
        private function initListeners():void {
            // Add event listeners life cycle events.
            addEventListener("preinitialize", logLifeCycleEvent);
            addEventListener("initialize", logLifeCycleEvent);
            addEventListener("creationComplete", logLifeCycleEvent);
            addEventListener("updateComplete", logLifeCycleEvent);

            // Add event listeners for other common events.
            addEventListener("click", logUIEvent);
            addEventListener("mouseUp", logUIEvent);
            addEventListener("mouseDown", logUIEvent);
            addEventListener("mouseOver", logUIEvent);
            addEventListener("mouseOut", logUIEvent);
        }
        private function initLogger():void {
            myLogger = Log.getLogger("MyCustomClass");
        }

        private function logLifeCycleEvent(e:Event):void {
            if (Log.isInfo()) {
                myLogger.info(" STARTUP: " + e.target + ":" + e.type);
            }
        }

        private function logUIEvent(e:MouseEvent):void {
            if (Log.isDebug()) {
                myLogger.debug(" EVENT:   " + e.target + ":" + e.type);
            }
        }
    }
}
```

Within the application that uses the MyCustomLogger class, define a TraceTarget, as the following example shows:

```
<?xml version="1.0"?>
<!-- charts/LoadCustomLogger.mxml -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" xmlns="*" >
   <mx:TraceTarget level="0" includeDate="true" includeTime="true" includeCategory="true"
includeLevel="true">
        <mx:filters>
            <mx:Array>
                <mx:String>*</mx:String>
            </mx:Array>
        </mx:filters>
    </mx:TraceTarget>
    <MyCustomLogger/>
</mx:Application>
```

After running this application, the flashlog.txt file looks similar to the following:

```
3/9/2006 18:58:05.042 [INFO] MyCustomLogger STARTUP:
Main_3.mcc:MyCustomLogger:preinitialize
3/9/2006 18:58:05.487 [INFO] MyCustomLogger STARTUP: Main_3.mcc:MyCustomLogger:initialize
3/9/2006 18:58:05.557 [INFO] MyCustomLogger STARTUP:
Main_3.mcc:MyCustomLogger:creationComplete
3/9/2006 18:58:05.567 [INFO] MyCustomLogger STARTUP:
Main_3.mcc:MyCustomLogger:updateComplete
3/9/2006 18:58:05.577 [INFO] MyCustomLogger STARTUP:
Main_3.mcc:MyCustomLogger:updateComplete
3/9/2006 18:58:05.577 [INFO] MyCustomLogger STARTUP:
Main_3.mcc:MyCustomLogger:updateComplete
3/9/2006 18:58:06.849 [DEBUG] MyCustomLogger EVENT: Main_3.mcc:MyCustomLogger:mouseOver
3/9/2006 18:58:07.109 [DEBUG] MyCustomLogger EVENT: Main_3.mcc:MyCustomLogger:mouseDown
3/9/2006 18:58:07.340 [DEBUG] MyCustomLogger EVENT: Main_3.mcc:MyCustomLogger:mouseUp
3/9/2006 18:58:07.360 [DEBUG] MyCustomLogger EVENT: Main_3.mcc:MyCustomLogger:click
3/9/2006 18:58:07.610 [DEBUG] MyCustomLogger EVENT: Main_3.mcc:MyCustomLogger:mouseOut
```

To log a message, you call the appropriate method of the ILogger interface. The ILogger interface defines a method for each log level: `debug()`, `info()`, `warn()`, `error()`, and `fatal()`. The logger logs messages from these calls if their levels are at or under the log target's logging level. If the target's logging level is set to `all`, the logger records messages when any of these methods are called.

To improve performance, a static method corresponding to each level exists on the Log class, which indicates if any targets are listening for a specific level. Before you log a message, you can use one of these methods in an `if` statement to avoid running the code. The previous example uses the `Log.isDebug()` and `Log.isInfo()` static methods to ensure that the messages are of level `INFO` or `DEBUG` before logging them.

The previous example logs messages dispatched from any category because the TraceTarget's `filters` property is set to the wildcard character (*). The framework code sets the category of the logger to the fully qualified class name of the class in which logging is being performed. This is by convention only; any String specified when calling `Log.getLogger(x)` is the category required in a `filters` property to receive the message.

When you set the `filters` property for logging within the Flex framework, you can restrict this to a certain package or packages, or to other classes. To restrict the logging to your custom class only, add the category specified when the logger was acquired ("MyCustomLogger") to the `filters` Array, as the following example shows:

```
<mx:filters>
    <mx:Array>
        <mx:String>MyCustomLogger</mx:String>
    </mx:Array>
</mx:filters>
```

In ActionScript, you can set the `filters` property by using the following syntax:

```
traceTarget.filters = ["p1.*", "p2.*", "otherPackage*"];
```

The wildcard character can appear only at the end of a value in the Array.

The `Log.getLogger()` method sets the category of the logger. You pass this method a String that defines the category.

***Note:** The Flex packages that use the logging API set the category to the current class name by convention, but it can be any String that falls within the filters definitions.*

The value of the category must fall within the definition of at least one of the filters for the log message to be logged. For example, if you set the `filters` property to something other than "*" and you use `Log.getLogger("MyCustomLogger")`, the filter Array must include an entry that matches MyCustomLogger, such as "MyCustomLogger" or "My*".

You can include the logger's category in your log message, if you set the logger's `includeCategory` property to `true`.

You can also use the ILogger interface's `log()` method to customize the log message, and you can specify the logging level in that method. The following example logs messages that use the log level that is passed into the method:

```
package { // The empty package.
    // logging/MyCustomLogger2.as
    import mx.controls.Button;
    import flash.events.*;
    import flash.events.MouseEvent;
    import mx.logging.*;
    import mx.logging.targets.*;
```

```
public class MyCustomLogger2 extends Button {

    private var myLogger:ILogger;

    public function MyCustomLogger2() {
        super();
        initListeners();
        initLogger();
    }
    private function initListeners():void {
        // Add event listeners life cycle events.
        addEventListener("preinitialize", logLifeCycleEvent);
        addEventListener("initialize", logLifeCycleEvent);
        addEventListener("creationComplete", logLifeCycleEvent);
        addEventListener("updateComplete", logLifeCycleEvent);

        // Add event listeners for other common events.
        addEventListener("click", logUIEvent);
        addEventListener("mouseUp", logUIEvent);
        addEventListener("mouseDown", logUIEvent);
        addEventListener("mouseOver", logUIEvent);
        addEventListener("mouseOut", logUIEvent);
    }
    private function initLogger():void {
        myLogger = Log.getLogger("MyCustomClass");
    }

    private function logLifeCycleEvent(e:Event):void {
        if (Log.isInfo()) {
            dynamicLogger(LogEventLevel.INFO, e, "STARTUP");
        }
    }

    private function logUIEvent(e:MouseEvent):void {
        if (Log.isDebug()) {
            dynamicLogger(LogEventLevel.DEBUG, e, "EVENT");
        }
    }

    private function dynamicLogger(
            level:int,
            e:Event, prefix:String):void {
        var s:String = "__" + prefix + "__" + e.currentTarget +
            ":" + e.type;
        myLogger.log(level, s);
```

```
        }
    }
}
```

Compiler logging

Flex provides you with control over the output of warning and debug messages for the application and component compilers. When you compile, you can enable the message output to help you to locate and fix problems in your application.

For the command-line compiler, the settings that you use to control messages are defined in the flex-config.xml file or as command-line compiler options.

You have a high level of control over what compiler messages are displayed. For example, you can enable or disable messages such as binding-related warnings in the flex-config.xml file by using the `show-binding-warnings` option. The following example disables these messages in the flex-config.xml file:

```
<show-binding-warnings>false</show-binding-warnings>
```

You can also set this option on the command line.

For Flex Builder, you set error and warning options in the Compiler Properties dialog box. To open the Compiler Properties dialog box, select Project > Properties > Flex Compiler. You can enable or disable warnings in this dialog box. In addition, you can enter more specific options such as `show-binding-warnings` in the Additional Compiler Arguments field.

If you enable compiler messages, they are written to the console window (or System.out) by default.

Also in Flex Builder is a separate Eclipse Error Log file. This file stores messages from the Eclipse environment. The default location of this log file on Windows XP is c:\Documents and Settings*user_name*\workspace\.metadata\.log. For MacOS and Linux, the default location is also in the workspace directory, but files and directories that begin with a dot are hidden by default. As a result, you must make those files visible before you can view the log file.

For more information on the compiler logging settings, see “Viewing warnings and errors” on page 172.

Chapter 12: Using the Command-Line Debugger

If you encounter errors in your applications, you can use the debugging tools to set and manage breakpoints in your code; control application execution by suspending, resuming, and terminating the application; step into and over the code statements; select critical variables to watch; evaluate watch expressions while the application is running, and so on.

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About debugging

Debugging Adobe® Flex® applications can be as simple as enabling `trace()` statements or as complex as stepping into an application's source files and running the code, one line at a time. The Adobe® Flex® Builder™ debugger and the command-line debugger, fdb, let you step through and debug the files used by your Flex applications.

Note: *For information on debugging Adobe® AIR™ applications, see "Using the AIR development tools" in* Developing AIR Applications with Adobe Flex 3.

To debug a Flex application, you must generate a debug SWF file. This is a SWF file with debug information in it. You then connect fdb to the debugger version of Adobe® Flash® Player that is running the debug SWF file.

The debugger is an agent that communicates with the application that is running in Flash Player. It connects to your application with a local socket connection. As a result, you might have to disable anti-virus software to use it if your anti-virus software prevents socket communication. The debugger uses this connection to transfer information from the SWF file to the command line so that you can add breakpoints, inspect variables, and do other common debugging tasks. The port through which the debugger connects to your application is 7935. You cannot change this port.

This topic describes how to use the fdb command-line debugger. To use the Flex Builder debugger, see "Running and Debugging Applications" on page 136 in *Using Adobe Flex Builder 3*.To use either debugger, you must install and configure the debugger version of Flash Player. To determine if you are running the debugger version or the standard version of Flash Player, open any Flex application in the player and right-click the mouse button. If you see the Show Redraw Regions option, you are running the debugger version of Flash Player. For more information about the debugger version of Flash Player, and how to detect which player you are running, see "Using the debugger version of Flash Player" on page 228.

Using the command-line debugger

The fdb command-line debugger is located in the *flex_install_dir*/bin directory. To start fdb, open a command prompt, change to that directory, and enter **fdb**.

For a description of available commands, use the following command:

```
(fdb) help
```

For an overview of the fdb debugger, use the following command:

```
(fdb) tutorial
```

Generating debug SWF files

To debug a Flex application, you first generate a debug SWF file. Debug SWF files are similar to other application SWF files except that they contain debugging-specific information that the debugger and the debugger version of Flash Player use during debugging sessions. Debug SWF files are larger than non-debug SWF files, so generate them only when you are going to debug with them.

To generate the debug SWF file using the mxmlc command-line compiler, you set the `debug` option to `true`, either on the command line or in the flex-config.xml file. The following example sets the `debug` option to `true` on the command line:

```
mxmlc -debug=true myApp.mxml
```

Flex Builder generates debug SWF files by default in the project's /bin-debug directory. To generate a non-debug SWF file in Flex Builder, you use the Export Release Build feature. This generates a non-debug SWF file in the project's /bin-release directory. You can also manually set the `debug` compiler option to `false` in the Additional Compiler Arguments field of the project's properties.

To generate the debug SWF file using the web-tier compiler with the Flex module for Apache and IIS, you can either set the `debug` compiler option to `true` or append `debug=true` on the query string:

```
http://www.yourdomain.com/MyApp.mxml?debug=true
```

For more information, see "Invoking the debugger compiler" on page 350.

Command-line debugger limitations

The command-line debugger supports debugging only at the ActionScript level and does not support the Flash timeline concept. The debugger also does not support adding breakpoints inside script snippets in MXML tags. You can set breakpoints on event handlers defined for MXML tags.

Flash Player may interact with a server. The debugger does not assist in debugging the server-side portion of the application, nor does it offer support for inspecting any of the IP transactions that take place from Flash Player to the server, and vice versa.

Command-line debugger shortcuts

You can open commands within the fdb debugger by using the fewest number of nonambiguous keystrokes. For example, to use the `print` command, you can type **p**, because no other command begins with that letter.

Using the default browser

When you debug an application in a web browser, fdb opens the player in the default browser. The *default browser* is the browser that opens when you open a web-specific file without specifying an application. You must also have the debugger version of Flash Player installed with this browser. If you do not have the debugger version of Flash Player, Flash displays an error indicating that your Flash Player does not support all fdb commands.

Your default browser might not be the first browser that you installed on your computer. For example, if you installed another web browser *after* installing Microsoft Internet Explorer, Internet Explorer might not be your default browser.

Determine your default browser

1. From the Windows toolbar, select Start.
2. Select Run and enter a URL in the Run dialog box. For example:

   ```
   http://www.adobe.com
   ```

3. Click OK.

   Windows opens the default browser or displays an error message indicating that there is no application configured to handle your request.

Set Internet Explorer 6.x as your default browser

1. Open the Internet Explorer application.
2. Select Tools > Internet Options.
3. Select the Programs tab.

4 Select the “Internet Explorer should check to see whether it is the default browser” option, and click OK.

The next time you start Internet Explorer, Internet Explorer prompts you to make it the default browser. If you are not prompted, Internet Explorer is already your default browser.

Set Firefox as your default browser

1 Open the Firefox application.
2 Select Tools > Options.
3 Select the General icon to view general settings.
4 Select the “Firefox should check to see if it is the default browser when starting” option, and click OK.

The next time you start FireFox, FireFox prompts you to make it the default browser. If you are not prompted, FireFox is already your default browser.

About the source files

Each application can have any number of ActionScript files. Some of the files that fdb steps into are external class files, and some are generated by the Flex compilers.

In general, Flex generates a single file that contains ActionScript statements used in `<mx:Script>` blocks in the root MXML file, and an additional file for each ActionScript class that the application uses. Flex generates many source files so that you can navigate the application from within the debugger.

To view a list of files that are used by the application you are debugging, use the `info files` command. For more information, see “Getting status” on page 259.

The generated ActionScript class files are sometimes referred to as compilation units. For more information about compilation units, see “About incremental compilation” on page 157.

Starting a debugging session

You start a debugging session by using the fdb command-line debugger. After you start a session, you typically type **continue** once before you set break points and perform other debugging tasks. This is because the first frame that suspends debugging occurs before the application has finished initialization.

For more information about which commands are available after you start a debugging session, see “Using the command-line debugger commands” on page 251.

Starting a session with the stand-alone Flash Player

You can start a debugging session with the stand-alone debugger version of Flash Player. You do this by compiling the application into a SWF file, and then invoking the SWF file with the fdb command-line debugger. The fdb debugger opens the debugger version of the stand-alone Flash Player.

The debugger version of the stand-alone Flash Player runs as an independent application. It does not run within a web browser or other shell. The debugger version of the stand-alone Flash Player does not support any server requests, such as web services and dynamic SWF loading, so not all applications can be properly debugged inside the debugger version of the stand-alone Flash Player.

Debug with the stand-alone Flash Player

1 Compile the Flex application's debug SWF file and set the `debug` option to `true`.

The following example compiles an application with the mxmlc command-line compiler:

```
mxmlc -debug=true myApp.mxml
```

You can also compile an application SWF file by using the web-tier compiler or the Flex Builder compiler. For more information on Flex compilers, see "About the Flex compilers" on page 125.

2 Find the *flex_install_dir*/bin directory. You installed the Flex application files to this directory.

3 Type **fdb** from the command line. The fdb prompt appears.

You can also open fdb with the JAR file, as the following example shows:

```
java -jar ../lib/fdb.jar
```

4 Type **run** at the fdb prompt, followed by the path to the SWF file, as shown in the following example:

```
(fdb) run c:/myfiles/fonts/EmbedMyFont.swf
```

The fdb debugger starts the Flex application in the debugger version of the stand-alone Flash Player, and the `(fdb)` command prompt appears. You can also start a session by typing **`fdb`** *filename***`.swf`** at the command prompt, rather than by using the `run` command.

Starting a session in a browser

You can start a debugging session in a browser. This requires that you pre-compile the SWF file and are able to request it from a web server.

Debug in a browser

1 Compile the Flex application's debug SWF file and set the `debug` option to `true`. The following example compiles an application with the mxmlc command-line compiler:

```
mxmlc -debug=true myApp.mxml
```

You can also compile an application SWF file by using the web-tier compiler or the Flex Builder compiler. For more information on Flex compilers, see "About the Flex compilers" on page 125.

2 Create an HTML wrapper that embeds this SWF file, if you have not already done so. For more information on creating a wrapper, see "Creating a Wrapper" on page 311.

3 Copy the SWF file and its wrapper files to your web server.

4 Find the *flex_install_dir*/bin directory. You installed the Flex application files to this directory.

5 Type **fdb** in the command line. The fdb prompt appears.

You can also open fdb with the JAR file, as the following example shows:

```
java -jar ../lib/fdb.jar
```

6 Type **run** at the fdb prompt:

```
(fdb) run
```

This instructs fdb to wait for a player to connect to it.

7 In your browser, request a wrapper that embeds the debug SWF file. Do not request the SWF file directly in a browser because some browsers do not allow you to run a SWF file directly.

Alternatively, you can type **`run`** *filename***`.html`** at the command line, and fdb launches the browser for you. The filename should include the entire URL; for example:

```
(fdb) run http://localhost:8100/flexapps/index.html
```

Configuring the command-line debugger

You can configure the current session of the fdb command-line debugger using variables that exist entirely within fdb; they are not part of your application. The configuration variables are prefixed with $.

The following table describes the most common configuration variables used by fdb:

Variable	Description
`$invokegetters`	Set to 0 to prevent fdb from firing getter functions. The default value is `1` (enabled).
`$listsize`	Sets the number of lines to display with the list command. The default value is `10`.

To set the value of a configuration variable, you use the `set` command, as the following example shows:

```
(fdb) set $invokegetters = 0
```

For more information on using the `set` command, see "Changing data values" on page 256.

Using the command-line debugger commands

The fdb command-line debugger includes commands that you use to debug and navigate your Flex application.

Running the debugger

The fdb debugger provides several commands for stepping through the debugged application's files. The following table summarizes those commands:

Command	Description
`continue`	Continues running the application.
`file [`*`file`*`]`	Specifies an application to be debugged, without starting it. This command does not cause the application to start; use the `run` command without an argument to start debugging the application.
`finish`	Continues until the function exits.
`next [`*`N`*`]`	Continues to the next source line in the application. The optional argument *`N`* means do this *`N`* times or until the program stops for some other reason.
`quit`	Exits from the debug session.
`run [`*`file`*`]`	Starts a debugging session by running the specified file. To run the application that the file command previously specified, execute the `run` command without any options. The `run` command starts the application in a browser or stand-alone Flash Player.
`step [`*`N`*`]`	Steps into the application. The optional argument *`N`* means do this *`N`* times or until the program stops for some other reason. These commands are nonblocking, which means that when they return, the client has at least begun the operation, but it has not necessarily finished it.

When you start a session, fdb stops execution before Flex renders the application on the screen. Use the `continue` command to get to the application's starting screen.

The following example shows a sample application after it starts:

```
(fdb) continue
[trace] ComboBase: y = undefined text_mc.bl = undefined
[trace] ComboBase: y = undefined text_mc.bl = undefined
[trace] ComboBase: y = undefined text_mc.bl = undefined
[trace] ComboBase: y = undefined text_mc.bl = undefined
[trace] ComboBase: y = undefined text_mc.bl = undefined
[trace] ComboBase: y = undefined text_mc.bl = undefined
[trace] ComboBase: y = undefined text_mc.bl = undefined
```

```
[trace] RadioButtonGroup.addInstance: instance = _level0._VBox0._Accordion0._For
m2._FormItem3._RadioButton1 data = undefined label = 2005
[trace] RadioButtonGroup.addInstance: instance = _level0._VBox0._Accordion0._For
m2._FormItem3._RadioButton2 data = undefined label = 2004
[trace] RadioButtonGroup.addInstance: instance = _level0._VBox0._Accordion0._For
m2._FormItem3._RadioButton3 data = undefined label = 2005
[trace] RadioButtonGroup.addInstance: instance = _level0._VBox0._Accordion0._For
m2._FormItem3._RadioButton4 data = undefined label = 2006
[trace] ComboBase: y = 0 text_mc.bl = 12
[trace] ComboBase: y = 0 text_mc.bl = 12
[trace] ComboBase: y = 0 text_mc.bl = 12
[trace] ComboBase: y = 0 text_mc.bl = 14
```

During the debugging session, you interact with the application in the debugger version of Flash Player. For example, if you select an item from the drop-down list, the debugger continues to output information to the command window:

```
[trace] SSL : ConfigureScrolling
[trace] SSP : 5 51 true 47
[trace] ComboBase: y = 0 text_mc.bl = 14
[trace] layoutChildren : bRowHeightChanged
[trace] >>SSL:layoutChildren
[trace] deltaRows 5
[trace] rowCount 5
[trace] <<SSL:layoutChildren
[trace] >>SSL:draw
[trace] bScrollChanged
[trace] SSL : ConfigureScrolling
[trace] SSP : 5 51 false 46
[trace] SSL Drawing Rows in UpdateControl 5
[trace] <<SSL:draw
```

You can store commonly used commands in a source file, and then load that file by using the `source` command. For more information, see "Accessing commands from a file" on page 254.

Setting breakpoints

Setting breakpoints is a critical aspect of debugging any application. You can set breakpoints on any ActionScript code in your Flex application. You can set breakpoints on statements in any external ActionScript file, on Action-Script statements in an `<mx:Script>` tag, or on MXML tags that have event handler properties. In the following MXML code, `click` is an event handler property:

```
<mx:Button click="ws.getWeather.send();"/>
```

Breakpoints are maintained from session to session. However, when you change the target file or quit fdb, break-points are lost.

The following table summarizes the commands for manipulating breakpoints with the ActionScript debugger:

Command	Description
`break [args]`	Sets a breakpoint at the specified line or function. The argument can be a line number or function name. With no arguments, the `break` command sets a breakpoint at the currently stopped line (not the currently listed line). If you specify a line number, fdb breaks at the start of code for that line. If you specify a function name, fdb breaks at the start of code for that function.
`clear [args]`	Clears a breakpoint at the specified line or function. The argument can be a line number or function name. If you specify a line number, fdb clears a breakpoint in that line. If you specify a function name, fdb clears a breakpoint at the beginning of that function. With no argument, fdb clears a breakpoint in the line that the selected frame is executing in. Compare the `delete` command, which clears breakpoints by number.
`commands [`*breakpoint*`]`	Sets commands to execute when the specified breakpoint is encountered. If you do not specify a breakpoint, the commands are applied to the last breakpoint.

`condition` *bnum* `[`*expression*`]`	Specifies a condition that must be met to stop at the given breakpoint. The fdb debugger evaluates *expression* when the *bnum* breakpoint is reached. If the value is `true` or nonzero, fdb stops at the breakpoint. Otherwise, fdb ignores the breakpoint and continues execution.
	
	To remove the condition from the breakpoint, do not specify an *expression*.
	
	You can use conditional breakpoints to stop on all events of a particular type. For example, to stop on every `initialize` event, use the following commands:
	
	`(fdb) break UIEvent:dispatch`
	`Breakpoint 18 at 0x16cb3: file UIEventDispatcher.as, line 190`
	`(fdb) condition 18 (eventObj.type == 'initialize')`

`delete [args]`	Deletes breakpoints. Specify one or more comma- or space-separated breakpoint numbers to delete those breakpoints. To delete all breakpoints, do not provide an argument.
`disable breakpoints [`*bp_num*`]`	Disables breakpoints. Specify one or more space-separated numbers as options to disable only those breakpoints.
`enable breakpoints [`*bp_num*`]`	Enables breakpoints that were previously disabled. Specify one or more space-separated numbers as options to enable only those breakpoints.

The following example sets a breakpoint on the `myFunc()` method, which is triggered when the user clicks a button:

```
(fdb) break myFunc
Breakpoint 1 at 0x401ef: file file1.mxml, line 5
(fdb) continue
```

```
Breakpoint 1, myFunc() at file1.mxml:5
 5ta1.text = "Clicked";
(fdb)
```

To see all breakpoints and their numbers, use the `info breakpoints` command. This will also tell you if a breakpoint is unresolved.

You can use the `commands` command to periodically print out values of objects and variables whenever fdb encounters a particular breakpoint. The following example prints out the value of ta1.text (referred to as `$1`), executes the `where` command, and then continues when it encounters the button's click handler breakpoint:

```
(fdb) commands 1
Type commands for when breakpoint 1 is hit, one per line.
End with a line saying just 'end'.
>print ta1.text
>where
>continue
>end
(fdb) cont
Breakpoint 1, myFunc() at file1.mxml:5
 5ta1.text = "Clicked";
$1 = ""
#0 [MovieClip 1].myFunc(event=undefined) at file1.mxml:5
#1 [MovieClip 1].handler(event=[Object 18127]) at file1.mxml:15
```

Breakpoints are not specific to a single SWF file. If you set a breakpoint in a file that is common to multiple SWF files, fdb applies the breakpoint to all SWF files.

For example, suppose you have four SWF files loaded and each of those SWF files contains the same version of an ActionScript file, view.as. To set a breakpoint in the `init()` function of the view.as file, you need to set only a single breakpoint in one of the view.as files. When fdb encounters any of the `init()` functions, it triggers the break.

Accessing commands from a file

You can use the `source` command to read fdb commands from a file and execute them. This lets you write commands such as breakpoints once and use them repeatedly when debugging the same application in different sessions or across different applications.

The `source` command has the following syntax:

```
(fdb) source file
```

The value of file can be a filename for a file in the current working directory or an absolute path to a remote file. To determine the current working directory, use the `pwd` command.

The following examples read in the mycommands.txt file from different locations:

```
(fdb) source mycommands.txt
(fdb) source mydir\mycommands.txt
(fdb) source c:\mydir\mycommands.txt
```

Examining data values

The `print` command displays values of members such as variables, objects, and properties. This command excludes functions, static variables, constants, and inaccessible member variables (such as the members of an Array).

The `print` command uses the following syntax:

```
print [variable_name | object_name[.] | property]
```

The `print` command prints the value of the specified variable, object, or property. You can specify the `name` or `name.property` to narrow the results. If fdb can determine the type of the entity, fdb displays the type.

If you specify the `print` command on an object, fdb displays a numeric identifier for the object.

To list all the properties of an object, use trailing dot-notation syntax. The following example prints all the properties of the object myButton:

```
(fdb) print myButton
```

To print the value of a single variable, use dot-notation syntax, as the following example shows:

```
(fdb) print myButton.label
```

Use the `what` command to view the context of a variable. The `what` command has the following syntax:

```
(fdb) what variable
```

Use the `display` command to add an expression to the autodisplay list. Every time debugging stops, fdb prints the list of expressions in the autodisplay list. The `display` command has the following syntax:

```
(fdb) display [expression]
```

The expression is the same as the arguments for the `print` command, as the following example shows:

```
(fdb) display myButton.color
```

To view all expressions on the autodisplay list, use the `info display` command.

To remove an expression from the autodisplay list, use the `undisplay` command. The `undisplay` command has the following syntax:

```
(fdb) undisplay [list_num]
```

Use the `undisplay` command without an argument to remove all entries on the autodisplay list. Specify one or more `list_num` options separated by spaces to remove numbered entries from the autodisplay list.

You can temporarily disable autodisplay expressions by using the `disable display` command. The `disable display` command has the following syntax:

```
(fdb) disable display [display_num]
```

Specify one or more space-separated numbers as options to disable only those entries in the autodisplay list.

To re-enable the display list, use the `enable display` command, which has the same syntax as the `disable display` command.

Changing data values

You can use the `set` command to assign the value of a variable or a configuration variable. The `set` command has the following syntax:

```
set [expression]
```

Depending on the variable type, you use different syntax for the *`expression`*. The following example sets the variable `i` to the number 3:

```
(fdb) set i = 3
```

The following example sets the variable `employee.name` to the string `Reiner`:

```
(fdb) set employee.name = "Reiner"
```

The following example sets the convenience variable `$myVar` to the number `20`:

```
(fdb) set $myVar = 20
```

You use the `set` command to set the values of fdb configuration variables. For more information, see "Configuring the command-line debugger" on page 250.

Viewing file contents

You use the `list` command to view lines of code in the ActionScript files. The `list` command uses the following syntax:

```
list [- | line_num[,line_num] | [file_name:]line_num | file_name[:line_num] |
[file_name:]function_name]
```

You use the `list` command to print the lines around the specified function or line of the current file. If you do not specify an argument, `list` prints 10 lines after or around the previous listing. If you specify a filename, but not a line number, `list` assumes line 1.

If you specify a single numeric argument, the `list` command lists 10 lines around that line. If you specify more than one comma-separated numeric argument, the `list` command displays lines between and including those line numbers.

To set the list location to where the execution is currently stopped, use the `home` command.

The following example lists code from line 10 to line 15:

```
(fdb) list 10, 15
```

If you specify a hyphen (-) in the previous example, the `list` command displays the 10 lines before a previous 10-line listing.

Specify a line number to list the lines around that line in the current file, as in the following example:

```
(fdb) list 10
```

Specify a filename followed by a line number to list the lines around that line in that file, as in the following example:

```
(fdb) list effects.mxml:10
```

Specify a function name to list the lines around the beginning of that function, as in the following example:

```
(fdb) list myFunction
```

Specify a filename followed by a function name to list the lines around the beginning of that function. This lets you distinguish among like-named static functions, as follows:

```
(fdb) list effects.mxml:myFunction
```

You can resolve ambiguous matches by extending the value of the function name or filename, as the following examples show:

Filenames:

```
(fdb) list UIOb
Ambiguous matching file names:
UIComponent.as#66
UIComponentDescriptor.as#67
UIComponentExtensions.as#68
(fdb) list UIComponent.
```

Function names:

```
(fdb) list init

Ambiguous matching function names:
init
initFromClipParameters
(fdb) list init(
```

Viewing and changing the current file

The `list` command acts on the current file by default. To change to a different file, use the `cf` command. The `cf` command has the following syntax:

```
(fdb) cf [file_name|file_number]
```

For example, to change the file to MyApp.mxml, use the following command:

```
(fdb) cf MyApp.mxml
```

If you do not specify a filename, the `cf` command lists the name and file number of the current file.

To view a list of all files used by the current application, use the `info files` command. For more information, see "Getting status" on page 259.

Viewing the current working directory

Use the `pwd` command to view the file system's current working directory, as the following example shows. This is the directory from which fdb was run.

```
(fdb) pwd
c:/Flex2SDK/bin/
```

Locating source files

Usually, fdb can find the source files for your application to display them with the `list` command. In some situations, however, you need to add a directory to the search path so that fdb can find the source files. This can be necessary, for example, when the application was compiled on a different computer than you are using to debug the application.

You use the `directory` command to add a directory to the search path. This command adds the specified directory or directories to the beginning of the list of directories that fdb searches for source files. The syntax for the `directory` command is as follows:

```
(fdb) directory path
```

For example:

```
(fdb) directory C:\MySource;C:\MyOtherSource
```

On Windows, use the semicolon character as a separator. On Macintosh and UNIX, use the colon character as a separator.

To see the current list of directories in the search path, use the `show directories` command.

Using truncated file and function names

The fdb debugger supports truncated file and function names. You can specify *`file_name`* and *`function_name`* arguments with partial names, as long as the names are unambiguous.

If you use truncated file and function names, fdb tries to map the argument to an unambiguous function name first, and then a filename. For example, `list foo` first tries to find a function unambiguously starting with *foo* in the current file. If this fails, it tries to find a file unambiguously starting with *foo*.

Printing stack traces

Use the `bt` command to display a back trace of all stack frames. The `bt` command has the following syntax:

```
(fdb) bt
```

Getting status

Use the `info` command to get general information about the application. The `info` command has the following syntax:

```
info [options] [args]
```

The `info` command displays general information about the application being debugged. The following table describes the options of the `info` command:

Option	Description
`arguments`	Displays the argument variables of the current stack frame.
`breakpoints`	Displays the status of user-settable breakpoints.
`display`	Displays the list of autodisplay expressions.

`files [arg]`	Displays the names of all files used by the target application. This includes authored files and system files, plus generated files. Also indicates the file number for each file.
	
	You can use wildcards and literals to select and sort the output. The `info files` command supports the following:
	
	`info files character` Alphabetically lists files with names that start with the specified *character*. The following example lists all files starting with the letter V:
	
	`info files V`
	
	`info files *.extension` Alphabetically lists all files with the given extension. The following example lists all files with the as extension:
	
	`info files *.as`
	
	`info files *string*` Alphabetically lists all files with names that include *string*.

Option	Description
`functions [arg]`	Displays all function names used in this application. The `info functions` command optionally takes an argument; for example: `info functions` Lists all functions in all files. `info functions` Lists all functions in the current file. `info functions MyApp.mxml` Lists all functions in the MyApp.mxml file.
`handle`	Displays settings for fault handling in the debugger.
`locals`	Displays the local variables of the current stack frame.
`sources`	Displays authored source files used by the target application.
`stack`	Displays the backtrace of the stack.
`swfs`	Displays all current SWF files.
`targets`	Displays the HTTP or file URL of the target application.
`variables`	Displays all global and static variable names.

For additional information about these options, use the `help` command, as the following example shows:

```
(fdb) help info targets
```

Handling faults

Use the `handle` command to specify how fdb reacts to Flash Player exceptions during execution. To view the current settings, use the `info` command, as the following example shows:

```
(fdb) info handle
```

The `handle` command has the following syntax:

```
(fdb) handle exception [action]
```

The *`fault_type`* is the category of fault that fdb handles. The *`action`* is what fdb does in response to that fault. The possible actions are `print`, `noprint`, `stop`, and `nostop`. The following table describes these actions:

Action	Description
`print`	Prints a message if this type of fault occurs.
`noprint`	Does not print a message if this type of fault occurs.

Action	Description
`stop`	Stops execution of the debugger if this type of fault occurs.
`nostop`	Does not stop execution of the debugger if this type of fault occurs.

Getting help

Use the `help` command to get information on particular topics. The `help` command has the following syntax:

```
help [topic]
```

The `help` command provides a relatively terse description of each command and its usage. The following example opens the `help` command:

```
(fdb) help
```

Type **help** followed by the command name to get the full help information, as the following example shows:

```
(fdb) help delete
```

Terminating the session

You use the `kill` and `exit` commands to end the current debugging session and exit from the fdb application. The `kill` and `exit` commands do not take any arguments. If fdb opened the default browser, you can also terminate the fdb session by closing the browser window.

To stop the current session, use the `kill` command, as the following example shows:

```
(fdb) kill
```

Using the `kill` command does not quit the fdb application. You can immediately start another session. To exit from fdb, use the `exit` command, as follows:

```
(fdb) exit
```

Chapter 13: Using ASDoc

ASDoc is a command-line tool that you can use to create API language reference documentation as HTML pages from the classes in your Adobe® Flex™ application. The Adobe Flex team uses the ASDoc tool to generate the *Adobe Flex Language Reference*.

Topics

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About the ASDoc tool

The ASDoc tool parses one or more ActionScript class definitions and MXML files, and generates API language reference documentation for all public and protected methods and properties, and for all `[Bindable]`, `[DefaultProperty]`, `[Event]`, `[Style]`, and `[Effect]` metadata tags.

You can specify a single class, multiple classes, an entire namespace, or a combination of these inputs as inputs to the ASDoc tool.

ASDoc generates its output as a directory structure of HTML files that matches the package structure of the input class files. Also, ASDoc generates an index of all public and protected methods and properties. To view the ASDoc output, you open the index.html file in the top-level directory of the output.

Invoking the ASDoc tool

To invoke ASDoc, invoke the `asdoc` utility from the bin directory of your Flex installation. For example, from the bin directory, enter the following command to create output for the Flex Button class:

```
asdoc -source-path C:\flex\frameworks\source
    -doc-classes mx.controls.Button
    -main-title "Flex API Documentation"
    -window-title "Flex API Documentation"
    -output flex-framework-asdoc
```

In this example, the source code for the Button class is in the directory C:\flex\frameworks\source\mx\controls. The output is written to C:\flex\bin\flex-framework-asdoc directory.

To view the output, open the file C:\flex\bin\flex-framework-asdoc\index.html. For more information on running the `asdoc` command, see "Running the ASDoc tool" on page 280.

Creating ASDoc comments

A standard programing practice is to include comments in source code. The ASDoc tool recognizes a specific type of comment in your source code and copies that comment to the generated output. The ASDoc tool recognizes the following formatting and parsing rules for comments.

Writing an ASDoc comment

An ASDoc comment consists of the text between the characters `/**` that mark the beginning of the ASDoc comment, and the characters `*/` that mark the end of it. The text in a comment can continue onto multiple lines.

Use the following format for an ASDoc comment:

```
/**
* Main comment text.
*
* @tag Tag text.
*/
```

As a best practice, prefix each line of an ASDoc comment with an asterisk (*) character, followed by a single white space to make the comment more readable in the ActionScript or MXML file, and to ensure correct parsing of comments. When the ASDoc tool parses a comment, the leading asterisk and white space characters on each line are discarded; blanks and tabs preceding the initial asterisk are also discarded.

The ASDoc comment in the previous example creates a single-paragraph description in the output. To add additional comment paragraphs, enclose each subsequent paragraph in HTML paragraph tags, `<p></p>`. You must close the `<p>` tag, in accordance with XHTML standards, as the following example shows:

```
/**
* First paragraph of a multiparagraph description.
*
* <p>Second paragraph of the description.</p>
*/
```

All of the classes that ship with Flex contain the ASDoc comments that appear in the *Adobe Flex Language Reference*. For example, view the mx.controls.Button class for examples of ASDoc comments.

Placing ASDoc comments

Place an ASDoc comment immediately before the declaration for a class, interface, constructor, method, property, or metadata tag that you want to document, as the following example shows for the `myMethod()` method:

```
/**
* This is the typical format of a simple
* multiline (single paragraph) main description
* for the myMethod() method, which is declared in
* the ActionScript code below.
* Notice the leading asterisks and single white space
* following each asterisk.
*/
public function myMethod(param1:String, param2:Number):Boolean {}
```

The ASDoc tool ignores comments placed in the body of a method and recognizes only one comment per ActionScript statement.

A common mistake is to put an `import` statement between the ASDoc comment for a class and the `class` declaration. Because an ASDoc comment is associated with the next ActionScript statement in the file after the comment, this example associates the comment with the import statement, not the `class` declaration:

```
/**
* This is the class comment for the class MyClass.
*/
import flash.display.*; // MISTAKE - Do not to put import statement here.
class MyClass {
}
```

Formatting ASDoc comments

The main body of an ASDoc comment begins immediately after the starting characters, `/**`, and continues until the tag section, as the following example shows:

```
/**
* Main comment text continues until the first @ tag.
*
* @tag Tag text.
*/
```

The first sentence of the main description of the ASDoc comment should contain a concise but complete description of the declared entity. The first sentence ends at the first period that is followed by a space, tab, or line terminator.

ASDoc uses the first sentence to populate the summary table at the top of the HTML page for the class. Each type of class element (method, property, event, effect, and style) has a separate summary table in the ASDoc output.

The tag section begins with the first ASDoc tag in the comment, which is defined by the first @ character that begins a line, ignoring leading asterisks, white space, and the leading separator characters, `/**`. The main description cannot continue after the tag section begins.

The text following an ASDoc tag can span multiple lines. You can have any number of tags, where some tags can be repeated, such as the `@param` and `@see` tags, while others cannot.

The following example shows an ASDoc comment that includes a main description and a tag section. Notice the use of white space and leading asterisks to make the comment more readable:

```
/**
* Typical format of a simple multiline comment.
* This text describes the myMethod() method, which is declared below.
*
* @param param1 Describe param1 here.
* @param param2 Describe param2 here.
*
* @return Describe return value here.
*
* @see someOtherMethod
*/
public function myMethod(param1:String, param2:Number):Boolean {}
```

For a complete list of the ASDoc tags, see "ASDoc tags" on page 275.

Using the @private tag

By default, the ASDoc tool generates output for all public and protected elements in an ActionScript class, even if you omit the ASDoc comment. To make ASDoc ignore an element, insert an ASDoc comment that contains the `@private` tag anywhere in the comment. The ASDoc comment can contain additional text along with the `@private` tag, which is also excluded from the output.

ASDoc also generates output for all public classes in the list of input classes. You can specify to ignore an entire class by inserting an ASDoc comment that contains the `@private` tag before the class definition. The ASDoc comment can contain additional text along with the `@private` tag, which is also excluded from the output.

Excluding an inherited element

By default, the ASDoc tool copies information and a link for all ActionScript elements inherited by a subclass from a superclass. In some cases, a subclass may not support an inherited element. You can use the `[Exclude]` metadata tag to cause ASDoc to omit the inherited element from the list of inherited elements.

The `[Exclude]` metadata tag has the following syntax:

```
[Exclude(name="elementName", kind="property|method|event|style|effect")]
```

For example, to exclude documentation on the `click` event in the MyButton subclass of the Button class, insert the following `[Exclude]` metadata tag in the MyButton.as file:

```
[Exclude(name="click", kind="event")]
```

Using HTML tags

You must write the text of an ASDoc comment in XHTML-compliant HTML. You can use selected HTML entities and HTML tags to define paragraphs, format text, create lists, and add anchors. For a list of the supported HTML tags, see "Summary of commonly used HTML elements" on page 279.

The following example comment contains HTML tags to format the output:

```
/**
* This is the typical format of a simple multiline comment
* for the myMethod() method.
*
* <p>This is the second paragraph of the main description
* of the <code>myMethod</code> method.
* Notice that you do not use the paragraph tag in the
* first paragraph of the description.</p>
*
* @param param1 Describe param1 here.
* @param param2 Describe param2 here.
*
* @return A value of <code>true</code> means this;
* <code>false</code> means that.
*
* @see someOtherMethod
*/
public function myMethod(param1:String, param2:Number):Boolean {}
```

Using special characters

The ASDoc tool might fail if your source files contain non-UTF-8 characters such as curly quotes. If it does fail, the error messages it displays should refer to a line number in the interim XML file that was created for that class. That can help you track down the location of the special character.

ASDoc passes all HTML tags and tag entities in a comment to the output. Therefore, if you want to use special characters in a comment, you must enter them using HTML code equivalents. For example, to use a less-than (<) or greater-than (>) symbols in a comment, use `<` and `>`. To use the at-sign (@) in a comment, use `&64;`. Otherwise, these characters will be interpreted as literal HTML characters in the output.

For a list of common HTML tags and their entity equivalents, see "Summary of commonly used HTML elements" on page 279.

Because asterisks (*) are used to delimit comments, ASDoc does not support asterisks within a comment. To use an asterisk in an ASDoc comment, you must use the double tilde (~~).

Hiding text in ASDoc comments

The ASDoc style sheet contains a class called `hide`, which you use to hide text in an ASDoc comment by setting the class attribute to `hide`. Hidden text does not appear in the ASDoc HTML output, but does appear in the generated HTML file so you should not use it for confidential information. The following example uses the `hide` class:

```
/**
*Dispatched when the user presses the Button control.
*If the <code>autoRepeat</code> property is <code>true</code>,
*this event is dispatched repeatedly as long as the button stays down.
*
*<span class="hide">This text is hidden.</span>
*@eventType mx.events.FlexEvent.BUTTON_DOWN
*/
```

Rules for parsing ASDoc comments

The following rules summarize how ASDoc processes an ActionScript file:

- If an ASDoc comment precedes an ActionScript element, ASDoc copies the comment and code element to the output file.
- If an ActionScript element is not preceded by an ASDoc comment, ASDoc copies the code element to the output file with an empty description.
- If an ASDoc comment contains the `@private` ASDoc tag, the associated ActionScript element and the ASDoc comment are ignored.
- The comment text should always precede any @ tags, otherwise the comment text is interpreted as an argument to an @ tag. The only exception is the `@private` tag, which can appear anywhere in an ASDoc comment.
- HTML tags, such as `<p></p>`, and `<ul></ul>`, in ASDoc comments are passed through to the output.
- HTML tags must use XML style conventions, which means there must be a beginning and ending tag. For example, an `<li>` tag must always be closed by a `</li>` tag.

Documenting ActionScript elements

You can add ASDoc comments to class, property, method, and metadata elements to document ActionScript classes. For more information on documenting MXML files, see "Documenting MXML files" on page 274.

Documenting classes

The ASDoc tool automatically includes all public classes in its output. Place the ASDoc comment for a class just before the `class` declaration, as the following example shows:

```
/**
* The MyButton control is a commonly used rectangular button.
* MyButton controls look like they can be pressed.
* They can have a text label, an icon, or both on their face.
*/
public class MyButton extends UIComponent {
}
```

This comment appears at the top of the HTML page for the associated class.

To configure ASDoc to omit the class from the output, insert an @private tag anywhere in the ASDoc comment, as the following example shows:

```
/**
* @private
* The MyHiddenButton control is for internal use only.
*/
public class MyHiddenButton extends UIComponent {
}
```

Documenting properties

The ASDoc tool automatically includes all public and protected properties in its output. You can document properties that are defined as variables or defined as setter and getter methods.

Documenting properties defined as variables

Place the ASDoc comment for a public or protected property that is defined as a variable just before the `var` declaration, as the following example shows:

```
/**
*The default label for MyButton.
*
*@default null
```

```
*/
public var myButtonLabel:String;
```

A best practice for a property is to include the `@default` tag to specify the default value of the property. The `@default` tag has the following format:

```
@default value
```

This tag generates the following text in the output for the property:

```
The default value is value.
```

For properties that have a calculated default value, or a complex description, omit the `@default` tag and describe the default value in text.

ActionScript lets you declare multiple properties in a single statement. However, this does not allow for unique documentation for each property. Such a statement can have only one ASDoc comment, which is copied for all properties in the statement. For example, the following documentation comment does not make sense when written as a single declaration and would be better handled as two declarations:

```
/**
 * The horizontal and vertical distances of point (x,y)
 */
public var x, y;// Avoid this
```

ASDoc generates the following documentation from the preceding code:

```
public var x
    The horizontal and vertical distances of point (x,y)

public var y
    The horizontal and vertical distances of point (x,y)
```

Documenting properties defined by setter and getter methods

Properties that are defined by setter and getter methods are handled in a special way by the ASDoc tool because these elements are used as if they were properties rather than methods. Therefore, ASDoc creates a property definition for an item that is defined by a setter or a getter method.

If you define a setter method and a getter method, insert a single ASDoc comment before the getter, and mark the setter as `@private`. Adobe recommends this practice because usually the getter comes first in the ActionScript file, as the following example shows:

```
/**
* Indicates whether or not the text field is enabled.
*/
public function get html():Boolean {};

/**
```

```
* @private
*/
public function set html(value:Boolean):void {};
```

The following rules define how ASDoc handles properties defined by setter and getter methods:

- If you precede a setter or getter method with an ASDoc comment, the comment is included in the output.
- If you define both a setter and a getter method, only a single ASDoc comment is needed – either before the setter or before the getter.
- If you define a setter method and a getter method, insert a single ASDoc comment before the getter, and mark the setter as `@private`.
- You do not have to define the setter method and getter method in any particular order, and they do not have to be consecutive in the source-code file.
- If you define just a getter method, the property is marked as read-only.
- If you define just a setter method, the property is marked as write-only.
- If you define both a public setter and public getter method in a class, and you want to hide them by using the `@private` tag, they both must be marked `@private`.
- If you have only one public setter or getter method in a class, and it is marked `@private`, ASDoc applies normal `@private` rules and omits it from the output.
- A subclass always inherits its visible superclass setter and getter method definitions.

Documenting methods

The ASDoc tool automatically includes all public and protected methods in its output. Place the ASDoc comment for a public or protected method just before the `function` declaration, as the following example shows:

```
/**
* This is the typical format of a simple multiline documentation comment
* for the myMethod() method.
*
* <p>This is the second paragraph of the main description
* of the <code>myMethod</code> method.
* Notice that you do not use the paragraph tag in the
* first paragraph of the description.</p>
*
* @param param1 Describe param1 here.
* @param param2 Describe param2 here.
*
* @return A value of <code>true</code> means this;
* <code>false</code> means that.
*
```

```
* @see someOtherMethod
*/
public function myMethod(param1:String, param2:Number):Boolean {}
```

If the method takes an argument, include an `@param` tag for each argument to describe the argument. The order of the `@param` tags in the ASDoc comment should match the order of the arguments to the method. The `@param` tag has the following syntax:

```
@param paramName description
```

Where *paramName* is the name of the argument and *description* is a description of the argument.

If the method returns a value, use the `@return` tag to describe the return value. The `@return` tag has the following syntax:

```
@return description
```

Where *description* describes the return value.

Documenting metadata

Flex uses metadata tags to define elements of a component. ASDoc recognizes these metadata tags and treats them as if there were properties or method definitions. The metadata tags recognized by ASDoc include:

- `[Bindable]`
- `[DefaultProperty]`
- `[Effect]`
- `[Event]`
- `[Style]`

For more information on these metadata tags, see "Metadata Tags in Custom Components" on page 33 in *Creating and Extending Adobe Flex 3 Components*.

Documenting bindable properties

A bindable property is any property that can be used as the source of a data binding expression. To mark a property as bindable, you insert the `[Bindable]` metadata tag before the property definition, or before the class definition to make all properties defined within the class bindable.

When a property is defined as bindable, ASDoc automatically adds the following line to the output for the property:

```
This property can be used as the source for data binding.
```

For more information on the `[Bindable]` metadata tag, see "Metadata Tags in Custom Components" on page 33 in *Creating and Extending Adobe Flex 3 Components*.

Documenting default properties

The `[DefaultProperty]` metadata tag defines the name of the default property of the component when you use the component in an MXML file.

When ASDoc encounters the `[DefaultProperty]` metadata tag, it automatically adds a line to the class description that specifies the default property. For example, see the List control in *Adobe Flex Language Reference*.

For more information on the `[DefaultProperty]` metadata tag, see "Metadata Tags in Custom Components" on page 33 in *Creating and Extending Adobe Flex 3 Components*.

Documenting effects, events, and styles

You use metadata tags to add information about effects, events, and styles in a class definition. The `[Effect]`, `[Event]`, and `[Style]` metadata tags typically appear at the top of the class definition file. To document the metadata tags, insert an ASDoc comment before the metadata tag, as the following example shows:

```
/**
* Defines the name style.
*/
[Style "name"]
```

For events and effects, the metadata tag includes the name of the event class associated with the event or effect. The following example shows an event definition from the Flex mx.controls.Button class:

```
/**
* Dispatched when the user presses the Button control.
* If the <code>autoRepeat</code> property is <code>true</code>,
* this event is dispatched repeatedly as long as the button stays down.
*
* @eventType mx.events.FlexEvent.BUTTON_DOWN
*/
[Event(name="buttonDown", type="mx.events.FlexEvent")]
```

In the ASDoc comment for the `mx.events.FlexEvent.BUTTON_DOWN` constant, you insert a table that defines the values of the `bubbles`, `cancelable`, `target`, and `currentTarget` properties of the Event class, and any additional properties added by a subclass of Event. At the end of the ASDoc comment, you insert the `@eventType` tag so that ASDoc can find the comment, as the following example shows:

```
/**
* The FlexEvent.BUTTON_DOWN constant defines the value of the
* <code>type</code> property of the event object
* for a <code>buttonDown</code> event.
*
* <p>The properties of the event object have the following values:</p>
* <table class=innertable>
* <tr><th>Property</th><th>Value</th></tr>
* ...
```

```
* </table>
*
* @eventType buttonDown
*/
 public static const BUTTON_DOWN:String = "buttonDown"
```

The ASDoc tool does several things for this event:

- In the output for the mx.controls.Button class, ASDoc creates a link to the event class that is specified by the `type` argument of the `[Event]` metadata tag.
- ASDoc copies the description of the `mx.events.FlexEvent.BUTTON_DOWN` constant to the description of the `buttonDown` event in the Button class.

For a complete example, see the mx.controls.Button and mx.events.FlexEvent classes.

For more information on the `[Effect]`, `[Event]`, and `[Style]` metadata tags, see “Metadata Tags in Custom Components” on page 33 in *Creating and Extending Adobe Flex 3 Components*.

Documenting MXML files

You can use the ASDoc tool with MXML files as well as ActionScript files. All ActionScript entities defined in an `<mx:Script>` block, such as properties and methods, appear in the output. Items defined in MXML tags do not appear in the ASDoc output.

Because the format of an ASDoc comment uses ActionScript syntax, you can only insert an ASDoc comment in an `<mx:Script>` block of an MXML file.

MXML files correspond to ActionScript classes where the superclass corresponds to the first tag in the MXML file. For an application file, that tag is the `<mx:Application>` tag and therefore an MXML application file appears in the ASDoc output as a subclass of the Application class.

ASDoc tags

The following table lists the ASDoc tags:

ASDoc tag	Description	Example
`@copy reference`	Copies an ASDoc comment from the referenced location. The main description, `@param`, and `@return` content is copied; other tags are not copied. You typically use the `@copy` tag to copy information from a source class or interface not in the inheritance list of the destination class. If the source class or interface is in the inheritance list, use the `@inheritDoc` tag instead. You can add content to the ASDoc comment before the `@copy` tag. Specify the location by using the same syntax as you do for the `@see` tag. For more information, see "Using the @see tag" on page 277.	`@copy #stop` `@copy MovieClip#stop`
`@default` *`value`*	Specifies the default value for a property, style, or effect. The ASDoc tool automatically creates a sentence in the following form when it encounters an `@default` tag: `The default value is` *`value`*`.`	`@default 0xCCCCCC`
`@eventType` *`package.class.CONSTANT`* `@eventType` *`String`*	Use the first form in a comment for an `[Event]` metadata tag. It specifies the constant that defines the value of the `Event.type` property of the event object associated with the event. The ASDoc tool copies the description of the event constant to the referencing class. Use the second form in the comment for the constant definition. It specifies the name of the event associated with the constant. If the tag is omitted, ASDoc cannot copy the constant's comment to a referencing class.	See "Documenting effects, events, and styles" on page 273

ASDoc tag	Description	Example

@example *exampleText*	Applies style properties, generates a heading, and puts the code example in the correct location. Enclose the code in <listing version="3.0"></listing> tags.
	
	Whitespace formatting is preserved and the code is displayed in a gray, horizontally scrolling box.
		@example The following code sets the volume level for your sound:
		<listing version="3.0">
		var mySound:Sound = new Sound();
		mySound.setVolume(VOL_HIGH);
		</listing>

@exampleText *string*	Use this tag in an ASDoc comment in an external example file that is referenced by the @example tag. The ASDoc comment must precede the first line of the example, or follow the last line of the example. External example files support one comment before and one comment after example code.	/** * This text does not appear * in the output. * @exampleText But this does. */
@inheritDoc	Use this tag in the comment of an overridden method or property. It copies the comment from the superclass into the subclass, or from an interface implemented by the subclass. The main ASDoc comment, @param, and @return content are copied; other tags are not. You can add content to the comment before the @inheritDoc tag. When you include this tag, ASdoc uses the following search order: 1. Interfaces implemented by the current class (in no particular order) and all of their base-interfaces. 2. Immediate superclass of current class. 3. Interfaces of immediate superclass and all of their base-interfaces. 4. Repeat steps 2 and 3 until the Object class is reached. You can also use the @copy tag, but the @copy tag is for copying information from a source class or interface that is not in the inheritance chain of the subclass.	@inheritDoc

ASDoc tag	Description	Example
`@internal text`	Hides the text attached to the tag in the generated output. The hidden text can be used for internal comments.	`@internal Please do not publicize the undocumented use of the third parameter in this method.`
`@param paramName description`	Adds a descriptive comment to a method parameter. The `paramName` argument must match a parameter definition in the method signature.	`@param fileName The name of the file to load.`
`@private`	Exclude the element from the generated output. To omit an entire class, put the `@private` tag in the ASDoc comment for the class; to omit a single class element, put the `@private` tag in the ASDoc comment for the element.	`@private`
`@return description`	Adds a Returns section to a method description with the specified text. ASDoc automatically determines the data type of the return value.	`@return The translated message.`
`@see reference [displayText]`	Adds a See Also heading with a link to a class element. For more information, see "Using the @see tag" on page 277. Do not include HTML formatting characters in the arguments to the `@see` tag.	`@see flash.display.MovieClip`
`@throws package.class.className description`	Documents an error that a method can throw.	`@throws SecurityError Local untrusted SWFs may not communicate with the Internet.`

Using the @see tag

The `@see` tag lets you create cross-references to elements within a class; to elements in other classes in the same package; and to other packages. You can also cross-reference URLs outside of ASDoc. The `@see` tag has the following syntax:

```
@see reference [displayText]
```

where *reference* specifies the destination of the link, and *displayText* optionally specifies the link text. The location of the destination of the `@see` tag is determined by the prefix to the *reference* attribute:

- `#` ASDoc looks in the same class for the link destination.
- `ClassName` ASDoc looks in a class in the same package for the link destination.

- `PackageName` ASDoc looks in a different package for the link destination.
- `global` ASDoc looks in the Top Level package for the link destination.
- `style` ASDoc looks for a style property for the link destination.

***Note:** You cannot insert HTML tags in* reference. *However, you can add an HTML link without using the* `@see` *tag by inserting the HTML code in the ASDoc comment.*

The following table shows several examples of the `@see` tag:

Example	Result
`@see "Just a label"`	Text string
`@see http://www.cnn.com`	External website
`@see package-detail.html`	Local HTML file
`@see Array`	Top-level class
`@see AccessibilityProperties`	Class in same package
`@see flash.display.TextField`	Class in different package
`@see Array#length`	Property in top level class
`@see flash.ui.ContextMenu#customItems`	Property in class in different package
`@see mx.containers.DividedBox#style:dividerAffordance`	Style property in class in different package
`@see #updateProperties()`	Method in same class as `@see` tag
`@see Array#pop()`	Method in top-level class
`@see flash.ui.ContextMenu#clone()`	Method in class in different package
`@see global#Boolean()`	Package method in Top Level (global)
`@see flash.util.#clearInterval()`	Package method in flash.util

Summary of commonly used HTML elements

The following table lists commonly used HTML tags and character codes within ASDoc comments:

Tag or Code	Description

`<p>`	Starts a new paragraph. You must close `<p>` tags.
	
	Do not use `<p>` for the first paragraph of a doc comment (the paragraph after the opening `/**`) or the first paragraph associated with a tag. Use the `<p>` tag for subsequent; for example:
	
	`/**`
	`* The first sentence of a main description.`
	`*`
	`* <p>This line starts a new paragraph.</p> *`
	`* <p>This line starts a third paragraph.</p>`
	`*/`
	
	ASDoc ignores white space in comments; to add white space for readability in the AS file, do not use the `<p>` tag but just add blank lines.

`class="hide"`	Hides text. Use this tag if you want to add documentation to the source file but do not want it to appear in the output.
`<listing>`	Indicates a program listing (sample code). Use this tag to enclose code snippets that you format as separate paragraphs, in monospace font, and in a gray background to distinguish the code from surrounding text. You must close `<listing>` tags.
`<pre>`	Formats text in monospace font, such as a description of an algorithm or a formula. Do not use ` ` tags at end of line. Use `<listing>` tag for code snippets.
` `	Adds a line break. You must close this tag. Comments for most tags are automatically formatted; you do not generally have to add line breaks. To create additional white space, add a new paragraph instead. This tag may not be supported in the future, so use it only if necessary.
`<ul>, <li>`	Creates a list. You must close these tags.

`<table>`
`<th>`
`<tr>`
`<td>`
	Creates a table. For basic tables that conform to ASDoc style, set the class attribute to `innertable`. Avoid setting any special attributes. Avoid nesting structural items, such as lists, within tables.
	
	ASDoc uses a standard CSS stylesheet that has definitions for the `<table>`, `<th>`, `<tr>` and `<td>` tags. You must close these tags.
	
	Use `<th>` for header cells instead of `<td>`, so the headers get formatted correctly.

Tag or Code	Description
<img>	Inserts an image. To create the correct amount of space around an image, enclose the image reference in tags. Captions are optional; if you use a caption, make it boldface. You must close the <img> tag by ending it with />, as the following example shows:
<code>	Applies monospace formatting. You must close this tag.
<strong>	Applies bold text formatting. You must close this tag.
<em>	Applies italic formatting. You must close this tag.
<	Less-than operator (<) . Ensure that you include the final semicolon (;).
>	Greater-than operator (>). Ensure that you include the final semicolon (;).
&	Ampersand (&). Ensure that you include the final semicolon (;).
—	Em dash.
™	Trademark symbol (™) that is not registered. This character is superscript by default, so do not enclose it in <sup> tags.
	Nonbreaking space.
®	Registered trademark symbol (®). Enclose this character in <sup> tags to make it superscript.
°	Degree symbol.
@	Do not use an @ sign in an ASDoc comment; instead, insert the HTML character code: @.

Running the ASDoc tool

You use the following options to specify the list of classes processed by the asdoc command: doc-classes, doc-sources, doc-namespaces. The doc-classes and doc-namespaces options require you to specify the source-path option to specify the root directory of your files.

The most basic example is to specify a class or list of classes using the doc-classes option, as the following example shows:

```
asdoc -source-path . -doc-classes comps.GraphingWidget comps.GraphingWidgetTwo
```

In this example, the classes must be located at comps\GraphingWidget.as and comps\GraphingWidgetTwo.as, where comps is a subdirectory of the directory from which you run the `asdoc` command. The arguments of the `doc-classes` option use dot notation that corresponds to the package name of the class.

If the classes are not in the current directory, use the `source-path` option to specify that directory. For example, if the two input classes are in the directory C:\flex\class_dir\comps, then use the following command-line to invoke `asdoc`:

```
asdoc -source-path C:\flex\class_dir -doc-classes comps.GraphingWidget
comps.GraphingWidgetTwo
```

Your application might require library files, represented as SWC files, to compile. In the next example, you use the `-library-path` option to specify the directory containing the SWC files:

```
asdoc -source-path . -doc-classes myComponents.BlueButton  -library-path C:\myLibs
```

You can also specify the source classes by using the `doc-sources` option. This option causes `asdoc` to recursively search directories. The following command line generates output for all classes in the current directory and its subdirectories:

```
asdoc -source-path . -doc-sources .
```

You can specify a namespace as the input by using the `doc-namespaces` option. The following command line documents all the classes in the core framework:

```
asdoc -source-path frameworks
    -namespace http://framework frameworks/core-framework-manifest.xml
    -doc-namespaces http://framework
```

Excluding classes

All of the classes specified by the `doc-classes`, `doc-sources`, and `doc-namespaces` options are documented, with the following exceptions:

- If you specified the class by using the `exclude-classes` option, the class is not documented.
- If the ASDoc comment for the class contains the `@private` tag, the class is not documented.
- If the class is found in a SWC, the class is not documented.

In the following example, you generate output for all classes in the current directory and its subdirectories, except for the two classes comps\PageWidget and comps\ScreenWidget.as:

```
asdoc -source-path . -doc-sources . -exclude-classes comps.PageWidget comps.ScreenWidget
```

Note that the excluded classes are still compiled along with all of the other input classes; only their content in the output is suppressed.

If you set the `exclude-dependencies` option to `true`, dependent classes found when compiling classes are not documented. The default value is `false`, which means any classes that would normally be compiled along with the specified classes are documented.

For example, you specify class A by using the `doc-classes` option. If class A imports class B, both class A and class B are documented.

Options to the asdoc command

The options to the `asdoc` command work the same way that mxmlc and compc options work. For more information on mxmlc and comp, see "Using the Flex Compilers" on page 125.

The following table lists the options to the `asdoc` command:

Option	Description
`-doc-classes` *path-element [...]*	A list of classes to document. These classes must be in the source path. This is the default option. This option works the same way as does the `-include-classes` option for the `compc` component compiler. For more information, see "Using compc, the component compiler" on page 161.
`-doc-namespaces` *uri manifest*	A list of URIs whose classes should be documented. The classes must be in the source path. You must include a URI and the location of the manifest file that defines the contents of this namespace. This option works the same way as does the `-include-namespaces` option for the `compc` component compiler. For more information, see "Using compc, the component compiler" on page 161.
`-doc-sources` *path-element [...]*	A list of files that should be documented. If a directory name is in the list, it is recursively searched. This option works the same way as does the `-include-sources` option for the `compc` component compiler. For more information, see "Using compc, the component compiler" on page 161.
`-exclude-classes` *string*	A list of classes that should not be documented. You must specify individual class names. Alternatively, if the ASDoc comment for the class contains the `@private` tag, is not documented.
`-exclude-dependencies true|false`	Whether all dependencies found by the compiler are documented. If `true`, the dependencies of the input classes are not documented. The default value is `false`.
`-footer` *string*	The text that appears at the bottom of the HTML pages in the output documentation.

Option	Description
`-left-frameset-width` *int*	An integer that changes the width of the left frameset of the documentation. You can change this size to accommodate the length of your package names. The default value is 210 pixels.
`-main-title` *"string"*	The text that appears at the top of the HTML pages in the output documentation. The default value is "`API Documentation`".
`-output` *string*	The output directory for the generated documentation. The default value is "`asdoc-output`".

`-package` *name "description"*	The descriptions to use when describing a package in the documentation. You can specify more than one `package` option.
	
	The following example adds two package descriptions to the output:
	
	`asdoc -doc-sources my_dir`
	`     -output myDoc`
	`     -package com.my.business "Contains business classes and interfaces"`
	`     -package com.my.commands "Contains command base classes and interfaces"`

`-templates-path` *string*	The path to the ASDoc template directory. The default is the asdoc/templates directory in the ASDoc installation directory. This directory contains all the HTML, CSS, XSL, and image files used for generating the output.
`-window-title` *"string"*	The text that appears in the browser window in the output documentation. The default value is "`API Documentation`".

The `asdoc` command also recognizes the following options from the compc component compiler:

- `-source-path`
- `-library-path`
- `-namespace`
- `-load-config`
- `-actionscript-file-encoding`
- `-help`
- `-advanced`
- `-benchmark`
- `-strict`
- `-warnings`

For more information, see “Using mxmlc, the application compiler” on page 139. All other application compiler options are accepted but ignored so that you can use the same command-lines and configuration files for the ASDoc tool that you can use for mxmlc and compc.

Chapter 14: Versioning

You might encounter some versioning issues when working on Adobe® Flex® applications. When compiling, you can choose the version of the SDK to use and you can target specific versions of Adobe® Flash® Player. You can replicate behavior of previous SDK versions. Also, you can design applications that can load modules and other SWF files that were compiled with different SDKs.

Topics

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Overview

When a new version of Flex is released, it usually includes changes to the APIs, compiler, and the user interface for Adobe® Flex® Builder™. As a result, if you were working on a project but then upgraded your version of the SDK, you might have to refactor some part of your code to be compatible with the new version. In addition, if the audience for your application is restricted in what Flash Player it can use, you might have to make certain concessions to ensure that your application runs without errors.

Flex Builder 3 lets you choose different SDKs, based on your needs. This lets you maintain projects in Flex Builder 3 that have not been updated to be compatible with the latest version of the SDK, or lets you use Flex Builder 3 features without having to refactor your Flex 2.0.1 projects. For more information, see "Using multiple SDKs" on page 286.

The differences between Flex 2.0.1 and Flex 3 go beyond new features. The layout schemes and the styles of many components have changed. If you want to use Flex 3 features but have your application look and feel the same as Flex 2.0.1, you can specify the version whose styles you want to use with the `compatibility-version` compiler option. For more information, see "Backward compatibility" on page 286.

With current Flex tools, you can target your application toward a specific version of Flash Player. To do this, you use the `target-player` compiler option. For more information, see "Targeting Flash Player versions" on page 295.

Using multiple SDKs

Flex Builder lets you change the version of the SDK that you use to compile your projects. You can select the SDK when you first create a project, or at any time you are working on a project. You can change the SDK for any type of Flex project, including library projects and ActionScript-only projects.

When you change the SDK, Flex Builder rebuilds your application and flags any code that is no longer compatible with the selected SDK.

Flex Builder includes the Flex 3 and Flex 2.0.1 SDKs. You can also add any SDK you want.

For more information about selecting different SDKs in Flex Builder, see “Using multiple SDKs in Flex Builder” on page 131 in *Using Adobe Flex Builder 3*.

Backward compatibility

To specify the version of the Flex compiler and framework that the output should be compatible with, use the `compatibility-version` compiler option. This option affects some behavior such as the layout rules, padding and gaps, skins, and other style settings. In addition, it affects the rules for parsing properties files. Setting the compatibility version does not enforce all differences that exist between the versions. For a list of differences that are enforced, see “Differences between SDK 2.0.1 and SDK 3” on page 287.

The currently supported values for the `compatibility-version` compiler option are 2.0.0 and 2.0.1. If you do not explicitly set the value of this option, the compiler defaults to the current SDK’s version. You can determine the current SDK’s version by using the -version option on the command line. For example:

```
mxmlc -version
```

In Flex Builder, you add the `compatibility-version` compiler option to the Additional Compiler Arguments field on the Flex Compiler properties panel. The following example sets the compatibility version to 2.0.1:

```
-compatibility-version=2.0.1
```

For the command-line compilers, you can either pass the `compatibility-version` compiler option on the command line or set the value in the configuration file. The following example sets the compatibility version to 2.0.1 in the flex-config.xml file:

```
<compiler>
    <mxml>
        <compatibility-version>2.0.1</compatibility-version>
    <mxml>
<compiler>
```

When you set the `compatibility-version` option, you must be sure that the configuration files that you use are compatible with the version you select. For example, the way that locales and metadata elements are set up in the flex-config.xml file is different between Flex 2.0.1 and Flex 3. For a complete list of differences, see “Differences between SDK 2.0.1 and SDK 3” on page 287.

You can programmatically access the version of the Flex application that you are running by using the mx.core.FlexVersion class. To get the current compatibility version in your application, use the `compatibilityVersionString` property of that class. This lets you conditionalize the logic in your application based on the compatibility version.

Using themes

When you set the compatibility version, you should also be sure to use the appropriate theme file that matches that version. For Flex 2.0.0 and 2.0.1, you should use the HaloClassic.swc theme file. Themes are located in the frameworks/themes directory. For Flex 3, you do not have to specify a theme file. The default theme file is designed for Flex 3 compatibility. For more information on using themes, see “About themes” on page 645 in the *Adobe Flex 3 Developer Guide*.

The default style sheets for several versions of Flex are available in the framework.swc file. This SWC file contains the current default style sheet (defaults.css), the Flex 2.0.1 default style sheet (defaults-2.0.1.css), and the Flex 2 default style sheet (defaults-2.0.0.css). The compiler uses the style sheet that is appropriate for the compatibility version you set. For example, if you set the `compatibility-version` option to 2.0.1, then the compiler uses the Flex 2.0.1 default style sheet.

Differences between SDK 2.0.1 and SDK 3

The differences between SDK 2.0.1 and SDK 3 that result from setting the `compatibility-version` option are mostly style properties and the styles applied to subcomponents.

Subcomponents are components within other components that inherited the styles of their parent in SDK 2.0.1 but do not in SDK 3. For example, the DateField control has a DateChooser subcomponent. In Flex 2.0.1, if you set noninheritable style properties such as `borderColor` or `cornerRadius` on the DateField control, the styles are also applied to the DateChooser subcomponent. This resulted in unexpected styling of the subcomponent and it was difficult to override this behavior. In Flex 3, these styles are not passed through from the DateField control to the DateChooser subcomponent, but you can choose to pass them through.

The following application shows the difference between how a DateField control appeared in SDK 2.0.1 and how it appears in SDK 3:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- versioning/DateFieldSubComponentStyles.mxml -->
<!-- Compile this sample twice: once with the compatibility-version
```

```
     compiler option set to 2.0.1 and once without setting it. -->
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
    <mx:DateField
        id="dateField1"
        yearNavigationEnabled="true"
        borderColor="red"
    />
</mx:Application>
```

To see the difference in how styles are passed (or not passed) to subcomponents, compile this application twice. The first time you compile this example, do not set the `compatibility-version` compiler option. The second time you compile this example, set the `compatibility-version` option to 2.0.1, as the following example shows:

```
mxmlc -compatibility-version=2.0.1 DateFieldSubComponentStyles.mxml
```

When you run this application without setting the `compatibility-version`, the `borderColor` style is applied to the DateField control, but not to any part of the DateChooser calendar. When you run the 2.0.1 version of this application, the `borderColor` style is applied to the DateField control as well as the buttons and header lines of the DateChooser calendar.

You can add style properties to a filter list so that they are passed from the control to its subcomponent. For more information, see "Subcomponent styles" on page 610 in the *Adobe Flex 3 Developer Guide*.

The following table lists the framework differences between Flex SDK 2.0.1 and Flex SDK 3 that are enforced when you use the `compatibility-version` compiler option:

Difference	Behavior in SDK 2.0.1	Behavior in SDK 3
Button control padding properties	The values of the `paddingLeft`, `paddingRight`, `paddingTop`, and `paddingBottom` styles are ignored by Button controls.	The values of the `paddingLeft`, `paddingRight`, `paddingTop`, and `paddingBottom` styles are honored. To make your icon Buttons look like the SDK 2.0.1 buttons, set the `paddingLeft` and `paddingRight` style properties to 0.
RadioButton control height	RadioButton controls do not use the padding properties when determining their height.	RadioButton controls take padding properties into account when determining their height.
	The default height of a RadioButton control is 18 pixels.	The default height of a RadioButton control is 22 pixels.
DateChooser year navigator skins	The `measuredHeight` property was larger because of the changes in Button sizing.	The `measuredHeight` property was smaller.
DataGrid header skins	To customize the DataGrid header background, you subclass DataGrid and override the `drawHeaderBackground()` method.	The logic from the `drawHeaderBackground()` method is in the DataGridHeaderBackgroundSkin class. Also, you use the `headerBackgroundSkin` style to style DataGrid header background skins.

Difference	Behavior in SDK 2.0.1	Behavior in SDK 3
Menu control's `horizontalGap` property	The default value of the `horizontalGap` property for Menu controls is 0. If a Menu has a RadioButton control and an icon, the two overlap.	The default value of the `horizontalGap` property is 6. Additional space is added for a RadioButton or CheckBox, but not for icons in a MenuItem control.
ScrollBar layout	The width of a ScrollBar was determined by the up arrow skin's width.	The width of a ScrollBar component is the largest width among the up arrow, down arrow, track, and thumb skins.
Disabled ScrollBars	There is no separate skin for the buttons on a disabled ScrollBar.	ScrollArrowSkin has a disabled state. The scroll track was changed from a DisplayObject to a Button. The ScrollTrackSkin now supports Button states.
ScrollBar subcomponent alignment	The up arrow, down arrow, track, and thumb are left-aligned.	The up arrow, down arrow, track, and thumb are center-aligned.
ScrollBar thumb width	The thumb width is the width of the ScrollBar.	The thumb width is the same as the thumb's `measuredWidth` property.
Padding styles with the Canvas container	Padding styles have no effect on the Canvas container.	Canvas respects padding styles.

Constraint-based layout rules for content-sized containers	Width is ignored when left and right styles are set for components in containers where no width is set. In these cases, the `preferredWidth` property of a component is used. Height is ignored when top and bottom styles are set for components in containers where no height is set. In these cases, the `preferredHeight` property of a component is used.
	
	In the following example, the Button control is 40 pixels wide:
	
	`<mx:Canvas id="mycanvas">`
	`  <mx:Button left="50" right="50"`
	`    width="100" id="b"/>`
	`</mx:Canvas>`
		Width and height are honored for components with constraints set in content-sized containers. In the previous example, the Button control's width is 100 pixels.

FormItem padding	FormItem controls add unnecessary extra padding underneath the controls when there is more than one control.	No extra padding is allocated underneath a FormItem control.
Scale-9 for Panel containers	The Panel container's skin uses the HaloBorder class.	The Panel container's skin uses the PanelSkin class. Some measurement logic was removed from the Panel class and put into the PanelSkin class.

Difference	Behavior in SDK 2.0.1	Behavior in SDK 3
Border style for Panel containers	You can set the `borderStyle` property to "solid" and set a `borderColor` and `borderThickness` property on the Panel container.	Panel does not support any value for the `borderStyle` property other than "default". You can use a combination of explicit heights and widths and absolute positioning to replicate most of the SDK 2.0.1 behavior for alternative `borderStyle` properties. The PanelSkin class's implementation of alternative `borderStyle` properties does not lay out the header and control bar in the correct locations; the Panel is not large enough.
TitleWindow title alignment	The TitleWindow control's `textHeight` property adjusts to the scale factor.	The TitleWindow control's `textHeight` property ignores the scale factor.
Accordion header padding	The `paddingTop` and `paddingBottom` properties of the Accordion headers is set to -1.	The height of the Accordion container's header is different by one to two pixels.
Accordion subcomponent styles	The styles of the Accordion headers are inherited from the Accordion container.	The Accordion header does not inherit its styles from the Accordion control. Instead, the header uses the `headerStyleName` style, if one is specified. The following Accordion styles are deprecated: `fillAlphas`, `fillColors`, `focusRoundedCorners`, `horizontalGap`, `selectedFillColors`, and `verticalGap`.
ColorPicker subcomponent styles	The ColorPicker's swatch panel subcomponent inherits its styles from the ColorPicker control.	Styles that affect the swatch panel do not apply if they are set on the ColorPicker. Instead, the swatch panel uses the `swatchPanelStyleName` style, if one is specified. The following ColorPicker styles are deprecated: `backgroundColor`, `columnCount`, `horizontalGap`, `verticalGap`, `previewHeight`, `previewWidth`, `swatchGridBackgroundColor`, `swatchGridBorderSize`, `swatchHeight`, `swatchHighlightColor`, `swatchHighlightSize`, `swatchWidth`, `textFieldWidth`, and `textFieldStyleName`.
ComboBox subcomponent styles	The List drop-down in a ComboBox control inherits its styles from the ComboBox control.	The List subcomponent does not inherit its styles from the ComboBox control. Instead, the List subcomponent uses the `dropdownStyleName` style, if one is specified.

Difference	Behavior in SDK 2.0.1	Behavior in SDK 3
DateChooser subcomponent styles	The `cornerRadius` and `fillColors` styles are applied to the next and previous month button subcomponents of a DateChooser control.	Setting the `cornerRadius` and `fillColors` style properties affects only the DateChooser itself, but not the subcomponent buttons. To style the buttons, you must edit their skin classes or override the style filters list. The `fillColors` and `fillAlphas` styles of the DateChooser control are deprecated.
DateField subcomponent styles	The DateChooser that pops up from clicking on a DateField inherits its styles from the DateField control.	The DateChooser subcomponent of a DateField control does not inherit its styles from the DateField control. Instead, the DateChooser subcomponent uses the `dateChooserStyleName` style, if one is specified. The following DateField styles are deprecated: `cornerRadius`, `fillAlphas`, `fillColors`, `headerColors`, `headerStyleName`, `highlightAlphas`, `todayStyleName`, and `weekDayStyleName`.
LinkBar subcomponent styles	The LinkButton subcomponents in a LinkBar control inherit their styles from the LinkBar control.	The LinkButton subcomponents of a LinkBar do not inherit their styles from the LinkBar control. Instead, the LinkButton subcomponents use the `linkButtonStyleName` style, if one is specified.
MenuBar subcomponent styles	The submenus of a MenuBar control inherit their styles from the MenuBar control.	The submenus of a MenuBar control do not inherit their styles from the MenuBar control. Instead, they use the `menuStyleName` style, if one is specified. The `backgroundAlpha` and `backgroundColor` MenuBar styles are deprecated.
NumericStepper subcomponent styles	The up and down buttons in a NumericStepper control inherit their border styles from the NumericStepper control.	The up and down buttons of a NumericStepper control do not inherit their border styles from the NumericStepper control. To change the border styles for a NumericStepper control's button subcomponents, you must subclass the NumericStepper class and override the getters for the `downArrowStyleFilters` and `upArrowStyleFilters` properties. For more information, see "Subcomponent styles" on page 610 in the *Adobe Flex 3 Developer Guide*.
TabBar subcomponent styles	The `firstButtonStyleName` and `lastButtonStyleName` are inherited from the ButtonBar control on a TabBar control.	The `firstTabStyleName` and `lastTabStyleName` styles apply to tab styles.

Difference	Behavior in SDK 2.0.1	Behavior in SDK 3
PopUpManager subcomponent styles	PopUp controls inherit their styles from the Application if they were not explicitly set on the PopUp control.	PopUp controls inherit styles from their owners.
ColorPicker alpha	The ColorPicker control's `alpha` property is lower, resulting in a lighter control.	The ColorPicker control's `alpha` property is higher, resulting in a darker control.
Form and FormItem layout	FormItem layout percentage height is not calculated correctly.	FormItem layout code uses BoxLayout. Percentage heights and widths are calculated correctly. Also, Form and FormItem now support the `includeInLayout` property.
Percent width rounding rule	If two the width of a container is 275 pixels and two children have the width set to 50%, each component is 137 pixels. The extra pixel is ignored.	If the width of a container is 275 pixels and two children have a width set to 50%, the components widths are 137 pixels and 138 pixels. The extra pixel is applied to one of the components.
Run-time localization	The _CompiledResourceBundleInfo class is not autogenerated for SWC and SWF files.	The _CompiledResourceBundleInfo class is autogenerated for SWC and SWF files.
Parsing rules for .properties files	Parsing .properties files requires removing certain sequences of characters. To use a double quote, you use \\". To use a new-line character, you use \\n. To use a backslash, you use \\\\.	Parsing .properties files use the same rules as Java. For more information about how properties files are parsed in SDK 3, see "Properties file syntax" on page 1106 in the *Adobe Flex 3 Developer Guide*.
Metadata	The `keep-as3-metadata` compiler option is set in flex-config.xml. The default metadata preserved by the Flex framework includes Bindable, Managed, ChangeEvent, NonCommittingChangeEvent, and Transient. If you use a third-party library with custom metadata in your projects, you must add that metadata to the `keep-as3-metadata` option.	SWC libraries define what metadata the linker preserves when linking in code from that library. When you compile a library, the `keep-as3-metadata` option instructs the compc compiler what metadata to declare. The option adds the metadata names to preserve in the SWC file's catalog.xml file. If you use that library, you do not need to specify the metadata when compiling your application.
Profiler	Applications are not compatible with the profiler.	Applications are compatible with the profiler.

<table>
<tr><th>Difference</th><th>Behavior in SDK 2.0.1</th><th>Behavior in SDK 3</th></tr>
<tr><td>Signed framework Runtime Shared Libraries (RSLs)</td><td>Applications are not compatible with signed framework RSLs.</td><td>Applications are compatible with signed framework RSLs.</td></tr>
<tr><td>Icons for disabled components</td><td>When the disabledIcon property is set to null, the icon is invisible when the component is disabled.</td><td>The icon for a disabled component does not disappear when the disabledIcon property is set to null. To mimic the Flex 2.0.1 behavior, you can create a style that specifies null for the classes in the appropriate icon properties. For example:

RadioButton {
  icon:ClassReference(null);
  disabledIcon:ClassReference(null);
  selectedDisabledIcon:
      ClassReference(null);
}

You can set remaining icon properties, such as downIcon and overIcon, to the appropriate skin class; for example, mx.skins.halo.RadioButton.</td></tr>
</table>

The configuration file syntax is also different between SDK 2.0.1 and SDK 3. If you use a customized flex-config.xml file, you must ensure that you match its syntax to the syntax of the SDK that you compile with. If you change SDKs, you might need to change the configuration file.

The following table lists the differences between the configuration files:

<table>
<tr><th>SDK 2.0.1</th><th>SDK 3</th></tr>
<tr><td><flash-type>
  true
</flash-type></td><td><advanced-anti-aliasing>
  true
</advanced-anti-aliasing></td></tr>
<tr><td><!-- <locale>en_US</locale> --></td><td><locale>
  <locale-element>en_US</locale-element>
</locale></td></tr>
<tr><td><!--
<source-path>
  <path-element>locale/{locale}</path-element>
  <path-element>string</path-element>
</source-path>
--></td><td><!--
<source-path>
  <path-element>string</path-element>
</source-path>
--></td></tr>
<tr><td><external-library-path>
  <path-element>
    libs/playerglobal.swc
  </path-element>
</external-library-path></td><td><external-library-path>
  <path-element>
    libs/player
  </path-element>
</external-library-path></td></tr>
</table>

SDK 2.0.1	SDK 3
<fonts> <managers> <manager-class> flash.fonts.JREFontManager </manager-class> <manager-class> flash.fonts.BatikFontManager </manager-class> </managers> </fonts>	<fonts> <managers> <manager-class> flash.fonts.JREFontManager </manager-class> <manager-class> flash.fonts.AFEFontManager </manager-class> <manager-class> flash.fonts.BatikFontManager </manager-class> </managers> </fonts>
<warn-class-is-sealed> false </warn-class-is-sealed>	<warn-class-is-sealed> true </warn-class-is-sealed>
<warn-deprecated-event-handler-error> false </warn-deprecated-event-handler-error>	<warn-deprecated-event-handler-error> true </warn-deprecated-event-handler-error>
<warn-deprecated-function-error> false </warn-deprecated-function-error>	<warn-deprecated-function-error> true </warn-deprecated-function-error>
<warn-deprecated-property-error> false </warn-deprecated-property-error>	<warn-deprecated-property-error> true </warn-deprecated-property-error>
<warn-level-not-supported> false </warn-level-not-supported>	<warn-level-not-supported> true </warn-level-not-supported>
n/a	<show-unused-type-selector-warnings> true </show-unused-type-selector-warnings>
n/a	<!-- <target-player>version</target-player> -->
n/a	<runtime-shared-library-path> <path-element>libs/framework.swc</path-element> <rsl-url>framework_3.0.183453.swz</rsl-url> <policy-file-url></policy-file-url> <rsl-url>framework_3.0.183453.swf</rsl-url> <policy-file-url></policy-file-url> </runtime-shared-library-path>
n/a	<static-link-runtime-shared-libraries> true </static-link-runtime-shared-libraries>

SDK 2.0.1	SDK 3
n/a	<!-- <compute-digest>boolean</compute-digest> -->
<metadata> <title>Adobe Flex 2 Application</title> </metadata>	<metadata> <title>Adobe Flex 3Application</title> </metadata>
<show-deprecation-warnings> true </show-deprecation-warnings>	n/a

Targeting Flash Player versions

You can use the `target-player` compiler option to specify the version of Flash Player that you want to target with the application. Features requiring a later version of Flash Player are not compiled into the application. Currently, this feature applies only to RSLs.

The command has the following syntax:

```
-target-player=player_version
```

The *`player_version`* parameter has the following format:

```
major_version.minor_version.revision
```

The *`major_version`* is required while *`minor_version`* and *`revision`* are optional. The minimum value is 9.0.0. If you do not specify the *`minor_version`* or *`revision`*, the compiler uses zero.

If you do not explicitly set the value of this option, the compiler uses the default from the flex-config.xml file. This option is commented out in the default flex-config.xml configuration file.

This option is used with framework RSLs. It helps ensure that an application is compiled correctly. For example, if you specify that your application should use a signed RSL but you do not specify a failover RSL, users of older versions of Flash Player will not load a signed framework RSL and will therefore experience errors when they try to run your application. If you don't set the `target-player` option or set it to some value less than 9.0.115, the compiler throws a warning. You must be sure that your users request your application only with a recent version of Flash Player. One way to do this is to include logic in your HTML wrapper that specifies a minimum required version of Flash Player. For more information, see "Adding the Express Install script to the wrapper" on page 334.

If you do not specify a failover RSL, but set the `target-player` option to some value greater than or equal to 9.0.115, the compiler will not throw a warning because players later than that version will load a signed framework RSL and therefore do not generally need a failover RSL.

Part 3: Application Deployment

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Chapter 15: Deploying Flex Applications

When you deploy an Adobe® Flex® application, you make the application accessible to your users. The process of deploying an application is dependent on your application, your application requirements, and your deployment environment. For example, the process of deploying an application on an internal website that is only accessible by company employees might be different from the process for deploying the same application on a public website accessible by anyone.

Use the overview of the deployment process and the general checklist as a guide when you deploy your application.

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About deploying an application

When you deploy an application, you move the application from your development environment to your deployment environment. After you deploy it, customers have full access to the application.

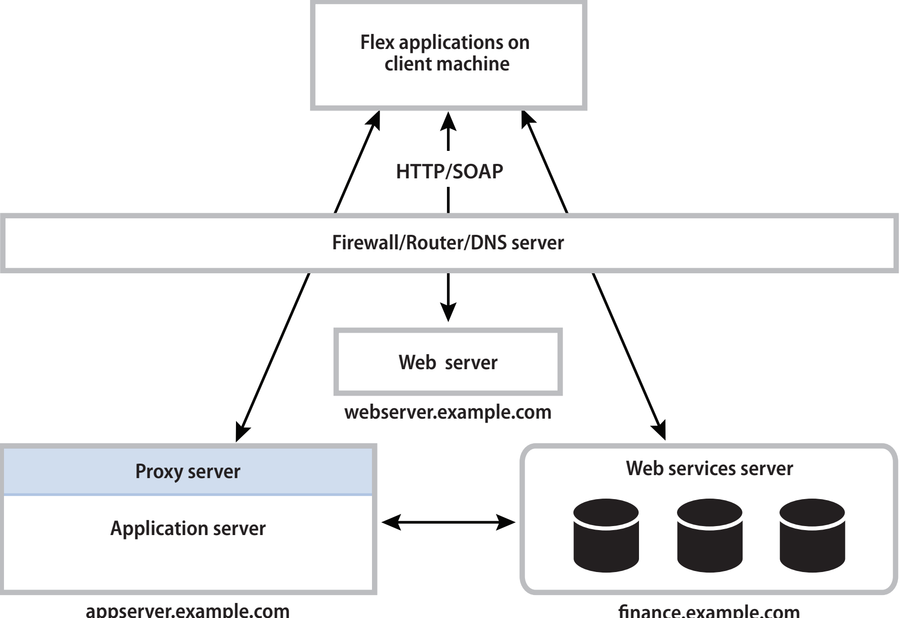
The deployment process that your organization uses might only require you to copy a Flex application's SWF file from your development server to your deployment server. In many organizations however, the deployment process is more complicated, and involves people from groups outside the development organization. For example, you might have an IT department that maintains your corporate website. The IT department might be responsible for staging, testing, and then deploying your application.

Your application architecture might also require you to deploy more than just a single SWF file. For example, your application might access Runtime Shared Libraries (RSLs) or other assets at run time. You must make sure to copy all required files to your deployment environment.

Deployment might also require you to perform operations other than just copying application files to a deployment server. Your application might access data services on your server, or on another server. You must ensure that your data services are accessible by a deployed Flex application that executes on a client's computer.

Deployment options

The following example shows a typical deployment environment for a Flex application:



Deploying an application for Flex SDK and Adobe® Flex® Builder® might require you to perform some or all of the following actions:

- Copy the application SWF file to your deployment server. As the previous example shows, you copy the application to webserver.example.com.
- Copy any asset files, such as icons, media files, or other assets, to your deployment server.
- Copy any RSLs to your web server or application server. For more information, see "Deploying RSLs with Flex SDK" on page 301.
- Copy any SWF files for your module to your deployment server in the same directory structure as you used for your development environment. "Deploying modules with Flex SDK" on page 301.
- Copy any SWF files required to support Flex features, such as deep linking. For more information, see "Deploying additional Flex files" on page 301.

- Write a wrapper for the SWF file if you access it from an HTML, JSP, ASP, or another type of page.

  A deployed SWF file can encompass your entire web application, however it is often used as a part of the application. Therefore, users do not typically request the SWF file directly, but request a web page that references the SWF file. Flex Builder can generate the wrapper for you, or, you can write the wrapper. For more information, see "Creating a Wrapper" on page 311.

- Create a crossdomain.xml file on the server for data service, if you directly access any data services outside of the domain that serves the SWF file. For more information, see "Accessing data services from a deployed application" on page 302

Deploying RSLs with Flex SDK

When your application uses an RSL, you must make sure to deploy the RSL on your deployment server, in the same domain, unless you are using cross-domain RSLs. You use the `runtime-shared-libraries` option of the Flex compiler to specify the directory location of the RSL at compile time. Ensure that you copy the RSL to the same directory that you specified with `runtime-shared-libraries`. For more information, see "Using Runtime Shared Libraries" on page 195.

Deploying modules with Flex SDK

Modules are SWF files that can be loaded and unloaded by an application. They cannot be run independently of an application, but any number of applications can share the modules. When your application uses a module, you must make sure to deploy the module's SWF file on your deployment server in the same directory structure as you used for your development environment. For more information, see "Creating Modular Applications" on page 981 in the *Adobe Flex 3 Developer Guide*.

Deploying additional Flex files

The implementation of some Flex features requires that you deploy additional files along with your application's SWF file. For example, if you use deep linking functionality in your application, you must deploy the history-Frame.html, history.css, and history.js files along with your application's SWF file. If you use express install version detection feature, you also must deploy the playerProductInstall.swf file with your SWF file. You typically deploy these files in the same directory as your application's SWF file.

For a complete list of additional Flex files that you might deploy with your application, see "Deployment checklist" on page 304.

Accessing data services from a deployed application

In a typical Flex development environment, you build and test your application behind a corporate firewall, where security restrictions are much less strict than when a customer runs the application on their own computer. However, when you deploy the application, it runs on a customers computer outside your firewall. That simple change of location might cause the application to fail if you do not correctly configure your data services to allow external access.

Most run-time accesses to application resources fall into one of the following categories:

- Direct access to asset files on a web server, such as image files.
- Direct access to resources on your J2EE application server.
- Data services requests through a proxy. A proxy redirects that request to the server that handles the data service request.
- Direct access to a data service.

As part of deploying your application, ensure that all run-time data access requests work correctly from the application that is executing outside of your firewall.

Compiling for deployment

When you create a deployable SWF file, ensure that you compile the application correctly. Typically, you disable certain compiler features, such as the generation of debug output, and enable other options, such as the generation of accessible content.

This section contains an overview of some common compiler options that you might use when you create a deployable SWF file. For a complete list of compiler options, see “Using the Flex Compilers” on page 125.

Creating a release build of your application in Flex Builder

When you create and run an application in Flex Builder, the Flex compiler includes debug information in that application so that you can set breakpoints and view variables and perform other debugging tasks. However, the SWF file that Flex Builder generates by default includes debugging information that makes it larger than the release build of the SWF file.

To create a release build of your application in Flex Builder, select Project > Export Release Build. This compiles a version of your application’s SWF file that does not contain any debug information in it. This SWF file is smaller than the SWF files you compile normally. This also compiles any modules that are in the application’s project without debug information.

In general, all compiled SWF files that are stored in the project's /bin-debug directory contain debug information. When you export the application, you choose a new output directory. The default is the /bin-release directory.

To compile a release build on the command line, set the `debug` compiler option to `false`. This prevents debug information from being included in the final SWF file.

Enabling accessibility

The Flex accessibility option lets you create applications that are accessible to users with disabilities. By default, accessibility is disabled. You enable the accessibility features of Flex components at compile time by using options to a Flex Builder project, setting the `accessible` option to `true` for the command-line compiler, or setting the `<accessible>` tag in the flex-config.xml file to `true`.

For more information on creating accessible applications, see "Creating Accessible Applications" on page 1139 in the *Adobe Flex 3 Developer Guide*.

Preventing users from viewing your source code

Flex lets you publish your source code with your deployed application. You might want to enable this option during the development process, but disable it for deployment. Or, you might want to include your source code along with your deployed application.

In Flex Builder, the Export Release Build wizard lets you specify whether to publish your source code. You can also use the `viewSourceURL` property of the Application class to set the URL of your source code.

Disabling incremental compilation

You can use incremental compilation to decrease the time it takes to compile an application or component library with the Flex application compilers. When incremental compilation is enabled, the compiler inspects changes to the bytecode between revisions and only recompiles the section of bytecode that has changed.

For more information, see "Using the Flex Compilers" on page 125.

Using a headless server

A *headless server* is one that is running UNIX or Linux and often does not have a monitor, keyboard, mouse, or even a graphics card. Headless servers are most commonly encountered in ISPs and ISVs, where available space is at a premium and servers are often mounted in racks. Enabling the headless mode reduces the graphics requirements of the underlying system and can allow for a more efficient use of memory.

If you deploy a Flex application on a headless server, you must set the `headless-server` option of the compiler to `true`. Setting this option to `true` is required to support fonts and SVG images in a nongraphical environment.

Deployment checklist

The deployment checklist contains some common system configuration issues that customers have found when deploying Flex applications for production. It also contains troubleshooting tips to diagnose common deployment problems.

Application assets

When deploying a Flex application, you must make sure you also deploy all the assets that the application uses at run time. These include files that are used by the wrapper to support deep linking or history management, as well as files that are loaded by the application such as resource bundles or RSLs.

In the case of wrapper code, you will probably be cutting and pasting it from the HTML templates included with the SDK into your JSP or ASP or PHP pages.

Check that the following assets are deployed with your application if you use those assets in your Flex applications:

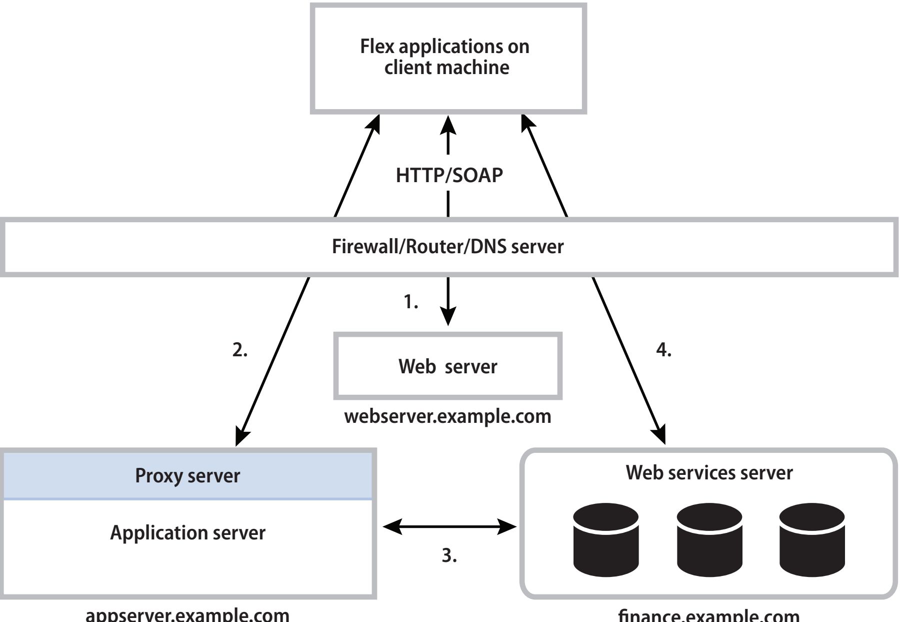
Feature	Assets to Deploy
Wrapper files	If you use a wrapper, be sure to include it in the deployment process. The wrapper can be any file that returns HTML, such as PHP, ASP, JSP, or ColdFusion. At a minimum, this file must include an `<object>` or `<embed>` tag to embed the Flex application. In addition, if you use dynamic pages to query databases or perform other server-side actions for your Flex application, be sure to deploy those as well. This is especially important if you use the data wizard in Flex Builder to generate these pages.
Version detection	To support version detection in your HTML wrapper, you must add the code based on the Flex wrapper templates to your wrapper, as well as deploy the AC_OETags.js file. This file defines several methods used for version detection. For more information, see "Creating a Wrapper" on page 311.
Express Install	To support Express Install, you must include the following files: • AC_OETags.js • playerProductInstall.swf For more information, see "Using Express Install" on page 333.

Feature	**Assets to Deploy**
History management and deep linking	To support history management and deep linking, you must include the following files in your deployment: • history.js • history.css • historyFrame.html You must import the first two files into your HTML wrapper, and store all through of these files in a /history subdirectory. For more information, see “Deep Linking” on page 1065 in the *Adobe Flex 3 Developer Guide*.
Runtime shared libraries (RSLs)	For standard RSLs, deploy the RSL SWF files with your Flex application. You must be sure to deploy the SWF files to the same relative location that the compiler used. If you are deploying an a custom RSL, be sure to optimize the RSL’s SWF file prior to deployment. For framework RSLs, be sure to deploy both the signed (*.SWZ) and unsigned (*.SWF) RSLs. For framework and cross-domain RSLs, be sure to deploy failover RSLs to the locations you specified when you compiled the application. For more information, see “Using Runtime Shared Libraries” on page 195.
Runtime stylesheets	If you use runtime stylesheets in your application, you must deploy the SWF files so that they can be loaded. You can load run-time stylesheet SWF files either locally or remotely. However, if you load them locally, the stylesheets must be in the same relative location that you specified in the application. For more information, see “Loading style sheets at run time” on page 633 in the *Adobe Flex 3 Developer Guide*.
Modules	If your application uses modules, you must deploy the module SWF files so that they can be loaded. Modules are SWF files that can be loaded and used by any number of applications. If multiple applications use your modules, then you should deploy them to a location that all applications can load them from rather than deploy them multiple times across different domains. For more information, see “Creating Modular Applications” on page 981 in the *Adobe Flex 3 Developer Guide*.
Runtime localization	If your application uses run-time localization (if it, for example, lets the user switch from English to Japanese language at run time), then you might need to deploy resource module SWF files. These modules can contain one or more resources bundles for one or more locales. For more information, see “Localizing Flex Applications” on page 1101 in the *Adobe Flex 3 Developer Guide*.

Feature	Assets to Deploy
Security files	If you use container-based security, then be sure to update your security constraints to include your Flex application. In addition, if you load assets from multiple domains, be sure to deploy any crossdomain.xml files that are required by your applications.
Miscellaneous runtime assets	Not all assets are embedded at compile time. For example, FLV and image files are usually loaded at run time to keep the SWF file as small as possible. Be sure to check that you deploy the following types of assets that are typically loaded at run time with your Flex application: • FLV files • SWF files • Sound files (such as MP3 files) • Images (such as GIF, JPG, and PNG files)
Data files	It is not uncommon for flat data files to be used as a data provider in Flex applications. Be sure to deploy any text files, which might appear in various formats such as XML, that are loaded at run time.
View source	If you use the view source functionality in Flex Builder, be sure to include the supporting files when you deploy your application. These files include the selected source code files, the source viewer's SWF file, HTML and CSS files for the source viewe, an XML file, and a ZIP file of the source code that users can download. You must maintain the directory structure that Flex Builder generates in the output directory. To enable view source and generate the ZIP file in Flex Builder, select Project > Export Release Build. Then select the Enable View Source option. For more information, see "Publishing source code" on page 134 in *Using Adobe Flex Builder 3*.

Types of network access

Deployed Flex applications typically make several types of requests to services within your firewall, as the following example shows:



Most of the deployment issues that customers report are related to network security and routing, and fall into one of the following scenarios:

1 Direct access to resources on a web server, such as image files. In the preceding example, the client directly accesses resources on webserver.example.com.

2 Direct access to resources on your application server. In the preceding example, the client directly accesses resources on appserver.example.com. Ensure that deployed Flex applications can access the appropriate servers.

3 Web services requests through a proxy. A proxy redirects a request to the server that handles the web service. In the preceding example, the client accesses a resource on appserver.example.com, but that request is redirected to finance.example.com. Ensure that you configure the proxy server correctly so that deployed Flex applications can access your web services, or other data services, through the proxy.

4 Direct access of a web service. In the preceding example, the client directly accesses a service on finance.example.com. If a deployed Flex application directly accesses web services, or other data services, ensure that access is allowed.

Step 1. Create a list of server-side resources

Before you start testing your network configuration, make a list of the IP addresses and DNS names of all the servers that a Flex application might access. A Flex application might directly access these servers, for example by using a web service, or another server might access them as part of handling a redirected request.

Enter the information about your servers in the following table:

Name	DNS name	IP address

Enter information about the server hosting the web service proxy:

Name	DNS Name	IP Address

Enter information about your web services or any other services accessible from a deployed Flex application:

Name	Location (URL)

Step 2. Verify access from server to server within your firewall

In some cases, an external request to one server can be redirected to another server behind your firewall. A redirected request can occur for a request to a web service or to any file, depending on the system configuration. Where it is necessary, ensure that your servers can communicate with each other so that a redirected request can be properly handled.

To determine if one server, called Server A in this example, can communicate with another server, called Server B, create a temporary file called temp.htm on Server A in its web root directory. Then, log in to Server B and ensure that it can access temp.htm on Server A. Try to access the file by using Server A's DNS name and also its IP address.

Servers can have multiple NIC cards or multiple IP addresses. Ensure that each server can communicate with all of the IP addresses on your other servers.

Also, log in to the server that hosts your web service proxy to make sure that it can access all web services on all other servers. You can test the web service proxy by making an HTTP request to the WSDL file for each web service. In the previous example, log in to appserver.example.com and ensure that it can access the WSDL files on finance.example.com.

If any server cannot access the other servers in your system, an external request from a Flex application might also fail. For more information, contact your system administrator.

Step 3. Verify access to your servers from outside the firewall

Some servers might have to be accessed from outside the firewall to handle HTTP, SOAP, or AMF requests from clients. You can use the following methods to determine if a deployed Flex application can access your servers from outside the firewall:

1 On each server that can be accessed from outside the firewall, create a temporary file, such as temp.htm, on the server in its web root directory. From a computer outside the firewall, use a browser to make an HTTP request to the temporary file to ensure that an external computer can access it.

   For example, for a file named temp.htm, try accessing it by using the following URL:

   ```
   http://webserver.example.com/server1/temp.htm
   ```

2 From a computer outside the firewall, use a browser to make an HTTP request to the WSDL file for each web service that can be accessed from outside the firewall to ensure that the WSDL file can be accessed.

   For example, try accessing the WSDL file for a web service by using the following URL:

   ```
   http://finance.example.com/server1/myWS.wsdl
   ```

You should be able to access the temp.htm file or the WSDL file on all of your servers from outside the firewall. If these requests fail, contact your IT department to determine why the files cannot be accessed.

Step 4. Configure the proxy server

In “Step 3. Verify access to your servers from outside the firewall” on page 309, you ensure that you can directly access your servers and server resources from outside the firewall.

After you configure your proxy server, ensure that the deployed Flex application can access web services and other server-side resources as necessary.

Step 5. Create a crossdomain policy file

Your system might be configured to allow a Flex application to directly access server-side resources on different domains or different computers without going through a proxy. These operations fail under the following conditions:

- When the Flex application’s SWF file references a URL, and that URL is outside the exact domain of the SWF file that makes the request
- When the Flex application’s SWF file references an HTTPS URL, and the SWF file that makes the request is not served over HTTPS

To make a data service or asset available to SWF files in different domains or on different computers, use a cross-domain policy file on the server that hosts the data service or asset. A *crossdomain policy file* is an XML file that provides a way for the server to indicate that its data services and assets are available to SWF files served from certain domains, or from all domains. Any SWF file that is served from a domain specified by the server’s policy file is permitted to access a data service or asset from that server. By default, place the crossdomain.xml at the root directory of the server that is serving the data.

For more information on using a cross-domain policy file, see “Using cross-domain policy files” on page 40.

Chapter 16: Creating a Wrapper

Adobe® Flex™ applications can take the form of a SWF file that you embed in an HTML page by using the `<object>` and `<embed>` tags. The HTML page can also reference an external JavaScript file to embed the Flex application. Collectively, the HTML page and JavaScript file are known as the *wrapper*.

Topics

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Adding features to the wrapper 319

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About the wrapper

The wrapper is responsible for embedding the Flex application's SWF file in a web page, such as an HTML, ASP, JSP, or Adobe ColdFusion page. In addition, you use the logic in the wrapper to enable deep linking and Express Install, and to ensure that users both with and without JavaScript enabled in their browsers can access your Flex applications. You can also use the wrapper to pass `flashVars` variables into your Flex applications and to use the ExternalInterface API. These topics are described in "Communicating with the Wrapper" on page 1035 in *Adobe Flex 3 Developer Guide*.

There are several ways to create a wrapper:

- Write a custom wrapper using the instructions in "Creating a simple wrapper" on page 315.
- Export and customize an HTML wrapper from Flex Builder. For more information, see "About the Flex Builder wrapper" on page 312.
- Use the templates provided in the /templates directory. For more information, see "About the HTML templates" on page 312.
- Use the `html-wrapper` Flex Ant task. For more information, see "Using the html-wrapper task" on page 190.
- Generate the HTML wrapper with the Flex module for Apache and IIS. For more information, see "Customizing the template" on page 348.

Adobe® Flex® Builder™and the Flex module for Apache and IIS generate a wrapper that embeds your Flex application. The Flex Builder wrapper include support for Express Install and deep linking by default, although you can disable these features or configure them to your specifications. Deep linking lets users navigate the history of their interactions within the Flex application using the browser's Forward and Back buttons, and it lets users read and write to the browser's address bar. Express Install ensures that your users have a good upgrade experience if their Players require an update. The wrapper created by the Flex module for Apache and IIS does not support Express Install or deep linking.

The mxmlc command-line compiler does not generate a wrapper. You must write it manually using the instructions in "Creating a simple wrapper" on page 315. You can start out with a simple wrapper that just embeds your Flex application. You can then add deep linking and Express Install support to your wrapper.

About the Flex Builder wrapper

To view the wrapper generated by Flex Builder, run the current project. Flex Builder generates an HTML page in the same directory as the project's root MXML file. This directory also includes the supporting files such as the history.css, history.js, historyFrame.html, and AC_OETags.js files.

You can configure the wrapper by using the Flex Compiler properties dialog box in Flex Builder. Configuration settings include:

- Enable or disable wrapper generation
- Set the minimum required version of Flash Player
- Use Express Install
- Enable deep linking and history management support

For more information, see the Flex Builder documentation.

About the HTML templates

Flex SDK includes a set of HTML templates in the *flex_install_dir*/templates directory. For Flex Builder, these files are located in the *install_dir*/sdks/3.0.0/templates directory. These templates provide a basic wrapper, as well as wrappers that implement various features. The following table describes the templates:

Directory	Description
client-side-detection	Provides scripts that detect the version of the client's player and return alternate content if the client's player does not meet the minimum required version.
client-side-detection-with-history	Provides the same scripts as those in the client-side-detection directory, but adds deep linking support.
express-installation	Provides scripts that support Express Install, which includes client-side version detection.

Directory	Description
express-installation-with-history	Provides scripts that support Express Install and deep linking.
no-player-detection	Provides a basic wrapper that embeds the SWF file by using an external JavaScript file.
no-player-detection-with-history	Provides a basic wrapper with deep linking support.

You typically use the index.template.html file found in each of these directories as the main HTML file that embeds your Flex application. For deployment, you should rename this file to index.html or whatever filename fits your web site's design. If you already have the HTML set up for your web site and are incorporating Flex into that site, then you can copy and paste the code from these templates to your existing web site's files. The template HTML also works with dynamic scripting code such as PHP, ASP, or JSP.

Each template contains a set of tokens, such as `${height}` and `${title}`. These tokens are used by Flex Builder to generate the wrapper code. Flex Builder replaces them with the appropriate values when it compiles a project. If you are editing the wrapper manually and deploying an application built with the SDK, then you must replace these tokens with the appropriate values.

In many cases, the tokens set the values of properties and attributes of the `<object>` and `<embed>` tags, or values of parameters that you pass to the `AC_FL_RunContent()` JavaScript method. For details on these properties, see the property's description in "About the object and embed tags" on page 321.

The following table describes the template tokens:

Token	Description
`${application}`	Identifies the SWF file to the host environment (a web browser, typically) so that it can be referenced by using a scripting language. This token is the value of the `id` and `name` properties that is described in "About the object and embed tags" on page 321.
`${bgcolor}`	The background color of the application. This token is the value of the `bgcolor` property that is described in "About the object and embed tags" on page 321.
`${height}`	The height of the application, in pixels. This token is the value of the `height` property that is described in "About the object and embed tags" on page 321.
`${swf}`	Specifies the location of the SWF file. This token is the value of the `src` and `movie` properties that is described in "About the object and embed tags" on page 321.
`${title}`	The title of the HTML page. This value appears in the browser's title bar when the user requests the HTML page. The default value supplied by Flex Builder is the name of the Flex application.

Token	Description
${version_major}	The required major version number of Flash Player. For example, 9. This token only appears in the wrappers with Flash Player version detection code. For more information, see “Using Express Install” on page 333.
${version_minor}	The required minor version number of Flash Player. For example, 0. This token only appears in the wrappers with Flash Player version detection code. For more information, see “Using Express Install” on page 333.
${version_revision}	The required revision version number of Flash Player. For example, 162. This token only appears in the wrappers with Flash Player version detection code. For more information, see “Using Express Install” on page 333.
${width}	The width of the application, in pixels. This token is the value of the `height` property that is described in “About the object and embed tags” on page 321.

For more information about Express Install, see “Adding Express Install to your wrapper” on page 320. For more information about deep linking, see “Adding deep linking to your wrapper” on page 321.

About the AC_OETags.js file

The AC_OETags.js file provides the HTML templates with version-checking and embedding functionality. All of the HTML templates included with Flex SDK embed the AC_OETags.js file using a line like the following:

```
<script src="AC_OETags.js" language="javascript"></script>
```

The logic in the AC_OETags.js file writes the `<object>` and `<embed>` tags out so that the browser embeds the SWF file. To accomplish this, most of the HTML templates call the `AC_FL_RunContent()` JavaScript method. This method uses a subset of the properties of the `<object>` and `<embed>` tags to embed the Flex application. The properties of these tags are similar to the parameters of this method. For example, the `src` parameter of the `AC_FL_RunContent()` method is equivalent to the `src` attribute of the `<embed>` tag. For more information, see “About the object and embed tags” on page 321.

The AC_OETags.js file also defines methods, such as `GetSwfVer()` and `DetectFlashVer()`, which are used by the version detection functionality. For more information on these methods, see “Editing your wrapper for Express Install” on page 334.

Creating a simple wrapper

You can write your own wrapper for your SWF files rather than use the wrappers generated by Flex Builder or the Flex module for Apache and IIS. Your own wrapper can be simple HTML, or it can be a JavaServer Page (JSP), a PHP page, an Active Server Page (ASP), or anything that can return HTML that is rendered in your client's browser. Typically, you integrate wrapper logic into your website's own HTML templates.

This section describes how to write the simplest wrapper possible to get your Flex application running on a web server. It does not include features such as deep linking and Express Install. These features improve the user experience and should be omitted only after careful consideration. Instructions for adding these features, which can make creating a wrapper more complex, are described in later sections.

A basic wrapper consists of the following files:

- **HTML page** This is the file that the client browser requests. It typically defines two possible experiences (one for users with JavaScript enabled and one for users without JavaScript enabled). This page also references a separate JavaScript file. In the provided HTML templates, a basic version of this page is included at /templates/no-player-detection/index.template.html.
- **JavaScript file** The JavaScript file referenced by the `<script>` tag in the HTML page includes the following:
  - `<object>` tag This tag embeds the SWF file for Internet Explorer.
  - `<embed>` tag This tag embeds the SWF file for Netscape-based browsers.

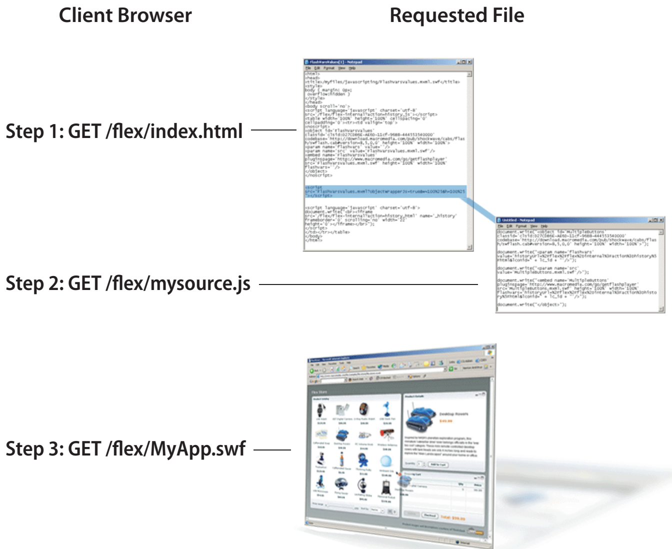
  In the provided HTML templates, the JavaScript file is named AC_OETags.js. This JavaScript file contains a great deal of logic that is unnecessary for a basic wrapper, so you will probably want to write your own when developing a basic wrapper.

The client first requests the HTML page. If the user's browser has JavaScript enabled, the HTML page then references the JavaScript file. The JavaScript file embeds the Flex application's SWF file.

To make your Flex application respond immediately without user interaction, use a `<script>` tag to load the JavaScript file that contains the `<object>` and `<embed>` tags. Do not write the `<object>` and `<embed>` tags directly in the HTML file. Controls that are directly loaded by the embedding page require activation before they will run in Microsoft Internet Explorer 6 or later. If you load the controls directly in the HTML page, users will be required to activate those controls before they can use them by clicking on the control or giving it focus. This is undesirable because you want your Flex application to run immediately when the page loads, not after the user interacts with the control.

If the client disabled JavaScript in their browser, you typically embed the Flex application directly in the `<noscript>` tag. You can add warnings that they should enable JavaScript or else they will have a less than ideal experience.

The following example illustrates the minimum number of requests that the client browser makes when JavaScript is enabled:



The following example shows the minimum requirements of the HTML page and JavaScript file to embed a Flex application named MyApp:

```
<!-- index.html -->
<!-- saved from url=(0014)about:internet -->
<html>
    <body>
        <script src="mysource.js"></script>
    </body>
</html>
```

```
<!-- mysource.js -->
document.write("<object id='MyApp' classid='clsid:D27CDB6E-AE6D-11cf-96B8-444553540000'
codebase='http://download.macromedia.com/pub/shockwave/cabs/flash/swflash.cab#version=9,
0,0,0' height='100%' width='100%'>");
document.write("<param name='movie' value='MyApp.swf'/>");
```

```
document.write("<embed name='MyApp' src='MyApp.swf'
pluginspage='http://www.macromedia.com/shockwave/download/index.cgi?P1_Prod_Version=Shoc
kwaveFlash' height='100%' width='100%'/>");
document.write("</object>");
```

Adding the Mark of the Web (MOTW) to your wrapper is optional. However, if you do not add the MOTW to your wrapper, your application might not open in the expected security zone within Internet Explorer. The following example MOTW forces Internet Explorer to open the page in the Internet zone:

```
<!-- saved from url=(0014)about:internet -->
```

In general, add a MOTW when you are previewing pages locally before publishing them on a server. For more information about the MOTW, see http://msdn.microsoft.com/workshop/author/dhtml/overview/motw.asp.

To support browsers that do not have scripting enabled, you can add a `<noscript>` block to the wrapper. The tags in this block of code usually mirrors the output of the `document.write()` methods in the embedded JavaScript file. The following example adds the `<noscript>` block:

```
<!-- index.html -->
<!-- saved from url=(0014)about:internet -->
<html>
    <body>
        <script src="mysource.js"></script>
        <noscript>
            <object id='MyApp' classid='clsid:D27CDB6E-AE6D-11cf-96B8-444553540000'
                codebase='http://download.macromedia.com
                /pub/shockwave/cabs/flash/swflash.cab#version=9,0,0,0'
                height='100%' width='100%'>
                <param name='src' value='MyApp.swf'/>
                <embed name='MultipleButtons' pluginspage='http://
                    www.macromedia.com/shockwave/download/index.cgi
                    ?P1_Prod_Version=ShockwaveFlash' src='MyApp.swf' height='100%'
                    width='100%'/>
            </object>
        </noscript>
    </body>
</html>
```

About the HTML page

The wrapper's HTML page includes the following:

<script> block The script block embeds the JavaScript file. This JavaScript file defines the `<object>` and `<embed>` tags that embed the SWF file in the HTML page. This block is for users who have enabled JavaScript in their browser.

<noscript> block The code in the `<noscript>` block uses `<object>` and `<embed>` tags to embed the SWF file in the HTML page for users who have disabled JavaScript in their browser. The `<noscript>` block is useful if your application requires JavaScript (for example, if you use the ExternalInterface API in your application). You can use this block to warn users that they will have limited functionality, or redirect them to another site. For a simple application, however, your `<noscript>` block typically contains identical tags as they are defined in the JavaScript file. For more complex wrappers that include support for Express Install, the `<script>` block can include a considerable amount of JavaScript code.

About the JavaScript file

The JavaScript file consists of a set of `document.write()` methods that write the `<object>` and `<embed>` tags that embed your application. In this example, these tags are identical to the `<object>` and `<embed>` tags used in the HTML page's `<noscript>` block. In more complex configurations, you can add Express Install or deep linking support to the JavaScript file that is not supported in the HTML page's `<noscript>` block. Remember that the code in the HTML page is for browsers that do not support JavaScript.

The `<object>` tag's `codebase` and the `<embed>` tag's `pluginspage` properties add support for basic player version detection and installation. The `codebase` tag defines the minimum version required at the end of the URL (for example, `#version=9,0,0,0`). If a client requests this page with a player version older than the version specified, they are prompted to upgrade their player.

The upgrade experience is considerably better with Express Install. If the user's player does not meet the minimum requirements, the new player is automatically installed for them. You add Express Install by editing your wrapper. For more information, see "Using Express Install" on page 333.

With a generic wrapper, a user who clicks the Back and Forward buttons in their browser navigates the HTML pages in the browser's history and not the history of their interactions within the Flex application. Deep linking lets users navigate their interactions with the Flex application by using the Back and Forward buttons in their browser. You can add deep linking by editing your wrapper. For more information, see "Deep Linking" on page 1065 in *Adobe Flex 3 Developer Guide*.

In addition to adding deep linking and Adobe® Flash® Player detection support to your wrapper, you can use other properties of the `<object>` and `<embed>` tags to add functionality. For more information, see "About the object and embed tags" on page 321.

Adding features to the wrapper

The default wrapper that Flex Builder creates includes deep linking and support for Express Install. The Browser-Manager lets users navigate through a Flex application using the web browser's Back and Forward buttons. Express Install detects if the client has the required version of Flash Player to run the application and installs a newer player on the client if necessary.

Each of these features requires additional files to be deployed with your application, as described here. For additional information on implementing these features, see "Deep Linking" on page 1065 in *Adobe Flex 3 Developer Guide* and "Using Express Install" on page 333.

Before adding additional functionality to your custom wrapper, you should understand the issues described in "Customizing the wrapper" on page 319.

A simple application uses only the main wrapper plus a JavaScript file that embeds the Flex application's SWF file.

Customizing the wrapper

Use the following guidelines when you create a custom wrapper.

- You can use the HTML templates in the /templates directory as guides to adding new features to the wrapper. For information about the templates, see "About the HTML templates" on page 312.
- You must embed the SWF file and not the MXML file. Set the value of the `src` property of the `<object>` tag to `*mxml_filename*.mxml.swf` if you use the web-tier compiler. If you use the command-line compiler or Flex Builder, set the value of the `src` property to `*mxml_filename*.swf`.

  The following example defines the `src` property of the `<object>` tag for an MXML application called MyApp.mxml:

  ```
  <param name='src' value='MyApp.mxml.swf'>
  ```

  The `<embed>` tag uses the `src` property to define the source of the SWF file:

  ```
  src='MyApp.mxml.swf'
  ```

- Do not include periods or other special characters in the `id` and `name` properties of the `<object>` and `<embed>` tags. These tags identify the SWF object on the page, and you use them when you use the ExternalInterface API. This API lets Flex communicate with the wrapper, and vice versa. For more information about using the ExternalInterface API, see "Communicating with the Wrapper" on page 1035 in *Adobe Flex 3 Developer Guide*.

- Do not put the contents of the JavaScript file directly in the HTML page. This causes Internet Explorer to prompt the user before enabling Flash Player. If the client has “Disable Script Debugging (Internet Explorer)” unchecked in Internet Explorer’s advanced settings, the browser still prompts the user to load the ActiveX plug-in before running it.
- If you use both the `<object>` and the `<embed>` tags in your custom wrapper, use identical values for each attribute to ensure consistent playback across browsers. For more information about the `<object>` and the `<embed>` tags, see “About the object and embed tags” on page 321.
- To add basic player detection logic without deep linking or Express Install support, use the templates in the /templates/client-side-detection directory. For more information, see “Editing your wrapper for Express Install” on page 334.
- To add support for deep linking, follow the instructions in “Deep Linking” on page 1065 in *Adobe Flex 3 Developer Guide*.
- To add support for Flash Player detection, follow the instructions in “About Express Install” on page 333.
- When using Flex Builder, the default wrapper includes deep linking and Express Install support. You can disable one or both of these features by using the Compiler Properties dialog box. You can also use this dialog box to set the minimum required version of the Flash Player.

Adding Express Install to your wrapper

Express Install is included by default in the wrappers generated by Flex Builder.

Disable Express Install in Flex Builder

1. Open your project in Flex Builder.
2. Select Project > Properties.
3. Select Flex Compiler from the tree at the left.
4. Deselect the Use Express Install option.
5. Click OK to save your changes.

If you write your own wrapper, however, you must add it manually or use the HTML templates in the /templates directory as a base.

Adding Express Install support involves adding JavaScript and VBScript to your main wrapper file, as well as deploying the AC_OETags.js file. In addition, you must deploy another SWF with your application.

The following files are required by a wrapper with Express Install support:

- index.template.html (with additional version detection logic)
- AC_OETags.js

- playerProductInstall.swf
- YourApp.swf

The AC_OETags.js file defines functions that the wrapper calls to embed the Flex application's SWF file. It also provides version checking methods. For more information about the AC_OETags.js file, see "About the AC_OETags.js file" on page 314.

In addition to using the AC_OETags.js file, you must also deploy the playerProductInstall.swf file in a location that is accessible by the main application SWF file.

The files required by Express Install are located in the /templates/express-installation and /templates/express-installation-with-history directories.

For more information about adding support for Express Install to your wrapper, see "Using Express Install" on page 333.

Adding deep linking to your wrapper

Support for deep linking, also known as history management, is included by default in the wrappers generated by Flex Builder. If you write your own wrapper, however, you must add it manually or use the HTML files in the /templates directory as a base.

To add deep linking support, you reference the history.js file in a `<script>` tag in your wrapper. The history.js file records actions for deep linking. You must also deploy the following files with your wrapper:

- history.js
- historyFrame.html
- history.css

If you do not add deep linking support to your wrapper, you cannot use the BrowserManager in your Flex application.

For more information about adding deep linking support to your wrapper, see "Deep Linking" on page 1065 in the *Adobe Flex 3 Developer Guide*.

About the object and embed tags

The HTML templates included with Flex Builder and Flex SDK use the `<object>` and `<embed>` tags embed your Flex application. In the case of Flex Builder, when you compile a project, Flex Builder sets the values for these tags for you. For the SDK, you must manually edit the templates and set the values of these tags.

The <object> and <embed> tags support a set of properties that add additional functionality to the wrapper. These properties let you change the appearance of the SWF file on the page or change some of its properties such as the title or language. If you want to customize your wrapper, you can add these properties to the wrapper.

The <object> tag is used by Internet Explorer 3.0 or later on Windows platforms or any browser that supports the use of the Flash ActiveX control. The <embed> tag is used by Netscape Navigator 2.0 or later, or browsers that support the use of the Netscape-compatible plug-in version of Flash Player.

When an ActiveX-enabled browser loads the HTML page, it reads the values set on the <object> and ignores the <embed> tag. When browsers using the Flash plug-in load the HTML page, they read the values set on the <embed> tag and ignore the <object> tag. Make sure that the properties for each tag are identical, unless you want different results depending on the user's browser.

You must set the values of four required properties as attributes in the <object> tag. The required properties are:

- `height`
- `width`
- `classid`
- `codebase`

All other properties are optional and you set their values in separate, named <param> tags.

Although the `movie` property is technically an optional tag, without it, there is no reference to the application you want the client to load. Therefore, your wrapper should always set the `movie` parameter in the <object> tag.

The following example shows the required properties as attributes of the <object> tag, and four optional properties, `movie`, `play`, `loop`, and `quality`, as <param> child tags:

```
<object classid="clsid:d27cdb6e-ae6d-11cf-96b8-444553540000" width="100" height="100"
codebase="http://active.macromedia.com/flash7/cabs/ swflash.cab#version=9,0,0,0">
    <param name="movie" value="moviename.swf">
    <param name="play" value="true">
    <param name="loop" value="true">
    <param name="quality" value="high">
</object>
```

For the <embed> tag, all settings are attributes that appear between the angle brackets of the opening <embed> tag. The <embed> tag requires the `height` and `width` attributes, and the `pluginspage` attribute, which is the equivalent of the <object> tag's `codebase` property. The <embed> tag does not require a `classid` attribute. As with the `movie` parameter of the <object> tag, the `src` attribute of the <embed> tag provides the reference to the Flex application. Without it, there would be no SWF file, so you should consider it a required attribute.

Although the `codebase` and `pluginspage` properties are required, they are not necessarily used if you use Flash Player Detection Kit to detect and install the required version of Flash Player. For more information, see "Using Express Install" on page 333.

The following example shows a simple `<embed>` tag with the optional `quality` attribute:

```
<embed src="moviename.swf" width="100" height="100" quality="high"
pluginspage="http://www.macromedia.com/shockwave/download/index.cgi?P1_Prod_Version=Shoc
kwaveFlash">
</embed>
```

To use both tags together, position the `<embed>` tag just before the closing `</object>` tag, as the following example shows:

```
<object classid="clsid:d27cdb6e-ae6d-11cf-96b8-444553540000" width="100" height="100"
codebase="http://active.macromedia.com/flash7/cabs/ swflash.cab#version=9,0,0,0">
    <param name="movie" value="moviename.swf">
    <param name="play" value="true">
    <param name="loop" value="true">
    <param name="quality" value="high">
    <embed src="moviename.swf" width="100" height="100" play="true" loop="true"
quality="high"
pluginspage="http://www.macromedia.com/shockwave/download/index.cgi?P1_Prod_Version=Shoc
kwaveFlash">
    </embed>
</object>
```

When you define parameters for the `<object>` tag, also add them as tag properties to the `<embed>` tag so that the SWF file appears the same on the page regardless of the client's browser.

If you are editing the HTML wrapper templates for the SDK, you will need to replace the tokens such as `${height}` and `${width}` in the `<object>` and `<embed>` tags with absolute values before deploying the wrapper. For more information, see "About the HTML templates" on page 312.

Not all properties are supported by both the `<object>` and the `<embed>` tags. For example, the `id` property is used only by the `<object>` tag, just as the `name` property is used only by the `<embed>` tag.

In some cases, the `<object>` and `<embed>` tag properties duplicate properties that you can set on the `<mx:Application>` tag in the Flex application source code. For example, you can set the `height` and `width` properties of the SWF file on the `<object>` and `<embed>` tags or you can set them on the `<mx:Application>` tag.

The following table describes the supported <object> and <embed> tag properties:

Property	Type	Description
`align`	String	Specifies the position of the SWF file. The `align` property supports the following values: • `bottom`: Vertically aligns the bottom of the SWF file with the current baseline. This is typically the default value. • `middle`: Vertically aligns the middle of the SWF file with the current baseline. • `top`: Vertically aligns the top of the SWF file with the top of the current text line. • `left`: Horizontally aligns the SWF file to the left margin. • `right`: Horizontally aligns the SWF file to the right margin.
`allowNetworking`	String	Restricts browser communication. This property affects more APIs than the `allowScriptAccess` property. The `allowNetworking` property supports the following values: • `all`: No networking restrictions. Flash Player behaves normally. This is typically the default. • `internal`: SWF files cannot call browser navigation or browser interaction APIs (such as the `ExternalInterface.call()`, `fscommand()`, and `navigateToURL()` methods), but can call other networking APIs. • `none`: SWF files cannot call networking or SWF-to-SWF file communication APIs. In addition to the APIs restricted by the `internal` value, these include other methods such as `URLLoader.load()`, `Security.loadPolicyFile()`, and `SharedObject.getLocal()`. For more information, see *Programming ActionScript 3.0*.

Property	Type	Description
`allowScriptAccess`	String	Controls the ability to perform outbound scripting from within the SWF file. The `allowScriptAccess` property can prevent a SWF file hosted from one domain from accessing a script in an HTML page that comes from another domain. Setting `allowScriptAccess` to `never` for all SWF files hosted from another domain can ensure security of scripts located in an HTML page. Valid values are as follows: • `always`: Outbound scripting always succeeds. • `never`: Outbound scripting always fails. • `samedomain:` Outbound scripting succeds only if the application is from the same domain as the HTML page. The default value for the web-tier compiler is `sameDomain`. This property affects the following operations: • `ExternalInterface.call()` • `fscommand()` • `navigateToURL()`, when used with `javascript` or another scripting scheme • `navigateToURL()`, when used with window name of `_self`, `_parent`, or `_top`. For more information, see *Programming ActionScript 3.0*.
`archive`	String	Specifies a space-separated list of URIs for archives containing resources used by the application, which may include the resources specified by the `classid` and `data` properties. Preloading archives can result in reduced load times for applications. Archives specified as relative URIs are interpreted relative to the `codebase` property.
`base`	String	Specifies the base directory or URL used to resolve relative path statements in ActionScript.

Property	Type	Description

bgcolor	String	Specifies the background color of the application. Use this property to override the background color setting specified in the SWF file. This property does not affect the background color of the HTML page.
		
		Valid formats for bgcolor are any #RRGGBB, hexadecimal, or RGB value.
		
		The Application container's style uses an image as the default background image. This image obscures any background color settings that you might make in the wrapper. So, to make the value of the bgcolor property display properly, you must clear the Application container's backgroundImage style property. To do this, you can set it to the value of a space character, as the following example shows:
		
		<mx:Style>
		    Application {
		        backgroundImage: " ";
		    }
		</mx:Style>

border	int	Specifies the width of the SWF file's border, in pixels. The default value for this property depends on the user agent.
classid	String	Defines the classid of Flash Player. This identifies the ActiveX control for the browser. Internet Explorer 3.0 or later on Windows 9x, Windows 2000, Windows NT, Windows ME, and Windows XP prompt the user with a dialog box asking if they would like to auto-install Flash Player if it's not already installed. This process can occur without the user having to restart the browser. This property is used for the <object> tag only. For the <object> tag, you set the value of this property as an attribute of the <object> tag and not as a <param> tag.
codebase	String	Identifies the location of Flash Player ActiveX control so that the browser can download it if it is not already installed. This property is used for the <object> tag only. You can modify this property by using the settings in Flex Builder. For the <object> tag, you set the value of this property as an attribute of the tag and not as a child <param> tag. Like the pluginspage property, the codebase property is required. However, they are not necessarily used if you use Flash Player Detection Kit to detect and install the required version of Flash Player. For more information, see "Using Express Install" on page 333.

Property	Type	Description
codetype	String	Defines the content type of data expected when downloading the application specified by the classid property The codetype property is optional but recommended when the classid property is specified; it lets the browser avoid loading unsupported content types. The default value of the codetype property is the value of the type property.
data	String	Specifies the location of the application's data; for example, instance image data for objects that define images. If the data property is a relative URI, it is relative to the codebase property.
declare	Boolean	Makes the current SWF file's definition a declaration only. The SWF file must be instantiated by a subsequent object definition referring to this declaration.
devicefont	Boolean	Specifies whether static text objects for which the deviceFont option is not selected are drawn using a device font anyway, if the needed fonts are available from the operating system.
dir	String	Specifies the base direction of text in an element's content and attribute values. It also specifies the directionality of tables. Valid values are LTR (left-to-right text or table) and RTL (right-to-left text or table).
flashVars	String	Sends variables to the application. The format is a set of name-value pairs, each separated by an ampersand (&). Browsers support string sizes of up to 64 KB (65535 bytes) in length. The default value of this property is typically an empty string. For more information on using flashVars to pass variables to Flex applications, see "Communicating with the Wrapper" on page 1035 in *Adobe Flex 3 Developer Guide*.
height	int	Defines the height, in pixels, of the SWF file. Flash Player makes a best guess to determine the height of the application if none is provided. The browser scales an object or image to match the height and width specified by the author. You can set this value to a fixed number or a percentage value; for example, length='100' or length='50%'. Lengths expressed as percentages are based on the horizontal or vertical space currently available, not on the default size of the SWF file. FireFox browsers do not support percentage-based values. You can also set the height of a Flex application by setting the height property of the <mx:Application> tag in an MXML file. For the <object> tag, you set the value of this property as an attribute of the <object> tag and not as a <param> child tag.

Property	Type	Description
hspace	int	Specifies the amount of white space inserted to the left and right of the SWF file. The default value is typically not specified, but is generally a small, nonzero length.
id	String	Identifies the SWF file to the host environment (a web browser, for example) so that it can be referenced by using a scripting language such as VBScript or JavaScript. The id property is only used with the <object> tag. It is equivalent to the name property used with the <embed> tag.
lang	String	Specifies the base language of an element's property values and text content. The default value is typically unknown. The browser can use language information specified using the lang property to control rendering in a variety of ways.
menu	Boolean	Changes the appearance of the menu that appears when users right-click over a Flex application in Flash Player. Set to true to display the entire menu. Set to false to display only the About and Settings options on the menu. The default value is typically true.
movie	String	Specifies the location of the SWF file. The movie property is only used with the <embed> tag. It is equivalent to the src property used with the <object> tag.
name	String	Identifies the SWF file to the host environment (a web browser, typically) so that it can be referenced by using a scripting language. The name property is only used with the <embed> tag. It is equivalent to the id property used with the <object> tag.
pluginspage	String	Identifies the location of Flash Player plug-in so that the user can download it if it is not already installed. This property is used for the <embed> tag only. You can modify this property by using the settings in Flex Builder. Like the codebase property, the pluginspage property is required. However, these properties are not necessarily used if you use Flash Player Detection Kit to detect and install the required version of Flash Player. For more information, see "Using Express Install" on page 333.

Property	**Type**	**Description**
`quality`	String	Defines the quality of playback in Flash Player. Valid values of quality are `low`, `medium`, `high`, `autolow`, `autohigh`, and `best`. The default value is typically `best`. The `low` setting favors playback speed over appearance and never uses anti-aliasing. The `autolow` setting emphasizes speed at first but improves appearance whenever possible. Playback begins with anti-aliasing turned off. If Flash Player detects that the processor can handle it, anti-aliasing is turned on. The `autohigh` setting emphasizes playback speed and appearance equally at first, but sacrifices appearance for playback speed if necessary. Playback begins with anti-aliasing turned on. If the actual frame rate drops below the specified frame rate, anti-aliasing is turned off to improve playback speed. Use this setting to emulate the View > Antialias setting in Flash. The `medium` setting applies some anti-aliasing and does not smooth bitmaps. The `high` setting favors appearance over playback speed and always applies anti-aliasing. The `best` setting provides the best display quality and does not consider playback speed. All output is anti-aliased and all bitmaps are smoothed.
`salign`	String	Positions the SWF file within the browser. Valid values are `L`, `T`, `R`, `B`, `TL`, `TR`, `BL`, and `BR`. `L`, `R`, `T`, and `B` align the SWF file along the left, right, top, or bottom edge, respectively, of the browser window and crop the remaining three sides as needed. `TL` and `TR` align the SWF file to the top-left and top-right corner, respectively, of the browser window and crop the bottom and remaining right or left side as needed. `BL` and `BR` align the SWF file to the bottom-left and bottom-right corner, respectively, of the browser window and crop the top and remaining right or left side as needed.
`scale`	String	Defines how the browser fills the screen with the SWF file. The default value is typically `showall`. Valid values of the `scale` property are `showall`, `noborder`, and `exactfit`. Set to `showall` to make the entire SWF file visible in the specified area without distortion, while maintaining the original aspect ratio of the SWF file. Borders may appear on two sides of the SWF file. Set to `noborder` to scale the SWF file to fill the specified area, without distortion but possibly with some cropping, while maintaining the original aspect ratio of the SWF file. Set to `exactfit` to make the entire SWF file visible in the specified area without trying to preserve the original aspect ratio. Distortion may occur.
`src`	String	Specifies the location of the SWF file. The `src` property is only used with the `<object>` tag. It is equivalent to the `movie` property used with the `<embed>` tag.
`standby`	String	Defines a message that the browser displays while loading the object’s implementation and data.

Property	Type	Description
`style`	String	Specifies style information for the SWF file. The syntax of the value of the `style` property is determined by the default style sheet language. In CSS, property declarations have the form "name:value" and are separated by a semicolon. Styles set with this property do not affect components or the Application container in the Flex application. Rather, they apply to the SWF file as it appears on the HTML page.
`supportembed`	Boolean	Determines whether the Netscape-specific `<embed>` tag is supported. The `supportembed` property is optional, and the default value is typically `true`. Set to `false` to prevent the `<embed>` tag from being read by the browser.
`tabindex`	int	Specifies the position of the SWF file in the tabbing order for the current document. This value must be a number between 0 and 32767. User agents should ignore leading zeros.
`title`	String	Displays information about the SWF file. Values of the `title` property can be rendered by browsers or other user agents in different ways. For example, some browsers display the title as a ToolTip. Audio user agents might speak the title information in a similar context.
`type`	String	Specifies the content type for the data specified by the `data` property. The `type` property is optional but recommended when data is specified; it prevents the browser from loading unsupported content types. If the value of this property differs from the HTTP Content-Type returned by the server, the HTTP Content-Type takes precedence.
`usemap`	String	Associates an image map with the SWF file. The image map is defined by a `map` element. The value of `usemap` must match the value of the `name` attribute of the associated `map` element.
`vspace`	int	Specifies the amount of white space inserted above and below the SWF file. The default value is typically not specified, but is generally a small, nonzero length.

Property	Type	Description
`width`	int	Defines the width, in pixels, of the SWF file. Flash Player makes a best guess to determine the width of the application if none is provided. Browsers scale an `object` or image to match the height and width specified by the author. You can set this value to a fixed number or a percentage value. For example, “width=100” or “width=”50%”. Lengths expressed as percentages are based on the horizontal or vertical space currently available, not on the natural size of the SWF file. You can also set the width of a Flex application by setting the `width` property of the `<mx:Application>` tag in an MXML file. For the `<object>` tag, you set the value of this property as an attribute of the `<object>` tag and not as a `<param>` tag.
`wmode`	String	Sets the Window Mode property of the SWF file for transparency, layering, and positioning in the browser. Valid values of `wmode` are `window`, `opaque`, and `transparent`. Set to `window` to play the SWF in its own rectangular window on a web page. Set to `opaque` to hide everything on the page behind it. Set to `transparent` so that the background of the HTML page shows through all transparent portions of the SWF file. This can slow animation performance. To make sections of your SWF file transparent, you must set the `alpha` property to 0. To make your application’s background transparent, set the `backgroundAlpha` property on the `<mx:Application>` tag to 0. The `wmode` property is not supported in all browsers and platforms.

The `<object>` and `<embed>` tags can also take additional properties that are not supported by Flex applications. These unsupported properties are listed in “Unsupported properties” on page 331.

Unsupported properties

Some optional Flash Player properties do not apply to Flex applications. These are properties that involve movie frames and looping. The following properties have no effect when used with Flex:

- `loop`
- `play`
- `swliveconnect`

Requesting an MXML file without the wrapper

If you are using the web-tier compiler, also known as the Flex module for Apache and IIS, you can request an MXML file that has not yet been compiled into a SWF and have it return only the SWF file (without the wrapper). You do this by appending *.swf to the end of the request string that specifies *.mxml.

For example, the following request returns only a SWF file and no wrapper:

```
http://www.mysite.com/flex/MyApp.mxml.swf
```

For more information, see "Using the Flex Module for Apache and IIS" on page 341.

Chapter 17: Using Express Install

After developing an application, you want to ensure that all users can run it and that they have a current version of the Adobe® Flash® Player. In most cases, the player is an ActiveX control running inside Microsoft Internet Explorer or a plug-in for Netscape-based browsers. You edit the wrapper to include version detection logic, and logic that installs a newer player on the client if necessary. This is known as Express Install. It is sometimes also known as Player Product Install.

Express Install requires that the client have Flash Player 6.0.65 or later installed on MacOS or Microsoft Windows, and that the browser has JavaScript enabled.

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About Express Install

Adobe® Flex® includes code and applications that make the updating process for the player simple for you and nearly transparent for the client. These files are located in the *sdk_install_dir*/templates directory for Flex SDK and the *install_dir*/sdks/3.0.0/templates directory for Adobe® Flex® Builder™.

The recommended method of ensuring that Flash Player can run the Flex application on the client is to use Express Install. With Express Install, you can detect when users do not have the latest version of Flash Player, and you can initiate an update process that installs the latest version of the player from the Adobe website. When the installation is complete, users are directed back your website, where they can run your Flex application.

Express Install runs a SWF file in the existing Flash Player to upgrade users to the latest version of the player. As a result, Express Install requires that Flash Player already be installed on the client, and that it be version 6.0.65 or later. The Express Install feature also relies on JavaScript detection logic in the browser to ensure that the player required to start the process exists. As a result, the browser must have JavaScript enabled for Express Install to work.

If the player on the client is not new enough to support Express Install, you can display alternate content, redirect the user to the Flash Player download page, or initiate another type of Flash Player upgrade experience. For information on using alternative Player upgrade techniques, see "Alternatives to Express Install" on page 338.

Editing your wrapper for Express Install

After you compile your application into a SWF file, you write a wrapper that embeds that SWF file. Clients request this wrapper directly. You can use Adobe Flex Builder to automatically generate a wrapper, or you can write one yourself. Express Install is included by default in the wrappers generated by Flex Builder.

Disable Express Install in Flex Builder

1. Open your project in Flex Builder.
2. Select Project > Properties.
3. Select Flex Compiler from the tree at the left.
4. Deselect the Use Express Install option.
5. Click OK to save your changes.

The wrapper generated by the Flex module for Apache and IIS does not support Express Install.

If you write your own wrapper, however, you must add Express Install manually. Sample wrapper templates are available in the *sdk_install_dir*/templates directory for Flex SDK and the *install_dir*/sdks/3.0.0/templates directory for Flex Builder. For more information, see “About the HTML templates” on page 312.

Refer to the following steps if you write your own wrapper and add Express Install support to it, and customize a generated wrapper or template. For more information about creating a wrapper, see “Creating a Wrapper” on page 311.

Adding the Express Install script to the wrapper

After you write your own wrapper, follow these steps to add support for Express Install. These steps require the following files, which are located in the /templates/express-installation directory:

- **index.template.html** Wrapper file that detects the Flash Player version and initiates Express Install if necessary. You can integrate this code with your website.
- **AC_OETags.js** Script file that provides methods for Flash Player version detection and embedding your Flex application. You call methods in this file from your wrapper.
- **playerProductInstall.swf** Application that initiates Express Install. You deploy this file with your application.

Add Express Install support to your wrapper

1 Open your wrapper in a text editor.

2 Add or include the script in the index.template.html file to your wrapper. This file is included in the /templates/express-installation directory. For a detailed description of this script, see "Understanding the Express Install script" on page 337.

3 In the Globals section of the script, set the minimum version of Flash Player that your users must be running. For example:

```
// Globals
// Major version of Flash required
var requiredMajorVersion = 9;
// Minor version of Flash required
var requiredMinorVersion = 0;
// Minor version of Flash required
var requiredRevision = 0;
```

If you are using Flex Builder to generate the wrapper, you can set this value in the Detect Flash Version text box in the Compiler Properties dialog box.

This is useful, too, to ensure that your users have a version of Flash Player that supports certain features. For example, if you want your users' Flash Player to support signed framework RSLs, set the minimum version to 9.0.115.

4 Deploy the AC_OETags.js file to a location that is accessible to your wrapper. This file is included in the /templates/express-installation directory. This file is also generated by Flex Builder. The default location is the same directory as the wrapper. If you change it, you must also edit the following line in the wrapper:

```
<script src="AC_OETags.js" language="javascript"></script>
```

5 Edit the calls to the `AC_FL_RunContent()` method. This method passes information about the SWF file to be run to the AC_OETags.js external script file. The functions defined in the AC_OETags.js file write the `<object>` and `<embed>` tags for the SWF file.

There are multiple calls to this method in script blocks that meet different conditions. In the first script block, change the `id` and `name` parameters to match your SWF file's name:

```
if (hasProductInstall && !hasRequestedVersion) {
        AC_FL_RunContent(
        "src", "playerProductInstall",
        "FlashVars", "MMredirectURL="+MMredirectURL+'&MMplayerType='+
            MMPlayerType+'&MMdoctitle='+MMdoctitle+"",
        "width", "100%",
        "height", "100%",
        "align", "middle",
        "id", "MyFirstProject",
        "quality", "high",
```

```
        "bgcolor", "#869ca7",
        "name", "MyFirstProject",
        "allowScriptAccess","sameDomain",
        "type", "application/x-shockwave-flash",
        "pluginspage", "http://www.macromedia.com/go/getflashplayer"
    );
}
```

In the second script block, change the `src`, `id`, and `name` parameters to match your SWF file's name:

```
} else if (hasRequestedVersion) {
    AC_FL_RunContent(
            "src", "MyFirstProject",
            "width", "100%",
            "height", "100%",
            "align", "middle",
            "id", "MyFirstProject",
            "quality", "high",
            "bgcolor", "#869ca7",
            "name", "MyFirstProject",
            "allowScriptAccess","sameDomain",
            "type", "application/x-shockwave-flash",
            "pluginspage", "http://www.macromedia.com/go/getflashplayer"
    );
}
```

When you edit these methods, you can also add `flashVars` variables, change the height and width of the SWF file, and set other properties of the SWF file, if necessary. For more information about available properties, see "About the object and embed tags" on page 321. For more information about adding deep linking support, see "Deep Linking" on page 1065 in the *Adobe Flex 3 Developer Guide*.

6 Replace the value of the `alternateContent` variable with your own custom content. In this step and the next, you can implement alternate methods of upgrading Flash Player for users who do not meet the requirements for Express Install. For more information, see "Alternatives to Express Install" on page 338.

7 Replace the HTML code found within the `<noscript>` tag with your own custom content. For more information, see "Alternatives to Express Install" on page 338.

8 Deploy the playerProductInstall.swf file included in the /templates/express-installation directory to your web server.

By default, you should deploy this file to the same directory as your Flex application. If you deploy it to another location, you must update the wrapper to point to this new location. This file is also included in your Flex application's bin directory in Flex Builder.

Understanding the Express Install script

The scripts that implement Express Install in your wrapper are contained in the AC_OETags.js and index.template.html files from the /templates/express-installation directory.

The following steps show the order of execution within the Express Install scripts.

For browsers with scripting

1 Sets global variables that define the required minimum version of the player.

2 Detects browser type (set the values of the `isIE`, `isWin`, and `isOpera` Boolean properties).

3 Sets the value of the `hasProductInstall` property by calling the `DetectFlashVer()` method.

4 This method returns `true` if the current player supports Flash Product Install. This method returns `false` if the current player does not support Flash Product Install. Flash Players later than version 6.0.65 meet this requirement.

5 Sets the value of the `hasRequestedVersion` property by calling the `DetectFlashVer()` method.

6 This method returns `true` if the current player is new enough to display the Flex application. This method returns `false` if the current player must be upgraded to display the Flex application.

7 Sets the value of the `MMredirectURL` property to specify the location where the browser is redirected after running Express Install.

8 Sets the value of the `document.title` and `MMdoctitle` properties so the unused browser windows can be closed after running Express Install.

9 Examines the values of the `hasProductInstall` and `hasRequestedVersion` properties:

- If the current player is version 6.0.65 or later (`hasProductInstall=true`) but it cannot play the current Flex application (`hasRequestedVersion=false`), run the playerProductInstall.swf file. This upgrades the player with Express Install.
- If the current version of the player meets the requirements for playback (`hasRequestedVersion=true`), run the Flex application.
- If the current player is earlier than version 6.0.65 (`hasProductInstall=false`) and the version is not new enough (`hasRequestedVersion=false`), show alternate content or upgrade without Express Install.

For browsers without scripting

1 Shows the link to the Flash Player download page.

2 Shows alternate content or prompts the user to upgrade without using Express Install.

Alternatives to Express Install

When you add the Express Install script to your wrapper, one of the following results occur when a client requests that wrapper:

- Client runs the application.
- Client upgrades Flash Player by using Express Install and then runs the application.
- Client upgrades Flash Player by using alternative method and then runs the application.
- Client does not upgrade Flash Player and runs alternate content.

Users who do not update the Flash Player version by using Express Install generally fall into the following categories:

- **Browser with disabled scripting** If the browser disables JavaScript, the browser executes content in the `<noscript>` tag of the wrapper. The version detection logic from the index.template.html and AC_OETags.js files is not interpreted when your wrapper is loaded into a browser, nor is Express Install usable.
- **Browser with no Flash Player installed** If the browser has no Flash Player installed but JavaScript is enabled, the browser executes the alternate content area in the `<script>` tag of the wrapper.
- **Browser with Flash Player version earlier than 6.0.65** If Flash Player is not new enough to run the Express Install SWF file (playerProductInstall.swf), but JavaScript is enabled, the browser executes the alternate content area in the `<script>` tag of the wrapper.
- **User refuses Flash Player installation or upgrade** If the user declines to install Flash Player or to upgrade their version of Flash Player, the browser executes the alternate content area in the `<script>` tag of the wrapper. It is up to you to determine whether to provide content in HTML format or some other format that the browser can render without using Flash Player.

In situations where the browser executes alternate content, you can use the `<object>` and `<embed>` tags to embed your Flex application and provide an upgrade and installation path for players that are old or missing.

The `<object>` tag's `codebase` property is used to enforce the player versioning for a Microsoft Internet Explorer browser. The tag adds support for basic player version detection and installation. The `codebase` property defines the minimum version specified at the end of the CAB file's location (for example, `#version=9,0,0`). If the browser requests this page with a player version older than that, the user is prompted to upgrade their player. This installation can occur without the user having to restart the browser.

The `<embed>` tag's `pluginspage` property is used for Firefox, Netscape 8, and Mozilla-based browsers. If there is no plug-in installed, the browser displays a plug-in icon and the text "Click here to get the plug-in." When a user clicks the icon, they are directed to an appropriate location, depending on the type of browser being used, where they can download and install the latest version of Flash Player. The `pluginspage` property does not enforce a required version of the plug-in.

Flash Player is available from the Firefox Plug-in Finder Service. This means that if the Firefox browser does not have the player installed when it encounters an `<embed>` tag, it guides the user through the process of downloading and installing Flash Player through the Finder Service.

Consider adding a note to users of Firefox, Netscape 8, and Mozilla-based browsers that if they have scripting disabled, they should upgrade their Flash Players to version 9 before continuing. You can put this in the `<noscript>` block to ensure that only users with scripting disabled get this message.

These upgrade processes result in a different upgrade experience than the experience of the user who upgrades by using Express Install. Express Install provides a clean installation and returns the user to the original page. These alternative paths require more steps and in some cases do not provide users with a return path to the original application.

You can do basic version detection without using Express Install. For an example of this, see the files in the /templates/client-side-detection and /templates/client-side-detection-with-history directories.

Other techniques for upgrading Flash Player without Express Install are described in the Flash Player Detection Kit. These include using server-side logic and writing a custom SWF file to perform version detection and installation. For more information, see the Detection Kit documentation at www.adobe.com/go/fp_detectionkit.

***Note:** Netscape users who do not initially have any version of Flash Plug-in installed may be redirected to a Netscape download page rather than the Flash Player upgrade page. To avoid this, instruct your users to select Edit > Preferences > Navigator > Helper Applications and deselect the Always Use the Netscape Plug-in Finder Service to Get Plug-ins setting. If this setting is selected, Netscape ignores download location specified by the* `<embed>` *tag in the HTML wrapper.*

Chapter 18: Using the Flex Module for Apache and IIS

Topics

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Introduction

The Adobe® Flex® module for Apache and IIS compiler provides web-tier compilation of MXML files on Apache and IIS web servers. This lets you rapidly compile, test, and deploy an application: Instead of compiling your MXML file into a SWF file and then deploying it and its wrapper files on a web server, you can just refresh the MXML file in your browser.

You do not need a Java 2 Enterprise Edition (J2EE) server to use the web-tier compiler. The Flex module for Apache and IIS works with just the web server and a Java Runtime Environment (JRE).

This document refers to the Flex module for Apache and IIS as the *web-tier compiler* or the *compiler module*.

For web tier compilation, you can also use the Adobe Flex compiler module for J2EE application servers. The Flex compiler module for J2EE application servers is a ZIP file that you can deploy to most J2EE application servers that support servlets. The Flex compiler module for J2EE application servers also provides a JSP tag library that lets you write Flex applications in JSPs. It is available as a download on the Adobe web site.

How the web-tier compiler works

This process contains the following steps:

1 The client requests a file with an *.mxml file extension.

2 The web server forwards the request to the compiler module.

3 The compiler module compiles the MXML file into a SWF file. The compiler module uses incremental compilation, so most compilations after the first one take less time to complete.

4 The compiler module returns an HTML file to the web server, which returns it to the client.

5 If the SWF file was compiled successfully, the HTML page embeds the SWF file. If the HTML file is an error page, the SWF file is not embedded in the HTML page and no further requests are made.

6 The client then requests the SWF file based on the contents of the wrapper's `<object>` and `<embed>` tags, if a current version of the SWF file is not in its local file cache.

When the web server receives a request for a file with the extension *.mxm.swf instead of *.mxml, the compiler module returns a SWF file only, and not the wrapper around it. In general, you should not request a SWF file directly, because it may run differently than if it were embedded in a wrapper.

The web-tier compiler has the following advantages over using the command-line compiler:

- Provides incremental compilation (recompiles only the bits that have changed, not necessarily the entire application).
- Saves you from having to deploy the SWF file and wrapper files after compiling.
- Lets you customize the HTML wrapper or template.
- Lets you debug by adding a query string parameter (`?debug=true`).
- Helps you share updates to your application across working groups by sending a link to the web server.
- Displays error and warning messages in the browser.

The web-tier compiler has the following disadvantages compared to using the command-line compiler:

- Not for production use.
- No built-in support for Express Install, deep linking, or version detection.
- Caching relies on the web server.
- On Linux systems, when you compile certain applications you may get an error message about not having a graphical display. This is due to the Java compiler being run by the Apache user, which does not have access to the desktop. To overcome this, add the following line to the flex-config.xml file used by the compiler:

```
<headless-server>true</headless-server>
```

Getting started

You can download the compiler module from the following location:

http://www.adobe.com/go/flex3_download

Versions and requirements

The compiler module comes in the following versions:

- Flex 3 compiler ISAPI filter for Windows (EXE)
- Flex 3 compiler module for Apache for Windows (EXE)
- Flex 3 compiler module for Apache for Macintosh (ZIP)
- Flex 3 compiler module for Apache for Linux and other platforms (ZIP)

The Windows and Macintosh installers include the Flex SDK and the required JRE. The Linux installer requires that you install the following separately:

- Flex SDK 2.0.1 or later
- JRE 1.4.2 or later

All of these versions require one of the following web servers:

- Apache 1.x/2.x (Windows, MacOS, or Linux)
- IIS version 5.1, 6, or 7 (Windows)

Installing the web-tier compiler

To install the compiler module, run the appropriate installer. The installer prompts you for the locations of various assets, including:

- Where to install the compiler module and SDK — The installer installs the Flex SDK and the compiler module. This document refers to this location as *module_install_dir.* On Windows, the default location is c:\Program Files*flex_sdk*. On MacOS, the default location is /Applications/*flex_sdk*.
- (Apache) Configuration files — The location of your Apache configuration files. This is not the document root of the web server, but rather the location of the web server's configuration files. For Apache on Windows XP, the default location is C:\Program Files\Apache Software Foundation\Apache2.2\conf.
- Web server root — The location of your web server root. This is the document root of the web server. For IIS on Windows XP, the default location is C:\Inetpub\wwwroot. For Apache on Window XP, the default location is C:\Program Files\Apache Software Foundation\Apache2.2\htdocs.

Linux users must use manual installation. The manual installation download does not include the SDK or JRE. For more information, see the readme file that is included in the download.

The compiler module installation sets the `JAVA_HOME` environment variable, if it is not already set. If it is set, then the compiler module verifies that the JRE version to which that variable points is supported by the module.

Verifying the installation

To verify that the web-tier compiler installation was successful, see "Using the web-tier compiler" on page 344.

The installer modifies your web server's configuration. On Apache, the installer adds the following to the end of your httpd.conf file:

```
LoadModule flex_module modules/mod_flex.dll
AddHandler flex .mxml
```

Do not modify the Flex settings in this file. For more information about the httpd.conf file, see the Apache documentation.

View the filter on IIS

1. From the Administrative Tools section of the control panel, open the Internet Information Services manager.
2. Right-click the Default Web Site and select Properties. The Default Web Site Properties dialog box appears.
3. Select the ISAPI Filters tab. The tab should list the Flex module.

You can use ISAPI Filters tab to disable the Flex filter without uninstalling it.

On IIS, the installer installs an ISAPI filter on the Default Web Site. You can add the filter to any web site running on IIS.

Install the ISAPI filter on web sites other than the Default Web Site

1. From the Administrative Tools section of the control panel, open the Internet Information Services manager.
2. Right-click the web site and select Properties. The Web Site Properties dialog box appears.
3. Select the ISAPI Filters tab.
4. Click the Add button. The Filter Properties dialog box appears.
5. In the Filter Name text box, enter a name for the filter.
6. In the Executable text box, browse to the location of the DLL that was installed on the Default Web Site.
7. Click OK and then click OK again to add the new filter to your web site.

Uninstalling the web-tier compiler

❖ Run the uninstall executable in the *module_install_dir*/uninstall directory.

On Apache, the uninstaller utility attempts to restore the httpd.conf file by using a backup. If any changes were made to the httpd.conf file between the time of the compiler module installation and the time of the uninstallation, answering Yes to the prompt erases those changes.

Using the web-tier compiler

After installing the web-tier compiler and restarting your web server, you can request an MXML file from your web server and receive a compiled SWF file in return.

Use the web-tier compiler

1 (Windows) Reboot your computer.

2 Start or restart the web server.

3 Copy your MXML file to the web server's document root. For Apache, the default document root is *Apache_install_dir*/htdocs. For IIS, it is *IIS_install_dir*/wwwroot.

4 Request the MXML file in your web browser. For example:

```
http://localhost/Main.mxml
```

The module returns a generated wrapper that embeds the SWF file.

Map the project's workspace to a virtual path in your web server

1 In Apache, set the `Alias` directive in the httpd.conf file:

```
Alias /flex "C:/Documents and Settings/knizia/workspace/MyBasicProject"
```

Alternatively, you can define your Adobe® Flex® Builder™ project directly under the web root.

2 In Flex Builder, select Run > Run to change the URL to launch in your project. The Run dialog box appears.

3 Under URL or Path to Launch, deselect the Use Defaults option.

4 Enter your request URL in the Debug and Run text boxes. For example:

```
http://localhost/flex/MyBasicProject.mxml
http://localhost/flex/MyBasicProject.mxml
```

Flex Builder appends `?debug=true` to the URL when it launches the browser. This query string parameter triggers a compilation with the debug compiler options enabled.

Configuring the web-tier compiler

You configure the web-tier compiler primarily with the following configuration files:

1 compiler.conf — Defines web-tier compiler-specific settings such as the location of the HTML template and the location of the flex-config.xml file. The compiler.conf file is located in the *module_install_dir* directory.

This file uses the following syntax:

```
option_name=value
```

For example:

```
template=default.html
```

You can add a comment to this file by using the pound (#) sign at the beginning of the line that you want to comment out.

If you make changes to this file, you must restart your web server for the changes to take effect. For more information on editing the default web-tier compiler's wrapper, see "Customizing the template" on page 348.

2 flex-config.xml — This file defines the default settings for the Flex compiler. The module finds this file by using the value of the `flex_config` property in the compiler.conf file. If you installed the Flex framework with the web-tier compiler, then the compiler.conf file points to the flex-config.xml file in the *module_install_dir*/frameworks directory. If you are currently using the SDK and have a custom flex-config.xml file, you might want to replace the default flex-config.xml file with your custom file or change the location by editing the compiler.conf file.

For more information about the flex-config.xml file, see "Using the Flex Compilers" on page 125.

If a configuration file exists in the same folder as the MXML file, with a name that matches the *app_name*-config.xml format, the web-tier compiler uses that configuration file. This configuration file has the same precedence as a local configuration file, as described in "About configuration files" on page 134.

You cannot instruct the web-tier compiler to compile files that have extensions other than *.mxml or *.mxml.swf. Therefore, although you can change the file extension that triggers the compiler (for example, by adding an additional `AddHandler` entry in your Apache httpd.conf file), anything that is passed to the web-tier compiler other than a *.mxml or *.mxml.swf file generates a compiler error.

About the compiler.conf options

The following table describes the options that you can set in the compiler.conf file:

Option	Description
`flex_config`	The location of the flex-config.xml file that is used by the web-tier compiler. This file contains all available compiler settings, and the compiler relies on it for default settings. If you installed the web-tier compiler with the Flex framework, the default value on Windows is C:\Program Files\FlexModule\frameworks\flex-config.xml. On MacOS, it is /Applications/FlexModule/frameworks. On Linux, it is /*user_home*/FlexModule/frameworks. Otherwise, the default value is the location of your framework's flex-config.xml file. For more information on the flex-config.xml file, see "Using the Flex Compilers" on page 125
`cache_folder`	The location of a cache file used by the MXML compiler. This is used for incremental compilation. On Windows XP, the default value is C:\Documents and Settings*username*\Local Settings\Temp\. On Windows Vista, it is /Users/*user_name*/Local Settings/temp. On Linux and MacOS, it is /tmp.

Option	Description
`flex_lib`	The location of the frameworks directory that contains SWC files used by the compiler. If you installed the web-tier compiler with the Flex framework, the default value on Windows XP is C:\Program Files\FlexModule\frameworks.
`height`	The height of the application. The value can be either a number (the number of pixels) or a percentage value. The default value is 100%, which the browser interprets as 100% of the available space. If the `height` property is explicitly set on the `<mx:Application>` tag in the source MXML file, then the value in the compiler.conf file is ignored. If this value is not set in the MXML file or in the compiler.conf file, Adobe® Flash® Player makes a best guess to determine the height of the application.
`width`	The width of the application. The value can be either a number (the number of pixels) or a percentage value. The default value is 100%, which the browser interprets as 100% of the available space. If the `width` property is explicitly set on the `<mx:Application>` tag in the source MXML file, then the value in the compiler.conf file is ignored. If this value is not set in the MXML file or in the compiler.conf file, Adobe Flash Player makes a best guess to determine the width of the application.
`template`	The name of the HTML template that is used to embed the compiled SWF file. This file is returned by the web server when the web-tier compiler is invoked. The Flex module replaces tokens (indicated by the `${`*`token`*`}` syntax) before the web server can return the file. At a minimum, this file must contain the `${swf}` token. The default value is `default.html`. The file must be in the *module_install_dir*/templates directory. You can view a generated template by requesting an MXML file from the web-tier compiler. Then, in your browser, select View Source. The source for the page is the generated HTML wrapper. If you make changes to this file, you do not have to restart the server or recompile your Flex application for the changes to take effect. For more information on customizing the HTML template, see "Customizing the template" on page 348.
`lines_in_context`	The number of lines above and below the source of an error or warning that are shown in the browser when the compiler returns an error warning. For example, if you set the value of this property to 10, when you request an MXML file with an error in it, the browser displays the 10 lines of code in the MXML file before and the 10 lines after the source line of the error. You set this value when you run the Flex module installer. The default value is 1.

Example compiler.conf file

The following is an example of a compiler.conf file:

```
flex_config=C:\Program Files\FlexModule\frameworks\flex-config.xml
flex_lib=C:\Program Files\FlexModule\frameworks
cache_folder=C:\Documents and Settings\knizia\Local Settings\Temp\
width=100%
height=100%
template=default.html
```

```
# increase number of lines to 10:
lines_in_context=10
```

Customizing the template

When the web-tier compiler compiles an MXML file into a SWF file, it also generates an HTML wrapper that embeds that SWF file. The browser first loads the wrapper, which embeds the SWF file. This wrapper is generated from a template that is included in the web-tier compiler installation.

The template file is in the *module_install_dir*/templates folder. The default template is default.html.

You specify the location of the template in the compiler.conf configuration file by using the `template` property; for example:

```
template=default.html
```

For more information on editing the compiler.conf file, see "Configuring the web-tier compiler" on page 345.

The template uses several tokens as placeholders that the compiler replaces when it generates the final output. For example, the token `${swf}` is replaced with the MXML file name (minus the MXML file extension).

You can customize the template, but you must adhere to several rules. The new template:

- Must be a *.html file.
- Must be in the *module_install_dir*/templates directory.
- Must include at least the `${swf}` token. You use this token to define the value of the `movie` parameter in the `<object>` tag and the value of the `src` attribute in the `<embed>` tag.
- Must not use any external script or CSS files. For example, you cannot use code similar to the following in the template:

```
<script src="mysource.js"></script>
```

Limitations of the template

The web-tier compiler is not meant to be used in a production environment. The wrapper does not support the following features:

- History management or deep linking
- Player detection and deployment
- Express Install

In addition, the template does not convert query string parameters to `flashVars` variables in the wrapper's `<object>` and `<embed>` tags. If you want to pass run-time data as a `flashVars` variable, you should hard-code it in the wrapper, or use some other method of inserting the values into the wrapper's `<object>` and `<embed>` tags.

Finally, you cannot include other script files or external CSS files in the template. The template must be a single flat file that embeds the Flex application. It can contain JavaScript or other client-side code.

In Internet Explorer version 6 and later, you must click somewhere in the browser's window before you can use the Flex application. You may be prompted to press the Spacebar or the Enter key to activate the control. This is because the wrapper returned by the web-tier compiler does not use an external JavaScript file to embed the SWF file. HTML wrappers that use external script files to embed SWF files do not exhibit this behavior. You cannot change this behavior because you cannot use external scripts in your template wrapper with the web-tier compiler.

For more information on HTML wrappers, see "Creating a Wrapper" on page 311.

About the template's tokens

The following table describes the tokens that you can use in the web-tier compiler's template:

Token	Description
`${application}`	Identifies the SWF file to the host environment (a web browser, for example) so that it can be referenced by using a scripting language such as VBScript or JavaScript in the wrapper. This token is used by the `id` property of the `<object>` tag and the `name` property of the `<embed>` tag.

`${bgcolor}`	Specifies the background color of the application. Use this property to override the background color setting specified in the source MXML file. This property does not affect the background color of the HTML page.
	
	Valid format for `bgcolor` is any #RRGGBB, hexadecimal, or RGB value.
	
	The Application container's style uses an image as the default background. This image obscures any background color settings that you might make. Therefore, to make the value of the `{$bgcolor}` token be displayed properly, you must clear the Application container's `backgroundImage` style property. To do this, you can set it to the value of a space character in the MXML source file, as the following example shows:
	
	`<mx:Style>`
	    `Application {`
	        `backgroundImage: " ";`
	    `}`
	`</mx:Style>`

`$(height)`	Defines the height of the application. The default value is 100%. You set the default value in the compiler.conf file. If this value is set in the MXML file, then the web-tier compiler uses that value. This token is used by the `height` properties of the `<object>` and `<embed>` tags.

Token	Description
$(swf)	Defines the name of the MXML file, minus the extension. For example, if the MXML file is named Main.mxml, the web-tier compiler inserts `Main` where this token occurs. This token is used by the `movie` parameter of the `<object>` tag and the `src` property of the `<embed>` tag.
$(width)	Defines the width of the application. The default value is 100%. You set the default value in the compiler.conf file. If this value is set in the MXML file, then the web-tier compiler uses that value. This token is used by the `width` properties of the `<object>` tag and `<embed>` tags.

Debugging with the web-tier compiler

The web-tier compiler has the following debugging-related features:

- Detects a query string parameter that you use to invoke the debugger compiler
- Controls the number of lines in the output that occur before and after an error or warning
- Logs access and error messages

Invoking the debugger compiler

You can compile a debug version of your Flex application when you are using the web-tier compiler. You do this by appending `?debug=true` to the end of the query string; for example:

```
http://www.myhost.com/myApps/Main.mxml?debug=true
```

You cannot disable this behavior of the web-tier compiler.

Adding `?debug=true` to your query string instructs the compiler to include debugging information in the final SWF file output. As a result, you can set breakpoints and use other features of the fdb command-line debugger or the Flex Builder visual debugger.

To debug the application, you launch the fdb command line debugger and then launch your application in the browser with `?debug=true` on the query string. The application connects to the running debugger.

You must have a debugger version of Flash Player to compile the application with debug information in it.

For more information on using fdb, see "Using the Command-Line Debugger" on page 245.

Customizing error output

You can select the number of lines of code to show in the browser before and after an error or warning. You do this in the Configuration screen of the installer.

The default value is 1. The value can be any nonnegative integer. If you set the value to 10, the compiler displays 10 lines of code before and after the location of a syntax error when the error is displayed in the browser.

If you want to change the number of lines after you have installed the web-tier compiler, you set the value of the `lines_in_context` property in the compiler.conf file. The following example sets the value to 10:

```
lines_in_context=10
```

You can disable warnings by setting `?warnings=false` in the request string.

For more information on editing the compiler.conf file, see "Configuring the web-tier compiler" on page 345.

Using the web-tier compiler log files

The web-tier compiler generates its own set of access and error log files. The compiler writes to these log files in the /logs subdirectory of the module installation directory:

- *module_install_dir*/logs/access.log
- *module_install_dir*/logs/error.log

The access log records the date, time, and path for each MXML file that the web-tier compiler compiles. The following is an example of the access log file after the file MyBasicProject.mxml was compiled repeatedly:

```
[2007/03/02 16:13:08]C:/Documents and
Settings/knizia/workspace/MyBasicProject/MyBasicProject.mxml
[2007/03/02 16:13:24]C:/Documents and
Settings/knizia/workspace/MyBasicProject/MyBasicProject.mxml
[2007/03/02 16:13:47]C:/Documents and
Settings/knizia/workspace/MyBasicProject/MyBasicProject.mxml
[2007/03/02 16:13:57]C:/Documents and
Settings/knizia/workspace/MyBasicProject/MyBasicProject.mxml
[2007/03/02 16:15:32]C:/Documents and
Settings/knizia/workspace/MyBasicProject/MyBasicProject.mxml
```

The error log records the date and time of any errors, plus the line of code that triggered the error, and the line number. The following is an example entry in the error log file:

```
[2007/03/02 16:15:34] [/MyBasicProject] error: Attribute name "s" must be followed by the
' = ' character. @ 11
```

The error log records only the line of code that triggered the error and not any lines of code above or below it, regardless of the value of the `lines_in_context` property.