Pro Silverlight 3 in C#

Matthew MacDonald
For my family
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Introduction

Silverlight is a framework for building rich, browser-hosted applications that run on a variety of operating systems. Silverlight works its magic through a browser plug-in. When you surf to a web page that includes some Silverlight content, this browser plug-in runs, executes the code, and renders that content in a specifically designated region of the page. The important part is that the Silverlight plug-in provides a far richer environment than the traditional blend of HTML and JavaScript that powers ordinary web pages. Used carefully and artfully, you can create Silverlight pages that have interactive graphics, use vector animations, and play video and sound files.

If this all sounds eerily familiar, it’s because the same trick has been tried before. Several other technologies use a plug-in to stretch the bounds of the browser, including Java, ActiveX, Shockwave, and (most successfully) Adobe Flash. Although all these alternatives are still in use, none of them has become the single, dominant platform for rich web development. Many of them suffer from a number of problems, including installation headaches, poor development tools, and insufficient compatibility with the full range of browsers and operating systems. The only technology that’s been able to avoid these pitfalls is Flash, which boasts excellent cross-platform support and widespread adoption. However, Flash has only recently evolved from a spunky multimedia player into a set of dynamic programming tools. It still offers far less than a modern programming environment like .NET.

That’s where Silverlight fits into the picture. Silverlight aims to combine the raw power and cross-platform support of Flash with a first-class programming platform that incorporates the fundamental concepts of .NET. At the moment, Flash has the edge over Silverlight because of its widespread adoption and its maturity. However, Silverlight boasts a few architectural features that Flash can’t match—most importantly, the fact that it’s based on a scaled-down version of .NET’s common language runtime (CLR) and allows developers to write client-side code using pure C#.

Understanding Silverlight

Silverlight uses a familiar technique to go beyond the capabilities of standard web pages: a lightweight browser plug-in.

The advantage of the plug-in model is that the user needs to install just a single component to see content created by a range of different people and companies. Installing the plug-in requires a small download and forces the user to confirm the operation in at least one security dialog box. It takes a short but definite amount of time, and it’s an obvious inconvenience. However, once the plug-in is installed, the browser can process any content that uses the plug-in seamlessly, with no further prompting.
Silverlight is designed to overcome the limitations of ordinary HTML to allow developers to create more graphical and interactive applications. However, Silverlight isn’t a way for developers to break out of the browser’s security sandbox. For the most part, Silverlight applications are limited in equivalent ways to ordinary web pages. For example, a Silverlight application is allowed to create and access files, but only those files that are stored in a special walled-off isolated storage area (described in Chapter 18). Conceptually, isolated storage works like the cookies in an ordinary web page. Files are separated by website and the current user, and size is limited.

Figure 1 shows two views of a page with Silverlight content. At the top is the page you’ll see if you don’t have the Silverlight plug-in installed. At this point, you can click the Get Microsoft Silverlight picture to be taken to Microsoft’s website, where you’ll be prompted to install the plug-in and then sent back to the original page. On the bottom is the page you’ll see once the Silverlight plug-in is installed.
At present, Silverlight is only on a fraction of computers. However, Microsoft is convinced that if compelling content exists for Silverlight, users will download the plug-in. There are a number of factors that support this argument. Flash grew dramatically in a short space of time, and Microsoft has obvious experience with other web-based applications that have started small and eventually gained wide adoption. (Windows Messenger comes to mind, along with numerous ActiveX plug-ins for tasks ranging from multiuser coordination on MSN Games to Windows verification on MSDN.)
Silverlight System Requirements

With any Web-centric technology, it’s keenly important to have compatibility with the widest possible range of computers and devices. Although Silverlight is still evolving, it’s clearly stated mandate is to “support all major browsers on Mac OS X and Windows.”

Currently, Silverlight 3 cross-browser compatibility stacks up fairly well:

- **Windows computers**: Silverlight works on PCs with Windows 7, Windows Vista, and Windows XP. The minimum browser versions that Silverlight 3 supports are Internet Explorer 6, Firefox 1.5, and . Silverlight will also work in Windows 2000, but only with Internet Explorer 6. Other browsers, such as Opera, Safari (for Windows), and Google Chrome (which is still in beta), aren’t currently supported.

- **Mac computers**: Silverlight works on Mac computers with OS X 10.4.8 or later, provided they have Intel hardware (as opposed to the older PowerPC hardware). The minimum browser versions that Silverlight 2 supports are Firefox 2 and Safari 3.

- **Linux computers**: Although Silverlight doesn’t currently work on Linux, the Mono team is creating an open-source Linux implementation of Silverlight 1 and Silverlight 2. This project is known as Moonlight, and it’s being developed with key support from Microsoft. To learn more, visit [http://www.mono-project.com/Moonlight](http://www.mono-project.com/Moonlight).

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**Note**  The system requirements for Silverlight may change as Microsoft releases plug-ins for other browsers. For example, the Opera browser currently works on PCs through an unsupported hack, but better supported is planned in the future. To see the latest system requirements, check [http://www.microsoft.com/silverlight/resources/install.aspx](http://www.microsoft.com/silverlight/resources/install.aspx).

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Installing Silverlight requires a small-sized setup (less than 5MB) that’s easy to download. That allows it to provide an all-important “frictionless” setup experience, much like Flash (but quite different from Java).

**Silverlight vs. Flash**

The most successful browser plug-in is Adobe Flash, which is installed on over 90 percent of the world’s web browsers. Flash has a long history that spans more than ten years, beginning as a straightforward tool for adding animated graphics and gradually evolving into a platform for developing interactive content.

It’s perfectly reasonable for .NET developers to create websites that use Flash content. However, doing so requires a separate design tool, and a completely different programming language (ActionScript) and programming environment (Flex). Furthermore, there’s no straightforward way to integrate Flash content with server-side .NET code. For example, creating Flash applications that call .NET components is awkward at best. Using server-side
.NET code to render Flash content (for example, a custom ASP.NET control that spits out a Flash content region) is far more difficult.

Silverlight aims to give .NET developers a better option for creating rich web content. Silverlight provides a browser plug-in with many similar features to Flash, but one that’s designed from the ground up for .NET. Silverlight natively supports the C# language and embraces a range of .NET concepts. As a result, developers can write client-side code for Silverlight in the same language they use for server-side code (such as C# and VB), and use many of the same abstractions (including streams, controls, collections, generics, and LINQ).

The Silverlight plug-in has an impressive list of features, some of which are shared in common with Flash, and a few of which are entirely new and even revolutionary. Here are some highlights:

- **2D Drawing**: Silverlight provides a rich model for 2D drawing. Best of all, the content you draw is defined as shapes and paths, so you can manipulate this content on the client side. You can even respond to events (like a mouse click on a portion of a graphic), which makes it easy to add interactivity to anything you draw.

- **Controls**: Developers don’t want to reinvent the wheel, so Silverlight is stocked with a few essentials, including buttons, text boxes, lists, and even a DataGrid. Best of all, these basic building blocks can be restyled with custom visuals if you want all of the functionality but none of the stock look.

- **Animation**: Silverlight has a time-based animation model that lets you define what should happen and how long it should take. The Silverlight plug-in handles the sticky details, like interpolating intermediary values and calculating the frame rate.

- **Media**: Silverlight provides playback of a range of video standards, including high-definition H.264 video and AAC audio. Silverlight doesn’t use the Windows Media Player ActiveX control or browser plug-in—instead, you can create any front-end you want, and you can even show video in full-screen mode. Microsoft also provides a free companion hosting service (at [http://silverlight.live.com](http://silverlight.live.com)) that gives you space to store media files. Currently, it offers a generous 10 GB.

- **The Common Language Runtime**: Most impressively, Silverlight includes a scaled-down version of the CLR, complete with an essential set of core classes, a garbage collector, a JIT (just-in-time) compiler, support for generics, threading, and so on. In many cases, developers can take code written for the full .NET CLR and use it in a Silverlight application with only moderate changes.

- **Networking**: Silverlight applications can call old-style ASP.NET web services (.asmx) or WCF (Windows Communication Foundation) web services. They can also send manually created XML requests over HTTP and even open direct socket connections for fast two-way communication. This gives developers a great way to combine rich client-side code with secure server-side routines.
• **Data binding:** Although it’s not as capable as in its big brother (WPF), Silverlight data binding provides a convenient way to display large amounts of data with minimal code. You can pull your data from XML or in-memory objects, giving you the ability to call a web service, receive a collection of objects, and display their data in a web page—often with just a couple of lines of code.

Of course, it’s just as important to note what Silverlight *doesn’t* include. Silverlight is a new technology that’s evolving rapidly, and it’s full of stumbling blocks for developers who are used to relying on .NET’s rich libraries of prebuilt functionality. Prominent gaps include the lack of database support (there’s no ADO.NET), no support for true 3-D drawing, no printing, no command model, and few rich controls like trees and menus (although many developers and component companies are building their own). All of these features are available in Windows-centric WPF applications, and they may someday migrate to the Silverlight universe—or not.

### Silverlight and WPF

One of the most interesting aspects of Silverlight is the fact that it borrows the model WPF uses for rich, client-side user interfaces.

WPF is a next-generation technology for creating Windows applications. It was introduced in .NET 3.0 as the successor to Windows Forms. WPF is notable because it not only simplifies development with a powerful set of high-level features, it also increases performance by rendering everything through the DirectX pipeline. To learn about WPF, you can refer to *Pro WPF: Windows Presentation Foundation in C# 2008* (Apress).

Silverlight obviously can’t duplicate the features of WPF, because many of them rely deeply on the capabilities of the operating system, including Windows-specific display drivers and DirectX technology. However, rather than invent an entirely new set of controls and classes for client-side development, Silverlight uses a subset of the WPF model. If you’ve had any experience with WPF, you’ll be surprised to see how closely Silverlight resembles its big brother. Here are a few common details:

• To define a Silverlight user interface (the collection of elements that makes up a Silverlight content region), you use XAML markup, just as you do with WPF. You can even map data to your display using the same data-binding syntax.

• Silverlight borrows many of the same basic controls from WPF, along with the same styling system (for standardizing and reusing formatting), and a similar templating mechanism (for changing the appearance of standard controls).

• To draw 2D graphics in Silverlight, you use shapes, paths, transforms, geometries, and brushes, all of which closely match their WPF equivalents.

• Silverlight provides a declarative animation model that’s based on storyboards, and works in the same way as WPF’s animation system.

• To show video or play audio files, you use the MediaElement class, as you do in WPF.
Microsoft has made no secret about its intention to continue to expand the capabilities of Silverlight by drawing from the full WPF model. In future Silverlight releases, you’re likely to find that Silverlight borrows more and more features from WPF. This trend is already on display with the shift from Silverlight 2 to Silverlight 3.

**Note**  WPF is not completely cut off from the easy deployment world of the Web. WPF allows developers to create browser-hosted applications called XBAPs (XAML Browser Applications). These applications are downloaded seamlessly, cached locally, and run directly inside the browser window, all without security prompts. However, although XBAPs run in Internet Explorer and Firefox, they are still a Windows-only technology, unlike Silverlight.

### The Evolution of Silverlight

Silverlight 1 was a relatively modest technology. It included 2D drawing features and media playback support. However, it didn’t include the CLR engine or support for .NET languages, so developers were forced to code in JavaScript.

Silverlight 2 was a dramatic change. It added the CLR, a subset of .NET Framework classes, and a user interface model based on WPF (as described in the next section, “Silverlight and WPF”). As a result, Silverlight 2 was one of the most hotly anticipated releases in Microsoft’s history.

Silverlight 3 isn’t as ambitious. It keeps the same development model as Silverlight 2, but adds a carefully selected group of features and performance enhancements. The highlights include:

- **Out of browser applications:** Silverlight 3 allows you to create applications that run outside of the browser—and keep on ticking even when the client computer is offline. Chapter 6 shows you how.

- **Animation easing:** These functions allow you to create more lifelike animations that bounce, accelerate and oscillate naturally. Chapter 10 has the full story.

- **Navigation:** Silverlight 3 introduces a Frame control that supports navigation, allowing you to move from page to page. Best of all, navigation is completely integrated with the browser history list. Chapter 7 describes the full details.

- **3-D projection:** Although it’s not true 3-D support, Silverlight 3 allows you to place elements on a flat 3-D surface, which you can tilt or rotate at will. Chapter 9 explains this feature.

- **Pixel shaders and WriteableBitmap:** Silverlight extends its 2-D drawing support with low-level routines for manipulating pixels and a way to generate bitmaps on the fly. Chapter 9 shows both.
• **Bitmap caching:** In the right situation, this opt-in feature can improve the performance of complex animations that move, rotate, or scale static content. Chapter 10 shows how to use this feature, and how to evaluate its performance.

• **Behaviors:** This new feature, initially introduced as a part of Expression Blend, allows you to wire up bits of user interface functionality (for example, movie playing or shape dragging) without writing a line of code. Chapter 12 explains behaviors, and covers the tune-ups in Silverlight’s style feature.

• **Better data validation:** Many Silverlight input controls now support validation states, allowing them to report bad bound data. For example, the standard text box shows error messages in a pop-up red balloon. Combine this with Silverlight’s new support for data annotations, and you can quickly apply constraints to all your data objects. Chapter 16 and 17 explore all the tools you can use to combine data binding and validation.

• **SaveFileDialog:** This new class gives you the ability to save your data to any location on the client computer—as long as the user picks it. Chapter 18 shows you how.

• **Local connection:** Although it doesn’t rival Silverlight’s high-powered networking support, the local connection feature gives a straightforward way for two Silvelright applications running on the same computer to communicate. Chapter 20 demonstrates this feature.

• **Assembly caching:** This deployment enhancement allows you to cache component assemblies in the client’s browser cache, shortening startup times for repeat visits. Chapter 6 shows it in action.

• **Element-to-element binding:** Long possible in WPF, Silverlight now allows you to connect two elements together so that changes in one affect the other. Chapter 2 explains how to set it all up.

• **New controls:** Silverlight 3 adds pop-up windows (ChildWindow), a textbox with automatic suggestion (AutoCompleteBox), a tree (TreeView), date controls (DatePicker and Calendar), and more. You’ll meet all these controls in this book.

**Note**  This book contains everything you need to master Silverlight. You don’t need any experience with previous versions of Silverlight. However, if you have developed with Silverlight 2, you’ll appreciate the “What’s New” tip boxes that follow the introduction in each chapter. They point out features that are new to Silverlight 3, so you can home in on its changes and enhancements.
At this point, you might be wondering if existing Silverlight 2 applications can run on a computer that has only the latest version of the Silverlight plugin (version 3) installed. It’s a reasonable question, as Silverlight 3 introduces some subtle changes and bug fixes that can influence the way applications work—and even change its behavior.

However, Silverlight 3 prevents these differences from causing problems by using its quirks mode feature. When the Silverlight 3 plugin loads an application that was compiled for Silverlight 2, it automatically switches into quirks mode, so that it exactly emulates the behavior of the Silverlight 2 runtime environment.

For more detailed information about breaking changes between Silverlight 2 and Silverlight 3, you can refer to http://www.silverlightshow.net/items/Silverlight-3-RTW-overview.aspx.

About This Book

This book is an in-depth exploration of Silverlight for professional developers. You don’t need any experience with WPF or previous versions of Silverlight, but you do need to know the .NET platform, the C# language, and the Visual Studio development environment.

What You Need to Use This Book

In order to run Silverlight applications, you simply need the Silverlight browser plug-in, which is available at http://silverlight.net. In order to create Silverlight applications (and open the sample projects included with this book), you need one of the following tools:

- **Visual Studio 2008:** You’ll also need the Visual Studio extensions that allow you to create Silverlight projects (known as the Silverlight Tools for Visual Studio), which are available at http://silverlight.net/GetStarted. The Silverlight Tools for Visual Studio include both the Silverlight 3 developer runtime and the Silverlight 3 SDK, so a single download is all you need.

- **Visual Studio 2010:** Although Visual Studio 2010 will support Silverlight 3 when it’s released, beta 1 (which is the only released version at the time of this writing) only supports Silverlight 2. To add support for Silverlight 3, you need to install the Silverlight 3 SDK (get it at http://tinyurl.com/y9qtltd) and the Silverlight 3 developer runtime (http://go.microsoft.com/fwlink/?linkid=150228). Once you’ve taken these steps, you’ll have the option of choosing to build applications for Silverlight 2 or Silverlight 3, as demonstrated in Chapter 1.