Pro Visual C++/CLI and the .NET 3.5 Platform

Stephen R. G. Fraser

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ISBN-13 (pbk): 978-1-4302-1053-5

ISBN-13 (electronic): 978-1-4302-1054-2

Printed and bound in the United States of America 9 8 7 6 5 4 3 2 1

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For information on translations, please contact Apress directly at 2855 Telegraph Avenue, Suite 600, Berkeley, CA 94705. Phone 510-549-5930, fax 510-549-5939, e-mail info@apress.com, or visit http://www.apress.com.

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To my daughter Shaina Shoshana, who makes everything worthwhile

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About the Author

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Introduction

In the first edition of this book, I said that .NET is the future. In the second edition, I said that C++/CLI is the future. In this third edition, I say, "Welcome to the future!" .NET has proven itself to be the future of software development, and C++/CLI has shown itself to be the leading language of bridging the gap between the past and the future.

Don't get me wrong; C# and Visual Basic 2008 are great development languages, but neither has the flexibility or the pedal-to-the-metal power of C++/CLI. And they are not designed to link the code from other realms that needs .NET to make it shine.

With C++/CLI, you can practically mix and match .NET code and ANSI C++ code (or code from many other development languages) at will. Of course, doing so comes at a cost (we'll get to that later in this book), but the benefits of being able to mix the code without having to rewrite a lot of it is often worth that cost. As a designer, architect, or developer, your task is to determine whether performing this mixing and matching *is* worth it.

But C++/CLI is not just a language for bridging the past and the future. It is the most powerful of the .NET languages for developing new code as well. Any functionality you want coded in .NET can be done in C++/CLI. And this book proves it.

Unfortunately, C++/CLI is frequently overshadowed by his younger sibling C#, who gets the majority of the limelight. Well, this book is designed to refocus the light in the correct direction—toward C++/CLI.

What Is This Book About?

This book is about writing .NET 3.5 applications using C++/CLI. You'll cover a lot of ground in a short period of time. In the end, you'll be proficient at developing .NET applications, be they console applications, Windows applications, Windows services, Web applications, or Web services.

While you're learning the ins and outs of .NET application development, you'll be learning the syntax of C++, both old and new to .NET 3.5. You will also gain a good understanding of the .NET architecture.

This book does not leave legacy developers out in the cold, as it also shows how to integrate your previously built C++ code and COM, DCOM, COM+, and ActiveX components with your new .NET 3.5 code. Note that this book does not show you how to build any of this legacy code (other than a very simple example code). Instead, it shows you how to code in the world of .NET 3.5 and how to access this legacy code only when it is needed.

Changes in This .NET 3.5 Edition

Microsoft has made several changes to C++/CLI between versions 2.0 and 3.5, fortunately none of them as large as those in the other .NET languages (it's nice to have a little stability once in a while).

To reflect the changes made between versions, a number of small changes were required throughout this book. In addition to these small changes, there are four significant additions:

- A lengthy section in Chapter 7 on collections covering the STL/CLR
- Chapter 9 on programming with configuration files
- Chapter 16 on Web application development
- Chapter 24 on the C++ Support Library

Who Should Read This Book?

If you're new to the Visual C++ language, this book is for you. The software world is changing, and learning a new language is hard enough without getting unnecessarily bogged down with a complex set of old technologies before you learn about the new ones.

If you're an experienced Visual C++ programmer, this book is also for you. Microsoft is changing your world, and this book will show you these changes. You'll find many books on the market that try to teach you how to force your old world into this new one. This book isn't one of those. Instead, you'll learn the right way to develop .NET code, as the only focus here is the new world: .NET development.

This book is for Visual C++ programmers who don't care about COM, DCOM, COM+, or ActiveX components, either because they already know them or because they never had any reason to learn to code them. You'll use a pure .NET development environment. The only time you'll use components is when you access them—a necessary evil, as there are thousands of them out there that may never be converted to .NET.

This book is also for the (gasp!) non-Microsoft C++ developer who wants to dive into the .NET world without getting bogged down with all the things that he or she disliked about pre-.NET Windows development.

What Does This Book Cover?

This book addresses the topic of C++/CLI in three parts.

The first four chapters cover the basics and background information that make up the C++/CLI and .NET worlds. I recommend that you read these chapters first, as they provide information that you'll need to understand the remainder of this book. I also recommend that you read these chapters in sequential order, because they build on one another.

The main body of the book is the next 17 chapters, which stand alone and cover specific topics. Here, you can pick and choose the chapters that interest you the most (hopefully every chapter) and read them in any order.

The final three chapters cover unsafe code and how to integrate it with C++/CLI. Like with the first four chapters, I recommend you read them in order, as they build on each other.

Chapter 1: Overview of the .NET Framework

In this chapter, you address the basics of the .NET architecture. You're bombarded with many new .NET terms such as assemblies, common language runtime (CLR), common language specification (CLS), common type system (CTS), just-in-time (JIT) compilation, Microsoft Intermediate Language (MSIL or IL), and manifests. This chapter tries to soften the blow of your first foray into the .NET world.

Chapter 2: C++/CLI Basics

This chapter should be a refresher course on the basics of C++. Be careful when you read it though, because there have been several changes related to C++/CLI, and some of them are subtle. This chapter covers the core syntax of C++/CLI. Old-time C++ programmers should pay attention to the reference handle.

Chapter 3: Object-Oriented C++/CLI

Now, with the basics covered, you delve into object-oriented programming (OOP). This chapter covers topics that old-time C++ programmers will take for granted, such as inheritance, encapsulation, polymorphism, classes, methods, and operator overloading. But be careful with this chapter too, as .NET makes some significant changes—in particular, properties, constructors, and two different destructors.

Chapter 4: Advanced C++/CLI

In this chapter, I start to discuss things that should make even seasoned C++ programmers sit up and take notice, because most of the topics I cover are new to C++. This chapter's topics include multifile programming, exception handling, and delegates.

Chapter 5: The .NET Framework Class Library

In this chapter, you start to work with .NET as you make your first strides into the .NET Framework class library. This chapter is just an overview and takes a cursory look at many of the framework's base classes. I focus on helping you learn how to find the classes that you need. In later chapters, I go into some of these base classes in much more detail.

Chapter 6: Integrated XML Documentation

In this chapter, you will learn how to add, generate, and finally view XML documentation that you will imbed in your C++/CLI code. This much-needed and welcome feature was added to C++/CLI in version 2.0 and closely maps to the documentation that has been available to the C# developer since the release of .NET.

Chapter 7: Collections

Working with collections should be nearly second nature to the average software developer. Because collections are so commonplace, most programmers expect powerful and feature-rich ways of handling them, and .NET doesn't disappoint. This chapter covers the four primary sets of collections available to the .NET Framework programmer, including the new addition to .NET 3.5 of STL/CLR.

Chapter 8: Input, Output, and Serialization

Many programs that you'll write in your career will involve moving, copying, deleting, renaming, reading, and/or writing files. More recently, with object-oriented programming, many of a file's I/O activities in a program involve serialization. With this in mind, you'll explore the `System::IO` and `System::Runtime::Serialization` namespaces.

Chapter 9: .NET Configuration File Programming

Since "one size fits all" does not always apply to software development, Microsoft added the configuration file as a dynamic common method of configuring .NET applications. You will cover how to read, modify, and create your own configuration file sections. A neat feature that I threw into this chapter is how to encrypt (and decrypt) sections in your configuration files.

Chapter 10: Basic Windows Forms Applications

Almost all Windows developers, at some time in their careers, will create a Windows application. This chapter shows you how to do it .NET style. You'll explore how Visual Studio .NET simplifies your development experience. You'll also cover the basic controls found in the `System::Windows::Forms` namespace in some detail.

Chapter 11: Advanced Windows Forms Applications

Having a handle on the basics is all well and good, but I'm sure that you, as a .NET developer, will want to add more elaborate controls to your Windows applications. This chapter takes what you learned in Chapter 10 and expands on it by exploring some of the more advanced controls available to you in the `System::Windows::Forms` namespace.

Chapter 12: Graphics Using GDI+

If you're like me, you like a little pizzazz in the form of graphics to spice up a boring Windows application. This chapter shows you how .NET has made adding images and graphics a whole lot easier with the `System::Drawing` namespace.

Chapter 13: ADO.NET and Database Development

What is software development without databases? In most cases, the answer is "not much." Microsoft is well aware of this and has gone to great lengths to make database programming easier. The solution is ADO.NET. In this chapter, you'll explore the many features of ADO.NET that you can find in the `System::Data` namespace.

Chapter 14: XML

XML is the new world order when it comes to data storage, and Microsoft has embraced XML in a big way. This chapter shows the many ways that you can now access XML data in the .NET environment.

Chapter 15: Windows Services

The C++ language has long been a stronghold for Windows services development. This will not change with C++/CLI. In fact, I predict that some of the defection to C# in this area may return because of the power of C++/CLI. In this chapter, you will see just how easy it is to create Windows services using C++/CLI.

Chapter 16: Web Applications

I added this chapter back after removing it from the previous edition, because it turns out that you can still create Web applications using C++/CLI, and this chapter proves it (okay, I had to create my own Visual C++ template to do it, but hey, the Web applications work). This chapter briefly covers HTML and ASP.NET. You then learn about the `System::Web` namespace in some detail.

Chapter 17: Web Services

The concept of Web services is not unique. In this chapter, you'll explore Web services within the .NET Framework. You'll examine how to design and create them by walking through the process yourself, creating a simple Web service and three different clients (console, Windows application, and Web application) to interact with the service.

Chapter 18: Multithreaded Programming

Being able to run multiple threads at the same time allows for better CPU usage and is a powerful feature. This chapter explores how the .NET Framework makes working concurrently with multiple threads a snap as you cover the .NET Framework's built-in multithreading capabilities.

Chapter 19: Network Programming

In this chapter, you'll examine the different methods of moving data over a network using .NET. Specifically, the chapter will examine socket coding in C++/CLI for both TCP and UDP in synchronous and asynchronous approaches.

Chapter 20: Assembly Programming

In traditional C++, application and library developers had few choices regarding what went into `.exe` and `.dll` files. With .NET assemblies, this limitation has changed, and you now have plenty of choices. This chapter explores those choices by looking at how you can augment your assemblies with resources, localization, attributes, and reflection.

Chapter 21: Security

.NET is touted as being an extremely secure software environment, and this is evident in the plethora of .NET Framework security features. In this chapter, we will look at how you can access many of them using C++/CLI.

Chapter 22: Unsafe C++ .NET Programming

This chapter takes a look at what is involved in mixing and matching unsafe C++, also known as unmanaged C++ or traditional C++, with C++/CLI. This chapter is designed to fill in the code areas not normally associated with C++/CLI. In fact, compiling any code from this chapter would require a special compiler option.

Chapter 23: Advanced Unsafe or Unmanaged C++ .NET Programming

Unlike other books that cover this topic, this book looks at advanced unsafe C++ from the eyes of someone who is coding in C++/CLI and wants to integrate some unsafe or unmanaged code into existing code. Usually, the approach is the opposite (i.e., a developer who is coding unsafe or unmanaged code is trying to force it into the C++/CLI environment). This chapter will regard the unsafe/unmanaged code as a black box that you will attach to your C++/CLI code in different fashions, depending on the type of unsafe/unmanaged code to which you are connecting.

Chapter 24: The C++ Support Library

Mixing managed and unmanaged code is quite often complex. Microsoft, trying to ease the process, has provided a library full of classes, functions, and templates to alleviate the complexity. This chapter walks you through the functionality provided by the C++ Support Library.

What You Need to Use This Book

The first thing you should probably do is download the code for this book from the Source Code section of the Apress Web site (`http://www.apress.com`) or from my Web site (`http://www.procppcli.net`). Most of the code in this book is listed in its entirety, but some of the larger programs (in particular, the Windows Forms applications) list only relevant code.

In addition to the source code, you should have a copy of Visual Studio 2008 in any of its flavors. Note that most, but not all, of the features mentioned in this book work with the free Visual C++ Express 2008 version.

As long as you have the .NET Framework version 3.5 and its associated C++ compiler, however, you should be able to build nearly everything in the book (though, in several areas, with a lot more effort if you don't have Visual Studio or Visual C++ Express 2008).

Caution This book contains material that isn't supported in Visual Studio .NET 2003 and the .NET Framework 1.1 or earlier.

This Book Is Not the End of the Story

A book is a pretty static thing, and once you finish reading it, you have to go elsewhere for more information. Fortunately, I have built a Web site devoted entirely to C++/CLI: `http://www.procppcli.net`.

On this site, you will not only find all the source code for this book but also further writings on C++/CLI by me and other authors. The Web site's goal is to promote further exploration of C++/CLI, thus the site will also contain news, a discussion area, an area to upload your code, and an area to download third-party code.

How to Reach Me

I would like to hear from you. Feel free to e-mail me at `srgfraser@procppcli.net`. If you have a question and you think others would benefit from the answer, ask it on the `http://www.procppcli.net` discussion board. I will respond to every e-mail and discussion entry that I can. Questions, comments, and suggestions are all welcome.

Oh, by the way, thank you for buying my book. Now, let's get started!