THE EXPERT'S VOICE™

Jason Bock,
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and
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.NET Security

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as they are implemented in the .NET Framework

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and XML encryption and signatures

Learn about role access security and secure remoting

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.NET Security

JASON BOCK, PETE STROMQUIST,
TOM FISCHER, AND NATHAN SMITH

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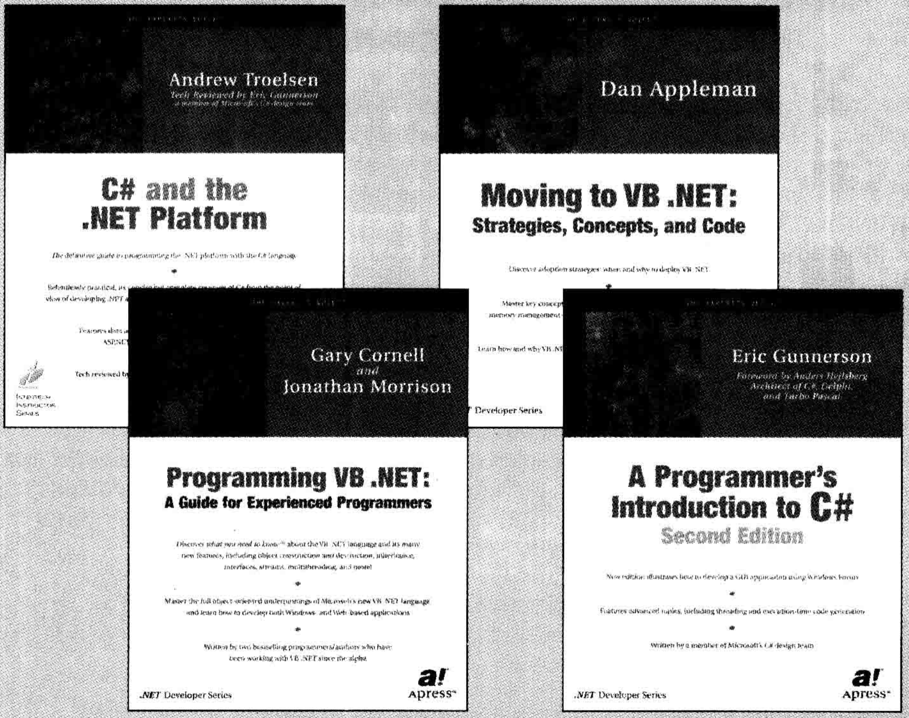

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Pete Stromquist is a consultant at Magenic Technologies (one of the nation's premier Microsoft Certified Solution Providers), specializing in Web-enabled application development using Microsoft tools and technologies. Pete has spent the last several years architecting and developing the following types of applications: intranet content management, Web-enabled training and testing software, B2B and B2C e-commerce, and Web-based telemetry and logistics. Pete has complemented his VB skills with several other technologies such as XML, XSL, COM+, IIS, ASP, and of course .NET. Pete also enjoys teaching and giving presentations on .NET technologies. Pete has a mechanical engineering background, receiving his bachelor of science from the University of Minnesota.

Tom Fischer's career spans a broad range of technologies with some of the most prestigious consulting firms in the Twin Cities. His certifications include the Sun Certified Java Programmer (SCJP), Microsoft Certified Solution Developer (MCSD), and Microsoft Certified Database Administrator (MCDBA). And as a Microsoft Certified Teacher (MCT), Tom also helps teach other developers about the latest Microsoft .NET tools and technologies.

Nathan Smith is a consultant with Spherion in Scottsdale, AZ. He holds almost every Microsoft acronym possible (all but MCT) and specializes in the development of and conversion to Web-enabled applications. Prior to the first beta release of C#, he focused primarily on Visual Basic development, which he's been involved with for approximately six years.

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Introduction

"We just lost all of our JPEGs on our Web server,
and . . . um . . . we don't have a backup."

"Attention! If you have received an e-mail from Bob, do not open it."

"Could you look at this attachment? I think it's a virus. . . . "

VIRUSES. MALICIOUS E-MAIL ATTACHMENTS. Denial of service attacks. You can probably think of a number of other incidents that have happened to either you or a friend of yours on the job where a piece of unwanted code wreaked havoc on unsuspecting users. We've seen our share at the places we've worked at. In fact, all three of the quotes are from our jobs. The first incident happened when an employee opened an e-mail that contained a virus. Since he had the Web server mapped as a network drive, the images located on the server were destroyed. The second occurred when a consultant had the e-mail preview option on in Outlook and a virus was accidentally started. The company panicked, and ended up broadcasting a warning message over the intercom system. The last one happened when someone within the company triggered a virus, and management wanted one of us (Jason) to examine the attachment, as it looked like VBScript. They were hoping that they'd have a chance at understanding what kind of damage was being done to their systems.

We'd all like code to do what we want it to do. We'd all like to be able to open an attachment that appears to be an image without it e-mailing questionable Web page links to our friends and coworkers. But up until .NET, it's been rather difficult for developers to program security effectively. It's not impossible, but it's not as easy as using C++ to open a file either. Windows has always been accommodating to the user in terms of ease of use when it came to their applications. That, however, has lead to numerous security breaches and malicious executables doing their work on machines, sometimes unbeknownst to their users. In a nutshell, this has been pretty frustrating for both users and developers.

With .NET, however, Microsoft has made a concerted effort to make writing secure code a much easier endeavor that what it was. This new architecture also has the added benefit of making it easier to configure what code can and cannot do. Because the security-related classes are straightforward to use, this will help in ensuring that a corporation's machines and networks are virus free. At the same time, since .NET is a whole new ball game to everyone involved (including yours truly), it takes some time to become familiar with the classes to use them effectively. This book is an attempt to help to facilitate that learning process so you can get up to speed on .NET security programming.

Target Audience

This book is targeting the intermediate .NET developer who wants to understand how security works in .NET. Although the language of choice within this book is C#, the concepts are .NET-general and are not specific to any .NET language. A VB .NET or JScript .NET developer should be able to apply the concepts to their preferred .NET language with relative ease. We're also assuming that you know the fundamentals of .NET (for example, what an assembly is, what the difference is between a static and an instance method, and so on).

Source Code

We have created a number of small applications that we mention throughout the book. You can download the code from Apress's Web site, at `http://www.apress.com`. We have made every attempt to ensure that the code compiles and behaves as expected, but mistakes can occur. If you find a bug with the source code, or you find an erroneous statement in the book itself, please contact us at `jason@jasonbock.net`, and we'll make sure that updates are made accordingly.

Brief Contents

Contents

CHAPTER 1

The Basics of Cryptography and Security

In this chapter, you'll learn the fundamental concepts of cryptography and security. I'll define what cryptography is and what it is used for, and cover the basics of ciphers and keys and how they work. I'll demonstrate the difference between symmetric and asymmetric cipher algorithms and show you how they can be used in concert for creating signatures and certificates. Finally, I'll talk about cryptography and its relation to security in general.

The Essence of Cryptography

The definition of *cryptography* is pretty straightforward: it is the science of keeping messages secure. In essence, cryptography is the study of the mathematical algorithms and functions used to secure messages. These algorithms fall into two camps: restricted and open.

Restricted Algorithms

Restricted algorithms are those created by a person or an organization and are not available to the general public. For example, this could apply to a compiled COM server from TrustUs.com, which won't give you the source code nor give you any information as to how its algorithms work.

Open Algorithms

Open algorithms are published and are available to anyone for analysis. This could take the form of an algorithm found on VerifyUs.com, where you can download white papers that document the algorithm along with a compiled

Eiffel .NET Web service and its corresponding source code that encrypts and decrypts files for you based on the algorithm.

Experience has shown that you should always go with the open algorithm. Even if it turns out that an open algorithm is not as secure as a restricted one, you as a customer of the two algorithms have no way to verify that the restricted one is better (although if the open algorithm is weak, I'd consider finding another one). And, more often than not, restricted algorithms are hacked anyway by disassembling executables, so their "security by obscurity" methodology is ineffective at best. Determining if an algorithm can withstand attacks takes lengthy analysis and testing by many qualified professionals, so it's beneficial to use an open algorithm. You can easily find out if someone has found a gaping hole in the algorithm or if it is secure.

Next, let's go over the basic terms you'll need to understand to get the most out of subsequent chapters.

Basic Terminology

This section discusses the following terms:

- Plaintext
- Ciphertext
- Hashes
- Keys
- Symmetric algorithms
- Asymmetric algorithms
- Comparison of key types
- Random number generation

I'll begin with plaintext and ciphertext.

Plaintext and Ciphertext

Plaintext describes the state of a message that can be easily read or used by anyone or anything. This can be a text file or an executable. To alter the file such that it cannot be easily read by anyone, you use an *encryption* algorithm to turn the plaintext into *ciphertext*. The encryption algorithm is simply a mathematical function that takes a message's value and from it computes another value (the ciphertext). The hope is that the resulting ciphertext cannot be converted back into the original value easily. To get the file back to a usable form, you use a *decryption* algorithm. Figure 1-1 illustrates this process.

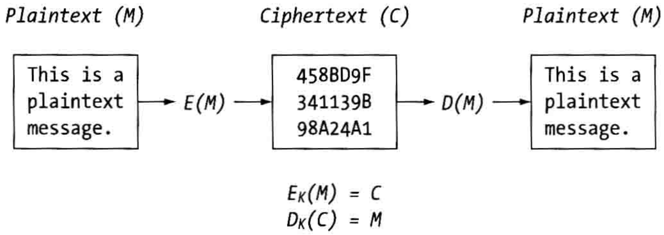

Figure 1-1. Encryption and decryption

The plaintext message is defined as M, and the ciphertext is C. In both situations, a function E (encryption) or D (decryption) operates on M or C, respectively, and produces the desired output.

A simple encryption algorithm that is widely known is Caesar's cipher. This takes each letter of the English alphabet and maps it to another letter. For example, one mapping would shift letters over a certain number of spaces. Therefore, a message such as "hello reader" could be changed to "ifmmp sfbefs," where each letter is shifted one letter in the cipher text.[1]

NOTE *Some books use the words* encipher *and* decipher *for* encryption *and* decryption, *respectively. I'll also use the word* ciphering *to describe the general process of changing a message from one form to another (this can be either the encryption or decryption process).*

Let's start looking at a number of encryption algorithms, beginning with hash algorithms.

[1] This algorithm is extremely easy to break, so I wouldn't suggest using it to encrypt sensitive corporate documents.