

# Windows<sup>®</sup> Communication Foundation 4

John Sharp  
content master



online book + practice files

# Step by Step

# Windows® Communication Foundation 4 Step by Step

John Sharp

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# Acknowledgments

On the back cover of his book, *Dirk Gently's Holistic Detective Agency*, Douglas Adams depicts an invoice presented by Mr. Gently to his client for attempting to find her missing cat. It contains the following items:

Item	Charge
Finding cat (repeated)	£50.00
Detecting and triangulating vectors of inter-connectedness of all things	£150.00
Taking some to beach on Bahamas, taxi and accommodation	£1500.00
Struggling on in face of draining skepticism from client, drinks	£27.00
Saving the human race from total extinction	No charge

Douglas Adams's book was published in 1987, but 23 years later I find myself empathizing with Dirk Gently. Happily, my own beloved Felice, Ginger, is still very much with us, but in common with many service-oriented developers these days, I spend more and more time searching for solutions that enable me to connect all things together. Clearly, my home office is not quite a beach on the Bahamas, but I do admit to enjoying a decent amount of time sunning myself in the sand at Edgbaston (the home of Warwickshire County Cricket Club) watching batsmen attempting to endange wicketmen guiding the new pavilion with lofted drives over the boundary, while I contemplate how to configure pieces of software to get them to interoperate and communicate correctly. My wife is always a little skeptical of how our jaunts to see how Warwickshire fares against other county cricket teams amount to "work," but she enjoys the cricket as much as I do, so she does not complain.

In the world of connected solutions, Microsoft Windows Communication Foundation has proved an absolute boon, and although I am yet to be convinced that it has saved the human race from extinction, I have authored papers and even produced a video on how using WCF can help to save your organization (it may be hype-bots, but you know what we technophiles are like when we desperately want to convince management of the need to invest in new software and machinery!). To that end, I always count it an absolute privilege whenever I get the chance to write or speak about my new technology, as I mentioned in the previous edition of this book. Thank a lot Content Master for allowing me to spend a significant amount of my time doing it.

It would also be very remiss of me not to thank Russell Jones at O'Reilly Media, who badgered me and patiently waited while I found the time to get started on this project as well as for all his support and help in editing and correcting my grammar during the initial drafts of each chapter, and to Bob Russell at Octopus Publishing, who had the unrewarding job of having to wade through every chapter seeking out any remaining "Britishisms." Additionally,

sincere thanks are due to Ashish Ghoda and Kenn Scribner who took on the daunting task of checking the technical accuracy of my work and who provided valuable advice, guidance, and corrections whenever I was wrong (any remaining technical errors in the book are my own, of course). Also, thanks to Lin Joyner at Content Master, who expended a significant effort at great personal risk to her own sanity, for agreeing to test many of the exercises for me.

Finally, I must pay the greatest tribute to my long-suffering family: to Diana, my wife and fellow cricket-watcher, who is never short of advice when seeing a batsman struggle against a short-pitched delivery ("Just hit the ball!"); to James who grew up and left home to go to university while I was writing Chapter 17; and to Francesca who has learned from my wife what it takes to make a truly excellent cup of tea.

And to Ginger—please stop trying to walk across my keyboard as I type.

—John Sharp

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# Introduction

Microsoft Windows Communication Foundation (WCF), alongside Windows Workflow Foundation (WF) and Windows Presentation Foundation (WPF), has become part of the primary framework for building the next wave of business applications for the Microsoft Windows operating system. WCF provides the underpinning technology driving distributed solutions based on the Microsoft platform; with it, you can build powerful service-oriented systems designed to address connected services and applications. WCF is also an integral technology for building and accessing services running in the cloud under Windows Azure.

You can use WCF to create new services as well as augment and interoperate with many existing services created by using other technologies. When designing distributed applications in the past, you frequently had to choose a specific technology, such as Web services, COM+, Microsoft Message Queue, or .NET Framework Remoting. That choice often had a fundamental impact on the architecture of your solutions. In contrast, WCF provides a consistent model for implementing scalable and extensible systems that employ a variety of technologies with which you can design and architect your solutions without being restricted by a specific connectivity mechanism.

In short, if you are building professional, service-oriented solutions for Windows, you need to learn about WCF.

## Who This Book Is For

This book will show you how to build connected applications and services using WCF. If you are involved in designing, building, or deploying applications for the Microsoft Windows operating system, sooner or later you are going to need to become familiar with WCF. This book will give you the initial boost you need to quickly learn many of the techniques required to create systems based on WCF. The book takes a pragmatic approach, covering the concepts and details necessary to enable you to build connected solutions.

## Assumptions

To get the most from this book, you should meet the following profile:

- You should be an architect, designer, or developer who will be creating solutions for the Microsoft Windows family of operating systems.
- You should have experience developing applications using Visual Studio and C#.
- You should have a basic understanding of concepts such as transactions, Web services, security, and message queuing.

## Finding Your Best Starting Point in This Book

This book is designed to help you build skills in a number of essential areas. It assumes that you are new to WCF and takes you step by step through the fundamental concepts of WCF, feature by feature. The techniques and ideas that you see in one chapter are extended by those in subsequent chapters; therefore, most readers should follow the chapters in sequence and perform each of the exercises. However, if you have specific requirements or are only interested in certain aspects of WCF, you can use the table below to find your best route through this book.

If you are	Follow these steps
New to Web services and distributed applications and need to gain a basic understanding of WCF.	<ol style="list-style-type: none"> <li>1. Install the code samples as described in the "Code Samples" section of this Introduction.</li> <li>2. Work through Chapters 1 to 5 sequentially and perform the exercises.</li> <li>3. Complete Chapters 6 to 16 as your level of experience and interest dictates.</li> </ol>
New to Web services and distributed applications and need to learn how to use WCF to implement solutions using common Web services features such as sessions, transactions, and reliable messaging.	<ol style="list-style-type: none"> <li>1. Install the code samples as described in the "Code Samples" section of this Introduction.</li> <li>2. Work through Chapters 1 to 10 sequentially and perform the exercises.</li> <li>3. Complete Chapters 11 to 13 as your level of experience and interest dictates.</li> </ol>
Familiar with Web services and distributed applications, and need to learn about WCF quickly, including its advanced features.	<ol style="list-style-type: none"> <li>1. Install the code samples as described in the "Code Samples" section of this Introduction.</li> <li>2. Skip the first chapter for an overview of WCF, but perform the exercises.</li> <li>3. Read Chapter 2 and perform the exercises.</li> <li>4. Skip Chapter 3.</li> <li>5. Read Chapters 4 and 5 and complete the exercises.</li> <li>6. Skip Chapters 6 to 13, performing the exercises that interest you.</li> <li>7. Complete the remaining chapters and exercises.</li> </ol>
Familiar with security concepts but need to understand how to use the security features that WCF provides.	<ol style="list-style-type: none"> <li>1. Install the code samples as described in the "Code Samples" section of this Introduction.</li> <li>2. Skip the first three chapters.</li> <li>3. Read Chapters 4 and 5 and perform the exercises.</li> <li>4. Skip Chapters 6 to 15.</li> <li>5. Read Chapter 17 and complete the exercises.</li> <li>6. Skip Chapter 18.</li> </ol>

If you are	Follow these steps
Referencing the book after working through the exercises	<ol style="list-style-type: none"> <li>1. Use the index or the Table of Contents to find information about particular subjects.</li> <li>2. Read the Summary sections at the end of each chapter to find a brief review of the concepts and techniques presented in the chapter.</li> </ol>

## Conventions and Features in This Book

This book presents information using conventions designed to make the information readable and easy to follow. Before you start, read the following list, which explains conventions you'll see throughout the book and points out helpful features that you might want to use:

- Each exercise is a series of tasks. Each task is presented as a series of numbered steps (1, 2, 3, and so on). A bullet (■) indicates an exercise that has only one step.
- Reader aids labeled "Note" and "Tip" provide additional information or alternative methods for completing a step successfully.
- Reader aids labeled "Important" alert you to information you need to check before continuing.
- Text that you type appears in **bold**.
- A plus sign (+) between two key names means that you must press those keys at the same time. For example, "Press Alt+Tab" means that you hold down the Alt key while you press the Tab key.

## System Requirements

You'll need the following hardware and software to complete the practice exercises in this book:

- Microsoft Windows 7 Professional, Enterprise, or Ultimate editions.



**Note** Some of the exercises require you to create local users and security groups. This feature is not available with Windows 7 Home Basic or Home Premium editions.

- Microsoft Visual Studio 2010 Professional, Premium, Ultimate, or Test Professional editions, including SQL Server 2008 Express.





**Note** The exercises in this book are not intended to work with Visual Studio 2010 Express edition.

- 1.6 GHz or faster 32-bit (x86) or 64-bit (x64) processor.
- 1 GB RAM (32-bit) or 2 GB RAM (64-bit).
- 20 GB available hard disk space (32-bit) or 25 GB (64-bit).
- DirectX 9 graphics device with WDDM 1.0 or higher driver.
- Microsoft mouse (or compatible) pointing device.

Some of the exercises require that you have installed Internet Information Services (IIS) and Message Queuing (MSMQ). You will also need the *AdventureWorks* database provided with the code samples for this book. Download and installation instructions are provided later in this introduction.



**Important** If you have other tools or services that establish network connections, you may need to temporarily halt them if they use the same ports required by the exercises in this book (alternatively, you can replace the port numbers referenced by the exercises with others of your own choice). For example, some of the exercises reference port 8080. If you have the Apache Web server running on your development computer, it defaults to using port 8080, so you may need to halt or reconfigure this service.

## Code Samples

Follow these steps to download and install the code samples and other companion content on your computer so that you can use them with the exercises:

1. Navigate to <http://oreilly.com/catalog/9780735645561/>.
2. Click the Companion Content link.

You'll see instructions for downloading the .zip archive containing the companion content files.

3. Unpack the .zip archive into your Documents folder. This action creates the following folder containing the exercise and solution files for each chapter:

Microsoft Press\WCF Step By Step

## Installing and Configuring Internet Information Services and Microsoft Message Queue

Many of the exercises in this book require you to build WCF services hosted by using Internet Information Services (IIS). You must make sure that you have installed and configured IIS on your computer, and you must have installed ASP.NET version 4.0 with IIS. Additionally, some exercises use Microsoft Message Queue (MSMQ) as the transport for connecting client applications to services, so you must also install the MSMQ Server Core. The following instructions describe how to do this. Note that you require administrative access to your computer to install and configure IIS and MSMQ.

1. Log on to Windows as an account that has Administrator access.
2. On the Windows Start menu, click Control Panel, and then click Programs. In the Programs pane, under Programs And Features, click Turn Windows Features On Or Off.
3. In the Windows Features dialog box, expand Internet Information Services, and then select the following features:
  - ❑ Web Management Tools | IIS Management Console
  - ❑ Web Management Tools | IIS 6 Management Compatibility | IIS 6 Metabase and IIS 6 Configuration Compatibility
  - ❑ World Wide Web Services | Application Development Features | ASP.NET (this will also select .NET Extensibility, ISAPI Extensions, and ISAPI Filters)
  - ❑ World Wide Web Services | Common Http Features | Directory Browsing (Default Document should already be selected)
  - ❑ World Wide Web Services | Security | Basic Authentication and World Wide Web Services | Security | Windows Authentication (Request Filtering should already be selected)
4. Expand Microsoft Message Queue (MSMQ) Server, and then select Microsoft Message Queue (MSMQ) Server Core (do not select the individual items in the Microsoft Message Queue (MSMQ) Server Core folder).
5. Click OK, and then wait for the features to be installed and configured.

## Installing ASP.NET Version 4.0

The exercises in this book rely on ASP.NET Version 4.0 being installed and configured with IIS. To do this, perform the following tasks:

1. On the Windows Start menu, click All Programs, click Microsoft Visual Studio 2010, click Visual Studio Tools, right-click Visual Studio Command Prompt (2010), and then click Run As Administrator. In the User Account Control dialog box, click Yes.
2. In the Visual Studio Command Prompt window, type the following command:  

```
aspnet_regiis -iru
```
3. When the command has completed, leave the Visual Studio Command Prompt window open; you will use it again after installing the *AdventureWorks* database.

## Installing and Configuring the *AdventureWorks* Database

The exercises and examples in this book make use of the *AdventureWorks* sample database. If you don't already have this database installed on your computer, a copy of the database installation program is supplied with the companion content for this book. Follow these steps to install and configure the database:

1. Log on to Windows as an account that has administrator access if you have not already done so.
2. Verify that the SQL Server (SQLEXPRESS) service is running.



**Tip** Start the SQL Configuration Manager utility in the Configuration Tools folder, located in the Microsoft SQL Server 2008 program group. In the left pane, click SQL Server Services. In the right pane, examine the status of the SQL Server (SQLEXPRESS) service. If the status is Stopped, right-click the service, and then click Start. Wait for the status to change to Running, and then close SQL Configuration Manager.

3. Using Windows Explorer, move to the Microsoft Press\WCF Step By Step\Setup folder located within your Documents folder.
4. Double-click the file *AdventureWorks2008\_SR4.exe*. If the User Account Control dialog box appears, click Yes.
5. Wait while the WinZip Self-Extractor tool unzips the installation program.
6. When the SQL Server 2008R2 Database Installer dialog box appears, read the license agreement. If you agree with the license terms, select the I Accept The License Terms check box, and then click Next.

7. On the AdventureWorks 2008 Community Sample Database SR4 page, set the Installation Instance to SQLEXPRESS, select the *AdventureWorks OLTP* database, deselect all other databases, and then click Install.



**Note** Make sure that you select the AdventureWorks OLTP database and *not* AdventureWorks OLTP 2008. Depending on how you have configured SQL Server, not all databases will be available anyway, and you may see a warning icon against some of these databases. You can ignore these warnings because these databases are not required.

8. On the Installation Execution page, wait while the database is installed and configured, and then click Finish.
8. Return to the Visual Studio Command Prompt window running as Administrator in the Microsoft Press\WCF Step By Step\Setup folder.
9. Type the following command:

```
osql -E -S .\SQLEXPRESS -i aspnet.sql
```

This command should complete without any errors (it will display a series of prompts, "1> 2> 1> 1> 2> 1> 1> 2> 1> 2> 1>").



**Note** The script *aspnet.sql* creates user accounts for the DefaultAppPool and ASP.NET v4.0 applications pools used by IIS and grants these accounts access to the *AdventureWorks* database.

10. Close the Visual Studio Command Prompt window.

## Using the Code Samples

Each chapter in this book explains when and how to use any code samples for that chapter. When it's time to use a code sample, the book will list the instructions for how to open the files. The chapters are built around scenarios that simulate real programming projects, so you can easily apply the skills you learn to your own work.

For those of you who like to know all the details, following is a list of the code sample, Visual Studio projects, and solutions, grouped by the folders where you can find them.



**Important** Many of the exercises require administrative access to your computer. Make sure you perform the exercises using an account that has this level of access.

Solution Folder	Description
<b>Chapter 1</b>	
Completed\ProductsService	This solution gets you started. Creating the ProductsService project lets you through the process of building a simple WCF service hosted by IIS. You can use the service to query and update product information in the AdventureWorks database. The ProductsClient project is a console-based WCF client application that connects to the ProductsService service. You use this project for testing the WCF service.
<b>Chapter 2</b>	
ProductsClient	This solution is the starting point for the exercises in this chapter. It contains a copy of the completed client application from Chapter 1.
Completed\ProductsClient	This solution contains a version of the client application that connects to the ProductsService service by using a TCP connection.
Completed\IIS\ProductsServiceHost	This solution contains Windows Presentation Foundation application that services a host environment for the ProductsService service. You use this application to manually start and stop the service. You configure the ProductsClient application to connect to the service hosted by this application by using an HTTP endpoint.
Completed\Windows\ProductsService	This solution contains a Windows service that hosts the ProductsService service. You can start and stop the service from the services applet in the Windows Control Panel. You reconfigure the ProductsClient application to connect to this service by using an endpoint based on the Named Pipe transport.
<b>Chapter 3</b>	
ProductsServiceHost	This solution contains a copy of the ProductsServiceHost, ProductsServiceHost and ProductsClient applications from Chapter 2. It is used as a starting point for the exercises in this chapter.
Completed\UntypedProductsServiceFault	The ProductsService service in this solution traps exceptions and reports them back to the client application as untyped SOAP faults, which are caught and handled by the ProductsClient application.
Completed\StronglyTypedProductsServiceFault	The ProductsService service in this solution reports exceptions as typed SOAP faults defined by using fault contracts. The ProductsClient application catches these strongly typed SOAP faults as exceptions.
<b>Chapter 4</b>	
ProductsService	This solution contains three projects: the ProductsService service, the ProductsServiceHost application and the ProductsClient. These projects are configured to catch and handle SOAP faults as described in Chapter 3. This solution forms the starting point for the exercises in this chapter.

Solution Folder	Description
<b>Chapter 4 (continued)</b>	
Completed\NetTcpProductsService\WithMessageLevelSecurity	This solution contains an implementation of the <i>ProductsService</i> service, the <i>ProductsServiceHost</i> application, and the <i>ProductsClient</i> application that applies message-level security over a TCP binding.
Completed\AsichttpProductsService\WithTransportLevelSecurity	This solution shows how to implement transport-level security over an HTTP binding.
Completed\WS2007HttpProductsService\WithMessageLevelSecurity	This version of the solution contains a host that implements message-level security over an HTTP binding.
Completed\ProductsService\WithBasicAuthentication	This solution contains a version of the <i>ProductsService</i> service that implements basic authentication and displays the name of the user calling the <i>GetProducts</i> operations. The client application explicitly provides the name and password of the user connecting to the service.
Completed\ProductsService\WithWindowsAuthentication	This solution is similar to the previous one, except that the <i>ProductsService</i> service implements Windows authentication. The credentials for the client application are picked up from the user's login session.
Completed\ProductsService\WithAuthorization	The <i>ProductsService</i> service in this solution authorizes users according to the Windows security groups to which they belong. Users that do not belong to a specified security group are denied access when they attempt to invoke operations.
<b>Chapter 5</b>	
Programs\Client	This folder contains a copy of the client application that is used for testing the various configurations of the <i>InteractProductsService</i> service in this chapter.
Completed\ASPNB\Membership	This solution contains the <i>InteractProductsService</i> service that is deployed to IIS and authenticates users by using the ASP.NET Role Provider rather than Windows security groups.
Completed\ASPNET\Membership\UsingCertificates	The <i>InteractProductsService</i> service in this solution uses the ASP.NET Role Provider in conjunction with certificates to authenticate users.
Completed\MutualAuthentication\UsingCertificates	The <i>InteractProductsService</i> service in this solution uses a certificate to authenticate itself to the client application.
<b>Chapter 6</b>	
ProductsService	This solution contains an amended copy of the <i>ProductsClient</i> , <i>ProductsServiceLibray</i> , and <i>ProductsServiceHost</i> projects from Chapter 4. The service implements message-level security and authenticates users by using Windows tokens. This solution is used as the starting point for the exercises in this chapter.

Solution Folder	Description
Chapter 5 (continued)	
ProductsServiceWithVersionedServiceContract	This solution contains an implementation of the <i>ProductsService</i> service and a client application that provides these two versions of the service contract. It is used by some of the exercises in the second part of the chapter.
Completed\ProductsServiceWithProtectedOperations	This solution contains a version of the <i>ProductsService</i> service in which client applications are required to encrypt and sign request messages for some operations, but only sign requests for others. The proxy class in the <i>ProductsClient</i> application has been updated to encrypt and sign, or just sign, messages, as appropriate. The purpose of this solution is to show how changing security requirements for operations can break a service contract.
Completed\ProductsServiceWithAdditionalBusinessLogic	The <i>ProductsService</i> service in this solution contains additional methods. However, because these methods implement internal logic for the service and are not exposed as part of the service contract, they do not require that existing client applications are updated.
Completed\ProductsServiceWithModifiedServiceContract	This solution contains a version of the <i>ProductsService</i> service with an additional operation and a modified service contract. The client application has not been updated, but it still works although it can not invoke the new operation.
Completed\ProductsServiceWithVersionedServiceContract	The <i>ProductsService</i> service in this solution exposes two versions of the service contract, enabling existing client applications to use the old contract while exposing the additional operation to new client applications.
Completed\ProductsServiceWithAdditionalFieldsInDataContract	This solution shows the effects that modifying a data contract can have on client applications and how you can implement a data contract that supports clients expecting different versions of a data contract.
Chapter 7	
Completed\ShoppingCart	This solution contains a completed version of the initial <i>ShoppingCartService</i> service that implements shopping cart functionality and a client application that exercises this functionality. This solution is used as the basis for subsequent exercises in this chapter.
Completed\ShoppingCartContextModes	The <i>ShoppingCartService</i> service in this solution demonstrates the use of the <i>SingleInstanceContextMode</i> .
Completed\ShoppingCartWithState	The <i>ShoppingCartService</i> service in this solution uses the <i>PerCall</i> instance context mode and contains code that saves the instance state to XML files.
Completed\ShoppingCartWithSequenceOperations	This solution shows how to control the sequence in which a client application can invoke operations and control the lifetime of a session.

Solution Folder	Description
Chapter 7 (continued)	
DurableShoppingCart	This solution contains a version of the <i>ShoppingCartService</i> service that in turn uses the <i>PerSession</i> instance context mode. The solution also contains a GUI client application called <i>ShoppingCartGUIClient</i> . This solution is used by exercises that convert the <i>ShoppingCartService</i> service to a durable service.
Completed\DurableShoppingCart	This solution contains a completed implementation of the durable version of <i>ShoppingCartService</i> service.
Chapter 8	
Completed\ProductsWorkflow	This solution contains a workflow service called <i>ProductsWorkflowService</i> that retrieves the details of a specified product. The solution also includes a basic example client application to test the service.
Completed\ProductsWorkflow WithFaultHandling	The <i>ProductsWorkflowService</i> service in this solution shows how to catch exceptions in a service and send SOAP faults to a client application.
ProductsClient	This version of the client application for the <i>ProductsWorkflowService</i> service that generates SOAP faults.
Completed\ProductsWorkflow WithIISDeployment	This solution shows how to deploy the <i>ProductsWorkflowService</i> service to IIS.
Completed\ProductsWorkflow WithCustomHost	This solution demonstrates how to create a custom host application for a workflow service.
Completed\ShoppingCartService	This solution contains a complete version of the <i>ShoppingCartService</i> service implemented as a workflow service.
ShoppingCartGUIClient	This is a copy of the <i>ShoppingCartGUIClient</i> developed in Chapter 7. It is used to test the workflow version of the <i>ShoppingCartService</i> service.
Completed\ShoppingCartWith HostAndClient	This solution contains a complete version of the workflow version of the <i>ShoppingCartService</i> service, hosted in a custom host application and accessed from the <i>ShoppingCartGUIClient</i> application.
Completed\DurableShopping CartWithHostAndClient	This solution demonstrates how to implement a workflow service as a durable service.
Chapter 9	
ShoppingCartService	This solution contains a copy of the non-durable <i>ShoppingCartService</i> , <i>ShoppingCartServiceHost</i> , and <i>ShoppingCartClient</i> projects from Chapter 7. It is used as the starting point for the exercises in this chapter.



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