5
Implementing a WCF Service in the Real World

In the previous chapter, we created a basic WCF service. The WCF service we created, `HelloWorldService`, has only one method, called `GetMessage`. Because this is just an example, we implemented this WCF service in one layer only. Both the service interface and implementation are all within one deployable component.

In this chapter and the next one, we will implement a WCF Service, which will be called `RealNorthwindService`, to reflect a real world solution. In this chapter we will separate the service interface layer from the business logic layer, and in the next chapter we will add a data access layer to the service.

In this chapter, we will create and test the WCF service by following these steps:

- Create the project using a WCF Service Library template
- Create the project using a WCF Service Application template
- Create the Service Operation Contracts
- Create the Data Contracts
- Add a Product Entity project
- Add a business logic layer project
- Call the business logic layer from the service interface layer
- Test the service

Why layering a service?

An important aspect of SOA design is that service boundaries should be explicit, which means hiding all the details of the implementation behind the service boundary. This includes revealing or dictating what particular technology was used.

Further more, inside the implementation of a service, the code responsible for the data manipulation should be separated from the code responsible for the business logic. So in the real world it is always a good practice to implement a WCF service in three or more layers. The three layers are the service interface layer, the business logic layer, and the data access layer.

- **Service interface layer**: This layer will include the service contracts and operation contracts that are used to define the service interfaces that will be exposed at the service boundary. Data contracts are also defined to pass in to and out of the service. If any exception is expected to be thrown outside of the service, then Fault contracts will also be defined at this layer.
- **Business logic layer**: This layer will apply the actual business logic to the service operations. It will check the preconditions of each operation, perform business activities, and return any necessary results to the caller of the service.
- **Data access layer**: This layer will take care of all of the tasks needed to access the underlying databases. It will use a specific data adapter to query and update the databases. This layer will handle connections to databases, transaction processing, and concurrency controlling. Neither the service interface layer nor the business logic layer needs to worry about these things.

Layering provides separation of concerns and better factoring of code, which gives you better maintainability and the ability to split layers out into separate physical tiers, for scalability. The data access code should be separated out into its own layer that focuses on performing translation services between the databases and the application domain. Services should be placed in a separate service layer that focuses on performing translation services between the service-oriented external world and the application domain.

The service interface layer will be compiled into a separate class assembly, and hosted in a service host environment. The outside world will only know about and have access to this layer. Whenever a request is received by the service interface layer, the request will be dispatched to the business logic layer, and the business logic layer will get the actual work done. If any database support is needed by the business logic layer, it will always go through the data access layer.

Creating a new solution and project using WCF templates

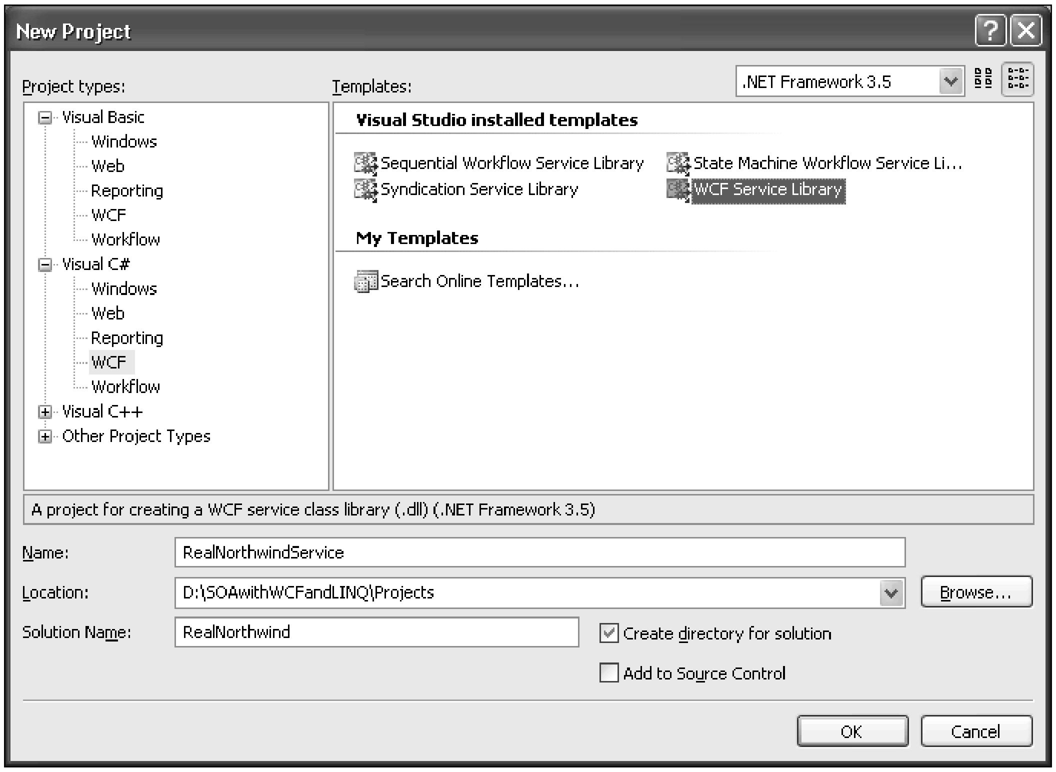
We need to create a new solution for this example, and add a new WCF project to this solution. This time we will use the built-in Visual Studio WCF templates for the new project.

Using the C# WCF service library template

There are two built-in WCF service templates within Visual Studio 2008: Visual Studio WCF Service Library and Visual Studio Service Application. In this section, we will use the service library template, and in the next section, we will use the service application template. Later, we will explain the differences between these two templates and choose the template that we are going to use for this chapter.

Follow these steps to create the `RealNorthwind` solution and the project using service library template:

1. Start Visual Studio 2008, select menu option **File | New | Project...,** and you will see the **New Project** dialog box. Do not open the `HelloWorld` solution from the previous chapter, as from this point onwards, we will create a completely new solution and save it in a different location.
2. In the **New Project** window, specify **Visual C# | WCF** as the project type, **WCF Service Library** as the project template, **RealNorthwindService** as the (project) name, and **RealNorthwind** as the solution name. Make sure that the checkbox **Create directory for solution** checkbox is selected.



A project for creating a WCF service class library (.dll) (.NET Framework 3.5)

Name: RealNorthwindService
Location: D:\SOAwithWCFandLINQ\Projects
Solution Name: RealNorthwind
☑ Create directory for solution

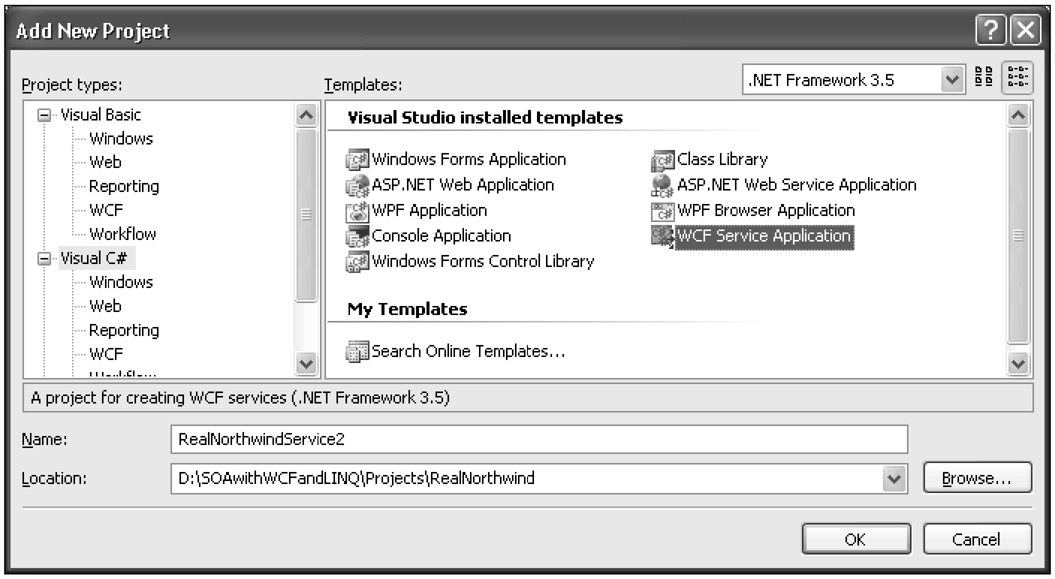
3. Click the **OK** button, and the solution is created with a WCF project inside it. The project already has a `IService1.cs` file to define an service interface and `Service1.cs` to implement the service. It also has an `app.config` file, which we will cover shortly.

Using the C# WCF service application template

Instead of using the Visual Studio WCF Service Library template to create our new WCF project, we can also use the Visual Studio Service Application template to create the new WCF project.

Because we have created the solution, we will add a new project using the Visual Studio WCF Service Application template.

1. Right-click on the solution item in the Solution Explorer, select menu option **Add | New Project...** from the context menu, and you will see the **Add New Project** dialog box.
2. In the **Add New Project** window, specify **Visual C#** as the project type, **WCF Service Application** as the project template, **RealNorthwindService2** as the (project) name, and leave the default location of **D:\SOAwithWCFandLINQ\Projects\RealNorthwind** unchanged.



A project for creating WCF services (.NET Framework 3.5)

Name: RealNorthwindService2

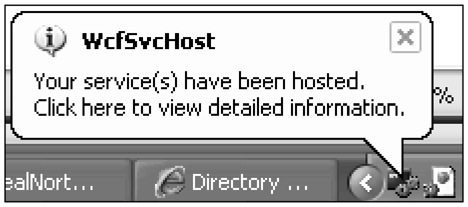
Location: D:\SOAwithWCFandLINQ\Projects\RealNorthwind

3. Click the **OK** button and the new project will be added to the solution. The project already has an `IService1.cs` file to define a service interface, and `Service1.svc.cs` to implement the service. It also has a `Service1.svc` file, and a `web.config` file, which are used to host the new WCF service. It has also had the necessary references added to the project such as `System.ServiceModel`.

You can follow these steps to test this service:

- Change this new project `RealNorthwindService2` to be the startup project (right-click on it from the Solution Explorer, and select **Set as Startup Project**). Then, run it (*Ctrl+F5* or *F5*). You will see that it can now run. You will see that an ASP.NET Development Server has been started, and a browser is open listing all of the files under the `RealNorthwindService2` project folder. Clicking on the **Service1.svc** file will open the Metadata page of the WCF service in this project. This is the same as we had discussed in the previous chapter for the `HostDevServer` project.
- If you have pressed *F5* in the previous step to run this project, you will see a warning message box asking you if you want to enable debugging for the WCF service. As we said earlier, you can choose enable debugging or just run in non-debugging mode.

You may also have noticed that the WCF Service Host is started together with the ASP.NET Development Server. This is actually another way of hosting a WCF service in Visual Studio 2008. It has been started at this point because, within the same solution, there is a WCF service project (`RealNorthwindService`) created using the WCF Service Library template. We will cover more of this host in a later section.


WcfSvcHost

Your service(s) have been hosted.
Click here to view detailed information.

So far, we have used two different Visual Studio WCF templates to create two projects. The first project, using C# WCF Service Library template, is a more sophisticated one because this project is actually an application containing a WCF service, a hosting application (`WcfSvcHost`), and a WCF Test Client. This means that we don't need to write any other code to host it, and as soon as we have implemented a service, we can use the built-in WCF Test Client to invoke it. This makes it very convenient for WCF development.

The second project, using C# WCF Service Application template, is actually a website. This is the hosting application of the WCF service, so you don't have to create a separate hosting application for the WCF service. This is like a combination of the `HelloWorldService` and the `HostDevServer` applications we created in the previous chapter. As we have already covered them and you now have had a solid understanding of these styles, we will not discuss them any more. But keep in mind that you have this option, although in most cases it is better to keep the WCF service as clean as possible, without any hosting functionalities attached to it.

To focus on the WCF service using the WCF Service Library template, we now need to remove the project `RealNorthwindService2` from the solution.

In the Solution Explorer, right-click on the **RealNorthwindService2** project item, and select **Remove** from the context menu. Then, you will see a warning message box. Click the **OK** button in this message box, and the `RealNorthwindService2` project will be removed from the solution. Note that all the files of this project are still on your hard drive. You will need to delete them using Windows Explorer.

'RealNorthwindService2' will be removed.

Creating the service interface layer

In the previous section, we created a WCF project using the WCF Service Library template. In this section, we will create the service interface layer contracts.

Because two sample files have already been created for us, we will try to re-use them as much as possible. Then, we will start customizing these two files to create the service contracts.

Creating the service interfaces

To create the service interfaces, we need to open the `IService1.cs` file, and do the following:

1. Change its namespace from `RealNorthwindService` to:

   `MyWCFServices.RealNorthwindService`

2. Change the interface name from **IService1** to **IProductService**. Don't be worried if you see the warning message before the interface definition line, as we will change the `web.config` file in one of the following steps.
3. Change the first operation contract definition from this line:

   ```
   string GetData(int value);
   ```

   To this line:

   ```
   Product GetProduct(int id);
   ```

4. Change the second operation contract definition from this line:

   ```
   CompositeType GetDataUsingDataContract(CompositeType composite);
   ```

   To this line:

   ```
   bool UpdateProduct(Product product);
   ```

5. Change the file's name from **IService1.cs** to **IProductService.cs**.

With these changes, we have defined two service contracts. The first one can be used to get the product details for a specific product ID, while the second one can be used to update a specific product. The product type, which we used to define these service contracts, is still not defined. We will define it right after this section.

The content of the service interface for `RealNorthwindService.ProductService` should look like this now:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Runtime.Serialization;
using System.ServiceModel;
using System.Text;

namespace MyWCFServices.RealNorthwindService
{
    // NOTE: If you change the interface name "IService1" here, you
must also update the reference to "IService1" in App.config.
    [ServiceContract]
    public interface IProductService
    {
        [OperationContract]
        Product GetProduct(int id);

        [OperationContract]
        bool UpdateProduct(Product product);

        // TODO: Add your service operations here
    }
}
```

[This is not the whole content of the `IProductService.cs` file. The bottom part of this file now should still have the class `CompositeType`, which we will change to our `Product` type in the next section.]

Creating the data contracts

Another important aspect of SOA design is that you shouldn't assume that the consuming application supports a complex object model. A part of the service boundary definition is the data contract definition for the complex types that will be passed as operation parameters or return values.

For maximum interoperability and alignment with SOA principles, you should not pass any .NET specific types such as `DataSet` or `Exceptions` across the service boundary. You should stick to fairly simple data structure objects such as classes with properties, and backing member fields. You can pass objects that have nested complex types such as 'Customer with an Order collection'. However, you shouldn't make any assumption about the consumer being able to support object-oriented constructs such as inheritance, or base-classes for interoperable web services.

In our example, we will create a complex data type to represent a product object. This data contract will have five properties: `ProductID`, `ProductName`, `QuantityPerUnit`, `UnitPrice`, and `Discontinued`. These will be used to communicate with client applications. For example, a supplier may call the web service to update the price of a particular product, or to mark a product for discontinuation.

It is preferable to put data contracts in separate files within a separate assembly, but to simplify our example, we will put the `DataContract` within the same file as the service contract. So, we will modify the file `IProductService.cs` as follows:

1. Change the `DataContract` name from `CompositeType` to `Product`.
2. Change the fields from the following lines:

   ```
   bool boolValue = true;
   string stringValue = "Hello ";
   ```

   To these 7 lines:

   ```
   int productID;
   string productName;
   string quantityPerUnit;
   decimal unitPrice;
   bool discontinued;
   ```

3. Delete the old `BoolValue`, and `StringValue` `DataMember` properties. Then, for each of the above fields, add a `DataMember` property. For example, for `productID`, we will have this `DataMember` property:

   ```
   [DataMember]
   public int ProductID
   {
      get { return productID; }
      set { productID = value; }
   }
   ```

A better way is to take advantage of the automatic property feature of C#, and add the following `ProductID` `DataMember` without defining the `productID` field:

```
[DataMember]
public int ProductID { get; set; }
```

To save some space, we will use the latter format. So, we need to delete all of those field definitions, and add an automatic property for each field, with the first letter capitalized.

The data contract part of the finished service contract file `IProductService.cs` should now look like this:

```
[DataContract]
public class Product
{
        [DataMember]
        public int ProductID { get; set; }
        [DataMember]
        public string ProductName { get; set; }
        [DataMember]
        public string QuantityPerUnit { get; set; }
        [DataMember]
        public decimal UnitPrice { get; set; }
        [DataMember]
        public bool Discontinued { get; set; }
}
```

Implementing the service contracts

To implement the two service interfaces that we defined in the previous section, open the `Service1.cs` file and do the following:

1. Change its namespace from `RealNorthwindService` to `MyWCFServices.RealNorthwindService`.
2. Change the class name from `Service1` to `ProductService`. Make it inherit from the `IProductService` interface, instead of `IService1`. The class definition line should be like this:

    ```
     public class ProductService : IProductService
    ```

3. Delete the `GetData` and `GetDataUsingDataContract` methods
4. Add the following method, to get a product:

    ```
    public Product GetProduct(int id)
    {
        // TODO: call business logic layer to retrieve product
        Product product = new Product();
        product.ProductID = id;
        product.ProductName = "fake product name from service layer";
        product.UnitPrice = (decimal)10.0;
        return product;
    }
    ```

[In this method, we created a fake product and returned it to the client. Later, we will remove the hard-coded product from this method, and call the business logic to get the real product.]

5. Add the following method to update a product:

    ```
    public bool UpdateProduct(Product product)
    {
        // TODO: call business logic layer to update product
        if (product.UnitPrice <= 0)
            return false;
        else
            return true;
    }
    ```

    Also, in this method, we don't update anything. Instead, we always return `true` if a valid price is passed in. In one of the following sections, we will implement the business logic to update the product and apply some business logics to the update.

6. Change the file's name from `Service1.cs` to `ProductService.cs`. The content of the `ProductService.cs` file should be like this:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Runtime.Serialization;
using System.ServiceModel;
using System.Text;
namespace MyWCFServices.RealNorthwindService
{
    // NOTE: If you change the class name "Service1" here,
    you must also update the reference to "Service1" in App.config.
    public class ProductService : IProductService
    {
        public Product GetProduct(int id)
        {
            // TODO: call business logic layer to retrieve product
            Product product = new Product();
            product.ProductID = id;
            product.ProductName = "fake product name
            from service layer";
            product.UnitPrice = (decimal)10;
            return product;
        }
        public bool UpdateProduct(Product product)
        {
            // TODO: call business logic layer to update product
            if (product.UnitPrice <= 0)
                return false;
            else
                return true;
        }
    }
}
```

Modifying the app.config file

Because we have changed the service name, we have to make the appropriate changes to the configuration file.

Follow these steps to change the configuration file:

1. Open `app.config` file from the Solution Explorer.
2. Change the `RealNorthwindService` string to `MyWCFServices.RealNorthwindService`. This is for the namespace change.
3. Change the `Service1` string to `ProductService`. This is for the actual service name change.
4. Change the service address port from `8731` to `8080`. This is to prepare for the client application.
5. You can also change the `Design_Time_Addresses` to whatever address you want, or delete this part from the service, `baseAddress`. This can be used to test your service locally.

The content of the `app.config` file should now look like this:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
  <system.web>
    <compilation debug="true" />
  </system.web>
  <!-- When deploying the service library project, the content of
       the config file must be added to the host's app.config file.
       System.Configuration does not support config files for
       libraries. -->
  <system.serviceModel>
    <services>
      <service name="MyWCFServices.RealNorthwindService.
                ProductService" behaviorConfiguration="MyWCFServices.
                RealNorthwindService.ProductServiceBehavior">
        <host>
          <baseAddresses>
            <add baseAddress = "http://localhost:8080/Design_Time_
             Addresses/MyWCFServices/RealNorthwindService/
             ProductService/" />
          </baseAddresses>
        </host>
        <!-- Service Endpoints -->
        <!-- Unless fully qualified, address is relative to base
                                    address supplied above -->
        <endpoint address ="" binding="wsHttpBinding"
        contract="MyWCFServices.RealNorthwindService.IProductService">
          <!-- Upon deployment, the following identity element should
           be removed or replaced to reflect the identity under which
           the deployed service runs.  If removed, WCF will infer an
           appropriate identity automatically. -->
          <identity>
            <dns value="localhost"/>
          </identity>
        </endpoint>
        <!-- Metadata Endpoints -->
        <!-- The Metadata Exchange endpoint is used by the service
         to describe itself to clients. -->
        <!-- This endpoint does not use a secure binding and should be
         secured or removed before deployment -->
        <endpoint address="mex" binding="mexHttpBinding" contract=
         "IMetadataExchange"/>
      </service>
    </services>
    <behaviors>
      <serviceBehaviors>
        <behavior name="MyWCFServices.RealNorthwindService.
         ProductServiceBehavior">
          <!-- To avoid disclosing metadata information,
          set the value below to false and remove the metadata
          endpoint above before deployment -->
          <serviceMetadata httpGetEnabled="True"/>
          <!-- To receive exception details in faults for debugging
           purposes, set the value below to true.  Set to false before
           deployment to avoid disclosing exception information -->
          <serviceDebug includeExceptionDetailInFaults="False" />
        </behavior>
      </serviceBehaviors>
    </behaviors>
  </system.serviceModel>
</configuration>
```

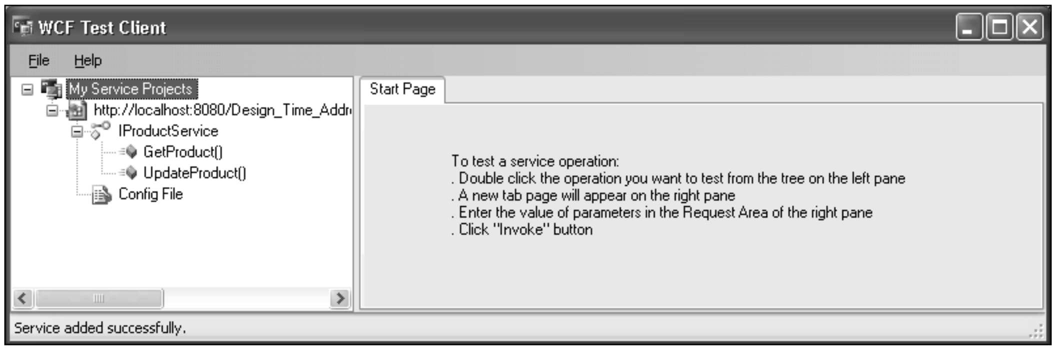
Testing the service using WCF Test Client

Because we are using the WCF Service Library template in this example, we are now ready to test this web service. As we pointed out when creating this project, this service will be hosted in the Visual Studio 2008 WCF Service Host environment.

[This is a new feature of Visual Studio 2008; if you are using Visual Studio 2005, you won't have this built-in functionality.]

To start the service, press *F5* or *Ctrl+F5*. The `WcfSvcHost` will be started and the WCF Test Client is also started. This is a Visual Studio 2008 built-in test client for WCF Service Library projects.

[In order to run the WCF Test Client, you have to log in to your machine as a local administrator.]

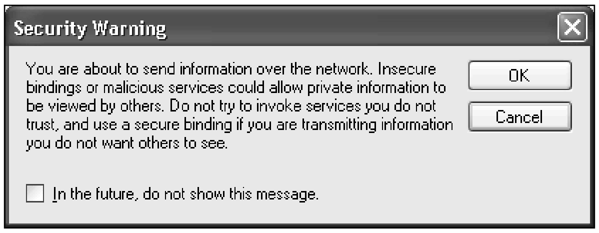


To test a service operation:
. Double click the operation you want to test from the tree on the left pane
. A new tab page will appear on the right pane
. Enter the value of parameters in the Request Area of the right pane
. Click "Invoke" button

Service added successfully.

From this WCF Test Client, we can double-click on an operation to test it. First, let us test the `GetProduct` operation.

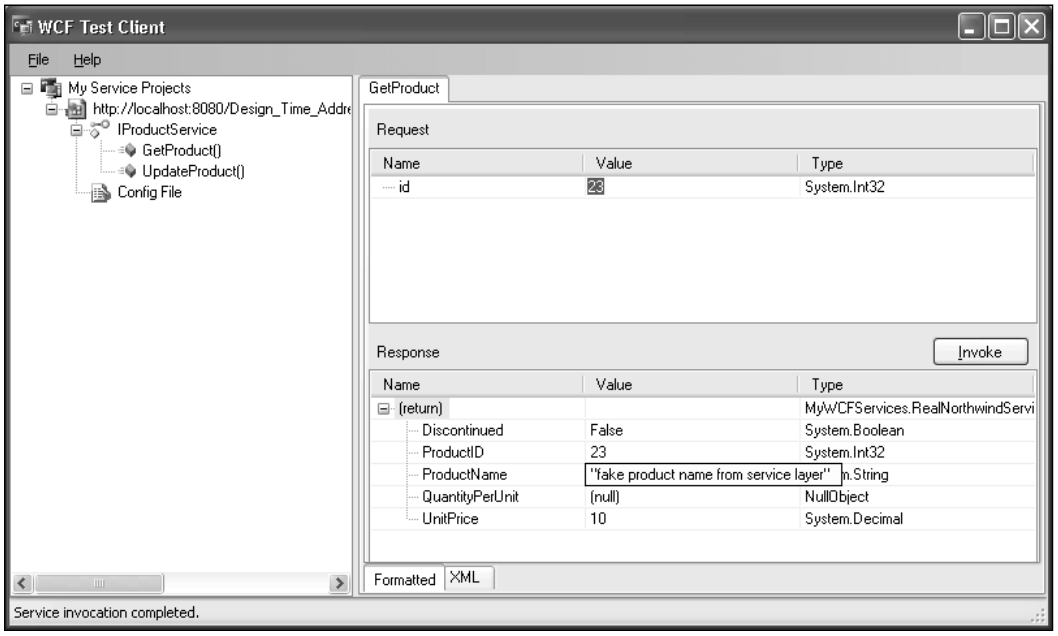
1. In the left panel of the client, double-click on the `GetProduct` operation; the `GetProduct` **Request** will be shown on the right-side panel.
2. In this **Request** panel, specify an integer for the product ID, and click the **Invoke** button to let the client call the service. You may get a dialog box to warn you about the security of sending information over the network. Click the **OK** button to acknowledge this warning (you can check the **'In the future, do not show this message'** option, so that it won't be displayed again).



You are about to send information over the network. Insecure bindings or malicious services could allow private information to be viewed by others. Do not try to invoke services you do not trust, and use a secure binding if you are transmitting information you do not want others to see.

☐ In the future, do not show this message.

Now the message **Invoking Service…** will be displayed in the status bar, as the client is trying to connect to the server. It may take a while for this initial connection to be made, as several things need to be done in the background. Once the connection has been established, a channel will be created and the client will call the service to perform the requested operation. Once the operation has completed on the server side, the response package will be sent back to the client, and the WCF Test Client will display this response in the bottom panel.



Name	Value	Type
id	23	System.Int32

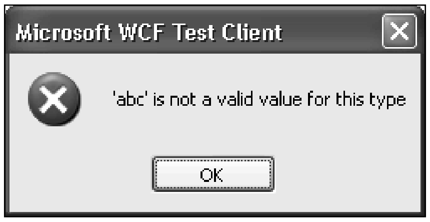
Name	Value	Type
(return)		MyWCFServices.RealNorthwindServi
Discontinued	False	System.Boolean
ProductID	23	System.Int32
ProductName	"fake product name from service layer"	n.String
QuantityPerUnit	(null)	NullObject
UnitPrice	10	System.Decimal

Service invocation completed.

If you have started the test client in the debugging mode (by pressing *F5*), you can set a breakpoint at a line inside the `GetProduct` method in the `RealNorthwindService.cs` file, and when the **Invoke** button is clicked, the breakpoint will be hit so that you can debug the service as we explained earlier.

Note that the response is always the same, no matter what product ID you use to retrieve the product. Specifically, the product name is hard-coded, as shown in the diagram. Moreover, from the client response panel, we can see that several properties of the `Product` object have been assigned default values.

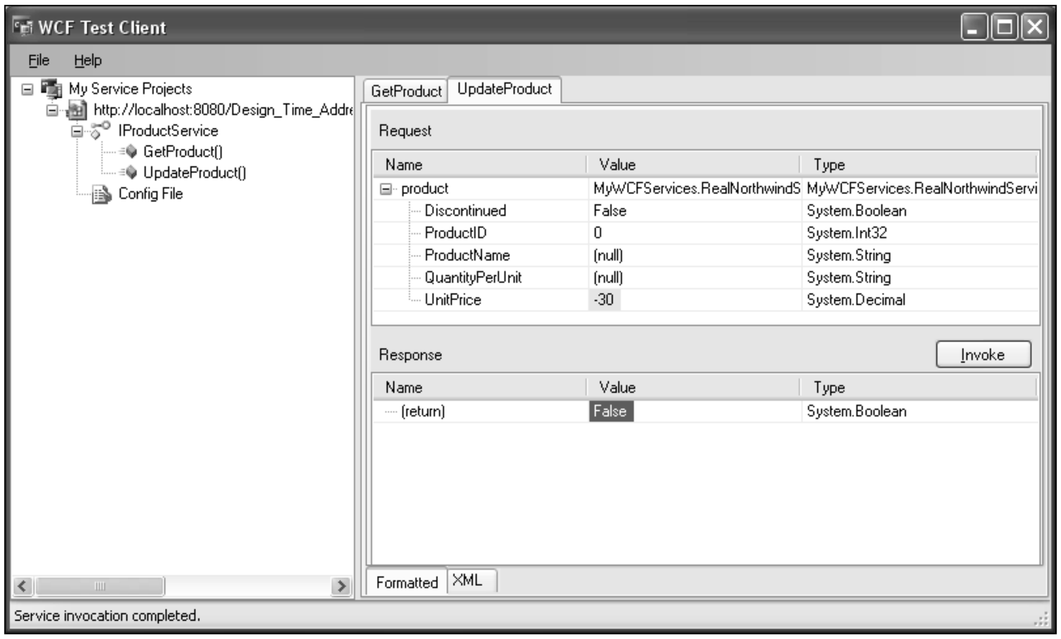
Also, because the product ID is an integer value from the WCF Test Client, you can only enter an integer for it. If a non-integer value is entered, when you click the **Invoke** button, you will get an error message box to warn you that you have entered the wrong type.


Microsoft WCF Test Client

'abc' is not a valid value for this type

Now let's test the operation, `UpdateProduct`.

- Double-click the `UpdateProduct` operation in the left panel, and `UpdateProduct` will be shown in the right-side panel, in a new tab.
- Enter a decimal value for the `UnitPrice` parameter, then click the **Invoke** button to test it. Depending on the value you entered in the `UnitPrice` column, you will get a `True` or `False` response package back.



Request

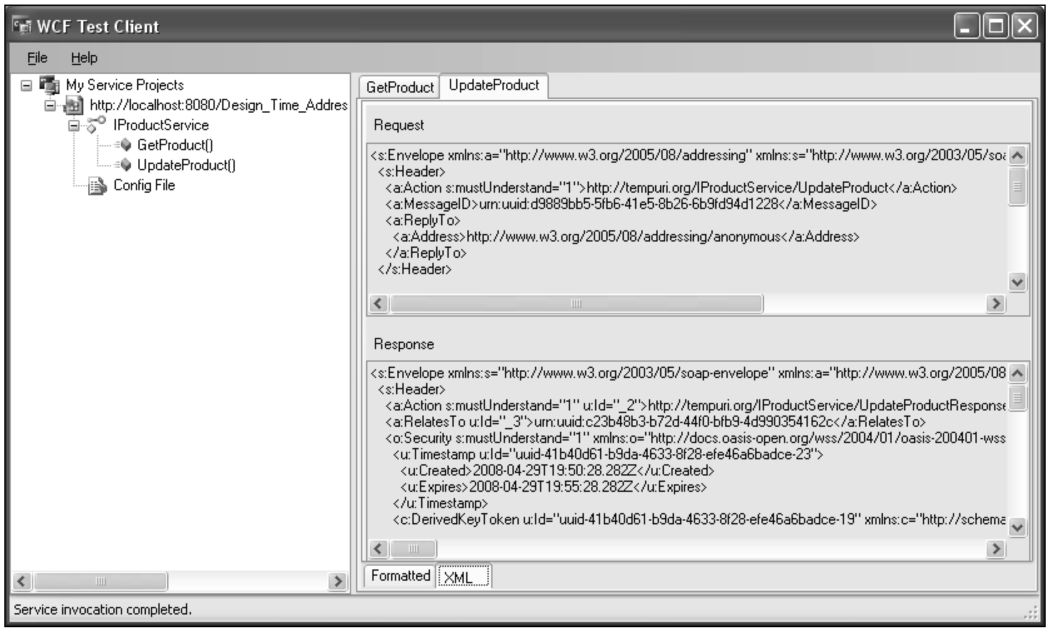
Name	Value	Type
product	MyWCFServices.RealNorthwindS	MyWCFServices.RealNorthwindServi
Discontinued	False	System.Boolean
ProductID	0	System.Int32
ProductName	(null)	System.String
QuantityPerUnit	(null)	System.String
UnitPrice	-30	System.Decimal

Response

Name	Value	Type
(return)	False	System.Boolean

Service invocation completed.

The Request/Response packages are displayed in grids by default, but you have the option of displaying them in the XML format. Just select the **XML** tab from the bottom of the right-hand side panel, and you will see the XML formatted **Request/ Response** packages. From these XML strings, you will discover that they are SOAP messages.

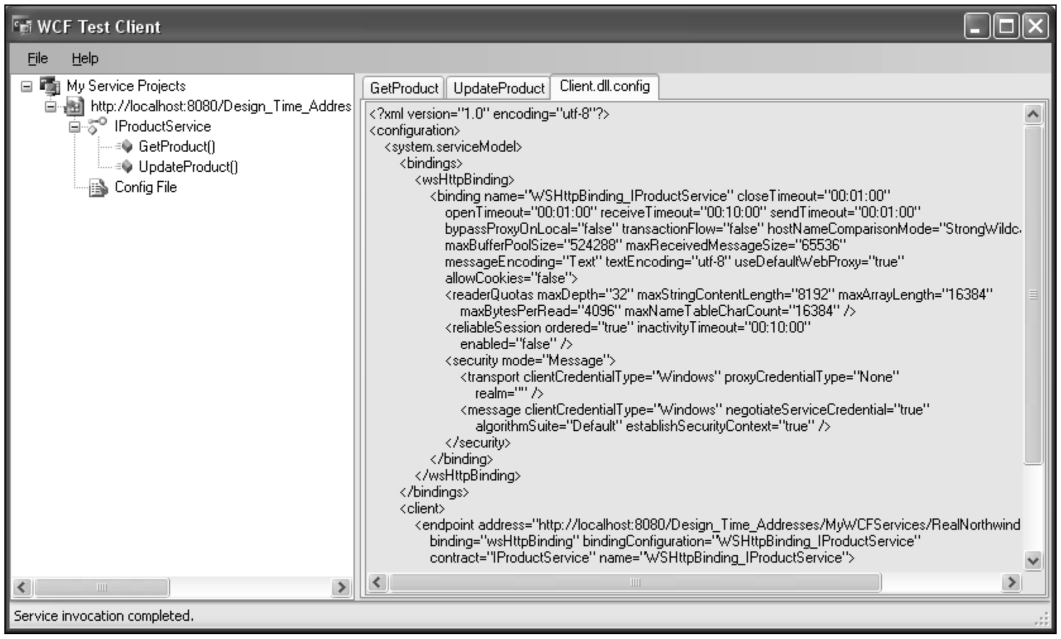


```
<s:Envelope xmlns:a="http://www.w3.org/2005/08/addressing" xmlns:s="http://www.w3.org/2003/05/soa
  <s:Header>
    <a:Action s:mustUnderstand="1">http://tempuri.org/IProductService/UpdateProduct</a:Action>
    <a:MessageID>urn:uuid:d9889bb5-5fb6-41e5-8b26-6b9fd94d1228</a:MessageID>
    <a:ReplyTo>
      <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
  </s:Header>
```

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope" xmlns:a="http://www.w3.org/2005/08
  <s:Header>
    <a:Action s:mustUnderstand="1" u:Id="_2">http://tempuri.org/IProductService/UpdateProductResponse
    <a:RelatesTo u:Id="_3">urn:uuid:c23b48b3-b72d-44f0-bfb9-4d990354162c</a:RelatesTo>
    <o:Security s:mustUnderstand="1" xmlns:o="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss
      <u:Timestamp u:Id="uuid-41b40d61-b9da-4633-8f28-efe46a6badce-23">
        <u:Created>2008-04-29T19:50:28.282Z</u:Created>
        <u:Expires>2008-04-29T19:55:28.282Z</u:Expires>
      </u:Timestamp>
      <c:DerivedKeyToken u:Id="uuid-41b40d61-b9da-4633-8f28-efe46a6badce-19" xmlns:c="http://schema
```

Besides testing operations, you can also look at the configuration settings of the web service. Just double-click on **Config File** from the left-side panel and the configuration file will be displayed in the right-side panel. This will show you the bindings for the service, the addresses of the service, and the contract for the service.

[What you see here for the configuration file is not an exact image of the actual configuration file. It hides some information, such as debugging mode and service behavior, and includes some additional information on reliable sessions and compression mode.]



```
<?xml version="1.0" encoding="utf-8"?>
<configuration>
  <system.serviceModel>
    <bindings>
      <wsHttpBinding>
        <binding name="WSHttpBinding_IProductService" closeTimeout="00:01:00"
          openTimeout="00:01:00" receiveTimeout="00:10:00" sendTimeout="00:01:00"
          bypassProxyOnLocal="false" transactionFlow="false" hostNameComparisonMode="StrongWildc
          maxBufferPoolSize="524288" maxReceivedMessageSize="65536"
          messageEncoding="Text" textEncoding="utf-8" useDefaultWebProxy="true"
          allowCookies="false">
          <readerQuotas maxDepth="32" maxStringContentLength="8192" maxArrayLength="16384"
            maxBytesPerRead="4096" maxNameTableCharCount="16384" />
          <reliableSession ordered="true" inactivityTimeout="00:10:00"
            enabled="false" />
          <security mode="Message">
            <transport clientCredentialType="Windows" proxyCredentialType="None"
              realm="" />
            <message clientCredentialType="Windows" negotiateServiceCredential="true"
              algorithmSuite="Default" establishSecurityContext="true" />
          </security>
        </binding>
      </wsHttpBinding>
    </bindings>
    <client>
      <endpoint address="http://localhost:8080/Design_Time_Addresses/MyWCFServices/RealNorthwind
        binding="wsHttpBinding" bindingConfiguration="WSHttpBinding_IProductService"
        contract="IProductService" name="WSHttpBinding_IProductService">
```

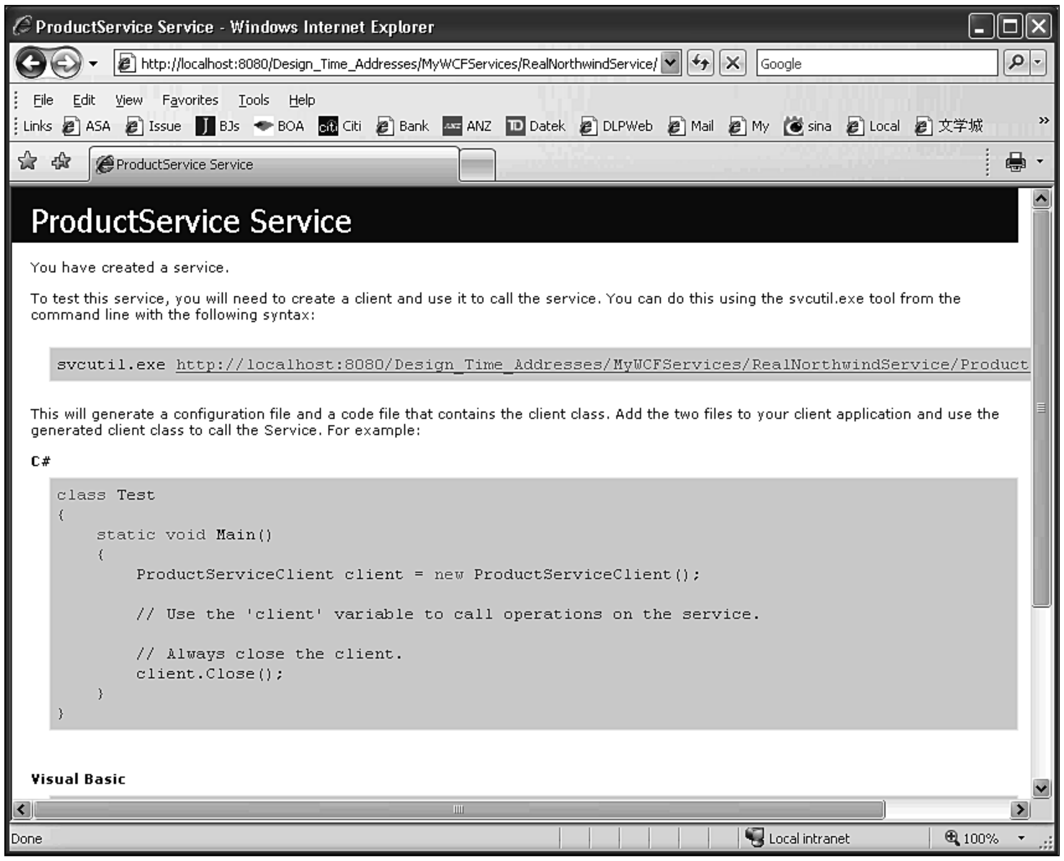
If you are satisfied with the test results, just close the WCF Test Client, and you will go back to Visual Studio IDE. Note that as soon as you close the client, the WCF Service Host is stopped. This is different from hosting a service inside the ASP.NET Development Server, where after you close the client, the ASP.NET Development Server still does not stop.

Testing the service using our own client

It is very convenient to test a WCF service using the built-in WCF Test Client, but sometimes, it is desirable to test a WCF service using your own test client. The built-in WCF Test Client is limited to only simple WCF services. So for complex WCF services, we have to create our own test client. For this purpose, we can use the methods we learned earlier, to host the WCF service in IIS, the ASP.NET Development Server, or a managed .NET application, and create a test client to test the service.

In addition to the previous methods we learned, we can also use the built-in WCF Service Host to host the WCF service. So we don't need to create a host application, but just need to create a client. In this section, we will use this hosting method, to save us some time.

First, let us find a way to get the Metadata for the service. From the Visual Studio 2008 built-in WCF Test Client, you can't examine the WSDL of the service, although the client itself must have used the WSDL to communicate with the service. To see the WSDL outside of the WCF Service Test Client, just copy the address of the service from the configuration file and paste it into a web browser. In our example, the address of the service is: `http://localhost:8080/Design_Time_Addresses/MyWCFServices/RealNorthwindService/ProductService/`. So, copy and paste this address to a web browser, and we will see the WSDL languages of the service, just as we have seen many times before.


ProductService Service - Windows Internet Explorer
http://localhost:8080/Design_Time_Addresses/MyWCFServices/RealNorthwindService/
Google
File Edit View Favorites Tools Help
Links ASA Issue BJs BOA Citi Bank ANZ Datek DLPWeb Mail My sina Local 文学城
ProductService Service
Done
Local intranet
100%

ProductService Service

You have created a service.

To test this service, you will need to create a client and use it to call the service. You can do this using the svcutil.exe tool from the command line with the following syntax:

```
svcutil.exe http://localhost:8080/Design_Time_Addresses/MyWCFServices/RealNorthwindService/Product
```

This will generate a configuration file and a code file that contains the client class. Add the two files to your client application and use the generated client class to call the Service. For example:

C#

```
class Test
{
    static void Main()
    {
        ProductServiceClient client = new ProductServiceClient();

        // Use the 'client' variable to call operations on the service.

        // Always close the client.
        client.Close();
    }
}
```

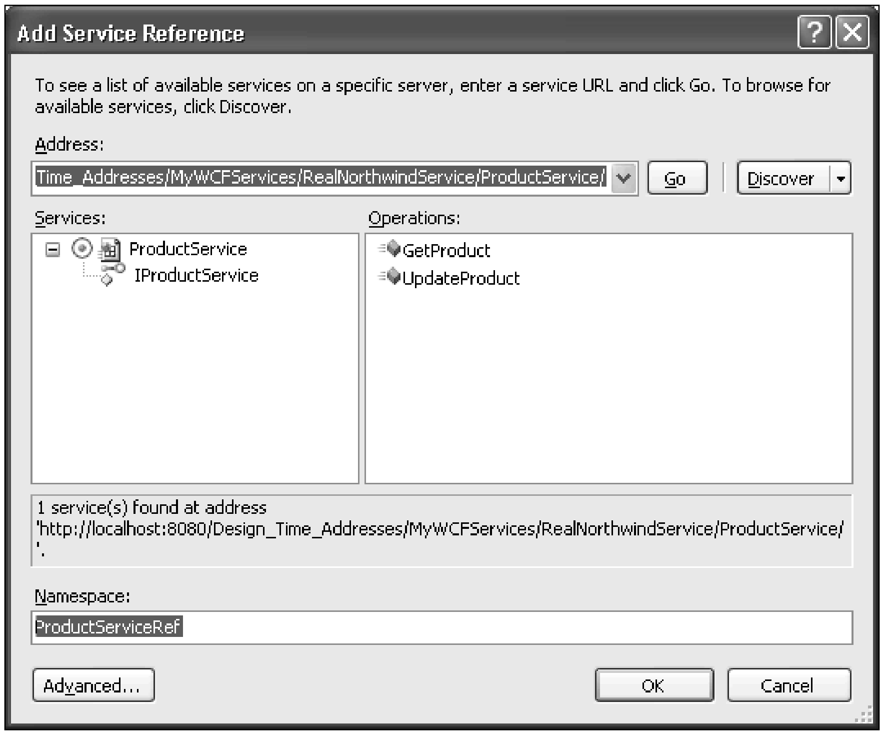
Visual Basic

To get the Metadata for the service, the service host application must run. The easiest way to start the `RealNorthwindService` in the WCF Service Host is to start the WCF Test Client and leave it running.

Now that we know how to get the Metadata for our service, we can start building the test client. We can leave the host application running, and manually generate the proxy classes using the same method that we used earlier. But this time we will let Visual Studio do it for us. So you can close the WCF Test Client for now.

Follow these steps to build your own client to test the WCF service:

1. Add a new **Console Application** project to the `RealNorthwind` solution. Let's call it `RealNorthwindClient`.
2. Add a reference to the WCF service. In the Visual Studio Solution Explorer, right-click on the **RealNorthwindClient** project, select **Add Service Reference ...** from the context menu, and you will see the **Add Service Reference** dialog box.



Add Service Reference

To see a list of available services on a specific server, enter a service URL and click Go. To browse for available services, click Discover.

Address: Time_Addresses/MyWCFServices/RealNorthwindService/ProductService/

Services: ProductService, IProductService

Operations: GetProduct, UpdateProduct

1 service(s) found at address 'http://localhost:8080/Design_Time_Addresses/MyWCFServices/RealNorthwindService/ProductService/'.

Namespace: ProductServiceRef

3. In the **Add Service Reference** dialog box, type the following address into the **Address** box, and then click the **Go** button to connect to the service:

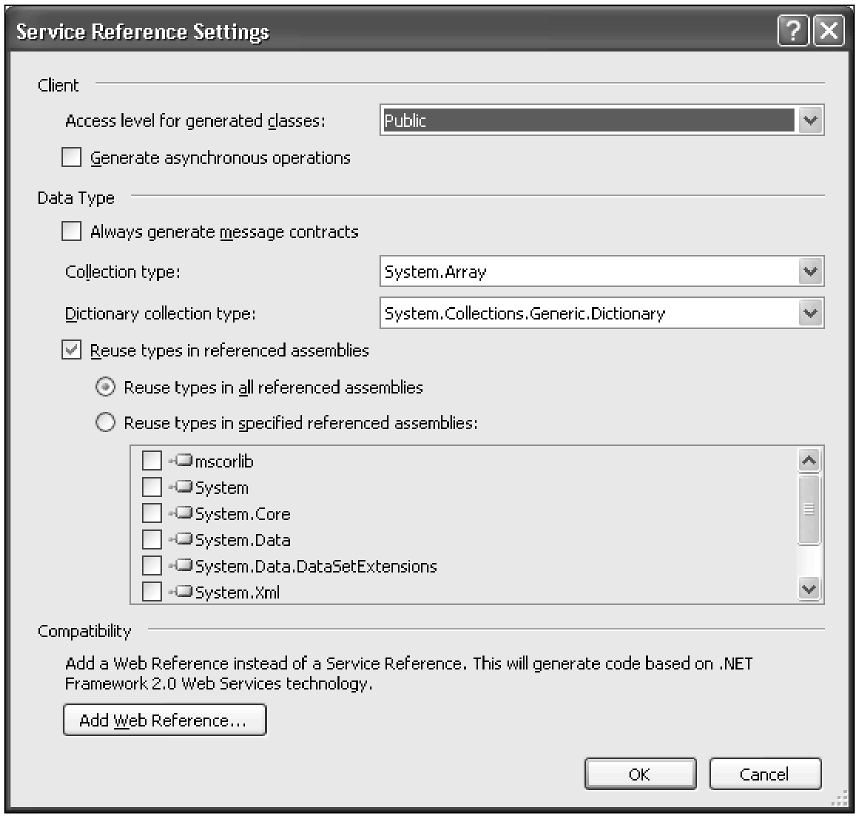
   ```
   http://localhost:8080/Design_Time_Addresses/MyWCFServices/
   RealNorthwindService/ProductService/
   ```

   Also, you can simply click the **Discover** button (or click on the little arrow next to the **Discover** button, and select **Services in Solution**) to find this service.

In order to connect to or discover a service in the same solution, you don't have to start the host application for the service. The WCF Service Host will be automatically started for this purpose. However, if it is not started in advance, it may take a while for the **Add Service Reference** window to download the required Metadata information for the service.

The `ProductService` should now be listed on the left-hand side of the window. You can expand it and select the service contract to view its details.

4. Next, let's change the namespace of this service from `ServiceReference1` to `ProductServiceRef`. This will make the reference meaningful in the code.
5. If you want to make this client run under .NET 2.0, click the **Advanced** button in the **Add Service Reference** window, and in the **Service Reference Settings** pop-up dialog box, click the **Add Web Reference** button. This will cause the proxy code will be generated based on the .NET 2.0 web services.


Service Reference Settings

Client

Access level for generated classes: Public

☐ Generate asynchronous operations

Data Type

☐ Always generate message contracts

Collection type: System.Array

Dictionary collection type: System.Collections.Generic.Dictionary

☑ Reuse types in referenced assemblies

◉ Reuse types in all referenced assemblies

○ Reuse types in specified referenced assemblies:

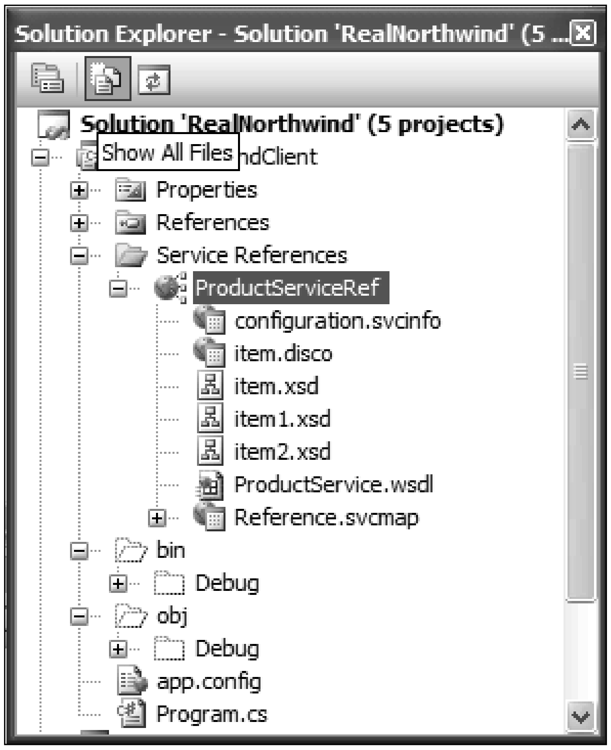
☐ mscorlib
☐ System
☐ System.Core
☐ System.Data
☐ System.Data.DataSetExtensions
☐ System.Xml

Compatibility

Add a Web Reference instead of a Service Reference. This will generate code based on .NET Framework 2.0 Web Services technology.

In this example, we won't do this. So, click the **Cancel** button to discard these changes.

6. Now click the **OK** button in the **Add Service Reference** dialog box to add the service reference. You will see that a new folder, named **ProductServiceRef**, is created under **Service References** in the Solution Explorer for the **RealNorthwindClient** project. This folder contains lots of files, including the WSDL file, the service map, and the actual proxy code. If you can't see them, click **Show All Files** in the Solution Explorer.



A new file, `App.config`, is also added to the project, as well as several WCF-related references such as `System.ServiceModel` and `System.Runtime.Serialization`.

At this point, the proxy code to connect to the WCF service and the required configuration file have both been created and added to the project for us, without us having to enter a single line of code. What we need to do next is to write just a few lines of code to call this service.

Just as we did earlier, we will modify `Program.cs` to call the WCF service.

1. First, open `Program.cs` file, and add the following `using` line to the file:

   ```
   using RealNorthwindClient.ProductServiceRef;
   ```

2. Then, inside the `Main` method, add the following line of code to create a client object:

   ```
   ProductServiceClient client = new ProductServiceClient();
   ```

3. Finally, add the following lines to the file, to call the WCF service to get and update a product:

   ```
   Product product = client.GetProduct(23);
   product.UnitPrice = (decimal)20.0;
   bool result = client.UpdateProduct(product);
   ```

The content of the `Program.cs` file is:

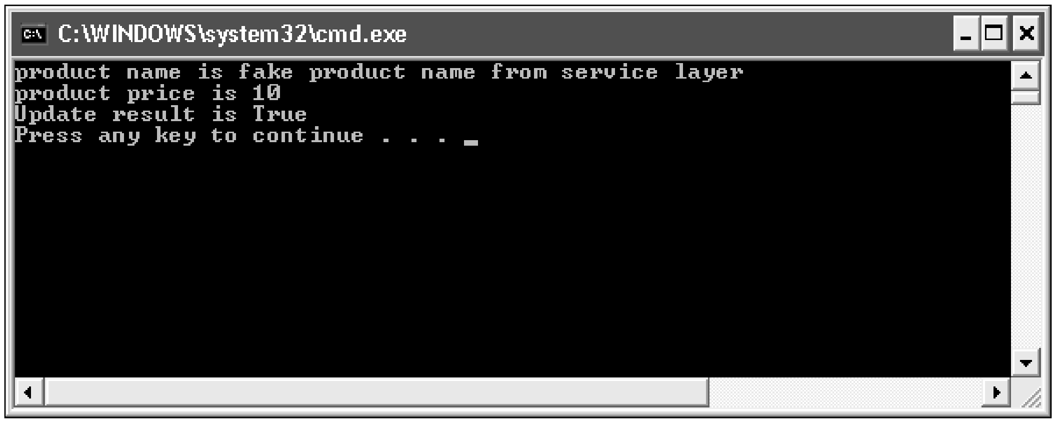
```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using RealNorthwindClient.ProductServiceRef;

namespace RealNorthwindClient
{
    class Program
    {
        static void Main(string[] args)
        {
            ProductServiceClient client = new ProductServiceClient();

            Product product = client.GetProduct(23);
            Console.WriteLine("product name is " +
                              product.ProductName);
            Console.WriteLine("product price is " +
                         product.UnitPrice.ToString());

            product.UnitPrice = (decimal)20.0;
            bool result = client.UpdateProduct(product);
            Console.WriteLine("Update result is " +
                                result.ToString());
        }
    }
}
```

Now you can run the client application to test the service. Remember that you need to set `RealNorthwindClient` to be the startup project before pressing *F5* or *Ctrl+F5*.

If you want to start it in debugging mode (*F5*), you need to add a `Console.ReadLine();` statement to the end of the program, so that you can see the output of the program. The WCF Service Host application will be started automatically before the client is started (but the WCF Test Client won't be started).

If you want to start the client application in non-debugging mode (*Ctrl+F5*), you need to start the WCF Service Host application (and the WCF Test Client application) in advance. You can start it from another Visual Studio IDE instance, or you can set the `RealNorthwindService` as the startup project, start it in the non-debugging mode (*Ctrl+F5*), leave it running, and then change `RealNorthwindClient` to be the startup project, and start it in non-debugging mode. Also, you can set the solution to start with multiple projects with the `RealNorthwindService` as the first project to be run, and `RealNorthwindClient` as the second project to be run.

The output of this client program is as shown in the following figure:



```
product name is fake product name from service layer
product price is 10
Update result is True
Press any key to continue . . .
```

Adding a business logic layer

Until now, the web service has contained only one layer. In this section, we will add a business logic layer, and define some business rules in this layer.

Adding the product entity project

Before we add the business logic layer, we need to add a project for business entities. The business entities project will hold of all business entity object definitions such as products, customers, and orders. These entities will be used across the business logic layer, the data access layer and the service layer. They will be very similar to the data contracts we defined in the previous section, but will not be seen outside of the service. The Product entity will have the same properties as the product contract data, plus some extra properties such as `UnitsInStock` and `ReorderLevel`. These properties will be used internally, and shared by all layers of the service. For example, when an order is placed, the `UnitsInStock` should be updated as well. Also, if the updated `UnitsInStock` is less than the `ReorderLevel`, an event should be raised to trigger the re-ordering process.

The business entities by themselves do not act as a layer. They are just pure C# classes representing internal data within the service implementations. There is no logic inside these entities. Also, in our example these entities are very similar to the data contracts (with only two extra fields in the entity class), but in reality the entity classes could be very different from the data contracts, from property names and property types, to data structures.

As with the data contracts, the business entities' classes should be in their own assembly. So, we first need to create a project for them. Just add a new C# class library, `RealNorthwindEntities`, to the Solution. Then, rename the `Class1.cs` to `ProductEntity.cs`, and modify it as follows:

1. Change its namespace from `RealNorthwindEntities` to `MyWCFServices.RealNorthwindEntities`
2. Change the class name from `Class1` to `ProductEntity`, if it hasn't been changed already
3. Add the following properties to this class:

   `ProductID, ProductName, QuantityPerUnit, UnitPrice, Discontinued, UnitsInStock, UnitsOnOrder, ReorderLevel`

Five of the above properties are also in the `Product` service data contract. The last three properties are for use inside the service implementations. Actually, we will use `UnitsOnOrder` to trigger business logic when updating a product, and update `UnitsInStock` and `ReorderLevel` to trigger business logic when saving an order (inside this book, we will not create a service for saving an order, but we assume that this is a required operation and will be implemented later).

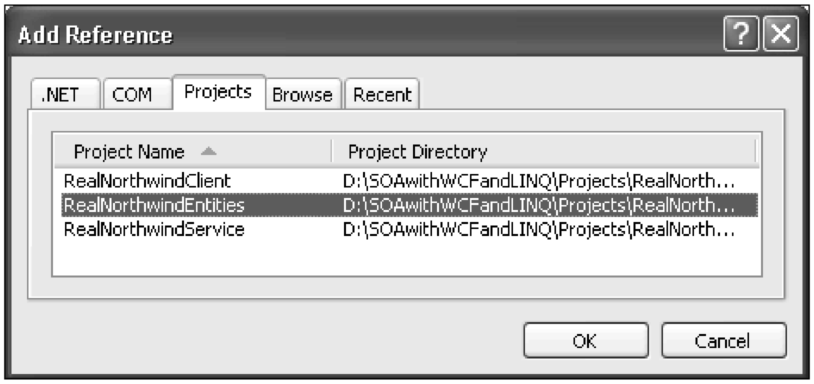
The following is the code list of the `ProductEntity` class:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
namespace MyWCFServices.RealNorthwindEntities
{
    public class ProductEntity
    {
           public int ProductID { get; set; }
           public string ProductName { get; set; }
           public string QuantityPerUnit { get; set; }
           public decimal UnitPrice { get; set; }
           public int UnitsInStock { get; set; }
           public int ReorderLevel { get; set; }
           public int UnitsOnOrder { get; set; }
           public bool Discontinued { get; set; }
    }
}
```

Adding the business logic project

Next, let us create the business logic layer project. Again, we just need to add a new C# class library project, `RealNorthwindLogic`, to the solution. So, rename the `Class1.cs` to `ProductLogic.cs`, and then modify it as follows:

1. Change its namespace from `RealNorthwindLogic` to `MyWCFServices.RealNorthwindLogic`
2. Change the class name from `Class1` to `ProductLogic`, if it hasn't been changed
3. Add a reference to the project `RealNorthwindEntities`, as shown in the following **Add Reference** image:



Project Name	Project Directory
RealNorthwindClient	D:\SOAwithWCFandLINQ\Projects\RealNorth...
RealNorthwindEntities	D:\SOAwithWCFandLINQ\Projects\RealNorth...
RealNorthwindService	D:\SOAwithWCFandLINQ\Projects\RealNorth...

Now, we need to add some code to the `ProductLogic` class.

1. Add the following `using` line:

```
using MyWCFServices.RealNorthwindEntities;
```

2. Add the method `GetProduct`. It should look like this:

```
public ProductEntity GetProduct(int id)
{
    // TODO: call data access layer to retrieve product
    ProductEntity p = new ProductEntity();
    p.ProductID = id;
    p.ProductName = "fake product name from business logic layer";
    p.UnitPrice = (decimal)20.00;
    return p;
}
```

   In this method, we create a `ProductEntity` object, assign values to some of its properties, and return it to the caller. Everything is still hard-coded so far.

We hard code the product name as "fake product name from business logic layer", so that we know this is a different product from the one returned directly from the service layer.

3. Add the method `UpdateProduct`, as follows:

```
public bool UpdateProduct(ProductEntity product)
{
    // TODO: call data access layer to update product
    // first check to see if it is a valid price
    if (product.UnitPrice <= 0)
        return false;
    // ProductName can't be empty
    else if (product.ProductName == null || product.ProductName.
                                                       Length == 0)
        return false;
    // QuantityPerUnit can't be empty
    else if (product.QuantityPerUnit == null || product.
                            QuantityPerUnit.Length == 0)
        return false;
    // then validate other properties
    else
    {
        ProductEntity productInDB = GetProduct(product.ProductID);
        // invalid product to update
        if (productInDB == null)
            return false;
        // a product can't be discontinued if there are
              non-fulfilled orders
        if (product.Discontinued == true && productInDB.
              UnitsOnOrder > 0)
            return false;
        else
            return true;
    }
}
```

4. Add test logic to the `GetProduct` method

   We still haven't updated anything in a database, but this time, we have added several pieces of logic to the `UpdateProduct` method. First, we check the validity of the `UnitPrice` property, and return `false` if it is not a valid one. We then check the product name and quantity per unit properties, to make sure they are not empty. We then try to retrieve the product, to see if it is a valid product to update. We also added a check to make sure that a supplier can't discontinue a product if there are unfulfilled orders for this product. However, at this stage, we can't truly enforce this logic, because when we check the `UnitsOnOrder` property of a product, it is always 0 as we didn't assign a value to it in the `GetProduct` method. For test purposes, we can change the `GetProduct` method to include the following line of code:

   ```
   if(id > 50) p.UnitsOnOrder = 30;
   ```

   Now, when we test the service, we can select a product with an ID that is greater than 50, and try to update its `Discontinued` property to see what result we will get.

After you put all of this together, the content of the `ProductLogic.cs` file should be as follows:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using MyWCFServices.RealNorthwindEntities;
using MyWCFServices.RealNorthwindDAL;

namespace MyWCFServices.RealNorthwindLogic
{
    public class ProductLogic
    {
```

```
        public ProductEntity GetProduct(int id)
        {
            // TODO: call data access layer to retrieve product
            ProductEntity p = new ProductEntity();
            p.ProductID = id;
            p.ProductName =
                        "fake product name from business logic layer";
            //p.UnitPrice = (decimal)20.0;
            if(id > 50) p.UnitsOnOrder = 30;
            return p;
       }
        public bool UpdateProduct(ProductEntity product)
        {
            // TODO: call data access layer to update product
            // first check to see if it is a valid price
            if (product.UnitPrice <= 0)
                return false;
            // ProductName can't be empty
            else if (product.ProductName == null || product.
                                   ProductName.Length == 0)
                return false;
            // QuantityPerUnit can't be empty
            else if (product.QuantityPerUnit == null || product.
                                    QuantityPerUnit.Length == 0)
                return false;
            // then validate other properties
            else
            {
                ProductEntity productInDB =
                                        GetProduct(product.ProductID);
                // invalid product to update
                if (productInDB == null)
                    return false;
                // a product can't be discontinued if there are
                   non-fulfilled orders
                else if (product.Discontinued == true && productInDB.
                   UnitsOnOrder > 0)
                    return false;
                else
                    return true;
            }
        }
    }
}
```

Calling the business logic layer from the service interface layer

We now have the business logic layer ready, and can modify the service contracts to call this layer, so that we can enforce some business logic.

First, we want to make it very clear that we are going to change the service implementations, and not the interfaces. So we will only change the `ProductService.cs` file.

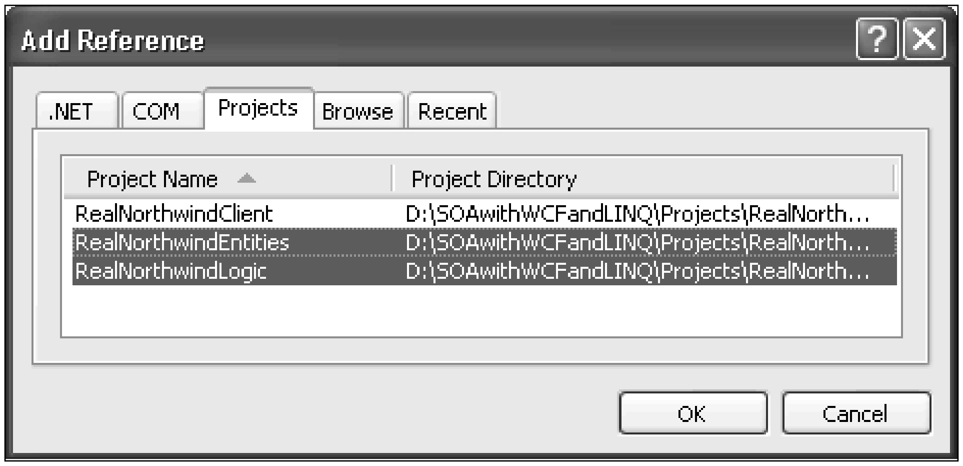
We will not touch the file `IProductService.cs`. All of the existing clients (if there are any) that are referencing our service will not notice that we are changing the implementation.

Follow these steps to customize the service interface layer:

1. Add a reference to the business logic layer.

   In order to call a method inside the business logic layer, we need to add a reference to the assembly that the business logic is included in. We will also use the `ProductEntity` class. So we need a reference to the `RealNorthwind-Entities` as well.

   To add a reference, from the Solution Explorer, right-click on the project **RealNorthwindService**, select **Add Reference ...** from the context menu, and select **RealNorthwindLogic** from the **Projects** tab. Also, select `RealNorth-windEntities` as we will need a reference to the `ProductEntity` inside it. Just hold down the *Ctrl* key while you are selecting multiple projects. Click the **OK** button to add references to the selected projects.



Project Name	Project Directory
RealNorthwindClient	D:\SOAwithWCFandLINQ\Projects\RealNorth...
RealNorthwindEntities	D:\SOAwithWCFandLINQ\Projects\RealNorth...
RealNorthwindLogic	D:\SOAwithWCFandLINQ\Projects\RealNorth...

2. Now we have added two references. We can add the following two `using` statements to the `ProductService.cs` file so that we don't need to type the full names for their classes.

```
using MyWCFServices.RealNorthwindEntities;
using MyWCFServices.RealNorthwindLogic;
```

3. Now, inside the `GetProduct` method, we can use the following statements to get the product from our business logic layer:

```
ProductLogic productLogic = new ProductLogic();
ProductEntity product = productLogic.GetProduct(id);
```

4. However, we cannot return this product back to the caller, because this product is of the type `ProductEntity`, which is not the type that the caller is expecting. The caller is expecting a return value of the type `Product`, which is a data contract defined within the service interface. We need to translate this `ProductEntity` object to a `Product` object. To do this, we add the following new method to the `ProductService` class:

```
    private void TranslateProductEntityToProductContractData(
        ProductEntity productEntity,
        Product product)
    {
        product.ProductID = productEntity.ProductID;
        product.ProductName = productEntity.ProductName;
        product.QuantityPerUnit = productEntity.QuantityPerUnit;
        product.UnitPrice = productEntity.UnitPrice;
        product.Discontinued = productEntity.Discontinued;
    }
```

Inside this translation method, we copy all of the properties from the `ProductEntity` object to the service contract data object, but not the last three properties—`UnitsInStock`, `UnitsOnOrder`, and `ReorderLevel`. These three properties are used only inside the service implementations. Outside callers cannot see them at all.

The `GetProduct` method should now look like this:

```
public Product GetProduct(int id)
{
    ProductLogic productLogic = new ProductLogic();
    ProductEntity productEntity = productLogic.GetProduct(id);
    Product product = new Product();
    TranslateProductEntityToProductContractData
                        (productEntity, product);
    return product;
}
```

We can modify the `UpdateProduct` method in the same way, making it like this:

```
public bool UpdateProduct(Product product)
{
    ProductLogic productLogic = new ProductLogic();
    ProductEntity productEntity = new ProductEntity();
    TranslateProductContractDataToProductEntity(
                         product, productEntity);
    return productLogic.UpdateProduct(productEntity);
}
```

5. Note that we have to create a new method to translate a product contract data object to a `ProductEntity` object. In translation, we leave the three extra properties unassigned in the `ProductEntity` object, because we know a supplier won't update these properties. Also, we have to create a `ProductLogic` variable in both the methods, so that we can make it a class member:

```
ProductLogic productLogic = new ProductLogic();
```

The final content of the `ProductService.cs` file is as follows:

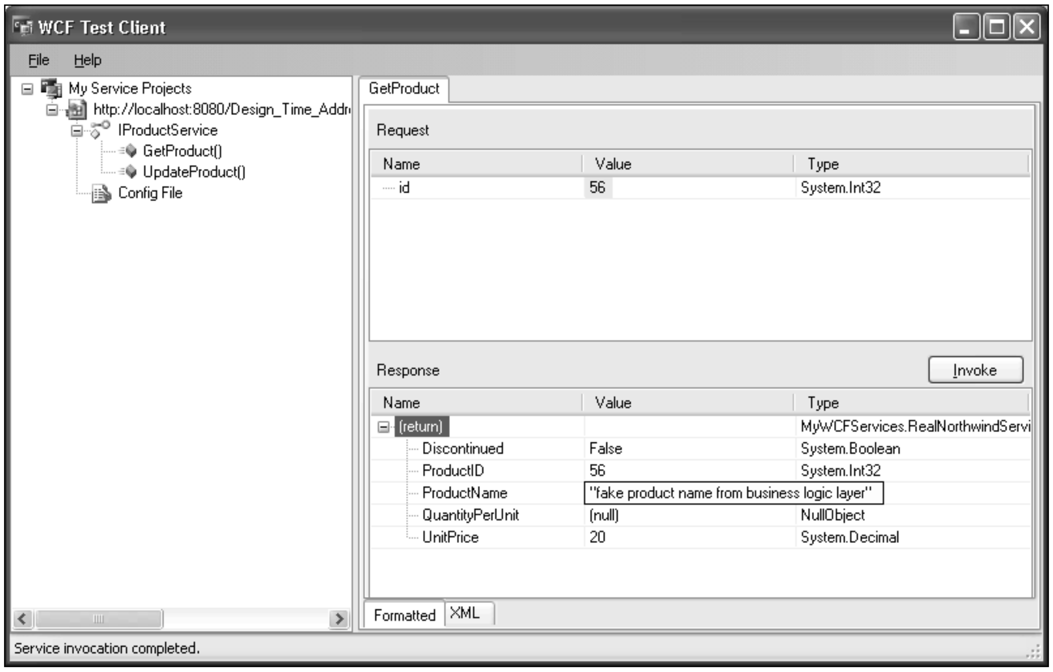
```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Runtime.Serialization;
using System.ServiceModel;
using System.Text;
using MyWCFServices.RealNorthwindEntities;
using MyWCFServices.RealNorthwindLogic;

namespace MyWCFServices.RealNorthwindService
{
    // NOTE: If you change the class name "Service1" here, you must
       also update the reference to "Service1" in App.config.
    public class ProductService : IProductService
    {
        ProductLogic productLogic = new ProductLogic();

        public Product GetProduct(int id)
        {
            /*
            // TODO: call business logic layer to retrieve product
            Product product = new Product();
            product.ProductID = id;
            product.ProductName =
                               "fake product name from service layer";
            product.UnitPrice = (decimal)10.0;
            */
            ProductEntity productEntity = productLogic.GetProduct(id);
            Product product = new Product();
            TranslateProductEntityToProductContractData(
                                productEntity, product);
            return product;
        }
        public bool UpdateProduct(Product product)
        {
            /*
            // TODO: call business logic layer to update product
            if (product.UnitPrice <= 0)
                return false;
            else
                return true;
            */
            ProductEntity productEntity = new ProductEntity();
            TranslateProductContractDataToProductEntity(
                                product, productEntity);
            return productLogic.UpdateProduct(productEntity);
        }
        private void TranslateProductEntityToProductContractData(
            ProductEntity productEntity,
            Product product)
        {
            product.ProductID = productEntity.ProductID;
            product.ProductName = productEntity.ProductName;
            product.QuantityPerUnit = productEntity.QuantityPerUnit;
            product.UnitPrice = productEntity.UnitPrice;
            product.Discontinued = productEntity.Discontinued;
        }
        private void TranslateProductContractDataToProductEntity(
            Product product,
            ProductEntity productEntity)
        {
            productEntity.ProductID = product.ProductID;
            productEntity.ProductName = product.ProductName;
            productEntity.QuantityPerUnit = product.QuantityPerUnit;
            productEntity.UnitPrice = product.UnitPrice;
            productEntity.Discontinued = product.Discontinued;
        }
    }
}
```

Testing the WCF service with a business logic layer

We can now compile and test the new service with a business logic layer. We will use the WCF Test Client to simplify the process.

1. Make the project `RealNorthwindService` the startup project
2. Start the WCF Service Host application and WCF Service Test Client, by pressing *F5* or *Ctrl+F5*
3. In the WCF Service Test Client, double-click on the `GetProduct` operation, to bring up the `GetProduct` test screen
4. Enter a value of 56 for the ID field and then click the **Invoke** button

   You will see that this time the product is returned from the business logic layer, instead of the service layer. Also, note that the `UnitsOnOrder` property is not displayed as it is not part of the service contract data type. However, we know that a product has a property `UnitsOnOrder`, and we will actually use this for our next test.



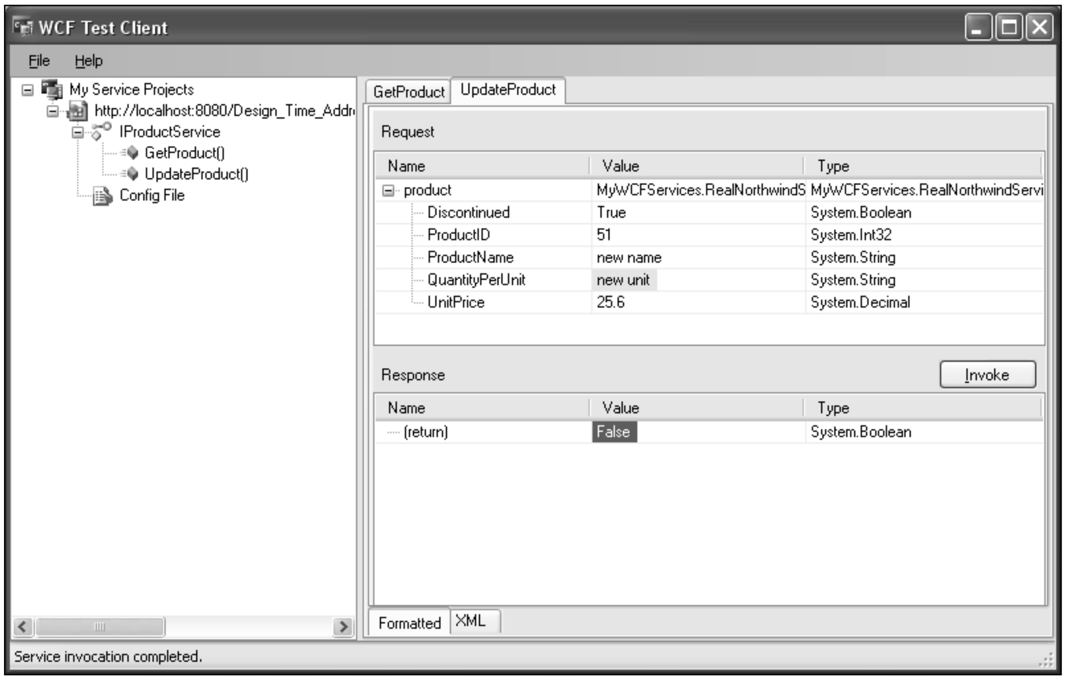
Name	Value	Type
id	56	System.Int32

Name	Value	Type
(return)		MyWCFServices.RealNorthwindServi
Discontinued	False	System.Boolean
ProductID	56	System.Int32
ProductName	"fake product name from business logic layer"	
QuantityPerUnit	(null)	NullObject
UnitPrice	20	System.Decimal

Service invocation completed.

Now, let us try to update a product.

1. In the WCF Service Test Client, double-click on the `UpdateProduct` operation to bring up the `UpdateProduct` test screen.
2. Enter **-10** as the price, and click the **Invoke** button. You will see that the **Response** result is **False**.
3. Enter a valid price, say **25.60**, a name, and a quantity per unit, leave the **Discontinued** property set to `False`, and then click the **Invoke** button. You will see that the **Response** result is now **True**.
4. Change the **Discontinued** value from `False` to `True`, and click the **Invoke** button again. The **Response** result is still **True**. This is because we didn't change the product ID, and it has defaulted to 0.
5. Change the product ID to **51**, leave the **Discontinued** value as **True** and product price as **25.60**, and click the **Invoke** button again. This time, you will see that the **Response** result is **False**. This is because the business logic layer has checked the `UnitsOnOrder` and `Discontinued` properties, and didn't allow us to make the update.



Name	Value	Type
product	MyWCFServices.RealNorthwindS	MyWCFServices.RealNorthwindServi
Discontinued	True	System.Boolean
ProductID	51	System.Int32
ProductName	new name	System.String
QuantityPerUnit	new unit	System.String
UnitPrice	25.6	System.Decimal

Name	Value	Type
(return)	False	System.Boolean

Service invocation completed.

Summary

In this chapter, we have created a real world WCF service that has a service contract layer, and a business logic layer. The key points in this chapter include:

- WCF Services should have explicit boundaries
- The WCF Service Application template can be used to create WCF services with a hosting web site created within the project
- The WCF Service Library template can be used to create WCF services that will be hosted by the WCF Service Host, and these can be tested using the WCF service Test Client
- The service interface layer should contain only the service contracts, such as the operation contracts, and data contracts
- The business logic layer should contain the implementation of the service
- The business entities represent the internal data of the service shared by all of the layers of the service, and they should not be exposed to the clients