ASP.NET Web Services and Web Clients

Web Services Overview

- The World Wide Web has opened up the possibility of large-scale **distributed computing**
- Web Applications only allow interaction between a client browser and web server hosting a web page
- Web Services create web-based apps that interact with other apps running on other computers
  - A Web Application is intended for viewing by a person using a browser
  - Web Service: a program with which any other program can interact. Web Server program has no user interface
  - Web Client: a program that consumes (uses, interacts with) a web service
    - Could be a Web Form, a Windows Form, or even a command line application
    - The web client usually has some sort of user interface

Some Example of Web Services

- There are lots of them out there
- http://seekda.com has a great Web Services search engine
- Microsoft's TerraService
  - Provides a programmatic interface to a massive database of geographic data
    - http://terraservice.net
- When you build a web client with Visual Studio, the "Add Web Reference" Browser tool can be used to find more online services
  - UDDI (Universal Description Discovery Integration) Directories

ASP.NET Web Services

- Before ASP.NET, distributed computing was highly dependent on OS and language
- ASP.NET web services and clients are entirely independent of either
  - Could have a web service written in VB running on Windows 2000 consumed by a web client written in C++ running on a UNIX box
- What is needed?
  - Both client and server must use industry standard protocols
    - SOAP – Simple Object Access Protocol: a lightweight object-oriented communication protocol based on XML
    - XML – the language of SOAP
      - An extension of HTML

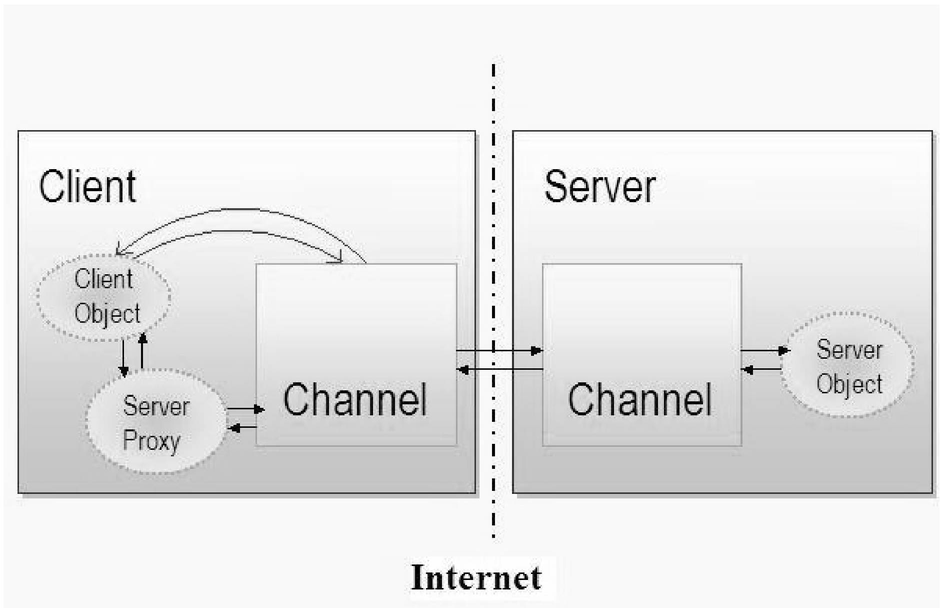
How Web Services Work

- A web service contains one or more functions or methods called over the internet
  - Clients call exposed methods of the web service using standard internet protocols
  - Both client and server must be connected to the internet
  - Methods are invoked by HTTP requests
  - Data format used for requests is usually SOAP
    - Self-describing text-based XML documents
    - Only requirement is that both server & client be able to send & receive messages that conform to the proper protocol standard

Sequence of Events

- Client makes a call to the web service method
  - It appears as though it's talking directly to the web service over the internet
  - But the actual call is being made to a "proxy class" local to the client
    - Proxy is a substitute or stand-in for the actual code to be called
    - An object that provides a local representation of a remote service
    - It's really a DLL that handles all the complexities of encoding & sending requests over the internet and getting responses back
    - It "marshalls" the call to exposed methods across the internet
    - <u>Proxy class object must be created by the client app</u>
      - Done by Visual Studio when you create a "web reference"
      - Actually it's done by the Wsdl.exe (Web Services Description Language) utility program

Web Service/Client Interaction



Writing Web Services

- Hand Code
  - Difficult to parse HTTP/SOAP/XML requests and generate HTTP/SOAP/XML responses
- Use the .NET Framework
  - Easy: ASP.NET does most of the work for you
  - Managed apps ✍ fewer runtime errors
  - Store code in a .asmx file
  - .asmx file begins with <@ WebService…> directive
    - Must identify a Class encapsulating the web service
    - Class definition has a [WebService…] attribute to assign a name and description of the service
    - Each class method has a [WebMethod…] attribute that describes the functionality of the method
  - Can be done manually or with VS Designer

Manual Adding Web Service

```
<%@ WebService Language="C#" Class="AddService" %>
using System;
using System.Web.Services;

[WebService (Name="Add Service", Description="Adds two integers over Web")]
class AddService
{
    [WebMethod (Description="Computes sum of two integers")]
    public int Add(int a, int b)
    {
        return a+b;
    }
}
```

- Store this with a .asmx extension in the default IIS directory (c:\inetpub\wwwroot)
  – e.g., AddService.asmx

Testing the Web Service

- 1. Just call it up in a browser
  – http://localhost/AddService.asmx
  – ASP.NET responds to the HTTP request by generating an HTML page for the browser
    - Name and description of the service appear
    - Also the names of methods provided by the server that, when clic ked, allow the user to test them
    - Also a link to a WSDL (Web Services Description Language) XML document describing in detail the “service contract”
      – This is an HTML document with ?wsdl at the end of its URL
- 2. Or write a .NET client program to use the service
  – e.g., AddClient – a Windows Form application
  – Must add a Web Reference to the AddService.asmx web service
    - Proxy class is generated ASP.NET
  – And invoke its Add(…) method after instantiating the proxy class object

AddClient Code

```
localhost.AddService myaddservice = new localhost.AddService();
int z = myaddservice.Add(x, y);
```

Creating a Web Service w/ Visual Studio

- Using IIS (if not use the Visual Web Developer)
  - "File" | "New" | "Web Site" | "ASP.NET Web Service"
    - "Project Type": C#
    - "Location": HTTP, http://localhost/WebserviceName
      - Project directory will be put in the home (Inetpub\wwwroot) directory of your IIS server
  - Creates Service.asmx file
    - Executed by IIS
      - Gives access to the web service
      - Specifies the implementation class of the web service
  - And Service.cs file
    - contains skeleton C# code for the web service
    - Note the "WEB SERVICE EXAMPLE HelloWorld()"
      - Comment it out or remove it
    - Just add the methods you want the service to expose at that place in the Service.cs file
  - Change its name (Service) everywhere it appears:
    - class name, constructor, also twice in .asmx file
    - Also rename the two files

Example Web Service: ConvertTemperature

- Has temperature conversion methods ctf() and ftc():

```
[WebMethod (Description="Converts a Centigrade temperature to Fahrenheit")]
public float ctf(float ctemp)
{   return (1.8F * ctemp + 32.0F); }
[WebMethod (Description="Converts a Fahrenheit temperature to Centigrade")]
public float ftc(float ftemp)
{   return ((5F/9F)*(ftemp - 32.0F));  }
```

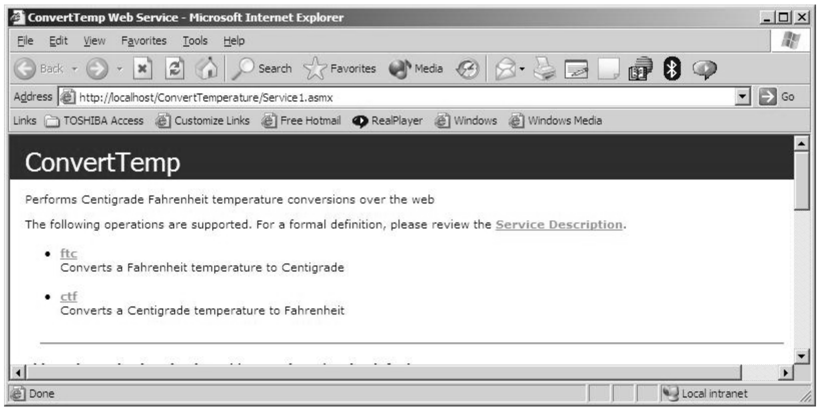
  - Note use of [WebMethod] attribute
    - Specifies that these methods are available to be used by web clients
    - Description will appear if service is tested in a browser
- Modify top line of file: the [WebService] attribute

```
[WebService (Namespace = "http://tempuri.org/", Name="ConvTemp2008", Description =
   "Performs Centigrade Fahrenheit temperature conversions over the web")]
```

    - tempuri: Temporary Uniform Resource Identifier (name)
    - Default namespace used by VS to distinguish this service from others on web
  - “Name” and “Description” will appear in the HTML page generated when user calls up the service in a browser
    - “Name” determines name of Proxy class created by client

Running and Testing the Web Service

- Run the Web Service from Visual Studio just as for any other application
  - “Debug” | “Start without debugging”
  - Brings up the following web page in your browser:


ConvertTemp Web Service - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://localhost/ConvertTemperature/Service1.asmx Go
Links TOSHIBA Access Customize Links Free Hotmail RealPlayer Windows Windows Media
Done
Local intranet

ConvertTemp

Performs Centigrade Fahrenheit temperature conversions over the web

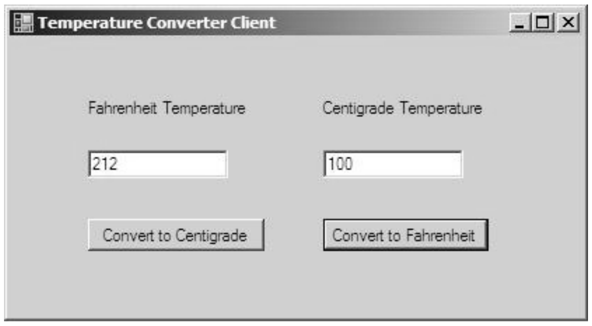
The following operations are supported. For a formal definition, please review the Service Description.

- ftc
  Converts a Fahrenheit temperature to Centigrade
- ctf
  Converts a Centigrade temperature to Fahrenheit

  - Clicking on ftc or ctf allows you to test the service’s methods

Creating a Web Client for the Service

- Can use Visual Studio to build a Windows Form or Web Form application to use the Web Service
- Example "ConvertTempClient"
  - A Windows Form app



  - User enters Fahrenheit or Centigrade temperature in a textbox
  - Presses appropriate button
  - Other textbox will contain the converted temperature

Using Visual Studio to Create a Web Client that consumes a Web Service on the local computer

- Start a Windows Application project as usual
- Drag the controls over to the form and rename them as usual
- Add a Web Reference:
  - In Solution Explorer, right click on References
  - Click on "Add Web Reference", or "Project | Add Web Reference"
    - "Add Reference Browser" page comes up
    - Select "Web Services on the Local Machine" and choose the ConvertTemp service
    - Click "Add Reference" button
  - A new "Web References" folder also was created
    - Contains a node name after the domain name where the Web service is
  - Also notice in Class View that under {} localhost, a ConvertTemp class has been added
    - This is the proxy class and contains the local representations of the ftc and ctf methods

Web Client Creation: Coding

- Double click the Convert Fahrenheit to Centigrade button and add the following button click event handler code

```
localhost.ConvTemp2008 obj = new localhost.ConvTemp2008();
string fstr = textBoxFahr.Text;
float ftemp = float.Parse(fstr);
float ctemp = obj.ftc(ftemp);
textBoxCent.Text = ctemp.ToString();
```

- Double click the Convert Centigrade to Fahrenheit button and add the following button click event handler code

```
localhost.ConvTemp2008 obj = new localhost.ConvTemp2008();
string cstr = textBoxCent.Text;
float ctemp = float.Parse(cstr);
float ftemp = obj.ctf(ctemp);
textBoxFahr.Text = ftemp.ToString();
```

- When you run the program, it will use the web service to perform the temperature conversions

Existing Web Services

- Example: Zip Code Distance calculator
  - http://teachatechie.com/GJTTWebServices/ZipCode.asmx
  - Its GetDistance( ) function takes the zip codes of two cities and computes the distance between them
  - There are many other functions provided by this web service
- We can use this or any other Web Services in our own Applications

A Zip Code Distance Client

- Creating a Web Client to use the “ZipCode” web service from teachatechie.com
  - Use Visual Studio to create a new C# Windows Application (e.g., ZipDistance2008)
  - Add a web reference:
    - In Solution Explorer right click on References and choose “Add Web Reference”
      - Or “Project” | “Add Web Reference”
    - http://teachatechie.com/GJTTWebServices/ZipCode.asmx in the URL Field
    - Scroll down to GetDistance function and click on it
      - Gives a dialog box in which you can test the function
      - Also gives SOAP request and response code containing data types
    - Click the “Add Reference” button
      - This adds new classes to the project (proxy classes):
        - » ZipDistance2008.com.teachatechie…

ZipDistance2008 User interface

- Drag over the following from the tool box:
  - Two text boxes (textBoxZip1, textBoxZip2)
  - Two label controls to label the text boxes
    - “First City Zip code”
    - “Second City Zip Code”
  - A label control to hold the computed distance (labelDistance)
  - A “Calculate Distance” button (buttonCalc)
- Add a button click event handler to the button

Coding the ZipDistance Application

– Add code to the button's click event handler to:

- retrieve the the zip codes entered by the user into the two textboxes
- Instantiate a ZipCode web service object
- call the ZipCode object's GetDistance(string, string) method
- set the labelDistance label control's Text property to the result (converted to a string):

```
private void buttonCalc_Click(object sender, System. EventArgs e)
{
    ZipDistance2008.com.teachatechie.ZipCode zd = new
            ZipDistance2008.com.teachatechie.ZipCode();
    string z1 = textBoxZip1.Text; string z2 = textBoxZip2.Text;
    decimal dist = zd.GetDistance(z1, z2);
    labelDistance.Text = dist.ToString();
}
```

– When you run it, you're using the remote web service