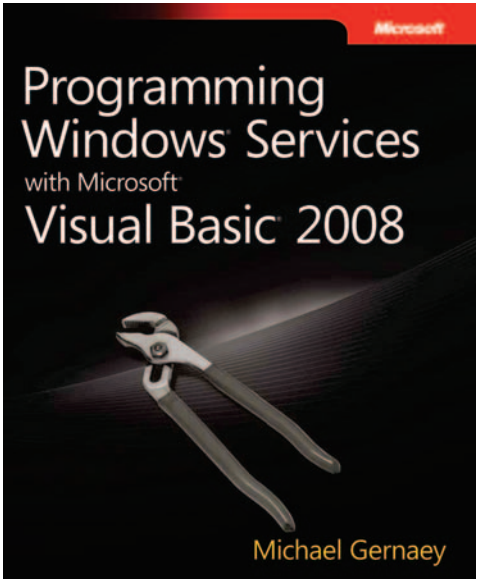

Programming Windows® Services with Microsoft® Visual Basic® 2008

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Chapter 10

Services That Listen

In this chapter:

Sometimes you need your service to be triggered by more than the generation of external data. Services also have the ability to wait for direct input, whether by listening on a Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Simple Network Management Protocols (SNMP), Named Pipes, MailSlots, or any other mechanism that allows for direct one-to-one or one-to-many communications.

You can design your service for more than just processing data. In some cases an end user or even another process needs to request data in real time. To do this, we have to design how the service will process incoming requests or monitor for incoming requests. Depending on how the request or connection is made, we need to set up our service listening protocols appropriate to that communication method. You'll need to decide whether to use static connections—such as a TCP connection—or a call/caller/callback method. For example, when a UDP request comes in, an acknowledgement might be sent, the data gathered, and then a call made from the service to the requester with either a static connection request or with a request for the original caller. Sometimes a request can come in that defines the information being requested and where and how it should be returned to the requester. Your service might be designed to accept a set of parameters from the caller that will determine the information requested, as well as the directory to store the data when the processing is completed. You can also provide security credentials, logon information, IP addresses, and any other information required to process the caller's request.

Listening with TCP/IP

When using TCP/IP to accept incoming connections and requests, you must account for several things before designing your service. These depend on the solution you are trying to build or the problem you are trying to resolve.

Design Points for Service Listeners

Many different types of service listeners are available. Whether the protocol is TCP, HTTP, UDP, FTP, or some custom variation, you need to consider some important questions before you start coding your service, including the following:

- Which server port (or list of ports) will requests come in on?
- How many active connections will you allow at one time?
- What type of security will you implement? Will you use network authentication, implied security, or clear-text authentication with user names and passwords stored in a secured place such as Microsoft SQL Server?
- If your service must perform actions on behalf of that caller, will it do so in the context of the caller, or in its own security context? Will your service have more or less security authorization than the caller?
- Will the connections be synchronous or asynchronous?
- Will connections have a time limit?
- Will each request from a caller require a new connection or can connections be static after a user is connected successfully?
- How will the service handle invalid connection attempts?
- In what format does the service expect the requests?
- What format will you use for communications between the service and the client?

Creating the First Listener Service

The preceding list shows some important characteristics of a service that you must carefully consider before design. In this section, we'll use a single server port to listen for connections. When connections arrive, they will be authenticated using a very simple, basic text authentication scheme. The user name and password will be hard-coded for now. When the connection is authenticated and a secondary socket has been created to service clients' requests, we'll wait for requests to come in from the client. All of these requests will be standard text-based requests with a standard delimiter. When the request comes in, the service will process the request and then return the information to the caller. After the caller acknowledges receipt of the information or the request times out, the connection will be dropped and the resources for that connection and any work it did will be cleaned up.

Coding the Service Listener

We'll continue with the code in Chapter 9, "Talking to the Internet." The code base gives us our standard service framework with the ability to start, stop, pause, continue, and shut down the service.

Adding a Configuration File

We need to add a configuration file that our application can use to create single or multiple listeners. In the first example, shown in Listing 10-1, we'll only use a single listener.

Listing 10-1 Configuration file schema.

```
<?xml version="1.0" encoding="utf-8" ?>
<Configuration>
  <Listeners>
    <Listener>
      <Port>15000</Port>
      <MaxConnections>1</MaxConnections>
    </Listener>
  </Listeners>
</Configuration>
```

The configuration file will allow us to have as many listeners as we want. The listeners themselves consist of the following two properties:

- *Port* represents the server side port to listen on. For most systems this is a number between 1 and 65,000. Ensure that the port you want to listen on is not already in use.
- *MaxConnections* represents how many client connections you can have at one time. Remember that connections do not stay connected on the server port that the client initially connected to. You have to create a server-side socket to hold the client's connection.

Creating a Listener Class

We need to create a class that can support multiple listeners. Although we won't be creating multiple services, we will be creating the ability for multiple entry points into this service. We could also extend our configuration file to include information that would tell the *Listener* class instance to do a specific task. If a single service could have multiple actions, you would want to have separate server ports, threads, and worker data for each possible action. You could optimize your service even more by separating the workload of each task that your service is capable of. Let's review our *Listener* class, shown in Listing 10-2.

Listing 10-2 The *Listener* class.

```
Imports System.Threading
Imports System.IO
Imports System.Text
Imports System.Net.Sockets
Imports System.Net
Imports System.ServiceProcess

Public Class Listener
    Public m_Incoming As Thread
    Private m_ThreadAction As ThreadActionState
    Private m_Listener As Socket = Nothing
    Private m_ClientSocket As Socket = Nothing
```

```
    Private m_MaxConnections As Integer
    Private m_Port As Integer

    Public Sub New(ByRef threadaction As ThreadActionState)
        m_ThreadAction = threadaction
    End Sub

    Public Sub Start()
        m_Incoming = New Thread(AddressOf StartListener)
        m_Incoming.Priority = ThreadPriority.Normal
        m_Incoming.IsBackground = True
        m_Incoming.Start()
    End Sub

    Private Sub StartListener()
        While Not m_ThreadAction.StopThread
            If Not m_ThreadAction.Pause Then
                Try
                    'We need to set up our Port listener and the ability
                    'to accept an incoming call.
                    Dim localEndPoint As IPEndPoint = Nothing

                    m_Listener = New Socket(AddressFamily.InterNetwork, _
                                  SocketType.Stream, ProtocolType.Tcp)

                    Dim ipHostInfo As IPHostEntry = Dns.GetHostEntry(Dns.GetHostName())
                    Dim ipAddress As IPAddress = ipHostInfo.AddressList(0)

                    localEndPoint = New IPEndPoint(ipAddress.Any, Me.Port)

                    m_Listener.Bind(localEndPoint)
                    m_Listener.Listen(Me.MaxConnections)

                    Dim bytes() As Byte = New [Byte](1024) {}

                    While True
    ' Program is suspended while waiting for an incoming connection.
                        m_ClientSocket = m_Listener.Accept

                        Dim Data As String = Nothing
                        Dim bError As Boolean = False
                        ' An incoming connection needs to be processed.
                        While True
                            Dim iStart As Long = Now.Ticks
                            'Create a Byte Buffer to receive data on.
                            bytes = New Byte(1024) {}

                            Dim bytesRec As Integer = _
                            m_ClientSocket.Receive(bytes)
                            Data += Encoding.ASCII.GetString(bytes, 0, _
                                                    bytesRec)

                            If ((Now.Ticks - iStart) / 10000000) > 30 Then
            'We have timed out based on a 30 second timeout
                                Try
```

```
                        m_ClientSocket.Shutdown(SocketShutdown.Both)
                                Catch ex As Exception
                                    'do nothing
                                End Try

                                Try
                                    m_ClientSocket.Close()
                                Catch ex As Exception
                                    'do nothing
                                End Try

                                Exit While
                            End If
   'if we have not timed out yet then let us   see if a command
                            'has come in and process it
                            If Data.IndexOf("<EOF>") > -1 Then
  'If we have found an EOF then we need to process that information
 'we could reset our timeout variable also if we have a command so it
                                'does not time out falsely
                                'Process the Command
                                Dim pszOut As String = Nothing

                                Try
                                    WriteLogEvent(Data, 15, _
                  EventLogEntryType.Information, My.Resources.Source)
                                    Call ProcessCommand(Data, pszOut)
                                    m_ClientSocket.Send(Encoding.ASCII.GetBytes(pszOut), _
                       Encoding.ASCII.GetBytes(pszOut).Length, SocketFlags.None)
                                Catch ex As Exception
                                    Exit While
                                End Try
                                'clean up
                                Try
m_ClientSocket.Shutdown(SocketShutdown.Both)
                                Catch ex As Exception
                                End Try

                                Try
                                    m_ClientSocket.Close()
                                Catch ex As Exception
                                End Try
                            End If

                            Exit While
                        End While
                    End While
                Catch nex As SocketException
               WriteLogEvent(My.Resources.ThreadErrorMessage + "_" + _
               nex.ToString + "_" + Now.ToString, THREAD_ERROR, _
                             EventLogEntryType.Error, My.Resources.Source)
                Catch tab As ThreadAbortException
               WriteLogEvent(My.Resources.ThreadAbortMessage + "_" + _
               tab.ToString + "_" + Now.ToString, THREAD_ABORT_ERROR, _
                      EventLogEntryType.Error, My.Resources.Source)
```

```
                Catch ex As Exception
                WriteLogEvent(My.Resources.ThreadErrorMessage + "_" + _
                   ex.ToString + "_" + Now.ToString, THREAD_ERROR, _
                   EventLogEntryType.Error, My.Resources.Source)
                End Try
            End If

            If Not m_ThreadAction.StopThread Then
                Thread.Sleep(THREAD_WAIT)
            End If
        End While

    End Sub

    Private Shared Sub WriteLogEvent(ByVal pszMessage As String, _
         ByVal dwID As Long, ByVal iType As EventLogEntryType, _
         ByVal pszSource As String)
        Try
            Dim eLog As EventLog = New EventLog("Application")
            eLog.Source = pszSource

  Dim eInstance As EventInstance = New EventInstance(dwID, 0, iType)
            Dim strArray() As String

            ReDim strArray(1)
            strArray(0) = pszMessage
            eLog.WriteEvent(eInstance, strArray)

            eLog.Dispose()
        Catch ex As Exception
            'Do not Catch here as it doesn't do any good for now
        End Try
    End Sub

    Private Function ProcessCommand(ByVal pszCommand As String, _
                  ByRef pszOut As String) As Boolean
        Try
            If pszCommand Is Nothing Then
                Return False
            End If

            'Get the Data and clear out our ending delimiter
            Try
                pszCommand = pszCommand.Remove(pszCommand.Length - 5,
                  "<EOF>".Length)
            Catch ex As Exception
                Return False
            End Try

            'Split the Command and find out which one we are doing
            Dim pszArray() As String = Split(pszCommand, "##")

            Select Case UCase(pszArray(0))
                Case "GETDATETIME"
                    pszOut = GetDateTime()
```

```
            Case "GETSERVICESTATUS"
                pszOut = GetServiceStatus(pszArray(1))
            Case "GETPROCESSLIST"
                pszOut = GetProcessList()
            Case Else
                pszOut = Nothing
                Return False
        End Select

        Return True
    Catch ex As Exception
        Return False
    End Try
End Function

Private Function GetDateTime() As String
    Try
        Return Now.ToString
    Catch ex As Exception
        Return Nothing
    End Try
End Function

Private Function GetServiceStatus(ByVal pszService As String) As String
    Try
        Dim tmpService As New ServiceController(pszService)
        Dim pszOut As String = Nothing

        Select Case tmpService.Status
            Case ServiceControllerStatus.ContinuePending
                pszOut = "ContinuePending"
            Case ServiceControllerStatus.Paused
                pszOut = "Paused"
            Case ServiceControllerStatus.PausePending
                pszOut = "PausePending"
            Case ServiceControllerStatus.Running
                pszOut = "Running"
            Case ServiceControllerStatus.StartPending
                pszOut = "StartPending"
            Case ServiceControllerStatus.Stopped
                pszOut = "Stopped"
            Case ServiceControllerStatus.StopPending
                pszOut = "StopPending"
            Case Else
                pszOut = "Unknown"
        End Select

        Try
            tmpService.Close()
            tmpService.Dispose()
            tmpService = Nothing
        Catch ex As Exception
            'Do nothing
        End Try
```

```
            Return pszOut
        Catch ex As Exception
            Return "Unknown"
        End Try
    End Function

    Private Function GetProcessList() As String
        Try
            Dim pszOut As String = Nothing
            Dim tmpProcesses() As Process = Process.GetProcesses
            Dim objProcess As Process
            For Each objProcess In tmpProcesses
                If pszOut Is Nothing Then
                    pszOut = objProcess.ProcessName
                Else
                    pszOut += "##" + objProcess.ProcessName
                End If
            Next

            objProcess = Nothing
            tmpProcesses = Nothing

            Return pszOut
        Catch ex As Exception
            Return Nothing
        End Try
    End Function

    Public Property Port() As Integer
        Get
            Return m_Port
        End Get
        Set(ByVal value As Integer)
            m_Port = value
        End Set
    End Property

    Public Property MaxConnections() As Integer
        Get
            Return m_MaxConnections
        End Get
        Set(ByVal value As Integer)
            m_MaxConnections = value
        End Set
    End Property

    Public ReadOnly Property Incoming() As Thread
        Get
            Return m_Incoming
        End Get
    End Property
End Class
```

The following sections review this code.

Listener Class Properties

Listener has two properties that we read from our configuration file. First is the *Port* property, which tells us which server port to use for this instance. Second is the *MaxConnections* property, which tells us how many clients can connect to this instance at one time. Each property must be set before the <*Start*> method of the class instance is called.

The <*StartListener*> Method

If you've never worked with sockets and TCP/IP before, it's especially important that you review this code.

The first thing I do is create an endpoint, shown in Listing 10-3. An endpoint defines the binding information used by the socket to bind to the local server and socket instance based on the port and server IP address.

Listing 10-3 Define local endpoint used by listener socket.

```
Dim localEndPoint As IPEndPoint = Nothing
```

Next I create a listener socket, shown in Listing 10-4. The listener socket waits on the endpoint for incoming requests.

Listing 10-4 Define listener socket used by service.

```
m_Listener = New Socket(AddressFamily.InterNetwork, _
                        SocketType.Stream, ProtocolType.Tcp)
```

I am using the standard TCP protocol. This indicates that I want to create a connection-based socket.

Next, as shown in Listing 10-5, I create the required *IPHostEntry* and *IPAddress* instances that are used by *IPEndPoint* to create the binding information for the listener socket. I use the *Dns.GetHostName* method to get the list of IP addresses of the local computer. I actually get back a list of IP addresses, but I only care about the first one. I could, of course, iterate through the list if I had multiple adapters and wanted to bind to a specific adapter.

Listing 10-5 Define listener socket attributes used to bind to server local port.

```
Dim ipHostInfo As IPHostEntry = Dns.GetHostEntry(Dns.GetHostName())
Dim ipAddress As IPAddress = ipHostInfo.AddressList(0)
localEndPoint = New IPEndPoint(ipAddress, Me.Port)
m_Listener.Bind(localEndPoint)
m_Listener.Listen(Me.MaxConnections)
```

Last, you will see that I use *IPEndPoint* to bind the listener socket, and then I use the *Socket.Listen* method to start listening for incoming connections. You should also notice that I am using the *MaxConnections* property from the configuration file to tell the listener how many client sockets can be connected at any time before it will return an unavailable connection error to the clients.

The <*StartListener*> Processing Loop

Once we have the service listener socket running, we are waiting for a client connection request. When a request comes in, we want to process that request. Let's review the code that does this, shown in Listing 10-6.

Listing 10-6 The <*StartListener*> processing loop.

```
Dim bytes() As Byte = New [Byte](1024) {}
While True
' Program is suspended while waiting for an incoming connection.
    m_ClientSocket = m_Listener.Accept

Dim Data As String = Nothing
Dim bError As Boolean = False
' An incoming connection needs to be processed.
    While True
Dim iStart As Long = Now.Ticks
'Create a Byte Buffer to receive data on.
        bytes = New Byte(1024) {}
Dim bytesRec As Integer = m_ClientSocket.Receive(bytes)
        Data += Encoding.ASCII.GetString(bytes, 0, bytesRec)
        If ((Now.Ticks - iStart) / 10000000) > 30 Then
'We have timed out based on a 30 second timeout
            Try
                m_ClientSocket.Shutdown(SocketShutdown.Both)
            Catch ex As Exception
            End Try

            Try
                m_ClientSocket.Close()
            Catch ex As Exception
            End Try
            Exit While
        End If
        If Data.IndexOf("<EOF>") > -1 Then
Dim pszOut As String = Nothing

            Try
                WriteLogEvent(Data, 15, EventLogEntryType.Information,
                              My.Resources.Source)
                Call ProcessCommand(Data, pszOut)
                m_ClientSocket.Send(Encoding.ASCII.GetBytes(pszOut),
                                    Encoding.ASCII.GetBytes(pszOut).Length,
                                    SocketFlags.None)
            Catch ex As Exception
                Exit While
            End Try
'clean up
            Try
                m_ClientSocket.Shutdown(SocketShutdown.Both)
            Catch ex As Exception
            End Try

            Try
                m_ClientSocket.Close()
```

```
            Catch ex As Exception
            End Try
        End If

        Exit While
    End While
End While
```

When a client connection request comes in, we use our single client socket and then use the listener socket's *accept* method to assign the client to the client socket. Then we begin an inner loop to receive the request from the client. In this case I am requiring a 30-second window for the client to send its request. If the request doesn't come within the allotted time, I consider a time-out has occurred, and then exit the loop and disconnect the client.

If the client does send its request in the time period allotted, I begin to peek the data and look for the <EOF>, which is required based on the communication specification for this client-server pair.

When I find the <EOF>, the data is read off into the allocated buffer and then sent to the <*ProcessCommand*> method. (I will go over this method shortly.) If the <*ProcessCommand*> call has no errors or issues, I use the client socket to send the response to the client, shut down the socket, close the socket, and then go back to listening for another connection request.

Listener Processing Methods

The *Listener* class has several processing methods that are used to parse, process, and respond to clients' requests. In our service, we support three separate requests. Each request is covered by a separate processing method. Each processing method is wrapped around the <*ProcessCommand*> function, which takes the request from the client, parses it, calls the processing method, and then returns the data to the <*StartListener*> thread.

The <*ProcessCommand*> Method

<*ProcessCommand*> is the main method used by our service. The service will use this wrapper method to determine the type of client request and then call the appropriate method to handle the gathering of the client's request. After the request is complete, the <*ProcessCommand*> method will return the data via a reference pointer to a string passed to it from the <*StartListener*> thread method. Each processing method will return back the appropriate string to <*ProcessCommand*>.

The <*GetDateTime*> Method

<*GetDateTime*> will return the current date and time of the local server. Although not an incredibly useful method, <*GetDateTime*> is good for demonstration purposes.

The <*GetServiceStatus*> Method

When <*GetServiceStatus*> is called, the user will pass in the short name of any service whose status it wants to validate. After this method is called, it will return the state of the requested service. In the case of an error, or if no service is found, <*GetServiceStatus*> will return an unknown status to the caller.

The <*GetProcessList*> Method

<*GetProcessList*> will return a comma-delimited list to the client of currently running processes on the server. The client can then parse the processes and get an alphabetized list of server processes.

Updating the <*Tutorials.ThreadFunc*> Method

We need to update the <*ThreadFunc*> method (as shown in Listing 10-7) so that we can read in the values from our configuration file.

Listing 10-7 The <*ThreadFunc*> method configuration code.

```
Private Sub ThreadFunc()
    Try
        'Load our Configuration File
        Dim Doc As XmlDocument = New XmlDocument()
        Doc.Load(My.Settings.ConfigFile)

        Dim Options As XmlNode
        'Get a pointer to the Outer Node
        Options = Doc.SelectSingleNode("//*[local-name()='Listeners']")

        If (Not Options Is Nothing) Then
            Dim tmpOptions As System.Xml.XPath.XPathNavigator = _
                        Options.FirstChild.CreateNavigator()

            If (Not tmpOptions Is Nothing) Then
                Dim children As System.Xml.XPath.XPathNavigator
                Do
                    Try
                        Dim tmpListener As New Listener(m_ThreadAction)

                        children = tmpOptions.SelectSingleNode("MaxConnections")
                        tmpListener.MaxConnections = Int32.Parse(children.Value)

                        children = tmpOptions.SelectSingleNode("Port")
                        tmpListener.Port = Int32.Parse(children.Value)

                        m_WorkerThreads.Add(tmpListener)
                        tmpListener.Start()
                    Catch ex As Exception
                        WriteLogEvent(ex.ToString(), CONFIG_READ_ERROR, _
                                      EventLogEntryType.Error, My.Resources.Source)
                    End Try
                Loop While (tmpOptions.MoveToNext)
```

```
            End If
        End If

    Catch ex As Exception
        WriteLogEvent(ex.ToString(), ONSTART_ERROR, _
                      EventLogEntryType.Error, My.Resources.Source)
        Me.Stop()
    End Try
End Sub
```

As with all our previous services, we need to be able to read in the values from the configuration file and then assign them to the properties of the class instance. In this case, we are assigning both the *MaxConnections* and *Port* properties to the *Listener* class instance. We can have as many instances as we want, and we can listen on practically an unlimited number of ports. I would recommend, however, that you don't use any ports below 1024 because these are usually associated with already existing applications or standards.

Updating the Tutorials <*OnStop*> Method

The service <*OnStop*> method needs to be updated to clean up the service threads properly for each class instance created, which is displayed in Listing 10-8.

Listing 10-8 The updated <*OnStop*> service method.

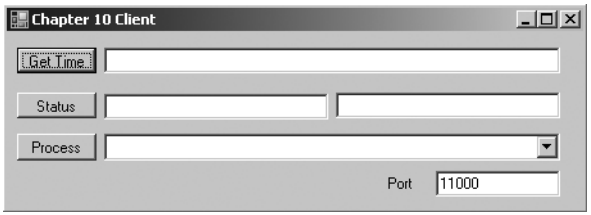
```
Protected Overrides Sub OnStop()
    ' Add code here to perform any tear-down necessary to stop your service.
    Try
        If (Not m_WorkerThread Is Nothing) Then
            Try
                WriteLogEvent(My.Resources.ServiceStopping, ONSTOP_INFO, _
                EventLogEntryType.Information, My.Resources.Source)

                m_ThreadAction.StopThread = True

                For Each listener As Listener In m_WorkerThreads
                    Me.RequestAdditionalTime(THIRTY_SECONDS)
                    Listener.Incoming.Join(TIME_OUT)
                Next
            Catch ex As Exception
                m_WorkerThread = Nothing
            End Try
        End If
    Catch ex As Exception
        'We Catch the Exception
        'to avoid any unhandled errors
        'since we are stopping and
        'logging an event is what failed
        'we will merely write the output
        'to the debug window
        m_WorkerThread = Nothing
        Debug.WriteLine("Error stopping service: " + ex.ToString())
    End Try
End Sub
```

Service Validation

To test the service, we need to connect to the service and call each of the processing methods to see what we get back. For this reason, I have created a client that can use the functionality of the service, whether it is remote or local. The important thing to realize is that we haven't yet implemented any type of authentication in the service, which means that anyone who has access to the server remotely would have access to call the functionality of the service. We will work on this in later chapters.

The Test Client

I have created a test client that looks like this and can be used to demonstrate the functionality of the service on any given port.



The code, which appears in Listing 10-9, is very simple, but shows how easily you can use your service. The three buttons do three different things: Each creates a Socket, calls <*GetDateTime*>, <*GetProcessList*>, or <*GetServiceStatus*>, and fills in the appropriate box with the response from the server. For the status, the first text box represents the service name, such as w3svc, and the second text box represents its status after you click the button and a response returns from the server.

Listing 10-9 Chapter 10 test client code.

```
Imports System.Text
Imports System.Net
Imports System.Net.Sockets

Public Class frmClient

    Private Sub Button1_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles getTime.Click
        Try
            Dim bytes(1024) As Byte
            Dim ipHostInfo As IPHostEntry = Dns.GetHostEntry(Dns.GetHostName())

            Dim ipAddress As IPAddress

            Dim sendersocket As New Socket(AddressFamily.InterNetwork, _
                    SocketType.Stream, ProtocolType.Tcp)
            Dim remoteEP As IPEndPoint

            For Each ipAddress In ipHostInfo.AddressList
                Debug.WriteLine(ipAddress.ToString + "-" +
```

```
ipAddress.AddressFamily.ToString)
                If ipAddress.AddressFamily = AddressFamily.InterNetwork Then
                    remoteEP = New IPEndPoint(ipAddress, CInt(txtPort.Text))

                    Try
                        sendersocket.Connect(remoteEP)
                        Exit For
                    Catch ex As Exception
                        Debug.WriteLine(ex.ToString())
                    End Try
                End If
            Next

            Dim msg As Byte() = _
                Encoding.ASCII.GetBytes("GETDATETIME##<EOF>")
            Dim bytesSent As Integer = sendersocket.Send(msg)
            Dim bytesRec As Integer = sendersocket.Receive(bytes)
            txtTime.Text = Encoding.ASCII.GetString(bytes, 0, bytesRec)

            sendersocket.Shutdown(SocketShutdown.Both)
            sendersocket.Close()
        Catch ex As Exception
        End Try
    End Sub

    Private Sub Button1_Click_1(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles Button1.Click
        Try
            cmbProcessList.Items.Clear()
            Dim bytes(1024) As Byte
            Dim ipHostInfo As IPHostEntry = Dns.GetHostEntry(Dns.GetHostName())

            Dim ipAddress As IPAddress = ipHostInfo.AddressList(0)
            Dim remoteEP As New IPEndPoint(ipAddress, CInt(txtPort.Text))
            Dim sendersocket As New Socket(AddressFamily.InterNetwork, _
                SocketType.Stream, ProtocolType.Tcp)

            For Each ipAddress In ipHostInfo.AddressList
                Debug.WriteLine(ipAddress.ToString + "-" +
ipAddress.AddressFamily.ToString)
                If ipAddress.AddressFamily = AddressFamily.InterNetwork Then
                    remoteEP = New IPEndPoint(ipAddress, CInt(txtPort.Text))

                    Try
                        sendersocket.Connect(remoteEP)
                        Exit For
                    Catch ex As Exception
                        Debug.WriteLine(ex.ToString())
                    End Try
                End If
            Next

            Dim msg As Byte() = _
                Encoding.ASCII.GetBytes("GETPROCESSLIST##<EOF>")
```

```
            Dim bytesSent As Integer = sendersocket.Send(msg)
            Dim bytesRec As Integer = sendersocket.Receive(bytes)
            Dim tmpArray() As String = Split((Encoding.ASCII.GetString(bytes, 0, bytesRec)),
 "##", , CompareMethod.Text)
            Dim iLoop As Integer

            For iLoop = 0 To tmpArray.Length - 1
                cmbProcessList.Items.Add(tmpArray(iLoop))
            Next
            sendersocket.Shutdown(SocketShutdown.Both)
            sendersocket.Close()
        Catch ex As Exception
        End Try
    End Sub

    Private Sub Button2_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles Button2.Click
        Try
            Dim bytes(1024) As Byte
            Dim ipHostInfo As IPHostEntry = Dns.GetHostEntry(Dns.GetHostName())
            Dim ipAddress As IPAddress = ipHostInfo.AddressList(0)
            Dim remoteEP As New IPEndPoint(IPAddress, CInt(txtPort.Text))
            Dim sendersocket As New Socket(AddressFamily.InterNetwork, _
                SocketType.Stream, ProtocolType.Tcp)

            For Each ipAddress In ipHostInfo.AddressList
                Debug.WriteLine(ipAddress.ToString + "-" +
ipAddress.AddressFamily.ToString)
                If ipAddress.AddressFamily = AddressFamily.InterNetwork Then
                    remoteEP = New IPEndPoint(ipAddress, CInt(txtPort.Text))

                    Try
                        sendersocket.Connect(remoteEP)
                        Exit For
                    Catch ex As Exception
                        Debug.WriteLine(ex.ToString())
                    End Try
                End If
            Next

            Dim msg As Byte() = _
                Encoding.ASCII.GetBytes("GETSERVICESTATUS##" +
txtService.Text + "<EOF>")
            Dim bytesSent As Integer = sendersocket.Send(msg)
            Dim bytesRec As Integer = sendersocket.Receive(bytes)
            txtServiceStatus.Text =
                 Encoding.ASCII.GetString(bytes, 0, bytesRec)

            sendersocket.Shutdown(SocketShutdown.Both)
            sendersocket.Close()
        Catch ex As Exception
        End Try
    End Sub
End Class
```

The code in Listing 10-9 is fast and reliable, and you can click the buttons repeatedly. This is neither a complicated process nor a robust one, but you can use this same client to test the code we created previously in this chapter, as we extend the service to allow more than one connection at a time.

If you click one of the buttons, the client utility will connect to the local server and try to run one of the commands. Because it is intended only for demonstration purposes, the error handling is not robust. If you wanted to test it against a remote server, you will need to modify the code to use the name of the server you want to connect to in place of the *Dns.GetHostName()* method used in conjunction with the *Dns.GetHostEntry()* method.

Allowing Multiple Connections

Allowing only a single connection might work, especially in cases where the requests come from either a single source or at intervals that help ensure that two resources cannot compete for a connection at the same time. However, in some circumstances a single instance of a service could be used to generate requests for multiple resources. A good example of this is when you have a server that is multi-homed for several subnets, and receives requests for data from any or all of these subnets—and possibly from multiple computers or processes on each subnet. In this case, a single point connection would not be beneficial; however, you still want to limit how many connections you allow for performance reasons.

Extending the *Listener* Class

We are going to modify the code in Listing 10-9 to allow for up to 10 simultaneous connections to our service. This will require us to create up to 10 client sockets to accept the incoming requests, as well as telling our listener socket to accept up to 10 client requests before it returns an error to the client stating that it is unable to connect. Listener sockets only accept one socket at a time. Our code uses synchronous sockets with a backlog of up to 10 socket requests. Remember, though, that our configuration file allows us to specify the maximum number of sockets at any given time. Therefore, it is not a hard-coded value.

We'll use *ThreadPool* to take care of the multiple connections that our class will now be able to accept. Let's review the new modifications.

The <*SocketThread*> Method

We need to create a secondary thread method that will act as our socket processing thread. Since we will allow more than one connection at a time, having only a single thread won't work. Listing 10-10 shows the newly created thread method.

Listing 10-10 The <*SocketThread*> thread method.

```
Private Sub SocketThread(ByVal args As Object)
    Dim lSocket As Socket = CType(args, Socket)
```

```
    Try
        Dim bytes() As Byte = New [Byte](1024) {}
        Dim Data As String = Nothing
        Dim bError As Boolean = False

        While Not m_ThreadAction.StopThread
            If Not m_ThreadAction.Pause Then
                Dim iStart As Long = Now.Ticks
                bytes = New Byte(1024) {}
                Dim bytesRec As Integer = lSocket.Receive(bytes)
                Data += Encoding.ASCII.GetString(bytes, 0, bytesRec)

                If ((Now.Ticks - iStart) / 10000000) > 30 Then
                    Try
                        lSocket.Shutdown(SocketShutdown.Both)
                    Catch ex As Exception
                    End Try

                    Try
                        lSocket.Close()
                    Catch ex As Exception
                    End Try

                    lSocket = Nothing
                    Exit Sub
                End If
                If Data.IndexOf("<EOF>") > -1 Then
                    Dim pszOut As String = Nothing
                    Try
                        Call ProcessCommand(Data, pszOut)
                        lSocket.Send(Encoding.ASCII.GetBytes(pszOut),
             Encoding.ASCII.GetBytes(pszOut).Length, SocketFlags.None)
                    Catch ex As Exception
                        'clean up
                        lSocket.Shutdown(SocketShutdown.Both)
                        lSocket.Close()
                        lSocket = Nothing
                        Return
                    End Try
                End If

                Exit While
            End If
        End While
    Catch ex As Exception
        lSocket = Nothing
    Finally
        'clean up
        Try
            lSocket.Shutdown(SocketShutdown.Both)
            lSocket.Close()
            lSocket = Nothing
        Catch ex As Exception
            lSocket = Nothing
```

```
        Finally
            lSocket = Nothing
        End Try
    End Try
End Sub
```

The method shown in the preceding listing will be created as a temporary thread by our <*StartListener*> method, which will listen for incoming connections and then create a temporary thread to process the request. The temporary thread accepts a socket as a parameter.

Next, we call the <*ProcessCommand*> method, just as we did earlier, and then send the response to the caller. Last, we close the socket and consider the communication closed. Although this requires us to continually recreate new sockets for the same client calling many different methods, or calling the same method many times, it is for demonstration purposes only. We are not required to drop this socket at all. We could simply make the temporary thread go back into a receive blocking state waiting for a new command from the client.

We could also consider using asynchronous sockets instead of synchronous sockets; however, depending on the workload required, synchronous sockets work for a fast, small service that has limited functional requirements and connections.

Updating the <*StartListener*> Method

We need to update our primary thread method because we only want it to listen for incoming connections now and not process them. Let's review the new code, shown in Listing 10-11.

Listing 10-11 The new <*StartListener*> method.

```
Private Sub StartListener()
    While Not m_ThreadAction.StopThread
        If Not m_ThreadAction.Pause Then
            Try
                Dim localEndPoint As IPEndPoint = Nothing

                m_Listener = New Socket(AddressFamily.InterNetwork, _
                             SocketType.Stream, ProtocolType.Tcp)

                Dim ipHostInfo As IPHostEntry =
                              Dns.GetHostEntry(Dns.GetHostName())
                Dim ipAddress As IPAddress = ipHostInfo.AddressList(0)

                localEndPoint = New IPEndPoint(ipAddress.Any, Me.Port)

                m_Listener.Bind(localEndPoint)
                m_Listener.Listen(Me.MaxConnections)

                While Not m_ThreadAction.StopThread
                    Dim tmpSocket As Socket
                    tmpSocket = m_Listener.Accept

                    Dim tmpThread As New Thread(AddressOf SocketThread)
```

```
                    tmpThread.IsBackground = True
                    tmpThread.Name = "Socket Thread"
                    tmpThread.Start(tmpSocket)
                End While
            Catch nex As SocketException
                WriteLogEvent(My.Resources.ThreadErrorMessage + "_" +
                      nex.ToString + "_" + Now.ToString, THREAD_ERROR,
                      EventLogEntryType.Error, My.Resources.Source)
            Catch tab As ThreadAbortException
                WriteLogEvent(My.Resources.ThreadAbortMessage + "_" +
                      tab.ToString + "_" + Now.ToString, THREAD_ABORT_ERROR,
                      EventLogEntryType.Error, My.Resources.Source)
            Catch ex As Exception
                WriteLogEvent(My.Resources.ThreadErrorMessage + "_" +
                      ex.ToString + "_" + Now.ToString, THREAD_ERROR,
                      EventLogEntryType.Error, My.Resources.Source)
            End Try
        End If

        If Not m_ThreadAction.StopThread Then
            Thread.Sleep(THREAD_WAIT)
        End If
    End While
End Sub
```

Now that we have our processing thread, this code just needs to wait for an incoming socket connection and then hand that socket off to our processing thread. It simply creates a local background thread and then passes it the socket that it just accepted from the client. Notice that our error handling is not as exhaustive as it could or should be. You should be very careful when deciding to run any type of service, especially when it comes to error handling and resources.

Service Validation

Install the new service and make sure that your configuration file has at least two separate entries for ports to listen on, with more than a single connection as its *MaxConnections* property.

Run multiple instances of the test client, assigning different ports to the test client to cover all possible listening server ports you configured. For each client you should receive a response from the server on the specified port. You can even run multiple instances of the client against the same port and each client will still receive its own response. Remember that the *accept* method can only accept one socket connection at a time per server port, so you won't be able to receive a response at the same instant that you do on another—the server has to process the incoming connection and hand it off to the processing thread. Also, remember that your *MaxConnections* property specifies how many connections can wait in the backlog of queued requests to the server. So if you launch, for example, 11 or more clients and expect them all to work at the same time, you'll be disappointed. When more than 10 clients are queued, client connections will start to fail.

Summary

- Microsoft Visual Basic 2008 has built-in support for sockets that allows for creation of services that can act as a client or a server answering to incoming requests.
- Services written in Visual Basic 2008 can support secured or unsecured socket protocols.
- Microsoft Visual Basic 2008 *System.NET* and *System.NET.Sockets* classes provide a vast amount of support for traditional and nontraditional connection and connectionless protocols.
- To interact properly, client-server applications must be written to a standard understood by both the client and the server.
- The number of sockets within a client or server is limited by several factors, but revolves around system resources such as memory, network hardware, virtual memory, and CPU. You should write applications to scale with worker threads and sockets, not on an unlimited one-to-one basis with simultaneous connection requests.