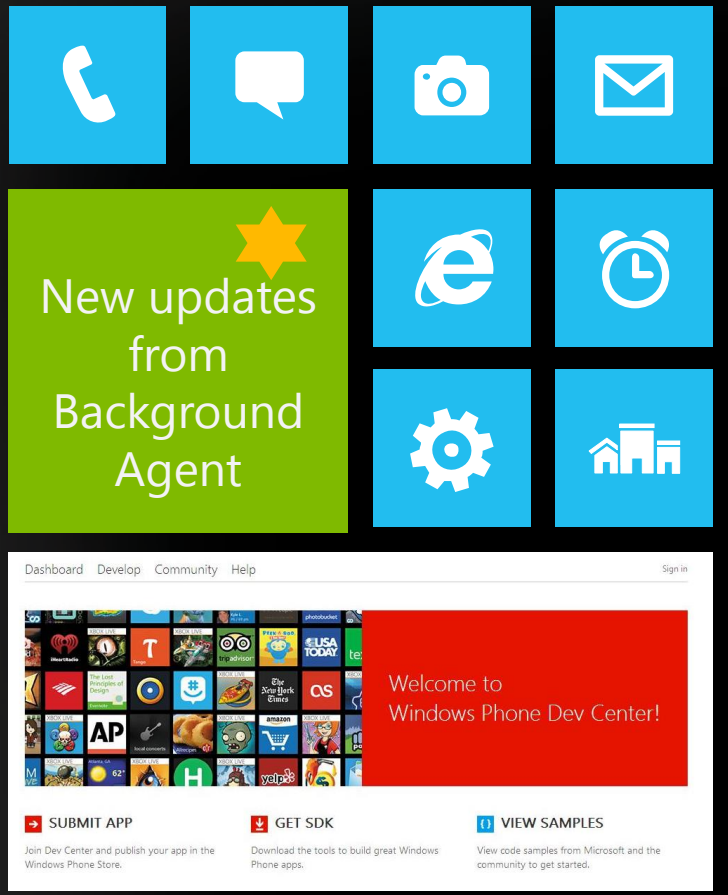
Background Agents



Windows Phone

Topics

- Windows Phone task management
- Multi-tasking with background agents
- Creating tasks in Visual Studio
- File transfer tasks
- Background notifications
- Background music playback tasks

Foreground Tasks

- Normally a Windows Phone application runs in the “foreground”
  - Has access to screen and interacts directly with the user of the phone
- At any given time one application is running in the foreground
  - Although others may be in the memory of the phone and can be selected as required
- This is to ensure the best possible performance and battery life for the phone user

Background Agents

- A Windows Phone application can start a “background agent” to work for it
  - It is a `PeriodicTask`, `ResourceIntensiveTask` or both at the same time
  - There is only one agent allowed per application
- The agent can run when the main application is not in the foreground
- An agent is **not** equivalent to a foreground application running in the background
  - It is limited in what it can do and the access it has to the processor and other phone facilities

Background Agent Health Warning

- The number of agents allowed to be active at one time is restricted by the Windows Phone operating system
- If the right conditions do not arise for an agent it will not be started
  - Background agents only run in situations where the operating system feels able to give them access to the processor
- If the phone goes into “Power Saver” mode it may stop running background agents completely
- Users can also manage the agents running on their phone and may chose to disable them

Agents and Tasks

- A **Task** is the scheduling type you request when you schedule a background agent to run
  - It is managed by the operating system which runs the agent at the appointed time
- There are two kinds of Tasks
  - Periodic tasks that are run every now and then
  - Resource intensive tasks that run when the phone is in a position to let them
- The background **Agent** is the actual code functionality you write which runs in the background and which does the work
  - The agent code is implemented in a class that derives from BackgroundAgent
  - The class is created as part of a Scheduled Task Agent Project

PeriodicTask Agents

- A PeriodicTask Agent runs every now and then
  - Typically every 30 minutes or so, depending on loading on the phone
- It is intended to perform a task that should be performed regularly and complete quickly
  - The agent is allowed to run for 25 seconds or so
  - Memory usage allowed <= 6 MB
  - Unscheduled after two consecutive crashes
  - The phone sets a limit on the maximum number of active agents at any time
- Good for location tracking, polling background services, tile updates

ResourceIntensive Agents

- Resource Intensive Agents run when the phone is in a position where it can usefully perform some data processing:
  - When the phone is powered by the mains
  - When the battery is >90% charged
  - When the phone is connected to WiFi
  - When the phone is not being used (Lock screen displayed)
- A “resource intensive” agent can run for up to 10 minutes
  - Memory usage allowed<= 6 MB
  - Unscheduled after two consecutive crashes
- Good for synchronisation with a host service, unpacking/preparing resources, compressing databases

Dual purpose Agents

- It is possible for an application to perform both periodic and resource intensive work in the background
- This can be achieved using a single background agent class, run from both kinds of task
- The agent will run periodically and when the phone is in a position to allow resource intensive work
- When the agent starts it can determine the context in which it is running and then behave appropriately

Background Agent Functionality

Allowed

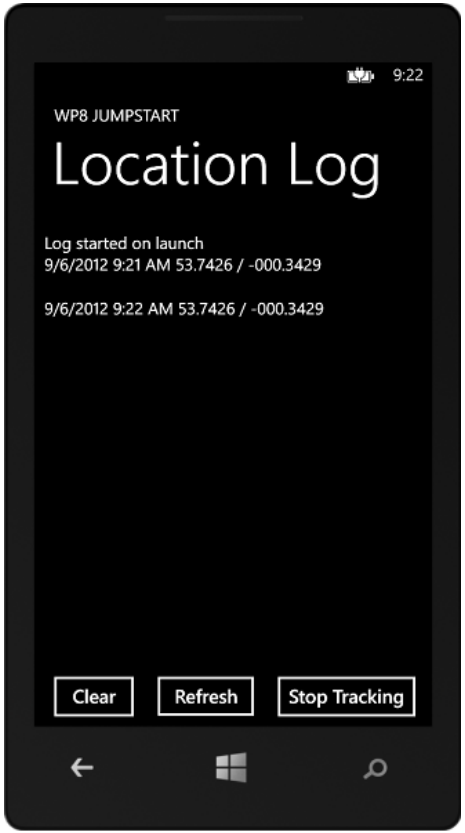
- Tiles
- Toast
- Location
- Network
- R/W ISO store
- Sockets

Restricted

- Display UI
- XNA libraries
- Microphone and camera
- Sensors
- Play audio
  (may only use background audio APIs)

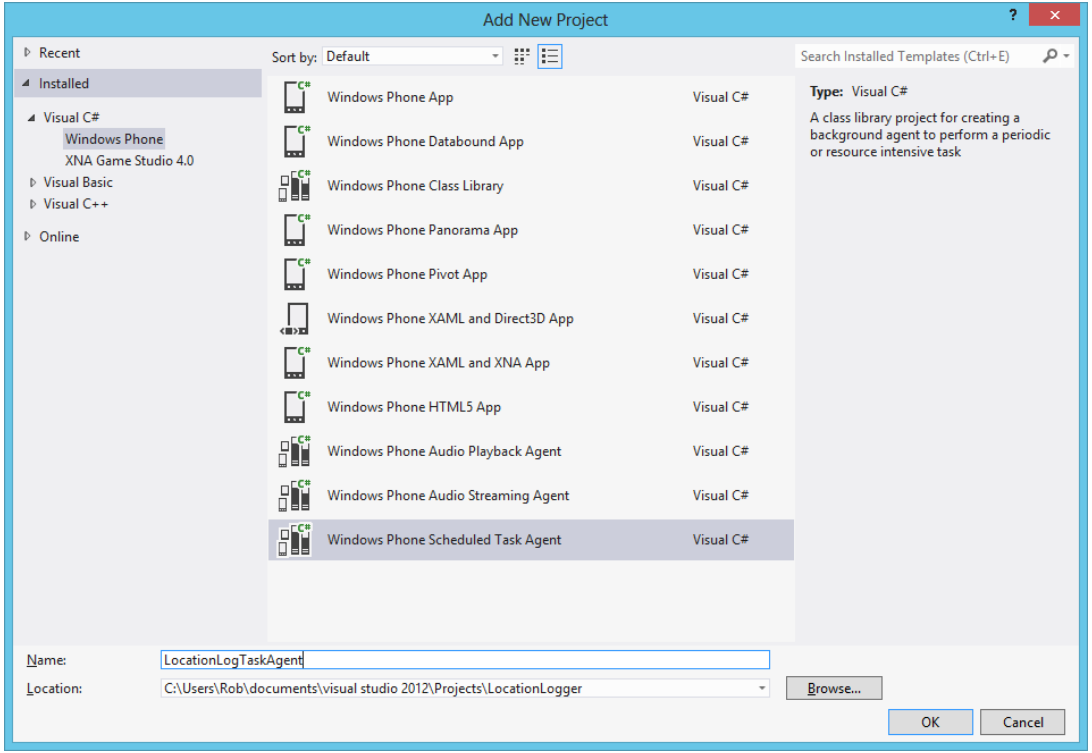
Location Tracker

- The Location Tracker program is a simple logging application
- It tracks the location of the phone by using a background agent to regularly store the location of the phone in a text log file
- The agent will update the position even when the log program is not active



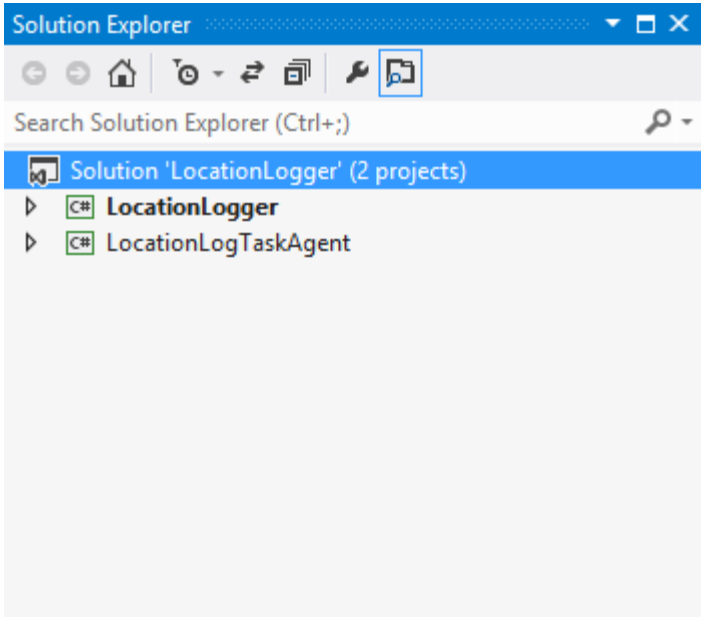
Creating a Background Agent

- A background agent is added to the application solution as a "Scheduled Task"
- There is a Visual Studio template just for this
- This agent will contain the code that runs when the agent is active



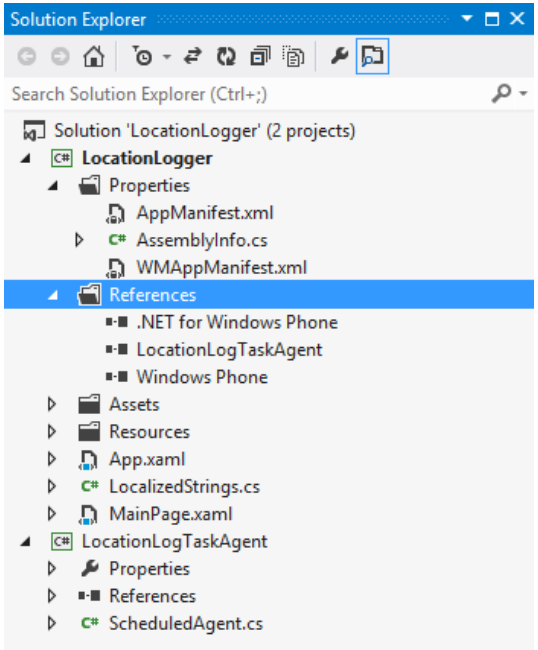
The Captains Log Solution File

- The solution file contains two projects
  - LocationLogger: the Windows Phone project which is the main application
  - LocationLogTaskAgent: the background agent to perform the tracking
- Solutions can contain many types of different projects
- When the solution is built all the assembly file outputs will be combined and sent to the phone



Connecting the Agent Project

- The CaptainsLog project contains a reference to the output of the LocationTaskAgent project
- The foreground application does not directly reference any objects in the agent class in code
- Nonetheless, we have to explicitly link these two projects by adding a reference to the LocationTaskAgent output to the CaptainsLog project



Background Agent Code

```
namespace LocationLogTaskAgent
{
    public class ScheduledAgent : ScheduledTaskAgent
    {
        protected override void OnInvoke(ScheduledTask task)
        {
            //TODO: Add code to perform your task in background
            NotifyComplete();
        }
    }
}
```

- We must implement the agent functionality in the `OnInvoke` method
- It notifies the run time system when it has completed

Sharing Data with Background Agents

```
protected override void OnInvoke(ScheduledTask task)
{
    string message ="";
    string logString = "";
    if (LoadLogFromIsolatedStorageFile() {
        message = "Loaded";
    }
    else {
        message = "Initialised";
    }
    ...
}
```

- First thing agent does is load the log string from isolated storage
- It is going to append the current location on the end of this string

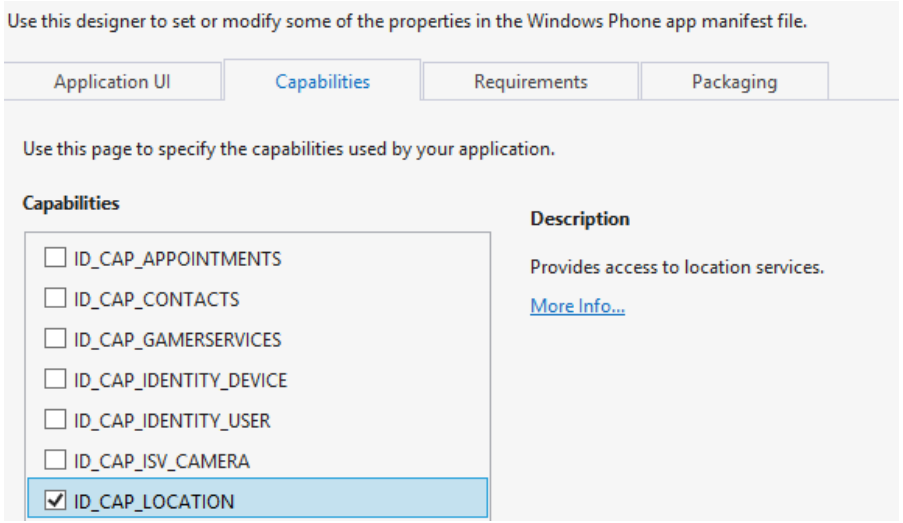
Concurrent Data Access

```
public bool LoadLogFromIsolatedStorageFile()
{
    mut.WaitOne(); // Wait until it is safe to enter

    try  {
          // read the file here
          return true;
    }
    catch {
          LogText = "";
          return false;
    }
    finally {
        mut.ReleaseMutex(); // Release the Mutex.
    }
}
```

- Protect access to files in Isolated Storage by using a named Mutex
- Make sure you release the mutex

Selecting the Location capability

- In Windows Phone 8 a new application does not have all its capabilities enabled when it is created
- The WMAppManifest.xml file in the Properties folder must be opened and the location tracking capability selected
- Otherwise the program will fail to run
- Don't forget to specify capabilities in your foreground app project that your background agent needs



Obtaining the Phone Location

```
protected override void OnInvoke(ScheduledTask task)
{
    ...
    GeoCoordinateWatcher watcher = new GeoCoordinateWatcher();
    watcher.Start();
    string positionString = watcher.Position.Location.ToString() +
                            System.Environment.NewLine;
    ...
}
```

- The GeoCoordinateWatcher class provides position information
- Use the Position property in background agents
- It uses cached location data that is updated at least every 15 minutes

Storing the Phone Location

```
protected override void OnInvoke(ScheduledTask task)
{
    ...
    logString = logString + timeStampString + " " + positionString;

    SaveLogToIsolatedStorageFile ();
    ...
}
```

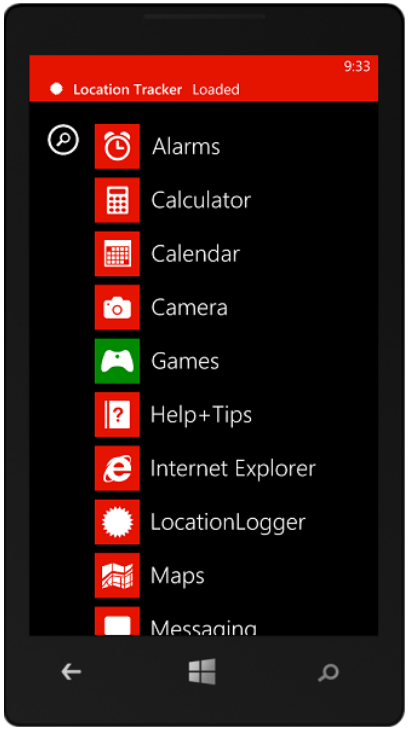
- The background agent now constructs a location message, with a timestamp and then saves the log string back to isolated storage
- This string can be displayed for the user by the foreground application

Background Location Tracking

- The code shown in this sample gets a new location whenever the Periodic agent runs
  - Every 30 minutes or so
- Windows Phone 8 supports continuous background location tracking
  - Suitable for Run Tracking apps and Turn-by-Turn navigation
- This is not covered here!
  - See the Location and Maps module

Showing a Notification

```
protected override void OnInvoke(ScheduledTask task)
{
    ...
    ShellToast toast = new ShellToast();
    toast.Title = "Location Log";
    toast.Content = message;
    toast.Show();
    ...
}
```



- The background task can pop up a toast notification to deliver a message
- If the user taps the message it will start up the foreground application
- Toast messages will not appear if the foreground application is active

Scheduling the Background Agent

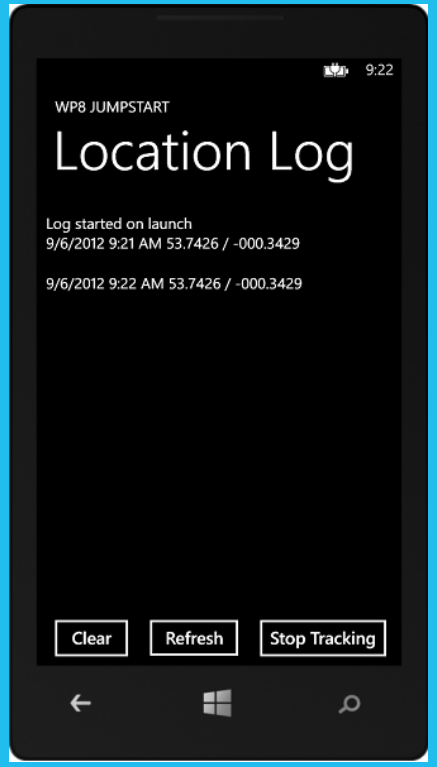
```
PeriodicTask t;
t = ScheduledActionService.Find(taskName) as PeriodicTask;
bool found = (t != null);
if (!found)
{
    t = new PeriodicTask(taskName);
}
t.Description = description;
t.ExpirationTime = DateTime.Now.AddDays(10);
if (!found)
{
    ScheduledActionService.Add(t);
}
else
{
    ScheduledActionService.Remove(taskName);
    ScheduledActionService.Add(t);
}
```

Debugging a Background Task

```
#if DEBUG_AGENT
 ScheduledActionService.LaunchForTest(taskName, TimeSpan.FromSeconds(60));
#endif
```

- It would be annoying if we had to wait 30 minutes to get code in the agent running so we could debug it
- When we are debugging we can force the service to launch the agent
- Such code can be conditionally compiled and excluded from the release build

Demo 1:
Location Logging



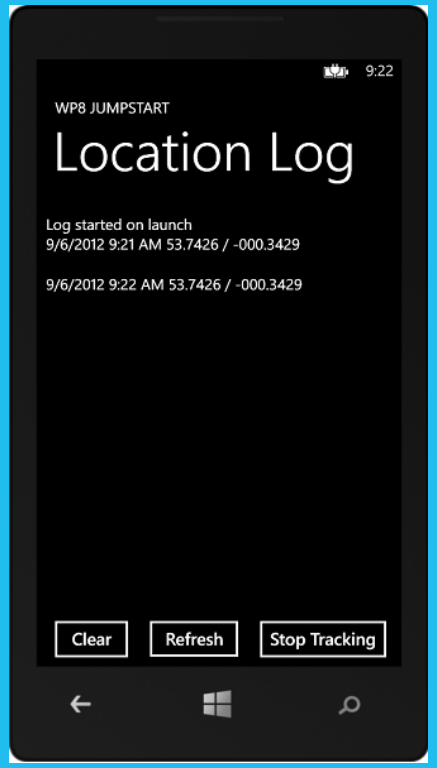
What we Have Just Seen

- The Location Logging application fired off a background task
- The task began running even if the Location Log application is still running in the foreground
- The background task loaded location information from the phone and added it to the log file that could then be displayed later
- The background task displayed popup notifications each time that it ran

Debugging the Agent Code

- When you use the Back button or Start on the phone to interrupt an application with an active Background Task, Visual Studio does not stop running
- It remains attached to the application
- You can then put breakpoints into the background task application and debug them as you would any other program
- You can single step, view the contents of variables and even change them using the Immediate Window
- This is also true if you are working on a device rather than the emulator
- The same techniques work on ResourceIntensive agents

Demo 2:
Debugging Tasks



Background Agent Tips

- Renew often
  - You must reschedule agents from your foreground app at least every two weeks
- Do not implement critical functionality in a background agent
  - User can disable them
  - OS can suspend them in low battery situation
- If you need more reliable execution of code outside your application and need to update Tiles or send Toast notifications, consider Push Notifications

Background File Transfers

File Transfer Tasks

- It is also possible to create a background task to transfer files to and from your application's isolated storage
- The transfers will take place when the application is not running
- An application can monitor the state of the downloads and display their status
- Files can be fetched from HTTP or HTTPS hosts
  - At the moment FTP is not supported
- The system maintains a queue of active transfers and services each one in turn
- Applications can query the state of active transfers

Background Transfer Policies

- There are a set of policies that control transfer behaviour
  - Maximum Upload file size: 5Mb
  - Maximum Download file size over cellular (mobile phone) data: 20Mb
  - Maximum Download file size over WiFi: 100Mb
- These can be modified by setting the value of `TransferPreferences` on a particular transfer
- Maximum number of Background Transfer Requests per app: 25
  - Increased from 5 in Windows Phone OS 7.1

The BackgroundTransfer namespace

```
using Microsoft.Phone.BackgroundTransfer;
```

- The Background Transfer services are all provided from the `BackgroundTransfer` namespace
- You do not need to create any additional projects to create and manage background transfers

Creating a Background Transfer

```
Uri transferUri = new Uri(Uri.EscapeUriString(transferFileName),
                                                UriKind.RelativeOrAbsolute);
// Create the new transfer request, passing in the URI of the file to
// be transferred.
transferRequest = new BackgroundTransferRequest(transferUri);

// Set the transfer method. GET and POST are supported.
transferRequest.Method = "GET";
```

- This creates a request and sets the source for the transfer
- It also sets the transfer method
  - POST can be used to send files to the server

Setting the Transfer Destination

```
string downloadFile = transferFileName.Substring(
                                        transferFileName.LastIndexOf("/") + 1);
// Build the URI
downloadUri = new Uri("shared/transfers/" + downloadFile,
                      UriKind.RelativeOrAbsolute);
transferRequest.DownloadLocation = downloadUri;

// Set transfer options
transferRequest.TransferPreferences =
                                TransferPreferences.AllowCellularAndBattery;
```

- Files are transferred into isolated storage for an application
- This code also sets the preferences for the transfer
  - `TransferPreferences` has a number of different settings

Starting the Transfer

```
try {
    BackgroundTransferService.Add(transferRequest);
}
catch (InvalidOperationException ex) {
    MessageBox.Show("Unable to add background transfer request. "
                                                        + ex.Message);
}
catch (Exception) {
    MessageBox.Show("Unable to add background transfer request.");
}
```

- This adds a transfer request to the list of active transfers
- An application can have a maximum of 25 transfers active at one time
- The Add method will throw exceptions if it fails

Monitoring the Transfer

```
// Bind event handlers to the progess and status changed events
transferRequest.TransferProgressChanged +=
    new EventHandler<BackgroundTransferEventArgs>(
        request_TransferProgressChanged);

transferRequest.TransferStatusChanged +=
    new EventHandler<BackgroundTransferEventArgs>(
        request_TransferStatusChanged);
```

- The application can subscribe to events fired by a **TransferRequest**
  - **TransferProcessChanged** is used for progress bars
  - **TransferStatusChanged** is used when the transfer completes or fails

Transfer Progress Changed

```
void request_TransferProgressChanged(object sender,
                                     BackgroundTransferEventArgs e)
{
    statusTextBlock.Text = e.Request.BytesReceived + " received.";
}
```

- When the progress changes our application can update a progress display
- You could use a progress bar here

Transfer Status Changed

```
void request_TransferStatusChanged(object sender,
                                   BackgroundTransferEventArgs e) {
  switch (e.Request.TransferStatus) {
     case TransferStatus.Completed:
         // If the status code of a completed transfer is 200 or 206, the
         // transfer was successful
         if (transferRequest.StatusCode == 200 ||
             transferRequest.StatusCode == 206)
         {
            // File has arrived OK – use it in the program
         }
       ...
```

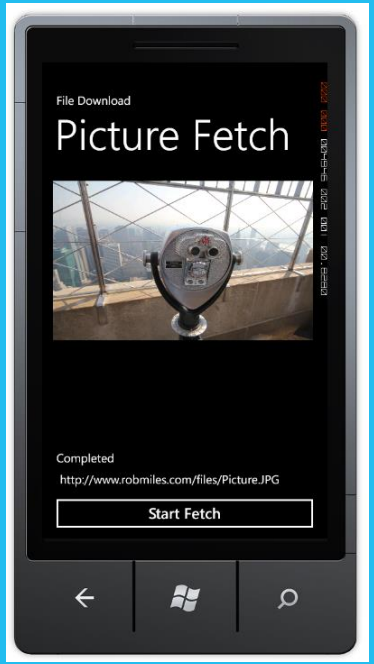
- This code checks that the file has arrived OK

Removing a Transfer

```
try {
    BackgroundTransferService.Remove(transferRequest);
}
catch {
}
```

- When a transfer has completed it is not automatically removed by the system
- This can cause completed transfers to block any new ones
- It is important that completed transfers are removed
- Note that the remove process may throw an exception if it fails

Demo 3:
Picture Fetch



Transfer Management

- An application can find out how many file transfers it has active
  - It will have to do this when it is restarted, as file transfers will continue even when the application is not running
- It can then perform transfer management as required
- There is a good example of transfer list management on MSDN

http://msdn.microsoft.com/en-us/library/hh202953.aspx

Getting Active Transfers

```
IEnumerable<BackgroundTransferRequest> transferRequests;
...
private void UpdateRequestsList()
{
    // The Requests property returns new references, so make sure that
    // you dispose of the old references to avoid memory leaks.
    if (transferRequests != null) {
        foreach (var request in transferRequests) {
            request.Dispose();
        }
    }
    transferRequests = BackgroundTransferService.Requests;
}
```

- This code builds an updated list of transfer requests

Supplying Credentials for Transfers

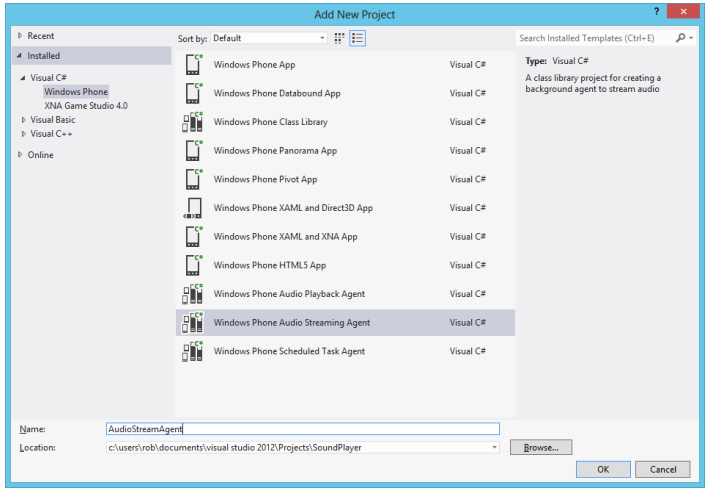
```
string username = "user";
string password = "pass@word1";

Uri transferUri = new Uri("https://www.contoso.com/getsecure/");
BackgroundTransferRequest myReq = new BackgroundTransferRequest(transferUri);
myReq.Method = "GET";

string usernamePassword = username + ":" + password;
myReq.Headers.Add("Authorization", "Basic "
    + Convert.ToBase64String(StringToAscii(usernamePassword)));
string downloadFile = "test";
Uri downloadUri = new Uri("shared/transfers/test", UriKind.RelativeOrAbsolute);
myReq.DownloadLocation = downloadUri;
BackgroundTransferService.Add(myReq);
```

- You can access files protected by HTTP Basic Authentication by manually attaching the required headers
- Use only with SSL-secured (HTTPS) services

Background Audio

Audio Playback Agents

- Also possible to create an Audio Playback Agent that will manage an application controlled playlist
- The mechanism is the same as for other background tasks
- The audio can be streamed or held in the application isolated storage



Review

- An application can create background processes
  - Periodic Task tasks run every 30 minutes or so as scheduled by the OS
  - ResourceIntensive tasks run when the device is connected to mains power, the battery is charged to 90% or better and the phone is not in use
  - Audio Playback run alongside the application
- Applications and their background processes can communicate via the local folder which is common to both
- Visual Studio can be used to debug background tasks in the same way as foreground applications
- The Background File Transfer service may be used to schedule file transfers with the OS

Windows Phone

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