Lab 2-1: Clone a BSP

Create, Build, and Run a New OS Design

Learning Objectives

- Create an OS Design using Visual Studio
- Identify the catalog features included in the design
- Extend the standard design by adding catalog items
- Build configuration for the run-time image and build a run-time image
- Run the OS image on the target device

Prerequisites

- Knowledge of the vocabulary used in OS design, Visual Studio, and the Platform Builder Plug-in for Visual Studio

Estimated time to complete this lab: 45 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0 with 2006 Roll up and Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- EVM Reference platform
- TI_EVM_3530-Training BSP

Exercise 1 Clone BSP

In this exercise, you will use the Clone BSP tool in Visual Studio 2005 to create a copy of the existing EVM Board Support Package (BSP). We can modify this copy instead of modifying the original that was delivered as a part of the Windows Embedded CE 6.0 tools.

❖ *Clone the EVM BSP*

1. Launch **Microsoft Visual Studio 2005**.

Note If this is the first time Visual Studio is launched after installation the **Choose Default Environment Setting** dialog will be displayed. For the purposed of this course select **Platform Builder Development Settings** and select **Start Visual Studio**.

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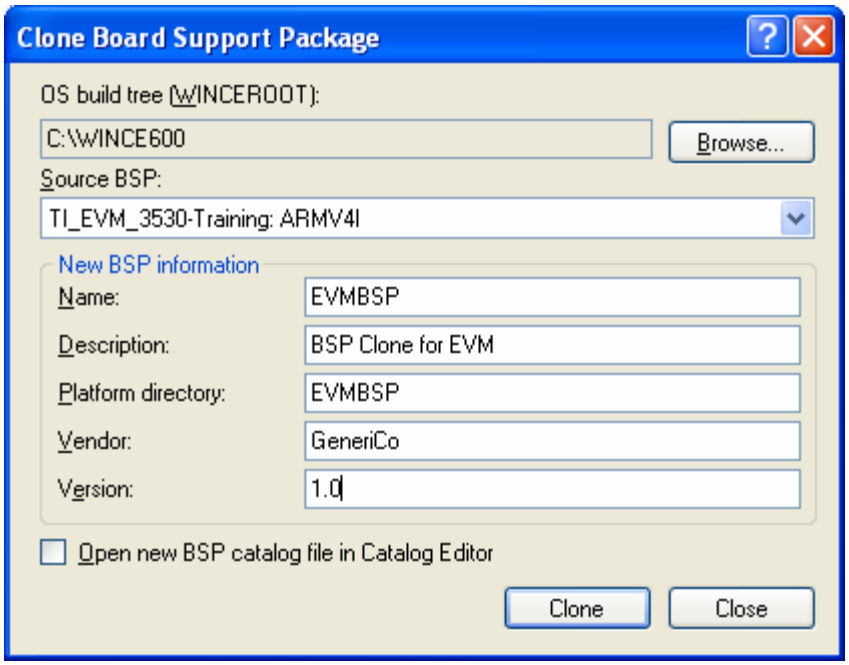
2. Select the **Tools | Platform Builder for CE6.0 | Clone BSP** from the menu in Visual Studio to bring up the Clone BSP dialog box.



3. In the Clone BSP dialog select **TI_EVM_3530-Training: ARMV4I** from the Source Board Support Package: drop down box.

4. Type **EVMBSP** in the Name field in the New Board Support Package Info area.

5. Type a description [**BSP Clone for EVM**] for your new BSP in the Description field.

6. Type **EVMBSP** in the Platform Directory field.

7. Type **GeneriCo** in the Vendor field.

8. Type **1.0** in the Version field.
9. Click the **Clone** Button. The Clone BSP tool will create a new Board Support Package based on the EVM Board Support Package.
10. Acknowledge the **Clone BSP** success message by selecting OK.

The EVM Board Support Package has now been cloned into a new Board Support Package called **EVMBSP**. This EVMBSP Board Support Package will be used in the remaining labs.

Exercise 2 Create, build and run the OS design

In this exercise you will create an OS design, and then customize that design by adding components from the catalog and build the result. You will run the OS Design on the EVM reference platform.

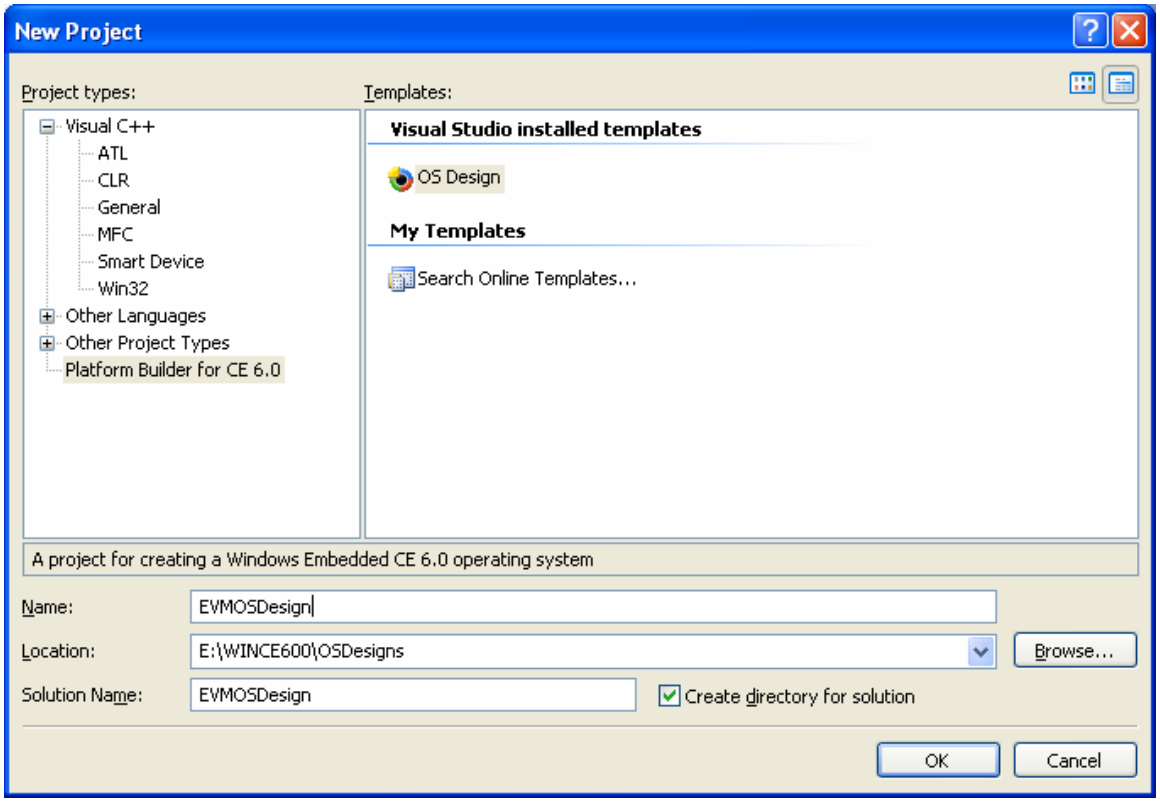
This OS Design will be used in other labs and will be a suitable platform for running a variety of Windows CE applications.

You will learn how to:

- Create an OS Design
- Set up the build configuration for your OS run-time image
- Build an OS run-time image
- Run the OS Design on the EVM reference platform.

❖ *Create an OS design*

1. Select **File | New | Project…** from the Visual Studio menu.



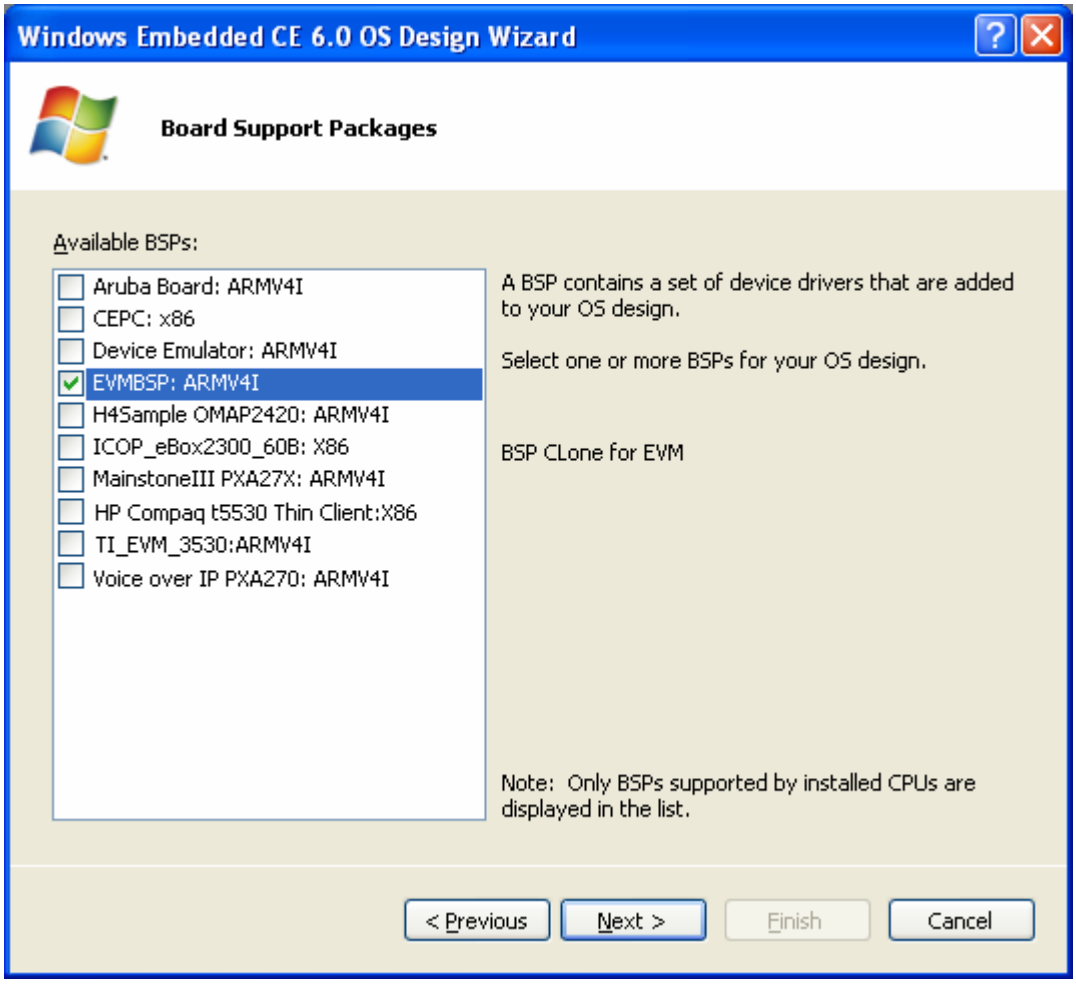
2. Select the **Platform Builder for CE 6.0** project type in the New Project dialog.

3. Select **OS Design** under Visual Studio installed templates.

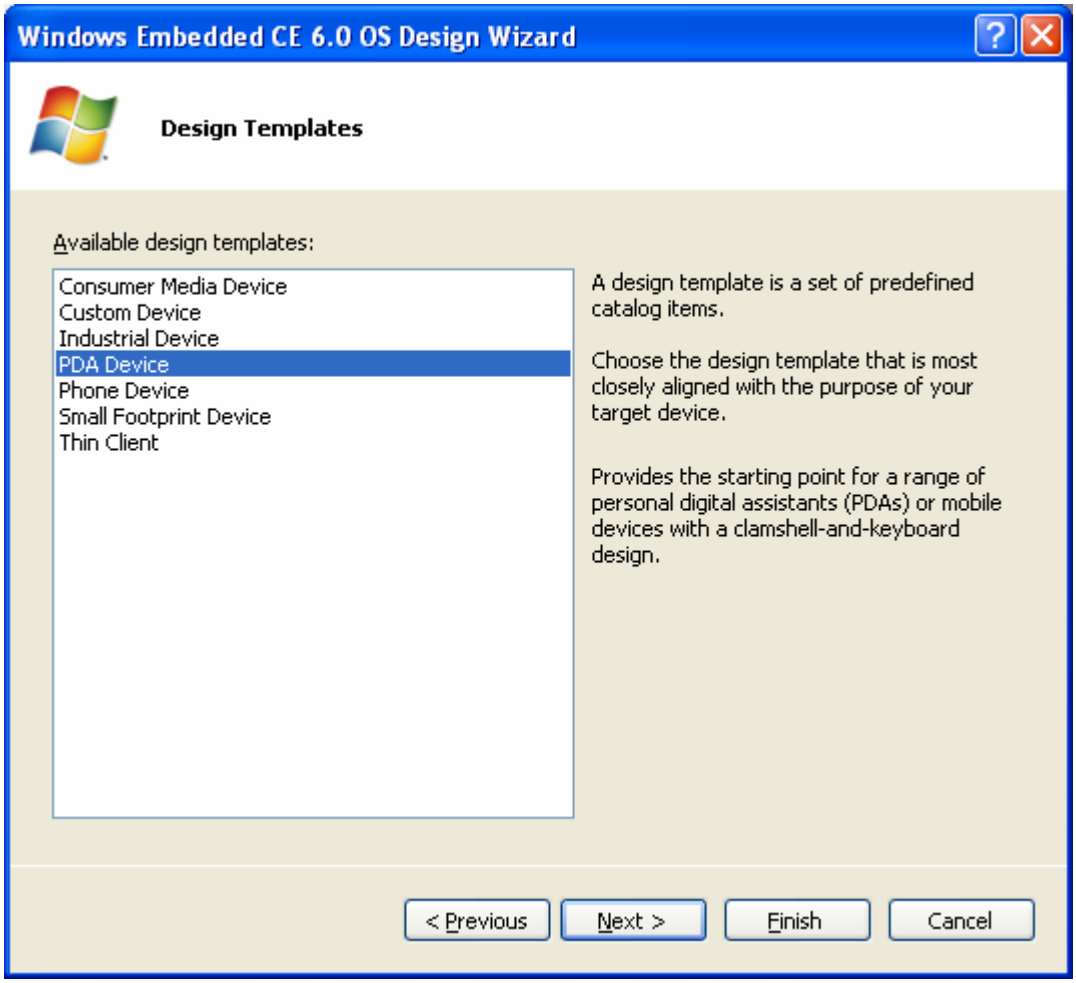
4. Type **EVMOSDesign** in the Name field. The solution name will default to EVMOSDesign as well.

5. Click **OK**. Visual Studio will launch the Windows Embedded CE 6.0 OS Design Wizard.

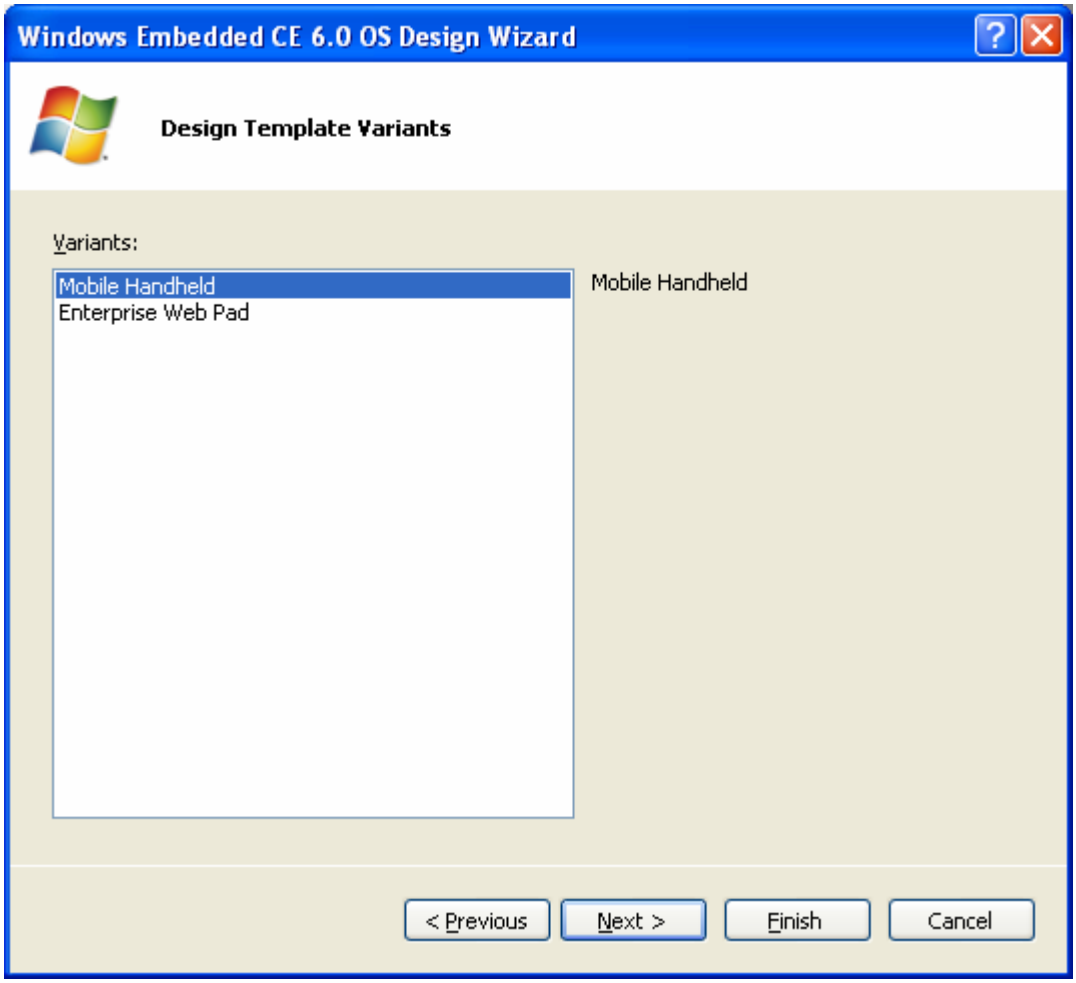
6. Click **Next**.



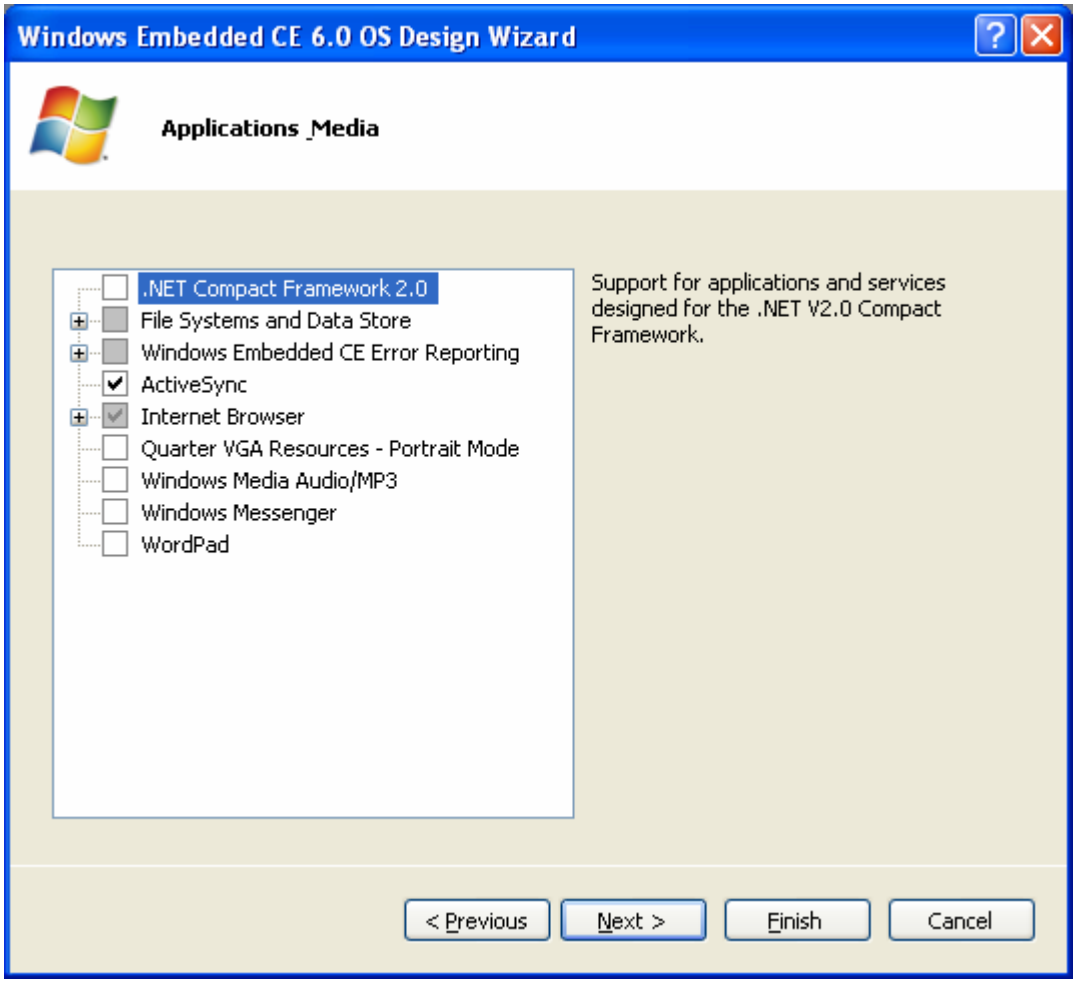
7. In the list of available BSPs, select **EVMBSP: ARMV4I** and click **Next**.



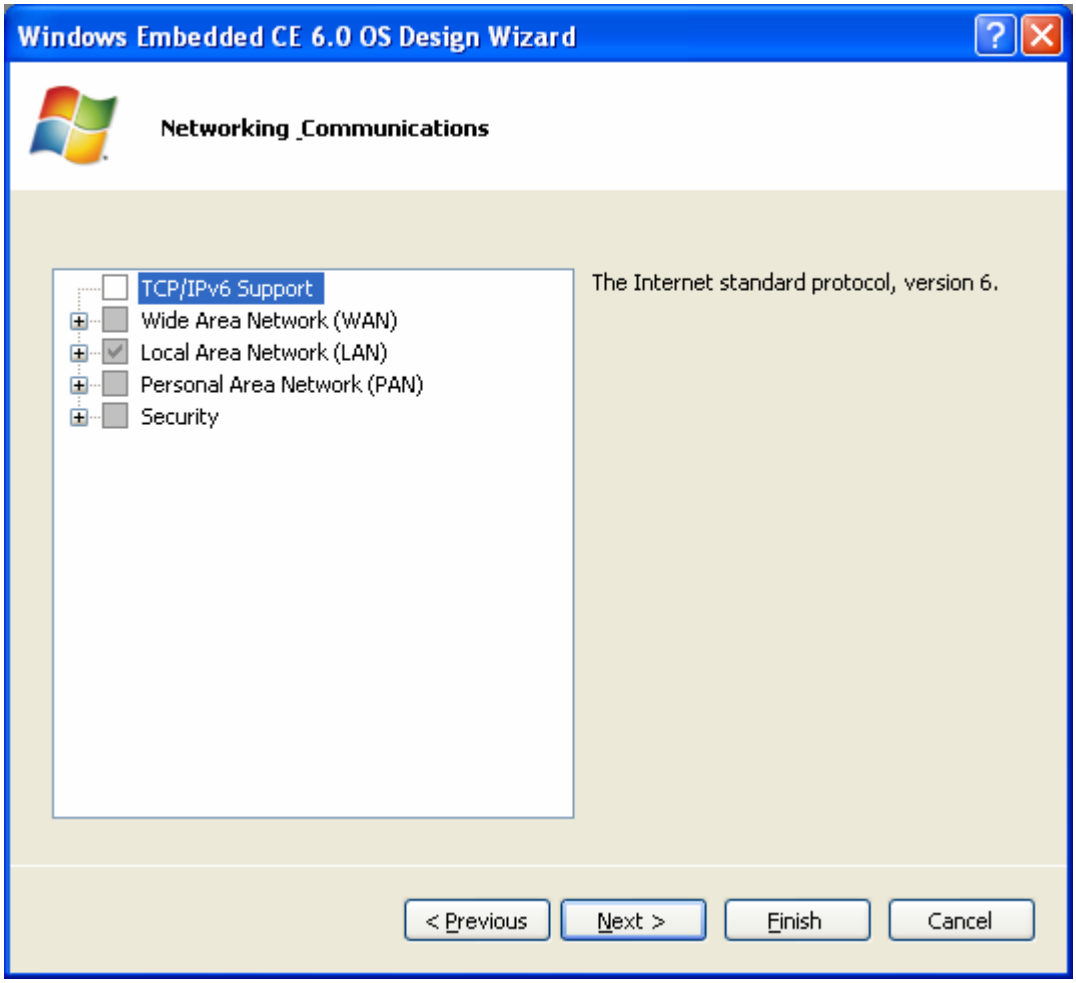
8. From the list of available design templates, select **PDA Device** and click **Next.**



9. From the list of available design variants, select **Mobile Handheld** and click **Next**. The **Applications & Media** configuration window will appear.



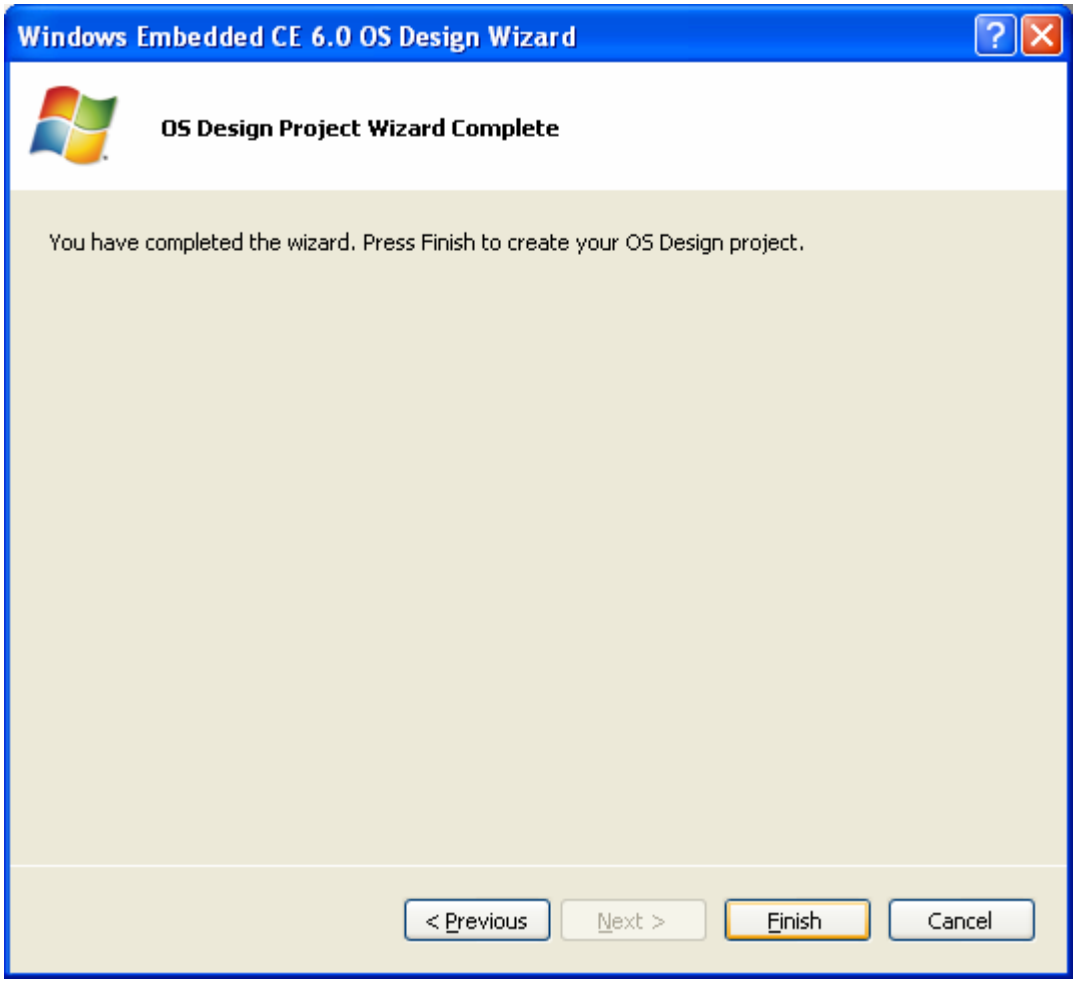
10. Deselect **.NET Compact Framework 2.0** and **Quarter VGA Resources – Portrait Mode** and click **Next**. The **Networking & Communications** configuration window will appear.



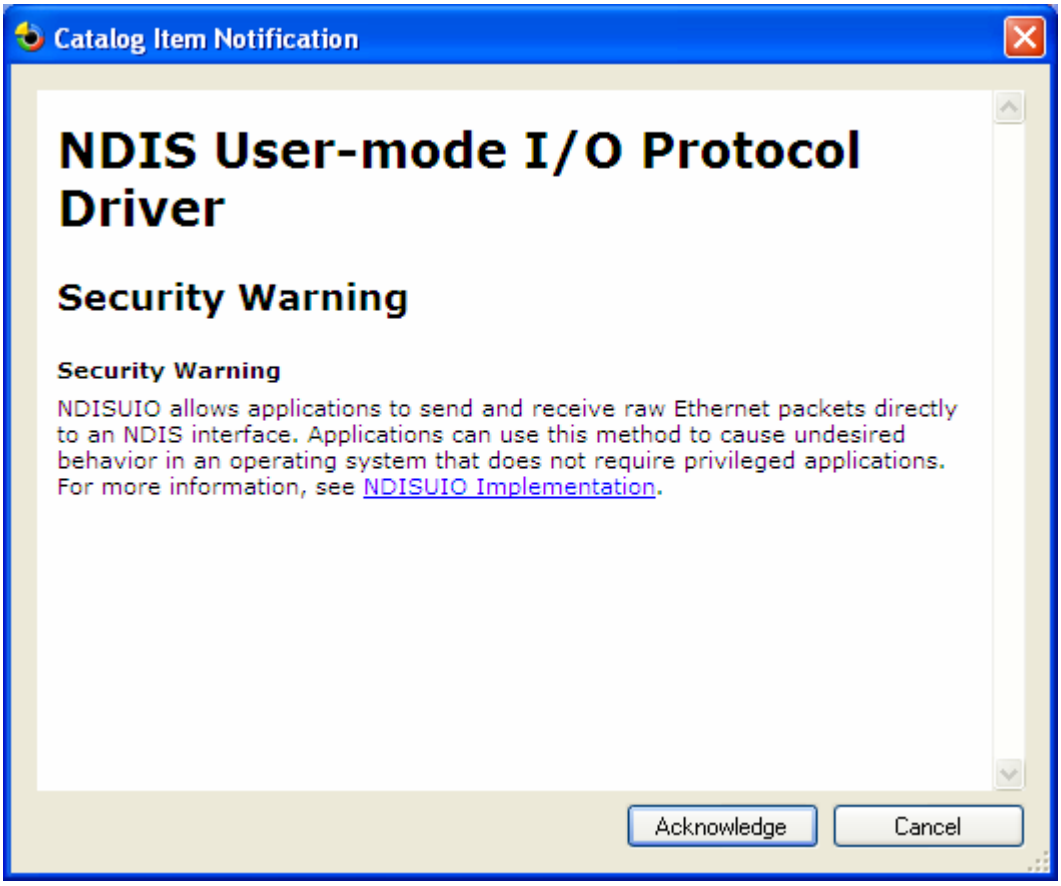
11. Deselect **TCP/IPv6 Support**.

12. Deselect **Personal Area Network (PAN)**. This will deselect Bluetooth and IrDA.

13. Click **Next**, and then **Finish** to complete the Windows Embedded CE 6.0 Design Wizard.

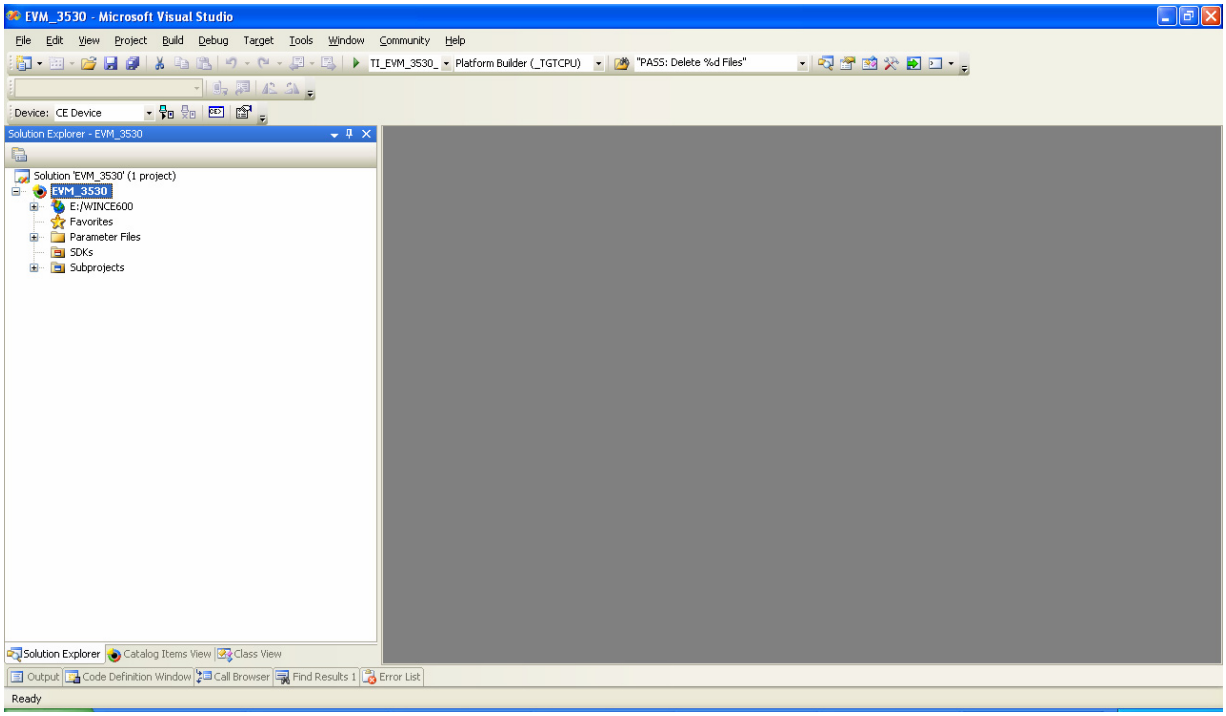


Note	The wizard creates the initial configuration for your OS Design. We will have the opportunity to make further changes to the OS Design after completing the wizard.



14. Click **Acknowledge** on the **Catalog Item Notification** dialog.

On completion, Visual Studio will display your OS design project. The Solution Explorer tab should be active and show your new EVMOSDesign project in your EVMOSDesign Solution.



❖ *Inspect the OS Catalog*

1. Click on the **Catalog Items View** tab to display the Catalog.

2. Click on the **Filter** drop down box in the upper left hand corner of the Catalog Items View. Observe the different filtering options. The filter controls the items that are displayed in the catalog. Ensure that **All Catalog Items in Catalog** is selected.

3. Observe the selection boxes and icons in the catalog by expanding the **nodes**. Selection boxes with a green check mark indicate an item that was specifically selected as a part of the OS design. Selection boxes with a green square indicate an item that was brought in to the OS design as a dependency. Selection boxes that are not marked indicate items that are not included in the OS design but are available to be added.

4. Locate a catalog item with a **green square** in its checkbox.

5. Right click on the catalog item and choose **Reasons for Inclusion of Item**. The **Remove Dependent Catalog Item** dialog box displays the catalog items you selected that caused this catalog item to automatically be included in the OS design.

6. Close the **Remove Dependent Catalog Item** dialog box.

7. Expand the **Core OS | CEBASE | Applications – End User | Active Sync** node in the catalog.

8. Right click on either of the **ActiveSync system cpl** items and select **Display in Solution View.** The view will change to the Solution Explorer tab. The subproject containing the ActiveSync component is displayed. This is a great way to navigate the source code that is available as part of Windows Embedded CE 6.0.

❖ *Add Additional Catalog Items to the OS Design*

➢ Add support for Internet Explorer 6.0

1. Select the **Catalog Items View** tab to display the OS Design catalog.

Note If the filtering option was not set to **All Catalog Items in Catalog,** you would not see catalog items that were not already included in the OS Design.

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2. Enter the text **Internet Explorer 6.0 Sample** into the search text box to the right of the filter button. Press **Enter** or click the **green arrow.** The path **Core OS | CEBASE | Internet Client Services | Browser Application | Internet Explorer 6.0 for Windows Embedded CE – Standard Components** should be expanded.

Note Depending on where you are currently located in the catalog, you may have to restart the search from the top.

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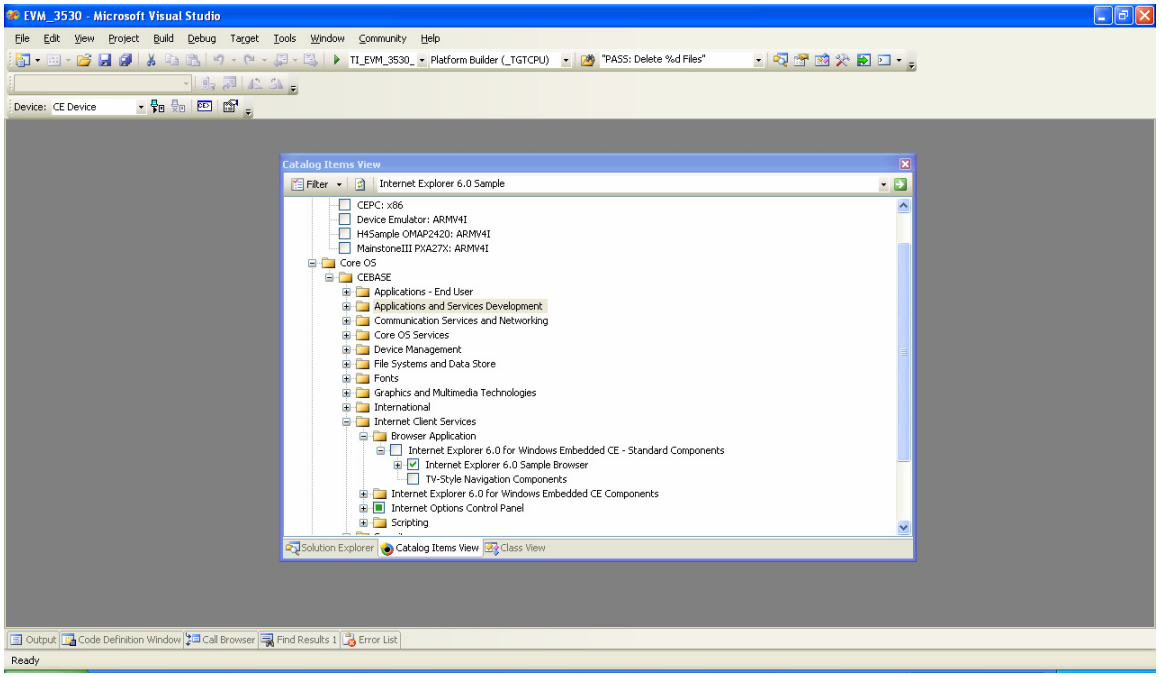
3. Select the **Internet Explorer 6.0 Sample Browser** catalog item.



➢ **Add support for managed code development to your OS design**

4. Enter the text **ipconfig** into the Search box and press Enter. The **Network Utilities (IpConfig, Ping, Route)** will be highlighted.

Note Again, depending on node selected when starting a search in the catalog, you may have to restart the search from the top.

5. Add the **Network Utilities** to your design by selecting the component.

6. Enter the text **wceload** into the Search box and press Enter. The **CAB File Installer/Uninstaller** component will be highlighted. This is due to the fact that the SYSGEN name for the component is "wceload".

7. Add the **Cab File Installer/Uninstaller** utility to your OS design.

8. Enter the text **sysgen_dotnetv2_support** into the Search box and press Enter. The **OS Dependencies for.NET Compact Framework 2.0** component will be highlighted.

9. Add the **OS Dependencies for .NET Compact Framework 2.0** to your OS design.

Note There are two separate components in this category. Be sure you select the one that does **NOT** have the **– Headless** modifier in its description.

❖ *Build the OS run-time image*

1. Select **Build | Configuration Manager…** from the Visual Studio menu to bring up the **Configuration Manager** dialog box.

2. Select **EVMBSP ARMV4I Release** from the Active solution configuration drop down box and then close the dialog box.

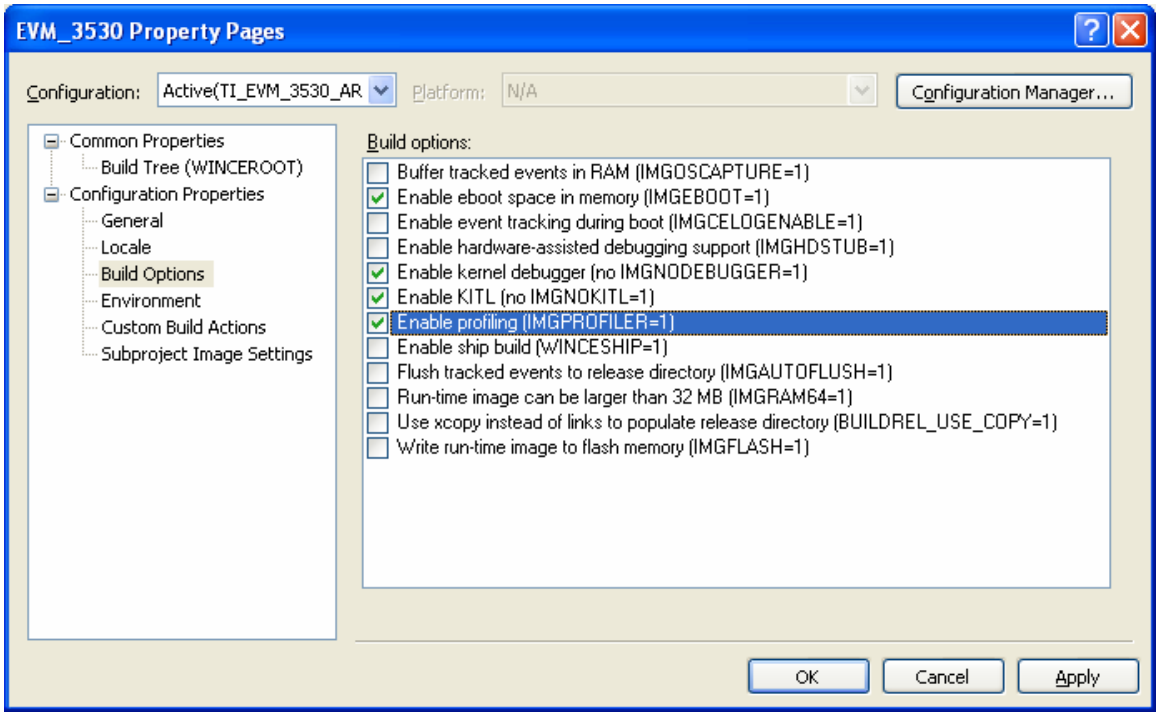
3. Select the **Solution Explorer** view by selecting the **Solution Explorer** tab.

4. In the **Solution Explorer** window, right click on the **EVMOSDesign** project (not the Solution node) and choose **Properties.** This will launch the Property Pages dialog for your OS design.

5. Expand the **Configuration Properties** tree and click on the **Build Options** node.

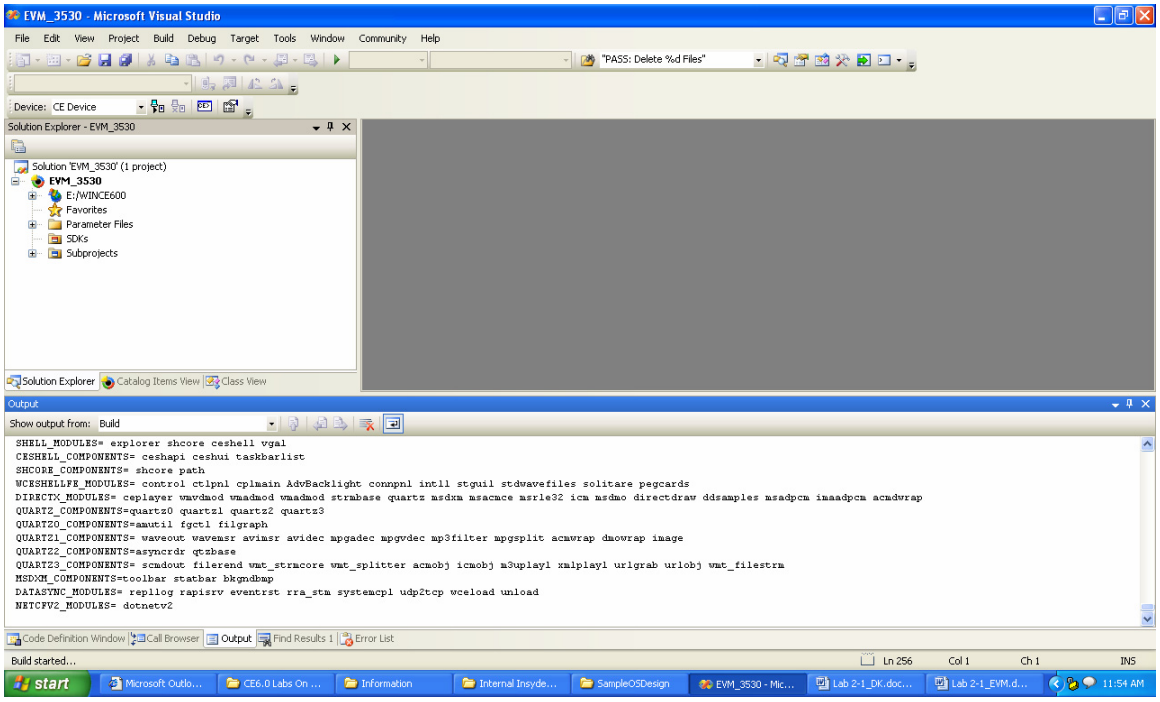
6. Ensure the following build options are set:

   - **Enable eboot space in memory**
   - **Enable kernel debugger**
   - **Enable KITL**
   - **Enable profiling**



7. Select **OK**

8. Select **Build | Build EVMOSDesign** from the Visual Studio menu.



Note	This will take several minutes to complete depending on the capabilities of your development system. The following steps for configuring connectivity may be accomplished while building.

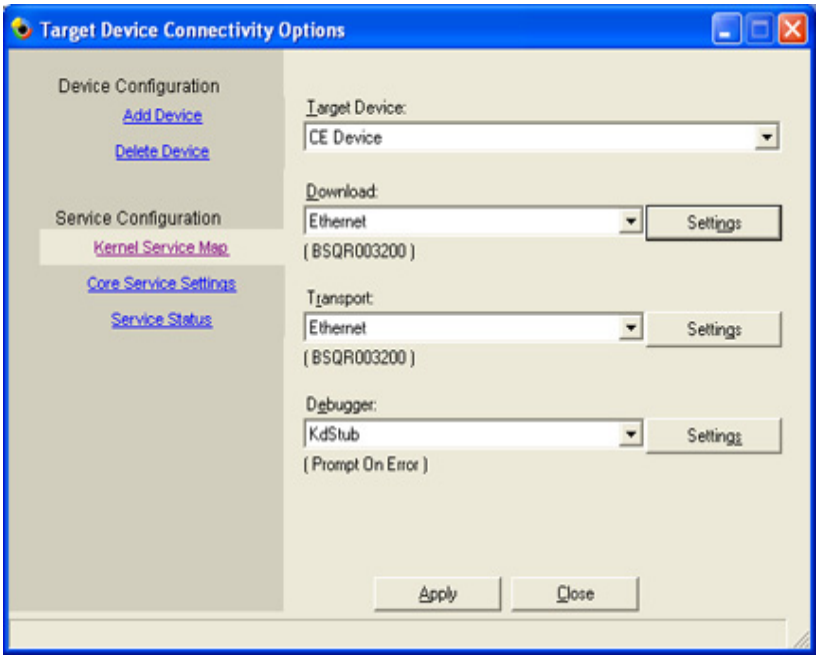
❖ *Configure connectivity options*

1. Select **Target | Connectivity Options…** from the Visual Studio menu. The **Target Device Connectivity Options** dialog will appear showing the Kernel Service Map configuration for the **CE Device** named connection.

2. Select **Ethernet** from the **Download** drop down box**.**

3. Select **Ethernet** from the **Transport** drop down box**.**

4. Select **KdStub** from the **Debugger** drop down box**.**



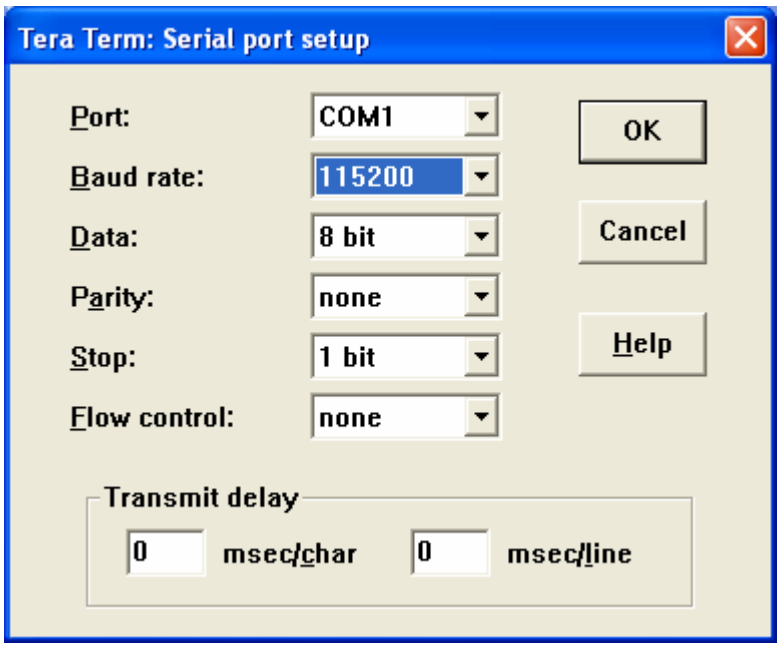
➢ **Change the device configuration**

The device has a number of configurable options.

5. Connect serial cable to UART3. Connect Ethernet cable to Ethernet jack

Note The device must be on the same subnet as host PC running PlatformBuilder

6. Open Terminal program on host PC (115200, N, 8, 1)



7. In the **Target Device Connectivity Options** dialog box in Visual Studio, Click the **Settings** button next to the **Download** drop down menu.

Note Steps 8 through 13 must immediately follow step 7. Read all of these steps and be prepared for the complete set of steps before performing step 7.

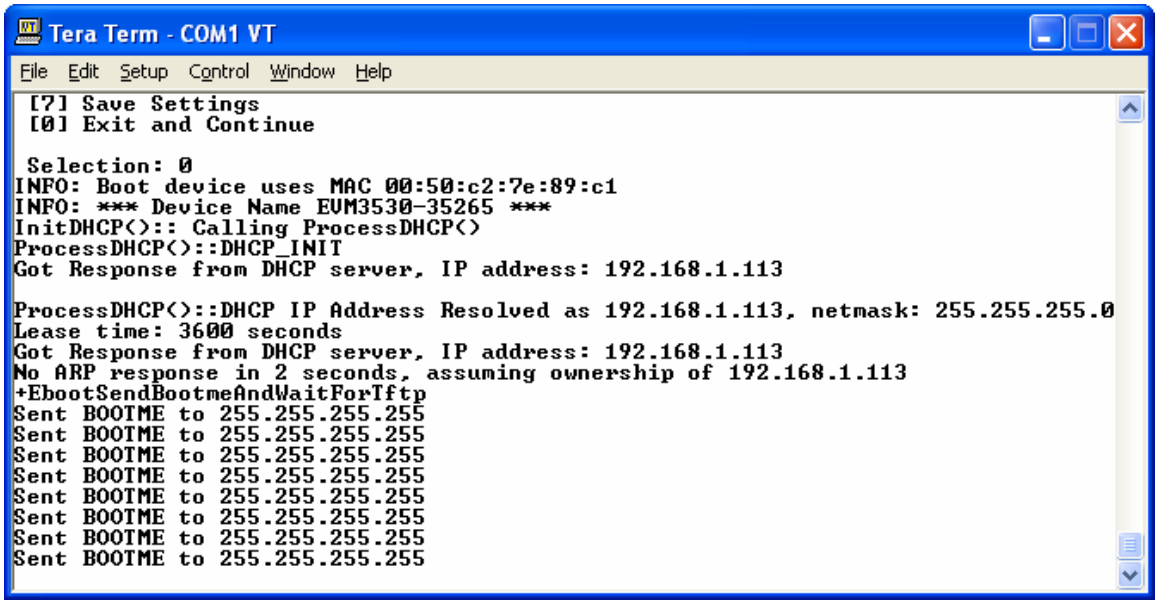
8. Power on the EVM Board. The power switch is located on the right side of the board by the power cord.

9. Status messages will be displayed on serial port and a 4 color boot screen will appear on the EVM Board. On first boot only the flash will be reformatted. This can be a lengthy operation, be patient.

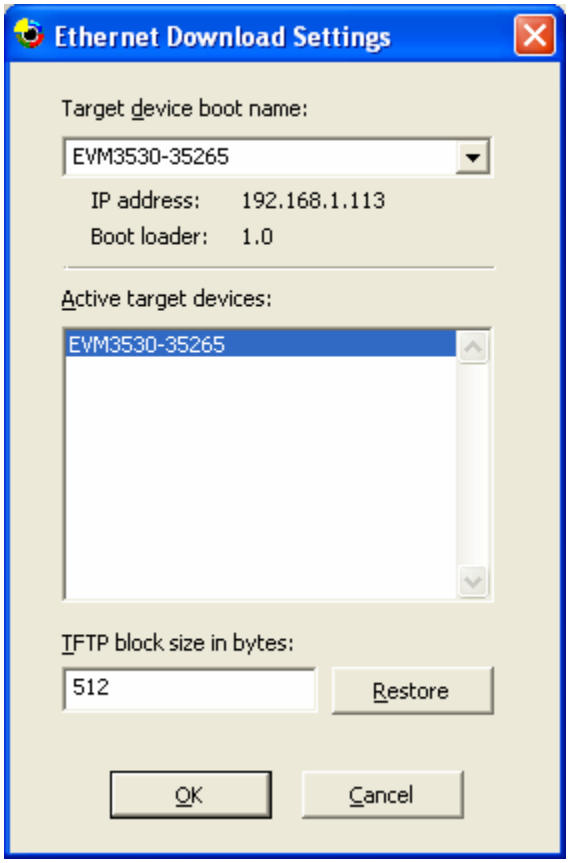
10. Monitor the boot loader progress using the serial terminal program.

11. Boot Menu appears on the EVM.

12. Wait for the EVM Board to get a DHCP address and broadcast BOOTME packets. . This will allow the Platform Builder to see your EVM on the network.



13. When the appropriate device name shows up in the **Active Target Devices** list in the **Ethernet Download Settings** dialog box, select it and click **OK**.

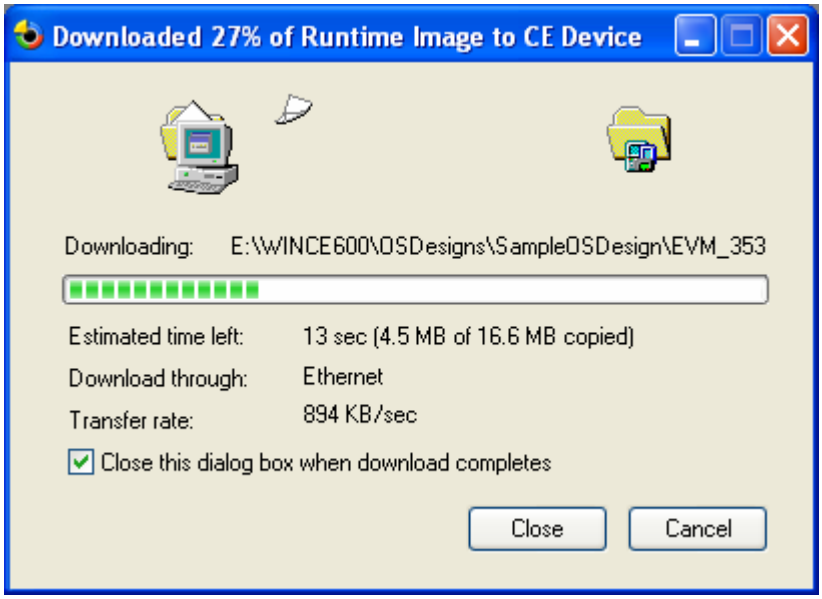


Note	In the case of your EVM board, the device name is based on the MAC address. Each platform actually has its own method of determining a device name, which it includes in its BOOTME packet.

❖ *Test your OS run time image on the Device*

1. Select **Target | Attach Device** from the Visual Studio menu.

Once the download has begun, wait for the transfer. It can take up to two minutes, during which the Platform Builder dialog will include a transfer rate and an estimated time to completion.



2. If the Download Runtime Image dialog remains open after the download completes, click **Close this dialog box when download completes** and then click **Close**.

3. After the device boots to the touch calibration screen, follow the instructions to calibrate the touch screen and continue.

Note During target device initialization and operation, diagnostic messages are displayed on the Debug tab of the Visual Studio output window. Some of these messages may sound serious, for example "OEMIoControl: Unsupported Code …" but do not indicate an error condition. Usually a serious error will be followed by additional failures or exceptions.

You will now be able to interact with the device and test the features of your new OS Design. Congratulations, you have successfully built and run your first Windows Embedded CE 6.0 OS Design!

If you are continuing with the next Hands-On Lab, keep your image running.

Lab 2-2: Develop and Test an Application Subproject

Objectives

- Create a simple Hello World application subproject
- Deploy the application to the device
- Debug the application running on the device

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

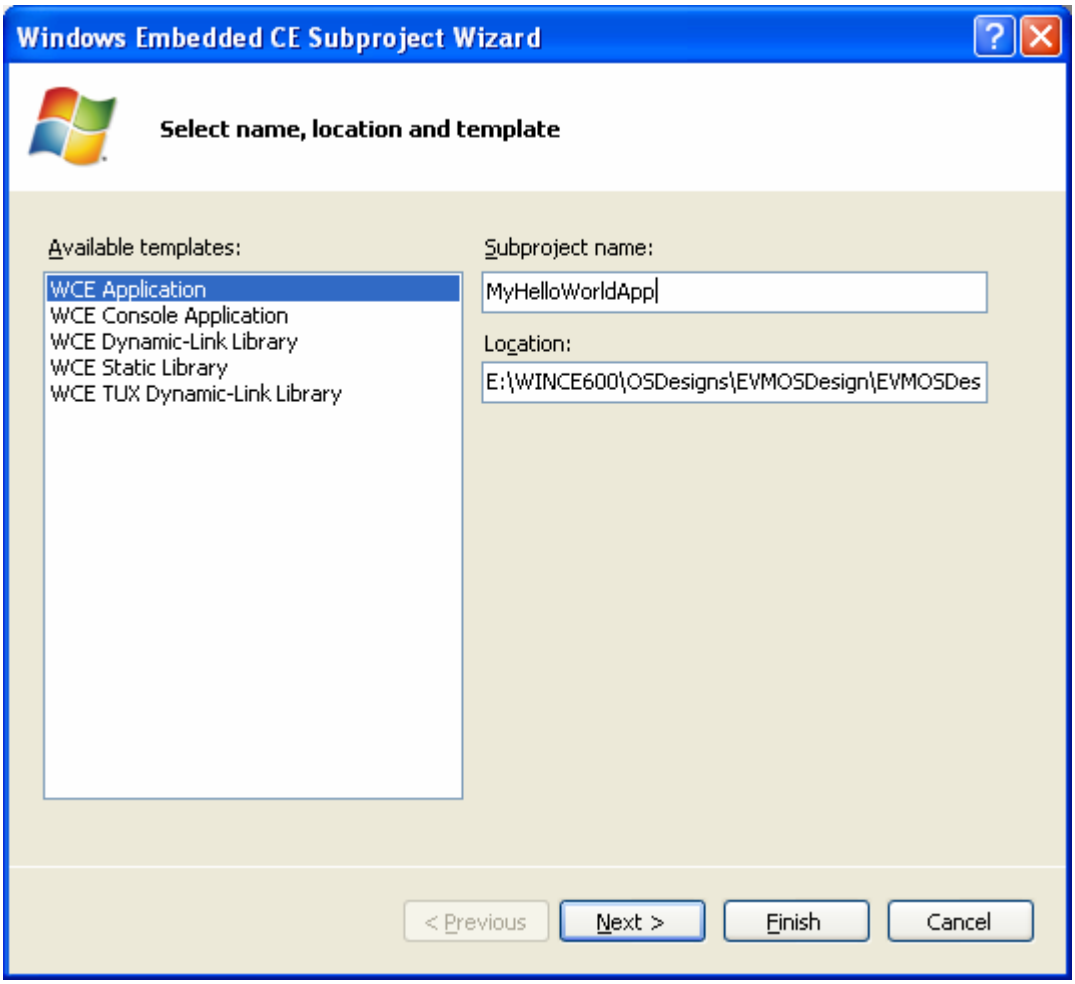
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Create and configure an application subproject

In this exercise you will create and configure an application subproject.

➢ Create the subproject

1. Click on the **Solution Explorer** tab to display the Solution Explorer.
2. Locate the **Subprojects** node below the **EVM_3530** project in the Solution Explorer window.
3. Right click on the **Subprojects** node and select **Add New Subproject...** The Windows Embedded CE Subproject Wizard will appear.
4. Select the **WCE Application** template.
5. Type **MyHelloWorldApp** in the **Subproject name** text box.



6. Click **Next**.

7. Select **A typical "Hello World" application** and click **Finish**. The wizard will create the files necessary for the typical Hello World application subproject.

- **Configure the subproject image settings**

We will configure the subproject settings so that we can easily debug it without needing to rebuild our OS Design. This is a good debugging technique that can save development time. We will use this same technique in most future labs.

1. Right click on the **EVM_3530 OSDesign** project in the Solution Explorer and select **Properties**.

2. From the **Configuration** drop down select **All Configurations**.

Note Remembering to select **All Configurations** can save a lot of time when switching between configurations. The following labs will reference this procedure and each time you should make sure to select **All Configurations** from the **Configuration** drop down.

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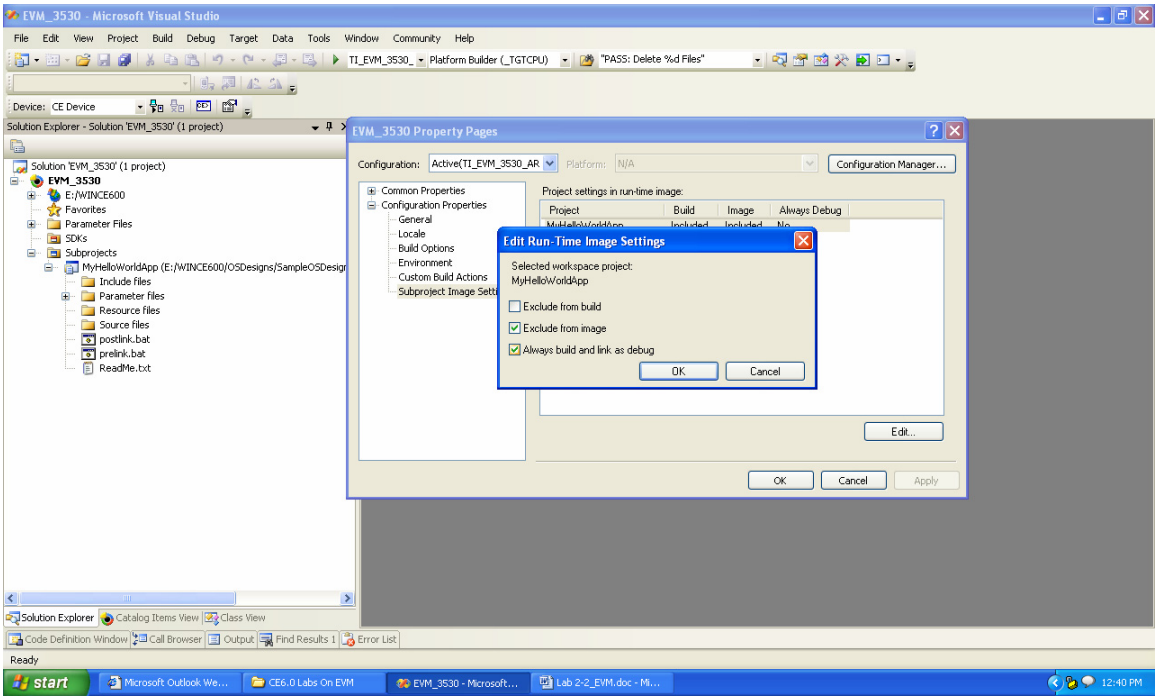
3. Expand the **Configuration Properties** node and select **Subproject Image Settings**.

4. Double click the **MyHelloWorldApp** entry in the **Project settings in run-time image** box. The **Edit Run-Time Image Settings** dialog box will appear.

5. Select the **Exclude from image** and **Always build and link as debug** check boxes, and click **OK**.

6. Click **OK** on the EVM_3530 OSDesign Property Pages dialog.



7. Select **Build | Targeted Build Settings** from the Visual Studio menu.

8. Ensure that **Make Run-Time Image After Building** does NOT have a check mark beside it. If it does, deselect it clicking on the menu item.

Note This step will prevent the OS run-time image from being rebuilt after we build individual subprojects. This setting will persist for all targeted builds through out the life of this OS Design.

➢ **Set a breakpoint in the application**

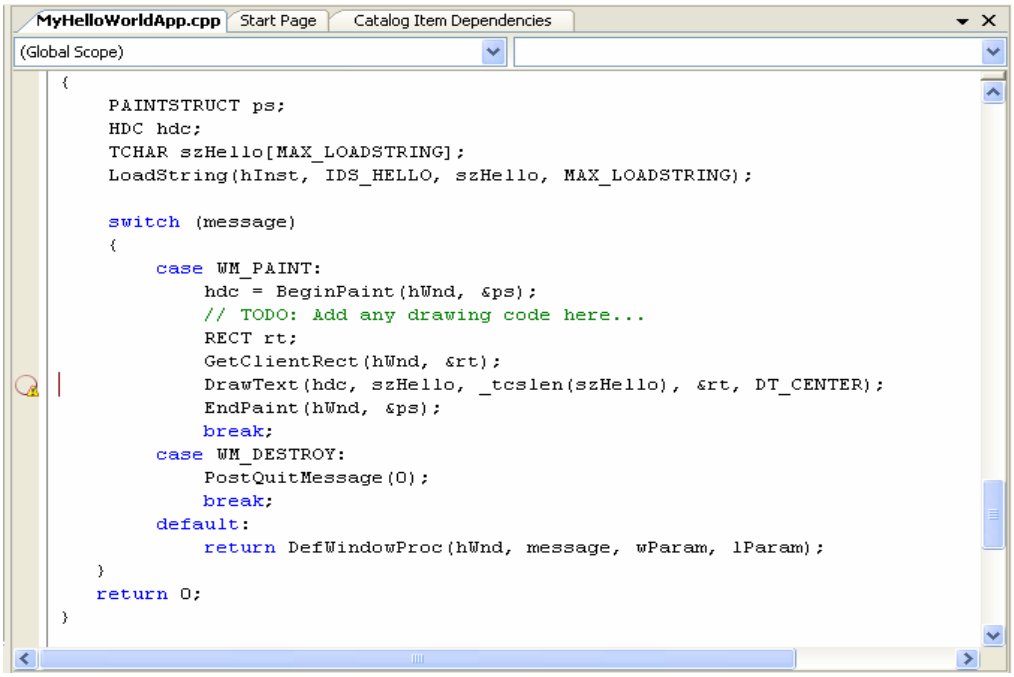
1. Locate and expand the **MyHelloWorldApp** subproject in the **Subprojects** node of the Solution Explorer.

2. Expand the **Source files** node of the **MyHelloWorldApp** subproject.

3. Double click the **MyHelloWorldApp.cpp** file. The file will load in the Visual Studio editor.

4. Locate the **WndProc()** function near the bottom of the file.

5. Click on the **DrawText(…)** function call and press **F9** to set a breakpoint there.



➢ Build and run your subproject

1. Right click the **MyHelloWorldApp** subproject in the Solution Explorer and select **Build**. The application will build and should complete with 0 errors and 0 warnings in the build output window.

Note Your Device instance should still be running from the previous lab. If it is not, you can restart it now by choosing **Target | Attach Device** from the Visual Studio menu.

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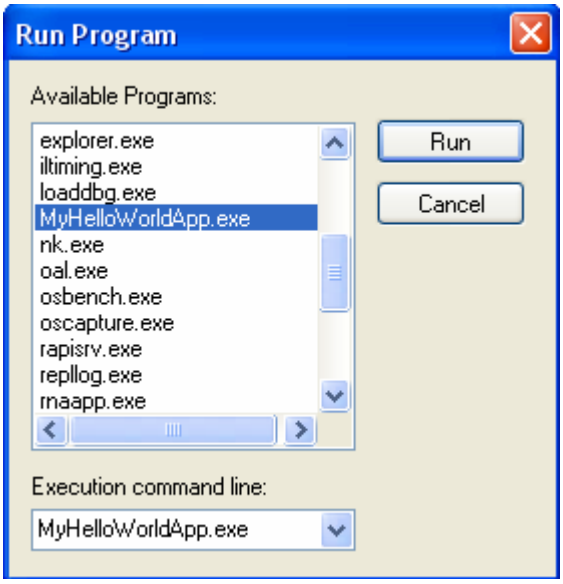
2. Select **Target | Run Programs…** from the Visual Studio menu.

3. Select **MyHelloWorldApp.exe** from the Available Programs box, and click on **Run.**



The kernel debugger will halt execution at the breakpoint we just set. Notice the yellow arrow inside the red circle at the line where we set our breakpoint in the source code file. This indicates the next statement to be executed.

4. Look at the **EVM Board.** Notice that the MyHelloWorldApp application is running, but the Hello World! string has not yet been drawn on the display.

5. Press **F10** or select **Debug | Step Over** from the Visual Studio menu.

6. Look at the **EVM Board** again. Notice that the Hello World! string has now been printed on the display.

7. Press **F5** or select **Debug | Start** to allow the EVM to continue running.

Note The sample application does not include a mechanism to allow it exit. We must close the application using the capabilities of the development environment.

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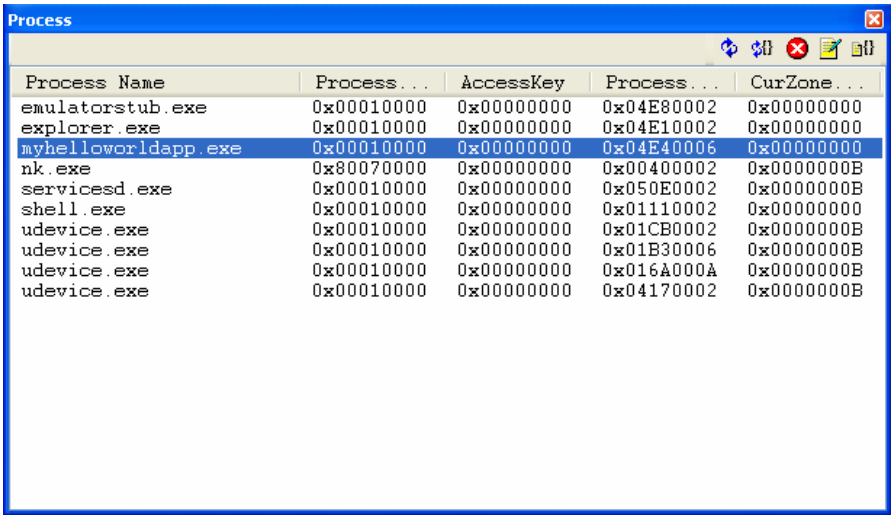
8. Select **Debug | Windows | Processes** to bring up the **Process** window. This window shows all processes running on the Device.



9. Right click on the **myhelloworldapp.exe** process and select **Terminate** to kill the process.

10. Select **Yes** to verify. The Process window will refresh after a short delay and the application will be gone.

11. Close the **Process** window by clicking on the **X** in the upper right hand corner.

Congratulations! You have successfully created, built and tested a simple Windows Embedded CE 6.0 application on your OS Design. We will follow a similar methodology in future labs.

If you are continuing with the next Hands-On Lab, keep your image running.

Lab 2-3: Using the Remote Tools

Objectives:

- Use the Remote System Information tool to see information about your device
- Use the Remote File Viewer to explore and change files on your device
- Use the Remote Performance Monitor to examine system resource loading

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Using the Remote File Viewer

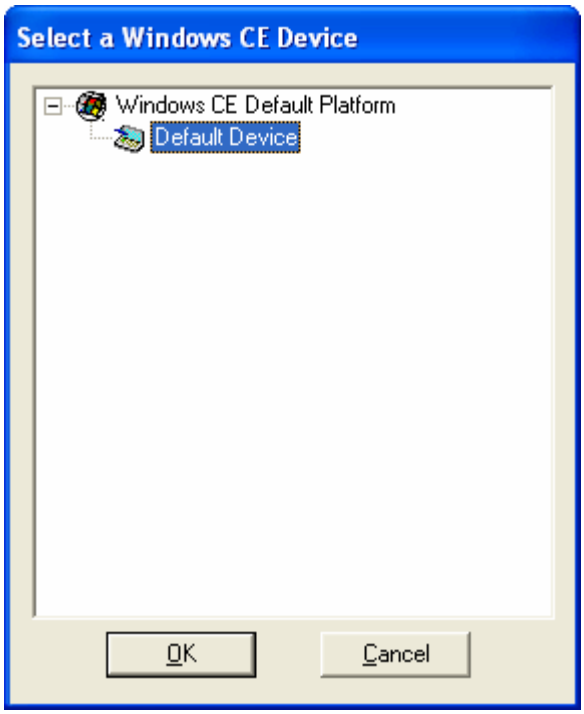
In this exercise you will use the Remote File Viewer to transfer files between your development workstation and EVM CE 6.0 target device.

Note Your Device should still be running from the previous lab. If not, restart it by selecting **Target | Attach Device** from the Visual Studio menu.

➢ **Starting the Remote File Viewer**

1. Select **Target | Remote Tools | File Viewer** from the Visual Studio menu. The **Select a Windows CE Device** dialog will appear.

2. Expand the **Windows CE Default Platform** node and select **Default Device.** Click **OK**. Visual Studio will begin transferring the required files for the Remote File Viewer to the EVM.



Note You will get a dialog box asking for the location of an executable. This is because the kernel debugger running on the device is attempting to monitor all processes that run on the device, including the remote tools. This can not be done because the debugging information is not available for these tools, and we can safely ignore the request. We will configure Visual Studio to suppress these dialogs in the future. Note that this issue only occurs because we have left the kernel debugger running inside our OS run-time.

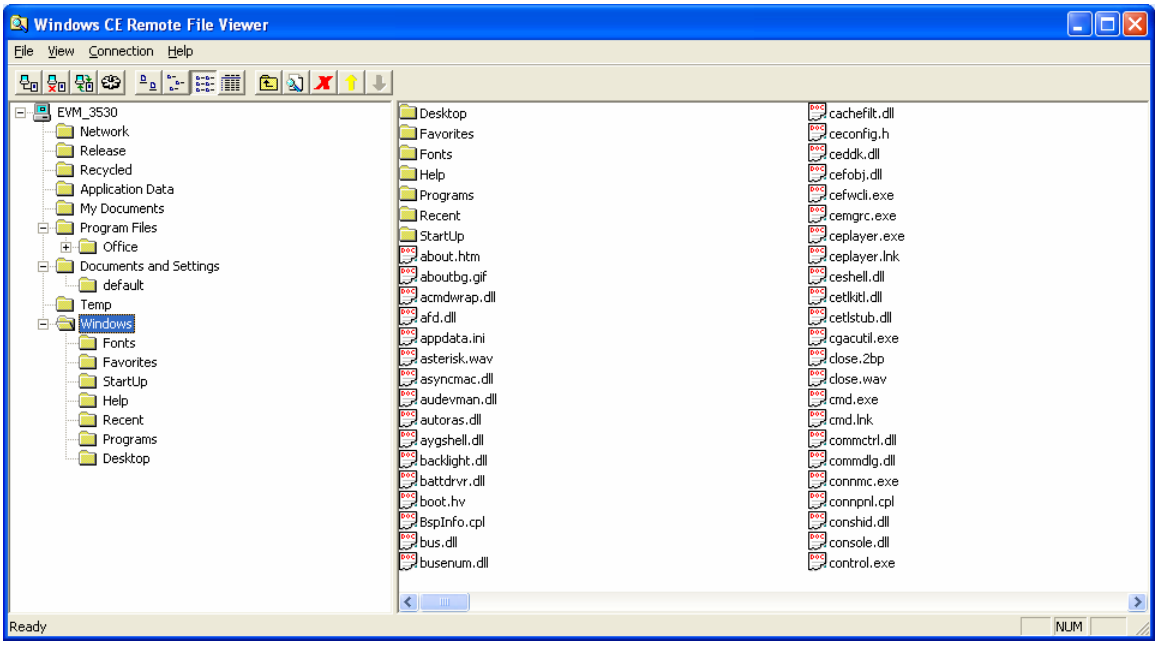
3. Select **Don't display this dialog again** in the **Find Executable** dialog box, and select **Cancel**. The Remote File Viewer tool should connect.

Note The Remote File Viewer may not connect if there has been too long of a delay while you were canceling the Find Executable dialog. If this occurs, you will need to restart the EVM by selecting **Target | Detach Device** followed by **Target | Attach Device**.

➢ **Explore the device file system**

4. Expand the **Default Device** node in the left hand pane and select the **Windows** directory. The right hand pane shows a list of the files in the Windows directory on the target device.

5. Select **View | Details** from the Remote File Viewer menu to see the details of each file in the folder.



➢ **Copy a file from the target device to the development workstation**

6. Select **WindowsCE.jpg** in the right hand pane. We will copy this file from the device to the PC.

7. Select **File | Import File** from the Remote File Viewer menu.

8. Save the **file** to a convenient folder on your development workstation desktop.

- **Copy a file to the target device**

9. Select the **Desktop** folder in the right hand pane of the Remote File Viewer. Expand the Windows folder, if necessary, to find the Desktop folder. Select **File | Export File** from the Remote File Viewer menu.

10. In the **Export File** dialog select the **WindowsCE.jpg** file from the development workstation and click Open. The file will be transferred from the development workstation to the device.

11. Close the **Remote File Viewer** application.

Exercise 2 Remote System Information

In this exercise you will use the Windows CE Remote System Information tool to examine system settings and properties of the EVM running your OS Design.

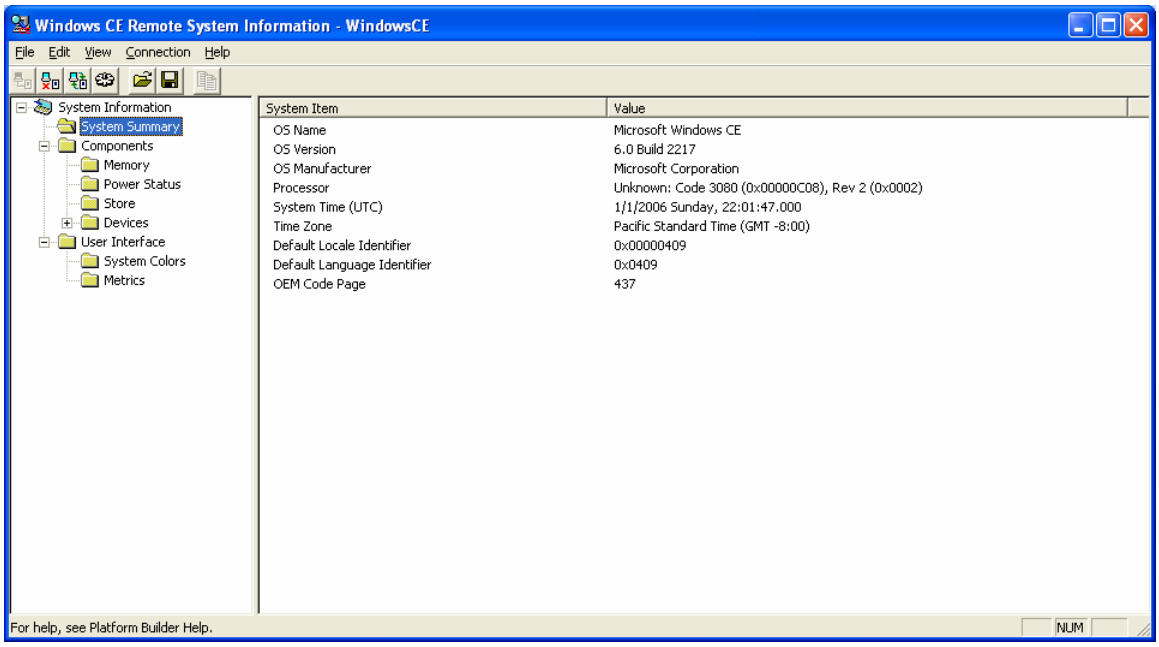
➢ **Launch the Remote System Information tool**

1. Select **Target | Remote Tools | System Information** from the Visual Studio menu.

2. Select **OK** to accept the Default Device configuration. There will be a delay while the System Information tool is transferred to the device and gathers information.

➢ **Explore System Information data**

3. Expand the **System Information** node and select **System Summary**. Details of the OS version, current time and time zone settings, and locale are presented on the right-hand pane.



4. Select **Components | Memory** in the left hand pane. The total and available memory, the fraction of program memory in use (Memory load), the amount of memory allocated to the object store, and other system memory statistics are reported.

5. Expand **Components | Devices** in the left hand pane. Observe the list of devices detected. You can click on individual devices to see information available about each device.

6. Browse the other information available from the tool.
7. Close the **Windows CE Remote System Information** tool.

Exercise 3 Remote Performance Monitor

In this exercise, you will use the Windows CE Remote Performance Monitor to log consumption of system resources and other performance related metrics on a EVM CE 6.0 target device.

➢ **Launch the Remote Performance Monitor**

1. Select **Target | Remote Tools | Performance Monitor** from the Visual Studio menu.

2. Click **OK** to use the Default Device connection. The Windows CE Remote Performance Monitor tool will load and show the Chart view.

➢ **Add Performance counters to the Chart view**

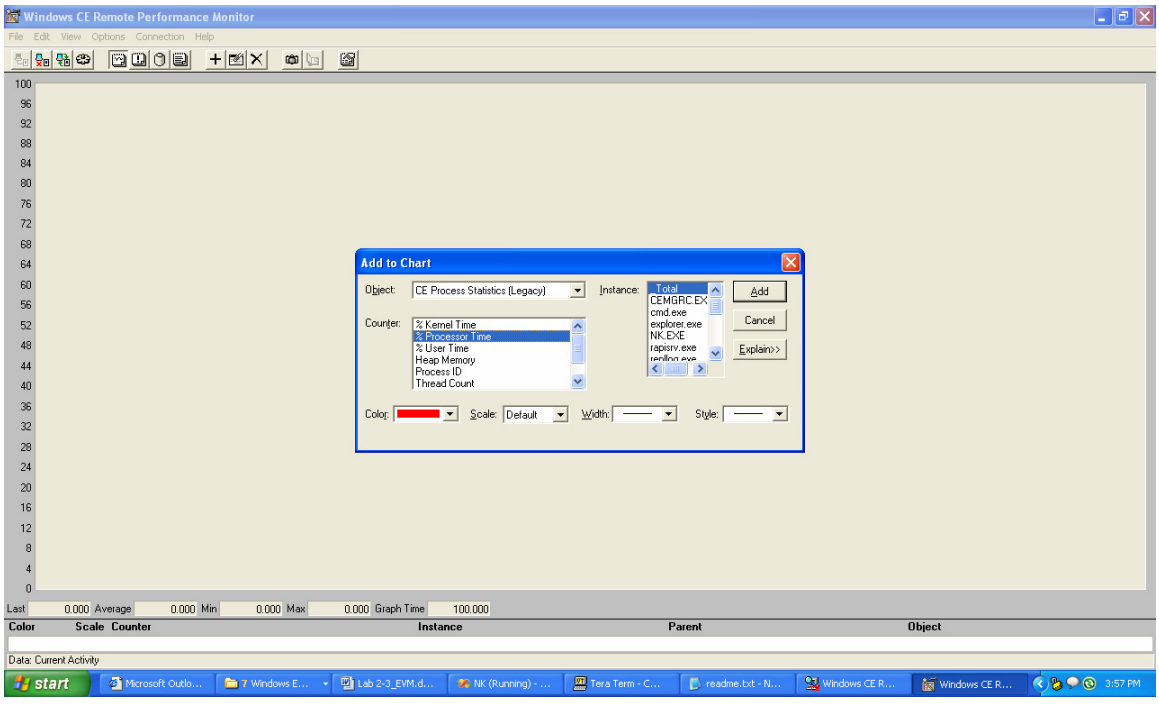
3. Select **Edit | Add to chart** from the Remote Performance Monitor tool to bring up the Add to Chart dialog.

4. Select **CE Process Statistics** from the **Object** drop down box.

5. Select **% Processor Time** from the **Counter** drop down box**.**

6. Select **_Total** from the **Instance** drop down box.

7. Click on **Add**.

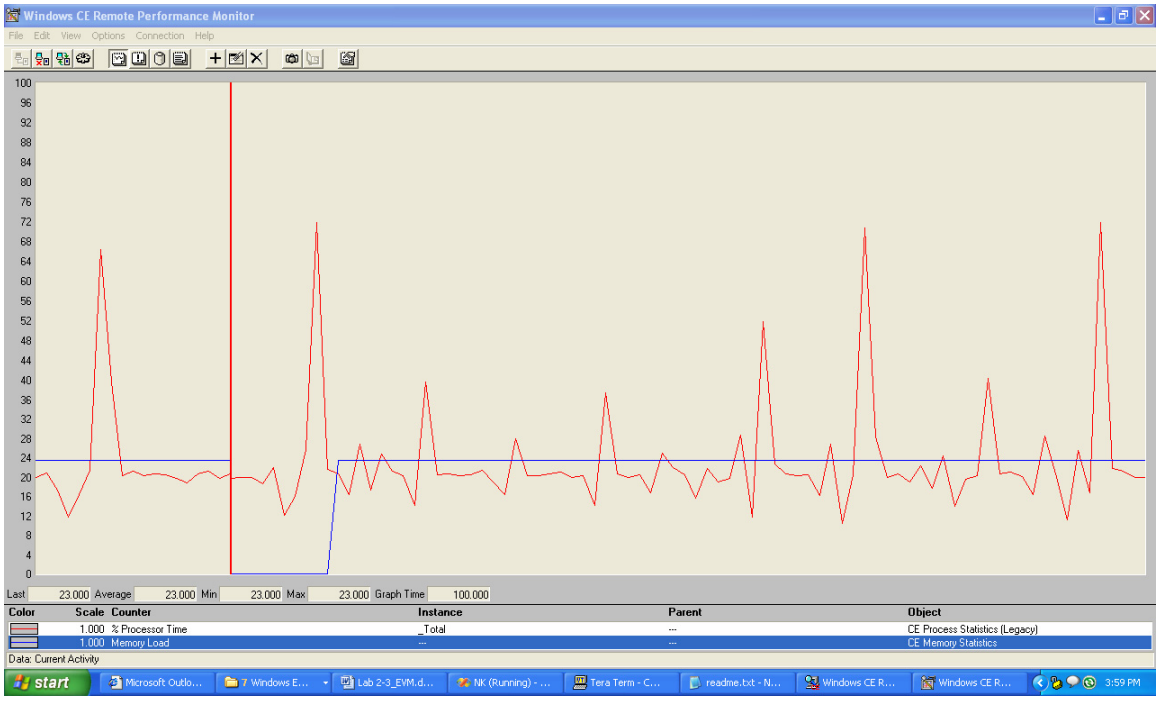


8. Select **CE Memory Statistics** from the **Object** drop down box.

9. Select **Memory Load** from the **Counter** drop down box.

10. Click **Add** and then click **Done**.

11. On the Windows CE desktop, drag an icon rapidly and note the increase in **% Processor Time**.



➢ **Create an Alert view and add performance counters**

12. Select **View | Alert** from the Remote Performance Monitor menu.

13. Select **Edit | Add to Alert…**.

14. Select **CE Process Statistics** from the **Object** drop down box.

15. Select **% Processor Time** from the **Counter** list.

16. Select **_Total** from the **Instance** list.

17. Select the **Over** radio button in the **Alert if** group and enter the number **10**.

18. Click on **Add** and then **Done**.

19. Open **My Device** on the device desktop to generate processor activity. The configured alert should fire.

20. Close the **Remote Performance Monitor** tool.

If you are continuing with the next Hands-On Lab, keep your image running.

Lab 3-1: Using the Remote Process Viewer

Objectives

- Use the Remote Process Viewer to explore the processes and threads running on a Windows Embedded CE 6.0 device

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 15 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1

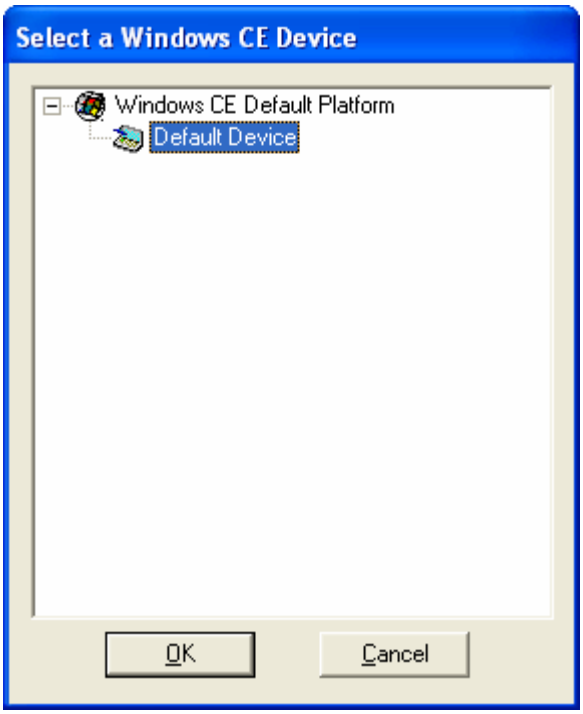
In this exercise, you will use the Windows CE Remote Process Viewer to examine the processes and threads running on a Windows CE target device.

Note	Your Device should still be running from the previous lab. If not, restart it by selecting **Target | Attach Device** from the Visual Studio menu.

➢ **Launch the Remote Process Viewer**

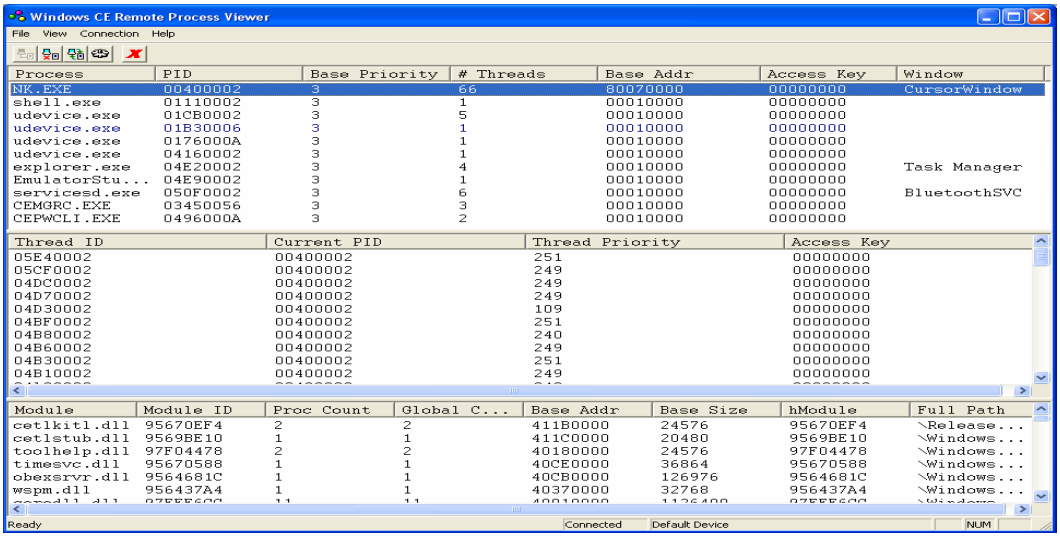
1. Select **Target | Remote Tools | Process Viewer** from the Visual Studio menu.

2. Click **OK** to use the **Default Device** connection. The Windows CE Remote Process Viewer tool will load.

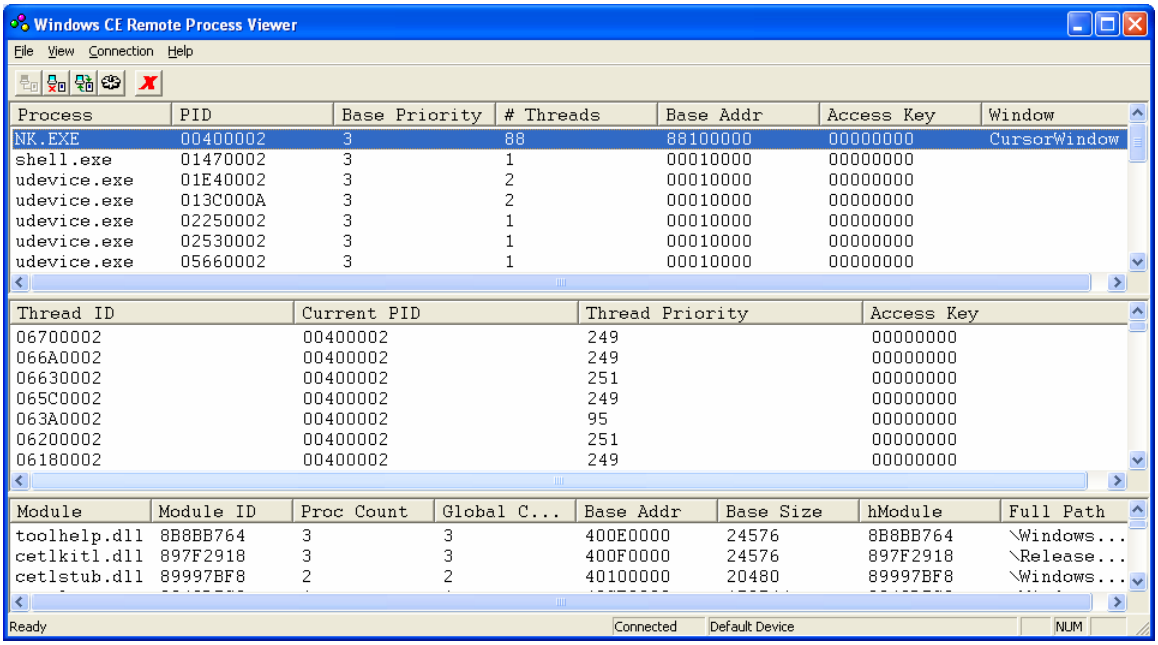


➢ **Explore running processes and threads**

3. Examine the list of active **processes** in the upper pane.



4. Click on **NK.EXE** in the Process pane. Thread details are presented in the center pane.

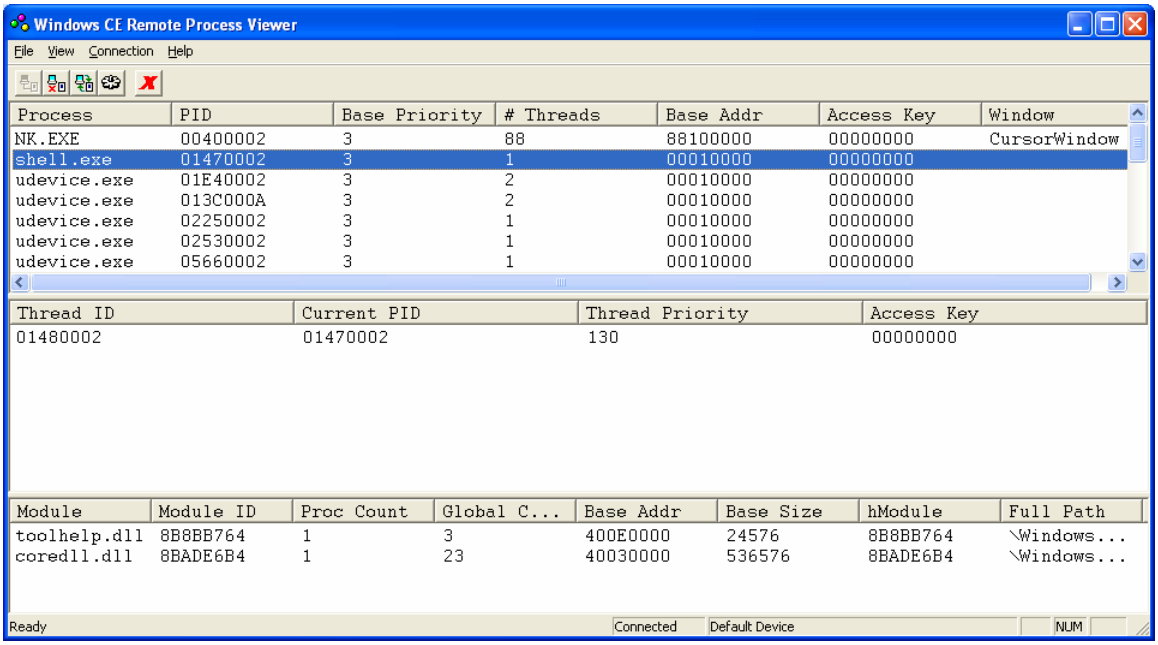


5. The DLLs loaded by a process are listed in the lower ‘Module’ pane. Note the base address of **coredll.dll**.

Module	Module ID	Proc Count	Global Count	Base Addr	Base Size
toolhelp.dll	97F04478	2	2	40180000	24576
timesvc.dll	95670588	1	1	40CE0000	36864
obexsrvr.dll	9564681C	1	1	40CB0000	126976
wspm.dll	956437A4	1	1	40370000	32768
coredll.dll	97FFE6CC	11	11	40010000	1126400
ceshell.dll	955F1AD4	1	1	40D10000	491520
ssllsp.dll	956345A4	1	1	403B0000	94208
msim.dll	956218C8	1	1	402E0000	102400
fpcrt.dll	97F109C0	2	2	40130000	98304
btdrt.dll	95621600	1	1	404D0000	110592
btsvc.dll	956214C8	1	1	404F0000	77824

Ready Connected

6. Click on **shell.exe** in the Process pane. This process has one thread and loads two modules. Note that coredll.dll is loaded at the same base address in **shell.exe** as it was in **NK.EXE**.



7. Click on **explorer.exe** in the Process pane. This process has many threads and many loaded modules. Scroll to the bottom of the module list. Note that **coredll.dll** is loaded at the same base address as in the other processes.

8. Close the **Remote Process Viewer**.

If you are continuing with the next Hands-On Lab, keep your image running.

Lab 3-2: Exploring the Heap

Objectives

- Become familiar with the Windows Embedded CE 6.0 heap

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

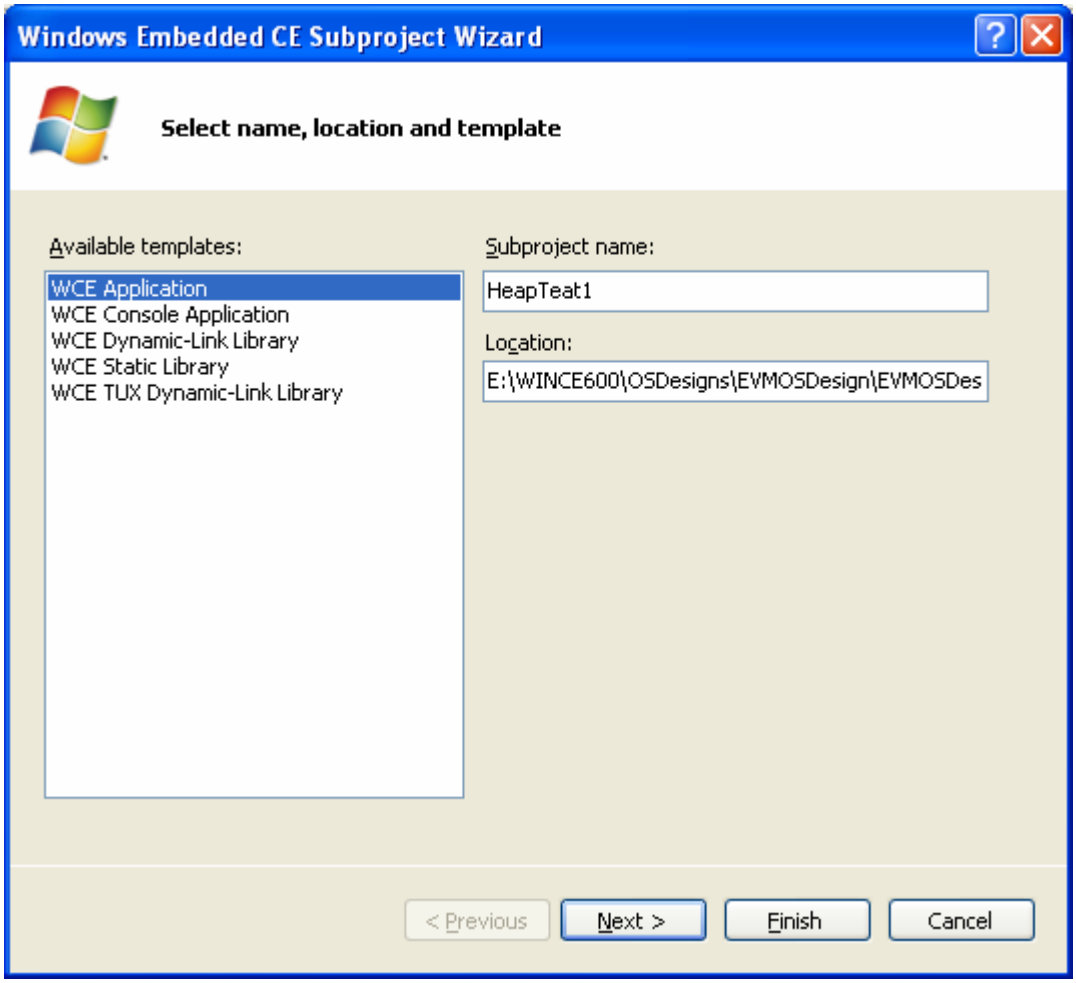
Exercise 1 Create and build the HeapTest1 subproject

The purpose of this exercise is to create, configure and build the subproject that we will use to examine the Windows Embedded CE 6.0 heap.

➢ Create HeapTest1 Subproject

1. Select **Project | Add New Subproject…** from the Visual Studio menu.

2. Enter the **WCE Application** subproject name: **HeapTest1** as shown below.



Note	By default, new subprojects are located in the current OS Design folder.

3. Click **Next** to continue the New Subproject Wizard.

4. Select **A simple Windows Embedded CE application**.

5. Click **Finish** to finish the wizard. The **HeapTest1** subproject can be accessed in the Subprojects folder in Solution Explorer.

➢ **Configure Subproject For Debug**

6. From the Solution Explorer, right-click on the **EVMOSDesign** project and select **Properties.**

7. Expand the Configuration Properties tree select **Subproject Image Settings**.

8. Select **All Configurations** from the Configuration drop down.

9. Double click the **HeapTest1** subproject to bring up the **Edit Run–Time Image Settings** dialog.

10. Check the boxes **Exclude from image** and **Always build and link as debug** and click **OK**.

Note **Exclude from image** will prevent the subproject from being included in the OS run-time image if it is built in the future. This is one way to allow the application to be run directly from the operating system build output folder (typically referred to as the flat release directory.)

Always build and link as debug will make the kernel debugger experience better by disabling compiler optimizations in a release build for this application.

---

11. Click **OK** to close the EVMOSDesign Property Pages dialog.

➢ **Build the application subproject**

12. Right click on the HeapTest1 subproject in the Solution Explorer and select **Build**. The application should build with zero errors and warnings.

Note This is referred to as a **Targeted build**. We built a specific subproject in the Solution Explorer. Builds that are initiated from the Visual Studio Build menu will cause the entire solution or project to be built (sometimes referred to as a **Global build**).

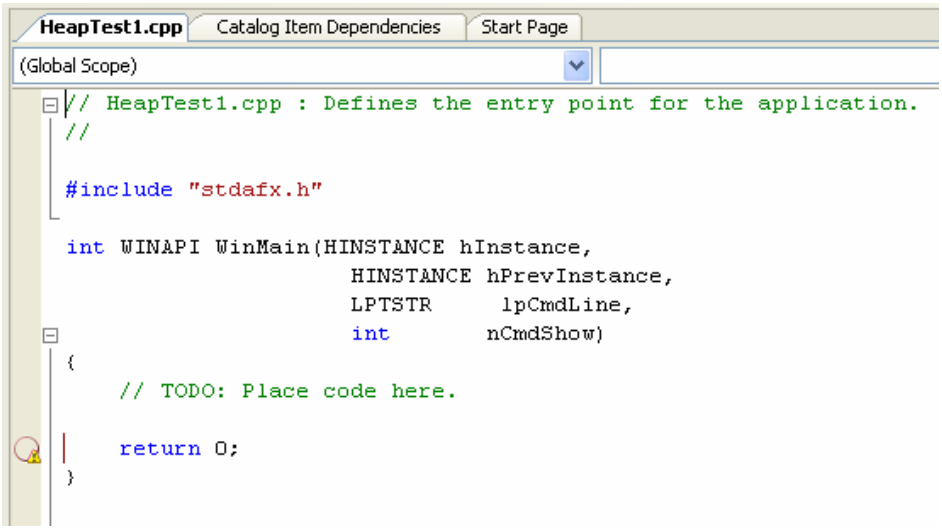
Global builds and Targeted builds can be separately configured with regard to whether they also cause the OS run-time image to be rebuilt. These settings are located in **Build | Global Build Settings** and **Build | Targeted Build Settings** from the Visual Studio menu. We previously configured the Targeted Build Settings not to rebuild the OS run-time image.

➢ **Set a breakpoint in the application**

13. Expand the **HeapTest1** subproject in the Solution Explorer.

14. Open the **Source files** branch and double-click on the **HeapTest1.cpp** file to open it in the Visual Studio editor.

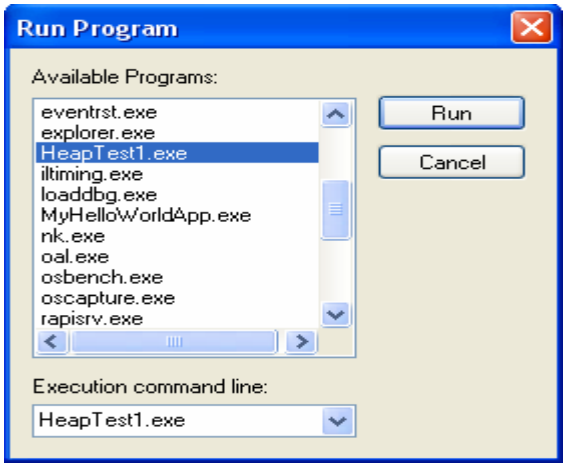
15. Set a breakpoint in this source file by clicking on the **return** statement and pressing **F9**. We will know that we have built and run the application successfully when we hit this breakpoint.



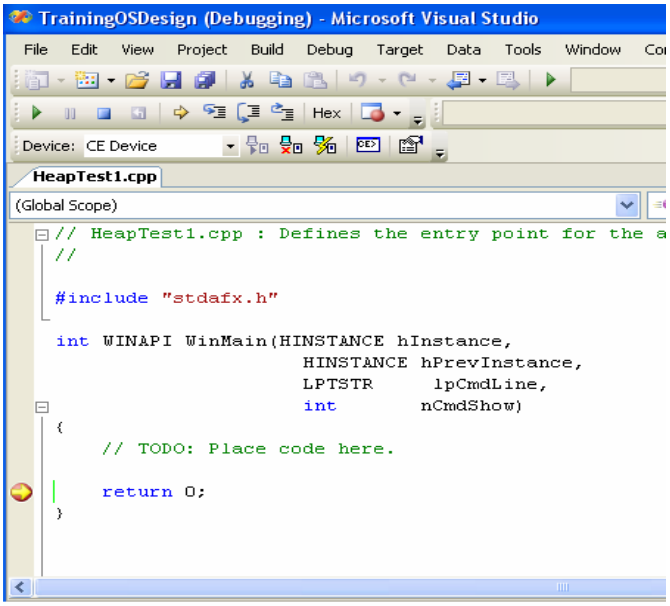
➢ **Run the application on the target device**

16. Select **Target | Run Programs** from the Visual Studio menu to bring up **Run Program** dialog.

17. Select **HeapTest1.exe**, and click **Run**.



18. Observe that the kernel debugger halts execution at the previously set breakpoint. We have successfully created, built and run our application.



19. Leave the application at the breakpoint.

Exercise 2 Explore Process Model of Simple Application

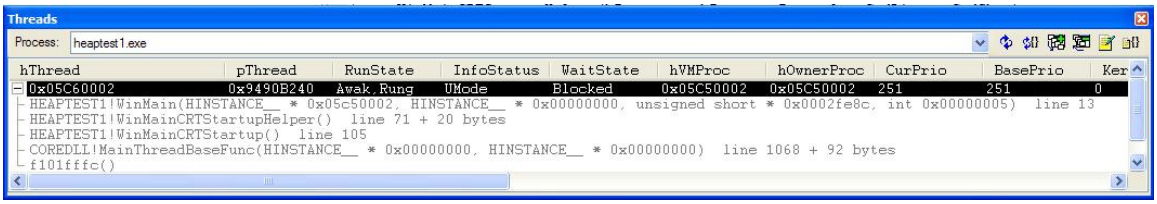
This exercise will use some of the debug capabilities of Platform Builder to explore some features of the HeapTest1 application.

➢ Examine HeapTest1 process details

1. Select **Debug | Windows | Threads** from the Visual Studio menu to bring up the **Threads** window. This window will allow you to see information for all the threads in a particular process,

2. Select **heaptest1.exe** from the **Process** drop down box. Note that heaptest1.exe has a single thread running at the default thread priority.

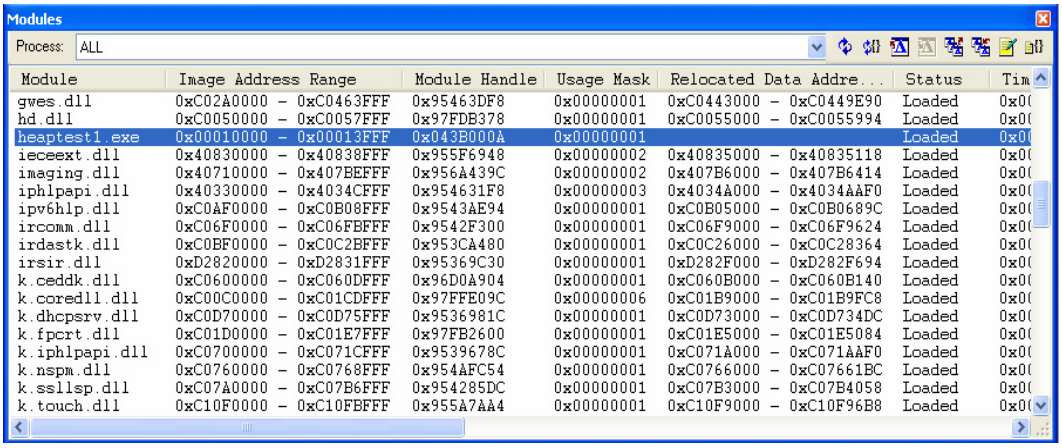
3. Expand the thread node to show the **call stack**.



Note You can double click on any of the entries in the call stack to attempt to see the source code at that point. If you have installed the Shared Source you would be able to view the source code for these functions. Otherwise you will see the disassembly view.

4. Close the **Threads** and **Call Stack** windows.

5. Select **Debug | Windows | Modules** from the Visual Studio menu. The **Modules** window will appear. This view shows all modules running on the target device.



6. Observe that the heaptest1.exe module has an Image Address starting at 0x00010000. This same starting address is used by all processes on the device with the exception of nk.exe.

7. Select **heaptest1.exe** from the **Process** drop down box. This shows just the module information related to the heaptest1.exe process.

8. Observe that the only module listed other than heaptest1.exe is **coredll.dll**. Coredll.dll is generally loaded by every process as it provides access to most system APIs.

9. Close the **Modules** window.

10. Press **F5** to allow this application to continue running, and it will exit.

- **Remove breakpoint**

11. Click on the line containing the breakpoint in **heaptest1.cpp**

12. Press **F9** to remove the breakpoint.

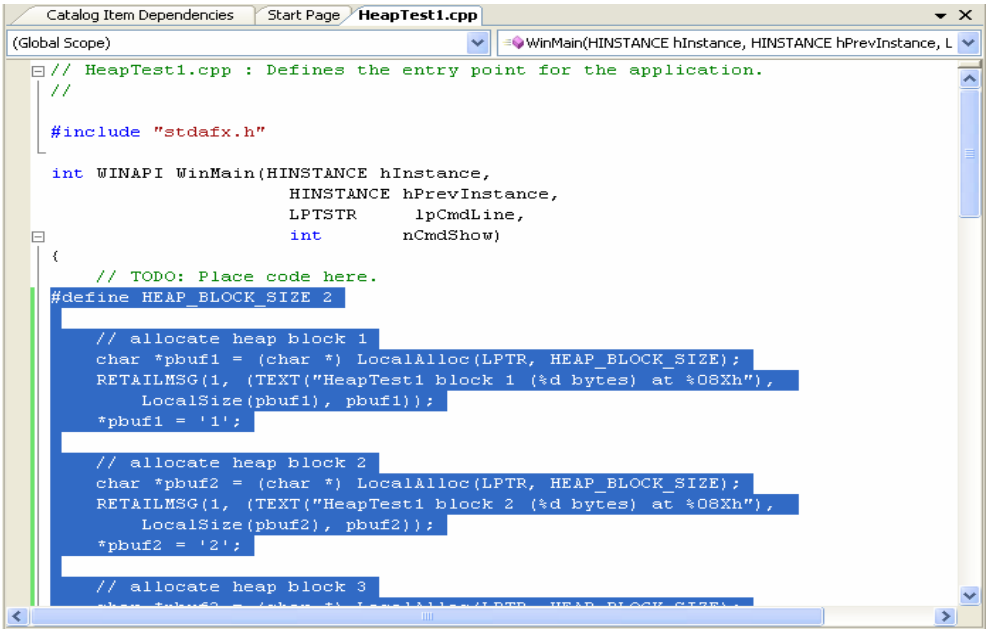
Exercise 3 Local Heap

The purpose of this exercise is to explore the implementation of Local Heap memory in a simple Windows CE application. This application will allocate a number of blocks, free the blocks and allocate the blocks again. You will use Platform Builder tools to view the heap structures and to demonstrate the behavior of the heap management algorithm.

➢ Copy HeapTest1 code to HeapTest1.cpp

1. Open **HeapTest1.cpp** file from **HeapTest1** subproject if not already open.

2. Open **Lab 3-2 HeapTest code.txt** file from the Student files, and then copy the code snippet to HeapTest1.cpp as below.



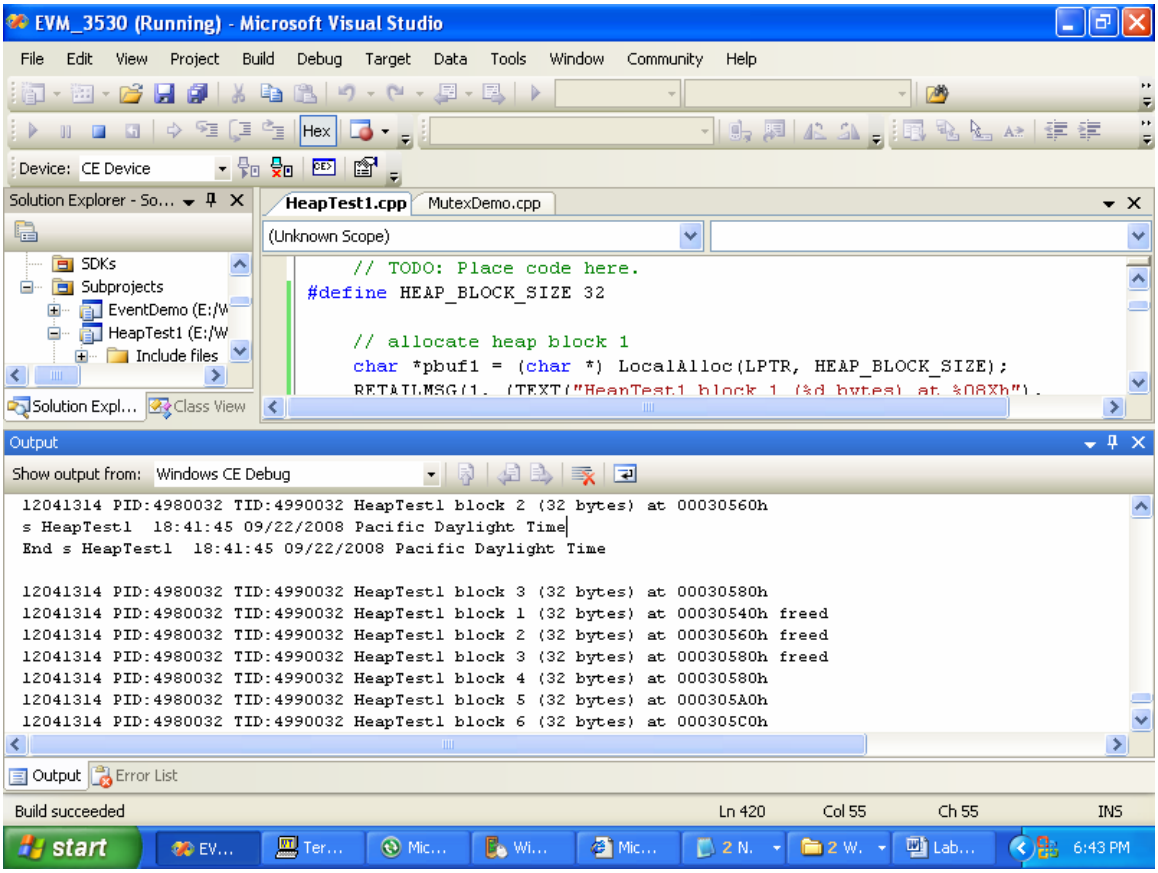
3. Save **HeapTest1.cpp**.

➢ Build and run HeapTest1.exe

4. Right click on the HeapTest1 subproject in the Solution Explorer and select **Build**.

5. Run **HeapTest1.exe** using the **Target | Run Programs** menu in Visual Studio.

6. Examine the debug output window in Visual Studio, which should be similar to the following:



Three identically sized blocks were allocated from the local heap and then freed in the same sequence they were allocated. Three more identically sized blocks were then allocated again.

Observe the addresses of each heap allocation in the debug output. Notice that the second group of allocations did not start at the same point as the first group even though those blocks had been freed and were available for use. Instead, the second set of allocations was given addresses starting with the address of the last item in the original group. The virtual address range that originally backed the first two memory allocations is now unused.

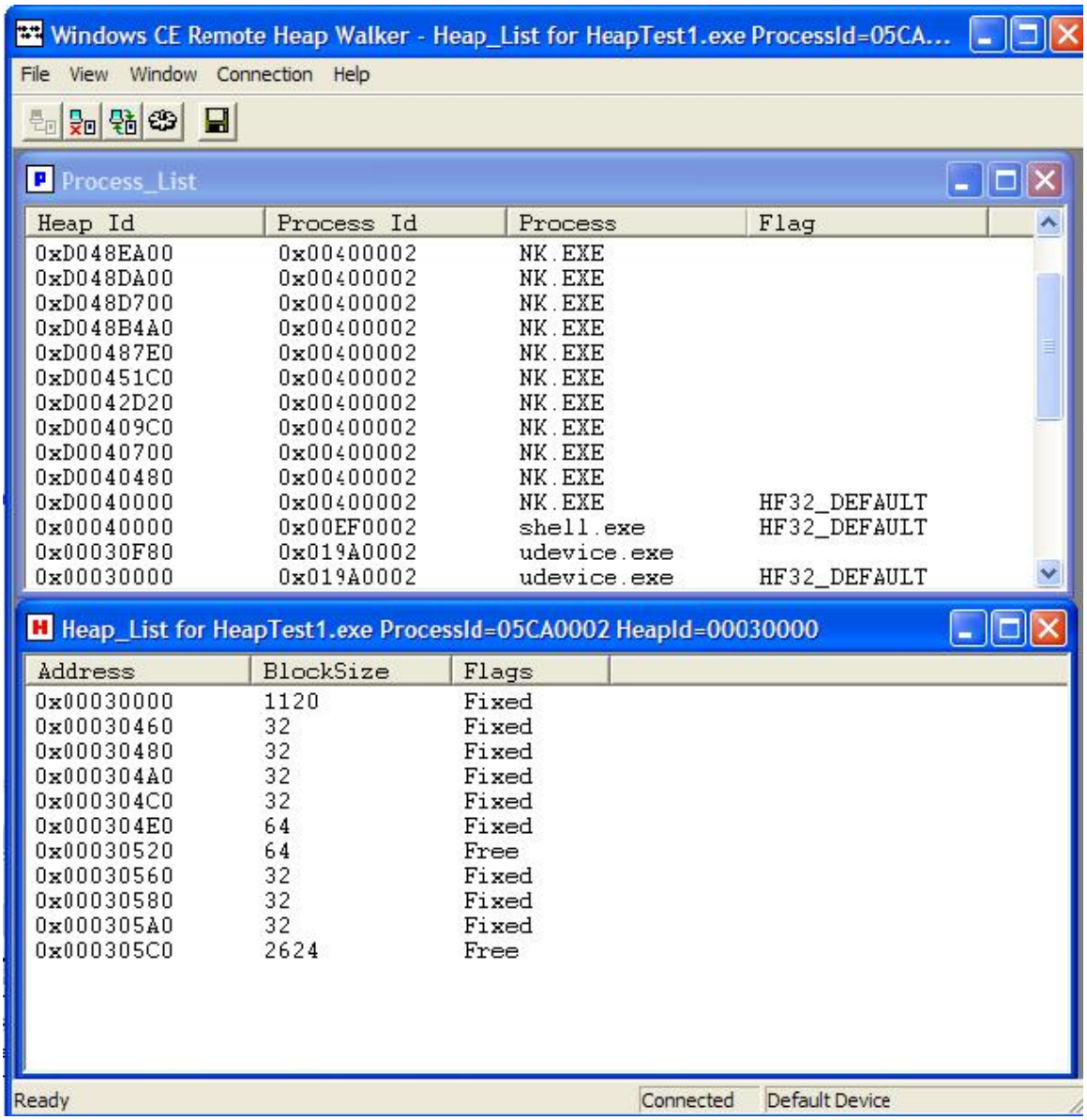
This demonstrates one of the characteristics of Windows Embedded CE 6.0 heaps. New heap allocations are taken from the last allocated or freed item first; the heap manager does not start allocation attempts at the beginning of the heap. In this case, only block 3 was reused because it was the last one previously freed. The virtual memory would have been used more efficiently if the application had freed the memory in the reverse order that it had been allocated.

➢ Run Remote Heap Walker Viewer

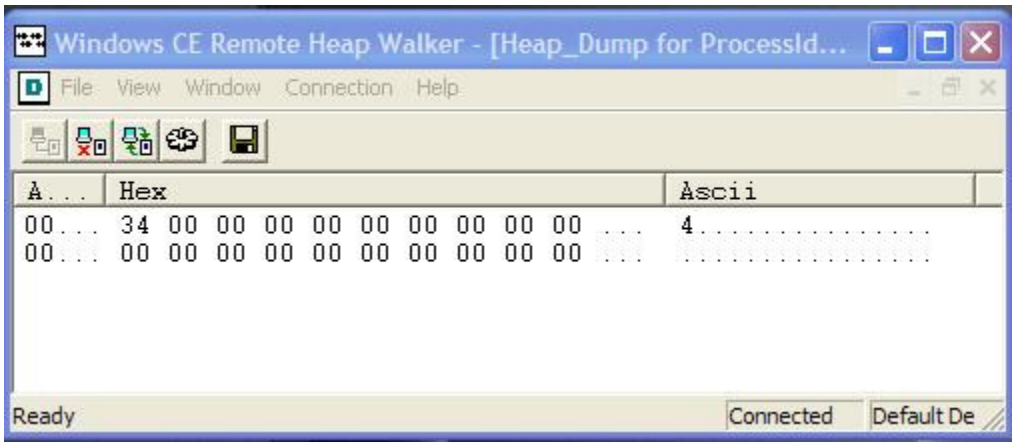
7. From the Visual Studio Platform Builder menu, select **Target | Remote Tools | Heap Walker.**

8. Click **OK** to select the **Default Device** configuration. The Remote Heap Walker window will appear.

9. Double click on the line containing **HeapTest1.exe** in the process list. A second window containing the process heap information will appear.



10. Double click on the heap entry at the **address** corresponding to **block 4** in the debug window. This will be the first Fixed block after the first Free block.



11. Observe the first byte is a '4' (0x34). This entry was written by the HeapTest1 application to identify its memory block.

12. Take some time and explore the source code to the application and what the tools can tell you about it. Step through the code and examine the various Platform Builder tools as you go through. This code could be used as a starting point to examine other aspects of heap management.

13. Close the **Remote Heap Walker** window.

- **Terminate the HeapTest1 application**

14. Select **Debug | Windows | Processes** from the Visual Studio menu.

15. Right click on the **heaptest1.exe** process and select **Terminate**.

16. Click **Yes** to confirm.

17. Close the **Processes** window.

If you are continuing with the next Hands-On Lab, keep your image running.

Lab 3-3: Scenario - Fixing a Memory Leak

Objectives

- Use the Target Control utility to identify a memory leak

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Virtual memory leak

QA is testing the functionality of some utilities that were written for your new CE 6.0 device. The utilities initially appeared to work correctly, however during the QA phase one application continues to lock up the system. A memory leak is suspected. You have been asked to take a look at the utility to identify the problem and solve it.

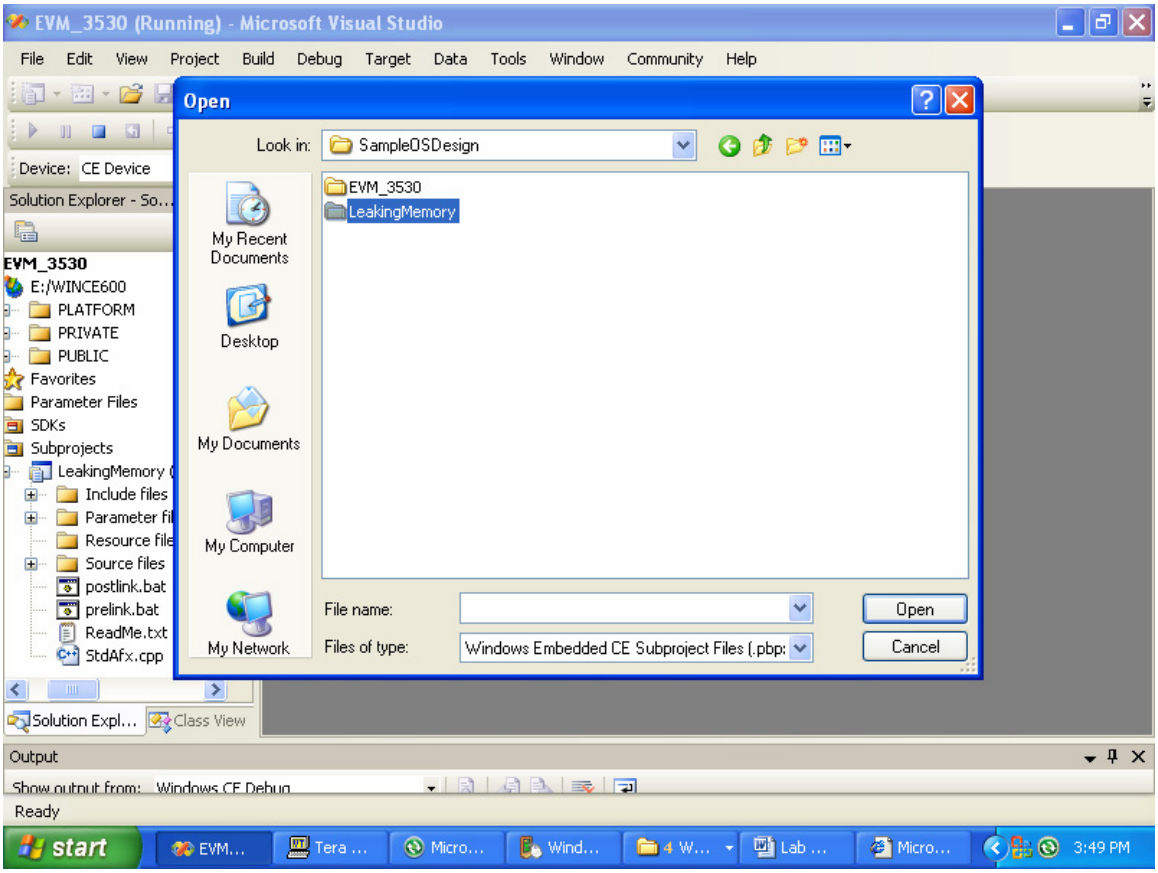
➢ **Add the LeakingMemory subproject to your development environment**

1. Copy the **LeakingMemory** folder from the **Lab 3-3 Project Files** from the Student files into your OS Design folder at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

2. In the Solution Explorer window right click on the **Subprojects** folder and select **Add Existing Subproject…**

3. Navigate to the **LeakingMemory** folder that you just copied.

4. Select **LeakingMemory.pbpxml** and click **Open**. Visual Studio will add the project to your current solution.



5. Configure the **LeakingMemory** subproject to be **excluded from the image** and **always build and link as debug**, just as you did in Lab 2-2 Exercise 1.

6. Right click the **LeakingMemory** subproject and select **Build**.

➢ **Investigate the memory leak**

7. Run the application by selecting **Run Programs…** in **Target** menu.

8. Observe the output on your device. The following message box appears:

Note This dialog box is used to stop the application from continuing without actually breaking into the debugger, thereby allowing us to use the memory tools.

This particular dialog indicates a point in the initialization sequence of the utility prior to any memory reservations. It allows us to get a picture of the initial memory usage that we can use as a basis for future comparisons.

9. Select **Target | Target Control** from the Visual Studio menu. The **Windows CE Command Prompt** window will open.

10. At the **Windows CE>** prompt, type **mi full**. This will show memory information for all processes running on the device.

11. Locate the section for the LeakingMemory.exe process.

12. Study the virtual memory contents of the process using the following legend:

Character	Definition
<blank>	A blank space indicates a virtual page that is not currently allocated. Does not require a physical page.
-	Reserved but not in use. Indicates a virtual page that is currently allocated but not mapped to any physical memory. Does not require a physical page.
C	Code pages in ROM. Does not require a physical page.
c	Code pages in RAM. Requires a physical page.
S	Indicates a virtual page that holds a stack. Requires a physical page.
P	Peripheral memory (pages used to map target device memory by using **VirtualAlloc**). Indicates a virtual page that is used to map a range of hardware addresses. Does not require a physical page. Peripheral memory may include frame buffer memory.
W	Indicates a virtual page that holds read-write data. Requires a physical page. Read-write pages include global variables as well as dynamically allocated memory.
O	Indicates a virtual page that is used by the object store. Requires a physical page. Should only appear in the Filesys process.
?	Contents unknown.

Character	Definition
r	Read-only data pages in RAM. Requires a physical page. Read-only data primarily comes from data items that are declared as a const type in the source code.
R	Read-only data pages in ROM. Does not require a physical page. Read-only data primarily comes from data items that are declared as a const type in the source code. **Note:** For CPUs such as ARM and SHx that do not distinguish between read-only and executable code pages in hardware, use R(r) to represent both data and code.

13. Copy the memory information for the LeakingMemory process to a temporary text file so that we can easily compare it with another run later.

14. In the device window, click **OK** in the message box. The utility will run, doing its useful work.

15. The following message box will display on the device:

Note This dialog box indicates the end of the utility processing. Presumably any resources that have been allocated have now been freed, and there should be no memory leaks.

16. At the **Windows CE>** prompt, type **mi full**. This will show the current memory information for all processes running on the device.

17. Compare the memory usage for the LeakingMemory.exe program against the one that was previously saved.

18. Click **OK** on the dialog box on the device, allowing it to exit.

- **Analysis**

The application should have similar memory usage after it has performed its useful work and cleaned up as it did before it started. The two memory dumps should be the same.

Before	*After*
Memory usage for Process 'LeakingMemory.exe' pid 5e0000e	**Memory usage for Process 'LeakingMemory.exe' pid 5e0000e**
00000000: -----	00000000: -----
00010000: -cWc	00010000: -cWc
00020000: ----------S	00020000: ----------S
00030000: W----------	00030000: W----------
00040000: RRRRRRRRRRRRRRR	00040000: RRRRRRRRRRRRRRR
00050000: RRRRRRRRRRRRRRR	00050000: RRRRRRRRRRRRRRR
00060000: RRRRRRRRRRRRRRR	00060000: RRRRRRRRRRRRRRR
00070000: RRRR	00070000: RRRR
	00080000: WWWWWWWWWWWWWWW
	00090000: WWWWWWWWWWWWWWW
40000000: ----------	40000000: ----------
40010000: -CCCCCCCCCCCCCC	40010000: -CCCCCCCCCCCCCC
40020000: CCCCCCCCCCCCCCC	40020000: CCCCCCCCCCCCCCC
40030000: CCCCCCCCCCCCCCC	40030000: CCCCCCCCCCCCCCC
40040000: CCCCCCCCCCCCCCC	40040000: CCCCCCCCCCCCCCC
40050000: CCCCCCCCCCCCCCC	40050000: CCCCCCCCCCCCCCC
40060000: CCCCCCCCCCCCCCC	40060000: CCCCCCCCCCCCCCC
40070000: CCCCCCCCCCCCCCC	40070000: CCCCCCCCCCCCCCC
40080000: CCCCCCCCCCCCCCC	40080000: CCCCCCCCCCCCCCC
40090000: W------CCCCCCC--	40090000: W------CCCCCCC--
400a0000: ---	400a0000: ---
Page summary: code=134(2) data r/o=52 r/w=3 stack=1 reserved=63	Page summary: code=134(2) data r/o=52 r/w=35 stack=1 reserved=63

However, the output of the Target Control utility shows that there is 128KB of read/write memory committed after the utility has finished that wasn't there before it started. That memory was allocated by the utility, but never released. That memory has been leaked.

- **Fix the application**

19. Uncomment the call to **VirtualFree** in the file **LeakingMemory.cpp**. This looks suspiciously like it might be the cause of the problem.

20. Right click on the **LeakingMemory** subproject and select **Build**.

21. Run the program again, and redo the analysis.

22. Observe that the two memory usage maps are now the same; the memory leak is gone!

Note	This particular leak was not all that serious and created just to illustrate the point. The memory would have been reclaimed automatically when the process exited. However, in other scenarios the leak could have been more serious. For example, a kernel mode dll could have a leak that would never be recovered since the kernel process never exits.

If you are continuing with the next Hands-On Lab, keep your image running.

Lab 3-4: Exploring Threads Using Kernel Tracker

Objectives

- Learn which build options are required to work with the Remote Kernel Tracker
- Be familiar with the Kernel Tracker menu options and what they control, such as the time scale
- Recognize different execution patterns in Kernel Tracker such as when threads start and stop running.

Prerequisites

- Completed Lab 2-1
- Completed Lab 3-2

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

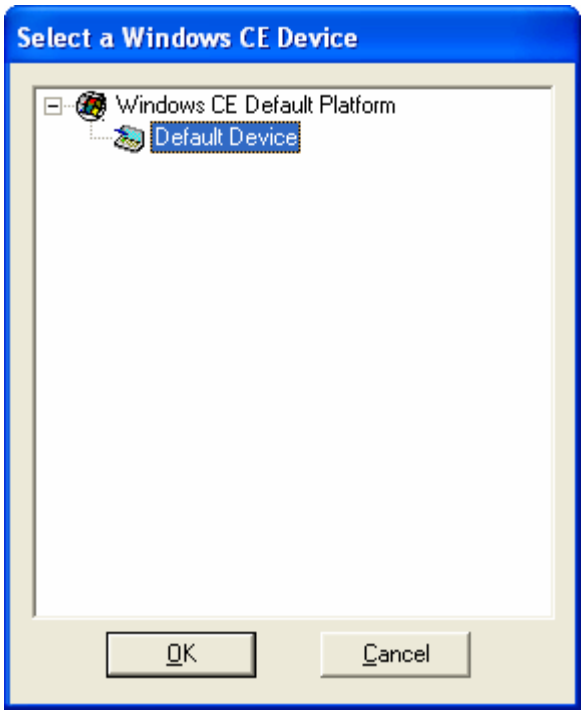
Exercise 1 Using the Remote Kernel Tracker

In this exercise you will become familiar with the Remote Kernel Tracker tool. The Remote Kernel Tracker allows you to see the kernel events that occur on your Windows Embedded CE6.0 device.

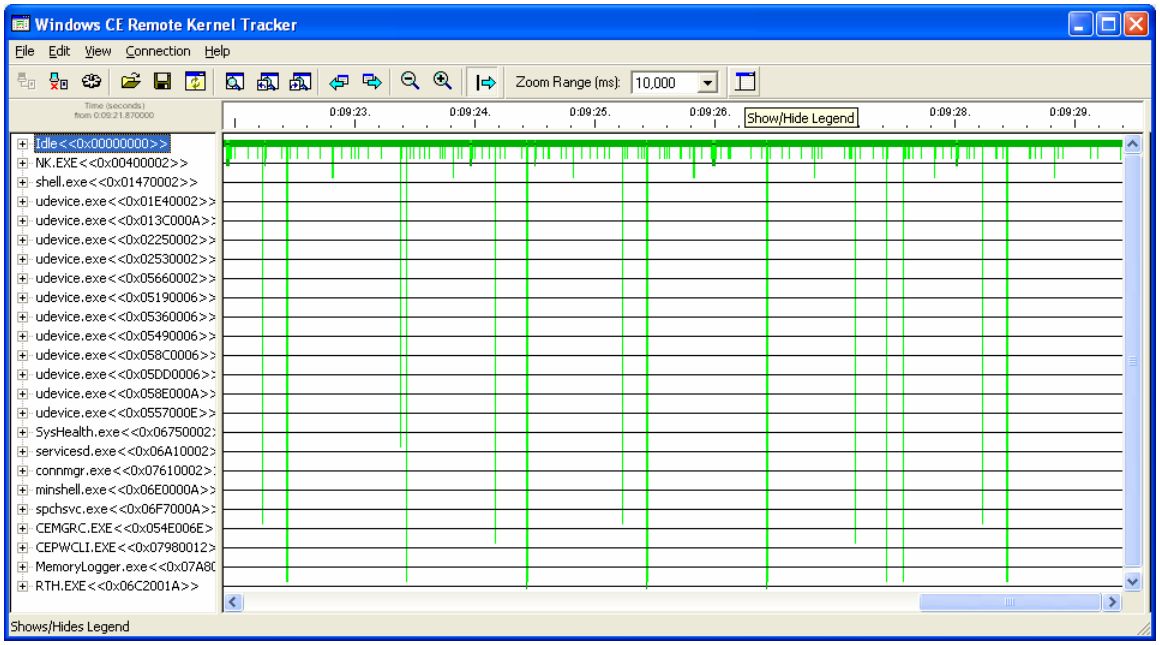
➢ **Launch the Remote Kernel Tracker**

1. Select **Target | Remote Tools | Kernel Tracker** from the Visual Studio menu.

2. Click **OK** to accept the **Default Device** connection.



3. Click  to toggle Show/Hide **Legend** mode as desired.



Events occurring on the CE Device are continuously being logged. First events are logged into local memory. CeLogFlush.exe periodically transmits the logged data to the host via the Platform Manager connection. The Remote Kernel Tracker tool displays the logged information in graphical form.

4. Click  to **refresh** the logging data being displayed and note the time frame increasing as new data is being added to the right.

5. Click  to **search** for an event by type or by a particular process or thread, etc.

6. Expand the **Interrupts** node.

7. Set the Zoom range to **10ms** using the **Zoom Range** drop down box.

Note We enabled the profiling option back in Lab 2-1. This option is what allows interrupts to be observable in the Remote Kernel Profiler. The profiler option also provides support for a Monte Carlo profiler that can be run using the Target Control utility.

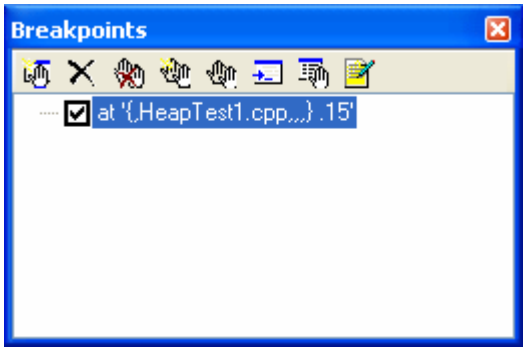
Exercise 2 Logging a Simple Application

Before looking at the complex relationships between multiple threads, we will look at the logging data being generated by a simple application. There is a great deal of data for even a simple application that only has one thread.

➢ **Ensure no breakpoints are set**

1. Select **Debug | Windows | Breakpoint** from the Visual Studio menu. This will bring up the Breakpoints window.

2. Delete any breakpoints that might have been left in source code files.



➢ **Examine the HeapTest1 application**

3. Launch the **HeapTest1** application using the Visual Studio **Target** menu.

Note	Moving the cursor over events in the Remote Kernel Tracker displays info tips showing more detail regarding the event.

4. Position the mouse over an icon, in the HeapTest1.exe process, for a few seconds to see a pop-up for more details on the **Load module** event. Use the **Find Event** tool if necessary to find a **Load Module** icon.

5. Position the mouse over a dark green line for a few seconds to see a pop-up for more details about **Process Info**.

6. Click on an event to set the cursor to assist in zooming and stepping through events and threads using menu buttons.

7. Change the **Zoom Range** to view thread transitions in more detail.

8. Observe the calls to **Sleep** that occur every 1000 milliseconds in the HeapTest1 application. Note that the application still has a loop at the end that keeps it from exiting automatically.

9. Terminate the **HeapTest1** application using the Processes window available from the Visual Studio menu.

10. Observe the **Free Module** event that occurs on the HeapTest1 application in the Remote Kernel Tracker.

    Take some time to explore the information provided by the kernel tracker to see how it shows the thread transitions and the reasons for them.

11. Close the **Remote Kernel Tracker.** Do not save the collected data.

Lab 3-5: Thread Synchronization

Objectives

- Understand the read / modify / write vulnerability
- Be able to implement an atomic read / modify / write sequence using a critical section that removes the vulnerability

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 15 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Observe the vulnerability

This sample demonstrates a read / modify / write vulnerability. Multiple threads increment a shared global variable by

- reading the current global variable value into a temporary variable (READ)
- adding 1 to the value in the temporary variable (MODIFY)
- writing the temporary variable back to the global variable (WRITE)

Each thread iterates over this sequence a set number of times. The final value of the variable should be the number of threads multiplied by the number of iterations each thread makes.

➢ **Add the existing ThreadSynchronization subproject to the OS Design**

1. Copy the **ThreadSynchronization** subproject from the Student files to your OS Design at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

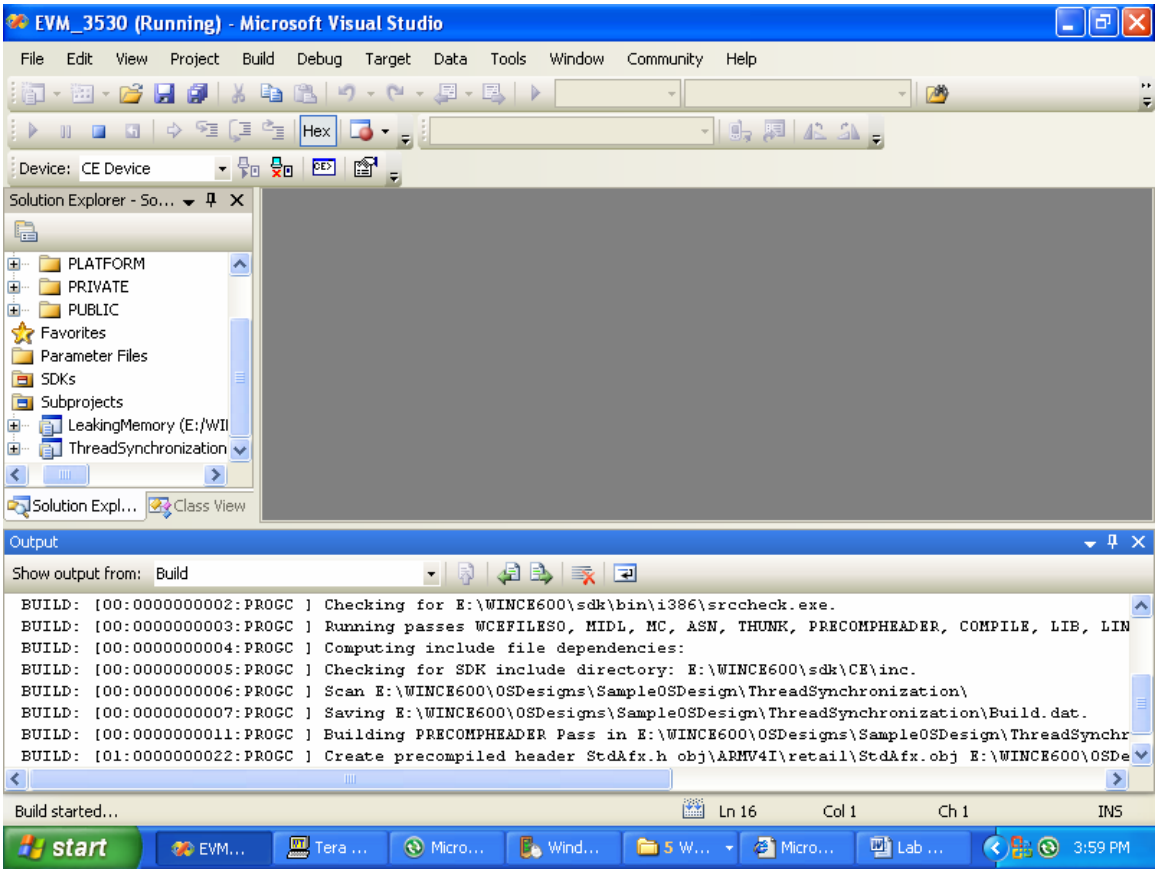
2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject.**

3. Select the **ThreadSynchronization.pbpxml** file from the **ThreadSynchronization** folder.

4. Configure the **ThreadSynchronization** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

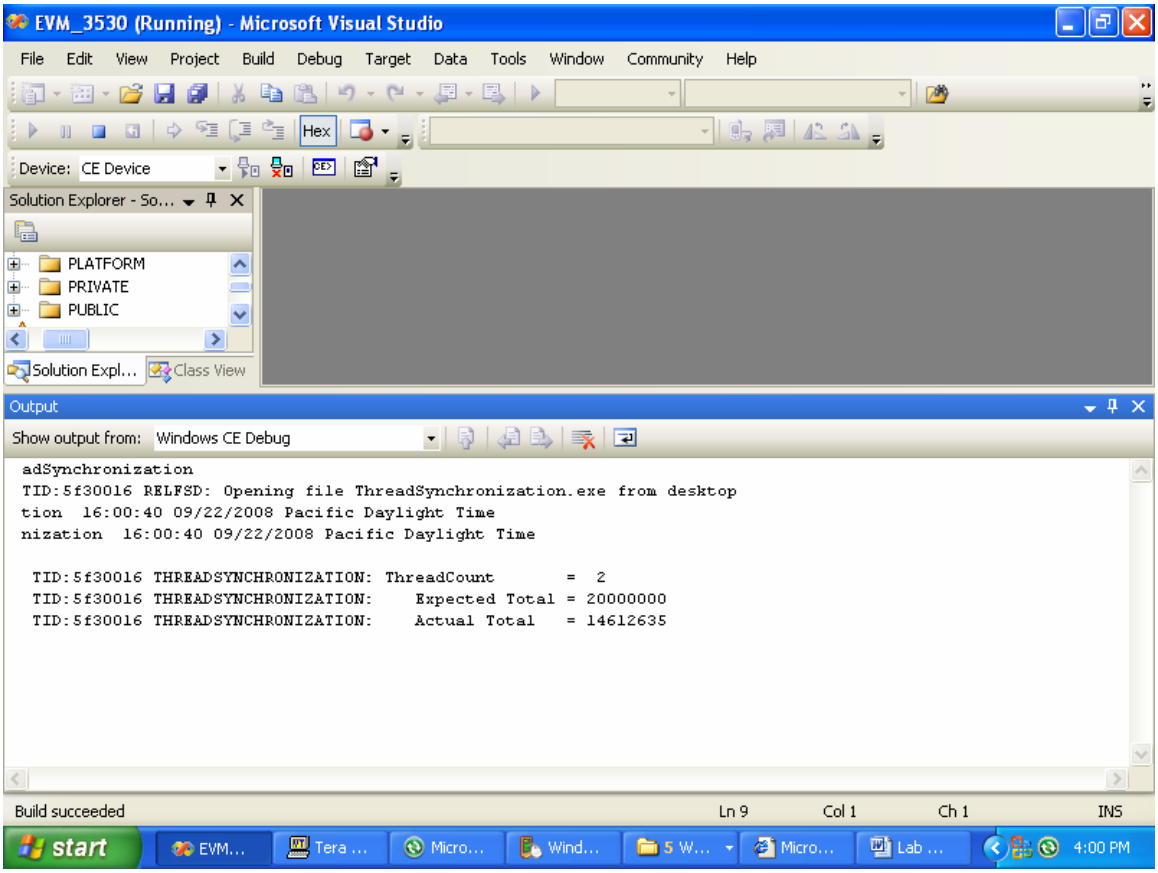
➢ **Build and run the application**

5. Right click on the **ThreadSynchronization** subproject in the Solution Explorer and select **Build**.



6. Launch **ThreadSynchronization.exe** using **Target** | **Run Programs**… from the Visual Studio menu.

7. Observe **output** similar to the following:



8. Notice that the final total is **less** than the expected total.

Analysis

The final value is less than expected because the read / modify / write sequence is not atomic. The scheduler can interrupt a thread after it has performed the read, and run another thread that is performing the same algorithm. The second thread continues to increment the variable from the same value where the original thread stopped. When the original thread is eventually scheduled again it continues where it left off, and writes the value stored in the temporary register out to the global variable. In so doing, it destroys the work that was done on the variable by other threads while it was blocked. Each thread ran the prescribed number of times, but some of the work was inadvertently reset.

This vulnerability exists any time a variable shared between multiple threads is accessed with a non-atomic read/modify/write sequence.

Exercise 2 Fix the vulnerability

The read / modify / write sequence can be made atomic using synchronization objects. In this exercise we will use a critical section, although mutexes could be used as well. Note that the best way to protect an increment of a single variable is to use an interlocked function. However, we have used functions to do our work so the entire sequence must be protected.

- **Instantiate the critical section**

  9. Open the **ThreadSynchronization.cpp** file from the Solution Explorer.

  10. Uncomment the global variable **MyCritSec**.

- **Initialize the critical section**

  11. Uncomment the call to **InitializeCriticalSection** in the function **WinMain**.

- **Protect the vulnerable code sequence**

  12. Uncomment the call to **EnterCriticalSection** in the function **DoWork**.

  13. Uncomment the call to **LeaveCriticalSection** in the function **DoWork**.

- **Clean up resources**

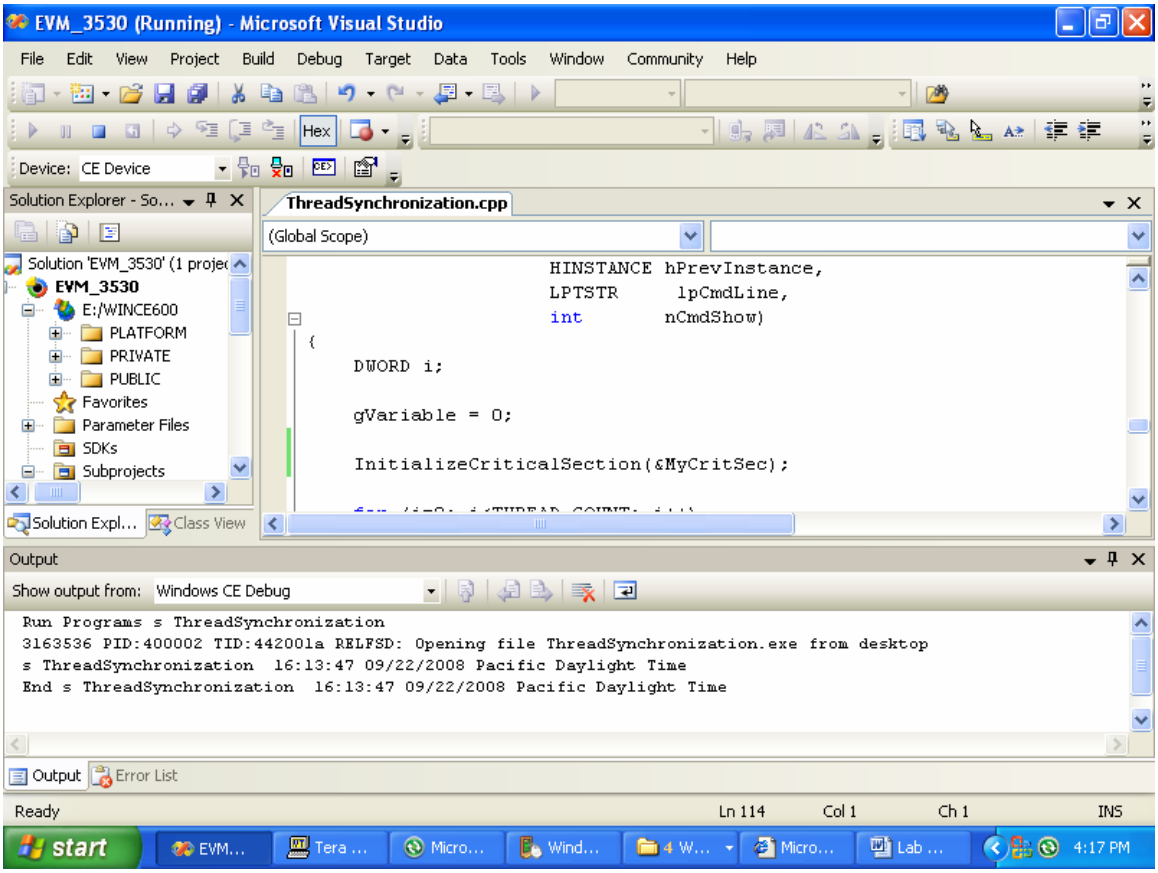
  14. Uncomment the call to **DeleteCriticalSection** in the function **WinMain**.

- **Build and run the application**

  15. Right click on the **ThreadSynchronization** subproject in the Solution Explorer and select **Build**.

  16. Launch **ThreadSynchronization.exe** using **Target | Run Programs** from the Visual Studio menu.

17. Observe correct **output** similar to the following:



If you are continuing with the next Hands-On Lab, keep your image running.

Lab 3-6: Exploring Synchronization Objects

Objectives

- Explain the different types of synchronization available in Windows CE
- Understand differences among synchronization objects.

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 40 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Mutex synchronization

In this exercise you will see a simple implementation of synchronization using mutexes.

➢ **Add the existing MutexDemo subproject to the OS Design**

1. Copy the **MutexDemo** subproject from the Student files to your OS Design at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

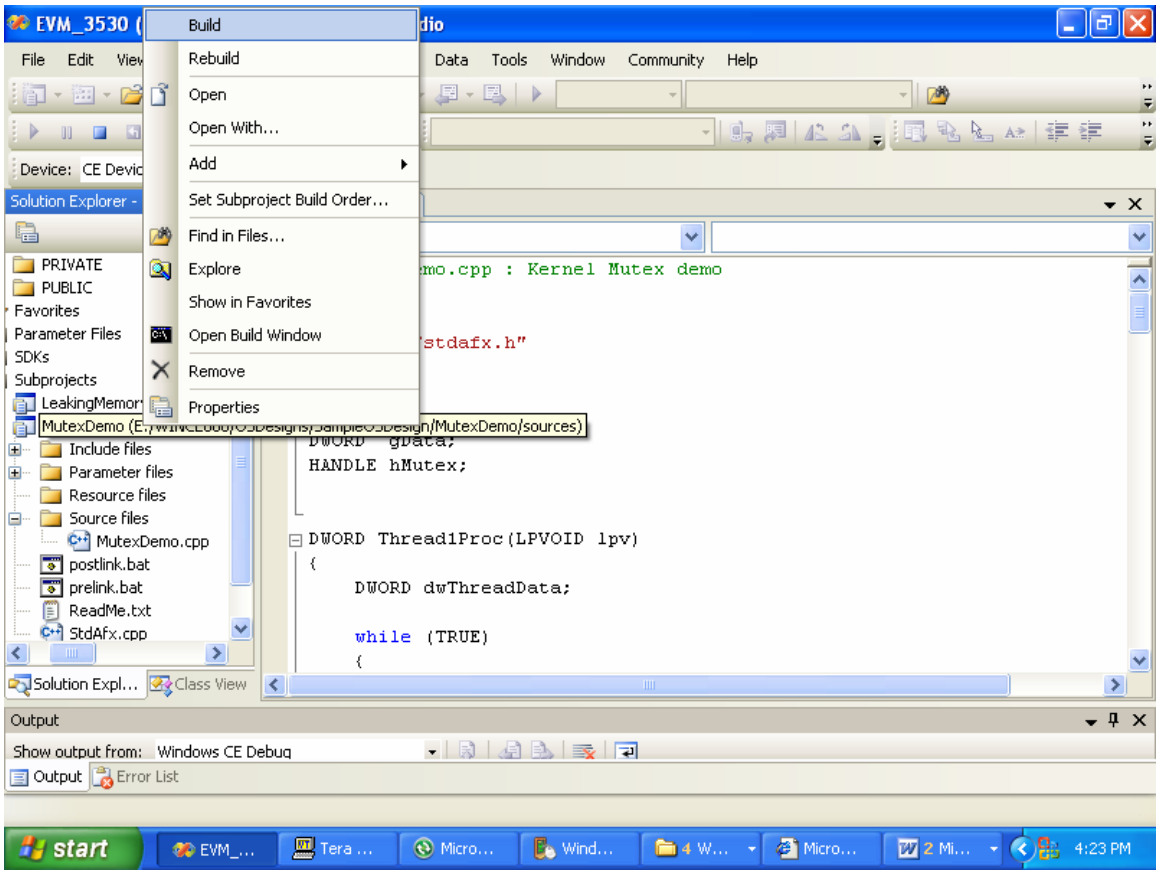
2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject.**

3. Select the **MutexDemo.pbpxml** file from the **MutexDemo** folder.

4. Configure the **MutexDemo** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

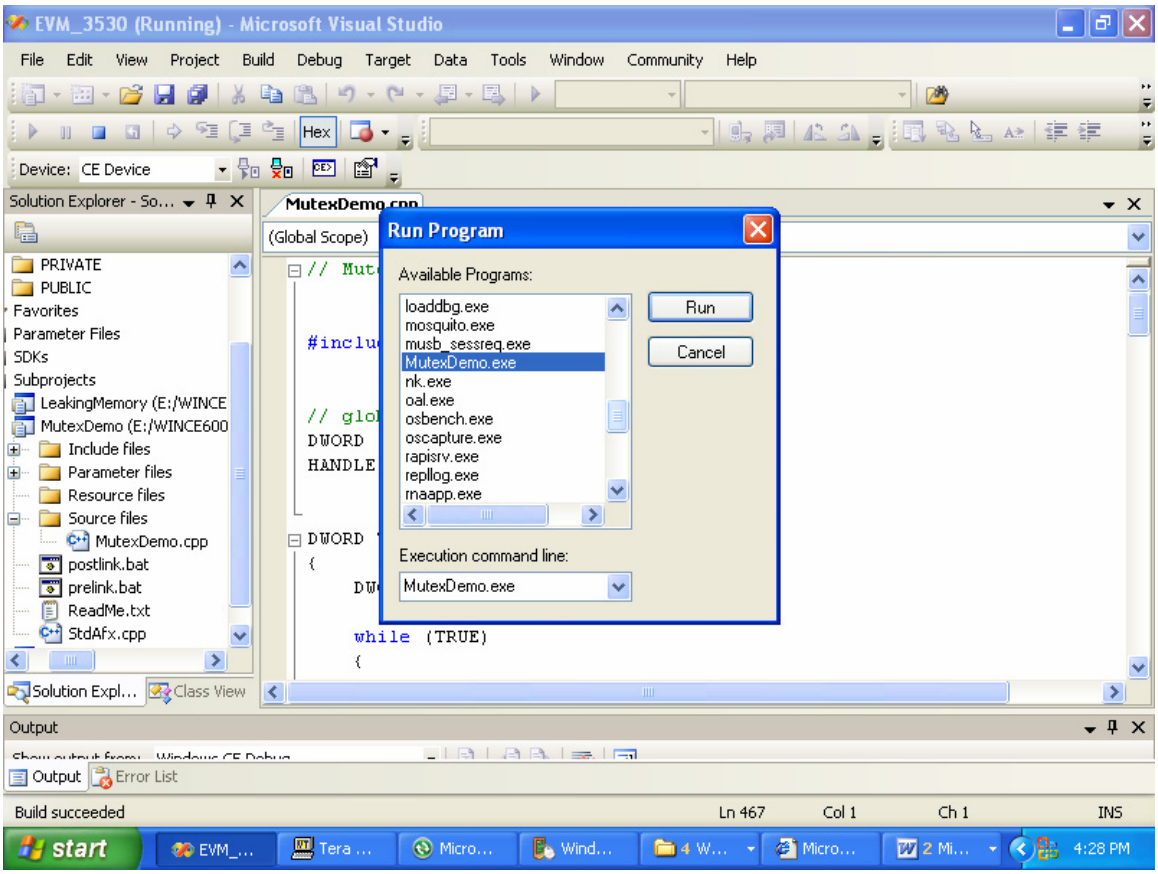
➢ **Build MutexDemo subproject**

5. Right click the **MutexDemo** subproject in the Solution Explorer and select **Build.**

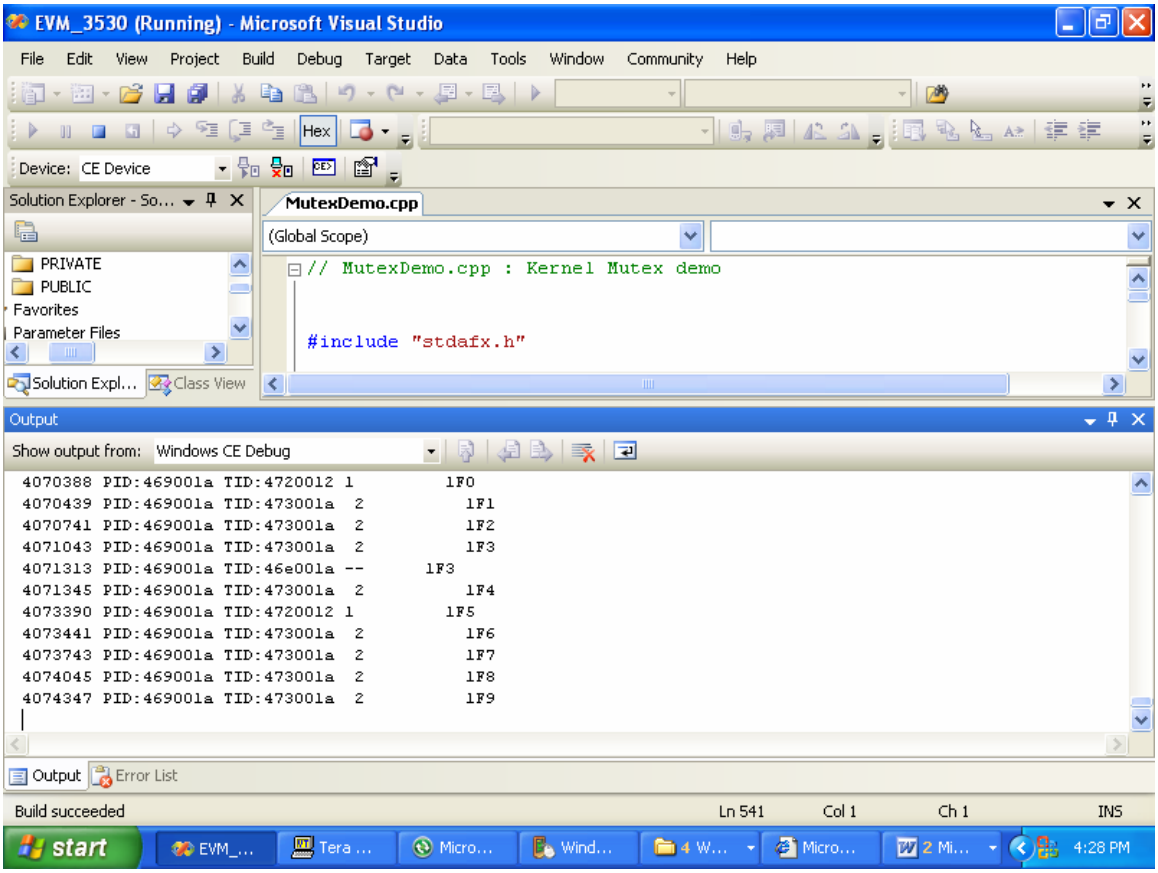
6. 

➢ Run application

7. Launch **MutexDemo.exe** using **Target** | **Run Programs**… from the Visual Studio menu.



8. Select **Windows CE Debug** from the drop down box in the Output window. This will allow us to see the debug output from the device when we run our test application.



Note The Output window is currently displaying the build output because we just performed a build. In many circumstances, Visual Studio anticipates what we would like to see and switches the Output window appropriately. However, this does not always work, and the Output window ends up displaying something other than the operation we are interested in. The following step is one of those that Visual Studio does not anticipate.

---

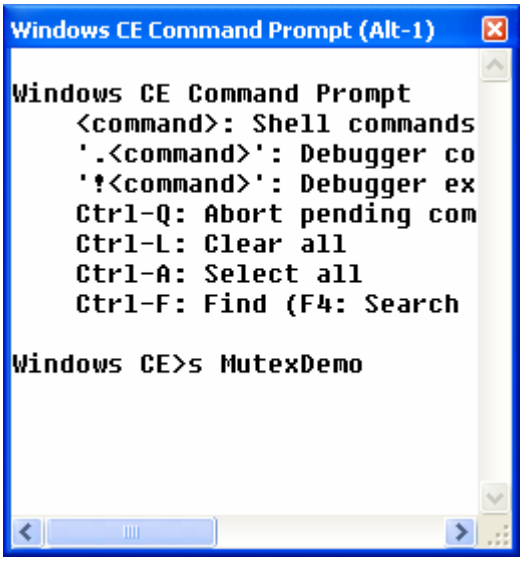
9. Select **Target | Target Control** from the Visual Studio menu to bring up the **Windows CE Command Prompt** window (the Target Control utility). You may dock this window in a convenient location if you wish.

Note We are running the application using the Target Control utility this time, instead of using the **Target | Run Programs** menu in Visual Studio. The Target Control utility is a lower level interface into the debug shell supported by Windows Embedded CE 6.0, and exposes a great deal of functionality. The Target | Run Programs menu item leverages the same debug shell functionality to launch programs as does the Target Control utility.

---

10. Type **s MutexDemo** command into **Windows CE Command Prompt** window as follows:

Windows CE>**s MutexDemo**



11. Press **<Enter>** and verify debug output is similar to the following sequence:

```
3771174 PID:469001a TID:46e001a Priority = 251
3771174 PID:469001a TID:46e001a --         0
3773184 PID:469001a TID:4720012 1           1
3773235 PID:469001a TID:473001a  2            2
3773537 PID:469001a TID:473001a  2            3
3773839 PID:469001a TID:473001a  2            4
3774141 PID:469001a TID:473001a  2            5
3776186 PID:469001a TID:4720012 1           6
3776237 PID:469001a TID:473001a  2            7
3776539 PID:469001a TID:473001a  2            8
3776841 PID:469001a TID:473001a  2            9
3777143 PID:469001a TID:473001a  2            A
3779188 PID:469001a TID:4720012 1           B
3779239 PID:469001a TID:473001a  2            C
3779541 PID:469001a TID:473001a  2            D
3779843 PID:469001a TID:473001a  2            E
3780145 PID:469001a TID:473001a  2            F
3781185 PID:469001a TID:46e001a --        F
3782190 PID:469001a TID:4720012 1          10
3782241 PID:469001a TID:473001a  2           11
3782543 PID:469001a TID:473001a  2           12
3782845 PID:469001a TID:473001a  2           13
3783147 PID:469001a TID:473001a  2           14
3785192 PID:469001a TID:4720012 1          15
3785243 PID:469001a TID:473001a  2           16
3785545 PID:469001a TID:473001a  2           17
3785847 PID:469001a TID:473001a  2           18
3786149 PID:469001a TID:473001a  2           19
3788194 PID:469001a TID:4720012 1          1A
3788245 PID:469001a TID:473001a  2           1B
3788547 PID:469001a TID:473001a  2           1C
3788849 PID:469001a TID:473001a  2           1D
3789151 PID:469001a TID:473001a  2           1E
3791186 PID:469001a TID:46e001a --        1E
3791196 PID:469001a TID:4720012 1          1F
3791247 PID:469001a TID:473001a  2           20
3791549 PID:469001a TID:473001a  2           21
3791851 PID:469001a TID:473001a  2           22
3792153 PID:469001a TID:473001a  2           23
```

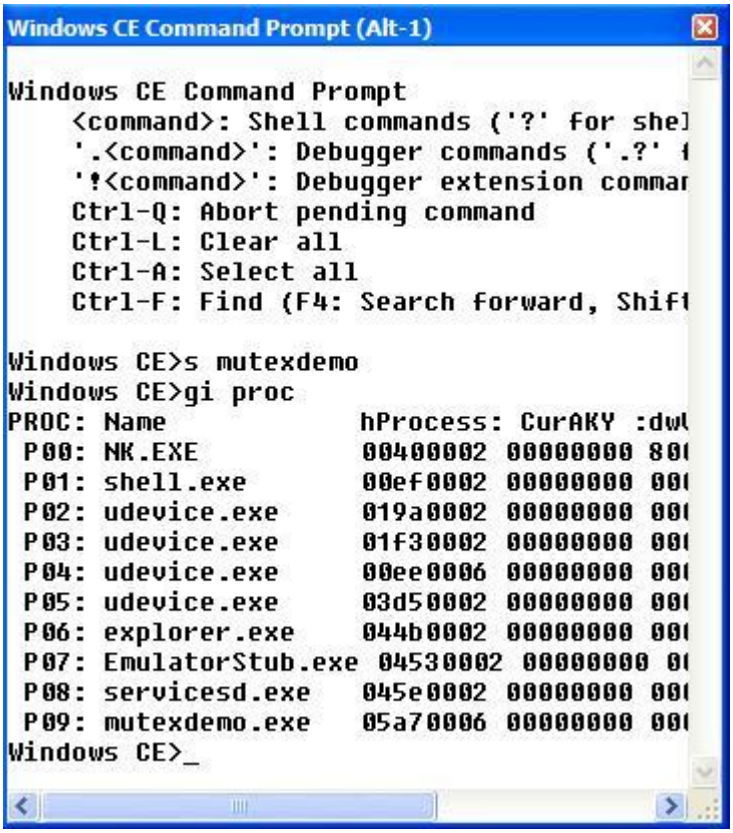
12. Launch the **Remote Kernel Tracker** to observe interaction between threads that are using the mutex. Try to correlate the events you see with the debug output and the source code.

Tip	Expand the MutexDemo node in the left hand pane to see the activity on the individual threads running in the process. Set the cursor on a particular area of thread activity, then change the zoom range to something small (10 milliseconds). This way, you can see everything that is going on in the thread.

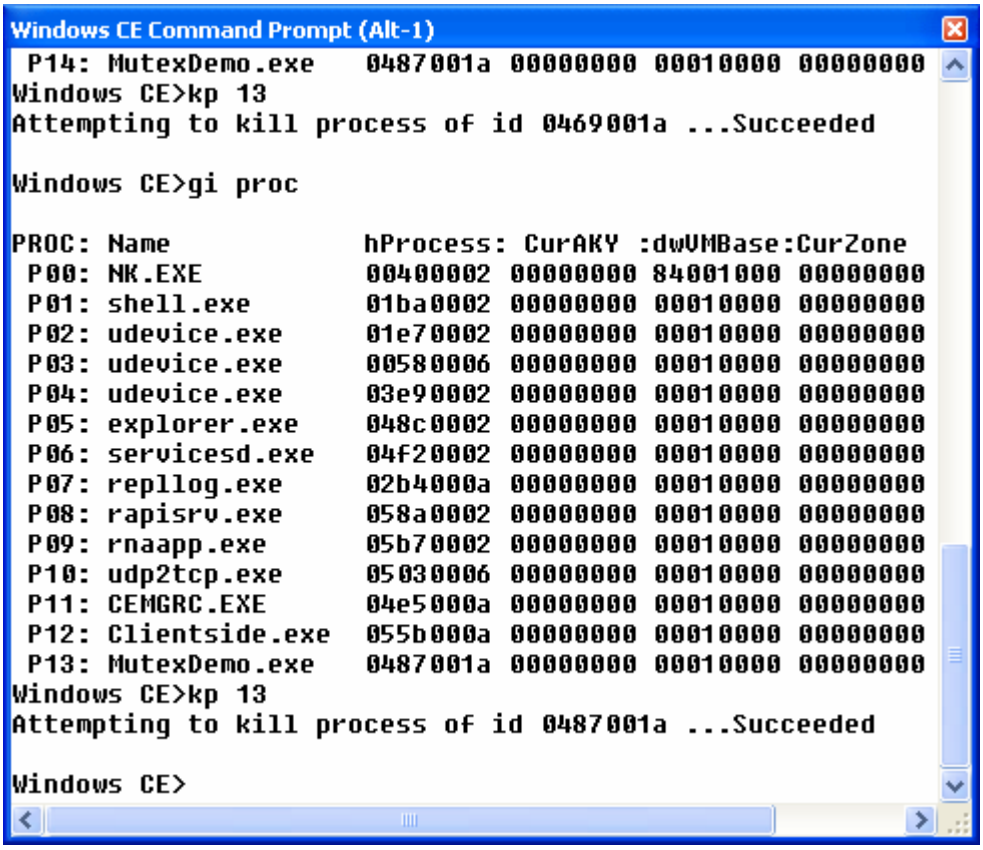
➢ **Terminate the application using the Target Control utility**

13. Type **gi proc** in the Windows CE Command Prompt window. This will display a list of processes, including the name and an identification number for each one.

14. Determine the process identifier number for the mutexdemo application. The identifier for the mutexdemo in the dialog shown below is **09**, your's may differ.



15. Terminate the process using the command **kp<space><id>**, where <id> is the process identifier returned from the gi proc command.

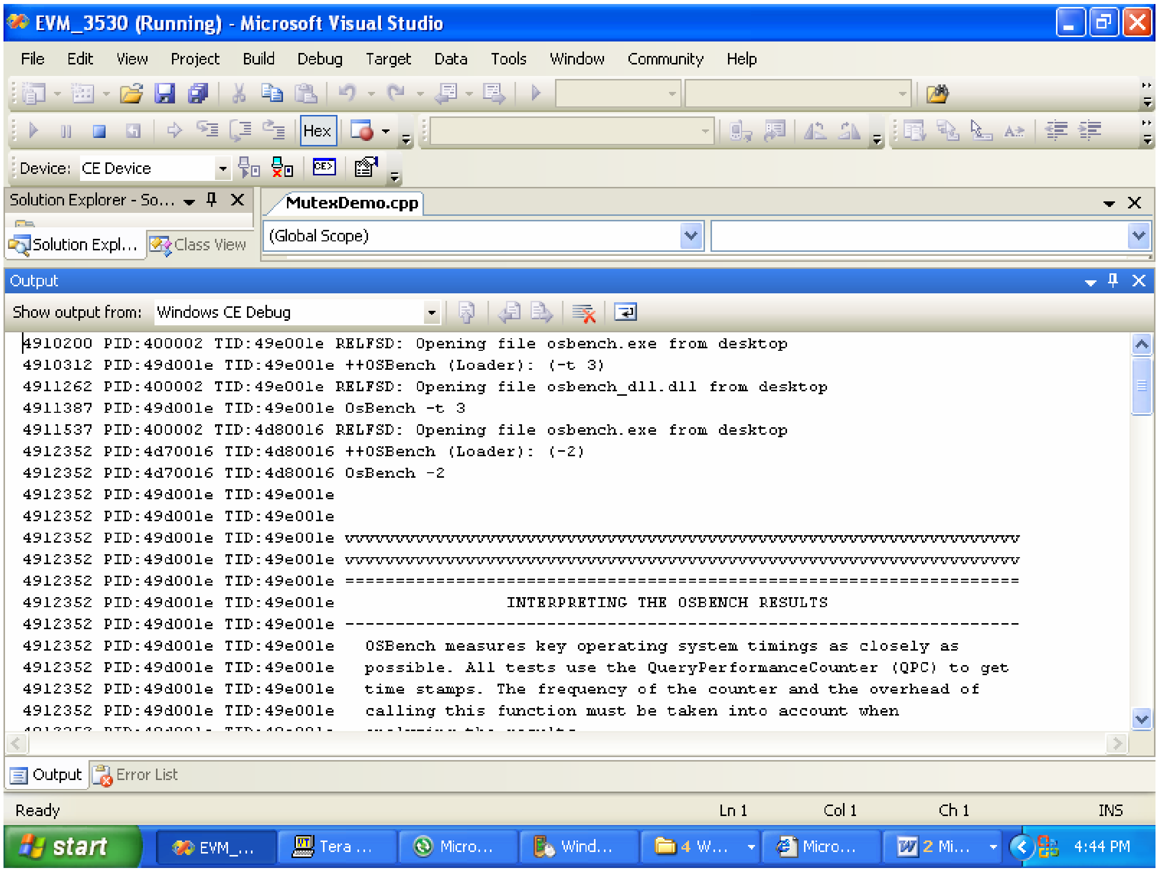


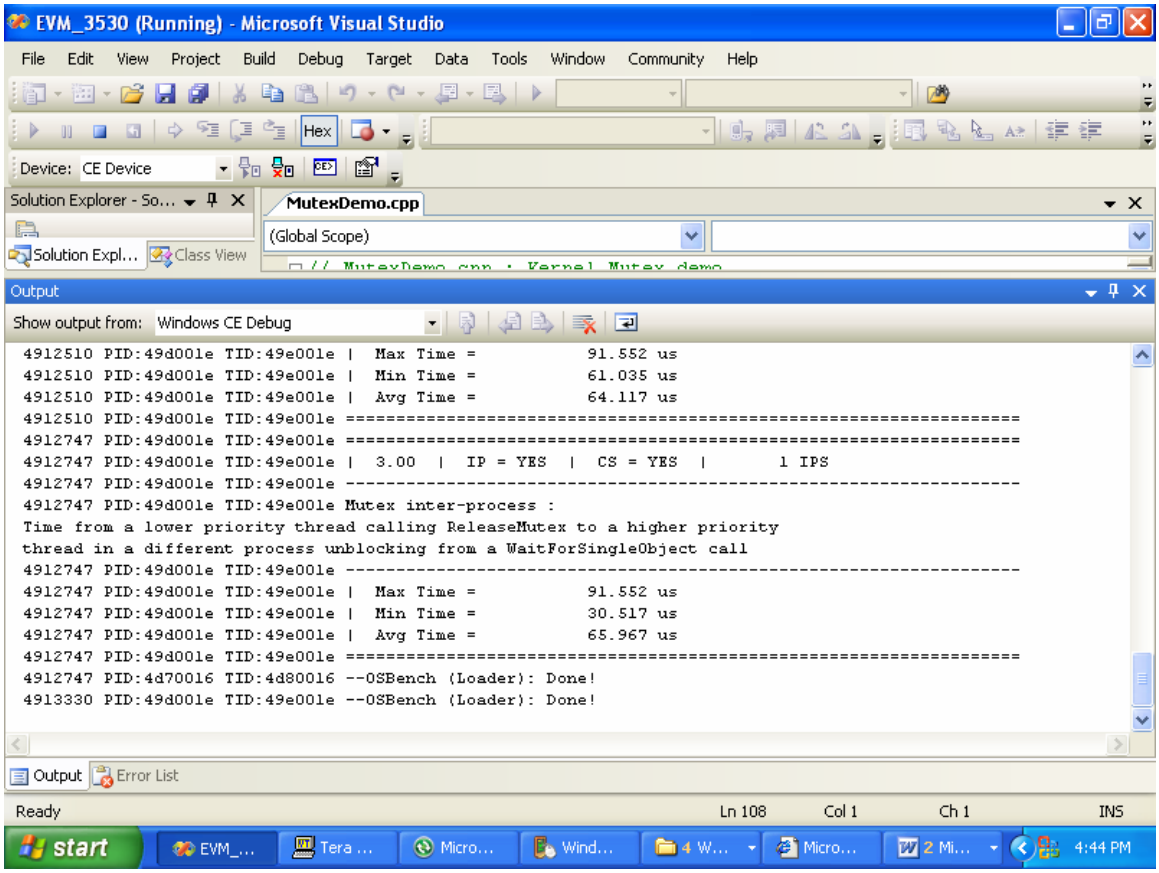
➢ **Measure synchronization performance**

16. Type **s osbench –t 3** and press <Enter> at the **Windows CE Command Prompt**. This will run the OSBench utility that tests the performance of various kernel API calls. This particular command line will limit the testing to mutexes only.

Note	The command line parameters for OSbench can be obtained by using the **–h** command line parameter to the OSBench utility.

17. Examine the **OSBench** output. You may wish to compare the performance of mutexes to other synchronization methods.


EVM_3530 (Running) - Microsoft Visual Studio
File Edit View Project Build Debug Target Data Tools Window Community Help
Device: CE Device
Solution Explorer - So...
MutexDemo.cpp
Solution Expl... Class View
(Global Scope)
Output
Show output from: Windows CE Debug
4910200 PID:400002 TID:49e001e RELFSD: Opening file osbench.exe from desktop
4910312 PID:49d001e TID:49e001e ++OSBench (Loader): (-t 3)
4911262 PID:400002 TID:49e001e RELFSD: Opening file osbench_dll.dll from desktop
4911387 PID:49d001e TID:49e001e OsBench -t 3
4911537 PID:400002 TID:4d80016 RELFSD: Opening file osbench.exe from desktop
4912352 PID:4d70016 TID:4d80016 ++OSBench (Loader): (-2)
4912352 PID:4d70016 TID:4d80016 OsBench -2
4912352 PID:49d001e TID:49e001e
4912352 PID:49d001e TID:49e001e
4912352 PID:49d001e TID:49e001e vvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvv
4912352 PID:49d001e TID:49e001e vvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvv
4912352 PID:49d001e TID:49e001e ==
4912352 PID:49d001e TID:49e001e INTERPRETING THE OSBENCH RESULTS
4912352 PID:49d001e TID:49e001e --
4912352 PID:49d001e TID:49e001e OSBench measures key operating system timings as closely as
4912352 PID:49d001e TID:49e001e possible. All tests use the QueryPerformanceCounter (QPC) to get
4912352 PID:49d001e TID:49e001e time stamps. The frequency of the counter and the overhead of
4912352 PID:49d001e TID:49e001e calling this function must be taken into account when
Output Error List
Ready Ln 1 Col 1 Ch 1 INS
start EVM_... Tera ... Micro... Wind... 4 W... Micro... 2 Mi... 4:44 PM


EVM_3530 (Running) - Microsoft Visual Studio
File Edit View Project Build Debug Target Data Tools Window Community Help
Hex
Device: CE Device
Solution Explorer - So...
Solution Expl... Class View
MutexDemo.cpp
(Global Scope)
Output
Show output from: Windows CE Debug
4912510 PID:49d001e TID:49e001e | Max Time = 91.552 us
4912510 PID:49d001e TID:49e001e | Min Time = 61.035 us
4912510 PID:49d001e TID:49e001e | Avg Time = 64.117 us
4912510 PID:49d001e TID:49e001e ==========
4912747 PID:49d001e TID:49e001e ==========
4912747 PID:49d001e TID:49e001e | 3.00 | IP = YES | CS = YES | 1 IPS
4912747 PID:49d001e TID:49e001e ----------
4912747 PID:49d001e TID:49e001e Mutex inter-process :
Time from a lower priority thread calling ReleaseMutex to a higher priority
thread in a different process unblocking from a WaitForSingleObject call
4912747 PID:49d001e TID:49e001e ----------
4912747 PID:49d001e TID:49e001e | Max Time = 91.552 us
4912747 PID:49d001e TID:49e001e | Min Time = 30.517 us
4912747 PID:49d001e TID:49e001e | Avg Time = 65.967 us
4912747 PID:49d001e TID:49e001e ==========
4912747 PID:4d70016 TID:4d80016 --OSBench (Loader): Done!
4913330 PID:49d001e TID:49e001e --OSBench (Loader): Done!
Output Error List
Ready Ln 108 Col 1 Ch 1 INS
start EVM_... Tera ... Micro... Wind... 4 W... Micro... 2 Mi... 4:44 PM

Exercise 2 Event synchronization

In this exercise you will see a simple implementation of synchronization using events.

- **Add the existing EventDemo subproject to the OS Design**

1. Copy the **EventDemo** subproject from the Student files to your OS Design at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject.**

3. Select the **EvenDemo.pbpxml** file from the **EventDemo** folder.

4. Configure the **EventDemo** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

- **Build EventDemo subproject**

5. Right click the **EventDemo** subproject in the Solution Explorer and select **Build.**

- **Run application**

6. Select **Windows CE Debug** from the drop down box in the output window. This will allow us to see the debug output from the device when we run our test application.

7. Type **s EventDemo** into the **Windows CE Command Prompt** window as follows:

   Windows CE>**s EventDemo**

8. Press **<Enter>** and verify debug output is similar to the following:

```
s EventDemo  17:14:10 09/22/2008 Pacific Daylight Time
End s EventDemo  17:14:10 09/22/2008 Pacific Daylight Time

6786826 PID:49b002a TID:49d002a Primary = 251
6786826 PID:49b002a TID:49d002a Thread1 = 250
6786826 PID:49b002a TID:49d002a Thread2 = 249
6786826 PID:49b002a TID:49d002a -- 1
6788647 PID:49b002a TID:49d002a -- 2
6791559 PID:49b002a TID:49d002a -- 3
6791559 PID:49b002a TID:49d002a E1 auto
6791559 PID:49b002a TID:4d50022 T2     1
6793236 PID:49b002a TID:49d002a -- 4
6794827 PID:49b002a TID:49d002a -- 5
6794827 PID:49b002a TID:49d002a E2 manual
6794827 PID:49b002a TID:4d50022 T2     2
6796562 PID:49b002a TID:49d002a -- 6
6796562 PID:49b002a TID:49d002a E1 auto
6796562 PID:49b002a TID:49f002a T1   1
```

```
6798442 PID:49b002a TID:49d002a -- 7
6800180 PID:49b002a TID:49d002a -- 8
6801880 PID:49b002a TID:49d002a -- 9
6801880 PID:49b002a TID:49d002a E1 auto
6801882 PID:49b002a TID:4d50022 T2     3
6803839 PID:49b002a TID:49d002a -- 10
6803839 PID:49b002a TID:49d002a E2 manual
6805639 PID:49b002a TID:49d002a -- 11
6806674 PID:49b002a TID:49d002a -- 12
6806674 PID:49b002a TID:49d002a E1 auto
6806674 PID:49b002a TID:4d50022 T2     4
6808499 PID:49b002a TID:49d002a -- 13
6810354 PID:49b002a TID:49d002a -- 14
6812098 PID:49b002a TID:49d002a -- 15
6812098 PID:49b002a TID:49d002a E1 auto
6812098 PID:49b002a TID:4d50022 T2     5
6812098 PID:49b002a TID:49d002a E2 manual
6813928 PID:49b002a TID:49d002a -- 16
6815698 PID:49b002a TID:49d002a -- 17
6817232 PID:49b002a TID:49d002a -- 18
6817232 PID:49b002a TID:49d002a E1 auto
6817232 PID:49b002a TID:4d50022 T2     6
6818980 PID:49b002a TID:49d002a -- 19
6820885 PID:49b002a TID:49d002a -- 20
6820885 PID:49b002a TID:49d002a E2 manual
6820885 PID:49b002a TID:4d50022 T2     7
6822497 PID:49b002a TID:49d002a -- 21
6822497 PID:49b002a TID:49d002a E1 auto
6822497 PID:49b002a TID:49f002a T1   2
6824389 PID:49b002a TID:49d002a -- 22
6826793 PID:49b002a TID:49d002a -- 23
6828271 PID:49b002a TID:49d002a -- 24
6828271 PID:49b002a TID:49d002a E1 auto
6828271 PID:49b002a TID:4d50022 T2     8
6830076 PID:49b002a TID:49d002a -- 25
6830076 PID:49b002a TID:49d002a E2 manual
6831919 PID:49b002a TID:49d002a -- 26
6833771 PID:49b002a TID:49d002a -- 27
6833771 PID:49b002a TID:49d002a E1 auto
6833771 PID:49b002a TID:4d50022 T2     9
6835713 PID:49b002a TID:49d002a -- 28
6837640 PID:49b002a TID:49d002a -- 29
6839533 PID:49b002a TID:49d002a -- 30
6839533 PID:49b002a TID:49d002a E1 auto
6839533 PID:49b002a TID:4d50022 T2     10
6839533 PID:49b002a TID:49d002a E2 manual
6841163 PID:49b002a TID:49d002a -- 31
6842912 PID:49b002a TID:49d002a -- 32
6844504 PID:49b002a TID:49d002a -- 33
6844504 PID:49b002a TID:49d002a E1 auto
6844505 PID:49b002a TID:4d50022 T2     11
6846250 PID:49b002a TID:49d002a -- 34
6848938 PID:49b002a TID:49d002a -- 35
6848938 PID:49b002a TID:49d002a E2 manual
6848938 PID:49b002a TID:4d50022 T2     12
6851540 PID:49b002a TID:49d002a -- 36
6851540 PID:49b002a TID:49d002a E1 auto
6851540 PID:49b002a TID:4d50022 T2     13
6853337 PID:49b002a TID:49d002a -- 37
6854992 PID:49b002a TID:49d002a -- 38
6856724 PID:49b002a TID:49d002a -- 39
6856724 PID:49b002a TID:49d002a E1 auto
6856724 PID:49b002a TID:4d50022 T2     14
6858369 PID:49b002a TID:49d002a -- 40
6858369 PID:49b002a TID:49d002a E2 manual
6859459 PID:49b002a TID:49d002a -- 41
6862226 PID:49b002a TID:49d002a -- 42
6862226 PID:49b002a TID:49d002a E1 auto
6862226 PID:49b002a TID:4d50022 T2     15
6863947 PID:49b002a TID:49d002a -- 43
6865796 PID:49b002a TID:49d002a -- 44
```

```
6867423 PID:49b002a TID:49d002a -- 45
6867423 PID:49b002a TID:49d002a E1 auto
6867423 PID:49b002a TID:4d50022 T2     16
6867423 PID:49b002a TID:49d002a E2 manual
6869214 PID:49b002a TID:49d002a -- 46
6870231 PID:49b002a TID:49d002a -- 47
6871994 PID:49b002a TID:49d002a -- 48
6871994 PID:49b002a TID:49d002a E1 auto
6871994 PID:49b002a TID:4d50022 T2     17
6873860 PID:49b002a TID:49d002a -- 49
6875578 PID:49b002a TID:49d002a -- 50
6875578 PID:49b002a TID:49d002a E2 manual
6875578 PID:49b002a TID:4d50022 T2     18
6877474 PID:49b002a TID:49d002a -- 50 shutdown
```

9. Use the **Remote Kernel Tracker** to observe interaction between threads that are using event objects. Try to correlate the events you see with the debug output and the source code.

Note This application terminates automatically. If you see the shutdown message in the debug output, the application has already terminated. If Remote Kernel Tracker was still running from the last Exercise, you should still be able see the event information.

- **Measure synchronization performance**

10. Type **s osbench –t 1** and press <Enter> at the **Windows CE Command Prompt**. This will run the OSBench utility that tests the performance of various kernel API calls. This particular command line will limit the testing to events only.

11. Examine the **OSBench** output. You may wish to compare the performance of events to other synchronization methods.

Exercise 3 Semaphore synchronization

In this exercise you will see a simple implementation of synchronization using semaphores.

- **Add the existing SemaphoreDemo subproject to the OS Design**

1. Copy the **SemaphoreDemo** subproject from the Student files to your OS Design at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject.**

3. Select the **SemaphoreDemo.pbpxml** file from the **SemaphoreDemo** folder.

4. Configure the **SemaphoreDemo** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

- **Build SemaphoreDemo subproject**

5. Right click the **SemaphoreDemo** subproject in the Solution Explorer and select **Build.**

- **Run application**

6. Select **Windows CE Debug** from the drop down box in the output window. This will allow us to see the debug output from the device when we run our test application.

7. Type **s SemaphoreDemo** into the **Windows CE Command Prompt** window as follows:

   Windows CE>**s SemaphoreDemo**

8. Press <Enter> and verify debug output is similar to the following:

```
6887811 PID:4f2000a TID:4f9000a 1 \ 1
6887838 PID:4f2000a TID:4fa000a 2 \ 2
6887891 PID:4f2000a TID:4fc000a 3 \ 3
6887943 PID:4f2000a TID:4fa000a 2 \ 4
6887994 PID:4f2000a TID:4fc000a 3 \ 5
6888015 PID:4f2000a TID:4fa000a 2 \ 6
6888045 PID:4f2000a TID:4f9000a 1 \ 7
6888066 PID:4f2000a TID:4fc000a 3 \ 8
6888117 PID:4f2000a TID:4fa000a 2 \ 9
6888168 PID:4f2000a TID:4fc000a 3 \ 10
6888219 PID:4f2000a TID:4fa000a 2 \ 11
6888246 PID:4f2000a TID:4fc000a 3 \ 12
6888270 PID:4f2000a TID:4f9000a 1 \ 13
6888297 PID:4f2000a TID:4fa000a 2 \ 14
6888348 PID:4f2000a TID:4fc000a 3 \ 15
```

```
6888399 PID:4f2000a TID:4fa000a 2 \ 16
6888451 PID:4f2000a TID:4fc000a 3 \ 17
6888471 PID:4f2000a TID:4fa000a 2 \ 18
6888502 PID:4f2000a TID:4f9000a 1 \ 19
6888522 PID:4f2000a TID:4fc000a 3 \ 20
6888573 PID:4f2000a TID:4fa000a 2 \ 21
6888626 PID:4f2000a TID:4fc000a 3 \ 22
6888677 PID:4f2000a TID:4fa000a 2 \ 23
6888706 PID:4f2000a TID:4fc000a 3 \ 24
6888729 PID:4f2000a TID:4f9000a 1 \ 25
6888757 PID:4f2000a TID:4fa000a 2 \ 26
6888808 PID:4f2000a TID:4fc000a 3 \ 27
6888885 PID:4f2000a TID:4fa000a 2 \ 28
6888931 PID:4f2000a TID:4fc000a 3 \ 29
6888939 PID:4f2000a TID:4f9000a 1 \ 30
6888982 PID:4f2000a TID:4fa000a 2 \ 31
6889035 PID:4f2000a TID:4fc000a 3 \ 32
6889086 PID:4f2000a TID:4fa000a 2 \ 33
6889137 PID:4f2000a TID:4fc000a 3 \ 34
6889140 PID:4f2000a TID:4fa000a 2 \ 35
6889188 PID:4f2000a TID:4f9000a 1 \ 36
6889191 PID:4f2000a TID:4fc000a 3 \ 37
6889242 PID:4f2000a TID:4fa000a 2 \ 38
6889293 PID:4f2000a TID:4fc000a 3 \ 39
6889344 PID:4f2000a TID:4fa000a 2 \ 40
6889389 PID:4f2000a TID:4fc000a 3 \ 41
6889395 PID:4f2000a TID:4f9000a 1 \ 42
6889440 PID:4f2000a TID:4fa000a 2 \ 43
6889491 PID:4f2000a TID:4fc000a 3 \ 44
6889542 PID:4f2000a TID:4fa000a 2 \ 45
6889593 PID:4f2000a TID:4fc000a 3 \ 46
6889596 PID:4f2000a TID:4fa000a 2 \ 47
6889644 PID:4f2000a TID:4f9000a 1 \ 48
6889649 PID:4f2000a TID:4fc000a 3 \ 49
6889701 PID:4f2000a TID:4fa000a 2 \ 50
6889752 PID:4f2000a TID:4fc000a 3 \ 51
6889758 PID:4f2000a TID:4f3000a Shutting down...
6889818 PID:4f2000a TID:4fa000a 2 \ 52
```

9. Use the **Remote Kernel Tracker** to observe interaction between threads that are using semaphore objects. Try to correlate the events you see with the debug output and the source code.

Note This application terminates automatically. If you see the shutdown message in the debug output, the application has already terminated. If Remote Kernel Tracker was still running from the last Exercise, you should still be able see the event information.

- **Measure synchronization performance**

10. Type **s osbench –t 2** and press <Enter> at the **Windows CE Command Prompt**. This will run the OSBench utility that tests the performance of various kernel API calls. This particular command line will limit the testing to semaphores only.

11. Examine the **OSBench** output. You may wish to compare the performance of semaphores to other synchronization methods.

If you are continuing with the next Hands-On Lab, keep your image running.

Lab 4-1: Using the Remote Registry Editor

Objectives

- Use the Remote Registry Editor to explore and change the device registry.

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

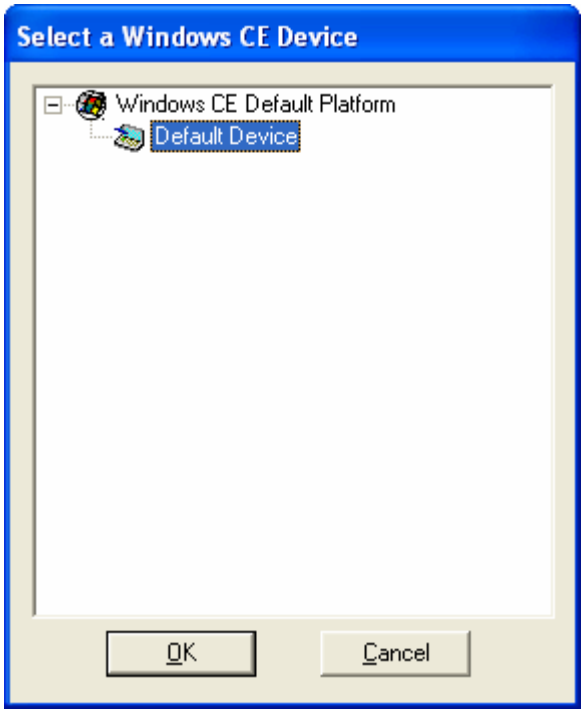
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Using the Remote Registry Editor

In this exercise, you will use the Windows CE Remote Registry Editor to examine and modify the registry on the target device.

➢ Starting the Remote Registry Editor

1. Select **Target | Remote Tools | Registry Editor** from the Visual Studio menu. Click **OK** to accept the **Default Device** connection.



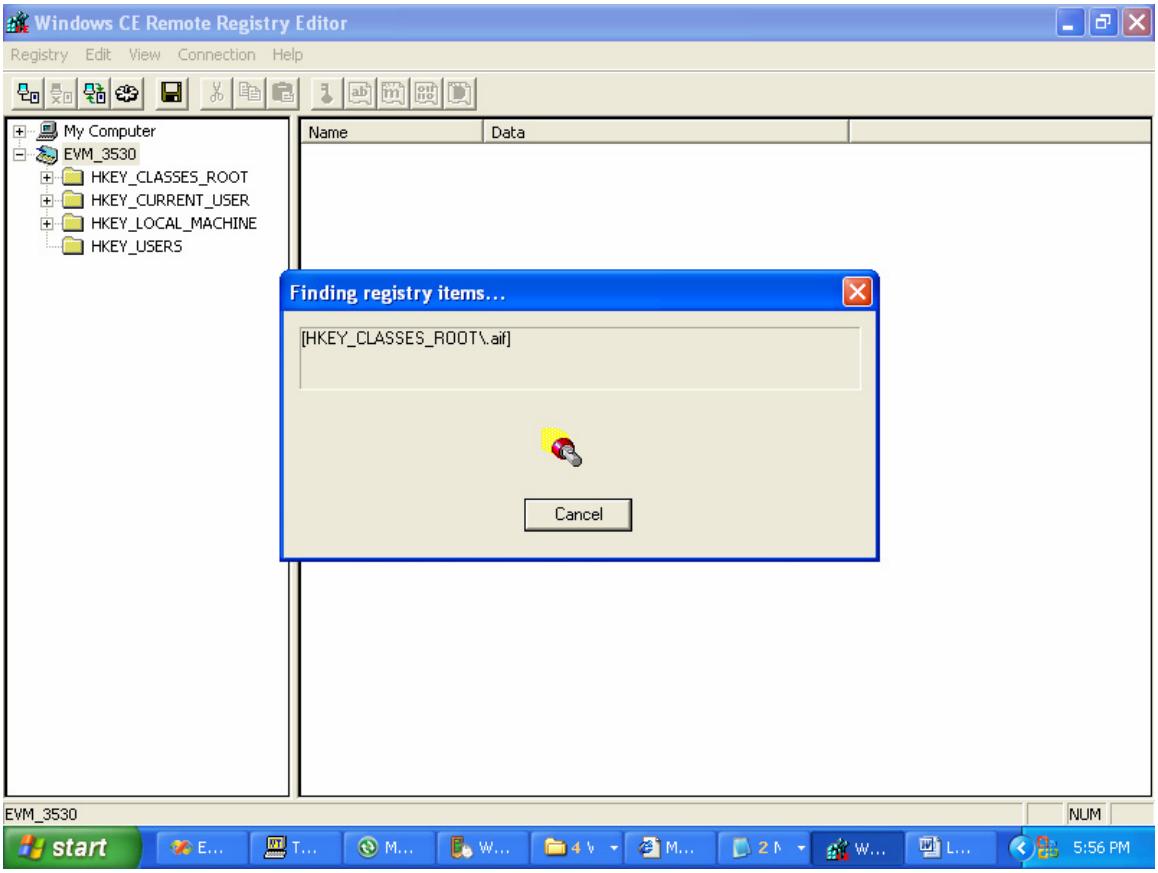
2. Wait a few seconds for the connection to be established and for required files to be transferred to the device.

Note The Remote Registry Editor also displays the registry of your development workstation under the My Computer tree in the left hand pane. This tree will be available even if you are not connected to the target device. Make sure you don't get confused about which registry you are viewing and/or editing.

➢ Explore the target device registry

3. In the left-hand pane of the Windows CE Remote Registry Editor, right-click on **Default Device** and then click **Find**. This will bring up the Find dialog.

4. Type **NE20001** in the Find dialog and click **OK**.



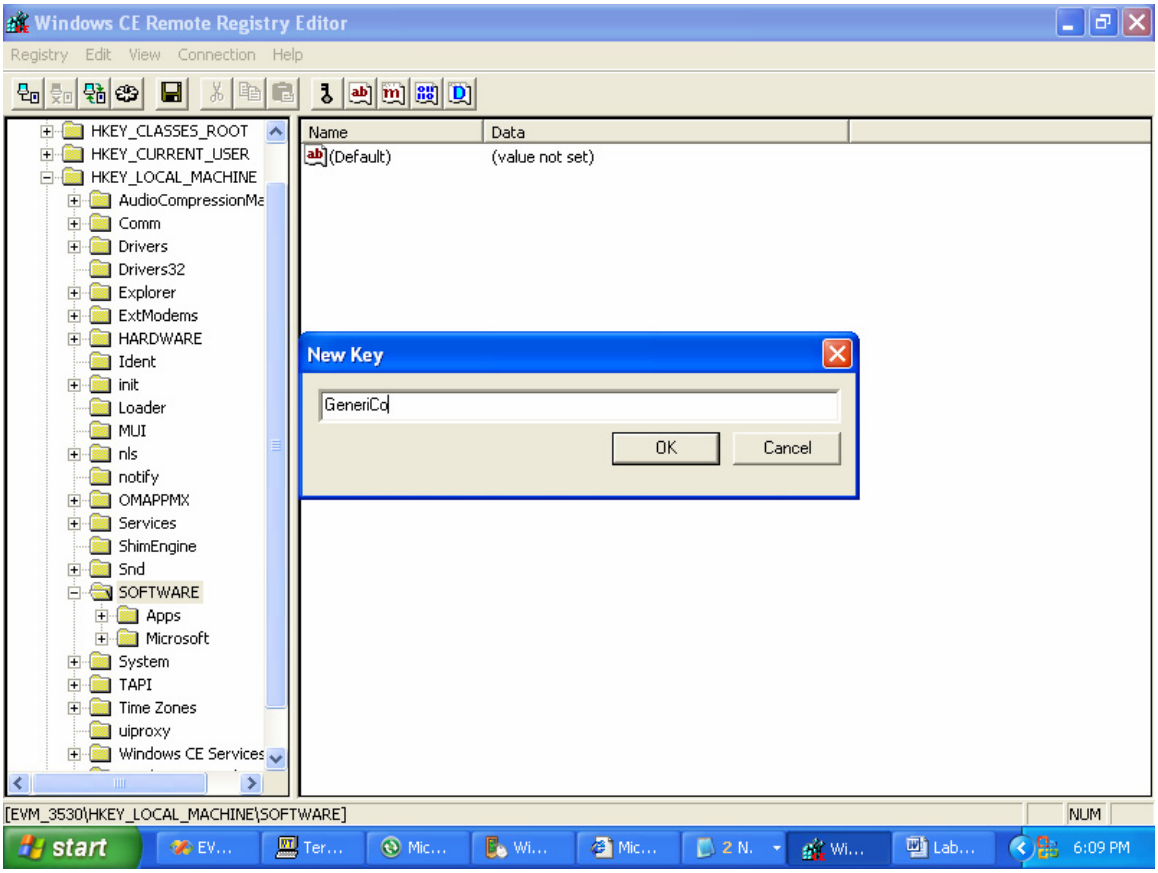
5. The **[HKEY_LOCAL_MACHINE\Comm\NE20001]** is displayed.

6. Expand the **NE20001** key and click on the **Parms** key.

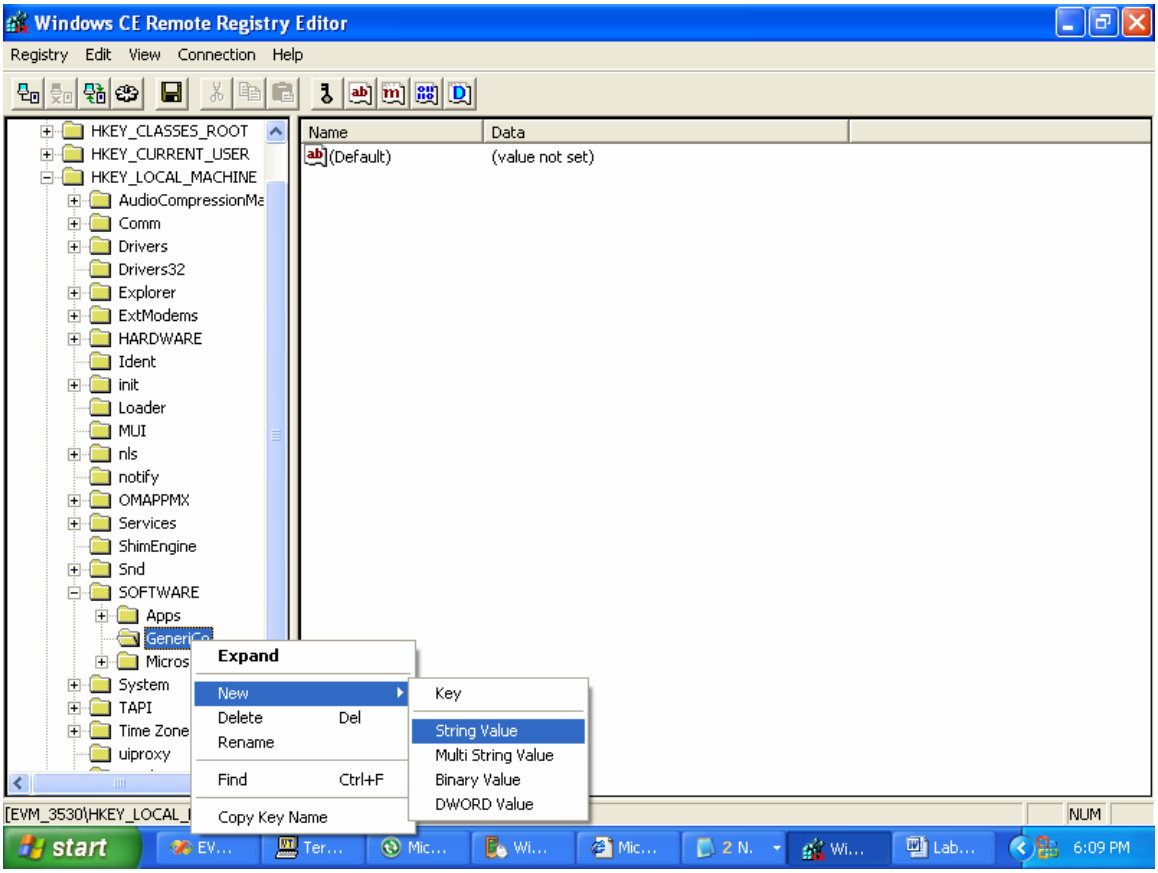
➢ **Modify the device registry**

7. Right click the **[HKEY_LOCAL_MACHINE\SOFTWARE]** key and select **New | Key**.

8. Create a key called **GeneriCo** and click **OK**.

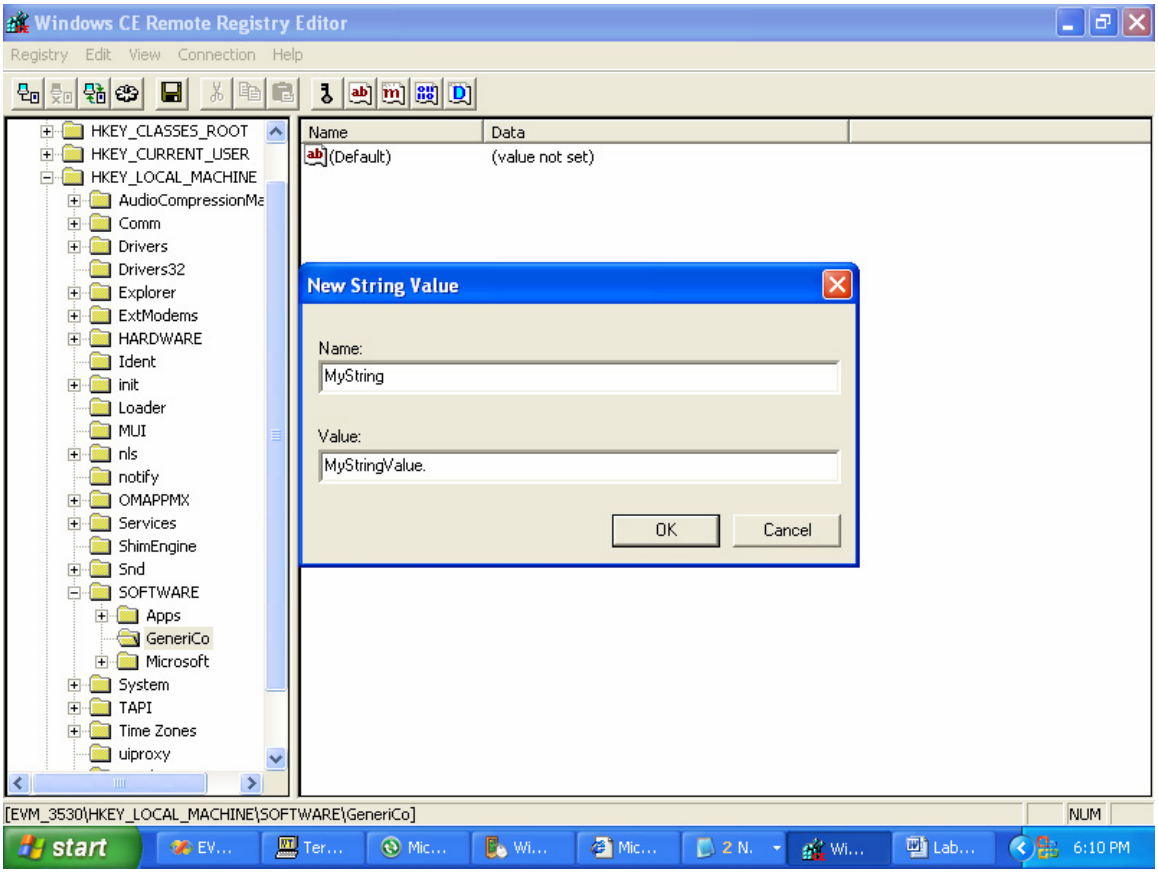


9. Right click on the new **GeneriCo** key and select **New | String Value**.

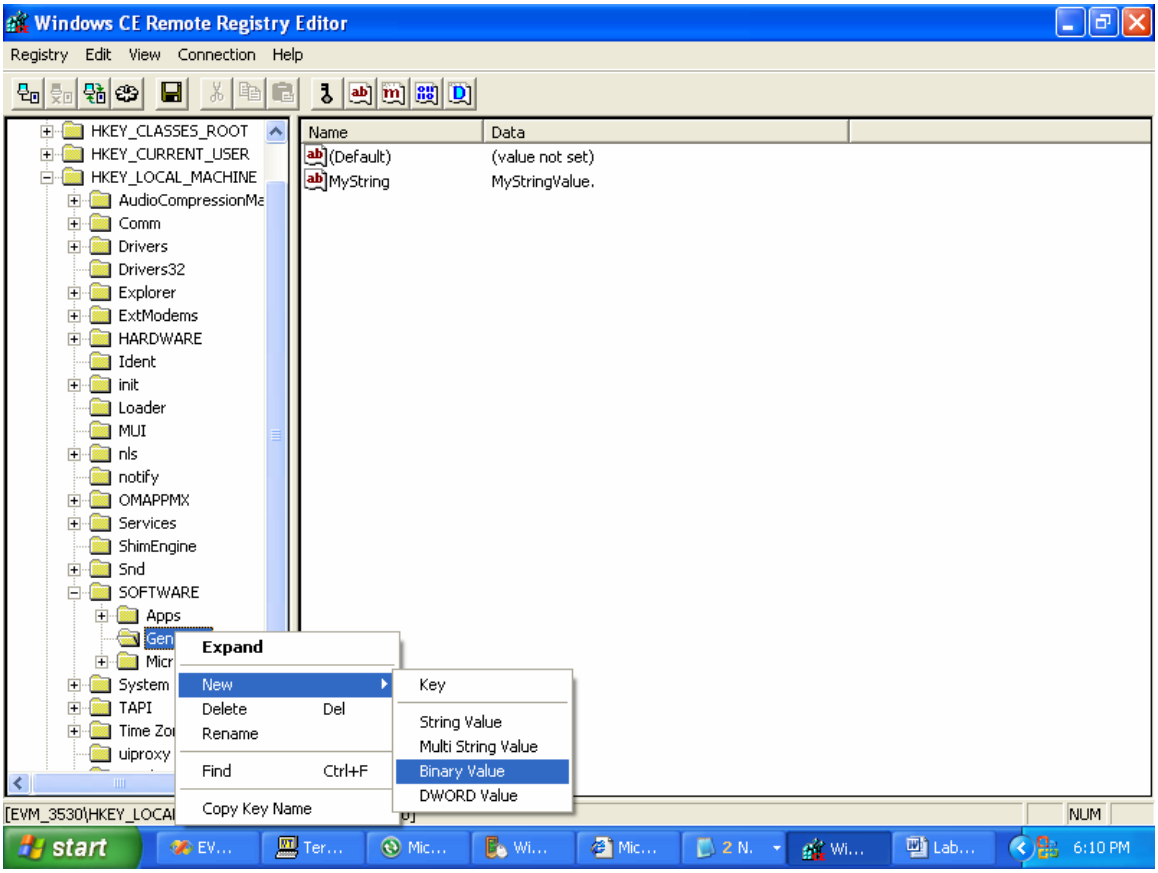


10. Create the string value with the name **MyString**, and the value **MyStringValue**.

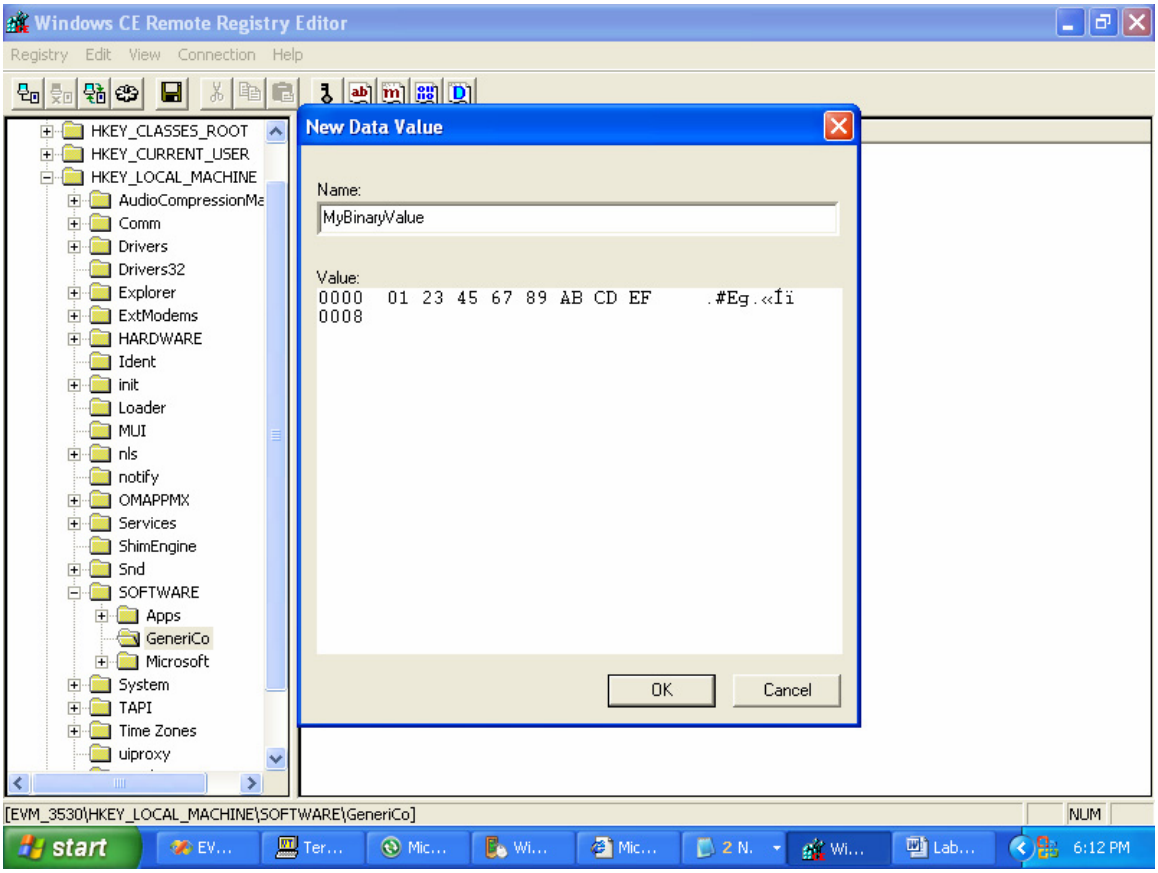
11. Click **OK** to create the value.



12. Right click on the **GeneriCo** key and select **New | Binary Value**. This will bring up the **New Data Value** dialog.



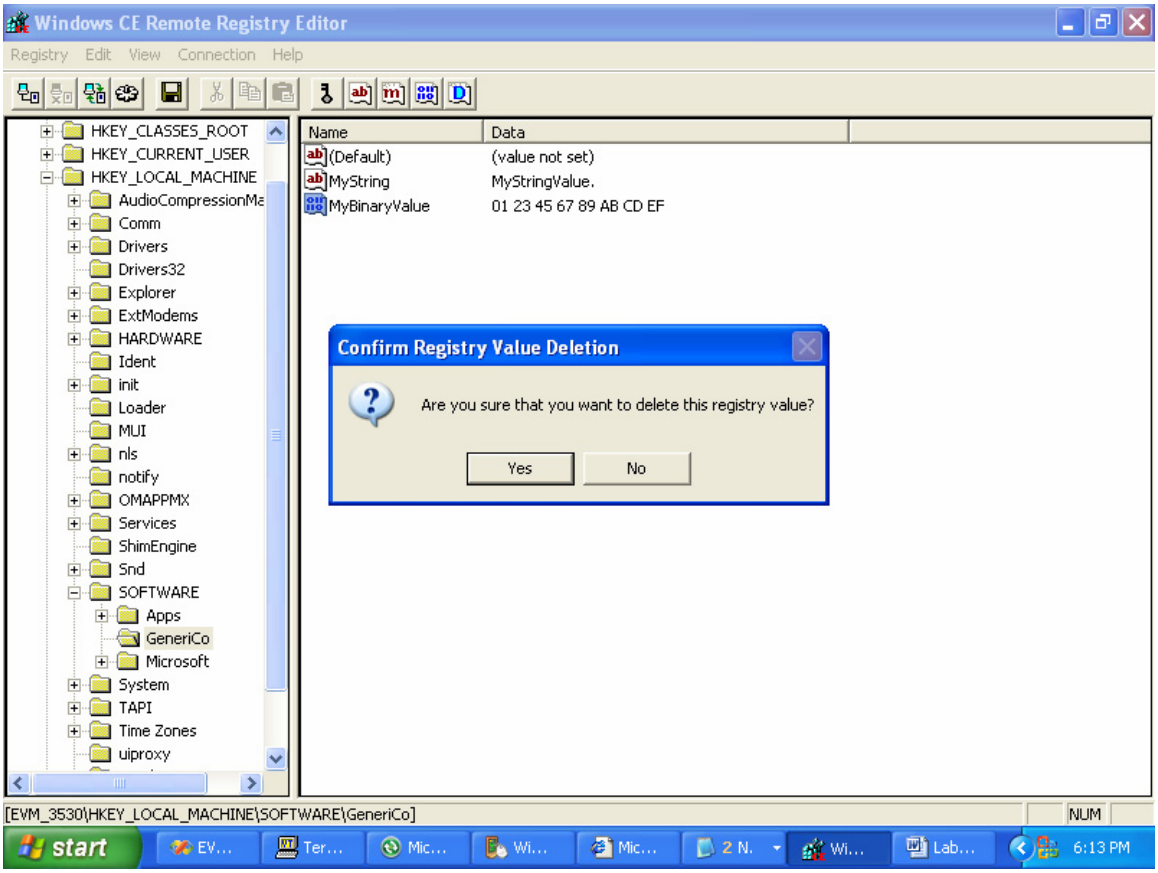
13. Create a binary value with the name **MyBinaryValue**. In the **Value** box, type **0123456789abcdef** and click **OK**. Notice that the editor groups the entry into bytes, and adds an ASCII translation of the values in the right column of the value box.



Note You can also edit the ASCII translation area of this dialog box instead of typing in binary values. There is no visible differentiator between the two areas in the dialog, just click your mouse in the far right hand area if you wish to enter ASCII text.

14. Right-click on **MyBinaryValue** and select **Delete**.

15. Confirm your intention to delete by clicking **Yes**.



16. In the left-hand pane, right click on **GeneriCo** and select **Rename**.

17. Type **GeneriCo2** and press **Enter**.

➢ **Save a portion of the device registry to a file on the development workstation**

18. In the left-hand pane of the Remote Registry Editor, highlight the **[HKLM\SOFTWARE\GeneriCo2]** key.

19. Select **Registry | Export Registry File** from the Remote Registry Editor menu.

20. Save the file to your desktop as **MyDeviceRegKey.txt**.

WARNING It is possible to merge an exported Windows CE registry file into the registry of your desktop system. This can result in catastrophic corruption of the registry on your workstation. So be careful!

21. Open the **MyDeviceRegKey.txt** file using Visual Studio.

22. Observe that the format of the Windows CE registry file is identical to that used in other version of Microsoft Windows.

23. Close and delete MyDeviceRegKey.txt

24. Close the Remote Registry Editor.

Lab 4-2: Power Management

Objectives

- Introduce the Windows Embedded CE 6.0 power management architecture
- Utilize portions of the CE 6.0 Power Management architecture
- Become familiar with several Power Management APIs
- Allow a test application to receive notification about system power events and to put power requirements into place

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1

This exercise demonstrates portions of the Windows Embedded CE 6.0 power management architecture. Several of the power management APIs are used, allowing the test application to receive notification about system power events and to put power requirements into place.

This lab will make use of the backlight driver to demonstrate the interaction between applications and drivers in the realm of power management. We will modify a portion of the existing backlight driver to better illustrate these concepts. We will rebuild the OS run-time image to include the modified backlight driver and the test application.

- **Add the existing Power_Management subproject to the OS Design**

1. Copy the **Power_Management** subproject from the Student files to your OS Design at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject.**

3. Select the **Power_Management.pbpxml** file from the **Power_Management** folder.

4. This time, **do not** configure the subproject to be excluded from the image or built as debug. We will rebuild the OS run-time image including the modules from this subproject.

- **Modify existing backlight driver**

5. Expand the node **C:/WINCE600 | PLATFORM | EVMBSP | src | drivers | backlight | MDD | Include Files** in the Solution Explorer.

6. Double click the file **bkli.h** to open the file in the Visual Studio editor.

7. Locate the **#define ZONE_BACKLIGHT** near the top of the file, and set it to **1**. This will cause the backlight driver to print debug messages when implementing power management requests.

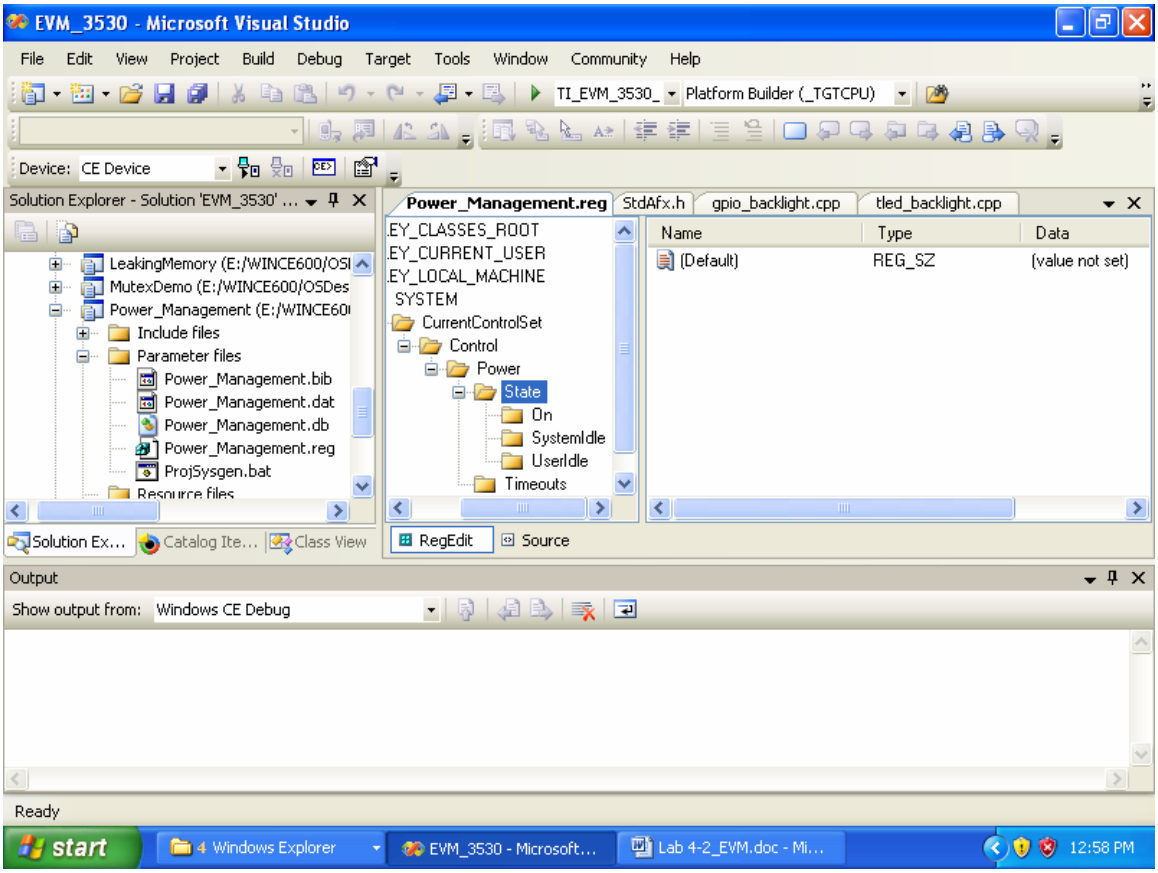
- **Examine registry changes**

8. Locate the **Power_Management** subproject in the Solution Explorer.

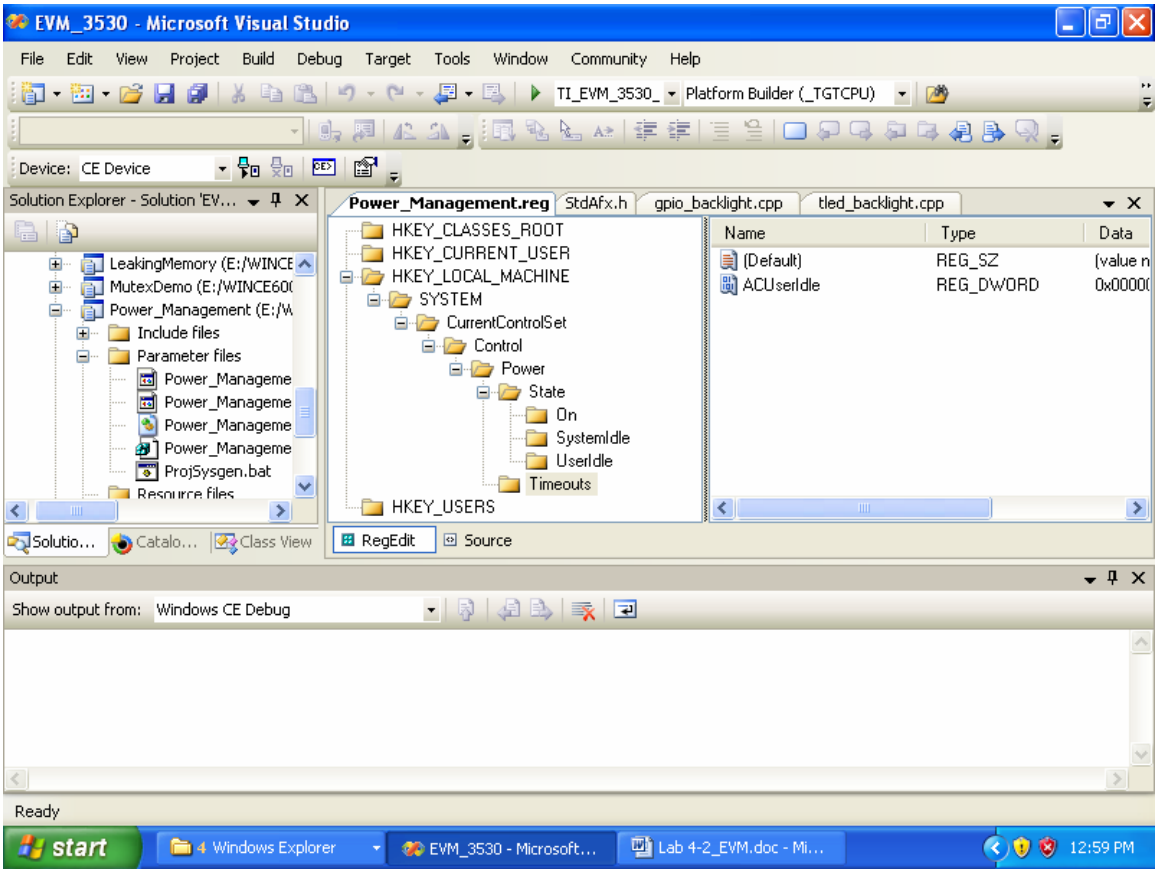
9. Open the file **Power_Management.reg** in the **Parameter files** node.

10. Examine the registry entries under **[HKLM\System\CurrentControlSet\Control\Power\State]**. These registry

entries override the default behavior for the backlight driver in each of the named system power states. They cause the backlight driver to default to its low power state instead of operating in its normal full power state.



11. Examine the registry entry under **[HKLM\System\CurrentControlSet\Control\Power\Timeouts]**. This changes the timeout period used by the Power Manager to determine when to move to the User Idle state.



Note	The registry entries contained in subprojects are processed last when building the OS run-time image. These registry entries override any entries that are defined by operating system components or the BSP.

➢ **Build and run the updated OS run-time image**

12. Select **Target | Detach Device** from the Visual Studio menu to detach the existing device image.

13. Close any **remote tools** that you may have open.

14. Select **Build | Advanced Build Commands | Build Current BSP and Subprojects** from the Visual Studio menu.

15. Select **Target | Attach Device** from the Visual Studio menu to re-attach the device.

➢ **Examine Power_Management application**

16. Open the **Power_Management.cpp** file from the Power_Management subproject using Solution Explorer.

17. Locate the **PowerNotificationThread** function. This secondary thread requests notification about power management events using the **RequestPowerNotifications** API. This thread allows the application to print out a message each time the system power state changes.

18. Locate the **WinMain** function. This function calls the **SetPowerRequirement** API against the backlight driver, forcing the backlight driver into a higher power state (D0). The **ReleasePowerRequirement** allows the backlight to return to its normal state (D4).

- **Run Power_Management application**

19. Launch the **Power_Management.exe** application using **Target | Run Programs** from the Visual Studio menu.

20. Observe debug messages in the **Output** window similar to the following:

```
76711 PID:423000e TID:43f000e Power Notification Message: PBT_POWERINFOCHANGE
76711 PID:423000e TID:43f000e Length: 28
76711 PID:423000e TID:43f000e BatteryLifeTime = -1
76711 PID:423000e TID:43f000e BatterFullLifeTime = -1
76711 PID:423000e TID:43f000e BackupBatteryLifeTime = -1
76711 PID:423000e TID:43f000e BackupBatteryFullLifeTime = -1
76711 PID:423000e TID:43f000e ACLineStatus = 255
76711 PID:423000e TID:43f000e BatteryFlag = 255
76711 PID:423000e TID:43f000e BatteryLifePercent = 255
76711 PID:423000e TID:43f000e BackupBatteryFlag = 255
76711 PID:423000e TID:43f000e BackupBatteryLifePercent = 255
```

Analysis	These messages come from the PowerNotificationThread, which received a PBT_POWERINFOCHANGE message. This message provides information from the battery driver about the state of the power sources on the device.

21. Click the **OK** button on the **Power dialog box** on the device. Observe the following debug messages in the **Visual Studio Output** window:

```
150459 PID:423000e TID:43f000e Power Notification Message: PBT_TRANSITION
150459 PID:423000e TID:43f000e Flags: 11000000
150459 PID:423000e TID:43f000e Length: 18
150459 PID:423000e TID:43f000e SystemPowerState: on
150459 PID:423000e TID:43f000e BKL_IOControl IOCTL code  = 3280904
150459 PID:423000e TID:43f000e  BKL: Received IOCTL_POWER_SET
150459 PID:423000e TID:43f000e IOCTL_POWER_SET to D0
```

Followed shortly by:

```
450461 PID:423000e TID:43f000e Power Notification Message: PBT_TRANSITION
450461 PID:423000e TID:43f000e Flags: 0
450461 PID:423000e TID:43f000e Length: 22
450461 PID:423000e TID:43f000e SystemPowerState: systemidle
```

Analysis	These messages show a system power state change to **on**, because we clicked a button on the screen. In addition, the backlight driver was forced to move to the **D0** state because the application called SetPowerRequirement against it. The application subsequently received notification that the device changed to a system power state of **useridle** after 5 seconds of inactivity.

22. Click the **OK** button on the **Power dialog box** on the device. This will cause the application to release the power requirement on the backlight, resulting in debug message output similar to the following:

```
150459 PID:423000e TID:43f000e Power Notification Message: PBT_TRANSITION
 150459 PID:423000e TID:43f000e Flags: 11000000
 150459 PID:423000e TID:43f000e Length: 18
 150459 PID:423000e TID:43f000e SystemPowerState: on
 150459 PID:423000e TID:43f000e BKL_IOControl IOCTL code  = 3280904
 150459 PID:423000e TID:43f000e  BKL: Received IOCTL_POWER_SET
 150459 PID:423000e TID:43f000e IOCTL_POWER_SET to D0
450461 PID:423000e TID:43f000e Power Notification Message: PBT_TRANSITION
 450461 PID:423000e TID:43f000e Flags: 0
 450461 PID:423000e TID:43f000e Length: 22
 450461 PID:423000e TID:43f000e SystemPowerState: systemidle
```

23. Click the **OK** button on the **Power dialog box** again. This will cause the application to exit.

Lab 5-1: Static and Dynamic Libraries

Objectives

- Create simple static library
- Link the static library with a dynamic library
- Link the dynamic library with an executable

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 45 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Create a static library (LIB)

In this exercise you will create a static library with routines that you will later link to when you build a dynamic library and an executable.

Note	This exercise involves a bit of typing; if you perfer you may copy the text from the Student files.

- **Create a static library subproject**

1. Select **Project | Add New Subproject…** from the Visual Studio menu. This will bring up the **Windows CE Subproject Wizard**.

2. Select the **WCE Static Library** template.

3. Set the Subproject name to **Power_Status** and click **Next**.

4. Check the **Precompiled header** box.

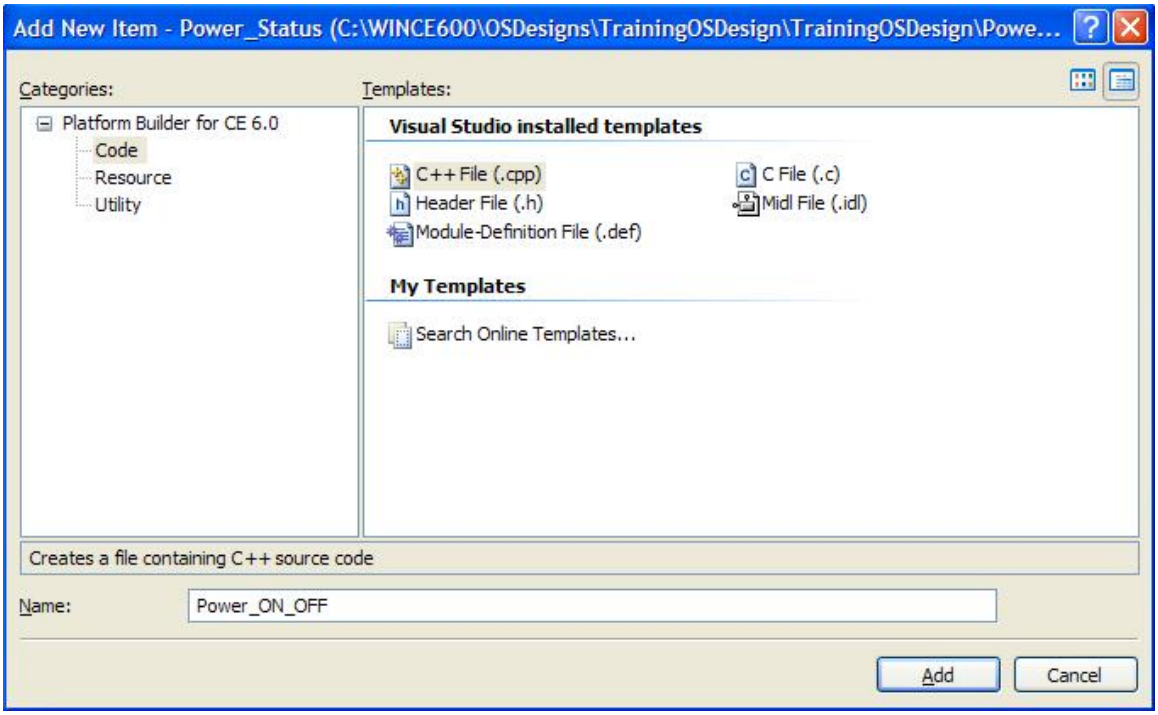
5. Click **Finish.**

6. Configure the **Power_Status** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

- **Create files**

7. Right click on the **Power_Status** subproject in the Solution Explorer and select **Add | New Item…**

8. Select the **Code** category, the **C++ File (.cpp)** template, and then type **Power_ON_OFF** in the name field.



9. Click on **Add** to add the new file.

10. Right click on the **Power_Status** subproject in the Solution Explorer and select **Add | New Item…**

11. Select the **Code** category, the **Header File (.h)** template, and then type **Power_Status** in the name field.

12. Click on **Add** to add the new file.

13. Using the Solution Explorer, locate the **Power_ON_OFF.cpp** file in the **Power_Status** subproject and open it.

14. Add the following code to the **Power_ON_OFF.cpp** file:

```
#include "stdafx.h"

LPCTSTR g_StrOn = L"Power is on";
LPCTSTR g_StrOff = L"Power is off";

LPCTSTR PowerOn()
{
	return g_StrOn;
}
LPCTSTR PowerOff()
{
	return g_StrOff;
}
```

15. Save and close **Power_ON_OFF.cpp**.

16. Expand the **Include files** node in the Power_Status subproject and open **stdafx.h**

17. Add an include for **<windows.h>** as follows:

```
// TODO: reference additional headers your program requires here
#include <windows.h>
```

18. Save and close **stdafx.h.**

19. Using the Solution Explorer, locate the **Power_Status.h** file in the **Power_Status** subproject and open it.

20. Add the following to **Power_Status.h**:

```
extern LPCTSTR PowerOff(void);
extern LPCTSTR PowerOn(void);
```

21. Save and close **Power_Status.h**.

- **Build the library**

22. Right click the **Power_Status** subproject in the Solution Explorer and select **Build**.

Exercise 2 Create a dynamic library (DLL)

In this exercise you will create a dynamic library that will link with the static library you created previously.

Note	This exercise involves a bit of typing; if you perfer you may copy the text from the Student files.

➢ **Create the dynamic library subproject**

1. Select **Project | Add New Subproject…** from the Visual Studio menu.
2. Select the **WCE Dynamic-Link Library** template.
3. Set the Subproject name to **ScanBarcode** and click **Next**.
4. Select **A simple Windows Embedded CE DLL subproject** and click **Finish**.
5. Configure the **ScanBarcode** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

➢ **Edit source files for DLL project**

6. In the Solution Explorer, right-click on the **ScanBarcode** subproject, and then select **Add | New Item…**
7. Select the **Code** category, the **Header File (.h)** template, and then type **ScanBarcode** in the name field.
8. Using the Solution Explorer, open the **ScanBarcode.h** file from the **ScanBarcode** subproject.
9. Add the following code to the **ScanBarcode.h** file:

```
#include <windows.h>

EXTERN_C LPCTSTR ScanBarcode(void);
EXTERN_C LPCTSTR ScanPowerOff(void);
EXTERN_C LPCTSTR ScanPowerOn(void);
```

10. Using the Solution Explorer, open the **ScanBarcode.def** file from the **Parameter files** node in the ScanBarcode subproject.
11. Add the following to the DEF file:

```
LIBRARY ScanBarcode
```

```
EXPORTS
      ScanPowerOff
      ScanPowerOn
      ScanBarcode
```

12. Save and close **ScanBarcode.def**.

13. Using the Solution Explorer, open the **ScanBarcode.cpp** file from the ScanBarcode subproject.

14. Add an include statement for **Power_Status.h** as follows:

```
// ScanBarcode.cpp : Defines the entry point for the DLL
application.
//

#include "stdafx.h"
#include "Power_Status.h"

BOOL APIENTRY DllMain( HANDLE hModule,
                       DWORD  ul_reason_for_call,
                       LPVOID lpReserved
                           )
{
    return TRUE;
}
```

15. Add the following code snippet to ScanBarcode.cpp after the inclusion of Power_Status.h.

```
LPCTSTR g_StrScan = L"123456789ABC";

EXTERN_C LPCTSTR ScanBarcode(void)
{
      return g_StrScan;
}

EXTERN_C LPCTSTR ScanPowerOn(void)
{
      return PowerOn();
}

EXTERN_C LPCTSTR ScanPowerOff(void)
{
      return PowerOff();
}
```

16. Save and close **ScanBarcode.cpp**.

- **Link to static library**

17. Right click on the **ScanBarcode** subproject node in the Solution Explorer, and then select **Open.** The ScanBarcode **SOURCES** file will open.

18. Locate the section of the file containing **TARGETLIBS**.

19. Add a reference to the Power_Status.lib static library by modifying this section as follows:

```
TARGETLIBS= \
    $(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\coredll.lib \
    $(PBWORKSPACEROOT)\Power_Status\obj\$(_CPUINDPATH)\Power_Status.lib \
```

Note The trailing backslash characters on each line are line continuation characters. Ensure that there is no white space after them. Also, ensure that there is a blank line following the last line.

---

20. Add the path to directory containing the Power_Status.h header file by adding the following to the bottom of the **SOURCES** file:

```
INCLUDES= \
    $(PBWORKSPACEROOT)\Power_Status \
```

Note Ensure that there is at least one blank line prior to the line containing the INCLUDES directive. This ensures that there are no line continuation characters prior to this statement that are still in effect.

---

21. Save and close the SOURCES file.

22. Right click on the **ScanBarcode** subproject in the Solution Explorer and select **Properties**.

23. Select the **C/C++** tab and observe the **Include Directories** entry. Notice that the directory you just added with the INCLUDES directive in the SOURCES file is listed here.

24. Select the **Link** tab and observe the **Additional Libraries** entry. Notice that the library you just added with the TARGETLIBS directive in the SOURCES file is listed at the end of this line.

Note The SOURCES file itself controls the build rules for the subproject. The graphical user interface shown here provides an alternate way to view and modify this file.

---

25. Select **Cancel** to close this dialog without making any changes.

- **Build the library**

26. Right click the **ScanBarcode** subproject in the Solution Explorer and select **Build**.

Exercise 3 Create an executable (EXE)

In this exercise you will create an executable that uses functionality from the dynamic library you just created.

- **Adding existing application subproject**

1. Copy the **BarcodeDllTest** subproject from the Student files to your OS Design at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject.**

3. Select the **BarcodeDllTest.pbpxml** file from the **BarcodeDllTest** folder.

4. Configure the **BarcodeDllTest** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

- **Add reference to dll**

5. Right click on the **BarcodeDllTest** subproject in the Solution Explorer and select **Open**.

6. Add the following to the bottom of the file:

```
INCLUDES= \
      $(PBWORKSPACEROOT)\ScanBarcode \
```

Note Ensure that there is a blank line preceding the INCLUDES directive. Ensure there is no whitespace after the trailing backslashes.

7. Locate the TARGETLIBS directive and add a reference to **ScanBarcode.lib** as follows:

```
TARGETLIBS= \
    $(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\coredll.lib \
    $(PBWORKSPACEROOT)\ScanBarcode\obj\$(_CPUINDPATH)\ScanBarcode.lib \
```

Note Ensure that there is a blank line after the line containing ScanBarcode.lib. Ensure there is no white space after the trailing backslashes.

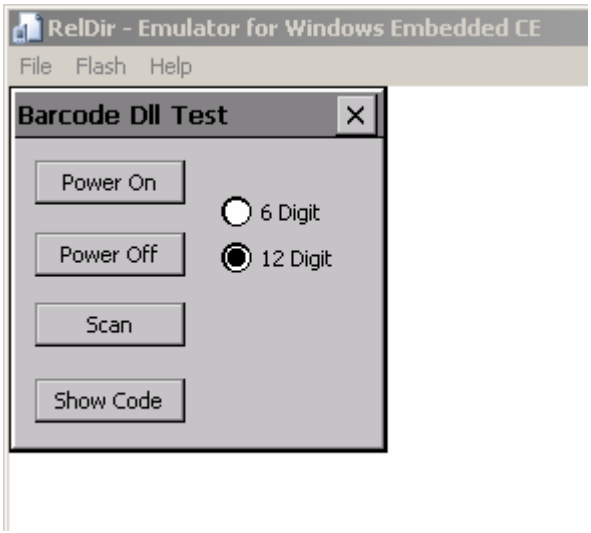
8. Save and close the **sources** file.

9. Right click on the **BarcodeDllTest** subproject and select **Build**.

- **Run the BarcodeDllTest application**

10. Launch **BarcodeDllTest.exe** using **Target** | **Run Programs** from the Visual Studio menu.

11. The BarcodeDllTest.exe application will present the following user interface. You can exercise it by clicking on the various buttons.



This simple application makes calls into the linked Scanbarcode.dll dynamic library, which includes functionality from the Power_Status.lib static library. You may wish to set breakpoints on functions in these modules and view the call stacks to see how they are eventually called from the application.

Lab 5-2: Command Line Build

Objectives

- Learn how some of the build commands available in the Visual Studio IDE map to command line actions
- Compare IDE and command line build mechanisms

Prerequisites

- Completed Lab 2-2

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-2

Exercise 1 Project build in command line

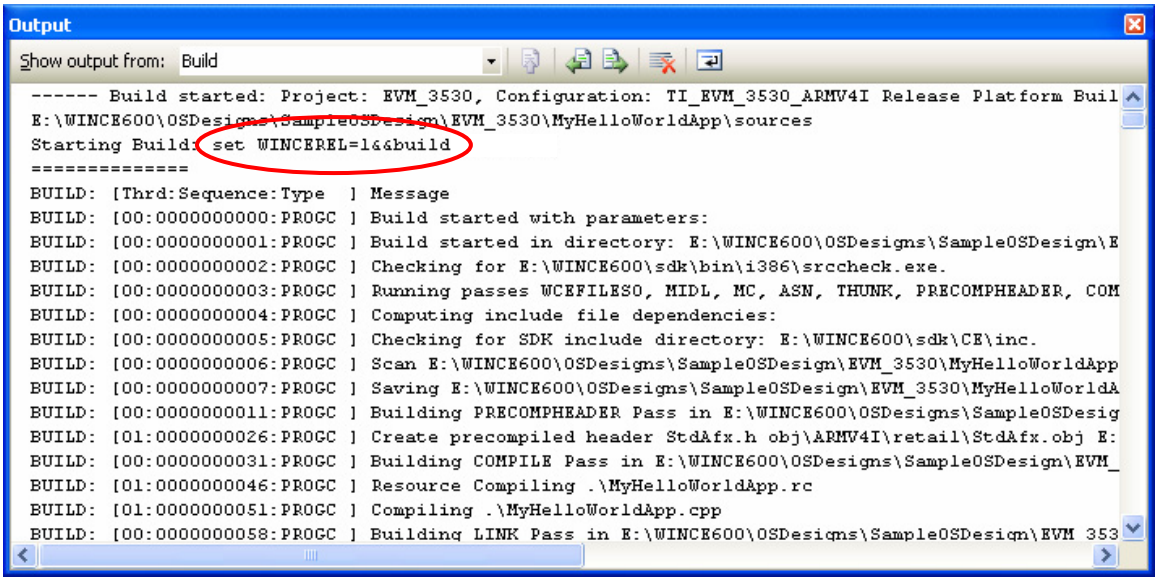
This exercise will demonstrate how some of the build commands available in the Visual Studio IDE map to command line actions. All of the build commands that are accessible from the Visual Studio IDE eventually resolve to command line actions. You will see how to determine what these mappings are.

We will use the MyHelloWorldApp subproject that we created at the beginning of this course to point out some of the build commands.

➢ **Build the MyHelloWorldApp subproject from the IDE**

1. Detach the target if attached.

2. Right click on the MyHelloWorldApp subproject and choose **Build**. Observe the Build Output window.



3. Observe the circled commands. This is a **compound** statement that consists of two commands. First, the environment variable WINCEREL is set to 1 and then the build command is issued.

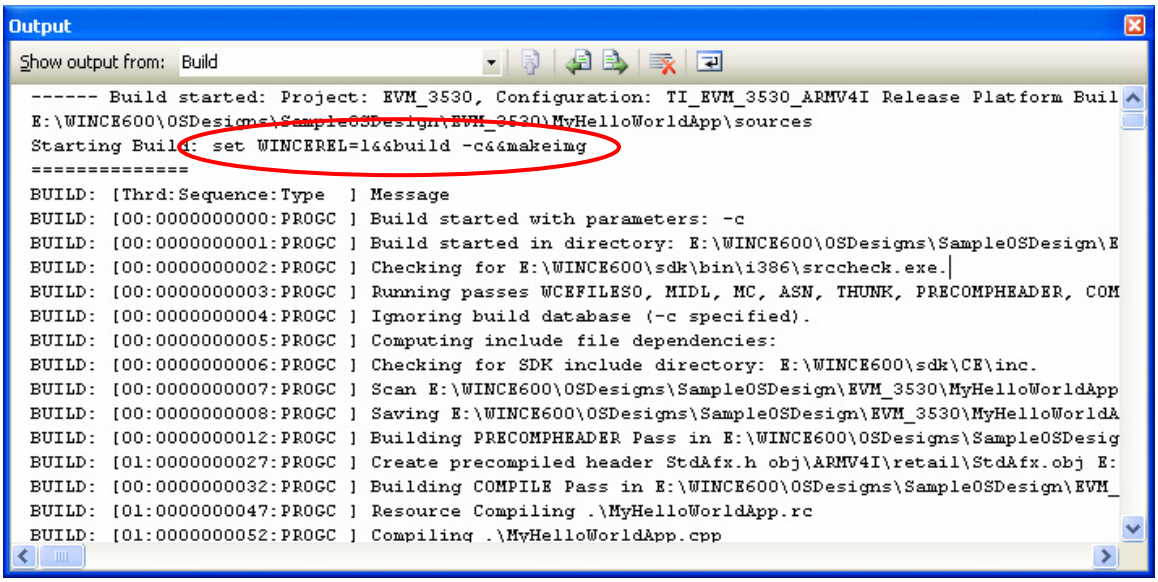
4. Select **Build | Targeted Build Settings | Make Run-Time Image After Building** on the Visual Studio menu. Selecting this menu item should cause it to become checked.

Note We disabled this option previously because we generally did not want the run-time image to be built after each targeted build. We are enabling it here to show its functionality.

---

5. Clear the Build Output window by right clicking in it and selecting **Clear All**.

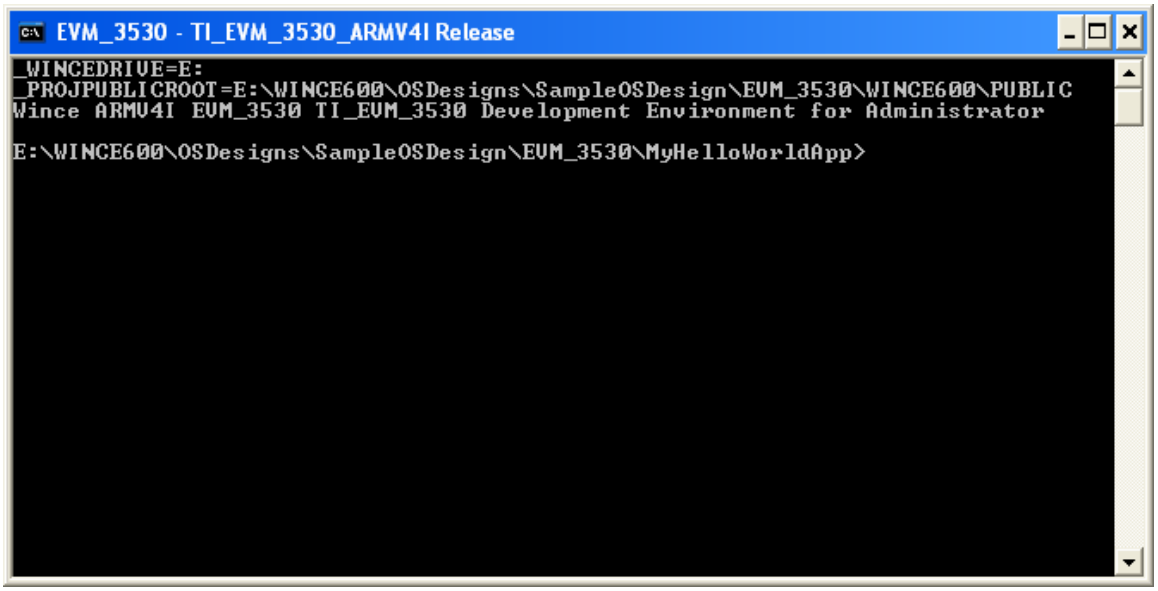
6. Right click on the **MyHelloWorldApp** subproject and choose **Rebuild**. Observe the Build Output window.



7. Observe the circled commands. This time there are three commands. The build command has the **–c** parameter, causing clean build to be performed. The clean build was performed because we chose **Rebuild** instead of **Build** from the menu. The last command is **makeimg**, which builds the OS run-time image. This command is performed because we selected the option to **Make Run-Time Image After Building** for targeted builds.

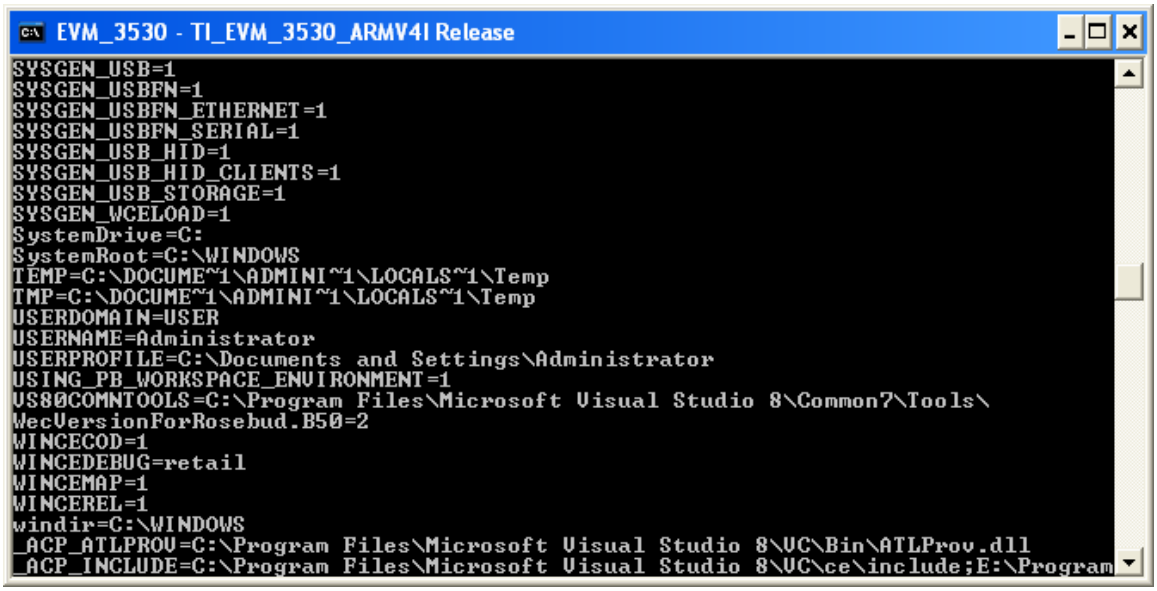
➢ **Build the MyHelloWorldApp subproject from the command line**

8. Right click on the MyHelloWorldApp subproject and select **Open Build Window**. The following window is displayed:



Note	This is not a generic DOS command shell. This command shell has been automatically configured for Windows Embedded CE 6.0 builds. You can not simply launch a generic DOS command shell and be able to do CE builds without configuring the build environment properly.

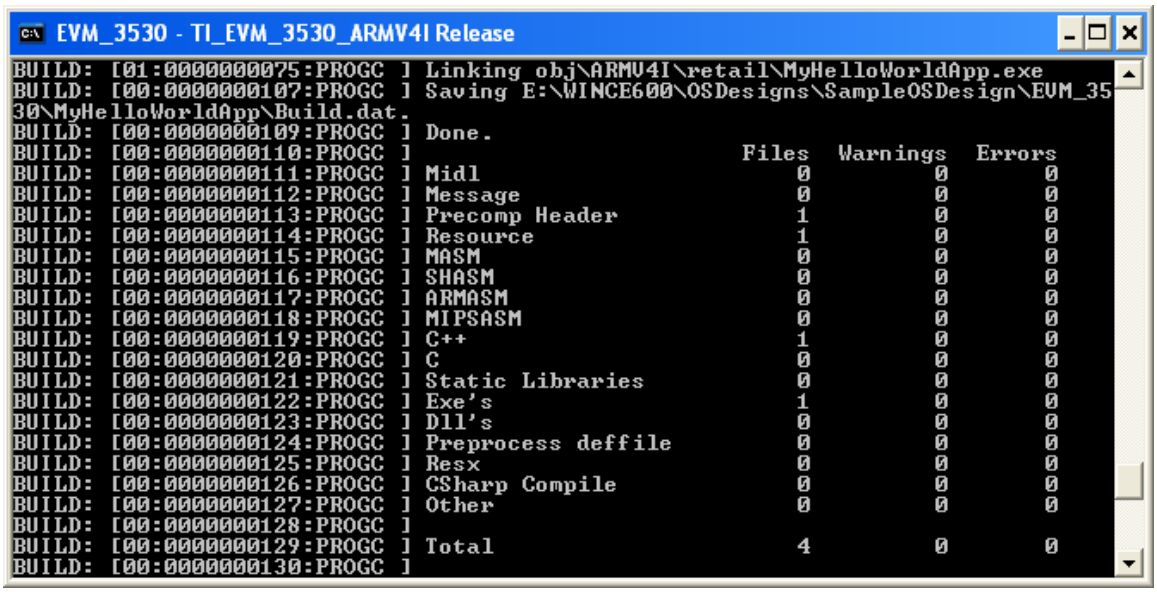
9. Type **set** at the command prompt and press <Enter>. Observe the many environment variables specific to Windows Embedded CE that have been configured. Notice that WINCEREL is one of those variables.



Note The **WINCEREL** environment variable causes the build mechanism to automatically copy the build output files to the flat release directory. This makes the build output files immediately available to be included in the OS run-time image, or to be loaded from the flat release directory using the debug shell.

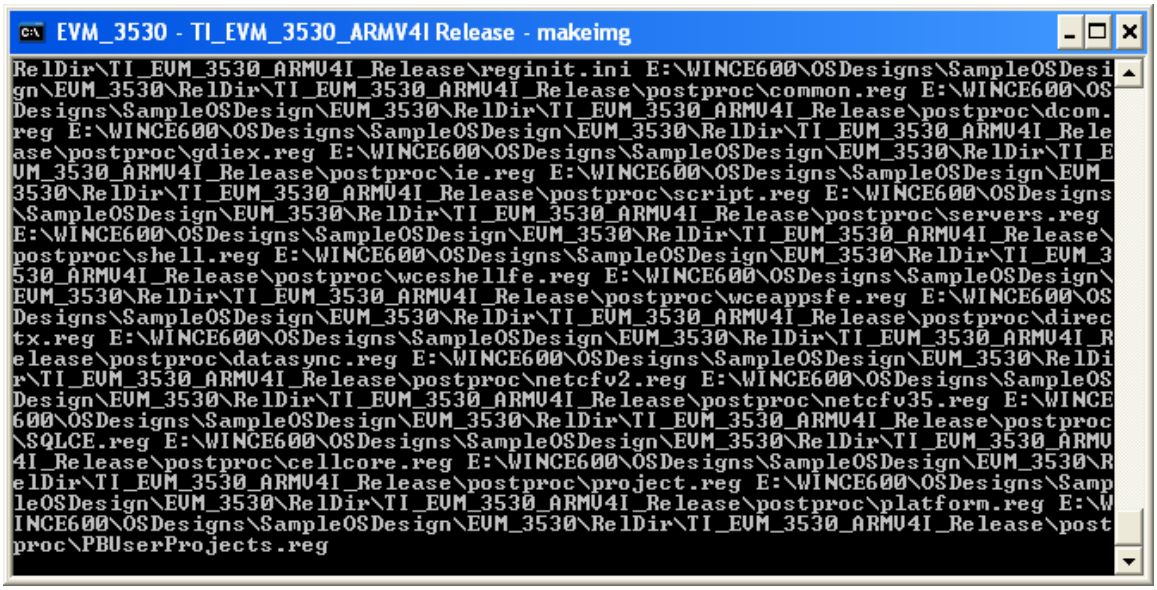
10. Type **build –c** at the command line.

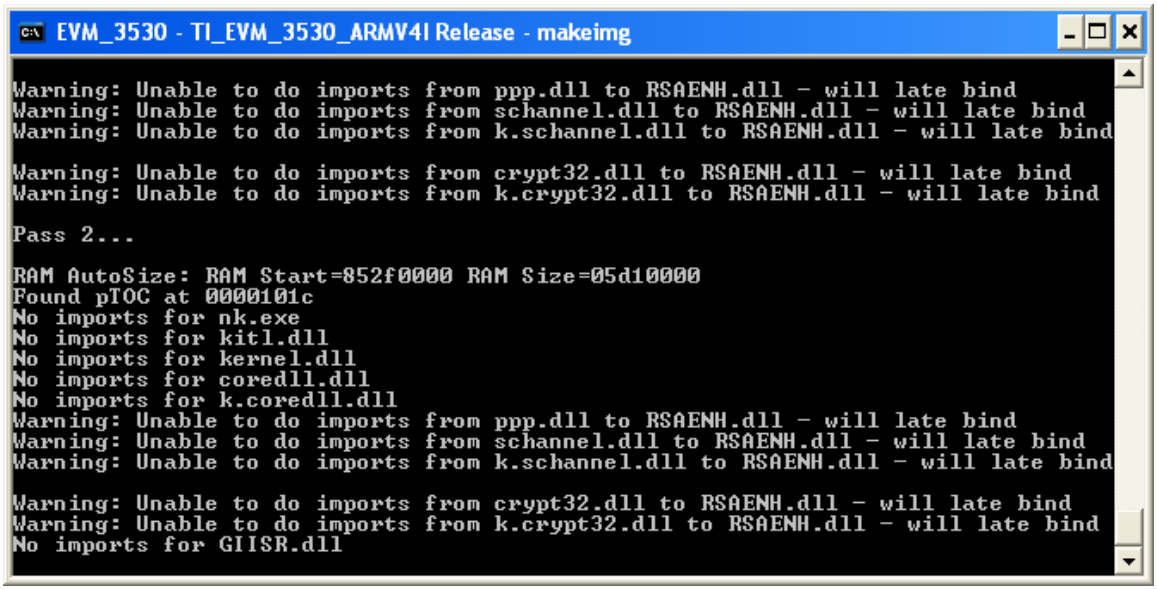
11. Compare the build output here with the information in the Build Output window. Notice that they are the same.

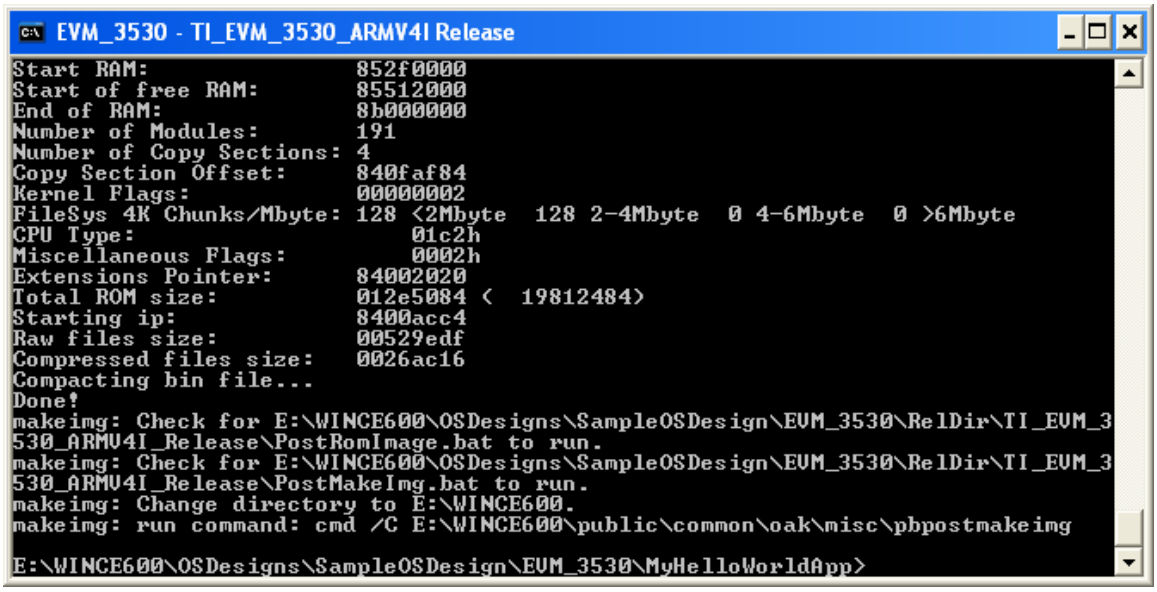


12. Type **makeimg** at the command line. This command causes the OS run-time image to be built.

13. Compare the makeimg output here with the corresponding portion in the Build Output window. Notice that they are the same.







14. Close the build window.

15. Select **Build | Targeted Build Settings | Make Run-Time Image After Building** from the Visual Studio menu to disable this option. We do not want to burden future targeted builds with this build step.

Lab 5-3: Troubleshooting Link Errors

Objectives

- Identify linker errors
- Learn how to determine the correct link library
- Resolve link errors

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Troubleshoot build errors

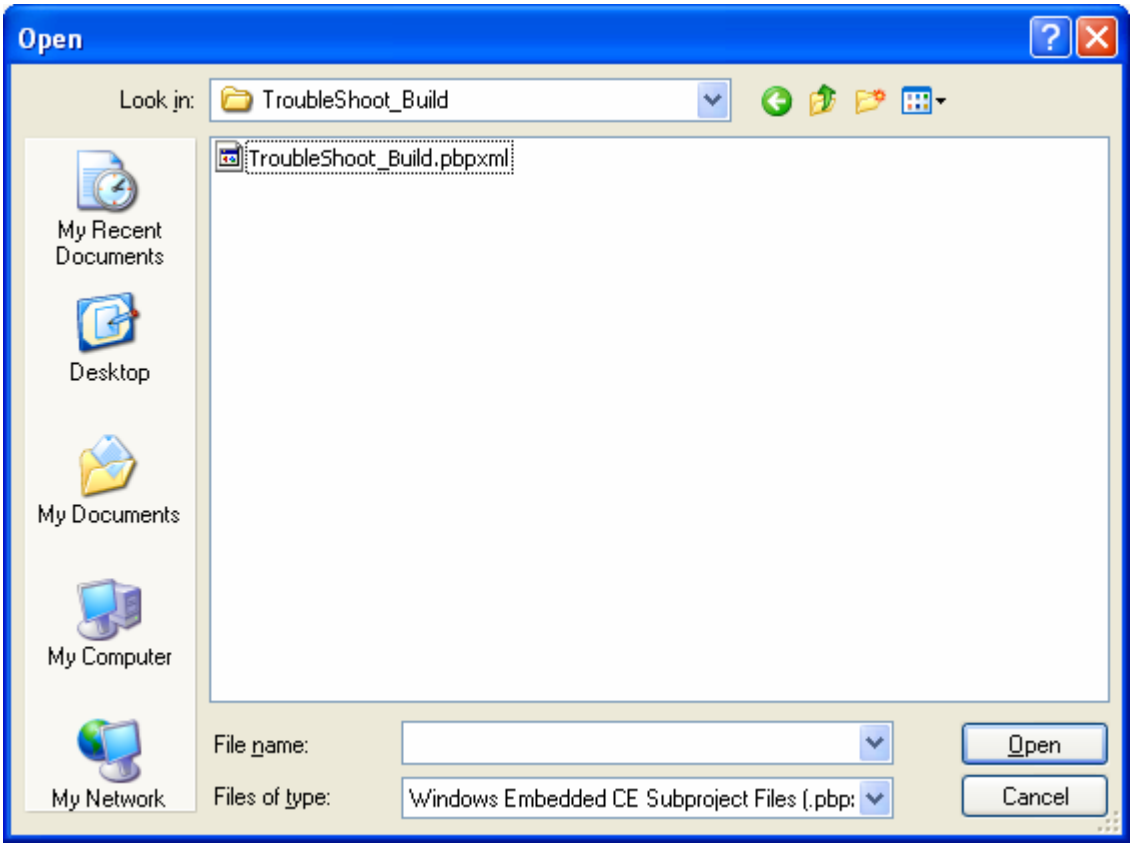
In this exercise you will identify a linker error and resolve it.

➢ **Add the existing TroubleShoot_Build subproject**

1. Copy the **TroubleShoot_Build** subproject from the Student files to your OS Design at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**.

2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject.**

3. Select the **TroubleShoot_Build.pbpxml** file from the **TroubleShoot_Build** folder.



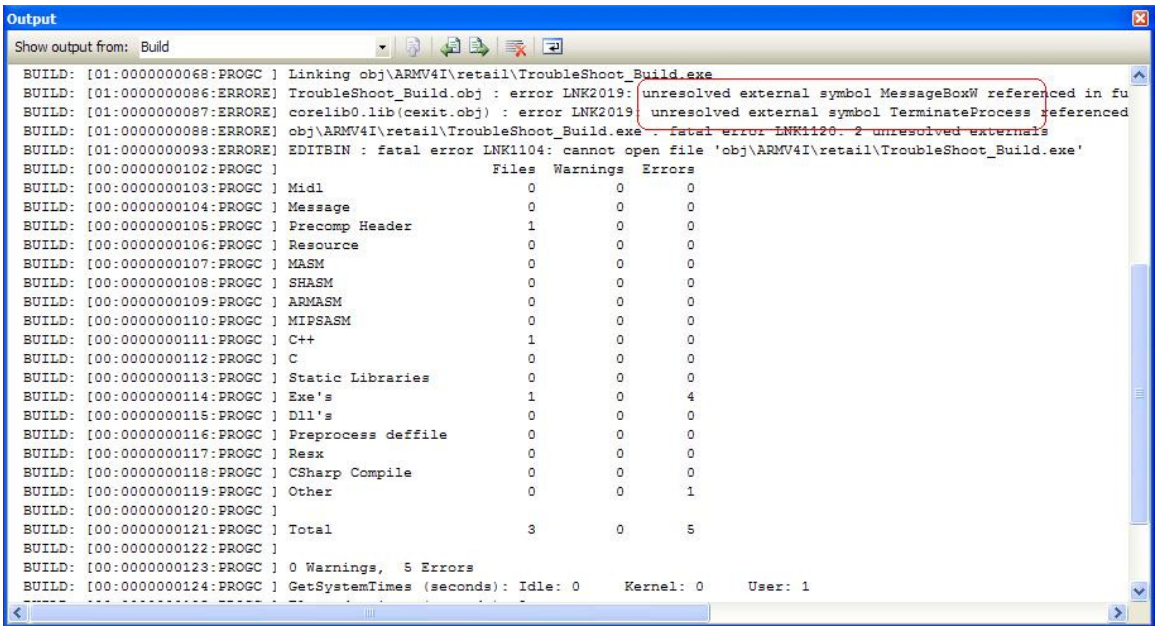
4. Configure the **TroubleShoot_Build** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

5. Using the Solution Explorer, open the file **TroubleShoot_Build.cpp** from the **TroubleShoot_Build** subproject. Notice that it is simply a call to MessageBox:

```
MessageBox(NULL, TEXT("Hello World!!"), TEXT("TroubleShoot App. is created!!")
,MB_OK);
```

➢ **Build the subproject.**

6. Right click on the **TroubleShoot_Build** subproject and select **Build**. Note error messages in the Build Output window similar to the following:



7. Observe that the error occurred during the link phase. The functions **MessageBoxW** and **TerminateProcess** could not be resolved. These functions are contained in an external library. The problem with this build is not in the application source code, but with the subproject settings that determine the external libraries that are used. We need to determine the correct library to resolve these functions.

➢ **Identify library**

8. Select **Edit | Find and Replace | Find in Files** from the Visual Studio menu. This will bring up the **Find and Replace** dialog.

9. Type **MessageBoxW** in the **Find what** box.

10. Type **C:\WINCE600\PUBLIC\COMMON\OAK\LIB\ARMV4I\RETAIL** in the **Look in:** box. You can also navigate to this folder and select it using the Choose Search Folders button on the far right hand side of this box.

11. Expand the **Find options** box and enter ***.def** in the **Look at these file types:** box.

12. Click **Find All** to perform the search.

13. Observe that the **MessageBoxW** function is exported by **coredll.def** and **k.coredll.def**. Therefore we need to link against coredll in order to resolve this link error.

14. Repeat this process for **TerminateProcess**.

15. Observe that **TerminateProcess** is also exported by coredll. Coredll will resolve both link errors for us.

Note This same general procedure can be followed for link errors that arise due to functionality contained in dynamic link libraries. The .def files will indicate which dll contains the desired functionality. However, not all .def files are located in the Common subtree. Each of the primary subtrees under \PUBLIC contain their own functionality, and their own .def files. You may need to search those trees as well in order to find the correct dll.

- **Add the correct link library**

16. Right click on the **TroubleShoot_Build** subproject and select **Open**. The **SOURCES** file for this subproject will open.

17. Observe that there is no **TARGETLIBS** directive. We will add one with an entry for coredll.

18. Add the following to the bottom of the **SOURCES** file:

```
TARGETLIBS= \
    $(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\coredll.lib \
```

Note Ensure that there is a blank line prior to the TARGETLIBS directive. Ensure that there is no what space after the trailing backslashes.

Also note that the path used to resolve coredll.lib is not the original location in the \PUBLIC\COMMON tree. Instead, it resolves to the filtered version of coredll.lib located in the project directory. This ensures that we link against the version of coredll.lib that was componentized for our OS Design.

---

19. Save and close the **SOURCES** file.

20. Right click on the **TroubleShoot_Build** subproject and select **Build**. Observe that the errors have been resolved, the build is successful.

Lab 6-1: Registry Initialization

Objectives

- Understand that multiple sources provide initial registry content
- Understand registry source precedence when conflicts occur
- Use the Run-Time Image Viewer to observe content in the OS Run-Time image

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1

In this exercise you will learn how the various registry files in the OS Design are combined to create the final device registry. You will observe how conflicting registry entries are resolved.

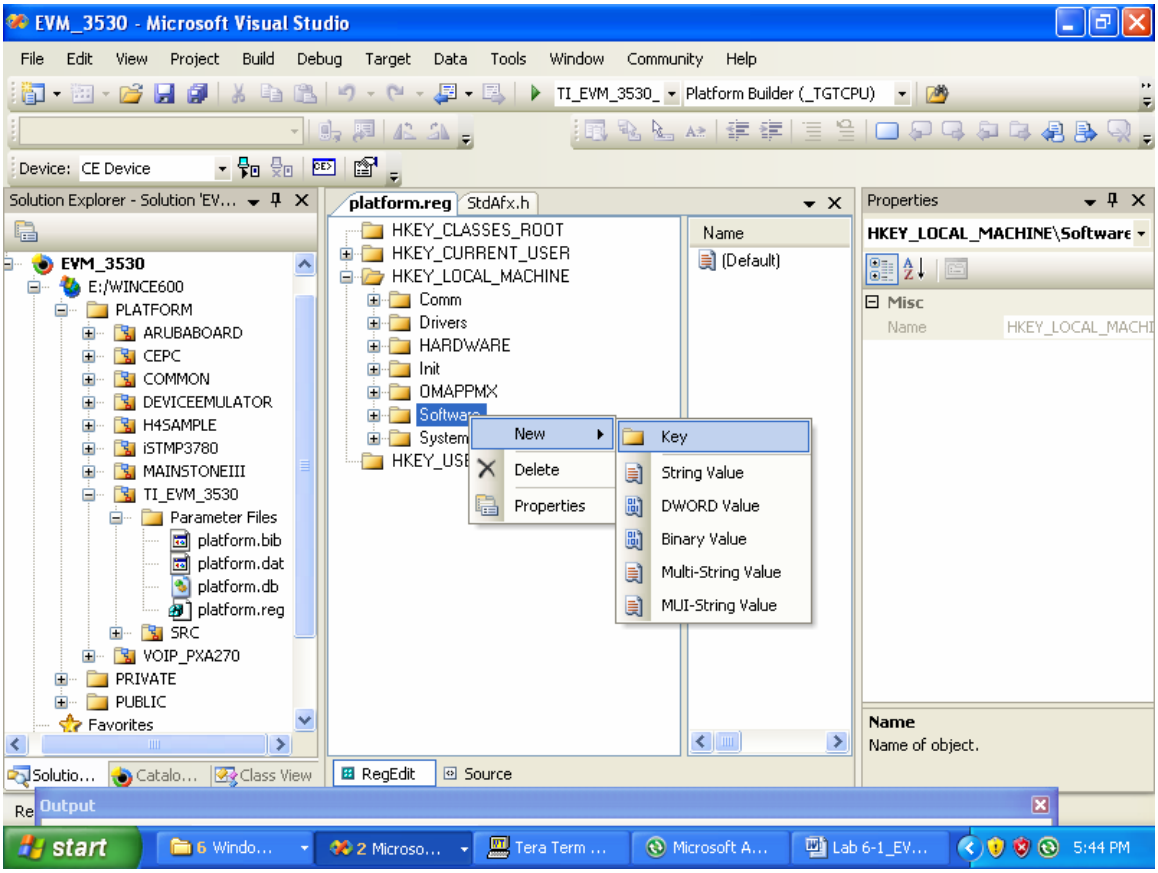
➢ **Add a new key to platform.reg**

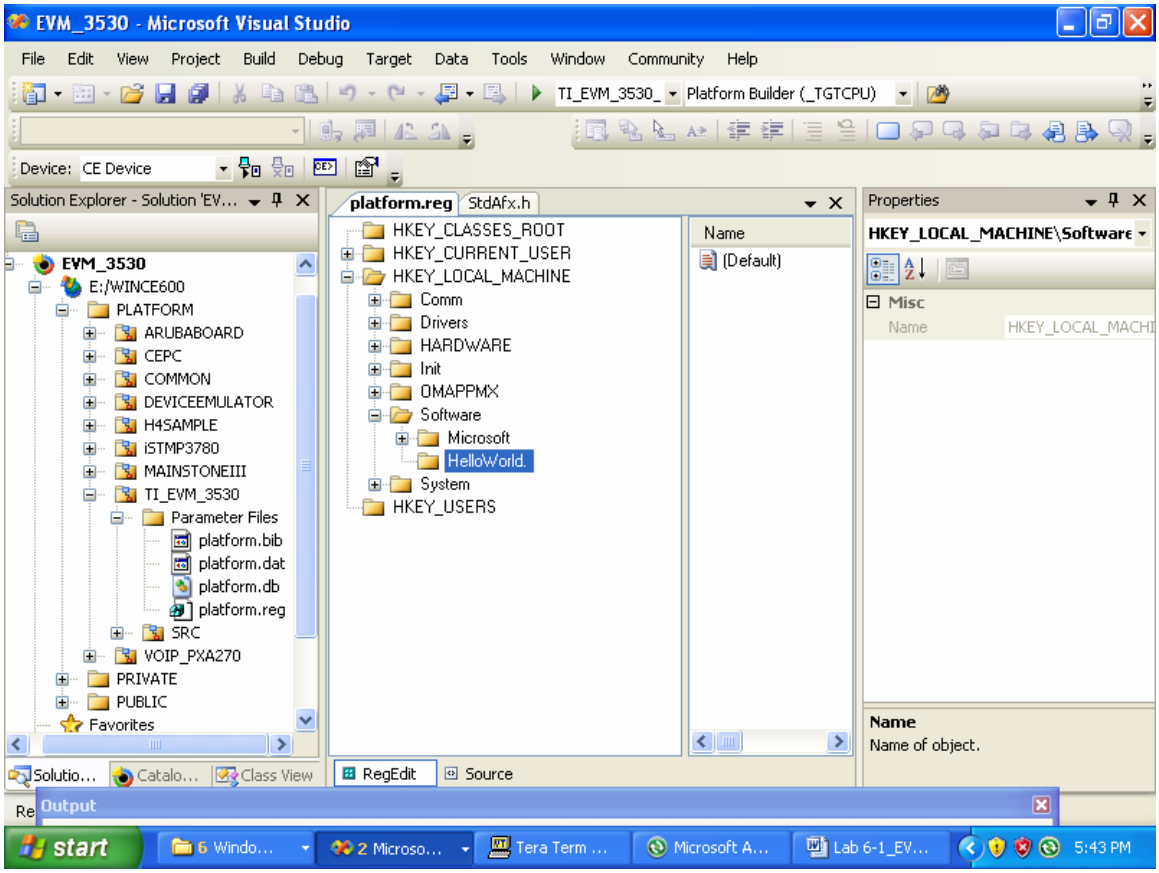
1. Expand the **C:/WINCE600** node under **EVMOSDesign** in the Solution Explorer. Navigate to **Platform/EVMBSP/Parameter Files**.

2. Double click on **platform.reg** to open it in the Visual Studio editor.

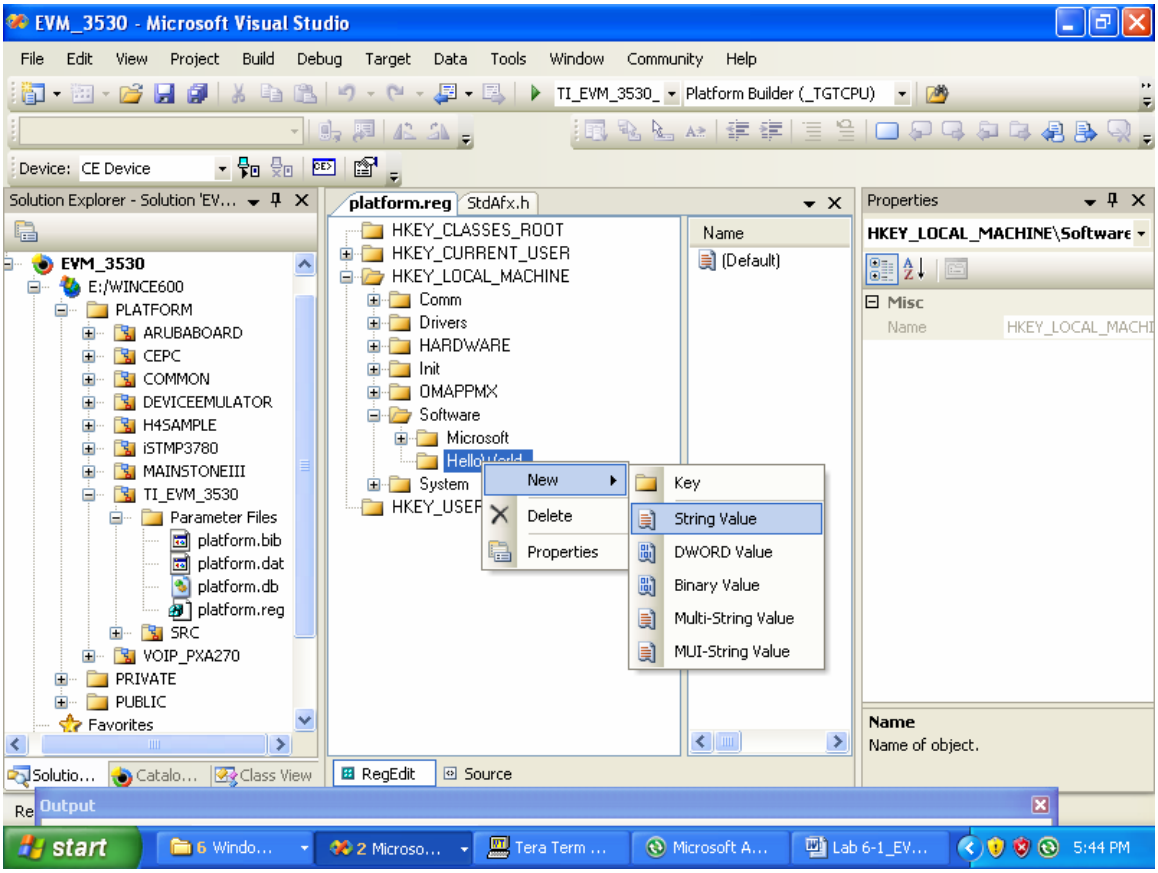
3. Navigate to **HKEY_LOCAL_MACHINE** then right-click on the **Software** key and select **New | Key**.

4. Name the new key **HelloWorld**.





5. Right click on the **HelloWorld** key and select **New** | **String Value**. Name the new value **PlatformMessage**.



6. Right click on the **PlatformMessage** value and select **Properties**.

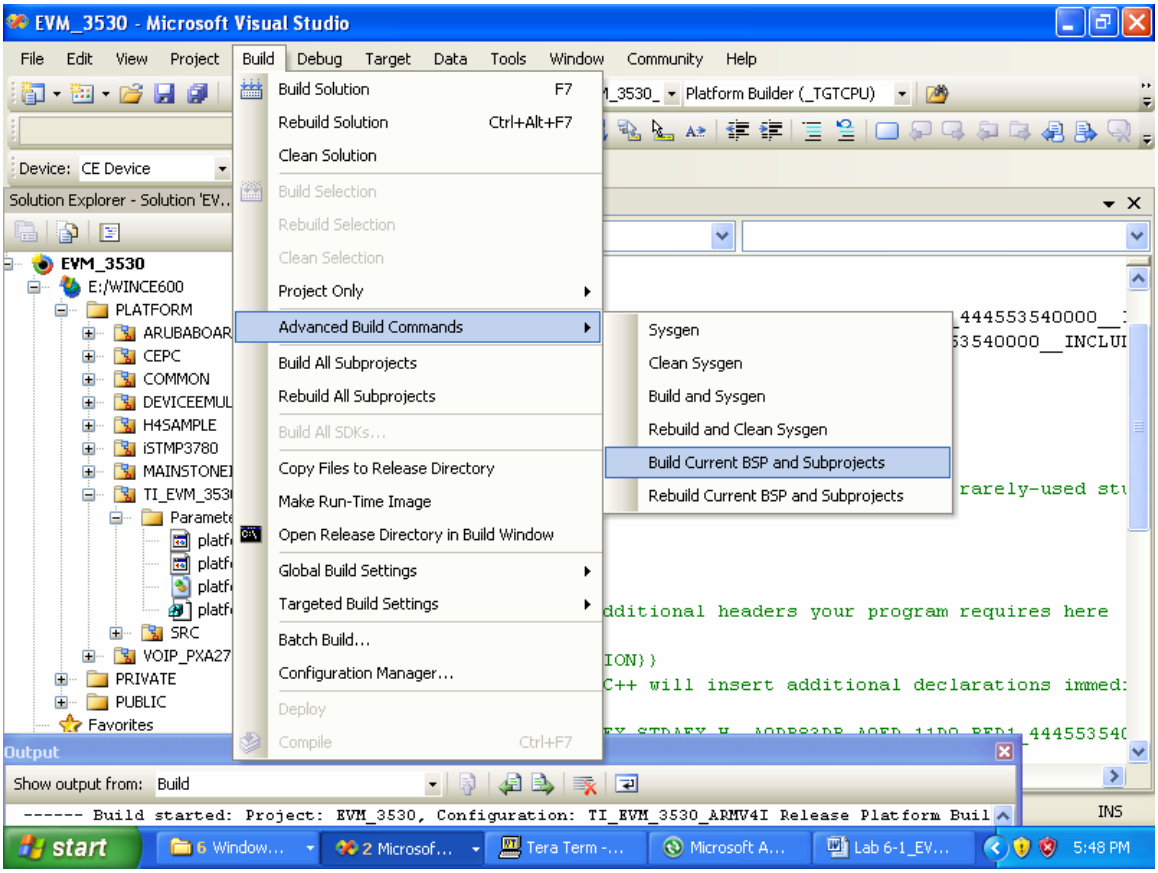
7. Type **Hello from platform.reg** in the **Data** field.

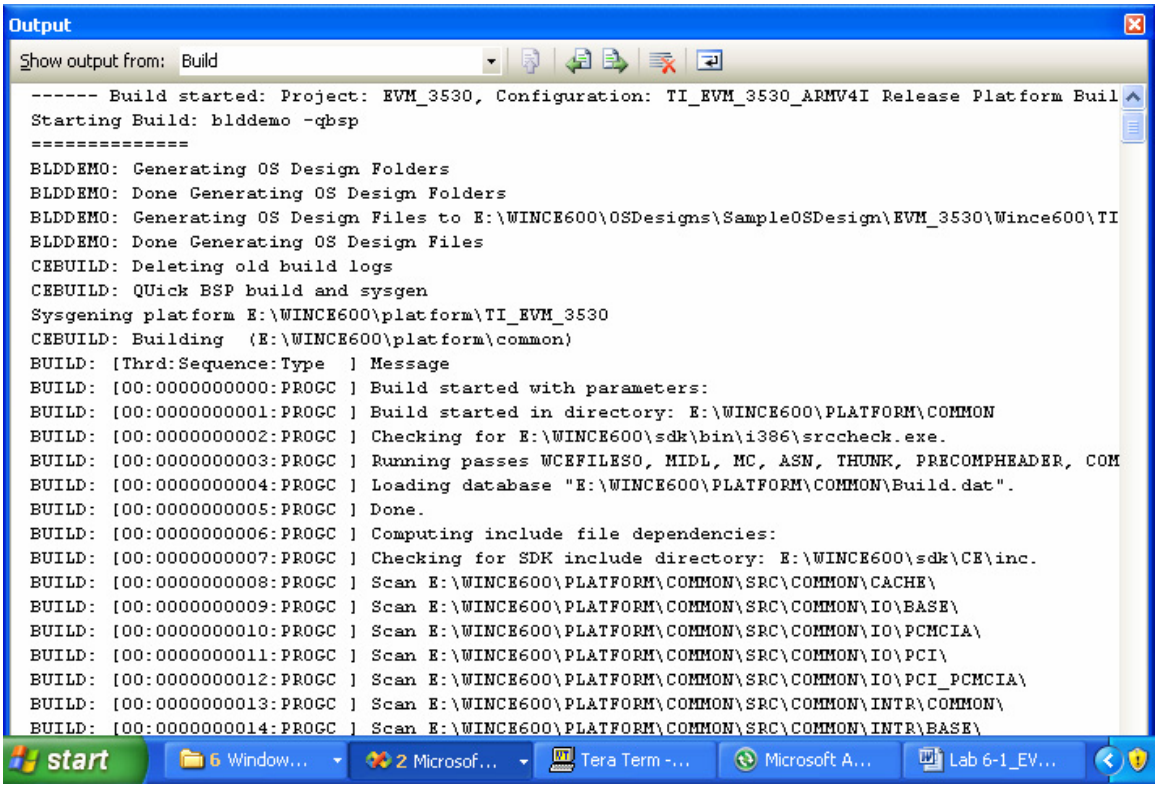
8. Save and close **platform.reg**.

➢ **Build the modified BSP**

9. **Detach** from the device if connected.

10. Select **Build | Advanced Build Commands| Build Current BSP and Subprojects** from the Visual Studio menu.


EVM_3530 - Microsoft Visual Studio
File Edit View Project Build Debug Target Data Tools Window Community Help
Build Solution F7
Rebuild Solution Ctrl+Alt+F7
Clean Solution
Build Selection
Rebuild Selection
Clean Selection
Project Only
Advanced Build Commands
Build All Subprojects
Rebuild All Subprojects
Build All SDKs...
Copy Files to Release Directory
Make Run-Time Image
Open Release Directory in Build Window
Global Build Settings
Targeted Build Settings
Batch Build...
Configuration Manager...
Deploy
Compile Ctrl+F7
Sysgen
Clean Sysgen
Build and Sysgen
Rebuild and Clean Sysgen
Build Current BSP and Subprojects
Rebuild Current BSP and Subprojects
Platform Builder (_TGTCPU)
Device: CE Device
Solution Explorer - Solution 'EV...
EVM_3530
E:/WINCE600
PLATFORM
Output
Show output from: Build
------ Build started: Project: EVM_3530, Configuration: TI_EVM_3530_ARMV4I Release Platform Buil
start
5:48 PM


Output
Show output from: Build
------ Build started: Project: EVM_3530, Configuration: TI_EVM_3530_ARMV4I Release Platform Buil
Starting Build: blddemo -qbsp
==========
BLDDEMO: Generating OS Design Folders
BLDDEMO: Done Generating OS Design Folders
BLDDEMO: Generating OS Design Files to E:\WINCE600\OSDesigns\SampleOSDesign\EVM_3530\Wince600\TI
BLDDEMO: Done Generating OS Design Files
CEBUILD: Deleting old build logs
CEBUILD: QUick BSP build and sysgen
Sysgening platform E:\WINCE600\platform\TI_EVM_3530
CEBUILD: Building (E:\WINCE600\platform\common)
BUILD: [Thrd:Sequence:Type] Message
BUILD: [00:0000000000:PROGC] Build started with parameters:
BUILD: [00:0000000001:PROGC] Build started in directory: E:\WINCE600\PLATFORM\COMMON
BUILD: [00:0000000002:PROGC] Checking for E:\WINCE600\sdk\bin\i386\srccheck.exe.
BUILD: [00:0000000003:PROGC] Running passes WCEFILES0, MIDL, MC, ASN, THUNK, PRECOMPHEADER, COM
BUILD: [00:0000000004:PROGC] Loading database "E:\WINCE600\PLATFORM\COMMON\Build.dat".
BUILD: [00:0000000005:PROGC] Done.
BUILD: [00:0000000006:PROGC] Computing include file dependencies:
BUILD: [00:0000000007:PROGC] Checking for SDK include directory: E:\WINCE600\sdk\CE\inc.
BUILD: [00:0000000008:PROGC] Scan E:\WINCE600\PLATFORM\COMMON\SRC\COMMON\CACHE\
BUILD: [00:0000000009:PROGC] Scan E:\WINCE600\PLATFORM\COMMON\SRC\COMMON\IO\BASE\
BUILD: [00:0000000010:PROGC] Scan E:\WINCE600\PLATFORM\COMMON\SRC\COMMON\IO\PCMCIA\
BUILD: [00:0000000011:PROGC] Scan E:\WINCE600\PLATFORM\COMMON\SRC\COMMON\IO\PCI\
BUILD: [00:0000000012:PROGC] Scan E:\WINCE600\PLATFORM\COMMON\SRC\COMMON\IO\PCI_PCMCIA\
BUILD: [00:0000000013:PROGC] Scan E:\WINCE600\PLATFORM\COMMON\SRC\COMMON\INTR\COMMON\
BUILD: [00:0000000014:PROGC] Scan E:\WINCE600\PLATFORM\COMMON\SRC\COMMON\INTR\BASE\
start

Note This command will also cause the OS Run-Time Image to be rebuilt due to the setting in **Build | Global Build Settings | Make Run-Time Image After Build**.

- **Observe the change using the Run-Time Image Viewer**

11. Select **File | Open | File…** from the Visual Studio menu.

12. Select **Windows Embedded CE Run-Time Image** from the **Files of Type** drop down box.

13. Navigate to your flat release directory at **C:\WINCE600\EVMOSDesign\EVMOSDesign\RelDir\EVMBSP_ARMV4I_Release** and open **nk.bin**. The OS run-time image will open in the Run-Time Image Viewer.

14. Select **NK**, then double click on **Registry**. Navigate to **HKEY_LOCAL_MACHINE\Software** and verify the **HelloWorld** key exists in the image with the **PlatformMessage** value.

15. Close the file.

- **Add a new key to project.reg in the OS Design**

16. Expand the **Parameter Files** node under the **EVMOSDesign** project in the Solution Explorer.

17. Expand the **EVMBSP: ARMV4I (Active)** node and open the **project.reg** file.

18. Right-click on **HKEY_LOCAL_MACHINE** and add a new key called **Software**.

19. Right click on the **Software** key and add a new key called **HelloWorld**.

20. Right click on the **HelloWorld** key and add a **String Value** with the name **ProjectMessage**.

21. Set the value of **ProjectMessage** to **Hello from project.reg**.

22. Save and close the file.

- **Build the OS run-time image**

23. Select **Build | Advanced Build Commands| Build Current BSP and Subprojects** from the Visual Studio menu.

- **Observe the change using the Run-Time Image Viewer**

24. Select **File | Open | File…** from the Visual Studio menu. In the file open box, select **Windows CE Run-Time Image** from the **Files of Type** drop down box.

25. Open **nk.bin** from the flat release directory. The OS run-time image will open in the Run-Time Image Viewer.

26. Select **NK**, then **Registry**. Navigate to **HKEY_LOCAL_MACHINE\Software** and verify the **HelloWorld** key exists in the image with the **ProjectMessage** value.

27. Close the file.

- **Dueling Registry Entries**

28. Open platform.reg and navigate to the **[HKEY_LOCAL_MACHINE\Software\HelloWorld]** key.

29. Create a new **String** value named **Conflicting** with the value **Platform.reg wins!**.

30. Open project.reg and navigate to the **[HKEY_LOCAL_MACHINES\Software\HelloWorld]** key.

31. Create a new **String** value named **Conflicting** with the value **Project.reg wins!**.

32. Save and close both files.

33. Select **Build | Advanced Build Commands| Build Current BSP and Subprojects** from the Visual Studio menu.

34. Open the OS run-time image file from your flat release directory

35. Navigate to [**HKEY_LOCAL_MACHINE\Software\HelloWorld]** and view the **Conflicting** value. This will tell you which file has precedence in the build process.

Note There are more registry files involved in the build process than just project.reg and platform.reg. Each of the OS subtrees also provides registry content, as do the subprojects that might be added to an OS Design. There is a defined order with all of these potential registry sources.

---

36. Close the run-time image file.

Lab 6-2: Adding a New IOCTL to the OAL

Objectives

- Understand architecture of OAL IOCTL library in the Common code
- Understand how to add a new IOCTL to the OAL based on the Common code

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in

Exercise 1 Adding an IOCTL to the OAL

In this exercise you will add a new IOCTL to the OAL and demonstrate that it is working. The OAL exposes IOCTLs via the OEMIoControl() function. The libraries that are provided in the Platform\Common subdirectory include an implementation for the OEMIoControl() function. If the OAL in your BSP is based on the PQOAL architecture, or just uses this particular library from the Platform\Common code base you will use this method to add IOCTL support to your OAL.

We will first examine the implementation of the OEMIoControl() function in the Common code, then we will implement IOCTL_HAL_POSTINIT and verify that our implementation was successful.

- **Review Common code implementation of OEMIoControl**

1. Open the file **ioctl.c** located in **C:\WINCE600\PLATFORM\COMMON\SRC\COMMON\IOCTL**

2. Observe that this file contains the required function **OEMIoControl().** This function is called by the kernel to implement all of the IOCTLs that are supported by the OAL. BSPs that link against the library containing this source code will use this implementation of OEMIoControl().

3. Observe that this function uses a global data structure named **g_oalIoCtlTable** containing the IOCTL codes and function pointers to implement them. BSPs that use the Common code to implement OEMIoControl() configure the function using this global data structure.

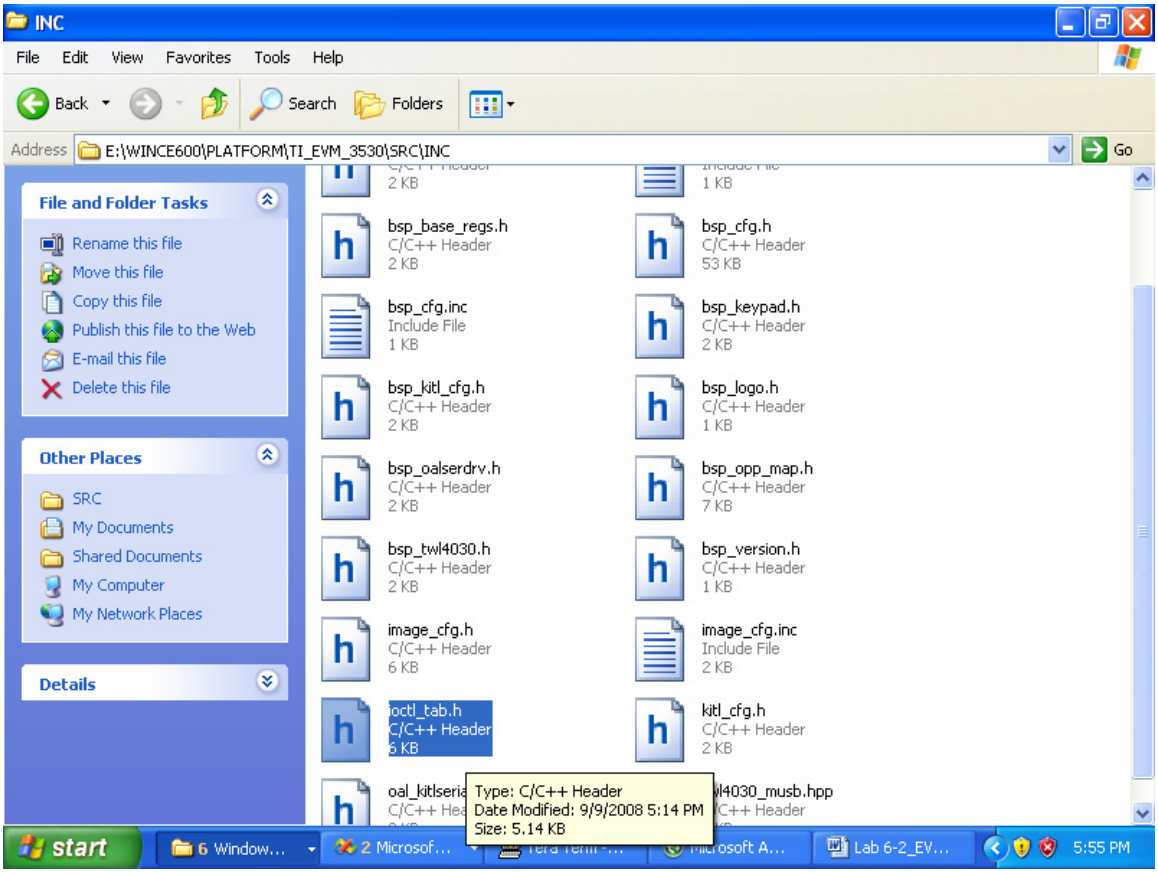
4. Close the file **ioctl.c**.

5. Open the file **ioctl.c** located in **C:\WINCE600\PLATFORM\EVMBSP\SRC\OAL\OALLIB**

6. Observe that this file contains the data structure **g_oalIoCtlTable** near the bottom of the file. This data structure is the one referenced by the OEMIoControl() function in the Common code. Note that this data structure is implemented using the header file **ioctl_tab.h**.

7. Also observe that this file contains routines that implement individual IOCTLs.

8. Open the file ioctl_tab.h located in **C:\WINCE600\PLATFORM\EVMBSP\SRC\INC**

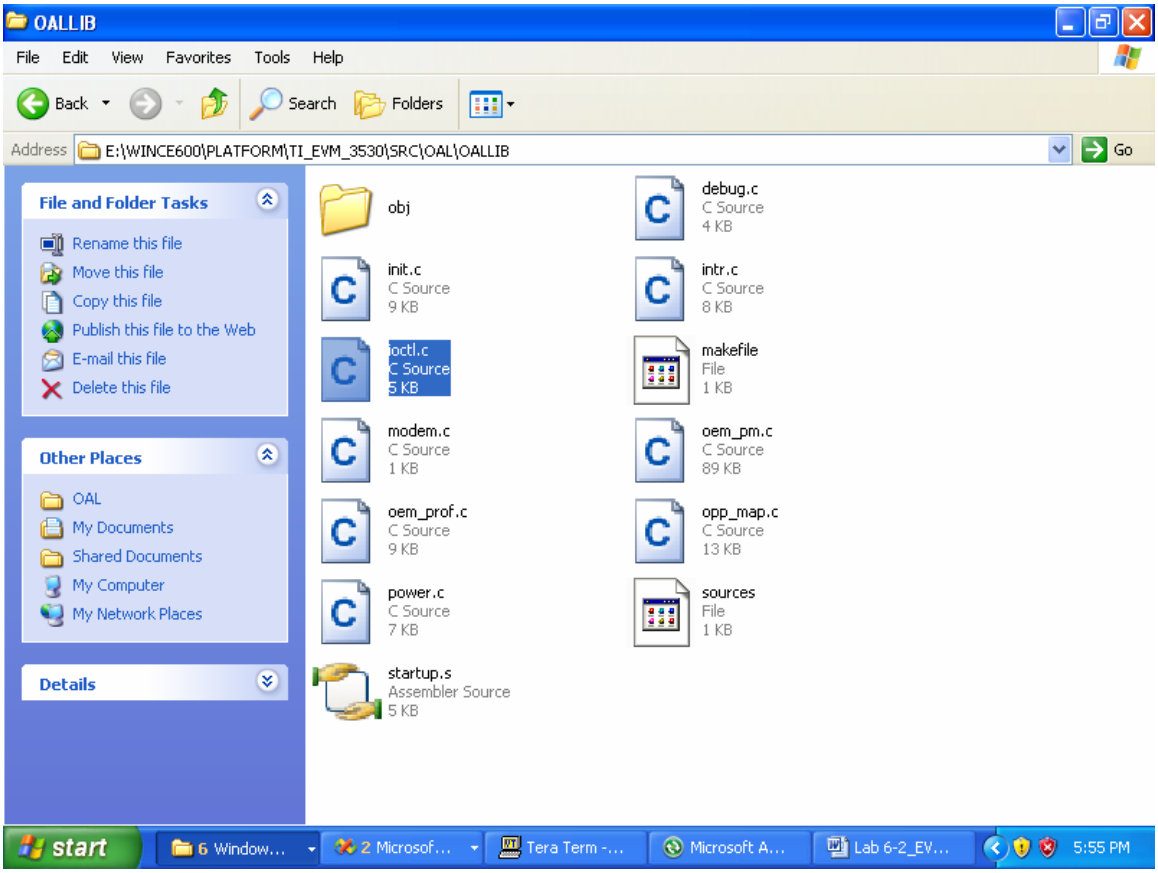


9. Observe that this file contains the pairing of IOCTL codes and the function pointers that implement them. The routines listed in this file are implemented directly in the BSP in the ioctl.c file mentioned above.

10. Observe that this file also includes the file **oal_ioctl_tab.h**. This file contains a list of IOCTL codes and function pointers for common IOCTLs that are already implemented in the Common code base. IOCTLs listed in that file do not have to be implemented in the BSP unless different functionality is needed.

➢ **Add IOCTL_HAL_POSTINIT handler to the BSP**

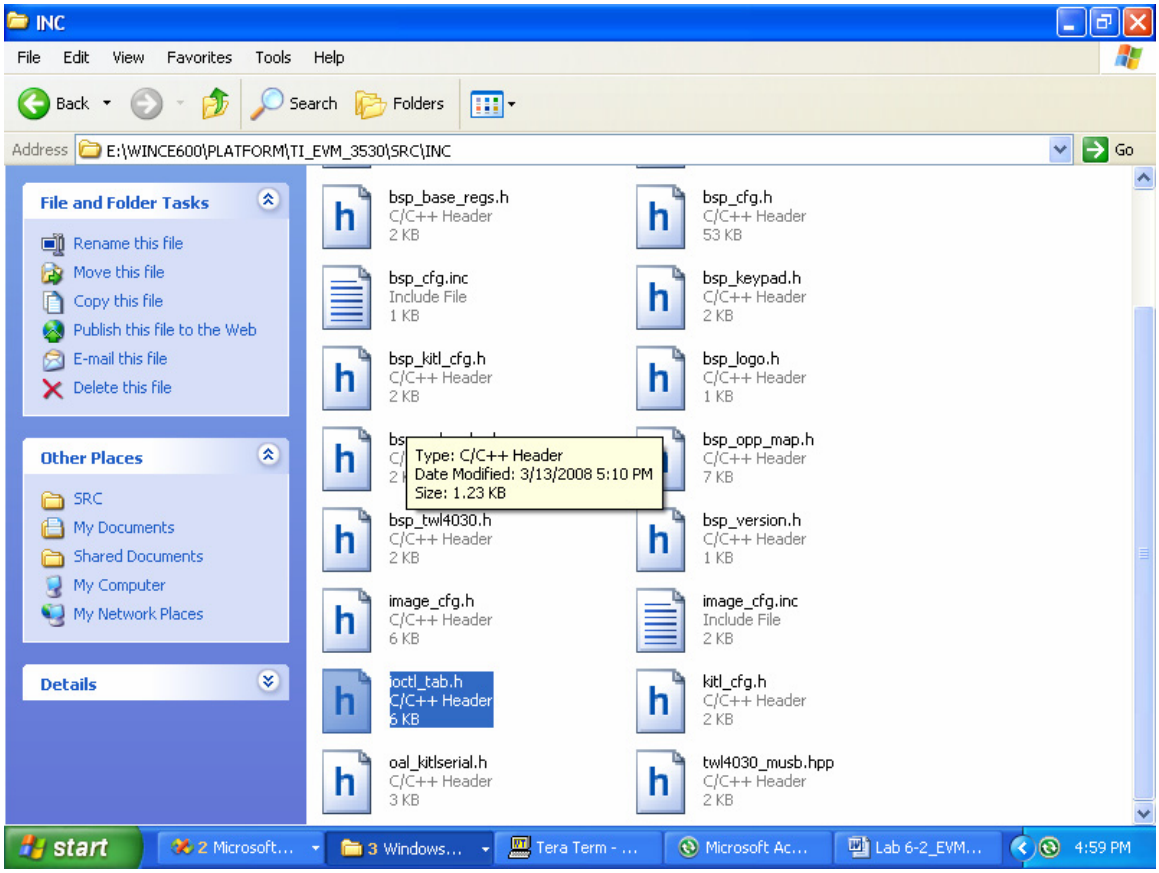
11. Add the following code snippet to the file **ioctl.c** located at **C:\WINCE600\PLATFORM\EVMBSP\SRC\OAL\OALLIB.** The routine should be added just above the g_oalIoCtlTable data structure.




```
static BOOL
OALIoCtlHalPostInit(
    UINT32 code, VOID *pInpBuffer, UINT32 inpSize, VOID *pOutBuffer,
    UINT32 outSize, UINT32 *pOutSize
)
{
    RETAILMSG(1, (TEXT("Hello World from IOCTL_HAL_POSTINIT!!!!\r\n")));
        return TRUE;
}
```

12. Add the following line to the file **ioct_tab.h** located at **C:\WINCE600\PLATFORM\EVMBSP\SRC\INC.** The line should be added just below the `{ IOCTL_HAL_POSTINIT, 0,  OALIoCtlHalPostInit },` line.

```
#include <oal_ioctl_tab.h>
```



13. Select **Build | Advanced Build Commands | Build Current BSP and Subprojects** from the Visual Studio menu.

14. Attach the device and view the output. You should see the following message printed on the Debug Output window during the boot process.

    Hello World from IOCTL_HAL _POSTINIT!!!!

Lab 7-1: Integrating a Device Driver

Objectives

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Integrate barcode scanner driver into BSP

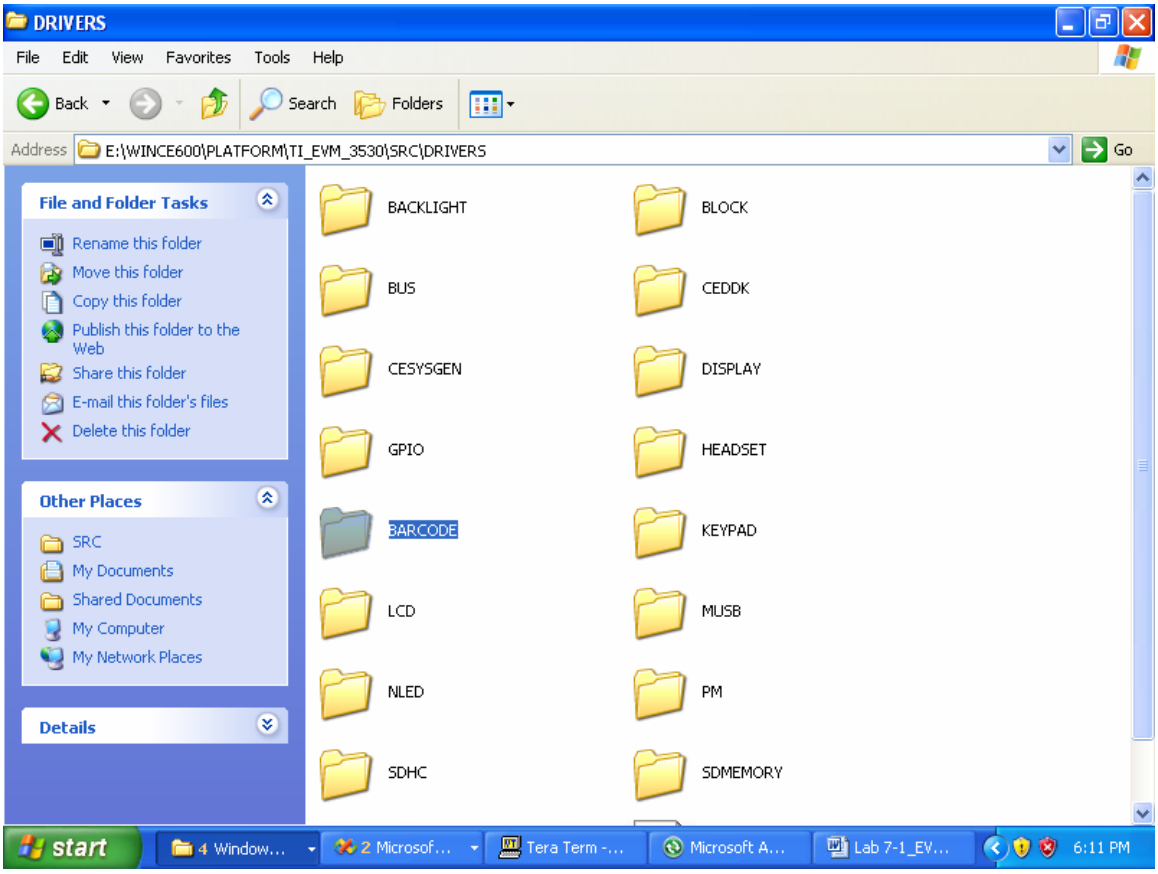
The purpose of this exercise is to integrate a driver into the BSP. In this exercise you will

- Add the driver subdirectory containing the driver source code to the BSP
- Add the appropriate bib entry to cause the driver to be included in the OS image
- Add the appropriate registry entries to cause the drive to be loaded at boot
- Update the BSP catalog file to support the new driver
- Build a debug OS run-time image that we will use in future labs

➢ Add driver source code to BSP directory

1. **Detach** from the device if connected.

2. Copy the **BARCODE** directory from Student files to the **C:\WINCE600\PLATFORM\EVMBSP\SRC\DRIVERS** directory.

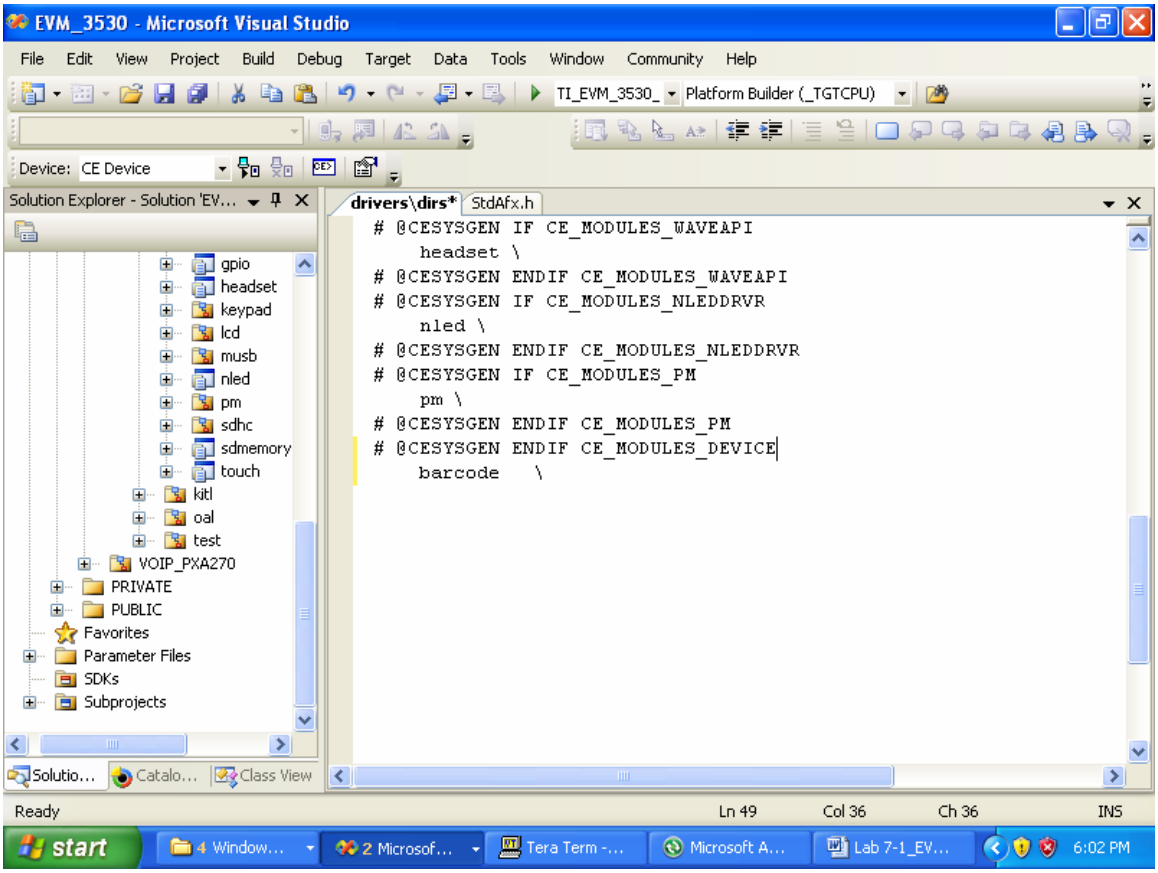


3. In Visual Studio, double click the **C:\WINCE600\PLATFORM\EVMBSP\src\drivers** node in the Solution Explorer. This will open the **Dirs** file.

4. Add the following line to the end of the **Dirs** file directly after the `# @CESYSGEN ENDIF CE_MODULES_DEVICE` line:

```
barcode   \
```

5. Save and close the **Dirs** file.

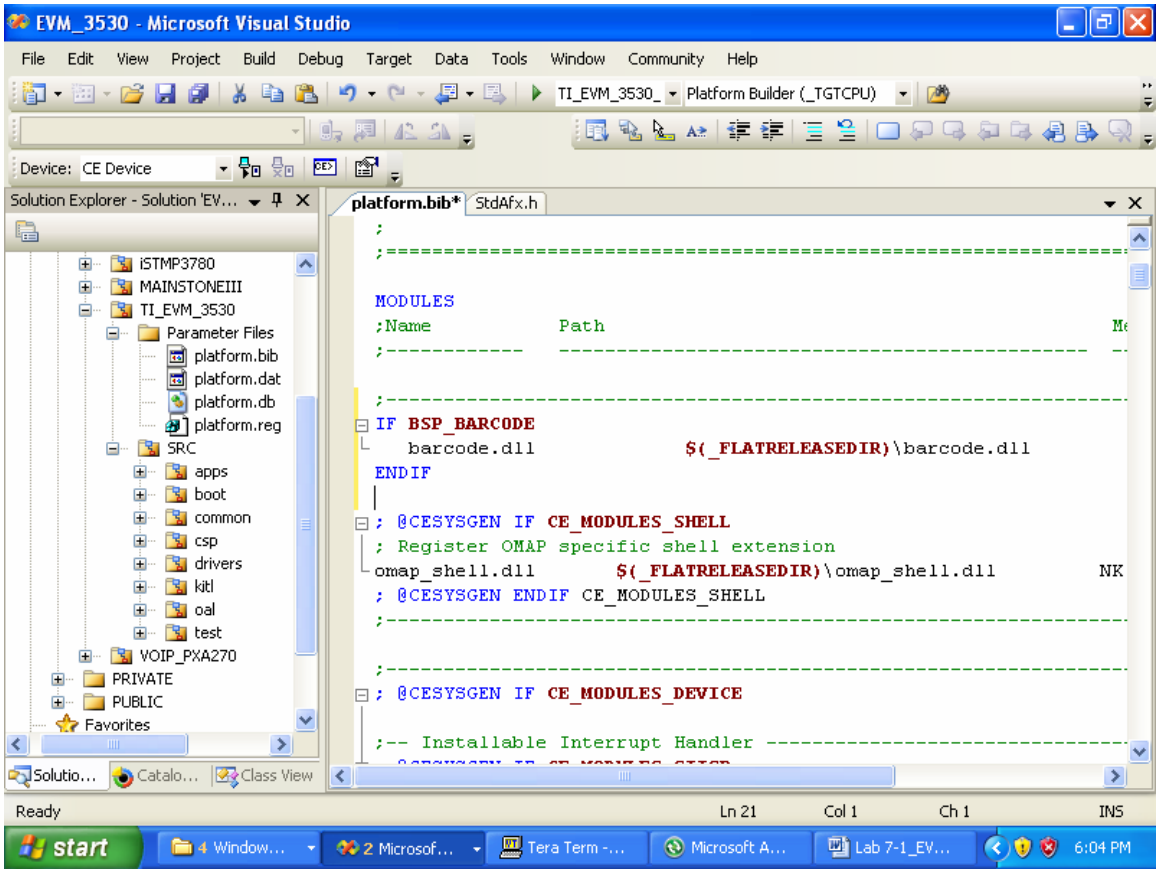


➢ Add Driver to image

1. Open the **platform.bib** file in the **Parameter Files** node of the **EVMBSP** in the Solution Explorer.

2. Add the following lines near the top of **platform.bib** as the first entry in the MODULES section.

```
IF BSP_BARCODE
   barcode.dll            $(_FLATRELEASEDIR)\barcode.dll          NK SHK
ENDIF
```


EVM_3530 - Microsoft Visual Studio
File Edit View Project Build Debug Target Data Tools Window Community Help
TI_EVM_3530_
Platform Builder (_TGTCPU)
Device: CE Device
Solution Explorer - Solution 'EV...
iSTMP3780
MAINSTONEIII
TI_EVM_3530
Parameter Files
platform.bib
platform.dat
platform.db
platform.reg
SRC
apps
boot
common
csp
drivers
kitl
oal
test
VOIP_PXA270
PRIVATE
PUBLIC
Favorites
platform.bib*
StdAfx.h
MODULES
;Name Path
IF BSP_BARCODE
barcode.dll $(_FLATRELEASEDIR)\barcode.dll
ENDIF
; @CESYSGEN IF CE_MODULES_SHELL
; Register OMAP specific shell extension
omap_shell.dll $(_FLATRELEASEDIR)\omap_shell.dll NK
; @CESYSGEN ENDIF CE_MODULES_SHELL
; @CESYSGEN IF CE_MODULES_DEVICE
;-- Installable Interrupt Handler
Ready
Ln 21 Col 1 Ch 1 INS
start
4 Window...
2 Microsof...
Tera Term -...
Microsoft A...
Lab 7-1_EV...
6:04 PM

When you are done, the top of the file should look similar to the following:

```
;
; Copyright (c) Microsoft Corporation.  All rights reserved.
;
;
; Use of this source code is subject to the terms of the Microsoft end-user
; license agreement (EULA) under which you licensed this SOFTWARE PRODUCT.
; If you did not accept the terms of the EULA, you are not authorized to use
; this source code. For a copy of the EULA, please see the LICENSE.RTF on your
; install media.
;

MODULES

;  Name                 Path                                    Memory Type
;  --------------       ----------------------------------      -----------
IF BSP_BARCODE
   barcode.dll             $(_FLATRELEASEDIR)\barcode.dll          NK SHK
ENDIF

; @CESYSGEN IF CE_MODULES_DISPLAY
IF BSP_NODISPLAY !
   TrainingBSP_lcd.dll   $(_FLATRELEASEDIR)\EVM_3530_lcd.dll   NK SHK
; @CESYSGEN IF SHELLW_MODULES_GX
; @XIPREGION IF MISC_TRAININGBSP_BIB

. . .
```

3. Save and **close** the file.

- **Add registry settings**

1. Open the file **Platform.reg** from the Parameter Files node of the **EVMBSP** using the Solution Explorer.

2. Right click on the **[HKEY_LOCAL_MACHINE\Drivers\BuiltIn]** key and add a new key with the name **Barcode.**

3. Add a **String Value** to the **Barcode** key with the name **Dll** and value **Barcode.dll**.

4. Add a second **String Value** to the **Barcode** key with the name **Prefix** and value **BAR**.

5. Save and close the file.

- **Add driver to the catalog**

1. From the Visual Studio menu, select **File | Open | File …** and navigate to the **C:\WINCE600\PLATFORM\EVMBSP\CATALOG** folder.

2. Change the file mask to show **Files of type: All Files (*.*)**

3. Open the **EVMBSP.pbcxml** file.

Note If no nodes are visible underneath **Catalog** in the Catalog Editor, click the **Show All Catalog Files** button.

4. Expand the catalog tree to show the **Device Drivers** node.
5. Right click on the **Device Drivers** node and select **Add Catalog Item**. The new item will be placed in the **Third Party** node.
6. Set the **Description** field to **Barcode Scanner**.
7. Set the **Title** field to **Barcode Scanner**.
8. Set the **Unique Id** field to **Item:GeneriCo:BarcodeScanner**.
9. Set the **Additional Variables** field to **BSP_BARCODE**.
10. Set the **Modules** field to **barcode.dll**.
11. Save and close the file.

- **Add barcode scanner driver to image**

1. Switch to the **Catalog Items View** and refresh the Catalog.
2. Expand the **EVMBSP** node under Third Party.

Note Ensure that the Filter option is set to All Items in the Catalog. The Filter option is a drop down box in the upper right hand corner of the Catalog Items View.

3. Select the **Barcode Scanner** item under **Device Drivers**. Refresh the Catalog View if necessary to see the Barcode Scanner.
4. Select **Build | Advanced Build Commands | Build Current BSP and Subprojects** from the Visual Studio menu.

- **Verify integration using Image Viewer**

1. Open the NK.bin file located in the flat release directory using Visual Studio. This will bring up the **Run-Time Image Viewer**.
2. Click on the **(All Files)** node in the Image Explorer. This shows all files that are built into the OS run time image.
3. Verify that **barcode.dll** is listed.

4. Verify that the **[HKLM\Drivers\BuiltIn\Barcode]** key exists under the registry node.

5. Close the Image Viewer.

❖ *Build a Debug OS image*

1. Select **Build | Configuration Manager…** using the Visual Studio menu.

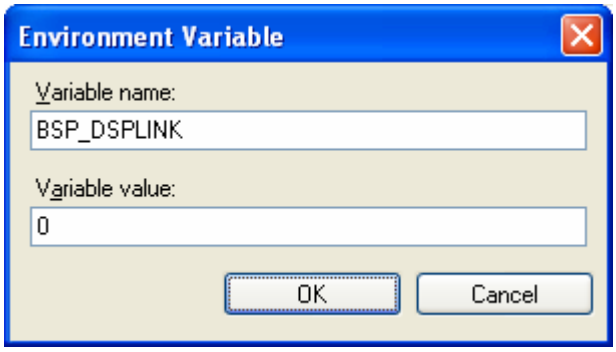
2. Set the **Active solution configuration** to **EVMBSP ARMV4I Debug**.

3. Remove the following subprojects from the OS Design by right-clicking on the subproject in the Solution Explorer view and selecting **Remove**:
    - MyHelloWorldApp
    - HeapTest1
    - LeakingMemory
    - ThreadSynchronization
    - MutexDemo
    - EventDemo
    - SemaphoreDemo
    - Power_Management
    - Troubleshoot_Build

4. Right-click **EVMOSDesign** in the Solution Explorer view and select **Properties**.

5. Under the **Configuration Properties** section, select **Environment**

6. Click **New** and set the environment **Variable Name** to **BSP_DSPLINK** and the **Variable Value** to **0**



7. Click **OK** to close the **Environment Variable** dialog box and **OK** to close the **EVMOSDesign Property Pages** window

8. Select **Build | Build Solution** using the Visual Studio menu. This will build a debug configuration that we will use in future labs.

Lab 7-2: Debugging the Scanner Device Driver

Objectives

- Understand driver interaction with application
- Use kernel debugger to investigate call stack

Prerequisites

- Completed Lab 2-1
- Completed Lab 7-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1 with CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1
- Image from Lab 7-1
- Debug build for the EVMOSDesign

Exercise 1 Application and Driver Integration

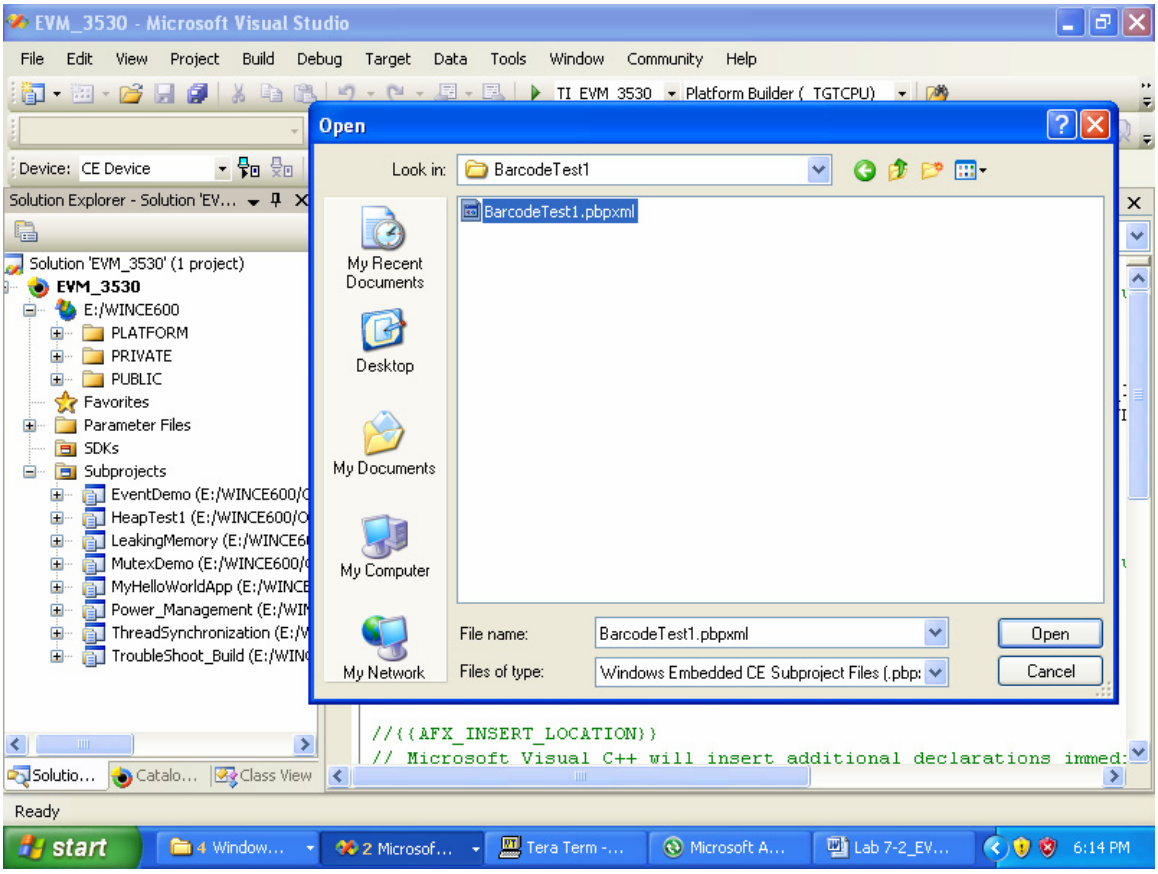
In this exercise you will add an application that communicates with the barcode scanner device driver. You will exercise the functionality of the driver and function call tree that results when the application calls into the driver.

➢ **Add BarcodeTest1 application subproject to your OSDesign**

1. Copy the **BarcodeTest1** folder from your Student files to **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign**

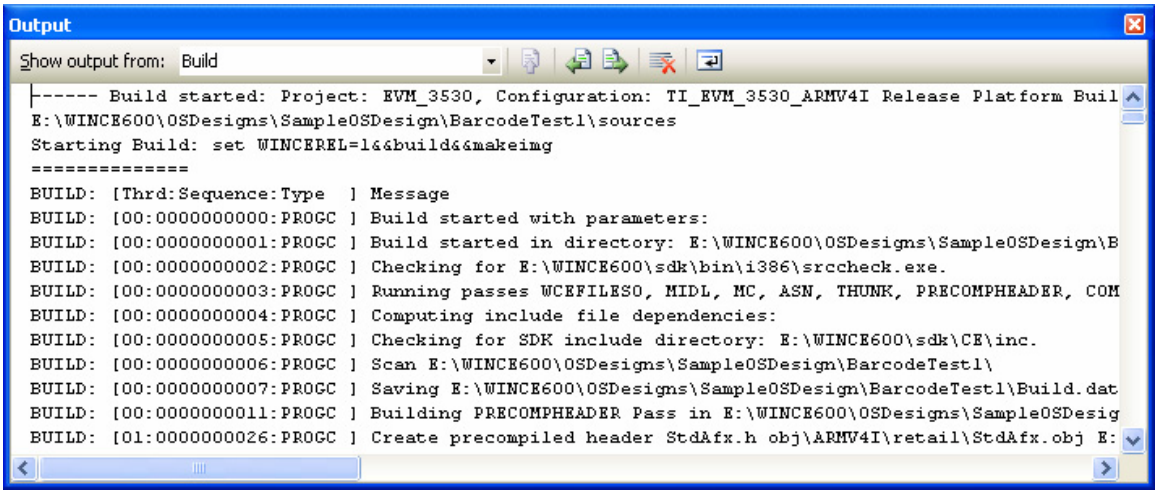
2. Right click on the **Subprojects** node in the Solution Explorer and select **Add Existing Subproject...**

3. Add the **BarcodeTest1** subproject to your OS Design.



4. Configure the **BarcodeTest1** subproject to be **excluded from the image** and **always build and link as debug**, as documented in Lab 2-2.

5. Right click on the **BarcodeTest1** subproject in the Solution Explorer and select **Build.**



➢ **Run test application on OS image**

6. Attach the device by selecting **Target | Attach Device** from the Visual Studio menu.

Note This lab uses an updated version of the OS run time image. You will need to first detach from the existing device instance if it is still running.

---

7. Open the **BarcodeTest1.cpp** file in the BarcodeTest1 subproject using the Solution Explorer.

8. Set a breakpoint on the call to **DeviceIoControl**().

9. Run the **BarcodeTest1** application using **Target | Run Programs…** from the Visual Studio menu. The debugger will halt execution at the breakpoint.

10. Select **Debug | Windows | Call Stack** from the Visual Studio menu to show the call stack. This window shows the sequence of calls that resulted in the statement containing the breakpoint. You can double click any of the calling functions to view the source code file containing each function.

Note The source code for the functions listed in this window is only available if you have installed the Shared Source. Only the disassembly view is available if the source code is not installed.

---

11. Step through the application by pressing **F10** through completion.

- **Add additional functionality to test application and retest**

12. Locate the comment // **Turn on power** and add the following function call:

```
// Turn on power
DeviceIoControl(hBARPort, BARCODE_IOCTL_POWER_ON, NULL, 0, NULL,
0, &dwNumBytesRead, NULL);
```

13. Locate the comment // **Check to make sure power is on** and add the following function call:

```
// Check to make sure power is on
DeviceIoControl(hBARPort, BARCODE_IOCTL_QUERY_POWER_STATE, NULL,
0, &dwResult, sizeof(DWORD), &dwNumBytesRead, NULL);
_tprintf(_T("Power Status = %d.\n"),dwResult);
```

14. Right click on the **BarcodeTest1** subproject and select **Build**.

15. Run the **BarcodeTest1** application using **Target | Run Programs…** from the Visual Studio menu. The debugger will halt execution at the breakpoint.

16. Press **F5**

17. Observe debug messages in the **Output** window similar to the following:

```
Test BAR1: driver open/close.
Barcode.DLL: +BAR_Open
Barcode.DLL: -BAR_Open
CreateFile returned a valid handle.
Barcode.DLL: +BAR_IOControl
Barcode.DLL: IOCTL - Set Power Management
Barcode.DLL: -BAR_IOControl
Barcode.DLL: +BAR_IOControl
Barcode.DLL: IOCTL - Power On Command.
Barcode.DLL: +BAR_PowerUp
Barcode.DLL: -BAR_PowerUp
Barcode.DLL: -BAR_IOControl
Barcode.DLL: +BAR_IOControl
Barcode.DLL: IOCTL - Query Power State
Barcode.DLL: -BAR_IOControl
Power Status = 1.
Barcode.DLL: +BAR_IOControl
Barcode.DLL: IOCTL - Read Barcode.
Barcode.DLL: -BAR_IOControl
Driver:  bytes read=7.
Driver:  buffer='
0
0
2
5
2
3
'

Barcode.DLL: +BAR_Close
Barcode.DLL: -BAR_Close
```

Lab 7-3: Using Debug Zones in a DLL

Objectives

- Learn to implement debug zones in a dll

Prerequisites

- Completed Lab 2-1
- Completed Lab 5-1
- Completed Lab 7-1
- Completed Lab 7-2

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1 with CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running debug image from Lab 7-2

Exercise 1 Integrate debug zones

In this exercise, you will implement debug zones in the ScanBarcode dll, and test the implementation using the BarcodeDllTest application. This exercise requires a debug OS run-time image on the EVM Board.

➢ Create the debug zones

1. Right click the **ScanBarcode** subproject in the Solution Explorer View and select **Add | New Item…**.

2. In the **Add New Item** Dialog box, select **Header File(.h)** and name the file **DbgZones.h**.

3. Add the following code snippet to the new DbgZones.h file:

```
#include <DBGAPI.H>

#define DEBUGMASK(n)        (0x00000001<<n)
#define MASK_INIT           DEBUGMASK(0)
#define MASK_ON             DEBUGMASK(1)
#define MASK_OFF            DEBUGMASK(2)
#define MASK_SCAN           DEBUGMASK(3)
#define MASK_WARN           DEBUGMASK(14)
#define MASK_ERROR          DEBUGMASK(15)
#define ZONE_INIT           DEBUGZONE(0)
#define ZONE_ON             DEBUGZONE(1)
#define ZONE_OFF            DEBUGZONE(2)
#define ZONE_SCAN           DEBUGZONE(3)
#define ZONE_WARN           DEBUGZONE(14)
#define ZONE_ERROR          DEBUGZONE(15)
```

➢ Instantiate the DBGPARAM structure

4. Open the **ScanBarcode.cpp** file in the **ScanBarcode** subproject.

5. Add the following code snippet just after the **#include Power_Status.h**.

```
#include "DbgZones.h"

DBGPARAM dpCurSettings =
{
       TEXT("ScanBarcode"),
       {
              TEXT("Init"), TEXT("PwrOn"), TEXT("PwrOff"), TEXT("Scan"),
              TEXT("na"), TEXT("na"), TEXT("na"), TEXT("na"),
              TEXT("na"), TEXT("na"), TEXT("na"), TEXT("na"),
              TEXT("na"), TEXT("na"), TEXT("Warning"), TEXT("Error")
       }
       , MASK_INIT | MASK_ON | MASK_OFF | MASK_SCAN
};
```

➢ **Register the Debug Zones**

6. Add the following code snippet to the **DllMain()** function just before the return statement.

```
if(ul_reason_for_call==DLL_PROCESS_ATTACH)

{
        DEBUGREGISTER((HMODULE)hModule);
}
```

➢ **Add debug messages to the dll**

7. Add the following debug message to the **DllMain()** function just after the DEBUGREGISTER macro:

```
DEBUGMSG(ZONE_INIT,(_T("ScanBarcode: Initialized!!\r\n")));
```

8. Add the following debug message to the **ScanBarcode()** function just before the return statement:

```
DEBUGMSG(ZONE_SCAN,(_T("ScanBarcode: Scanned!!\r\n")));
```

9. Add the following debug message to the **ScanPowerOn()** function just before the return statement:

```
DEBUGMSG(ZONE_ON,(_T("ScanBarcode: Power ON!!\r\n")));
```

10. Add the following debug message to the **ScanPowerOff()** function just before the return statement:

```
DEBUGMSG(ZONE_OFF,(_T("ScanBarcode: Power OFF!!\r\n")));
```

11. Save and close **ScanBarcode.cpp** and **DbgZones.h**.

➢ **Build the DLL**

12. Right click on the **ScanBarcode** subproject in the Solution Explorer and select **Build.**

➢ **Test the application**

13. Launch the **BarcodeDllTest.exe** application using **Target | Run Programs** from the Visual Studio menu.

14. Observe the debug message output when you use the Power and Scan buttons.

15. Select **Target | CE Debug Zones…** from the Visual Studio menu.

16. Scroll down and click on **scanbarcode.dll.**

17. Click on the **Scan** check box to remove the check, and click **OK**.

18. Select the **Scan** button again in the BarcodeDllTest application.

19. Observe that the **ScanBarcode: Scanned!!** debug message is no longer being displayed. This demonstrates the ability to control message output using debug zones.

Note If you do not have the ability to configure debug zones in a particular module when using the Target | CE Debug Zones menu, it is probably because there were no debug zones registered in that particular module.

---

20. Close the **BarcodeDllTest.exe** application.

- **Change to Release configuration**

Note We will change back to the Release configuration now for better performance in the remaining labs.

---

21. **Detach** the device.

22. Select **Build | Configuration Manager** from the Visual Studio menu

23. Select **EVMBSP ARMV4I Release** from the **Active solution configuration** drop down box.

24. Click on **Close**.

Lab 8-1: Adding a Catalog Item

Objectives

- Understand how the Catalog works in Windows Embedded CE 6.0
- Be able to add items to the catalog

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 Add an item to the catalog

In this exercise you will create and add the CoreCon ARMV4I Files Helper catalog item to your Windows Embedded CE 6.0 installation. This catalog item will activate a subproject that brings in the files necessary to support application development with Visual Studio. The catalog item can be added to any ARMV4I based BSP.

The subproject that implements the component has already been created and is in your Student files. This subproject simply copies the appropriate binaries into the flat release directory using a batch file. It also adds bib file entries so that the binaries are included in the OS run-time image. See the files postlink.bat and CoreCon_Armv4i.bib for details.

- **Create 3rdParty area in WINCE600 tree**

1. Navigate to **C:\WINCE600** with Windows Explorer.
2. Create a directory called **3rdParty** (no spaces) in **C:\WINCE600**.
3. Create a directory called **GeneriCo** in **C:\WINCE600\3rdParty**.
4. Create a directory called **Catalog** in **C:\WINCE600\3rdParty\GeneriCo**.

Note The 3rdParty area we created above is the standard location for vendors to add their own functionality other than BSPs. In our case, we are the vendor GeneriCo. The Platform Builder plugin for Visual Studio will look in WINCE600\3rdParty*\Catalog for any catalog files that could add items to the catalog. This provides a consistent mechanism for vendors to add their own functionality.

- **Copy CoreCon_ARMV4I subproject to 3rdParty area**

5. Copy the **CoreCon_ARMV4I** folder from your Student files to our 3rdParty folder at **C:\WINCE600\3rdParty\GeneriCo**.

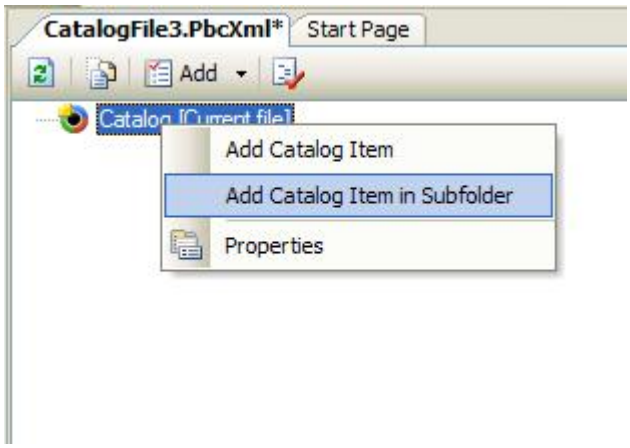
Note This subproject is only implemented for ARMV4I CPUs. It directly includes the ARMV4I binaries. It could be modified to support all CPU types generically.

- **Create a new Catalog Item**

6. In Visual Studio, select **File | New | File…** to open the **New File** dialog.
7. In the Categories tree, select **Platform Builder**.
8. In the Templates list, select **Platform Builder Catalog File**.

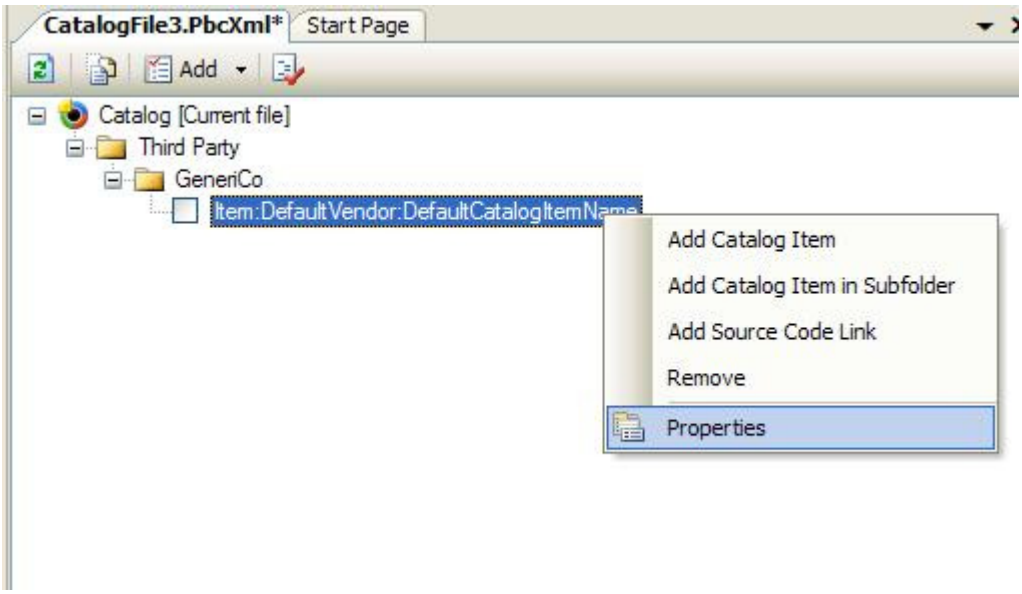
9. Click **Open**. A new catalog file will open in the Visual Studio editor.

10. Right click on the node **Catalog [Current file]** and select **Add Catalog Item in Subfolder**.



11. Name the new folder **GeneriCo** and select **OK**.

12. The new Item will appear under the **Third Party | GeneriCo** node in the Catalog. **Right click** on the item and choose **Properties**. This will bring up the Properties window for this catalog item.



13. Type **CoreCon Files Helper for ARMV4I** in the **Comment** block in the **Identification** section.

14. Type **CoreCon Files Helper for ARMV4I** in the **Description** block in the **Identification** section.

15. Type **CoreCon Files Helper for ARMV4I** in the **Title** block in the **Identification** section.

16. Type **Item:GeneriCo:CoreCon_ARMV4I** in the **Unique Id** block in the **Identification** section

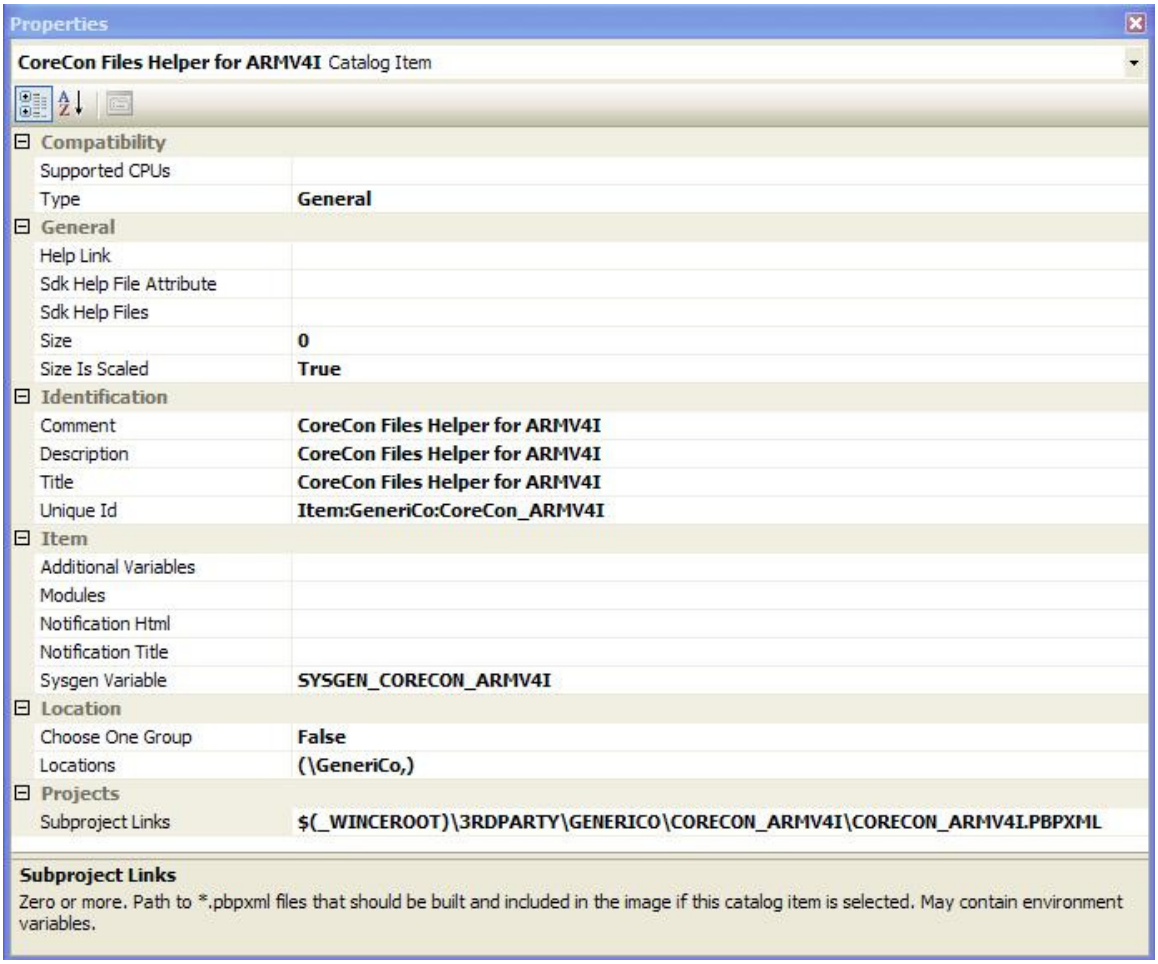
17. Type **SYSGEN_CORECON_ARMV4I** in the **Sysgen Variable** block in the **Item** section.

18. Click in the data area for **Subproject Links** in the **Projects** section, then click on the **…** button on the right hand side. This will bring up the **PbpXml Project Links** dialog.

19. Click **Add**

20. Navigate to the **C:\WINCE600\3rdParty\GeneriCo\CoreCon_Armv4i** folder and select **CoreCon_Armv4i.pbpxml**.

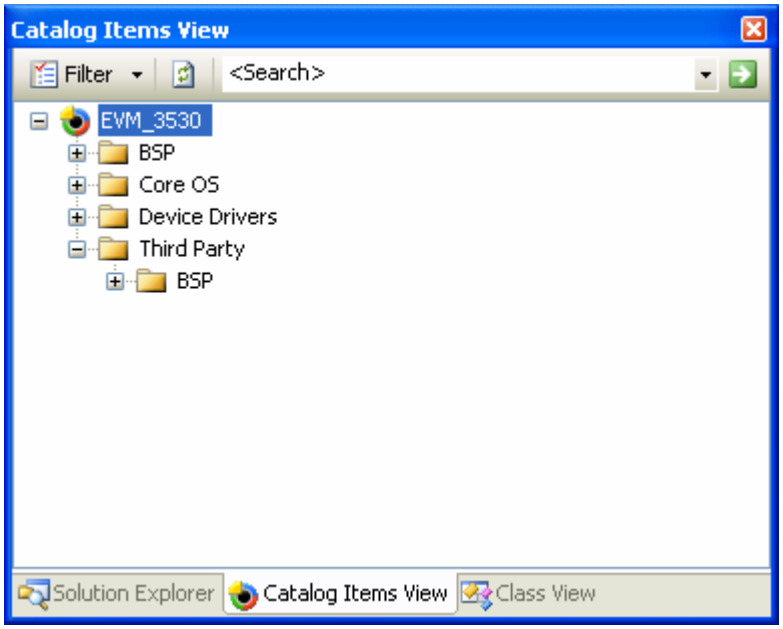
21. Click **OK** to close the dialog. The final Properties window should look like the following:



22. Save the Catalog File to **C:\WINCE600\3rdParty\GeneriCo\Catalog**, with the name **CoreCon_ARMV4I.PbcXml**.

23. Switch to the **Catalog Items View** if it is not already open.

24. Refresh the **Catalog Items View** by clicking on the refresh button located on the command bar.



25. Expand the new **GeneriCo** node under Third Party, and observe the new **CoreCon Files Helper for ARMV4I** item.

26. Select the **CoreCon Files Helper for ARMV4I**. A green check mark should appear in the box indicating the item has been added to your OS Design.

27. Switch to the **Solution Explorer** view.

28. Observe that the **CoreCon_ARMV4I** subproject has been automatically added to your design. This OS Design will now include the binaries necessary to support application debugging with Visual Studio.

Note Do not exclude this subproject from the build. Its purpose is to include files into the build.

---

29. Select **Build | Advanced Build Commands | Build Current BSP and Subprojects** from the Visual Studio menu. The new OS run-time image will include the CoreCon helper files.

Lab 8-2: Replace the Standard Explorer Shell with IESHELL

Objectives

- Understand how to implement a custom shell

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 45 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- A running image from Lab 2-1

Exercise 1 IESHELL

In this exercise you will clone the IESimple browser application into a new subproject and call it IESHELL. The IESimple application is a simple container around the IE browser object. This application is sometimes used as the starting point to write custom browser based shells.

You will run the application and verify its functionality. You will use this application in the next exercise as a replacement for the Standard Shell.

- **Clone IESIMPLE**

1. Using the Solution Explorer, create an empty subproject of type **WCE Application** with the name **IESHELL**.

2. Navigate to **C:\WINCE600\PUBLIC\IE\OAK\IESIMPLE** and copy all the files except sources and makefile to your new IESHELL subproject directory at **C:\WINCE600\OSDesigns\EVMOSDesign\EVMOSDesign\IESHELL**.

3. Rename **iesimple.rc** to **ieshell.rc** in your new subproject directory.

4. Add the newly copied files by right clicking on the **IESHELL** subproject and selecting **Add | Existing Item…**. Add the files **mainwnd.h**, **resource.h**, **ieshell.rc** and **mainwnd.cpp**.

5. Right click on the **IESHELL** subproject and select **Open**. The **SOURCES** file will open in the Visual Studio editor.

6. Add the following INCLUDES directive to the bottom of the file. Ensure there is a blank line between the INCLUDES directive and the line above it.

```
INCLUDES= \
       $(_WINCEROOT)\PUBLIC\IE\SDK\INC; \
       $(_WINCEROOT)\PUBLIC\COMMON\OAK\INC \
```

7. Add the following libraries immediately after the last library listed in the TARGETLIBS directive. Ensure there is a blank line after the last entry.

```
$(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\wininet.lib \
$(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\commctrl.lib \
$(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\uuid.lib \
$(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\ole32.lib \
$(_PROJECTROOT)\cesysgen\sdk\lib\$(_CPUINDPATH)\oleaut32.lib \
```

8. Save and close the file.

9. Right click on the **IESHELL** subproject and select **Build**.

- **Test IESHELL**

10. **Attach** to the device if not already attached.

11. Launch **ieshell.exe** using **Target | Run Programs** from the Visual Studio menu. The default home page will appear.

Note You may not be able to access the internet using the IESHELL browser application. There are a number of issues that can limit connectivity. The device must be configured for Internet access, there must be a virtual network driver installed on your development system, you must have Internet connectivity available at your location etc.

---

12. Press **Ctrl + G** to bring up an address dialog box. You may type other web addresses in this dialog to navigate to other sites.

- **Terminate IESHELL**

13. Select **Target | Target Control** from the Visual Studio menu to bring up the Target Control utility.

14. Type **gi proc** at the Windows CE prompt to determine the ID of the ieshell.exe process.

15. Terminate the ieshell process using the **kp** command at the Windows CE prompt.

Exercise 2 Configure IESHELL as the shell

In this exercise you will configure IESHELL to run as the default shell application instead of the Standard Shell. We will rebuild the OS run-time image to include this new component.

Note You should normally remove the Standard Shell from your OS design if you are going to use a different application as the shell. We are not going to remove the Standard Shell in this exercise so that we do not have to rebuild the OS design.

➢ **Detach the device**

1. Select **Target | Detach Device** from the Visual Studio menu.

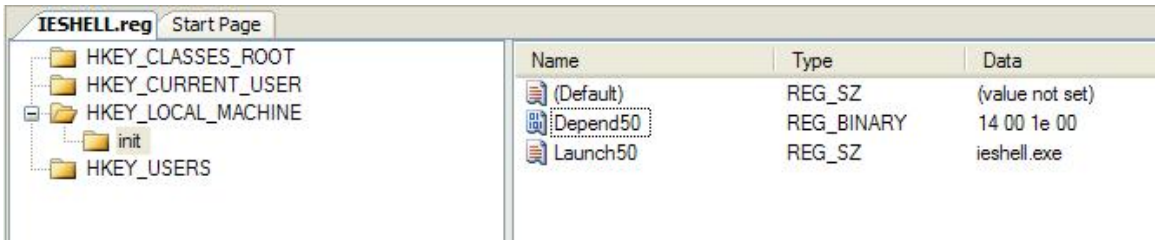
➢ **Configure IESHELL to launch at boot**

2. Open the **ieshell.reg** file in the IESHELL subproject using the Solution Explorer.

3. Add a new key called **Init** to **HKEY_LOCAL_MACHINE**.

4. Add a new **String Value** to the Init key called **Launch50** with the value **ieshell.exe**.

5. Add a new **Binary Value** to the Init key called **Depend50** with the value **14 00 1e 00**.



Note These registry settings will override existing settings that are provided by the Standard Shell. They will cause ieshell.exe to be launched automatically during the boot process. The settings we provide here take precedence because registry entries from subprojects are processed last during the build.

➢ **Add SignalStarted() to ieshell**

6. Open **mainwin.cpp** from the IESHELL subproject

7. Add the following code near line 171 to handle the **SignalStarted()** call. There should be a PeekMessage statement followed by an "if" logic statement. The code will need to go between these to points.

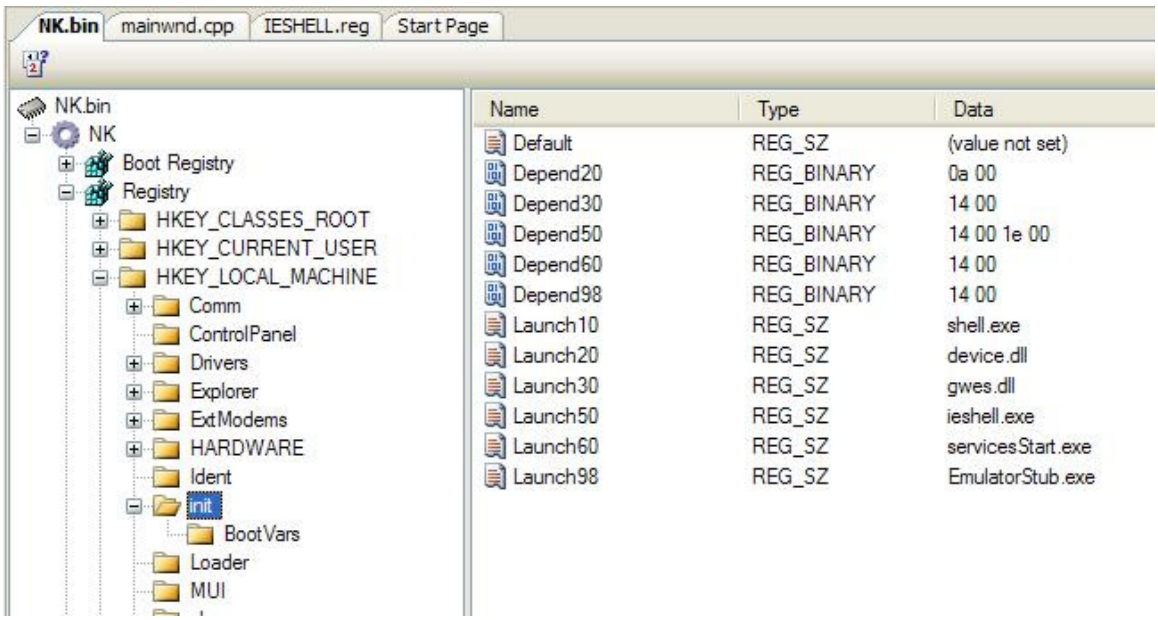
```
int initSignal = _wtol(lpCmdLine);
if(initSignal != 0)
{
        SignalStarted(initSignal);
        if ( FAILED(HandleNewWindow2(_T(""),NULL)))
        {
                goto Cleanup;
        }
}
else
{
        // EXISTING CODE HERE
        if(FAILED(HandleNewWindow2(lpCmdLine, NULL)))
        {
                goto Cleanup;
        }
}
```

8. Select **Build | Advanced Build Commands | Build Current BSP and Subprojects** from the Visual Studio menu.

➢ Test

9. Open the OS run-time image file (NK.BIN) from the flat release directory. The Run-Time Image viewer will load.

10. Verify that the [HKLM\Init] key contains **ieshell.exe** and not explorer.exe



11. **Attach** to the device. Observe that the default shell is now ieshell and not the Standard Shell.

Note We want the Standard Shell for future labs. So we'll remove ieshell from the OS design here.

---

12. **Detach** the device

13. Right click on the IESHELL subproject in the Solution Explorer and select **Remove**

14. Select **Build | Advanced Build Commands | Build Current BSP and Subprojects** from the Visual Studio menu.

Lab 8-3: Exporting an SDK

Objectives

- Be able to create an SDK for native code development in Visual Studio 2005

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 15 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in

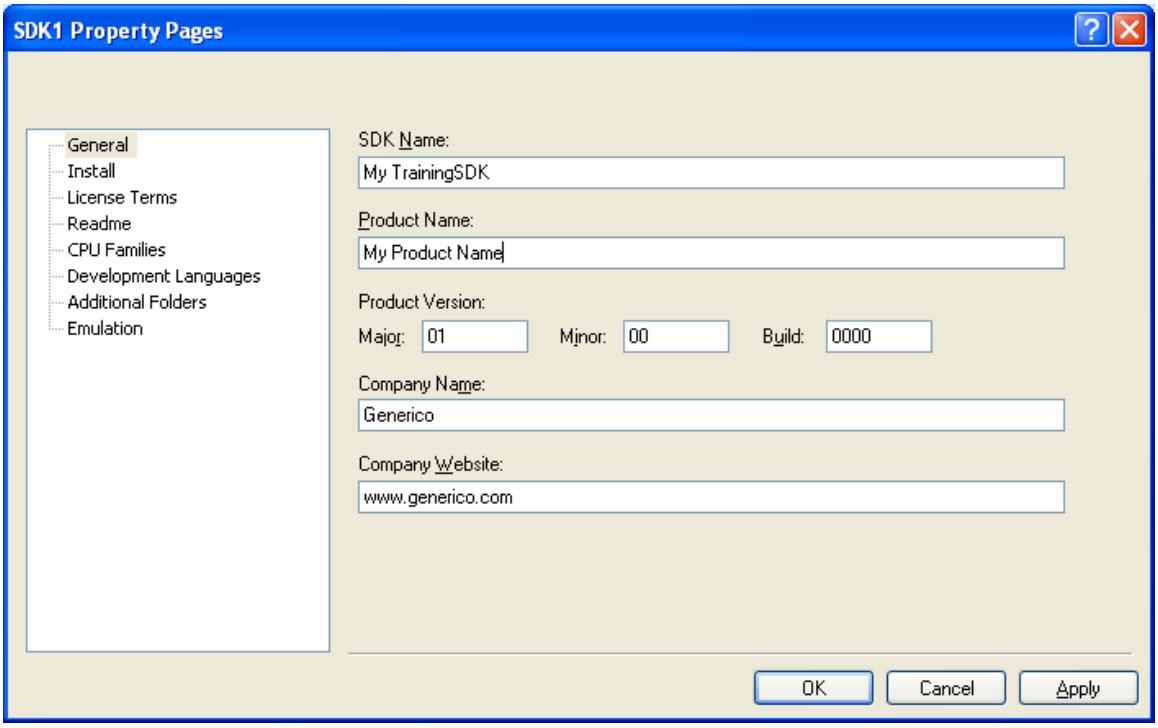
Exercise 1

In this exercise you will create an SDK based on your OS Design. The SDK can be installed by application developers using Visual Studio to target applications to your device.

➢ **Add New SDK**

1. Select **Project | Add New SDK…** from the Visual Studio menu.
2. Click **General** in the left window.
3. Change **SDK Name** to **myTrainingSDK**.
4. Fill in **Product Name**, **Company Name**, and **Company Website** with appropriate values.
5. Add **Major**, **Minor**, and **Build** numbers.

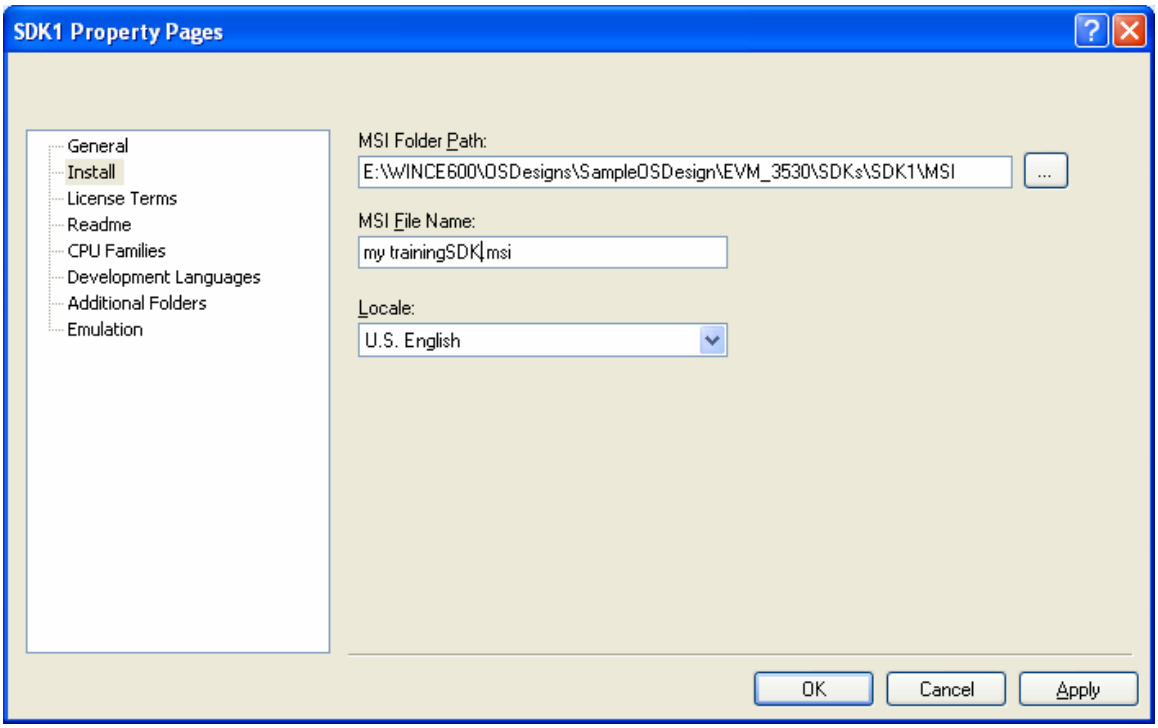
Note	You should increment the build number every time you create a new version of the SDK. The installer uses this version information to compare different installations of the SDK



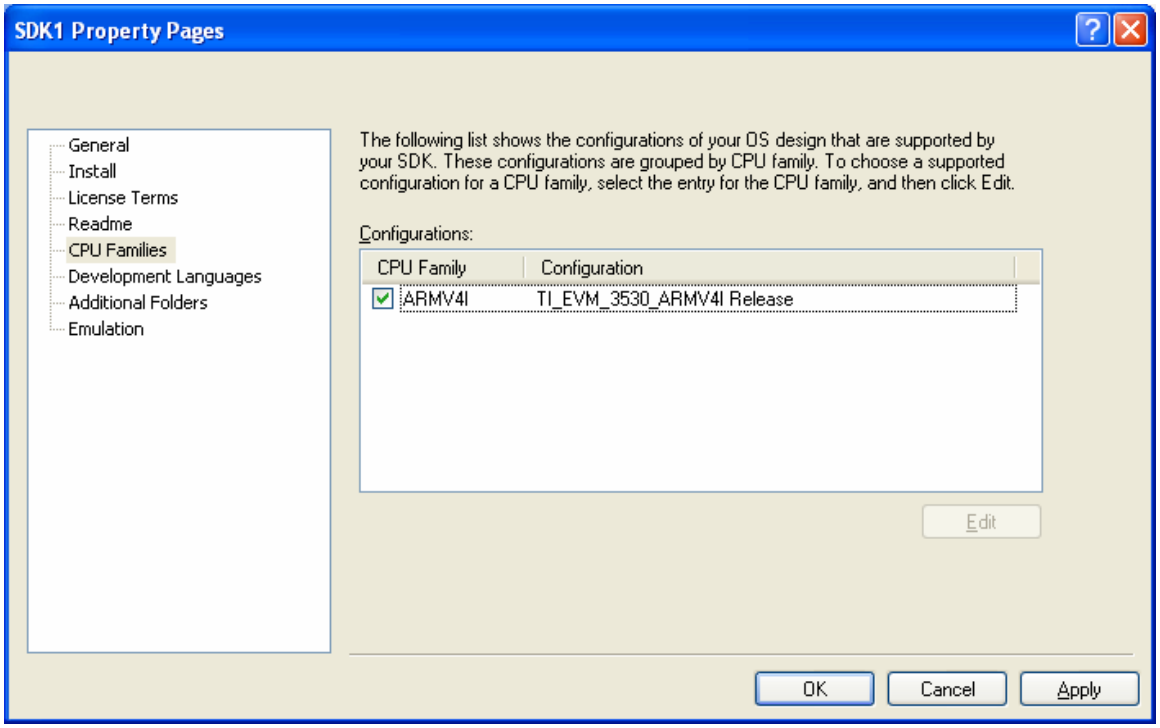
6. Select **Install** in the left window.

7. Make note of the **MSI Folder Path**.

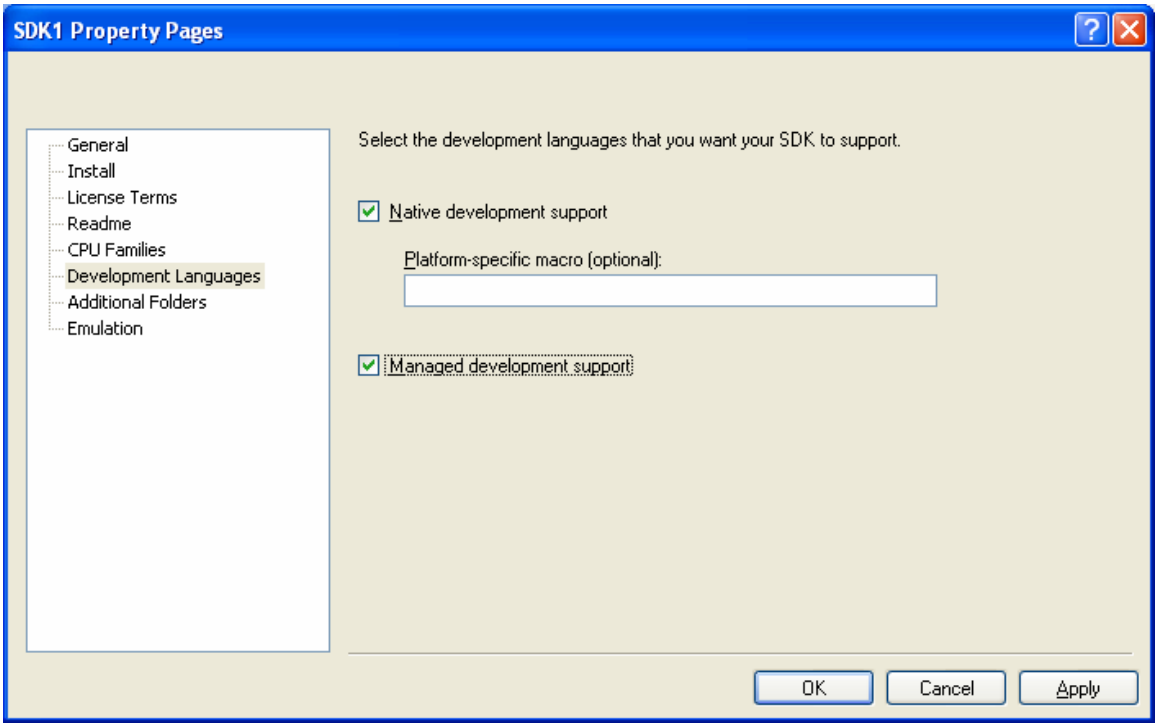
8. In the **MSI File Name** box type **myTrainingSDK.msi**.



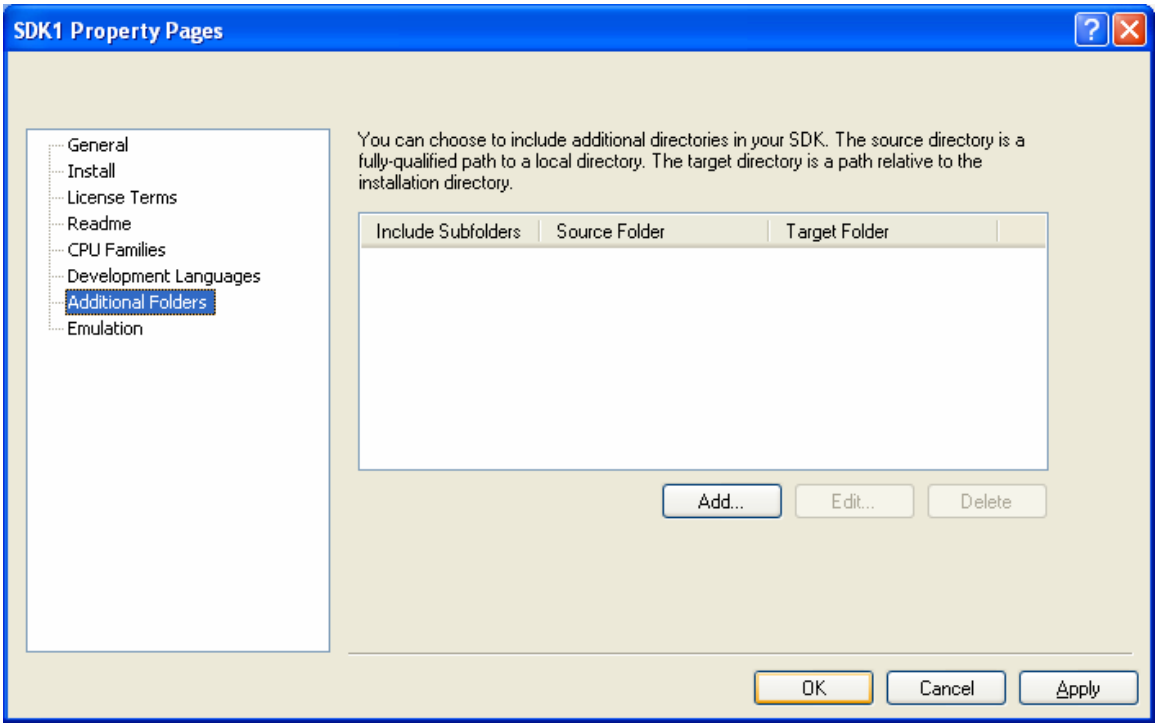
9. Select **CPU Families** in the left window. SDK Property Pages dialog should appear as follows.



10. Select **Development Languages** in the left window. Note that if you have added the .NET Compact Framework to your OS Design, you will have the option to check the **Managed development support** checkbox.



11. Select **Additional Folders** in the left window. This dialog allows you to add custom folders to your SDK.

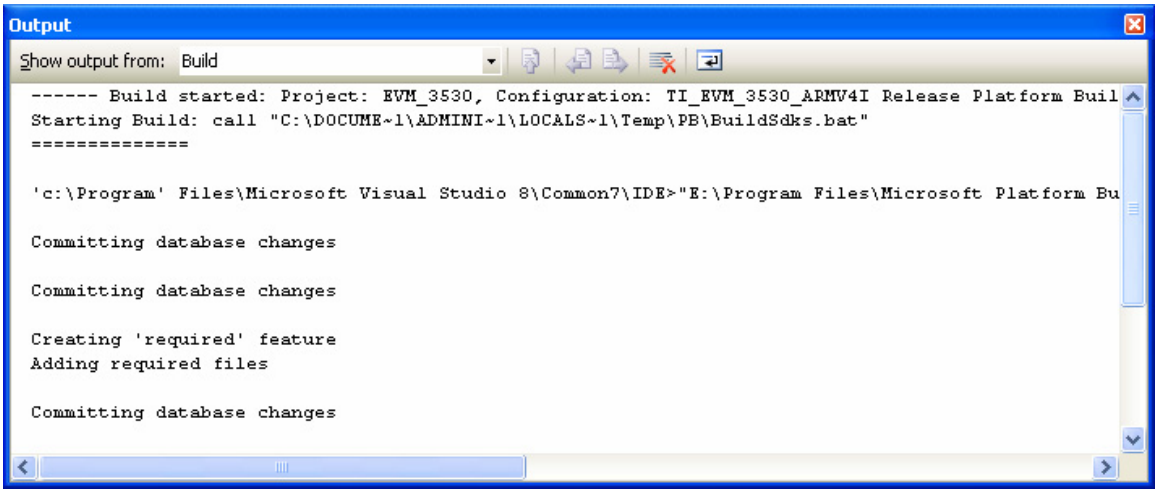


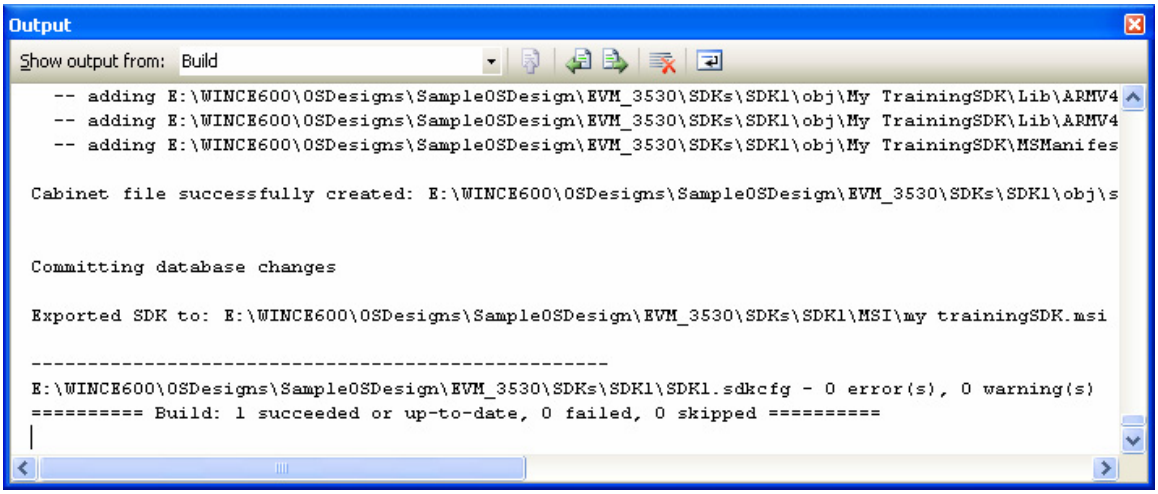
12. Click **OK**.

13. The new SDK will appear in the Solution Explorer in the **SDKs** node.

➢ **Build the new SDK**

14. In Solution Explorer under the SDKs folder, right-click myTrainingSDK and select **Build**. Once the build is completed, the SDK can be installed from the MSI file created in the MSI Folder Path.




Output
Show output from: Build
-- adding E:\WINCE600\OSDesigns\SampleOSDesign\EVM_3530\SDKs\SDK1\obj\My TrainingSDK\Lib\ARMV4
-- adding E:\WINCE600\OSDesigns\SampleOSDesign\EVM_3530\SDKs\SDK1\obj\My TrainingSDK\Lib\ARMV4
-- adding E:\WINCE600\OSDesigns\SampleOSDesign\EVM_3530\SDKs\SDK1\obj\My TrainingSDK\MSManifes
Cabinet file successfully created: E:\WINCE600\OSDesigns\SampleOSDesign\EVM_3530\SDKs\SDK1\obj\s
Committing database changes
Exported SDK to: E:\WINCE600\OSDesigns\SampleOSDesign\EVM_3530\SDKs\SDK1\MSI\my trainingSDK.msi
E:\WINCE600\OSDesigns\SampleOSDesign\EVM_3530\SDKs\SDK1\SDK1.sdkcfg - 0 error(s), 0 warning(s)
========== Build: 1 succeeded or up-to-date, 0 failed, 0 skipped ==========

Lab 9-1: Developing with Managed Code

Objectives

- Learn to develop and debug managed applications in a separate Visual Studio 2005 instance

Prerequisites

- Completed Lab 2-1
- Completed Lab 8-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- Visual Studio 2005 Service Pack 1
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- .NET Compact Framework 2.0 Service Pack 1 Patch

Exercise 1 Create a managed application project

In this exercise you will create a managed application project in a separate instance of Visual Studio targeting your Windows Embedded CE 6.0 device. You will deploy this application to the running device and debug it in the next exercise.

➢ Create a new Managed Project

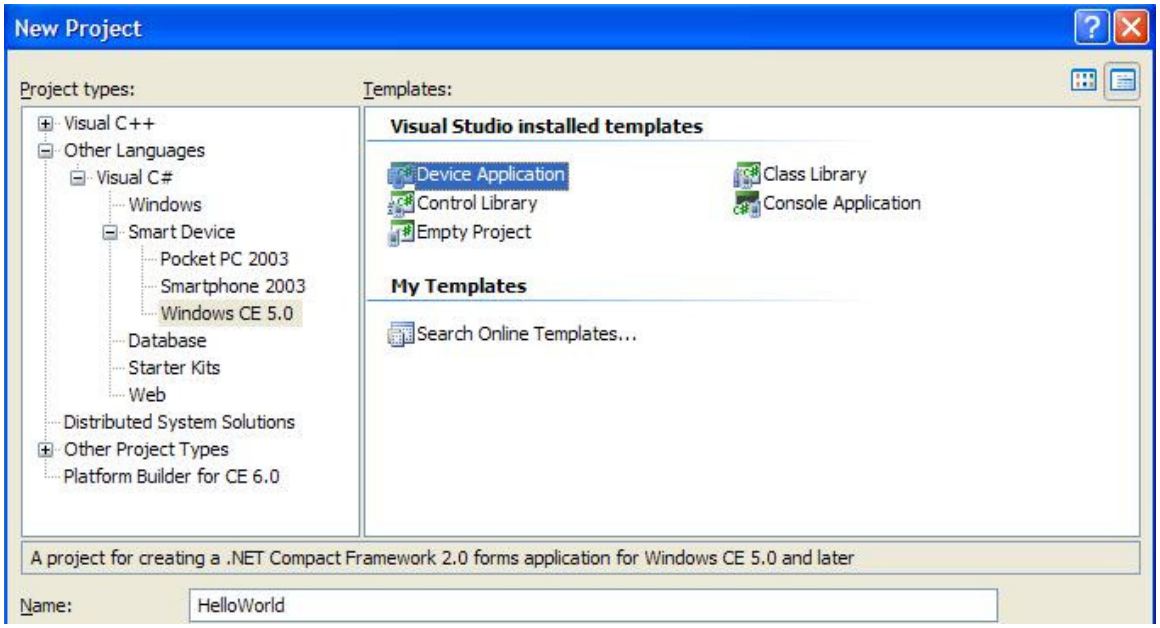
1. Start a **new instance** of Visual Studio (NOT the same instance that contains your Windows Embedded CE 6.0 OS Design; leave that instance running).

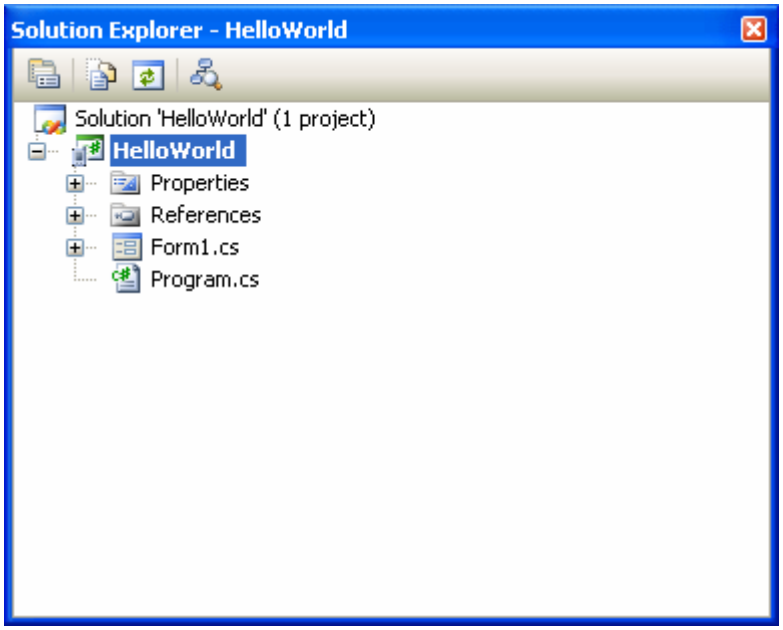
2. Select **File | New Project …** from the Visual Studio menu.

3. In the **New Project** window select **Visual C# | Smart Device | Windows CE 5.0**.

4. Select the **Device Application** template.

5. Name your project **HelloWorld**, and click **OK**.

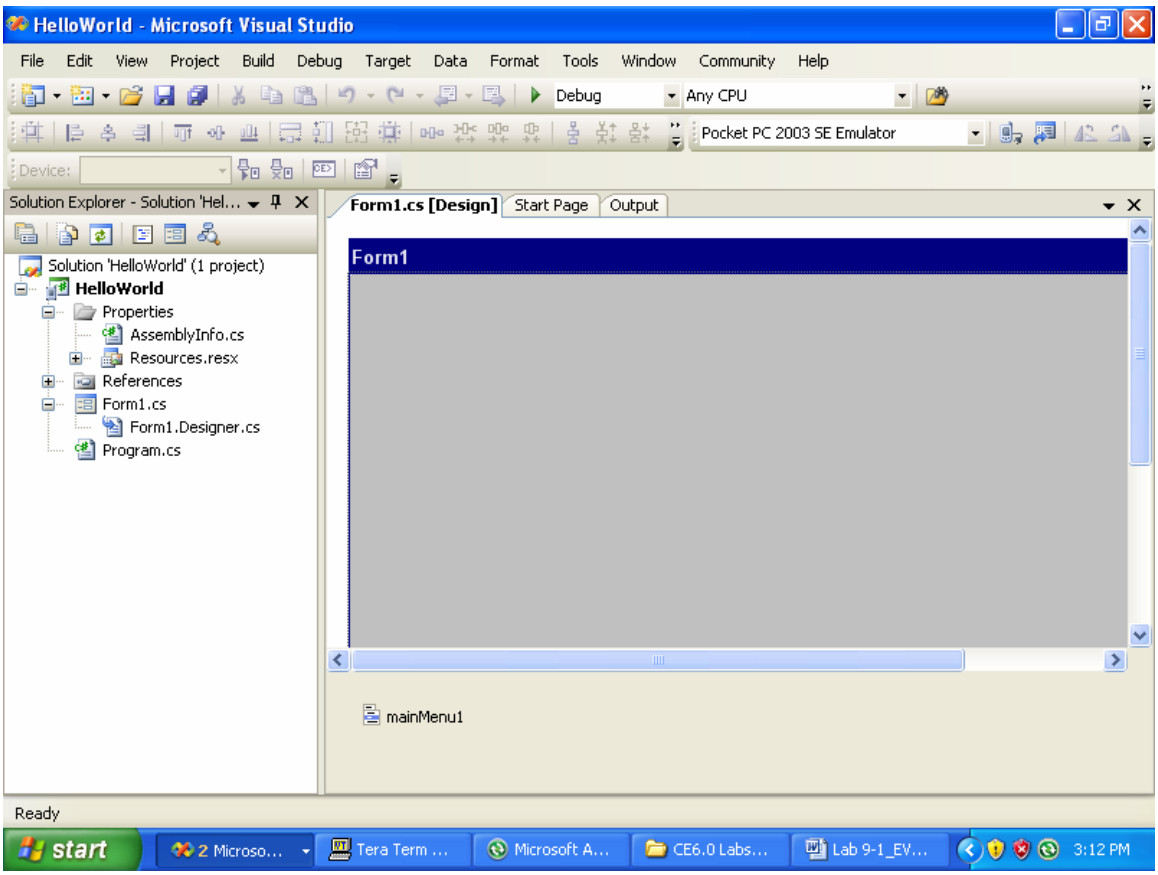




Note	The Windows CE 5.0 option in the Smart Device category applies to both Windows CE 5.0 and Windows Embedded CE 6.0 development. There is no difference between the two OS versions with regard to managed code development in Visual Studio 2005.

➢ **Add controls to the form**

6. Double click on **Form1.cs** in the **HelloWorld** project in the Solution Explorer.

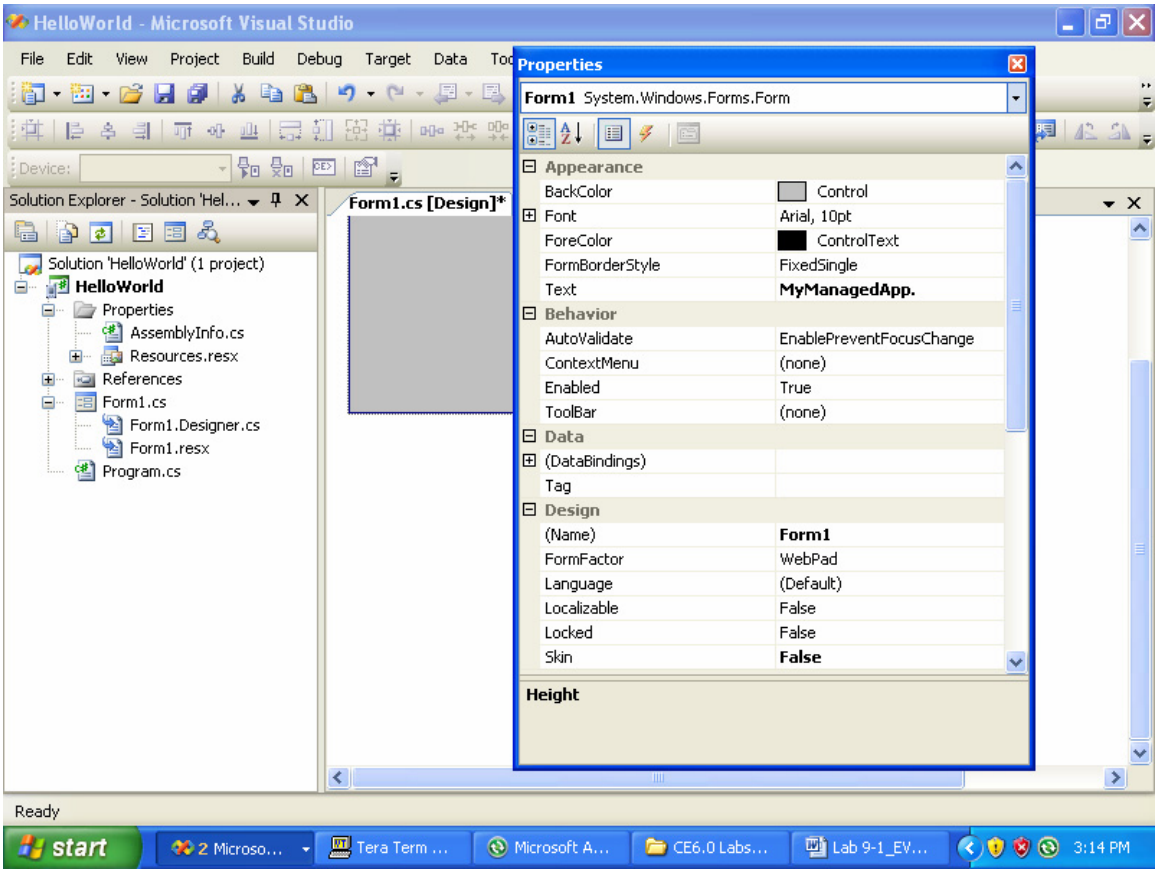


7. Delete the **mainMenu1** control at the bottom of the design window. Our application will not have a menu.

8. Right click on the form and select **Properties**.

9. Change the **Text** property in the Appearance group to **MyManagedApp**.

10. Expand the **Size** property in the Layout group. Change the **Width** and **Height** to **240**.

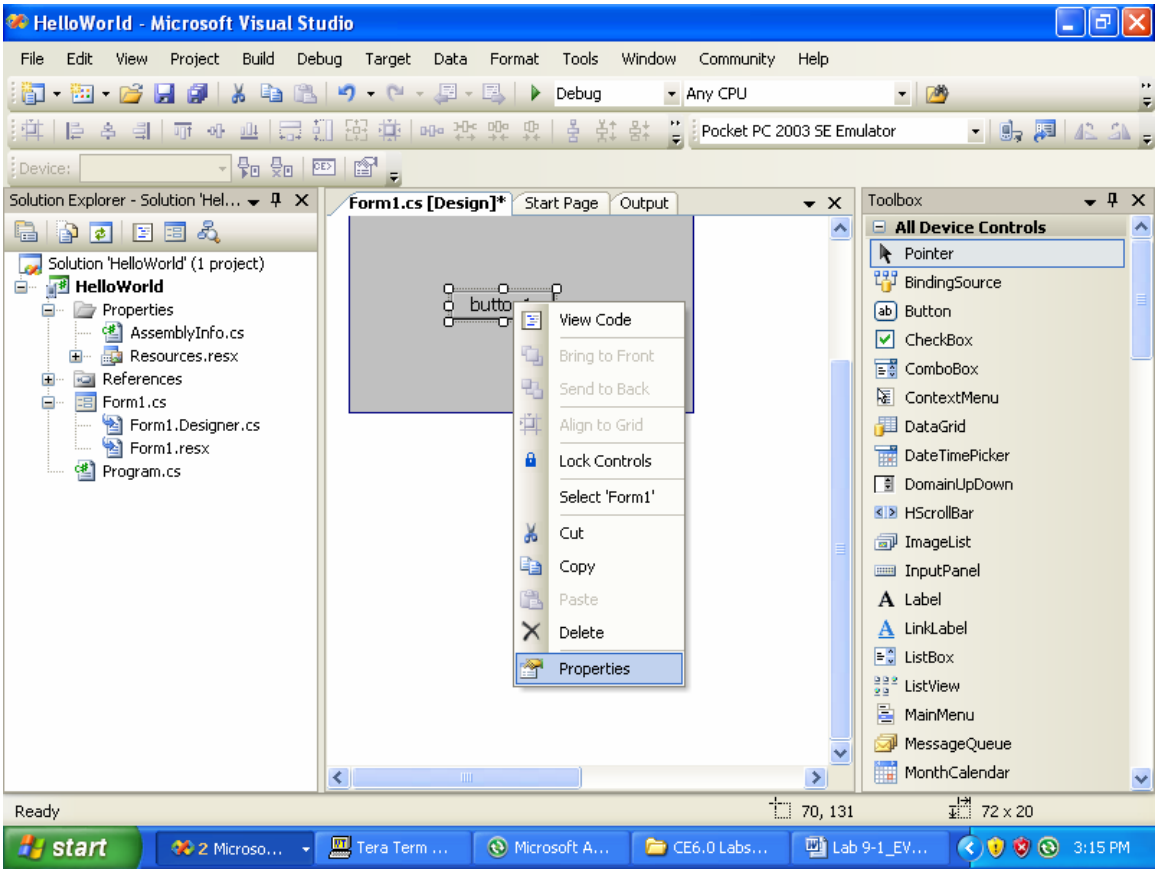


11. Close the **Properties** window.

12. If the Toolbox is not visible, select **View** | **Toolbox** from the Visual Studio menu.

13. Drag a button from the Toolbox onto the center of the form. Size the button to whatever dimensions you wish.

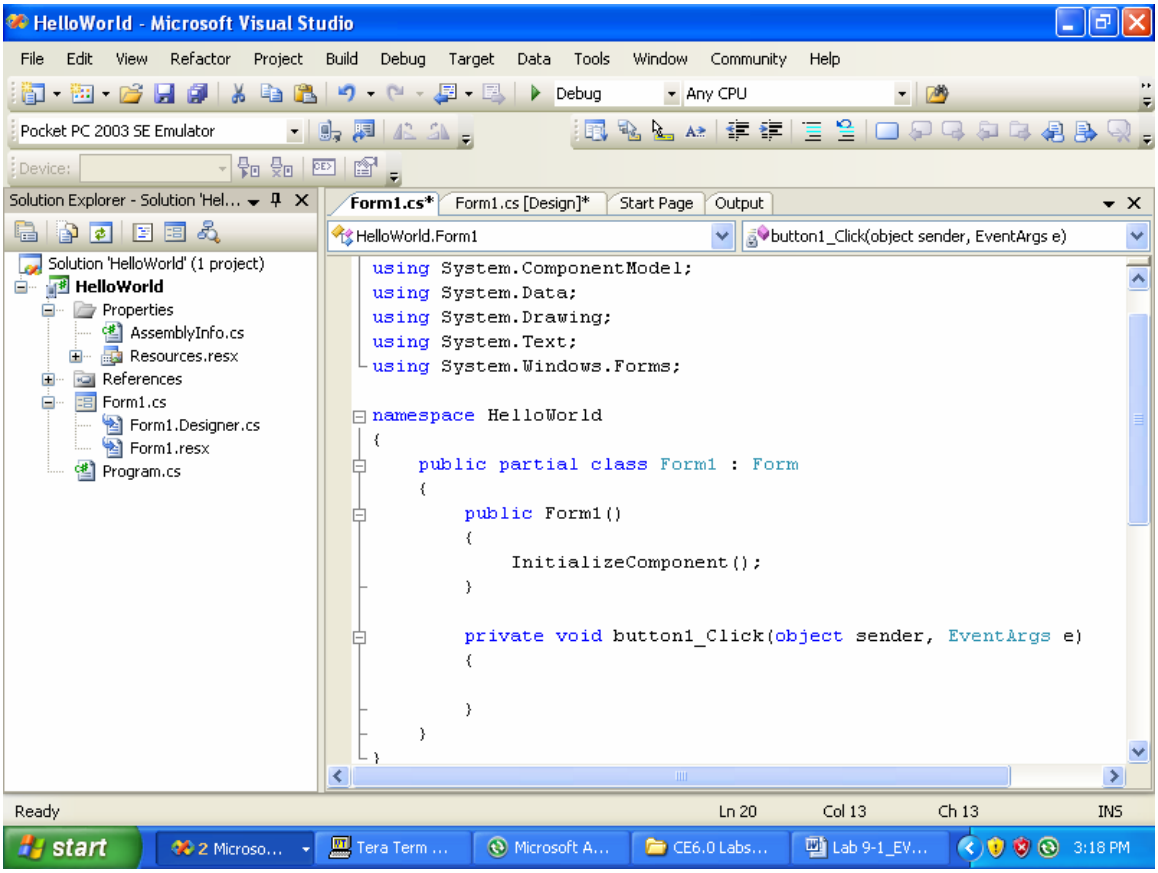
14. Right click on the button and select **Properties**.



15. Change the **Text** property in the Appearance group to **Click Me!**

16. Close the **Properties** window.

17. Double click the button you just added. The **Form1.cs** file will open in the editor with the cursor in the **button1_Click ()** function.



18. Add the following code snippet to the click handler.

```
MessageBox.Show ("Hello World!");
```

19. Right click the **HelloWorld** project in the Solution Explorer and select **Build**. Your managed application is complete.

Exercise 2 Deploy to device

In this exercise you will deploy your application to the device and debug it. The OS run-time image running on the device already contains the helper files necessary to support communication between the device and Visual Studio thanks to the helper component we added in a previous lab.

- **Determine device IP address**

1. In the CE6 instance of Visual Studio, **Attach** to the device if not currently attached.

2. Open the **Target Control** utility by pressing **Alt+1** in the Platform Builder session of Visual Studio**.**

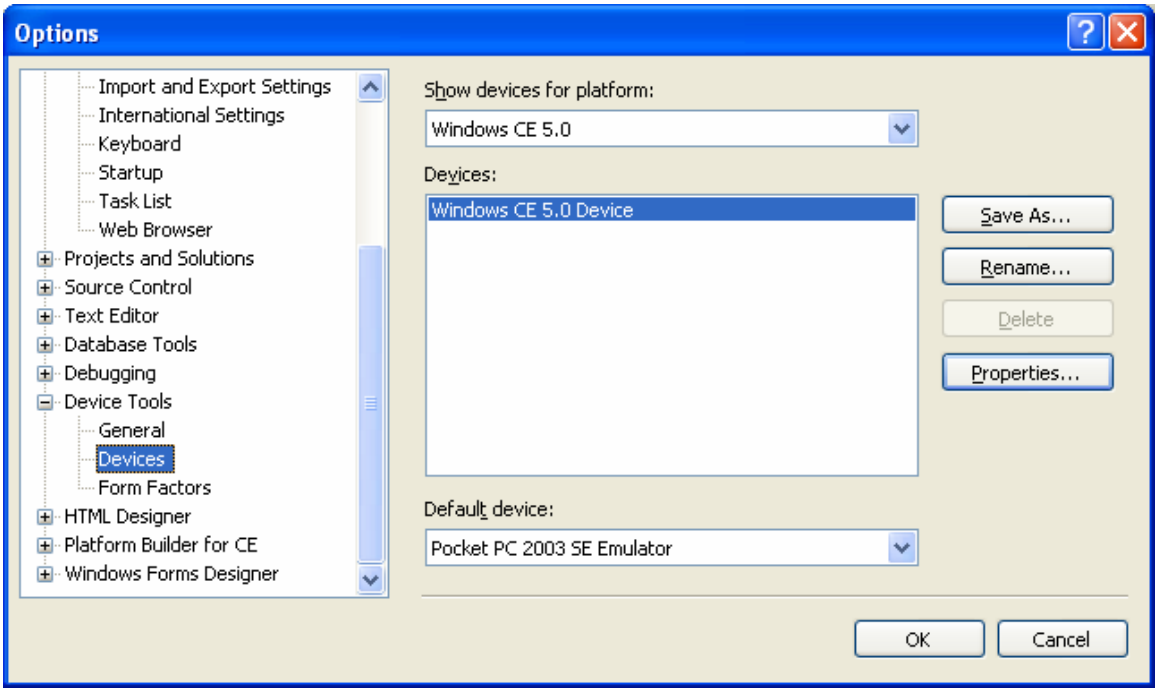
3. At the Windows CE prompt, type **s ipconfig /d**. Note the device IP address.

Note The ipconfig utility was included in our OS Design as a part of the networking utilities. The /d option causes the output of the command to be displayed in the debug Output window where we can easily retrieve it.

- **Configure managed application development environment for deployment**

4. In the Visual Studio instance containing your managed application, select **Tools | Options** from the menu.

5. In the Options window, expand the **Device Tools** node and select **Devices**.

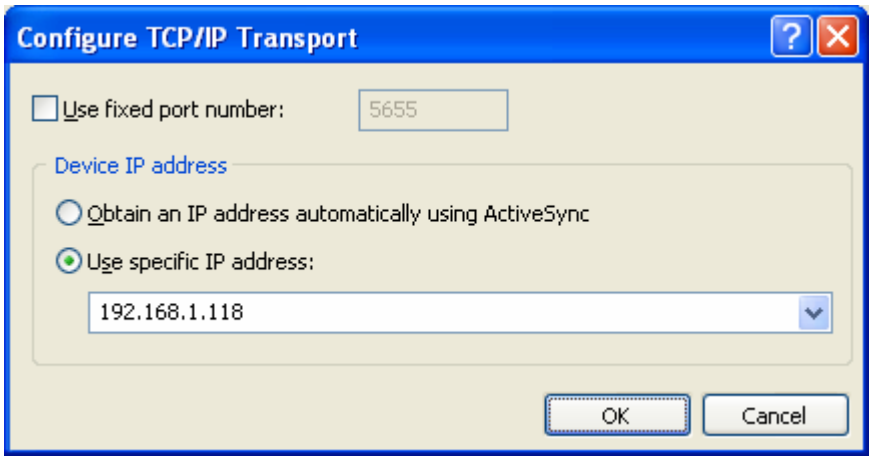


6. In the **Show device for platform:** drop down box select **Windows CE 5.0**.

7. Click on **Windows CE 5.0 Device** and select **Properties**.

8. Click the **Configure** button beside the **Transport** drop down box. We are going to configure the TCP Connect Transport.

9. Select the **Use specific IP address** button, and type in the IP address of the target device.



10. Click **OK** through all of the dialogs.

➢ **Prepare the target device**

11. At the Windows CE prompt in the Target Control utility, type **s ConmanClient2**.

12. Then, type **s cmaccept**. You now have 3 minutes to establish a connection with your managed application.

Note These two utilities were included in the CoreCon File Helper that we previously added to this OS Design.

➢ **Deploy the managed application**

13. Set a breakpoint in your application on the call to **MessageBox.Show("Hello World!");** in the button1_Click() function in **Form.cs**.

14. Select **Debug | Start Debugging** from the Visual Studio menu.

15. Select **Windows CE 5.0 Device** from the list of devices in the **Deploy HelloWorld** box and click **Deploy**. Visual Studio will deploy several cab files to the device in addition to your application. Your application will run on the target device.

16. Click on the **Click Me!** button in your application, and you will hit the breakpoint you just set. You are now debugging your managed application!

Lab 9-2: Integrating a Managed Application

Objectives

- Learn how to integrate a managed application into the BSP

Prerequisites

- Completed Lab 2-1
- Completed Lab 8-1
- Completed Lab 9-1

Estimated time to complete this lab: 20 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in
- Visual Studio 2005 Service Pack 1
- CE 6.0
- CE 6.0 2006 Roll up
- CE 6.0 Service Pack 1
- CE 2007 Updates upto month 9th month{QFEs}
- CE R2
- CE 2007 Updates 11th and 12th month {QFES}
- CE 2008 Updates
- .NET Compact Framework 2.0 Service Pack 1 Patch

Exercise 1 Integrating a managed application

In this exercise you will integrate your managed application directly into the OS run-time image by including it into the BSP instead of deploying it from Visual Studio.

- **Build a Release version of your application**

1. Select **Build | Configuration Manager** from the Visual Studio menu in the Visual Studio instance that is building your managed HelloWorld project.

2. Select **Release** from the **Active solution configuration** drop down box, and click **Close**.

3. Select **Build | Build Solution** from the Visual Studio menu to build the Release version of your application.

4. Note the output directory for the executable. By default, it will be in your **My Documents** folder in the **Visual Studio 2005\Projects\HelloWorld\bin\Release** subfolder.

Note The project directory for Visual Studio is configurable using the **Options** dialog available from the **Tools | Options** menu in Visual Studio.

- **Add the managed application to your BSP**

5. Copy the **HelloWorld.exe** application from the Visual Studio output directory to the FILES directory of the EVMBSP located at **C:\WINCE600\PLATFORM\EVMBSP\FILES.**

Note Everything in the **FILES** directory automatically gets copied to the flat release directory during the Build Release Directory phase.

---

6. Open **platform.bib** from the **Parameter Files** node of the EVMBSP using the Solution Explorer.

7. Add the following line to the bottom of **platform.bib** in the **FILES** section:

```
HelloWorld.exe   $(_FLATRELEASEDIR)\HelloWorld.exe          NK
```

Note Managed applications must be included in the FILES section of a .bib file. Do not place a managed application in the MODULES section.

- **Add the .NET Compact Framework 2.0 to the OS Design**

Note	We previously only included the OS dependencies for the .NET Compact Framework 2.0 in our OS Design; we did not include the framework itself. We allowed Visual Studio to deploy the framework to our device during the managed code development process. Now we want the framework on the device so that we can run managed applications without the support of Visual Studio.

8. **Detach** the device. We are going to be rebuilding the OS run-time image.

9. Locate the **.NET Compact Framework 2.0** catalog item in the Catalog Items View under **Core OS | CEBASE | Applications and Services Development | .NET Compact Framework 2.0**.

10. Add the **.NET Compact Framework 2.0** catalog item to your OS Design.

Note	There are two versions of the .NET Compact Framework 2.0. Be sure to select the one that does **NOT** have the – Headless modifier in the name.

- **Rebuild the OS Design**

11. Select **Build | Rebuild EVMOSDesign** from the Visual Studio menu. This will clean our existing design (both Debug and Release) and rebuild the currently selected Release configuration.

Note	This will take several minutes to complete, depending on the capabilities of your development workstation.

- **Test the managed application**

12. **Attach** the device.

13. Navigate to the **\Windows** directory on the device.

14. Double click on **HelloWorld**.

Your managed application will load and run. You have successfully integrated your managed application into your OS run-time image.

Lab 10-1: Using the CETK

Objectives

- Run automated tests using the Windows Embedded CE Test Kit (CETK)
- Modify the default behavior of the standard tests

Prerequisites

- Completed Lab 2-1

Estimated time to complete this lab: 30 minutes

Lab Setup

To complete this lab, you must have:

- A development workstation running Windows XP
- Visual Studio 2005 (Version 8) with Platform Builder plug-in

Exercise 1 Run a simple CETK test

In this exercise you will learn how to launch the Windows Embedded CE Test Kit. You will run selected tests and observe the results.

- **Launch the Windows Embedded CE Test Kit**

1. Ensure that the EVM is attached.

2. Copy the file **ktux.dll** from the `C:\Program Files\Microsoft Platform Builder\6.00\cepb\wcetk\ddtk\armv4i` folder on your workstation to the `\windows` directory on your device.

3. Using the **Start Menu** on your workstation, select **Start | All Programs | Windows Embedded CE 6.0 | Windows Embedded CE 6.0 Test Kit**. The Windows Embedded CE Test Kit (CETK) window will appear.

Note The CETK is not available from within the Visual Studio 2005 development environment.

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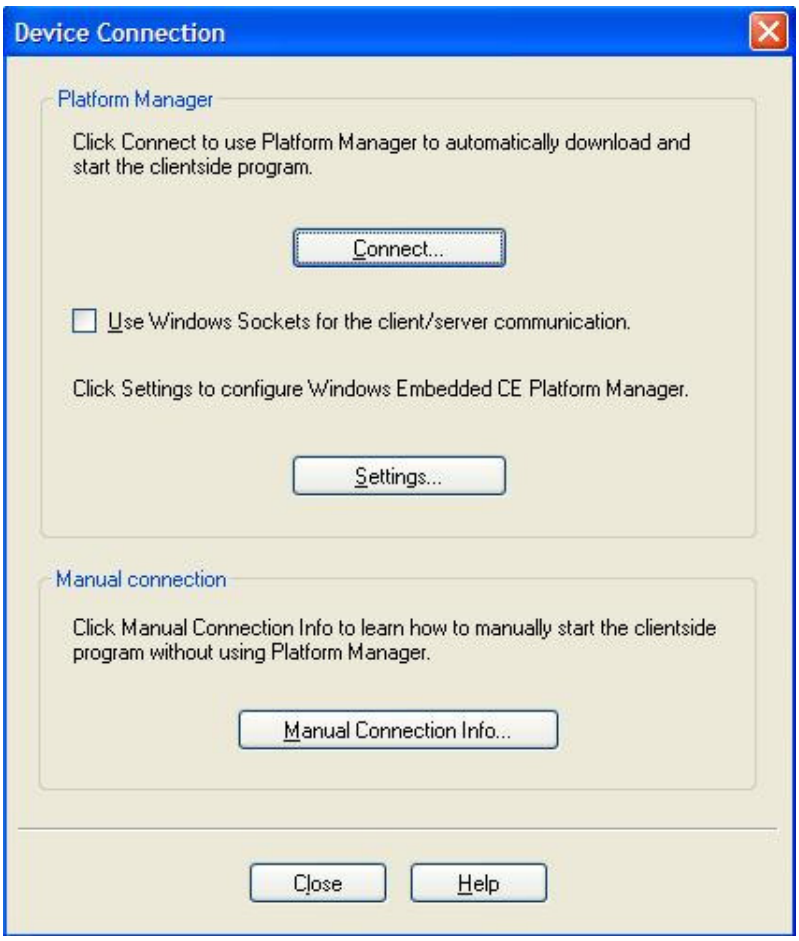
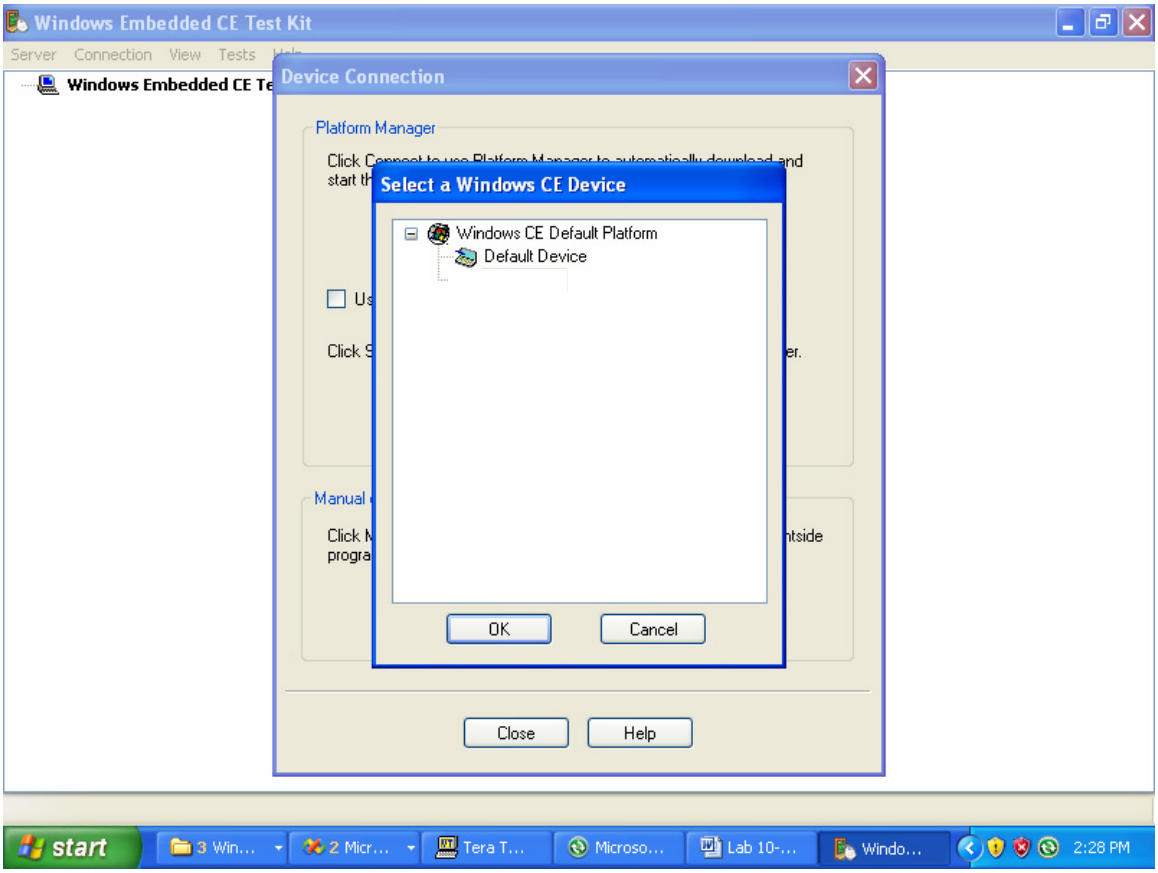
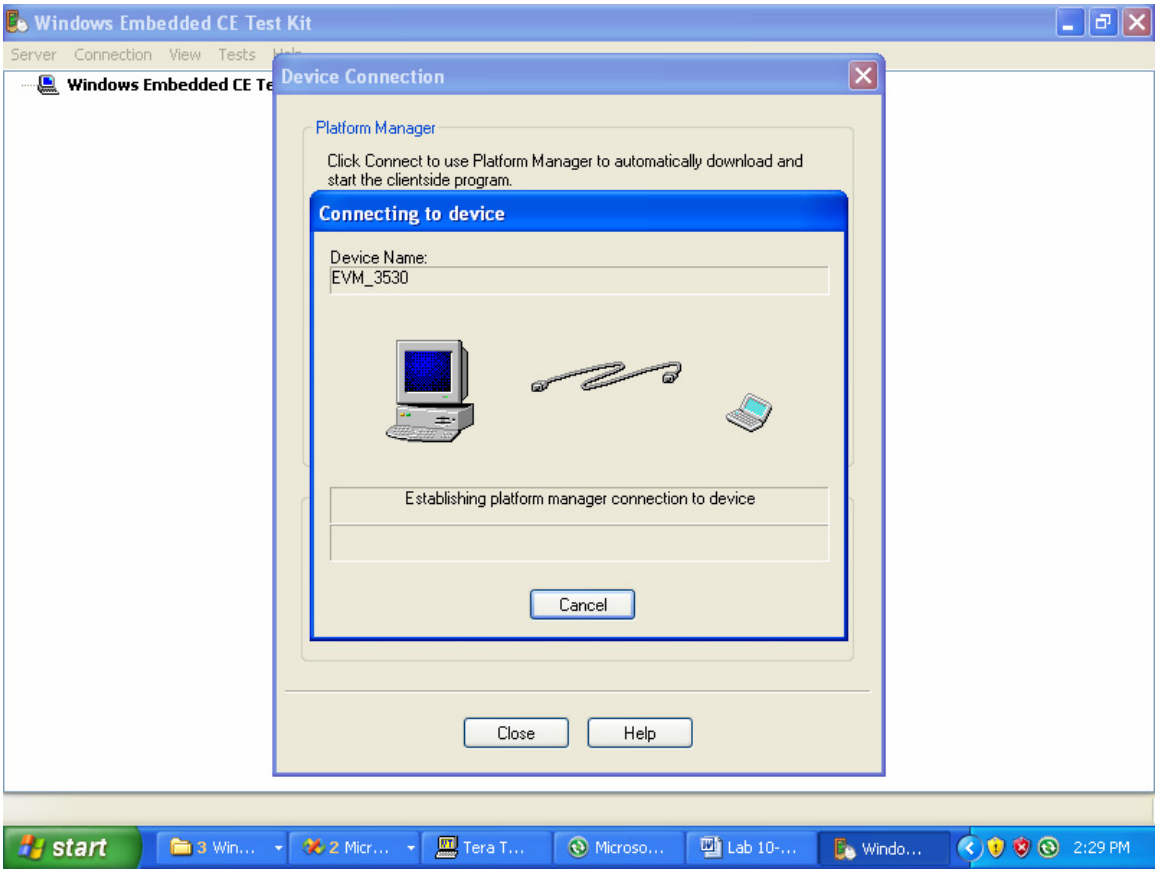
4. Select **Connection | Start Client…** from the CETK menu. The Device Connection dialog will appear.


Device Connection
Platform Manager
Click Connect to use Platform Manager to automatically download and start the clientside program.
Connect...
Use Windows Sockets for the client/server communication.
Click Settings to configure Windows Embedded CE Platform Manager.
Settings...
Manual connection
Click Manual Connection Info to learn how to manually start the clientside program without using Platform Manager.
Manual Connection Info...
Close
Help



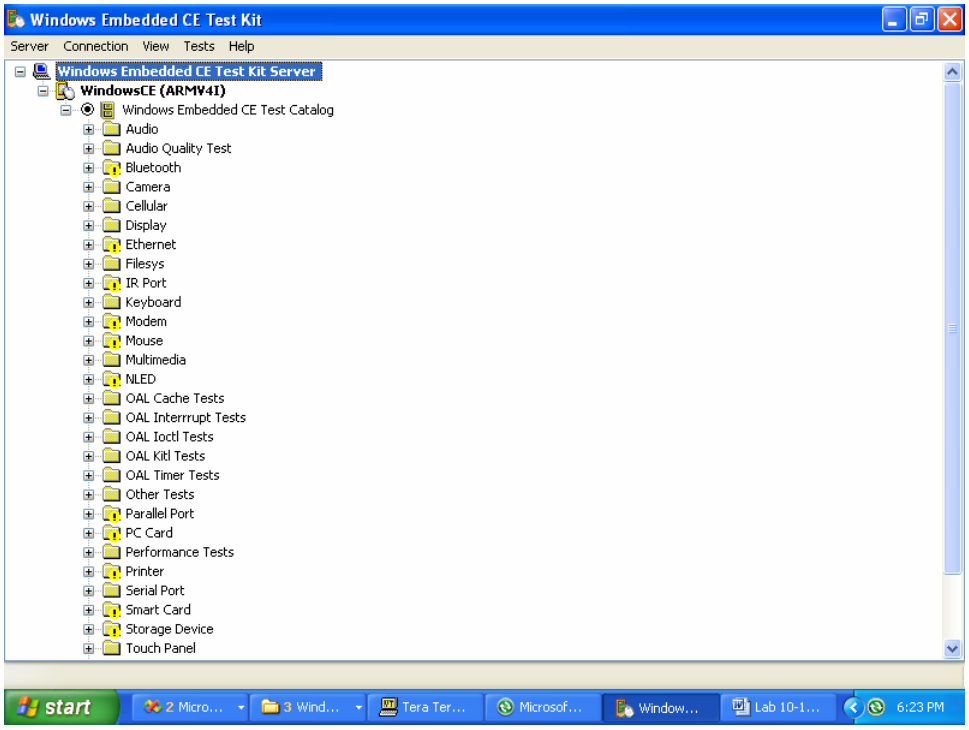
5. Click on **Connect….** The **Select a Windows CE Device** dialog will appear.

6. Click **OK** to accept the **Default Device** connection. The CETK server on the development workstation will download client software to the device and connect to it.



Note	The CETK supports multiple connection methods. This allows the test suite to be used in a variety of scenarios. We are using the same connection that we have been using with the Remote Tools. This connection configuration relies on the KITL transport.

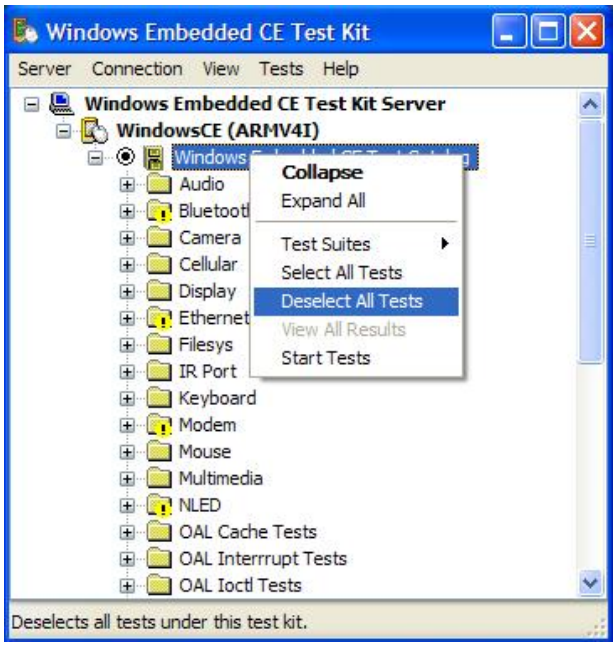
➢ Run selected tests



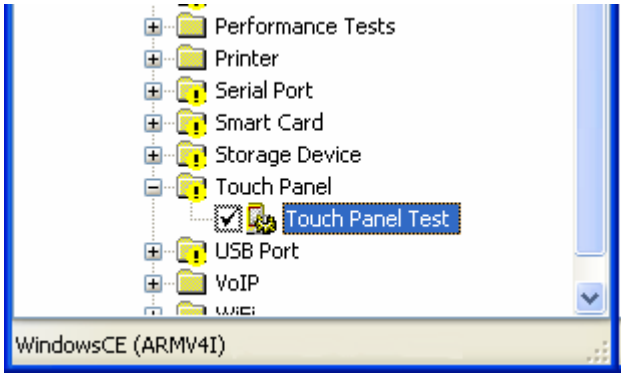
7. Expand the **WindowsCE (ARMV4I)** node.

8. Expand the **Windows Embedded CE Test Catalog** node to show the test groups.

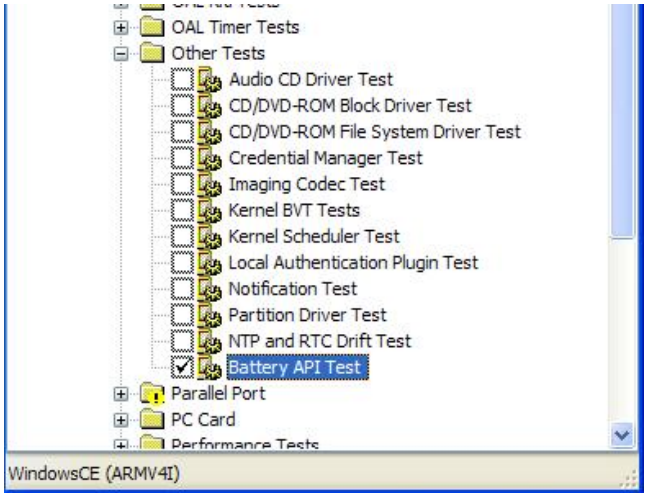
9. Right click on **Windows Embedded CE Test Catalog** and choose **Deselect All Tests**.



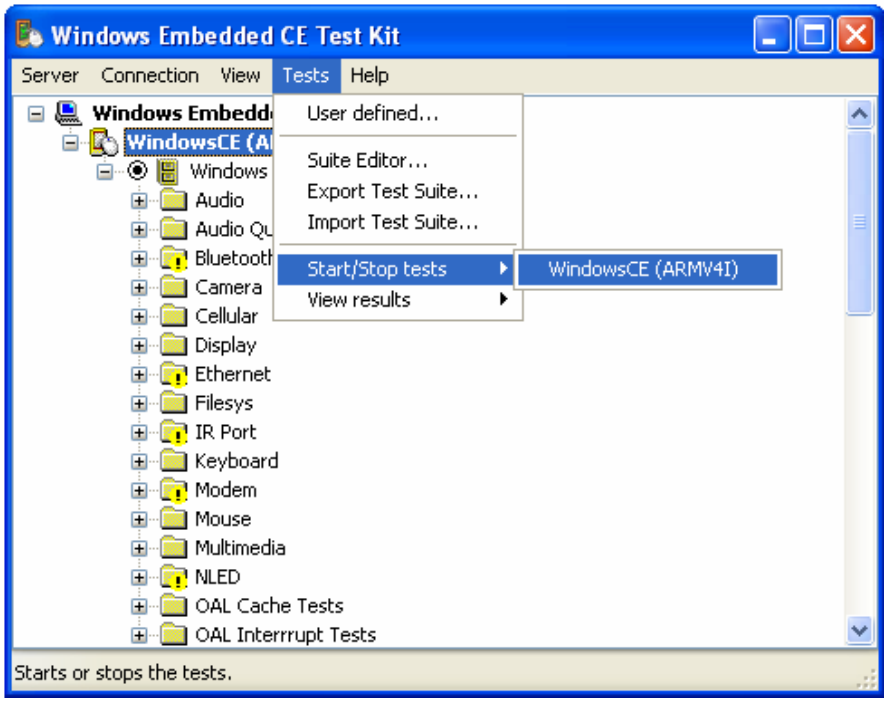
Note	By default, the CETK will select the all the tests it determines are appropriate for the device. We wish to run only a subset of the tests, so it is easier to select them individually.



10. Expand the **Touch Panel** node and select **Touch Panel Test**.



11. Expand the **Other Tests** node and select **Battery API Test**. Note that the list is not in alphabetical order.

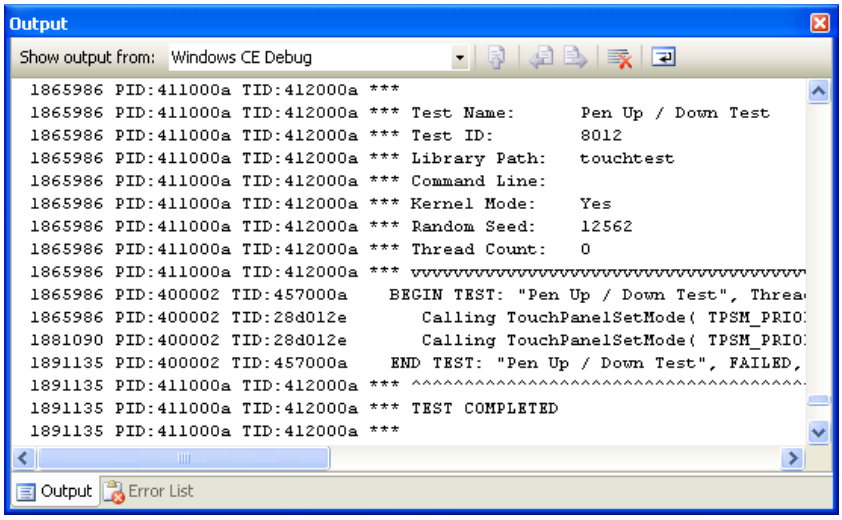


12. Select **Tests | Start/Stop Tests | WindowsCE (ARMV4I)** from the CETK menu. The CETK will indicate which test is currently running.

Note	Some tests are fully automatic, others require user interaction.

13. Follow the instructions on the EVM screen to complete the tests that require user input.

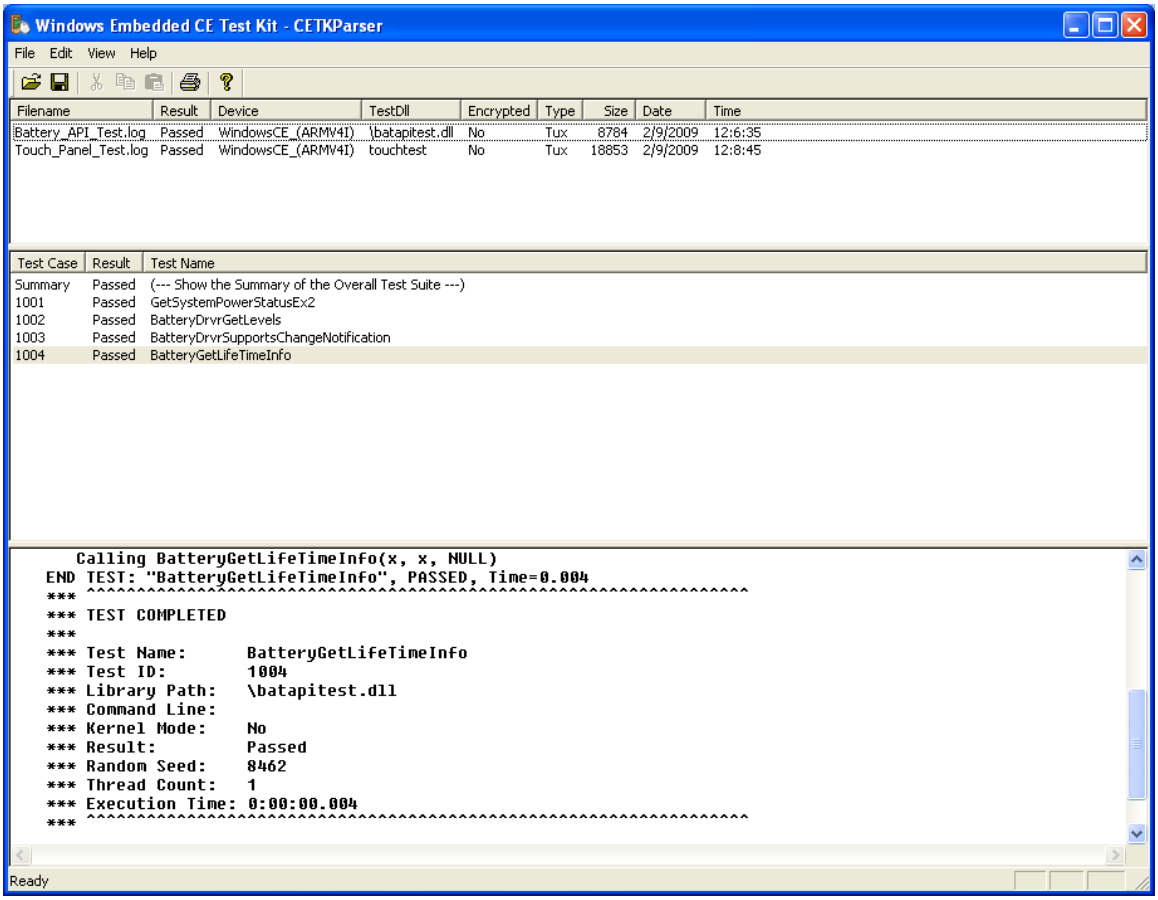
14. Switch to Visual Studio and view the testing progress in the Output window. You will see details of what the test is doing in addition to the results. These same results will be available from within the CETK once the tests are complete.



➢ View results

15. Once the tests are complete switch back to the Windows Embedded CE Test Kit window.

16. Select **Tests | View Results | WindowsCE (ARMV4I) | View All Results** from the CETK menu. The **CETKParser** window will appear.



17. Click on the **Battery_API_Test.log** in the top pane. The middle pane will show each of the subtests along with their status.

18. Click on the last subtest, **BatteryGetLifeTimeInfo** in the middle pane. The bottom pane will show the detailed test log for that particular subtest.

19. Close the **CETKParser** window.

Exercise 2 Modify the command line for CETK tests

In this exercise you will modify the command line of individual tests. Each test typically has a number of configurable parameters that can be changed from within the CETK window. These parameters can be used to target the testing to a particular problem area, speeding up the overall development cycle. The CETK test harness itself also has configurable parameters.

- **Configure Graphics Device Interface Test**

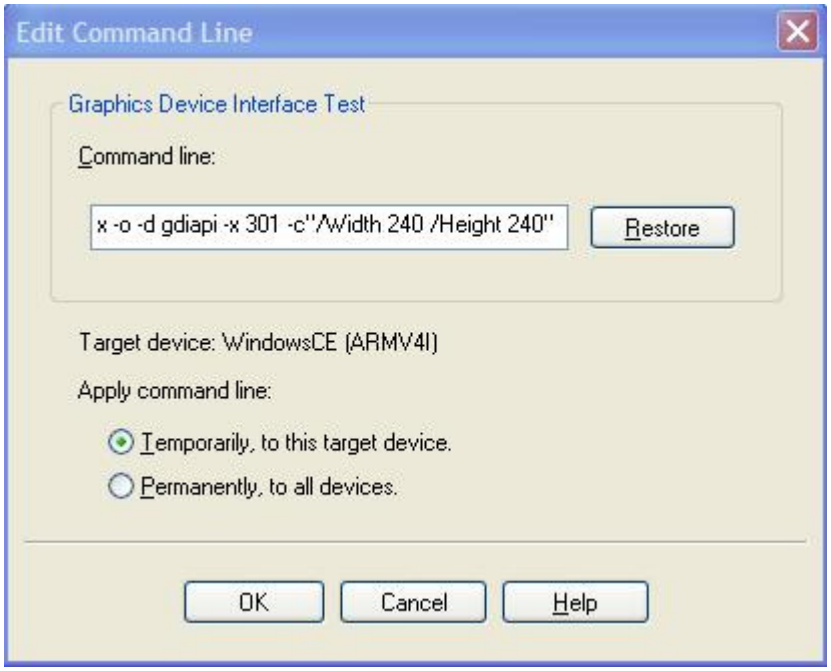
1. Right click on the **Graphics Device Interface Test** in the **Display** node and select **Test Information.** The documentation for this specific test will load in the Microsoft Document Explorer. The documentation indicates what parameters are available for this specific test.

Note	There are typically several pages in the documentation for each test. You may have to change to a different page to see the command line parameters.

2. Right click on the **Graphics Device Interface Test** in the **Display** node and select **Edit Command Line…**

3. Add the following command line parameters to the end of the existing command line:

   -x 301 -c"/Width 240 /Height 240"



Note The **–x** parameter tells the test harness to run only subtest number 301.

The **–c** parameter tells the test harness to pass everything in quotes to the actual test dll, in this case gdiapi. The parameters within quotes are interpreted by the individual test and are not consistent among tests.

4. Click **OK** to temporarily change the command line.

5. Right click on the **Graphics Device Interface Test** and select **Quick Start**. This individual test will run, and no others. This is a convenient way to run targeted tests.

Note For a lab that covers writing custom CETK tests, go to www.microsoft.com and search for **Advanced Automated Test Development with TUX**.