



Documentation

Win CE Integrators

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These notes refer to the UPDD CE driver 5.1.x, and above, first released Aug 13. This release supersedes version 4.1.10 and 4.0.6 which are no longer supported.

[Windows CE](#) or Windows Embedded Compact are embedded operating systems. For OEMs requiring a touch screen, or other pointer interface on Windows CE devices, the Touch-Base Universal Pointer Device Driver suite of software includes a 5.x, 6.x and 7.x CE driver.

With this release UPDD supports an interface with the standard Windows CE GWES (Graphics, Windowing, and Events Subsystem) touch interface. This allows for calibration via the built in CE control panel Stylus option and provides an interface to the gesture interface in Windows CE 6.0 and later. The old 'mouse' interface is retained for testing purposes and can also be used in situations whereby the GWES touch interface is not part of the CE image.

This UPDD version is built on the same software base as all other UPDD variants so that most UPDD functions available on other platforms are now supported in Windows CE (except for minor differences to accommodate variance in the Windows CE implementation). Known exceptions are listed in the [limitation section](#) below.

The [UPDD Application Program Interface](#) is supported on Windows CE allowing 3rd party utilities to be developed.

The main differences between the new and previous driver are:

- has been implemented as a native CE touch device driver interfacing with the standard Windows CE GWES touch interface
- utilises CE calibration procedure
- supports the native gesture interface introduced in Win CE 6
- is shipped with the new [command line utility](#)
- uses the standard [UPDD settings file](#)

Development History

5.1.xx was launched in August 2013 and development history is available here.

Hardware Interfaces

The driver mainly supports Serial and USB interfaces. We have supported i2c but this interface is highly specialised and targeted at specific controller chipsets.

USB has been tested on X86 and ARM processors. If there are USB interface issues on other processors we may need to be supplied a target system to investigate further and modify the UPDD USB interface where applicable.

PS/2, supported since release 5.1.1246, has been tested on X86 processors with a specific PS/2 touch device. There is no guarantee this will work for all PS/2 devices.

I2C has been tested on CE6 X86 only. Needs a [manual setting](#) to be defined in the setting file.

Other interfaces could be added if required.

See important [Port Interface issues](#) below.

Processor support

The driver has been tested in house with X86 and ARM CE. We can build drivers for other processors, as supported by the Microsoft CE Platform Builder, on request.

At the time of writing, the processors supported by UPDD in the various versions of CE are as follows:

Win CE version	Processor
5	X86, armv4i, mipsii, mipsii_fp, mipsiv, mipsiv_fp, (for SH4 contact Touch-Base)
6	4.1.0 - X86, armv4i, mipsii, mipsii_fp, mipsiv, mipsiv_fp, SH4 5.1.xx - X86, armv4i – Dec 2013 – others can be made available on a per request basis ARM note. Based on this article which states "The ARMV6 and V7 architectures have enhanced cache designs which can improve the performance of the Windows Embedded CE 6.0 kernel. The ARMV6 processor is architecturally similar to the ARMV4I. The ARMV6 can run an OS image targeted for the ARMV4I processor" there is a possibility that the armv4i driver will run on ARMV6 architecture (ARM11 processors) – see also http://www.arm.com/community/software-enablement/microsoft/windows-embedded-ce.php , Architecture Support tab.
7	X86, armv5, armv6, armv7, mipsii, mipsii_fp
2013	X86, ARM7 (please contact us if other builds are required)

More information on the CE product range is available here:

<http://www.microsoft.com/windowsembedded/en-us/develop/windows-embedded-products-for-developers.aspx>

Any system/processor can be supported as long as a Board Support Package is available for the target processor. Read

<http://www.microsoft.com/windowsembedded/en-us/downloads/board-support-packages-for-windows-embedded.aspx>

for more information on BSP's

Target hardware may have to be supplied for testing if any problems are experienced with the driver.

Important note: Although we have built the CE components for the processors listed above we can not test the driver on all supported processors due to lack of target hardware. In theory the drivers should work on the target processor as long as the component build process utilises the relevant BSP.

Software delivery

In this environment, UPDD is supplied as a number of separate components. Software sent via email will be held in the file ZIP file TBUPDDCE_n.n.n.ZIP where n.n.n is the release number.. Touch-Base utilises virus detection software on all of our systems but recipients of the software should pass the files through their own virus checking software before proceeding with installation.

Normally a software package will be supplied with just one touch controller supported in which case the [settings file](#) can be used as supplied, unless

using a serial controller and the com port needs to be changed via the [autoinstalldevice](#) setting. If the software package contains more than one controller definition this setting is also used to indicate the serial controller definition to use.

Components

The UPDD CE package consists of the following components:

Component	Description
Logo.png	Suppliers logo file – not used in this release but may be in future if a CE version of UPDD Console is generated
Calib*.bmp	Corner arrows calibration bitmaps. Crosshair bitmap embedded in calibration program. (5.1.0 onwards)
tbupdd.bib	UPDD Configuration file entries
tbupdd.dat	UPDD System file entries
tbupdd.reg	UPDD Registry file entries
tbupdd.ini	Driver and touch device settings file.
tbapi.h	Header file (<i>Application Programming Interface – See **</i>)
Processor sub folder	UPDD target processor related files: X86, ARMV4I, MIPS etc
upddce.dll	Native CE touch driver.
tbupddceusb.dll	USB interface. Not required for serial interface.
tbcilib.exe	Calibration program. Can be used to calibrate in systems missing CE stylus calibration.
tbutils.exe	Command line interface.
ace.dll	Inter process communication library for the target processor
tbapi.dll/.lib	API function calls (<i>Application Programming Interface – See **</i>)

** Under CE the UPDD Application Programming Interface is implemented as a Dynamic Link Library TBAPI.DLL/TBAPI.LIB and function declaration file TBAPI.H. These are supplied with the driver but documented [here](#)

Requirements

The basic system requirements for utilising UPDD are as follows:

- Supported CE version: 5, 6, 7 or 2103
- Supported processor version or one where a BSP program can be supplied. Alternatively x86 based images can be run on a standard PC using the LOADCEPC utility.
- Supported touch controller
- The driver's touch interface into CE is via GWES *or* standard mouse port.

To utilize the native CE touch interface (GWES) and calibration utility the target CE system must contain the [touch screen CE components](#). If these components are not part of the image the ['mouse' interface is used](#).

- The driver requires access to [TCP IP port 4141](#) for internal computer processing only. Can be disabled if not using any UPDD API based programs such as tbutils, tbcilib or any user written programs.
- The target system image must have been created with the appropriate platform builder with any relevant system packs. We have had a customer report that he was showing 'crazy' errors in the CE log file and identified the problem as being a CE update applied to his Visual Studio 2005. He rolled back the updates and the error disappeared!

For internal testing we build images with VS2005 with the relevant system packs applied but with NO subsequent CE updates applied.

Specific embedded or post install requirements are specified in the relevant section below.

Using the components

The components can either be installed on an existing CE system or embedded into a CE image as detailed below.

Installing on existing image

Installing into an already created image can be performed for two reasons, either to test / demo the driver prior to embedding or as a permanent installation solution whereby there is not an option to embed the driver into the desired image.

If installing the driver for test or demo purposes then the driver can be installed, tested/demoed and then discarded. However, if the installation is being used to install the driver as a fully working solution this can only be achieved on systems that have persistent storage for the file system and the registry such that the changes to the system are retained over a reboot and available during driver load.

These notes are based on installing on a CE5 image that did not contain the touch stylus components built into the image and therefore the driver was configured to use the basic mouse interface to handle cursor movements and click.

Whether a post installation is possible for a given system depends completely on the architecture of that specific system and in some cases may simply not be possible. However these notes can be used as a starting point to experiment.

As a minimum the system will need:

- 1) Persistent disk storage, such as a flash drive or similar device.
- 2) A mechanism to save updates to the registry again typically on a flash device.
A customer reported using an image whereby the manufacturer of the board had embedded a utility that periodically wrote any registry changes to the flash drive.
- 3) A mechanism to load files onto the target system.

You will also need a tool to edit the registry. One such editor is described here

<http://geekswithblogs.net/BruceEitman/archive/2009/07/27/window-ce-simple-little-registry-editor.aspx>

Without these aspects the software will probably not work in a post installation scenario. There may well be other dependencies which prevent this working so we cannot guarantee that post installation will be successful and this will need to be assessed on a case by case basis.

The steps to follow are:

- 1) Identify the [system path](#) by examining registry entry HKEY_LOCAL_MACHINE\Loader\SystemPath or HKEY_LOCAL_MACHINE\Launch\SystemPath for the system path entry. This lists the folders searched by the system for .dll or .exe files.

Identify if one of these folders is on your persistent storage device which can be used for the driver modules and settings file or create a new folder and add its location to this registry entry. If you need to add additional folder names to the system path you will need a registry editor, such as [ceregeditor](#) or [SLRE](#).

It is our understanding that most CE systems will have a SystemPath. However, if this is not the case and you have to create one ensure the key is created as type REG_MULTI_SZ.

- The driver's touch interface into CE is via GWES **or** standard mouse port. The GWES interface will only be available if the image was built for touch and includes the [Touch Screen \(Stylus\) components](#). If the touch component is not built into the image (*the stylus calibration option in the control panel will be missing*) then [enable the mouse port interface](#).
- Extract the supplied updd files and copy to the target system by whatever means are appropriate, copy to the folder described in Step 1 above. The files *.bib, *.dat, *.h *.reg are not required on the target.

If copying over a previously installed UPDD driver then the system will report certain UPDD files are in use and cannot be overwritten. Renaming the file will allow another copy to be placed on the system – e.g. 'ren upddce.dll deleteme' – which can then be deleted following the next reboot and once the updates have been tested.

When extracting the driver software some files will be placed in a sub folder that represents the processor type, i.e. X86. One customer implied that they had issues when using the sub folder structure and placed all files in the same folder. We did not experience any issues when using the sub folder structure.

- Replicate all the registry setting entries in tbupdd.reg in to the registry on the device, using a suitable registry editor, such as [ceregeditor](#) or [SLRE](#).
- Create a further registry setting to identify the full path to the driver's [settings file](#):

HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd\settings=<path to ini>.
e.g. \Hard Disk\System\tbupdd.ini (please note that the path must contain the name of the file)

Embedding

It is assumed that the developer is using the appropriate Visual Studio, Platform Builder and service packs to create the relevant Win CE image for the target hardware.

The software is supplied in a form to make it easy for users with little experience with Windows CE to get up and running as quickly as possible. CE experts with knowledge of the BIB structure are free to amend the configuration files as required, so long as the embedded files are located in accessible locations on the target and with the correct attributes.

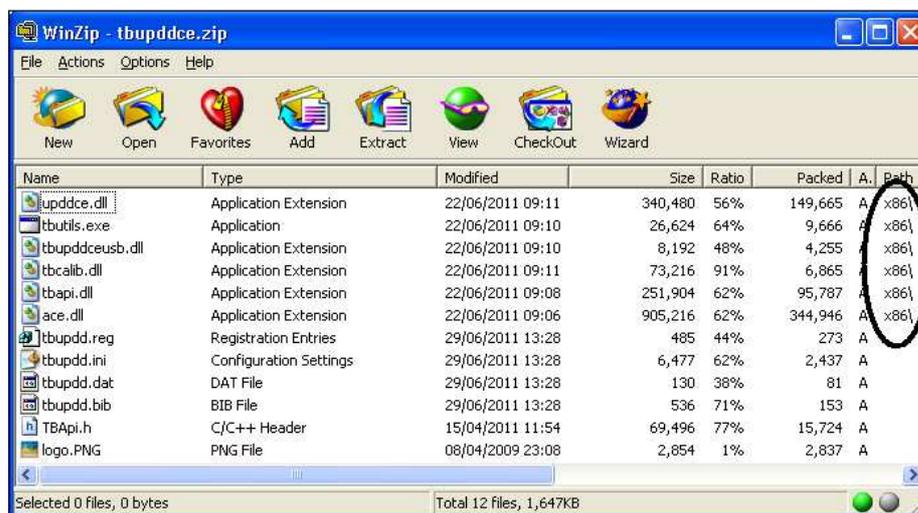
For users unfamiliar with Windows CE we suggest the following guides to creating a Windows CE image.

[http://msdn.microsoft.com/en-US/library/ee483161\(v=WinEmbedded.60\).aspx](http://msdn.microsoft.com/en-US/library/ee483161(v=WinEmbedded.60).aspx) (CE 6 / 7)

<http://msdn.microsoft.com/en-us/library/aa446910.aspx> (CE5)

To incorporate the driver into your image follow these instructions:

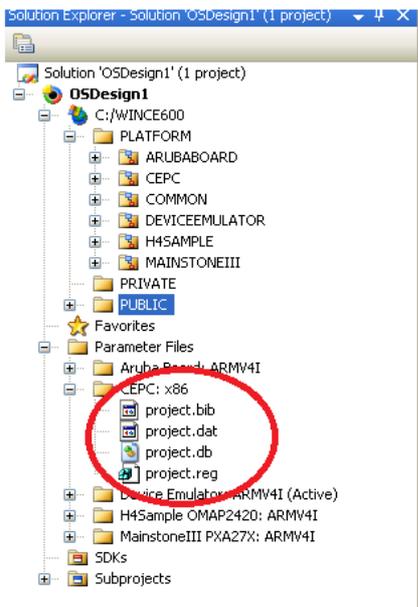
- Expand the tbupddce.zip file. Some of the files are target specific, these target specific files are shown by the black highlight in the example below (in this case for the x86 target):



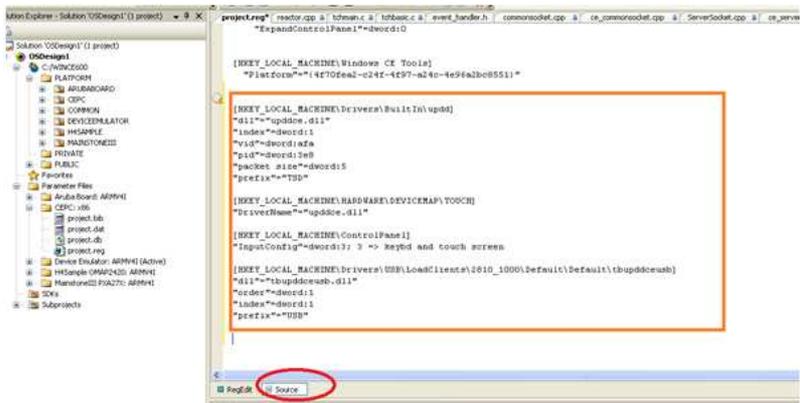
- Copy the files for your chosen target (processor) to the root folder of your build system (typically c:\wince500, c:\wince600 or c:\wince700).

Also copy the file tbupdd.ini to the same location

- Locate the files project.bib, project.reg and project.dat in your platform builder (visual studio in CE 6.0 and later) project tree. Open the files tbupdd.bib, tbupdd.reg and tbupdd.dat and copy / paste the contents at the bottom of the corresponding project files



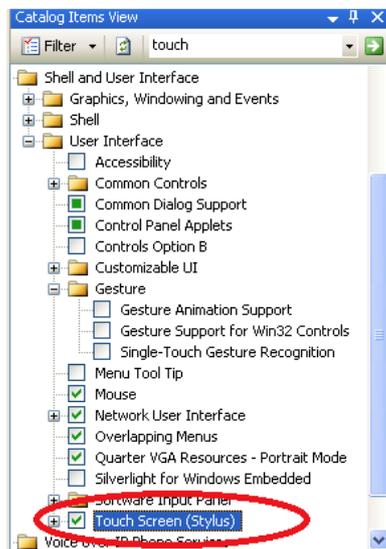
The following example shows the updd settings added to the project.reg file. Note in this case the source tab is selected.



- In order to utilize the native touch interface and calibrate the screen via the stylus calibration option in the control panel the [Touch Screen \(Stylus\) option](#) is selected in the design view / project catalog. If this component cannot be embedded it is important to [enable the mouse interface](#).

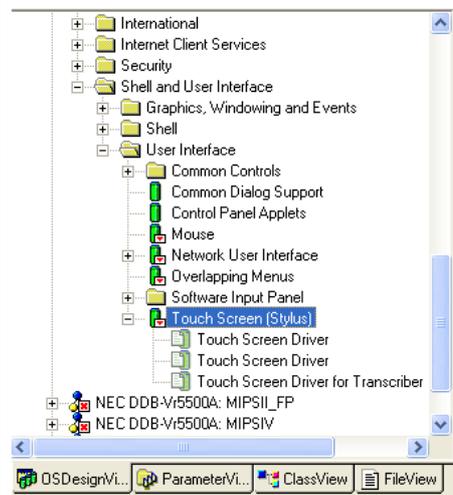
This option enables [stylus functionality](#) within the CE image. A certain amount of input functionality, such as the [Software-based Input Panel](#), Handwriting Recognizer Engine (HWX), and Transcriber Handwriting Recognizer Application Catalog items, require the Touch Screen (Stylus) Catalog item. UPDD utilizes the control panel Stylus option to perform [calibration](#).

CE6 touch stylus enable



CE7 touch stylus enable

CE5 touch stylus enable (*see important note below*)



Important note: In our tests this turned out not to work correctly. We circumvented this issue by making the following change, which might be useful if a similar problem is encountered.



- 1) Open the file C:\WINCE500\PUBLIC\CEBASE\OAK\MISC\wceshellfe.bat
- 2) Locate the line


```
if "%_SYSGEN_TOUCH_CURSOR%"=="1" set
CPLMAIN_COMPONENTS=%CPLMAIN_COMPONENTS%
stylus
```
- 3) Edit this line to read


```
set CPLMAIN_COMPONENTS=%
CPLMAIN_COMPONENTS% stylus
```

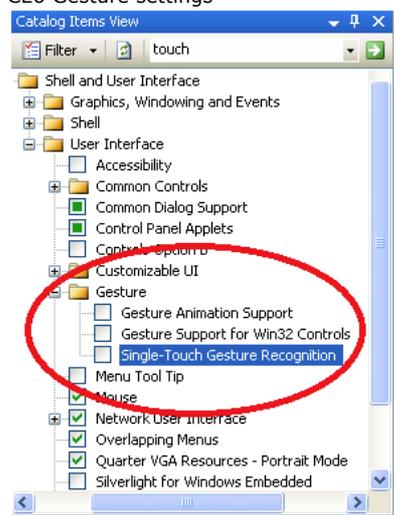
5. Gestures

Starting with CE version 6.0 Windows CE supports gesture functionality allowing gestures from the touch-screen to be passed to applications that support such gestures. This functionality can be enabled by selecting the items shown below in the CE catalog. This functionality is part of GWES and so cannot be used when [Mouse Mode](#) is used. It is only useful when applications are in use that supports this functionality.

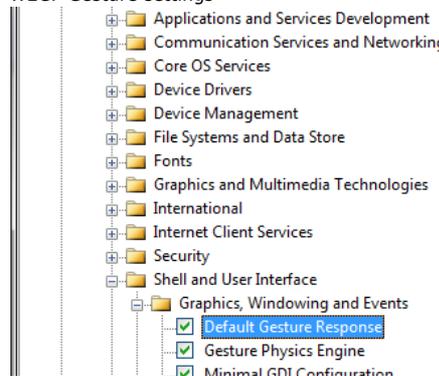
In addition, WEC7 introduced support for dual touch and gestures that can work with gesture aware applications. We added support for dual touch in UPDD version 5.0.2 and further revised it in 5.1.0. This is only available via the GWES interface if the appropriate settings have been enabled in the image. The driver receives single and dual touch data from the touch device and posts this to the GWES interface. As long as the controller output characteristics are adequate (data rate, timely pen clicks, correct stylus streams etc) then gestures should be correctly calculated and performed.

As documented: "Depending on your touch screen driver, Compact 7 supports multi-touch gestures with two contact points, or dual-symmetrical gestures. If your touch screen driver supports dual-symmetrical gestures, the gesture engine will try to determine how the X and Y coordinates should be paired. For both dual-touch symmetrical and multi-touch gestures, the gesture recognizer designates one contact point as the primary contact and keeps track of the distance between the primary contact and the secondary contact.

CE6 Gesture settings



WEC7 Gesture settings



Enable the following settings as required:

- Default Gesture Response
- Gesture Physics Engine
- Touch Gesture GWES component

An interesting article describing this functionality is available at

<http://www.ptgsystems.com/blognet/post/2009/10/20/Touch-Gestures-and-the-Physics-Engine-in-Windows-Embedded-CE-60-R3.aspx>

Another comprehensive gesture article: <http://blogs.msdn.com/b/marcpe/archive/2009/06/29/let-s-talk-about-touch-part1.aspx>

Touch gestures in WEC7 are further described here <http://msdn.microsoft.com/en-us/library/ee499124.aspx> and caters for dual touch gestures.

A video relating to WEC7 multi-touch is available here: <http://www.microsoft.com/en-us/showcase/details.aspx?uid=508dba11-4955-437f-abc0-3fef8ccd0b5b>.

Updated gesture support notes with UPDD 5.1.0 release

UPDD version 5.1.0 for Windows Compact Edition 7 introduces fully tested support for the system dual touch interface. WCE7 only supports dual touches; additional touches can be supported using the UPDD API.

In conjunction with WCE7 dual touch support WCE7 provides a gesture recognition engine, it is important to note that this engine is intended to deliver gesture information to 3rd party applications. As far as we are aware there is no usage of this recogniser in the WCE7 shell or supplied applications, so software has to be written by the system developer to utilise these gestures.

There may be a need to verify a WCE7 configuration that supports gestures without writing addition software, for example to test the hardware implementation. Note that UPDD passes data to the GWES component of WCE7 unchanged, therefore the performance of the gesture solution is dependant for the most part on the performance of the touch hardware and the implementation of the gesture recogniser itself. We outline a procedure here which can be used to verify how well these components perform with UPDD in use.

To test your configuration use the Touch Driver Verification Tool described [below](#).

6. Right Click Processing

A "right click on hold" feature in Windows CE is provided by the WinCE component AYG SHELL, as seen in this WEC7 setting:



Windows CE generates this right click automatically when the left touch is held stationary for a certain period of time. There is nothing that the driver can currently do to influence this. If this component is present in a Win CE image the right click on hold feature is enabled and you will see the progress indicator if you hold a touch steady for a period of time.

When building an image AYGShell may or may not be included depending on your requirements.

If installing the touch driver on an already created image you may or may not have right click processing depending on the inclusion of AYGShell in the image. If you do have right click processing and wish to disable or adjust the right click threshold we are currently unaware of how this is achieved but there are references on the web to a registry entry that can be used to adjust the time "This amount of time can be controlled by the OEM through a registry setting" but we've been unable to find it!

Further, this article <http://msdn.microsoft.com/en-us/library/aa925176.aspx> implies that applications can specify if right click processing is enabled within an application.

Having followed the above instructions you should now be able to build and test your CE image.

Additional embedding notes:

1. Registry entries
 - If using a USB device then one of the entries in the .reg settings refers to the device and will contain the USB Vendor and Product ID values. The VID and PID values MUST match the VID and PID of the controller in use, e.g. Controller has hex VID = **1234** and PID = **11** values. Hex 1234 = decimal **4660** and Hex **11** = decimal **17**. Based on this example the settings would be as follows:

project.reg

```
[HKEY_LOCAL_MACHINE\Drivers\USB\LoadClients\4660_17\Default\Default\tbupddceusb]
```

tbupdd.ini

```
[updd\parameters\1]
Product id=0x00000011
Vendor id=0x00001234
```

Important note: The files supplied should have the correct vendor and product ids as they will have been generated for a touch device as requested. If the values in the registry do not match the values of the usb controller then request a driver that does match. If you manually change these values to match then the driver will connect to the device. However, the touch data generated is unlikely to match that as expected so it is likely the touch will not work as expected.

- The registry entries for a USB controller define a named USB device that is a placement holder for the UPDD device and not a device that is actually used but must exist, e.g.

```
[HKEY_LOCAL_MACHINE\Drivers\USB\LoadClients\4660_17\Default\Default\tbupddceusb]
```

```
"dll"="tbupddceusb.dll"
"order"=dword:1
"index"=dword:1 (this value should be defined such that it creates a unique device name)
"prefix"="USB"
```

These default settings will reference a device USB1. If this is already defined in the system change the index number to provide a unique name.

- Ensure the InputConfig entry is updated to indicate a touch screen is in use. For more information on this setting see <http://msdn.microsoft.com/en-us/library/ee482243.aspx>
2. If, for any reason, the GWES component cannot be utilised in the image then it is important to [enable the 'mouse' interface](#).
 3. Modify any settings in the UPDD [settings file](#) as required. See [Driver Setting section](#) below for more information.
 4. If system does not have persistent registry or file system determine appropriate calibration strategy as described in the calibrate section below.
 5. Make any required software changes to the system components. See "Port interface issues" below.

Testing

One feature of the CE touch interface is that there is no mouse cursor shown if the Touch Stylus has been enabled in the image. This is by design as in a touch environment the visual feedback is at the point of touch. If no cursor is present, the easiest and quickest test is to touch on the CE desktop – when dragging on this screen a "wire frame" marker is seen. This is particularly useful when working with an uncalibrated or unattached touch screen.

There is also a touch verification utility for WEC7 when using the GWES interface called [CETouchView](#), a standalone tool in the Windows Embedded Compact Test Kit (CTK).

You can choose to run the CETouchView.exe on its own for basic feedback or combined with the CETouchFilter.DLL which offers more detailed information.

Using the CETouchFilter.DLL

Important note: In the current CETouchView documentation it states you need to set up a registry entry DriverExName for the CETouchFilter.dll in order to view both raw touch data and gesture messages. In our testing we found this to be incorrect and the registry entry should be named DriverName.

i.e.

```
[HKEY_LOCAL_MACHINE\HARDWARE\DEVICEMAP\TOUCH]
```

```
"DriverExName"="upddce.dll"
"DriverName"="CETouchFilter.dll"
```

In our tests we also discovered that to use the CETouchFilter.dll this you must also make the following setting:

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd]
;"dll"="upddce.dll" (; = line is changed to a comment )
```

Further, although the instructions are comprehensive they do omit the location of cetouchfilter.dll / cetouchview.exe

These are located at : \$(_WINCEROOT) \public\COMMON\oak\target\ \$(_CPUINDPATH)

e.g. C:\WINCE700\public\COMMON\oak\target\x86\debug

The tool is also available in source form at:

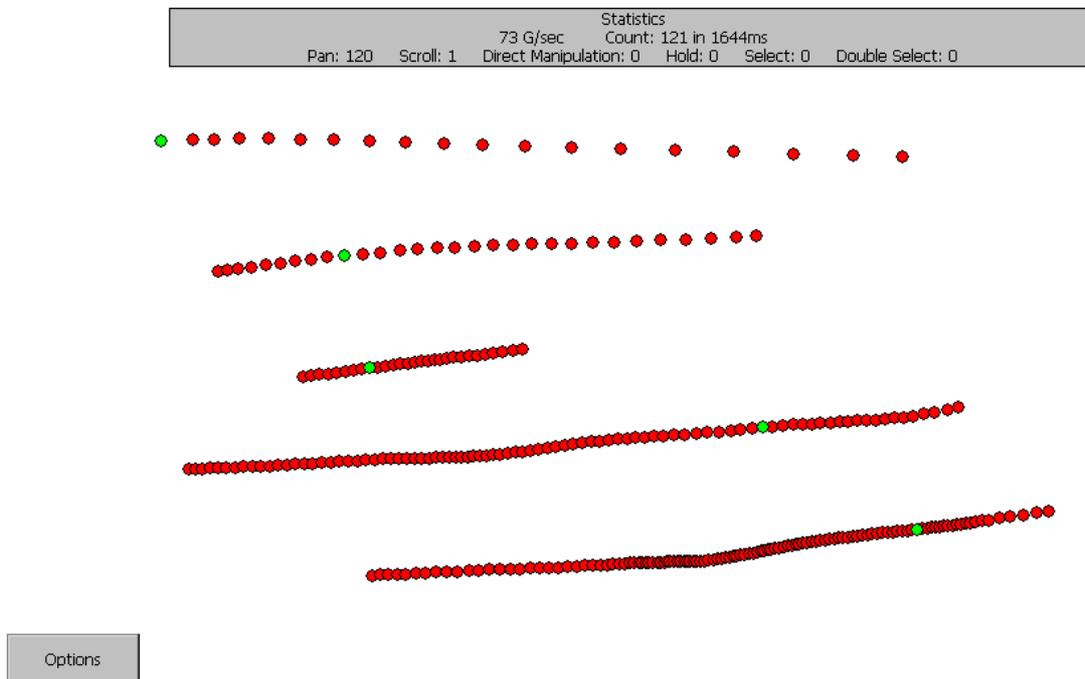
```
$( _WINCEROOT ) \public\COMMON\sdk\samples\CeTouchView\App
```

Which might provide a useful starting point for developing a WCE7 gesture aware application.

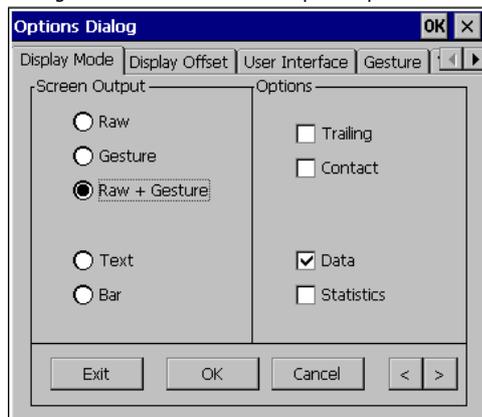
You will also need the following entries in the MODULES section of your BIB

```
MODULES
cetouchfilter.dll  $( _FLATRELEASEDIR )\cetouchfilter.dll  NK SHK
cetouchview.exe   $( _FLATRELEASEDIR )\cetouchview.exe   NK
```

You can use CETouchView to verify the raw touch data and gesture messages generated by your device as seen in this screen shot:



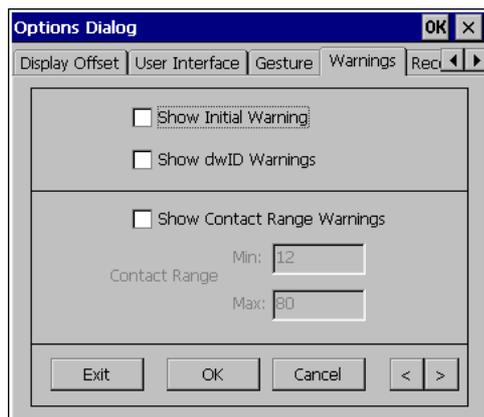
During our tests we found a few options quite useful:



Setting the "Raw" option causes the program to draw a single black line for each touch.

Setting "Gesture" causes the program to draw red lines denoting gesture event positions when using a single touch and additional detail when multiple touches are used.

"Trailing" causes the drawing and other information to remain on the screen when no longer touching. Opening and closing the options dialog is a useful way to clear the screen when this option is selected.



If running a debug build and you wish to avoid the debug assertions issued by the gesture recogniser it is helpful to turn off all the warnings on this screen.

We found [this video](#) on the net that shows CETouchView in use on a multi-touch system.

Calibration

The touch screen needs to be calibrated with the desktop such that the point of touch generates a touch at the correct position on the desktop. The calibration procedure generates touch co-ordinate data that is associated with known positions on the desktop. Using this data the driver can calculate the correct desktop position from incoming touch co-ordinate data. This calibration data can be both generated and utilised in a number of ways as discussed below. The method you select will be dependent on your system's configuration.

Irrespective of the calibration method used, in all cases calibration data in tbupdd.ini is what the driver actually uses. Data external to this file is loaded to tbupdd.ini to make the calibration effective.

During calibration, whether it be via the built in CE stylus option or using UPDD's calibration routine calibration data is written

- 1) To tbupdd.ini – always
- 2) To the registry – if the device setting ceregcalibration is on (1) in tbupdd.ini
- 3) To eeprom - if the touch controller supports eeprom storage and the device setting "eeprom calibration" is on (1) in tbupdd.ini

When the driver loads calibration data is read

- 1) From eeprom - if the device setting eepromreadatstart = 1 in tbupdd.ini (which invokes command 'tbcilib eeprom' to read the eeprom).
- 2) From the registry - if the device setting ceregcalibration = 1 in tbupdd.ini

Really important note: Prior to the initial calibration of the device, the calibration is based on a 2 point, corner calibration scaled to the co-ordinate touch range defined for the controller. Only when a calibration is initiated is the calibration configuration defined for the device copied to the active controller area in the .ini file (e.g. updd\parameters\1\calibration styles\0) and utilised. In cases where the tbupdd.ini file is not in persistent storage it is important that after the initial calibration the tbutil.ini file is taken from the working system and re-embedded back in the image. This is particularly important when using manual calibration or registry calibration.

Calibration Options

Based on your requirements you may choose any combination of the following calibration options to cater for calibration within your system.

Option	Description
Manual	A calibration procedure is invoked to show on-screen calibration points that are touched to collect calibration data
CE Stylus	Using the build in stylus calibration function. A user invokes this function from the control panel, stylus, calibration option. This method offers tight integration with Windows CE. This is only available on systems built with touch support enabled so is not suitable for "post installation" unless the image already has touch support enabled. It is currently also restricted to a 4 point calibration with a 10% margin.
UPDD Calibration	Using the UPDD calibration program. Tbcilib.exe provides most calibration features available to the desktop based calibration software (apart from some custom graphic features and eeprom support for some controllers. This module is not integrated with CE (e.g. in the control panel) by default although of course an integrator is free to adopt an appropriate integration strategy to suit the target device.
Pre-defined	The supplied UPDD settings file does not contain any calibration data so devices are uncalibrated when first used. However, it is possible to place good calibration data in the settings file such that the device is calibrated following image creation or install.
EEPROM storage	UPDD data
	Where supported, caters for UPDD calibration data to be stored in the controller's eeprom and not dependant on any calibration data being available on the CE system.
	Hardware based
	Invokes controller based calibration procedure – not supported in new driver but will be available in a future release.
Registry Storage	Starting with updd version 5.1.796 updd for Windows CE supports registry based calibration. This allows integrators of systems with a persistent registry to utilise this for storage of calibration data.

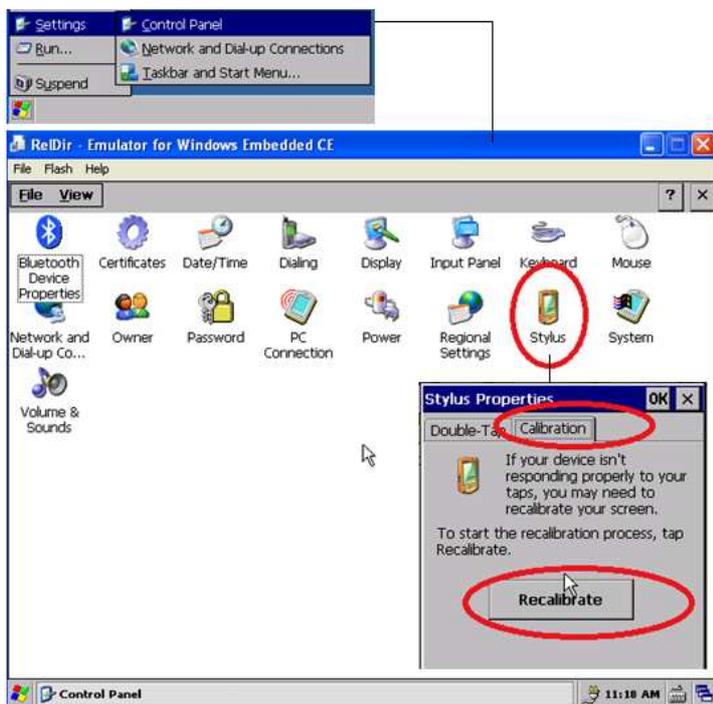
Manual Calibration

The native stylus or UPDD calibration functions are invoked to perform manual calibration. An implementation using manual calibration needs to decide on a strategy for initiating the calibration procedure. E.g. [executing the calibration program at start-up](#) or placing an icon on the desktop. These and other options are implemented via the platform configuration.

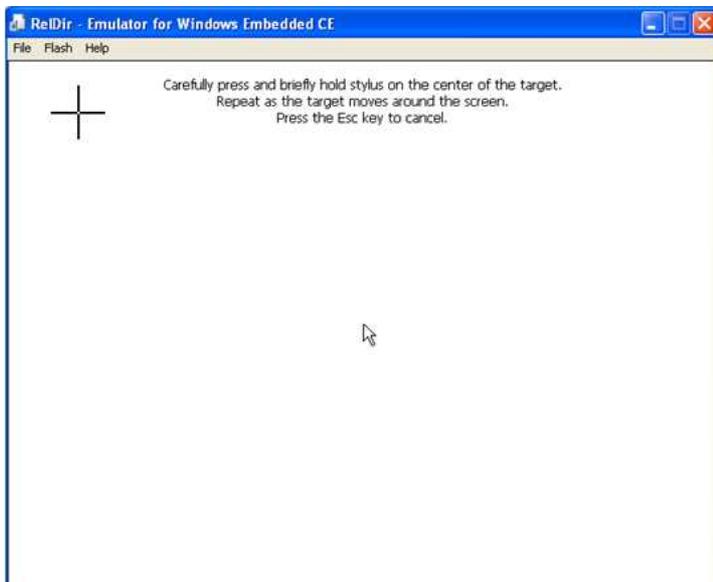
One option we are considering is that the driver will automatically invoke the calibration procedure at startup based on a system setting. This would be used in environments where calibration was performed every time the system started. Please contact us if this is required.

Native CE stylus

Once the image is running you can calibrate the touch screen by using the Stylus option in the control panel. This is illustrated below. Note that the exact screens vary according to the system configuration.



This will invoke the calibration procedure:



We understand that registry setting HKLM\HARDWARE\DEVICEMAP\TOUCH\MaxCalError deals with how picky the touch calibration application will be when you touch the calibration crosses.

Given that the UPDD driver is a GWES conformant driver the native calibration calls the SetCalibrationPoints function within our driver. The calibration data is converted to the format used by UPDD and stored in the UPDD settings file.

If eeprom storage is enabled and configured for UPDD data storage then the calibration data is also written to eeprom.

If registry storage is enabled then the data is also written to the registry.

UPDD Calibration function

Once the image is running you can calibrate the touch screen by using the TBcalib program. The number of calibration points used and their position is dictated by the values in the tbupdd.ini file, branch [updd\parameters\1\calibration styles\0].

In this example the number of calibration points has been set to 5 points, no margin (0% - corner). Note any changes to the number of calibration points must be reflected in the number of cal and ref entries defined.

```
[updd\parameters\1\calibration styles\0]
calibration background=0x00000001
calibration points=0x00000005
calibration rotation=0x00000000
calibration start pct=0x00000000
calibration style=Normal
calibration timeout=0x0000000A
calx0=0x0000000F
calx1=0x00000010
calx2=0x000003BD
calx3=0x00000772
calx4=0x00000770
caly0=0x0000000D
caly1=0x00000425
caly2=0x0000021C
caly3=0x00000012
caly4=0x00000429
refx0=0x00000000
refx1=0x00000000
refx2=0x00007FFF
refx3=0x0000FFFF
refx4=0x0000FFFF
refy0=0x00000000
refy1=0x0000FFFF
refy2=0x00007FFF
refy3=0x00000000
refy4=0x0000FFFF
```

Following calibration, the new active calibration data is always stored in the UPDD settings file at branch [updd\parameters\1].

If eeprom storage is enabled and configured for UPDD data storage then the calibration data is also written to eeprom.

If eeprom storage is enabled and configured for hardware eeprom the associated hardware calibration procedure is performed such that the controller scales the co-ordinate output accordingly.

If registry storage is enabled then the data is also written to the registry

Note: Early versions of tbcilib had a dependency on a graphic shell being part of the CE image. Since Nov 2013, build 5.1.???, this dependency has been removed. With Win CE 2013 there is less emphasis on the use of a graphical shell as discussed here: <http://blogs.msdn.com/b/windows-embedded/archive/2013/08/06/creating-a-custom-shell-in-compact-2013.aspx>

Pre-define calibration data

In cases where neither persistent storage (registry or file) nor EEPROM based calibration are available the calibrated data can be embedded in the target image to pre-calibrate the system. This approach is only suitable for systems where the calibration data does not change significantly over time or with use.

To pre-calibrate the system:

TBUPDD.INI file

- 1) Calibrate normally
- 2) From a command prompt (cmd.exe) type "tbutils dump4tba". – for more information see [Command Line Interface document](#)
- 3) Open the file tbcilib.tba created by this process and copy the string contained in it (if no file is created ensure you are running the program in a writable folder and try again, e.g. /application/data/updd).
- 4) Paste the string into the calibration styles section for the controller replacing the default info shown in red below. This is in the copy of tbupdd.ini in your build environment:

```
[updd\parameters\controller\ts001]
....
calibration styles=Normal,n,n,n,n,n,n,n,n
```

- 5) Adjust the following settings to cater for any calibration inversion required:

```
[updd\parameters\controller\ts001]
invertx=0x00000000
inverty=0x00000000
swapxy=0x00000000
```

- 6) Rebuild the target image.

Registry Storage

Starting with updd version 5.1.796 updd for Windows CE supports registry based calibration.

This allows integrators of systems with a persistent registry to utilise this for storage of calibration data.

It also provides an alternate means by which default calibration data can be proved on a system that does not have a persistent registry.

To utilise registry run the command 'tbutils setting dw ceregcalibration 1' after the system is loaded with the touch plugged in but before calibration.

With the above setting defined then after a calibration has been performed the Registry calibration data is held at:

```
HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd\calibration\N
```

Where N is the device handle for a specific device (usually 1 on CE systems) naming a REG_SZ value with the following format

```
<npoints>,<style>,<rotation when calibrated>,<swapxy>,<margin>,<calx0>,<caly0>, .... <calxn>,<calyn>
```

To embed this data in a target system the easiest approach is to calibrate a working system and simply copy the value of this key to your .reg file and re-embed the tbupdd.ini file taken from the same system.

It is important to take both the registry setting and the tbupdd.ini file back to the image because the calibration data held in the registry is associated with the updd device entry and its defined calibration criteria (percentage margin, no of calibration points etc) in the UPDD settings file. The UPDD device entry is created at the time the touch device is first discovered. Assuming you are implementing registry storage because the setting file is not held in persistent storage then it is important to take a copy of the setting file after the initial calibration so that the captured registry calibration data matches the calibration criteria held in the settings file.

Therefore the procedure for setting up register calibration is as follows:

1. On the embedded image Open a command windows with start -> run -> cmd.
2. Locate and run the command `TButils setting dw ceregcalibration 1`
3. Perform the calibration.
4. Take the registry setting calibration data and place in your .reg file.
5. Take a copy of /application/updd/tbupdd.ini from the target system and re-embed this in your image replacing the supplied tbupdd.ini file.

This way the captured registry data matches the calibration configuration for the device held in the settings file.

Note: The native calibration procedure will also store calibration co-ordinates in the registry at

*HKEY_LOCAL_MACHINE\Hardware\DeviceMap\Touch\CalibrationData. E.g.
[HKEY_LOCAL_MACHINE\HARDWARE\DEVICEMAP\TOUCH] "CalibrationData"="585,628 541,3562 3527,599 3524,3550 "*

This is not held in a format that can be utilised by the driver hence the registry implementation is as documented above.

EEPROM Storage

Some controllers support the saving of calibration data in persistent memory (eeprom) on the controller itself. Subject to the controller supporting this feature and UPDD [implementing EEPROM support for the specific device](#) then calibration data can be saved on the device.

If the UPDD setting file has an entry 'eeprom protocol = 'protocol id' then this indicates that updd supports eeprom storage for the touch controller but it does not necessarily indicate if this is supported in CE due to differences in the CE platform. See [EEPROM documentation](#) for more information about supported controllers under CE.

For supported controllers simply set the eeprom calibration option in tbupdd.ini to 1

```
[updd\parameters\controller\ts001]
eeprom calibration=0x1
eeprom protocol='protocol id' – This is the protocol id used by the driver to support eeprom in the controller.
```

For the eeprom data to be read from the device automatically at startup the following registry setting must also be set; eepromreadatstart=1; e.g.:-

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd]
" eepromreadatstart "= dword:1
```

Important Note, reading the eeprom data at startup loads an additional module (tbcilib.exe) into kernel memory so in some cases the memory mapping layout of the image may need to change. We most often see this in debug images. If enabling this option leads to a crash in tbcilib at startup this is very likely the cause.

For hardware based eeprom calibration (where supported) the controller's coordinate touch data will be scaled accordingly.

Calibration persistence

A common issue with CE devices is saving calibration data when the device is reset or restarted. There are three possibly choices available depending on the touch controller hardware and the setup of the CE device.

The driver will utilize, in preference of order, EEPROM (if enabled), registry (if calibration data exists) and TBUPDD.INI file calibration data. In the case of eeprom or registry storage the calibration data is accessed and then stored in the tbupdd.ini file such that this file will always contain the current calibration data. It is up to the system integrator to ensure that which every method is used there is valid calibration data available.

- 1) Registry storage. If utilising UPDD registry storage the data is read from the registry and stored in the UPDD settings file.
- 2) EEPROM storage. Subject to the controller supporting this feature and UPDD implementing support for the specific device calibration data can be saved on the device. The calibration data is read from eeprom and stored in the UPDD settings file
- 3) File system storage. Irrespective of calibration utility used (Stylus or tbcilib based calibration) the calibration data is stored in the driver's setting file tbupdd.ini. If the file is in persistent storage then the calibration data held there will be saved across a system restart. If the file is placed in a different location to that expected by the driver [this setting can be used](#) to specify the alternate location. Note, if both registry and file based calibration data is available the driver will utilise the registry based data although the data will be written to both locations.

Unless the target system has persistent storage for the registry, or the file system holding tbupdd.ini, or eeprom storage is used then calibration data will not be saved across a reboot.

If persistent storage is available for the tbupdd.ini or registry file then no further action is required. In the case that a persistent registry is available the software saves the calibration data to the registry and this data is written to tbupdd.ini at startup.

However, if calibration data is not held in permanent or non-volatile memory then additional calibration options, such as [pre-calibration](#), should be considered.

Calibration beeps

Calibration beep option to be investigated and not currently available. Please contact Touch-Base should this be required.

Calling calibration from an application

This section to be confirmed as is untested and speculation only. It has been copied from an article on the internet...

Sometimes it may be necessary to cause a touch calibration to occur from an application, perhaps because of drift or because the initial values as set during the production process weren't quite right.

This is fairly straightforward to achieve as the relevant method is exposed by coredll.dll

All that is needed is to declare a platform invoke (P/Invoke) to the coredll.dll method, which can then be called from within application code:

A C# compact framework example would be:

```
using System;
using System.Runtime.InteropServices;

namespace DynamicDevices.Utilities
{
    ///
    /// Expose 'coredll' native methods
    ///
}
```

```

public class NativeMethods
{
    [DllImport("coredll.dll")]
    public static extern void TouchCalibrate();
}
}

```

Rotate

The current version of the driver supports operation in a fixed rotated mode. All that is required is to calibrate in the desired rotation (as long as your system's display driver supports rotation).

The following articles discuss Win CE rotation

Win CE 5 - <http://msdn.microsoft.com/en-us/library/ms914404.aspx> describes how to set Portrait mode as default if required

Win CE 6 - <http://msdn.microsoft.com/en-us/library/ee499095%28v=winembedded.60%29.aspx>

<http://msdn.microsoft.com/en-us/library/ee485865%28v=winembedded.60%29.aspx>

Win CE 7 - <http://msdn.microsoft.com/en-us/library/ee505713.aspx>

Dynamic rotation is not yet supported. Given that GWES is used and is responsible for rotation it is possible that this will also just work, but this is subject to confirmation.

Typically, the rotate will be set in the registry, such as this example for portrait mode:

```
HKEY_LOCAL_MACHINE\System\GDI\Rotation\Angle=dword:10e.
```

After the system has rotated we suggest that you calibrate the touchscreen and then take the driver's settings file tbupdd.ini (e.g. /application support/updd/tbupdd.ini) from the target and embed this file in your image and reboot.

TBcalib size optimisation

Starting with UPDD version 5.1.0 the Windows CE version of the calibration utility tbcablib.exe has been optimised for size.

In order to reduce the image to the smallest possible size the calibration target images are held externally.

These notes refer to build 5.1.792 and above and supports calibration with additional visual feedback as described [here](#).

The system integrator should choose which files to embed and include these in the target at /application data/updd

The exact method for doing this up to the choice of the integrator. The default UPDD configuration files shipped with UPDD implement an example method using upddce.bib and upddce.dat.

In this default configuration only the files required for a calibration margin $\geq 5\%$ are included. The others are present as comments.

The comments in these files describe the usage and are repeated here

upddce.dat

```

;; image files for calibration margin  $\geq 5\%$  with visual feedback
;; note _cr_ means cross
Directory("application data\updd"):-File("calib_cr_32_1.bmp", "\Windows\calib_cr_32_1.bmp")
Directory("application data\updd"):-File("calib_cr_32_2.bmp", "\Windows\calib_cr_32_2.bmp")
Directory("application data\updd"):-File("calib_cr_32_3.bmp", "\Windows\calib_cr_32_3.bmp")

;; image files for calibration margin  $< 5\%$ 
;; note not all files are used for all styles so is for example a 4 point calibration is required
;; only bl/tr/tl/br (bottom left, top right etc) images are required
;Directory("application data\updd"):-File("calibbl_32_n_p.bmp", "\Windows\calibbl_32_n_p.bmp")
;Directory("application data\updd"):-File("calibbr_32_n_p.bmp", "\Windows\calibbr_32_n_p.bmp")
;Directory("application data\updd"):-File("calibb_32_n_p.bmp", "\Windows\calibb_32_n_p.bmp")
;Directory("application data\updd"):-File("calibl_32_n_p.bmp", "\Windows\calibl_32_n_p.bmp")
;Directory("application data\updd"):-File("calibr_32_n_p.bmp", "\Windows\calibr_32_n_p.bmp")
;Directory("application data\updd"):-File("calibtl_32_n_p.bmp", "\Windows\calibtl_32_n_p.bmp")
;Directory("application data\updd"):-File("calibtr_32_n_p.bmp", "\Windows\calibtr_32_n_p.bmp")
;Directory("application data\updd"):-File("calibt_32_n_p.bmp", "\Windows\calibt_32_n_p.bmp")
;Directory("application data\updd"):-File("calib_cr_32_n_p.bmp", "\Windows\calib_cr_32_n_p.bmp")

```

tbupdd.bib

```

;; see upddce.dat for a description of these files
calib_cr_32_1.bmp $( _WINCEROOT)\calib_cr_32_1.bmp
calib_cr_32_2.bmp $( _WINCEROOT)\calib_cr_32_2.bmp
calib_cr_32_3.bmp $( _WINCEROOT)\calib_cr_32_3.bmp

;calibbl_32_n_p.bmp $( _WINCEROOT)\calibbl_32_n_p.bmp
;calibbr_32_n_p.bmp $( _WINCEROOT)\calibbr_32_n_p.bmp
;calibb_32_n_p.bmp $( _WINCEROOT)\calibb_32_n_p.bmp
;calibl_32_n_p.bmp $( _WINCEROOT)\calibl_32_n_p.bmp
;calibr_32_n_p.bmp $( _WINCEROOT)\calibr_32_n_p.bmp
;calibtl_32_n_p.bmp $( _WINCEROOT)\calibtl_32_n_p.bmp
;calibtr_32_n_p.bmp $( _WINCEROOT)\calibtr_32_n_p.bmp
;calibt_32_n_p.bmp $( _WINCEROOT)\calibt_32_n_p.bmp
;calib_cr_32_n_p.bmp $( _WINCEROOT)\calib_cr_32_n_p.bmp

```

You can of course implement your own icons as long as you follow these guidelines:

- 1) Use the Windows BMP format.
- 2) Use a fixed size of 32 x 32 pixels.
- 3) Ensure the "hotspot" (the point of intended contact, a red dot in the default icons) is in the same pixel location.

At the time of writing tbcablib on Windows CE does not support other bitmap based operation on Windows CE, such as custom dialogs for toolbars.

Invoking calibration at system startup

Should this be required then this [link](#) appears to describe how this can be achieved.

Driver settings and general notes

The driver's settings are located in the UPDD [settings file](#) and will usually be set to the default settings for the controller in use. These settings are defined as part of generating the CE driver for a given touch screen device.

For CE **it is really important** to understand that there are default settings held in the setting file that are used to create a group of setting for an active controller discovered on the system. This means that there are two areas, default and active, in the settings file that hold settings for a device. The setting file as delivered has a number of sections but the default settings for a device are held at [updd\parameters\controller\ts001] (assuming one device supported in the package). When a device is discovered in the system a copy of the settings at this location are copied to [updd\parameters\1] or [updd\parameters\2] for a 2nd device and so on.

To change a controller setting **prior** to embedding the setting should be changed in the [updd\parameters\controller\ts001] default setting branch. To change a setting **after** embedding for the active device it should be changed in the [updd\parameters\N] active setting branch using the [tbutils](#) command line interface.

Given that all settings for an embedded system are defined in the CE Platform Builder and the image then embedded on the target image it has been decided that there is no need for a UPDD CE GUI as settings in these environments are locked down and in most cases the supplied configuration file will contain the required device and driver settings. If this is not the case then settings can be manually edited in the settings file as required. We also offer a [command line interface](#) utility that can be used to change settings on the fly.

When embedding there will be two copies of tbupdd.ini on the CE target system, the location of which is dictated by the contents of the tbupdd.dat file.

```
\windows\tbupdd.ini or \Windows\tbupdd.ini.orig (Oct 11 onwards)
\application data\updd\tbupdd.ini
```

This is because the BIB script creates the first entry and the DAT script then creates the second real working entry.

By default the software use the settings file in \application data\updd\tbupdd.ini

The example tbupdd.dat places a copy of the read only file from the image (\windows\tbupdd.ini) in this location.

If you need to place the file in a different location, typically to utilise persistent storage then define the following registry entry:

```
HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd\settings=<path to ini> ; full path to tbupdd.ini
e.g. \Hard Disk\System\tbupdd.ini (please note that the path must contain the name of the file)
```

If implementing persistent storage remove the tbupdd.dat file entries and use a means appropriate to your target to place a copy of tbupdd.ini in the desired location upon first usage. As persistent storage requires custom changes to your image generic guidance cannot be given for this step. The file \windows\tbupdd.ini is only used in the example to be copied to the writeable ram disk location in default configurations and can be omitted in a production system that implements an alternate means to install this file.

Pre Oct 11 - We did not find a method to eliminate the \windows copy. The redundant copy can be ignored and in any case is very small.

Post Oct 11 - We determined it is not possible to delete the \windows copy so we now copy the file to \Windows\tbupdd.ini.orig and this is in turn copied to the active area. This is handled by the .dat file so no user action is required.

Disable access to TCP/IP port

UPDD API based programs communicate to the driver via local port 4141. If you are not using any API based programs, such as tbalib, tbutils or any user written API program then access to the port can be disabled as follows:

```
[updd\parameters] <- after this line
port=0x00000000
```

Incorrect screen dimension issues

The driver utilises GetSystemMetrics() to determine the logical (pixel) size of the screen. In some cases we see that this API gives unexpected information (For example with a custom BSP in conjunction with screen rotation). In this case the following entries in tbupdd.ini can be used to override the system supplied settings. These values if set these are always used in preference to the system supplied settings.

```
[updd\parameters] <- after this line
"ScreenWidth"=dword:00000320
"ScreenHeight"=dword:00000258
```

Change the hexadecimal value of these keys to reflect the resolution of the screen. In the above example it is for an 800x600 screen (320 x 258 hexadecimal).

Touch interface via mouse port

The driver's touch interface into CE is via GWES **or** standard mouse port. The GWES interface will only be available if the image was built for touch and includes the [Touch Screen \(Stylus\) components](#). If the touch component is not built into the image (*the stylus calibration option in the control panel will be missing*) then enable the mouse port interface as follows:

```
Edit the supplied settings file tbupdd.ini to add these entries:
(With UPDD 4.1.0 update both locations, in 5.1.0 only one need be defined)
[updd] <- after this line
cesendinput=0x00000001 <- add this entry or amend if it is already defined
[updd\parameters] <- after this line
cesendinput=0x00000001 <- add this entry or amend if it is already defined
```

This setting instructs the driver to use the standard mouse interface and might not be necessary if the system supports a GWES touch interface. If unsure try with and without this setting.

Serial port device and com port issues

Device and port definition

The setting `autoinstalldevice` is used to direct the installation of the device through the UPDD PNP manager. For USB devices this is handled automatically but for serial devices this setting is used to select the required serial device and specify the com port, even when only one is configured in the software package.

This setting is described below.

Example

```
[updd\parameters]
autoinstalldevice=1-Microchip, AR1100, Serial--COM1
```

Description

`autoinstalldevice` is comprised of several fields separated by the "-" symbol as described below:

- 1) The controller id. Usually 1. This tells the PnP manager which TSNNN (default controller settings – one per supported controller in the settings file) entry to select during installation of the device. This value should not be changed unless you have a software package with multiple controllers and you wish to select a controller other than the first defined for installation. E.g. to select TS003 set this to 3.
- 2) The name with which the device will be installed. This can be freely edited.
- 3) Unused (needed for compatibility with the standard updd installer).
- 4) The COM port. This can be edited as required. This is the com port that will be selected when the device is installed. See important [Port Interface issues](#) below when defining serial ports.

Stop bit definition

As of the driver issued Aug 2012 the stop bit definition in the UPDD setting file has changed such that the entry `StopBits=0x0000000N` defines the stop bit usage as follows, where N =:

- 1 = ONESTOPBIT
- 2 = TWOSTOPBITS
- 3 = ONE5STOPBITS (1.5)

Prior to this date the driver interpreted these settings differently, 0 = 1, 1 = 1.5 and 2 = 2.

Important note:

For single device definitions, when defining a serial device it is important that you do not define the USB settings in the registry as this will prevent touch working in serial mode. USB is considered configured if the vid is defined in the registry

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd]
;"vid"=dword:nnnn
```

It should not be defined or commented out as in the example above.

Multi-device definitions that include both serial and USB devices are covered separately [here](#).

Serial port close delay setting

The driver will re-establish all interfaces when the `TBAPISApply` or `TBAPIReloadNoApply` API is called. This is called at various times, such a when a setting is changed using `TButils`, or when running other UPDD utility programs, such as calibration. When using serial devices this will result in the closing and immediate opening of a serial port connection. However, on a particular CE5 system it was discovered that the close could take a period of time to complete so the subsequent open request was failing; indicating port was not closed resulting in all sorts of strange effects when dealing with serially connected devices.

In UPDD 5.1.780 we introduced a device setting, `cepauseafterclose` that can be used to specify a wait time after closing a serial port to allow time for the close to complete. On this particular system a 200ms delay overcame the issues i.e. `cepauseafterclose=0xc8`.

PS/2 port device

Device and port definition

The setting `autoinstalldevice` is used to direct the installation of the device through the UPDD PNP manager. For USB devices this is handled automatically but for PS/2 devices this setting is used to select the required PS/2 device, even when only one is configured in the software package.

This setting is described below.

Example

```
[updd\parameters]
autoinstalldevice=1-Microchip PS/2--PS2
```

Description

`autoinstalldevice` is comprised of several fields separated by the "-" symbol as described below:

1. The controller id. Usually 1. This tells the PnP manager which TSNNN (default controller settings – one per supported controller in the settings file) entry to select during installation of the device. This value should not be changed unless you have a software package with multiple controllers and you wish to select a controller other than the first defined for installation. E.g. to select TS003 set this to 3.
2. The name with which the device will be installed. This can be freely edited.
3. Unused (needed for compatibility with the standard updd installer).
4. Indicates it's a PS/2 port interface.

I2C interface

To configure this interface you need to manually update the port type in the settings file thus:

```
[updd\parameters\1]
PortType=0x00000004
```

The current implementation uses a I2C proxy driver, which must be loaded, and you need to define the Port value to a valid value for the proxy driver. In the system we used to develop the I2C interface the port value was set to "I2C1". We believe that an I2C interface will be very implementation specific and the driver may need tailoring to the specific utilisation of the I2C interface. Please contact us to discuss further.

Sound

Not currently supported in the new driver. Please contact us should this be required.

Mouse Mode

As standard the GWES touch interface does not utilize the mouse cursor therefore there is no mouse cursor movement when touching the screen. In fact, when using the touch interface the mouse cursor becomes invisible. For test purposes, during the development of the new native touch interface we retained the previous mouse interface (which utilises the SendInputAPI) and this can be enabled if mouse emulation (and therefore mouse cursor movement) is required. It should be noted that operating systems are moving away from the system cursor when utilising touch and we believe more end users should be encouraged to use touch without the traditional mouse cursor utilized for visual placement feedback. Mouse cursor is Mouse interface, other or no visual feedback is Touch.

However, should you wish to see mouse cursor movement then the following UPDD setting will enable the old mouse interface:

```
[updd\parameters]
cesendinput=0x00000001
```

It should be noted that any touch functionality built into the OS which is enabled when touch input is processed via the GWES touch interface will be lost if the touch data is passed via the mouse interface. This is likely to be more relevant to Windows Compact (CE 7) than pre CE 7 versions.

We believe that for mouse mode to work you will need to configure the [Mouse Catalog](#) in your CE image.

Multi-processor considerations

Windows Compact Edition 7 supports SMP (Symmetric multi-processor) systems. Until recently all CE systems have utilised a single processor core and updd has been tested on such systems.

The core UPDD driver software runs on a number of systems and is known to be stable on multi processor systems.

However we have been advised by a customer that on SMP systems problems can occur.

Until such time as we can reproduce this issue we have implemented a solution to run all UPDD threads on a single core.

To utilise this new feature set a registry DWORD value at

```
HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd\affinity
```

The value specified is the processor number to be used, we understand that this is a number from 0 – n-1 where n is the number of processors available.

Priority levels

In order to provide adequate performance it is necessary for the driver to execute at a higher priority than other active processes. In particular the explorer component consumes a lot of CPU in some cases, so dragging items on the desktop can be slowed. By default all critical threads in the driver execute at priority level 249 (Hex FA) which gives good results in most cases (which was the same as the HID mouse).

Should you wish to alter this priority for any reason you can change the following settings.

For the main driver (upddce.dll) add the Priority setting in tbupdd.ini setting in the [updd] section.

```
[updd]
....
priority=0x000000FA <change as required
```

For the USB interface component (tbupddceusb.dll) add the registry setting

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd]
"priority"=dword:fa <change as required
```

Module size and ram usage

The tbupdd.bib specifies that all modules/files are loaded:

MODULES		Approx size KB	
upddce.dll	\$(_WINCEROOT)\upddce.dll	NK SHK	324K
tbapi.dll	\$(_WINCEROOT)\tbapi.dll	NK	72K
k.tbapi.dll	\$(_WINCEROOT)\tbapi.dll	NK SK	
tbupddceusb.dll	\$(_WINCEROOT)\tbupddceusb.dll	NK SHK	10K
tbcalib.exe	\$(_WINCEROOT)\tbcalib.exe	NK	132K
tbutils.exe	\$(_WINCEROOT)\tbutils.exe	NK	30K
ace.dll	\$(_WINCEROOT)\ace.dll	NK	905K
k.ace.dll	\$(_WINCEROOT)\ace.dll	NK SK	

FILES

```
tbupdd.ini.orig $( _WINCEROOT )\tbupdd.ini NK
```

The ACE and TBAPI files are loaded in both user and kernel space and the user space version may not be required if the utilities, such as tbutils and tbcalib, are not being utilised in which case they can be excluded from the tbupdd.bib file. When using serial devices the tbupddceusb.dll can also be excluded.

Excluding these modules is subject to verification within your own image.

Touch packet data rate

In years gone by it had been observed on some lower end systems that if all the incoming data packets from fast touch controllers are processed it can have a detrimental effect on the performance of the system. By default the driver processes 100% of the packets. This percentage can be adjusted by the UPDD setting [updd\Parameters\1\]:SampleRate.

Changing the setting from 64hex (100 dec) to 32hex (50 dec) indicates to process 50% of incoming packets.

Multi-monitor / controller support

Windows CE does not support multiple monitors but video splitters can be used to run multiple monitors in mirrored mode or extended mode.

We have implemented support for multi monitor configurations in a number of ways:

UPDD 4.1.10

UPDD will support a configuration where 2 or more monitor and associated touch-screens are utilized in a "mirrored" configuration, i.e. where both monitors show the same image. No special UPDD configuration is required for this mode, each additional controller detected will bind to the same device definition. Calibration can take place on either monitor. It is assumed that calibration on one monitor is good for the other so the devices must be identical.

UPDD 5.1.0

Starting with release 5.1.0, multiple concurrent controllers are now supported under Windows CE.

After configuring the system use the [tbutils adddevice option](#) to add any required serial devices and connect any usb devices.

After adding the devices you can view a device list via the [tbutils list option](#). This will show the device number allocated to each device.

Use the "tbutils device n setting sz "logical desktop segment" "xxxx" for each device where 'n' is the device number and 'xxxx' is describes a screen segment:

(i.e. monitor 1 - mirrored mode / Left half, Right half; Left third, Middle third, Right third; Top left, bottom left, top right, bottom right – extended mode)

The tbupdd.ini file will now hold information needed to identify each device. Take this file and re-embed in your image.

Note that currently only one USB controller can be supported.

There are no such limitations on serial devices.

Once the system is configured as required you can execute tbcilib.exe to calibrate each device in turn, or calibrate an individual one using:

'tbcilib Device=n' where 'n' is the device number

or

tbcilib Segment=segment id, e.g. tbcilib "Segment=Left third"

Some further development is required to support multiple USB devices under CE – please contact us if this is required.

Toolbars

A toolbar is an area on the touch screen that acts independently from the main calibrated video area. A toolbar can simply be used to mask off areas of the calibrated video area or they can be used to trigger an application event or perform an associated system action. Toolbar utilisation is described in the [Toolbar document](#).

Toolbars were re-implemented into CE starting with UPDD builds after 5.1.563

To utilise in a CE environment the toolbars need to be defined and configured under a desktop OS using the UPDD Console, Toolbar dialog and then embed the toolbar entries in the TBUPDD.INI settings file into the CE settings file.

A procedure for this is detailed below.

Ensure this setup is performed on a system, preferable Windows, with one device connected only.

On the desktop start the [UPDD Console](#) from a command prompt with the argument /tbr

Select the toolbars option and define your toolbars as required. Note that on screen visual effects are not supported (show cells / highlight cells, cell images) under CE so will be ignored if defined. [Calculate the placements](#) of the toolbars as best as possible as described (these can be adjusted once moved to and tested on the CE system)

If using toolbars to perform a [predefined system action](#) then in the case of CE only actions "ascii key" and "virtual key" are supported" as are the related options ctrl/ shift/alt / repeat/Windows/sticky. It is not possible to send ctrl+alt+delete. All other combinations are supported.

Having created the toolbar(s) you now need to move the toolbar settings from the desktop tbupdd.ini file to the CE tbupdd.ini file. This can be performed as follows:

Semi automated update of CE settings file (UPDD 5.1.618 and above)

Given the toolbar manual copy procedure is prone to finger trouble we have implemented a semi automated process that can aid the transfer of toolbars created on a desktop system to the CE system as follows:

Having defined the toolbar(s) on desktop system:

- 1) Use the [Toolbar export function](#) to dump the toolbar configuration to a file
- 2) Copy the exported file to the target CE system.
- 3) Use the command tbutils importtoolbar <fn>
- 4) Repeat for as many toolbars that have been exported
- 5) Take the updated file \application data\updd\tbupdd.ini and re-embed this in your image.

Manual update of CE settings file

Having defined the toolbars on the desktop system copy the toolbar definitions as held in the tbupdd.ini file to the CE tbupdd.ini. To do this copy all sections starting

```
[updd\parameters\1\toolbars\...]
```

Copy all the content of these sections and place at the end of the tbupdd.ini file for the target CE system. There will be a large number of entries, please copy all of these.

Finally copy the entry "number of toolbars" from the section [updd\parameters\1] to the same section in the target

E.g.

```
[updd\parameters\1]
number of toolbars=0x00000003
```

Test and manually adjust toolbar placements as required in the setting file at [updd\parameters\1\toolbars\...]

Under CE, if using any of the [specific Toolbar APIs](#) please note that API "TBAPIAddToolbar" is not supported.

Touch Stylus Notes

Settings

We are aware that Microsoft publishes a number of settings that relate to the GWES touch stylus and we are unsure if these settings relate to all versions of CE or have in some cases been superseded by newer versions of the OS. Nevertheless we are aware that various settings are documented that may or may not affect stylus usage. Experimentation would be necessary to determine the affect they have on the stylus

interface. One such reference to stylus registry settings is [here](#).

Double Click Setting

One interesting entry is the [dblTapDist](#) (also described for [WEC7](#)) setting at HKEY_CURRENT_USER\ControlPanel\Pen documented as "Default setting is 20 pixels. Indicates the size of a reference rectangle constructed around the location of a stylus tap. If a second tap occurs inside the rectangle within the allowed time, it is considered a double-tap."

[This Win CE 6 link](#) also references dblTapTime but indicates it is only used with the [Thin Client shell](#) instead of the [Standard shell](#). It is documented as "Indicates the time between clicks in a double-click action. The default value for a thin client is 256 milliseconds or 0xFF in hexadecimal format."

Usage

A good overview of CE touch related issues can be viewed [here](#).

Diagnostics

If you've embedded the software and the touch does not work there are several things you can check. Several of these require an active debugger connection, such as that provided by Platform Builder.

1) Check for known issues

Check the [known issues](#) section.

2) Manually reload the driver

From a command prompt (cmd.exe) type "tbutils reload"

This operation requires a connection to the driver process (implemented in upddce.dll). If a message indicates that this connection cannot be made then recheck that upddce.dll is in place and check all registry settings.

If you are using a USB controller and a message box pops up at startup asking for a driver for a specified device, then check if this message occurs without the controller plugged in. If not then this suggests an error in the registry settings, pay particular attention that the vendor id and product id match the controller in use. See the multi controller definitions section later in this document if you have more than one controller listed.

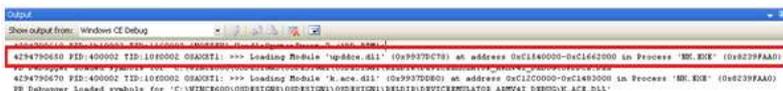
3) Check the UPDD modules loaded

Check in the debug log that both upddce.dll and tbupddceusb.dll (if using USB) are loaded and not subsequently unloaded. The usage and location of the debug log will be image specific.

Typically the module load entry will read:

```
PID:00400003 TID:03770006 OSAXST1: >>> Loading Module 'tbupddceusb.dll' (0xC0845838) at address 0xEE5B0000-0xEE5B6000 in Process 'NK.EXE' (0x85302A60)
```

As see in the debug log below:



Check the log for other messages including the text UPDD, particularly when touching the screen. In the event of USB errors useful information is output in the log. Typical touch related entries are as follows, showing the driver loading and starting to function:

```
4294830336 PID:400002 TID:10f0002 DEVICE!RegReadActivationValues RegQueryValueEx(Drivers\BuiltIn\updd\BusPrefix) returned 2
4294830337 PID:400002 TID:10f0002 OSAXST1: >>> Loading Module 'upddce.dll' (0x831B7BF8) at address 0xC1200000-0xC12EB000 in Process 'NK.EXE' (0x81D7FCA0)
4294830366 PID:400002 TID:10f0002 OSAXST1: >>> Loading Module 'k.ace.dll' (0x831B7D30) at address 0xC1010000-0xC1162000 in Process 'NK.EXE' (0x81D7FCA0)
4294830401 PID:400002 TID:10f0002 OSAXST1: >>> Loading Module 'k.winsock.dll' (0x831B7E68) at address 0xC0DF0000-0xC0DF5000 in Process 'NK.EXE' (0x81D7FCA0)
4294830438 PID:1990002 TID:1160002 [NOTIFY] HandleSystemEvent 7 /ADD ETM1:
4294830659 PID:400002 TID:10f0002 Dll Process Attach
4294830659 PID:400002 TID:10f0002 DdsiTouchPanelAttach+
4294830659 PID:400002 TID:10f0002 DdsiTouchPanelAttach-
4294830659 PID:400002 TID:10f0002 Console NOT redirected for process 0x400002
4294830662 PID:400002 TID:10f0002 TBUPDD: 0 CDriver::CDriver()
4294830662 PID:400002 TID:10f0002
4294830663 PID:400002 TID:10f0002 TBUPDD: 0 CreatePrimaryDevice()
4294830663 PID:400002 TID:10f0002
4294830663 PID:400002 TID:10f0002 TBUPDD: 0 Created primary device
4294830663 PID:400002 TID:10f0002
4294830663 PID:400002 TID:10f0002 TBUPDD: 0 Created device map entry
4294830663 PID:400002 TID:10f0002
```

In this example an exception has been thrown on the first touch (possibly due to the missing Touch Stylus component):

```
4294869773 PID:400002 TID:5300062 TBUPDD: 1748 CUSBConnection::ReadInterruptDataThread read 1 bytes
4294869783 PID:400002 TID:526000a TBUPDD: 1748 CCeMousePort::MouseEvent 41335 43949
4294869827 PID:400002 TID:526000a
4294869827 PID:400002 TID:526000a !ERROR: Calling EnterCriticalSection on a CS (c0fe2fa0) that is not initialized!
4294869852 PID:400002 TID:526000a Coredll: DEBUGCHK failed in file d:\yzkqfe\private\winceos\coreos\core\dll\cscode.c at line 117
4294869881 PID:400002 TID:5300062
```

4) Enable UPDD debug log information

Additional UPDD debug information can also be seen by setting the tbupdd.ini debuglevel setting to 5.

```
TBUPDD.INI file
[UPDD]
Debuglevel=0x00000005
```

The USB component also shows more debug information when executed in a debug build.

5) File based debug

Now available in build 4.1.10 (Nov 2012 build) and 5.0.2 you can enable a file based debug log if the standard debugging facilities are unavailable, especially when installing the driver post image creation.

To enable file based debugging define these settings:

```
[updd]
DebugLevel=0x00000003
FileDebug=0x00000001
```

Under CE the file produced is /application data/updd.log.

FileDebug=0x00000000 is OFF.

If after following the steps above you are unable to resolve the issue please send the log file to us for further analysis.

Serial debug connection

If you wish to use a Serial connection to the Windows CE device for debug purposes we did document many years ago that there is a consideration that is not always made clear in the Microsoft documentation. A null modem cable is required, but this differs from a standard null modem cable in that the RI pin is connected straight through. Without this connection it will be impossible to make a serial connection from the NT host to the Win CE device. Nowadays most system integrators do not debug over serial so we are not sure if this is still a valid issue.

Port interface issues – important

Serial

Touch-screens may be connected to a CE device via a standard serial (COM). A CE image builder should bear in mind that the default CE image generated by platform builder might well make assumptions regarding the usage of such ports. E.g. debug output will be sent to the first physical COM port, preventing its use. By default, CE creates two com port instances, Com 0 and Com 1. Com 0 is used as the debug port and relates to the physical port com 1. Com 1 is therefore the first port that can be used by the touch screen that actually relates to the physical Com 2 port.

Many customers have been unable to get their touch screens working with a default CE build until they have plugged the touch screen into com2 or changed the BIOS so that serial port is referenced as Com2, although the references in the CE build refer to com 1 !!!!

In some circumstances the CE builder will need to amend the CE configuration to alter the default serial port behavior. If you are not familiar with this procedure we have technical bulletin that covers this subject.

Port initialisation

We have discovered that with serial communications on some motherboards if we set up UART flow control options then we receive either no data or garbage. When this setup is omitted the serial port works as expected. This is fine for serial controllers that do not need either a specific state or change of state in the CTS/RTS lines in order to operate.

We have introduced a device level setting called "IgnoreDCB" and if it is set to 0x00000001 then the com port flow control initialisation is skipped.

```
[updd\Parameters\1]:IgnoreDCB = 0x00000001
```

We found that the TI OMAP Platform motherboard required this setting.

This is also used for the Zytronic ZXY100 controller on ARM hardware where setting DCB causes rubbish to be read.

USB

The CE image must be amended to support the USB host controller (this is the system's USB host controller and NOT the USB touch controller). Consult the manufacturer's documentation and or Platform Builder help for details of how to achieve this with the particular model of hardware in use. A 3rd party driver might be required for the host controller, although this has not the case for the hardware we have tested so far. To ensure the CE system's USB host controller is functioning use a HID mouse prior to testing the USB touch controller.

PS/2

PS/2 support needs to be reinstated for the new driver as and when required....

Known issues

The list of known issues is as follows:

- 1) Device warning message in debug log with touch working fine

When viewing the system debug log you may find an entry in a system where the touch is working fine that specifies:

```
DEVICE!InitDeviceContent: can not Init Device content for 'Drivers\USB\LoadClients\2801_1\Default\Default\Tbupddceusb,error code 2404'
!UPDD_USB: Could not ActivateDevice Drivers\USB\LoadClients\2810_1\Default\Default\Tbupddceusb 0x00000964
```

This error is documented thus "System error code 2404 means "The device is in use by an active process and cannot be disconnected." This error code may also display as "ERROR_DEVICE_IN_USE" or as the value 0x964.

We aren't quite sure why the "already in use" error occurs, but our suspicion is that it relates to the fact that the module load is attempted at two points.

- 1) During the enumeration and matching phase (i.e. when the OS is looking for a matching driver).
- 2) When the USB system activates the driver.

We think this message is simply a warning that the module is already loaded.
We believe this only occurs in Win CE7.

This error should not be ignored if the touch is not working!

- 2) After installing driver image worked once but failed to boot on subsequent reboots

Customer determined that the image had increased in size and was too big for the flash disc allocated space. They increased the value associated with setting PLAT_IPSM_START_OFFSET and subsequent boots were OK.

- 3) Hot plug of device not working

Hot plugging is not fully supported, in some cases this is due to limitations of the USBHC driver and / or USBHC hardware component. As of 23/02/12 improved hot plug supported added.

With UPDD CE release 5.1.nnn we identified changes required to further improve hot plug capabilities. This can be added whenever required.

- 4) Missing \application data\updd folder and therefore no tbupdd.ini

This caused issues with the driver. The user had used #includes in platform.reg, platform.bib and platform.dat. However it was not recognised in platform.dat, so tbupdd.dat was not included. As a consequence tbupdd.ini file was not included in the build.

- 5) Exception shown in system log when touching – touch no longer working

This issue was initially experienced on one system running CE 5 but another customer reported the same issue under CE6 when switching computer board and BSP. Our investigation revealed that the system appeared to be loading 2 instances of the driver DLL and in one of the instances certain UPDD internals were uninitialized such that the touch processing crashed. The driver provides entry points to load both as a "builtin" driver and a GWES client. Ordinarily both sets of entry points are called and the second call references the same DLL instance, suggesting that the same system process is responsible for both calls. For historic reasons the built-in load initiates the main driver logic, with the GWES call initialising the mouse interface. In this system we were seeing the DLL instance communicating with USB and reacting to touch, but it was referencing GWES related items that had only been initialised in the other instance and causing an exception.

To overcome this issue we have made a change to the driver such that all UPDD internals are initialized by the GWES interface and therefore we believe that there is no longer any requirement for the DLL to be invoked as a built in driver, such that the following line can be removed from the .reg file:

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd]
"dll"="upddce.dll" << remove this line only
```

Until we are able to undertake extensive testing that it is OK to remove this entry in all cases it remains as part of the distributed .reg file and should be removed as required.

Note: This line should only be removed if using the upddce.dll dated July 2012 or later.

- 6) Serial not working

We have had incidences whereby users have configured both UPDD USB and Serial devices in the UPDD configuration when using serial devices and reported that serial is not working. If the driver finds the USB vid (HKEY_LOCAL_MACHINE\Drivers\BuiltIn\updd) definition in the registry it determines that it is dealing with a USB configuration and ignores any serial configuration. Ensure USB settings are not defined when working with a serial device.

- 7) Touch not working although debug logs showed GWES and Cesendinput driver interfaces both working as expected

We raised our concern that there was a unspecified CE configuration that was preventing the touch interface working. After further investigation the customer reported that they had "tried to patch the Microsoft HID mouse driver in the past to work with the HID Touch device and this driver had accidentally been included in the image." Once this driver was removed the touch started working.

- 8) Multi-core processor issue

Customer reported that before enabling SMP (Symmetric Multi Processor) the touch function works well. After SMP enabled, touch function fails.

Here is the debug log showing the start up issue with SMP enabled:

```
PID:00400003 TID:01770062 Warning! Kernel DLL 'tbupddceusb.dll' is registered for thread creation/deletion notification.
To improve performance if you dont need thread notifications call DisableThreadLibraryCalls from inside
```

```
PID:00400003 TID:01770062 DEVICE!InitDeviceContent: can not Init Device content for
'Drivers\USB\LoadClients\1240_3074\Default\Default\Tbupddceusb,error code 2404'
```

In this instance restrict the driver to using one processor as [described in the notes above](#).

- 9) Calibration issues:

Customer reported with CE 5 "When I start tbcilib.exe, I get the message: 'tbcilib' cannot be accessed." This was from Windows Explorer and further investigation revealed that the hidden attribute was enabled and this seemed to prevent its execution.

TBcalib crashed when used in an image that did not contain a graphical shell. Since Nov 2013 this dependency has been removed.

Some customers have reported that the built in calibration icons are not shown, in this case embedding image calib_cr_32_n_p.bmp [as described in the calibration section](#) has resolved the issue.

Limitations

Known limitations to be addressed as required:

USB hot plug support – can be added as and when required.

USB and serial and i2c (Nov 12) support only. Other interfaces to be added as required.

No sound support.

Dynamic rotate untested.

Hardware based eeprom storage not supported.

Limited testing of software based eeprom calibration storage.

No GUI settings dialog (UPDD Console) to allow for dynamic setting changes.

Contact

For further information or technical assistance please email the technical support team at technical@touch-base.com.