Programmer's Reference Guide

BCM1000-WCE

BTW-M 3.0 OEM Interface

1000-WCE-PG1204-R

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Revision History

Revision	*Date*	*Change Description*
1000-WCE-PG1204-R	8/9/10	**Updated:** • Broadcom FM PDD, "Registry Values" on page 7 • "Snoop Logging" on page 15
1000-WCE-PG1203-R	6/23/10	**Updated:** • "Registry Values" on page 8 • Table 3: "Power Control Library Functions," on page 13 • Table 4: "Debug Registry Values," on page 14 **Added:** • "Snoop Logging" on page 14 • "FM RSSI and Frequency" on page 15
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Introduction

This document is a guide for integrating the Broadcom® Host Controller Interface (HCI) interface and the FM Platform-Dependent Driver (PDD) on a Windows® Phone 7 Series device running the Microsoft® Bluetooth® stack.

Broadcom provides the following files:

- BrcmHci.dll Implements the HCI transport layer as defined by Microsoft and provides a stream driver interface to the FM PDD. This module multiplexes access to the CIA interface.
- BrcmFmPdd.dll Implements the FM PDD as defined by Microsoft.
- BrcmInit.dll Used by the CIA transport layer to initialize the Bluetooth radio.
- BCMxxxx.hcd Broadcom firmware configuration file.

Note: All of these files should be placed in the Windows folder of the device.

Figure 1 shows the BTW-M 3.0 architecture.

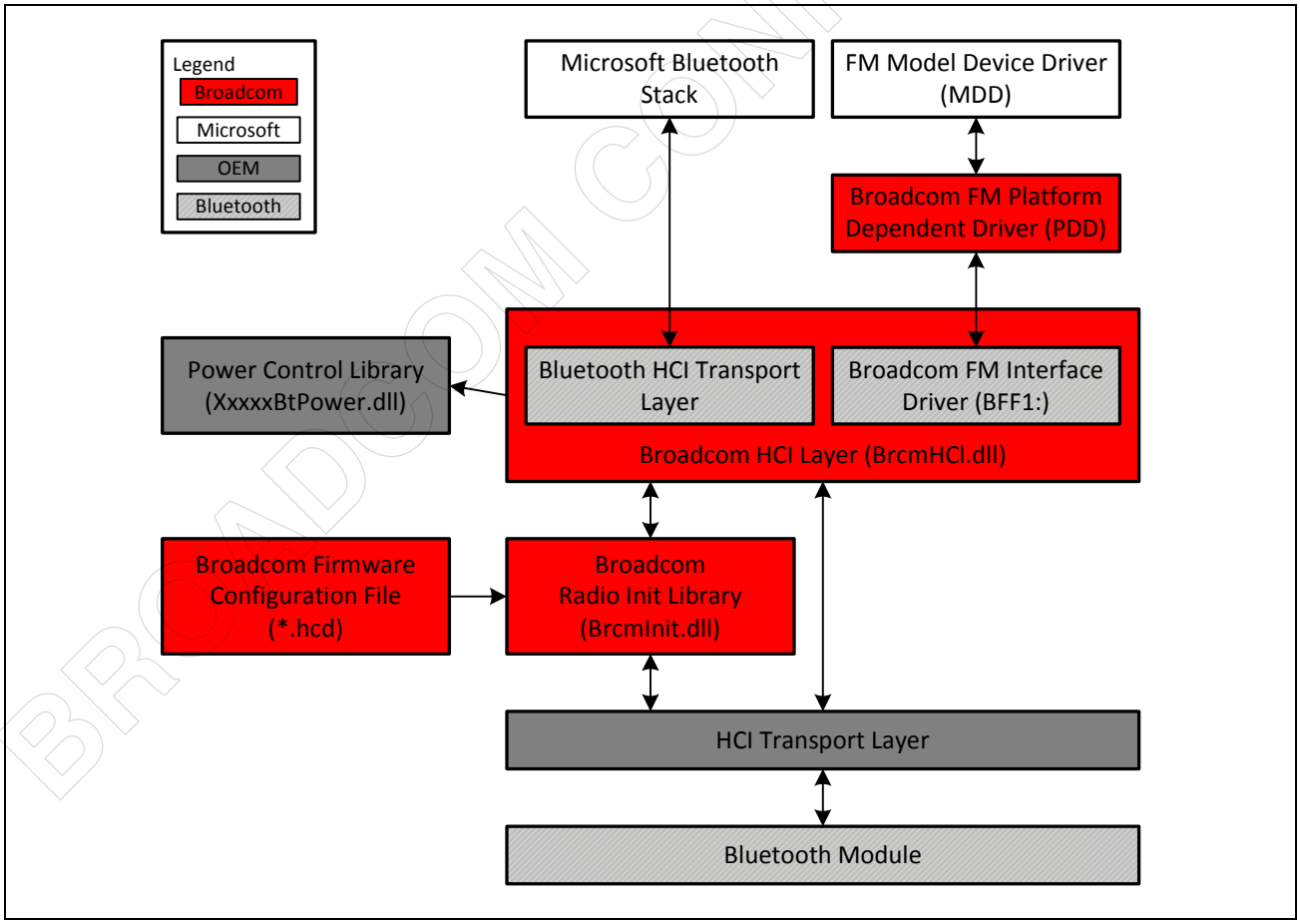

Figure 1: BTW-M 3.0 Architecture

Broadcom FM PDD

Windows Phone 7 series architecture requires FM functionality to be provided using the Model Device Driver/ Platform Dependent Driver (MDD/PDD) model. The MDD model is implemented by Microsoft. The PDD model is implemented by Broadcom in the BrcmFmPdd.dll dynamic-link library (DLL).

The Broadcom FM radio uses the HCI interface to communicate with the host operating system. Consequently, the HCI transport is shared between the Bluetooth stack and the Broadcom FM PDD. Multiplexing the HCI transport between Bluetooth and FM is done on the HCI transport layer. The FM PDD communicates with the HCI transport layer using a stream driver interface.

For details on the MDD model, refer to the Microsoft Windows Phone 7 OEM Documentation dated February 22, 2010.

Note: Since the HCI transport must be shared between FM and Bluetooth, only the Broadcom HCI transport layer can be used with the Broadcom FM PDD.

Registry Values

The FM audio tuner driver must know the name of the FM PDD DLL. This is specified using the following registry setting:

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\AudioTuner]
"PddDll"="BrcmFmPdd.dll"
```

The FM PDD must know what type of FM antenna is to be used, as well as threshold and power state values. Registry values are used to specify these settings, as described in Table 1.

Table 1: FM PDD Registry Values

Value	*Description*
AntennaType	FM antenna type 0 = External (e.g., wired) 1 = Internal
ScanRSSIThreshold	Received Signal Strength Indicator (RSSI) threshold (in dBm) for detecting a radio station. Valid values are between 0 and 127.
PowerState	FM radio power state 0 = Power off 1 = Power on
SoftMute	Enable/disable soft-mute feature 0 = Disable 1 = Enable

The following is an example of the registry value set to indicate that the FM radio antenna is internal, the RSSI threshold is 102 dBm (hex 66), and the power is off:

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\FM]
"AntennaType"=dword:1
"ScanRSSIThreshold"=dword:66
"PowerState"=dword:0
"SoftMute"=dword:1
```

Broadcom HCI Layer

The Broadcom HCI transport DLL implements the Microsoft HCI transport interface in a DLL named BrcmHCI.dll.

Besides the Bluetooth stack, the Broadcom FM PDD also communicates with the controller over the HCI transport. Therefore, the Broadcom HCI layer acts as a filter driver to control the power state of the controller and multiplex communications between the controller and the host interfaces. This ensures that the Bluetooth/FM controller is initialized and in the correct mode when either Bluetooth, FM, or both are enabled by the user.

Registry Values

The Microsoft Bluetooth stack must know the name of the HCI transport interface DLL. This is specified using the following registry setting:

```
[HKEY_LOCAL_MACHINE\Software\Microsoft\Bluetooth\Transports\BuiltIn\1]
"Driver"="BrcmHci.dll"
```

The interface between the Broadcom HCI transport DLL and the FM PDD is implemented as a stream driver. The following registry value activates the stream driver when the phone is booted:

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\BrcmHCI]
"FriendlyName"="FM Filter Driver BBF1:"
"DeviceArrayIndex"=dword:00000001
"Prefix"="BBF"
"Dll"="BrcmHCI.dll"
"Order"=dword:00000099
"Index"=dword:00000001
```

The following registry setting controls the inactivity time (in milliseconds) before the HCI transport tells the radio that it can suspend:

```
[HKEY_LOCAL_MACHINE\Software\WIDCOMM\BTConfig\General]
"SuspendTimeout"=dword:00001388
```

The following registry settings allow the OEM to customize how the Bluetooth HCI layer interfaces with the Bluetooth serial transport. Specifically, the ReadTotalTimeoutConstant and WriteTotalTimeoutConstant offsets of the COMMTIMEOUTS structure used in the call to SetCommTimeouts can be customized using the following registry values:

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\BtConfig\General]
"SerialReadTimeout"=dword:000000C8
"SerialWriteTimeout"=dword:00000032
```

The default values are ReadTotalTimeoutConstant=INFINITE and WriteTotalTimeoutConstant=50 if these registry settings are not provided.

Broadcom Radio Initialization Library

When either the Bluetooth stack or FM is enabled, the Bluetooth radio will be powered on and initialized. The initialization of the Bluetooth radio is handled by the Broadcom Radio Initialization library implemented in a DLL named BrcmInit.dll.

The radio initialization involves downloading the firmware configuration file, resetting the radio, and sending HCI commands to configure the radio (e.g., setting the Bluetooth Device address).

Registry Values

The HCI transport DLL must know the name of the Radio Initialization library DLL. This is specified using the following registry setting:

```
[HKEY_LOCAL_MACHINE\Software\WIDCOMM\BTConfig\General]
"RadioInitLibrary"="BRCMInit.dll"
```

There are registry values that determine how the Radio Initialization library opens the serial transport. For example, the following sample settings indicate that COM9: will be opened at a baud rate of 115,200:

```
[HKEY_LOCAL_MACHINE\Software\WIDCOMM\BTConfig\SerialTransport]
"BaudRate"=dword:0001c200
"ByteSize"=dword:00000008
"Device"="COM"
"FlowControl"=dword:00000001
"Parity"=dword:00000000
"Port"=dword:00000009
"StopBits"=dword:00000000
```

The initialization requires platform-specific settings that are defined in the registry. The following is an example of the registry values that may be used:

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\BtConfig\Platform\RadioInit]
"BRCMBaudRateAfterConfigDownload"=dword:003d0900
"BRCMBaudRateBeforeConfigDownload"=dword:003d0900
"BRCMConfigFile"="\Windows\BCM4329B1_002.002.023.0157.0168.hcd"
"BRCMHostBaudRateAfterConfigDownload"=dword:0001C200
"BRCMRadioInitConfigureSleepMode"=dword:00000001
"ChannelClassificationEnabled"=dword:00000000
"CollaborationArchitecture"=dword:00000001
"CollaborationPriorities"=dword:CB7FBDB0
"CollaborationSolution"=dword:00000003
"DelayBeforeClockUpdate"=dword:00000000
"PCMClockMode"=dword:00000000
"PCMFillMethod"=dword:00000002
"PCMFillNum"=dword:00000000
"PCMFillValue"=dword:00000003
"PCMInCallBitclock"=dword:00000004
"PCMLSBFirst"=dword:00000000
"PCMMaster"=dword:00000000
"PCMRightJustify"=dword:00000000
```

```
"PCMRouting"=dword:00000000
"PCMShortFrameSync"=dword:00000000
"PCMSyncMode"=dword:00000000
"RadioInitConfigureAudio"=dword:00000001
"RadioInitEnableCoexistence"=dword:00000000
"RadioInitWriteChannelClassification"=dword:00000001
"SleepModeBT_WAKEActiveHigh"=dword:00000001
"SleepModeHOST_WAKEActiveHigh"=dword:00000001
"SleepModeMode"=dword:00000001
"SleepModeSuspendTimeout_HC"=dword:00000bb8
"SleepModeSuspendTimeout_Host"=dword:00000000
```

Table 2 describes the registry values that may be used.

Table 2: Radio Initialization Registry Values

Value	*Description*
BRCMBaudRateAfterConfigDownload	The baud rate to set the Bluetooth radio to, after downloading the config file.
BRCMBaudRateBeforeConfigDownload	The baud rate to set the Bluetooth radio to, before downloading the config file.
BRCMHostBaudRateAfterConfigDownload	The baud rate to set the host UART to, after downloading the config file.
DelayBeforeClockUpdate	A delay (in ms) that is applied after changing the host baud rate, after downloading the config file. This happens before we send HCI_VS_WriteUARTClockSetting. The default is 0 (no delay).
BRCMConfigFile	Full path to the firmware configuration file to be downloaded.
BRCMRadioInitConfigureSleepMode	If set to 1, send HCI_VS_SetSleepModeParam
SleepModeMode	0 = Disable sleep mode 1 = Sleep mode UART 3 = Sleep mode USB 5 = Sleep mode USB with HOST_WAKE
SleepModeSuspendTimeout_HC	Time (in ms) for the host controller (HC) idle threshold
SleepModeSuspendTimeout_Host	Time (in ms) for the HOST idle threshold
SleepModeBT_WAKEActiveHigh	0 = BT_WAKE active low 1 = BT_WAKE active high
SleepModeHOST_WAKEActiveHigh	0 = HOST_WAKE active low 1 = HOST_WAKE active high
RadioInitWriteChannelClassification	If set to 1, send HCI_WriteChannelClassification
ChannelClassificationEnabled	0 = Channel classification disabled 1 = Channel classification enabled
RadioInitEnableCoexistence	If set to 1, send HCI_VS_WriteCollaborationMode
CollaborationArchitecture	0 = 2035 1 = 2045 or newer
CollaborationPriorities	Bit field of priorities, default is 0xCB7FBDB0.

Table 2: Radio Initialization Registry Values (Cont.)

Value	*Description*
CollaborationSolution	0 = No coexistence 1 = 2 pin 2 pin 2 = 3 pin 2 pin ***Note:*** This is currently only supported for the BCM4325. And it is enabled by default, so you do not need to enable coexistence for the BCM4325.
PCMClockMode	0 = BT is clock mode slave. 1 = BT is clock mode master.
PCMFillMethod	0 = 0s 1 = 1s 2 = signed 3 = programmable
PCMFillNum	0-3, the number of bits to fill
PCMInCallBitclock	0 = 128 Kbps 1 = 256 Kbps 2 = 512 Kbps 3 = 1024 Kbps 4 = 2048 Kbps
PCMLSBFirst	0 = MSB first 1 = LSB first
PCMMaster	–
PCMRightJustify	0 = Left justify 1 = Right justify
PCMRouting	0 = Pulse Code Modulation (PCM) routing 1 = Use transport (UART/USB)
PCMShortFrameSync	0 = Short frame sync 1 = Long frame sync
PCMSyncMode	0 = BT is sync mode slave 1 = BT is sync mode master
RadioInitConfigureAudio	If set to 1: • Send HCI_WriteVoiceSettings • Send HCI_VS_WriteSCOPCMIntParameters • Send HCI_VS_WritePCMDataFormatParameters • Send HCI_VS_WriteSCOTimeSlot

If the following BDAddr registry value is set, then it will be used to set the local Bluetooth Device address through the HCI_VS_WriteBDAddr command:

```
[HKEY_LOCAL_MACHINE\Software\WIDCOMM\BTConfig\General]
"Bdaddr"=hex:00,25,e5,b5,7a,7b
```

For debugging purposes, the following registry value can be set:

```
[HKEY_LOCAL_MACHINE\Software\WIDCOMM\BTConfig\Debug]
"BRCMRadioInitTraces"=dword:00000001
```

Broadcom Firmware Configuration File

The firmware configuration file contains firmware configuration settings and patches. This file is downloaded to the controller during radio initialization.

Registry Values

The name of the firmware configuration file is defined in the following registry:

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\BtConfig\Platform\RadioInit]
"BRCMConfigFile"="<full pathname of config file>"
```

Power Control Library

A Power Control library DLL is required to power on (and off) the radio, to signal the controller that it can suspend, and to check the suspend state. This library is loaded and used from the Broadcom HCI layer.

Note: The Power Control library must be implemented by the OEM.

Table 3 shows the C (not C++) functions that this DLL should export.

Table 3: Power Control Library Functions

Item	*Description*
BOOL PowerOn(void);	Called to turn the radio on.
BOOL PowerOff(void);	Called to turn the radio off.
BOOL SetHostSuspendLine (BOOL bSuspend);	(Optional) Called to set or clear the host to controller suspend (also known as deep sleep) signal. When bSuspend is TRUE, it means to set the suspend signal indicating that the radio can go to sleep.
BOOL ReadHCSuspendLine (void);	(Optional) Called to read the controller suspend state. Returns TRUE if suspended (or in deep sleep). This function is not currently used by the Broadcom HCI layer.
void SetSerialHandle(HANDLE hCOMPort);	(Optional) Called to provided the COM port handle for the BT Serial transport to the Power Control Library. This has been created to allow the Power Control Library to do flow-control if needed.

Note: If the SetHostSuspendLine function is not implemented, lower power mode is not used.

Caution! It is crucial that these functions execute very fast; otherwise, the device will lockup during a power cycle. These functions usually contain the code that directly accesses the hardware.

Registry Values

The name of the Power Control library DLL is contained in the following registry setting:

```
[HKEY_LOCAL_MACHINE\SOFTWARE\WIDCOMM\BtConfig\General]
"PowerControlLibrary"="<DLL name; eg. OemBtPower.dll>"
```

Debugging

This section describes methods that can be used to debug the various modules provided by Broadcom. All three DLLs (BrcmHci.dll, BrcmFmPDD.dll, and BrcmInit.dll) output their version number and build time in retail messages.

Registry Values

Retail messages can be enabled using the following registry value:

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\BTConfig\Debug]
"RetailMessageMask"=dword:02
```

The value of RetailMessageMask can be adjusted at runtime and takes effect immediately.

Table 4 describes the registry values that may be used.

Table 4: Debug Registry Values

Value	*Description*
RetailMessageMask	A bit field used to control the amount of diagnostic output: Bit 0x00 = minimal diagnostic output (default) Bit 0x02 = log basic functionality Bit 0x04 = log HCI debugging, including HCI decoding Bit 0x08 = log detailed FM functionality Bit 0x10 = print time stamp Bit 0x20 = log Radio Data System data If set to 0xFFFFFFFF, then log everything.

Snoop Logging

The HCI traffic can be saved to a file in Bluetooth snoop format, which is recognized by Frontline® FTS4BT™ software (FTS4BT software can be used to view the file). The file is opened and truncated when Phone 7's Bluetooth feature is turned on. The file is closed when the Bluetooth feature is turned off. The file name can reference internal, memory card, or desktop storage via KITL.

Table 5: Snoop Logging Registry Values

Value	*Description*
BtSnoopFilename	Absolute path name to the log file.
BtSnoopMaxMem	Maximum size, in bytes, of the memory-mapped file specified by BtSnoopFileName. If zero, the memory-mapped file is not used. If the memory-mapped file is full, new data is discarded.

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\BTConfig\Debug]
"BtSnoopFileName"="absolute path name to the log file"
"BtSnoopMaxMem"=dword:0
```

FM RSSI and Frequency

It is possible to log the live FM RSSI and frequency information to the registry for debugging purposes.

Note: This feature is only enabled when the following value is set to 1.

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\FM]
"RegistryLiveUpdate"=dword:00000001
```

These registry values will be created and updated while FM is active:

```
[HKEY_LOCAL_MACHINE\Software\Widcomm\FM]
"CurrentFrequency"=dword:00000000
"CurrentRSSI"=dword:00000000
"CurrentAudioMode"=dword:00000000
```

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