PCI-SIG ENGINEERING CHANGE NOTICE

TITLE:	Mini-WFF Alignment Changes
DATE:	Updated: May 27, 2005 (Original submittal May 14, 2005)
AFFECTED DOCUMENT:	PCIe Mini CEM Specification, Revision 1.1
SPONSOR:	Brad Saunders, Intel Corporation

Part I

1. Summary of the Functional Changes

Changes are proposed that would serve to align the Mini CEM specification with that of the WFF CEM specification in areas of specific overlap.

Top level summary of changes covered by this ECR:

1. Specifically disallow use of WAKE# signal with USB functions.
2. Align functional specifications on W_DISABLE# signal definition.
3. Align CLKREQ# support definition – mandating its support and enabling.
4. Align electrical and termination requirements on logic signals: WAKE#, W_DISABLE#, CLKREQ#, and PERST#.
5. Align specifications on LED signal usage definition – simplifying the definition.
6. Specifically label coexistence pins and add defining text.
7. Add card emumeration requirements

2. Benefits as a Result of the Changes

Aligning specifications on these items will increase consistency between products delivered in both form-factors.

3. Assessment of the Impact

Should ease costs associated with delivering similar products in both form-factors.

4. Analysis of the Hardware Implications

Designs not current with these changes will have to be modified to comply as applicable by the OEM purchasing specifications. Specific to hardware, the proposed changes herein have been relatively understood prior to these formal spec updates and should not represent a significant impact to adapt.

5. Analysis of the Software Implications

Designs not current with these changes will have to be modified to comply as applicable by the OEM purchasing specifications. Specific to software, the proposed changes herein have been relatively understood prior to these formal spec updates and should not represent a significant impact to adapt.

Part II

Detailed Description of the change

Change Table 3.1, page 25 as follows:

Table 3-1: PCI Express Mini Card System Interface Signals

Signal Group	Signal	Direction	Description
Power	+3.3V (2 pins)		Primary 3.3 V source
	+3.3Vaux (1 pin)		Auxiliary 3.3 V source
	+1.5V (3 pins)		Primary 1.5 V source
	GND (12 pins)		Return current path
PCI Express	PETp0, PETn0 PERp0, PERn0	Input/Output	PCI Express x1 data interface: one differential transmit pair and one differential receive pair
	REFCLK+, REFCLK–	Input	PCI Express differential reference clock (100 MHz)
Universal Serial Bus (USB)	USB_D+, USB_D–	Input/Output	USB serial data interface compliant to the USB 2.0 specification
Auxiliary Signals (3.3V Compliant)	PERST#	Input	Functional reset to the card
	CLKREQ#	Output	Reference clock request signal
	WAKE#	Output	Open Drain active Low signal. This signal is used to request that the system return from a sleep/suspended state to service a function initiated wake event.
	SMB_DATA	Input/Output	SMBus data signal compliant to the SMBus 2.0 specification
	SMB_CLK	Input	SMBus clock signal compliant to the SMBus 2.0 specification
Communications Specific Signals	LED_WPAN#, LED_WLAN#, LED_WWAN#	Output	Open drain, active low signals. These signals are used to allow the PCI Express Mini Card add-in card to provide status indicators via LED devices that will be provided by the system.
	W_DISABLE#	Input	Active low signal. This signal is used by the system to disable radio operation on add-in cards that implement radio frequency applications. When implemented, this signal requires a pull-up resistor on the card

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Signal Group	Signal	Direction	Description
User Identity Module (UIM) Signals	UIM_PWR (1 pin)	Output	Power source for the UIM. Compliant to the ISO/IEC 7816-3 specification (VCC).
	UIM_RESET	Output	UIM reset signal. Compliant to the ISO/IEC 7816-3 specification (RST).
	UIM_CLK	Output	UIM clock signal. Compliant to the ISO/IEC 7816-3 specification (CLK).
	UIM_VPP	Output	Variable supply voltage (e.g., programming voltage) for class A devices. Refer to ISO/IEC 7816-3 for operating class definitions. This signal is reserved for future use for devices of other classes. Compliant to the ISO/IEC 7816-3 specification (VPP).
	UIM_DATA	Input/Output	UIM data signal. Compliant to the ISO/IEC 7816-3 specification (I/O).

Change Section 3.2.3, page 28 as follows:

3.2.3 USB Interface

The USB interface supports USB 2.0 in all three modes (Low Speed, Full Speed, and High Speed). Because there is not a separate USB-controlled voltage bus, USB functions implemented on a PCI Express Mini Card add-in card are expected to report as self-powered devices. All enumeration, bus protocol, and bus management features for this interface are defined by *Universal Serial Bus Specification, Revision 2.0*.

USB-based Mini cards that implement a wakeup process are required to use the in-band wakeup protocol (across the USB_D+/USB_D- pins) as defined in the *Universal Serial Bus Specification* and shall not use the WAKE# signal to enable the in-band wakeup process.

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Change Section 3.2.4.2.3, page 31 as follows:

3.2.4.2.3 Clock Request Support Reporting and Enabling

Support for the CLKREQ# dynamic clock protocol should be reported using bit 18 in the PCI Express link capabilities register (offset 0C4h). To enable dynamic clock management, bit 8 of the Link Control Register (offset 010h) is provided. By default, the card shall enable CLKREQ# dynamic clock protocol upon initial power up and in response to any warm reset

by the host system. System software may subsequently disable this feature as needed. See *PCI Express Base Specification, Rev. 1.1* (or later) for more information regarding these bits.

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Change Section 3.2.4.4, page 32 as follows:

3.2.4.4. WAKE# Signal

The WAKE# signal is an open drain, active low signal that is driven low by a PCI Express Mini Card function to reactivate the PCI Express Link hierarchy's main power rails and reference clocks. Only add-in cards that support the wakeup process connect to this pin. If the add-in card has wakeup capabilities, it must support the WAKE# signal. Likewise, only systems that support the wakeup function need to connect to this pin, but if they do, they must fully support the WAKE# function. If the wakeup process is used, the +3.3Vaux supply must be present and used for this function. The assertion and de-assertion of WAKE# are asynchronous to any system clock. See Chapter 5 of the *PCI Express Base Specification* for more details on PCI compatible power management. See the *PCI Express Card Electromechanical Specification* for more details on the functional requirements for the WAKE# signal.

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If implemented in the host platform, a host pull-up resistor (≥5 KΩ) tied to no higher than +3.3Vaux is required on this pin.

Change Section 3.2.5.1, page 32 as follows:

3.2.5.1. Status Indicators

Three LED signals are provided to enable wireless communications add-in cards to provide status indications to users via system provided indicators.

LED_WPAN#, LED_WLAN#, and LED_WWAN# output signals are active low and are intended to drive system-mounted LED indicators. These signals shall be capable of sinking to ground a minimum of 9.0 mA at up to a maximum V_{OL} of 400mV.

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Table 3-4 presents a simple indicator protocol for each of two defined LED states as applicable for wireless radio operation. Although the actual definition of the indicator protocol is established by the OEM system developer, the following recommendation may be useful in establishing a minimum common implementation across many platforms.

Table 3-4: Simple Indicator Protocol for LED States

State	Definition	Interpretation
OFF	The LED is emitting no light.	Radio is incapable of transmitting. This state is indicated when the card is not powered, the W_DISABLE# signal is asserted to disable the radio, or when the radio is disabled by software.
ON	The LED is emitting light.	Radio is capable of transmitting. The LED should remain ON even if the radio is not actually transmitting. For example, the LED remains ON during temporary radio disablements performed by the Mini card of its own volition to do scanning, switching radios/bands, power-management, etc. If the card is in a state wherein it is possible that radio can begin transmitting without the system user performing any action, this LED should remain ON.

More advanced indicator protocols are allowed as defined by the OEM system developer. Advanced features might include use of blinking or intermittent ON states which can be used to indicate radio operations such as scanning, associating, or data transfer activity. Also, use of blinking states might be useful in reducing LED power consumption.

Change Section 3.2.5.2, page 33 as follows:

3.2.5.2. W_DISABLE# Signal

The W_DISABLE# signal is provided to allow wireless communications add-in cards to allow users to disable, via a system-provided switch, the add-in card's radio operation in order to meet public safety regulations or when otherwise desired. Implementation of this signal is required for systems and all add-in cards that implement radio frequency capabilities.

The W_DISABLE# signal is an active low signal that when asserted (driven low) by the system shall disable radio operation. A pull-up resistor between W_DISABLE# and +3.3Vaux is required on the card and should be in the range of 100KΩ – 200KΩ in value. The assertion and de-assertion of the W_DISABLE# signal is asynchronous to any system clock. All transients resulting from mechanical switches need to be de-bounced by system circuitry.

When the W_DISABLE# signal is asserted, all radios shall be disabled. When the W_DISABLE# is not asserted, the radio may operate (transmit/receive) if not disabled by other means such as software. This signal may be shared between multiple Mini cards.

Deleted: Each LED has four defined states as detailed in Table 3-4.

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0.2 ± 25% Hz blink rate

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Deleted: The LED is flashing intermittently proportional to activity on the interface.

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3 Hz minimum blink rate
20 Hz maximum blink rate

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Deleted: Table 3-5 defines the recommended use for the LED states for each of the three wireless classes (W-PAN, W-LAN, and W-WAN).¶
Table 3-5: Recommended Use for LED Indicators by Wireless Classes¶
State ... [1]

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In normal operation, the card should disassociate with the wireless network and cease any further operations (transmit/receive) as soon as possible after the W_DISABLE# signal is asserted. Given that a graceful disassociation with the wireless network fails to complete in a timely manner, the Mini card shall discontinue any communications with the network and assure that its radio operation has ceased no later than thirty (30) seconds following the initial assertion of the W_DISABLE# signal. Once the disabling process is complete, the LED specific to the radio shall indicate the disabled condition to the user.

The card should initiate and indicate to the user the process of resuming normal operation within one second of de-assertion of the W_DISABLE# signal. Due to the potential of a software disable state, the combination of both the software state and W_DISABLE# assertion state must be determined before resuming normal operation. Table 3-5 illustrates this requirement as a function of W_DISABLE# AND the software control setting such that the radio's RF operation remains disabled unless both the hardware and software are set to enable the RF features of the card.

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Table 3-5: Radio Operational States

W_DISABLE#	SW Control Setting[1]	Radio Operation
De-asserted (HIGH)	Enable Radio	Enabled (RF operation allowed)
De-asserted (HIGH)	Disable Radio	Disabled (no RF operation allowed)
Asserted (LOW)	Enable Radio	Disabled (no RF operation allowed)
Asserted (LOW)	Disable Radio	Disabled (no RF operation allowed)

Notes:

1. This control setting is implementation specific, this column represents the collective intention of the host software to manage radio operation.

The system is required to assure that W_DISABLE# be in a deterministic state (asserted or de-asserted) whenever power is applied to the add-in; i.e., whenever either +3.3V or +3.3Vaux is present.

Change Section 3.2.6.4, page 35 as follows:

3.2.6.4 UIM_VPP

Refer to ISO/IEC 7816-3 for more details on the voltage and current tolerance requirements for the UIM_VPP power source for class A devices.

This signal is reserved for future use for devices of other classes.

UIM_VPP maps to contact number C6 as defined in ISO/IEC 7816-2.

Change Table 3-6, page 36 as follows:

Table 3-6: System Connector Pin-out

Pin #	Name	Pin #	Name
51	Reserved*	52	+3.3V
49	Reserved*	50	GND

Pin #	Name	Pin #	Name
47	Reserved*	48	+1.5V
45	Reserved*	46	LED_WPAN#
43	Reserved*	44	LED_WLAN#
41	Reserved*	42	LED_WWAN#
39	Reserved*	40	GND
37	Reserved*	38	USB_D+
35	GND	36	USB_D-
33	PETp0	34	GND
31	PETn0	32	SMB_DATA
29	GND	30	SMB_CLK
27	GND	28	+1.5V
25	PERp0	26	GND
23	PERn0	24	+3.3Vaux
21	GND	22	PERST#
19	Reserved** (UIM_C4)	20	W_DISABLE#
17	Reserved** (UIM_C8)	18	GND
Mechanical Key			
15	GND	16	UIM_VPP
13	REFCLK+	14	UIM_RESET
11	REFCLK-	12	UIM_CLK
9	GND	10	UIM_DATA
7	CLKREQ#	8	UIM_PWR
5	COEX2	6	1.5V
3	COEX1	4	GND
1	WAKE#	2	3.3V

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* Reserved for future second PCI Express Lane (if needed)

** Reserved for future UIM interface (if needed)

Deleted: ** Reserved for future wireless coexistence control interface (if needed)

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Insert a new Section 3.2.2, page 37 as follows:

3.2.2. Coexistence Pins

COEX1 and COEX2 are provided to allow for the implementation of wireless coexistence solutions between the radio(s) on the Mini card and other off-card radio(s). These other radios can be located on another Mini card located in the same host platform or as alternate radio implementations (e.g. using a PCI Express Mini CEM or a proprietary form-factor add-in solution).

The functional definition of these pins are OEM specific and should be coordinated between the host platform OEM and card vendors. The ordered labeling of these signals in this specification are intended to help establish consistent implementations, where practical, across multiple instances of cards in the host platform.

Change original Section 3.2.2, page 37 as follows:

3.2.3. Reserved Pins

Reserved pins are expected to be not terminated on either the add-in card or system board side of the connector. These pins are reserved for definition with future revisions of this specification. Non-standard use of these pins may result in incompatibilities in solutions aligned with the future revision.

Two subsets of the reserved pins are tentatively reserved for specific applications as noted in Table 3-6. If new functionality requires use of these specially marked pins, they may be released for redefinition on an as needed basis.

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Insert a new Section 3.4.1, page 37 as follows:

3.4.1. Logic Signal Requirements

The 3.3V card logic levels for single-ended digital signals (WAKE#, CLKREQ#, PERST#, W_DISABLE#) are given in Table 3-x.

Table 3-x: DC Specification for 3.3V logic signaling

Symbol	Parameter	Conditions	Min	Max	Units	Notes
+3.3V	Supply Voltage		3.3 – 9%	3.3 + 9%	V	3
V_{IH}	Input High Voltage		2.0	3.6	V	1
V_{IL}	Input Low Voltage		-0.5	0.8	V	1
I_{OL}	Output Low Current for open-drain signals	0.4V	4		mA	2
I_{IN}	Input Leakage Current	0 to 3.3 V	-10	+10	µA	1
I_{LKG}	Output Leakage Current	0 to 3.3 V	-50	+50	µA	1
C_{IN}	Input Pin Capacitance			7	pF	1
C_{OUT}	Output Pin Capacitance			30	pF	2

Notes:
1. Applies to PERST# and W_DISABLE#
2. Applies to CLKREQ# and WAKE#
3. As measured at the card connector pad

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Insert a new Section 3.5, page 40 as follows:

3.5 Card Enumeration

All PCI Express-based Mini cards must enumerate to either multi-function or single function PCI endpoints.

All USB-based Mini cards must enumerate to either single function traditional USB Devices or Composite Devices or Compound Devices.

Table 3-5 defines the recommended use for the LED states for each of the three wireless classes (W-PAN, W-LAN, and W-WAN).

Table 3-5: Recommended Use for LED Indicators by Wireless Classes

State	W-PAN	W-LAN	W-WAN
OFF	Not powered	Not powered	Not powered
ON	Powered; ready to transmit or receive	Powered, associated, and authenticated but not transmitting or receiving	Powered, associated, and authenticated but not transmitting or receiving
Slow Blink	N/A	Powered but not associated or authenticated; searching	Powered but not associated or authenticated; searching
Intermittent Blink	Activity proportional to transmitting/receiving speed	Activity proportional to transmitting/receiving speed	Activity proportional to transmitting/receiving speed For voice applications, turning off and on the intermittent blink based on the ring pulse cycle can indicate a ring event