

IEEE P802.15
Wireless Personal Area Networks

Project	IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)	
Title	Draft Text for Multi-PHY-Mode (MPM) Management Scheme through Common Signaling Mode (CSM) for 802.15.4g WPAN	
Date Submitted	Feb., 2010	
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Re:		
Abstract	IEEE 802.15 Task Group TG4g Comment Resolution	
Purpose	Draft Text for Comment Resolution Process	
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Note to Editors:

1. *The numberings of the sub-clauses are suggestions and may be changed along the editorial process*
2. *The cross references in red font are temporary and should be renumbered*

Editorial note: Add the following sub-clause

5.2.1 Multi-PHY-Mode (MPM) Management of the IEEE 802.15.4g WPAN

A compliant device shall at least implement one of the following PHY modes, the FSK PHY, the OFDM PHY or the OQPSK PHY. In order to mitigate interference due to networks with different PHY modes operating in the same location, a Multi-PHY-Mode (MPM) management scheme is specified to enable inter-PHY-mode coexistence. For this purpose, the MPM management scheme facilitates negotiation among potential coordinators with different PHY modes before starting respective networks by employing a common communication bridge known as the Common Signaling Mode.

Editorial note: Add the following sub-clause

6.1b Common Signaling Mode (CSM)

To facilitate the MPM management scheme described in 5.2.1, CSM index 0 is specified. A compliant device acting as a coordinator shall be able to transmit and receive in CSM index 0. The specification of CSM index 0 is given in Table 1. The details on PHY design for CSM index 0 is given in 6.X.X.

Table 1 PHY Specification of the CSM for MPM Scheme

Index	Band	Modulation	BT	Modulation Index	BW	Data Rate
0	2.4 GHz 902-928 MHz 863-870 MHz 470-510 MHz	(G)FSK	0.5 for GFSK N/A for FSK	1	200 kHz	50 kb/s
	400-430 MHz 950-955 MHz					100 kb/s

7.2.1.1.1 Frame Type subfield

Editorial note: Change table as the following:

Table 79 – Values of the Frame Type subfield

Frame type value b2 b1 b0	Description
<u>100</u>	<u>Coex-beacon</u>
100-111 101-111	Reserved

Editorial note: Add the following sub-clause

7.2.2.1b Coexistence-beacon (Coex-beacon) frame format

The coex-beacon frame shall be formatted as illustrated in **Figure 1**.

Octets: 2	1	4/10	4	variable	2
Frame Control	Sequence Number	Addressing fields	Coex-Specification	Coex-beacon Payload	FCS
MHR			MAC Payload		MFR

Figure 1 Frame format for the coex-beacon

Editorial note: Add the following sub-clause

7.2.2.1b.1 Coex-beacon frame MHR fields

The MHR for a coex-beacon frame shall contain the Frame Control field, the Sequence Number field and the Addressing fields.

In the Frame Control field, the Frame Type subfield shall contain the value that indicates a coex-beacon frame, as shown in Table 79, and the Source Addressing Mode subfield shall be set as appropriate for the address of the coordinator transmitting the coex-beacon frame. All other subfields shall be set to zero and ignored on reception.

The Sequence Number field shall contain the current value of *macCBSN*.

The Addressing fields shall comprise only the Source PAN Identifier and Source Address fields, containing respectively, the PAN identifier and address of the device transmitting the coex-beacon frame.

Editorial note: Add the following sub-clause

7.2.2.1b.2 Coex-Specification field

The Coex-Specification field shall be formatted as illustrated in [Figure 2](#).

Bits: 0-3	4-7	8-11	12-16	17-20	21-24	25-28	29-31
Beacon Order	Superframe Order	Final CAP Slot	Coex-beacon Order	Offset Time Order	PHY Mode Control	Frequency Diversity Control	Reserved

[Figure 2](#) Coex-specification

The MAC Payload for a coex-beacon frame shall contain the Coex-Specification field with Beacon Order, Superframe Duration, Final CAP Slot, Coex-beacon Order, Offset Time Order, PHY Mode Control and Frequency Diversity Control subfields.

The Beacon Order, Superframe Order and Final CAP Slot subfields are specified in 7.2.2.1.2.

The Coex-beacon Order subfield shall specify the transmission interval of the coex-beacon frames. See [7.5.1.5](#) for explanation of the relationship between coex-beacon order and coex-beacon interval.

The Offset Time Order subfield shall specify the interval between the coex-beacon and the following beacon. See [7.5.1.5](#) for more explanation.

The PHY Mode Control subfield shall specify the PHY mode of the source PAN. The values for the PHY modes shall be specified in [Table 2](#).

The Frequency Diversity Control subfield shall specify the types of supported frequency diversity schemes in the source PAN. This subfield consists of 4 bits [**b**₀ **b**₁ **b**₂ **b**₃], with **b**₀ representing the Extended-Guaranteed-Time-Slot Distributed Channel Hopping (EGTS-DCH), **b**₁ representing the EGTS-Channel Adaptation (CA), **b**₂ representing the Time Slot Channel Hopping (TSCH), and **b**₃ is reserved. A bit shall be set to 1 if the corresponding frequency diversity scheme is supported and 0 if otherwise.

Additionally, if the source and destination PAN with respective PHY modes, both intending to employ a particular frequency diversity scheme, all corresponding frames facilitating that frequency diversity scheme shall be conducted using the CSM specified in [Table 1](#).

Table 2 Format of the PHY Mode Control subfield

Value	PHY Mode Description
0000	FSK
0001	OFDM
0010	OQPSK
0011 - 1111	Reserved

Editorial note: Add the following sub-clause

7.2.2.1b.3 Coex-beacon Payload field

The Coex-beacon Payload field is an optional sequence of up to *aMaxBeaconPayloadLength* octets specified to be transmitted in the coex-beacon frame by the next higher layer. The set of octets contained in *macBeaconPayload* shall be copied to this field.

Editorial note: Modify the following sub-clause

7.4.2 MAC PIB attributes

Editorial note: Add into the table as following:

Table 86 – MAC PIB attributes

Attribute	Identifier	Type	Range	Description	Default
<u><i>macCBSN</i></u>	<u>0x60</u>	<u>Integer</u>	<u>0x00-0xff</u>	<u>The sequence number added to the transmitted coex-beacon frame.</u>	<u>Random value from within the range</u>
<u><i>macCoexBeaconOrder</i></u>	<u>0x61</u>	<u>Integer</u>	<u>0-31</u>	<u>Specification of how often the coordinator transmits its coex-beacon. If <i>CBO</i>=31, the PAN is in non-beacon</u>	<u>0</u>

				<u>mode</u>	
<i>macOffsetTimeOrder</i>	<u>0x62</u>	<u>Integer</u>	<u>0-15</u>	Specification of the duration between the coex-beacon and the following beacon. If <i>BO=15</i> , this attribute shall be <u>ignored</u> .	15

Editorial note: Add the following sub-clause

7.5.1.5 Coex-beacon related timing

In a beacon-enabled PAN, besides the mandatory beacon at the beginning of every superframe, a coordinator shall transmit a coex-beacon in every or every multiple superframes. The superframe timing shall be specified as in [Figure 3](#).

The interval between two coex-beacon frames is described by the Coex-beacon Order, *CBO*. The *CBO* MAC PIB attribute *macCoexBeaconOrder* describes the interval at which the coordinator shall transmit its coex-beacon frames. The values of *CBO* and Coex-beacon Interval, *CBI* are related as follows: $CBI = aBaseSuperframeDuration * 2^{CBO}$ symbols.

The interval between a coex-beacon and the following outgoing beacon is described by the Offset Time Order, *OTO*. The MAC PIB attribute for *OTO* is *macOffsetTimeOrder*. The values of *OTO* and offset time duration, *OTD* are related as follows: $OTD = aBaseSuperframeDuration * 2^{OTO}$ symbols.

In a non-beacon-enabled PAN, the only related timing information is *macCoexBeaconOrder*, used to describe the interval between two coex-beacon frames.

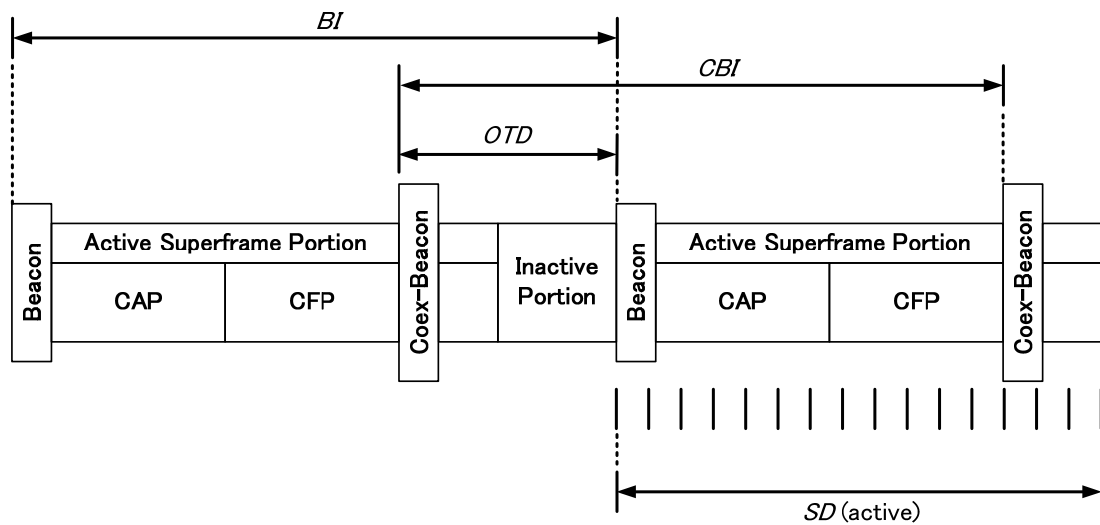


Figure 3 Illustrations of the timing information for coex-beacon frames

7.5.6.1 Transmission

Editorial note: add the following paragraph after the second paragraph

Each coordinator shall store its current coex-beacon sequence number (CBSN) value in the MAC PIB attribute *macCBSN* and initialize it to a random value: the algorithm for choosing a random number is out of the scope of this standard. Each time a coex-beacon frame is generated, the MAC sublayer shall copy the value of *macCBSN* into the Sequence Number field of the MHR of the outgoing frame and then increment it by one. The value of *macCBSN* shall be permitted to roll over.

Editorial note: modify the third paragraph as following:

It should be noted that ~~both~~ the DSN, ~~and~~ BSN and CBSN are 8-bit values and therefore, have limited use to the next higher layer (e.g. in the case of the DSN, in detecting retransmitted frames).

Editorial note: Add the following sub-clause

7.5.9 Inter-PHY-mode coexistence with coex-beacon frames

In order to effectively manage multiple networks with different PHY modes in the same location, the MPM management scheme specifies that all coordinators shall be able to transmit and receive CSM index 0 as given in [Table 1](#). A coex-beacon shall be sent in the CSM index 0.

In a beacon-enabled PAN, an existing coordinator shall transmit a coex-beacon in every

or every multiple superframes by using CSM index 0. The coex-beacon may be transmitted in any part of the superframe. Any incoming potential coordinator shall first scan for the coex-beacon for at least the duration of the *CBI* before starting its own network. If an incoming coordinator detects a coex-beacon, it shall occupy another channel, achieve synchronization with the existing PAN, or stop communication. While specific mechanisms to achieve synchronization between two PAN with different PHY modes are implementation-dependent, the timing information that are applicable for synchronization purposes are specified in the coex-beacon. The illustration of the procedure is given in [Figure 4](#).

In a non-beacon-enabled PAN, an existing coordinator shall transmit a coex-beacon periodically by using CSM index 0. The rest of the procedure is similar to that in a beacon-enabled PAN. The illustration of the procedure is given in [Figure 5](#).

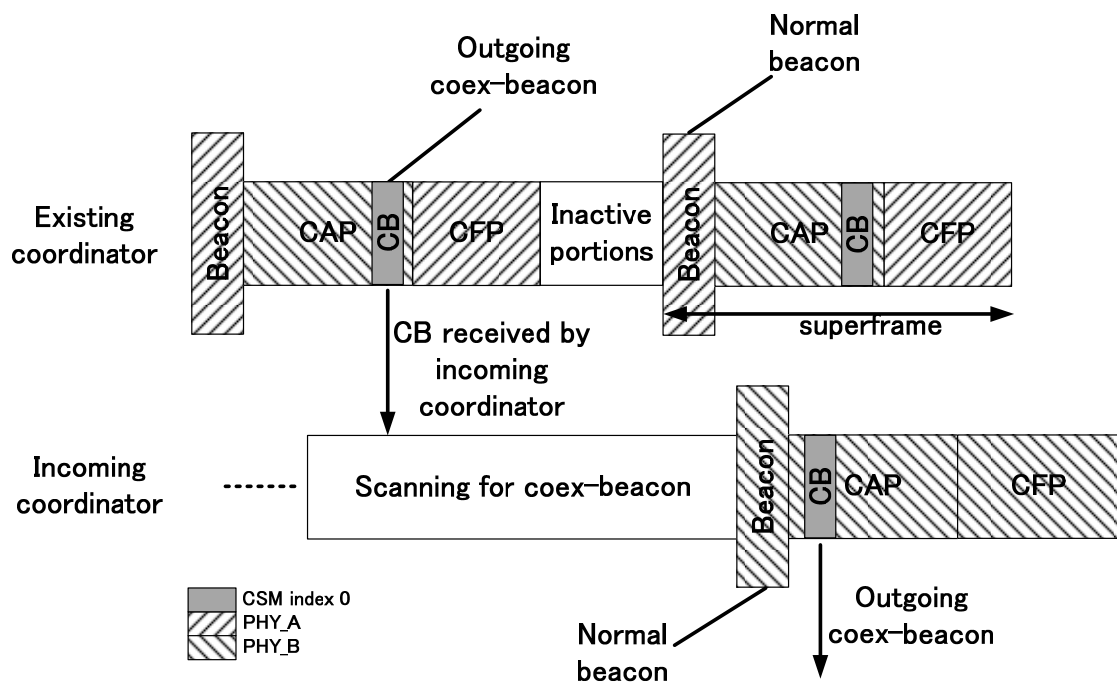


Figure 4 Inter-PHY-mode coexistence in a beacon-enabled PAN

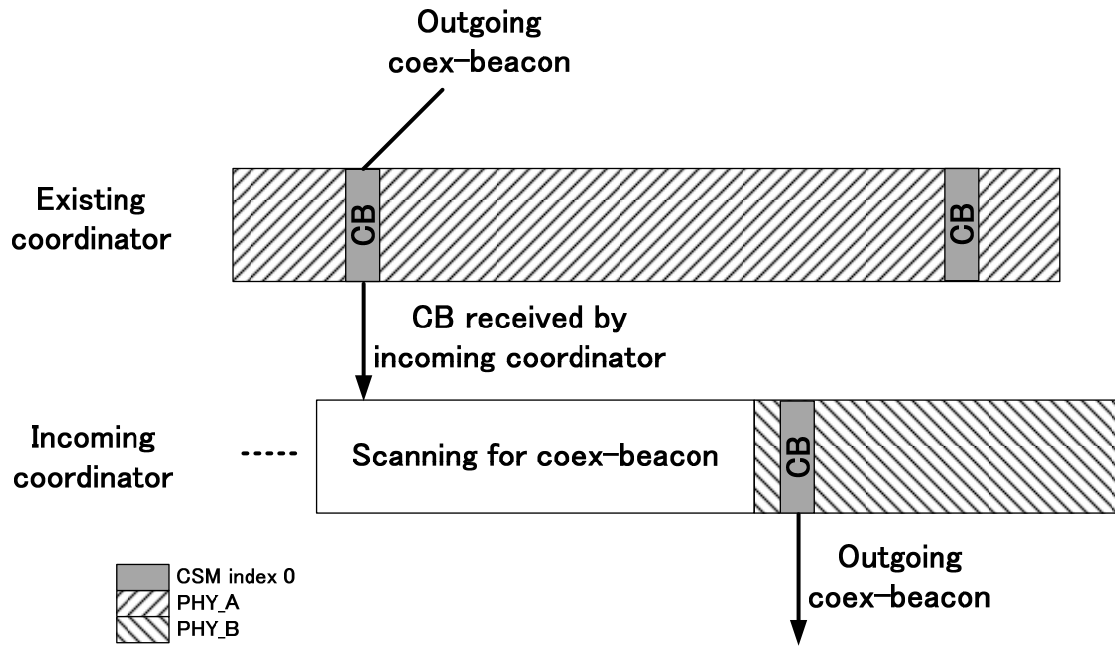


Figure 5 Inter-PHY-mode coexistence in a non-beacon-enabled PAN