

**IEEE P802.15**  
**Wireless Personal Area Networks**

Project	IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)	
Title	<b>TG3 Rolling Meadows Ad-Hoc Working Document</b>	
Date Submitted	[1 November, 2001]	
Source	[James P. K. Gilb] [Mobilian] [12707 High Bluff Dr., Suite 335, San Diego, CA 92130]	Voice: [858-436-2201] Fax: [858-436-2301] E-mail: [gilb@ieee.org ]
Re:	[]	
Abstract	[This document is contains the issues and resolutions developed by the TG3 subcommittee at the Rolling Meadows ad-hoc meeting. It also serves to document the addtions made to the draft standard D07 to produce D08.]	
Purpose	[To provide a record of the resolutions of TG3 and the changes to the draft standard D07 to make D08.]	
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## 1. Goals

- 1) Power Management Proposal and suggested wording  
Proposal by Jay Bain, 01/430r0, 01/429r1 - **Unused CTA bits - accept, need text. Null CTAs, accept in principle, but waiting for the details.**
- 2) Geographic coordinator selection and daughter network  
proposal by B. Huang, 01/304r3, 01/305r3 - **Cleanup and modify GIP to do reconfiguration, due at Austin. Child network only requires 1 extra information element, agreed that this is a good idea.**
- 3) Resolve QoS Policy and QoS MLME-primitives  
proposal by A. Heberling, 01/469r0, 01/470r0 - **Most of the text is complete, needs some work. Agree in principle to multiple possible convergence layers, the concept of a service flow and the commands at the MLME-SAP level.**
- 4) Security Proposal recommendation and wording  
Proposal by G. Rasor (SEC, Auth, Assoc), 01/423r0 - **Still waiting for proposal.**
- 5) Management control outside of the CAP  
Proposal by W. Shvodian, 01/xxxr0- **Direct approved, waiting text**
- 6) 11 Mb/s QPSK-TCM mode  
Proposal by J. Karaoguz, 01/448r0 - **DONE**
- 7) The rest of the prioritized issues list. (perform triage prioritization on issues and resolve the most important ones first.)

## 2. Agenda

Tuesday October 9th:

8:00 am Call meeting to order  
 8:01 am Approve/modify agenda  
 8:05 am Begin work on goals\* in the order listed  
 10:00 am Recess for break  
 10:20 am Meeting called to order  
 10:21 am Continue work  
 12:00 pm Recess for lunch  
 1:00 pm Meeting called to order  
 1:01 pm Continue work  
 3:00 pm Recess for break  
 3:20 pm Meeting called to order  
 3:21 pm Continue work  
 5:30 pm Recess for dinner

Wednesday, October 10th:

8:00 am Meeting called to order  
 8:01 am Continue work on goals  
 10:00 am Recess for break  
 10:20 am Meeting called to order  
 10:21 am Continue work  
 12:00 pm Recess for lunch  
 1:00 pm Meeting called to order  
 1:01 pm Continue work  
 3:00 pm Recess for break  
 3:20 pm Meeting called to order  
 3:21 pm Continue work  
 6:00 pm Recess for dinner

Thursday, October 11th:

8:00 am Meeting called to order  
 8:01 am Continue work on goals  
 10:00 am Recess for break  
 10:20 am Meeting called to order  
 10:21 am Continue work  
 12:00 pm Working lunch  
 1:00 pm Adjourn

Items to communicate:

- 1) Describe Protocol Implementation Conformance Spec. (PICS) to authors
- 2) SDL Scope and Effort

### 3. Items to resolve

#### 3.1 Power management/Wake on WPAN

Consensus is that we already have the mechanisms that allow the higher layers to perform Wake on WPAN. Suggestion is to provide text in an informative annex that describes how this feature can be used.

#### 3.2 Additions to 7.5.11 EPS Configuration request

Suggest following definitions

EPSTime has a range of 0 to 65,535 ms. A value of zero has the interpretation of DEVs waking for each superframe. Depending on the value of superframe duration parameter, values of EPSTime that are a value that is less than the current value of superframe duration are interpreted as wake for each superframe. Since wake time is bounded by superframe beacon location, the beacon start point preceding the completion of EPSTime shall be the wake point.

EPSPHase is a value of beacon number as defined in Piconet synchronization parameters element. The value is determined by the EPSSync parameter in the MLME-POWERMGT.request primitive. The current beacon number when that primitive is received by the SME is used for EPSPHase in building the EPS configuration request command.

EPSTime is OK, EPSPHase definition needs some work, perhaps a new name, the EPSPHase. EPSSync needs a definitions and rename it to EPSPHase.

EPSPHase is a value of beacon number as defined in xref. The value may be determined by higher layers, but this is not specified in the standard.

#### 3.3 MAX CTAs elements

The text says “maximum number of GTS slots that may be assigned to a DEV, where the DEV is either the source or destination, including group or multicast destinations.” However the elements does not have an AD-AD or device ID, so where is the DEV defined? Is it implicit, i.e. it is the DEV that is sending the element? If so, then the DEV cannot be a group or multicast destination.

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### 3.4 Coordinator selection, 8.2.3

We need to add text that all ACs that hear the PNC selection frame and are not currently associated with piconet shall participate in the coordinator selection process. Also need to add that ACs that are currently associated with a piconet shall not participate.

### 3.5 11 Mb/s QPSK-TCM mode

Agree to change BPSK mode to QPSK-TCM. Agree to modify the the current TCM encoder for the extra feedback path.

### 3.6 Max Burst Size definition

Sub-clause 7.5.20, figure 51. Proposed definition: Max Burst Size is the maximum number of octets that can be sent by a stream in any one superframe.

The max burst size is the maximum number of octets sent at the maximum data rate that can be received by the DEV. (This definition leaves out the duty cycle length which is required).

Upon further review, perhaps this should be deleted. Keep this as an issue. Review all of the parameters, which are really necessary without overly complicating the MAC.

## 4. Editorial changes

- 7.4.12 MAX CTAs element, reformat to match the previous sub-clauses in 7.4 and move the functional description to clause 8.
- Check the PNC handover process to make sure that we state that the current PNC checks the DEV-info table to find the most qualified AC to become the new PNC.
- 7.3.1 Add xref to the channel change element and the CTA element in table 58 verify the use of the correct terminology. Also, change the Device ID entry to be device identifier element with description “IEEE 802 address of the PNC, xref 7.4.1” Change to piconet synchronization element and xref in notes.
- 7.3.1 Add text that says that the beacon elements can occur in any order and that DEVs shall ignore information elements other than the ones defined.
- 7.4.6 Add pad byte for word alignment and text for how to handle the pad byte.
- 7.4.3 Fix the TBD in the PHY table mapping by adding the appropriate section to the PHY and the xref to it in 7.4.3.
- 7.4.2 Fix length parameter for piconet sychronization parameter.
- 7.3.3 and 7.3.4, define the SA and DA for the command and data frames.
- 7.5.1, 7.5.2, 7.5.3, Make notes that the PNC selection commands, and the association commands are never sent with other commands. Or perhaps better is to say that a command can only be piggy-backed with commands that are sent with the same SA and DA pair.
- 7.2.1.9 Note that the beacon shall not have the SEC bit set (perhaps this is true of the command frames?).
- 7.5.2 ATP definitions disagrees with 8.2.5 definition of ATP. Did we fix this since Schaumburg.
- 7.5.17 (D06) add xref to stream identifier element to the appropriate information element (stream ID)
- Page 97, change aa to a
- 7.5.21 Fix QoS paramters length in table 49, fix table sizing for table 51
- 7.5.21 Need to get a good definition for Max Burst Size
- Figure 27, change length of the individual elements to be 7 instead of 6.

- 8.8 The acronyms TPC and DCS are mentioned, but are not defined. It should be DFS rather than DCS. Perhaps delete this sentence.

## 5. Changes from conference calls

### 5.1 September 20, 2001

#### 5.1.1 Usage of RTC, issue 397

Shvodian suggested that RTC in Section 7.4.3, and the acronyms section be deleted because it is not currently used. Gilb agreed that we could delete it. There was consensus agreement to remove it and its references. There was consensus agreement to remove it and its references. We discussed what to do with the bit. Gilb suggested we make it the PS (power save) bit in this capability field. This makes PNC DES mode, and whether you are plugged into the wall, periodically posted to the network. This change showed that PS got dropped my mistake, and confused with a similar term

Action: Gilb will put PS (power saving) into 7.4.3 We also need definition. Shvodian opened issue 397 to "get rid of RTC bit and clean this up " and rename PS to PSAVE for power save.

Gilb suggested we re-look at positioning the bits in the order in which they are evaluated. Gilb will put them in order if it makes a difference. The assumption is that MSB is high bit and sent last. Rank high to low in order of comparison with AC in position 15.

Capabilities Field by bit number:.

15 AC, 14 PNC DES, 13 SEC, 12 PSRC, 11 PSAVE, 10-6 Max PHY rate, 5-0 is reserved.

Ed. Actions:

RTC references deleted in D08. PSAVE and PSRC bits added, the definition of the bits in D08 is:

The PSAVE bit is set to 1 if the DEV is planning to use sleep state as a part of power management. Otherwise the PS bit is set to 0. The PNC shall always set this bit to 0 in its capability field.

The PSRC bit shall be set to 1 if the DEV is receiving power from the AC (alternating current) mains and shall be set to 0 otherwise.

The power source field was deleted from table 64, 7.5.1.3 and from figure 21 (now a reserved byte) since it is now PSRC bit in the capabilities field.

The bits in figure 12 have been re-ordered as indicated above. I added a sentence to the beginning of 7.4.3 to explain the order of the bits in the capability field. The sentence that was added was:

Bits b11-b15 are arranged in order of preference for PNC selection, with the highest preference (AC) corresponding to the MSb

### 5.2 September 25, 2001

#### 5.2.1 PNC selection

Issue: Table 64 in D07 belongs in clause 8 rather than clause 7

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1 Resolution: Move Table 64 to 8.2.3

2  
3 Ed. action: Changed as indicated.

### 4 5 **5.3 September 27, 2001**

#### 6 7 **5.3.1 PNC-Des mode**

8  
9 Issue 229: Need to clarify the use of the Des-mode bit.

10  
11 Resolution: (none suggested)

12  
13 Issue 262: Definition of PNC-DES mode is not clear,

14  
15 Resolution: Should say: The PNC-Des-Mode is the designated mode of the DEV as currently set. The  
16 PNC-Des-Mode bit is set to one if the DEV is designated by a user to be PNC for the piconet. Otherwise the  
17 bit shall be zero. The PNC-Des-Mode bit shall always be set to zero if the DEV is not PNC capable.

18  
19 Issue 331: If the PNC-DesMode bit is set...

20  
21 Resolution: Please clarify the use of the PNC-DesMode bit.

22  
23 Ed. action: Based on email discussion, we adopted the following text:

24  
25 If more than one AC participates in the PNC selection process, then the AC receiving an alternate PNC selection com-  
26 mand from another AC shall compare the received PNC selection parameters with its own using the evaluation criteria  
27 defined in Table 64. If the AC finds that its parameters score higher than the received ones, the AC shall continue to  
28 broadcast the PNC-selection frame. If the AC finds that its parameters score lower than the ones received, the AC shall  
29 no longer send the alternate PNC selection command and wait for the piconet to start within the last received indicated  
30 timeout. Thus the DEV with the highest capabilities will be chosen as the PNC. The MAC address acts as a tie breaker  
31 for DEVs with identical capabilities, i.e. the highest MAC address will be chosen as the PNC.

32  
33 As Table 64 shows, PNC Des-Mode is the top priority field in the PNC selection criteria. Since the PNC Des-Mode is  
34 the highest priority, a DEV with this bit set is more likely to become the PNC of the piconet. Thus, this bit should be set  
35 if it is desirable for the DEV to be the PNC of the piconet. If only one DEV has PNC Des-Mode set, that DEV should  
36 become the PNC. If two or more DEVs that are competing to be PNC all have the PNC Des-Mode bit set, the rest of the  
37 capabilities are used to determine which of the DEVs will be the PNC.

### 38 39 **5.4 October 2, 2001**

40  
41 No items

### 42 43 **5.5 October 4, 2001**

44  
45 Issue 304: The ACK policy field definition is TBD

46  
47 Resolution: Defined by cross reference to 7.2.1.2 in 7.5.21 in D08

48  
49 Ed. action: Changed as indicated in D08.

50  
51 Issue: This paragraph referenced here is dependent upon there being a channel time request rejection indica-  
52 tion which does not exist. For instance, there is nothing in the CTA info elements to indicate a failure. And  
53 there is nothing in the Channel Time Grant to indicate a failure. The only command that provides the type of  
54

indication required here is the stream command when its Action Type field is set to a value of 3. Consequently, it is my opinion that this paragraph is broken and should be deleted from the document.

Resolution: Resolved in conference calls, details in the minutes.

Ed. action: The paragraph in question has been modified according to the minutes. Actual text follows:

The PNC may compute more than one superframe slot allocation at a time and keep them repeating over time until the situation changes. The allocation by the PNC may not exactly match the duration of time requested by a DEV. However, the allocation shall be at least the minimum requested by the DEV in the channel time request command except when the request is rejected. If the PNC allocates less time than requested but more than minimum, it shall allocate more time if it becomes available in the CFP. If the time slot is not allocated via the beacon, the DEV is free to request the time slot again.

Issue 259: The guaranteed start time parameter is redundant since the CFP duration and the superframe duration uniequely define the start of the CFP. One of these needs to be deleted.

Resolution: Guaranteed Start Time Removed

Ed. action: Changed as indicated in D08.

Issue 292: Not clear whether Tx and Rx frame count includes immediate ACKs.

Resolution: Add text "not including Imm-ACK frames" to each of the RX frame count items.

Ed. action: Changed as indicated in D08.

Issue 293: Does the Rx Frame Count include errored frames?

Resolution: Add the word "correctly"

Ed. action: changed as indicated. Paragraph now says:

The RX frames count is the total number of frames, not including Imm-ACK frames, that were correctly received by the sender of this command. Only the directed frames intended for this DEV are included.

Issue 283: Kus is not enough resolution for the Duration between time slots.

Resolution: Change Duration between time slots to be 2 bytes and change figure 25 number 6-8, also delete the pad byte and change length to  $n*8$ . In section 7.5.5.1, change the first sentence to "first block " and delete this size. Change Latency to "Stream" twice in the paragraph. On page 85, line 5 Change "kmicroseconds" to 8 us and do the range of requested time is 0 to 524280 us ( $(2^{16}-1)*8us$ ).

Ed. action: changed as indicated. New text for duration between time slots is given below:

The duration between transmissions indicates the requested frequency of time slots that needs to be allocated for the DEV. The resolution of this field is 8 ms and so the range of this field is [0-524280] ms.

## 5.6 October 16, 2001

Issue 102: Power Save Parm's are TBD.

Resolution: Not needed, deleted from D08.

Ed. action: Changed as indicated in D08.

1 Issue 260: When a DEV sends this element in one of its frames, for all the fields, it sends the same...

2  
3 Resolution: The frame formats only describe the organization of the frame, not their usage. The usage  
4 should be described in the MAC functional description. The sentence needs to be deleted anyway since this  
5 information element is only sent in the beacon by the PNC.

6  
7 Ed. action: Deleted in D08.

8  
9 Issue 313: The priority field in stream ID field contained in channel time request block...

10 Resolution: StreamID changed to stream control. Stream Control will be referenced.

11  
12 Ed. action: Lots of changes in D08, rename Stream ID to stream control which is 2 bytes. Use stream index as the handle  
13 for the specific stream, it is 1 byte.

14  
15 In 7.5.21.1, retransmission request, the Stream ID of 2 bytes was changed to stream index, 1 byte and the change in the  
16 length of the individual blocks was updated. Same change for 7.5.21.2 Retransmission sequence resync.

## 17 18 **5.7 October 18, 2001**

19  
20 Issue 102: 8 bit pkt window size only allows 256K Octets, which limits rate to 20 Mbps with a 100 ms  
21 superframe.

22  
23 Resolution: Receive Window Size needs to be increased to 2 Octets.

24  
25 Ed. action: Changed as indicated in D08.

## 26 27 **5.8 October 23, 2001**

28  
29 Issue 102: Why is minimum channel time in 32 us increments? Should be the same as requested channel  
30 time.

31  
32 Resolution: Change to 8 us, change to 2 bytes. Remove the pad byte that was added.

## 33 34 **5.9 October 25, 2001**

35  
36 Issue 394: Need to clarify how SME knows that the station is PNC when a piconet is started or when PNC  
37 handover occurs.

38  
39 Resolution: Add the following Sentence: ResultCode of SUCCESS indicates that the DEV is PNC. If  
40 another DEV is chosen as PNC or a piconet is already established, the result code shall be  
41 ALREADY\_STARTED\_OR\_SYNCHed

42  
43 Ed. action: The following sentence was added: A ResultCode of SUCCESS indicates that the DEV is the PNC. If  
44 another DEV is chosen as the PNC or a piconet is already established, the result code shall be  
45 ALREADY\_STARTED\_OR\_SYNCHed

46  
47 Issue 241 and 250: FCS should not be sent if frame body is zero bytes.

48  
49 Resolution: Add the following sentence: If the frame body has zero length (as in an immediate ACK frame)  
50 the FCS shall not be sent. In this case, the length of the FCS field is zero bytes. Change 4 in the FCS octets  
51 to 0 or 4.



Ed. action: Added sentence "If the frame body has zero length (as in an immediate ACK frame) the FCS shall not be sent."

## 5.10 October 30, 2001

Issue 369, change 11.2.7 to match definition of max frame body size in 7.2, change example in Table 76 to have a proper example.

Ed. action: change 11.2.7 to be:

The maximum frame length allowed, aMaxFrameSize, shall be 2048 octets. This total includes the frame body and FCS but not the PHY preamble, PHY header or MAC header.

The example in the table is:

An 11 bit field that contains the length of the frame body, in octets, MSB is b5, LSB is b15, e.g. 4 octets of data, is encoded as 0b00000000100. A zero length frame body is encoded as 0b00000000000 and there is no FCS for this packet.

Issue 336: ... Beacon frame transmission shall use RIFS for their transmission. Huh? Why?

Resolution: Please strike this sentence, it is technically incorrect.

Ed. action: changed the sentence to:

The beacon frame, which is neither in the CAP nor the CFP, does not use interframe spacing.

Issue 352: Figure 50 shows t=0 at the end of the header. Shouldn't it be at the beginning of the preamble?

Resolution: Please change the diagram to illustrate the correct reference Time-zero.

Ed. action: Changed as indicated in D08

## 5.11 November 1, 2001

Issue 351: ... at the end of the beacon header... relative to the end of the beacon header. ... where it expects the end of the beacon.

Resolution: Please change the indicated fragments to: ... at the beginning of the beacon preamble... relative to the beginning of the beacon preamble. ... where it expects the beginning of the beacon preamble.

Ed. action: Changed as indicated in D08

Issue 353: ... the accuracy of the timer to be +/-0.01% of its resolution. Comment: This doesn't seem sufficiently accurate. Particularly, since we are going to be specifying guardTime intervals. Guardtimes are going to be dependent upon the clock drift. Consequently, I see a need for a more precise specification here.

Resolution: Please provide the specification in PPM.

Ed. action: Changed as indicated in D08, text now reads:

A compliant implementation shall maintain the accuracy of the timer to be +25 ppm.

Item 295, Time Unit. This will be replaced with microseconds or milliseconds as Gilb sees fit. He will note all the changes so it is easier to review.

Ed. action: Changed TU for beacon period to ms in 6.3.3.1, 6.3.9.1. Changed TU in AuthenticationFailureTimeout to ms in 6.3.4.1

Issue 246: ... The PNID remains constant during the life of the piconet. The question regarding this sentence is: "Does this imply that the PNID is a transient value? Does this mean that when the PNC or the piconet AC go away, the PNID is not persistent?"

Resolution: Change the text indicated to: "... The PNID remains constant during the current instantiation of the piconet and may be persistent for multiple sequential instantiations of the same PNC initiated piconet.

Ed. action: Accept text except use "to instantiations of the piconet by the same PNC" in the place of "instantiation" Text now reads:

The PNID is a unique identificaion for the piconet. The PNID remains constant during the current instantiation of the piconet and may be persistent for multiple sequential instantiations of the piconet by the same PNC.

## 6. Static GTS, MTS - proposal by WMS, 01/476r0

### 6.1 Management Time Slots

#### 6.1.1 Clause 7.4.x Where to put CAP restriction bits? Piconet Synchronization IE?

Table or fig:

- B0 - Data in the CAP
- B1 - Commands (not including Association) in the CAP
- B2 - Association Command in the CAP
- B3 - EPS in the CAP

Frames of each type are only allowed in the CAP if the corresponding CAP restriction bit is set to one. If the CAP restriction bit is set to zero, those type of frames are only allowed in the CFP. The PNC may choose to limit the types of frames in the CAP so that it can minimize the size of or eliminate the CAP altogether.

Should no CAP be default or even the only mode?

Ed. action: this requires 2 new bytes (1 plus reserved). New figures and supporting text shown below

<b>Octet: 1</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>
Element ID	Length (=12)	Beacon number	Superframe duration	CFP duration	CAP MaxBurstDuration	CAP mode	Reserved

**Figure 1—Piconet synchronization parameters element.**

... (descriptions of the other elements)

The CAP mode indicates what type of information is allowed to be sent in the CAP of the current superframe. The encoding of this octet is illustrated in Figure 2. If a bit is set in the CAP mode field, i.e. its value is 1, then that type of

data or command is allowed to be sent in the CAP of the current superframe. Otherwise, that type of frame is not allowed to be sent in the CAP. The use of this command is described in 8.3.2

b0	b1	b2	b3	b4-b7
Data	Commands (except association)	Association commands	EPS	Reserved

**Figure 2—CAP mode field**

The paragraph describing the restrictions belongs in the functional description and has been added to 8.3.2 in D08. The added text is shown below:

The PNC controls what type of data or commands may be sent in the CAP via the CAP mode field of the piconet synchronization information element, 7.4.2, in the beacon. A DEV shall only send frames of the type indicated by the CAP mode field in beacon for the current superframe. The CAP mode field may be changed by the PNC from superframe to superframe.

### 6.1.2 New Clause 8.3.3 Slotted Aloha Access in MTS slots

Management Time Slots (MTSs) are identical to GTSs except that the PNC address (zero) is the source or the destination address in the CTA. An open MTS is an MTS where the source address in the CTA for the MTS is the broadcast address. Any DEV associated to the piconet can attempt to send a command frame to the PNC in an open MTS. An MTS with the association address as the SA in the CTA for the MTS is called an association MTS. Any station not currently associated to the piconet can attempt to send an association command to the PNC in an association MTS. Association commands are not permitted in open MTSs. Likewise, only association commands are allowed in association MTSs.

Slotted Aloha is the access mechanism in an open MTS or an association MTS. The access to an open or association MTS shall be controlled by a contention window  $CW_a$  maintained by each DEV. The contention window shall be derived from the number  $a$ , where  $a$  is the number of retransmission attempts made by the DEV. For the first access attempt,  $a$  shall be set to 0. The size of the contention window,  $CW_a$ , is defined as follows:

$$CW_a = \begin{cases} 256 & 2^{a+1} \geq 256 \\ 2^{a+1} & 2^{a+1} \leq 256 \end{cases}$$

The open or association MTS used for the  $a$ th retransmission attempt shall be chosen by a uniformly distributed random integer value  $r_a$  within the interval  $[1, CW_a]$ . The random number generator is not specified. The DEV shall start counting  $r_a$  from the open or association MTS slot in the next superframe. The lack of an ACK indicates the failure of the previous access attempt, but the presence of an ACK does not necessarily equal success for an association frame since all stations attempting to associate use the same unassigned SA. See clause 8.2.5 for a description of the Association process.

This first broadcast or unassigned MTS is specified by number ' $r_a=1$ '. The open or association MTS with number equal to  $r_a$  is the slot that the DEV shall access. The DEV shall not access the MTS before its counter has reached the open or association MTS with the number equal to  $r_a$ . After receiving an ACK,  $a$  shall be reset to 0.

Ed. action: Text that was added is given below.

#### 8.3.3.1 Management Time Slots

Management Time Slots (MTSs) are identical to GTSs except that the PNC address (zero) is the source or the destination address in the CTA. An open MTS is an MTS where the source address in the CTA for the MTS is the broadcast address. Any DEV associated to the piconet can attempt to send a command frame to the PNC in an open MTS. An MTS with the association address as the SA in the CTA for the MTS is called an association MTS. Any station not currently associated to the piconet may attempt to send an association command to the PNC in an association MTS. Association commands shall not be sent in open MTSs. Likewise, only association commands shall be sent in association MTSs.

The access mechanism for regular MTSs, i.e. neither open nor association MTSs, is TDMA, as described in 8.3.3.1

Slotted Aloha is the access mechanism in an open MTS or an association MTS. The access to an open or association MTS shall be controlled by a contention window  $CW_a$  maintained by each DEV. The contention window shall be derived from the number  $a$ , where  $a$  is the number of retransmission attempts made by the DEV. For the first access attempt,  $a$  shall be set to 0. The size of the contention window,  $CW_a$ , is defined as follows:

$$CW_a = \begin{cases} 256 & 2^{a+1} \geq 256 \\ 2^{a+1} & 2^{a+1} \leq 256 \end{cases} \quad (1)$$

The open or association MTS used for the  $a^{\text{th}}$  retransmission attempt shall be chosen by a uniformly distributed random integer value,  $r_a$ , within the interval  $[1, CW_a]$ . While the random number generator is not specified, it is important that designers recognize the need for statistical independence among the random number streams among DEVs. The DEV shall start counting  $r_a$  from the open or association MTS slot in the current superframe and continue across superframes. The lack of an ACK indicates the failure of the previous access attempt, but the presence of an ACK does not necessarily equal success for an association frame since all stations attempting to associate use the same unassigned SA. The association process is described in more detail in 8.2.5.

This first broadcast or unassigned MTS after the DEV begins the access process is specified by number ' $r_a=1$ '. The open or association MTS with number equal to  $r_a$  is the slot that the DEV shall access. The DEV shall not access the MTS before its counter has reached the open or association MTS with the number equal to  $r_a$ . After receiving an ACK,  $a$  shall be reset to 0.

### 6.1.3 Clause 8.12.3.5 Additional Traffic to EPS DEVs

Add the following paragraph:

If management time slots are used, the PNC shall only assign management time slots for a device in EPS mode during superframes when the EPS device is scheduled to be listening to the beacon.

Ed. action: Above text added to the end of 8.12.3.5

## 6.2 Static GTS

### 6.2.1 Clause 7.5.21 Figure 49

Change Reason code to 4 bits. Use 2 bits for GTS type. 2 bits reserved.

Note: Modified stream management command appears below.

Ed. actions: Reason code modified, see 6.3.2 in this document.

### 6.2.2 Clause 8.3.3.1

Add the following sentence:

There are three types of GTS: dynamic GTS, Static GTS and pseudo-static GTS. The type of GTS slots are indicated in the stream management command as specified in 7.5.21.

### 6.2.3 New Clause 8.3.3.1.1 Dynamic Guaranteed Time Slots

The PNC is free to move dynamic GTSs within the superframe on a superframe by superframe basis. This allows the PNC the flexibility to rearrange GTS assignments to optimize the utilization of the slot assignments. The PNC can move a dynamic GTS by simply changing the CTA parameters in the Beacon.

### 6.2.4 New Clause 8.3.3.1.2 Static Guaranteed Time Slots

The PNC is not allowed to move the position of a static GTS slot in a superframe after the GTS has been assigned. Static GTSs require a stream connection - non stream GTSs cannot be static. The indication of the type of GTS is contained in the Stream Management command. DEVs can request a change in a static Slot channel time using the Channel Time Request command.

### 6.2.5 New Clause 8.3.3.1.3 Pseudo Static Guaranteed Time Slots

Pseudo static GTSs can be moved by the PNC, but the PNC must notify the affected DEVs by sending them acknowledged Channel Time Grant frames with the new CTA. As with dynamic GTSs, the PNC can rearrange pseudo static GTSs so that the GTS assignments can be optimized, but it must use the Channel Time Grant and coordinate the channel time grants with the CTAs in the beacon.

Before a pseudo static GTS is moved, the PNC shall ensure that the new position is unoccupied by another GTS. Then, the PNC sends a directed channel time grant to the receiving DEV so that the receiving DEV is listening to both the old GTS position and the new position. This channel time grant contains both the old and the new CTA. If the old and the new position overlap, the CTA can be one larger CTA.

Next the PNC sends a channel time grant to the transmitting DEV that contains only the new CTA. By moving the receiver first, the PNC ensures that no frames are lost if Channel time requests are corrupted.

Lastly, the PNC sends a channel time grant to the receiving DEV which only contains the new CTA.

DEVs can request a change in a pseudo-static Slot channel time using the Channel Time Request command.

(Figure here, not reproduced) Figure 1 CTA Assignment Sequence for pseudo-static GTSs

Ed action: The text added is given below:

There are three types of GTSs: dynamic GTS, static GTS and pseudo-static GTS. The type of a GTS is indicated in the stream management command as specified in 7.5.22.

The PNC may move dynamic GTSs within the superframe on a superframe by superframe basis. This allows the PNC the flexibility to rearrange GTS assignments to optimize the utilization of the slot assignments. The PNC moves a dynamic GTS by simply changing the CTA parameters in the beacon.

The PNC shall not move the position of a static GTS slot in a superframe after the GTS has been assigned. Static GTSs require a stream connection - non stream GTSs shall not be static. The indication of the type of GTS is contained in the Stream Management command. DEVs may request a change in a static slot channel time using the channel time request command, 7.5.21.1.

Pseudo-static GTSs may be moved by the PNC, but the PNC needs to notify the affected DEVs by sending channel time grant frames, 7.5.21.2, with the new CTA. As with dynamic GTSs, the PNC may rearrange pseudo static GTSs so that the GTS assignments will be optimized, but it must use the channel time grant command and coordinate the channel time grants with the CTAs in the beacon.

Before a pseudo static GTS is moved, the PNC shall ensure that the new position is unoccupied by another GTS. Then, the PNC shall send a directed channel time grant to the receiving DEV so that the receiving DEV is listening to both the old GTS position and the new position. The channel time grant shall be acknowledged with an Imm-ACK by the DEV if it is received correctly. If the PNC does not receive an Imm-ACK, it may re-send the channel time grant command, but it shall not continue with the process until the acknowledgement is received. The channel time grant sent by the PNC to the receiving DEV contains both the old and the new CTA. If the old and the new position overlap, the CTA may be one larger CTA.

The PNC shall then send a channel time grant to the transmitting DEV that contains only the new CTA. The transmitting DEV shall acknowledge with an Imm-ACK if it is received correctly. If the PNC does not receive the Imm-ACK, it may re-send the channel time grant command, but it shall not move the pseudo-static GTS until the acknowledgement is received. By moving the receiver first, the PNC ensures that no frames are lost if channel time requests are corrupted.

Finally, the PNC shall send a channel time grant to the receiving DEV which only contains the new CTA. The receiving DEV shall acknowledge this command with an Imm-ACK if it is received correctly. If the PNC does not correctly receive the acknowledgement, it may re-send the channel time grant command. However, the PNC may re-allocate the original pseudo-static GTS even if it does not receive the acknowledgement to the command.

Throughout the process, the PNC will ensure that the beacon contains the current CTAs for the pseudo-static GTS that it is moving.

DEVs may request a change in a pseudo-static GTS channel time using the channel time request command.

A graphical illustration of the procedure for moving a pseudo-static GTS is illustrated in Figure 3

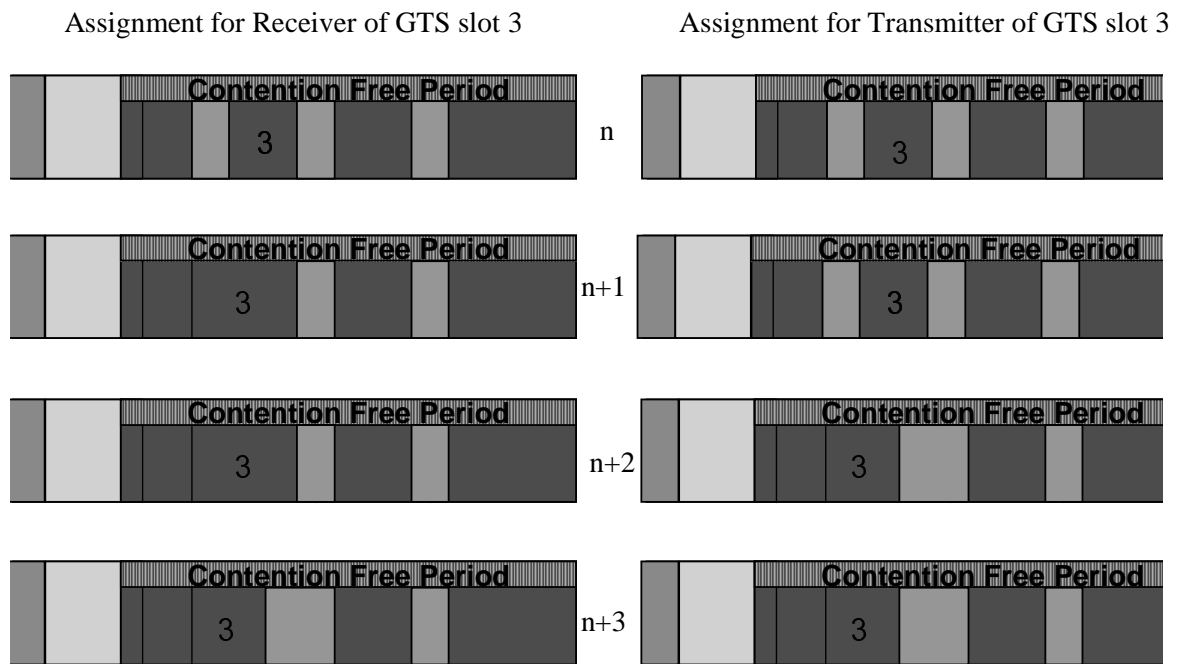


Figure 3—CTA assignment sequence for pseudo-static GTSs

**6.2.6 Modified Clause 8.3.3.2 paragraph 1**

The DEVs associated with a PNC shall send their changes in channel time requirement whenever they wish to make a change. Once a request for channel time is received from a station, the PNC shall remember that as the outstanding request for every superframe until, a change in request is received from the DEV. In addition to this the PNC shall make use of the properties of the stream provided during the stream connection process. The slot assignments within the CFP are based on the current pending requests from all the DEVs and the currently available channel time within the CFP. The slot assignments for dynamic GTS may change

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from superframe to superframe as required by the PNC. A lot assignments for pseudo-static GTS slots require directed channel time grant commands. All of the slot assignments are broadcast in the beacon. The PNC may announce the slot assignments in directed or broadcast channel time grant command in addition to the announcement in the beacon. However, additional announcements by the PNC shall not change from what was broadcast in the beacon. The start time of all the GTSs are with reference to the start of beacon frame, whether they were announced in beacon or channel time grant command. The algorithm used to allocate the channel time and assign slots is beyond the scope of this standard. Channel time requests that are ACKed are valid until the next channel time request is made.

Ed. actions: Text added to D08, changed sentence “A lot ... commands.” to “Changes to the assignments of pseudo-static GTSs require directed channel time grant commands, xref”.

**6.2.7 Modified Clause 8.3.3.2 paragraph 4**

In any superframe there may be one or more DEVs in the piconet that receives the Beacon in error. This may not happen to the same DEV all the time but may happen to different DEVs at different times depending upon their location and type of interference they are subjected to. If a DEV did not receive the ~~CTA information~~ beacon correctly, it shall not access the ~~channel dynamic GTS~~ channel dynamic GTS during CFP. Stations with static or pseudo static GTS(s) are allowed to transmit during these GTS(s) as long as the number of consecutive lost beacons is less than or equal to MaxLostBeacons. A DEV shall stop transmitting in its static and pseudo-static GTS when the number of consecutive lost beacons exceeds MaxLostBeacons.

The channel time grant command gives the flexibility to the PNC to broadcast the CTA information during the superframe in addition to the beacon. This increases the chances of all DEVs obtaining the allocation information. In addition, this also provides the flexibility to the PNC to help preserve the QoS by sending directed channel time grant command to a DEV that may be experiencing more than usual channel errors during certain time segments. The PNC may use the channel statistics to decide whether to send such a directed channel time grant command. Note that when channel becomes too severe for the DEV to receive the beacon, the directed channel time grant command or the data frame itself there is little help that can be provided to that DEV through these channel time grant commands.

Ed action: Text added, minor editorial changes. aMaxLostBeacons is an xref to a TBD at the end of the MAC functional description. New paragraph is below:

In any superframe there may be one or more DEVs in the piconet that receives the beacon in error. This may not happen to the same DEV all the time but may happen to different DEVs at different times depending upon their location and type of interference to which they are subjected. If a DEV did not receive the beacon, it shall not access any dynamic GTSs during CFP. Stations with static or pseudo static GTS(s) are allowed to transmit during these GTS(s) as long as the number of consecutive lost beacons is less than or equal to aMaxLostBeacons.. A DEV shall stop transmitting in its static and pseudo-static GTS when the number of consecutive lost beacons exceeds aMaxLostBeacons.

**6.3 Modified Stream Management Command**

Reserved Byte for max Delayed ACK frames in stream Mgt Command (Issue 310) and source/target address field in stream management command (Issue 400)

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**6.3.1 Figure 49 Modified Stream Management Command**

Octets: 2	2	2	1	1	1	1	1	1	20
Command type	Length (=30)	Stream request identifier	Originator AD-AD	Target AD-AD	DSAA	Max Frames (delayed ACK)	Reason code/GTS type	reserved	Stream QoS parameter

Note: Reserved field will not be needed if the stream QoS parameters become odd after pending changes.

Ed actions: New table shown below: I have not added a reserved field pending the outcome of the Stream Oos paramters evaluation.

<b>Octets: 2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>20</b>
Command type	Length (=26)	Stream request ID	Originator AD-AD	Target AD-AD	Max Frames (del-ACK)	Control Information	Stream QoS parameters

**Figure 4—Stream management command format**

**6.3.2 New Figure Reason code / GTS Type field (after figure 50)**

4 bits	2 bits	2 bits
Reason Code	GTS Type	reserved

Ed actions: this is merged with DSAA which was temporarily frame policy, now management infromation field, shown below:.

<b>Bits b0:b1</b>	<b>b2:b3</b>	<b>b4:b6</b>	<b>b7</b>	<b>b8:b11</b>	<b>b12:b13</b>	<b>b14-b15</b>
Action Type	ACK Policy	Security	Direction	Reason code	GTS type	Reserved

**Figure 5—Control information field in the stream management command**

**6.3.3 Replace line 50 and 51 of page 95 with the following:**

The Originator AD-AD is the 8 bit address of the originator of the stream management command. The Target AD-AD is the 8 bit address of the target of the stream management command.

Ed action: text added, exact text is listed below.

The originator AD-AD the allocated address of the DEV that is the originator of the stream manament command. Depending on the value of the direction field, this DEV may be either the source or the destination of the stream.

The target AD-AD is the allocated address of the DEV that is the target of the stream managment command. Depending on the value of the direction field, this DEV may be either the source or the destination of the stream.

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**6.3.4 Add the following text after line 29, page 96:**

Max Frames specifies the maximum number of frames that can be outstanding when the ACK policy for the stream is Delayed ACK.

Ed action: text added, exact text is listed below:

The max frames field specifies the maximum number of frames that can be outstanding when the ACK policy for the stream is Del-ACK.

**7. Power management additional proposals, 01/430r1**

Proposal by Jay Bain and Mark Schrader

Global change: Through the document, change occurrences of EPSPhase to EPSNext.

Ed action: Global find/replace accomplished in D08.

**7.1 Add new section following 8.12.3.3 and before existing 8.12.3.4**

**8.12.3.4 Control of remote equipment power**

Operations of EPS and AWAKE modes are extended into the equipment a DEV is incorporated into (DEV-host). MLME-POWERMGT.request and indicate primitives provide parameters to facilitate power saving in the equipment.

The MLME-POWERMGT.request Wakeup parameter causes a Switch to AWAKE CTA mode or Switch to EPS CTA mode to be sent to an EPS DEV. The EPS DEV receiving this command shall provide the MLME-POWERMGT.indicate primitive parameter PeerWakeup to its DEV-host.

The PeerWakeup parameter shall also provide indication that a packet has been received as a result of operation in EPS mode either with low duty cycle periodic information or momentary information. For each received packet while in EPS mode, the MLME-POWERMGT.indicate primitive shall be generated.

Annex xx provides information to achieve the appropriate power management benefits both in the EPS DEV and the DEV-host.

PS editor note: the following annex information is a placeholder for text to be added based on doc 01/430r0 and decisions reached in Rolling Meadows

Annex xx Considerations for power management in DEV-hosts

Informative

Power management techniques described in this standard are specific to the equipment that represent the PHY and MAC. This informative annex considers the relationship of power management in the DEV-host to the power management in the EPS DEV.

Remaining text TBD

Ed. action: text added to D08 and new annex (A). Also added a definition for device-host and acronym definitions for DEV and DEV-host. The definition is:

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**3.8 device:** A device that implements an IEEE P802.15.3 conformant media access control and physical layer interface to the wireless medium.

**3.9 device-host:** The equipment that incorporates and IEEE P802.15.3 device. The device-host may have more than one device incorporated in it as well as other networking connections, both wired and wireless.

## 7.2 Add the following in the 7.5.11 EPS configuration request

New descriptions -

EPSTime has a range of 0 to 65,535 milliseconds. A value of zero has the interpretation of DEVs waking for each superframe. Depending on the value of superframe duration parameter, values of EPSTime that are a value that is less than the current value of superframe duration are interpreted as wake for each superframe. Since wake time is bounded by superframe beacon location, the beacon start point preceding the completion of EPSTime shall be the wake point.

EPSNext is a value of beacon number as defined in Piconet synchronization parameters element. EPSNext informs PNC or DEVs where the next EPSTime will occur. For this command the value of EPSNext is taken from the EPSSync parameter in the MLME-POWERMGT.request primitive. The current beacon number when that primitive is received by the SME is used to calculate the beacon number for the next EPSTime event and inserts that beacon number as EPSNext in building the EPS configuration request command.

Ed. action: Added the following text (minor editorial changes).

EPSTime has a range of 0 to 65,535 ms. A value of zero indicates that the DEV is waking for each superframe. Depending on the value of superframe duration parameter, values of EPSTime that are less than the current value of superframe duration indicate that the DEV wakes for each superframe. Since the wake time is bounded by superframe beacon location, the beacon start point immediately preceding the completion of EPSTime shall be the wake point.

EPSNext is a beacon number as defined in piconet synchronization parameters element, 7.4.2. EPSNext informs the PNC or DEVs when the next EPSTime will occur. For this command, the value of EPSNext is taken from the EPSSync parameter in the MLME-POWERMGT.request primitive. The current beacon number when that primitive is received by the SME is used to calculate the beacon number for the next EPSTime event and inserts that beacon number as EPSNext when building the EPS configuration request command.

## 7.3 Replace the existing 6.3.1.3 MLME-POWERMGT.indication with the following

### 6.3.1.3 MLME-POWERMGT.indication

This primitive reports power management changes from a specific peer (peer, master, and slave) MAC entity. The primitive parameters are as follows

```
MLME-POWERMGT.indication      (
                                PeerPowerManagementMode,
                                PeerPowerManagementRole,
                                PeerWakeup,
                                PeerEPSTime,
                                DeviceID,
```

#### 6.3.1.3.1 When generated

This primitive is generated by the DEV as a result of a command or activity by another DEV in the piconet.

#### 6.3.1.3.2 Effect of receipt

**Table 1—MLME-POWERMGT.indication primitive parameters**

Name	Type	Valid Range	Description
PeerPowerManagementMode	Enumeration	POWERED, RPS, EPS	Indicates the Power management mode of the peer
PeerPowerManagementRole	Boolean	True, False	Indicates the Power management role of the peer
PeerWakeup	Enumeration	EPS, ACTIVE, SHORTTERM	An indication that a mode change has occurred based on network information as described in clause 8
PeerEPSTime	Integer	65,535 ms	EPSTime from a specific peer. This should match sent EPSTime. If not, this is a negotiation request
DeviceID	MAC Address	Any valid individual MAC address.	Identifies the source of the indication primitive

The SME is notified of changes in power management configuration or to wake up for information reception.

Ed. action: Table in D08 updated to include new parameter definitions and additional text listed above.

## 8. Corrections suggested by Wim VanHouton

(all references to D07)

o) On page 133 line 7 you wrote: ".....the first symbol of the PHY header....." but it should be at my opinion ".....the first symbol of the PHY preamble....."

Changed as indicated in D08.

oa) On Page 133 line 24 you use the word MPDU, this is not by my opinion, the commonly used terminology within the 15.3 standard.

Changed to "The maximum frame length allowed" in D08.

ob) On page 133 line 25 you wrote MAC Header or HCS, but Figure 3 on page 66 shows that HCS is part of the MAC header.

"or HCS" deleted in D08, text now says "... not the PHY preamble, PHY header or MAC header."

i) On page 135 line 49 .....above is given... should be at my opinion.....above are given.....

Changed to "... above are given ..." in D08.

ii) On page 137 line 10 till 12: The higher.....to right. This sentence is in my opinion not adding a lot, I have to be honest. I actually do not understand the meaning of this statement. Should it be possible to leave this out and only writing: The decimal representations of the bitmapping..... (line 13 and further)

This is an informative comment to explain why we chose this mapping. However, we will try to improve the explanation in D09.

iii) On page 140 line 45 Section 11.3.4 is called QPSK modulation but if I read further it is actually Differential QPSK (DQPSK), is it not sensible to talk about DQPSK instead of QPSK also for BPSK in the whole document? I can not clearly ditinguish what is differntial modulated and what is not.....

Change QPSK to DQPSK in PHY, BPSK will changed to QPSK-TCM in either D08 or D09.

iv) On page 140 line 48 regarding differential encoding What is the starting dibit for the DQPSK modulation (the reference dibit for the first phase change....)

Added sentence in D08 to clarify the issue: "The phase change of the first symbol is determined relative to the phase of the last symbol in the CAZAC sequence, 11.4.6."

iva) On page 140 line 53 you stated that differential encoding gives you the possibility for non coherent reception, but the CAZAC sequence (PHY preamble) is not differential encoded so you need a coherent "like" reception anyway (carrier offset compensation, equalization), don't you agree.....?

To get the most information out of the CAZAC sequence, you would do soft decisions with a coherent receiver. However, you can still get useful information (particularly AGC and packet timing) with differential detection. We discussed this particular issue before adopting the differential encoding. No change made, request the commenter withdrawn his objection.

v) In Table 74 on page 141 there is written pi in stead of \pi.

Changed to \pi in D08, thanks.

va) On page 141 line 23 you wrote PHY header , MAC header and HCS but in Figure 3 on page 66, the HCS is shown as part of the MAC header. Do you mean FCS or uses this field the same modulation as the Frame body?

Changed to "PHY header and MAC header" in D08.

vb) On page 141 line36 you also talk about MAC header and HCS.....

The text ", HCS" deleted in D08.

vi) The header of Table 75-Scramber seed selection should be Table 75-Scrambler seed selection.

"Scrambler" spelled correctly in D08.

vii) On page 143 line 3 you use octets in stead of bytes, why?

Octets is a carry over from 802.11 where they may have picked it up from someone else. The rest of the draft uses octets instead of bytes, so I have changed all occurances of bytes to octets in the PHY clause as well. Change completed in D08.

viii) In Table 76 you miss the reference Table 75 for the dibits b0-b1.

Cross reference to the scrambler seed selection table added to D08 (xref is to table 75)

ix) The content field of Table 76 for b5-b15 there is written Freme body length and this should be Frame body length

"Frame" correctly spelled in D08

x) In Table 77 is not clear if b2 is the most right bit or the one just to the right of the x.

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The table now has 5 columns, the last three are for b2, b3 and b4, to clarify the mapping.

xi) On page 143 line 44 you talk about the end of the message payload, but I did not see the definition in the frame format. In my opinion you should use something like the end of a packet after the FCS.

Text is changed to "... added to the end of frame body, i.e. after the FCS, ..." in D08.

xii) On page 144 line 48 and further, you talk about tail symbols for QPSK and BPSK, but in this mode no-trellis encoder is used, why do you need tail symbols then?

The reason is that it allows soft symbol detection of DQPSK modulation in a clean manner with a very tiny impact on the overhead. While this is not required, an implementer could use this technique to improve performance of the modem. Do you think a description of why it was chosen will be useful?

xiii) On page 145 line 22 you use: "...added before the message payload" but, by using the same terminology as in Chapter 7 and section 11.4.2 of the standard, it should be in my opinion something like: "A PHY preamble shall be added before the PHY Header, MAC header....."

Good catch, the preamble goes in front of the PHY header, not the message payload. The text reads "... shall be added prior to the PHY header ..." in D08 now.

xiv) On page 148 Table 80 there is no EVM for BPSK

With the change of BPSK to QPSK-TCM, the EVM for DQPSK will apply to QPSK-TCM and BPSK EVM will not be necessary.

xv) On page 148 line 17 you wrote 6 MHz of the center frequency, is this -3 MHz and +3 MHz or -6 MHz and +6 MHz or only + 6 MHz?

Changed text to read "... measured within +/- 6 MHz of ..." in D08

xvi) On page 148 line 12 the transmit mask is specified, why is the transmit mask specified and not the type of filtering at the transmitter and receiver i.e. raised cosine with a certain roll-off.....?

We discussed this at various meetings. The reason is that the filter is an implementation detail whereas the spectral mask directly affects the adjacent channel performance (regardless of the type of the filtering). There was a proposal to provide a recommended filter, but that text has not yet been approved. Note that it is not sufficient to specify a raised cosine filter with excess bandwidth parameter since an implementation must use an approximation to the filter. The recommended filter should specify what approximation is sufficient.

xvii) On page 149 line 17 you wrote: "...the emissions conform with...." it should be at my opinion "...the emissions conform with...."

Changed "... the emissions should also conform with the ..." to "... the emissions should also conform to the ..." in D08.

xix) On page 150 line 5 till 9 you use MPDU and MAC Header and the HCS, same remarks as above...

Changed "... only the MPDU of 1024 bytes, but also the PHY preamble, PHY header, MAC header and the HCS." to "... only the frame body of 1024 octets, but also the PHY preamble, PHY header, MAC header and FCS." in D08.

Also changed "... with an MPDU length of 1024 bytes ..." to "... with an frame body length of 1024 octets ..." in the prior paragraph in D08.

xx) On page 150 line 16 you wrote: "sensitivity is listed in Table 83" it should be at my opinion "sensitivity listed in Table 83"

Extra "in" removed, now reads "... reference sensitivity listed in Table 83 ..." in D08.

xxi) On page 150 line 47 you wrote: ".....is the alternate channels Channel....." it should be at my opinion ".....is the alternate channel. Channel....."

Changed as indicated in D08.

xxii) On page 150 line 53 you wrote ".....one of the four modulation....." it should be at my opinion ".....one of the five modulation....."

Changed as indicated in D08.

xxiii) On page 151 the field in the right lower corner of Table 84 should be 16 dB i.s.o. 16 db.

Capitalization of dB fixed in D08.

xxiv) On page 151 line 29 and line 38 interferred should be at my opinion interfering.

Spelling on line 29 corrected (it was spelled correctly on line 38) in D08.

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