IEEE P802.11
Wireless LANs

Comments Resolution for Letter Ballot 15

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Abstract

A compilation of the comments received on letter ballot 15 for the TGb draft standard. This consists of a table with all the comments and a column of resolutions along with the suggested draft text of two sections and edited draft text of a poor (the original is in FrameMaker) copy of the text.

resolution #	users #	para	voter	E/T	part of no vote?	Comment	fix suggested by commenter	editor’s comments
1	1	Front Page	VH	E	N	Second line declares this to be a revision, while we are having a supplement	Replace "Revision of" by "Supplement to"	DONE

2	**2**	**Front Page**	**VH**	**E**	**N**	**The title of the document should be exactly the same as the title mentioned in the PAR**	**Change the title into: "STANDARD [FOR] Information Technology-Telecommunications and information exchange between systems-Local and Metropolitan networks-Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher speed Physical Layer (PHY) extension in the 2.4 GHz band"**	DONE
3	**7**	**General**	**VH**	**E**	**N**	**The headers do not look properly made**	**Check the following proposal with the IEEE editor:** **On left hand side pages:** **Second line, right hand side:** **DRAFT SUPPLEMENT TO STANDARD FOR LAN/MAN PART 11: MAC & PHY SPECIFICATIONS:** **On right hand side pages:** **Second line, left hand side:** **HIGHER SPEED PHYSICAL LAYER IN THE 2.4 GHz BAND**	OK EDITOR will fix
4	**6**	**Participants**	**VH**	**E**	**N**	**This section will be completed by the IEEE editor at the time of publication readiness work. It will contain all those that were Voting member at the approval meeting to start Sponsor ballot extended with those that made extended contributions**	**Remove all the names from the draft**	**remove names** **DONE**
5	**1**	**Introduction**	**M BS, CH**	**E**	**NO**	**Misspelled name**	**Change Mathew Shoemake to Matthew Shoemake**	**remove all names** **DONE**
6 P	**1**	**-**	**SB**	**T**	**-**	**New PHY must have new PICS section (mandatory)**	**Generate new PICS**	
7P	**24**	**none**	**JZ W**	**T**		**There is no PICS Proforma. I believe this is a requirement for the document to go to sponsor ballot.**	**Add a PICS Proforma.**	**Add PICS Proforma**

8	8	General	VH	E	N	This standard is a supplement to the existing standard and should therefore contain instructions to changes to be made to the clauses from the main standard	Add the following clauses: Definitions, Abbreviations and acronyms, Physical Layer service specification (if needed), PHY management, Protocol Implementation Conformance Statement Proforma, ASN1 encoding of the MAC and PHY MIB	Since this is a part of the main document, Definitions, Abbreviations and acronyms, are taken care of there. If any new are needed, then we will add them to this supplement. Add MIB and PICS EDITOR
9E	23	none	JZW	T		There is no PHY MIB. The MIB needs to have controls for setting the PLCP header length and the modulation type.	Add a section with a MIB, and add references (as asked for in my other comments) to the items in the MIB where needed.	Add MIB and PICS
10	2	Table of Contents	MBS, CH	E	NO	Table of Contents does not include subsections. Subsections are included in the Table of Contents in IEEE Std 802.11-1997	Incorporate subsections into the Table of Contents	OK, but to what level? EDITOR
11	9	general	JZW	E		The term "MPDU" is used in what I believe to be an inappropriate sense throughout the document. The PHY does not send MAC Protocol Data Units – it exchanges PHY Protocol Data Units that contain PHY Service Data Units. The MAC uses the PHY service, so each MPDU corresponds to a PSDU that is carried in a PPDU.	Use "PSDU" instead of "MPDU" throughout.	accepted
12	13	General	VH	E	N	Some references to figures and subclauses are wrong	Make all references to figures, tables and subclauses should be automatic, so that if material is inserted, there does not need to be manual updates	EDITOR
13	3	General	VH	E	N	It is hard to point to certain text if there are no line numbers mentioned	Include line numbers	EDITOR
14	4	General	VH	E	N	All replaced text should be in strike through text, new text should be underlined and changes must be marked in the margin by a line A document Dx.0 is always a document without revision marks. The editor uses the revision marks feature through the various versions. To keep track of versions made available during the meetings, he uses versions	Please implement this feature	EDITOR

						Dx.0L where the L is an a, b, c ….. As soon as the editor has done his job, he will make a version Dx.# where # is a number 1, 2, 3,…. And that document will go on the web. If at a next meeting, there will be another set of changes, the editor will use the version Dx.1L. If a letter ballot is started, he will also make a version without revision marks which will have the version Dx+1.0.		
15	14	Global	VH	E	N	In many places the text reads "high speed" or "HS" where "high rate and "HR" are supposedly meant.	Do a global replace from speed to rate and from HS to HR	Do a global replace from speed to rate and from HS to HR DONE
16	2	Many	SB	E	-	General review of language required throughout. Shall is the recommended term for a mandatory requirement, I think it is may for an optional Example is last sentence of 18.2.2 …' Acknowledgements to high rate packets may not use the FH PLCP' … I think this should be shall … else it is optional not to use the FH PLCP !	General editorial review	Go through and fix. For the specific example, it was intended that this be read as optional EDITOR
17	15	various	CT	E		various table and figure numbering mismatches	correct them on later versions	EDITOR
18	1	18	AS	E	N	I think we should assume this is a standalone document so numbering it Clause 18 is probably not the right thing. In addition we should reference clauses and figures in the existing 802.11 standard with a complete reference.		The chosen technique was to make it a supplement to be included into the standard, but stand alone as a clause. REJECT.
19	2	18.1	AS	E	N	I think the second sentence needs to say something other than initially. This is no longer an initial RF LAN.	Delete the word initially	DONE
20	3	18.1	AS	E	N	Fix the reference in paragraph 1	I think it should be 18.4.6.2	EDITOR
21	15	18.1	VH	E	N	1st §, 3rd line: ISM band is a non-existing term	Replace GLOBALLY "ISM band" by "band designated for ISM applications"	DONE
22	16	18.1	VH	E	N	1st §, last line: reference is wrong	Replace 1.4.6.2 into 18.4.6.2	DONE

23E	**17**	**18.1**	**VH**	**T**	**Y**	**3rd §, first sentence. It does not sound right that 1 or 2 Mbit/s interoperate with 5.5 Mbit/s or 11 Mbit/s. This term, used more down throughout this para is incorrect.**	**Replace the first 2 sentences by:** **The HR/DSSS uses the same PLCP preamble and header as the DSSS so both PHYs can co-exist in the same BSSS and can use the rate switching mechanism as provided.**	**Replace the first 2 sentences by:** **The HR/DSSS uses the same PLCP preamble and header as the DSSS so both PHYs can co-exist in the same BSSS and can use the rate switching mechanism provided.**
24E	**18**	**18.1**	**VH**	**T**	**Y**	**3rd §, 4th sentence: This sentence is true, but should be better expressed**	**Replace the sentence by:** **HR/DSSS/short can not co-exist with DSSS and HR/DSSS.**	**Replace the sentence by:** **HR/DSSS/short can not co-exist with DSSS and HR/DSSS.**
25E	**19**	**18.1**	**VH**	**T**	**Y**	**3rd §, 5th sentence: the sentence is not true. The FHSS can not interoperate with HR/DSSS/FH because of the rate difference**	**The continued support of this option should be considered in light of the proof that the system works and subject to reconsideration of the viability in term of real benefit (see comment number 20**	**Words to the effect of:** For interoperability with FH systems an optional FH ~~interoperable~~ PLCP Frame format is defined. **The HR/DSSS/FH format uses the same PLCP preamble and header as the FH PHY so both PHYs can co-exist in the same BSSS and can use the rate switching mechanism provided.** The **HR/DSSS/FH format** is intended to let FH networks participate in high rate networks when they have favorable propagation conditions and to rate shift back to low rate FH when propagation conditions are poor. It also gives the high rate DS signal frequency agility for increased probability of success.
26	**1**	**18.1**	**CT**	**E**		**should provide correct reference**	**This clause describes the high speed extension of the physical layer for the Direct Sequence Spread Spectrum** **(DSSS) system (clause 15 in the standard). The Radio Frequency LAN system is initially aimed at the 2.4 GHz ISM band as provided in**	**DONE**

							the USA according to Code of Federal Regulations, Title 47, Section 15.247, in Europe by ETS 300-328 and other countries according to clause 1.4.6.2.	
27	22	8.1.1	VH	E	Y		Make a real scope, including material from comment 21	rejected, COMMENTOR TO PROVIDE MORE SPECIFIC DRAFT TEXT
28	23	8.1.1 a	VH	T	Y	The MAC/PHY interface is a byte interface. At that interface the descriptions can only be on byte boundaries. The PMD interface is a symbol interface and it is 4 and 8 bits for CCK but I think it is 1 and 2 bits for PBCC.	Replace "shall" by a more appropriate verb	
29	3	18.1	M BS, CH	E	YES	In paragraph two of this section, the last sentence states, “An optional Packet Binary Convolutional Coding (PBCC) mode is also provided for potentially enhanced performance where regulatory considerations can be met.” To the best of my knowledge, neither CCK nor PBCC has received regulatory approval at this time. It is most likely, that they will not received regulatory approval at exactly the same time in each country in which approval is sought. There will be a point in time in any given country when one is certified and the other is not. However, the body has accepted CCK and PBCC based on the assumption that regulatory bodies will approve both. These assumptions have been based on presentations presented by Harris and Alantro. Since there is no reason to believe either waveform will not receive regulatory approval, there is no need to	The phrase, “where regulatory considerations can be met.”, should be stricken from this sentence, so that the sentence reads as follows: An optional Packet Binary Convolutional Coding (PBCC) mode is also provided for potentially enhanced performance.	There is a reason to specify this. Followers of the standard need to be warned that these modulations may not have been approved and may never be approved by the regulatory bodies in their country. Editor will draft a new sentence that accomplishes this for both modulations.

						imply this in the text of the standard.		
30	**4**	**18.1.2**	**M BS, CH**	**E**	**NO**	**A reference is made to Figure 11. The figure that is intended to be reference is Figure 11 of IEEE Std 802.11-1997, not Figure 11 of the current document.**	**The editor needs to determine if this standard will start number figures at 1 or if it will increment from the last figure number used in Clause 17. Depending on this decision, appropriate changes should be made to figure references to make sure there is no ambiguity, as there currently is in section 18.1.2.**	**yes, it should be figure 11 of clause:…. EDITOR**
31	**1**	**18.1.2**	**MI F**	**E**	**NO**	**The first sentence of this section refers to a "Figure 11" which is clearly not meant to refer to the Figure 11 that appears 12 pages ahead in section 18.2.7.**	**Either correct the reference or delete the citation.**	**See above EDITOR**
32	**25**	**18.1.2**	**VH**	**E**	**N**	**Can not understand the reference to figure 11**	**Replace by reference to Fig 12?**	**See above EDITOR**
33	**5**	**18.1.2**	**AS**	**E**	**N**	**I assume this refers to figure 11 in the current 802.11 standard.**	**Reference 802.11-1998**	**EDITOR**
34	**6**	**18.1.2**	**AS**	**E**	**N**	**In paragraph 2 Clause 12 is referenced.**	**Reference 802.11-1998**	**DONE**
35	**24**	**18.1.2**	**VH**	**E**	**N**	**"ISO/IEC basic" is used wrongly here**	**Remove the fragment**	**REJECT**
36	**7**	**18.1.2.2**	**AS**	**E**	**N**	**Sentence 2 refers to direct sequence modulation. My understanding of the PMD sublayer is that it deals with transferring bits from one side to the other.**	**It should say something about the different modulation schemes, rates**	**PHY GROUP TO CLARIFY accepted**
37 SP	**4**	**18.1**	**AS**	**T**	**Y**	**Short preamble should not be optional. It would allow manufacturers of new HR PHY cards to build cards that would not be able to operate in high-rate PHY BSSs that were using the short preamble.**	**The ability to receive short preamble frames should be mandatory.**	**Rejected. No concensus. Cost and time to market issues warrant a stepped approach.**
38 SP	**1**	**18.1**	**TT**	**T**	**Y**	**"To optimize data throughput at the higher rates an *optional* short PLCP preamble is provided..." The short preamble should not be optional. Since a PHY that has not implemented the short preamble cannot co-exist with PHYs that are using a**	**Remove the word optional from this sentence. Remove all other references to the short preamble being an option. OR**	**Rejected. No concensus. Cost and time to market issues warrant a stepped approach. It was intended that the use of the short preamble be optional**

						short preamble, this is forcing a non-interoperability mode amongst "new, high speed" devices. **There is no interoperability or co-existence already with legacy systems using the short preamble, why confuse things by classifying new devices in the same category.** **Critics would say (and they would be right) 802.11 has "designed in" interoperability problems.** **In addition, when radio cards are available with the short preamble, the ability to sell a card that didn't have this capability would be about nil.**	**Remove the short preamble altogether from the standard.**	**and that short preambles only be used in networks exclusively composed of high rate capable equipment.**
39 SP	**4**	**18.2.2 18.2.3. 14**	**W B**	**T**	**Y**	**Short preamble header should use more robust modulation. Suggest using 56 µs rate 1/11 Barker (1 Mb/s) SYNC.**	**(Wording needs to be determined.)**	**already using 1 MBps sync field comment accepted, no technical change necessary.**
40 SP	**1**	**18.2.2 18.2.7**	**W D**	**T**	**Y**	**Coexistence between the systems with short and long preamble is claimed. In this draft however there are no proper coexistence procedures defined that allow coexistence between the standard implemented "long preamble" and the optional defined "short preamble" Since systems that do not implement the option do not understand the "short preamble", there is no length based coexistence possible.** **The main problem is in the case where a PPDU with a short preamble is being transmitted, while a transceiver configured to receive a long preamble only, wants to transmit. Suppose the transceiver is also configured in CCA mode 2 or 3 (carrier or carrier above energy level).**	**Changes in 18.2.7 PLCP receive procedure:** **Second paragraph, last sentence: The short SFD will normally not be detected and the receiver defers until the energy or carrier sense drops. Special provision are added to the receive procedure to guarantee that the receiver keeps CCA busy until the end of the CCK signal, thus providing coexistence capabilities between the systems.** **In 8th paragraph (After PHY-CCA.indicate………..RX Idle state) add:** **In these cases the CCA method is**	**Rejected:** **Energy detection not a reliable means of starting a timer.** **Penalty caused by 3.5 msec outages from false CCA triggers too expensive.** **Energy detection is not required in the standard.** **Intent is that only stations with the ability to receive short headers will exist in a BSS using short preamble.**

						The receiver will sense the carrier of the short preamble, set CCA busy and waits for the longSFD. The SFD will not be detected. After the short preamble a CCK modulated signal is in the air. The receiver returns to the idle state (no SDF or drop of carrier) and senses the medium before transmitting the waiting frame. There is no Barker code carrier sense because of the CCK modulated signal (CCA idle). A transmission will start resulting in a collision. The chance on a collision in this scenario is 100%! **Provisions have to be added to cope with this, otherwise the standard is broken. It must be guaranteed that CCA stays busy during reception of (until the end of) the CCK signal.** **I propose two resolutions (both have the same effect).** **1. In the case a receiver senses a carrier (positive identification of a DSSS signal) but no SFD is detected, or header CRC fails or Carrier drops before validation of the header, the receiver will keep CCA busy until** **- an energy drop of more than 10dB is detected or** **- energy falls below the defer threshold or** **- a watchdog timer expires (timer is set to the longest CCK frame:2400 bytes @ 5.5 Mbit/s = 3.5 ms** **2. In the case a receiver senses a carrier (positive identification of a DSSS signal) but no SFD is detected, or**	**changed to CCA mode 1 (see 18.4.8.4) and a timer is set and started. CCA mode 1 will be maintained until the status of CCA becomes idle or until the timer expires. In these cases the CCA method is reset to its original mode. The value of the timer will be set to 3.5 ms.**	

						header CRC fails or Carrier drops before validation of the header, the receiver returns to the idle state while the CCA mode is forced to be mode 1 (energy above threshold). The forced CCA mode will return to the original mode if: **- no energy is detected (energy below threshold) or** **- a watchdog timer expires (timer is set to the longest CCK frame:2400 bytes @ 5.5 Mbit/s = 3.5 ms** **The watchdog timer is there to overcome the situation when there is a strong interferer (above the energy threshold) in the air, that will otherwise keep CCA busy as long as this interferer is present.** **The second solution and the changes in the next column will reflect this.**		
41 SP	**9**	**18.2.1**	**AS**	**T**	**Y**	**Short preamble should not be optional. It would allow manufacturers of new HR PHY cards to build cards that would not be able to operate in high-rate PHY BSSs that were using the short preamble.**	**The ability to receive short preamble frames should be mandatory.**	**Rejected.** **No consensus.** **Cost and time to market issues warrant a stepped approach.**
42 SP	**10**	**18.2.2**	**AS**	**T**	**Y**	**Short preamble should not be optional. It would allow manufacturers of new HR PHY cards to build cards that would not be able to operate in high-rate PHY BSSs that were using the short preamble.**	**The ability to receive short preamble frames should be mandatory.**	**Rejected.** **No consensus.** **Cost and time to market issues warrant a stepped approach.**
43 SP	**4**	**18.2.2**	**TT**	**T**	**Y**	**"In addition an *optional* short HR/DSSS PLCP preamble and header is defined."** **See tt #1 for comment (18.1)**	**Remove the word optional from this sentence.** **Remove all other references to the**	**Rejected.** **No consensus.** **Cost and time to market issues warrant a stepped approach**

							short preamble being an option. **<u>OR</u>** **Remove the short preamble altogether from the standard.**	
44 SP	**5**	**18.2.2**	**TT**	**T**	**Y**	**"Usage of the short preamble and header is *optional*. A transmitter using the short PLCP will not be interoperable with a receiver, which is not capable of receiving this short PLCP. *However coexistence is maintained.* To be interoperable with a *receiver that is not capable of receiving* a short preamble and header, *the transmitter must use the long* PLCP preamble and header."** **The above paragraph in section 18.2.2 shows the problem with making the short preamble an option.** **The only way to get interoperability with a radio that is "not capable of receiving a short preamble" in a BSS that is using short preambles, is to either turn the offending radio OFF, or switch everyone to use long headers.**		**Rejected.** **No consensus.** **Cost and time to market issues warrant a stepped approach.** **Strike sentence saying "However coexistence is maintained."**
45 SP	**1**	**18.2.2 18.2.7**	**JBO**	**T**	**Y**	**Coexistence between the systems with short and long preamble is claimed. In this draft however there are no coexistence capabilities!** **The main problem is in the case where a PPDU with a short preamble is being transmitted, while a transceiver configured to receive a long preamble only, wants to transmit. Suppose the transceiver is also configured in CCA mode 2 or 3 (carrier or carrier above energy level).**	**Changes in 18.2.7 PLCP receive procedure:** **Second paragraph, last sentence: The short SFD will normally not be detected and the receiver defers until the energy or carrier sense drops. Special provision are added to the receive procedure to guarantee that the receiver keeps CCA busy until the end of the CCK signal, thus providing coexistence capabilities**	**(Same as 40)** **Rejected:** **Energy detection not a reliable means of starting a timer.** **Penalty caused by 3.5 msec outages from false CCA triggers too expensive.** **Energy detection is not required in the standard.**

						The receiver will sense the carrier of the short preamble, set CCA busy and waits for the longSFD. The SFD will not be detected. After the short preamble a CCK modulated signal is in the air. The receiver returns to the idle state (no SDF or drop of carrier) and senses the medium before transmitting the waiting frame. There is no carrier sense because of the CCK modulated signal (CCA idle). A transmission will start resulting in a collision. The chance on a collision in this scenario is 100%! **Provisions have to be added to cope with this, otherwise the standard is broken. It must be guaranteed that CCA stays busy during reception of (until the end of) the CCK signal.** **I propose two resolutions (both have the same effect).** **1. In the case a receiver senses a carrier (positive identification of a DSSS signal) but no SFD is detected, or header CRC fails or Carrier drops before validation of the header, the receiver will keep CCA busy until** **- a energy drop of more than 10dB is detected or** **- energy falls below the defer threshold or** **- a watchdog timer expires (timer is set to the longest CCK frame:2400 bytes @ 5.5 Mbit/s = 3.5 ms** **2. In the case a receiver senses a carrier (positive identification of a DSSS signal) but no SFD is detected, or**	**between the systems.** **In 8th paragraph (After PHY-CCA.indicate………..RX Idle state) add:** **In these cases the CCA method is changed to CCA mode 1 (see 18.4.8.4) and a timer is set and started. CCA mode 1 will be maintained until the status of CCA becomes idle or until the timer expires. In these cases the CCA method is reset to its original mode. The value of the timer will be set to 3.5 ms.**	

						header CRC fails or Carrier drops before validation of the header, the receiver returns to the idle state while the CCA mode is forced to be mode 1 (energy above threshold). The forced CCA mode will return to the original mode if: **- no energy is detected (energy below threshold) or** **- a watchdog timer expires (timer is set to the longest CCK frame:2400 bytes @ 5.5 Mbit/s = 3.5 ms** **The watchdog timer is there to overcome the situation when there is a strong interferer (above the energy threshold) in the air, that will otherwise keep CCA busy as long as this interferer is present.** **I prefer the second solution and the changes in the next column will reflect this.**		
46 SP	**2**	**18.2.1**	**TT**	**T**	**Y**	**"Three different preambles and headers are defined: the mandatory supported long preamble and header interoperable with the current 1 and 2 Mbit/s DSSS specification, an *optional* short preamble and header, and an optional FH interoperable preamble and header."** **See TT # 1 for comment (18.1)**	**Remove the word optional from this sentence.** **Remove all other references to the short preamble being an option.** **<u>OR</u>** **Remove the short preamble altogether from the standard.**	**Rejected.** **No consensus.** **Cost and time to market issues warrant a stepped approach.**

47 FH	**1**	**18.2.1**	**SR**	**T**	**Y**	**The combination of an optional short preamble and, especially an optional FH interoperable preamble and header leads to multiple PHY implementations. This is not keeping with the task group's goal of implementing one high rate PHY.**	**Eliminate backward compatibility to low rate FH systems. Clearly define one preferred implementation. Outline clear situations when the designer would want to implement the options.**	Rejected. Does not violate the PAR. Clarification will be provided in new overview of use of different modes.
48 SP	**5**	**18.2.2**	**M BS, CH**	**T**	**YES**	**By transmitting the PLCP header of the Short PLCP frame format at 5.5 Mbps, we are writing a standard that is not compatible with itself.** **A system must be able to decode CCK and PBCC to determine how long the MPDU will be. If the system can not decode both, which the standard does not mandate, since PBCC is optional, then a system with no PBCC decoder would not be able to tell how long to back off when a PBCC packet is sent.**	**There are several acceptable solutions to this problem that will be presented by Alantro at the November 1998 meeting in IEEE 802.11 doc:98-YYY.** **An acceptable correction is to adopt whichever fix the Working Group agrees to at the November 1998 meeting.**	**Accept Alantro option 2 in paper 98/366 to use 2 Mbit/s barker in PLCP header.**
49 E	**3**	**18.2.1 18.2.6 18.2.x**	**SB**	**T**	**-**	**There is no mechanism for a sending station to be able to determine whether a receiving station can accept a SHORT or FH PLCP header. For rate we have a mechanism for STAs to learn of each others capabilities by the supported rates information element.** **This is not a show-stopper. A transmitting STA could find out by (a) a proprietary means – not ideal in an open standard, or (b) by trial and error (though if it were also using trial and error to judge the rate it could achieve given the channel conditions it the results would be somewhat ambiguous).**	**Taking the PAR mandate to the limit you cannot change the MAC … so I guess you'll have to put up with. However, I don't really like this and would recommend doing something like defining a new extended HR S parameter set information element for use in beacons, etc (in place of current DS parameter set). This would have the current channel, and then a control word for optional PLCP formats and modulation schemes supported).** **I'm not going to No vote on this due to the PAR limitation, but I would like some thought to be given to a solution**	**Accepted, Anil to supply text. See 227, 276** The parameters are passed by existing mechanisms in the FH and DS backward interoperability modes. In the case of FH, the FH/HR unit must associate with an FH BSS and get all of the parameters associated with the BSS. The association response provides all parameters needed to operate in FH mode and to derive all parameters need to rate shift up to the HR PHY. Clarification will be provided in new overview of use of different modes.
50 E	**1**	**Gener al**	**JZ W**	**T**		**The fact that the PLCP can operate in 3 or 4 or 5 different modes isn't dealt with clearly. I assume that there ought to be something in the MIB for setting**	**Add text to the overview, to the Transmit Procedure and to the Receive Procedure sections clarifying that Short and Long are**	**See the above response, add text as appropriate.**

						Long or Short PLCP as well as something to set CCK versus PBCC. If it were desired to be able to mix different types of frames, we would have to change the MAC so that the PLCP type was part of the TXVECTOR and RXVECTOR, and that is not in the 802.11b PAR. So, given that there are several different modes, the transmit and receive state machines and procedures need to make it clear that only one type of PLCP header is supported at any given time. With 2 modulation schemes and 3 PLCP headers, are there 6 different operating modes? This is terribly confusing.	**mutually-exclusive.**	
51	**20**	**Gener al**	**VH**	**E**	**N**	**The future set of radio devices in the 2.45 GHz band will contain 6 options. It is hard to distinguish them from each other.**	**Adopt the following acronyms and use consistently throughout the document, so that the reader does not have to guess what the subject is: DSSS for the existing Direct sequence PHY FHSS for the existing Frequency Hopping PHY HR/DSSS for the 5.5 & 11 Mbit/s PHY HR/DSSS/short for the short preamble option of the HR/DSSS PHY HR/DSSS/PBCC for the PBCC option HR/DSSS/FH for the option of the FH header in the HR/DSSS**	**Accepted. Since the CCK and PBCC will share a short preamble, the definition needs to be: HR/DSS/PBCC/short, Etc.**
52 SP	**21**	**Gener al**	**VH**	**T**	**Y**	**It is impossible to understand from the standard which options can co-exist, switch rates or switch from one to the other**	**Make a matrix in the Scope subclause that has the 6 options in both rows and columns and show in the cells whether the combination can: Co-exist w/o interference (defer) Co-exist with interference**	**Accepted, Add a matrix which says that you should not have these types together and another that shows interoperability.**

							Can not co-exist due to major interference **Co-exist and switch** **Co-exist and etc.** **Alternatively, or in addition, make a set of scenarios of systems that can communicate depending on the set of options used by various option combinations.**	
53	**8**	**18.2.1**	**AS**	**E**	**N**	**The convergence procedure for 1 and 2 Mbit/s should be referenced back to 802.11-1998.**		**COMMENTOR TO IDENTIFY SPECIFIC REFERENCE** **accepted**
54 E	**26**	**18.2.1**	**VH**	**T**	**Y**	**"shall" is inappropriate in an overview clause**	**Replace by a more appropriate verb**	**EDITOR** **change “shall” with “will be”**
55	**1**	**18.2.2**	**AP**	**E**		**Reference made to lowest TDB or the highest TBD FH Channel**	**Resolve by working group**	**This section WAS moved to 18.4.6 and resolved there see 58**
56	**1**	**18.2.2**	**GE**	**E**	**Y**	**The appropriate lowest and highest FH channel probably depends upon the regulatory domain, and so it is not possible to put in specific values for TBD in this section.**	**If my assertion is correct, replace “lowest TBD and highest TBD” with “certain FH channels at the extremities of the allowed band”**	**SEE ABOVE**
57 E	**2**	**18.2.2**	**JZ W**	**T**		**Fill in values for “TBD” in the 4th paragraph.**		**Dean K. will resolve. The section was moved to 18.4.6.8 and the frequency plan described there.**
58 FH	**2**	**18.2.2**	**MI F**	**T**	**NO**	**In the last paragraph on page 505 there are two references to “TBD” FH channel numbers. Since this pertains to a specification critical for radio design and regulatory compliance, these channel numbers should be defined prior to sponsor ballot.**	**Define the channel numbers outside of which HR/DS signaling cannot be used.**	The editorial changes made before publishing D1.0 was inadvertently left out. All of the channel frequency definitions were moved to clause 18.4.6.8. The paragraph will read as follows: Figure 202 shows the optional Frequency Hopping interoperability format for the

								PPDU. This includes the standard FH PLCP preamble, the FH PLCP header, an 8 microsecond gap, followed by the short preamble and header and the MPDU. The FH interoperability mode uses the FH preamble and header to establish the channel the signal will be radiated on and the rate it will use. The length contained in the FH PLCP header shall indicate the length in octets of the MPDU contained in the following HS/DSSS frame. ~~When in this mode, the HR DS channel will be chosen as the closest DS channel from the set of: 1, 3, 5, 7, 9, and 11 (plus 13 in Europe). The receiver IF which will process the high rate DSSS data must be wide enough in bandwidth to encompass the FH preamble. When operating on the lowest TBD or the highest TBD FH channels, the HR DS will not be used and all FH transmissions will occur at the 1 or 2 Mbit/s rates. These channels are too far away from the available DS channels to be processed within the IF bandwidth.~~
59 FH	**1**	**18.2.2**	**PK**	**T**		**Pg 505, last paragraph has TBD for the low and high FH channel**	**Put in the correct channel number**	See response to comment 58.
60 FH	**5**	**18.2.2**	**SB**	**T**	**-**	**Fill in TBDs in FH channel spec**	**Provide real values**	See response to comment 58.
61	**2**	**18.2.2**	**AP**	**E**		**Figure 3 MBIT/S**	**Mbps (make entire doc consistent)**	**REJECT – SHOULD READ MBIT/S**
62	**11**	**18.2.2**	**AS**	**E**	**N**	**In paragraph 2 a sentence refers to the closest DS channel available. This needs to be clarified to specify what closest**	**Could be the DS channel which provides the lowest difference between the centre frequency of the**	**This section moved to 18.4.6 and resolved there** See response to comment 58.

						means.	**DS and FH channel. Use the lower one if the difference is the same on both sides.**	
63 FH	**12**	**18.2.2**	**AS**	**T**	**Y**	**For the FH compatibility mode the last sentence states that ACK to high rate packets may not use the FH PLCP. What about CTS, CF-ACK, Null, etc.** **The current 802.11 MAC does not support this kind of facility. I think it would be non-trivial changes to the MAC to allow a receiving station to transmit an ACK without the FH preamble. It would destroy the collision avoidance capability of legacy FH STA's because they cannot get the NAV from the data frame and would not be able to receive the ACK either. In addition STAs that can only hear one side of the conversation would not be able set their NAV and perform collision avoidance correctly.**	**Delete the sentence.** **All frames in this mode must be sent with the FH preamble.**	Accept comment to delete sentence. The 802.11 MAC/PHY interface does not provide information for PHY to discriminate frame types.
64 FH	**2**	**18.2.2 18.4.6. 8 0/1/2**	**JB O**	**T**	**Y**	**The spec for the FH Interoperable PLCP Frame Format is far from complete. No receive and transmit procedures are defined.** **As I understand it from the scarce descriptions the FH interoperability mode is not coexistent with any HR/DSSS. The FH interop Frames are being blown into the air without sensing the medium for a DSSS transmission, even although 90% of the frame is HR/DSSS.** **I think (for any standard) that it is not acceptable that options are being designed that 'break' the standard for the basic functions.**	**Add (by FH guys) Transmit and Receive procedures that guarantees coexistence of the FH interoperability mode option with the basic specification of the HR/DSSS PHY specification.**	In the FH interoperable mode, the station must conform to all requirements of the FH PHY including transmit, receive, and CCA procedures. Clarification will be provided in new overview of use of different modes. Refer to resolution of comment 87.

65 FH	**3**	**18.2.2**	**JZ W**	**T**		**The final paragraph imposes a requirement on the MAC. In fact, I believe that it is required that if the PHY is operating in FH PLCP mode, any frame the MAC generates would need to be in FH PLCP mode. The PHY can't tell an ACK from any other kind of MAC frame.**	**Delete this requirement.**	In the FH interoperable mode, the station must conform to all requirements of the FH PHY including transmit, receive, and CCA procedures. Clarification will be provided in new overview of use of different modes. Refer to resolution of comment 87. Accept this comment. See response to comment 63.
66 FH	**25**	**18.2.2**	**MI F**	**E**	**NO**	**The last sentence in this section reads "Acknowledgements to high rate packets may not use the FH PLCP." This is ambiguous because it does not refer to ACK frames, so "acknowledgements" could also include Management Response-type frames, which SHOULD use FH PLCP in a mixed FH/HRDS environment. Also, "packet" should be "frame".**	**Replace this sentence with "Frames of type ACK, CTS, or any of the CF-subtypes of type Data shall not use the FH PLCP."**	**DONE** Reject this comment. See response to comment 63.
67 FH	**27**	**18.2.2**	**MI F**	**T**	**YES**	**When using the FH Interoperability PLCP headers the stations must be able to maintain the FH hop sequence and dwell synchronization as well as to communicate as HR/DSSS stations if/when using the 5.5Mbit/s or 11Mbit/s data rates. This means that, for a BSS operating in FH interoperability mode, the stations need the information from BOTH the FH Parameter Set element and the DS Parameter Set element for proper operation of the BSS.**	**In the discussion of the FH interoperability format in this section (or in a new section, if desired), state that, in a BSS using FH interoperability format, all Beacon and Probe Response management frames shall include both the FH Parameter Set element and the DS Parameter Set element.** **NOTE: This does NOT constitute a "change" to the MAC. Please read carefully the notes in 7.2.3.1 (Table 5) and 7.2.3.9 (Table 12) regarding the inclusion of the FH and DS parameter set elements based on what type of PHYs the STA are "using." In the case of HR/DSSS with FH Interoperability, the answer**	Reject this comment. All parameters are derived from the FH parameter set which includes a new expanded rate capability set.

							is "BOTH" FH PHY (for 1Mbit/s and 2Mbit/s) and DS PHY (for 5.5Mbit/s and 11Mbit/s) Similarly, the MLME-START.request primitive has a parameter named "PHY parameter set" (see 10.3.10.1.2) which is specified to be "as defined in frame format."	
68 FH	**1**	**18.2.2**	**NC**	**T**	**Y**	**The FH optional mode is suffering from many deficiencies, which need either to be resolved or the whole FH compatibility mode needs to be withdrawn.** **1. The FH is required to hop according to a FH pattern. However, there is no requirement that a station operating in a FH-compatible mode will associate with a FH network, obey with its CCA rules, use its deferral mechanisms, slot times etc. It seems like a pure Electronic Warfare deception trick to avoid interference. Moreover, DS will protect itself from only one FH hopping sequence but will suffer from and disturb to all other FH channels with which it overlaps. This behavior is hostile towards dense FH networks, which already achieve high aggregate throughput by using several APs in parallel.** **2. If FH+DS capability is supported, including association etc., then a station needs a mechanism to declare to its buddies that it is DS-capable. Also, there is a need for DS-capable stations to decide on the fly that a specific packet will not continue as FH but rather will**	**Either (preferred):** **Withdraw FH compatibility mode entirely** **Or:** **Specify that a station operating in the FH-compatible mode will become a part of a FH network, performing all the association, backoff slots, etc. mechanisms, while using the HS DS as a method to accelerate the data carrying portion of the message.**	Accept comment choice B, i.e., Specify that a station operating in the FH-compatible mode will become a part of a FH network, performing all the association, backoff slots, etc. mechanisms, while using the HS DS as a method to accelerate the data carrying portion of the message. Clarification will be provided in a new overview of use of different modes.

						evolve into a DS packet. There is no such capability in FH's PLCP header. **3. Will the carrier sense mechanism use both FH carrier sense and DS carrier sense? Once a station starts transmitting the FH preamble it will not be able to hear DS transmissions.** **4. The system employing FH and DS simultaneously becomes, under FCC rules, a Hybrid Spread Spectrum system. The Processing Gain in such case is required to be at least 17 dB. Given that MBOC passed the 10 dB FCC DS requirement with a small margin (and CCK did not pass yet) and that hopping of the DS is only over 3 nonoverlapping channels (which is 5 dB), I don't see how will a resulting hybrid SpSp system will pass regulation** **5. The implementation complexity of the dual mode transceiver is such, that it makes it highly improbable that anybody will support that capability. Lets don't fool ourselves and save some trees as well, and withdraw this FH-compatibility part entirely.**		
69	**4**	**18.2.2**	**SB**	**E**	**-**	**Be consistent with the use of CAPS for field names – either … Signal/LENGTH**	**Fix**	**DONE**
70	**3**	**18.2.2**	**TT**	**E**	**N**	**The only exceptions are the added rates in the rate Signal Field and the use of a bit in the Service field *used* to resolve an ambiguity in packet**	**Delete word "used" shown italicized in text to the left.**	**DONE**

						length in octets when the length is expressed in whole microseconds and another bit to indicate if the optional PBCC mode is being used.		
71	**27**	**18.2.2**	**VH**	**E**	**N**	**4th line: Interoperate used wrongly.**	**Remove "supported" and replace "interpretable" by "equal in format"**	**NOT FOUND**
72	**28**	**18.2.2**	**VH**	**E**	**N**	**Interpretable is used wrongly**	**Use a better qualification**	**DONE**
73	**29**	**18.2.2**	**VH**	**E**	**N**	**"field" is missing**	**Add the word "field" 4 times in line 4.**	**DONE**
74	**30**	**18.2.2**	**VH**	**E**	**N**	**5th and 6th sentence, the word long seems not to be a good qualification** **penultimate line: used is redundant** **7th line: added rates are incorrect expressions**	**Find a better way to qualify consistently** **Remove "used"** **Add "encodings of the"**	**DONE**
75	**31**	**18.2.2**	**VH**	**E**	**N**	**2nd para; in addition is redundant**	**Remove and begin the sentence with An….**	**DONE**
76	**34**	**18.2.2**	**VH**	**E**	**N**	**On page 505, bottom para: 2 occurrences of the unacceptable name of FH interoperable format or mode**	**Replace by HR/DSSS/FH format or mode**	**DONE**
77 FH	**35**	**18.2.2**	**VH**	**T**	**Y**	**On page 505, bottom para: The second half of this para is unprofessionally and incompletely defined.** **As described the mechanism seems broken.** **It starts with a sentence in the passive tense and does not specify how the mechanism works.** **1. Is the FH hop sequence prevailing and is the DS channel selected depending on the specific FH channel? If so, what do the hop sequences in figure 19 have to do with the matter?** **2. What happens when the FH sequence is in the channel edges? Will there be no 5.5 nor 11 Mbit/s transmission?**	**Repair the definition as well as the mechanism OR remove the HR/DSSS/FH option at all.**	See response to comment 58.

78 FH	**2**	**18.2.2 18.4.6.8 0/1/2**	**W D**	**T**	**Y**	**The spec for the FH Interoperable PLCP Frame Format is far from complete. No receive and transmit procedures are defined. As far as I understand it from the scarce descriptions the FH interoperability mode is NOT coexistent with any HR/DSSS, nor is it interoperable. The FH interop Frames are being blown into the air without sensing the medium for a DSSS transmission, even although 90% of the frame is HR/DSSS. I think (for any standard) that it is not acceptable that options are being designed that 'break' the standard for the basic functions. Furthermore it should be understood that as far as I understand the definitions, there will be NO INTEROPERABILITY with devices that comply to this HR/DSSS standard as currently defined, since the FH device that is HR capable will still follow a hopping pattern, and consequently send the HR/DSSS frames on an other DSSS defined channel after the dwell time. There is only a limited form of interoperability between compatible FH devices, and also no coexistence between multiple FH devices. Any FH device that is using an other hopping sequence in the same area will blow over the HR/DSSS signal even though the FH interoperable PLCP frame format is being used. If an FH Interoperable PLCP frame format needs to be defined, then it needs to be defined in the FH standard, but NOT in this HR/DSSS standard. In**	**Either delete the specification of the FH Interoperable PLCP frame format, or: Add proper Transmit and Receive procedures that guarantees MUTUAL coexistence of the FH interoperability mode option with the basic specification of the HR/DSSS PHY specification. In addition it should be clarified that this does NOT provide interoperability between HR/DSSS capable FH devices and the HR/DSSS devices that comply to this standard.**	In the FH interoperable mode, the station must conform to all requirements of the FH PHY including transmit, receive, and CCA procedures. Clarification will be provided in new overview of use of different modes. Accept the second paragraph. Add the following comment: When associated to an FH/HR BSS, a station will not be able to associate and communicate with another HR/DSSS BSS on the same or different frequency. Refer to resolution to comment 87.

						this HR/DSSS standard we should define the coexistence procedures.		
79 SP	**32**	**18.2.2 and 18.2.6 and 18.2.7**	**MI F**	**T**	**NO**	**The multirate mechanism used by the 802.11 MAC assumes the existence of a PLCP header, receivable by all stations, even on the higher-rate frame transfers which cannot be received by stations that do not implement the optional, higher data rates. The existence of an optional, short PLCP format violates this assumption. The users of a mixed network in which a subset of the HR/DSSS stations support (and use) short PLCP is likely to be less reliable and/or less efficient than one in which all stations support short PLCP (unless short PLCP is made non-optional, as suggested in my comment Seq #17). There should be mention in the text that, because the stations not supporting short PLCP do not receive the frame, and therefore benefit from NEITHER the length information in the PLCP header nor the Duration information in the MAC header, only the physical detection of RF energy (which is subject to fades, etc.) is protecting the active communication activity from destructive interference. Neither the length-based surrogate ending delimiter provided by PHYs that successfully receive PLCP headers, nor the virtual carrier sense provided by the MAC's NAV operate in this "coexistence" scenario. These limitations of coexistence are likely to effect most severely the ability to communicate reliably near the area of overlap between BSSes.**	**Add text to 18.2.2, 18.2.6, and/or 18.2.7 noting these limitations to "coexistence."**	**Accepted:** **See coexistence table that was added to Scope subclause.**

80	**32**	**18.2.2 Fig 1**	**VH**	**E**	**N**	**Mbps is not a correct symbol and PBCC is missing** **The micro symbol should have equal point size as the other characters and should have a space to the left**	**Use Mbit/s and add PBCC** **Correct the symbol**	**EDITOR**
81	**33**	**18.2.2 Fig 2**	**VH**	**E**	**N**	**The reference lines from the top format figure at the right hand side and the from the next format figure at the left hand side do not match the divider line in the next to the bottom format figure** **The micro symbol should have equal point size as the other characters and should have a space to the left**	**Line-up the reference line** **Correct the symbol**	**DONE**
82 E	**36**	**18.2.2 Fig 3**	**VH**	**T**	**N**	**There is an unsupported gap in the figure between preamble and header**	**Redraw the figure without the gap**	**Fix figure**
83	**2**	**18.2.2, 1st para**	**CT**	**E**		**not knowing why the original standard seems inconsistent in capitalizing fields, it seems worthwhile fixing here**	**The PLCP Header contains the following fields: IEEE 802.11 Signaling (SIGNAL), IEEE 802.11 Service (SERVICE), IEEE 802.11 length(LENGTH), and CCITT CRC-16 (CRC).** **Each of these fields is described in detail in 18.2.3.**	**DONE**
84	**3**	**18.2.2, 1st para**	**CT**	**E**		**clarity**	**The only exceptions are the added rates in the rate Signal Field and the use of a bit in the Service field used to resolve an ambiguity in packet length in octets when the length is expressed in whole microseconds and another bit in the service field to indicate if the optional PBCC mode is being used.**	**DONE**
85 FH	**4**	**18.2.2, 4th para**	**CT**	**T**	**Y**	**TBD in conjunction with determining when HR DS cannot be used for specific FH channels is not appropriate**	**?**	See response to comment 58.
86 FH	**1**	**18.2.2, 4th**	**H W**	**T**	**Y**	**TBD in conjunction with determining when HR DS cannot be used for specific**	**?**	See response to comment 58.

		para				**FH channels is not appropriate**		
87 FH	**1**	**18.2.2 and 18.4.6.8.0 through 18.4.68.2**	**AK**	**T**	**Y**	**FHSS and DSSS systems operating at 1 and 2 Mbit/s give a well performing throughput behavior for collocated systems. The large number of hop channels (FHSS) and the selection of channels (DSSS), and the CSMA/CA minimize the risk on contention and adjacent (hop) channel interference. Furthermore, collocated FHSS and DSSS systems operating at 1 or 2 Mbit/s give a limited mutual interference because of the small risk of relevant channel overlap (11/75) and the filtering/despreading (10 dB rejection) of each others signals.** **However, with the proposed scheme the collocated HR/FHSS systems give a low aggregate throughput for the following reasons:** **1. HR/FHSS systems will only make a CCA check of the 1 MHz channel they are using during the first part of the frame transmission. After switching to the HR state they might occupy a channel that is already used by a collocated HR/FHSS system. This causes contention problems because the CSMA/CA and CCA approach is not followed in relation to the channel occupied during the HR state.** **2. The above mentioned risk on using the same HR channel by collocated HR/FHSS systems and the limited number of HR channels which are available, lead to low aggregate throughput for collocated HR/FHSS systems. Non-synchronized HR/FHSS systems**	**A HR/FHSS device should make a CCA check with respect to the HR channel it wants to occupy.**	Comment rejected. Good idea in general, but not necessarily part of the standard. The cross PHY CCA is left for manufacturer differentiation. The existing FH and DS PHYs do not specify cross PHY CCA, and they both work with some reduction to throughput in each network while separated by inches. The energy detect option may be utilized to resolve this problem.

						will start using the very same HR channel or two HR channels with insufficient Adjacent Channel Interference isolation. The non-synchronized hopping and frame transmissions by different systems will enlarge the effect. **3. Likewise a HR/FHSS system might occupy a channel that is already in use by a collocated DSSS system (a HR/DSSS or a LR/DSSS).** **4. A DSSS (HR or LR) might occupy a channel that is already in use by a collocated HR/FHSS system, because the CSMA/CA and CCA approach is followed with respect to its 1 Mbit/s header signal** **5. The random nature of HR/FHSS channel selection for the HR state is right opposite to the optimized planning with DSSS for channels and cells in relation to Adjacent Channel Interference and distances between all Access Points and Stations involved.**		
88	**13**	**18.2.3**	**AS**	**E**	**N**	**The entire PLCP Preamble and Header is not transmitted at 1 Mbit/s as stated.**	**Delete sentence**	**DONE**
89	**14**	**18.2.3**	**AS**	**E**	**N**	**All transmitted bits are not scrambled as stated. The FH PLCP header is not scrambled.**	**Change to say something like all bits sent using one of the DSSS modulations are scrambled.**	**DONE**
90 E	**6**	**18.2.3**	**TT**	**T**	**Y**	**"The entire PLCP Preamble and Header shall be transmitted using the 1 Mbit/s DBPSK modulation described in 18.4.6.4."** **The introductory sentence is only valid for the Long PLCP. If next comment is accepted then this sentence should be deleted from the Short and FH Header introductory paragraphs.**	**Delete this sentence.**	**ACCEPTED**

91 E	**37**	**18.2.3**	**VH**	**T**	**Y**	**In the clause and subclauses the MSB/LSB designation is used. This is considered an inadequate method as the interpretation may be ambiguous. A defined bit pattern is a bit string with all equal significance.**	**Use a method with figures and bit numbers**	**rejected, Draft follows the style established by the DSSS PHY clause. Changing here might confuse more than clarify.**
92	**38**	**18.2.3**	**VH**	**E**	**N**	**The # sign used is inelegant**	**The # sign should be replaced by better wording.**	**DONE**
93	**7**	**18.2.3.x**	**TT**	**E**	**N**	**Describing all the different header fields in a linear list is confusing.**	**Create 3 "PLCP field definitions" sub-sections for Long, Short and FH headers, rather than grouping them all in the same one.**	**EDITOR**
94 SP	**1**	**18.2.3.2**	**KO**	**T**		**Current SFD seems not to be interoperable. New scheme should be included.**		**Need more explanation of comment. longSFD is same as existing PHY**
95 E	**5**	**18.2.3.3**	**CT**	**T**	**Y**	**Two optional rates are mentioned but not listed, what are they? Also editorially fix list alphabetically**	**?**	Accepted, change to: The extended HR/DSSS PHY supports four mandatory rates ~~and two optional rates~~ given by the following 8 bit words, where the LSB shall be transmitted first in time:
96	**6**	**18.2.3.3**	**CT**	**E**		**reference for 18.2.3.15 incorrect**	**18.2.3.14**	**DONE**
97 E	**2**	**18.2.3.3**	**HW**	**T**	**Y**	**Two optional rates are mentioned but not listed, what are they? Also editorially fix list alphabetically**	**?**	**see 95**
98	**3**	**18.2.3.3**	**HW**	**E**		**reference for 18.2.3.15 incorrect**	**18.2.3.14**	**DONE**
99 E	**2**	**18.2.3.3**	**SR**	**T**	**Y**	**Four mandatory and two optional data rate options are being incorporated in this standard. The optional rates are not clearly defined.**	**Fully define the optimal rates and guide the designer at to when he may want to implement the optional rates.**	**See 95**
100 E	**3**	**18.2.3.3**	**JBO**	**T**	**Y**	**There are no optional rates, PBCC is an optional modulation method.**	**Delete 'and two optional rates'**	**see 95**

101 E	4	18.2.3.3	JZW	T		The first paragraph mentions two optional rates, but nothing else in the section (nor the document) appears to disclose them.	Either explain these two optional rates, or delete the reference to them.	See 95
102	5	18.2.3.3	JZW	E		There are two (a)'s.	Re letter the list of rates so each has a unique letter.	DONE
103	29	18.2.3.3	MIF	E	NO	At the end of this section is a reference to rate change described in 18.2.3.15, but that section is entitled "FH PLCP Field Definitions."	Change to refer to 18.2.3.7	EDITOR
104 E	8	18.2.3.3	TT	T	Y	Signal field indicates rate not only the modulation. There are no optional rates, only optional codes.	"The 8-bit IEEE 802.11 signal field indicates to the PHY the modulation <u>and</u> <u>rate</u> that shall be used for transmission (and reception) of the MPDU." "The extended HR/DSSS PHY supports four mandatory rates ~~and two optional rates~~ given by the following 8 bit words, where the LSB shall be transmitted first in time:"	first part rejected THE service field has the modulation , second part accepted, see 95
105 E	3	18.2.3.3	WD	T	Y	There are no optional rates, PBCC is an optional modulation method.	Delete the phrase "and two optional rates".	See 95
106	3	18.2.3.4	AP	E		Table 1 naming CCU	change to CCK	yes DONE
107	2	18.2.3.4	GE	E	Y	Table should say 0=CCK	Fix table to say 0=CCK	OKDONE
108	3	18.2.3.4	GE	E	Y	First sentence is misleading, since two bits are not reserved, not just the MSB.	Replace "except that the MSB" in the first sentence with "except for two bits. The MSB"	OK DONE
109	1	18.2.3.4	HMO	E		Table 1 defines for Code Selection bit: "j = CCU"	Change to "0 = CCK" (I suppose).	Approved DONE
110 E	4	18.2.3.4	JBO	T	Y	CCK and PBCC are described as modulation. To be able to use reserved fields in the future they have to be defined. This does not mean that the receiver has to drop a frame because the service field is out of spec.	Change 'code' to 'modulation method' IEEE802.11 device compliance is signified by the values of the bits d0,d1,d2,d4,d5 and d6 being 0.	Change 'code' to 'modulation method' IEEE802.11 device compliance is signified by the values of the bits d0,d1,d2,d4,d5 and d6 being 0.

111	**6**	**18.2.3.4**	**JZW**	**E**		**The diagram discusses "CCU" with some wacky Greek letter.**	**Change it to "0 = CCK"**	**DONE**
112	**6**	**18.2.3.4**	**MBS, CH**	**E**	**NO**	**In Table 1, there are typos under the fourth bit, d3.**	**Change d3 to read:** **Code Selection Bit** **0 = CCK** **1 = PBCC**	**DONE**
113E	**3**	**18.2.3.4**	**MIF**	**T**	**NO**	**The length extension scheme defined in 18.2.3.5 works for data rates between 8Mb/s and 16Mb/s. For data rates greater than 16Mb/s, additional bits of extension are required. While it is unlikely that a future PHY in the 2.4GHz ISM band will operate at data rates >16Mb/s, there will be such PHYs, and reserving the extra bits for this purpose will make it easier to interface such future PHYs to pre-existing MAC controllers. This is analogous to the definition of DataRate codes up to 4.5Mb/s in Clause 14 even though the FH PHY only defined operation at 1Mb/s and 2Mb/s. Keep in mind that future revisions and extensions to this standard will tend to use existing functionality wherever possible, just as 802.11b is doing with Clauses 12-15. Also, some non-802 standards groups are using 802.11 as a template.**	**Instead of listing Service field bits d5 and d6 as "reserved," list them as "reserved for expansion of Length Extension field necessary to support data rates greater than 16Mb/s." This causes no functional nor operational change to what is required for Clause 18 conformance, while leaving a record of where and how to handle higher data rates for future standards groups and implementers.**	**Rejected, the standard specifies what a reserved bit is and this would conflict with that. It should be obvious that these bits are candidates for more length bits.**
114	**4**	**18.2.3.4 Table 1**	**MIF**	**E**	**NO**	**In Table 1, the entry for bit d3 appears as "Φ = CCU"**	**Change to "0=CCK"**	**OK** **DONE**
115E	**4**	**18.2.3.4**	**WD**	**T**	**Y**	**CCK and PBCC are described as modulation.** **To be able to use reserved fields in the future the have to be defined. This does not mean that the receiver has to drop a frame because the service field is out of spec.**	**Change 'code' to 'modulation method'** **IEEE802.11 device compliance is signified by the values of the bits d0,d1,d2,d4,d5 and d6 being 0.**	**See 110**

116 SP	**8**	**18.2.3.4 18.4.6.3**	**SB**	**T**	**-**	**There is no mechanism for a sending station to be able to determine whether a receiving station can accept the optional PBCC. For rate we have a mechanism for STAs to learn of each others capabilities by the supported rates information element. This is not a show-stopper. A transmitting STA could find out by (a) a proprietary means – not ideal in an open standard, or (b) by trial and error.**	**Taking the PAR mandate to the limit you cannot change the MAC … so I guess you'll have to put up with. However, I don't really like this and would recommend doing something like defining a new extended HR DS parameter set information element for use in beacons, etc (in place of current DS parameter set). This would have the current channel, and then a control word for optional PLCP formats and modulation schemes supported). I'm not going to No vote on this due to the PAR limitation, but I would like some thought to be given to a solution**	**Accepted. See #227 and #276.**
117	**7**	**18.2.3.5**	**JZW**	**E**		**The discussion of LEB and the repeated references to "the service field MSB bit" are confusing. Also, the phrase "if the rounding took less than 8/11" is not precise enough. Also, the value of LEB is unspecified for most of the cases (should be 0).**	**Use "LEB" throughout the section to refer to the Length Extension Bit. Define the LEB as being set if and only if the difference between the rounded value and the unrounded value is greater than or equal to 8/11. In the "At the receiver" section, just define the length as the rounded calculated value minus 1 if LEB is set (this is why having the LEB be 0 in all the other cases makes sense).**	**DONE**
118	**7**	**18.2.3.5**	**M BS, CH**	**E**	**NO**	**In the calculation of the Length at the transmitter and the number of octets at the receiver, PBCC has an additional addend of one and minus one, respectively. These equations are correct. For clarity a note should be added stating that these factor arises from the addition zero octet used to force the PBCC encoder into a know state at the end of the packet.**	**Add a note similar to the following: The addend of one and minus one in the calculation for PBCC is a due to the fact that an addition zero octet is used to force the PBCC encoder into the zero state at the end of every packet (See section18.4.6.7).**	**DONE - AFTER REVIEW OF COMMENTS IN TGB MEETING 11/10/98**
119	**6**	**18.2.3.**	**MI**	**E**	**NO**	**In the second paragraph there are two**	**Change the first "will be" to "is" and**	**DONE**

		5	F			occurrences of “will be” and one of “an extra bit” that render the sentence poor standardese.	the second “will be” to “shall be.” Change the “an extra bit” to “a Length Extension bit.” Add “... of octets” to “number.” The resulting sentence reads: “Since there is an ambiguity in the number of octets that is described by a length in integer microseconds for any data rate over 8 Mbit/s, a Length Extension bit shall be placed at bit position d7 in the Service field to indicate when the larger potential number of octets is incorrect.”	
120	7	18.2.3.5 Table 2 and Table 3	MIF	E	NO	The heading which reads “SERVICE bit” in each of these tables is incorrect: Service is a field, not a bit. What is being referred to is the Length Extension bit at position d7 of the Service field. Also, the heading “Octets *8/11” in Table 3 is incorrectly copied from Table 2, although the values in this column of Table 3 are correct.	Change the “SERVICE bit” headings in both Tables to “Length Extension bit.” Change the “Octets *8/11” heading in Table 3 to “(Octets*8/11)+1” Also, if the change recommended in my comment #8 is adopted, change the headings “round down” to “floor.”	EDITOR TO REVIEW & CHANGE AS APPROPRIATE Change the “SERVICE bit” headings in both Tables to “Length Extension bit.” Change the “Octets *8/11” heading in Table 3 to “(Octets*8/11)+1”
121	8	18.2.3.5	MIF	E	NO	The calculations to encode and decode the MPDU length in octets to/from the PLCP Length field value in microseconds and the Length Extension bit value are described in a poor mix of equations and prose. I feel VERY strongly that the current description, while correct, will foster non-interoperable implementations because of a high likelihood that people not thoroughly familiar with the issues involved may read some of this prose differently than the working group intends. My largest concerns are the phrases “...if the rounding took less than...” and “...if the rounding took more than or equal to...” in which the “taking” refers to the fractional part	Replace the text after the second paragraph and before the line just above Table 2 with the following: At the transmitter, the values of the Length field and Length Extension bit are calculated as follows: Length = Ceiling(((#octets+P)*8) / R) If (R = 11) AND (4 > Mod(((#octets+P)*8), R) > 0) Then LengthExtension = 1 Else LengthExtension = 0 Where: R = data rate in Mbit/s P = 0 for CCK, =1 for PBCC Ceiling(X) returns the smallest integer value greater than or	EDITOR TO REVIEW & CHANGE AS APPROPRIATE

						that must be added to the quotient in the process of rounding rather than referring to the fractional part of the quotient itself. If this section used equations throughout there would be a reduced risk of non-interoperable implementations.	equal to X.
							Mod(X,Y) returns the integer remainder from dividing X by Y to yield an integer quotient.
							
							At the receiver, the number of octets in the MPDU is calculated as follows:
							#octets =
							Floor(((Length*R) / 8) - P)
							- LengthExtension
							Where:
							R = data rate in Mbit/s
							P = 0 for CCK, =1 for PBCC
							Floor(X) returns the largest integer value less than or equal to X.	

122 E	6	18.2.3.5	SB	T	-	PLCP length field … (11 to 2^16 as defined by aMPDUMaxLngth) Should be 4 to 2^13 as per table 6 in 18.3.3	Make consistent	accept, fix text in 18.2.3.5 to not refer to the aMaxMPDUlength and change the table from 4 to 14 as the minimum length in octets. Also make sure to show units in octets or microseconds.
123 SP	7	18.2.3.5	SB	T	-	Not sure why the length encoding scheme has to be different for CCK and PBCC – first is octets/rate rounded appropriately, second is (octets+1)/rate. This is just an unnecessary complication.	Make encodings the same and make the implementers life simple.	Rejected: Extra byte needed to have a known data pattern at the end of the frame to finish decoding of the data.
124 E	10	18.2.3.5	TT	T	Y	The algorithm described requires one to round up to the next whole number. In order to do this one would require at least one extra addition over simple truncation. i.e. Length = int(#octets * 8 / 11) Service field bit would be set if amount truncated was >= 8/11.		Accepted, EDITOR will consider the righr form of the equation.

						At the receiver this would reverse the action if the service bit is set. If set the # octets would be incremented by 1.		
12SP	9	18.2.3.5	TT	T	Y	LENGTH is in bytes, therefore need to use DATARATE parameter as well when calculating the PLCP Length field. Clause reference is incorrect.	The transmitted value shall be determined from the LENGTH and DATARATE parameters in the TXVECTOR issued with the PHY-TXSTART.request primitive described in clause ~~18.2.3.5.4.~~ ????????	EDITOR
126	5	18.2.3.5 and 18.3.3	MIF	E	NO	In the first paragraph it states that the upper bound on length is “2^{16}-1 as defined by aMPDUMaxLngth” (also a misspelling of the characteristic name) whereas in 18.3.3 it states that the upper bound on aMPDUMaxLength is 2^{13}-1. These two constraints on the same characteristic should be consistent.	Correct the erroneous value (presumably the one in 18.2.3.5), also fix the spelling of “Length” in 18.2.3.5.	EDITOR TO REVIEW & CHANGE AS APPROPRIATE
127	4	18.2.3.6	AP	E		IEEE802.11 Signal, IEEE802.11 SERVICE	remove IEEE802.11	DONE
128	5	18.2.3.6	AP	E		Figure 4 CCITT CRC-16 Implementation	Insert + exor sign in drawing	EDITOR TO PUT “+” SIGNS IN CIRCLES
129	8	18.2.3.6	JZW	E		The circles in Figure 4 ought to have “+” in them so they define the XOR operation.		EDITOR TO PUT “+” SIGNS IN CIRCLES
130	9	18.2.3.6	MIF	E	NO	In third paragraph is a reference to “24 bytes”	Change to “24 octets”	DONE
131	7	18.2.3.6, figure 4	CT	E		seem to have a few typos	CCITT CCITT CRC-16 POLYNOMIAL: G(x) = X 16 + X^{12} +X 5 + 1	EDITOR TO CHANGE FIGURE 4 TYPOS
132	6	18.2.3.7	AP	E		2 bit for DQPSK, 4 bits for 5.5Mbit/s G(x) =x16+x5+1	Make document consistent 2-bit 5.5Mbps Change to G(x)=x16+x12+x5+1	EDITOR TO REVIEW & CHANGE AS APPROPRIATE
133	15	18.2.3.7	AS	E	N	The third sentence refers to the first symbol of the MPDU. The MAC/PHY interface is a byte interface.	The sentence should say first byte of the MPDU.	DONE
134	16	18.2.3.7	AS	E	N	The last sentence in the first paragraph refers to TXVECTOR parameter in	Replace: The MPDU transmission rate shall	DONE

						clause 15.4.5.3. This is the wrong TXVECTOR parameter. This is the one across the PMD interface, the reference should be to the one in clause 12 of 802.11 standard.	**be set by the DATARATE parameter in the TXVECTOR issued with the PHY-TXSTART.request primitive described in clause 15.4.5.3. With: The MPDU transmission rate and modulation shall be set by the DATARATE parameter in the TXVECTOR issued with the PHY-TXSTART.request primitive described in clause 12.3.4.4 of the 802.11 standard[Ref].**	
135 E	**5**	**18.2.3.7**	**JBO**	**T**	**Y**	**Service field d3 also defines modulation(PCBB)**	**Extend text: The 802.11 Signal and Service field …. …..indicated by the 802.11 signal and service field….. …..5.5 CCK or 5.5 PCBB ….etc.**	Accepted: The transmitter and receiver shall initiate the modulation indicated by the 802.11 SIGNAL and SERVICE field….
136	**9**	**18.2.3.7 and others**	**SB**	**E**	**-**	**Be consistent with PLCP pre-fixes to indicate the different types. The use of Short, Long and FH is fine, but make sure you use them EVERYWHERE you mean that type of PLCP. In some places it is ambiguous.**	**Be consistent editorially.**	
137 E	**11**	**18.2.3.7**	**TT**	**T**	**Y**	**Need to state that code also starts at the first symbol of MPDU. Clause reference is also not correct.**	**"...The transmitter and receiver shall initiate the modulation and code indicated by the 802.11 SIGNAL and SERVICE fields starting with the first symbol (1bit for DBPSK, 2 bits for DQPSK, 4 bits for 5.5 Mbit/s, 8 bits for 11Mbit/s) of the MPDU...."**	**Accepted, except it should modulation only, not code. See 135**
138 E	**5**	**18.2.3.7**	**WD**	**T**	**Y**	**Service field d3 also defines modulation(PCBB)**	**Extend text: The 802.11 Signal and Service field …. …..indicated by the 802.11 signal and service field….. …..5.5 CCK or 5.5 PCBB ….etc.**	**see 135, 137**

139	**10**	**18.2.3.8**	**JZW**	**E**		**The phrase "56 scrambled all zeros" is yukky.**	**Say "shall consist of a scrambled sequence of 56 zeros".**	**DONE**
140 E	**8**	**18.2.3.8**	**MBS, CH**	**T**	**NO**	**The state that the scrambler shall be started in is not specified. Specifying the initial state will provide additional sync info for those who want to use it.**	**Specify initial state.**	**Change to "For the purposes of this preamble, the scrambler shall be seeded with 0x6C"**
141 E	**10**	**18.2.3.8**	**MIF**	**T**	**NO**	**This paragraph states that "...shall be seeded with a non zero seed..." Does the seed value matter to the receiving stations? If so, the value needs to be specified here. If not, the fact that the seed value is arbitrary and its value will not detract from interoperability should be stated.**	**Make the change either to specify the scrambler seed value or to state that this value is arbitrary and may be chosen by implementers without impacting interoperability.**	
142	**12**	**18.2.3.8**	**TT**	**E**	**Y**	**Clause reference is not correct.**	**15.4.8.4 should be 18.4.8.4**	**15.4.8.4 should be 18.4.8.4** **15.4.8.5 DONE**
143	**7**	**18.2.3.9**	**AP**	**E**		**MSB to LSB**	**use consistent lower case**	**use consistent lower case** **REJECT**
144 E	**6**	**18.2.3.9**	**JBO**	**T**	**Y**	**There is no Low rate and High rate SFD**	**Change to … longSFD, …shortSFD**	**Change to … longSFD, …shortSFD**
145 E	**11**	**18.2.3.9**	**JZW**	**T**		**Since it does not matter what seed the scrambler is seeded with, it should be explicit that it is implementation dependent but can never be all 0 or all 1 (since the restrictions place a normative requirement on an implementation). Also, I think it might be wise to clarify that the seed value need not be the same for each frame.**	**Change to "For the purposes of this preamble, the scrambler shall be seeded with an implementation-dependent seed value, that shall never consist entirely of 0s or entirely of 1s, at the start of each frame."**	**Change to "For the purposes of this preamble, the scrambler shall be seeded with 0x6C"**
146	**13**	**18.2.3.9**	**TT**	**E**	**Y**	**This clause discusses the short SFD. There is not need to confuse things by describing the long SFD as well.** **Delete the line starting with:** **"Low rate SFD:X'F3A0..."** **Change High Rate SFD to shortSFD.**	~~**Low rate SFD: X'F3A0' = 1111 0011 1010 0000 MSB - LSB**~~ ~~**High Rate**~~ **shortSFD: X'05CF' = 0000 0101 1100 1111 MSB - LSB**	**Delete reference to: Low rate SFD and change to:** **shortSFD: X'05CF' = 0000 0101 1100 1111 msb - lsb** **DONE**
147 E	**6**	**18.2.3.9**	**WD**	**T**	**Y**	**Two SFDs are defined for use to distinct short and long preamble/PLCP formats, not for high and low rate.**	**Change to … longSFD, …shortSFD indication**	**see above**

148	**11**	**18.2.3.14 also Figure 8 and Figure 10**	**MIF**	**E**	**NO**	**This paragraph states that the "The short PLCP header shall be transmitted using the 5.5Mbit/s modulation." However, there are two 5.5Mbit/s modulations. Because PBCC is stated in 18.2.2 to be optional, I assume that the short PLCP header is transmitted using CCK.**	**State that the short PLCP header is transmitted at 5.5Mbit/s using CCK modulation. In several subsequent places, including Figures 8 and 10, the end of the PLCP header is identified as the instant of "Rate change start" but in fact should be "Rate change and/or Modulation change start" because there will be a modulation change with no rate change at this point in the PPDU when using a short PLCP header with a Signal field that specifies PBCC modulation. Also, in the middle of the paragraph in 18.2.3.14, change "...with the first symbol" to "...with the first symbol of the MPDU"**	**EDITOR TO CHANGE TO BE CONSISTANT WITH THE REVISED SHORT PREAMBLE "The short PLCP header shall be transmitted using the 2Mbit/s QPSK modulation."**
149	**13**	**18.2.3.15**	**MIF**	**E**	**NO**	**The TXVECTOR (both for the DS PHY in clause 15 and here in 18.2.6) is stated to provide the values for the SIGNAL (DATARATE), SERVICE, and LENGTH fields. Nowhere does it state where the values for the PSF and PLW fields of FH Interoperable PLCP headers are obtained. Because the data rate and length indicated in the FH PLCP header should be the same as the data rate and length indicated in the Short PLCP header, there is no need to add PSF & PLW parameters to the TXVECTOR.**	**Add a statement that "The value transmitted in the FH PSF field is derived from the SIGNAL (DATARATE) parameter provided in the TXVECTOR, and the value transmitted in the FH PLW field is derived from the LENGTH parameter provided in the TXVECTOR.**	**DONE**
150	**12**	**18.2.3.15.1 and Table 4**	**MIF**	**E**	**NO**	**There is a reference to "Rates 1-4.5Mbit/s" pointing back to clause 14.3.2.2.2. While correct, this implies that the HR/DSSS PHY will operate properly with FH rates other than 1Mbit/s and 2Mbit/s, which is inconsistent with the statement about FH Interoperability in 18.2.2. Specified in this manner, clause 18 creates a risk**	**Replace the first row of Table 4 with two rows: A row with b0:b3 of "0000" and Indicated Rate of 1Mbit/s; and a row with b0:b3 of "0010" and Indicated Rate of 2Mbit/s. Change two occurrences of "Mbps" in other rows to "Mbit/s" Also, change "compliant" to**	**EDITOR TO REVIEW & CHANGE AS APPROPRIATE**

						that future changes to clause 14 will inadvertently create non-conformance among devices designed to conform to clause 18. There should be an explicit specification in clause 18 of the rates at which the HR/DSSS station are required to provide FH Interoperability.	**"conformant" and make the reference to the table in the paragraph and the table number in the table heading consistent.**	
15 1 SP	**17**	**18.2.3. 10**	**AS**	**T**	**Y**	**The short header is transmitted at 5.5 Mbit/s rate. Since this does not state what modulation is to be used I assume it means that frames using CCK modulation would encode this part with CCK and frames using the optional PBCC would use PBCC to encode this portion. I think this is highly undesirable as it would make the two short preamble modes non-interoperable. We already have three non-interoperable modes as it is (long preamble, short preamble and FH preamble).**	**Define the encoding used for PLCP header in addition to the rate. Perhaps the rate should be lowered to 2 Mbit/s QPSK to improve the probability of receiving the PLCP header, independent of the encoding.**	**Accepted by virtue of making the short header 2 MBps. See 48**
152 SP	**9**	**18.2.3. 10**	**M BS, CH**	**T**	**YES**	**If the short PLCP header may be encoded with CCK or PBCC and the same SFD is used for both, then a receiver does not know if it should be decoding CCK or PBCC.**	**The best solution for this is to come up with one common modulation scheme for the PLCP header.** **Acceptable changes are listen in IEEE 802.11 doc:98-YYY**	**Accepted . see 48**
153	**14**	**18.2.3. 10**	**TT**	**E**	**Y**	**This sentence does not belong in this sub clause, it adds no relevant information on the Signal field which is being described. Delete.**	**"...transmission (and reception) of the MPDU. ~~The short header is transmitted at the 5.5 Mbit/s rate~~. The** **high rate HR/DSSS PHY operating with..."**	**DONE**
154 SP	**18**	**18.2.3. 14**	**AS**	**T**	**Y**	**The short header is transmitted at 5.5 Mbit/s rate. Since this does not state what modulation is to be used I assume it means that frames using CCK modulation would encode this part with CCK and frames using the optional PBCC would use PBCC to encode this**	**Define the encoding used for PLCP header in addition to the rate. Perhaps the rate should be lowered to 2 Mbit/s QPSK to improve the probability of receiving the PLCP header, independent of the encoding.**	**Accepted see 48**

						portion. I think this is highly undesirable as it would make the two short preamble modes non-interoperable. We already have three non-interoperable modes as it is (long preamble, short preamble and FH preamble).		
155	**19**	**18.2.3.14**	**AS**	**E**	**N**	**The signal and service bits combined indicate what modulation is used to transmit the MPDU. The signal bits indicate the rate and service bits indicate the code.**		**DONE**
156 E	**7**	**18.2.3.14**	**JBO**	**T**	**Y**	**Same comments as in 18.2.3.7 (my #5)**		**Accepted, see 135 for similar wording**
157	**20**	**18.2.3.14**	**AS**	**E**	**N**		**Change "first symbol" in the 4th sentence to "first byte".**	**DONE**
158	**15**	**18.2.3.14**	**TT**	**E**	**Y**	**Need to state that code also starts at the first symbol of MPDU.** **Sentence is not complete.** **Clause reference is also not correct.**	**"...The transmitter and receiver shall initiate the modulation and code indicated by the 802.11 SIGNAL and SERVICE fields starting with the first symbol (4 bits for 5.5 Mbit/s, 8 bits for 11 Mbit/s) of the MPDU. ...primitive described in clause ~~15.4.4.1~~ 18.4.4.1."**	**DONE**
159	**21**	**18.2.3.15**	**AS**	**E**	**N**		**Reference 802.11 standard.**	**Make it "802.11 standard, clause 14.3.2"** **DONE**
160 FH	**22**	**18.2.3.15**	**AS**	**T**	**Y**	**The point of adding this mode was to allow legacy cards to co-exist in HR environments. There is not enough description here to explain how that is to be accomplished.** **How does a legacy system determine the length (in time) of a HR frame from the PLCP header. 5.5 and 11 Mbit rates are not defined in the current 802.11 standard. If it can't determine the length of the incoming frame it will either defer for too long or clobber it.**	**Add text to completely describe this option and how this mode is to be used effectively.**	Comment accepted. The FH PLCP modification in 18.2.3.15 will be changed to use the existing FH PLCP PSF field using an indication of a 4 Mbps data rate (0110) which is currently unused and a length indication sufficient to cover greater than or equal to the duration of the full HR/DSSS packet. For example, if a FH/HR station takes the duration of the full HR/DSSS packet including guard time in microsec and

								divide by 2 and rounds up to calculate the length to insert in the FH PLCP header, a legacy FH station will defer for a period greater than or equal to the length of the packet whether it calculates the equivalent length with or without the 33/32 stuff expansion factor used in the 1 and 2 Mbps FH mode.
161 E	**12**	**18.2.3. 15.1**	**JZ W**	**T**		**Not all cases are covered in Table 4.**	**Add a row: "1 0 1 X remaining patterns are reserved".**	**Add all the unsupported patterns as reserved.**
162	**10**	**18.2.3. 15.1**	**SB**	**E**	**-**	**In table 4 (data rates in modified PLCP signalling field) the remaining patterns are reserved row is not quite correct. The remaining patterns are not just 111X but actually 1010 – 1111.**	**Add the whole range of values to the table.**	**See 161** **EDITOR TO REVIEW & CHANGE AS APPROPRIATE**
163	**16**	**18.2.5**	**TT**	**E**	**Y**	**This clause is a remnant of the DS section. What is stated here has been covered in the individual header descriptions.**	**Delete 18.2.5**	**DONE**
164	**14**	**18.2.5**	**MI F**	**E**	**NO**	**This paragraph appears to have been copied from clause 15 and never updated to reflect the new modulations and data rates.**	**Either update this text to match the HR/DSSS PHY or delete this paragraph entirely, since the information on rate and modulation changes appears to be covered adequately in 18.2.3.7 and 18.2.3.14.**	**EDITOR TO REVIEW & CHANGE AS APPROPRIATE**
165	**23**	**18.2.5**	**AS**	**E**	**N**	**Edit for changes from original DS PHY.** **Currently TXVECTOR is not defined in this document.**	**New Text:** **The PLCP Preamble shall be transmitted using the 1 Mbit/s DBPSK modulation. The IEEE 802.11 SIGNAL and SERVICE fields indicate the modulation that shall be used to transmit the MPDU. The transmitter shall initiate the modulation indicated by the IEEE 802.11 SIGNAL field starting with the first byte (1 bit for DBPSK, 2 bits for DQPSK, 4 bits for 5.5 Mb/s CCK, 8 bits for 11 Mb/s CCK, 1 bit for 5.5 Mb/s PBCC and 2 bits for 11**	**EDITOR TO REVIEW & CHANGE AS APPROP EDITOR TO REVIEW & CHANGE AS APPROPRIATE BECAUSE OF PREAMBLE CHANGES AND SUPPORTED OPTIONS ADDITIONS.RIATE**

							Mb/s PBCC) of the MPDU. The MPDU transmission rate and code shall be set by the DATARATE parameter in the TXVECTOR issued with the PHY-TXSTART.request primitive described in.	
166	24	18.2.6	AS	E	N	Change references to correct subclauses in this document in paragraph 1.		DONE
167	25	18.2.6	AS	E	N	In sentence 2, the short PLCP header is excluded and then it states that the procedure is the same in essence. There are either no differences or the differences have to be clearly described. I believe there are none.	Remove the exclusion in the first sentence and delete the second sentence.	DONE
168	26	18.2.6	AS	E	N	I'm not sure what the CS/CCA rules have to do with the transmit procedure in the PHY (that is a MAC issue). The referenced clause is actually the transmit procedure clause for the FH PHY. I think this needs to be reworded and the reference should be to the current 802.11 standard.		PHY GROUP TO CLARIFY accept
169	27	18.2.6	AS	E	N	There are a number of refences to the TXVECTOR parameter in the subclause. TXVECTOR at the PHY SAP is not defined in this document. The TXVECTOR defined in this document is the at the PMD SAP. I think a subcluase has to be added in this document to clearly describe the TXVECTOR parameter at the PHY SAP or somehow reference it to the parameter at the PMD SAP.		PHY GROUP TO CLARIFY accept
170 SP	28	18.2.6	AS	T	Y	There are a number of refences to the DATARATE parameter in the subclause. DATARATE at the PHY SAP is not defined in this document. In addition no mechanism is currently specified to allow the MAC to inform		Accepted, see 276

						the PHY which modulation (CCK or PBCC) is to be used to transmit this MPDU. It seems to me that unless we change clause 12 in the current standard we have to encode the code in the DATARATE parameter at that interface. The PMD interface does allow the SERVICE field to be passed separately and could be used to pass the code information.		
171	**29**	**18.2.6**	**AS**	**E**	**N**	**The length calculation for the PLCP header only specifies the 1 and 2 Mbit/s rates. There is no reference to the service field of the PLCP header.**		**EDITOR**
172 E	**30**	**18.2.6**	**AS**	**T**	**Y**	**Figure 9 is only correct for the long header mode. For the other modes the state machine needs to fixed up.**		**Fix state machine for all rates/modulations**
173								
174 E	**2**	**18.2.6 18.2.7**	**H M O**	**T**	**Y**	**The impact of PBCC is not defined in the transmit and receive procedures.**	**Define the impact of PBCC on the transmit and receive procedures.**	**See 172**
175 E	**5**	**18.2.6**	**H W**	**T**	**Y**	**LENGTH calculation is incorrect since it appears to be for 1Mbps and 2 Mbps as compared with clause 18.2.3.5**	**Based on the status of clear channel assessment (CCA) indicated by PHY-CCA.indicate, the MAC will assess that the channel is clear. A clear channel shall be indicated by PHY-CCA.indicate(IDLE). If the channel is clear, transmission of the PPDU shall be initiated by issuing the PHY-TXSTART.request (TXVECTOR) primitive. The TXVECTOR elements for the PHY-TXSTART.request are the PLCP Header parameters SIGNAL (DATARATE), SERVICE, and LENGTH, and the PMD parameters of TX_ANTENNA and TXPWR_LEVEL. The PLCP Header parameter LENGTH is calculated from the**	~~The PLCP Header parameter LENGTH is calculated from the TXVECTOR element by multiplying by 8 for 1 Mbit/s and by 4 for 2 Mbit/s.~~ **The PLCP Header parameter LENGTH is calculated from the TXVECTOR element by the algorithm in clause 18.2.3.5**

							TXVECTOR element by the algorithm in clause 18.2.3.5	
176 E	13	18.2.6	JZ W	T		The Transmit Procedure doesn't discuss changing from 1 Mbps to 5.5 Mbps for the Short PLCP header. It also doesn't base the behavior on any MIB variable value.	Add text to clarify when modulation method switches during the frame. Also, clarify that the PHY only transmits a single variety of PLCP frame at a time.	Accepted, add text
177 SP	14	18.2.6	JZ W	T		The phrase "if the channel is clear" in the sixth paragraph places a MAC-controlled requirement on the PHY. My understanding is that the PHY has to transmit when the MAC says it should, irrespective of the PHY's idea of whether the channel is clear. As phrased, it sounds like the PHY has to make the determination.	Clarify that what you mean is that if the MAC thinks the channel is clear and asks the PHY to transmit, transmission of the PPDU shall be initiated.	Accepted " the MAC actually issues the PHY_TX.start directive."
178	16	18.2.6	MI F	E	NO	In the second paragraph beneath Figure 8 it states "The PLCP Header parameter LENGTH is calculated from the TXVECTOR element by multiplying by 8 for 1Mbit/s and by 4 for 2Mbit/s." This ignores the 5.5Mbit/s and 11Mbit/s data rates. This also misuses the term "element" for a value from the TXVECTOR: the term should be "parameter" to be consistent with 12.3.4.4.	Change this sentence to "The PLCP LENGTH field and Length Extension bit values are calculated from the Length parameter in the TXVECTOR using the equations specified in 18.2.3.5." [see my comment #8 about unambiguous equations for 18.2.3.5]	EDITOR Change this sentence to "The PLCP LENGTH field and Length Extension bit values are calculated from the Length parameter in the TXVECTOR using the equations specified in 18.2.3.5."
179 SP	4	18.2.6	GE	T	Y	Need to allow for selection of short or long preamble	In Paragraph 6, replace "TXPWR_LEVEL" with "TXPWR_LEVEL and TXPREAMBLE_TYPE". This must be combined with the following comment pertaining to Section 18.4.4.4.	Accepted: See #276
180 E	9	18.2.6	CT	T	Y	LENGTH calculation is incorrect since it appears to be for 1Mbps and 2 Mbps as compared with clause 18.2.3.5	Based on the status of clear channel assessment (CCA) indicated by PHY-CCA.indicate, the MAC will assess that the channel is clear. A clear channel shall be indicated by PHY-CCA.indicate(IDLE). If the channel	accepted see 175

							is clear, transmission of the PPDU shall be initiated by issuing the PHY-TXSTART.request (TXVECTOR) primi-tive. The TXVECTOR elements for the PHY-TXSTART.request are the PLCP Header parameters SIGNAL (DATARATE), SERVICE, and LENGTH, and the PMD parameters of TX_ANTENNA and TXPWR_LEVEL. The PLCP Header parameter LENGTH is calculated from the TXVECTOR element by the algorithm in clause 18.2.3.5	
181	8	18.2.6	AP	E		It is recommended that chipping continue during power down	It is recommended that modulation continue during power down	ACCEPTED
182								
183	11	18.2.6	SB	E	-	First sentence has difficult to understand double negative.	Reword to clarify.	DONE
184	12	18.2.6	SB	E	-	A question of style here … this text is pulled word for word from the current DS clause. I would question the duplication of existing text where a reference could be used, but I'm not sure if this is IEEE editorial style. Actually looking more closely there is a mix of reference and duplication here …	Clarify correct thing to do with editor – duplicate, or reference.	EDITOR
185 E	13	18.2.6	SB	T	-	End of 6th paragraph. The PLCP Header parameter LENGTH is calculated … surely this should mention the other rates if applicable also.	Correct	accepted see 175
186	18	18.2.6	TT	E	Y	Shouldn't overly use negation. Improve clarity.	The transmit procedures for a HR/DSSS PHY transmitter ~~not~~ using the ~~short~~ long PLCP preamble and header are the same as those described in sections 15.2.7 and 15.2.8 and will not change apart from the ability to transmit 5.5 and	EDITOR

							11 Mbit/s.	
187 SP	**15 also see my Seq #17 and Seq #24**	**18.2.6 and 18.2.7**	**MIF**	**T**	**YES**	**Near the beginning of the section is a statement that "The decision for using a long or short PLCP {header} is beyond the scope of this standard." Even if this statement is true (which this voter does not believe, see my comments Seq #17 and Seq #24), it is not acceptable to omit a MEANS by which the MAC transmission control function can specify the use of a long or a short PLCP header, nor to omit a MEANS by which the MAC reception control function can determine whether the current frame was preceded by a long or a short PLCP header. Note that clause 9.6 includes the statement that "The algorithm for performing rate switching is beyond the scope of this standard..." but the TXVECTOR and RXVECTOR have a DATARATE parameter (specified in 12.3.4.4) so there is a means by which the {un-standardized} rate selection function can control the transmit rate and can determine the receive rate.**	**Add a PLCPFormat parameter that can take values of "LongPLCP," "ShortPLCP," or "FHPLCP" to the TXVECTOR and RXVECTOR of the HR/DSSS PHY. The PLCPFormat parameter in the PHY-TXSTART.request controls which PLCP format is prepended to the outgoing frame. The PLCPFormat parameter in the PHY-RXSTART.indicate reports which PLCP format was detected and validated (by CCITT CRC-16) at the start of the incoming frame.**	**Accepted, see 276, 187. Need to also add Modulations. Add a clause that says that all responses use the same preamble as received.**
188 SP	**17 also see my Seq #24 and Seq #30**	**18.2.6 and 18.2.7 and 18.3.3 (and 18.2.2)**	**MIF**	**T**	**YES**	**In isolation, there is not an inherent problem with the statement that "The decision for using a long or short PLCP {header} is beyond the scope of this standard." However, there are several, very significant side effects of this statement that relate directly to interoperability and which are appropriate to include in this standard. (Furthermore, there may be reasons to place the decision about PLCP format within the standard, as discussed in my comment Seq #24.)**	**Issue 1 can be addressed by defining a "Supported PLCP Formats" element, and allowing the inclusion of this element in Beacon, Association Request, Association Response, Reassociation Request, Reassociation Response, Probe Request, and Probe Response frames. Because stations are supposed to ignore elements whose ElementID they do not recognize, this addition, while a "change" to the MAC, is fully interoperable with existing implementations and does**	**Issue 1 Accepted: See #276 Issue two Rejected: Response preambles must be same as received frame.**

						ISSUE 1: Because a transmitter using short PLCP at 5.5Mbit/s or 11Mbit/s cannot communicate with other HR/DSSS stations which do not implement the short PLCP option, there should be an indication of whether a BSS is operating with (or allowing the use of, depending upon your point of view) short PLCP so that HR/DSSS stations that do not implement this option can identify themselves and so that a decision about whether to associate (or whether to allow association) by such stations can be made. ISSUE 2: The multirate mechanism defined in clause 9.6 introduces the concept of "rate sets," and requires certain frame types to be sent using mandatory rates or rates known to be receivable by all stations in the BSS. By allowing an optional short PLCP format, clause 18 creates a partially orthogonal group of "PLCP sets" and raises the question of whether there should be rules regarding the transmission of certain frame types using headers known to be receivable by all stations (or at least known to be receivable by the addressed recipient station).	not require a change to existing DS or FH PHY specifications. Issue 2 can be addressed by defining the rules for the use of short PLCP (as a subset of the multirate rules in 9.6 because, as an option, short PLCP never falls in a "mandatory" or a "basic" category. SIMPLER ALTERNATIVE: Do not make short PLCP optional (it already is mandatory for a station to be able to support FH Interoperable PLCP). Require all stations implementing the HR/DSSS PHY to support short PLCP. This is the approach this commenter prefers.	
189	15	18.2.6 18.2.7	SB	E	-	In figures 9 and 11 PMP rate should be corrected to PMD_rate	Editorial fix	DONE
190 E	14	18.2.6 18.4.5	SB	T	-	I see nothing here in the sequence of primitives that tells the PLCP to use the necessary header type, nor anything in the PMD interface that tells the PHY to use the required modulation … CCK or PBCC. I think or a complete service specification this needs to be added. Of	Add necessary header type and modulation type parameters to service specification and sort out how they are set.	Accepted, add to service specifications. see 276

						course this means you need to work out who logically has the responsibility of setting this information (which CANNOT be in the MIB as it is a per transmission (aper destination) thing. That comes back to my comments about how a STA learns what another is capable of … and the suggestion that you define a new HR DSSS parameter set.		
191 E	8	18.2.6, 1st 2 sentences	CT	T	Y	Not sure if this is editorial or technical, but clause references seem to be incorrect if referring to original standard. Perhaps what is meant is that the TX procedures are the same as original standard except for the higher rate transmissions if using the long preamble and header. Second sentence is vague, seems to indicate no difference even with short preamble and header but not sure what "in essence" means	?	Clarify sentence
192 E	4	18.2.6, 1st 2 sentences	HW	T	Y	Clause references seem to be incorrect if referring to original standard. Perhaps what is meant is that the TX procedures are the same as original standard except for the higher rate transmissions if using the long preamble and header. Second sentence is vague, seems to indicate no difference even with short preamble and header but not sure what "in essence" means	?	see above
193	3	18.2.6, 5th paragraph	HW	E		LSB MSB not capitalized	At the PMD layer, the data octets in LSB to MSB order and presented to the PHY layer through PMD_DATA.request primitives.	DONE
194	10	18.2.7	AP	E		Figure reference… RX Idle state as shown in Figure 9.	Change to Figure 10	DONE
195	11	18.2.7	AP	E		but the SERVICE field is out of IEEE802.11 HR/DSSS specification,	remove the text	DONE
196	12	18.2.7	AP	E		Figure 11 RX 8 bit Signal	upper case for SIGNAL	DONE

197	9	18.2.7	AP	E		Figure reference… RX Idle state as depicted in Figure 9	change to Figure 10	DONE
198 SP	31	18.2.7	AS	T	Y	There is insufficient justification for making short preamble an optional feature. If short preamble is made mandatory then all compliant receivers should be able to decode long and short headers independent of the mode the transmitter is configured for.	Make short preamble mandatory. Then a receiver would be able to determine the frame type by looking at the SFD.	Rejected: However need to modify the text in the 2nd paragraph 2 of 18.2.7 for correctness.
199	32	18.2.7	AS	E	N	There seems to be some confusion as to what are the PHY SAP primitives and what are the PMD SAP primitives. The parameters for these two sets of primitives are different and should be identified and used separately.		EDITOR
200	10	18.2.7	CT	E		clause reference for modulation rate change mechanism appears to be incorrect	?	DONE
201 E	11	18.2.7	CT	T		missing length adjustment from bit in service field as indicated in 18.2.3.5	If the PLCP Header reception is successful (and the SIGNAL field is completely recognizable and sup-ported), a PHY-RXSTART.indicate(RXVECTOR) shall be issued. The RXVECTOR associated with this primitive includes the SIGNAL field, the SERVICE field, the MPDU length in bytes (calculated from the LENGTH field in microseconds plus one bit of the SERVICE field), the antenna used for receive (RX_ANTENNA), RSSI, and SQ.	accepted, change to read: If the PLCP Header reception is successful (and the SIGNAL field is completely recognizable and sup-ported), a PHY-RXSTART.indicate(RXVECTOR) shall be issued. The RXVECTOR associated with this primitive includes the SIGNAL field, the SERVICE field, the MPDU length in bytes <u>(calculated from the LENGTH field in microseconds plus one bit of the SERVICE field),</u> the antenna used for receive (RX_ANTENNA), RSSI, and SQ.
202 E	6	18.2.7	H W	T		missing length adjustment from bit in service field as indicated in 18.2.3.5	If the PLCP Header reception is successful (and the SIGNAL field is completely recognizable and sup-ported),	see above

							A PHY-RXSTART.indicate(RXVECTOR) shall be issued. The RXVECTOR associated with this primitive includes the SIGNAL field, the SERVICE field, the MPDU length in bytes (calculated from the LENGTH field in microseconds plus one bit of the SERVICE field), the antenna used for receive (RX_ANTENNA), RSSI, and SQ.	
203 E	**8**	**18.2.7**	**JB O**	**T**	**Y**	**Figure 11 , I don't know what happened to this figure but the arrow with length and length count are not correct**	**Compare to the original figure in our green book (802.11 standard)**	**fix diagram which was redrawn from the green book**
204 E	**15**	**18.2.7**	**JZ W**	**T**		**The PLCP Receive Procedure doesn't account for what PLCP type is being used (Short/Long) and doesn't mention changing the data rate to 5.5 Mbps if we're in Short mode. Also, the fact that the PHY has to reject any frames with different PLCP header type should be clarified. If the PHY were to accept Long PLCP frames when we're in Short PLCP mode, it would pass a frame to the MAC that we would reply to with a Short PLCP header, which almost certainly would not be received by the originator.**	**Add text to clarify when modulation method switches during the frame. Also, clarify that the PHY only receives a single variety of PLCP frame at a time.**	**Accepted, Add text to clarify when modulation method switches during the frame. Reject modality.**
205	**10**	**18.2.7**	**M BS, CH**	**E**	**NO**	**Depending on the resolution to the preamble issue, the rate of the header may not be 5.5Mbps.**	**Should the rate of the header change, the statement, "receiver shall be enabled to receive 5.5 Mbits/s in order to process the rest of the header", will need to be changed.**	"receiver shall be enabled to receive 2 Mbits/s in order to process the rest of the header",
206	**18**	**18.2.7**	**MI F**	**E**	**NO**	**In the third paragraph there is a reference to "clause 1.2.3.3" which is clearly incorrect. It appears that the correct citation should be "18.2.3.7 and 18.2.3.14."** **Also, in the 5th paragraph after Figure 10 (middle of page 516) is a reference to**	**Correct these references, either as stated to the left or other, proper target clause(s).** **[see my comment #14 regarding the content of clause 18.2.5]**	**DONE**

						"18.2.5" which also should be to "18.2.3.7 and 18.2.3.14."		
207	**19**	**18.2.7**	**MIF**	**E**	**NO**	**In the 5th paragraph after Figure 10 (middle of page 516) is a reference to "Figure 9" which appears to actually be referring to Figure 11.**	**Correct this reference**	**DONE**
208	**20**	**18.2.7**	**MIF**	**E**	**NO**	**In the 7th paragraph after Figure 10 (bottom of page 516) is a "... but the indicated rate ..." that should be "... but the indicated rate or modulation ..." as well as a "... will not be issued." that should be "... shall not be issued."**	**Correct this wording**	**DONE**
209E	**21**	**18.2.7**	**MIF**	**T**	**NO**	**The fourth paragraph states that "The detection of the long PLCP preamble can be based on the data content of the preamble (scrambled all 1's compared to scrambled all 0's) or on the absence of the short SFD after 56 microseconds." The first criterion is valid, the second is INVALID. The absence of the short SFD after 56 microseconds ONLY allows the receiving station to conclude that what is being received is NOT a short PLCP preamble, whereas the statement which appears could lead a reader to conclude that this is sufficient for acceptance of a long PLCP preamble. If, as I suspect, the underlying issue is that the data patterns for the short and long SFDs are different, and the receiver might need a decision factor on which to base changing some SFD pattern detection hardware or software between these patterns, then this should be made more clear – because it IS valid for the receiving station to cease looking for a short SFD, and commence looking for a long SFD, either because the preamble data is scrambled 1's or because no short SFD was detected within 56**	**Specify the decision criteria in a manner that does not allow an affirmative result (detection of a PLCP preamble) based on the absence of an event. If the decision is actually about which SFD value to search for, reword to make this clear, in which case the stated criteria are appropriate, but the detection of a given type of PLCP preamble (actually PLCP header in this case) must be stated to occur upon recognition of the appropriate SFD pattern.**	**"The detection of the long PLCP preamble can be based on the data content of the preamble (scrambled all 1's compared to scrambled all 0's). Absence of the short preamble can be inferred on the failure to find the short SFD after 56 microseconds."**

						microseconds of the start of the preamble.		
210 SP	**31**	**18.2.7**	**MI F**	**T**	**NO**	**The statement in 18.2.7 regarding "coexistence" between stations using short PLCP and stations that do not support short PLCP ignores the fact that this coexistence only works for stations within mutual range of each other, so that the physical carrier sense mechanism operates to cause deferral. This is likely to create a partially false impression on new readers, because it does not point out that, because the stations not supporting short PLCP do not receive the frame, and therefore benefit from NEITHER the length information in the PLCP header nor the Duration information in the MAC header, only the physical detection of RF energy (which is subject to fades, etc.) is protecting the active communication activity from destructive interference. Neither the length-based surrogate ending delimiter provided by PHYs that successfully receive PLCP headers, nor the virtual carrier sense provided by the MAC's NAV operate in this "coexistence" scenario. These limitations of coexistence are likely to effect most severely the ability to communicate reliably near the area of overlap between BSSes.**	**Add text to 18.2.7 noting these limitations to "coexistence."**	**Accepted:** **Need to modify the text in the 2nd paragraph of 18.2.7 for correctness.**
211 SP	**17**	**18.2.7**	**TT**	**T**	**Y**	**Receiving the short header should not be optional. (see tt 18.2.1)** **Receivers should be able to on the fly detect and receive either preamble/header.** **Co-existence is not a given, as there are**	**If a PPDU with a short preamble and header is being transmitted a ~~receiver configured to receive a long PLCP preamble and header will also react as described herein. The~~ receiver ~~will detect energy or a carrier, perform the CCA procedure and defer if necessary. The short~~**	**Rejected, see 37**

						no specs in this standard dictating the behavior of energy/carrier detect when receiving an unexpected rate/code.	~~preamble is a HR/DSSS signal which can be sensed by the carrier sense mechanism. The short SFD will normally not be detected and the receiver defers until the energy or carrier sense drops, thus providing coexistence capabilities between the systems.~~ ~~The receiver configured to receive a short PLCP preamble and header~~ shall perform CCA and synchronize on the short preamble (56 microseconds) in order to be able to detect the short SFD. After detection of the short SFD the receiver shall be enabled to receive 5.5 Mbit/s in order to process the rest of the header. After this, the receive procedure is the same as described herein. The modulation rate change mechanism is described in clause ~~1.2.3.3~~. 18.?.?.?	
212 SP	17	18.2.7	TT	T	Y	..(cont'd) from above.	~~The receiver configured to receive a short PLCP shall also be capable of receiving a PPDU with a long PLCP preamble or header. The detection of the long PLCP preamble can be based on the data content of the preamble (scrambled all 1's compared to scrambled all 0's) or on the absence of the short SFD after 56 microseconds.~~	See above
213 E	12	18.2.7	VH	T	Y	In the second paragraph, the first line, the operation is "transmitted". We are describing the receiver, hence we can not say anything about the transmitter	Replace "transmitted" by "received"	accepted, Replace "transmitted" by "received"
214	12	18.2.7 figure	CT	E		figure is missing some arrows. Typo with PMP_RATE	PMD_RATE	EDITOR

		11						
215 SP	1	18.2+	JH A	T	Y	Detailed study of the draft showed a lack of coexistance capabilities between the options (PCBB and FH option) in the standard. Since the goal of the standard in to create interoperable products in the market the draft as it is now is not acceptable.	The group should either refine the definition of the options to allow interoperable (or at least co-existant) systems or reconsider the defined option as a whole.	Accepted, we refined the definition of the options. See 52
216 E	33	18.3	AS	T	Y	There needs to be some mechanism added to this clause by which the MLME can determine what options are supported by the PHY and what options should be in use.		ACCEPTED, See resolution 227 and 49
217	10	18.3.2	H M O	E	Y	Reference to dot11PhyDSSComplianceGroup is incorrect.	Refer to dot11PhyDSSTable.	DONE
219	11	18.3.2	H M O	E	Y	Reference to dot11AntennasListGroup is incorrect.	Refer to dot11AntennasListTable.	DONE
220	3	18.3.2	H M O	E	Y	Reference to “Clause 12” is incorrect.	Replace this reference by a reference to Annex D.	DONE
221	4	18.3.2	H M O	E	Y	Reference to dot11PhyOperationComplianceGroup is incorrect.	Refer to dot11PhyOperationTable.	DONE
222	5	18.3.2	H M O	E	Y	“dot11PHTdot11TempType” does not exist; is concatenation of two names.	Split this row out to two: dot11PHYType and dot11TempType	DONE
223	6	18.3.2	H M O	E	Y	dot11RegDomainsSupported is not part of the dot11PhyOperationTable .	Define this as separate dot11RegDomainsSupportedTable.	DONE
224	7	18.3.2	H M O	E	Y	Reference to dot11PhyRateGroup with items dot11SupportedDataRatesTx and dot11SupportedDataRatesRx is incorrect.	Refer to separate dot11SupportedDataRatesTxTable and dot11SupportedDataRatesRxTable.	ACCEPTED TO DO 2 TABLES
225	8	18.3.2	H M O	E	Y	Reference to dot11PhyAntennaComplianceGroup is incorrect.	Refer to dot11PhyAntennaTable.	DONE
226	9	18.3.2	H	E	Y	Reference to	Refer to dot11PhyTxPowerTable.	DONE

			MO			**dot11PhyTxPowerComplianceGroup is incorrect.**		
227 E	**22**	**18.3.2 Table 5 also 18.4.6.7**	**MIF**	**T**	**NO**	**The need to disseminate information about the existence of optional capabilities pertaining to the optional PLCP formats and modulation is discussed at length in my comments Seq #15, #17, #24, and #30. Besides a means to transfer this information across the MAC/PHY boundary (#15) and across the air interface (#17, #24, #30), there is also a need for a means to transfer this information across the management interface.**	**Add two, new managed objects to the PHY MIB: "dot11PLCPFormatsSupported" (or "dot11PLCPModesSupported" if the modal recommendation from my comment Seq #24 is adopted) and "dot11CurrentPLCPFormat" (or "dot11CurrentPLCPMode"). If PLCP format is made modal, a station joining a BSS will set its "current" values to match those of the BSS. I do not have a strong opinion about whether the initial setting for the BSS should come from the preexisting value of the "CurrentPLCP" object at the time the BSS is started or whether this should be a new parameter to the MLME-START.request primitive. NOTE: An analogous pair of new managed objects may be necessary for supported and current modulations as part of addressing the issues raised in my comment Seq #30 regarding PBCC.**	**Accepted in principle except for making it modal. The restriction is unnecessary and may prevent useful modes from being used. MIB variables to be added by editor**
228	**23**	**18.3.2 Table 5**	**MIF**	**E**	**NO**	**The object name in the first row of Table 5 has an editing artefact attached.**	**Change this name to read "dot11PHYType"**	**DONE**
229 E	**34**	**18.3.3**	**AS**	**T**	**Y**	**The PHY characteristics are described as static. However many of the values for the PHY characteristics are dependent on the set of options in use. The MAC needs to know these values to be able to set and interpret fields in frames. Need to add channel switch time for the FH interoperability mode. The MAC**	**The simplest method is to define different PHY types for the different modes of operation. The other possibility is to make the characteristics dynamic, but that would require changes to the MAC to cause it to reread these values whenever the mode changes.**	**See comments above for the different PHY types. As for the channel switch time, I believe it is the same as in the FH PHY.**

						need this to determine how long it has to hold off before transmitting after a hop.		
230 E	24	18.3.3 Table 6 also relates to 18.2.6, 18.2.7, and 18.2.2	MI F	T	YES	Issue 1: The second of the two values listed for aPreambleLength is wrong. The value 144us for Long PLCP headers is correct (equal to the DS PHY value from Table 58 in Clause 15.3.2). This 144us includes both the Sync field (128us) and the SFD (16us). The value 56us for Short PLCP headers should be 72us, because there are 56 bits in the ShortSync field plus 16 bits in the ShortSFD, all of which are sent at 1Mbit/s. Issue 2: There is a third value that applies when using FH Interoperable PLCP headers: The time from the beginning of the FHSync field through the end of the ShortSFD is 208us. Issue 3: The aPreambleLength parameter returned by the PLME-CHARACTERISTICS.confirm (10.4.3.2 of 802.11rev) is a scalar (single integer, NOT an vector of integers). Without changes to the MAC there must be a single value for aPreambleLength. It is not sufficient to simply redefine aPreambleLength to be a vector because of how the MAC uses this value (discussed in detail in the column to the right). Even if aPreambleLength were a vector, the MAC would require rules regarding what element of the vector is to be used under various circumstances, and any such rules are likely to be equivalent to, or more complex than, the rules for using different PLCP formats in a	The statement near the beginning of 18.2.6 that "The decision for using a long or short PLCP is beyond the scope of this standard" is incorrect. In the absence of defined rules governing the use of the various PLCP formats, the MAC will either break or will operate with reduced efficiency, thereby negating most benefit from short PLCP format. The MAC uses aPreambleLength in calculations of the duration value transmitted in the Duration/ID field, and the length of response timeouts. Therefore, aPreambleLength must be static, AT LEAST during each frame exchange sequence (see 9.7). Otherwise the MAC must calculate the duration and response timeout for any bilateral frame exchange assuming the maximum possible aPreambleLength. This would be aPreambleLength =144us except when using FH Interoperability PLCP (which only makes sense if used on a BSS-wide basis), when aPreambleLength =208us. However, this is an inefficient approach: Stations which detect the duration value in early frame(s) of a sequence, but do not detect the final ACK will have their NAV expire 72us or 136us late, placing them at a disadvantage in contending for the medium after the sequence. For a communication failure, the sending station will react to non-response 72us or 136 us late,	Correct the lengths and add one for the FH case. Study the other comments relative to the length parameter.

						manner that allows deterministic PLCP usage within a single frame exchange sequence (or within a BSS).	**delaying retries and reducing overall throughput.** **A superior approach is to make PLCP header length modal, with an entire BSS operating in one mode. This has the advantage of reducing the opportunity for problems due to the non-interoperability of Tx using short PLCP to an Rx unable to decode short PLCP. In this scenario, a BSS operates in LongPLCP mode where all transfers use long format and aPreambleLength is reported as 144; in ShortPLCP mode, where all 5.5Mbit/s and 11Mbit/s transfers use short format and aPreambleLength is reported as 72; or in FHPLCP mode, where all transfers use FH Interoperable format and aPreambleLength is reported as 208us. This requires removing the restriction in 18.2.2 that "acknowledgements to high rate packets may not use the FH PLCP."** **Another approach is rule-based rather than modal. This permits the initiator of a frame exchange sequence to use any PLCP format, but requires the responder to use the same format as the initiator. For FH PLCP format, responses could be defined to use Short PLCP, since any station able to handle FH PLCP can decode Short PLCP. This DOES require changes to the MAC, both in duration calculations and by adding an internal decision regarding the PLCP format to use for responses. It also would require the addition of an**	

							"aResponsePreambleLength" parameter to the PLME-CHARACTERISTICS.confirm. **A hybrid of the modal and rule-based alternatives would be to have each BSS operate in a single PLCP mode, but to define rules for responses. This is the approach this voter personally favors, although it DOES require changing the MAC (in an upward compatible manner). In LongPLCP mode all frames would use Long format. In ShortPLCP mode the initiator of a frame exchange sequence at 5.5Mbit/s or 11Mbit/s could select Long or Short format, but all subsequent frames in the sequence would use the same format. In FHPLCP mode all 5.5Mbit/s or 11Mbit/s frames of type Data or Management, except those sent during the Contention Free Period, as well as PS-Poll and RTS Control frames, would use FH Interoperable format; while ACK frames, CTS frames, and all CF-frames would use Short format. In this hybrid, as well as in any modal scheme, the "Supported PLCP Formats" information element sent in Beacon and Probe Response frames (discussed in my comment Seq #17) could be used to indicate the operating mode of the BSS.**	
231 E	**26**	**18.3.3 Table 6**	**MI F**	**T**	**NO**	**The upper bound on the value of aMPDUMaxLength is listed as (2^{13} - 1), which is only correct if FH interoperability PLCP headers are not being used. When using FH PLCP**	**Change the entry in the "Value" column to list (2^{13} –1) in Long PLCP mode and Short PLCP mode, and (2^{12} –1) in FH PLCP mode. Also, the heading of clause 18.3.3**	**change the maximum value to (2^{12} –1) for all cases, since this length (4095 octets) is already substantially longer than the greatest length MPDU that will**

						mode, the upper bound on aMPDUMaxLength is (2^{12} - 1) because this is the maximum value that can be represented in the PLW field of the FH PLCP header.	and of Table 6 should include "HR/DSSS" in place of "DS." It would also be acceptable (and simpler) to change the maximum value to (2^{12} –1) for all cases, since this length (4095 octets) is already substantially longer than the greatest length MPDU that will be generated by the MAC (2304 octets).	be generated by the MAC (2304 octets).
232 E	19	18.3.3	TT	T	Y	Require two sets of aCWmin and aCWmax parameters. One for operation in compatibility (Legacy) mode and the other when using the high speed mode. The values specified are fine for 1 and 2 Mbits/s but they are excessive when operating at 5.5 and 11 Mbits/s. Since the time an MPDU takes on the air is now up to 10 times less, the congestion being alleviated by the CW backoff should clear up much faster as well. Therefore you don't need as much a backoff to get the same effect. Regardless, the CW values must be preserved when using long headers so that fairness is maintained when inter-operating with legacy systems.	Change table entries to: Using long preamble/header: aCWmin 31 aCWmax 1023 Using short preamble/header: aCWmin 7 aCWmax 127	accepted, Change table entries to: Using long preamble/header: aCWmin 31 aCWmax 1023 Using short preamble/header: aCWmin 7 aCWmax 127
233	13	18.4.2	AP	E		peer-to-peer interactions, and	remove , and	DONE
234 E	35	18.4.4.1	AS	T	Y	The primitives defined in Table 7 are the PHY sap primitives not the PMD_SAP primitives. It looks like the standard document also has this wrong.	Put in a table with the correct PMD SAP primitives.	Put in a table with the correct PMD SAP primitives.
235 E	20	18.4.4.1	TT	T	Y	Table 7 contains the PMD_SAP peer-to-peer Service primitives. Those actually displayed are the PHY_SAP primitives.	1) Delete the first 5 rows of table 7. 2) Change PHY-DATA to PMD-DATA in the last row. 3) PMD-DATA primitive does not have a .Confirm (remove X).	SEE ABOVE
236 E	36	18.4.4.2	AS	T	Y	This is the PHY section. There shouldn't be anything here that says		ACCEPTED

						"PHY dependent". The "PHY dependent" stuff is supposed to be defined here.		
237	37	18.4.4.2	AS	E	N	The RXVECTOR and TXVECTOR parameters here have the same names as the RXVECTOR and TXVECTOR parameters at the PHY SAP even though they are different things. This has lead to confusion in the rest of the document as to which is being referenced.	Change the name of these parameters.	ACCEPTED
238	16	18.4.4.2	JZW	E		The word "actually" in the second sentence is confusing.	Delete the word "actually".	Remove word DONE
239 E	21	18.4.4.2	TT	T	Y	This section serves absolutely no purpose and should be deleted. All these parameters are described in the next section anyway.	Delete this section in its entirety	
240 E	38	18.4.4.3	AS	T	Y	Need to add primitives to select different modes of operation, i.e. preamble length, FH interoperability.	Add: PMD_PREAMBLE PMD_FHMODE	Add: PMD_PREAMBLE PMD_FHMODE PMD_HRMODE this last for CCK vs PBCC
241 E	39	18.4.4.4	AS	T	Y	Need to add a parameter to select the MPDU encoding, CCK or PBCC.	Add: CODE	SEE ABOVE
242	40	18.4.4.4	AS	E	N	Remove references to PHY SAP primitives.		DONE
243 E	5	18.4.4.4	GE	T	Y	Need to allow for selection of short or long preamble	In Table 10 add the following line: "TXPREAMBLE_TYPE PHY-TXSTART.....Short/Long". This comment must be combined with the previous comment.	SEE 240 ABOVE
244 E	9	18.4.4.4	JBO	T	Y	Table 10. PCBB not defined	Define PCBB in Value column.	Delete the "CCK" from the table so it applies to both
245 E	23	18.4.4.4	TT	T	Y	This section describes the PMD_SAP and should not have any PHY_SAP primitives in it. Need parameter to specify the PBCC code/CCK code selection.	1) Delete the first 3 rows of table 10. 2) Delete row for parameter RF_STATE, since this parameter is not used or defined anywhere in the document. 3) In row for TXPWR_LEVEL	Accepted, see 244

							Associated primitive should be PMD-TXPWRLVL and not PHY-TXSTART. **4) Add row for new Parameter "CODE" associated with the PMD_CODE primitive and defined values: X'01' for CCK and X'02' for PBCC.**	
246 E	**22**	**18.4.4.5**	**TT**	**T**	**Y**	**A primitive is needed to convey which code will be used for the higher rates.**	**5) Add row to Table 9 with the following parameters.** **Primitive: PMD_CODE** **Request: X** **Indicate: X** **2) Need to add appropriate subsections in 18.4.5.x to describe it.**	**ACCEPTED, SEE 240**
247	**15**	**18.4.5.1.2**	**AP**	**E**		**OxoF**	**use upper caseOx0F**	**DONE**
248 E	**24**	**18.4.5.1.2**	**TT**	**T**	**Y**	**This primitive is independent of the code used and should not mention either. Also, the way its worded implies that these values are different for PBCC.**	**Delete references to CCK, or if insufficient to simply say 5.5 Mbits/s state both CCK and PBCC.**	**Delete reference to CCK when discussing rates in general.**
249 E	**16**	**18.4.5.1.2 18.4.5.2.2**	**SB**	**T**	**-**	**No mention of PBCC here**	**Probably needs adding.**	Change to: The TXD_UNIT parameter takes on the value of either one(1) or zero(0) for DBPSK modulation or the dibit combination 00, 01, 11, or 10 for DQPSK modulation. For 5.5 Mbit/s ~~CCK~~ modulation it takes on the values of 0x00 to 0xoF and for 11 Mbit/s ~~CCK~~ modulation it takes on the values 0x00 to 0xFF.
250	**14**	**18.4.5.2.2**	**AP**	**E**		**OxoF**	**use upper case Ox0F**	**DONE**
251 E	**25**	**18.4.5.2.2**	**TT**	**T**	**Y**	**See tt 18.4.5.1.2**		

252	11	18.4.6.10	JBO	E	Y	Ms should be micro seconds		EDITOR
253 E	22	18.4.6.10	JZW	T		I suspect the time should be 10 microseconds, not 10 milliseconds.	Change units to microseconds.	Yes, microseconds
254 E	2	18.4.6.10	PK	T	Y	TX to RX turnaround time cannot be 10 mSec	10 uS?	Yes, microseconds
255	21	18.4.6.10	SB	E	-	ms should me microseconds	fix editorial	EDITOR
256 E	26	18.4.6.10	TT	T	Y	Incorrect units.	The TX-to-RX turnaround time shall be less than 10 usec.~~ms~~, including the power-down ramp specified in 18.4.7.7.	
257	16	18.4.6.2	AP	E		redundant text “an optional”	remove text	EDITOR
258	20	18.4.6.2	AP	E		Figure 14 incomplete	add input/output and Z delay to drawing	EDITOR
259	21	18.4.6.2	AP	E		as s in Figure CC.	Change to “as “S” in Figure 15.	DONE
260	22	18.4.6.2	AP	E		c0 c1 c2…..	Add figure and spaces between rows	ACCEPTED
261 E	17	18.4.6.2	SB	T	-	Take this opportunity to consider hard whether there are other regulatory domains that need to be added	Review	
262	17	18.4.6.5	AP	E		1.4.6.5.4	change to 18.4.6.5.2	EDITOR
263	17	18.4.6.5	JZW	E		There are incorrect references to 1.4.6.5.2 and 1.4.6.5.3 and a missing bibliographic citation to Hadamard.	Correct/add references.	Remove reference citation EDITOR
264	11	18.4.6.5	MBS, CH	E	YES	The current specification of CCK specifies complex chips in the set {-1, +1, +i, -i} The IEEE Std 802.11-1997 refers to the QPSK constellation as {1+i, -1+i, 1-i, -1-i}. See Figure 99 for example. In addition, the codeword description is not clear. The CCK encoder can be express as a	Adopt changes in IEEE doc:98/XXX submitted by Matthew B. Shoemake, Chris Heegard and Stanley Ling.	Rejected, the new description seems to be more confusing and complex than the original.

						simple matrix multiply with a scramble sequence added in. **The differential encoding is not clear.** **It would be good to have one block that describes how to generate the codewords and another block that is the differential encoder.**		
265	**18**	**18.4.6.5**	**SB**	**E**	**-**	**Missing reference in 5th para**	**Add reference**	**Deleted Reference**
266	**1**	**18.4.6.5**	**WB**	**E**	**Y**	**Phrase "(add reference)' is spurious**	**This is a form of the generalized Hadamard transform encoding where j1 is added to all** **code chips, j2 is added to all odd code chips, j3 is added to all odd pairs of code chips and j4 is added to all** **odd quads of code chips.**	**Deleted Reference**
267	**13**	**18.4.6.5.1**	**CT**	**E**		**last sentence refers to equation but clause reference appears to be incorrect**	**correct clause reference**	**Editor to provide correct reference.** This can be seen by the minus sign on the 4th and 7th terms in the equation in clause **18.4.6.5**
268 E	**18**	**18.4.6.5.2**	**JZW**	**T**		**Is the text correct that for the header (but not the rest of the frame) there is an additional 180 degrees of rotation? That sounds wacky. If that is really what is meant, there should be a DQPSK Encoding Table for the header and a different table for the rest of the frame, and more text to clarify the numbering of the dibits in the frame.**	**Add another table and clarifying text.**	**It is intended that the additional 180 degree rotation apply for all CCK modulation, header and body**
269	**19**	**18.4.6.5.3**	**AP**	**E**		**180 degree (*)**	**change (*) to PI symbol**	**DONE**
270	**14**	**18.4.6.6**	**CT**	**E**		**missing header for clause**	**delete clause number and renumber**	**DONE**
271	**19**	**18.4.6.6**	**JZW**	**E**		**This section is empty.**	**Delete spurious section heading.**	**DONE**

272	19	18.4.6.6	SB	E	-	Spurious section heading	fix editorial	DONE
273E	10	18.4.6.7	JBO	T	Y	Figure 13. What data in, scrambled or unscrambled? In my opinion should be scrambled.	Change figure accordingly	change figure to show that the data input is scrambled.
274E	20	18.4.6.7	JZW	T		The paragraph that begins "Since the system is packet based" is confusing. Is the idea that 0s get shifted in at the end of one packet and remain there when transmission of the next packet commences? The scramblers are initialized to a known value prior to when they kick in for each frame – so the convolutional coder seems to be treated differently.	Clarify that the state of the encoder persists between frames, and exactly when 0 bits get clocked into it.	The state of the encoder should not be maintained between transmissions. The 0 bits are clocked in to finish the encoding process and the decoding process. Convolutional encoding spreads the bit energy over the constraint length of the code, so it needs these extra bits to finish the process.
275E	28	18.4.6.7	MIF	T	YES	The second paragraph above Figure 14 includes the statement that "To place the encoder in a known state at the end of a packet, six deterministic bits are input immediately following the last data bit input the convolutional encoder." This breaks a fundamental assumption of both MAC and PLCP: that the PDU lengths are integral numbers of octets. If six zeros place the encoder into a deterministic state, then eight zeros should do the same, while maintaining octet alignment. (Also, the term in this standard for the unit transmitted is "frame" or "PDU" not "packet.")	Change this provision to read: "To place the encoder in a known state at the end of a frame, at least six deterministic bits must be input immediately following the last data bit input the convolutional encoder. This is achieved by appending one octet containing all zeros to the end of the PPDU prior to transmission and discarding the final octet of each received PPDU."	See above
276SP	30 also see my Seq #17	18.4.6.7	MIF	T	NO	The existence of two, different modulations, one mandatory and one optional, for the 5.5Mbit/s and 11Mbit/s data rates complicates the multirate decision function in the MAC because, unlike with the PHYs in clauses 14-16, clause 18 introduces a PHY with potential incompatibilities at a single data rate. This means that knowledge,	Issue 1 can be addressed by defining a "Supported Modulations" element, and allowing the inclusion of this element in Beacon, (Re)Association Request/Response, and Probe Request/Response frames. Because stations are supposed to ignore elements whose ElementID they do not recognize, this addition, while a	Accepted: Add a supported options Element wherever the current Supported rates element is used. Element will have two fields: A byte for supported codes And a byte for supported PLCP

						through the existing mechanisms, that a station shares a non-basic data rate in the operational rate set is no longer sufficient to know how to exchange PPDUs with that station. ISSUE 1: Because a transmitter using PBCC at 5.5Mbit/s or 11Mbit/s cannot communicate with other HR/DSSS stations which do not implement the PBCC option, there should be an indication of whether a BSS is operating with (or allowing the use of, depending upon your point of view) PBCC so that HR/DSSS stations that do not implement this option can identify themselves and so that a decision about whether to associate (or whether to allow association) by such stations can be made. ISSUE 2: The multirate mechanism defined in clause 9.6 introduces the concept of "rate sets," and requires certain frame types to be sent using mandatory rates or rates known to be receivable by all stations in the BSS. By allowing a second, optional modulation format for 5.5Mbit/s and 11Mbit/s operation, clause 18.4.6.7 creates a partially orthogonal group of "modulation sets" and raises the question of whether there should be rules regarding the transmission of certain frame types using CCK modulation because only CCK is known to be receivable by all stations (or at least rules which limit the use of PBCC modulation to cases where PBCC is known to be receivable by the addressed recipient station).	"change" to the MAC, is fully interoperable with existing implementations. A far less elegant alternative is to encode 5.5Mbit/s PBCC and 11Mbit/s PBCC using a pair of rate codes (such as 5.0 and 10.5, respectively) that would otherwise be unused. This avoids new elements and another group of "sets" but requires ugly special cases rather than the current ability to use the supported rate encoding directly in duration calculations. Issue 2 can be addressed by defining the rules for the use of PBCC modulation (as a subset of the multirate rules in 9.6 because, as an option, short PBCC never falls in a "mandatory" or a "basic" category. POTENTIAL ALTERNATIVE: Remove PBCC entirely. It is unclear to this commenter why HR/DSSS needs 2 modulations. Should we ignore the lessons of the FH/DS wars from 1993-5? If PBCC is sufficiently superior, then require it. If PBCC is only slightly better, or is only usable in certain regulatory domains, trade this off against the added MAC and network management complexity.	headers. Add associated PHY MIB elements to allow MAC to know what options the PHY has. Add parameters to the RXVECTOR and TXVECTOR for short or long header and code selection. See 227 for additional resolutions.

277	**20**	**18.4.6.7**	**SB**	**E**	**-**	**Figure reference missing under Figure 15 and peculiar character in cover code sequence rows**	**fix editorial**	**EDITOR**
278 E	**2**	**18.4.6.7**	**WB**	**T**	**Y**	**Sequence of 256 bits is ambiguous. Should show all 16 rows**	**This sequence of 256 bits is produced by taking the first sixteen bits of the sequence as the seed sequence, the second sixteen bits as the seed sequence cyclically left rotated by three, the third sixteen bits as the seed sequence cyclically left rotated by six, etc. If ci is the ith bit of the seed sequence, where 0 <= I <= 15, then the sequence that is used to cover the data is given row-wise as follows: c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 c10 c11 c12 c13 c14 c15 c3 c4 c5 c6 c7 c8 c9 c10 c11 c12 c13 c14 c15 c0 c1 c2 c6 c7 c8 c9 c10 c11 c12 c13 c14 c15 c0 c1 c2 c3 c4 c5 (show all intermediate rows) c10 c11 c12 c13 c14 c15 c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 c13 c14 c15 c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 c10 c11 c12 For packet based systems with more than 256 bits and continuous systems this sequence of 256 bits is simply repeated.**	**SHOW ALL 16, EDITOR**
279 E	**7**	**18.4.6.7**	**WD**	**T**	**Y**	**Figure 13. It is unclear from the picture what data is, scrambled or unscrambled?**	**Change figure to indicate that all data is scrambled.**	**SEE 273**
280	**23**	**18.4.6.8**	**AP**	**E**		**Reference to table…..are defined in Table 9**	**change to table 10**	**DONE**
281	**41**	**18.4.6.8**	**AS**	**E**	**N**	**The figure, table and clause references need to be corrected.**		**DONE**
282 FH	**3**	**18.4.6.8**	**PK**	**T**	**Y**	**Use of hopping and direct sequence comes under the mandate of FCC part**	**No hopping?**	**It is intended that the system not be a hybrid system, but a**

						15.247 "(f) Hybrid systems that employ a combination of both direct sequence and frequency hopping modulation techniques shall achieve a processing gain of at least 17 dB from the combined techniques. The frequency hopping operation of the hybrid system, with the direct sequence operation turned off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The direct sequence operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this Section. I don't understand how this operation can satisfy the 17 dB process gain requirement.		frequency agile DS system
283	42	18.4.6.8.1						NO INFO
284	24	18.4.6.8.1	AP	E		Table 17 reference to HS/DSS	change to HS/DSSS	DONE
285	25	18.4.6.8.1	AP	E		Table 17 reference Mhz same for Figure 19	add MHz to all frequencies across access	DONE

286 FH	**21**	**18.4.6.8.1, and general**	**JZW**	**T**		**OK, I admit I'm baffled by this FH stuff. It clearly is not going to be the case that an 802.11 FHSS PHY system can actually interoperate with an 802.11b HR/FH PHY. So the point is just to allow the FHSS system to detect that frames are being transmitted and indicate CCA to its MAC, right? Is this really a new, different FH PHY? It seems like 802.11b is creating a real mess of noninteropable new PHYs (as many as 6, it appears). Also, it isn't clear what the PHY parameter set in MAC beacons will be for each of the new PHY operational modes. Is the idea that the HR FH PHY will send out beacons with the FH Parameter Set in them? Or do we need to invent new PHY parameter sets for the MAC to use?**	**Clarify how the MAC will interoperate with all the various possible configurations of the 802.11b PHY.**	Comment accepted. Clarification will be provided in new overview of use of different modes. The co-existence matrix is being written by the SP committee.
287 FH	**3**	**18.4.7.4**	**SR**	**T**	**Y**	**The transmit spectrum mask defined in Figure 20 does not support the use of 3 frequency channels with the HR/DSSS PHY. This is not consistent with the use of three frequency channels which was demanded by the membership of the working task groups of other submitted proposals.**	**Implement the recommend 25 Mhz frequency change spacing and make all rules and guidelines, including the transmit spectrum mask defined in Figure 20, consistent with this guideline.**	**ACCEPTED. In the US 25 MHz is the normally used frequency spacing.**
288 E	**13**	**18.4.7.9**	**JBO**	**T**	**N**	**Some formula mistakes that are also in the current standard. The summation is over 1000 samples, which makes sum from 0 to 999 (4 times). Verr formula: result is 1 if there is no distortion (can not be the intention)**	**Change sums. Replaces in the Verr formula the division by minus sign.**	**I don't see a division by a negative number but will restudy the equations for accuracy.**
289 E	**27**	**18.4.8.1**	**TT**	**T**	**Y**	**Is it assumed that the sensitivity of a high speed implementation at 1 and 2 Mbits/s would meet the requirements specified in clause 15? If so it should be stated here.**	**Specify the sensitivity requirements for all rates.**	**Since this section only talked about the 5.5 and 11 MBps modes, it does not have sensitivity specs for 1 and 2 MBps. We can restate the**

						Is it possible to implement a radio that meets this sensitivity requirement at 11 Mbits/s but does not meet the sensitivity requirements of the old DS radios?		sensitivity of the 1 and 2 MBps, but that makes it appear in two places and can possibly cause confusion as to which place takes precedence.
290 E	3	18.4.8.2	WB	T	Y	Maximum input level FER should be specified for 11 Mb/s CCK, not 2 Mb/s DQPSK	The receiver shall provide a maximum FER of 8´10 –2 at an MPDU length of 1024 bytes for a maximum input level of –10 dBm measured at the antenna. This FER shall be specified for 11 Mbits/s CCK modulation.	The receiver shall provide a maximum FER of 8*10 –2 at an MPDU length of 1024 bytes for a maximum input level of –10 dBm measured at the antenna. This FER shall be specified for 11 Mbits/s CCK modulation.
291	26	18.4.8.4	AP	E		47for	add a space “47 for”	add a space “47 for” DONE
292 E	28	18.4.8.4	TT	T	Y	In the second subclause a) it indicates levels for the energy detection threshold. Forgive me in advance if I’m missing the obvious, but why is the energy detection threshold dependent on the output power of the transmitter? Is this not limiting my range when talking to nodes of equal output power?	There should only be one energy detection threshold.	I copied the current standard. The reasoning was that the low cost transciever with low power and high noise figure will need more relaxation of the spec.
293	18	18.5.6.5	AP	E		(add reference?)	remove text	DONE
294	13	Annex A	HMO	E	Y	The subclause promises to give a scope, but the contents does not give a scope. In stead, the 1st sentence promises that it would specify the services provided and again does not do so. The remainder of the subclause gives the architecture for the PHY	Provide revision of Annex A.	EDITOR
295 p	11	Annex A	VH	T	Y	There is no PICS Proforma. This clause is needed to define which functions are mandatory and which are optional (or mandatory in case an option is implemented)	Add a PICS Proforma	EDITOR
296	14	Annex C	HM	E	Y	State Machines need to be updated.	Provide revision of Annex C.	EDITOR

			O					
297	12	Annex D	H M O	E	Y	New values are defined for MIB attributes (e.g. data rates). This requires the MIB definition to be updated.	Provide revision of the MIB definition (Annex D).	EDITOR
	1	Table 1	TG	E	N	Column 4 contains the line "Φ = CCU"	"0 = CCK"	EDITOR
	2	18.2.3.5	TG	E	N	Paragraph 2, line 4 contains the phrase "extra bit will be placed"	"extra bit shall be placed"	EDITOR
	3	18.2.3.5	TG	E	N	In the descriptions in b) and d), the phrases "the rounding took" are not clear.	Replace the descriptions with equations, such as: Encode = ceiling((#octets * 8) / 11) Decode = floor((length * 11) / 8) - ext.bit ext.bit = (length*8) mod 11 in [3,2,1]	I will study these equations to be sure they encode the bits properly. I believe that we need to specify the ext.bit on the encode side. The proper equations will be used in place of the words. the intent of the examples was to make sure that the proper scheme is followed. If this change is made, it might be possible to delete them. See 124
	4	Table 3	TG	E	N	In the heading of column 2, the equation is wrong, but the information in the column is correct	(Octets +1) * 8 / 11	editor
	5 SP	18.2.6	TG	T	N	There is no information in the TXVECTOR that tells the PHY which preamble length to use. This information also needs to be in the RXVECTOR to indicate which preamble length was received.	Add a TXVECTOR parameter to the PHY-TXSTART.request to specify which preamble is to be generated. Add an RXVECTOR parameter to indicate the received frame's preamble length.	Accepted
	6 SP	18.2.6	TG	T	N	The sentence "The PLCP Header parameter LENGTH is calculated from the TXVECTOR element by multiplying by 8 for 1 Mbit/s and by 4 for 2 Mbit/s." is incomplete without the 5.5 and 11Mb/s rates.	"The PLCP Header parameter LENGTH is calculated from the TXVECTOR element using the algorithms described in 18.2.3.5"	accepted, added elements see
	7 SP	Figure 9	TG	T	N	In the PLCP Transmit State Machine, TX SYNC PATTERN block, the operation "TX 128 Scrambled 1's" is incomplete	"TX 128 Scrambled 1's for the long preamble or TX 56 Scrambled 0's for the short preamble"	Add to the state machine, the words: "TX 128 Scrambled 1's for the long preamble or TX 56 Scrambled 0's for the short preamble"

	8 SP	Table 6	TG	T	N	aPreambleLength is a single integer. Since it is not a vector, it cannot contain lengths for the three different preambles. Also, the correct values are 144uS, 72uS, and 208uS, not 144uS and 56uS as shown.	Three operating modes should be defined, and all members of a BSS must be in the same mode. The modes would be LongPreamble, ShortPreamble, and FHPreamble. In LongPreamble mode, the long preambles would always be used. In ShortPreamble mode, long preambles would be used for 1 and 2Mb/s rates, and short preambles would be used for 5.5 and 11Mb/s rates. In FHPreamble mode, FH mode would be used for 1 and 2Mb/s rates and short preambles would be used for 5.5 and 11Mb/s rates. The value for aPreambleLength would remain a single integer of value 144, 72, and 208, for these three modes, respectively.	Correct the length values. Three operating modes will be defined. see 230.
	9	Table 6	TG	T	N	aMPDUMaxLength cannot exceed 2^12 in FH interoperability mode, since the length of the PLW field in the FH preamble is 12 bits.	Make an exception in the table for the FH interoperability mode.	I think that is does not apply since the Header being used is specific to either FH or DS and whenever the FH/DSSS mode is being used, the FH preamble is followed by a shortHeader which has the DS definition.
	10	18.4.6.7	TG	E	N	In the 4th paragraph, the sentence “To place the encoder in a known state at the end of a packet, six deterministic bits are input immediately following the last data bit input to the convolutional encoder” is incorrect. All lengths must be multiples of 8 bits.	Change references from 6 bits to 8 bits. I list this as an editorial change because during my conversation with the authors of the PBCC proposal, they indicated that the value was supposed to be 8 bits.	Change to 8 bits.
	11	18.4.6.8	TG	E	N	In the first paragraph, there is a reference to table 9. That is not the correct table.	The reference should be to Table 11.	Fix reference
	12	18.4.6.8.1	TG	E	N	The table reference is incorrect.	Table 11 specifies the operating channels for specified geographical areas.	See above

	13	18.2.2	TG	T	N	Because the low rates are FH, the stations need the hop sequence and dwell synchronization information available in the FH parameter set element as well as the DS channel information in the DS parameter set element. This does not conflict with the frame formats as specified in clause 7.	When operating in the FH Preamble mode, the Beacon and Probe Response frames must include both an FH Parameter Set element and a DS Parameter Set element.	ACCEPTED
	1	18.2.2	DK	E	N	Last sentence of clause states "…may not use the FH PLCP."	Should state "…shall not use the FH PLCP."	editor
	2	18.2.3.6	DK	E	N	The definition of CRC16 is not sufficient.	Use the definition in clause 14.3.2.2.3.	I left out some of the examples in the clause 14 definition because I did not think it was needed again.
	3	18.2.3.15.1	DK	E	N	Table 4 does not adequately spell out the remaining patterns that are reserved.	Spell out separately the patterns that are reserved: 1010, 1011, 1100,1101,1110, 1111	Spell out separately the patterns that are reserved: 1010, 1011, 1100,1101,1110, 1111
	4	18.4.8.4	DK	E	N	The statement is not clear: "The CCA shall be TRUE if there is no energy detect or carrier sense."	Either delete sentence or correct to say "The CCA indication shall be CLEAR…"	This is the same wording as in the current standard. Changing it here would make the two sections different and I do not think this is more clear. We would have to define what is meant in logic terms what is meant by "clear" is that 1 or 0?
	5	18.4.8.4	DK	E	N	The statement is inconsistent with the 802.11 standard: "This implies that the CCA signal is available as an exposed test point."	Delete sentence.	Why is it inconsistent? The same sentence is in clause 14.
	1	18.2.3.2	TO	T	Y	Current SFD seems not to be interoperable. New scheme should be included.		Not sure what is meant here.
	1 SP	18.2.3.8 to 18.2.3.11	JC	T	Y	The specified short preamble is not rationalized with the "optional" FEC modes defined by Alantro; only a single short-preamble mode should be defined, and it should support all modes.	Rationalize short-preamble mode with both Harris and Alantro modes; ensure that optional mode (Alantro) is really an option by making sure that the short preamble supports both.	Accepted

	2	**18.4.8.3**	**JC**	**T**	**Y**	The channelization described requires 30-MHz separation of carrier frequencies. Since the US allocation supports 3 frequency channels only if there is 25-MHz of carrier offset, it is critical that the ACR be specified for 25-MHz separation as well as 30-MHz.	**Three channels is (was) a key issue for the standard; since US band only supports 3 channels at 25-MHz spacing, the standard should specify the ACR at this spacing.**	**Yes, the standard should specify the ACR for 25 MHz. EDITOR**
	3	**18.2.3.15 18.4.6.8**	**JC**	**T**	**Y**	The FH option contained in the draft violates the PAR restriction to a single PHY. Anyone can build a dual-mode transceiver if desired, but specifying how to do this violates our PAR.	**Remove FH material from HR DSSS PHY standard.**	**REJECTED**
		18.2.2	**LW**	**T**	**Y**	**The channel is 22 MHz wide, multiple FH BSS may be within one HS DS channel. How do we choose which FH BSS channel to transmit the header on? the HS DS transmit/interfere with multiple FH BSS.**	**I do not know how to resolve this, it should be discussed in the group.**	**Rejected, This is explained in the FH interoperability section.**
		18.2.2	**LW**	**T**	**Y**	**8uS between 1Mbit/s FH header and short.**	**16 to 20uS is practical.**	**REJECTED**
		18.4.6	**LW**	**T**	**N**	**A transmit to receive turn around time of 10 ms is excessive and maybe a typing error.**	**10uS**	**ACCEPTED**

		18.4.6.7	**JF**			**The PBCC mode should not be optional. The CCK modulation is inherently very weak by today's communications standards. If the PBCC is not used then the only way to make this waveform useful is with a sever measure of equalization. Therefore the only way to make this standard a useful one depends on a companies implementation, not on the standard waveform itself. By making the PBCC a requirement then the standard waveform itself will have inherent utility.**		**Rejected**

Overview of FH PHY interoperability mode

Replace the third paragraph with the following:

(part of existing text)
The higher speed system is interoperable with the 1 and 2 Mbit/s DSSS systems. It can use the same PLCP preamble and PLCP header as the 1 and 2 Mbit/s system and thus can make use of the rate switching capabilities as provided. To optimize data throughput at the higher rates an optional short PLCP preamble is provided. The short preamble is not interoperable with the 1 and 2 Mbit/s DSSS systems.

(new text)
An optional FH interoperable PLCP Frame format is defined to allow the 1 and 2 Mbit/s FHSS systems to rate shift up to the HR/DSSS mode. A station operating in the FH compatible mode shall become a part of an FH BSS, performing all the association, hop sequence synchronization, CCA, backoff slots, and transmit and receive state machines as specified by the FH PHY. If the FH BSS supports the HR/DSSS high rates within its rate capability set as indicated upon association, the station may use the HR/DSSS as a method to accelerate the data carrying portion of the message. To transmit using the HR/DSSS for the payload, the station shall begin with the FH preamble and PLCP header. The PHY Signaling Field shall indicate either 5.5 or 11 Mbit/s. The FH signal shall terminate immediately following the PLCP header. After the specified gap duration, a HR/DSSS packet shall begin using the short header option as defined in the following clauses. The formatting of the packet and the data within the packet shall comply with all of the requirements of the HR/DSSS PHY. The channel center frequency to be used for the HR/DSSS signal shall be derived from the current FH hop frequency as defined in clause 18.4.6.8. When associated to an FH/HR BSS in the FH compatible mode, a station will not be able to associate and communicate with a HR/DSSS BSS on the same or different frequency.

Notes for MAC changes:
Control frames are sent at the BSS basic rate using one of the existing FH PHY supported rates.

ERRATA for MAC Sections (this text overrides the resolutions noted above for this issue)

7.3.1.4 Capability Information Field
The Capability Information Field contains a number of subfields that are used to indicate requested or advertised capabilities. The length of the Capability Information Field is two octets. The Capability Information Field consists of the following subfields: ESS, IBSS, CF-Pollable, CF-Poll Request, Privacy, Short Preamble and PBCC. The remaining part of the Capability Information Field is reserved. The format of the Capability Information Field is as illustrated in Figure 27.

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STAs shall set the Short Preamble subfield to 1 in transmitted Beacon, Probe Response, Association Response and Reassociation Response management frames to indicate that the use of the short preamble option, as described in clause 18.xxxx is allowed within this BSS. To indicate that the use of the short preamble option is not allowed then the Short Preamble subfield shall be set to 0 in Beacon, Probe Response, Association Response and Reassociation Response management frames transmitted within the BSS.

STAs shall set the Short Preamble subfield to 1 in transmitted Association Request and Reassociation Request frames when the MIB attribute dot11ShortPreambleOptionImplemented is true. Otherwise STAs shall set the Short Preamble subfield to 0 in transmitted Association Request and Reassociation Request frames.

STAs shall set the PBCC subfield to 1 in transmitted Beacon, Probe Response, Association Response and Reassociation Response management frames to indicate that the use of the PBCC modulation option, as described in clause 18.xxxx is allowed within this BSS. To indicate that the use of the PBCC modulation option is not allowed then the PBCC subfield shall be set to 0 in Beacon, Probe Response, Association Response and Reassociation Response management frames transmitted within the BSS.

STAs shall set the PBCC subfield to 1 in transmitted Association Request and Reassociation Request frames when the MIB attribute dot11PBCCOptionImplemented is true. Otherwise STAs shall set the PBCC subfield to 0 in transmitted Association Request and Reassociation Request frames.

7.3.1.9 Status Code Field

The Status Code Field is used in a response management frame to indicate the success or failure of a requested operation. The length of the Status Code Field is two octets. The Status Code Field is illustrated in Figure 32.

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Status code	Meaning
19	Association denied due to requesting station not supporting the short preamble option.
20	Association denied due to requesting station not supporting the PBCC modulation option.

9.6 Multirate Support

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To allow the transmitting STA to calculate the contents of the Duration/ID field, the responding STA shall transmit its Control Response frame (either CTS or ACK) at the highest rate in the BSS basic rate set that is less than or equal to the rate of the immediately previous frame in the frame exchange sequence (as defined in 9.7). In addition the Control Response frame shall be sent using the same PHY options as the received frame. The time required to transmit a frame, for use in the Duration/ID field, can be calculated using the following equation:

Frame duration = PreambleLength + PLCPHeaderLength +
(8 x MPDU length x MPDUDurationFactor) /
(MACCurrentRate x 32768)

Where PreambleLength is the length of the preamble in microseconds for the set of PHY options used to transmit the frame and where PLCPHeaderLength is the length of the PLCP header in microseconds for the set of PHY options used to transmit the frame.

10.4.6 PLME-EXTENDEDCHARACTERISTICS.request

10.4.6.1 Function

This primitive is a request by the LME to provide the PHY extended operational characteristics.

10.4.6.2 Semantics of the service primitive

The primitive provides the following parameters:

PLME-EXTENDEDCHARACTERISTICS.request ( )
There are no parameters associated with this primitive.

10.4.6.3 When generated
This primitive is generated by the LME at initialization time, to request the PHY entity to provide its extended operational characteristics.

10.4.6.4 Effect of receipt
The effect of receipt of this primitive by the PHY entity will be to generate a PLME-EXTENDEDCHARACTERISTICS.confirm primitive that conveys its extended operational characteristics.

10.4.7 PLME-EXTENDEDCHARACTERISTICS.confirm
10.4.7.1 Function
This primitive provides the PHY extended operational parameters.

10.4.7.2 Semantics of the service primitive
The primitive provides the following parameters:

```
PLME-CHARACTERISTICS.confirm(
        PHY DEPENDENT
)
```

Appendix D

```
dot11ShortPreambleOptionImplemented OBJECT-TYPE
        SYNTAX INTEGER { true(1) false(2) }
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "This attribute, when true, shall indicate that the short preamble option as defined in clause 18.xxx is implemented. The default
        value of this attribute shall be false."
        ::= { dot11PhyHRDSSSEntry 6 }


dot11PBCCOptionImplemented OBJECT-TYPE
        SYNTAX INTEGER { true(1) false(2) }
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
                "This attribute, when true, shall indicate that the PBCC modulation option as defined in clause 18.xxx is implemented. The default
        value of this attribute shall be false."
```

::= { dot11PhyHRDSSSEntry 6 }

INSTRUCTIONS TO EDITOR

The rate parameter in the RXVECTOR provides an existing mechanism in the MAC to transfer the PHY options used in the current frame (bit rate, encoding, header length, FH compatibility) so that the MAC is able to perform as described in clause 9.6 Multirate. This clause currently requires the MAC to respond to received frames using the same rate as the received frame, i.e., ACK at the same rate as DATA.

The desire of the HRPHY group is to have this behavior extended to include the encoding, header length and FH compatibility. Examination of the MAC state machines shows that the MAC uses the rate information received from the PHY to select the real rate used for calculation of the duration field. The rate received from the PHY is turned around and passed back to the PHY in the TXVECTOR of the response frame.

The HRPHY will describe the information to be carried in the rate parameter of the RXVECTOR and TXVECTOR in the clause dealing with the PHY SAP parameters.

The following is the changed text done by the editorial group and reflects all the DONE comments in the above table

 IEEE P802.11B/D1.0 (Revision to IEEE Std 802.11-1997)

STANDARD [FOR] Information Technology-Telecommunications and information exchange between systems-Local and Metropolitan networks-Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher speed Physical Layer (PHY) extension in the 2.4 GHz band

Sponsor **LAN MAN Standards Committee of the IEEE Computer**

Society Abstract: This Local and Metropolitan Area Network standard specifies the physical characteristics for wireless local area networks. The first issue of this standard contains the Medium Access Con-troller and three physical layer units: two radio units, both operating in the 2,400 - 2,500 MHz band, and one baseband infrared unit. One radio unit employs the Frequency Hopping Spread Spectrum technique and the other employs the Direct Sequence Spread Spectrum technique. This draft cov-ers extensions to the DSSS radio PHY for higher data rates. **Keywords:** LAN, Local Area Network, Wireless, Radio Frequency

 Introduction (This introduction is not part of P802.11B/D1.0, Draft Standard for Wireless LAN Physical Layer Standards) This standard is part of a family of standards for Local Area Networks (LANs). This standard covers an extension to the approved 802.11 standard to increase the data rates in the 2.4 GHz band to greater than 10 Mbit/s **Participants** At the time of the making of this draft, the committee had the following members: This section is usually supplied by IEEE Balloting Center staff. However, if your group conducted it's own balloting, please insert the names of the balloters here. Follow the style used in the Working Group list above.

IEEE P802.11B/D1.0 DRAFT STANDARD FOR

Contents

18 High rate direct sequence spread spectrum (HR/DSSS) PHY specification for the 2.4 GHz band designated for ISM applications

18.1 Overview This clause describes the high rate extension of the physical layer for the Direct Sequence Spread Spec-trum (DSSS) system (clause 15 in the standard). The Radio Frequency LAN system is aimed at the 2.4 GHz bands designated for ISM applications as provided in the USA according to Code of Federal Regulations, Title 47, Section 15.247, in Europe by ETS 300-328 and other countries according to clause 18.4.6.2. Above the 1 Mbit/s and 2 Mbit/s data payloads as described in clause 15, the extension of the DSSS system provides for 5.5 and 11 Mbit/s payload data rates. To provide the higher rates, 8 chip Complementary Code Keying (CCK) is employed as the modulation scheme. The chipping rate will be 11 MHz, which is the same as the current DSSS system, thus providing the same channel bandwidth. An optional Packet Binary Convolutional Coding (PBCC) mode is also provided for potentially enhanced performance where regulatory considerations can be met. The higher speed system is interoperable with the 1 and 2 Mbit/s DSSS systems. It can use the same PLCP preamble and PLCP header as the 1 and 2 Mbit/s system and thus can make use of the rate switching capabilities as provided. To optimize data throughput at the higher rates an optional short PLCP preamble is pro-vided. The short preamble is not interoperable with the 1 and 2 Mbit/s DSSS systems. For interoperability with FH systems an optional FH interoperable PLCP Frame format is defined. The FH interoperability mode is intended to let FH networks participate in high rate networks when they have favorable propagation condi-tions and to rate shift back to low rate FH when propagation conditions are poor. It also gives the high rate DS signal frequency agility for increased probability of success.

18.1.1 Scope The PHY services provided to the IEEE 802.11 wireless LAN MAC by the 2.4 GHz HR/DSSS system are described in this clause. The HR/DSSS PHY layer consists of two protocol functions: a) A physical layer convergence function, which adapts the capabilities of the physical medium dependent (PMD) system to the PHY service. This function shall be supported by the physical layer convergence procedure (PLCP), which defines a method of mapping the IEEE 802.11 MAC sublayer protocol data units (MPDU) into a framing format suitable for sending and receiving user data and management information between two or more STAs using the associated PMD system. b) A PMD system, whose function defines the characteristics of, and method of transmitting and receiving data through, a wireless medium (WM) between two or more STAs each using the HR/ DSSS system.

18.1.2 HR/DSSS PHY functions The 2.4 GHz HR/DSSS PHY architecture is depicted in the ISO/IEC basic reference model shown in Figure 11. The HR/DSSS PHY contains three functional entities: the PMD function, the physical layer convergence function, and the layer management function. Each of these functions is described in detail in the following subclauses. The HR/DSSS PHY service shall be provided to the MAC through the PHY service primitives described in 802.11-1998, Clause 12.

18.1.2.1 PLCP sublayer To allow the IEEE 802.11 MAC to operate with minimum dependence on the PMD sublayer, a physical layer convergence sublayer is defined. This function simplifies the PHY service interface to the IEEE 802.11 MAC services.

18.1.2.2 PMD sublayer The PMD sublayer provides a means to send and receive data between two or more STAs. This clause is concerned with the 2.4 GHz bands designated for ISM applications using direct sequence modulation.

18.1.2.3 Physical layer management entity (PLME) The PLME performs management of the local PHY functions in conjunction with the MAC management entity.

18.1.3 Service specification method and notation The models represented by figures and state diagrams are intended to be illustrations of functions provided. It is important to distinguish between a model and a real implementation. The models are optimized for sim-plicity and clarity of presentation; the actual method of implementation is left to the discretion of the IEEE 802.11 HR/DSSS PHY compliant developer. The service of a layer or sublayer is a set of capabilities that it offers to a user in the next-higher layer (or sublayer). Abstract services are specified here by describing the service primitives and parameters that char-acterize each service. This definition is independent of any particular implementation.

18.2 HR/DSSS PLCP sublayer

18.2.1 Overview This clause provides a convergence procedure for the 5.5 and 11 Mbit/s specification in which MPDUs are converted to and from PPDUs. During transmission, the MPDU shall be prepended with a PLCP preamble and header to create the PPDU. Three different preambles and headers are defined: the mandatory supported long preamble and header interoperable with the current 1 and 2 Mbit/s DSSS specification, an optional short preamble and header, and an optional FH interoperable preamble and header. At the receiver, the PLCP preamble and header are processed to aid in demodulation and delivery of the MPDU.

18.2.2 PLCP frame format Figure 1 shows the format for the interoperable PPDU including the HR/DSSS PLCP Preamble, the HR/ DSSS PLCP Header, and the MPDU. The PLCP Preamble contains the following fields: Synchronization (Sync) and Start Frame Delimiter (SFD). The PLCP Header contains the following fields: IEEE 802.11 Signaling field (SIGNAL), IEEE 802.11 Service field (SERVICE), IEEE 802.11 Length field (LENGTH), and CCITT CRC-16 field. Each of these fields is described in detail in

18.2.3. The format for the PPDU including the Long HR/DSSS PLCP preamble, the Long HR/DSSS PLCP header and the MPDU do not differ from the 1 and 2 Mbit/s standard. The only exceptions are the encoding of the rate SIGNAL Field and the use of a bit in the SERVICE field to resolve an ambiguity in packet length in octets when the length is expressed in whole microseconds and another bit to indicate if the optional PBCC mode is being used. An optional short HR/DSSS PLCP preamble and header is defined. The short preamble and header can be used to minimize overhead and thus maximize the data throughput. The frame format of the PPDU with short preamble and header is depicted in Figure 2.

IEEE P802.11B/D1.0, 1 October 1998 DRAFT STANDARD FOR 505 This is an unapproved IEEE Standards Draft, subject to change Usage of the short preamble and header is optional. A transmitter using the short PLCP will not be interop-erable with a receiver which is not capable of receiving this short PLCP. However coexistence is maintained. To be interoperable with a receiver that is not capable of receiving a short preamble and header, the transmit-ter must use the long PLCP preamble and header. The short preamble uses the 1 Mbit/s Barker code with DBPSK modulation to allow stations not equipped to demodulate the short preamble the opportunity to do clear channel assessment (CCA) on the initial portion of it. Figure 3 shows the optional Frequency Hopping interoperability format for the PPDU. This includes the standard FH PLCP preamble, the FH PLCP header, an 8 microsecond gap, followed by the short preamble and header and the MPDU. The HR/DSSS/FH mode uses the FH preamble and header to establish the channel the signal will be radiated on and the rate it will use. When in this mode, the HR DS channel will be chosen as the closest DS channel available. The receiver IF which will process the high rate HR/DSSS data must be wide enough in bandwidth to encompass the FH preamble. When operating on the lowest TBD or the highest TBD FH channels, the HR DS will not be used and all FH transmissions will occur at the 1 or 2 Mbit/s rates. These channels are too far away from the available DS channels to be processed within the IF bandwidth. **Figure 1—PLCP frame format** PPDU 192 µs SYNC 128 BITS SFD 16 BITS SIGNAL 8 BITS SERVICE 8 BITS LENGTH 16 BITS CRC 16 BITS PLCP PREAMBLE 144 BITS MPDU PLCP HEADER 48 BITS SCRAMBLED ONES 1 Mbit/s DBPSK BARKER 1 DBPSK BARKER 2 DQPSK BARKER 5.5 OR 11 Mbit/s PPDU 80.7 µs SHORT SYNC 56 BITS SHORT SFD 16 BITS SIGNAL 8 BITS SERVICE 8 BITS LENGTH 16 BITS CRC 16 BITS SHORT PLCP PREAMBLE 72 BITS @ 1 Mbit/sMbit/sMbit/s PLCP HEADER 48 BITS @ 5.5 Mbit/sMbit/s SCRAMBLED ZEROS BACKWARD SFD DBPSK BARKER 5.5 Mbit/s MDPU VARIABLE @ 5.5 OR 11Mbit/sMbit/s **Figure 2—Short PLCP frame format**

 Frames of type ACK, CTS, or any of the CF-subtypes of type Data shall not use the FH PLCP.

18.2.3 PLCP field definitions All transmitted bits, except in the case of FH, shall be scrambled using the feedthrough scrambler described in 18.2.4. In the following PLCP field definition clauses, the definitions for the Long (i.e. clause 15) PLCP fields are described first. Subsequently, the definitions of the short PLCP and the FH interoperable PLCP are defined. The names for the short PLCP fields are preceded with the term Short. The names of the FH interoperable fields are preceded with the term FH.

18.2.3.1 Long PLCP Synchronization (SYNC) field The SYNC field shall consist of 128 bits of scrambled “1” bits. This field shall be provided so that the receiver can perform the necessary operations for synchronization.

18.2.3.2 Long PLCP Start Frame Delimiter (SFD) The SFD shall be provided to indicate the start of PHY dependent parameters within the PLCP Preamble. The SFD shall be a 16-bit field, X'F3A0' (msb to lsb). The lsb shall be transmitted first in time.

18.2.3.3 Long PLCP IEEE 802.11 Signal (SIGNAL) field The 8-bit IEEE 802.11 signal field indicates to the PHY the modulation that shall be used for transmission (and reception) of the MPDU. The data rate shall be equal to the Signal field value multiplied by 100 kbit/s. The extended HR/DSSS PHY supports four mandatory rates and two optional rates given by the following 8 bit words, where the lsb shall be transmitted first in time: a) X'0A' (msb to lsb) for 1 Mbit/s b) X'14' (msb to lsb) for 2 Mbit/s c) X’37’ (msb to lsb) for 5.5 Mbit/s d) X’6E’ (msb to lsb) for 11 Mbit/s The HR/DSSS PHY rate change capability is described in 18.2.3.14. This field shall be protected by the CCITT CRC-16 frame check sequence described in 18.2.3.6. FH SYNC 80 BITS FH SFD 16 BITS PLW 12 BITS PSF 4 BITS CRC 16 BITS FH PLCP PREAMBLE 96 BITS FH PLCP HEADER 32 BITS MPDU PPDU SHORT 120 BITS 1 Mbit/sMbit/s FSK 1 Mbit/sMbit/s FSK 8µs GAP 5.5 OR 11 Mbit/sMbit/s 128µs 81µs 217µs **Figure 3. FH Interoperable PLCP Frame Format**

18.2.3.4 Long PLCP IEEE 802.11 Service (SERVICE) field The 8 bit IEEE 802.11 Service field shall be reserved for future use except that the msb bit shall be used to supplement the LENGTH field described in
18.2.3.3 and the 4th bit from the lsb shall be used to indicate whether the code is CCK <0> or PBCC <1>. This field shall be transmitted lsb first in time and shall be protected by the CCITT CRC-16 frame check sequence described in
18.2.3.6.

18.2.3.5 Long PLCP Length (LENGTH) field The PLCP length field shall be an unsigned 16 bit integer which indicates the number of microseconds (11 to 2^{16} -1 as defined by aMPDUMaxLngth) required to transmit the MPDU. The transmitted value shall be determined from the LENGTH parameter in the TXVECTOR issued with the PHY-TXSTART.request prim-itive described in clause
18.2.3.5.4.The length field provided in the TXVECTOR is in octets and is converted to microseconds for inclusion in the PLCP LENGTH field. The Length field is calculated as follows: Since there is an ambiguity in the num-ber of octets described by a length in integer microseconds for any data rate over 8 Mbit/s, a length extension bit shall be placed in the service field to indicate when the larger potential number of octets is incorrect. a) 5.5Mbit/s CCK Length = number of octets * 8/5.5, rounded up to the next integer. b) 11Mbit/s CCK Length = number of octets * 8/11, rounded up to the next integer and the service field msb bit shall indicate a ‘0’ if the results in a number less than 8/11 or a ‘1’ if the rounding results in a number greater than or equal to 8/11. c) 5.5 Mbit/s PBCC Length = (number of octets + 1)* 8/5.5, rounded up to the next integer. d) 11 Mbit/s PBCC Length = (number of octets + 1)* 8/11, rounded up to the next integer and the service field msb bit shall indicate a ‘0’ if the rounding results in a number less than 8/11 or a ‘1’ if the rounding results in a number greater than or equal to 8/11. At the receiver, the number of octets in the MPDU is calculated as follows: a) 5.5 Mbit/s CCK number of octets = Length * 5.5/8, rounded down to the next integer b) 11 Mbit/s CCK number of octets = Length * 11/8, rounded down to the next integer, minus 1 if the service field lsb bit is a ‘1’. c) 5.5 Mbit/s PBCC number of octets = (Length * 5.5/8) -1, rounded down to the next integer d) 11 Mbit/s PBCC number of octets = (Length * 11/8) -1, rounded down to the next integer, minus 1 if the ser-vice field lsb bit is a ‘1’.Note: The PBCC requires a known octet at the end to permit the decoding to complete.**Table 1.** d0, L SBd1d2 d3 d4 d5 d6 d7, msb Reserved Reserved Reserved Code Selection Bit 0 = CCK 1 = PBCC Reserved Reserved Reserved Length Extension Bit

IEEE Wireless LAN PHYSICAL (PHY) LAYER SPECIFICATIONS P802.11B/D1.0 Copyright © 1998 IEEE. All rights reserved. 508 This is an unapproved IEEE Standards Draft, subject to change The following is an example calculation for several packet lengths of CCK at 11 Mbit/s: The following is an example calculation for several packet lengths of PBCC at 11 Mbit/s: This indicates why normal rounding or truncation of the number will not produce the right result. The lsb (least significant bit) shall be transmitted first in time. This field shall be protected by the CCITT CRC-16 frame check sequence described in clause
18.2.3.6.

18.2.3.6 PLCP CRC (CCITT CRC-16) field The SIGNAL, SERVICE, and LENGTH fields shall be protected with a CCITT CRC-16 FCS (frame check sequence). The CCITT CRC-16 FCS shall be the one’s complement of the remainder generated by the modulo 2 division of the protected PLCP fields by the polynomial: $x^{16} + x^{12} + x^{5} + 1$ The protected bits shall be processed in transmit order. All FCS calculations shall be made prior to data scrambling. As an example, the SIGNAL, SERVICE, and LENGTH fields for a DBPSK signal with a packet length of 192 µs (24 octets) would be given by the following: 0101 0000 0000 0000 0000 0011 0000 0000 (leftmost bit transmitted first in time) The one’s complement FCS for these protected PLCP Preamble bits would be the following: 0101 1011 0101 0111 (leftmost bit transmitted first in time) Figure 4 depicts this example. An illustrative example of the CCITT CRC-16 FCS using the information from Figure 4 follows in Figure 5. **Tabl e 2 TX Octets Octets *8/11 LENGTH SERVICE bit LENGTH *11/8 round down RX Octets** 1023 744 744 0 1023 1023 1023 1024 744.7273 745 0 1024.375 1024 1024 1025 745.4545 746 0 1025.75 1025 1025 1026 746.1818 747 1 1027.125 1027 1026 **Tabl e 3 TX Octets Octets *8/11 LENGTH SERVICE bit (LENGTH *11/8) - 1 round down RX Octets** 1023 744.7273 745 0 1023.375 1023 1023 1024 745.4545 746 0 1024.750 1024 1024 1025 746.1818 747 1 1026.125 1026 1025 1026 746.9091 747 0 1026.125 1026 1026

18.2.3.7 Long PLCP Data Modulation and Modulation Rate Change The PLCP preamble shall be transmitted using the 1 Mbit/s DBPSK modulation. The 802.11 SIGNAL field shall indicate the modulation which shall be used to transmit the MPDU. The transmitter and receiver shall initiate the modulation indicated by the 802.11 SIGNAL field starting with the first octet (1bit for DBPSK, 2 bits for DQPSK, 4 bits for 5.5 Mbit/s, 8 bits for 11Mbit/s) of the MPDU. The MPDU transmission rate and modulation shall be set by the DATARATE parameter in the TXVECTOR issued with the PHY-TXSTART.request primitive described in clause 12.3.4.4 of the 802.11 standard[Ref]. **Figure 4—CCITT CRC-16 Implementation** **CCITT CRC-16 PRESET TO ONES SERIAL DATA INPUT SERIAL DATA OUTPUT TRANSMIT AND RECEIVE PLCP HEADER CCITT CRC-16 CALCULATOR 1. PRESET TO ALL ONES 2. SHIFT SIGNAL, SERVICE LENGTH FIELDS THROUGH THE SHIFT REGISTER 3. TAKE ONES COMPLEMENT OF REMAINDER 4. TRANSMIT OUT SERIAL msb FIRST ONES COMPLEMENT SERIAL DATA OUTPUT (msb FIRST) SERIAL DATA INPUT CCITT CRC-16 POLYNOMIAL: G(x) = X 16 + X 12 + X 5 + 1 X 15 X 14 X 13 X 12 X 11 X 10 X 9 X 8 X 7 X 6 X 5 X 4 X 3 X 2 X 1 X 0 msb lsb**

18.2.3.8 Short PLCP Synchronization (shortSYNC) The short PLCP synchronization field shall consist of a scrambled sequence of zeros. For the purposes of this preamble, the scrambler shall be seeded with a non zero seed to insure it will scramble. The preamble is used for energy or carrier detection (CCA as described in clause 18.4.8.4), antenna diversity (optional) and receiver synchronization.

18.2.3.9 Short PLCP Start Frame Delimiter Field (shortSFD) The shortSFD shall be a 16 bit field and be the time reverse of the field of the SFD in the long PLCP preamble (clause 15.2.3.1). The field is 0x05CF (msb to lsb). The lsb shall be transmitted first in time. A receiver not configured to receive the high rate signals will not detect this SFD. shortSFD: X'05CF' = 0000 0101 1100 1111 msb - lsb

18.2.3.10 Short PLCP Signal Field (shortSignal) The 8 bit 802.11 Signal Field of the short header indicates to the PHY the modulation which shall be used for transmission (and reception) of the MPDU. The high rate HR/DSSS PHY operating with a short preamble and header supports two mandatory rates given by the following 8 bit words, where the lsb shall be transmitted first in time: **Data CRC registers msb lsb** 1111111111111111 ; initialize preset to 1's 0 1110111111011111 1 1101111110111110 0 1010111101011101 1 0101111010111010 0 1011110101110100 0 0110101011001001 0 1101010110010010 0 1011101100000101 0 0110011000101011 0 1100110001010110 0 1000100010001101 0 0000000100111011 0 0000001001110110 0 0000010011101100 0 0000100111011000 0 0001001110110000 0 0010011101100000 0 0100111011000000 0 1001110110000000 0 0010101100100001 0 0101011001000010 0 1010110010000100 1 0101100100001000 1 1010001000110001 0 0101010001000011 0 1010100010000110 0 0100000100101101 0 1000001001011010 0 0001010010010101 0 0010100100101010 0 0101001001010100 0 1010010010101000 0101101101010111 ; one's complement, result = CRC FCS parity **Figure 5—Example CRC calculation**

a) X'37' (msb to lsb) for 5.5 Mbit/s b) X'6E' (msb to lsb) for 11 Mbit/s

18.2.3.11 Short PLCP Service Field (shortService) The SERVICE field in the short header shall be the same as the SERVICE field described in clause 18.2.3.4.

18.2.3.12 Short PLCP Length Field (shortLength) The LENGTH field in the short header shall be the same as the LENGTH field described in clause 18.2.3.5

18.2.3.13 Short CCITT CRC-16 Field (shortCRC) The CRC in the short header shall be the same as the CRC field as defined in clause 15.2.3.6. The CRC-16 is calculated over the shortSIGNAL, shortSERVICE, and shortLENGTH fields.

18.2.3.14 Short PLCP Data Modulation and Modulation rate Change The short PLCP preamble shall be transmitted using the 1 Mbit/s DBPSK modulation. The short PLCP header shall be transmitted using the 5.5 Mbit/s modulation. The 802.11 SIGNAL and SERVICE fields combined shall indicate the modulation which shall be used to transmit the MPDU. The SIGNAL field indicates the rate and the SERVICE field indicates the code. The transmitter and receiver shall initiate the modu-lation and code indicated by the 802.11 SIGNAL field starting with the first octet (4 bits for 5.5 Mbit/s, 8 bits for 11 Mbit/s). The MPDU transmission rate shall be set by the DATARATE parameter in the TXVECTOR issued with the PHY-TXSTART.request primitive described in clause 18.4.4.1.

18.2.3.15 FH PLCP Field Definitions The FH PLCP field definitions are the same as found in IEEE 802.11 Standard, clause 14.3.2 except for the PHY Signaling field (PSF).The value transmitted in the FH PSF field is derived from the SIGNAL (DATARATE) parameter provided in the TXVECTOR, and the value transmitted in the FH PLW field is derived from the LENGTH parameter provided in the TXVECTOR.

18.2.3.15.1 FH PLCP Signalling Field (PSF) The first bit (the number 0) of the PSF which is reserved in clause 14.3.2.2.2 will be used to indicate that a high rate transmission will follow. This bit is nominally 0 for transmissions compliant to clause 14. When raised to a 1, it will signal that a high rate short preamble will follow. The remainder of the bits will indicate the rate which should be used to calculate the end of the packet. Table 201 below shows the rate mapping of the PSF bits. **Table 4. Data Rates in Modified PLCP Signaling Field** **b0 b1 b2 b3 Indicated Rate** 0 X X X Rates 1 - 4.5 Mbit/s per clause 14 100 0 5.5 M bps 100 1 11 M bps 1 1 1 X remaining patterns are reserved

18.2.4 PLCP/HR/DSSS PHY data scrambler and descrambler The polynomial $G(z) = z^{-7} + z^{-4} + 1$ shall be used to scramble *all* bits transmitted by the HR/DSSS PHY. The feedthrough configuration of the scrambler and descrambler is self-synchronizing, which requires no prior knowledge of the transmitter initialization of the scrambler for receive processing. Figure 6 and Figure 7 show typical implementations of the data scrambler and descrambler, but other implementations are possible. The scrambler should be initialized to any state except all ones when transmitting a long PLCP and all zeros when transmitting a short PLCP.

18.2.6 PLCP transmit procedure The transmit procedures are the same as those described in sec-tions IEEE 802.11 Standard, clauses 15.2.7 and 15.2.8 apart from the ability to transmit 5.5 and 11 Mbit/s. **Figure 6—Data scrambler** SERIAL DATA INPUT Z 1 Z 2 Z 3 Z 4 Z 5 Z 6 Z 7 XOR XOR SERIAL DATA OUTPUT Scrambler Polynomial; G(z) = Z -7 +Z -4 +1 **Figure 7—Data descrambler** SERIAL DATA INPUT Z 1 Z 2 Z 3 Z 4 Z 5 Z 6 Z 7 XOR XOR SERIAL DATA OUTPUT Descrambler Polynomial; G(z) = Z -7 +Z -4 +1

 The transmit procedure for a transmitter employing the short PLCP preamble and header is in essence the same. The decision for using a long or short PLCP is beyond the scope of this standard. The transmit procedure for a transmitter employing the FH PLCP preamble and header is for the sending sta-tion to follow the rules for CS/CCA in 14.3.3.1.2. When this transmission is to be a high rate transmission, the transmitter will set the signal and Length fields appropriately and will radiate the FH preamble and header on the assigned frequency channel. Following the PLCP transmission, there is an 8 microsecond gap followed by the short high rate preamble and header. The PLCP transmit procedure is shown in Figure 8. In order to transmit data, PHY-TXSTART.request shall be enabled so that the PHY entity shall be in the transmit state. Further, the PHY shall be set to operate at the appropriate channel through station manage-ment via the PLME. Other transmit parameters such as DATARATE, TX antenna, and TX power are set via the PHY-SAP with the PHY-TXSTART.request(TXVECTOR) as described in 18.4.4.2. Based on the status of clear channel assessment (CCA) indicated by PHY-CCA.indicate, the MAC will assess that the channel is clear. A clear channel shall be indicated by PHY-CCA.indicate(IDLE). If the channel is clear, transmission of the PPDU shall be initiated by issuing the PHY-TXSTART.request (TXVECTOR) primi-tive. The TXVECTOR elements for the PHY-TXSTART.request are the PLCP Header parameters SIGNAL (DATARATE), SERVICE, and LENGTH, and the PMD parameters of TX_ANTENNA and TXPWR_LEVEL. The PLCP Header parameter LENGTH is calculated from the TXVECTOR element by multiplying by 8 for 1 Mbit/s and by 4 for 2 Mbit/s. The PLCP shall issue PMD_ANTSEL, PMD_RATE, and PMD_TXPWRLVL primitives to configure the PHY. The PLCP shall then issue a PMD_TXSTART.request and the PHY entity shall immediately initiate data scrambling and transmission of the PLCP Preamble based on the parameters passed in the PHY-TXSTART. request primitive. The time required for TX power on ramp described in 18.4.4.7 shall be included in the PLCP synchronization field. Once the PLCP Preamble transmission is complete, data shall be exchanged between the MAC and the PHY by a series of PHY-DATA.request(DATA) primitives issued by the MAC and PHY-DATA.confirm primitives issued by the PHY. The modulation rate change, if any, shall be initiated with the first data symbol of the MPDU as described in

18.2.5. The PHY proceeds with MPDU transmission through a series of data octet transfers from the MAC. At the PMD layer, the data octets are sent in lsb to msb order and presented to the PHY layer through PMD_DATA.request primitives. Transmission can be prema-Copyright **Figure 8—PLCP transmit procedure** **MAC (TXVECTOR) PHY_TXSTART.req PHY_TXSTARTconfirm PHY_DATA.reg(DATA) PHY_TXEND.reg OR LENGTH COUNT MET SYNC SFD CRC MPDU Signal, Service, Length PHY PLCP PHY PMD PMD_TXSTART PMD_DATA.reg PMD_TXEND PMD_ANTSEL, PMD_RATE PMD_TXPWRLVL Scramble start TX Power RAMP CRC16 CRC16 Rate change start TX Power start end RAMP off** turely terminated by the MAC through the primitive PHY-TXEND.request. PHY-TXSTART shall be disabled by the issuance of the PHY-TXEND.request. Normal termination occurs after the transmission of the final bit of the last MPDU octet according to the number supplied in the HR/DSSS PHY preamble LENGTH field. The packet transmission shall be completed and the PHY entity shall enter the receive state (i.e., PHY-TXSTART shall be disabled). It is recommended that chipping continue during power-down. Each PHY-TXEND.request is acknowledged with a PHY-TXEND.confirm primitive from the PHY. A typical state machine implementation of the PLCP transmit procedure is provided in Figure 9. **Figure 9—PLCP transmit state machine** **PHY_TXSTART.request(TXVECTOR) initialize TX MPDU OCTET TX SYMBOL TX PLCP DATA SETUP MPDU TX Decrement Bit Decrement Length Switch to RX STATE A A At any stage in the above flow diagram, if a PHY_TXTEND.request is received PMD_TXPWRLVL.req PMD_ANTSEL.req TX SYNC PATTERN PMD_RATE.req (DBPSK) PMD_TXSTART.req TX 128 scrambled 1's TX 16 bit SFD TX 8 bit SIGNAL TX 8 bit SERVICE TX 16 bit LENGTH TX 16 bit CRC if Rate = DQPSK PMD_RATE.req (DQPSK) set length count decrement length count decrement bit count by bits per symbol PMD_DATA.req PHY_DATA.req(DATA) get octet from MAC Set Octet bit count bit count = 0 bit count <> 0 length = 0 length <> 0 else if RATE = 5.5Mbit/s PMD_RATE.req (5.5) else if RATE = 11Mbit/s PMD_RATE.req (11)**

18.2.7 PLCP receive procedure The receive procedure for a receiver configured to receive a long PLCP preamble and header is described in this section. A receiver conformant to this high rate extension of the standard is capable of receiving 5.5 Mbit/s and 11 Mbit/s in addition to 1 and 2 Mbit/s. If a PPDU with a short preamble and header is being transmitted a receiver configured to receive a long PLCP preamble and header will also react as described herein. The receiver will detect energy or a carrier, perform the CCA procedure and defer if necessary. The short preamble is a HR/DSSS signal which can be sensed by the carrier sense mechanism. The short SFD will normally not be detected and the receiver defers until the energy or carrier sense drops, thus providing coexistence capabilities between the systems. The receiver configured to receive a short PLCP preamble and header shall perform CCA and synchronize on the short preamble (56 microseconds) in order to be able to detect the short SFD. After detection of the short SFD the receiver shall be enabled to receive 5.5 Mbit/s in order to process the rest of the header. After this, the receive procedure is the same as described herein. The modulation rate change mechanism is described in clauses

18.2.3.7 and

18.2.3.14. The receiver configured to receive a short PLCP shall also be capable of receiving a PPDU with a long PLCP preamble or header. The detection of the long PLCP preamble can be based on the data content of the pream-ble (scrambled all 1's compared to scrambled all 0's) or on the absence of the short SFD after 56 microsec-onds. The PLCP receive procedure is shown in Figure 10. In order to receive data, PHY-TXSTART.request shall be disabled so that the PHY entity is in the receive state. Further, through station management via the PLME, the PHY is set to the appropriate channel and the **Figure 10—PLCP receive procedure** **MAC PHY_CCA.ind(BUSY) PHY_RXSTART.ind(RXVECTOR) PHY_DATA.ind(DATA) PHY_RXEND.ind(RXERROR) PHY PLCP PHY PMD PMD_ED or PMD_CS PMD_DATA.ind PHY_CCA(IDLE) PMD_ED/PMD_CS Descrambler start CRC CRC Rate change start start end SYNC SFD CRC MPDU Signal, Service, Length**

 CCA method is chosen. Other receive parameters such as receive signal strength indication (RSSI), signal quality (SQ), and indicated DATARATE may be accessed via the PHY-SAP. Upon receiving the transmitted energy, according to the selected CCA mode, the PMD_ED shall be enabled (according to
18.4.8.4) as the RSSI strength reaches the ED_THRESHOLD and/or PMD_CS shall be enabled after code lock is established. These conditions are used to indicate activity to the MAC via PHY-CCA. indicate according to
18.4.8.4. PHY-CCA.indicate(BUSY) shall be issued for energy detection and/or code lock prior to correct reception of the PLCP frame. The PMD primitives PMD_SQ and PMD_RSSI are issued to update the RSSI and SQ parameters reported to the MAC. After PHY-CCA.indicate is issued, the PHY entity shall begin searching for the SFD field. Once the SFD field is detected, CCITT CRC-16 processing shall be initiated and the PLCP IEEE 802.11 SIGNAL, IEEE 802.11 SERVICE and LENGTH fields are received. The CCITT CRC-16 FCS shall be processed. If the CCITT CRC-16 FCS check fails, the PHY receiver shall return to the RX Idle state as depicted in Figure 11. Should the status of CCA return to the IDLE state during reception prior to completion of the full PLCP pro-cessing, the PHY receiver shall return to the RX Idle state. If the PLCP Header reception is successful (and the SIGNAL field is completely recognizable and sup-ported), a PHY-RXSTART.indicate(RXVECTOR) shall be issued. The RXVECTOR associated with this primitive includes the SIGNAL field, the SERVICE field, the MPDU length in bytes (calculated from the LENGTH field in microseconds), the antenna used for receive (RX_ANTENNA), RSSI, and SQ. The received MPDU bits are assembled into octets and presented to the MAC using a series of PHY-DATA. indicate(DATA) primitive exchanges. The rate change indicated in the IEEE 802.11 SIGNAL field shall be initiated with the first symbol of the MPDU as described in
18.2.3.7 and
18.2.3.14. The PHY proceeds with MPDU reception. After the reception of the final bit of the last MPDU octet indicated by the PLCP Preamble LENGTH field, the receiver shall be returned to the RX Idle state as shown in Figure 9. A PHY-RXEND. indicate(NoError) primitive shall be issued. A PHY-CCA.indicate(IDLE) primitive shall be issued following a change in PHYCS (PHY carrier sense) and/or PHYED (PHY energy detection) according to the selected CCA method. In the event that a change in PHYCS or PHYED would cause the status of CCA to return to the IDLE state before the complete reception of the MPDU as indicated by the PLCP LENGTH field, the error condition PHY-RXEND.indicate(CarrierLost) shall be reported to the MAC. The HR/DSSS PHY will ensure that the CCA will indicate a busy medium for the intended duration of the transmitted packet. If the PLCP Header is successful, but the indicated rate or modulation in the SIGNAL and SERVICE fieldsare not receivable, a PHY-RXSTART. indicate will not be issued. The PHY shall issue the error condition PHY-RXEND.indi-cate(UnsupportedRate). If the PLCP Header is invalid,a PHY-RXSTART.indicate will not be issued. The PHY shall issue the error condition PHY-RXEND.indicate(FormatViolation). Also, in both cases, the HR/DSSS PHY will ensure that the CCA shall indicate a busy medium for the intended duration of the transmitted frame as indicated by the Length field. The intended duration is indicated by the Length field (length $\times$ 1 μs). A typical state machine implementation of the PLCP receive procedure is provided in 802.11-1998, Figure 11.

18.3 HR/DSSS physical layer management entity (PLME)

18.3.1 PLME_SAP sublayer management primitives Table 5 lists the MIB attributes that may be accessed by the PHY sublayer entities and intralayer of higher layer management entities (LME). These attributes are accessed via the PLME-GET, PLME-SET, and PLME-RESET primitives defined in Clause 10.

18.3.2 HR/DSSS PHY MIB All HR/DSSS PHY MIB attributes are defined in Annex D of the IEEE 802.11 Standard, with specific values defined in Table 5. **Figure 11—PLCP receive state machine** RX Idle State Detect SYNC PATTERN RX SYMBOL SIGNAL not Valid Decrement Length END OF MPDU RX PHY_RXEND.ind (carrier lost) Wait for intended end of MPDU PHY_CCA.ind(IDLE) PHY_RXEND.ind (No_Error) PHY_CCA.ind (IDLE) Decrement count by 1 microsecond SETUP MPDU RX VALIDATE PLCP RX PLCP CRC RXPLCP Fields Wait for PMD_ED.ind and/or PMD_CS.ind as needed for CCA mode Wait until SFD is detected CCA(IDLE) CCA(BUSY) length count = 0 length = 0 length <> 0 length count <> 0 PHY_DATA.ind Check PLCP RX and Test CRC RX 8 bit Signal RX 8 bit SERVICE RX 16 bit LENGTH Decrement Length Decrement Length Count length = 0 if RATE = DQPSK PMD_RATE.ind (DQPSK) set length count set octet bit count PHY_RXSTART.ind (RXVECTOR) PLCP Correct CRC Correct PHY_CCA.ind (IDLE) PHY_CCA.ind (IDLE) PHY_CCA.ind (IDLE) PHY_CCA.ind (IDLE) or CRC FAIL BYTE Assimilation Increment bit count set octet bit count PHY_DATA.ind(DATA) PLCP Field Out of Spec if RATE = 5.5Mbit/s PMD_RATE.ind (5.5) if RATE = 11Mbit/s PMD_RATE.ind (11)

IEEE Wireless LAN PHYSICAL (PHY) LAYER SPECIFICATIONS P802.11B/D1.0 518 **Table 5—MIB Attribute Default Values/Ranges** **Managed object Default value/range Operational semantics dot11PhyOperationTable** dot11PHYType dot11TempType dot11TempType Implementation dependent Static dot11CurrentRegDomain Implementation dependent Static **dot11RegDomainsSupported Implementation dependent Static dot11SupportedDataRatesTable Tx X'02', X'04,' X'0B', X'16' Static dot11SupportedDataRatesTable Rx X'02', X'04,' X'0B', X'16' Static dot11PhyAntennaTable** dot11CurrentTxAntenna Implementation dependent Dynamic dot11DiversitySupport Implementation dependent Static dot11CurrentRxAntenna Implementation dependent Dynamic **dot11PhyTxPowerTable** dot11NumberSupportedPowerLevels Implementation dependent Static dot11TxPowerLevel1 Implementation dependent Static dot11TxPowerLevel2 Implementation dependent Static dot11TxPowerLevel3 Implementation dependent Static dot11TxPowerLevel4 Implementation dependent Static dot11TxPowerLevel5 Implementation dependent Static dot11TxPowerLevel6 Implementation dependent Static dot11TxPowerLevel7 implementation dependent Static dot11TxPowerLevel8 Implementation dependent Static dot11CurrentTxPowerLevel Implementation dependent Dynamic **dot11PhyDSSSTable** dot11CurrentChannel Implementation dependent Dynamic dot11CCAModeSupported Implementation dependent Static dot11CurrentCCAMode Implementation dependent Dynamic dot11EDThreshold Implementation dependent Dynamic **dot11AntennasListTable** dot11SupportTxAntenna Implementation dependent Static dot11SupportRxAntenna Implementation dependent Static dot11DiversitySelectionRx Implementation dependent Dynamic NOTE—The column titled "Operational semantics" contains two types: static and dynamic. Static MIB attributes are fixed and cannot be modified for a given PHY implementation. MIB attributes defined as dynamic can be modified by some management entities. IEEE P802.11B/D1.0, 1 October 1998 DRAFT STANDARD FOR 519

18.3.3 DS PHY characteristics The static DS PHY characteristics, provided through the PLME-CHARACTERISTICS service primitive, are shown in Table 6. The definitions of these characteristics are in 10.4.3.

18.4 HR/DSSS PMD sublayer

18.4.1 Scope and field of application This subclause describes the PMD services provided to the PLCP for the HR/DSSS PHY. Also defined in this subclause are the functional, electrical, and RF characteristics required for interoperability of implemen-tations conforming to this specification. The relationship of this specification to the entire HR/DSSS physi-cal layer is shown in Figure 12. **Table 6—DS PHY Characteristics** **Characteristic Value** aSlotTime 20 µs aSIFSTime 10 µs aCCATime <15 µs aRxTxTurnaroundTime <5 µs aTxPLCPDelay Implementors may choose any value for this delay as long as the requirements of aRxTxTurnaroundTime are met. aRxPLCPDelay Implementors may choose any value for this delay as long as the requirements of aSIFSTime and aCCATime are met. aRxTxSwitchTime <5 µs aTxRampOnTime Implementors may choose any value for this delay as long as the requirements of aRxTxTurnaroundTime are met. aTxRampOffTime Implementors may choose any value for this delay as long as the requirements of aSIFSTime are met. aTxRFDelay Implementors may choose any value for this delay as long as the requirements of aRxTxTurnaroundTime are met. aRxRFDelay Implementors may choose any value for this delay as long as the requirements of aSIFSTime and aCCATime are met. aAirPropagationTime 1 µs aMACProcessingDelay 0 (not applicable) aPreambleLength 144 µs or 56 µs aPLCPHeaderLength 48 bits aMPDUDurationFactor 1 aMPDUMaxLength 4< x < (2^{13} – 1) aCWmin 31 aCWmax 1023

18.4.2 Overview of service The HR/DSSS PMD sublayer accepts PLCP sublayer service primitives and provides the actual means by which data shall be transmitted or received from the medium. The combined function of HR/DSSS PMD sublayer primitives and parameters for the receive function results in a data stream, timing information, and associated received signal parameters being delivered to the PLCP sublayer. A similar functionality shall be provided for data transmission.

18.4.3 Overview of interactions The primitives associated with the IEEE 802.11 PLCP sublayer to the HR/DSSS PMD fall into two basic categories: a) Service primitives that support PLCP peer-to-peer interactions b) Service primitives that have local significance and that support sublayer-to-sublayer interactions.

18.4.4 Basic service and options All of the service primitives described in this clause are considered mandatory unless otherwise specified. **Figure 12. Layer Reference Model** MAC MAC MAC MANAGEMENT STATION MANAGEMENT CONVERGENCE LAYER PHY DSSS PLCP SUBLAYER DSSS PMD SUBLAYER PMD SAP

18.4.4.1 PMD_SAP peer-to-peer service primitives Table 7 indicates the primitives for peer-to-peer interactions.

18.4.4.2 PMD_SAP peer-to-peer service primitive parameters Several service primitives include a parameter vector. This vector shall be a list of parameters that may vary depending on PHY type. Table 8 indicates the parameters required by the MAC or HR/DSSS PHY in each of the parameter vectors used for peer-to-peer interactions.

Table 7—PMD_SAP Peer-to-Peer Service Primitives **Primitive Request Indicate Confirm Response** PHY-RXSTART X PHY-RXEND X PHY-CCA X PHY-TXSTART X X PHY-TXEND X X PHY-DATA X X X **Table 8—HR/DSSS PMD_SAP Peer-to-Peer Service Primitives** **Parameter Associated primitive Value** LENGTH RXVECTOR, TXVECTOR 11 to $2^{16} - 1$ DATARATE RXVECTOR, TXVECTOR PHY dependent SERVICE RXVECTOR, TXVECTOR PHY dependent TXPWR_LEVEL TXVECTOR PHY dependent TX_ANTENNA TXVECTOR PHY dependent RSSI RXVECTOR PHY dependent SQ RXVECTOR PHY dependent RX_ANTENNA RXVECTOR PHY dependent

18.4.4.3 PMD_SAP sublayer-to-sublayer service primitives Table 9 indicates the primitives for sublayer-to-sublayer interactions.

18.4.4.4 PMD_SAP service primitive parameters Table 10 indicates the parameters for the PMD primitives. **Table 9—PMD_SAP Sublayer-to-Sublayer Service Primitives** **Primitive Request Indicate Confirm Response** PMD_TXSTART X PMD_TXEND X PMD_ANTSEL X X PMD_TXPWRLVL X PMD_RATE X X PMD_RSSI X PMD_SQ X PMD_CS X PMD_ED X X **Table 10—List of Parameters for the PMD Primitives** **Parameter Associate primitive Value** PHY-DATA.indicate Octet value: X'00'–X'FF' TXD_UNIT PMD_DATA.request One(1), Zero(0): DBPSK dibit combinations 00,01,11,10: DQPSK 00h - 0Fh : CCK 5.5 Mbit/s 00h - FFh : CCK 11 Mbit/s RXD_UNIT PMD_DATA.indicate One(1), Zero(0): DBPSK dibit combinations 00,01,11,10 : DQPSK 00h - 0Fh : CCK 5.5 Mbit/s 00h - FFh : CCK 11 Mbit/s RF_STATE PMD_TXE.request Receive, Transmit ANT_STATE PMD_ANTSEL.indicate PMD_ANTSEL.request 1 to 256 TXPWR_LEVEL PHY-TXSTART 0, 1, 2, 3 (max of 4 levels) RATE PMD_RATE.indicate PMD_RATE.request X'0A' for 1 Mbit/s DBPSK X'14' for 2 Mbit/s DQPSK X’37’ for 5.5 Mbit/s CCK X’6E’ for 11 Mbit/s CCK RSSI PMD_RSSI.indicate 0–8 bits of RSSI SQ PMD_SQ.indicate 0–8 bits of SQ

18.4.5 PMD_SAP detailed service specification The following subclauses describe the services provided by each PMD primitive.

18.4.5.1 PMD_DATA.request

18.4.5.1.1 Function This primitive defines the transfer of data from the PLCP sublayer to the PMD entity.

18.4.5.1.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_DATA.request(TXD_UNIT) The TXD_UNIT parameter takes on the value of either one(1) or zero(0) for DBPSK modulation or the dibit combination 00, 01, 11, or 10 for DQPSK modulation. For 5.5 Mbit/s CCK modulation it takes on the values of 0x00 to 0xOF and for 11 Mbit/s CCK modulation it takes on the values 0x00 to 0xFF. This parameter rep-resents a single block of data, which, in turn, shall be used by the PHY to be differentially encoded into a transmitted symbol. The symbol itself shall be spread by the PN code prior to transmission.

18.4.5.1.3 When generated This primitive shall be generated by the PLCP sublayer to request transmission of a symbol. The data clock for this primitive shall be supplied by PMD layer based on the PN code repetition.

18.4.5.1.4 Effect of receipt The PMD performs the differential encoding, PN code modulation and transmission of the data.

18.4.5.2 PMD_DATA.indicate

18.4.5.2.1 Function This primitive defines the transfer of data from the PMD entity to the PLCP sublayer.

18.4.5.2.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_DATA.indicate(RXD_UNIT) The RXD_UNIT parameter takes on the value of one(1) or zero(0) for DBPSK modulation or as the dibit 00, 01, 11, or 10 for DQPSK modulation. For 5.5 Mbit/s CCK modulation it takes on the values of 0x00 to 0xoF and for 11 Mbit/s CCK modulation it takes on the values 0x00 to 0xFF. This parameter represents a single symbol that has been demodulated by the PMD entity.

18.4.5.2.3 When generated This primitive, which is generated by the PMD entity, forwards received data to the PLCP sublayer. The data clock for this primitive shall be supplied by PMD layer based on the PN code repetition.

18.4.5.2.4 Effect of receipt The PLCP sublayer either interprets the bit or bits that are recovered as part of the PLCP convergence proce-dure or passes the data to the MAC sublayer as part of the MPDU.

18.4.5.3 PMD_TXSTART.request

18.4.5.3.1 Function This primitive, which is generated by the PHY PLCP sublayer, initiates PPDU transmission by the PMD layer.

18.4.5.3.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_TXSTART.request

18.4.5.3.3 When generated This primitive shall be generated by the PLCP sublayer to initiate the PMD layer transmission of the PPDU. The PHY-DATA.request primitive shall be provided to the PLCP sublayer prior to issuing the PMD_TXSTART command.

18.4.5.3.4 Effect of receipt PMD_TXSTART initiates transmission of a PPDU by the PMD sublayer.

18.4.5.4 PMD_TXEND.request

18.4.5.4.1 Function This primitive, which is generated by the PHY PLCP sublayer, ends PPDU transmission by the PMD layer.

18.4.5.4.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_TXEND.request

18.4.5.4.3 When generated This primitive shall be generated by the PLCP sublayer to terminate the PMD layer transmission of the PPDU.

18.4.5.4.4 Effect of receipt PMD_TXEND terminates transmission of a PPDU by the PMD sublayer.

18.4.5.5 PMD_ANTSEL.request

18.4.5.5.1 Function This primitive, which is generated by the PHY PLCP sublayer, selects the antenna used by the PHY for transmission or reception (when diversity is disabled).

18.4.5.5.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_ANTSEL.request(ANT_STATE) ANT_STATE selects which of the available antennas should be used for transmit. The number of available antennas shall be determined from the MIB table parameters aSuprtRxAntennas and aSuprtTxAntennas.

18.4.5.5.3 When generated This primitive shall be generated by the PLCP sublayer to select a specific antenna for transmission (or reception when diversity is disabled).

18.4.5.5.4 Effect of receipt PMD_ANTSEL immediately selects the antenna specified by ANT_STATE.

18.4.5.6 PMD_ANTSEL.indicate

18.4.5.6.1 Function This primitive, which is generated by the PHY PLCP sublayer, reports the antenna used by the PHY for reception of the most recent packet.

18.4.5.6.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_ANTSEL.indicate(ANT_STATE) ANT_STATE reports which of the available antennas was used for reception of the most recent packet.

18.4.5.6.3 When generated This primitive shall be generated by the PLCP sublayer to report the antenna used for the most recent packet reception.

18.4.5.6.4 Effect of receipt PMD_ANTSEL immediately reports the antenna specified by ANT_STATE.

18.4.5.7 PMD_TXPWRLVL.request

18.4.5.7.1 Function This primitive, which is generated by the PHY PLCP sublayer, selects the power level used by the PHY for transmission.

18.4.5.7.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_TXPWRLVL.request(TXPWR_LEVEL) TXPWR_LEVEL selects which of the optional transmit power levels should be used for the current packet transmission. The number of available power levels shall be determined by the MIB parameter dot11NumberSupportedPowerLevels. Subclause
18.4.7.3 provides further information on the optional HR/ DSSS PHY power level control capabilities.

18.4.5.7.3 When generated This primitive shall be generated by the PLCP sublayer to select a specific transmit power. This primitive shall be applied prior to setting PMD_TXSTART into the transmit state.

18.4.5.7.4 Effect of receipt PMD_TXPWRLVL immediately sets the transmit power level given by TXPWR_LEVEL.

18.4.5.8 PMD_RATE.request

18.4.5.8.1 Function This primitive, which is generated by the PHY PLCP sublayer, selects the modulation rate that shall be used by the HR/DSSS PHY for transmission.

18.4.5.8.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_RATE.request(RATE) RATE selects which of the HR/DSSS PHY data rates shall be used for MPDU transmission. Subclause
18.4.6.3 provides further information on the HR/DSSS PHY modulation rates. The HR/DSSS PHY rate change capability is fully described in
18.2.

18.4.5.8.3 When generated This primitive shall be generated by the PLCP sublayer to change or set the current HR/DSSS PHY modula-tion rate used for the MPDU portion of a PPDU.

18.4.5.8.4 Effect of receipt The receipt of PMD_RATE selects the rate that shall be used for all subsequent MPDU transmissions. This rate shall be used for transmission only. The HR/DSSS PHY shall still be capable of receiving all the required HR/DSSS PHY modulation rates.

18.4.5.9 PMD_RATE.indicate

18.4.5.9.1 Function This primitive, which is generated by the PMD sublayer, indicates which modulation rate was used to receive the MPDU portion of the PPDU. The modulation shall be indicated in the PLCP Preamble IEEE 802.11 SIGNALING field.

18.4.5.9.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_RATE.indicate(RATE) In receive mode, the RATE parameter informs the PLCP layer which of the HR/DSSS PHY data rates was used to process the MPDU portion of the PPDU. Subclause
18.4.6.3 provides further information on the HR/ DSSS PHY modulation rates. The HR/DSSS PHY rate change capability is fully described in
18.2.

18.4.5.9.3 When generated This primitive shall be generated by the PMD sublayer when the PLCP Preamble IEEE 802.11 SIGNALING field has been properly detected.

18.4.5.9.4 Effect of receipt This parameter shall be provided to the PLCP layer for information only.

18.4.5.10 PMD_RSSI.indicate

18.4.5.10.1 Function This optional primitive, which is generated by the PMD sublayer, provides to the PLCP and MAC entity the received signal strength.

18.4.5.10.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_RSSI.indicate(RSSI) The RSSI shall be a measure of the RF energy received by the HR/DSSS PHY. RSSI indications of up to 8 bits (256 levels) are supported.

18.4.5.10.3 When generated This primitive shall be generated by the PMD when the HR/DSSS PHY is in the receive state. It shall be continuously available to the PLCP, which, in turn, provides the parameter to the MAC entity.

18.4.5.10.4 Effect of receipt This parameter shall be provided to the PLCP layer for information only. The RSSI may be used in conjunction with SQ as part of a CCA scheme.

18.4.5.11 PMD_SQ.indicate

18.4.5.11.1 Function This optional primitive, which is generated by the PMD sublayer, provides to the PLCP and MAC entity the signal quality (SQ) of the HR/DSSS PHY PN code correlation. The SQ shall be sampled when the HR/ DSSS PHY achieves code lock and held until the next code lock acquisition.

18.4.5.11.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_SQ.indicate(SQ) The SQ shall be a measure of the PN code correlation quality received by the HR/DSSS PHY. SQ indications of up to 8 bits (256 levels) are supported.

18.4.5.11.3 When generated This primitive shall be generated by the PMD when the HR/DSSS PHY is in the receive state and code lock is achieved. It shall be continuously available to the PLCP, which, in turn, provides the parameter to the MAC entity.

18.4.5.11.4 Effect of receipt This parameter shall be provided to the PLCP layer for information only. The SQ may be used in conjunction with RSSI as part of a CCA scheme.

18.4.5.12 PMD_CS.indicate This primitive, which is generated by the PMD, shall indicate to the PLCP layer that the receiver has acquired (locked) the PN code and data is being demodulated.

18.4.5.12.1 Function This primitive, which is generated by the PMD, shall indicate to the PLCP layer that the receiver has acquired (locked) the PN code and data is being demodulated.

18.4.5.12.2 Semantics of the service primitive The PMD_CS (carrier sense) primitive in conjunction with PMD_ED provide CCA status through the PLCP layer PHYCCA primitive. PMD_CS indicates a binary status of ENABLED or DISABLED. PMD_CS shall be ENABLED when the correlator SQ indicated in PMD_SQ is greater than the CS_THRESHOLD parame-ter. PMD_CS shall be DISABLED when the PMD_SQ falls below the correlation threshold.

18.4.5.12.3 When generated This primitive shall be generated by the PHY sublayer when the HR/DSSS PHY is receiving a PPDU and the PN code has been acquired.

18.4.5.12.4 Effect of receipt This indicator shall be provided to the PLCP for forwarding to the MAC entity for information purposes through the PHYCCA indicator. This parameter shall indicate that the RF medium is busy and occupied by a

HR/DSSS PHY signal. The HR/DSSS PHY should not be placed into the transmit state when PMD_CS is ENABLED.

18.4.5.13 PMD_ED.indicate

18.4.5.13.1 Function This optional primitive, which is generated by the PMD, shall indicate to the PLCP layer that the receiver has detected RF energy indicated by the PMD_RSSI primitive that is above a predefined threshold.

18.4.5.13.2 Semantics of the service primitive The PMD_ED (energy detect) primitive, along with the PMD_SQ, provides CCA status at the PLCP layer through the PHYCCA primitive. PMD_ED indicates a binary status of ENABLED or DISABLED. PMD_ED shall be ENABLED when the RSSI indicated in PMD_RSSI is greater than the ED_THRESHOLD parameter. PMD_ED shall be DISABLED when the PMD_RSSI falls below the energy detect threshold.

18.4.5.13.3 When generated This primitive shall be generated by the PHY sublayer when the PHY is receiving RF energy from any source that exceeds the ED_THRESHOLD parameter.

18.4.5.13.4 Effect of receipt This indicator shall be provided to the PLCP for forwarding to the MAC entity for information purposes through the PMD_ED indicator. This parameter shall indicate that the RF medium may be busy with an RF energy source that is not HR/DSSS PHY compliant. If a HR/DSSS PHY source is being received, the PMD_CS function shall be enabled shortly after the PMD_ED function is enabled.

18.4.5.14 PMD_ED.request

18.4.5.14.1 Function This optional primitive, which is generated by the PHY PLCP, sets the energy detect ED THRESHOLD value.

18.4.5.14.2 Semantics of the service primitive The primitive shall provide the following parameters: PMD_ED.request(ED_THRESHOLD) ED_THRESHOLD sets the threshold that the RSSI indicated shall be greater than in order for PMD_ED to be enabled.

18.4.5.14.3 When generated This primitive shall be generated by the PLCP sublayer to change or set the current HR/DSSS PHY energy detect threshold.

18.4.5.14.4 Effect of receipt The receipt of PMD_ED immediately changes the energy detection threshold as set by the ED_THRESHOLD parameter.

18.4.5.15 PHY-CCA.indicate

18.4.5.15.1 Function This primitive, which is generated by the PMD, indicates to the PLCP layer that the receiver has detected RF energy that adheres to the CCA algorithm.

18.4.5.15.2 Semantics of the service primitive The PHY-CCA primitive provides CCA status at the PLCP layer to the MAC.

18.4.5.15.3 When generated This primitive shall be generated by the PHY sublayer when the PHY is receiving RF energy from any source that exceeds the ED_THRESHOLD parameter (PMD_ED is active), and optionally is a valid corre-lated HR/DSSS PHY signal whereby PMD_CS would also be active.

18.4.5.15.4 Effect of receipt This indicator shall be provided to the PLCP for forwarding to the MAC entity for information purposes through the PHY-CCA indicator. This parameter indicates that the RF medium may be busy with an RF energy source that may or may not be HR/DSSS PHY compliant. If a HR/DSSS PHY source is being received, the PMD_CS function shall be enabled shortly after the PMD_ED function is enabled.

18.4.6 PMD operating specifications, general The following subclauses provide general specifications for the HR/DSSS PMD sublayer. These specifica-tions apply to both the Receive and the Transmit functions and general operation of a HR/DSSS PHY.

18.4.6.1 Operating frequency range The HR/DSSS PHY shall operate in the frequency range of 2.4 GHz to 2.4835 GHz as allocated by regula-tory bodies in the USA and Europe or in the 2.471 GHz to 2.497 GHz frequency band as allocated by regu-latory authority in Japan.

18.4.6.2 Number of operating channels The channel center frequencies and CHNL_ID numbers shall be as shown in Table 11. The FCC (US), IC (Canada), and ETSI (Europe) specify operation from 2.4 GHz to 2.4835 GHz. For Japan, operation is speci-fied as 2.471 GHz to 2.497 GHz. France allows operation from 2.4465 GHz to 2.4835 GHz, and Spain allows operation from 2.445 GHz to 2.475 GHz. For each supported regulatory domain, all channels in Table 11 marked with "X" shall be supported. In a multiple cell network topology, overlapping and/or adjacent cells using different channels can operate simultaneously without interference if the distance between the center frequencies is at least 30 MHz. Chan-nel 14 shall be designated specifically for operation in Japan.

18.4.6.3 Modulation and channel data rates Four modulation formats and data rates are specified for the HR/DSSS PHY. The basic access rate shall be based on 1 Mbit/s DBPSK modulation. The extended Direct Sequence specification defines three additional data rates. The enhanced access rate shall be based on 2 Mbit/s DQPSK. The high rate access rates shall be based on the Complementary Code Keying (CCK) modulation scheme for 5.5 Mbit/s and 11 Mbit/s. An optional Packet Binary Convolutional Coding (PBCC) mode may be provided for potentially enhanced performance.

18.4.6.4 Spreading sequence and modulation for 1 and 2 Mbit/s The following 11-chip Barker sequence shall be used as the PN code sequence for the 1 and 2 Mbit/s modulation: +1, –1, +1, +1, –1, +1, +1, +1, –1, –1, –1 **Table 11—HR/DSSS PHY Frequency Channel Plan** **Regulatory domains CHNL_ID Frequency X'10' FCC X'20' IC X'30' ETSI X'31' Spain X'32' France X'40' MKK** 1 2412 MHz X X X — — — 2 2417 MHz X X X — — — 3 2422 MHz X X X — — — 4 2427 MHz X X X — — — 5 2432 MHz X X X — — — 6 2437 MHz X X X — — — 7 2442 MHz X X X — — — 8 2447 MHz X X X — — — 9 2452 MHz X X X — — — 10 2457 MHz X X X X X — 11 2462 MHz X X X X X — 12 2467 MHz — — X — X — 13 2472 MHz — — X — X — 14 2484 MHz — — — — — X

The leftmost chip shall be output first in time. The first chip shall be aligned at the start of a transmitted sym-bol. The symbol duration shall be exactly 11 chips long. The DBPSK encoder for the basic access rate is specified in Table 12 while the enhanced access rate shall be based on 2 Mbit/s DQPSK. The DQPSK encoder is specified in Table 13. (In the tables, +jω shall be defined as counterclockwise rotation.)

18.4.6.5 Spreading Sequences and modulation for CCK modulation at 5.5 and 11 Mbit/s The spreading code length is 8 and based on complementary codes. The chipping rate is 11 Mchip/s. The symbol duration shall be exactly 8 complex chips long. The following formula shall be used to derive the CCK code words that shall be used for spreading both 5.5 and 11 Mbit/s: (lsb to msb), where c is the code word The terms: φ1, φ2, φ3, and φ4 are defined in clause 1.4.6.5.2 for 5.5 Mbit/s and clause 1.4.6.5.3 for 11 Mbit/s. This formula creates 8 complex chips (lsb to msb) that are transmitted lsb first in terms. This is a form of the generalized Hadamard transform encoding where φ1 is added to all code chips, φ2 is added to all odd code chips, φ3 is added to all odd pairs of code chips and φ4 is added to all odd quads of code chips. **Table 12—1 Mbit/s DBPSK Encoding Table** **Bit input Phase change (+jω)** 0 0 1 π **Table 13—2 Mbit/s DQPSK Encoding Table** **Dibit pattern (d0,d1) d0 is first in time Phase change (+jω)** 00 0 01 π/2 11 π 10 3π/2 (–π/2) *c e e e e e e e e j* = +++ ++ ++ − + +++ − + {e j() , j() , j() , j() , j() , j() , j() ,} φ φφφ φ φφ φφφ φ φ φφφ φφ φφ φ 1 234 1 34 124 1 4 1 23 13 12 1

 The phases j1 modify the phase of all code chips of the sequence and will be DQPSK encoded for 5.5 and 11 Mbit/s. This will take the form of rotating the whole symbol by the appropriate amount relative to the phase of the preceding symbol. Note that the msb chip of the symbol defined above is the chip that indicates the symbol's phase and it is transmitted last.

18.4.6.5.1 Cover Codes for CCK The 4th and 7th chips are rotated 180 degrees (as shown) by a cover sequence to optimize the sequence cor-relation properties and minimize DC offsets in the codes. This can be seen by the minus sign on the 4th and 7th terms in the equation in clause 1.4.2.6.5.

18.4.6.5.2 CCK 5.5 Mbit/s Modulation At 5.5 Mbit/s 4 bits (d0 to d3; d0 first in time) are transmitted per symbol. The data bits d0 and d1 encode. φ1 based on DQPSK. The DQPSK encoder is specified in Table 204. (In the tables, +jw shall be defined as counterclockwise rotation.). The phase change for φ1 is relative to the phase φ1 of the preceding symbol. For the case of the preamble to header transition, the phase change for φ1 is rel-ative to the phase of the preceding DBPSK (1 Mbit/s) symbol. See the definition in clause 15.4.6.3 for the reference phase of this Barker symbol. A "+1" chip in the Barker code shall represent the same carrier phase as a "+1" chip in the CCK code. All odd numbered symbols of the short Header or MPDU shall be given an extra 180 degree (*) rotation in addition to the standard DQPSK modulation as shown in the table. The symbols of the short Header or MPDU shall be numbered starting with "0" for the first symbol for the purposes of determining odd and even symbols. That is, the short Header or MPDU starts on an even numbered symbol. The data dibits d2, and d3 CCK encode the basic symbol as specified in table 205. This table is derived from the formula above by setting φ2 = (d2*p)+ p /2, φ3 = 0, and φ4 = d3*p. In the table d2 and d3 are in the order shown and the complex chips are shown lsb to msb (left to right) with lsb transmitted first. **Table 14. DQPSK Encoding Table** **Dibit pattern (d(0),d(1)) d(0) is first in time Even Symbols Phase Change (+jω) Odd Symbols Phase Change (+jω)** 00 0 π 01 π/2 3π/2 (-π/2) 11 π 0 10 3π/2 (-π/2) π/2 **Table 15. 5.5 Mbit/s CCK Encoding Table** d2, d3 00 : 1*j* 1 1 *j* -1 1*j* 1 -1*j* 1 01 : -1*j* -1 -1*j* 1 1*j* 1 -1*j* 1 10 : -1*j* 1 - 1*j* -1 -1*j* 1 1*j* 1 11 : 1*j* -1 1*j* 1 -1*j* 1 1*j* 1

18.4.6.5.3 CCK 11 Mbit/s modulation. At 11 Mbit/s, 8 bits (d0 to d7; d0 first in time) are transmitted per symbol. The first dibit (d0,d1) encodes φ1 based on DQPSK. The DQPSK encoder is specified in Table 204 above. The phase change for φ1 is relative to the phase φ1 of the preceding symbol. In the case of rate change, the phase change for φ1 is relative to the phase φ1 of the preceding CCK symbol. All odd numbered symbols of the MPDU are given an extra 180 degree (π) rotation in accordance with the DQPSK modulation as shown in table 204. Symbol numbering starts with "0" for the first symbol of the short Header or MPDU. The data dibits: (d2,d3), (d4,d5), (d6,d7) encode φ2, φ3, and φ4 respectively based on QPSK as specified in table 16. Note that this table is binary, not Grey, coded.

18.4.6.6 DSSS/PBCC Data Modulation and Modulation Rate (Optional) This optional coding scheme uses a binary convolutional coding with a 64-state binary convolutional code (BCC) and a cover sequence. The output of the BCC is encoded jointly onto the I and Q channels, as further documented below. The encoder for this scheme is shown in Figure 13. Incoming data is first encoded with a binary convolu-tional code. The encoded data is then covered before transmission through the channel.

Table 16. QPSK Encoding Table **Dibit pattern (d(i),d(i+1)) d(i) is first in time Phase** 00 0 01 π/2 11 π 11 3π/2 (-π/2) DATA IN BCC CODEWORD QPSK SIGNAL COVER SEQUENCE BCC RATE 1/2 ENCODER QPSK COVER MAP COVER CODE M C X S **Figure 13. PBCC Modulator Scheme**

 The binary convolutional code that is used is a 64-state, rate ½ code. The generator matrix for the code is given as or in octal notation, it is given by Since the system is packet based, the encoder is defined as being in state zero, i.e. all memory elements con-tain zero, at the beginning of each packet. The encoder must also be placed in a known state at the end of each packet to prevent the data bits near the end of the packet from being substantially less reliable than those early on in the packet. To place the encoder in a known state at the end of a packet, six deterministic bits are input immediately following the last data bit input to the convolutional encoder. These bits are all zero, which places the encoder in the zero state. An encoder block diagram is shown in Figure 14. It consists of six memory elements. For every data bit input, two output bits are generated. The output of the binary convolutional code described in above is mapped to a constellation using one of two possible rates. The 5.5 Mbit/s rate uses BPSK and the 11 Mbit/s rate uses QPSK. In QPSK mode each pair of output bits from the binary convolutional code is used to produce one symbol, while in BPSK mode each pair of bits from the BCC is taken serially and used to produce two PSK symbols. This yields a throughput of one bit per symbol in QPSK mode and one-half a bit per symbol in BPSK mode. The mapping from BCC outputs to PSK constellation points in BPSK and QPSK modes is determined by a pseudo-random cover sequence. This is shown for both modes in Figure 15. $G\ DDDD\ DDDDD =++++ ++ ++ +$ [,] 6 43 1 6 5 43 2 1 $G =$ [,] 133 175 + ++ + +++ + + **Figure 14. PBCC Convolutional Encoder**

 The pseudo-random cover sequence is generated from a seed sequence. The 16-bit seed sequence is 0011001110001011, where the first bit of the sequence in time is the left most bit. This sequence in octal notation is given as 150714, where the least significant bit is the first in time. This seed sequence is used to generate the pseudo-random cover sequence of length 256 bits that is used in the mapping of the current PSK symbol. It is the current binary value of this sequence at every given point in time that is taken as S in Figure 15. This sequence of 256 bits is produced by taking the first sixteen bits of the sequence as the seed sequence, the second sixteen bits as the seed sequence cyclically left rotated by three, the third sixteen bits as the seed sequence cyclically left rotated by six, etc. If ci is the ith bit of the seed sequence, where 0 <= I <= 15, then the sequence that is used to cover the data is given row-wise as follows: c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 c10 c11 c12 c13 c14 c15 c3 c4 c5 c6 c7 c8 c9 c10 c11 c12 c13 c14 c15 c0 c1 c2 c6 c7 c8 c9 c10 c11 c12 c13 c14 c15 c0 c1 c2 c3 c4 c5 Ö c10 c11 c12 c13 c14 c15 c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 c13 c14 c15 c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 c10 c11 c12 For packet based systems with more than 256 bits and continuous systems this sequence of 256 bits is sim-ply repeated.

18.4.6.7 Hop Sequences (Optional) The optional hop sequences for each of the specified geographical areas are defined with two sets. HR/DSSS frequency channels referred to in this clause are defined in Table 10. **QPSK MODE (1 BIT PER SYMBOL) BPSK MODE (1/2 BIT PER SYMBOL) S = 0 S = 1 S = 0 S = 1 01 00 11 10 00 10 11 01 0 1 0 1 Figure 15. Cover Code Mapping**

 The first set uses non-overlapping frequency channels to allow the HR/DSSS systems to minimize interfer-ence degradation. The synchronization of frequency hopping is performed by the MAC sub-layer manage-ment entity as defined in the IEEE 802.11 Standard, clause 11.1.5 for the FH PHY. The PLME SAP service primitives to command a new frequency channel is as defined in the IEEE 802.11 Standard, clause 10.4. The second set uses half overlapping frequency channels with 10 MHz center frequency spacing to maintain interoperability with 802.11 1 and 2 Mbit/s FH systems hopping with the approved 802.11 hop sequences. Hop synchronization is provided by the FH PHY management mechanisms and sent at the FH basic rate. The HR/DSSS hop frequency is calculated from the specific 1 MHz channel chosen for a given hop by pick-ing the closest HR/DSSS channel within the set. Where there is a choice of two DS channels, the lower one will be the one chosen. Therefore, the chosen channel will be no more than +/-5 MHz of the channel center of the FH channel. When operating on the FH channels beyond +/-5 MHz of the closest HR/DSSS channel specified in the set, the HR/DSSS mode will not be used and all FH transmissions will occur at the 1 or 2 Mbit/s rates. These channels are too far away from the available DS channels to be processed within the IF bandwidth.

18.4.6.7.1 Operating channels The operating channels for specified geographical areas are defined in Table 17. **Table 17. North American Operating Channels** **Set Number of Channels HR/DSSS Channel Numbers** 1 3 1, 6, 11 2 6 1, 3, 5, 7, 9, 11 CHANNEL 1 CHANNEL 6 CHANNEL11 2400 2412 2483.5 MHz 2437 2462 **Figure 16. North American Channel Selection - Non overlapping**

 Table 18. Europe Operating Channels (except France and Spain) **Set Number of Channels HR/DSSS Channel Numbers** 1 3 1, 7, 13 2 7 1, 3, 5, 7, 9, 11, 13 **2400 2412 2442 2472 2483.5 MHz 2422 2432 2452 2462** **Figure 17. North American Channel Selection - Overlapping** **CHANNEL 1 CHANNEL 7 CHANNEL13 2400 MHz 2412 MHz 2442MHz 2472MHz 2483.5 MHz** **Figure 18. European Channel Selection - Non overlapping** **2400 MHz 2412 MHz 2442 MHz 2472 MHz 2483.5 MHz 2422 MHz 2432 MHz 2452 MHz 2462 MHz** **Figure 19. European Channel Selection - Overlapping**

18.4.6.7.2 Hop Patterns The hop patterns for Set 1 of each geographic area is defined by the Hop Patterns in Tables 19 and 20. The hop patterns for Set 2 of each geographic area is defined by the 1/2 Mbit/s FH PHY hop sequences as described in clause
18.4.2.

18.4.6.8 Transmit and receive in-band and out-of-band spurious emissions The HR/DSSS PHY shall conform with in-band and out-of-band spurious emissions as set by regulatory bodies. For the USA, refer to FCC 15.247, 15.205, and 15.209. For Europe, refer to ETS 300–328.

18.4.6.9 Transmit-to-receive turnaround time The TX-to-RX turnaround time shall be less than 10 ms, including the power-down ramp specified in
18.4.7.7. The TX-to-RX turnaround time shall be measured at the air interface from the trailing edge of the last trans-mitted symbol to valid CCA detection of the incoming signal. The CCA should occur within 25 µs (10 µs for turnaround time plus 15 µs for energy detect) or by the next slot boundary occurring after the 25 µs has elapsed (refer to
18.4.8.4). A receiver input signal 3 dB above the ED threshold described in
18.4.8.4 shall be present at the receiver.

18.4.6.10 Receive-to-transmit turnaround time The RX-to-TX turnaround time shall be measured at the MAC/PHY interface, using PHYTXSTART.request and shall be 5 µs. This includes the transmit power up ramp described in
18.4.7.7. **Table 19. North America Set 1 Hop Patterns** Index Pattern 1 Pattern 2 1 1 1 2 6 11 3 116 **Table 20. Europe Set 1 Hop Patterns (except France and Spain)** Index Pattern 1 Pattern 2 1 11 2 713 3 137

18.4.6.11 Slot time The slot time for the HR/DSSS PHY shall be the sum of the RX-to-TX turnaround time (5 μs) and the energy detect time (15 μs specified in 18.4.8.4). The propagation delay shall be regarded as being included in the energy detect time.

18.4.6.12 Transmit and receive antenna port impedance The impedance of the transmit and receive antenna port(s) shall be 50 Ω if the port is exposed.

18.4.6.13 Transmit and receive operating temperature range Three temperature ranges for full operation compliance to the HR/DSSS PHY are specified in Clause 13. Type 1 shall be defined as 0 $_{o}$C to 40 $_{o}$C, and is designated for office environments. Type 2 shall be defined as –20 $_{o}$C to +50 $_{o}$C, and Type 3 shall be defined as –30 $_{o}$C to +70 $_{o}$C. These are designated for industrial environments.

18.4.7 PMD transmit specifications The following subclauses describe the transmit functions and parameters associated with the PMD sublayer.

18.4.7.1 Transmit power levels The maximum allowable output power as measured in accordance with practices specified by the regulatory bodies is shown in Table 21. In the USA, the radiated emissions should also conform with the ANSI uncon-trolled radiation emission standards (IEEE Std C95.1-1991).

18.4.7.2 Minimum transmitted power level The minimum transmitted power shall be no less than 1 mW.

18.4.7.3 Transmit power level control Power control shall be provided for transmitted power greater than 100 mW. A maximum of four power lev-els may be provided. At a minimum, a radio capable of transmission greater than 100 mW shall be capable of switching power back to 100 mW or less.

18.4.7.4 Transmit spectrum mask The transmitted spectral products shall be less than –30 dBr (dB relative to the SINx/x peak) for f_c – 22 MHz < f < f_c –11 MHz, f_c +11 MHz < f < f_c + 22 MHz, –50 dBr for f < f_c –22 MHz, and f > f_c + 22 MHz, where f_c is the channel center frequency. The transmit spectral mask is shown in Figure 20. The measurements shall be made using 100 kHz resolution bandwidth and a 30 kHz video bandwidth. **Table 21—Transmit Power Levels** **Maximum output power Geographic location Compliance document** 1000 mW USA FCC 15.247 100 mW (EIRP) Europe ETS 300–328 10 mW/MHz Japan MPT ordinance for Regulating Radio Equipment, Article 49-20

18.4.7.5 Transmit center frequency tolerance The transmitted center frequency tolerance shall be ±25 ppm maximum.

18.4.7.6 Chip clock frequency tolerance The PN code chip clock frequency tolerance shall be better than ±25 ppm maximum.

18.4.7.7 Transmit power-on and power-down ramp The transmit power-on ramp for 10% to 90% of maximum power shall be no greater than 2 µs. The transmit power-on ramp is shown in Figure 21. The transmit power-down ramp for 90% to 10% maximum power shall be no greater than 2 µs. The transmit power down ramp is shown in Figure 22. The transmit power ramps shall be constructed such that the HR/DSSS PHY emissions conform with spuri-ous frequency product specification defined in 18.4.6.9. **Figure 20—Transmit spectrum mask** fc fc -11 MHz fc -22 MHz Sinx/x fc +11 MHz fc +22 Mhz 0 dBr -30 dBr -50 dBr Unfiltered Transmit Spectrum Mask **Figure 21—Transmit Power-On Ramp** Transmit Power Output Max Tx Power Time usec 0 1 2 34 90% MAX 10% MAX

18.4.7.8 RF carrier suppression The RF carrier suppression, measured at the channel center frequency, shall be at least 15 dB below the peak SIN(x)/x power spectrum. The RF carrier suppression shall be measured while transmitting a repetitive 01 data sequence with the scrambler disabled using DQPSK modulation. A 100 kHz resolution bandwidth shall be used to perform this measurement.

18.4.7.9 Transmit modulation accuracy The transmit modulation accuracy requirement for the HR/DSSS PHY shall be based on the difference between the actual transmitted waveform and the ideal signal waveform. Modulation accuracy shall be deter-mined by measuring the peak vector error magnitude measured during each chip period. Worst-Case vector error magnitude shall not exceeded 0.35 for the normalized sampled chip data. The ideal complex I and Q con-stellation points associated with DQPSK modulation (0.707,0.707), (0.707, –0.707), (–0.707, 0.707), (–0.707, –0.707) shall be used as the reference. These measurements shall be from baseband I and Q sampled data after recovery through a reference receiver system. Figure 23 illustrates the ideal DQPSK constellation points and range of worst-case error specified for modu-lation accuracy. Error vector measurement requires a reference receiver capable of carrier lock. All measurements shall be made under carrier lock conditions. The distortion induced in the constellation by the reference receiver shall be calibrated and measured. The test data error vectors described below shall be corrected to compensate for the reference receiver distortion. The IEEE 802.11 vendor compatible radio shall provide an exposed TX chip clock, which shall be used to sample the I and Q outputs of the reference receiver. The measurement shall be made under the conditions of continuous DQPSK transmission using scrambled all 1’s. The eye pattern of the I channel shall be used to determine the I and Q sampling point. The chip clock pro-vided by the vendor radio shall be time delayed such that the samples fall at a 1/2 chip period offset from the mean of the zero crossing positions of the eye (see Figure 24). This is the ideal center of the eye and may not be the point of maximum eye opening. **Figure 22—Transmit Power-Down Ramp** Transmit Power Output Max Tx Power Time usec 0 1 2 34 90% MAX 10% MAX

 Using the aligned chip clock, 1000 samples of the *I* and *Q* baseband outputs from the reference receiver are captured. The vector error magnitudes shall be calculated as follows: Calculate the dc offsets for *I* and *Q* samples. **Figure 23—Modulation Accuracy Measurement Example** I Q Ideal Constellation Point Range of Worst Case Error Measured Point Error Vector **Figure 24—Chip Clock Alignment with Baseband Eye Pattern** Time Amplitude 1 Chip Period Geometric Center Ideal Sample Point 1/2 Chip Period Vendor Chip Clock $I_{mean} I n ( )1000 / _{n 0 = 1000} \sum =$

 Calculate the dc corrected I and Q samples for all n =1000 sample pairs. $I_{dc}(n) = I(n) - I_{mean}$ $Q_{dc}(n) = Q(n) - Q_{mean}$ Calculate the average magnitude of I and Q samples. Calculate the normalized error vector magnitude for the $I_{dc}(n)/Q_{dc}(n)$ pairs. with $V_{correction}$ = error induced by the reference receiver system. A vendor HR/DSSS PHY implementation shall be compliant if for all n =1000 samples the following condi-tion is met: $V_{err}(n) < 0.35$

18.4.8 PMD receiver specifications The following subclauses describe the receive functions and parameters associated with the PMD sublayer.

18.4.8.1 Receiver minimum input level sensitivity The frame error ratio (FER) shall be less than 8×10^{-2} at an MPDU length of 1024 bytes for an input level of – 76 dBm measured at the antenna connector. This FER shall be specified for 11 Mbit/s CCK modulation. The test for the minimum input level sensitivity shall be conducted with the energy detection threshold set less than or equal to –76 dBm.

18.4.8.2 Receiver maximum input level The receiver shall provide a maximum FER of 8×10^{-2} at an MPDU length of 1024 bytes for a maximum input level of –10 dBm measured at the antenna. This FER shall be specified for 2 Mbit/s DQPSK modulation. $Q_{mean}\ Q\ n\ (\ )1000 / {}_{n\ 0=1000} \sum =$ $I_{mag}\ I_{dc}\ n\ (\ )\ 1000 / {}_{n\ 0=1000} \sum =$ $Q_{mag}\ Q_{dc}\ n\ (\ )\ 1000 / {}_{n\ 0=1000} \sum =$ $V_{err}\ n\ (\ )\ 1\ 2\ \text{--}\ \text{-}\ I_{dc}\ n\ (\ )\ I_{mag} / \{\ \}\ (\ {}_2 \times Q_{dc}\ n\ (\ )\ Q_{mag} / \{\ \}\ {}_2\ ) +\ {}_{1\ 2}\ \text{--}\ \text{-} V_{correction} - =$

18.4.8.3 Receiver adjacent channel rejection Adjacent channel rejection is defined between any two channels with >30 MHz separation in each channel group defined in 18.4.6.2. The adjacent channel rejection shall be equal to or better than 35 dB with an FER of 8×10^{-2} using 11 Mbit/ s CCK modulation described in 18.4.6.3 and an MPDU length of 1024 bytes. The adjacent channel rejection shall be measured using the following method: Input a 11 Mbit/s CCK modulated signal at a level 6 dB greater than specified in 18.4.8.1. In an adjacent channel (>30 MHz separation as defined by the channel numbering), input a signal modulated in a similar fashion that adheres to the transmit mask specified in 18.4.7.4 to a level 41 dB above the level specified in 18.4.8.1. The adjacent channel signal shall be derived from a separate signal source. It cannot be a frequency shifted version of the reference channel. Under these conditions, the FER shall be no worse than 8×10^{-2}.

18.4.8.4 CCA The HR/DSSS PHY shall provide the capability to perform CCA according to at least one of the following three methods: a) *CCA Mode 1:* Energy above threshold. CCA shall report a busy medium upon detecting any energy above the ED threshold. b) *CCA Mode 2:* Carrier sense only. CCA shall report a busy medium only upon the detection of a HR/ DSSS signal. This signal may be above or below the ED threshold. c) *CCA Mode 3:* Carrier sense with energy above threshold. CCA shall report a busy medium upon the detection of a HR/DSSS signal with energy above the ED threshold. The energy detection status shall be given by the PMD primitive, PMD_ED. The carrier sense status shall be given by PMD_CS. The status of PMD_ED and PMD_CS is used in the PLCP convergence procedure to indicate activity to the MAC through the PHY interface primitive PHY-CCA.indicate. A busy channel shall be indicated by PHY-CCA.indicate of class BUSY. Clear channel shall be indicated by PHY-CCA.indicate of class IDLE. The PHY MIB attribute dot11CCAModeSupported shall indicate the appropriate operation modes. The PHY shall be configured through the PHY MIB attribute dot11CurrentCCAMode. The CCA shall be TRUE if there is no energy detect or carrier sense. The CCA parameters are subject to the following criteria: a) If a valid HR/DSSS signal is detected during its preamble within the CCA assessment window, the energy detection threshold shall be less than or equal to –76 dBm for TX power > 100 mW, –70 dBm for 50 mW < TX power ó 100 mW, and –64 dBm for TX power < 50 mW. b) With a valid signal (according to the CCA mode of operation) present at the receiver antenna within 5 µs of the start of a MAC slot boundary, the CCA indicator shall report channel busy before the end of the slot time. This implies that the CCA signal is available as an exposed test point. Refer to Fig-ure 47 for a definition of slot time boundary definition. c) In the event that a correct PLCP Header is received, the HR/DSSS PHY shall hold the CCA signal inactive (channel busy) for the full duration as indicated by the PLCP LENGTH field. Should a loss of carrier sense occur in the middle of reception, the CCA shall indicate a busy medium for the intended duration of the transmitted packet.

IEEE Wireless LAN PHYSICAL (PHY) LAYER SPECIFICATIONS P802.11B/D1.0 Conformance to HR/DSSS PHY CCA shall be demonstrated by applying a HR/DSSS compliant signal, above the appropriate ED threshold (a), such that all conditions described in b) and c) above are demon-strated.