IEEE P802.11

Wireless Access Method and Physical Layer Specification

Section 5.5 thru 5.6 Response to Draft D1 Letter Ballot Processed at March 1995 Meeting

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Abstract: This paper presents the Section 5.5 thru 5.6 Response to Draft D1 Letter Ballot processed at March 1995 meeting.

Action: Adopt the changes in this paper to replace the relevent portions of Section 5 of P802.11/D1, as shown in the companion document P802.11-95/61.

SEC	AUTHOR	T	REQUIRED CHANGE	RATIONALE	RESPONSE
1 - 5.5	CHRIS ZEGELIN	T	SIMPLE STATEMENT THAT ONCE THE POLL HAS BEEN TRANSMITTED THAT PSP STATIONS RECEIVE THE MSDU JUST LIKE A CAM STATION	HOW FRAGMENTATION WORKS FOR 'PSP' STATIONS IS NOT ADEQUATELY SPECIFIED.	REJECT - PSP has not been introduced at this point. Section 7.2.1.7 explains how PSP stations handle fragmentation and reassembly.
5.5	Bob O'Hara	E	replace "needs" with "is" in the third paragraph		✓
5.5	Bob O'Hara	E	add "for an MSDU of 1500 octets" to the end of paragraph five		✓
5.5	Bob O'Hara	E	change all "bytes" to "octets" in figure 5-24		
5.5	Bob O'Hara	E	replace "must" with "shall" in paragraph seven	Proper standard language	✓
5.5	Bob O'Hara	E	change all "bytes" to "octets" in figure 5-25		✓
5.5	Bob O'Hara	E	update to reflect new sequence control semantics.		✓
5.5	C. Heide	e	last paragraph last sentence, replace "than" with "then"		✓
5.5	Geiger	E	Whenever possible, the size of the payload of a fragment shall be some fixed number of bytes	Good, I would hate to see it be some variable number of sheep. What does this mean?	✓
5.5	Renfro	E	In 4th Paragraph change '... following two ...' to '... following three ...'. Add c) aFrag_Payload. Update references to MSDU ID and fragment ID to reflect Sequence Control Field		✓
5.5	Rick White	E	¶ 10: Change MSDU ID to Sequence Number.	MSDU ID no longer used.	✓
5.5	Tim Phipps	E	When data needs to be transmitted, the number of octets in the payload of the fragment shall be determined based on the time at which the fragment is to be transmitted for the first time. Once a fragment is transmitted for the first time, its contents shall be fixed until **the MSDU** is successfully delivered to **the DS or destination station.**	The specification said that the fragment size must be kept constant until the MPDU reaches the destination. Fragmentation is applied within a BSS, different BSSs will chose different fragment sizes. Therefore, when more than one 'radio 'hop' is used, fragment size cannot be fixed until the ultimate "destination" is reached.	✓
5.5	Tom T.	E	Change 'MSDU ID' to: 'Dialog Token' in third last paragraph.		✓
2 - 5.5	A. Bolea	T		References to MPDU ID need to be replaced with Sequence Control. Last Fragment bit is now in Frame Control Field and not in Fragment Number.	ACCEPT
3 - 5.5	bdobyns	T	An implementation whose PHY MIB parameter aMPDU_Minimum is greater than 2304 plus MAC Header may choose to not implement fragmentation on either transmit or receive.		DEFERR

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4 - 5.5	Bob O'Hara	T	insert "assembled" between "is" and "to be" in the fourth paragraph	further clarification of when fragmentation takes place.	ACCEPT
5 - 5.5	Bob O'Hara	T	in paragraph seven change the second sentence to be "In this case, the station shall wait until after the dwell boundary to create..."	Better clarity	ACCEPT (with spelling correction)
6 - 5.5	Bob O'Hara	T	delete paragraph eleven	Unnecessary complexity to squeeze, on average, half a frame into each hop period.	DEFERR
7 - 5.5	Bob O'Hara	T	Define all attributes in the MIB in section 7	These attributes are not defined.	ACCEPT - **modification required to section 7.**
8 - 5.5	C. Heide	t	remove references to MSDU ID.	MSDU ID undefined	ACCEPT = 2 - 5.5
9 - 5.5	C. Heide	t	define aTransmit_MSDU_Timer attribute	section 4 frame descriptions do not define this.	ACCEPT = 7 - 5.5
10 - 5.5	C. Thomas Baumgartner	t	Authors of this section need to get with authors of frame format section and decide where the MSDU ID will be.	No MSDU ID in section 4 frame format description	ACCEPT = 2 - 5.5
11 - 5.5	David Bagby	T	**1. Fragmentation** ***POINT #1 combine this section with sec 5.1.5 so frag info all in one place[DB1] ***POINT #2 After due consideration, and recognizing that stations are explicitly not required to attempt to fit fragments to remaining dewell times fir FH PHYs, and considering that the increase in band width utilization involved is very slight, I conclude that the complexity of attempting to match fragment size to remaining dwell time does not justify the effort involved. Even as an option, I don't believe we should retain this feature as the draft is already the most complex MAC ever defined. This is an area were we should increase the odds of interoperability and simplicity over functionality. Therefore, I vote against sponsor ballot until this feature is removed. If this modification is adopted, I shall volunteer to edit sections 1.1.4 and 5.5 to make the needed wording changes. I have not provided exact text here as word does not allow recursive annotations and that change would obscure other comments I have made in the same sections.[DB2]	See embedded comments and annotations	POINT #1 REJECT - 5.1.4 has mostly moved to section 7, what remains is a brief overview of the concept, which is consistent with the format of the document. POINT #2 DEFFER = 6 - 5.5 POINT #3 and #4 ACCEPT POINT #5 ACCEPT with replace "accounts" with "allows"

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			***POINT #3 The MAC *may*~~will~~ fragment and reassemble MSDUs. The fragmentation and reassembly mechanisms allows for fragments to be retransmitted.		
5.5	David Bagby continuation	T	one the consequences of providing fragmentation at the MAC layer is that a station must contain have MSDU buffering to cover ((max MSDU size + MAC overhead) * number of ad-hoc stas one wishes to communicate with simultaneously). This is true for both infrastructure and IBSS operation. To provide a minimal level of interoperability, a minimal number for simulations station support must be specified. this is on the order of 2k+ per simultaneous station and may not be an insignificant implementation cost. Once the number of different MSDUs being received exceeds the available buffering, there will be a failure condition. It is my assumption that the way this failure will manifest itself is that new MSDUs will not be received and therefore not acked, eventually resulting in retransmission (hopefully when the number of simultaneous MSDUs being received at the destination is		

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			less). To guarantee some level of avoidance of this problem, we must specify a minimally supported number of simultaneous MSDU receptions. to do this the following sentence should be added. I have chosen 6 MSDUs as it adds up to a bit less than a common memory increment. POINT #4 *All Stations shall support the* simultaneous *reception of a minimum of 6 MSDUs.* POINT #5 *The fragmentation mechanism design accounts for the characteristics of FH PHYs.* For the purposes of this description a 'dwell time' will refer to the duration of time spent on a single frequency in a FH system. Therefore in a FH PHY, the PHY will hop to the next frequency in the hop sequence at the end of the current dwell time. For other systems a 'dwell time' will refer to the period of time spanning from the start of transmission of a TIM until just before the start of transmission of the next TIM.		
5.5	David Bagby continuation	T	POINT #6	POINT #6 REJECT - definitions of afragment_Payload and afragment_threshold were modified in a	

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			Whenever possible, the size of the payload of a fragment shall be some fixed number of octets. This is denoted by aFragment_*Threshold*~~Payload~~. aFragment_Payload equals ~~aFragmentation_Threshold minus MAC Header minus CRC~~. The payload of a fragment *can*~~shall~~ never be larger than *(aFragmentation_Threshold - MAC Header Length - CRC Length)*~~aFragment_Payload~~. However, the size of the payload may be less than *this*~~aFragment_Payload~~. When data needs to be transmitted, the number of octets in the payload of the fragment shall be determined based on the time at which the fragment is to be transmitted for the first time. Once a fragment is transmitted for the first time, its contents shall be fixed until it is successfully delivered to the destination station. The number of data octets in the payload of a fragment shall depend on the values of the following two variables at the instant the fragment is to be transmitted for the first time: a) The time remaining in the current dwell time. b) The number of octets in the MSDU that have not yet been transmitted for the first time.	previous section and the editors will reflect that change here. POINT #7 ACCEPT	Since the control of the channel will be lost at a dwell time boundary and the station will have to contend for the channel after the dwell boundary, it is required that the acknowledgment of a fragment be transmitted before the stations cross the dwell time boundary. Hence, if there is not enough time remaining in the dwell time to transmit a fragment with an aFragment_Payload payload, the number of octets in the payload may be reduced to the maximum number of octets that will allow the fragment plus the MAC acknowledgment to fit within the time remaining in the dwell time. This is shown in Figure 5-24. POINT #6 REJECT - definitions of afragment_Payload and afragment_threshold were modified in a previous section and the editors will reflect that change here. POINT #7 ACCEPT

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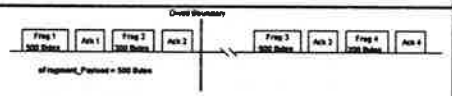
			Since the control of the channel will be lost at a dwell time boundary and the station will have to contend for the channel after the dwell boundary, it is required that the acknowledgment of a fragment be transmitted before the stations cross the dwell time boundary. Hence, if there is not enough time remaining in the dwell time to transmit a fragment with an aFragment_Payload payload, the number of octets in the payload may be reduced to the maximum number of octets that will allow the fragment plus the MAC acknowledgment to fit within the time remaining in the dwell time. This is shown in Figure 5-24.		
5.5	David Bagby continuation	T	 **Figure 5-24: Fragmentation Near a Dwell Boundary** Referring to Figure 5-24, a example 1500 octet MSDU is fragmented into four fragments with aFragment_Payload set at 500 octets. There is enough time left in the dwell to send two fragments, one of 500 octets and a second of 300 octets. After the dwell boundary, the rest of the MSDU is sent, one 500 octet		

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			fragment and one 200 octet fragment. POINT #7 A station may elect not to adjust the size of the *fragment*~~payload~~ when approaching a dwell boundary. In this case, the station shall wait until the next dwell time to create and transmit a fragment. ~~with a aFragment_Payload octet payload (provided there are at least aFragment_Payload more octets remaining in the MSDU).~~ A station must be capable of receiving fragments of ~~varying~~ size*s varying between aMin_Full_MPDU and aMax_Full_MPDU* for a single MSDU. POINT #8 - E If a fragment requires retransmission, its contents and length shall remain fixed for the lifetime of the MSDU~~at that station~~. ~~In other words,~~ *A*~~a~~fter a fragment is transmitted once, *the* contents *and*~~or~~ length of that fragment *shall*~~are~~ not ~~allowed to~~ *change*~~fluctuate~~ to accommodate ~~the~~ dwell time boundaries. *For example;* Let the fragmentation set refer to the contents and length of each of the fragments that make up the MSDU. The fragmentation set is		

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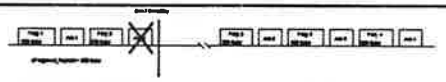
			created at a station as soon as the fragments are attempted for the first time. The fragmentation set remains fixed for the lifetime of the packet at the transmitting station. This is shown in Figure 5-25.		
5.5	David Bagby continuation	T	 **Figure 5-25: Fragmented MSDU with missed ACK Near a Dwell Boundary** In the example shown in Figure 5-25, the same 1500 octet MSDU is fragmented at the same point in the dwell time as in Figure 5-24 but the ACK for the second fragment is missed. After the dwell boundary, the fragment is retransmitted and the fragment size remains 300 octets. Each fragment will contain a MSDU ID and fragment ID. When a station is transmitting a MSDU, the MSDU ID will remain the same for a given MSDU and the fragments will be in order of lowest ID to highest ID. The fragment ID also contains a bit that indicates the last fragment of the MSDU. If, when retransmitting a fragment, there is not enough time remaining in the dwell time		

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			to allow transmission of the fragment plus the acknowledgment, the station shall wait until the start of the next dwell time before retransmitting that fragment. The source station will maintain a aTransmit_MSDU_Timer attribute for each MSDU being transmitted. There is also an attribute, aMax_Transmit_MSDU_Lifetime, that specifies the maximum amount of time allowed to transmit a MSDU. The aTransmit_MSDU_Timer starts on the attempt to transmit the first fragment of the MSDU. If aTransmit_MSDU_Timer exceeds aMax_Transmit_MSDU_Lifetime than all remaining fragments are discarded by the source station and no attempt is made to complete transmission of the MSDU.		
12 - 5.5	John Hayes	T	TBD	This section does not address how to fragment broadcast and multicast frames.	ACCEPT - add text to the end of the first sentance mentioning multicast/broadcast.
13 - 5.5	Mahany	T	First Paragraph: Correct Definition of Dwell Time to be Applicable to All PHY's per 5.3.1	Statement that interval between TIM's of FH time on frequency defines dwell time is incorrect if PCF is used.	ACCEPT = 17 - 5.5 Also, comment indicates that the text is not clear that the primary reason for fragmentation is a PHY with aFragment_Payload smaller than the MSDU. To help this add new sentance to first paragraph explaining this.

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14 - 5.5	Paul Pirillo	T	Timing diagrams and/or text should be modified to show that aMax_Transmit_MSDU_Lifetime is actually the "dwell time." Define the relationship between aMax_Transmit_MSDU_Lifetime and the SF Period defined in section 5.3. Or if there is no relationship state so.	I am unclear as to what parameters define "dwell time." May want to consider modifications to section 5.2.6.5 as well, to improve clarity. I also am unclear as to how the PCF environment affects fragmented MSDUs.	REJECT - definitions of the LIFETIME variables are being enhanced in other sections. They will clarify this for the author of this comment.
15 - 5.5	Paul Pirillo	T	Timing diagrams and/or text should be modified to show that aMax_Transmit_MSDU_Lifetime is actually the "dwell time." Define the relationship between aMax_Transmit_MSDU_Lifetime and the SF Period defined in section 5.3. Or if there is no relationship state so.	I am unclear as to what parameters define "dwell time." May want to consider modifications to section 5.2.6.5 as well, to improve clarity. I also am unclear as to how the PCF environment affects fragmented MSDUs.	REJECT = 14 - 5.5
16 - 5.5	Renfro	T		Fragmentation should only apply to either directed messages or broadcast/multicast messages with To DS bit set. For non-ACKed messages, better probability of success will be achieved if the message is not fragmented. The cost of not fragmenting will be that for long broadcast messages a station will not be able to send a portion of the message before a hop and the remainder afterwards.	REJECT - if aFragment_Payload for a PHY is less than 2304 plus MAC overhead, fragmentation MUST be performed on an MSDU regardless of whether it is are directed or multicast/broadcast.
17 & 18 - 5.5	Wim Diepstraten	T E T	Delete the last sentence of the first paragraph. The second paragraph below figure 5-25 needs to be made consistent with section 4.1.2.4. It should be specified somewhere that every fragment except the last fragment of a MSDU should have an even Byte length.	Systems other then Frequency Hopping do not have a "dwell time" limitation. The PCF and the Beacon generation is specified such that a normal defer occurs when the medium is busy at that instant of time. This will eliminate fragment concatenation alignment problems in an implementation.	ACCEPT 17 - 5.5 editorial ✓ ACCEPT 18 = 19 - 5.5
5.5 (global)	Fischer, Mike.	E	change ÒMSDU IDÓ to Òdialog tokenÓ	consistency with chapter 4	✓
19 - 5.5, 2nd paragraph	Fischer, Mike.	T	Replace first sentence with ÒThe payload of a fragment shall always consist of an even number of octets except, if necessary, for the last fragment of an MSDU.Ó Also, the middle sentence should state Ò. . . minus MAC header, minus IV and ICV if WEP=1, minus CRC.Ó	simpler implementation, also this provision was approved in a motion at the November, 1994 Plenary Meeting, but the relevant text updates overlooked this paragraph	ACCEPT

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20 - 5.5, paragraph 4 through paragraph 9	Fischer, Mike.	TMAJOR ISSUE	I recommend that this whole discussion of fragment size variation for dwell boundary optimization be eliminated, and replaced with something to the effect that ÒFragmentation shall only be applied when the MPDU required to hold the entire MPDU exceeds aFragment_Threshold. When fragmentation is applied, each fragment shall have a payload length of aFragment_Payload octets, except the final fragment, which may have a shorter payload.Ó	The fundamental reason that fragmentation was added to the MAC was because certain PHYs were unable to deliver maximum length MSDUs in a single PhPDU. This can be overcome using fixed size fragments. The concept of dwell optimization is unnecessarily complex, only beneficial to the FHSS PHY, if at all, and complicates buffer management at the receiving station. The complexity penalizes all MAC implementations whether or not they can attach an FHSS PHY. The benefits are dubious, because if the fragmentation decision must be made based on the amount of time expected to be left after the Ack to the previous fragment, in order to build a MAC header and TXVECTOR for the correct length fragment, but if deferral is needed due to a CCA event, or retransmission of the previous fragment proves necessary, the time calculation is invalid. Finally, with a maximum MPDU size of 400 octets, the FHSS PHY whether operating at 1Mbps or 2Mbps, stands to gain, best case, less than 80Kbps of aggregate raw data transfer, assuming perfect dwell optimization, no extra deferrals, no failures to acknowledge, perfect hop synchronization, etc.	DEFER = 6 - 5.5
21 - 5.5.	M. Rothenberg	T	The Fragmentation Mechanism must be changed to a Window-based, Selective Retransmission Algorithm	1. The current Fragmentation Algorithm is inefficient, adds an overhead of SIFS + ACK time (about 265 microsec in FHSS) for each fragment. 2. The current Fragmentation algorithm is broken: Different aMaxTransmit_MSDU_Lifetime and aMax_Receive_MSDU_Lifetime may cause one side (e.g the receiver) to drop the MSDU but continue acknowledging the following Fragments, hence the frame will be discarded without the transmitter noticing that.	REJECT - the efficiency/simplification tradeoff was considered in selection of this algorithm. The fragmentation algorithm is not broken is the lifetimes are different - delay may be incurred but no lock up will occur.
5.6	Bob O'Hara	E	update to reflect new sequence control semantics.		✓
5.6	Fischer, Mike.	E	change ÓMSDU IDÓ to Ódialog tokenÓ fragment numbers should be 0Ðorigin (0,1,2,3, ...) ÒOnly the last fragment or only fragment of an MSDU shall have this bit set to one.Ó	consistency with chapter 4	✓
5.6	Jim Panian	E	Specify that the duplicate fragment is acknowledged even if the fragment is discarded.	The text does not describe if an ACK is returned for a duplicate fragment.	✓
5.6	Renfro	E	Update MSDU ID to reflect Sequence Control Field. To last sentence add '...but still ACK frame.'		✓

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5.6	Rick White	E	¶ 1: Change MSDU ID to Sequence Number.	MSDU ID no longer used.	✓
5.6	Rick White	E	¶ 4: Change MSDU ID to Sequence Number.	MSDU ID no longer used.	✓
5.6	Tom T.	E	Change 'MSDU ID' to: 'Dialog Token' throughout this section.		✓
5.6	Wim Diepstraten	E	Section should be updated in its use of the MSDU-ID.		✓
22 - 5.6	John Hayes	E/ T	TBD	The current wording describes reassembly as a function of the receiving station. Because it is possible that different APs along the way will have different values for aFragmentation_Threshold that a single fragment will not be able to pass through without additional fragmentation. The current fragmentation scheme does not allow for recursive fragmentation. Therefore, this requires that reassemble be accomplished at each intermediate AP.	REJECT - reassembly is a function of the receiving station for exactly the reasons described here. The receiving station must completely rebuild the MSDU prior to re-fragmenting for forwarding into another medium if required.
23 - 5.6	bdobyns	T	An implementation whose PHY MIB parameter aMPDU_Minimum is greater than 2304 plus MAC Header may choose to not implement fragmentation on either transmit or receive.		DEFER = 3 - 5.5
24 - 5.6	Bob O'Hara	T	Define all attributes in the MIB in section 7	These attributes are not defined.	ACCEPT = 7 - 5.5
25 - 5.6	C. Heide	t	remove references to MSDU ID	MSDU ID undefined	ACCEPT = 2 - 5.5
26 - 5.6	C. Thomas Baumgartner	t	Authors of this section need to get with authors of frame format section and decide where the MSDU ID will be.	No MSDU ID in section 4 frame format description	ACCEPT = 2 - 5.5
27 - 5.6	Geiger	T	Reassembly The description of the contents of a Data Frame header in section 4 are not consistent with the MSDU ID, Fragment number and Last Fragment indicator.	Make both these section agree which ever is the last agreement.	ACCEPT = 2 - 5.5
28 - 5.6	Tim Phipps	T	Dialog Token: This field allows the destination station to check that all incoming fragments belong to the same MSDU. Fragment Number: Fragments of an MSDU are numbered sequentially, starting at zero.	MSDU ID no longer exists, dialog token is the correct term. All other fields in the specification start at zero, a normal convention in the field of modern computing. It is perverse to have only one field starting from 1. Either it is more sensible to start all fields from 1, or it is more sensible to start all fields from zero. I believe that zero is more usual.	ACCEPT = 2 5.5