Title: **3 Mbit/sec FH PHY format definition**

Date: January 1996

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Introduction

The 802.11 D2.0 standard defines 1 Mbit/sec and 2 Mbit/s. The standard doed not define higher rates. The purpose of this submission is to describe a direct logical extension of the 1 and 2 Mbit/sec ideas to 3 Mbit/sec. The 3 Mbit/sec format, as described, is implemented in BreezeCom equipment and operates successfully in the field.

We move to accept the optional 3 Mbit/sec format, as described, into the standard. We move also to reallocate an additional bit in the PLCP header (there is one now) to pass the required rate information (1,2 or 3 Mbit/sec). The required text changes will be provided by the author upon request.

3 Mb/s modulation and frame construction

The 3 Mb/s modulation is an 8 level GFSK. The GFSK is with BT=0.5, just as the 2GFSK and 4GFSK for 1 and 2 Mb/s, respectively. The modulation index is, nominallly $h_8=0.5h_4=0.225h_2$. For 340 KHz spacing between the frequencies in 2-GFSK it amounts to 150 KHz between frequencies with 4-GFSK and 75 KHz with 8-GFSK.

The HS FHSS PHY frame consists of PLCP preamble, PLCP header and PLCP_PDU. The PLCP preamble and PLCP header format are identical to 1 Mbit PHY, as described in 10.3.2. The PLCP_PDU is transmitted in 2GFSK, 4GFSK or 8FSK format, according to the rate chosen. The rate is indicated in a 2 bit field in a PLCP header, having value of 1,2 or 3 bits/symbol (or Mbit/sec).

The incoming bit stream at 1/2/3 Mb/sec will be converted, after being scrambled in the standard manner, into rate (1,2 or 3) bit words or symbols, with a rate of Fclk=1M symbol/sec. The first received bit will be encoded as the left most bit of the symbol in the table 1. The bits will be encoded into symbols as shown in Table 1.

The input bit group encoding into symbols follows Gray encoding rule. Such encoding results in a single bit error when an error between adjacent levels occurs. In spite of tendency to discard a whole packet in case of errors, irrespectively of amount of them, this common practice is adopted for both 2 and 3 Mbit/sec rates.

The PLCP_PDU is transmitted as 2,4 or 8 level symbols, with the amount determined by number_of_symbols = (number_of_MPDU_bytes*8+(rate-1))/rate . In contrary to the 1 and 2 Mbit/sec case, the last symbol can contain less than 3 information bits (e.g. 1 octet packet has two 3 bit symbols and one with just 2 information bits); in such case the last symbol will be constructed by appending 1 or 2 slack "0" bits to the message.

1 Mbit/sec, 2-GFSK

Symbol	Carrier Deviation
1	1/2 * h2*Fclk
0	-1/2 * h2*Fclk

2 Mbit/sec, 4-GFSK

Symbol	Carrier Deviation
10	3/2 * h4*Fclk
11	1/2 * h4*Fclk
01	-1/2 * h4*Fclk
00	-3/2 * h4*Fclk

3 Mbit/sec, 8-GFSK

Symbol	Carrier Deviation
100	7/2 * h8*Fclk
101	5/2 * h8*Fclk
111	3/2 * h8*Fclk
110	1/2 * h8*Fclk
010	-1/2 * h8*Fclk
011	-3/2 * h8*Fclk
001	-5/2 * h8*Fclk
000	-7/2 * h8*Fclk

Table 1. Symbol Encoding into Carrier Deviation

A bias suppression algorithm is applied to the resulting symbol stream. The bias suppression algorithm same as defined in 802.11 D2. A polarity control symbol is inserted prior to each block of 32 symbols (or less for the last block). The polarity control signals for 4GFSK are 4GFSK symbols 10 or 00; for 8GFSK - symbols 100 or 000. The algorithm is equivalent to the case of

2GFSK, with the polarity symbol 2GFSK '1' replaced with symbol '10' or '100', and the 2GFSK polarity symbol '0' replaced with a symbol '00' or '100'. The weights used for the symbols in the whitening algorithm are summarized in the table 2. The weights in the table differ from those appearing in 802.11 D2 for 1 and 2 Mbit/sec, but it does not alter the operation of the whitener since it only scales all the weights fy a factor of 2, and the algorithm is not sensitive to it. The table lists also the mappings to frequency offsets corresponding to all the rates for the illustrative example of h_2=0.34.

1 Mb/s	2-GFSK	2 Mb/s	4-GFSK	3 Mb/s	8-GFSK	
bits	nominal deviation	bits	nominal deviation	bits	nominal deviation	whitening weight
				100	262.5 KHz	7
		10	225 KHz			6
				101	187.5 KHz	5
1	170 KHz					4
				111	112.5 KHz	3
		11	75 KHz			2
				110	37.5 KHz	1
	center		center		center	0
				010	-37.5 KHz	-1
		01	-75 KHz			-2
				011	-112.5 KHz	-3
0	-170 KHz					-4
				001	-187.5 KHz	-5
		00	-225 KHz			-6
				000	-262.5 KHz	-7

Table 2. Symbol Mapping , illustrative frequency offsets for h_2=0.34 and whitening weiths

Receiver Sensitivity

The theoretical difference in sensitivity between the 4GFSK and 8GFSK is 6 dB. On ther other side, 8GFSK is more sensitive to implementation inaccuracies. In BreezeCom equipement, the typical sensitivity at 3 Mbit/sec mode is -69 dBm.