IEEE 802.11
Wireless Access Methods and Physical Layer Specifications

Draft Proposal for a Frequency Hopping Spread Spectrum PHY Standard

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Introduction

This contribution is intended to provide a framework for the definition of the IEEE802.11 FHSS PHY standard. It also outlines some of the criteria used for defining this PHY. First PHY will be defined at 2.4 GHz, other frequencies will follow. Some parameters in the specifications require inputs from the MAC group and an agreed channel model. Committee members are invited to provide inputs to the completion of this document. The specification was put in a table format for as long as it is a "live" document . Once finalized, the spec. will be converted to the std. IEEE 802 format.

Requirements outline:

- Compliance with Regulatory Agencies for unlicensed operation
- Compliance with 802.11 PAR (Data Rate at least 1 Mbps, etc.)
- Operation in a multinetwork environment (multiple collocated networks)
- Minimum Area coverage
- Suitable for low power consumption implementations
- Cost effective
- Ensure Interoperability between conformant FHSS stations.
- Modes of operation:
  - peer to peer with no prior knowledge
  - node to AP and AP to node
- Support asynchronous and time deterministic connectivity.
- Support a specified number of stations per cell (Access Point)
- Suitable for small size implementation
- Robust operation in narrow band and partial band interference as well as multipath fading.
- Graceful degradation under load and interference.

Specifications

The following table represents a template for Frequency Hopping PHY specification. Several blanks were left for those items that will be determined after the channel model is agreed and after PHY MAC interface is determined; Other parameters have to be worked out between PHY and MAC groups.

	Parameter	Proposed Spec.	Comments/Notes
1.	Frequency Range	2.4 to 2.4835 GHz	Other frequency bands will follow.
2.	Minimum number of hopping channels / set	75	per FCC part 15.247
3.	No of hops per sec.	2.5 to 10(?)	propose 4
4.	Transmitted power levels [mW]	a. 1000 / 100 b. 250,100, 50 mW (optional) levels	a. default US/default Europe b. optional levels
5.	Optional Transmitted power control	Four discrete levels as above or continuous	
6.	Max. Radiated EIRP	a. 6 dBW in US ? dBW in Europe	Total radiated power including antenna gain As defined by regulatory agencies in each country.
7.	Transmitted power variation (tolerance)	+0 /-3 dB max. (total)	&
8.	Frequency deviation	ΔFmax= 300KHz(?)	&
9.	Spurious Output: transmit and receive **In band** (2.4 -2.4835 GHz) at more than 2 MHz from F_C **Out of Band**	85 dBc 65 dBC	
10	Minimum Receiver Sensitivity	-80 to -90 dBm [TBD]	& Final number TBD after channel and link model agreed
11	Max. Input signal level at antenna connector with no performance degradation	0 dBm	&
12	Adjacent Channel selectivity	-25 dB at channel boundary -65 dB @Δf=2 MHz	
13	Channel bandwidth (allocated)	1 MHz	

14	Occupied channel bandwidth (spectrum shape)	30 dBc @ Δf=.5 MHz 86 dBc @ Δf=2 MHz	
15	Receiver center frequency acceptance range	+/- TBD [Hz]	For interoperability purposes
16	Modulation	4 level CPFSK	
17	Channel Data Rate	1.25 Mbps	Higher data rates not recommended because of delay spread and bandwidth constraints
18	Fallback data rate	a. 250 Kbps b. TBD (optional)	
19.	Phy supplied Clock Jitter	0.0625 microsec.	
20	Adjacent channel rejection margin: Maximum power of a signal with random data at F_c+/- 2 MHz for 10E-5 BER in a signal at Fc with -85 dBm input power level	-20 dB	
21	Preamble length	a. 32 bit times b. Variable PHY preamble length	& TBD
22	Clock recovery	withstands patterns up to (7)continuous 1's or (7) 0's with no degradation in output signal to noise ratio and bit error rate	
23	Carrier (energy)detect response time	TBD	&
24	Spurious emissions in band (@ Δf≥1 MHz from Fc)	-80 dBC @ ?W TX power	
25	Spurious emissions out of band	a. -20 dBW in US b. - 60 dBW/100 KHz @ 1 to 10 GHz c. -66 dBW/100 KHz @ 30 MHz to 1 GHz	country dependent

26	Switching time TX to RX	TBD	Time from full power transmission to full sensitivity receiver availability. This parameter should include any preamble time used for receiver synchronization.
27	Switching time RX to TX	TBD	time from full sensitivity reception to full power transmitter availability
28	Channel switching time (hop settling time)	typically 100 to 200 μS	Elapsed time from receipt of hop command until unit frequency settles within +/- ΔF= Receiver Acceptance range or TX frequency tolerance (whichever is tighter)
29			deleted
30	BER at specified Eb/No	10 exp. -6 @ Eb/No=17 dB	Includes modem implementation margin
31	Channel availability	99.5 %	Could also be specified as probability of outage. With no interference.
32	TX Frequency Stability	15 ppm	
33	Data Line / Clock input / output Jitter	TBD	& Includes static and dynamic Jitter (see 802.3 definition) dependent on MAC requirements.
34			deleted
35			deleted
36	Antenna port impedance	50 ohms	

37	VSWR	Devices shall stand 0≤VSWR≤∞ with no damage. -Operational VSWR =TBD	
38			deleted
39			deleted
40	Interface lines to Convergence layer (when exposed)	***RX Data*** ***TX Data*** ***RX/TX clock*** ***Data valid*** ***Control line*** ***Status line*** ***Ctl./Sta clock***	& Timing and levels TBD.
41	PHY-MAC Net Management info./control variables	a. Signal Quality b. Loop back c. No. of channels available d. Channel in use (sequence) e. No. of diversity channels f. Which Diversity in use g. Alternate Diversity use h. Lock i. No. of RX signal strength levels j. RX signal strength levels k. RX Signal Strength l. PHY type m. Channel quality n. Channel available (for LBT) o. No. of TX power levels p. Read TX output level q. Set TX output level r. Hop [?] s. Transmit t. Receive u. Sleep mode v. Wake-up w. Standby mode (low power) x. Data rate -indication - command y. Jabber control function z. Jabber indication	&,* Most signals are bi-directional

42	Other PHY-MAC Net Management info./control variables	a. PHY initialize b. PHY specific tally collection c. Adaptive power control by learning reception statistics.	*
43	Safety Requirements	Compliance with applicable Safety Agencies requirements **[TBD]**	
44	DTE/DCE Interface	TBD	*
45	ACK protocol support	TBD	*

Notes:
& indicates dependency on the channel model.
* indicates inputs from MAC group.
Status of the receive signal/on a per frame basis
Status of the PHY control parameter /on a per frame basis
1. Coding not addressed yet.
2. Issue: how to deal with diversity? Should this be covered by the "channel"

- **MAC-PHY Paired exchanges**

PHY_data.request sequence=start_ of_ activity +consecutive **activity_ requests** specifying data **+end_of_ data**
PHY_data.request _completion=**PHY_data.confirmation**

- **PHYE reports**
  PHY_data.indication
  -start of activity
  -consecutive data activity indicators
  -single end of data