www.rfwireless-world.com

An overview of WLAN-11a Physical layer

Introduction to 802.11a

This section describes **802.11a physical layer** or **WLAN Physical layer** frame structure, symbol structure and Physical layer as defined in IEEE 802.11a-1999 standard. 802.11a operates at 2.4GHz RF frequency and supports data rate up to 54Mbps. There are other popular standards in the 802.11 family 802.11b, 802.11g and 802.11n. 802.11b operates at 2.4GHz and supports data rate up to 11 Mbps, where in DSSS and CCK modulation schemes are employed. 802.11g operates at 5GHz and supports both 11a and 11b standards.

Frame structure of 802.11a OFDM

Frame structure: 802.11a frame structure consists mainly PLCP Preamble, Signal (Header) part and Data Part. PLCP preamble field, composed of 10 repetitions of a "short training sequence " and two repetitions of a "long training sequence" preceded by a guard interval (GI). Header part consists of 24 bits which is always BPSK modulated. Header part contains Rate (modulation-code rate) and length (Unit of OFDM symbols) of the Data part. Refer page on 11a frame structure for the depictive view of parts of WLAN frame as per 11a standard.

In 802.11a one symbol consists of 64 point FFT. It consists of 48 data carriers, 4 pilot carriers, 1 DC and rest of the carriers are used as guard carriers. The 11a standard defines modulation-code rate table as mentioned below, based on data rate various physical layer configuration is made.

Data Rate Mbits/s	Modulation	Coding Rate R	Coded bits per subcarrier	Coded bits per OFDM symbol	Data bits per OFDM symbol
6	BPSK	1/2	1	48	24
9	BPSK	3/4	1	48	36
12	QPSK	1/2	2	96	48
18	QPSK	3/4	2	96	72
24	16-QAM	1/2	4	192	96
36	16-QAM	3/4	4	192	144
48	64-QAM	2/3	6	288	192
54	64-QAM	3/4	6	288	216

11a WLAN Rate Table

The Table-1 above mentions different data rates supported by WLAN 11a standard.

Parameter	Value
Nsd : number of data subcarriers	48
Nsp : number of pilot subcarriers	4
Nst :number of subcarriers total	52(Nsd + Nsp)
Tfft : FFT/IFFT period	3.2 microsec
Tsignal : duration of signal BPSK OFDM symbol	4 microsec(Tgi + Tfft)
Tgi : GI duration	0.8 microsec (Tfft/4)
Tgi2 : training symbol GI duration	1.6 microsec (Tfft/2)
Tsym : symbol interval	4 microsec (Tgi + Tfft)

11a WLAN Symbol Table

The table-2 above mentions parameters of 11a WLAN OFDM symbol.

The Transmitter encoding process of 802.11a physical layer is described in the block schematic below.

For Example, If 18 Mbps data rate is selected, modulation is set to QPSK, coding rate is set to 3/4, coded bits per carrier is set to 2, coded bits per OFDM symbol is set to 96. For this case Data bits per OFDM symbol will be 72.

WLAN 11a Preamble and Data Generation

1. Preamble Generation:

Preamble part consists of short training field(STF) and long training field(LTF). **2. Header Generation:**

-Generating the SIGNAL field bits

-Coding and interleaving the SIGNAL field bits

-Mapping the SIGNAL field into frequency domain

-Pilot and Guard insertion

-Transforming into time domain

3. Data Generation:

The message to be transmitted if it is not already in bits then the same is converted first to ASCII; then it is pre-pended with an appropriate MAC header and a CRC32 is added. Once this is done number of OFDM symbols need to be derived based on length and modulation-code rate. This is used for generating OFDM symbols for the DATA as mentioned below for each symbol.

-represent data which is in octects into bits

-Pre pending the SERVICE field and adding the pad bits, thus forming the DATA

-Scrambling and zeroing the tail bits

-Encoding the DATA with a convolution encoder and puncturing

-Mapping into complex 16-QAM symbols

-Pilot and Guard insertion

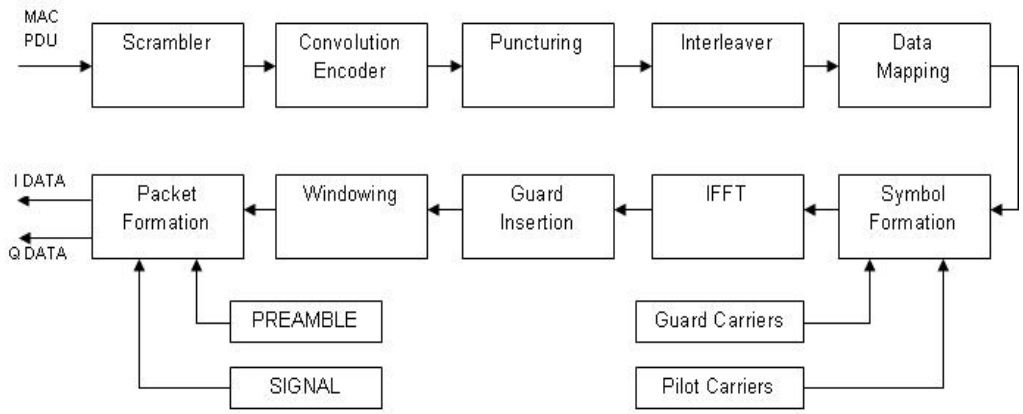
-Transforming from frequency to time and adding a cyclic prefix

WLAN packet formation as per 802.11a standard

4. Packet Formation:

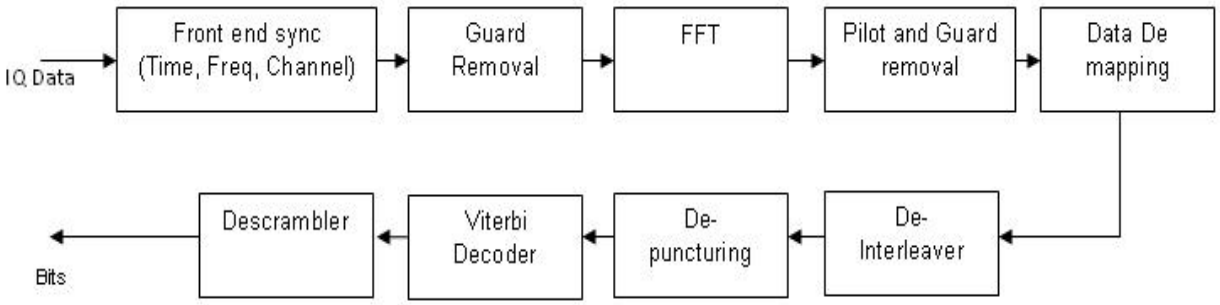
Combine these symbols in the order which includes preamble, Header and data symbols, hence the packet is formed to be transmitted.

The entire process for a message of 100 octets and data rate of 36 Mbit/s is described in the Standard IEEE 892.11a-1999 Annex G.



TRANSMITTER BLOCK SCHEMATIC www.rfwireless-world.com

The receiver consists of all the blocks reverse of the transmitter except it will have front end synchronization modules for time offset, frequency offset and channel impairment correction. This is shown in the figure below. This is achieved using preamble pattern. After this is done header is decoded as the modulation-code rate is known i.e. BPSK 1/2. Based on header information viz. rate and length data is decoded and passed on to the MAC layer for further processing.



RECEIVER BLOCK SCHEMATIC www.rfwireless-world.com