SOFTWARE PHYSICAL LAYER MODEL OF 802.11B WIRELESS NETWORK

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Abstract

The Research paper deals with modeling of the communication channel in the 802.11b standard wireless network with computer software. A software model of signal processing is designed to validate probability of the proposal of localization system. Model Functionality of the signal generation and processing was validated by the Spectrum Analyzer. The Simulink and mat lab soft wares simulates experiments with models. The Simulink is used to create the signal processor model and a pure Mat lab software is useful for mathematical evaluations of data processor model and for determination of initial conditions.

I. INTRODUCTION

Wireless networks are used recently to locate consumer devices extensively in addition to communication among wireless devices (see [1], [2], [3]). In present days, large localizes wi-fi services uses for various consumer applications wherein excessive accuracy of localization isn't always required. Based on time differences of the signals arrival, validate the possibility of concept of localization is achieved using a designed computer model of signal and data processing. Simulations run within Simulink/Matlab Software. Simulink is usually employed for the signal processor model and Matlab software is sent applications for mathematical assessments and for determination of basic situations.

2. THE MODEL OF 802.11B STANDARD WIRELESS NETWORK PHYSICAL LAYER

The 802.11b physical layer is modelled for signal processing since this is most wi-fi standard using for data transmission. This model generates the signal of searched subscribers station and all message signals.in practical, the model uses three networks of 802.11b standard in one location. This case can happen e.g. at large number of client devices, when a network would not be sufficient for their requirements however This this situation should not be repeated, due to the fact at setting up of network the location must be divided to smaller sized covering localities which will employ channels on principles of similar cell network of GSM. This continues e.g. particular floors of buildings, possibly only area of a few workplaces. Consideration regarding other standard networks should not have substantial influence on received signal because these networks work with different principles like Basic data rate is 1 Mb/s in defined system. Increased bit rates are obtained only by another coding approach ultimately by multistate modulations e.g. QPSK modulation at the same bandwidth (see [4], [6]). Using of higher data rates at user side will not result in significant deterioration of transmitting situations and with this reason all of us only consider system with standard data rate at our evaluation. Configuration of communication channel is shown in Fig.1.

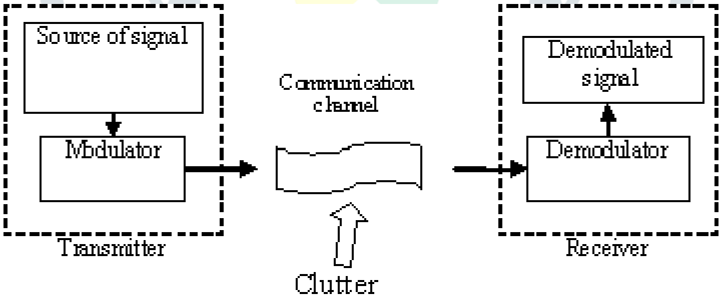

Fig. 1. ***The diagram of communication channel in the 802.11b standard wireless network physical layer***

The pseudo-random data and chip sequence in form Barker code with length 11 generates modulated signal and used for Direct sequence spread spectrum, in the model, see Fig.2.Information from Output of this block is assigned for BPSK modulator, see Fig.3.

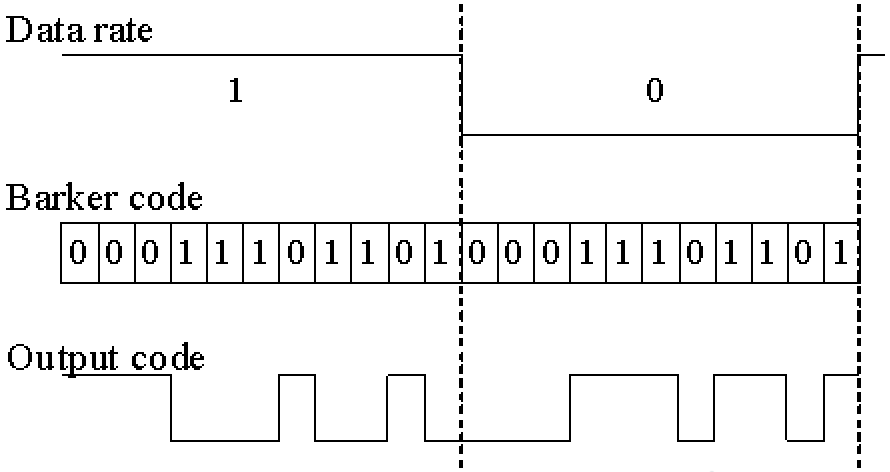

Fig. 2. Generation of 802.11b standard output code

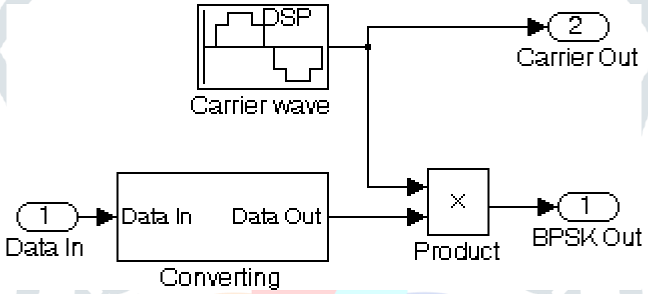

Fig. 3. BPSK modulator

First the data signal is usually become binary signal after which it is multiplied by carrier frequency in band 2.4 GHz. Phase change comes in at any time, because carrier frequency is not a multiple of bit frequency, which are displayed by data rate. The carrier frequency can correspond to any channel of thirteen available channels available for standard 802.11b.

Model considers with real allocation of frequency channels during network planning, so transmitter, which transmitting on adjacent channel, do not occur in same location. The busy bandwidth of the spread-spectrum channel is 22 MHz, therefore the 2.4GHz band accommodates only three non-overlapping channels spaced 25 MHz apart. These no overlapping signals are possible to filter very well. The signals of far more distant devices can be transmitting in band 2.4 GHz to nearer adjacent channels but due to a longer distance from our device they will have lower signal level. These signals are attenuated more and more in consequence of coming through walls and ceilings (see [5], [7]). The signal is mixed with carrier frequency of evaluating channel in receiver, see Fig.4. This specific signal passes through low pass filter with cut-off frequency 6 MHz which is slightly over data rate 11 Mb/s. The low pass Chebyshev filter of degree four gives the best results in our case (described system is aimed to localization purposes). Low-order filters are not sufficiently sharp; however high-order filters cause excessive delay and distortion of signal. Chebyshev filter of degree four is sharper then Butterworth filter and has only few ripples within the bandwidth.multiplied by Barker code, however it is corrupt by multipath propagation, side bands disturbance of other channels working in the same location and by channels of other devices in further zone. Input band pass filter is determined to noise restriction. Next signal is sampled by sample frequency fV, which we choose higher (e.g. twenty times) than Nyquist frequency in aspect of other operation. The high sample frequency simulate analog signal in real system. This sampled signal can be processing in high-level systems. We are additionally able to estimate original data sequence by correlation with Barker code.

3. RECEIVING SIGNAL ANALYSIS

The receiving device in our system receives not really a direct signal by each and every transmitter found in the station range, but also reflected signals from walls, ceilings and floors within the building. With regards to outdoor situation, the signals are generally reflected from buildings and terrain. We suppose that all these reflected signals change from the direct signal only in the amplitude and the delay, see Fig.5. All direct and reflected signals give the total signal sAm(t) at receiving device, which may be written in the following way K where

$$s_{\Lambda m}(t) = \sum_{k=0}^{K} A_k s(t - t_d - \tau_k)$$

Ak is the amplitude of the k-th reflected signal with the receiving device td is the delay of the direct signal coming to the receiving device ,τk is the delay of the k-th reflected signal in respect to the direct signal

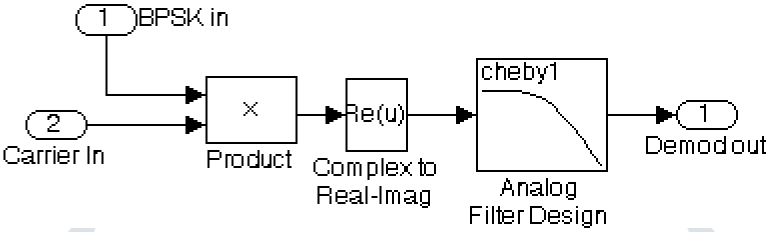

Fig.4. Receiver

Complete clutter, that is given by amount of signals of networks working on surrounding channels within the same location (e.g. within building) and networks which use any channels in further locality, is included in signal sAm(t) in real conditions.

Clutter at receiver device input eN(t) is defined as white random process with normal distribution. This specific clutter is limited at receiver input by filter with 200 MHz band width. Absolute signal at input of receiver is given by K

$$s_{Bv}(t) = \sum_{k=0}^{K} A_{uk} s_n(t - t_v - \tau_{tk}) + \\ + \sum_{n=1}^{N} \sum_{k=0}^{K} B_{nk} s_n(t - t_n - \tau_{nk}) + e_{Nv}(t)$$

where

sBυ (t) is signal in υ-th channel with frequency ωυ

Bnk is amplitude of k-th delayed signal of n-th transmitting device Bnk << Aυ k

eN υ (t) is clutter in υ-th channel

Features in the signal generation and processing model was validated with the AirMagnet’s Spectrum Analyzer. This device determines, classifies, and finds sources of RF interferences that impact the particular performance of WiFi networks. The a comparison of spectra of generated as well as real signals shows an acceptable agreement, see Fig.6 and Fig. 7.

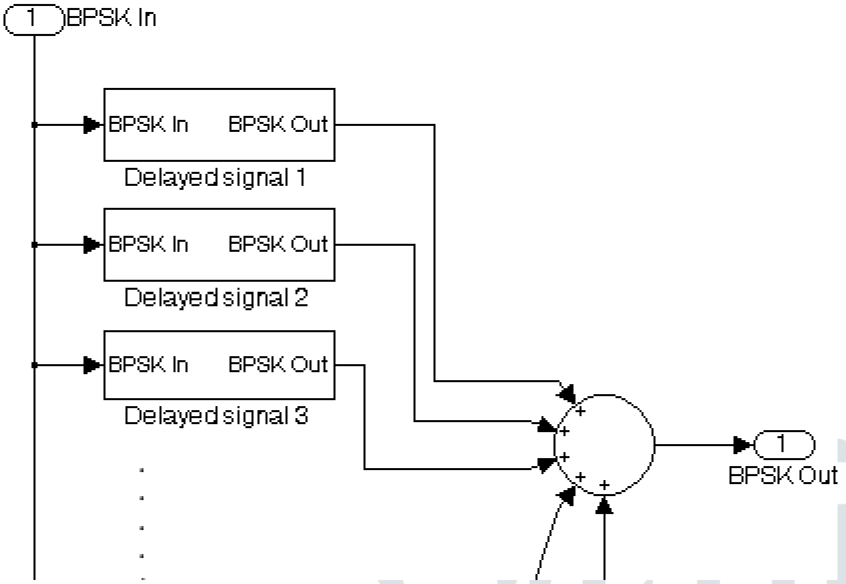

Fig.5. Sum of reflected signals

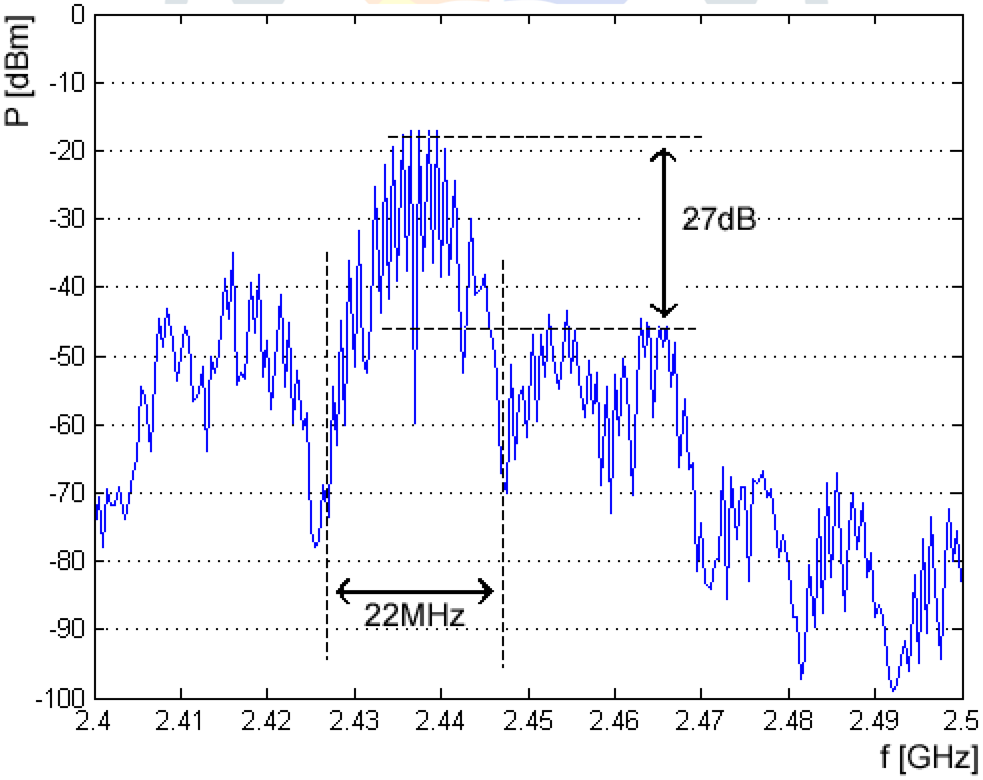

Fig. 6. The spectra of generated signals

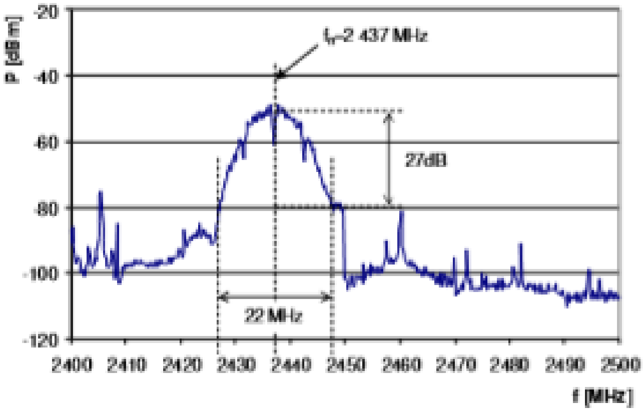

Fig.7. The spectra of measured signals

II. CONCLUSION

The particular paper tackles a model of a communication channel in the 802.11b standard wireless network physical layer. A feasibility with the signal and interference models was analyzed by comparing with measured spectra of real signals and clutter. Models of emitted signals and of interference and a model of a wireless multipath communication channel were built in Matlab/Simulink SW.

III. REFERANCES

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