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BER Performance Comparison of HIPERLAN/2 for Different Modulation Schemes with ½ and ¾ Code Rates

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ABSTRACT: In this paper, simulation results of HIPERLAN/2 using MATLAB/Simulink with 1/2 & 3/4 code rates are shown. The simulations are carried out for different modulation schemes for Additive White Gaussian Noise (AWGN) channel and are compared for both code rates. Simulation results will demonstrate that compared to 1/2 code rate, the performance of 3/4 code rate in terms of the Bit Error Rate (BER) produces remarkable degradation in the system performance. This paper, also showed that more stable modes can be achieved with code rate 1/2 for different modulation schemes than 3/4 code rate. Signal to Noise Ratio (SNR) improvement compared to coding rate 3/4 (with puncturing) is achieved with coding rate 1/2,

KEYWORDS: Bit Error Rate (BER), Code Rate, HIPERLAN/2, OFDM, Signal to Noise Ratio (SNR), QAM, QPSK, BPSK

I. INTRODUCTION

In wireless communication, higher data rates can be achieved by increased or more efficient use of bandwidth and transmitting power. A key technique for spectral optimization is Orthogonal Frequency Division Multiplexing (OFDM) [1]. OFDM is a technique proposed for high-speed wireless LAN by the European Telecommunication Standards Institute (ETSI) and IEEE which is being considered for 4G mobile. OFDM technology is described for physical (PHY) layer of ETSI's proposed HIPERLAN/2 standard whose data rate ranges from 6 to 54 Mbit/s depending on Quality of Service (QoS). It is designed to provide Wireless Local Loop (WLL) to core networks, e.g. Asynchronous Transfer Mode, GSM/UMTS or any IP-based multimedia network. Data rate, coding rate and modulation type are determined by the link adoption scheme automatically depending on the channel conditions.

Using a MATLAB simulation model for HIPERLAN/2 with 1/2 and 3/4 code rates the BER performance for different modulation schemes is compared. It can be easily seen that the BER curves for all modulations with 1/2 code rates are less degraded as compared to that with 3/4 code rate. Also the SNR is improved for ½ code rate that for 3/4 code rate.

II. RELATED WORK

In [1] the concept of dividing the entire channel into many narrow subchannels and modulating orthogonal subcarriers by means of the inverse fast Fourier transform (IFFT) is discussed. In [3] the HIPERLAN/2 air interface with the specifications of layer 1 (physical layer), following the ISO-OSI model is presented. HIPERLAN/2 is confined to only the radio access system consisting of the physical (PHY) layer and DLC layer, which are core network independent, and the core network specific Convergence sublayers. In [7] HIPERLAN/2 based Orthogonal Frequency-Division Multiplexing OFDM, Discrete Multiwavelet Transform (DMWT) performance via a MATLAB/ Simulink simulation is carried out. HIPERLAN/2 block diagram is discussed. As well as the different modulation schemes for HIPERLAN/2 is discussed. Packet (PDU or PSDU) error rate (PER) vs. average C/N graphs are also plotted and discussed.

III. BACKGROUND

Due to its good performance on highly dispersive channels. OFDM which is investigated in [3, 4] is used in IPERLAN/2 as a modulation scheme. To provide a reasonable number of channels in 100 MHz bandwidth, the channel raster is equal to 20 MHz which may be the narrowest continuous system bandwidth available, for instance, in Japan.

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The sampling frequency is also chosen equal to 20 MHz in order to avoid unwanted frequency products in implementations at the output of a typically used 64-point IFFT. The obtained subcarrier spacing is 312.5 kHz. In order to facilitate implementation of filters and to achieve sufficient adjacent channel suppression, 52 subcarriers are used per channel. 48 subcarriers carry actual data and 4 subcarriers are pilots which facilitate phase tracking for coherent demodulation. The duration of the cyclic prefix is equal to 800 ns, which is sufficient to enable good performance on channels with (r.m.s.) delay spread up to 250 ns (at least).

The basic principle of OFDM is to split a high – rate data stream into a number of lower rate streams that are transmitted simultaneously over a number of subcarriers. The frequency domain signals are converted into a time domain signals) using Fast Fourier Transform (FFT) at the transmitter and the process is reversed at the receiver. Energy for each subcarrier is determined using FFT that correlates with every basis function. Since subcarriers are uncorrelated their spectra can overlap without causing intercarrier interference (ICI). Intersymbol interference (ISI) is caused by delay spread which is the time difference between the first and last reception of the same symbol due to multipath effects in the channel, causes. Hence, guard times are required to separate successive OFDM symbols, but contain no information and waste energy. To make the associated loss smaller than 1 dB, the duration of an OFDM symbol is usually chosen to be six times the guard time [2]. The guard time must contain cyclically extended symbol, in order to prevent ICI that occurs due to loss of orthogonality. The complex envelope of the OFDM signal can be written as,

$$S_i(t) = \frac{1}{N}\sum_{n=0}^{N-1} x_n(t) e^{j[\omega_n t + \phi_n(t)]}$$

Where, $\omega_n = \omega_0 + n\Delta\omega$

IV. SIMULATION MODEL

The HIPERLAN/2 simulation models with different modulation schemes are used. In the transceiver model shown in fig. 1, binary data bits are generated by the random binary generator. Channel coding is performed by Forward Error Correction (Convolutional) encoder with rate ½ and constraint length seven. The code rate ¾ is obtained by puncturing. The modes are chosen such that the number of encoder output bits fits integer number of OFDM symbols. The effect of frequency selective fading in the AWGN channel is reduced by interleaving which contains a block size corresponding to the number of bits in an OFDM symbol. Binary values are then mapped according to different modulation schemes using respective modulators, which are normalized to achieve the same average power for all mappings. For transmission over the channel, all the symbols in the frequency domain are mapped into a time domain signal by the use of IFFT.

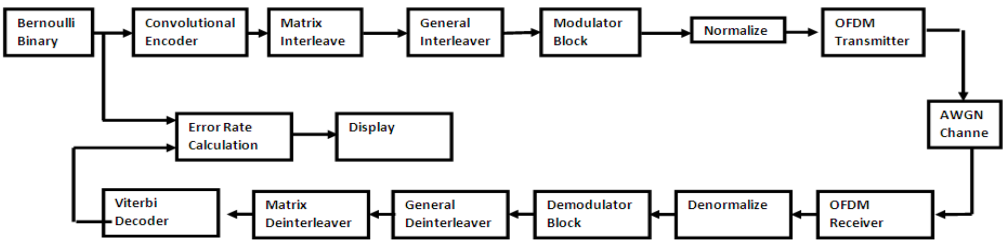

Fig 1Transreciever model for HIPERLAN/2

Aliasing can be avoided by adding extra zero bits in the OFDM symbol. The process of adding the last few bits of a symbol at the beginning of the symbol is called cyclic prefix which is used for both frequency and timing synchronization [2]. On the receiver side, the functions of most of the blocks are just the opposite of the equivalent

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transmitter blocks. The time domain signals are converted into the frequency domain by the FFT and symbols are extracted by a demodulator. Cyclic prefixes pilot carriers, frame synchronization are eliminated in the receiver block. After denormalisation, frames are passed through a de-interleaving process. Viterbi algorithm is used to decode convolutionally encoded input data. With the Viterbi algorithm, the zero-valued dummy bit has no effect on the outcome of the decoder. Finally the received data bits are compared to the transmitted bits by a bit error calculator.

V. SIMULATION RESULTS

The main purpose of the simulation was to simulate a baseband HIPERLAN/2 SIMULINK model and observe its behaviour for variation of bit error rate (BER) with signal-to-noise ratio (SNR) for coding rates of 3/4 (with puncturing) and ½ (mother code rate) as shown in following figs. In this section we present some simulation results showing the performance of HIPERLAN/2 with ¾ and ½ code rates for all the four modulation schemes (i.e. 16QAM, BPSK, QPSK & 64QAM).

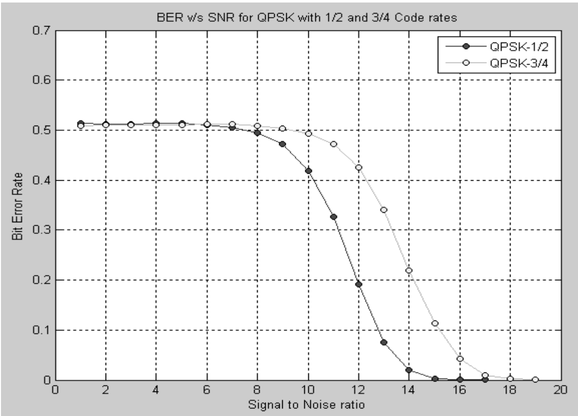

Fig. 2 BER vs. SNR for QPSK modulation with ½ & ¾ code rates

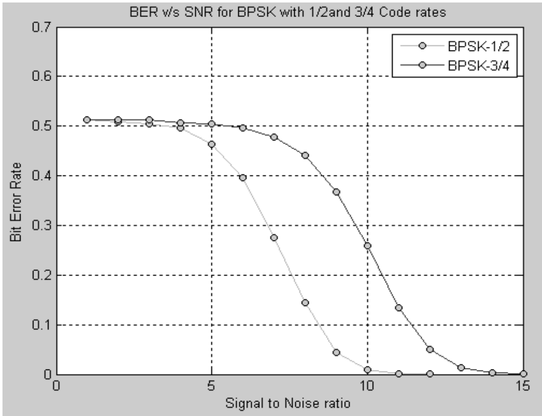

Fig. 3 BER vs. SNR for BPSK modulation with ½ & ¾ code rates

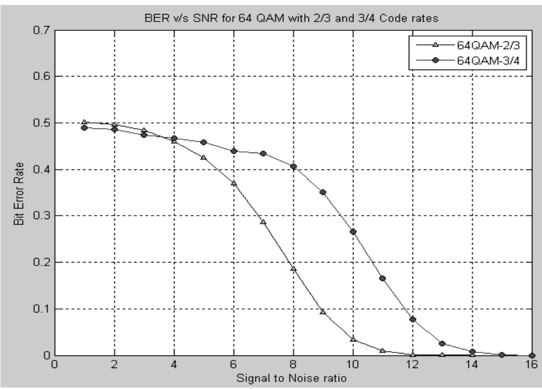

Fig. 4 BER vs. SNR for 16QAM modulation with ½ & ¾ code rates

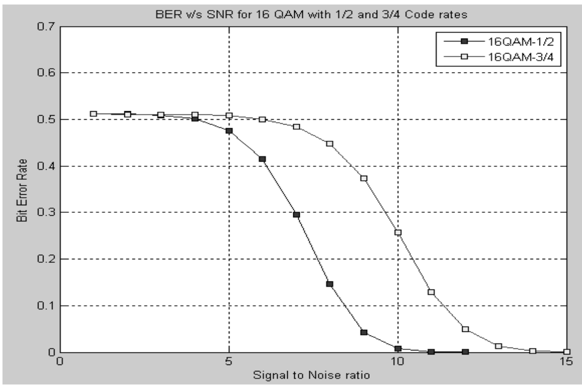

Fig. 5 BER vs. SNR for 64QAM modulation with ½ & ¾ code rates

Figures 1-4 show the BER vs. SNR plots for QPSK, BPSK, 16 QAM AND 64 QAM modulations respectively for ¾ and ½ code rates. As can be seen that the BER for ¾ code rate is much more degraded than the BER curve for ½ code rate. For instance refer fig. 2, for SNR=14 dB, BER is 0.22 dB and 0.02 dB for 3/4 and 1/2 code rates respectively. Similarly, in fig.3, when SNR=10 dB, BER is 0.36 and 0.01 for 3/4 and 1/2 code rates respectively. From fog.4 we can see that for SNR= 12dB, BER is 0.05 and 0 for 3/4 and 1/2 code rates respectively. Similarly, in fig.5, for SNR=12 dB, BER is 0.09 and 0 for 3/4 and 1/2 code rates respectively.
The reason behind this (in all cases) is that while changing code rate ½ to ¾ code rate we are using puncturing. Puncturing is a technique of generating additional rates from a single convolutional code. The basic idea behind

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puncturing is not to transmit some of the output bits from the convolutional encoder, thus increasing the rate of the code. This increase in rate decreases the free distance of the code, but usually the resulting free distance is very close to the optimum one that is achieved by specifically designing a convolutional code for the punctured rate. The receiver inserts dummy bits to replace the punctured bits in the receiver, hence only one encoder/decoder pair is needed to generate several different code rates. Due to this the performance for ¾ as compared to ½ code rate is losses.

VI.CONCLUSION

The observation concerns the rate of change of BER with SNR in puncturing mode. Because HIPERLAN/2 works in different modes based on the link adoption scheme, it from one data rate to another data rate depending on the prevailing channel conditions. The rate of change of BER in puncturing mode in both BPSK and QPSK is quite high so the possibility of switching from a higher data rate to a lower data rate is very high even for a 1 dB fall in SNR. On the other hand, the BER with code rate ½ (when used as a mother convolutional code) change more slowly and thus yield more stable modes with regard to changing channel conditions than code rate ¾. A further important observation is that the effect of ½ and ¾ code rates on the performance of HIPERLAN/2 with BPSK and QPSK modulation schemes has been analyzed. As expected BPSK and QPSK have the same Eb/N0 requirement. The performance of the rate-¾ code shows a remarkable degradation compared to the rate- ½ code, which is due to the considerable frequency selectivity of the channel. With coding rate ½ SNR improvement compared to coding rate 3/4 (with puncturing) is achieved.

REFERENCES

1. Chang, R.W.: 'Synthesis of band limited orthogonal signals for mulitchannel data transmission', Bell Syst. Tech. J., 1996, 45, pp. 1775–1796
2. Van Nee, R., and Prasad, R.: 'OFDM for wireless multimedia communication' (Artech House Boston, London, 2000)
3. ETSI TS 101 475 V1.1.1, 'Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Physical (PHY) layer', April 2000. http://www.etsi.org
4. Heiskala, J., and Terry, J.: 'OFDM wireless LANS a theoretical and practical guide' (Sams Publishing, 2002)
5. R.A.N. Ahmed and M. Berwick: 'Performance analysis of HIPERLAN/2 in QAM mode with punctured and non-punctured convolutional coding', Electronics Letter 31st March 2005 Vol. 41 No. 7.
6. Jamshid Khun-Jush1, Peter Schramm1, Udo Wachsmann1, Fabian Wenger21 Ericsson Euro lab Deutschland GmbH, D-90411 Nürnberg, Germany 2 Ericsson Mobile Data Design AB, S-41266 Göteborg, Sweden 'Structure and Performance of the HIPERLAN/2 Physical Layer'.
7. Dr. Mohammed Aboud Kadhim 1* Saleim Hachem Farhan2 Maher Ibraheem Gamaj3," Design and Improvement of HiperLAN/2 Physical Layer Model Based Multiwavelet Signals", Innovative Systems Design and Engineering www.iiste.org ISSN 2222-1727 (Paper) ISSN 2222-2871 (Online) Vol.5, No.6, 2014
8. U. Dettmar, J. Khun-Jush, P. Schramm, J. Thielecke,U. Wachsmann. Modulation for HIPERLAN/2. Proc. of VTC '99 Spring (Houston), pp. 1094-1100

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