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A Multi-Gigabit Speed Wireless Communication Standard- IEEE802.11ad

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ABSTRACT— In this paper we consider the wireless standard IEEE 802.11ad to increase the overall throughput and efficiency of the system and suggest appropriate Channel coding - Modulation Scheme pairs for speeds beyond MCS23, at MCS23 and lesser than MCS23 and further efficiency also improved by means of punctured convolution codes and 3D turbo codes

KEYWORDS— 3 dimensional turbo codes, Orthogonal frequency division multiplexing, wireless local area network, Modulation and coding schemes.

I. INTRODUCTION

As demands of high data-rate wireless data services all over the world increased, new wireless local area network (WLAN) systems IEEE 802.11ad introduced that achieve up to 7Gbps maximum throughput in physical (PHY) and medium access control (MAC) layers [5]. Multiple inputs multiple output (MIMO) scheme is well known that an extraordinary spectral efficiency achieved by employing multiple transmit and receive antennas. Mostly proposed one is multiple input multiple output orthogonal frequency division multiplexing (MIMO-OFDM) scheme as a key technology for 802.11 PHY level specification. Some proposed MIMO-OFDM mode with up to 4 transmits antennas, achieving approximately

600Mbps speed in 40GHz spectrum band. Additionally in order to increase the overall throughput of the system IEEE 802.11ad [1] introduced on December 2012 that offers the speed of operation upto7Gbps, and spectrum band of 60 GHZ and having mcs (modulation and coding schemes) values up to 31. The IEEE 802.11ad standard also requires punctured convolution code as one for higher throughput (HT) data rate settings .The system to be investigated is based on bit-interleaved coded orthogonal frequency-division multiplexing (OFDM) which supports IEEE 802.11ad version with HT transmission mode up to MCS 31. A three-dimensional (3D) TC (turbo codes) was introduced, combining both parallel and serial concatenation. It is from the classical TC by concatenating a rate-1 post encodes at its output, which encodes only a fraction λ of the parity bits from the upper and lower constituent encoders. The fraction 1-λ of parity bits which are not re-encoded is directly sent to the channel or punctured to achieve the desired code rate. The 3D TC improves performance in the error floor compared to the TC. Thus it can be made operational even below the minimal snr (-13 dB) by means of 3D turbo codes.

II. 3D TURBO CODES

In 1971, the whole community of coding and information theory was in phase with the famous speech of Professor Robert McEliece: "Too many equations had been generated with too few consequences… Coding theorist professors had begotten more coding theory Ph.D.'s in their own image… no one else cared; it was time to see this perversion for what it was. Give up this fantasy and take up a useful occupation… Coding is dead." This assertion was contradicted 20 years later by the invention of turbo codes (TCs) , which was a revival for the channel coding research community. Their near-capacity performance and their suitability for practical implementation explain the adoption of TCs in various communication standards as early as the late 1990s. However, TCs suffer from a flattening effect when the error rate reaches a limit and stops improving. In future system generations, low error rates will be required to open the way to real time and demanding applications, such as TV broadcasting or videoconferencing. The minimum Hamming distance (MHD) of state-of-the-art TCs may not be sufficient to ensure large asymptotic gains at very low error rates.

Therefore, they are no longer suitable for these kinds of applications, and more powerful coding schemes are required. At the same time, a reasonable level of complexity should be preserved. At that time a three-dimensional (3D) TC was introduced by Berrou et al., is able to ensure large asymptotic gains at very low error rates, combining both parallel and serial concatenation. They further investigate the association of the 3D TC [3] with high-order modulations according to the bit-interleaved coded modulation approach. The 3D TC improves performance in the error floor compared to the TC, at the expense of a loss in the convergence threshold and an increase in complexity

III. Punctured Convolution Codes

Using punctured convolution codes the maximum throughput of the system can be increased as with a higher rate channel coder. The IEEE 802.11ad standard requires relatively high punctured convolution code rate for spectrally efficient high-throughput data rate settings. Generally it is used to lower down the bit rate as the complexity of a decoder increases rapidly with the code rate. Puncturing is a technique that allows the encoding and decoding of higher rate codes using standard rate

IV. Table

MCS	CODER	MODULATIONS	SPEED
0	1/2 LDPC	DBPSK	27.5mbps
1-12	1/2, 3/4, 5/8, 13/16 LDPC	BPSK,QPSK,16QAM	385-4620mbps
13-23	1/2, 3/4, 5/8, 13/16 LDPC	SQPSK, QPSK, 16QAM, 64QAM	693-6756.75mbps

The above table shows the appropriate coder modulation pair with different speeds. With the wireless standard IEEE 802.11ad the best pair of coder modulator has to be identified with by means of varying speed and appropriate SNR values to be predicted, hence by providing different puncturing bits for different coder and modulator the overall efficiency of the system can be increased.

V. Functions Of Block IEEE802.11ad

This block represents an end-to-end baseband model of the physical layer of a wireless local area network (WLAN) according to the IEEE® 802.11ad standard [1]. The model supports all mandatory and optional data rate. The block also illustrates adaptive modulation and coding over a dispersive multipath fading channel, whereby the simulation varies the data rate dynamically. The top row of blocks contains the transmitter components while the bottom row contains the receiver components. The communication system in this block performs these tasks:

1. Generation of random data at a bit rate that varies during the simulation. The varying data rate is accomplished by enabling a source block periodically for a duration that depends on the desired data rate. Initially there are 900 bits per frame.

2. Coding, interleaving, and modulation using one of several schemes specified in the standard.

3. In particular, each modulator block in the bank performs these tasks:

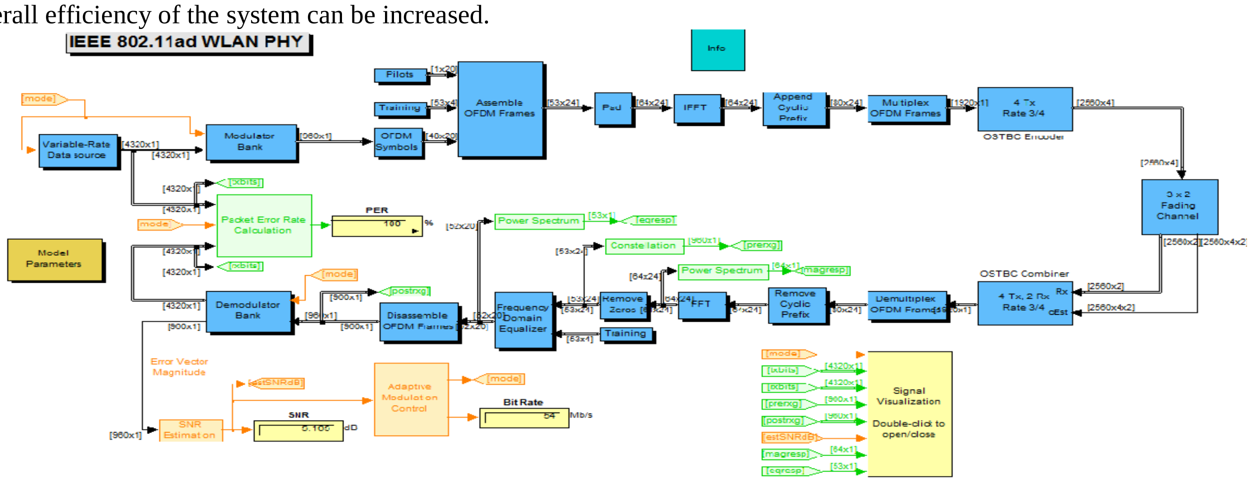
(1)Low Density Parity coding and puncturing using code rates of
½,3/4,5/8,13/16,2/3

(2)Data interleaving.

(3)BPSK, QPSK, 16-QAM, 64-QAM modulation are performed and depends upon the data rate or speed the corresponding modulation performs.

4. OFDM (orthogonal frequency division multiplexing) transmission using 52 subcarriers, 4 pilots, 64-point FFTs, and a 16-sample cyclic prefix.

5. 4x4 MIMO channels are used here to improve the speed and rician fading channels are for line of sight



6. PLCP (physical layer convergence protocol) preamble modeled as four long training sequences.

7. Dispersive multipath fading channel.

8. Receiver equalization.

Simplifications and Assumptions has to be made as,

(1)Fixes the number of data symbols in each packet and omits pad bits

(2)Operates continuously from frame to frame and thus omits tail bits that would have been used for resetting the decoder state

(3)Fixes the transmit power level, instead varying the average SNR of the channel

(4)Assumes idealized timing/frequency acquisition

A configuration block called Model Parameters enables to set parameters such as the composition of each OFDM frame, and trace back depth for the Viterbi decoder. One parameter of particular interest for the adaptive modulation and coding in this block is the Low-SNR thresholds parameter. This is a seven-element vector that indicates how the simulation should choose a data rate based on the SNR estimate. The model has eight modes, each associated with a particular modulation scheme and convolution code. The seven thresholds are the boundaries between eight adjacent regions that correspond to the eight modes. Ideally, the simulation should use the highest-throughput mode that achieves a desired packet error rate. Determining appropriate thresholds often involves running the simulation multiple times, varying the values of the Low-SNR thresholds parameter.

The plots within the display window shows the following as

(1)A portion of the random binary data, meant to helps to visualize the varying data rate.

(2)Scatter plots of the received signal before and after equalization. From the plot of the equalized signal, can assume which modulation type the system is currently using, because the plot resembles a signal constellation of 2, 4, 16, or 64 points.

(3)The power spectrum of the received signal before and after equalization, in dB. The dynamics of the signal's spectrum before equalization depend on the Fading mode parameter in the Multipath Channel block.

(a) The estimate of the SNR based on the error vector magnitude.

(b)The bit rate of the transmission.

(c)The bit error rate per packet. For most packets, the BER is zero. Because this plot uses a logarithmic scale for the vertical axis, BER values of zero do not appear in the plot.

The following blocks display numerical results:

(1)The PER block shows the packet error rate as a percentage.

(2)The SNR block at the top level of the model shows an estimate of the SNR based on the error vector magnitude. The SNR block in the Multipath Channel subsystem shows the SNR based on the received signal power.

(3)The Bit Rate block shows which of the bit rates specified in the standard is currently in use

VI. Results And Discussion

In this the calculation for the standard 802.11ad was attained and hence the overall block was implemented by means of SIMULINK in MATLAB. Thus the value of SNR for various modulation schemes attained by means of MATLAB coding

MCS	MODULATION	DATA RATE(Mbps)	SNR
1	**BPSK**	**385**	**3**
2	**BPSK**	**626**	**5**
3	**BPSK**	**770**	**6.25**
4	**BPSK**	**834**	**6.75**
5	**BPSK**	**962.5**	**7.75**
6	**BPSK**	**1112**	**9**
7	**BPSK**	**1155**	**9.25**
8	**BPSK**	**1251.25**	**10.25**
9	**QPSK**	**1251**	**16.75**
10	**QPSK**	**1386**	**18.5**
11	**QPSK**	**1540**	**20.75**
12	**QPSK**	**1668**	**22.5**
13	**QPSK**	**1732**	**23.25**
14	**QPSK**	**1925**	**26**

15	**QPSK**	**2079**	**28**
16	**QPSK**	**2224**	**30**
17	**QPSK**	**2310**	**31**
18	**QPSK**	**2502.5**	**33.75**
19	**QPSK**	**2503**	**33.75**
20	**16QAM**	**2772**	**46.5**
21	**16QAM**	**3080**	**51.75**
22	**16QAM**	**3465**	**58.25**
23	**16QAM**	**3850**	**64.5**
24	**16QAM**	**4158**	**69.75**
25	**16QAM**	**4504.5**	**75.5**
26	**16QAM**	**4620**	**77.5**
27	**64QAM**	**5197.5**	**80**
28	**64QAM**	**6237**	**100**
29	**64QAM**	**6756.75**	**100**

VII. CONCLUSION

As long as for the increasing a speed or date rate values, the corresponding signal to noise ratio also increases .Thus with low probability of error as 0.1a high SNR attained by using a LDPC coder and also 4x4 MIMO channel. Hence further improvement has also attained by using of punctured convolution codes and finally the performance of the system can be increased

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