

Pruning of Blind Decoding Results for Long Term Evolution

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Abstract— Long Term Evolution (LTE) downlink sub frame includes two major physical channels. One is a physical downlink control channel (PDCCH) and the other is a physical downlink shared channel (PDSCH). In Long-Term Evolution (LTE) downlink control channel, a large number of blind decoding attempts are made, while the number of valid code words is limited. The blind decoding results are then verified using a 16-bit cyclic redundancy check (CRC). However, even with the 16-bit CRC, the false alarm (FA) rate of such blind decoding is inevitably high. This paper investigates the problem of pruning of blind decoding results for reduction of the FA rate. To the best of our knowledge, the approach using a soft correlation metric (SCM) shows the best FA reduction performance among existing schemes. However, following the Bayes principle, we propose novel likelihood-based pruning that provides systematic balancing between the FA rate and the miss (MS) rate.

Key words: Long Term Evolution, Blind decoding, Soft correlation metric.

I. INTRODUCTION

Many modern wireless communication systems provide dedicated control channels, which are designed to convey various short messages and physical-layer control signals. Long Term Evolution (LTE) is a fourth generation wireless high speed broadband technology developed by the third generation partnership project (3GPP). Long Term Evolution (LTE) is important because it will bring up to a 50x performance improvement and much better spectral efficiency to cellular networks. LTE is different from other technologies that call themselves 4G because it is completely integrated into the existing cellular infrastructure for 2G and 3G. Long Term Evolution (LTE) downlink sub frame includes two major physical channels. One is a physical downlink control channel (PDCCH) and the other is a physical downlink shared channel (PDSCH).

The PDCCH carries the downlink control information such as scheduling assignments while the PDSCH carries application data for all users. Making a reliable decision on PDCCH is important because any decision error on PDCCH can potentially lead to loss of the PDSCH and an increase in packet errors. Architecture of LTE is comprised of following three main components:

- 1) The User Equipment (UE).
- 2) The Evolved UMTS Terrestrial Radio Access Network (E-UTRAN).
- 3) The Evolved Packet Core (EPC).

However the location and the format of PDCCH are not known, and thus in a sub frame, a number of PDCCH blind decoding attempts are made over predefined search spaces using the predefined set of PDCCH formats. The blind decoding results are then verified using a 16-bit cyclic redundancy check (CRC). Since a large number of blind decoding attempts are made while the number of valid PDCCHs is limited in a sub frame, the false alarm (FA) rate of such blind decoding can be high even with the 16-bit CRC. The high FA rate of PDCCH blind decoding can cause

various link quality and connection issues for LTE mobile devices. For example, due to FA, the correct downlink control information may not be properly processed in the higher layer. Naturally, approaches for pruning of blind decoding results for PDCCH FA reduction have been investigated in where pruning is considered as a process of discarding of a portion of decoding results.

II. SYSTEM OVERVIEW

This architecture is meant to investigate the problem of pruning of blind decoding results for reduction of the FA rate.

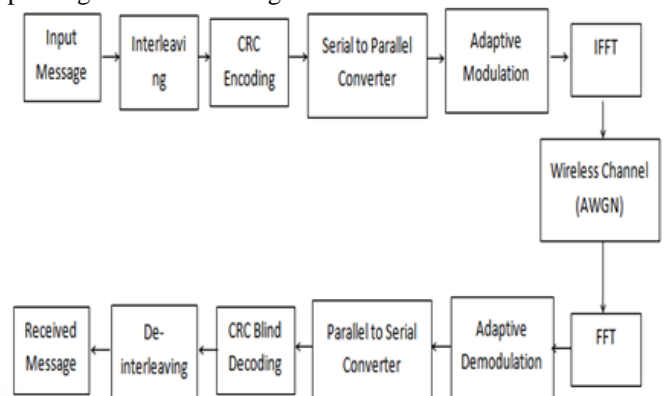


Fig. 1: System Overview

The flow of proposed system is shown in above figure. Random generated binary message is provided the input to interleaving. Interleaving perform on the message which reduces the ISI. We have performed Cyclic Redundancy Check (CRC) encoding. The encoding section was completed by interleaving the encoded data. Conversion of message is done from serial to parallel convertor. Then various digital modulation techniques are used to modulate the encoded data .i.e. QAM, QPSK, 16QAM and 64QAM. Adaptive modulation is used for matching of the modulation, coding and other signal and protocol parameters to the conditions on the radio link. The modulated data in the frequency domain is then converted into time domain data by performing IFFT on it. Then through wireless channel, channel modeling (AWGN) is done on message. Finally the modulated parallel data were converted into serial data stream and transmitted through different communication channels .Then CRC blind decoding is used to reduce false alarm rate (FA) and miss rate (MR).Then De-interleaving is performed and finally get the received message.

A. Cyclic Redundancy Check:

The cyclic redundancy check, or CRC, is a technique for detecting errors in digital data, but not for making corrections when errors are detected. It is used primarily in data transmission. In the CRC method, a certain number of check bits, often called a checksum, are appended to the message being transmitted. The receiver can determine whether or not the check bits agree with the data, to ascertain with a certain degree of probability whether or not an error occurred in transmission. If an error occurred, the receiver sends a “negative acknowledgement” (NAK) back to the sender,

requesting that the message be retransmitted. CRC check block is a combinational logic that performs 16 bits CRC check in only one clock cycle to reduce the total amount of delayed time required for blind decoding process.

B. Adaptive Modulation:

Adaptive modulation is a method to improve the spectral efficiency of a radio link for a given maximum required quality. Adaptive modulation is used to dynamically switch modulation schemes according to the prevailing channel conditions. Adaptive modulation and coding (AMC), is a term used in wireless communications to denote the matching of the modulation, coding and other signal and protocol parameters to the conditions on the radio link. Different order modulations allow you to send more bits per symbol and thus achieve higher throughputs or better spectral efficiencies. However, it must also be noted that when using a modulation technique such as 64QAM, better signal to noise ratios (SNRs) are needed to overcome any interference and maintain a certain bit error ratio (BER). The use of adaptive modulation allows a wireless system to choose the highest order modulation depending on the channel conditions. QPSK (Quadrature Phase Shift Keying) is type of phase shift keying. QAM has both an analog and a digital modulation scheme. It conveys two analog message signals, or two digital bit streams by changing (modulating) the amplitudes of two carrier waves, using the Amplitude-Shift Keying (ASK) or amplitude Modulation (AM). QAM is the encoding of the information into a carrier wave by variation of the amplitude of both the carrier wave and a quadrature carrier that is 90 degrees out of phase with the main carrier in accordance with two input signals. The transmitted QPSK data undergoes impairments that simulate the effects of wireless transmission such as addition of Additive White Gaussian Noise (AWGN).

C. Orthogonal Frequency Division Multiplexing:

Orthogonal Frequency Division Multiplexing (OFDM) is promising technique to perform Multicarrier modulation with maximum utilization of bandwidth and high mitigation characteristic's profile against fading in Multipath. OFDM has recently seen rising popularity in wireless applications since it provides an efficient means to mitigate the inter symbol interference (ISI) caused by the channel multipath spread and high data rate transmission. This is a multicarrier technique in which modulating the entire data stream with different subcarriers and each of these subcarriers is orthogonal to each other. An OFDM transmitter can be implemented by using inverse fast Fourier transform (IFFT) and the output of IFFT block is a time domain signal. The output of IFFT(OFDM signals) have an inherent difficulty that it may exhibit a very high peaks since it is generated by the addition of several independently modulated signal.

D. Channel Modeling (Awgn Channel):

AWGN is often used as a channel model in which the only impairment to communication is a linear addition of wideband or white noise with a constant spectral density (expressed as watts per hertz of bandwidth) and a Gaussian distribution of amplitude. The model does not account for fading, frequency selectivity, interference, nonlinearity or dispersion. AWGN is a noise that affects the transmitted signal when it passes through the channel. It contains a

uniform continuous frequency spectrum over a particular frequency band.

III. PROPOSED SYSTEM

A. Algorithm for Proposed System:

- 1) Start
- 2) Generate Random Binary Message
- 3) Interleave binary message to reduce ISI
- 4) Perform Cyclic Redundancy Check Encoding
- 5) Convert Serial bit stream in parallel block to transmit on different bands
- 6) Modulate Data Using Adaptive Modulation Schemes like,
 - QPSK
 - 8PSK
 - 8QAM
 - 16-QAM
 - 32-QAM
 - 64-QAM
- 7) Convert frequency domain signal into time domain using IFFT transform.
- 8) Channel Modeling (AWGN Channel)
- 9) Receive Data
- 10) FFT Transform
- 11) Demodulate by the technique used at transmitter
- 12) Parallel to serial Conversion
- 13) Perform Blind CRC Decoding
- 14) Select valid code word from possible code words.
- 15) De-Interleave data
- 16) Perform analysis of FA and MS at const SNR
- 17) Perform analysis of BER vs SNR
- 18) Stop

B. Bit Error Rate (BER):

The BER, or quality of the digital link, is calculated from the number of bits received in error divided by the number of bits transmitted.

C. Signal to Noise Ratio:

SNR is the ratio of the received signal strength over the noise strength in the frequency range of the operation. It is an important parameter of the physical layer of Local Area Wireless Network (LAWN). Noise strength, in general, can include the noise in the environment and other unwanted signals (interference). BER is inversely related to SNR, that is high BER causes low SNR. High BER causes increases packet loss, increase in delay and decreases throughput. The exact relation between the SNR and the BER is not easy to determine in the multi channel environment. Signal to noise ratio (SNR) is an indicator commonly used to evaluate the quality of a communication link and measured in decibels.

IV. CONCLUSION

We proposed a novel likelihood-based method for pruning of blind decoding results. Our proposed likelihood-based pruning has the following advantages over the SCM-based pruning. First; it has a substantial SNR gain. While it has been shown that the SNR gain is around 1 dB in the AWGN channel, the SNR gain is more significant in the i.i.d.

Rayleigh fading channel, which has been shown to be unbounded. Second, it has systematic and adaptive nature. Third, it has been shown that the proposed likelihood-based pruning is computationally even less complex than the existing SCM-based pruning. Finally, it has been proved that the proposed likelihood-based pruning is near optimal even with approximate computation of likelihood. In addition, the proposed FA reduction approach can be applied to any error-correction/detection systems whose decoders make multiple blind decoding attempts.

V. OUTPUT

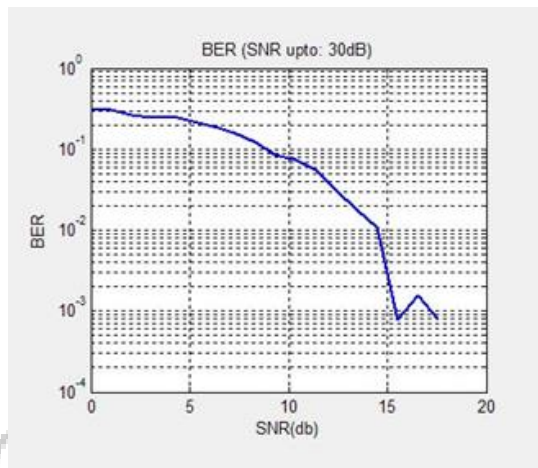


Fig. 2:

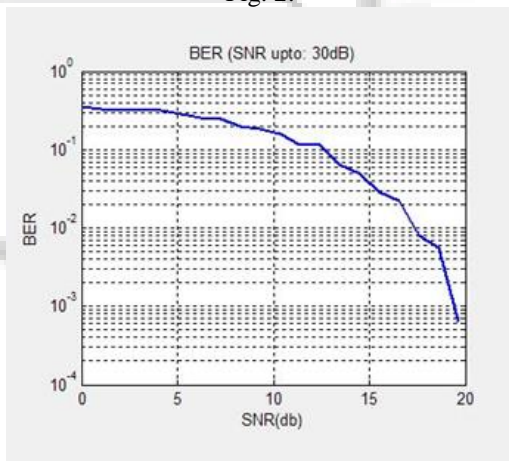


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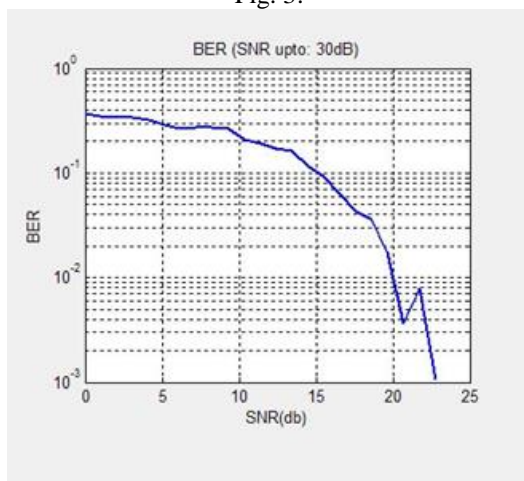


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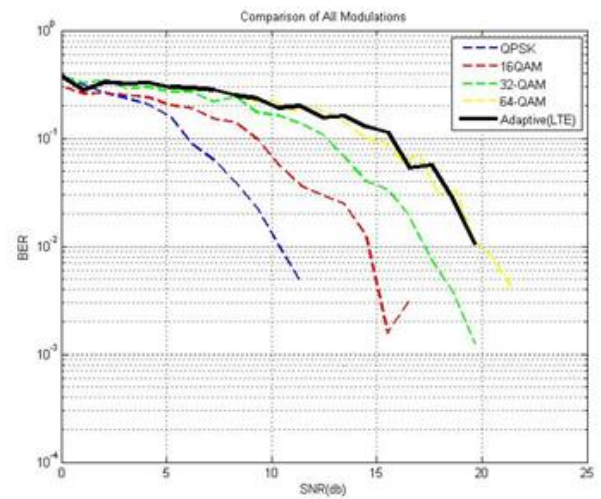


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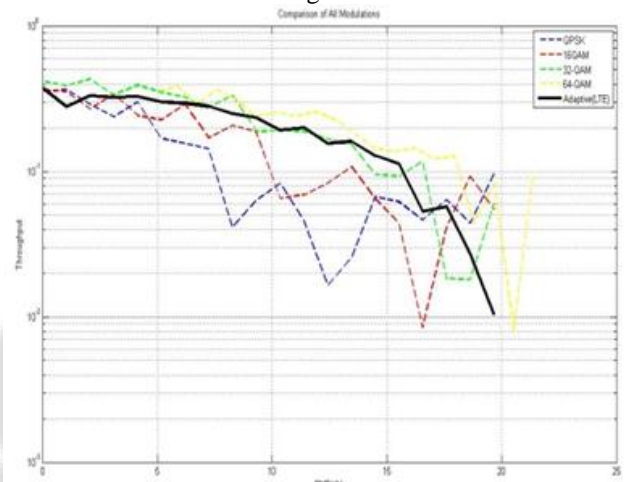


Fig. 6:

REFERENCES

- [1] D. Bai et al., "LTE-Advanced modem design: Challenges and perspectives," *IEEE Commun. Mag.*, vol. 50, no. 2, pp. 178–186, Feb. 2012.
- [2] Motorola, "PDCCH false detection," 3rd Generation Partnership Project, Sophia Antipolis Cedex, France, 3GPP TSG RAN1 #57a,R1-091945, May 2009.
- [3] D. Doan, K. Seong, and H. Bagheri, "Method and apparatus for reliability aided pruning of blind decoding results," U.S. Patent Appl., Pub.No. US2011/0182385 A1, Jul. 30, 2011.
- [4] D. Bai, J. Lee, S. Kim, H. Kim, and I. Kang, "Systematic pruning of blind decoding results," in *Proc. Conf. Rec. 46th ASILOMAR*, Nov. 2012,