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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>** |
| Title | **A Modified Chase Combining for H-ARQ** |
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| Re: | For consideration in Working Group Recirculation Ballot #14b, on P802.16d/D3. |
| Abstract | A modified chase combining for H-ARQ is proposed. |
| Purpose | Adoption |
| Notice |  |
| Release |  |
| Patent Policy and Procedures |  |

# A Modified Chase Combining for H-ARQ

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## 1. Introduction

The conventional Chase Combing (CCC) always retransmits the same FEC block, for high rate code, the punctured bit will never have a chance to be transmitted. Here we proposed a Modified Chase Combining (MCC) method which take the puncture pattern into account, and try to balance the bit to be transmitted. MCC method still can be apply to all kinds of channel coding system (Non-punctured code can be regarded as a special case).

The basic idea of MCC is: for each retransmission, the coded block is not the same anymore. Different puncture patterns are used to create the retransmission FEC block. The puncture patterns are predefined and can be selected based on retransmission number. At the receiver, the received signals are depunctured according to its specific puncture pattern which is decided by the current retransmission number, then the combination is performed at bit metrics level. The pros of the modified CC are:

1. The combined version becomes a low rate code instead of a punctured code because of the puncture pattern change. The additional coding gain can be obtained. Our simulation results show nearly 1 dB addition gain over CCC in both AWGN and Rayleigh fading channel.
2. The retransmission block length can be flexible by choosing the puncture pattern with different puncture length.
3. The decoding complexity is almost the same as CCC, and is much lower than IR.
4. Compatible with CCC which is proposed by [1]
5. Only minor modification is needed based on [1]

## 2. Performance simulation results

The MCC H-ARQ scheme is evaluated over both AWGN and uncorrelated Rayleigh fading channel. The modulation is QPSK. The channel coding scheme is ¾ punctured convolutional code, which is a puncture version from ½ mother code is. In the simulation, 3 retransmissions are allowed. The puncture pattern for the n-th retransmission is generated by cyclically shifting n columns based on the original puncture pattern in the current standard. For example, the original puncture pattern is [1,0,1;1,1,0] as Table 317 in 802.16 D5; the puncture patterns for the 1$^{st}$, 2$^{nd}$, and 3$^{rd}$ retransmission are [1,1,0;0,1,1], [0,1,1;1,0,1] and [1,0,1;1,1,0], respectively.
The simulation results are showed in Fig.1 and Fig.2. The MCC has almost 1 dB gain compared to conventional CC H-ARQ over AWGN. In Rayleigh fading channel, the gain is even better (almost 3dB)

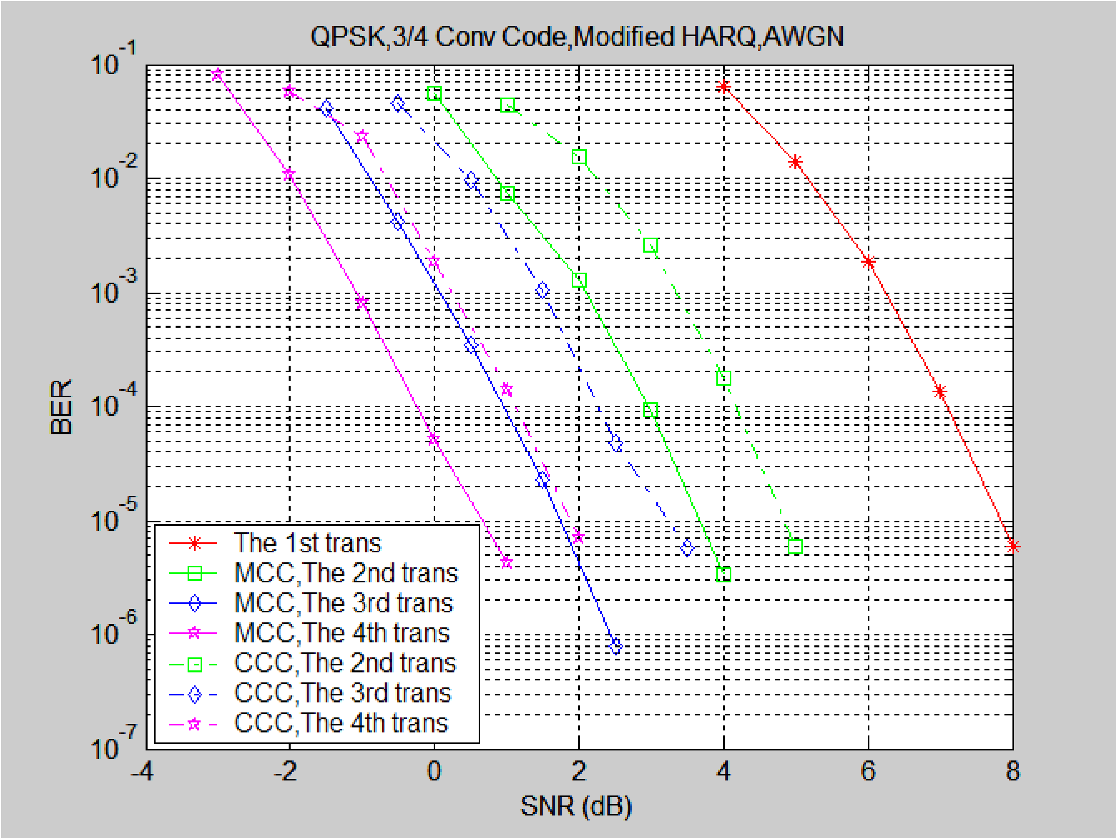


Fig.1 The modified CC H-ARQ scheme performance over AWGN

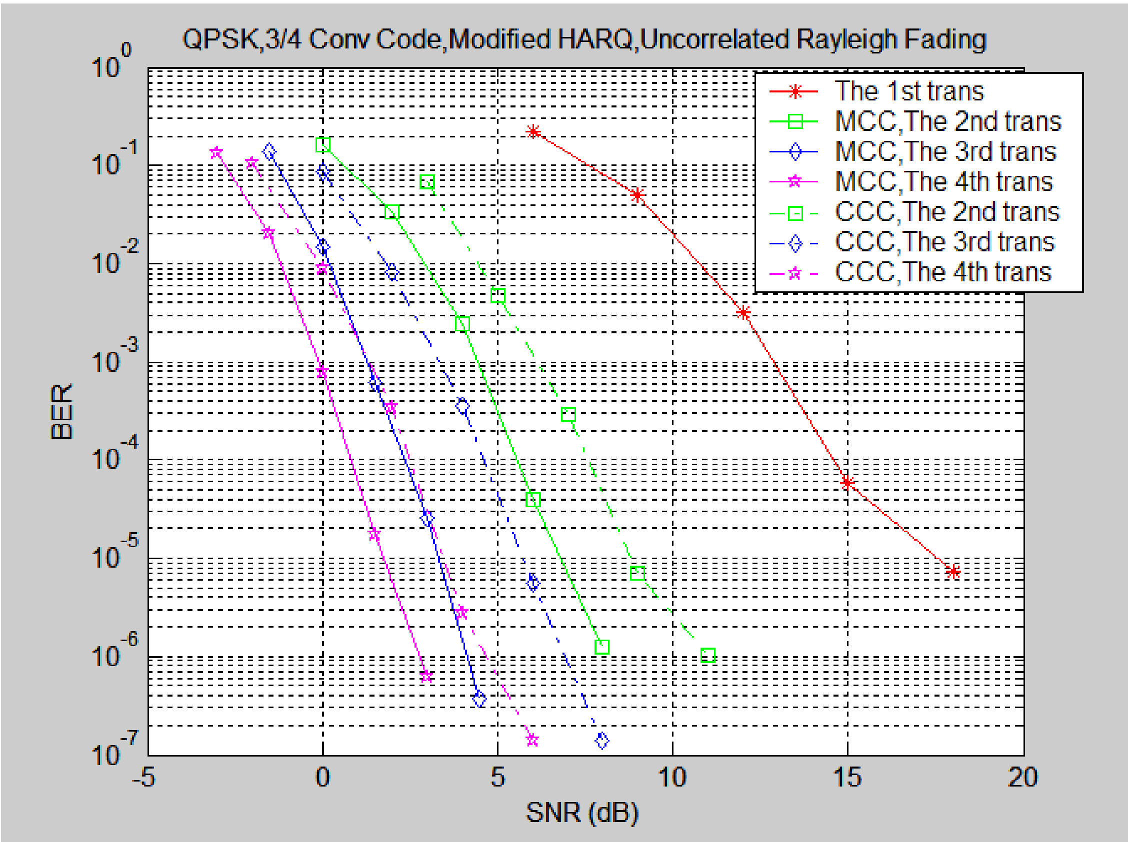


Fig.2 The modified CC H-ARQ scheme performance over uncorrelated Rayleigh fading

## 3. Proposed Text Change

Based on proposal [1], only minor changed is needed.

a. Modify table AAA to add MCC mode

b. Add the following text
6.4.17.1 Subpacket generation

When MCC mode is defined, the FEC encoder is responsible for generating subpackets based on the predefined puncture pattern. The subpacket are combined by the receiver after de-puncturing.

c. Modify the SPID in H_ARQ Control IE: delete reserved.

d. In other tables where Generic appears, add MCC

e. The puncturing pattern can be decided based on the coding rate and each SPID since it is the cyclic shift of original puncturing pattern.

## 4. Reference

[1] IEEE C802.16e-04/136 , Chase H-ARQ support for all FEC schemes, by Mark Cudak, Brian Classon (Motorala) & Valentine J.Rhodes (Intel)