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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 basic idea of Modified Chase Combining (MCC) is taking the puncture pattern into account, and for each retransmission the coded block is not the same. Different puncture patterns are used to create the retransmission FEC block. The puncture patterns are predefined or can be easily deducted from the original pattern, 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 conventional Chase Combining (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.
4. Compatible with conventional chase combining.
5. Only minor modification is needed.

## 2. 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 1st, 2nd, and 3rd retransmission are [1,1,0;0,1,1], [0,1,1;1,0,1] and [1,0,1;1,1,0], respectively. For the ½ conventional code, we can regard the puncture pattern as [1 1 1;1 1 1], the MCC becomes CCC.

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)

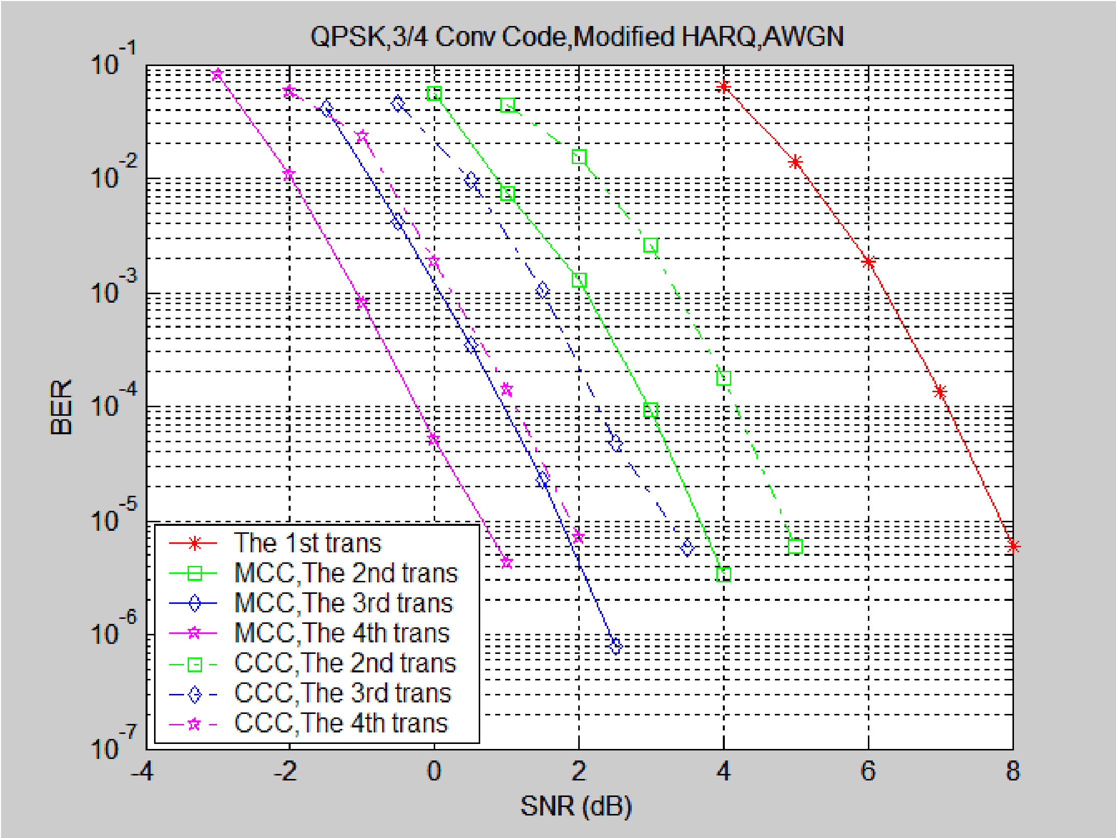


Fig.1 The modified CC H-ARQ scheme performance over AWGN

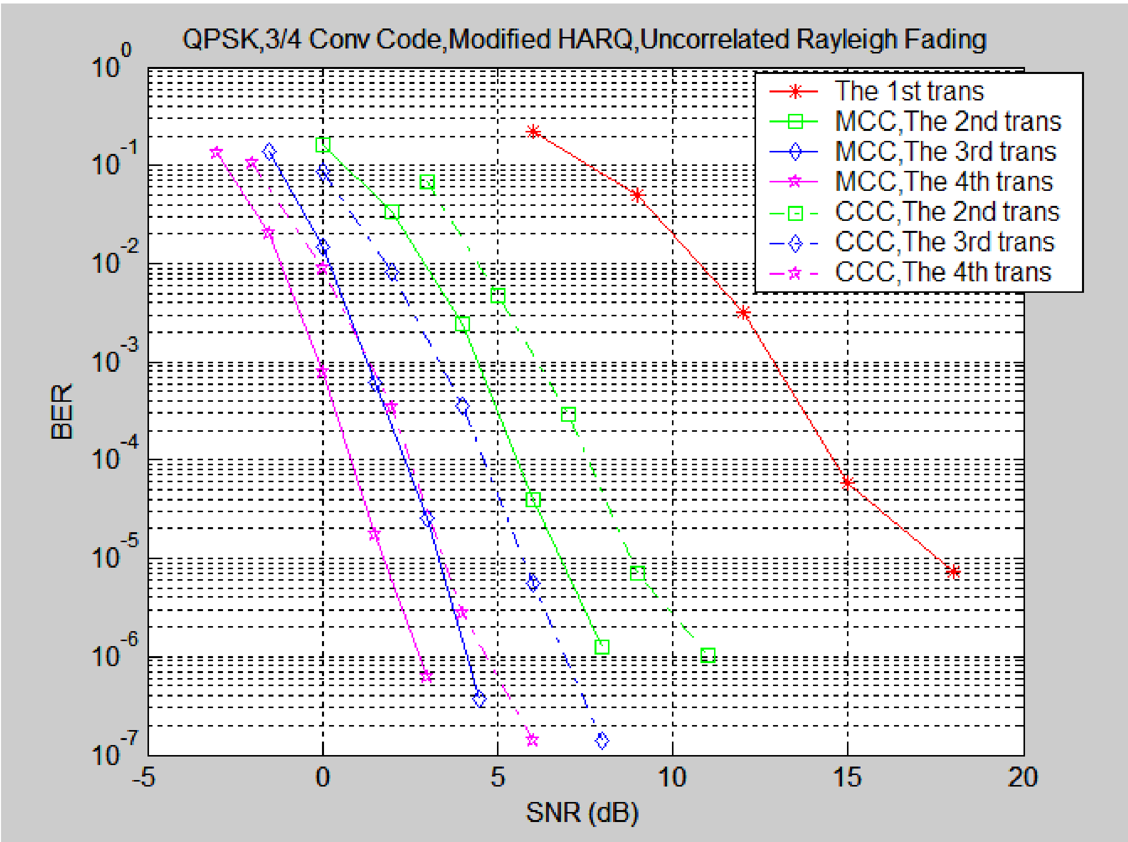


Fig.2 The modified CC H-ARQ scheme performance over uncorrelated Rayleigh fading

## 3. Proposed Text Change

a. A change in the H-ARQ mode is signaled using the "H-ARQ Compact_DL-MAP IE format for Switch H-ARQ Mode" (see section 6.3.2.3.43.6.7). The definitions of the H-ARQ modes are defined in Table AAA.

**Table AAA HARQ Companded Sub Channel Definitions**

| H-ARQ Mode | Description |
|---|---|
| 0 | CTC Incremental Redundancy |
| 1 | Generic Chase |
| 2 | Modified Chase for CC |
| 3…5 | Reverse |

b. Add the following text

6.3.17.1 Subpacket generation

H-ARQ operates at the FEC block level. When MCC is defined, the FEC encoder generates subpackets based on the cyclically shifted version of the original puncture pattern. The subpackets are combined by the receiver FEC decoder as part of the decoding process.

## 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)