Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**A codebook addressing approach to reduce the index bit for MIMO pre-coding**
Date Submitted	**2005-01-23**
Source:	Wen Tong, Ming Jia, Hua Xu, Dongsheng Yu, Jianglei, Ma, Peiying Zhu, Mo-Han Fong, Hang, Zhang and Brian Johnson Nortel Networks 3500 Carling Avenue Ottawa, ON. K2H 8E9 CANADA Voice: (613)-763-1315 Fax: (613)-765-7723 wentong@nortelnetworks.com
Re:	IEEE 802.16-REVe/D5a, BRC recirc
Abstract	Propose to use the differential index addressing the codebook with large number of code-words. The update is in blue font.
Purpose	To incorporate the changes here proposed into the 802.16e/D5a draft.
Notice	
Release	
Patent Policy and Procedures	

A codebook addressing approach to reduce the index bit for MIMO pre-coding

1 Introduction

The code-book size of an optimized unitary pre-coding code book determines the pre-coding loss. The large the codebook size the less the pre-coding loss. However, the large code book requires large among feedback resource to signaling the codeword index. In this contribution we propose to reduce the feedback for large codebook index signaling by exploit the correlation properties for the code words in a sub-space of the code book. In general, only a sub-set of the code words possess high correlation with a given code word. For OFDMA signal, there exists a very high MIMO channel correlation in either time direction or frequency direction, in this case, if we re-range the word-word addressing such that for any code word, the highly the correlated code words can be addressed by a small offset against its address index.

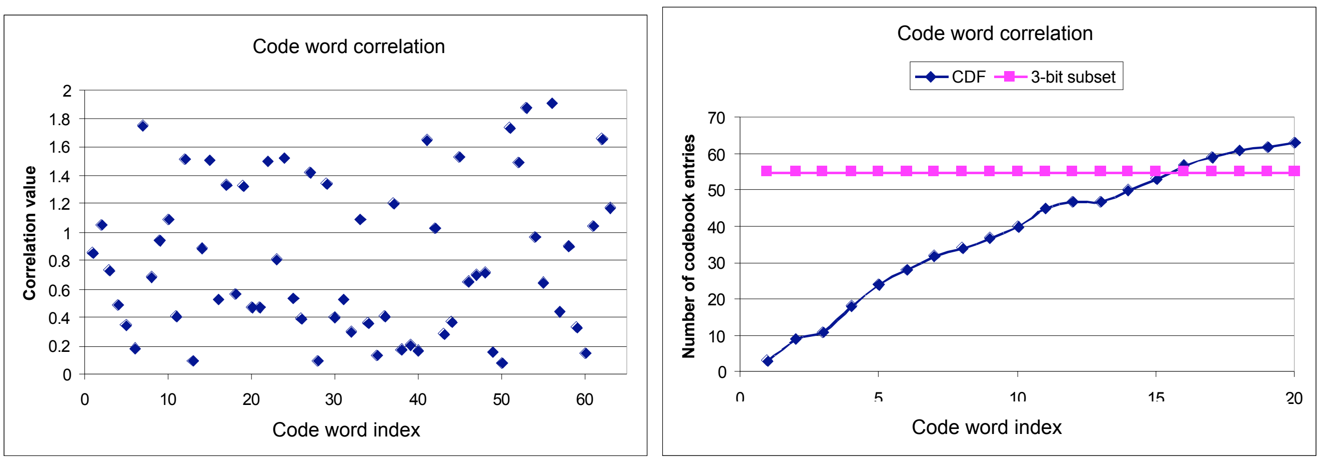

Figure 1. (Left) typical code word correlation vs addressing indexing, (Right) Correlation based addressing

As we can see for a 64 code words code-book, given a codeword, only 8 code-words are highly correlated. In this case, the proposed addressing method can reduce the code word feedback index form 6 to 3.

2 Proposed Text Change

Insert text in section 8.4.8.3.6

--------- *Start text* --------------

The mapping o the index of the unitary pre-coding codebook and codeword can be determined by using the criterion such that for any index j its associated codeword $c(j)$ satisfies the condition such inner product of $c(j)$ and $c(j+k)$ i.e. $\langle c(j), c((j+k) \bmod L)\rangle \le T$, *k=1,2,…8.L* is the codebook size and *T* is a constant. In this case, the offset index *k* is sent to the BS with CQICH channel to allow the BS to reconstruct the codebook index as *j+k* where *j* is the precious codebook index.

~~These unitary precoding matrices are quantized according to a code book described below. Let *L=64* denote the total number of entries in the codebook. Given a 2 x *Mt* matrix *U* = [*I U'*], *Mt* x *Mt* diagonal matrices~~

$$[C_k]_{m,m} = e^{\frac{j2\pi}{\sqrt{L}}[U]_{k,m}}, k = 1,2; m = 1,\ldots,M_t; C_k^{\sqrt{L}} = I$$

and *Mt* x *B* matrix *Y* (*B*<=*Mt*), the entries in the codebook are given as: $W_l = C_1^{l_1} C_2^{l_2} Y$, with $l = [l_1 \quad l_2]$, and *li* are elements in the ring of integers mod $\sqrt{L}$. The elements, , of the basis matrix *Y* is given by:

Where is a selection of distinct indices from the set . The elements of the matrix *U'* and the column subset selection for *Y* will be further specified. The mapping of the codeword index *i* *(i=1,2,…L)* and *l (l=1,2….L)* is list in Table aaa.

Table aaaa

i	1	2	3	4	5	6
l	TBD	TBD	TBD	TBD	TBD	TBD

--------- *End text* ------------------