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Title	**UCD for CL-MIMO**
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Re:	Contribution to support a Comment on the DL-MIMO Rapporteur group final draft: C802.16m-08/657r2.
Abstract	This document describes a proposal for 802.16m DL or UL CL-MIMO
Purpose	To be discussed and adopted by 802.16m SDD.
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UCD for CL-MIMO

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1. Introduction

Typical rank-2 operation decomposes the channel using SVD and transmits on the two eigen-subchannels. This orthogonalization of the channel may cause reduced performance in practical implementations which do not use matched MCS to each singular vector especially in SCW.

The problem can be solved by carefully rotating the eigen-subchannels such that the two subchannels become two layers with identical output SINR when decoded using successive interference cancellation (SIC) receiver. This is the underlying idea of the method called uniform channel decomposition [1]. Although original UCD idea was proposed assuming SIC detection, it also allows the use of a ML decoder. The complexity of the precoder calculation for UCD is only slightly more than SVD.

[1] "**Uniform Channel Decomposition for MIMO Communications**," IEEE Transactions on Signal Processing, vol. 53, pp. 4283 - 4294, November 2005   Y. Jiang, J. Li, and W.W. Hager,

2. Rank Adaptation with UCD

Here we propose to use this method in a practical CL-MIMO operation. The MS or BS decides on the best rank for the transmission according to the channel, SINR and other considerations using for example a capacity criterion.

In case of rank-1 transmission the strongest singular vector is used. In case of rank-2 transmission the precoder is calculated based on the UCD method.

In order to calculate UCD, knowledge of the channel right singular vectors and singular values is required.

This is best facilitated in FDD by the MS feeding back analog feedback of the channel or channel covariance matrix. It is also possible to feed back the two singular vectors and the ratio of the singular values.

This can also be facilitated by using codebooks and feeding back for rank-2 one extra value representing the ratio of the singular values.

3. Simulation Results

The following plots shows a comparison of rank-2 transmission between the UCD method and regular SVD in a 2x2 and 2x4 configurations using the GSM TU channel. One precoder per 9 subcarriers (bin) is used and 6bps/Hz is the combined two stream spectral efficiency.
The gain of UCD is apparent.

2x2 TU, 8bin/band, 8precoders/band, 6bps/Hz

4x2 TU, 8bin/band, 8precoders/band, 6bps/Hz
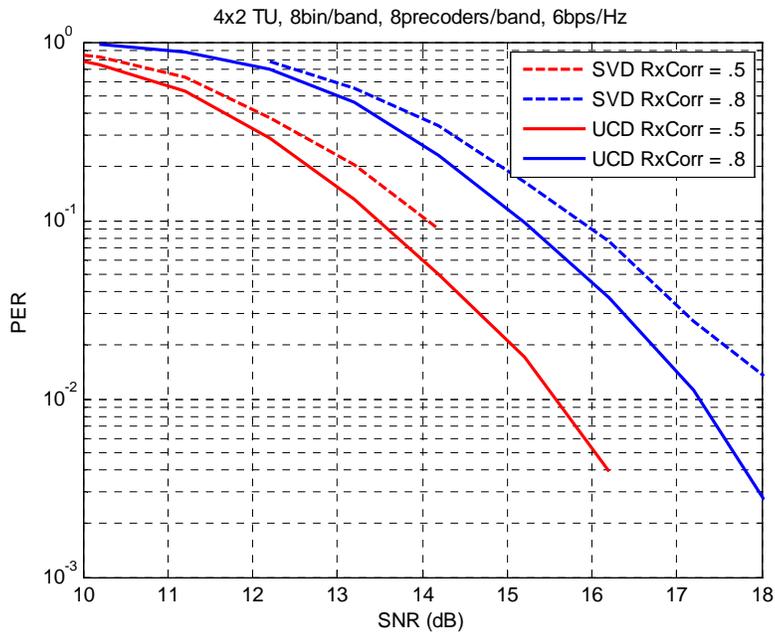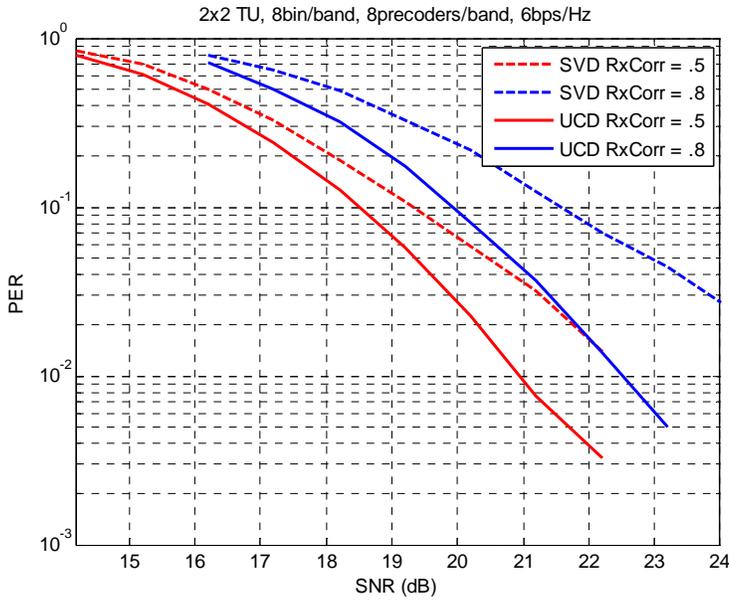
4. Recommendation

Based on the above we recommend to include UCD based precoding in the DL MIMO SDD.