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Re:	Call for Comments on Project 802.16m System Description Document (SDD), IEEE 802.16m-08/052 (Interference mitigation section)	
Abstract	This contribution provides the PMI restriction scheme for IEEE 802.16m Interference mitigation	
Purpose	For discussion and approval by TGM	
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PMI Restriction with Adaptive Feedback Mode

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1. Introduction

PMI coordination (restriction or recommendation) has been adopted in order to mitigate inter-cell interference from adjacent cells, particularly for the case of codebook based closed-loop MIMO [1].

Here, we have evaluated the performance of PMI restriction when the adaptive feedback mode [2] is applied to the closed-loop SU-MIMO. From the evaluation results, the PMI for neighboring cell shall be reported based on the base codebook whether or not the adaptive feedback mode is used at the neighboring cell.

2. Impact of adaptive feedback mode on PMI restriction

In the previous meeting, it has been agreed that long term CSI (Channel State Information) such as channel covariance matrix of received signal can be exploited in order to enhance system throughput performance when codebook based precoding is applied for closed-loop MIMO. So, we have total three feedback modes in DL MIMO section: standard mode, differential mode and adaptive mode.

In differential mode, there are two kinds of candidates, currently. First candidate of differential mode makes the codebook entity of base codebook to be differentially rotated so that the total number of codebook size is increased. Therefore, it is not suitable for the differential mode to be used together with PMI coordination since the MS does not know differential codebook entries of the interfering BS exactly. So, we recommend using this differential feedback mode as an option mode only for a special MS who wants to increase throughput. In the second candidate of differential mode, its codebook entries are the same as those of standard feedback mode, that is, base codebook.

In adaptive mode, the codebook entity is transformed by the long term CSI. The long term CSI is calculated by averaging covariance matrix of the channel. In other words, it means that it is difficult to restrict the long term CSI from the MS side. Moreover, the transformed codebook can be treated as a huge codebook. Only part of the total codebook entries is used for each transmission to individual MS. Therefore, to enable PMI coordination in case of huge codebook, the number of restricted or recommended codebook entity shall be enlarged as codebook size increases. This requires much higher feedback overhead from the MS side. Accordingly, the adaptive feedback mode has the possibility to make degradation of PMI restriction performance in ICI mitigation. But, thanks to the property of adaptive codebook whose codebook entity is transformed by the long term covariance matrix, the restricted or recommended PMI can be reported only within base codebook.

In this contribution, we investigate the performance of PMI restriction in adaptive feedback mode.

3. Evaluation results

Table 1 shows the basic simulation parameters for the SLS evaluation in order to know the impact of the adaptive feedback mode on the PMI restriction performance.

Table 1. Basic parameters

Parameter	Assumption
Cellular Layout	19 cell, 3 sectors per cell
Inter-site distance (ISD)	1500m
Fading Channel	IEEE 802.16m ITU-PEDB
MS speed	3 km/h
Center frequency	2.5GHz
Bandwidth	10 MHz
Number of MS per Sector	10
Feedback delay for serving BS	3 subframes
Channelization	CRU
Subframe_duration	0.617 ms
Antenna configuration	[2Tx, 2Rx], [4Tx, 2Rx]
Receiver type	MMSE
Codebook	IEEE 802.16e 2Tx and 4Tx 3bit codebook
Period of Restricted PMI / Backbone delay	20ms / 40 ms

Table 2. Gain of PMI restriction

Num Tx	Antenna Spacing	Metric	Standard feedback mode	Adaptive feedback mode
			Gain of PMI restriction	Gain of PMI restriction
2Tx	4 lambda	Edge throughput	19.7%	10.3%
		Average user throughput	-1.41%	-1.87%
	0.5 lambda	Edge throughput	15.66%	11.95%
		Average user throughput	1.69%	2.81%
4Tx	4 lambda	Edge throughput	22.84%	15.51%
		Average user throughput	-4.87%	-3.54%
	0.5 lambda	Edge throughput	23.61%	11.95%
		Average user throughput	3.14%	2.99%

From table 2, we can figure out that PMI coordination still works with adaptive feedback mode even though the PMI for neighboring cell is calculated based on the base codebook.

3. Trivial issues for PMI coordination implementation

- **Backbone latency**

Backbone latency is not critical issue for the implementation of PMI coordination because the PMI restriction or recommendation technique uses the statistical criterion for the decision of PMI to be restricted or recommended. We had investigated the performance of PMI restriction while changing the backbone delay for SLS evaluation. But, we couldn't find any noticeable change in the PMI restriction performance.

- **Interference signal estimation**

It is important how to measure the adjacent interference signals in the MS side. We need to be very careful when we design downlink reference signal. One possible solution can be found in [3]

- **PMI feedback overhead**

Feedback information for PMI coordination is delivered to the corresponding interfering BSs via serving BS. Feedback period for PMI coordination information will be much longer than that of regular feedback for serving BS as PMI coordination technique shows its robustness to the delay period variation.

4. Conclusion

- In this contribution, we have investigated the impact on the performance of PMI restriction when the adaptive feedback mode coexists with PMI restriction in the CL SU-MIMO through the SLS evaluation.
- We have confirmed through the evaluation results that PMI restriction is still the very effective technique in order to mitigate ICI from adjacent cells for the CL SU-MIMO regardless of the existence of the adaptive feedback mode.
- In order to work with all three feedback mode, we recommend reporting PMI for neighboring cell based on base codebook.

Reference

- [1] C802.16m-08/430r1, "PMI Restriction for the downlink Closed-loop MIMO"
 [2] C802.16m-08/1345, "Transformation method for codebook based precoding"
 [3] C802.16m-09/0018, "MIMO Midamble"

----- Proposed SDD text -----

Line 34-37, page 152

Add the following sentence at the end of the text.

In order to support DL PMI coordination to mitigate inter-cell interference, the AMS shall be capable to measure the channel from the interfering ABS, calculates the worst or least interfering PMIs, and

feedbacks the restricted or recommended PMIs to the serving ABS together with the associated ABS IDs or information assisting in determining the associated ABS IDs. PMI for neighboring cell is reported based on the base codebook. (cf. 11.8.2.1.3 and 11.8.2.2.3.2)

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