Issues with MU-MIMO CQI Definition (Section 15.3.9.3.1.3 / Comment A1222)

IEEE 802.16 Presentation Submission Template (Rev. 9)

Document Number:
C802.16m-09/2536

Date Submitted:
2009-11-13

Source:
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*http://standards.ieee.org/faqs/affiliationFAQ.html

Venue: Session #64 - Atlanta Meeting

Re: P802.16m/D2 comments for LB30a
Area: Section 15.3.9.3.1.3 – Uplink Control Channel

Purpose:
This contribution proposes a modification to the CQI definition for DL MU-MIMO feedback modes.

Issues with MU-MIMO CQI Definition

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CQI Reporting for MU-MIMO

- The following text in IEEE P802.16m/D2 defines CQI calculation at the AMS for MU-MIMO feedback modes:

  "For MU-MIMO feedback modes with codebook-based feedback, the CQI is calculated at the AMS assuming that the interfering users are scheduled by the serving ABS using rank-1 precoders orthogonal to each other and orthogonal to the rank-1 precoder represented by the reported PMI."

- The disadvantages of this CQI definition for MU-MIMO are as follows:
  - The definition only covers codebook-based feedback, and it does not extend to sounding or correlation MTX feedback methods, where PMI is not reported by the AMS
  - The definition is not fully defined as it is not clear what orthogonal precoders are to be used for the CQI calculation.
  - MU-MIMO TX weights (rank-1 precoders) in general are not orthogonal and are unknown to the AMS at the time of its MU-MIMO CQI calculation.
  - The number of users paired in an MU-MIMO allocation are also unknown to the AMS at the time of its MU-MIMO CQI calculation.
  - This definition complicates AMS compliance testing, since the proposed CQI calculation is quite complex and not fully defined.

- In summary, AMS does not possess sufficient information on the MU-MIMO scheduling process to compute an accurate MU-MIMO CQI estimate as currently specified.

Proposal

- We propose to allow the ABS to have the option of taking over the task of MU-MIMO CQI calculation.

- The AMS reports a rank-1 SU-MIMO CQI assuming no pairing of other users in its MU-MIMO allocation.
- Based on the exact knowledge of TX weights and users paired, the ABS transforms the reported SU-MIMO CQI into the required MU-MIMO CQI.
- The exact transformation method is implementation specific, but several well-known methods exist in the literature.

Proposed Text Changes (1 of 3)

[Modify the text on page 502, lines 39-42 as follows:]

For MU-MIMO CQI feedback, two CQI measurement modes at the AMS are supported. The CQI measurement mode is indicated to the AMS in the Feedback Allocation A-MAP IE or Feedback Polling A-MAP IE. Under the first MU-MIMO measurement mode, the CQI is calculated at the AMS assuming that the interfering users are scheduled by the serving ABS using rank-1 precoders orthogonal to each other and orthogonal to the rank-1 precoder represented by the reported PMI. Under the second MU-MIMO measurement mode, the CQI is calculated at the AMS assuming rank-1 transmission from the ABS and assuming no MU-MIMO user pairing. For codebook feedback, the CQI is calculated assuming rank-1 transmission based on the PMI index signaled from the AMS to the ABS."

Proposed Text Changes (2 of 3)

[Modify Table 818 on page 394 as follows:]

If (MFM == 0,1,2,5){		
Measurement Method Indication	[1]	0b0: Use the midamble for CQI measurements 0b1: Use pilots in OL region with MaxMt streams for CQI measurement
}		
If (MFM == 6,7){		
MU-MIMO CQI Measurement Mode	[1]	0b0: Use MaxMt orthogonal rank-1 precoders for MU-MIMO CQI 0b1: Use rank-1 SU-MIMO CQI as MU-MIMO CQI
}		
Padding	*Variable*	Padding to reach byte boundary

Proposed Text Changes (3 of 3)

[Insert the following text following line 30 on page 395 as follows:]

- **Measurement Method Indication**: This field indicates the use of midamble or pilots for CQI measurement.
- **MU-MIMO CQI Measurement Method**: This field indicates the method used to calculate MU-MIMO CQI at the AMS.

[Modify Table 821 on page 400 as follows:]

If (MFM == 3,4,6,7){		
CM	[TBD]	[TBD]
CS	1	0b0: report PMI from the base codebook 0b1: report PMI from the codebook subset
MU-MIMO CQI Measurement Mode	[1]	0b0: Use MaxMt orthogonal rank-1 precoders for MU-MIMO CQI 0b1: Use rank-1 SU-MIMO CQI as MU-MIMO CQI
}		
if (MFM == 0,1,2.5){		