Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**E-MBS feedback channel for adaptive E-MBS**
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Re:	PHY aspects of enhanced MBS; in response to the TGm Call for Contributions and Comments 802.16m-08/033 for Session 57
Abstract	This contribution describes several consideration points in E-MBS feedback channel for adaptation of E-MBS.
Purpose	To be discussed and adopted by TGm for use in the IEEE 802.16m SDD
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E-MBS feedback channel for adaptive E-MBS

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1. Introduction

The current 802.16e reference system has no specific MBS feedback so that there is no adaptive mechanism to adjust the MCS of MBS to obtain the optimal quality. In this paper, it is shown that adaptive modulation and coding (AMC) based on statistical NACK feedback information is an efficient method to improve the performance of E-MBS.

2. Adaptive E-MBS

2.1. AMC on E-MBS based on statistics

E-MBS packets are received by multiple users who are in different channel quality, thus it is impossible to employ the usual link adaptation such as MCS level adjusting and power control based on dedicated CQI feedback and ACK/NACK feedback information. The one possible way to adjust the MCS level of E-MBS packets is based on the channel quality information obtained when BS and MS has connection for unicast data. However, this method has trouble because of users in idle mode. Channel quality information of idle mode users are not available.

Another possible method is the use of responses for QoS E-MBS from MSs. NACK is proper response to E-MBS QoS since it is as light as 1~2bit per E-MBS service and its statistical information is directly used for BS to adapt the MCS level of E-MBS packet. MS who is not satisfied with E-MBS service can report NACK to BS through E-MBS feedback channel, and then BS can determine the most appropriate MCS level based on statistics of these NACK feedbacks from unsatisfied MSs.

2.2. Simulation results

Adaptive E-MBS and non-adaptive MBS are compared in terms of throughput in several cases as shown in Table 1. The former outperforms the latter since time varying statistics of QoS of multiple users can be come up with. Error-free E-MBS feedback was assumed in this simulation.

		1 MS	**3 MS**	**5 MS**	**7 MS**	**10 MS**	**15 MS**
Cell radius 1.5km	**Throughput gain**	18.6%	11.60%	5%	4.90%	6.73%	4.84%
	Average coverage	97.89%	96.55%	95.86%	95.79%	95.32%	95.53%
Cell radius 3km	**Throughput gain**	31.90%	24.90%	20%	21.48%	22.80%	9.00%
	Average coverage	96.60%	95.40%	95.50%	95.44%	95.20%	95.35%

Table 1 Performance comparison of adaptive E-MBS and non-adaptive MBS in terms of throughput and coverage.

3. Requirement of E-MBS feedback

Multiple bit contention based opportunities are allocated for E-MBS feedback per MBS service because NACK signal consists of 1~2bit and anonymous feedbacks from multiple MS can take a place. For contention based E-MBS feedback channel, multiple codes are provided as in ranging channel for MS to send NACK to BS. BS counts the number of codes transmitted through E-MBS feedback channel to detect the portion of unsatisfied MSs among whole E-MBS MSs.

As the minimum QoS requirements of MBSFN system are 1 % PER and 95% coverage and only MSs which are not satisfied with QoS requirement sends NACK signal through E-MBS feedback channel, the recommended number of codes is about 10% of the total number of E-MBS MSs. As shown in Table 2, the coverage varies from 85% to 100% during the adaptation of E-MBS. Therefore the number of code corresponding to 15% of the total number of MSs is enough to detect NACK feedback efficiently.

		1 MS (per sector)	3 MS	5 MS	7 MS	10 MS
1.5km	**Max coverage**	100%	98.83%	99.65%	98.75%	98.60%
	Min coverage	87.72%	92.40%	91.23%	92.73%	93.16%
3.0km	**Max coverage**	100%	100%	98.60%	98.50%	98.50%
	Min coverage	85.56%	90.06%	89.47%	92.23%	93.68%

Table 2. Variations of coverage in AMC procedure

Feedback error of E-MBS feedback channel decreases the gain of adaptive E-MBS. Figure 1 and 2 show the performance loss of adaptive E-MBS from throughput and coverage points due to detection error.

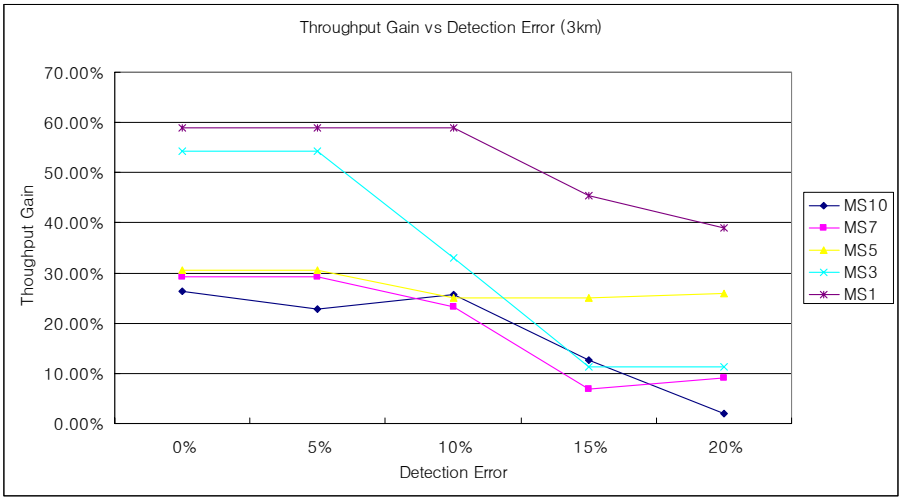

Figure 1.The loss of throughput gain due to detection error

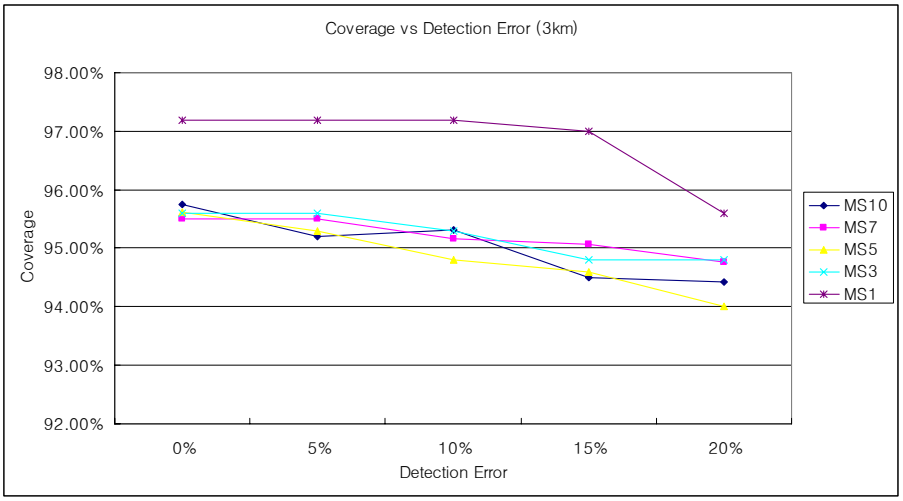

Figure 2.The variation of coverage due to detection error

As shown in Figure 1 and 2, detection error of E-MBS feedback channel shall be below 10%.

4. Conclusion

Here is a summary of our proposals on E-MBS feedback.

- Adaptive E-MBS using NAKC feedback shall be supported to improve performance.
- E-MBS feedback channel shall be defined as contention based channel using orthogonal codes representing NACK signal.
- The required number of orthogonal code: about 15% of the total number of MS
- The tolerance limit of feedback detection error: <10%

Text Proposal for the 802.16m SDD

========== *Start of Proposed Text*
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11.9.1.6 E-MBS feedback

E-MBS feedback provides information for DL MBS transmission to one or multiple cells. Details are TBD.

NACK signal is sent back from MS which are not satisfied with QoS requirement.

E-MBS feedback channel is based on contention using multiple codes.

The structure of E-MBS feedback channel is FFS.

========== *End of Text Proposal* ==========