Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>
Title	Proposed Text on Link-to-System Mapping for Project 802.16m Evaluation Document
Date Submitted	2007-05-0~~3~~4
Source(s)	Wookbong Lee wbong@lge.com Jinsoo Choi emptylie@lge.com Jin Sam Kwak samji@lge.com Yeong-Hyeon Kwon wishwill@lge.com Sungho Moon msungho@lge.com Ronny (Yong-Ho) Kim ronnykim@lge.com LG Electronics Inc. LG R&D Complex, 533 Hogye-1dong, Dongan-gu, Anyang, 431-749, Korea Voice: +82-31-450-7903 Fax: +82-31-450-7912
Re:	IEEE 802.16m-07/014r1 Call for Comments on Draft 802.16m Evaluation Methodology Document
Abstract	This contribution proposes a specific text on Link-to-System Mapping session - in the IEEE 802.16m requirement document.
Purpose	For discussion and approval by TGM
Notice	
Release	
Patent Policy and Procedures	

Proposed Text on Legacy Support for P802.16m Requirements

Wookbong Lee, Jin Soo Choi, Jin Sam Kwak, Yeong-Hyeon Kwon,
Sungho Moon, and Ronny (Yong-Ho) Kim
LG Electronics Inc.

Abstracts

This document provides several simulation results which show EESM is a quite accurate method with very simple calculation. We propose to use ESM PHY abstraction method as an ESM PHY abstraction.

Simulation Results

The EESM is simply given by

$$SINR_{eff} = -\beta \ln\left(\frac{1}{N}\sum_{n=1}^{N}\exp\left(-\frac{SINR_n}{\beta}\right)\right)$$

where *N* is the number of transmitted codeword bits, β is a value for optimization.

The following is an example of the verification of EESM method.

The βs are same as in [1]

QPSK β = 0.413 * ER + 1.3661 (1.45 to 1.71 for ER=1/5 to 5/6)

16QAM β = 4.4492 * ER * ER + 4.5655 * ER + 1.2982 (2.39 to 8.19 for ER=1/5 to 5/6)

64QAM β=4.1182 * exp(2.4129 * ER) (6.67 to 30.76 for ER=1/5 to 5/6)

where ER is effective encoding rate.

[1] "LTE Downlink System Performance Evaluation Results," R1-061626, May 2006.

Suggested Remedies

[Remedy 1: <u>Add reference [xxx].</u> Delete subsection 5.1.2.1., and replace the subsection 5.1.2.2 as follows:]

<u>[xxx] "LTE Downlink System Performance Evaluation Results," R1-061626, May 2006.</u>

5.1.2.2. Exponential ESM (EESM)

The EESM is simply given by

$$SINR_{eff} = -\beta \ln\left(\frac{1}{N}\sum_{n=1}^{N}\exp\left(-\frac{SINR_n}{\beta}\right)\right) \quad (10)$$

where $SINR_n$ is the ~~per-tone SINR~~<u>post processed *SINR* for nth transmitted coded bit</u>, *N* is the number of transmitted ~~sub-carriers~~<u>coded bits.</u> and β is a value for optimization/adjustment.

The β s are same as in [xxx]
QPSK β = 0.413 * ER + 1.3661 (1.45 to 1.71 for ER=1/5 to 5/6)
16QAM β = 4.4492 * ER * ER + 4.5655 * ER + 1.2982 (2.39 to 8.19 for ER=1/5 to 5/6)
64QAM β =4.1182 * exp(2.4129 * ER) (6.67 to 30.76 for ER=1/5 to 5/6)
where ER is effective encoding rate.

~~[xxx] "LTE Downlink System Performance Evaluation Results," R1-061626, May 2006.~~

[Remedy 2: change section 5.4.2 as followings:]

5.4.2. The Case of Repeated Bits/Symbols

This section details a method to handle symbol/coded bit repetitions accurately. Depending on the rate matching algorithm used, every H-ARQ transmission could have a set of new parity bits and other bits that are repeated. ~~Accumulating the mutual information is appropriate as long as new parity bits are transmitted in every symbol. Otherwise, the receiver combines the demodulation symbols or, more typically, the LLRs. In this section, we consider a rate-matching approach that does pure IR transmissions and involves coded bit repetitions once all the coded bits from a base code rate are exhausted.~~
The effective SINR for kth transmission can be calculated as follows :

~~To handle this case, we consider a code-block transmission of N_{NR} symbols that are not repeated, and a set of N_R symbols (or coded bits) that constitute repeated coded bits. We assume that the block of N_R symbols/coded bits have SINR {$SINR_{R,i}$} $i=1,\ldots,N_R$. Note that if the $SINR_{R,i}$ corresponds to the SINR of the repeated coded bits, then we can take $m_{R,i}=1$.~~

$$SINR^1_{eff} = -\beta \ln\left(\frac{1}{|U_1|}\sum_{n\in U_1}\exp\left(-\frac{SINR_{n,1}}{\beta}\right)\right)$$

$$SINR^k_{eff} = -\beta \ln\left(\frac{1}{|U_k|}\left(|U_{k-1}|\sum_{n\in U_{k-1}}\exp\left(-\frac{1}{\beta}\left(SINR^{k-1}_{eff}+I_{n,k}SINR_{n,k}\right)\right)+\sum_{n\in V_k\setminus U_{k-1}}\exp\left(-\frac{SINR_{n,k}}{\beta}\right)\right)\right)$$

Where $SINR^k_{eff}$ is kth transmission's effective SINR, $SINR_{n,k}$ is kth transmission's post processed SINR for bit index n, V_k is the set of indices where a coded bit was transmitted on kth transmission, $I_{i,k}$ is an indicator function for codeword bit index i for the set V_k, ($I_{i,k}$ = 0 for $i \notin V_k$, and $I_{i,k}$ = 1 for $i \in V_k$), and U_k is the unique bit indices transmitted up to transmission k, $U_k = \bigcup_{j=1}^{k} V_j$.

~~We can then compute an effective SINR using the weight sum of the repeated and non- repeated effective SINR as follows:~~

~~Here, $_bI$ corresponds to the coded-bit level mutual information using all the non- repeated bits, defined by either Equation (5) or (7), and~~
~~∑~~

~~is the total number of coded bits of the non-repeated portion, each symbol transmitted with modulation order {m_i} $i=1,\ldots,N_{NR}$. The function $f^{-1}(\cdot)$ is the mapping from bit SINR to mutual information per bit that is used by a given link-system mapping method. This effective bit-level SINR can be used to compute the PER by looking up the PER curve corresponding to an effective code rate obtained from only the non-repeated portion of the coded bits.~~

This method involves computing ~~the mutual information, or~~ the effective SINR, at the coded-bit level, which can be easily computed in a recursive fashion using the ~~mutual information~~effective SINR of a previous block of bits and the current ~~vector of symbol~~post processed SINRs. The modification to include repetition is of low-complexity, and can work with any bit-level or symbol-level link to system mapping methodology.~~]~~