Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Corrections to fast DL S/N measurements**
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Re:	IEEE P802.16e/D8
Abstract	This contribution corrects some problems with fast DL S/N measurements on enhanced fast-feedback channels.
Purpose	Discuss and approve.
Notice	
Release	
Patent Policy and Procedures	

Introduction

802.16-2004 defines mechanisms for the MS to feedback measurements of the DL S/N on a fast-feedback channel. This type of fast feedback is termed "CQICH" (channel quality indication). The MS can be requested to send a S/N measurement via several means, including: sending a Fast Feedback subheader, and sending a CQICH Allocation IE in the UL-MAP.

In an 802.16-2004 fast-feedback channel, 4 bits of information are encoded into a single slot; consequently only 16 different S/N values can be sent on a CQICH. In 802.16-2004, the range of S/N that can be reported is -2 to +26 dB in 2 dB steps.

In P802.16e/D8, an enhanced fast-feedback channel is defined that encodes 6 bits into a slot. The draft also defines new mechanisms for requesting the MS to report DL S/N on this enhanced fast-feedback channel (including an "Enhanced CQICH Allocation IE"), and indicates how the S/N value is to be encoded. However there are a number of problems with the draft:

1) It is not clearly stated if requesting a report via the (old) CQICH Allocation IE should result in 6-bit S/N feedback, although this seems to be intent.

2) The section that specifies the S/N coding (8.4.5.4.10.5) contains a number of errors and ambiguities, in particular,

    a. It is not clearly stated which encoding formula is supposed to be used in which cases;

    b. The encoding formulas make use of Nr (number of MS receive antennas) which is not always known by the BS (for example, if the MS has 2 antennas, but does not support receiving either STC matrix A or B, then there is no way for the MS to indicate the number of its antennas in the "OFDMA SS Demodulator for MIMO Support" IE in SBC).

    c. Several minor errors, e.g. incorrect cross-references.

    These problems could result in the BS mis-interpreting the S/N value reported by an MS, which would have a negative impact on system operation.

In the proposed changes, we clarify the text in 8.4.5.4.10.5. To eliminate the dependency on Nr in the coding formulas, we introduce an explicit "S/N base" value, which is sent to the MS in the REG-RSP, and used by the MS in the encoding formulas. This allows the BS to insure that the MS's S/N reports cover the numerical range of interest regardless of the antenna configurations. This is a robust approach that will future-proof this important function.

Proposed text changes:

[Replace the contents of 8.4.5.4.10.5 (page 328, line 33 thru page 329, line 19) with the following text]:

When the FAST_FEEDBACK allocation subheader Feedback Type field is 0b00 or the MIMO_Permutation_Feedback_Cycle field in the CQICH_Alloc_IE() is 0b00 (see section 8.4.5.4.12), or the Feedback_type field in CQICH_Enhanced_Alloc_IE() is 0b000-0b011 with CQICH type 0b000, 0b001 or 0b100 (see 8.4.5.4.15), the MS shall report the S/N it measures on the DL. The following formula shall be used:

$$payload\_bits = \begin{cases} 0, & S/N \quad B \\ n, & (n \quad 1 \quad B) \quad S/N \quad (n \quad B), \quad 0 \quad n \quad 31 \\ 31, & S/N \quad 30 \quad B \end{cases}$$

When the Feedback_type field in CQICH_Enhanced_Alloc_IE() is 0b000 with CQICH type 0b101 the following formula shall be used:

$$payload\_bits = \begin{cases} 0, & S/N \quad 1 \quad B \\ n, & (2n \quad 1 \quad B) \quad S/N \quad (2n \quad 1 \quad B), \quad 0 \quad n \quad 15 \\ 15, & S/N \quad 29 \quad B \end{cases}$$

where B is the positive integer value indicated in the SN Reporting Base IE (see 11.7.27). B shall default to "3" if the SN Reporting Base IE was not included in the REG-RSP.

The BS may allocate one or multiple CQICH channels to the MS in UL_MAP for the purposes of Fast DL Measurement. If a single CQICH is allocated, MS shall report the average post processing S/N. If more than one CQICH is allocated, the MS shall report post processing S/N of individual layers in order of layer index.

[On page 527, line 21, insert new subclause 11.7.27]:

11.7.27 SN Reporting Base

SN Reporting Base indicates the (negative of the) base value that the MS shall use in sending fast DL measurement feedback on an enhanced fast-feedback channel.

Type	Length	Value	Scope
-	1	A positive integer in the range 0-255; the base value used in reporting shall be the negative of this value.	REG-RSP