

Project	<b>IEEE 802.16 Broadband Wireless Access Working Group</b> < <a href="http://ieee802.org/16">http://ieee802.org/16</a> >
Title	<b>Power Control of Uplink AAS Preamble</b>
Date Submitted	<b>2005-01-11</b>
Source(s)	Inseok Hwang, Jaehee Cho, Seungjoo Maeng, Jaeho Jeon, Soonyoung Yoon, Jeong-Heon Kim, Jaehyok Lee, Myungkwang Byun, Panyuh Joo, Jiho Jang, Sanghoon Sung, Hoon Huh, janghoon yang, Samsung Electronics Co. Ltd. <a href="mailto:is91.hwang@samsung.com">is91.hwang@samsung.com</a>
Re:	Recirculation of P802.16 REVe/D5a
Abstract	Accurate spatial channel estimate is essential for AAS operation. For this end, framework for uplink AAS preamble power control is proposed.
Purpose	Adoption of suggested changes into P802.16e/D6
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures (Version 1.0) < <a href="http://ieee802.org/16/ipr/patents/policy.html">http://ieee802.org/16/ipr/patents/policy.html</a> >, including the statement "IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard."  Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair < <a href="mailto:r.b.marks@ieee.org">mailto:r.b.marks@ieee.org</a> > as early as possible, in written or electronic form, of any patents (granted or under application) that may cover technology that is under consideration by or has been approved by IEEE 802.16. The Chair will disclose this notification via the IEEE 802.16 web site < <a href="http://ieee802.org/16/ipr/patents/notices">http://ieee802.org/16/ipr/patents/notices</a> >.

## Problem Definition

The main purpose of uplink AAS preamble is for spatial signature estimation, which is necessary for deciding uplink demodulation beam-vector and downlink transmit beam-forming vector. In the current text, the normalized power level of AAS preamble is equal to that of the following data sub-carriers and 4 (PUSC), 3 (O-PUSC) and 9 (AMC, 1 × 6 type) consecutive tones in one AAS preamble is a minimal processing block for spatial signature estimation. Thus, the processing gains are 6.0, 4.7 and 9.5 dB, respectively. Although these gains are acceptable for SISO reception, more accurate estimation is required if we consider power control scenario in multiple antenna diversity reception in uplink since the SS's transmit power level decreases as the uplink antenna combining gain increases. In other words, the antenna combining gain is not applied for spatial signature estimation itself and therefore the boosting of uplink AAS preamble is required for better spatial channel estimate. The requirement for spatial signature estimation errors becomes more stringent when computationally efficient zero-forcing beam-forming algorithm is employed for SDMA operation.

## Proposed Solution

The main purpose of this contribution is to provide a flexible power control mechanism for UL AAS preamble. In the current text, the power level of data sub-carrier in UL is determined by equation (135) in 8.4.10.3.

$$P_{Data} = L + (C/N) + NI - 10 * \log_{10}(R) + Offset\_SS_{perSS} + Offset\_BS_{perSS} \quad (135)$$

where,

$P_{Data}$ : Tx. Power level (dB<sub>m</sub>) per a sub-carrier for current data transmission

L: Estimated current UL propagation loss including SS/BS antenna gain and path loss

(C/N): Required normalized C/N of the modulation/FEC rate for the current transmission in Table 332, which can be modified by UCD (Normalized C/N override)

R: Number of repetitions for the modulation/FEC rate

NI: Estimated average power level (dB<sub>m</sub>) of the noise and interference per a sub-carrier at BS

Offset<sub>SS</sub><sub>perSS</sub>: Correction term for SS-specific power offset controlled by SS. Initially zero.

Offset<sub>BS</sub><sub>perSS</sub>: Correction term for SS-specific power offset controlled by BS with correction message. Initially zero.

For control of normalized transmit power of uplink AAS preamble, predefined upper bound and the predefined lower bound is introduced in normalized C/N Table 332. Then, if the required (C/N) value of the current transmission, excluding code repetition factor, is between the predefined upper bound and the predefined lower bound, then normalized transmit power of uplink AAS preamble is set to that of the current transmission. Otherwise, the transmit power level of uplink AAS preamble is increased or decreased by the difference between (C/N) excluding code repetition factor and lower bound and upper bound. The LowerBound<sub>AAS\_PREAMBLE</sub>, UpperBound<sub>AAS\_PREAMBLE</sub> are broadcasted in UCD TLV.

$$\begin{cases} P_{AAS\_Preamble} = P_{Data} - (C/N) + 10 * \log_{10}(R) + LowerBound_{AAS\_PREAMBLE} & \text{if } (C/N) - 10 * \log_{10}(R) < LowerBound_{AAS\_PREAMBLE} \\ P_{AAS\_Preamble} = P_{Data} + (C/N) - 10 * \log_{10}(R) - UpperBound_{AAS\_PREAMBLE} & \text{if } (C/N) - 10 * \log_{10}(R) > UpperBound_{AAS\_PREAMBLE} \\ P_{AAS\_Preamble} = P_{Data} & \text{elsewhere} \end{cases}$$

Note that power outage can occur for preamble power boosting. However, there is no amplitude ambiguity for uplink demodulation if we use only pilot tones after receiver beam-forming using the (relative) estimated spatial signature. When QPSK modulation is assigned, phase reference from AAS preamble can be also utilized for uplink demodulation.

The BS operation can be summarized as follows

1. Use UL AAS preamble only for spatial signature estimation.
2. For demodulation of 16 QAM or 64 QAM signals, channel estimation is carried out only with pilot sub-carriers in data symbols after receiver beam-forming.
3. For QPSK demodulation, both beam-formed UL AAS preamble and beam-formed pilot sub-carriers in data symbol can be used.

**Suggested text changes to 16.e standard**

[Add the text as follows somewhere in 8.4.4.6.4 “AAS Uplink Preamble”]

**8.4.4.6.4 AAS Uplink Preamble**

The transmit power level of uplink AAS preamble is equal to that of data sub-carrier determined by Eq. (135) in 8.4.10.3 when the required (C/N) excluding code repetition factor value of the current transmission between the predefined lower bound and the predetermined upper bound. Otherwise, the transmit power level of uplink AAS preamble is boosted or reduced. The predefined lower bound and upper bound are broadcasted in UCD TLV. Thus, transmit power level of AAS preamble can be determined as follows

$$\begin{cases} P_{AAS\_Preamble} = P_{Data} - (C/N) + 10 * \log_{10}(R) + LowerBound_{AAS\_PREAMBLE} & \text{if } (C/N) - 10 * \log_{10}(R) < LowerBound_{AAS\_PREAMBLE} \\ P_{AAS\_Preamble} = P_{Data} + (C/N) - 10 * \log_{10}(R) - UpperBound_{AAS\_PREAMBLE} & \text{if } (C/N) - 10 * \log_{10}(R) > UpperBound_{AAS\_PREAMBLE} \\ P_{AAS\_Preamble} = P_{Data} & \text{else where} \end{cases}$$

(aaa)

where,

$P_{Data}$ : Tx. Power level (dB<sub>m</sub>) per a sub-carrier for current data transmission determined by Eq. (135) in 8.4.10.3

(C/N): Required normalized C/N of the modulation/FEC rate for the current transmission in Table 332.

R: Number of repetitions for the modulation/FEC rate

[Modified Table 332 Normalized C/N table in 8.4.10.3 as follows]

Add “LowerBound<sub>AAS\_PREAMBLE</sub>”, “UpperBound<sub>AAS\_PREAMBLE</sub>” in Table 332.

Table 332 – Normalized C/N per Modulation

Modulation/FEC rate	Normalized C/N
...	
....	
...	
LowerBound <sub>AAS_PREAMBLE</sub>	10 dB
...	
...	
UpperBound <sub>AAS_PREAMBLE</sub>	20 dB

[Modified Table 355 UCD burst profile encodings – WirelessMAN-OFMDA in 11.3.1.1 as follows]

Add “LowerBound<sub>AAS\_PREAMBLE</sub>”, “UpperBound<sub>AAS\_PREAMBLE</sub>” in Table 355.

Table 355 – UCD burst profile encodings – WirelessMAN-OFMDA

Name	Type (1 byte)	Length	Value (variable length)
FEC Code type and Modulation type	150	1	0 = QPSK (CC) 1/2 ... 25 = 64 QAM (ZT-CC) 3/4 <del>26 ~ 255 = Reserved</del> 26 = LowerBound <sub>AAS_PREAMBLE</sub> 27 = UpperBound <sub>AAS_PREAMBLE</sub> <u>28 ~ 255 = Reserved</u>
....			