Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Optional Open Loop Power Control for OFDM**
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Re:	Sponsor Ballot Comment
Abstract	This document proposes a clarification to the OFDM DL subchannelization zone
Purpose	For consideration as a modification to D8 during Sponsor Ballot resolution.
Notice	
Release	
Patent Policy and Procedures	

Optional Open Loop Power Control in OFDM Implementation.

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Introduction

The purpose of this document is to define the optional open loop power control related to the implementation of OFDM UL in the 802.16e/D8 document.

Explanation of Problem

During network's malfunctioning (e.g. high intranet interference levels) the closed loop power control algorithm could be no longer operational or it could request higher transmission power levels from the MS side, thus potentially increasing the interference in the network. In these situations, the closed loop power control algorithm could be no longer operational .

The actual document proposes an optional fall back mode defined as an open loop control algorithm for the UL OFDM mode to fix this problem.

Suggested Remedy

1. Insert the following instruction on p. 263, line 9:
   [Insert a new subheading 8.3.7.4.1 Closed Loop Power Control Mode

2. Insert the following text on p. 263, line 31:

   "[Insert a new subclause 8.3.7.4.2:]

   8.3.7.4.2 Open Loop Power Control Mode (Optional)

When the open loop power control is supported and the uplink power control mode is changed to open loop power control by PMC_RSP, the power per a subcarrier shall be maintained for the UL transmission as follows.

This open loop power control shall be applied for all the uplink bursts.

$$P_{EIRP}(dBm) \quad PL \quad CNR \quad (N \quad I) \quad 10\log_{10} BW_{sch} \quad Offset\_SS_{perSS} \quad Offset\_BS_{perSS}$$

(84a)

Where:

P_{EIRP} is the TX effective isotropic radiated power (EIRP) level, expressed in dBm, per subcarrier for the current transmission. It includes the MS Tx antenna gain and its related coupling losses.

PL is the estimated average current UL path loss.

CNR is the normalized Carrier to Noise Ratio (per subcarrier) for the given modulation, FEC and the related Convolutional Coding scheme used for the current transmission as presented in Table 262a. The normalized Carrier to Noise Ratio can be modified by UCD (Normalized C/N override).

R is the number or repetitive sequences used by the receiving circuitry employed to determine the path losses.

BW_{sch} is the bandwidth occupied by an OFDM subcarrier, expressed in Hz.

N+I is the estimated normalized average power level (dBm) of the noise and interference per subcarrier at the Rx antenna port of the receiving side (BS), for BW=1 Hz. It doesn't include the equivalent gain of the Rx antenna and its related coupling losses.

$Offset_{MS\_UL}$ represents the correction term for SS-specific power offset. Practically it amounts to the desired Fade Margin for the respective UL link. It is controlled by the MS and initially is set to zero.

$Offset_{BS\_UL}$ represents the MS-specific power offset, controlled by the BS through the power control messages. When $Offset_{BS\_UL}$ is set through the PMC_RSP message, it shall include the equivalent BS Rx antenna gain, including its related coupling losses, measured at the antenna port of the equipment.

Modulation/FEC-CC Rate	Normalized CNR [dB]
BPSK 1/2	13.9
QPSK 1/2	16.9
QPSK 3/4	18.65
16QAM 1/2	23.7
16QAM 3/4	25.45
QAM64 1/2	29.7
QAM64 3/4	31.45

Table 262a: Normalized CNR per modulation (BER=1e-6)

The normalized CNR is calculated based on Noise Figure=7 dB and MIL (Modulation Implementation Losses=5 dB)

The estimated average current UL propagation loss, PL_{UL}, shall be calculated based on the total power received on the active subcarriers of the frame preamble, referenced to the BS_EIRP parameter sent by the BS.

Table 262a returns the default normalized CNR values per modulation. The operating parameters BS_EIRP and NI are signaled by a DCD message [Table 358—DCD channel encoding].

Additionally, the BS controls the Offset_BSperSS using PMC_RSP message (6.3.2.3.58) to override t he Offset_BSperSS value or using RNG-RSP(6.3.2.3.6), Fast Power Control(FPC) message (6.3.2.3.34), Power Control IE (8.3.6.3.5) to adjust the Offset_BsperSS value. The accumulated power control value shall be used for Offset_BsperSS.

The Offset_BSperSS can be updated using relative or fixed form (as a function of the relevant adjustment commands used). Fixed form is used when the parameter is obtained from a PMC_RSP message. In this case, the MS should replace the old Offset_BSperSS value by the new Offset_BSperSS sent by the BS. With all other messages mentioned in the previous paragraph, relative form is used. In this case, MS should increase and decrease the Offset_BSperSS according to the offset value sent by BS.

The actual power setting shall be quantized to the nearest implementable value, subject to the specification (specified by TBD). For each transmission, the SS shall limit the power, as required to satisfy the spectral masks and EVM requirements.

Passive Uplink open loop power control
In passive Uplink open loop power control the MS will set Offset_SSperSS to zero and modify the TX power value using Eq. (84a).

Active Uplink open loop power control
An alternative way is that the SS may adjust *Offset_SSperSS* value within a range.

$$\mathrm{Offset\_Bound}_{lower} <= \mathrm{Offset}_{perSS} <= \mathrm{Offset\_Bound}_{upper} \quad (2)$$

Where:

Offset_Boundupper is the upper bound of *Offset_SSperSS*
*Offset_Boundlower*is the lower bound of *Offset_SSperSS"*

3. Update the PMC-REQ and PMC-RSP messages. On page 142, line 31, make the following change:

"This sub-clause is ~~applied only to~~ applicable to the OFDM and OFDMA PHY modes.

On page 142, line 37, make the following change:

"The closed and open loop power control schemes are described in 8.3.7.4 (for OFDM) and 8.4.10.3 (for OFDMA)."

On page 143, line 58, make the following change:

"For OFDM or OFDMA PHY modes ~~only~~, PMC_RSP is sent from BS…"

4. Add another entry to Table 358. On p. 516, line 34, insert the following row:

Name	Type (1 byte)	Length	Value (variable length)	PHY scope
N+I	60	1	The operator will define the N+I (Noise + Interference) based on the related RF system design calculations	OFDM

5. Add new TLV's for negotiating the optional open loop power control message. On page 536, line 35, insert the following text:

“***[Insert new subclause 11.8.3.7.7:]***

11.8.3.7.7 OFDM SS uplink power control support

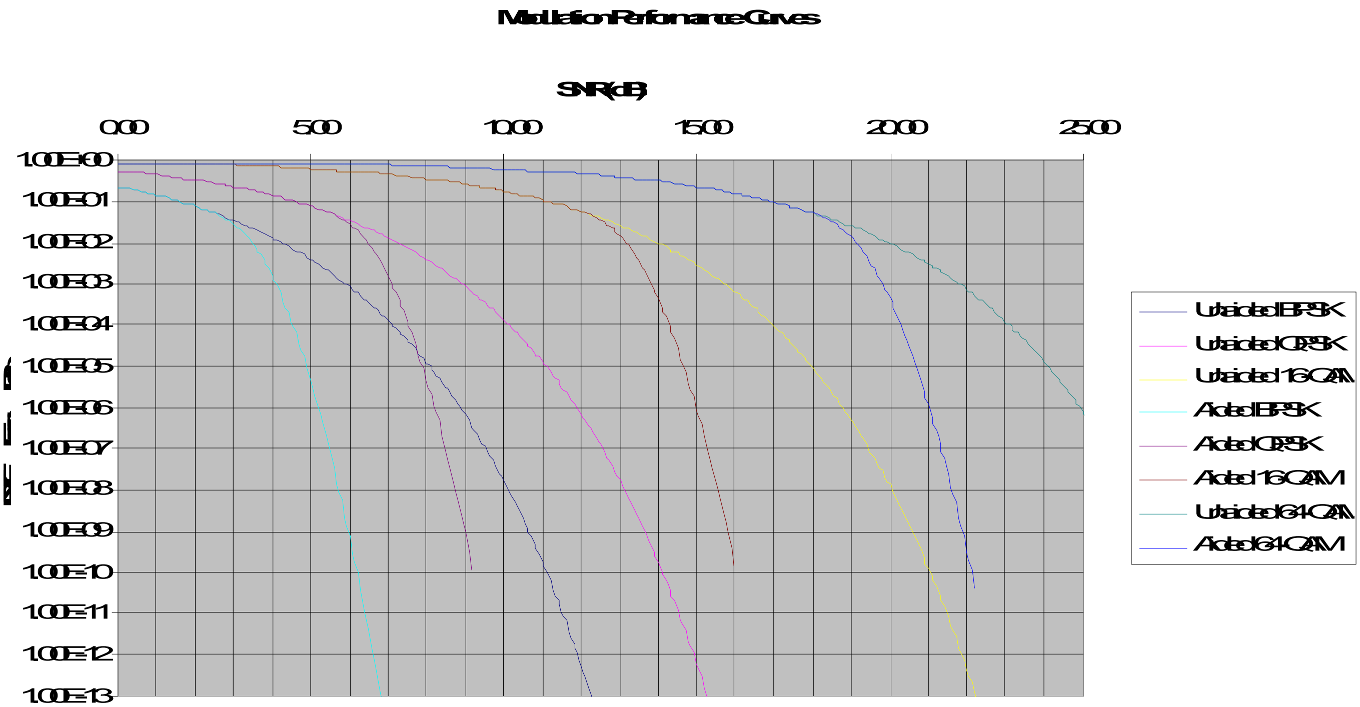
The ‘OFDM SS uplink power control support’ field indicates the uplink power control options supported by a WirelessMAN-OFDM PHY SS for uplink transmission This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported.”

Type	Length	Value	Scope
156	1	Bit #0: Uplink open loop power control support Bit #1: Uplink AAS preamble power control support. Bits #2-7: *reserved*, shall be set to zero.	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)
157	1	The minimum number of frames that SS takes to switch from the open loop power control scheme to the closed loop power control scheme or vice versa.	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)

Appendix

CNR Calculation
Basic assumption: noise limited cell.

CNR=NoiseFloor (20C)+NoiseFigure (20C)+MIL+SNR-CC-NoiseFloor (20C)=NF+SNR+MIL-CC
Where:
CC is the convolutional coding gain calculated
NF is the Noise Figure (20C), expressed in [dB]
MIL are the Modulation Implementation Losses
SNR is the Signal to Noise Ratio (BER=1E-6)



CNR=SNR-CC+12 [dB]
CC (1/2)=3 dB (BER=1E-6)
CC (3/4)=1.25 dB (BER=1E-6)