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Re:	Call for contributions, IEEE P802.16e/D6 Sponsor Ballot
Abstract	This document suggests changes in TGe Draft Document IEEE 802.16e-D6 to define Uplink power control mechanism in order to reduce UL interference in multi-cell deployment.
Purpose	Adopt into the current TGe working draft
Notice	
Release	
Patent Policy and Procedures	

Correction to Power Control for OFDMA PHY

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1 Introduction

A great deal of consideration has gone into designing the power control for the OFDMA PHY in the 802.16e standard. However, there are a number of issues that need clarification or amendment to compliment the work done already.

This contribution is aimed at clarifying the previous PC elements, and organizing those elements and new complementary elements into the complete PC flow.

The contribution is organized as follows: The motivation behind the changes are explained in the next section, followed by an explanation about the changes needed, and finally detailed text changes that need to be implemented.

2 Motivation for the Changes

To simplify the changes needed, this contribution will only address a few issues.

2.1 Open loop power control

Section 8.4.10.3.1 discuses the transmit power of the SS but is missing the value of the transmit power in equation 138a. Moreover, there is no discussion on evaluating the UL path loss and the equation doesn't take into account the possible difference between the Tx and Rx gains of the BS antenna (for example due to beam forming). Another issue that needs clarification is a split into two distinct cases in open loop power control: active mode and passive mode (to restrict unreliable users).

2.2 Initial ranging and periodic ranging

The extensive explanation on initial and periodic ranging is lacking the definition of the transmit power to be used in the ranging process. The 802.16-2004 mechanism doesn't align with the OFDMA zoning limitation. Therefore a common PC process should be implemented in all the different zones of the OFDMA frame.

2.3 Closed loop power control

From the description in section 8.4.10.3, there is no clear definition of closed loop PC. A clear distinction between open loop and closed loop PC needs to be characterized. In addition, the explanation about closed loop power control is incomplete. This contribution will try to clarify these issues.

2.4 Others

To be able to make the above changes, it is necessary to modify the relevant TLV and add missing ones. It is also necessary to have a unified way of looking at power units to prevent confusion.

3 Power control mechanism

3.1 Open Loop Power Control

Each mobile station measures the received signal strength. From this measurement and from information on the link power budget that is transmitted during initial synchronization, the DL path loss is estimated. Assuming a similar path loss for the UL and DL, the mobile uses this information to determine its transmit power. A simplified link budget equation for the downlink can be written:

Equation 1:

$$L_{DL}\ (dB) = P^{sub}_{BS}\ (dBm) - Rx\_RSSI\ (dBm)$$

Where,

L_{DL}	The estimated average current DL propagation loss. It includes Tx/Rx antenna gain and path loss.
P^{sub}_{BS}	BS TX Power level (dBm) per subcarrier for the current transmission of the preamble.
Rx_RSSI	Average received DL RSSI (dBm) per subcarrier at SS. Measured by the SS on the preamble.

Assuming:

Equation 2:

$$L_{DL} = L_{UL} = L$$

The required mobile power per subcarrier to be transmitted is determined by:

Equation 3:

$$P(dBm) = L(dB) + C/N(dB) + NI(dBm) - 10 \log(R) + Offset\_SSperSS + Offset\_BSperSS + RxTxGainComp$$

Where,

P	SS TX Power level (dBm) per subcarrier for the current transmission
L	The estimated average current UL propagation loss. It includes Tx/Rx antenna gain and path loss. Estimated based on Equation 1
C/N	Normalized C/N of the modulation/FEC rate for the current transmission as specified in the UL map IE. The normalized C/N is defined in Table 334.
R	Number of repetitions for the modulation/FEC rate.
NI	Estimated average power level (dBm) of the noise and interference per SS at the BS.
Offset_SSperSS	The correction term for SS-specific power offset, controlled by the SS. Its initial value is zero.
Offset_BSperSS	The correction term for SS-specific power offset, controlled by the BS.
RxTxGainComp	BS RX to TX gains compensation factor that reflects the difference between transmit and receive antenna gains at the BS.

This equation neglects the fact that the mobile's measurement of received base station power is corrupted by DL noise and interference.

To maintain at the BS a power density consistent with the modulation and FEC rate used by each SS, the BS may change the SS TX power as well as the SS assigned modulation and FEC rate. There are, however, situations where the SS should automatically update its TX power without being explicitly instructed by the BS. This happens when the SS transmits in a region marked by UIUC = 0, UIUC = 12, or UIUC = 14. In all these situations, the SS shall use a temporary TX power value set according to Equation 3.

The BS may control the Offset_BSperSS using PMC_RSP message (6.3.2.3.58), Fast Power Control (FPC) message (6.3.2.3.34) and Power Control IE (8.4.5.4.5). In this mode, the power control values delivered by the power control messages from the PMC_RSP that orders a SS to use the open loop power control shall be accumulated.

Passive Uplink open loop power control

In passive Uplink open loop power control the SS will set Offset_SSperSS to zero and modify the TX power value according to Offset_BSperSS only.

Active Uplink open loop power control

An alternative way is that the SS may adjust Offset_SSperSS value within a range:

Equation 4:

$$Offset\_Boundlower \leq Offset\_SSperSS \leq Offset\_Boundupper$$

Where,

Offset_Boundupper Upper bound of power offset adjustment (dB).

Offset_Boundlower Lower bound of power offset adjustment (dB).

Or the Offset_SSperSS may be updated automatically based on the **Ack/Nack** [if enabled at corresponding UL connections] of an uplink burst within the range specified by Equation 4. The specific algorithm is described as follows (in dB):

if NACK is recieved

$$Offset\_SSperSS = Offset\_SSperSS + UP\_STEP$$

else if ACK is received

$$Offset\_SSperSS = Offset\_SSperSS - DOWN\_STEP$$ [1]

else

$$Offset\_SSperSS = Offset\_SSperSS$$

Where,

UP_STEP The up adjustment step (dB)

DOWN_STEP The down adjustment step (dB)

The operating parameters UP_STEP, DOWN_STEP, Offset_Boundupper, Offset_Boundlower are signaled by a dedicated UCD message TLV.

[1] *Note that DOWN_STEP here replaces the original value to simplify the equation, maintaining the original methodology. The BS calculates DOWN_STEP based on* FER_{TARGET}.

3.2 Initial ranging and periodic ranging

Uplink ranging consists of two procedures: initial ranging and periodic ranging. Initial ranging (see 6.3.9.5) allows a SS joining the network to acquire correct transmission parameters, such as time offset and Tx power level, so that the SS can communicate with the BS. Following initial ranging, periodic ranging allows the SS to adjust transmission parameters so that the SS can maintain uplink communications with the BS.
In OFDMA the initial ranging and periodic ranging process begins by sending initial-ranging CDMA codes in the UL allocation dedicated for that purpose. The power adjustment shall start from the initial value selected (PTX_IR_MAX) based on open loop power control calculation methodology addressed previously.

3.3 Closed Loop Power Control (Inner-loop power control / fast power control)

The closed-loop power control is used to compensate for power fluctuations due to fast fading. It is closed loop in that the process involves both the base station and the SS. Once the mobile transmits information to the base station and starts to communicate with the base station, the closed-loop power-control process can operate along with the open-loop power control or separately.

The SS shall use a temporary TX power value set according to the following Equation

Equation 5:

Pnew = Plast + (C/Nnew – C/Nlast) – (10log10(Rnew) – 10log10(Rlast)) + (Offset_BSperSSnew-Offset_BSperSSlast) + (RxTxGainCompnew - RxTxGainComplast)

Where,

Pnew	is the temporary TX Power(dBm) per a subcarrier
Plast	is the last used TX Power(dBm) per a subcarrier. When any power control message has arrived and the TX Power is updated based on the message before the new transmission, Plast is the updated TX Power.
C/Nnew	is the normalized C/N of new modulation/FEC rate instructed by the UIUC, as appearing in Table 334.
C/Nlast	is the normalized C/N of the last used modulation/FEC rate UIUC , as appearing in Table 334

Rnew	is the number of repetitions for the new modulation/FEC rate instructed by the UIUC.
Rlast	is the number of repetitions on the last used modulation/FEC rate.
Offset_BSperSSnew	is the correction for the current transmission term for SS-specific power offset.
Offset_BSperSSlast	is the correction for the last transmission term for SS-specific power offset.
RxTxGainCompnew	BS RX to TX gains compensation factor for the current transmission that reflects the difference between transmit and receive antenna gains at the BS.
RxTxGainComplast	BS RX to TX gains compensation factor for the last transmission that reflects the difference between transmit and receive antenna gains at the BS.

In the closed-loop power control, the base station continuously monitors the uplink and measures the link quality. If the link quality starts to diminish, then the base station commands the SS, by changing Offset_BSperSS, to power up. If the link quality is too good, then there is excess power on the uplink. In this case, the base station commands the SS to power down. Note that in this mode, the Offset_SSperSS is freezed at the original value. The base station should send the power-control adjustment commands using one of the following options:

- Fast Power Control (FPC) message (6.3.2.3.34)
- OFDMA Power Control IE (8.4.5.4.5) message
- Power control mode change response (PMC_RSP) (6.3.2.3.58) message
- Ranging response (RNG-RSP) message (6.3.2.3.6) Power Adjust Information - Power Level Adjust TLV (11.6 type 2)
- UL-MAP IE format (8.4.5.4) UL_MAP_Fast_Tracking_IE (8.4.5.4.21) message

The Offset_BSperSS can be updated using relative or fixed form (as a function of the relevant adjustment commands used). When fixed form is used the SS should replace the old Offset_BSperSS value by the new Offset_BSperSS sent by the BS . In relative form SS should increase and decrease the Offset_BSperSS according to the offset value sent by BS. These power-control commands are in the form of power control bits (PCBs). The amount of mobile power increase and decrease in each PCB is nominally +0.25 dB and -0.25 dB. The SS should update the Offset_BSperSS accordingly.

4 Detailed Text Changes

1. *[Modify in section 8.4.10.3, from page 456 lines 5 to page 458 line 40 as follows]*
-------- BEGIN --------

[Change the text describing Equation 138 as indicated:]

~~To maintain at the BS a power density consistent with the modulation and FEC rate used by each MS, the BS may change the MS TX power as well as the MS assigned modulation and FEC rate. There are, however, situations where the MS should automatically update its TX power, without being explicitly instructed by the BS. This happens when the MS transmits in region marked by UIUC=0, UIUC=12, UIUC=13 (Sounding) or UIUC=14. In all these situations the MS shall use a temporary a TX power value set according to the formula (in dB):~~

~~$P_{new} = P_{last} + (C/N_{new} - C/N_{last}) - (log10(R_{new}) - log10(R_{last}))$ (138)~~

8.4.10.3.1 Closed loop power control
To maintain at the BS a power density consistent with the modulation and FEC rate used by each SS, the BS may change the SS TX power as well as the SS assigned modulation and FEC rate. There are, however, situations where the SS should automatically update its TX power, without being explicitly instructed by the BS. This happens when the SS transmits in region marked by UIUC = 0, UIUC = 12, or UIUC = 14. In all these situations, the SS shall use a temporary TX power value set according to Equation (138c) (in dB),

$Pnew = Plast$ ~~$+(Lnew - Llast)$~~ $+ (C/Nnew - C/Nlast) - (10log10(Rnew) - 10log10(Rlast))$ $+ (Offset\_BSperSSnew - Offset\_BSperSS\ last) + (RxTxGainCompnew - RxTxGainComplast)$ ~~$OffsetperSS$~~ (138)

Where,

Pnew	is the temporary TX Power(dBm) per a subcarrier.
Plast	is the last used TX Power(dBm) per a subcarrier. When any power control message has arrived and the TX Power is updated based on the message before the new transmission, Plast is the updated TX Power.
~~*Lnew*~~	~~*is the estimated current UL propagation loss.*~~
~~*Llast*~~	~~*is the estimated last UL propagation loss. When any power control message is arrived and the TX Power is updated based on the message before new transmission, Llast is the value of the estimated UL propagation loss when the TX Power is updated.*~~
C/Nnew	is the normalized C/N of new modulation/FEC rate instructed by the UIUC, Table 334.
C/Nlast	is the normalized C/N of the last used modulation/FEC rate UIUC, Table 334.
Rnew	is the number of repetitions for the new modulation/FEC rate instructed by the UIUC.
Rlast	is the number of repetitions on the last used modulation/FEC rate.
~~*OffsetperSS*~~ *Offset_BSperSSnew*	is the correction term for the current transmission (MS-specific power offset).
Offset_BSperSSlast	is the correction term for the last transmission (for SS-specific power offset).
RxTxGainCompnew	BS RX to TX gains compensation factor for the current transmission that reflects the difference between transmit and receive antenna gains at the BS.
RxTxGainComplast	BS RX to TX gains compensation factor for the last transmission that reflects the difference between transmit and receive antenna gains at the BS.

In the closed-loop power control, the base station continuously monitors the Uplink and measures the link quality. If the link quality starts to diminish, then the base station commands the SS, by changing Offset_BSperSS, to increase Tx power. If there is excess power on the Uplink, the base station commands the SS to decrease Tx power.

The base station shall send the power-control adjustment commands using one of the following options: Fast Power Control (FPC) message (6.3.2.3.34) , OFDMA Power Control IE (8.4.5.4.5) message, Power control mode change response (PMC_RSP) (6.3.2.3.58) message, Ranging response (RNG-RSP) message (6.3.2.3.6)

Power Adjust Information - Power Level Adjust TLV (11.6 type 2) or UL-MAP IE format (8.4.5.4) UL_MAP_Fast_Tracking_IE (8.4.5.4.21) message. All the above messages update the Offset_BSperSS parameter. In this mode, the SS shall freeze the Offset_SSperSS value.

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 SS 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 current transmitted power is the power per subcarrier of the burst that carries the message. The maximum available power is reported for QPSK QAM16 and QAM64 constellations. The current transmitted power and the maximum power parameters are reported in dBm per subcarrier. The parameters are quantized in 0.5dBm steps ranging from –64dBm (encoded 0x00) to 63.5dBm (encoded 0xFF). Values outside this range shall be assigned the closest extreme. SSs that do not support QAM64 shall report the value of 0x00 in the maximum QAM64 power field.

~~The specific algorithm is described as follows (in dB). The initial value of OffsetperSS is ‘0’.~~

~~*if NAK is received*~~
~~*OffsetperSS = OffsetperSS + UP_STEP*~~
~~*else if ACK is received*~~
~~*OffsetperSS = OffsetperSS 1/ (…..) UP_STEP*~~

~~*if OffsetperSS Offset_Boundupper then OffsetperSS = Offset_Boundupper*~~
~~*if OffsetperSS Offset_Boundlower then OffsetperSS = Offset_Boundlower*~~

~~Where,~~
~~*UP_STEP is the adjustment step*~~
~~*FERTARGET is the target frame error rate*~~
~~*Offset_Boundupper is the upper bound of power offset adjustment*~~
~~*Offset_Boundlower is the lower bound of power offset adjustment*~~

[Insert the following row into Table 334:]

Table 334a—Normalized C/N per modulation

Modulation/FEC rate	Normalized C/N
Sounding transmission	Sounding transmission

~~The operating parameters *UP_STEP*, *FERTARGET*, *Offset_Boundupper*, *Offset_Boundlower* are signaled by a dedicated UCD message TLV. The default normalized C/N values per modulation are given by Table 332. These values may be overridden by the BS by using a dedicated UCD message TLV. The minimum step size and accuracy of the RF transmit power level shall satisfy the transmitter requirements in 8.4.12.1.~~

[Insert a new sub-clause 8.4.10.3.~~1~~2:]

8.4.10.3.~~1~~2 Open loop power control

When the open loop power control is supported and the uplink power control mode is changed to open loop power control by ~~PCS~~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 the all uplink bursts.

$$P = L + C/N + NI - 10\log 10(R) + Offset\_SS_{perSS} + Offset\_BS_{perSS} + RxTxGainComp \quad (138a)$$

Where,

P	is the TX Power level (dBm) per a subcarrier for the current transmission.
L	is the estimated average current UL propagation loss. It includes Tx/Rx antenna gain, and pathloss.
C/N	is the normalized C/N of the modulation/FEC rate for the current transmission, as appearing

in Table ~~332~~ 334. Table ~~332~~ 334 can be modified by UCD (Normalized C/N override). ~~Additionally, the normalized C/N values for UL ACK region and QPSK 1/3 also can be obtained through UCD~~.

R is the number of repetitions for the modulation/FEC rate.

NI is the estimated average power level (dBm) of the noise and interference per a subcarrier at BS.

$Offset\_SS_{perSS}$ is the correction term for SS-specific power offset. It is controlled by SS. Its initial value is zero.

$Offset\_BS_{perSS}$ Is the correction term for SS-specific power offset. It is controlled by BS with power control messages. It is initialized during initial ranging to zero.

RxTxGainComp BS RX to TX gains compensation factor that reflects the difference between transmit and receive antenna gains at the BS.

L - The estimated average current UL propagation loss shall be calculated as follows:

$$L = P^{sub}_{BS} - Rx\_RSSI \quad (138a1)$$

Where,

P^{sub}_{BS} BS TX Power level (dBm) per subcarrier for the current transmission of the preamble.

Rx_RSSI Average received DL RSSI (dBm) per subcarrier at SS. Measured by the SS on the preamble.

The default normalized C/N values per modulation are given by Table 334. The operating parameters P^{sub}_{BS} 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 the Offset_BSperSS value, or using Fast Power Control(FPC) message (6.3.2.3.34) and Power Control IE (8.4.5.4.5) 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 SS 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 (8.4.12.1). 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 SS will set Offset_SSperSS to zero and modify the TX power value only according to Offset_BSperSS

Active Uplink open loop power control

An alternative way is that the ~~A~~ SS may adjust $Offset\_SS_{perSS}$ value within a range.

$$Offset\_Bound_{lower} \leq Offset\_SS_{perSS} \leq Offset\_Bound_{upper} \quad (138b)$$

where,

$Offset\_Bound_{upper}$ is the upper bound of $Offset\_SS_{perSS}$

$Offset\_Bound_{lower}$ is the lower bound of $Offset\_SS_{perSS}$

Or in case ARQ is enabled at some UL connections the $Offset\_SS_{perSS}$ may be updated automatically based on the Ack/Nack ~~of uplink burst~~ within the range as specified by Equation (138b). The specific algorithm is described as follows (in dB)

if NAK is recieved $Offset\_SS_{perSS} = Offset\_SS_{perSS} + UP\_STEP$

else if ACK is receivedOffset_SSperSS = Offset_SSperSS – DOWN_STEP ~~(1/ (1/ FER~~$_{TARGET}$~~-1)) UP_STEP~~ (138c)

else where Offset_SSperSS = Offset_SSperSS

Where,
UP_STEP is the up adjustment step as specified by" SS-specific up power offset adjustment step" TLV
DOWN _STEP is the down adjustment step as specified by" SS-specific down power offset adjustment step" TLV
~~*FERTARGET is the target frame error rate*~~

The operating parameters *UP_STEP*, *DOWN _STEP* , ~~*FER*~~$_{TARGET}$~~,~~ *Offset_Boundupper*, *Offset_Boundlower* are signaled by a dedicated UCD message TLV. ~~*The default normalized C/N values per modulation are given by Table 332.*~~
~~*Additionally, BS may control the Offset_BSperSS using PCS_RSP message (6.3.2.3.58), Fast Power Control (FPC) message (6.3.2.3.34) and Power Control IE (8.4.5.4.5). The accumulated power control value shall be used for Offset_BSperSS*~~.

-------- END --------

2. *[Modify section 11.3.1, page 473 lines 34-40 as follows]*

-------- BEGIN --------

Name	**Type (1 byte)**	**Length**	**Value (variable length)**
MS-specific up power offset adjustment step	176	1	Unsigned in units of 0.01 dB
~~Target frame error rate of UL burst transmission~~ MS-specific down power offset adjustment step	177	1	~~Unsigned integer of -10*log(FERtarget)~~ Unsigned in units of 0.01 dB
BS RX to TX gains compensation factor	181	1	Unsigned in units of 0.01 dB

-------- END --------

3. *[Modify section 8.4.5.3.19, page 255 lines 6-65 as follows]*

-------- BEGIN --------

Syntax	**Size**	**Notes**
UL interference and noise level_IE{		
Extended DIUC	4 bits	UL_NI = 0x0F
Length	4 bits	Length = 0x02~5
Bitmap	8 bits	LSB indicates the there exists "CQI/ACK/Ranging region NI" field (1). Otherwise, it is '0' The 2nd LSB indicates the there exists "PUSC region NI" field (1). Otherwise, it is '0' The 3rd LSB indicates the there exists "Optional PUSC region NI" field (1). Otherwise, it is '0' The 4th LSB indicates the there exists "AMC region NI" field (1). Otherwise, it is '0' The 5th LSB indicates the there exists "AAS region NI" field (1). Otherwise, it is '0'

		The 6th LSB indicates the there exists "Initial ranging region NI" field (1). Otherwise, it is '0' The 7th LSB indicates the there exists "Periodic ranging region NI" field (1). Otherwise, it is '0'
if (LSB of Bitmap = 1) {		
CQI/ACK/Ranging region NI	8 bits	Estimated average power level (dBm) per a subcarrier in CQI/ACK region.
}		
if (The 2nd LSB of ~~Bitmpa~~ Bitmap = 1) {		
PUSC region NI	8 bits	Estimated average power level (dBm) per a subcarrier in PUSC region.
}		
if (The 3rd LSB of Bitmap = 1) {		
Optional PUSC region NI	8 bits	Estimated average power level (dBm) per a subcarrier in optional PUSC region.
}		
if (The 4th LSB of Bitmap = 1) {		
AMC region NI	8 bits	Estimated average power level (dBm) per a subcarrier in AMC region.
}		
if (The 5th LSB of Bitmap = 1) {		
AAS region NI	8 bits	Estimated average power level (dBm) per a subcarrier in AAS region. The interference and noise level shall be estimated before the beam forming.
}		
if (The 6th LSB of Bitmap = 1) {		
Initial ranging region NI	8 bits	Estimated average power level (dBm) per a subcarrier in Initial ranging region. The interference and noise level shall be estimated before the beam forming.
}		
if (The 7th LSB of Bitmap = 1) {		
Periodic ranging region NI	8 bits	Estimated average power level (dBm) per a subcarrier in Periodic ranging region. The interference and noise level shall be estimated before the beam forming.
}		
}		

-------- END --------

4. ***[Modify section 11.3.1.1, page 474 lines 57-65 as follows]***

-------- BEGIN --------

Name	**Type**	**Length**	**Value**
~~Normalized C/N for UL ACK region and QPSK 1/3~~	~~153~~	~~1~~	~~This is a list of numbers, where each number is encoded by one nibble, and interpreted as a signed integer. The first LS nibble corresponds to the C/N difference of the UL ACK region comparing to the CDMA code in Table 332. The last nibble corresponds to the C/N difference of the QPSK 1/3 comparing to the CDMA code in table 332.~~

.

-------- END --------

5. ***[Modify section 6.3.9.5, page 126 lines 1 -40 as follows]***

-------- BEGIN --------

For MS that are employing the optional Association procedure, and to which the MS and BS are currently Associated, the MS may use its un-expired, previously obtained and retained associated Ranging transmit parameters to set initial ranging values including PTX_IR_MAX power levels.

For OFDMA PHY, the TX power should be determined using open loop power control mechanism (8.4.10.3.2)

-------- END --------

6. ***[Modify section 6.3.2.1.3, page 18 lines 25-29 as follows]***

-------- BEGIN --------

Name	Length (bits)	Description
UL-TX-POWER	7	UL Tx power in dBm, from +63 to -64 in dBm per subcarrier. ~~EIRP~~

-------- END --------

7. ***[Modify section 6.3.2.3.57, pages 118 lines 20-23 as follows]***

-------- BEGIN --------

Syntax Size Notes	Syntax Size Notes	Syntax Size Notes
UL Tx power	8 bits	UL Tx power level in dBm per subcarrier for the burst that carries this header (11.1.1). When the Tx power is different from slot to slot, the maximum value is reported

-------- END --------

8. ***[Modify section 6.3.2.3.57, page 118 lines 20-23 as follows]***

-------- BEGIN --------

UL Tx power

UL Tx power level in dBm per subcarrier for the burst that carries this header (11.1.1). When the Tx power is different from slot to slot, the maximum value is reported.

-------- END --------

9. ***[Modify section 6.3.2.1.2.1, page 16 lines 22-25 as follows]***

-------- BEGIN --------

Name	Length (bits)	Description
UL Tx power	8	UL Tx power in dBm per subcarrier for the burst that carries this header(11.1.1). When the Tx power is different from slot to slot, the maximum value is reported

-------- END --------

10. ***[Modify section 6.3.2.1.2.2, page 17 lines 19-23 as follows]***

-------- BEGIN --------

Name	Length (bits)	Description
CINR	7	UL Tx power level in dBm per subcarrier for the burst that carries this header(11.1.1). When the Tx power is different from slot to slot, the maximum value is reported.

-------- END --------

11. ***[Modify section 6.3.2.1.2.2, page 17 lines 34-38 as follows]***

-------- BEGIN --------

CINR

~~This parameter indicates the CINR in dB, and it shall be interpreted as a single value from -16.0 dB to 47.5 dB in unit of 0.5 dB.~~

UL Tx power level in dBm per subcarrier.

-------- END --------

12. ***[Modify section 6.3.2.1.4.1, page 20 lines 31-32 as follows]***

-------- BEGIN --------

Feedback Type	Feedback contents	Description
0b0100	UL-TX-Power (7 bits) (see Table 7a)	UL transmission power dBm per subcarrier

-------- END --------

13. ***[Modify section 6.3.2.3.58, page 119 lines 5-61 as follows]***

-------- BEGIN --------

Syntax	Size	Notes
PMC_REQ message format{		
Management Message Type = 65	8 bits	Type = 65
Power control mode change	~~1~~ 2 bits	~~0~~0b00: Closed loop power control mode 0b01: Reserved 0b10: Open loop power control passive mode 0b11: Open loop power control active mode ~~1: Open loop power control mode~~
Start frame	~~7~~ 6 bits	~~7~~ 6 LSBs of frame number when the indicated power control mode is activated. When it is same with the current frame number, the mode change shall be applied from the current frame.
~~If (Power control mode change==0) {~~		
~~Power adjust~~	~~8 bits~~	~~Signed integer, which expresses the change in power level (in multiples of 0.25 dB) that the SS shall apply to its current transmission power. When subchannelization is employed, the subscriber shall interpret the power offset adjustment as a required change to the transmitted power density.~~
~~} else {~~		
Offset_BSperSS	8 bits	Signed integer, which expresses the change in power level (in multiples of 0.2 dB) that the SS shall apply to the power control formulas in 8.4.10.3.1 and 8.4.10.3.2.
~~}~~		
}		

CID shall be the basic CID of SS. SS shall generate the PMC_REQ message including the following parameters.

Power control mode change

~~0~~0b00: Closed loop power control mode
0b01: Reserved
0b10: Open loop power control passive mode
0b11: Open loop power control active mode
~~1: Open loop power control mode~~

Start frame

~~3~~6 LSBs of frame number when the indicated power control mode is activated. When it is same with the current frame number, the mode change shall be applied from the current frame.

~~**Power adjust**~~

~~Signed integer, which expresses the change in power level (in multiples of 0.25 dB) that the SS shall apply to its current transmission power. When subchannelization is employed, the subscriber shall interpret the power offset adjustment as a required change to the transmitted power density.~~

Offset_BSperSS

Signed integer, which expresses the change in power level (in multiples of 0.2 dB) that the SS shall apply to the closed and open loop power control formulas in 8.4.10.3.1 and 8.4.10.3.2 respectively.

-------- END --------

14. ***[Modify section 11.4.1, page 476 line 49as follows]***

-------- BEGIN --------

Name	Type	Length	Value	PHY Scope
P^{sub}_{BS}	24	1	BS TX Power level (dBm) per subcarrier of the preamble for the current transmission. Signed in units of 1 dBm per subcarrier.	OFDMA

-------- END --------

15. ***[Modify section 6.3.9.5, page 126 line 8 as follows]***

-------- BEGIN --------

[modify the following text in 6.3.9.5.1:]

The SS shall calculate the maximum transmit signal strength for initial ranging, $P_{TX\_IR\_MAX}$, from Equation (10).

$$P_{TX\_IR\_MAX} = EIRxP_{IR,max} + BS\_EIRP - RSS \quad (10)$$

where the $EIRxP_{IR,max}$ and BS_EIRP are obtained from the DCD, and RSS is the measured RSSI, by the SS, as described in the respective PHY.

In the case that the receive and transmit gain of the SS antennae are substantially different, the SS shall use Equation (11).

$$P_{TX\_IR\_MAX} = EIR \times P_{IR,max} + BS\_EIRP - RSS + (G_{Rx\_SS} - G_{Tx\_SS}). \quad (11)$$

where

G_{Rx_SS} is the SS receive antenna gain,

G_{Tx_SS} is the SS transmit antenna gain.

In the case that the EIR x $P_{IR,max}$ and/or BS_EIRP are/is not known, the SS shall start from the minimum transmit power level defined by the BS

NOTE—The EIRxPIR,max is the maximum equivalent isotropic received power, which is computed for a simple single antenna receiver as RSSIR,max - GANT_BS_Rx, where the RSSIR,max is the received signal strength at antenna output and GANT_BS_Rx is the receive antenna gain. The BS_EIRP is the equivalent isotropic radiated power of the base station, which is computed for a simple single-antenna transmitter as P_{Tx} + GANT_BS_Tx, where P_{Tx} is the transmit power and GANT_BS_Tx is the transmit antenna gain.

For OFDMA PHY The SS shall calculate the maximum transmit signal strength for initial ranging, PTX_IR_MAX, from Equation (10a).

$$P_{TX\_IR\_MAX} = L + C/N + NI - 10\log 10(R) + Offset\_SS_{perSS} + Offset\_BS_{perSS} + RxTxGainComp \quad (10a)$$

Where,

$P_{TX\_IR\_MAX}$	is the maximum transmit signal strength(dBm) per a subcarrier for initial ranging
L	is the estimated current UL propagation loss. It includes Tx/Rx antenna gain and pathloss.
C/N	is the normalized C/N of the modulation/FEC rate for the current transmission, as appearing in Table 334. Table 334 can be modified by UCD (Normalized C/N override).
R	is the number of repetitions for the modulation/FEC rate.
NI	is the estimated average power level (dBm) of the noise and interference per a subcarrier at BS.
$Offset\_SS_{perSS}$	is the correction term for SS-specific power offset. It is controlled by SS. Its initial value is zero.
$Offset\_BS_{perSS}$	is the correction term for SS-specific power offset. It is controlled by BS with power control messages. It is initialized during initial ranging to zero.
RxTxGainComp	BS RX to TX gains compensation factor.

L - The estimated current UL propagation loss shall be calculated as follow:

$$L = P^{sub}_{BS}\ Rx\_RSSI \quad (10b)$$

Where,

P^{sub}_{BS}	BS TX Power level (dBm) per subcarrier for the current transmission.
Rx_RSSI	Received DL RSSI (dBm) per subcarrier at SS. Measured by the SS.

The default normalized C/N values per modulation are given by Table 334. The operating parameters P^{sub}_{BS} and NI are signaled by a DCD message [Table 358—DCD channel encoding].
Additionally, BS may control the Offset_BSperSS using PMC_RSP message (6.3.2.3.58), Fast Power Control (FPC) message (6.3.2.3.34) and Power Control IE (8.4.5.4.5). The accumulated power control value shall be used for Offset_BSperSS.

-------- END --------

16. ***[Modify section 11.8.3, page 494 line 4 as follows]***
-------- BEGIN --------
[modify the following text in 11.8.3.3:]

This parameter indicates the transmitted power used for the burst which carried the message. The parameter is defined in the common TLV encodings subclause (11.1.1). When included in an SBC-REQ message, the TLV is encapsulated in the physical supported parameters compound TLV.
For OFDMA PHY the transmitted power should be set as transmitted power level (dBm) per a subcarrier
-------- END --------

17. ***[Modify section 11.1, page 467 line 5 as follows]***
-------- BEGIN --------
[modify the following text in 11.1.1:]

The parameter indicates the transmitted power used for the burst which carried the message. The parameter is reported in dBm and is quantized in 0.5 dBm steps ranging from –64 dBm (encoded 0x00) to 63.5 dBm (encoded 0xFF). Values outside this range shall be assigned the closest extreme. The parameter is only applicable to systems supporting the SCa, OFDM, or OFDMA PHY specifications.
For OFDMA PHY the transmitted power should be set as transmitted power level (dBm) per a subcarrier.
-------- END --------

5 References

[1] IEEE P802.16-2004.
[2] IEEE P802.16e-D6.
[3] IEEE P802.16e-D5.