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Abstract	Enhanced H-ARQ MAC Support for MIMO OFDMA
Purpose	Adoption of proposed changes into P802.16e
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Enhanced H-ARQ MAC Support for MIMO OFDMA

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1 Introduction

H-ARQ MAC support for an efficient MIMO operation is provided in this contribution. The problem with the current MAP is that there is no special zone for MIMO SS and MIMO and non-MIMO SS are allocated within the same OFDMA symbol. In addition, the inefficiency with the current H-ARQ MAP IEs increases the overall MAP sizes. These problems are addressed and some enhancements are made to resolve the issues.

2 Specific Text Changes

2.1 H-ARQ Control IE format

[Make the following changes to section 6.3.2.3.43.4]

6.3.2.3.43.4 H-ARQ control IE

The format of H-ARQ Control_IE, which includes encoding/decoding information for H-ARQ enabled DL/UL bursts, is presented in Table 92. This IE shall be located in the compact DL/UL MAP_IE.

Table 92—H-ARQ_Control IE format

Syntax	Size	Notes
H-ARQ_Control_IE () {		In DL/UL-MAP
if (! H-ARQ_Compact_DL-MAP_IE exists) {		
Prefix	1 bit	0 = Temporary disable H-ARQ 1 = enable H-ARQ
if (Prefix ==1){		
AI_SN	1 bits	H-ARQ ID Seq. No
SPID	2 bits	Subpacket ID
ACID	4 bits	H-ARQ CH ID
} else{		
Reserved	3 bit	
}		
}		
}		

2.2 CQI Control IE format

[Make the following changes to section 6.3.2.3.43.5]

6.3.2.3.43.5 CQI Control IE

Table 93—CQI_Control IE format

Syntax	Size	Notes
CQICH_Control_IE () {	_	_
if (! CQI_Compact_DL-MAP_IE exists) {		
CQICH indicator	1 bit	If the indicator is set to 1, the CQICH Control IE follows.
if CQICH indicator == 1 {	_	_
Allocation Index	6 bits	Index to the channel in a frame the CQI report should be transmitted by the SS.
Period (=p)	2 bits	A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every 2^p frames.
Frame offset	3 bits	The MSS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MSS should start reporting in 8 frames
Duration (=d)	4 bits	A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for 2^(d-1) frames. If d is 0000, the CQICH is de-allocated. If d is 1111, the MSS should report until the BS command for the MSS to stop.
} else {	_	_
Reserved	3 bits	_
}	_	_
}		
}	_	_

2.3 H-ARQ Compact DL MAP IE format

[add a new section 6.3.2.3.43.6.8 as follows]

6.3.2.3.43.6.8 H-ARQ Compact DL MAP IE format

Table 99a—Compact_DL-MAP IE format for H-ARQ Control

Syntax	Size	Notes
H-ARQ_Compact_DL-MAP_IE {	_	_
DL-MAP Type = 7	3 bits	
DL-MAP Sub-Type = 1	5 bits	H-ARQ Control = 0x01
Length	4 bits	Length of the IE in Bytes
BITMAP length	4 bits	in nibble

BITMAP	variable	size = BITMAP length x 4 bits
for(i=0 ; i< count ; i++){		count = the number of '1' in BITMAP
reserved	1 bits	Shall be set to 0
AI_SN	1 bits	H-ARQ ID Seq. No
SPID	2 bits	Subpacket ID
ACID	4 bits	H-ARQ CH ID
}		
}		

BITMAP Length
This filed indicates the length of BITMAP in nibble.
BITMAP
N-th MSB set to 1 when the burst defined by n-th MAP_IE in the MAP message has following Control information.
AI_SN
Defines ARQ Identifier Sequence Number. This is toggled between '0' and '1' on successfully transmitting each encoder packet with the same ARQ channel.
SPID
Defines SubPacket ID, which is used to identify the four subpackets generated from an encoder packet.
ACID
Defines H-ARQ Channel ID, which is used to identify H-ARQ channels. Each connection can have multiple HARQ channels, each of which may have an encoder packet transaction pending.

2.4 CQI Compact DL MAP IE format

[add a new section 6.3.2.3.43.6.9 as follows]

6.3.2.3.43.6.9 CQI Compact DL MAP IE format

Table 99b—Compact_DL-MAP IE format for CQI Control

Syntax	Size	Notes
CQI_Compact_DL-MAP_IE() {		
DL-MAP Type	3	Type = 7
DL-MAP Sub-type = 2	5	CQI Control = 0x02
Length	4	Length of the IE in Bytes
BITMAP length	4	in nibble
BITMAP	variable	size = BITMAP length x 4 bits
for (i = 0; i<count; i++) {		count = the number of '1' in BITMAP = the number of newly assigned CQI SS in the frame
Period (=p)	2	A CQI feedback is transmitted on the CQICH every 2^p frames
Frame offset	3	The SS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the SS should start reporting in 8 frames

Duration (=d)	3	A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for 10 x 2^d frames. If d == 0, the CQI-CH is de-allocated. If d == 111, the SS should report until the BS command for the SS to stop.
Feedback_type	2	00 = Fast DL measurement 01 = Layer specific channel strengths 10 = Antenna weight associated with specific antenna (See Figure 231) 11 = MIMO mode and permutation zone feedback
if (Feedback_type !=11) { MIMO_permutation_feedback cycle }	2	00 = No MIMO and permutation mode feedback 01 = the MIMO and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 4 frames. The first indication is sent on the 8th CQICH frame. 10 = the MIMO mode and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 8 frames. The first indication is sent on the 8th CQICH frame. 11 = the MIMO mode and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 16 frames. The first indication is sent on the 16th CQICH frame.
CQICH_Num	2	Number of CQICHs assigned to this SS is (CQICH_Num +1)
for (i=0;i<CQICH_Num;i++) {		
Allocation index	6	Index to uniquely identify the CQICH resource assigned to the SS
}		
}		
Padding	variable	The padding bits is used to ensure the IE size is integer number of bytes.
}		

BITMAP Length

This filed indicates the length of BITMAP in nibble.

BITMAP

N-th MSB set to 1 when the burst defined by n-th MAP_IE in the MAP message has following Control information.

Allocation Index

It indicates its position from the start of the CQICH region.

Period

It informs the SS of the period of CQI reports.

Frame offset

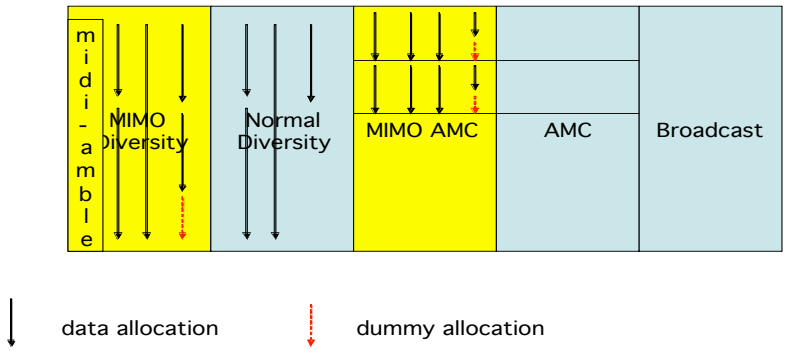
It informs the SS of when to start. The SS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the SS should start reporting in 8 frames.

Duration

It indicates when the SS should stop reporting unless the CQICH allocation is refreshed beforehand. If duration d == 0b0000, the BS is intended to de-allocate the CQICH. If d == 0b1111, the CQICH is allocated indefinitely and the SS should report until the BS commands the SS to stop, which happens it receives another MAP_IE with d =0b0000.

2.5 MIMO Region Compact DL MAP IE

Figure 1 shows the region allocation when using H-ARQ MAP messages in the frame.



[add a new section 6.3.2.3.43.6.10]

6.3.2.3.43.6.10 MIMO Region Compact DL MAP IE format

The MIMO midamble is placed at the very first symbol in the region defined by H-ARQ Format Configuration IE.

Table 99c - MIMO Region Compact DL-MAP_IE

Syntax	Size	Notes
MIMO Region Compact_DL-MAP_IE () {	_	_
DL-MAP Type	3 bits	Type = 7
DL-MAP Sub-Type	5 bits	MIMO Region = 0x03
Length	4 bits	Length of the IE in Bytes
Number Symbols for MIMO Diversity Region	4 bits	MIMO diversity region is placed before the normal diversity region
Number Symbols for MIMO AMC Region	4 bits	MIMO AMC region is placed before the normal AMC region
}	-	-

2.6 MIMO Compact DL MAP IE format

[add a new section 6.3.2.3.43.6.11 as follows]

6.3.2.3.43.6.11 MIMO Compact DL MAP IE format

Table 99d—Compact_DL-MAP IE format for MIMO Control

Syntax	Size (bits)	Notes
MIMO_Compact_DL-MAP_IE() {		
DL-MAP Type	3	Type = 7
DL-MAP Sub-type = 3	5	MIMO Control = 0x04
Length	4	Length of the IE in Bytes
BITMAP length	4	in nibble
BITMAP	variable	size = BITMAP length x 4 bits
for (i = 0; i<count; i++) {		count = the number of '1' in BITMAP
STC	1	STC order 0 = STC using 2 antennas 1 = STC using 4 antennas
Closed-loop	1	0 = Open-loop 1 = Closed-loop

Matrix indicator	2	STC matrices (see 8.4.8.3)
		
		if (STC == 0) {
		00 = Matrix A
		01 = Matrix B
		10-11 = Reserved }
		else if (STC == 1) {
		00 = Matrix A
		01 = Matrix B
		10 = Matrix C
		11 = Reserved
		}

Num_layer	2	
for (j=0;j<Num_layer; j++) {		
Layer_index	2	
DIUC	4	0-11 burst profiles
}		
}		
Padding	variable	The padding bits are used to ensure the IE size is integer number of bytes.
}		

References:

[1] IEEE P802.16e/D3 Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands