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Re:	Contribution supporting TGe WG ballot #14b
Abstract	Enhanced H-ARQ MAC Support for MIMO OFDMA
Purpose	Adoption of proposed changes into P802.16e ~~Crossed-out indicates deleted text,~~ underlined blue indicates new text change to the Standard, and underlined green indicates newly added text from the original contribution
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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.~~, which may create serious channel estimation problem due to the difference in pilot allocations for MIMO and non-MIMO SS.

In addition, the inefficiency with the current H-ARQ MAP IEs increases the overall MAP sizes. For example, in the current H-ARQ MAP, 4 bits are wasted for each non-CQI or non-HARQ SS. This problem can be alleviated by introducing new DL-MAP extensions for CQI and H-ARQ control which, by using a BITMAP, effectively reduce overall MAP sizes. A new DL-MAP extension for MIMO control is also suggested for the same reason.

Some clarification is also made on burst mapping for H-ARQ when multiple MIMO layers are transmitted on the same physical resource.

2 Specific Text Changes

2.1 H-ARQ Control IE format

[Make the following changes to section 6.3.2.3.43.4 in [2]]

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 () {		
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 in page 17 in [1]]

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~~ CQI reporting threshold	3 bits	~~Shall be set to zero~~ A threshold used for SS to report its CINR using CQI channel; If 000, this threshold is neglected.
}	_	_
}		
}	_	_

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

The format of H-ARQ Compact DL-MAP IE is presented in Table 99a. When used, the H-ARQ control information of all H-ARQ enabled DL bursts shall be contained in this IE.

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~~
num_layers	2 bits	Allows different H-ARQ channel IDs for different MIMO layers: 00 – 1 layer 01 – 2 layers 10 – 3 layers 11 – 4 layers
for(j=0; j< num_layers; j++) {		
AI_SN	1 bits	H-ARQ ID Seq. No
SPID	2 bits	Subpacket ID
ACID	4 bits	H-ARQ CH ID
}		
}		
}		
Padding	variable	The padding bits are 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.

num_layers
In the case of STC transmissions, allows different H-ARQ channel IDs for the various layers. When in non-MIMO mode, this is set to 1.

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

The format of CQI Compact DL-MAP IE is presented in Table 99b. When used, the CQI control information of all CQI enabled DL bursts shall be contained in this IE.

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.

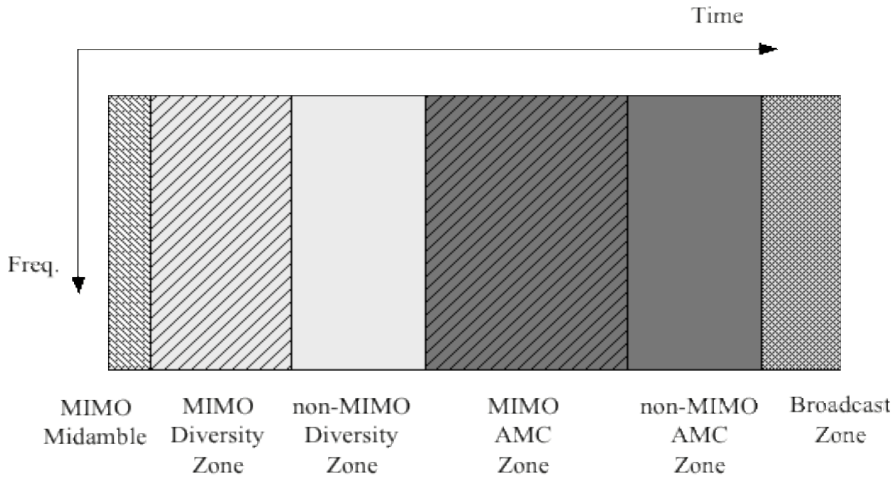

Figure 1 H-ARQ region allocation

[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

Inside the H-ARQ region which is defined by Format Configuration IE, the allocation of MIMO region shall be represented by MIMO Region Compact DL-MAP IE in Table 99c. In order to help channel estimation and tracking a~~The~~ MIMO midamble is placed at the very first symbol in the region defined by H-ARQ Format Configuration IE if either of the fields "Number Symbols for MIMO Diversity" or "Number Symbols for MIMO AMC Region" are non-zero.

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~~6 bits	MIMO diversity region is placed before the normal diversity region
Number Symbols for MIMO AMC Region	46 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

The format of MIMO Compact DL-MAP IE is presented in Table 99d. When used, the MIMO control information of all MIMO enabled DL bursts shall be contained in this IE.

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
STC	3	STC order 00 = STC using 2 antennas 01 = STC using 3 antennas 10 = STC using 4 antennas 11 = Reserved
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	00 – 1 layer 01 – 2 layers 10 – 3 layers 11 – 4 layers
~~for (j=0;j<Num_layer; j++) {~~		
for (j=1;j<Num_layer; j++) {		This loop specifies the Nep and RCID for layers 2 and above when required for STC. Nep, Nsch and RCID for the first layer comes from the compact DL-MAP IE.
~~Layer_index~~	~~2~~	
~~DIUC~~ Nep	4	~~0 11 burst profiles~~
RCID	variable	
}		
}		
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

[2] IEEE P802.16-REVd/D5-2004 Draft IEEE Standards for local and metropolitan area networks part 16: Air interface for fixed broadband wireless access systems