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Re:	IEEE P802.16e/D5a
Abstract	The document contains suggestions for extending the Normal MAP for MIMO H-ARQ support.
Purpose	Adoption of proposed changes into P802.16e /D5a-2004
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Normal MAP Extension for MIMO H-ARQ

1. Introduction

This contribution is a companion document to IEEE C802.16e-05/023 [1] and provides H-ARQ functionality for MIMO bursts within the normal MAP structure. Just as is described in [1], the proposed solution is a two level allocation: to first define a 2D region, and then partition this region in a 1D frequency-first manner into bursts. All the bursts in the 2D allocation share the same burst profile and boosting parameters (similar to PDU concatenation in non-HARQ burst).
The same H-ARQ DL/UL MAP extensions introduced in [1] are reproduced with the additional MIMO modes and the required text changes are made throughout the document. The proposed texts provide simpler and more efficient MAP support for MIMO bursts than using the existing H-ARQ MAP package in the standard.

2. Description of Multi-layer MIMO H-ARQ

Multi-layer transmission, which allows multiple spatial streams with possibly different rates, is already adopted in the standard [2] [3], and this feature is also enabled for H-ARQ mode in this contribution. Each layer is assigned to specific DIUC/Nep, depending on method of burst profiling. For non H-ARQ mode, there is no difference in signaling between DIUC and Nep approaches. For H-ARQ mode, however, there is a difference. That is, when DIUC is used (i.e., chase combining) with H-ARQ, DIUC of each layer can be independently assigned to match the channel of each stream, whereas Nep with H-ARQ (i.e., incremental redundancy) can not have that feature due to the way current CTC modulation and coding table (Table 329 in [2]) is defined.
The reason for this is as follows: let Nep^1_1 indicate 1st layer Nep for 1st frame, $Nsch^1$ for Nsch for 1st frame for both layers. Suppose layer 2 has NACK, then at the next frame the layer 2 should use the same Nep^1_2, and $Nsch^2$ should be carefully chosen to match the required MCS for the retransmission. But if the layer 1 has ACK from the original transmission, it should be able to transmit the same MCS or the level suggested by CQI feedback for the next transmission, which is generally not possible due to the fixed $Nsch^2$.

	Frame 1	Frame 2
Layer 1	Nep^1_1 / $Nsch^1$ _ ACK _	**?** / $Nsch^2$
Layer 2	Nep^1_2 / $Nsch^1$ _ NACK _	Nep^1_2 / $Nsch^2$

Therefore, the link adaptation per layer is not possible in general for IR H-ARQ mode, which is the reason why we do not assign separate H-ARQ control information per layer for IR. Instead we use single H-ARQ channel ID for both layers.

3. Specific Text Changes

[Modify section 8.4.5.3.20 as follows]

8.4.5.3.20 H-ARQ DL MAP Extension

Table 306a H-ARQ DL MAP IE Format

Syntax	Size	Note
H-ARQ DL MAP IE {		
Extended DIUC 2	4	Set to 0x1
Length	8	Length of the IE in bytes
RCID_Type	2 bits	00 = Normal CID 01 = RCID11

				10 = RCID7 11 = RCID3	
While (data remains) {					
OFDMA Symbol offset		8 bits		Offset from the start symbol of DL sub-frame	
Subchannel offset		6 bits			
Boosting		3 bits		000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB;	
No. OFDMA Symbols		7 bits			
No. Subchannels		6 bits			
N sub burst		3 bits		Number of sub-bursts in 2D region	
Mode		4 bit		Indicates the mode of this IE 0000 = Chase H-ARQ 0001 = Inremental redundancy H-ARQ for CTC 0010 = Inremental redundancy H-ARQ for convolutional code 0011 = MIMO Chase H-ARQ 0100 = MIMO IR H-ARQ 0101 = MIMO IR H-ARQ for Convolutional Code 0110 = MIMO STC H-ARQ 0111-1111 *Reserved*	
If (Mode==000) {					
DL H-ARQ Chase Sub-Burst IE ()		variable			
} else if (Mode==001) {					
DL H-ARQ IR Sub-Burst IE ()		variable			
} else if (Mode==010) {					
DL H-ARQ IR CC Sub-Burst IE ()		variable			
} else if (Mode==011) {					
MIMO DL Chase H-ARQ Sub-Burst IE ()		variable			
} else if (Mode==100) {					
MIMO DL IR H-ARQ Sub-Burst IE ()		variable			
} else if (Mode==101) {					
MIMO DL IR H-ARQ for CC Sub-Burst IE ()		variable			
} else if (Mode == 110) {					
MIMO DL STC H-ARQ Sub-Burst IE ()		variable			
}					
}					
Padding		Variable		Padding to byte; shall be set to 0	
}					

Table 306i MIMO DL Chase H-ARQ Sub-Burst IE Format

MIMO DL Chase H-ARQ Sub-Burst IE {					
For (j=0; j< N sub burst; j++){					
MU Indicator		1 bit		Indicates whether this DL burst is intended for multiple SS	
Dedicated MIMO DL Control Indicator		1 bit			
If (MU indicator == 0) {					
RCID IE()		Variable			
}					
If (Dedicated MIMO DL Control Indicator ==1) {					

Dedicated MIMO DL Control IE ()	variable	
}		
Length	10 bits	
For (i=0;i<N_layer;i++) {		
if (MU indicator == 1) {		
RCID IE()	Variable	
}		
DIUC	4 bits	
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
ACID	4 bits	
AI_SN	1 bit	
}		
}		
}		

For each multi SS sub-burst (MU Indicator = 1), if the dedicated pilot bit is set to 1 in the STC_ZONE IE (section 8.4.5.3.4) for the zone in which the sub-burst allocations are being made, N_layer for this sub-burst selects the pilot format for the sub-burst by interpreting N_layer as the number of transmit antennas (as defined in 8.4.8), and the SS with the first RCID shall be assigned the pilot pattern corresponding to antenna 1, of section 8.4.8, the second to the pilot pattern corresponding to antenna 2, and so on.

Table 306j MIMO DL IR H-ARQ Sub-Burst IE Format

MIMO DL IR H-ARQ Sub-Burst IE {		
For (j=0; j< N sub burst; j++){		
MU Indicator	1 bit	Indicates whether this DL burst is intended for multiple SS
Dedicated MIMO DL Control Indicator	1 bit	
ACK Disable	1 bit	When this bit is "1" no ACK channel is allocated and the SS shall not reply with an ACK.
If (MU indicator == 0) {		
RCID IE()	Variable	
}		
If (Dedicated MIMO DL Control Indicator ==1) {		
Dedicated MIMO DL Control IE ()	variable	
}		
Nsch	4 bits	
If (ACK Diable ==1) {		
SPID	2 bits	
ACID	4 bits	
AI_SN	1 bit	
}		
For (i=0;i<N_layer;i++) {		
if (MU indicator == 1) {		

RCID IE()		Variable	
}			
Nep		4 bits	
}			
}			
}			

Table 306k MIMO DL IR H-ARQ for CC Sub-Burst IE Format

MIMO DL IR H-ARQ for CC Sub-Burst IE {			
For (j=0; j< N sub burst; j++){			
MU Indicator		1 bit	Indicates whether this DL burst is intended for multiple SS
Dedicated MIMO DL Control Indicator		1 bit	
If (MU indicator == 0) {			
RCID IE()		Variable	
}			
If (Dedicated MIMO DL Control Indicator ==1) {			
Dedicated MIMO DL Control IE ()		variable	
}			
Length		10 bits	
For (i=0;i<N_layer;i++) {			
if (MU indicator == 1) {			
RCID IE()		Variable	
}			
DIUC		4 bits	
Repetition Coding Indication		2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
ACID		4 bits	
AI_SN		1 bit	
SPID		2 bits	
}			
}			
}			

Table 306l MIMO DL STC H-ARQ Sub-Burst IE Format

MIMO DL STC H-ARQ Sub-Burst IE {			
For (j=0; j< N sub burst; j++){			
Tx count		2 bits	00: first transmission 01: second transmission 10: third transmission 11: fourth transmission
Length		10 bits	
if (Tx count ==00) {			

MU Indicator	1 bit	Indicates whether this DL burst is intended for multiple SS
Dedicated MIMO DL Control Indicator	1 bit	
If (MU indicator == 0) {		
RCID IE()	Variable	
}		
If (Dedicated MIMO DL Control Indicator ==1) {		
Dedicated MIMO DL Control IE ()	variable	
}		
For (i=0;i<N_layer;i++) {		
if (MU indicator == 1) {		
RCID IE()	Variable	
}		
DIUC	4 bits	
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
}		
ACID	4 bits	
}		
}		
}		

[End of "Add a new section 8.4.5.3.20 as follows"]

Dedicated DL Control IE for MIMO contains additional control information for each sub-burst in the tables above. Because each sub-burst may have its own control information format dependent on the MSS capability, the length of the Dedicated DL Control IE for MIMO is variable.

[Add a new section 8.4.5.3.20.2 as follows]

8.4.5.3.20.2 Dedicated DL Control IE for MIMO

Table 306l Dedicated MIMO DL Control IE Format

Syntax	**size**	**Note**
Dedicated MIMO DL Control IE() {	-	-
Length	5 bits	Length of following control information in Nibble.
Control Header	3 bits	Bit #0 : MIMO Control Info Bit #1 : CQI Control Info Bit #2 : Reserved
N_layer	2 bits	Number of coding/modulation layers 00 = 1 layer 01 = 2 layers 10 = 3 layers 11 = 4 layers
if(MIMO Control Info == 1){		
Matrix	2 bits	Indicates transmission matrix (See 8.4.8)

}		
If(CQICH Control Info == 1){		
Period	2 bits	Period (in frame) = 2^period
Frame offset	3 bits	
Duration	4 bits	A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for 10 x 2^d frames.
for (j=0;N_layer+1;j++) {		
Allocation index[1]	6 bits	Index to CQICH assigned to this layer.
}		
CQICH_Num	2 bits	Number of additional CQICHs assigned to this SS (0-3)
for (i=0; i<CQICH_Num; i++) {		
Feedback type	3 bits	Type of feedback on this CQICH
Allocation index	6 bits	
}		
}		
Padding	Variable	Padding to Nibble; shall be set to 0
}		

Control Header
4 bits are used to indicate the following control information. If the first bit is set to 1, this means that MIMO Control information follows. If the second bit is set to 1, this IE shall contain CQI control information. Other bits are reserved for future extension.
N_layer
Specifies the number of layers contained in this burst. The layer is defined as a separate coding/modulation path.
Matrix Indicator
This field indicates MIMO matrix for the burst.
Period
Informs the SS of the period of CQI reports. A CQI feedback is transmitted on the CQICH every 2^p frames
Frame Offset
Informs the SS when to start transmitting reports. The SS starts reporting at the frame number which has the same 3 LSBs as the specified Frame Offset. If the current frame is specified, the SS shall start reporting in 8 frames.
Duration
Indicates when the SS should stop reporting unless the CQICH allocation is refreshed beforehand. If Duration is set to 0b0000, the BS shall de-allocate the CQICH. If Duration is set to 0b1111, the CQICH is allocated indefinitely and the SS should report until it receives another MAP_IE with Duration set to 0b0000.
Allocation Index[1]
Indicates position from the start of the CQICH region.
Feedback Type
Indicates the type of feedback content on the allocated CQICH from SS. Its mapping shall be
000 = Fast DL measurement/Default Feedback
001 = Quantized precoding weight feedback
010-111 = Reserved

[End of "Add a new section 8.4.5.3.20.3 as follows"]

[Modify section 8.4.5.4.23 as follows]

8.4.5.4.23 H-ARQ UL MAP Extension

Table 306l H-ARQ MIMO UL MAP IE

Syntax	Size	Note
H-ARQ UL MAP IE() {		

Extended UIUC 2	4	Set to 0x1
Length	8	Indicates the length of the IE in bytes
RCID_Type	2 bits	00 = Normal CID 01 = RCID11 10 = RCID7 11 = RCID3
while (data remains) {		
Allocation Start Indication	1 bit	0: No allocation start information 1: Allocation start information follows
If (Allocation Start Indication == 1) {		
OFDMA Symbol offset	8 bits	This value indicates start Symbol offset of subsequent sub-bursts in this H-ARQ UL MAP IE
Subchannel offset	7 bits	This value indicates start Subchannel offset of subsequent sub-bursts in this H-ARQ UL MAP IE
}		
Mode	3 bit	Indicates the mode of this IE 000 = Chase H-ARQ 001 = Inremental redundancy H-ARQ for CTC 010 = Inremental redundancy H-ARQ for convolutional code 011 = MIMO Chase H-ARQ 100 = MIMO IR H-ARQ 101 = MIMO IR H-ARQ for Convolutional Code 110 = MIMO STC H-ARQ 111 = Reserved
N sub-Burst	4 bits	This field indicates the number of bursts in this UL MAP IE
For (i =0 ;i < N Sub-burst; i++){		
if (Mode == 000) {		
UL HARQ Chase Sub-Burst IE ()		
} else if (Mode== 001) {		
UL HARQ IR CTC Sub-Burst IE ()		
} else if (Mode== 010) {		
UL HARQ IR CC Sub-Burst IE ()		
} else if (Mode== 011) {		
MIMO UL Chase HARQ Sub-Burst IE ()		
} else if (Mode== 100) {		
MIMO UL IR H-ARQ Sub-Burst IE ()		
} else if (Mode== 101) {		
MIMO UL IR HARQ for CC Sub-Burst IE ()		
} else if (Mode == 110) {		
MIMO UL STC HARQ Sub-Burst IE ()		
}		
}		
}		
Padding	Variable	Padding to byte; shall be set to 0
}		

Table 306t MIMO UL Chase HARQ Sub-Burst IE Format

MIMO UL Chase HARQ Sub-Burst IE{		
MU Indicator	1 bit	Indicates whether this UL burst is intended for multiple SS
Dedicated MIMO UL Control Indicator	1 bit	
if (MU indicator == 0) {		
RCID IE()	Variable	
If (Dedicated MIMO UL Control Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
}		
Duration	10 bits	
For (i=0;i<N_layer;i++) {		
if (MU indicator == 1) {		
RCID IE()	Variable	
}		
UIUC	4 bits	
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
ACID	4 bits	
AI_SN	1 bit	
}		
}		

For each single SS sub-burst (MU indicator = 0) matrix and layer information shall be read from Dedicated MIMO UL Control IE, if set by the indicator bit, and be applied to the burst accordingly. For each multi SS sub-burst (MU Indicator = 1), N_layer for this sub-burst shall be set to 2 and the first SS with the first RCID shall use the pilot pattern A in 8.4.8.1.5 and the first UIUC, whereas the second SS with the second RCID shall use the pilot pattern B and the second UIUC.

Table 306u MIMO UL IR HARQ Sub-Burst IE Format

MIMO UL IR HARQ Sub-Burst IE{		
MU Indicator	1 bit	Indicates whether this UL burst is intended for multiple SS
Dedicated MIMO UL Control Indicator	1 bit	
if (MU indicator == 0) {		
RCID IE()	Variable	
If (Dedicated MIMO UL Control Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
}		
Nsch	4 bits	
SPID	2 bits	
ACID	4 bits	
AI_SN	1 bit	

For (i=0;i<N_layer;i++) {		
if (MU indicator == 1) {		
RCID IE()	Variable	
}		
Nep	4 bits	
}		
}		

Table 306v MIMO UL IR HARQ for CC Sub-Burst IE Format

MIMO UL IR HARQ for CC Sub-Burst IE{		
MU Indicator	1 bit	Indicates whether this UL burst is intended for multiple SS
Dedicated MIMO UL Control Indicator	1 bit	
if (MU indicator == 0) {		
RCID IE()	Variable	
If (Dedicated MIMO UL Control Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
}		
Duration	10 bits	
For (i=0;i<N_layer;i++) {		
if (MU indicator == 1) {		
RCID IE()	Variable	
}		
UIUC	4 bits	
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
ACID	4 bits	
AI_SN	1 bit	
SPID	2 bit	
}		
}		

Table 306u MIMO UL STC HARQ Sub-Burst IE Format

MIMO UL STC HARQ Sub-Burst IE{		
Tx count	2 bits	00: first transmission 01: second transmission 10: third transmission 11: fourth transmission
Duration	10 bits	
if (Tx count ==0) {		
if (MU indicator == 0) {		
RCID IE()	Variable	

If (Dedicated MIMO UL Control Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
}		
For (i=0;i<N_layer;i++) {		
If (MU indicator == 1) {		
RCID IE()	Variable	
}		
UIUC	4 bits	
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11 – Repetition coding of 6 used
}		
ACID	4 bits	
}		
}		

[End of "Add a new section 8.4.5.4.23 as follows"]

Dedicated UL Control IE for MIMO contains additional control information for each sub bursts.

[Add a new section 8.4.5.4.23.2 as follows]

8.4.5.4.23.2 Dedicated UL Control IE for MIMO

Table 306v Dedicated MIMO UL Control IE Format

Syntax	**size**	**Note**
Dedicated MIMO UL Control IE() {	-	-
Matrix	2 bits	Indicates transmission matrix (See 8.4.8) 00 = Matrix A (Transmit Diversity) 01 = Matrix B (Spatial Multiplexing) 10-11 = Reserved
N_layer	2 bits	Number of coding/modulation layers 00 = 1 layer 01 = 2 layers 10-11 = Reserved
}		

[End of "Add a new section 8.4.5.4.23.2 as follows"]

Reference

[1] IEEE C802.16e-05/023 Normal MAP Extension for H-ARQ, submitted for 35th 802.16 Meeting in Jan. 2005

[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

[3] IEEE P802.16e/D5a 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