Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Support for Closed-Loop MIMO in H-ARQ MAP IE**
Date Submitted	**2005-03-17**

Source(s)		
	Wonil Roh, JeongTae Oh, Kyunbyoung Ko, Chan-Byoung Chae, Hongsil Jeong, Sung-Ryul Yun, Seungjoo Maeng, Jaeho Jeon, Jaeyeol Kim, Soonyoung Yoon, Yong Chang	wonil.roh@samsung.com Voice: +82-31-279-3868
	Samsung Electronics Co., Ltd.	
	Erik Lindskog, Kamlesh Rath, Dave Garrett and Brett Schein.	elindskog@beceem.com Voice: +1-408-387-5014
	Beceem Communications, Inc.	
	Wen Tong, Mo-Han Fong	
	Nortel Networks	
	Yigal Eliaspur, Jose Puthenkulam, Randall Schwartz	
	Intel	
	Bin-Chul Ihm, Jin Young Chun	
	LGE	
	Mark Cudak, Kevin Baum	
	Motorola	
	Sean Cai, Jason Hou	
	ZTE	

Re:	
Abstract	Support for Closed-Loop MIMO in H-ARQ MAP IE
Purpose	Adoption of proposed changes into P802.16e ~~Crossed-out indicates deleted text,~~ underlined blue indicates new text change to the Standard

Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.

Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures (Version 1.0) <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:r.b.marks@ieee.org> as early as possible, in written or electronic form, of any patents (granted or under application) that may cover technology that is under consideration by or has been approved by IEEE 802.16. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Support for Closed-Loop MIMO in H-ARQ MAP IE

1. Introduction

There are two objectives that this document is prepared to achieve: one editorial and one technical. The editorial part is to provide the correct Section/Table numbers and the technical part is to provide an important feature with small amount of text changes.
The H-ARQ MAP IE for MIMO bursts was introduced in [2] and accepted by the Working Group in 35th meeting in Sanya, but it failed to be added to the current draft standard [1]. The same proposal is re-written with proper Section and Table numbers in line with the existing texts. This is the editorial part. Based on this accepted texts, a much needed closed-loop capability is proposed with a minimal impact to the spec, which is the technical part of the document. The CL-MIMO functionalities included in the text change are identical to the accepted CL-MIMO DL MAP IE (8.4.5.3.25) with additional H-ARQ features.

To clarify, the text change in underlined blue is what was accepted and that in underlined red is what is being proposed in this document.

This document is the results of harmonization efforts among the following comments:
3326, 3327, 3333, 3334, 3527, 3528

2. Specific Text Changes

[Add the following text after line 65 on page 264]

---------- Start of Text Change ----------

Table 285q -- MIMO DL Chase H-ARQ Sub-Burst IE Format

MIMO DL Chase H-ARQ Sub-Burst IE {					
N sub burst		5		Number of sub-bursts in the 2D region	
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			
}					
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
If (ACK Disable ==0) {		
ACID	4 bits	
AI_SN	1 bit	
}		
}		
}		
}		

When MU_Indicator = 1 for a particular loop index j in the MIMO DL Chase H-ARQ Sub-Burst IE, MIMO DL IR H-ARQ Sub-Burst IE, or the MIMO DL IR H-ARQ for CC Sub-Burst IE, each layer shall be allocated its associated ACK channel. In this case, the number of ACK channels associated with the sub-burst IE will be greater than N_sub_burst.

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 285r -- MIMO DL IR H-ARQ Sub-Burst IE Format

MIMO DL IR H-ARQ Sub-Burst IE {		
N sub burst	5	Number of sub-bursts in the 2D region
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 Disable ==0) {		
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 285s -- MIMO DL IR H-ARQ for CC Sub-Burst IE Format

MIMO DL IR H-ARQ for CC Sub-Burst IE {		
N sub burst	5	Number of sub-bursts in the 2D region
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	
}		
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
If (ACK Disable ==0) {		
ACID	4 bits	
AI_SN	1 bit	
SPID	2 bits	
}		
}		
}		
}		

Table 285t -- MIMO DL STC H-ARQ Sub-Burst IE Format

This IE is used to support the STC subpacket retransmission .

MIMO DL STC H-ARQ Sub-Burst IE {		
N sub burst	5	Number of sub-bursts in the 2D region
For (j=0; j< N sub burst; j++){		
Tx count	2 bits	00: ~~first~~ initial transmission 01: ~~second~~ odd retransmission 10: ~~third~~ even retransmission 11: ~~fourth transmission~~ reserved
Length	10 bits	
Sub-burst offset indication	1 bits	Indicates the inclusion of sub-burst offset
Reserved	3 bits	
If (Sub-burst offset indication == 1) {		
Sub-burst offset	8 bits	Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first subburst within the data region, this offset is with respect to slot 0 of the data region.
}		
RCID IE()	Variable	
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	
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	
}		
~~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
}		
If (ACK Disable ==0) {		
ACID	4 bits	

}					
}					
}					
}					

8.4.5.3.22.1 Dedicated MIMO DL Control IE Format

Dedicated DL Control IE for MIMO contains additional control information for each sub-burst. 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.

Table 285u -- 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~~ Closed MIMO Control Info
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 (Dedicated Pilots == 1) {		Dedicated Pilots field in STC_Zone_IE()
Num_Beamformed_Streams	2 bits	Indicates the number of beamformed streams which is equal to the number of pilot patterns 00 = 1 stream 01 = 2 streams 10 = 3 streams 11 = 4 streams
}		
}		
If(CQICH Control Info == 1){		
Period	~~2~~3 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	
}		
}		
if(Closed MIMO Control Info == 1){		

if(MIMO Control Info==1)
MIMO mode = Matrix
else
MIMO mode = Matrix in STC_Zone_IE()				

If (MIMO mode == 00 or 01) {				

Antenna Grouping Index }		3 bits		Indicates the index of antenna grouping
				See 8.4.8.3.4 and 8.4.8.3.5
				If((Matrix_indicator == 00)
				000~010 = 0b101110~0b110000 in Table 298c
				else
				000~101 = 0b110001~0b110110 in Table 298c

elseif (MIMO mode == 10) {				
Num_stream		2 bits		Indicates the number of streams in Table 316f for 3 Tx and Table 316g for 4 Tx.
Antenna Selection Index }		3 bits		Indicates the index of antenna selection See 8.4.8.3.4 and 8.4.8.3.5 000~110 = 0b110000~0b110101 in Table 298d
elseif (MIMO mode == 11) {				
Num_stream		2 bits		Indicates number of streams
Codebook Precoding Index }		6 bits		Indicates the index of precoding matrix W in the codebook See 8.4.8.3.6
}				
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 with antenna grouping
001 = Fast DL measurement/Default Feedback with antenna selection
010 = Fast DL measurement/Default Feedback with reduced code book
011 = Quantized precoding weight feedback
100 = Index to precoding matrix in code book
101 = Channel Matrix Information
110 = Per stream power control
111 = Reserved
~~000 = Fast DL measurement/Default Feedback~~
~~001 = Quantized precoding weight feedback~~

~~010-111 = Reserved~~

---------- End of Text Change ----------

[Add the following text after line 27 on page 351]

---------- Start of Text Change ----------

Table 302p – 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	
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 UL Control Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
} else {		
Matrix	1 bit	Indicates transmission matrix (See 8.4.8) for MS with dual Tx antennas 0 = Matrix A 1 = Matrix B Ignored by MS with single Tx antenna
}		
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
If (ACK Disable ==0) {		
ACID	4 bits	
AI_SN	1 bit	
}		
}		
}		

When MU Indicator = 1 for a particular loop index j in the MIMO UL Chase H-ARQ Sub-Burst IE, MIMO UL IR H-ARQ Sub-Burst IE, or the MIMO UL IR H-ARQ for CC Sub-Burst IE, each layer shall be allocated its associated bit position in the ACK channel bitmap. In this case, the number of bits in the ACK channel bitmap associated with the sub-burst IE will be greater than N_sub_burst.

For each single MS 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 for single antenna MS or the pilot pattern A/B for dual antenna MS in 8.4.8.1.5 and the first UIUC, whereas the second MS with the second RCID shall use the pilot pattern B for single antenna MS or the pilot pattern C/D for dual antenna MS and the second UIUC.

Table 302q -- 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	
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 UL Control Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
} else {		
Matrix	1 bit	Indicates transmission matrix (See 8.4.8) for MS with dual Tx antennas 0 = Matrix A 1 = Matrix B Ignored by MS with single Tx antenna
}		
Nsch	4 bits	
If (ACK Disable ==0) {		
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 302r -- 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	
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 UL Control Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
} else {		
Matrix	1 bit	Indicates transmission matrix (See 8.4.8) for MS with dual Tx antennas 0 = Matrix A 1 = Matrix B Ignored by MS with single Tx antenna
}		
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
If (ACK Disable ==0) {		
ACID	4 bits	
AI_SN	1 bit	
SPID	2 bit	
}		
}		
}		

Table 302s -- MIMO UL STC HARQ Sub-Burst IE Format

MIMO UL STC HARQ Sub-Burst IE{		
Tx count	2 bits	00: ~~first~~ initial transmission 01: ~~second~~ odd retransmission 10: ~~third~~ even retransmission 11: ~~fourth transmission~~ reserved
Duration	10 bits	
ACK Disable	1 bit	When this bit is "1" no ACK channel is allocated and the SS shall not reply with an ACK.
Dedicated MIMO DL Control Indicator	1 bit	
if (Tx count ==0) {		
if (MU indicator == 0) {		
RCID IE()	Variable	
If (Dedicated MIMO UL Control		

Indicator ==1) {		
Dedicated MIMO UL Control IE ()	variable	
}		
} else {		
Matrix	1 bit	Indicates transmission matrix (See 8.4.8) for MS with dual Tx antennas 0 = Matrix A 1 = Matrix B Ignored by MS with single Tx antenna
}		
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
}		
If (ACK Disable ==0) {		
ACID	4 bits	
}		
}		
}		

---------- End of Text Change ----------

[Add the following text after line 61 on page 351]

---------- Start of Text Change ----------

8.4.5.4.25.2 Dedicated MIMO UL Control IE Format

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

Table 302t -- 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 Text Change ----------

[Add the following text after line 14 on page 335]

---------- Start of Text Change ----------

Table 302a. CQICH Enhanced allocation IE format

Syntax	**Size (bits)**	**Notes**
CQICH_Enhanced_Alloc_IE() {		
Extended UIUC 2	4	0x0~~9~~0
Length	~~4~~8	Length in bytes of following fields
CQICH_ID	variable	Index to uniquely identify the CQICH resource assigned to the MSS
Period (=p)	~~2~~3	A CQI feedback is transmitted on the CQICH every 2^p frames
Frame offset	3	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)	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 CQICH is de-allocated. If d == 111, the MSS should report until the BS command for the MSS to stop.
CQICH_Num	4	Number of CQICHs assigned to this CQICH_ID is (CQICH_Num +1)
for (i=0;i<CQICH_Num+1;i++) {		
Feedback_type	3	000 = Fast DL measurement/Default Feedback with antenna grouping 001 = Fast DL measurement/Default Feedback with antenna selection 010 = Fast DL measurement/Default Feedback with reduced code book 011 = Quantized precoding weight feedback 100 = Index to precoding matrix in code book 101 = Channel Matrix Information 1~~1~~0 = Per stream power control ~~110~~ 111 = Reserved
Allocation index	6	Index to the fast feedback channel region marked by UIUC=0
CQICH Type	2	00 = 6 bit CQI, 01 = DIUC-CQI, 10 = 3 bit CQI (even), 11 = 3 bit CQI(odd)
}		
Band_AMC_Precoding_Mode	1	0 = One common precoder for all bands. 1 = Distinct precoders for the bands with the highest S/N values, up to the number of short term precoders fed back as specified by Nr_Precoders_feedback
If (Band_AMC_Precoding_Mode =1) { Nr_Precoders_feedback (=N)	3	Nr of precoders feedback = N.

}		
Padding	variable	The padding bits are used to ensure the IE size is integer number of bytes.
}		

---------- End of Text Change ----------

References

[1] IEEE P802.16e/D6 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 C802.16e-05/038r1 "Normal MAP Extension for MIMO H-ARQ", accepted at 35th 802.16 Meeting in Jan. 2005