Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Enabling SDMA in H-ARQ Map IE's**
Date Submitted	**2005-01-24**
Source(s)	Frederick W. Vook Voice: +1-847-576-7939 Kevin L. Baum Fred.Vook@motorola.com Xiangyang (Jeff) Zhuang Mark Cudak Motorola Labs 1301 E. Algonquin Road Schaumburg, IL 60196
Re:	IEEE P802.16-REVe/D5-2004
Abstract	Modifications to H-ARQ Map IEs to enable SDMA allocations
Purpose	Adoption of proposed changes into P802.16e
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 <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of 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:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Enabling SDMA in H-ARQ Map IE's

Frederick W. Vook, Kevin L. Baum, Xiangyang (Jeff) Zhuang, Mark Cudak

Motorola Labs, Schaumburg, IL, USA

1   Introduction

Spatial Division Multiple Access (SDMA) requires the ability to allocate the same subchannels to two or more SS's. Currently, SDMA cannot be used with H-ARQ because the H-ARQ Map IE's do not support the allocation of a subchannel to more than one SS. The main reason is that the time/frequency resource allocations made using H-ARQ based IE's are relative and cumulative in nature. Before any allocations are made, a starting point is defined in the OFDMA frame. Then, the first allocation is assumed to begin at the previously defined starting point, and the second allocation begins at the end of the first allocation, and so forth. Therefore, there is no way to assign the same set of resources to a multiple SS's.

This contribution provides a solution that is backward compatible with the regular H-ARQ mechanism. Similar to the idea that defines a MIMO Compact DL-MAP IE as an extended H-ARQ DL-MAP to handle MIMO transmission, this contribution defines a new extended H-ARQ Compact DL-MAP IE called SDMA Compact DL-MAP IE. SDMA Compact DL-MAP IE immediately follows the regular Compact DL-MAP IE. In this case, the regular Compact DL-MAP IE describes the location of the burst on which downlink SDMA is performed. This allocation information does not need to repeat in the SDMA Compact DL-MAP IE. While the regular Compact DL-MAP also describes, for the first user, the information of its reduced CID, coding and modulation scheme, the connection-specific H-ARQ control and CQICH control, and the Compact UL-MAP, the SDMA Compact DL-MAP specifies these information for all other users. The pilot pattern for SDMA is also specified by in the SDMA Compact DL-MAP.

2   Specific Text Changes

----------------------- Beginning of Text Changes -------------------------------------

[Add the following section after Section **6.3.2.3.43.6.9:**]

6.3.2.3.43.6.10   SDMA Compact DL-MAP IE format

When the BS is provided downlink channels corresponding to multiple users, it may schedule simultaneous downlink transmission to a number of users on the same burst. Downlink SDMA burst may be allocated in the STC zone where the pilot shall be transmitted in a dedicated manner corresponding to each user (see section 8.4.5.3.4).

If a burst is allocated as a downlink SDMA burst, the regular Compact DL-MAP IE shall be followed by an SDMA Compact DL-MAP IE that is an extended H-ARQ Compact DL-MAP. In this case, the regular Compact DL-MAP IE describes the location of downlink SDMA burst for diversity subchannels (see Table 94)

and AMC subchannels (see Table 95). It also describes the coding and modulation scheme for the first user. The format of SDMA Compact DL-MAP IE is presented in Table 99c.

Table 99c —SDMA Compact DL-MAP IE format

Syntax	Size (bits)	Notes
SDMA Compact DL-MAP IE() {		
Compact DL-MAP Type	3	Type = 7
DL-MAP Sub-type	5	SDMA = 0x02
Length	4	Length of the IE in Bytes
Num Additional SDMA Users	2	
Pilot Mode	1	0: "transparent DL-SDMA" (single-antenna pilots pattern) 1: "informed DL-SDMA" (multi-antenna pilot pattern with the antenna number being the total number SDMA
H-ARQ_Control_IE	variable	
CQICH_Control_IE	variable	
Coupled UL SDMA Flag	1	0: UL transmission of SDMA users are not simultaneous ("uncoupled") 1: UL transmission of SDMA users are simultaneous ("uplink SDMA")
for (n=1;n<Num_Additional_Users; n++) {		
RCID_IE	variable	
if (H-ARQ mode = "CTC IR") {		
N_{EP} code	4 bits	Code of encoder packet bits (see 8.4.9.2.3.5)
} else if (H-ARQ mode = "Generic") {		
Shortened DIUC	3 bits	Shortened DIUC
}		
H-ARQ_Control_IE	variable	
CQICH_Control_IE	variable	
if (Coupled UL SDMA Flag=1) {		
if (H-ARQ mode = "CTC IR") {		
N_{EP} code for UL	4 bits	Code of encoder packet bits (see 8.4.9.2.3.5)
}else if (H-ARQ mode = "Generic") {		
ShortenedUIUC	3 bits	Shortened DIUC
} else {		
UL-MAP append	1 bit	
if (UL-MAP append) {		
if (H-ARQ mode = "CTC IR") {		
N_{EP} code for UL	4 bits	Code of encoder packet bits (see

		8.4.9.2.3.5)
N_{SCH} code for UL	4 bits	Code of allocated subchannels (see 8.4.9.2.3.5)
}else if (H-ARQ mode = "Generic") {		
ShortenedUIUC	3 bits	Shortened DIUC
Companded SC	5 bits	Code of allocated subchannels (see 8.4.9.5)
}		
}		
}		
H-ARQ_Control_IE for UL	variable	
}		
}		

Num Additional SDMA Users

The number of total SDMA users is this number plus one.

Pilot Mode

This field indicates how the pilot pattern should be interpreted. In "transparent downlink SDMA", the BS controls the interference of the simultaneously transmitted multiple streams in the received signal at different user. Each user can ignore the interference in this case. A single-antenna pilot pattern is assumed.   In "informed downlink SDMA", a multi-antenna pilot pattern is adopted to allow each user to estimate all the spatial streams for possibly advanced receive processing. In this case, the number of antennas is equal to the total number of SDMA users. The user/antenna index follows the order in which their RCID are specified.

Coupled UL SDMA Flag

This field indicates whether the downlink SDMA users will transmit their uplink data in an uplink SDMA fashion as well. A value of "0" means that the UL transmission will not be simultaneous ("uncoupled") but rather be independent, in which case the UL-MAP for each SDMA user may or may not append this SDMA Compact DL-MAP IE, or if appended, can have its own uplink allocation. A value of "1" means that the UL transmission will be simultaneous as well (i.e., "uplink SDMA" for the same set of users). In this case, the UL-MAP information of each user is always appended. The first user's uplink information is included in the appended portion of the regular Compact DL-MAP IE. Since the uplink subchannel allocation for other users are the same as the first one, the other users will only append their own unique uplink information in this SDMA Compact UL-MAP IE.

[Add the following section after Section **6.3.2.3.43.7.9:**]

6.3.2.3.43.7.9   SDMA Compact UL-MAP IE format

The BS may schedule simultaneous uplink transmission to a number of users on the same burst. If a burst is

allocated as an uplink SDMA burst, the regular Compact UL-MAP IE shall be followed by an SDMA Compact UL-MAP IE that is an extended H-ARQ Compact UL-MAP. In this case, the regular Compact UL-MAP IE describes the location of the uplink SDMA burst for diversity subchannels (see Table 94) and AMC subchannels (see Table 95). It also describes the coding and modulation scheme for the first user. The format of SDMA Compact UL-MAP IE is presented in Table 14c.

Table 99c —SDMA Compact UL-MAP IE format

Syntax	Size (bits)	Notes
SDMA Compact UL-MAP IE() {		
Compact UL-MAP Type	3	Type = 7
DL-MAP Sub-type	5	SDMA = 0x02
Length	4	Length of the IE in Bytes
Num Additional SDMA Users	2	
H-ARQ_Control_IE	variable	
CQICH_Control_IE	variable	
for (n=1;n<Num_Additional_Users; n++) {		
RCID_IE	variable	
if (H-ARQ mode = "CTC IR") {		
N_{EP} code	4 bits	Code of encoder packet bits (see 8.4.9.2.3.5)
} else if (H-ARQ mode = "Generic") {		
Shortened DIUC	3 bits	Shortened DIUC
}		
H-ARQ_Control_IE	variable	
CQICH_Control_IE	variable	
}		
}		

Num Additional SDMA Users

The number of total SDMA users is this number plus one. A multi-antenna pilot pattern is used to allow the BS to estimate the channels to all the users. In this case, the number of antennas is equal to the total number of SDMA users. The user/antenna index follows the order in which their RCID are specified.

--------------------------- End of Text Changes --