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Re:		
Abstract	This document defines an optimization to IEEE802.16 MAC specification in order to provide better utilization of the air resource by reducing MAC overhead	
Purpose	Integration into TGd draft.	
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ARQ ACK Channel

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1. General

This document defines an optimization to IEEE802.16 MAC specification in order to provide better utilization of the air resource by reducing MAC overhead

When transmitting information in the downlink direction using connections that enable ARQ, a feedback must be sent by the SS in the uplink direction. The transmission of the ARQ feedback information by the SS can be done in four different ways:

1) By piggybacking ARQ feedback on uplink data PDUs transmitted by the SS upon allocation.
2) By sending ARQ feedback message using contention mechanism.
3) By sending ARQ feedback message using allocation provided by the BS specifically for sending feedback.
4) By requesting BW using contention, and sending ARQ feedback message on uplink allocation provided by the BS.

Beside option (1), all other options define inefficient way for ARQ feedback message, by adding additional overhead in the MAP message for allocations, and by potentially adding latency by the contention mechanisms. In addition, the ARQ feedback standalone message, contains redundant information, such as MAC header, which can be avoided.

The current contribution proposes a method of defining an uplink ARQ acknowledge channel, ARQ_ACK channel, which will be used by the SSs to send ARQ feedback information. The ARQ-ACK is allocated using a single uplink MAP entry, and uses a well-known modulation and rate of QPSK ½. The basic unit of the ARQ_ACK channel is one slot. Slots are allocated to different SSs using a new MAC subheader, ARQ_ACK allocation subheader.

The BS shall allocate an ARQ-ACK channel, which is used by to SSs to send ARQ feedback, the specific allocation for a slot in the ARQ-ACK channel, for a specific SS is done using a subheader of a PDU sent in the downlink direction.

2. Specific Changes

6.4.2.1.1 Generic MAC header

[Change size of Type field in the Generic MAC header format to 7 bits using the reserved bit at the right of the type field]

[Change Table 6 as follows:]

Table 6—Type encodings

Type bit	Value
#~~5~~6 most significant bit (MSB)	Mesh subheader 1= present, 0= absent
#~~4~~5	ARQ Feedback Payload 1= present, 0= absent
#~~3~~4	Extended Type Indicates whether the present Packing or Fragmentation Subheaders, is Extended 1 = Extended, Applicable only to connections where ARQ is enabled 0 = not Extended. Applicable to connections where ARQ is not enabled
#~~2~~3	Fragmentation subheader 1= present, 0= absent
#~~1~~2	Packing subheader 1= present, 0= absent
#~~0~~1 ~~least significant bit (LSB)~~	Grant Management subheader 1= present, 0= absent Shall be set to 0 in downlink.
#0 least significant bit (LSB)	ARQ_ACK allocation subheader 1= present, 0= absent Shall be set to 0 in uplink.

6.4.2.2 MAC subheaders

~~Four~~Five types of subheaders may be present. The per-PDU subheaders (i.e., Mesh, Fragmentation, ARQ_ACK allocation and Grant Management) may be inserted in MAC PDUs immediately following the Generic MAC header. If both the Fragmentation subheader and Grant Management subheader are indicated, the Grant Management subheader shall come first. If the Mesh subheader is indicated, it shall precede all other subheaders.

The ARQ_ACK allocation subheader shall always be the last subheader included.

The only per-SDU subheader is the Packing subheader. It may be inserted before each MAC SDU if so indicated by the Type field. The Packing and Fragmentation subheaders are mutually exclusive and shall not both be present within the same MAC PDU.

If present, all per-PDU subheaders shall always come before the first per-SDU subheader.

[Insert new section 6.4.2.2.6]

6.4.2.2.6 ARQ-ACK allocation subheader

The ARQ_ACK allocation subheader, which, when using the ARQ mode for a specific connection, will always be the last subheader as specified in 6.4.2.1.1. The format of the ARQ_ACK allocation subheader is specified in table 13.

Table 7—ARQ-ACK allocation subheader format

Syntax	Size	Notes
ARQ_ACK allocation subheader {		
Allocation offset	8 bits	
}		

Allocation offser
Defines the offset, in units of slots, from the beginning of the ARQ_ACK acknowledge channel, in which the SS with the CID same as in the MAC generic header, must send an ARQ_ACK feedback message.

[Insert new section 6.4.2.3.41]

6.4.2.3.41 ARQ_ACK message

This message is sent in uplink direction on the ARQ-ACK channel and contains ARQ feedback information. This message is sent as defined in table 85, without using the MAC header. The message is send using the allocation given by the ARQ-ACK allocation subheader in a downlink PDU sent to the SS.

Table 85—ARQ-ACK message format

Syntax	Size	Notes
ARQ_ACK message format {	variable	
Reserved	1 bit	Reserved, shall be set to zero
ACK Type	2 bit	0x0 = Selective ACK entry 0x1 = Cumulative ACK entry 0x2 = Cumulative with Selective ACK entry 0x3 = *Reserved*
BSN	11 bits	
Number of ACK Maps	2 bits	If ACK Type == 01, the field is reserved and set to 00. Otherwise the field indicates the number of ACK maps: 0x0 = 1, 0x1 = 2, 0x2 = 3, 0x3= 4
if (ACK Type!= 01) {		
for (i=0; i< Number of ACK Maps + 1; ++i) {		
ACK Map	16 bits	
}		

Table 85—ARQ-ACK message format (Continued)

Syntax	Size	Notes
}		
}		

BSN

If (ACK Type == 0x0): BSN value corresponds to the most significant bit of the first 16 bit ARQ ACK map.

If (ACK Type == 0x1): BSN value indicates that its corresponding fragment and all fragments with lesser (see 6.2.4.5.1) values within the transmission window have been successfully received.

If (ACK Type == 0x2): Combines the functionality of types 0x0 and 0x1.

ACK Map

Each bit set to one indicates the corresponding ARQ fragment has been received without errors. The bit corresponding to the BSN value in the IE, is the most significant bit of the first map entry. The bits for succeeding fragment numbers are assigned left-to-right (MSB to LSB) within the map entry. If the ACK Type is 0x2, then the most significant bit of the first map entry shall be set to one and the IE shall be interpreted as a cumulative ACK for the BSN value in the IE. The rest of the bitmap shall be interpreted similar to ACK Type 0x0.

8.5.5.3.1 UIUC Allocation

Table 238 defines the UIUC encoding that should be used in the UL-MAP_IE().

Table 238—OFDMA UIUC values

UIUC	Usage
0	ARQ_ACK Channel
~~0~~1–9	Different burst profiles
10	Null IE
11	CDMA Bandwidth Request, CDMA periodic ranging
12	Initial ranging
13	*Reserved*
14	CDMA Allocation IE
15	Extended UIUC