Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Changes to clarify ARQ Support**
Date Submitted	**2007-01-18**
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Re:	Supporting document for comment 80216-07/004#2
Abstract	Changes required to clarify support of ARQ.
Purpose	The document is intended for consideration within comments resolution process.
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Changes to clarify ARQ Support

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January 2007

References

1. IEEE, "IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems," IEEE 802.16-2004.
2. IEEE, "IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands" IEEE 802.16e-2005.
3. IEEE 802.16-066 commentary database, November 2006.
4. IEEE P802.16/Cor2/D1, January 2007.

Introduction

On page 101 of [4] there is the statement:

> ARQ shall not be used with the PHY specification defined in 8.1. If ARQ is supported, then support of the 'cumulative ACK entry' entry is mandatory.

Without further changes then in addition to the use of cumulative ACK it is necessary to support Selective ACK. While it is efficient to support cumulative ACK, it is not necessary, nor is it sufficient.

I suggest the following replacement:

> ARQ shall not be used with the PHY specification defined in 8.1. If ARQ is supported, then support of the 'cumulative ACK entry' entry and at least one of "Selective ACK" or "Cumulative+Selective ACK" is mandatory.

In IEEE 802.16e-2005 [2], page 175, the statement that ARQ support is optional has been removed, though I believe the standard does not mandate use of ARQ.

If the first block of a sequence is received with an error, there is no way to signal this without support for either selective ACK or cumulative+selective ACK. Cumulative ACK on its own is not sufficient, as it indicates the successful receipt of all blocks up to and including the specified one.

According to [1] page 134, second paragraph after figure 33:

> When an acknowledgment is received, the transmitter shall check the validity of the BSN. A valid BSN is one in the interval ARQ_TX_WINDOW_START to ARQ_TX_NEXT_BSN-1 (inclusive). If BSN is not valid, the transmitter shall ignore the acknowledgment.

The context of this message is that the BSN is the one transmitted in the message, not the BSN corresponding to the bit being dealt with in the ACK map.

This requires changes to the definitions of both the Cumulative+Selective ACK and the Cumulative ACK, in order to support the usage suggested by the note on page 176 of 802.16e-2005 [2]:

NOTE—Selective ACK bit-maps are referenced to a specific BSN, which indicates to absolute number of the block referenced by the first bit in the bit-map. It is the responsibility of the ARQ feedback sender to assign the BSN such that all bits in the bit define either ACK or NAK for a specific ARQ block. This can be achieved by assigning the BSN number low enough (modulo 2^{11}), such that every bit in the bit map provides correct feedback information.

Where I believe the intent was to allow the BSN to point ahead of the block in error.

Required Changes

Additions in blue, deletions in red.

Page 101 of IEEE P802.16/Cor2/D1, modify lines 24 - 26:

> ARQ shall not be used with the PHY specification defined in 8.1. If ARQ is supported, then support of the 'cumulative ACK entry' ~~entry~~ and at least one of other acknowledgement types is mandatory.

In section 6.3.4.6.2 Transmitter State Machine, add the following text (at line 25, page 102 of IEEE P802.16/Cor2/D1):

Change the 5th paragraph as indicated:

> When a Cumulative ACK acknowledgement is received, the transmitter shall check the validity of the BSN. A valid BSN is one in the interval ARQ_TX_WINDOW_START to ARQ_TX_NEXT_BSN-1 (inclusive). If BSN is not valid, the transmitter shall ignore the acknowledgment.

Add after the 5th paragraph:

> When a Selective ACK, Cumulative+Selective ACK or Cumulative ACK with Block Sequence acknowledgment is received, the transmitter shall check the validity of each block described in the message. The acknowledgement of a block is valid if its corresponding block number lies in the interval ARQ_TX_WINDOW_START to ARQ_TX_NEXT_BSN-1 (inclusive). If the block number lies outside this interval the transmitter shall ignore the acknowledgment of that block.