Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Proposal to allow Extended Type subheaders for connections where ARQ is not enabled**
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Re:	802.16REVd/D4 Sponsor Ballot
Abstract	The document proposes to allow the use of extended subheader type for connections where ARQ is not enabled.
Purpose	To adopt the proposed changes during comment resolution procedure for sponsor ballot recirculation of 802.16-REVd/D4.
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Proposal to allow Extended Type subheaders for connections where ARQ is not enabled

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Reference

[1] IEEE P802.16-REVd/D4-2004, IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems

Introduction

In the definitions of the Fragmentation and Packing subheaders (Tables 8 and 11 of [1]), **the use of the Extended Type subheader** (with sequence number BSN represented by 11 bits) **is only applicable to connections where ARQ is enabled** and **the use of the non-Extended Type subheader** (with sequence number FSN represented by 3 bits) **to connections where ARQ is not enabled**. Although for connections with ARQ enabled the use of the Extended Type shall be mandatory, there is no reason not to allow non-ARQ connections to use either type of subheader, especially since bit #3 of the Type field in the MAC Header (Table 6 in [1]) indicates the type of the subheaders used. More importantly, restricting non-ARQ connections to 3-bit FSN may, under some conditions, lead to incorrect reassembly of SDUs as shown in the next section.

We propose some minor changes to the IEEE P802.16-REVd/D4 document which will allow the use of either type of subheader for connections where ARQ is not enabled. These changes do not affect ARQ connections and at the same time do not prohibit the use of non-extended type for non-ARQ connections. The objective is to add more flexibility to the use of either type of subheader.

Problems that may arise with current scheme

We next illustrate with an example how incorrect reassembly of an SDU may occur if a 3-bit FSN is used. In the scenario shown in Figure 1, 8 consecutive fragments are lost due to a lost FCH/DL-MAP and as a result the FSN wraps-around and causes incorrect reassembly. Given that Ethernet frames do not have CRC, such errors would cause significant performance degradation of upper layer protocols (such as TCP, UDP etc).

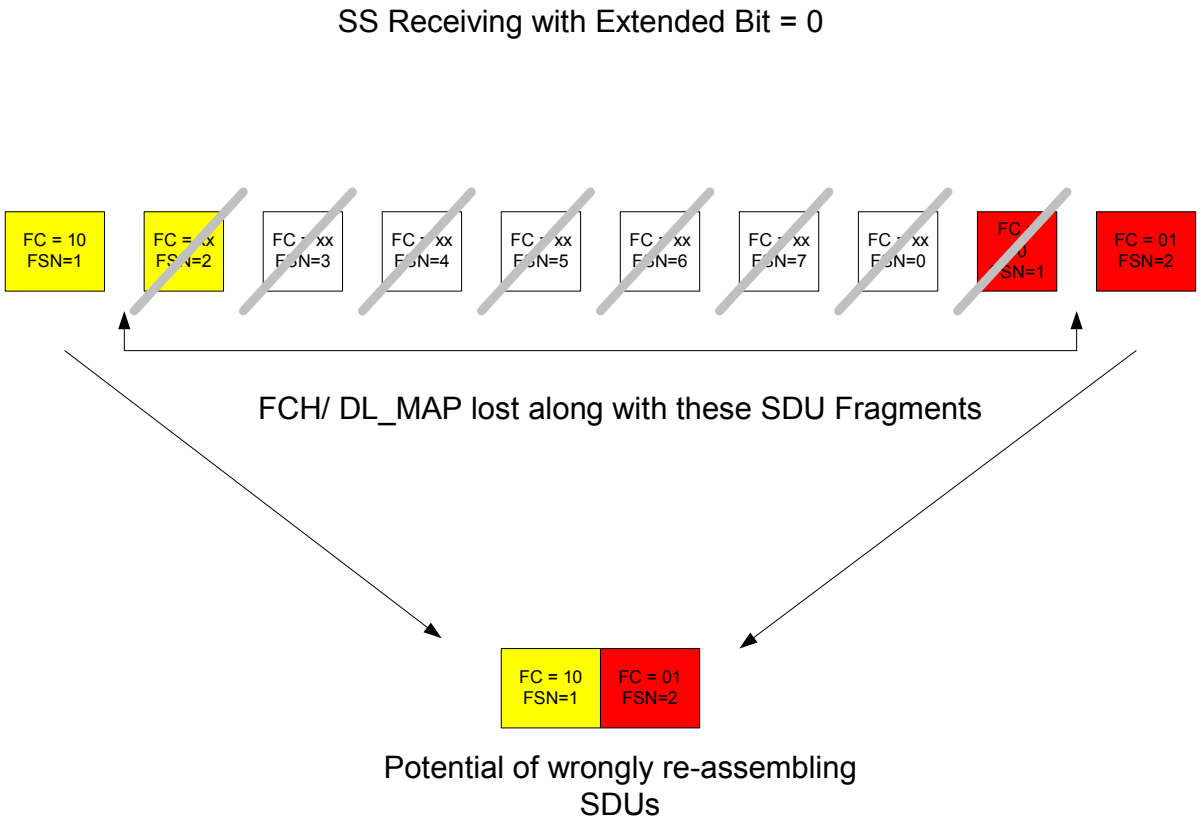

Figure 1: Example of incorrect reassembly for non-ARQ connection using 3-bit FSN

Proposed changes in 802.16-REVd/D4-2004

In this section we propose some changes to the working group document (P802.16-REVd/D4) to allow the use of the Extended Type for connections where ARQ is not enabled. **The rationale is that 11-bit FSN practically eliminates the probability of the scenario shown in Figure 1.**

Moreover, the requirement that ARQ connections should still use the Extended Type is maintained.

The following format is used to better illustrate the changes:

> Text to be added is shown in red and in blue (blue used to highlight changes from rev1 of this document)
> *Editorial instructions are marked by [red italic]*
> Text to be deleted is shown as ~~strikethrough.~~

Change 1:

[In section 6.3.2.1.1, page 38, Table 6 (Type Encodings), modify the table as follows]:

Type bit	Value
#5 most significant bit(MSB)	Mesh subheader 1= present, 0= absent
#4	ARQ Feedback Payload 1= present, 0= absent
#3	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	Fragmentation subheader 1= present, 0= absent
#1	Packing subheader 1= present, 0= absent
#0 least significant bit (LSB)	Downlink: FAST-FEEDBACK Allocation subheader Uplink: Grant Management subheader 1= present, 0= absent

Change 2:

[In section 6.3.2.2.1, page 40, Table 8 (Fragmentation Subheader Format), modify the table as follows]:

Syntax	Size	Notes
Fragmentation Subheader() {		
FC	2 bits	Indicates the fragmentation state of the payload: 00 = no fragmentation 01 = last fragment 10 = first fragment 11 = continuing (middle) fragment
if (ARQ-enabled Connection)		
BSN	11 bits	Sequence number of first block in the current SDU fragment. ~~Applicable to connections where ARQ is enabled.~~
else		
if (**Type** bit **Extended Type**)		see Table 6
FSN	11 bits	Sequence number of the current SDU fragment. This field increments by one (modulo 2048) for each fragment, including unfragmented SDUs.
else		
FSN	3 bits	Sequence number of the current SDU fragment. This field increments by one (modulo 8) for each fragment, including unfragmented SDUs. ~~Applicable to connections where ARQ is not enabled~~.

Reserved	3 bits	
}		

Change 3:

[In section 6.3.2.2.3, page 42, Table 11 (Packing Subheader Format), modify the table as follows]:

Syntax	Size	Notes
Packing Subheader() {		
FC	2 bits	Indicates the fragmentation state of the payload: 00 = no fragmentation 01 = last fragment 10 = first fragment 11 = continuing (middle) fragment
if (ARQ-enabled Connection)		
BSN	11 bits	Sequence number of first block in the current SDU fragment. ~~Applicable to connections where ARQ is enabled~~.
else		
if (**Type** bit **Extended Type**)		see Table 6
FSN	11 bits	Sequence number of the current SDU fragment. This field increments by one (modulo 2048) for each fragment, including unfragmented SDUs.
else		
FSN	3 bits	Sequence number of the current SDU fragment. This field increments by one (modulo 8) for each fragment, including unfragmented SDUs. ~~Applicable to connections where ARQ is not enabled~~.
Length	11 bits	
}		

Change 4:

[In section 6.3.3.4.2, page 109, "Packing for ARQ-enabled connections", Lines 4-6, make the following changes]:

The use of Packing subheaders for ARQ-enabled connections is similar to that for non-ARQ connections as described in 6.3.3.4.1.2, except that ARQ-enabled connections shall always set the Extended Type bit

(see Table 6) in the generic MAC header to 1~~, whereas non-ARQ connections shall set the Extended Type bit to 0~~.

Change 5:

This change is required to prevent the possibility of "intermixing" extended and non-extended subheaders for a non ARQ connection.

[In section 11.8.2, page 598, "Capabilities for Contruction and Transmission of MAC PDUs", Lines 22-35, make the following changes]:

11.8.2 Capabilities for Construction and Transmission of MAC PDUs

Type	Length	Value	Scope
4	1	Bit #0: Ability to unpack MAC PDUs that contain multiple packed SDUs (or fragments) Bit #1: Ability to receive requests piggybacked with data Bit #2: Specifies the size of FSN values used when forming MAC PDUs on non-ARQ connections 0: Only 3-bit FSN values are supported 1: Only 11-bit FSN values are supported Bits ~~#2~~ 3–7: *reserved*; shall be set to zero	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)