Changes in ARQ

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Venue:

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Purpose:

This document is to be presented to 802.16 TGd to fix 802.16d document

Changes in ARQ

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Problem

- New situation after 802.16d/e changes:
  - Varying channel conditions (mobility)
  - Large number of subchannels in OFDM => narrow UL channel
  - Example
    - BW = 3.5 MHz
    - Frame size = 2.5 ms
    - MAP burst = 64 bytes (QPSK ½)
    - DL preamble[2]+ MAP burst[2] +TTG[1] = 5 (sym)
    - UL rate = QPSK ½
  - Frame [36] – 5 = 31 (sym)   *1.5 bytes = 48 bytes

Problem(2)

- So the fragment size should be less than that
- It means that having middle size packet e.g. 480 bytes we have to split it into 10 fragments (and probably pack into a single MAC PDU). Otherwise SS may have no choice but to discard all fragments waiting for retransmission each time when BS provides narrow channel. There is no mechanism to inform SS why it was decided
- **We have to keep fragment size low even if at the moment everything is OK** (lot of bandwidth)

Problem(2)

- As a result:
  - Overhead of Fragmentation Subheader (2/48=4%)
  - Need to process **10 fragmentation subheaders** instead of one

Solution

- Return to block-based ARQ (802.16-D1) where block size [not fragment size] is small enough to fit into MAC frame at the lowest possible data rate
  - Allows re-fragmentation so we **don't need anymore fragment packets while everything is OK**
- We may keep unchanged fragmentation/packing at connections with ARQ disabled

Solution(2)
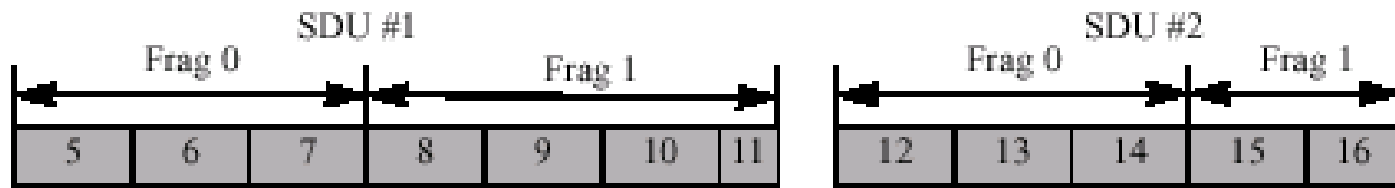
Figure 139—Block usage examples for ARQ transmissions and retransmissions
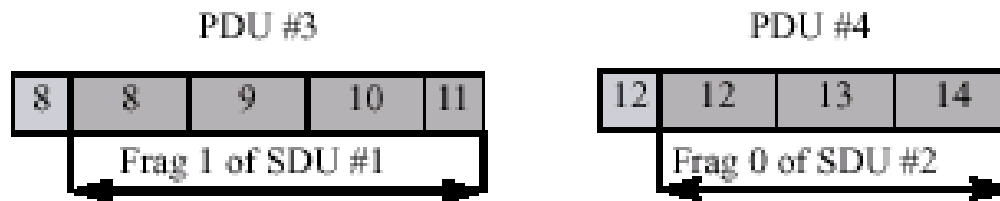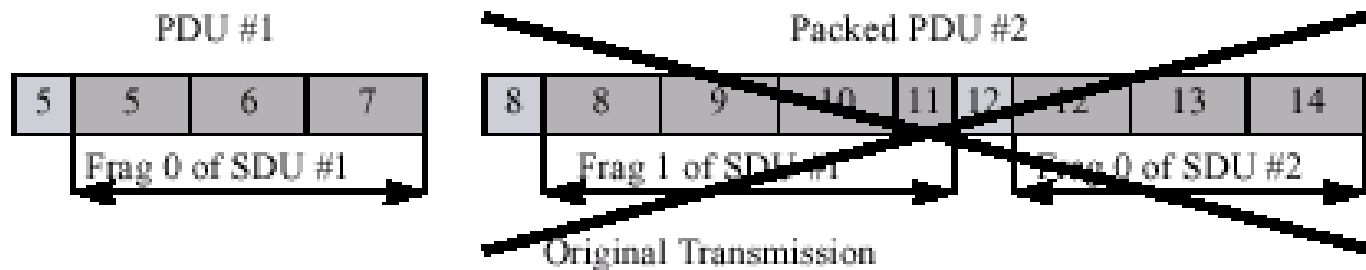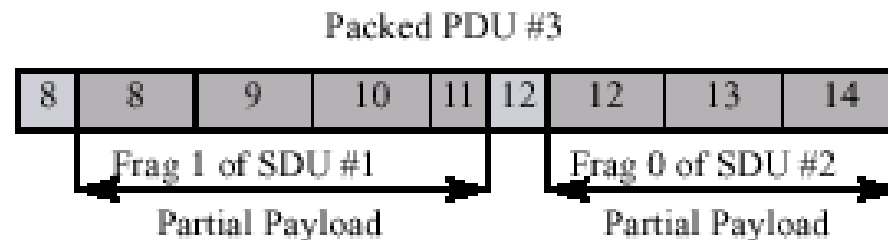
How to fix the document (Example #1)

Table 11—Packing Subheader format

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 (Type bit **Extended Type**)		See Table 4.
BSN	11 bits	Sequence number of the current SDU **block** This field increments by one (modulo 8) for each fragment, including unfragmented SDUs. **For connections with ARQ enabled**
else		
FSN	3 bits	Sequence number of the current SDU fragment. This field increments by one (modulo 2048) for each fragment, including unfragmented SDUs.
Length	11 bits	
}		

How to fix the document (Example #2)

Table 56b—ARQ Discard message format

Syntax	Size	Notes
ARQ_Discard_Message_Format() {		
Management Message Type = 34	8 bits	
Connection ID	16 bits	CID to which this message refers;
Reserved	5 bits	
BSN	11 bits	**Block** : Sequence Number of the last **Block** in the transmission window that the transmitter wants to discard
}		

Possible Comment to 802.16d-D2

- Copy from 802.16a-D1 to replace the correspondent items in 802.16a-D5
  - Figure 135—SDU encapsulation and ARQ Block Numbering in PDUs Table 164—Format of 2 - 11 GHz Fragmentation sub-header
  - Table 165—Format of 2 - 11 GHz Packing sub-header
  - Section 6.2.4.1 Block Numbering Scheme
  - Replace throughout the text Fragment Sequential Number (FSN) to Block Sequential Number (BSN)
  - …