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Title	**Changes to Fragment Sequence number (FSN) in optional MAC sub-headers**
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Re:	In response to 802.16 Letter Ballot #3
Abstract	This contribution suggests the removal of FSN field from optional fragmentation and packing sub-headers. We propose that the FSN field of fragmentation sub-header be changed to an MPDU-Sequence number and the FSN field in the packing sub-header be reserved.
Purpose	Approve FSN changes proposed in this document and include the alternate text and figures provided in this submission.
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Changes to Fragment Sequence number (FSN) in optional MAC sub-headers

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Summary and Rationale

The Fragment Sequence Number (FSN) defined in IEEE 802.16/D2-2001 has the following problems:

1. The number of bits is not consistent throughout the document: Figures 18 and 19 on page 20 and Table 1 on page 52, specify a 4-bit FSN. Figure 61 on page 104 indicate a 3-bit FSN field.
2. 3/4-bit FSN limits the maximum number of fragments (hence number of MPDUs) per-MSDU to 8/16. This may not be sufficient for some systems that may want to support smaller MPDUs.
3. A per-packet FSN is not required for reassembly. Since two FC bits can unambiguously indicate the first and last fragments of an MSDU, a per-connection MPDU-Sequence number (MPDU-SN) works well for re-assembly.
4. Per-packet FSN causes ambiguity in re-assembly. This is especially true if multiple MPDUs of the same connection are transmitted in the same frame.

   Example: Consider two consecutive MSDUs, MSDU1 and MSDU2 of the same connection. Assume that both MSDU1 and MSDU2 require exactly two MPDUs each, i.e., both MSDUs are fragmented into two. The FSN and FC bits of these four fragments (shown in binary) are as follows: MPDU1 = [001, 10], MPDU2 = [010, 01], MPDU3 = [001, 10] and MPDU4 = [010, 01]. If MPDU2 and MPDU3 are lost, then the receiver has no easy way of detecting gaps, and could re-assemble the wrong fragments (MPDU1 and MPDU4), as the re-assembler is expecting an MPDU with [010, 01]. This can be resolved by the re-assembler, to some extent, by keeping the Connection ID information from MAPs, and creating gaps if an MPDU that was suppose to be received for a connection (based on the information from the MAP) is corrupted/lost. Since the connection ID in the MAPs is primarily used by the receiver to identify which MPDUs are addressed to it, this may create some implementation problems. Moreover, if all the four MPDUs were sent in the same frame, even this would not work reliably. In general, the ambiguity exists if the last X consecutive fragments of packet (P) and the first X consecutive fragments of packet (P + 1) of the same connection are lost.

   We propose that the fragmentation sub-header include a 6-bit MPDU-SN, instead of the 3-bit per-packet FSN. With the MPDU-SN, the re-assembler can unambiguously determine if there are gaps in the sequence and discard the incompletely received MSDUs.

Specific Changes

Remove FSN description from Table 1 on page 52.

Changes to section 6.2.3.2

Insert the following paragraph at line 8:

"*Fragmentation sub-header is optional and the connections that support fragmentation need to include this field. The TYPE field in the generic MAC header is used to control the inclusion of fragmentation sub-header in the generic MAC header. Different sub-headers may be included based on specific convergence layer-requirements*"

Remove the FSN column from Table 20.

Replace text from lines 8 to 12 with the following:

"Fragmentation may be initiated by a BS for a downlink connection. Fragmentation may be initiated by an SS for an uplink connection. A connection may be in only one fragmentation state at any given time. A connection that is not in the fragmentation state shall set the FC files of the Connection's Service Flow to 00. The FC along with the MPDU-SN shall be used by the receiver to correctly re-assemble MSDUs fragmented by the transmitter"

Changes to section 6.2.3.3.2

Replace text from lines 45 to 50 with the following:

"The packing sub-header starts with a 3-bit reserved field and a 2-bit Fragmentation Control (FC) field. The FC field in the MAC header itself is set to 00 by the transmitter and interpreted as " do not care" by the receiver. These are followed by an 11-bit length field expressing the length of the SDU or SDU fragment following the packing sub-header"

Replace Figure 61 of IEEE802.16/D2-2001 with the following Figure 1:

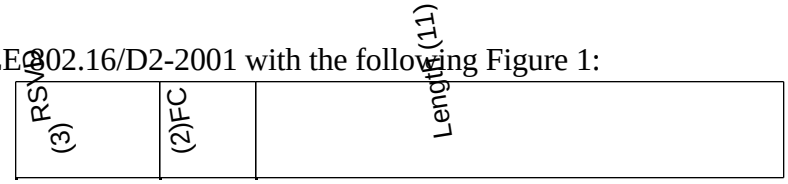

Figure 1: Packing Sub-header

Changes to section 6.2.3.3.2.1

Replace the FSN with RSVD (Reserved) in all packing sub-headers shown in Figure 64 on page 106.

Changes to 802.16.1c-01/10

If 802.16.1c-01/10 is accepted, replace Figure C of that document with the following Figure 2.

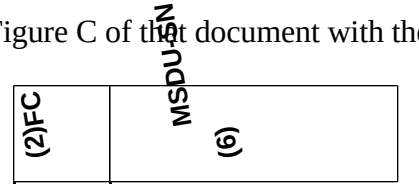

Figure 2: Fragmentation Sub-header