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Title	**Clean-up of OFDMA Numerology, TTG/RTG, and Irregular Subframe in IEEE 802.16m AWD**	
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Re:	"802.16m AWD" IEEE 802.16m-09/0012, "Call for Contributions on Project 802.16m Amendment Working Document (AWD) Content" – Call for Comments on Amendment Working Document.	
Abstract	This contribution proposes to change OFDMA numerology, TTG/RTG lengths, and irregular subframe structure in the current IEEE 802.16 AWD, in order that they should be aligned with those in the current IEEE 802.16 SDD.	
Purpose	To be discussed and adopted by TGm for the 802.16m AWD.	
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Clean-up of OFDMA Numerology, TTG/RTG, and Irregular Subframe in the IEEE 802.16m AWD

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1. Introduction

At the IEEE 802.16 Session #59 in January 2009, the following modifications to the IEEE 802.16m SDD were adopted, and they have been included into the latest version of the SDD [1]:

- Add the OFDMA numerology of 1/16 CP for 7MHz, 8.75MHz, and 1/4 CP for 5MHz, 10MHz, 20 MHz.
- Define *type-3 subframe* which consists of five OFDMA symbols
- Change *6-symbol subframe with idle symbol* (type-1 short subframe) to the *type-3 subframe*
- Change the lengths of TTG and RTG to the same values defined in WiMAX Profile R1.0 [2].

In order to make the IEEE 802.16 AWD aligned with the current SDD, we propose the same modifications to the AWD.

2. References

[1] IEEE 802.16m-08/003r7, “The Draft IEEE 802.16m System Description Document”

[2] WiMAX Forum™ Mobile System Profile, Release 1.0 Approved Specification (Revision 1.4.0: 2007-05-02)

3. Proposed Text Changes to Amendment Working Document

[Remedy 1: Replace Table 647 in page 12 with the following Table]

Table 647 – OFDMA parameters

The nominal channel bandwidth, *BW* (MHz)			5	7	8.75	10	20
Sampling factor, *n*			28/25	8/7	8/7	28/25	28/25
Sampling frequency, F_s (MHz)			5.6	8	10	11.2	22.4
FFT size, N_{FFT}			512	1024	1024	1024	2048
Subcarrier spacing, Δf (kHz)			10.94	7.81	9.77	10.94	10.94
Useful symbol time, T_b (μs)			91.4	128	102.4	91.4	91.4
CP ratio, *G* = 1/8	OFDMA symbol time, T_s (μs)		102.857	144	115.2	102.857	102.857
	FDD	Number of OFDMA symbols per 5ms frame	48	34	43	48	48
		Idle time (μs)	62.857	104	46.40	62.857	62.857
	TDD	Number of OFDMA symbols per 5ms frame	47	33	42	47	47
		TTG + RTG (μs)	165.714	248	161.6	165.714	165.714
CP ratio, *G* = 1/16	OFDMA symbol time, T_s (μs)		97.143	136	108.8	97.143	97.143
	FDD	Number of OFDMA symbols per 5ms frame	51	36	45	51	51
		Idle time (μs)	45.71	104	104	45.71	45.71
	TDD	Number of OFDMA symbols per 5ms frame	50	35	44	50	50
		TTG + RTG (μs)	142.853	240	212.8	142.853	142.853
CP ratio, *G* = 1/4	OFDMA symbol time, T_s (μs)		114.286			114.286	114.286
	FDD	Number of OFDMA symbols per 5ms frame	42			42	42
		Idle time (μs)	199.98			199.98	199.98
	TDD	Number of OFDMA symbols per 5ms frame	42			42	42
		TTG + RTG (μs)	199.98			199.98	199.98
Number of Guard Sub-Carriers		Left	40	80	80	80	160
		Right	39	79	79	79	159
Number of Used Sub-Carriers			433	865	865	865	1729
Number of Physical Resource Blocks (18x6)			24	48	48	48	96

[Remedy 2: Change the text from line 36 to 42 on the page 14, in 15.3.3.1., as follows:]

There are ~~two~~ three types of subframes ~~depending on the size of cyclic prefix~~:

1) the type-1 subframe which consists of six OFDMA symbols, ~~and~~

2) the type-2 subframe that consists of seven OFDMA symbols, and

3) the type-3 subframe which consists of five OFDMA symbols. ~~In both subframe types, some of symbols may be idle symbols.~~

[Remedy 3: Change the text from line 48 to 50 on the page 16, in 15.3.3.2.2., as follows:]

Figure 391 illustrates an example TDD frame structure with D:U = 5:3, which is applicable to the nominal channel bandwidths of 5, 10, and 20 MHz with G = 1/8. In Figure 391 the last DL subframe, i.e. DL SF4, is a type-3 subframe and the other subframes are type-1 subframes. TTG and RTG are 105.714 μs and 60μs, respectively.

[Remedy 4: Replace Figure 391 in page 17 with the following Figure]

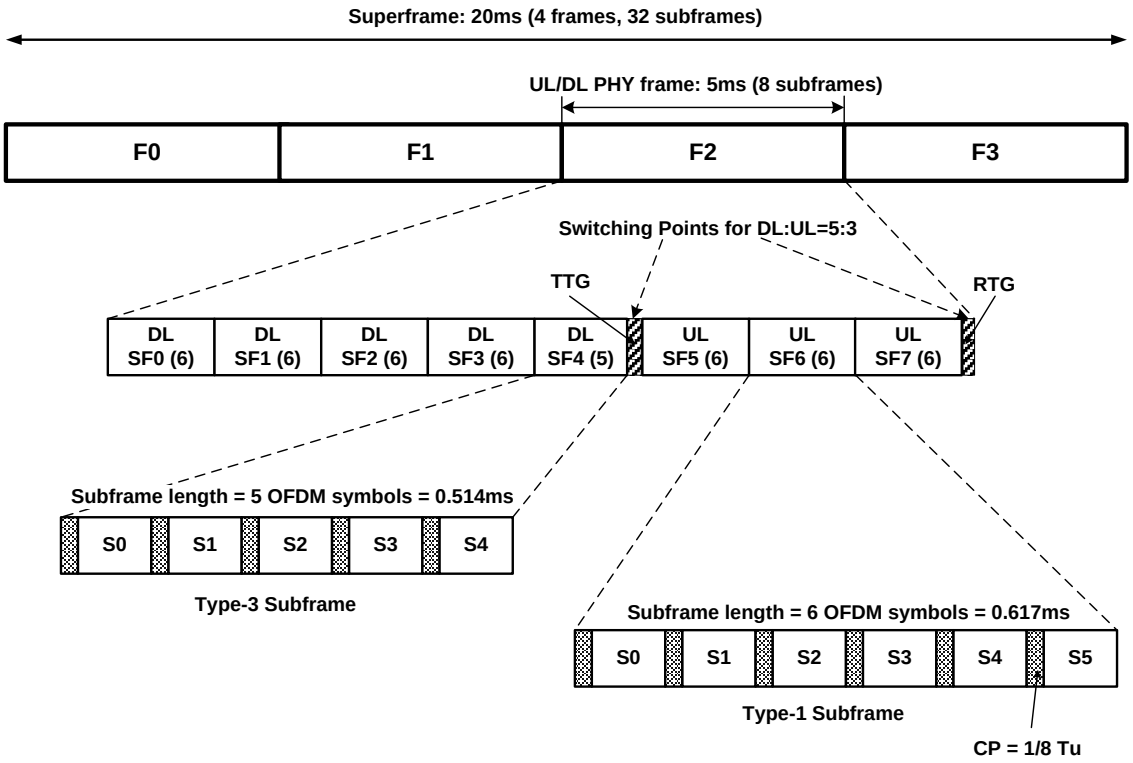

Figure 391 Frame Structure with type-1 and type-3 subframes in TDD duplex mode for 5, 10, 20 MHz channel bandwidths (CP=1/8 T_b)

[Remedy 5: Change the text from line 43 to 57 on the page 17, in 15.3.3.3., as follows:]

For channel bandwidths of 5, 10, and 20 MHz, a FDD frame shall have five type-1 subframes and three type-2 subframes, and a TDD frame shall have six type-1 subframes and two type-2 subframes. The subframe preceding a DL to UL switching point shall be a type-1 subframe.

In the TDD frame, the first and last subframes within each frame shall be type-2 subframes. ~~The last OFDMA~~

~~symbol in a type-2 subframe preceding a DL to UL switching point shall be an idle symbol, which is used to accommodate the gap required to switch from DL to UL.~~

In the FDD frame, the first, fifth, and last subframes within each frame shall be type-2 subframes.

Figure 392 illustrates an example of TDD and FDD frame structure with a CP of 1/16 T_b. Assuming OFDMA symbol duration of 97.143 μs and a CP length of 1/16 T_b, the length of type-1 and type-2 subframes are 0.583 ms and 0.680 ms, respectively. TTG and RTG are 82.853 μs and 60 μs, respectively.

[Remedy 6: Replace Figure 392 in page 18 with the following Figure]

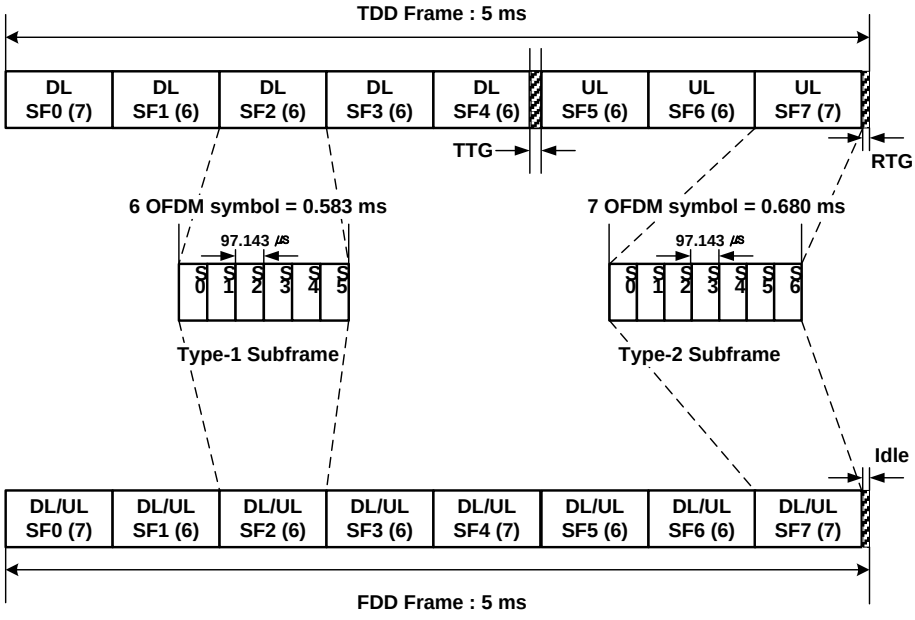

Figure 392 TDD and FDD Frame Structure with CP of 1/16 T_b (DL to UL ratio of 5:3)

[Remedy 7: Change the text from line 32 to 39 on the page 24, in 15.3.5.1., as follows:]

A physical resource unit (PRU) is the basic physical unit for resource allocation that comprises P_{sc} consecutive subcarriers by N_{sym} consecutive OFDMA symbols. P_{sc} is 18 subcarriers and N_{sym} is 6 OFDMA symbols for type-1 subframes, ~~and~~ N_{sym} is 7 OFDM symbols for type-2 sub frames, and N_{sym} is 5 OFDMA symbols for type-3 subframes. A logical resource unit (LRU) is the basic logical unit for distributed and localized resource allocations. A LRU is $P_{sc} \cdot N_{sym}$ subcarriers for type-1 subframes, ~~and~~ type-2 subframes, and type-3 subframes. The LRU includes the pilots in (ref. TBD) that are used in a PRU. The effective number of subcarriers in an LRU depends on the number of allocated pilots.