

Project	IEEE 802.16 Broadband Wireless Access Working Group < http://ieee802.org/16 >	
Title	Frame Structures for 7MHz and 8.75MHz Channel Bandwidths	
Date Submitted	2009-01-07	
Source(s)	Jaeweon Cho, Hoky Choi, Heewon Kang, Jeongho Park, Hwasun Yoo, Jaehee Cho Samsung Electronics Co., Ltd.	Voice: +82-31-279-5796 E-mail: jaeweon.cho@samsung.com
Re:	IEEE 802.16m-08/053r1, "Call for Comments and Contributions on Project 802.16m Amendment Working Document".	
	<ul style="list-style-type: none"> Target topic: Call for Comment on Amendment Working Document Text (IEEE 802.16m-08/050). 	
Abstract	This contribution proposes frame structures for 7MHz and 8.75MHz channel bandwidths.	
Purpose	To be discussed and adopted by TGM for the 802.16m Amendment Working Document.	
Notice	<i>This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups. It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein.</i>	
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.	
Patent Policy	<p>The contributor is familiar with the IEEE-SA Patent Policy and Procedures: http://standards.ieee.org/guides/bylaws/sect6-7.html#6 and http://standards.ieee.org/guides/opman/sect6.html#6.3.</p> <p>Further information is located at http://standards.ieee.org/board/pat/pat-material.html and http://standards.ieee.org/board/pat.</p>	

Frame Structures for 7MHz and 8.75Mhz Channel Bandwidths

*Jaeweon Cho, Hoky Choi, Heewon Kang, Jeongho Park, Hwasun Yoo, Jaehee Cho
Samsung Electronics Co., Ltd.*

1. Introduction

So far there has been no discussion at TGm on frame structures for 7MHz and 8.75MHz channel bandwidths. Only OFDMA parameters for them are defined in the current draft of 802.16m SDD [1] and Amendment working document [2]. So, this contribution discusses and proposes frame structures for 7MHz and 8.75MHz for inclusion in the Amendment Working Document.

Before discussing the detailed frame structures, we need to identify the issue and requirement in design of frame structures for 7MHz and 8.75MHz.

- 1) First, the issue is that the 10MHz frame structure cannot be applied to 7MHz and 8.75MHz. The reason is because the number of OFDMA symbols per frame is not the same among different channel bandwidths; i.e. 48 symbols for 10MHz, but 43 and 34 symbols for 8.75MHz and 7MHz, respectively. The subframe configuration adopted in the 10MHz frame structure, i.e. 8 subframes per 5ms frame, therefore cannot be kept in 7MHz and 8.75MHz by using a combination of type-1 subframe (6-symbol) and type-1 short subframe (5-symbol) only.
- 2) There may be two design approaches for 7MHz and 8.75MHz frame structures: One is to reduce the number of subframes per frame while trying to employ only the subframe types defined in the current SDD (type-1 subframe, type-1 short subframe, and type-2 subframe). The other is to reduce the number of OFDMA symbols per subframe while keeping the configuration of 8 subframes per frame. Both options have their own drawbacks. In particular, reducing the number of OFDMA symbols in subframe produces another new subframe type, then a new PRU should be defined accordingly. In addition, we may need a new control channel structure for it, especially in UL. Therefore, in the design of 7MHz and 8.75MHz frame structures, we have to find a proper number of subframes per frame so as to void another new subframe type.
- 3) In design of 7MHz and 8.75MHz frame structures, the legacy support requirements defined in SRD [3] shall be considered. In particular, the DL to UL symbol ratio employed in the current practical WiMAX systems shall be supported; i.e. DL:UL = 27:15 for 8.75MHz, DL:UL = 21:12 for 7MHz [4].

After due consideration of the issue and requirements above, we have developed candidates for the 7MHz and 8.75MHz frame structures. We present and discuss them in the following sections.

2. Frame Structures in TDD for 7MHz

The proposed frame structure for 7MHz with DL:UL = 21:12 is shown in Figure 1. In this structure, a 5ms frame consists of six subframes. For the ratio of DL:UL = 21:12, downlink subframe is comprised of one type-1 subframe and three newly-defined 5-symbols subframes (which is called type-3 subframe here), uplink

subframe of two type-1 subframes. It is noted that although we need to newly define the 5-symbols subframe in the SDD, there is already the concept of a 5-symbols subframe, i.e. type-1 short subframe that is a 6-symbols subframe with an idle symbol. So, we just need to replace the type-1 short subframe with the 5-symbols subframe. It is also noted that in our other contribution [5] we propose to define the 5-symbol subframe for another reason.

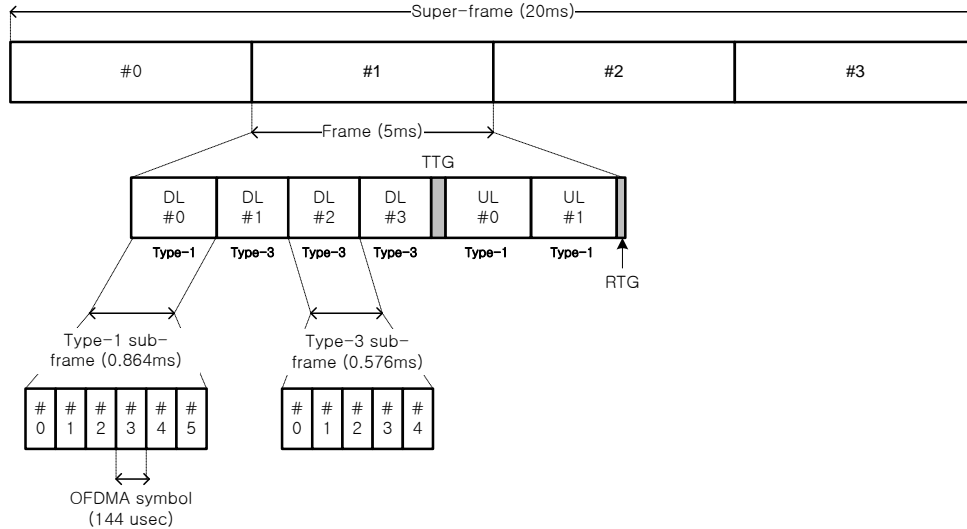


Figure 1. Frame Structure in TDD mode for 7 MHz channel bandwidths (CP=1/8 Tb)

3. Frame Structures in TDD for 8.75MHz

The issue in design of 8.75MHz is more complicated and tricky. For DL to UL symbol ratio of 27:15, the UL subframe of 15 symbols should be divided into multiple subframes, but then it is not easy to avoid the use of another irregular subframe type.

Various options for UL configuration for DL:UL = 27:15 are listed-up and compared in Table 1. All options in the table have the same downlink configuration of DL = {6, 6, 5, 5, 5}, i.e. two 6-symbol subframes (type-1) and three 5-symbol subframes. Each option has its own pros and cons, but the most critical issue is whether the option mandates a new UL control structure design or not. Another new UL control structure design only for 8.75 MHz is much burden to the specification. In this sense, we prefer to pick up the two options, A-2 and C, which both re-use the UL control structure of 6-symbols subframe.

Table 1. Various options for UL configuration for 8.75MHz frame structure with DL:UL = 27:15

UL configuration options		Pros	Cons
A-1	UL = {5, 5, 5}	- No impact on upper-level control procedure (scheduling, HARQ, ...) - Easy new PRU design (the same PRU as DL)	- Need New UL control design
	New UL Control structure for 5 symbol		
A-2	UL = {5, 5, 5}	- No impact on upper-level control procedure (scheduling, HARQ, ...)	- Performance degradation of UL Control channel due to the truncation
	Re-use UL Control		

	structure of 6 symbol (by truncation)	- Easy new PRU design (the same PRU as DL) - No need of new UL Control design	
B-1	UL = {6, 6, 3}	- No impact on HARQ operation	- Need New PRU design for 3 symbols - Need New ACK channel design
	UL ACK channels only in 3-symbol subframe	- Less burden to UL control design (Only New ACK design)	
B-2	UL = {6, 6, 3}	- No need of new UL control design	- Need New PRU design for 3 symbols - Impact on DL HARQ operation (Different ACK timing from 10MHz frame structure)
	No UL Control structure in 3-symbol subframe		
C	UL = {6, 9}	- No need of new UL control design	- Need New PRU design for 9 symbols (but easier than for 3 symbols) - 7 subframes / frame (Different DL & UL HARQ timings from 10MHz frame structure)
	Re-use UL Control structure of 6 symbol in 9-symbol subframe		

Figure 2 and 3 show option A-2 and C for 8.75 MHz frame structure, respectively. Although both options have the advantage of no need of new UL control design, they have also drawbacks: Option A-2 may degrade the performance of UL control channel due to the truncation of one symbol, and Option C needs a new PRU design for 9 symbols. Because of these observation, we prefer to have more investigation and discussion at TGM and to defer the decision of the 8.75MHz frame structure to the next March TGM meeting.

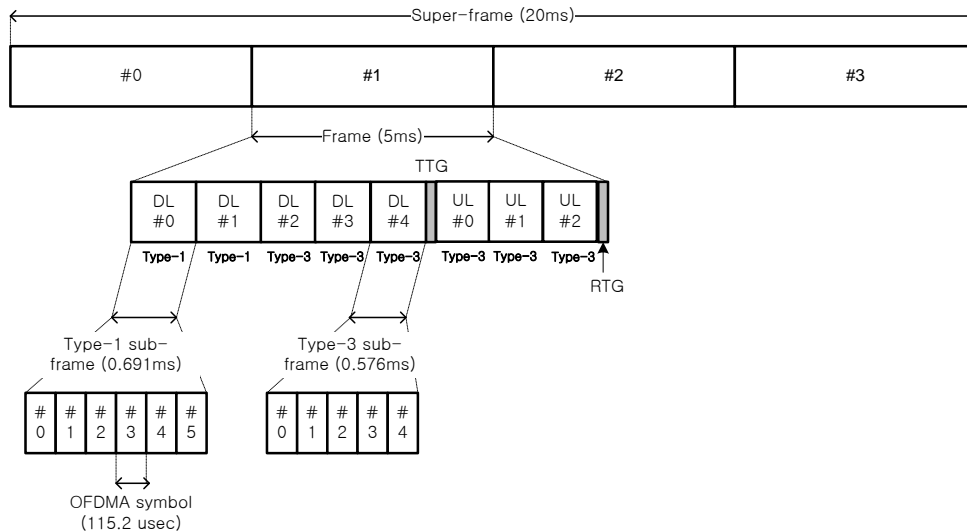


Figure 2. Option A-2 for 8.75 MHz Frame Structure with DL:UL = 27:15 (CP=1/8 Tb)

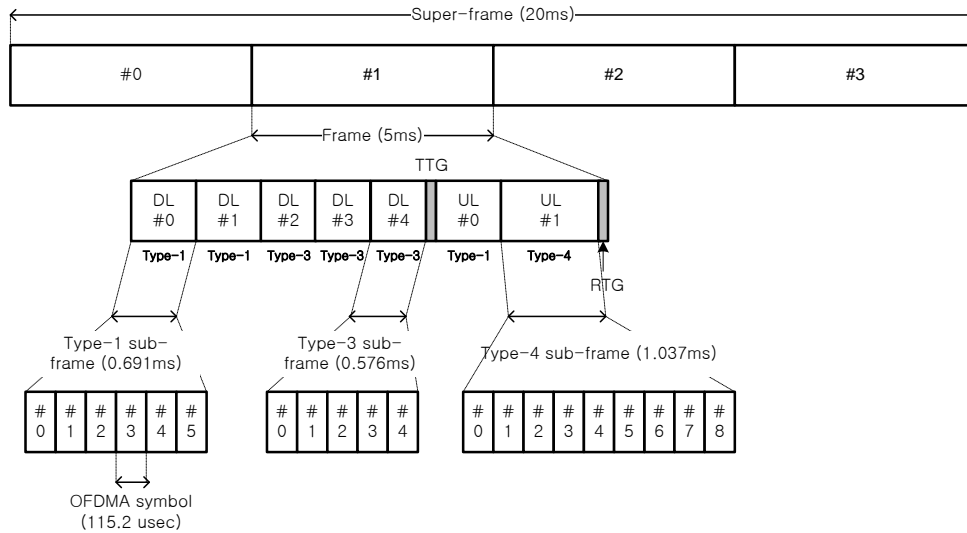


Figure 3. Option C for 8.75 MHz Frame Structure with DL:UL = 27:15 (CP=1/8 Tb)

4. Conclusions

We suggest the frame structure consisting of 6 subframes per 5ms frame, for the 7MHz frame structure. For DL:UL = 21:12, downlink subframe is comprised of one 6-symbols subframe and three 5-symbols subframes, and uplink subframe of two 6-symbols subframes.

For the 8.75MHz frame structure, we propose to defer the decision to the next March TGM meeting for more investigation and discussion at TGM.

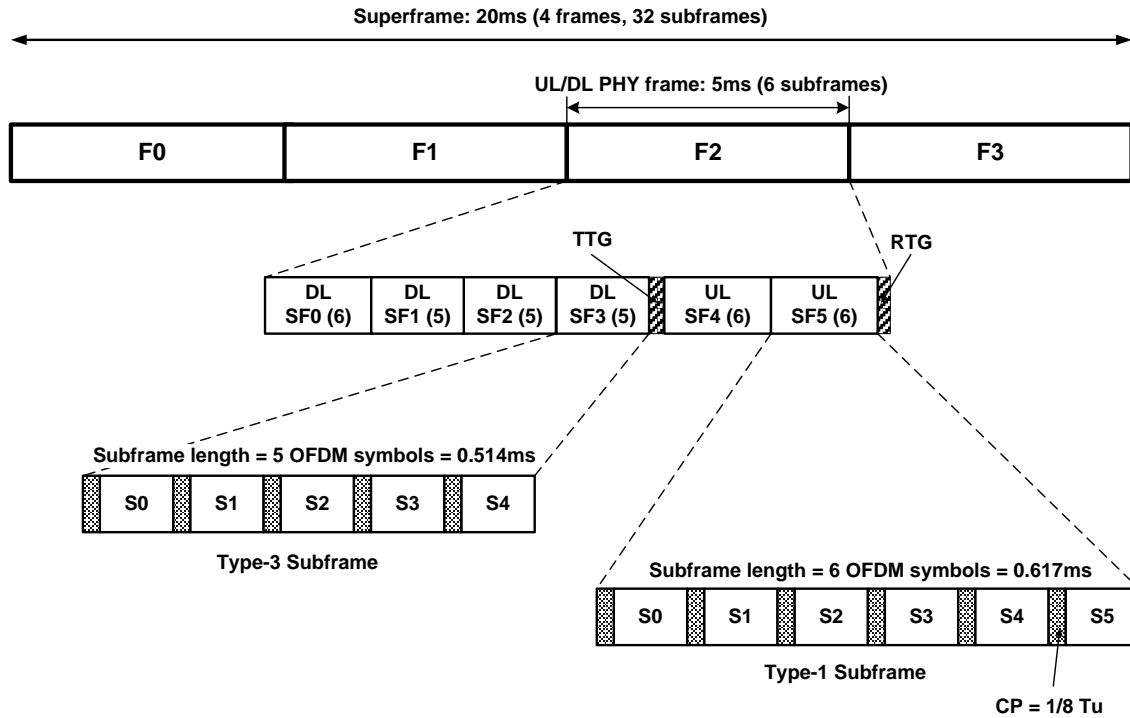
5. Proposed Text

[Remedy 1: Change the text from line 37 to 38 on the page 16, in 15.3.3.2.2, as follows:]

In a TDD frame with DL to UL ratio of D:U, the 1st contiguous D subframes and the remaining U subframes are assigned for DL and UL, respectively, where $D + U = 8$ for 5, 10 and 20 MHz channel bandwidths, and $D + U = 6$ for 7 MHz channel bandwidth.

[Remedy 2: Insert the following text and Figure after Figure 391 in page 17]

Figure xxx illustrates an example TDD frame structure with D:U = 4:2, which is applicable to the nominal channel bandwidth of 7MHz with $G = 1/8$.



[Figure xxx Frame Structure with type-1 and type-3 subframes in TDD duplex mode for 7 MHz channel bandwidths \(CP=1/8 \$T_b\$ \)](#)

6. References

- [1] IEEE 802.16m-08/003r6, "The Draft IEEE 802.16m System Description Document."
- [2] IEEE 802.16m-08/050, "IEEE 802.16m Amendment Working Document."
- [3] IEEE 802.16m-07/002r7, "IEEE 802.16m System Requirements."
- [4] WiMAX Plugfest 5 guideline, Dec 2007.
- [5] IEEE C802.16m-09/0010r1, "Clean-up of TTG/RTG and Irregular Subframe in IEEE 802.16m SDD and Amendment Working Document."