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Re:	Re: IEEE 802.16m-09/0028r1 Call for Comments and Contributions on Project 802.16m Amendment Content - Call for Comments and Related Contributions on Amendment Working Document	
Abstract	The contribution proposes the text of frame structure section to be included in the 802.16m amendment.	
Purpose	For discussion and approval by TGM for 802.16m amendment.	
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H-FDD Frame Structures for the AAIF and Legacy Supports

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1. Introduction

In the current IEEE 802.16m Amendment, TDD and FDD frame structures are considered together for supporting both the legacy system and Advanced Air Interface (AAIF). In addition, the AAIF needs to define how to support H-FDD MSs in a given FDD structure while considering legacy supports in IEEE 802.16-2009 [3]. However, the legacy support section in 15.3.3.4 describes only TDD frame structures. Therefore, the legacy supports of FDD frame structure should be described in the current IEEE 802.16m Amendment. In addition, H-FDD frame structure in section 15.3.3.2.1.1 is also empty. Thus, the H-FDD frame structure for IEEE 802.16m only should be described together with H-FDD legacy supports. This contribution proposes the H-FDD frame structure for IEEE 802.16m only and the FDD and H-FDD frame structures for legacy supports to be adopted in the IEEE 802.16m Amendment.

2. H-FDD Frame Structure

The H-FDD MSs should be supported without any impact on Full-FDD (F-FDD) frame structure. Thus, the H-FDD frame structure should be defined based on the F-FDD frame structure in the current IEEE 802.16m Amendment. The H-FDD frame structure can be constructed based on the following descriptions:

- The DL frame and the UL frame are divided into two groups of AAIF H-FDD MSs (group1 and group 2) that occupy the distinct partition of a 5ms frame. Here, the allocated partition of each group is basically in the unit of subframes.
- The DL frame contains two regions for two groups of AAIF H-FDD MSs, e.g., DL1 and DL2, in which, each region consists in the units of subframes. The DL1 is composed of A-preamble, SFH, A-MAP and data symbols. The DL2 is composed of A-MAP and data symbols.
- The UL frame also contains two regions, e.g., UL2 and UL1 with the corresponding order of DL1 and DL2. The AAIF H-FDD MSs included in the group1 receive data and controls from DL1 and transmit data and controls in UL1. Other H-FDD MSs included in the group2 listen to DL 2 and transmit data and controls in UL2.

As mentioned in the above, two partitions for the DL and UL transmissions of the AAIF H-FDD MSs are separated in both time and frequency. Thus, since the H-FDD AAIF MSs need transition gaps between DL and UL (and vice versa), one and more additional OFDMA symbols should be allocated to these gaps compared to the original FDD structure. However, these additional gaps in the symbol level cause the following problems with full-FDD MSs in AAIF:

- If the additional gaps are allocated to UL, some UL subframes may be defined as type-3 with 5 symbols. Thus, an additional UL control design is necessary.

- Due to these additional gaps in the symbol-level, there exist some type-3 subframes or new types of subframes which has less than 5 symbols in DL or UL. However, full-FDD MSs always expect to receive a type-1 subframe consisting of 6 OFDM symbols in the frame structure of 5, 10, 20 MHz and a CP length of 1/8Tu . Thus, it is necessary to announce the existence of other type of subframes to the full-FDD MSs, or the full-FDD MSs should have some performance loss.

To avoid disadvantages stemming from the symbol-level gaps, it can be considered to allocate subframes for the transition gap. The subframe-level gaps can be created by allocating idle subframes in either DL or UL.

Figure 1 shows the proposed H-FDD frame structure to support only AAIF H-FDD MSs when two subframes in DL and UL are used for transaction gaps, i.e., for TTG1, TTG2, RTG1, and RTG2. The DU_OFFSET denotes a positive or negative time difference of UL frame relative to DL frame in the unit of OFDM symbols.

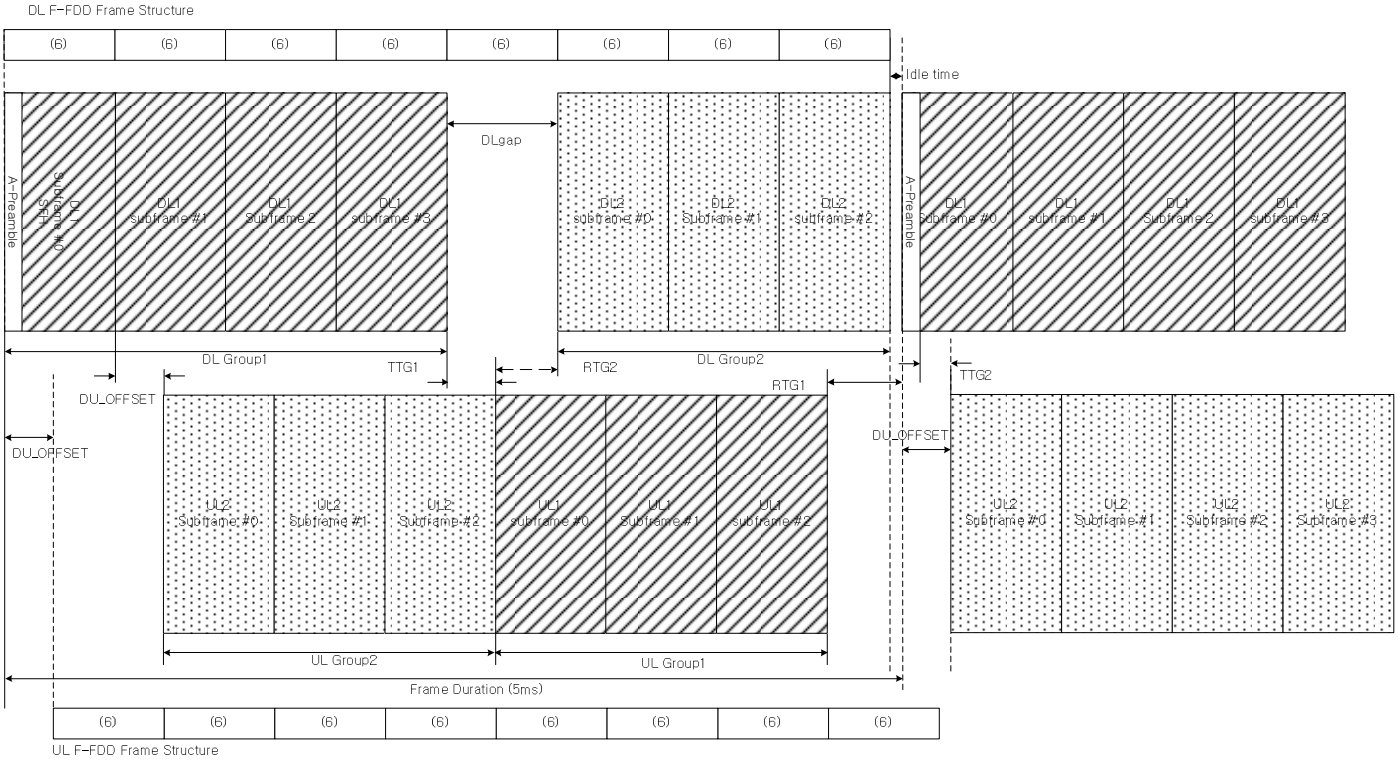

Figure 1 H-FDD frame structure for supporting AAIF H-FDD MSs

The SFH and A-Preamble are only transmitted to H-FDD MSs by using either partial or full portion of the first subframe of a frame. Because all MSs included each group should receive the SFH and A-Preamble, all the AAIF H-FDD MSs should not transmit UL subframe which is overlapped with the first DL subframe of a superframe. However, the SFH does not transmit every first subframe of frames of a superframe. Therefore, thanks to the DU_OFFSET, the first subframes of the second, third, and forth frames don't have to be idled, and all H-FDD MSs can still listen to every A-Preamble. The DU_OFFSET may be signaled in the SFH or ABI.

For given TTG1, TTG2, RTG1, and RTG2, the DU_OFFSET shall be satisfied with following condition in order to save three UL subframes in a superframe:

1) DU_OFFSET ≥ ceil(TTG2 + PS_1Symbol, PS_1Symbol),

2) DU_OFFSET ≤ ceil(Symbols_ Subframe* PS_1Symbol - RTG2, PS_1Symbol),

3) DU_OFFSET ≤ ceil(Symbols_ Subframe * PS_1Symbol + PS_Idle - RTG1, PS_1Symbol),

where

PS_1Symbol is the number of PSs per symbol,

Symbols_ Subframe is the number of symbols per subframes, and

PS_Idle is an idle time (PS) in a frame.

2. FDD Frame Structure in the Legacy Support Scenarios

A FDD frame structure for supporting the legacy H-FDD MSs can be constructed from the AAIF H-FDD frame structure as shown in Fig. 1. Thus, the DL frame contains two regions, DL1 and DL2, which have multiple durations of subframes. The DL1 is for the legacy H-FDD MSs and composed of a preamble symbol, a MAP region, and data symbols. The DL2 is used for AAIF and composed of A-preamble, SFH, A-MAP and data symbols. The UL frame also contains two regions, UL2 and UL1, which are also defined in the units of subframes. Since the DL region of data burst for the legacy H-FDD shall be cross allocated to avoid the overlapping with UL subframes of legacy H-FDD, the legacy region does not need an UL idle for receiving the Preamble. In one 5ms frame, the legacy H-FDD and AAIF can be multiplexed in DL and UL with offsets DL_FRAME_OFFSET and UL_FRAME_OFFSET, respectively, which are defined as a fixed number of subframes. The UL_FRAME_OFFSET is defined as the time duration of AAIF UL zone, while the DL_FRAME_OFFSET is defined as the difference from the starting point of legacy H-FDD to the starting point of AAIF.

The gap, DL_{gap} is located between the two DL region because the DL region of legacy is allocated by using the unit of OFDMA symbol. Thus, the size of DL_{gap} is shall be an integer number of OFDMA symbols.

Figure 2 shows the FDD frame structure to efficiently support legacy H-FDD MSs. In the case of 5, 10, and 20MHz for supporting the legacy H-FDD MSs, all DL and UL subframes for AAIF are type-1 subframes and total number of subframes is eight. DU_OFFSET is defined as the time difference between DL frame and UL frame can be fixed as 0 OFDMA symbol to avoid the impact on legacy MSs when legacy MSs are supported with AAIF MSs in the FDD frame structure. The DL_FRAME_OFFSET, UL_FRAME_OFFSET, and DU_OFFSET may be announced in the SFH or ABI to indicate the starting point of DL/UL region of subframes. In addition, the size of DL region of AAIF can be indicated using the DL_FRAME_OFFSET.

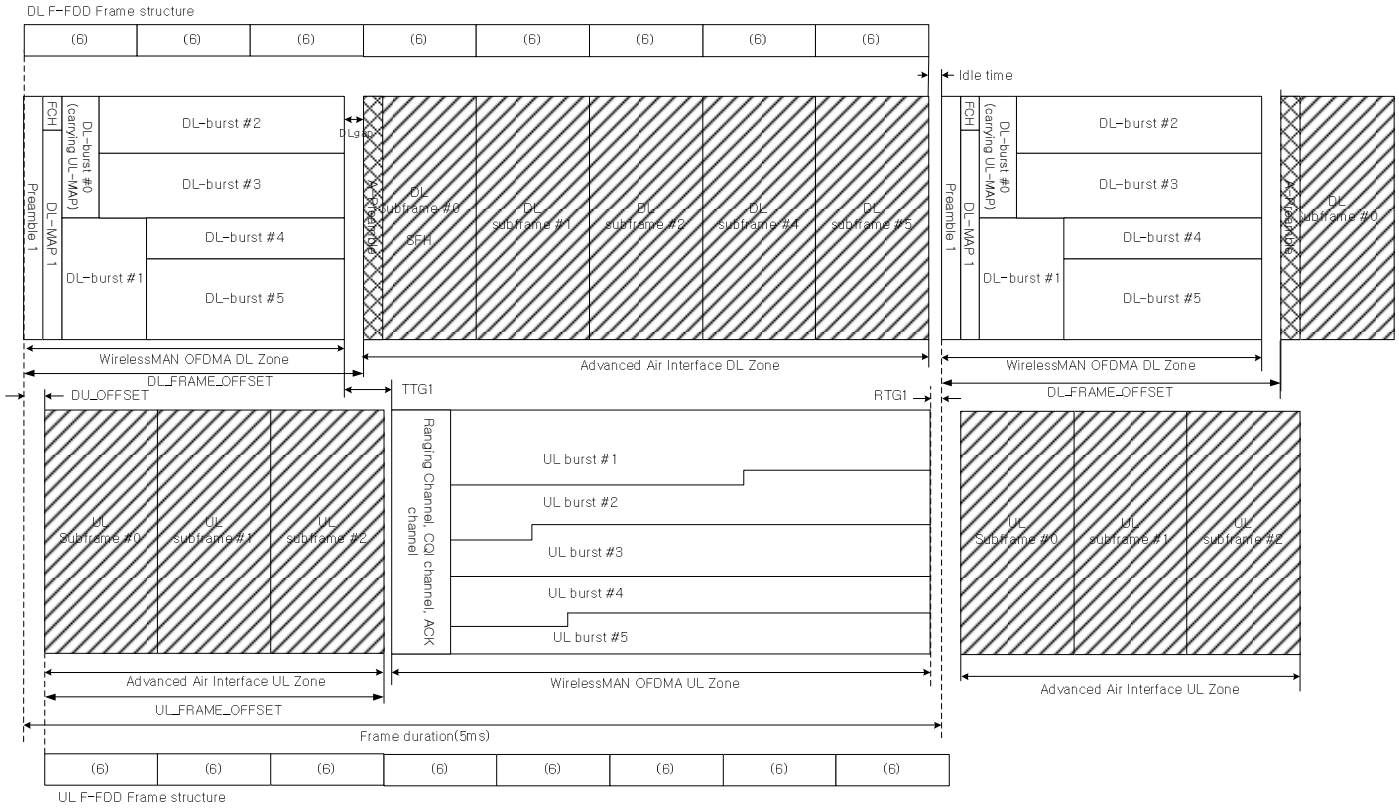

Figure 2 FDD frame structure for supporting legacy MSs

3. H-FDD Frame Structure in the Legacy Support Scenarios

The H-FDD frame structure to support the coexistence of legacy H-FDD MSs and AAIF H-FDD MSs can be constructed by succeeding the frame structure shown in Fig. 1. The regions of DL 1 and UL 1 can be allocated to legacy H-FDD MSs instead of the AAIF H-FDD MSs.

As shown Fig. 1, the H-FDD AAIF MSs also need transition gaps between DL and UL (and vice versa). In order not to have an impact on full FDD MSs operating in this frame structure, the subframe-level gaps can be considered. One UL subframe overlapped with the switching time between DL2 and UL2 can be allocated as a transition gap for H-FDD AAIF MSs. The DL1 and UL1 structures for legacy H-FDD MSs are exactly the same as those defined in the FDD frame structure shown in Fig. 2. The DU_OFFSET can also be set to be 0 OFDMA symbol considering legacy system operations. The legacy H-FDD MSs can exactly follow the procedure defined in the legacy H-FDD specification. In the AAIF H-FDD operation, the BS shall indicate the number of subframes in DL2 of current frame and the number of subframes in UL2 of next frame to the H-FDD MSs of AAIF using the control signal, i.e., SFH, A-MAP. Herein, the size of DL2 of current frame can be defined by using the DL_FRAME_OFFSET because the DL_FRAME_OFFSET is defined in unit of subframes.

The DL_{gap} can be allocated between two DL regions according to the regions of DL 1 allocated to legacy H-FDD MSs. the size of the DL_{gap} shall be an integer number of OFDMA symbols within one subframe.

Figure 3 shows the H-FDD frame structure for supporting the legacy H-FDD MSs when one subframe is used in the UL frame for transition gaps, i.e., TTG2 and RTG2. All the subframe boundary and the number OFDM symbols of subframes in DL2 and UL2 should be aligned with F-FDD DL and UL frame structures, respectively.

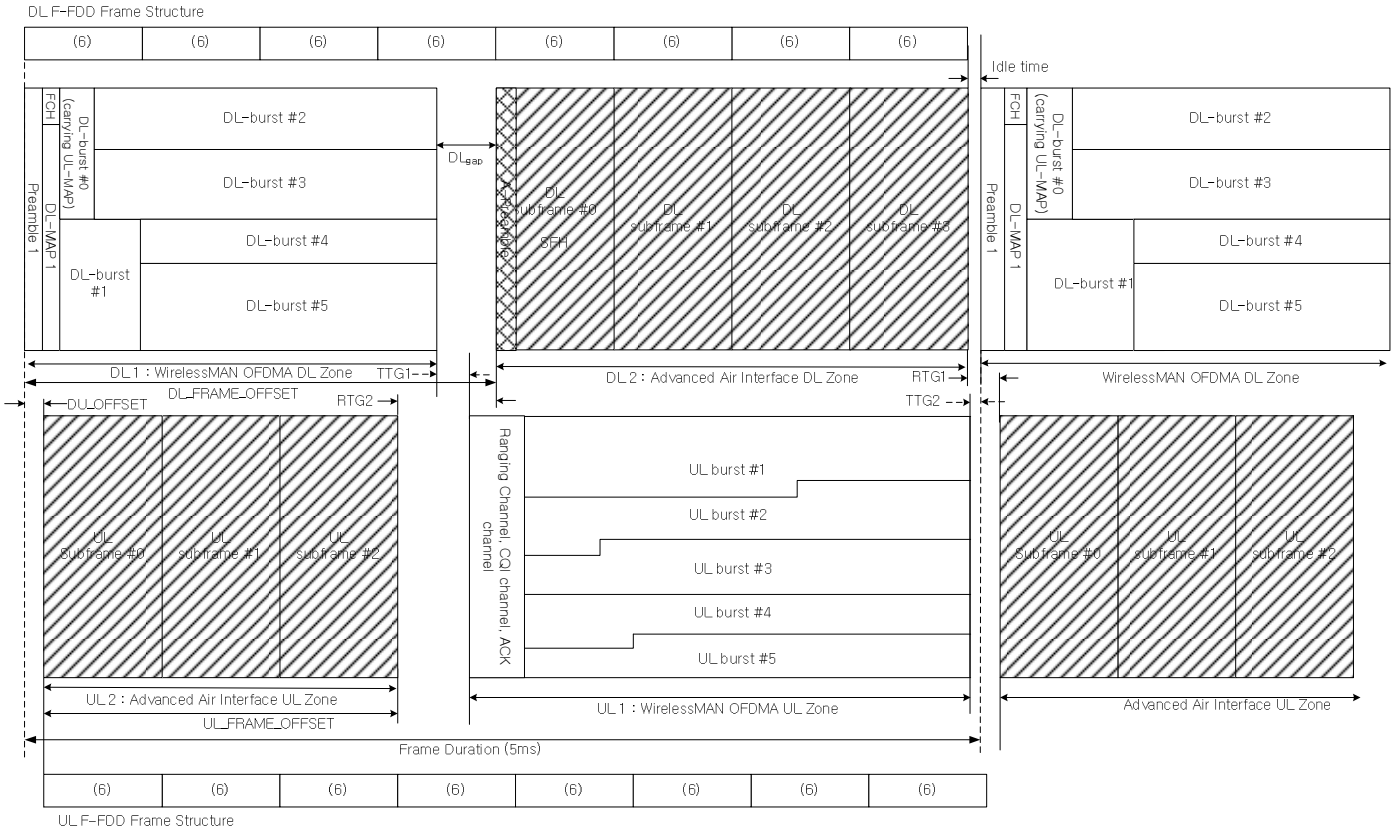

Figure 3 H-FDD frame structure for supporting legacy H-FDD and AAIF H-FDD MSs

3. Reference

[1] IEEE 802.16m-08/0010r2, “IEEE 802.16m Amendment Working Document.”

[2] IEEE 802.16m-08/003r9a, “The Draft IEEE 802.16m System Description Document.”

[3] IEEE P802.16 2009, “IEEE Standard for Local and Metropolitan Area Networks: Air Interface for Broadband Wireless Access,” Mar. 2009.

[4] IEEE 802.16m-08/043, “Style guide for writing the IEEE 802.16m amendment.”

4. Text Proposal for the 802.16m Amendment

========== *Start of Proposed Text* ==========

[Remedy 1: insert the new text in line 37 on page 118:]

15.3.3.2.1.1 H-FDD Frame structure

The H-FDD frame structure is based on the F-FDD frame structure defined 15.3.3.1. The AAIF H-FDD MSs are classified into two groups, i.e., H-FDD group1 and H-FDD group2. Each frame is also divided into two time zones in DL and UL in the units of subframes. The DL subframes for H-FDD group 1 (DL1) is comprised of A-Preamble, SFH, A-MAP, and data symbols. The DL subframes for H-FDD group 2 (DL2) is comprised of A-MAP and data symbols.

Figure x illustrates the example of H-FDD frame structure for supporting AAIF H-FDD MSs. As shown in the Figure x, TTG1, TTG2, RTG1, and RTG2 for each H-FDD group denote the switching intervals between DL and UL zones. One or more idle subframes in DL and UL for AAIF H-FDD MSs shall be assigned for accommodating the transition intervals and for receiving the DL control signals. An idle DL subframe is used for occupying a gap DL_{gap} between two DL zones. The last UL subframe in a frame is idle for transition time between DL and UL zones. The first UL subframe in a superframe for all AAIF H-FDD MSs shall be also idle for receiving SFH in the first DL subframe of a superframe. DU_OFFSET denotes a positive or negative time difference of UL frame relative to DL frame in the unit of OFDM symbol as shown in figure x. The DU_OFFSET value is adjustable for the idle DL and UL subframes to be used for support the transition gap and the reception of the DL control signal.

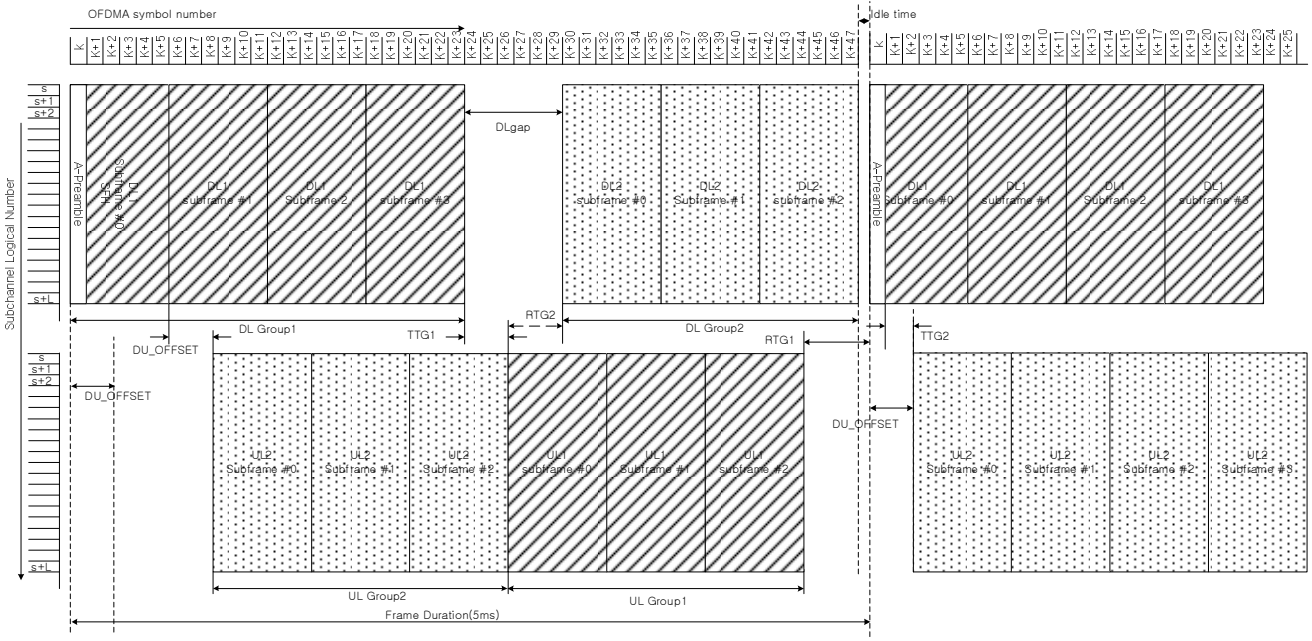

Figure x AAIF H-FDD frame structure

[Remedy 2: insert the new text in line 41 on page 130:]

15.3.3.4.3 FDD Frame structure

The FDD frame structure is separated two regions in the DL and UL for supporting the coexistence of the WirelessMAN-OFDMA H-FDD MSs and AAIF full-FDD MSs in the same frame.

The WirelessMAN-OFDMA H-FDD frame and AAIF FDD frames can be offset by a fixed number of subframes. The DL_FRAME_OFFSET is defined as the starting DL subframe for AAIF and UL_FRAME_OFFSET is defined as the time duration for the AAIF UL zone. In this case, the DU_OFFSET can be set as DU_OFFSET=0.

Figure xxx illustrates an example of the frame configuration for supporting the mix of WirelessMAN-OFDMA H-FDD and AAIF F-FDD for 5, 10, 20MHz with a CP length of 1/8 T_b.

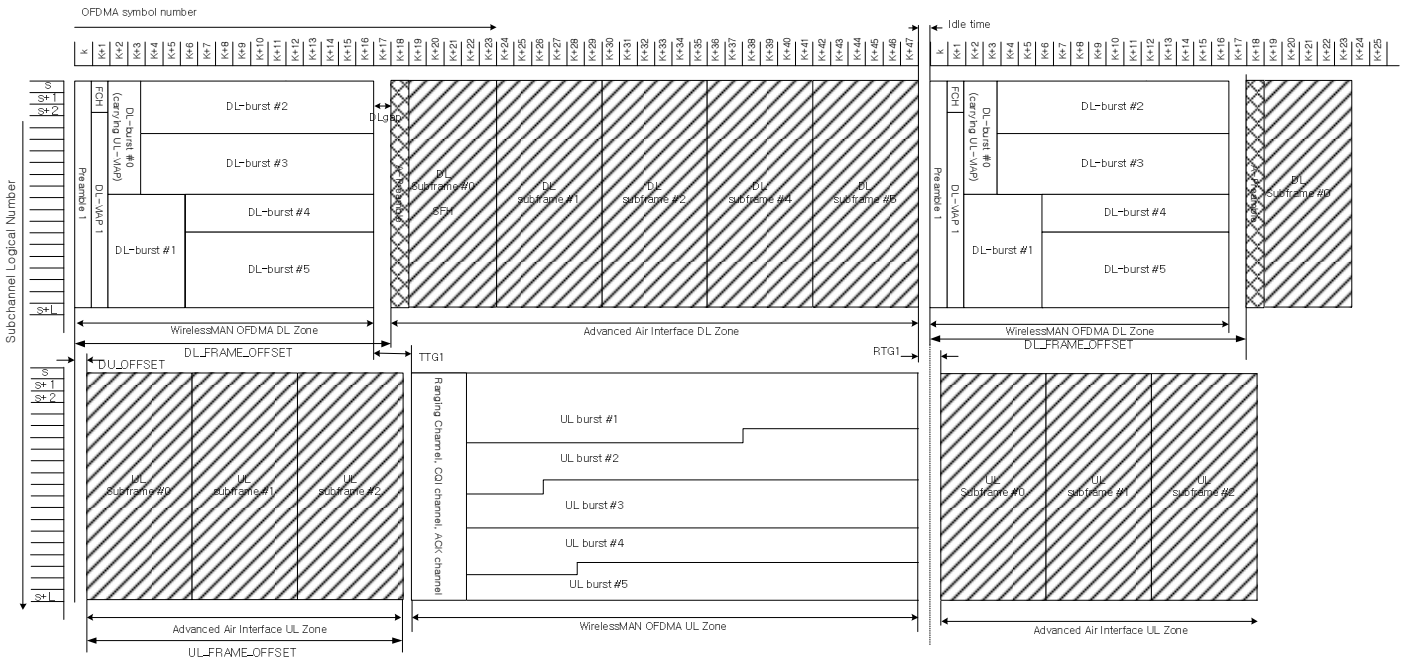

Figure xxx AAIF FDD frame configuration for supporting the legacy H-FDD

15.3.3.4.3.1 H-FDD supports in the FDD frame structure

The WirelessMAN-OFDMA H-FDD MSs and AAIF H-FDD MSs are supported by using the H-FDD frame structure defined 15.3.3.2.2.1.1. The distinct partition of a 5ms frame for group 1 can be allocated to legacy H-FDD MSs. The DL subframes for group 1 (DL 1) is comprised of Preamble, MAP and data symbols. The DL subframes for group 2 (DL 2) is comprised of A-Preamble, SFH, A-MAP and data symbols.

Figure xx shows the H-FDD frame structure supporting the WirelessMAN-OFDMA H-FDD for 5, 10, 20MHz with a CP length of 1/8 T_b. All subframes in DL and UL AAIF zone are type-1 subframes irrespective of the DL and UL zone

partitions. The last UL subframe in the AAIF UL zone is set as an idle UL subframe for the UL to DL transition of AAIF H-FDD MSs.

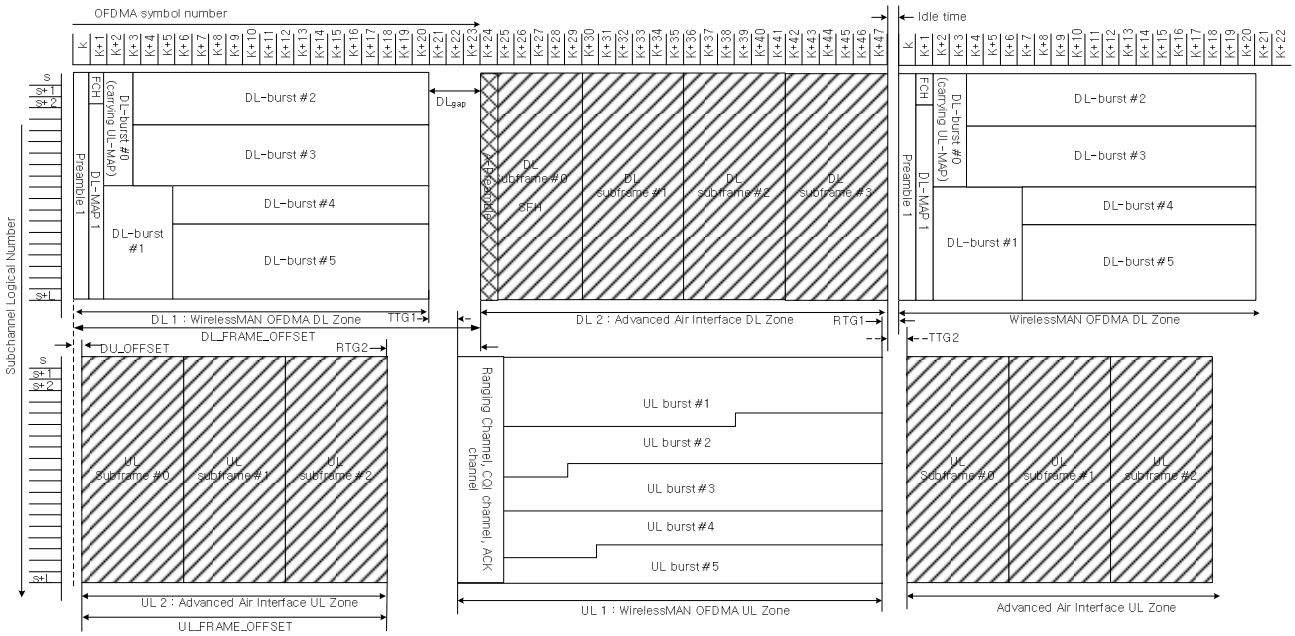

Figure xx AAIF H-FDD frame structure for supporting the legacy H-FDD

========== *End of Text Proposal* ==========