Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**TDD Frame Structure for IEEE 802.16m Draft**
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Re:	IEEE 802.16m-08/042 "Call for contributions on Project 802.16m Draft Amendment Content" P802.16m amendment text Target topic: "Frame Structure"
Abstract	This contribution proposes text for the 802.16m frame structure that is consistent with the decisions previously made by TGm and therefore reflects the content in Section 11.4 of the 802.16m SDD.
Purpose	To be discussed and adopted by TGm for incorporation in the P802.16m draft
Notice	
Release	
Patent Policy	

TDD Frame Structure for IEEE 802.16m

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Introduction

This contribution proposes text for the frame structure section of the 802.16m amendment. The proposed text is consistent with the decisions previously made by TGm and therefore reflects the content in Section 11.4 of [1]. In particular, we focus on a legacy-supporting TDD frame structure.

The coexistence of both legacy and 16m terminals within the proposed frame structure will have no impact on the performance of legacy MSs. Depending on the required number of either legacy or 16m terminals that need be supported, the deployment operator will have the flexibility to define a frame configuration based on the feature set of the operational subscriber stations and the mobility and latency requirements of enhanced feature mobile stations (16m) such that the frame structure at all times retains sufficient features to support the attachment of legacy stations that do not support the enhanced features of 16m.

The proposed frame structure meets the legacy support and latency requirements in sections 5.1 and 6.2 of [2], respectively. Therefore, we propose to adopt the following text into Section 15.3.4 of the Advanced Air Interface (AAIF) in the P802.16m draft.

Proposed Text

Add the following text into Section 15.3.4 of the Advanced Air Interface in the P802.16m draft.

-- Text Start ---

15.3.4 Frame Structure

15.3.4.1 Basic Frame Structure

The basic frame structure is illustrated in Figure 15.3.4-1. Each 20 ms superframe shall be divided into four 5 ms radio frames of equal duration. When using channel bandwidths of 5, 10 and 20 MHz, each 5 ms radio frame shall further consist of eight subframes, with each subframe assigned for either DL or UL.

There are three types of subframes. The Type 1 subframe consists of 6 symbols. The Type 2 subframe consists of 7 symbols. The Type 3 subframe consists of 5 symbols. The frame structure with CP of 1/8 T_u uses only Type 1 and Type 3 subframes. The frame structure with CP of 1/16 T_u uses only Type 1 and Type 2 subframes.

The duplexing method shall be either FDD or TDD. FDD MSs may be full-duplex (F-FDD) or half-duplex (H-FDD). The FDD BS shall support both MS types concurrently.

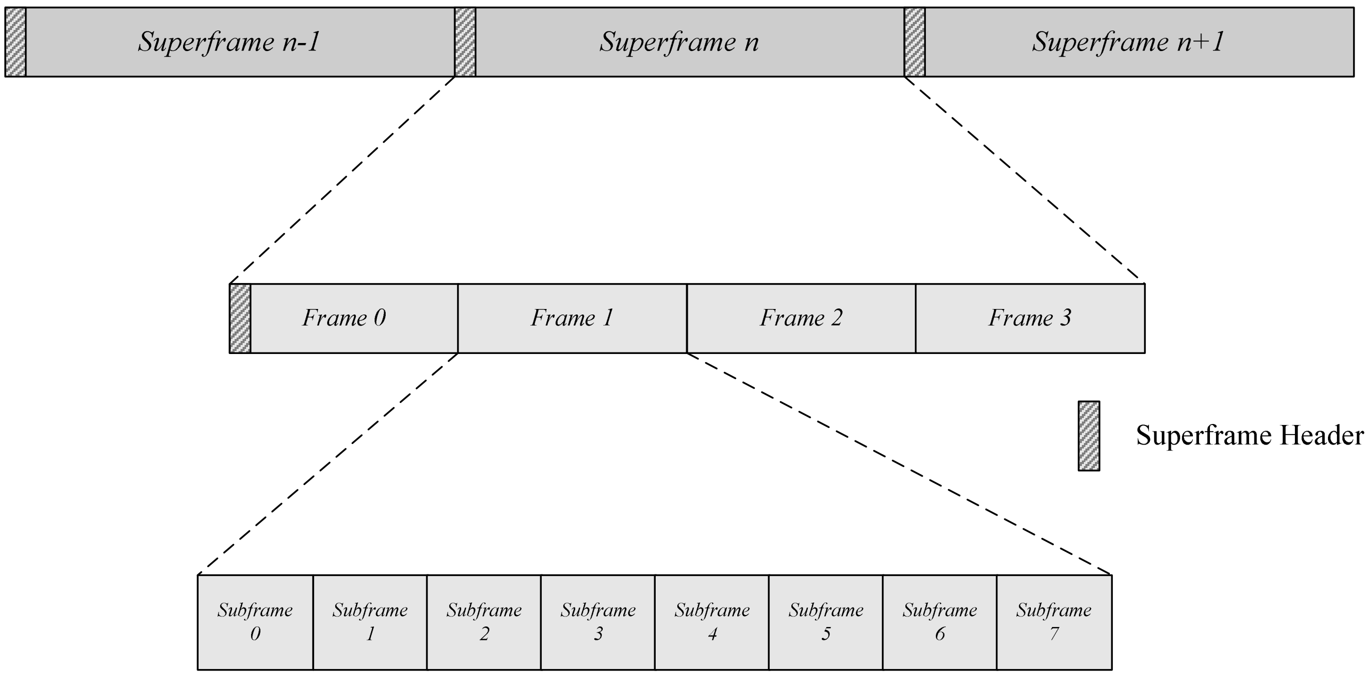

Figure 15.3.4-1 – Basic Frame Structure

15.3.4.1.1 Superframe Header

As shown in Figure 15.3.4-1, each superframe shall begin with a DL subframe that begins with a superframe header. The superframe header shall consist of the Primary Synchronization Channel (P-SCH) followed the Primary Broadcast Channel (P-BCH). The Secondary Broadcast Channel (S-BCH) may also be transmitted as part of the superframe header.

15.3.4.2 TDD Frame Structure

When implementing a TDD system, the frame structure is built from BS and MS transmissions. The number of switching points in each radio frame shall be 2 or 4. A switching point is defined as a change of transmission directionality, i.e., from DL to UL or from UL to DL. At each switching point, a transition gap shall be inserted as to allow the BS to switch its Tx and Rx circuitry. For illustration purposes, Figure

15.3.4.2-1 shows the frame structure with two switching points with an assumed DL:UL ratio of 5:3, whereas Figure 15.3.4.2-2 shows the frame structure with four switching points assuming DL:UL ratio of 4:4. Switching points should be synchronized across the network to reduce inter-cell interference.

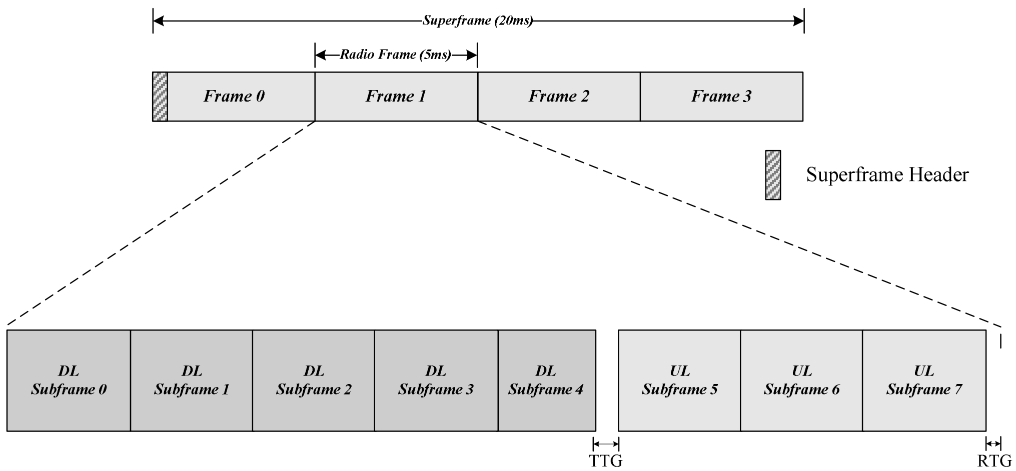

Figure 15.3.4.2-1 – TDD Frame Structure with two switching points

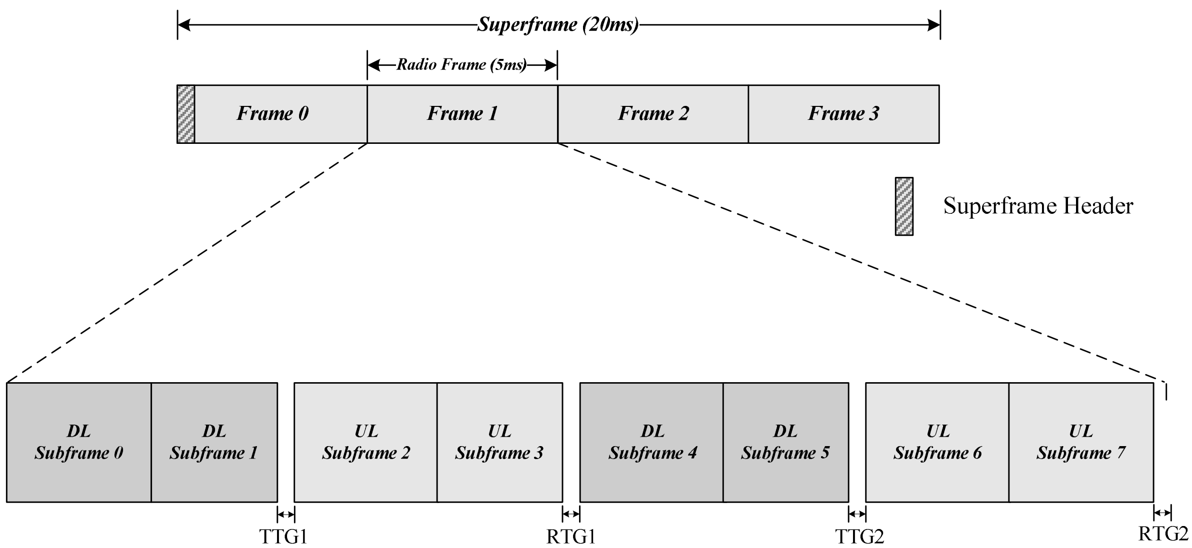

Figure 15.3.4.2-2 – TDD Frame Structure with four switching points

The transition gap parameters (TTGs and RTGs) shall be announced in P-BCH and they shall be sufficiently large as to accommodate the MS and BS transmit/receive receive/transmit switching time plus round trip propagation delay (RTD). The BS shall not transmit DL information to an MS later than (SSRTG + RTD) before the beginning of the UL subframe and shall not transmit DL information to it earlier than (SSTTG – RTD) after the end of the last UL subframe, where RTD denotes round-trip delay. The SSTTG and SSRTG are capabilities provided by the MS to BS during network entry.

15.3.4.2.1 TDD Frame Structure for Supporting Legacy Frames

Support for Legacy frames, as described here, shall be provided only when CP = 1/8 T_u. In this case, the symbol duration is exactly the same as that of the Legacy system.

The Legacy frame and AAIF frame shall be offset by a duration T_{offset}, which shall be an integer number of Type 1 subframes. Figures 15.3.4.2-3 and 15.3.4.2-4 illustrate example frame structures in which the Legacy Frames and AAIF frames are offset by two subframes.

For an AAIF BS also supporting the Legacy MSs, TDM shall be used in the DL for multiplexing the AAIF and Legacy zones. For UL transmissions TDM or FDM shall be used for multiplexing AAIF and Legacy MSs. For illustration purposes, Figure 15.3.4.3-3 shows an example of the TDD frame structure supporting Legacy frames for the case of two switching points. TDM is used in the DL, and TDM or FDM is used in the UL.

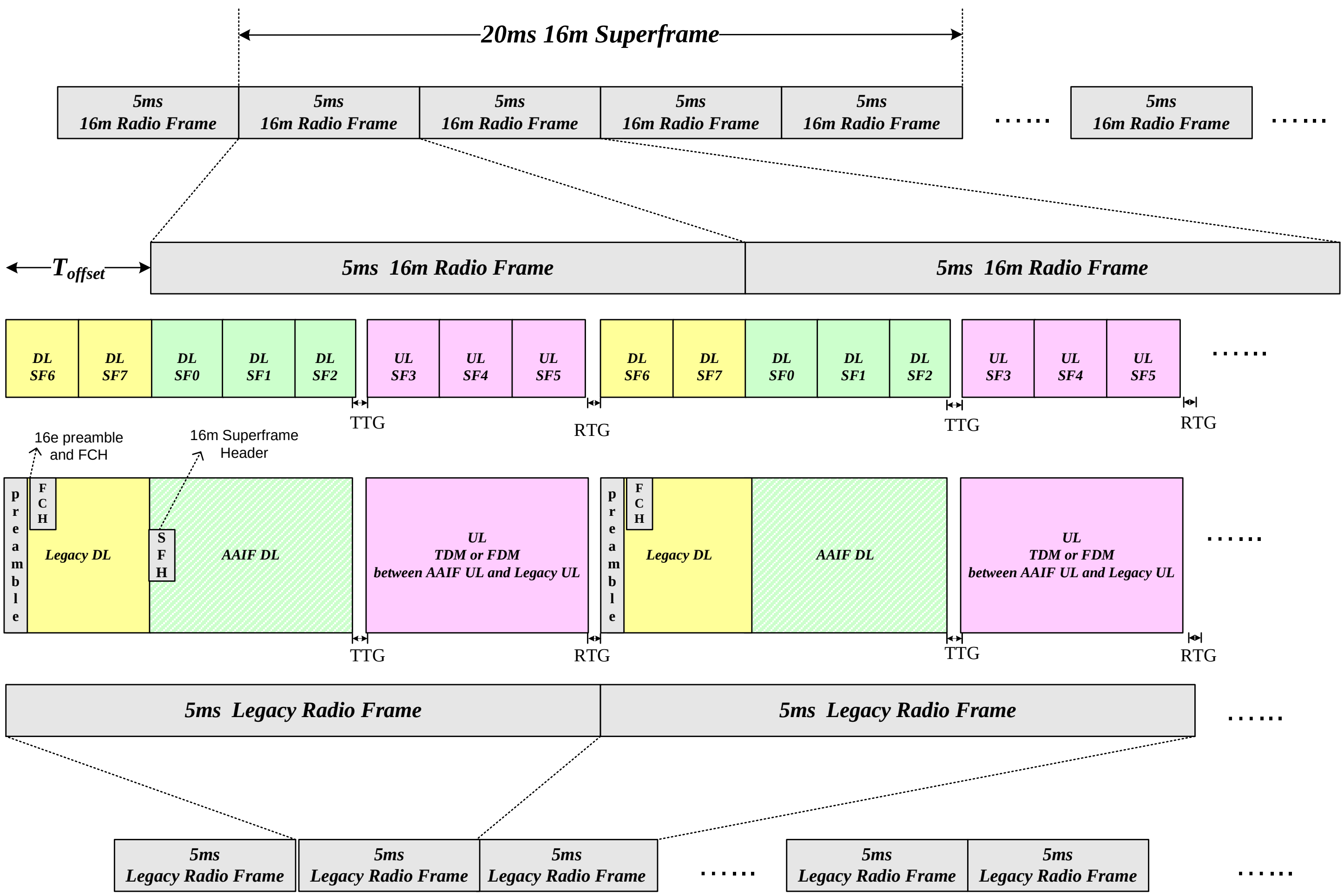

Figure 15.3.4.3-3 – Two switching point frame structure for supporting Legacy and AAIF

Each Legacy frame shall begin with a Legacy preamble followed by FCH, DL-MAP and possibly UL-MAP as per the Legacy specification. The remaining period of this Legacy zone shall be used for DL transmissions to Legacy MSs. The Legacy DL duration shall be equal to T_{offset}. A Legacy Ranging region shall be allocated in the Legacy UL zone.

Legacy MSs shall be allocated resources within Legacy zones only. AAIF MSs may be allocated resources in either the AAIF or Legacy zones, but not both.

In order to support legacy frames, the TDD frame structure shall support switching points that all are inside the radio frame, rather than at frame boundaries. At each switching point, an idle time, serving as the TTG or RTG transition gap, shall be inserted between two subframes. This idle time need not be the duration of an integer number of symbols. The locations and sizes of the gaps are determined by T_{offset}, the DL:UL ratio, and the number of switching points in a radio frame.

For illustration purposes, Figure 15.3.4.3-4 shows an example of the TDD frame structure supporting Legacy frames for the case of four switching points. TDM is used in the DL, and TDM or FDM is used in the UL.

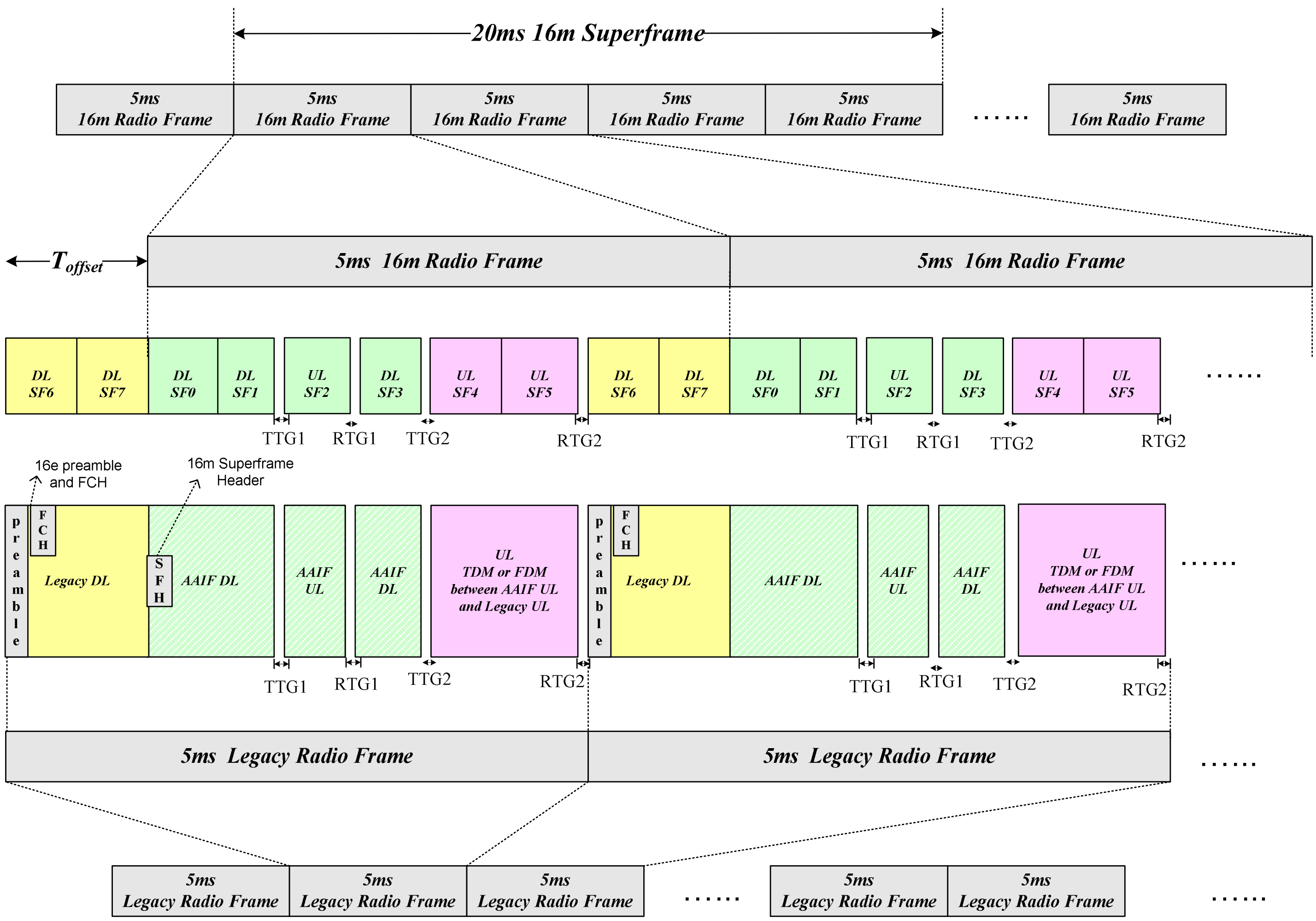

Figure 15.3.4.3-4 – Four switching point frame structure for supporting Legacy and AAIF

15.3.4.2.2 TDD Frame Structure Configurations

The TDD frame configurations are defined in Table 15.3.4-1. The TDD BS shall announce its TDD frame configuration by providing the frame configuration index in the P-BCH.

Table 15.3.4-1 TDD Frame Structure Configuration Index

index	Frame Configuration D= 6-symbol DL; U= 6-symbol UL D_s=5-symbol DL; U_s=5-symbol UL	Transition Gaps	Notes
0	D D D D_s g_0 U U U U g_1	g_0= 102.86 µs; g_1= 62.86 µs;	T_{offset} = 0, i.e., AAIF only. DL/UL split: 4:4 # of switching points = 2.
1	D D D D D_s g_0 U U U g_1	g_0= 102.86 µs; g_1= 62.86 µs;	T_{offset} = 0, i.e., AAIF only. DL/UL split: 5:3 # of switching points = 2.
2	D D D D D D_s g_0 U U g_1	g_0= 102.86 µs; g_1= 62.86 µs;	T_{offset} = 0, i.e., AAIF only. DL/UL split: 6:2 # of switching points = 2.
3	D D D D D D D D g_1	g_1= 62.86 µs;	T_{offset} = 0, i.e., AAIF only. DL/UL split: 8:0 (DL only)
4	D D g_0 U U g_1 D D_s g_2 U U g_3	g_0 = 50 µs; g_1= 32.86 µs; g_2 = 50 µs; g_3 = 32.86 µs;	T_{offset} = 0, i.e., AAIF only. DL/UL split: 4:4 # of switching points = 4.
5	D D D_s g_0 U g_1 D D g_2 U U g_3	g_0 = 50 µs; g_1= 32.86 µs; g_2 = 50 µs; g_3 = 32.86 µs;	T_{offset} = 0; i.e., AAIF only DL/UL split: 5:3 # of switching points = 4.
6	D D D_s g_0 U g_1 D D D g_2 U g_3	g_0 = 50 µs; g_1= 32.86 µs; g_2 = 50 µs;	T_{offset} = 0; i.e., AAIF only DL/UL split: 6:2 # of switching points = 4.

		g_3 = 32.86 µs;	
7	D D_s g_0 U U U U g_1 D D	g_0=102.86 µs; g_1= 62.86 µs;	T_{offset} = 2 Type-1 subframes; DL/UL split: 4:4 # of switching points = 2.
8	D g_0 U U U U_s g_1 D D D	g_0=102.86 µs; g_1= 62.86 µs;	T_{offset} = 3 Type-1 subframes; DL/UL split: 4:4 # of switching points = 2.
9	D D D_s g_0 U U U g_1 D D	g_0=102.86 µs; g_1= 62.86 µs;	T_{offset} = 2 Type-1 subframes; DL/UL split: 5:3 # of switching points = 2.
10	D D_s g_0 U U U g_1 D D D	g_0=102.86 µs; g_1= 62.86 µs;	T_{offset} = 3 Type-1 subframes; DL/UL split: 5:3 # of switching points = 2.
11	D D D D_s g_0 U U g_1 D D	g_0=102.86 µs; g_1= 62.86 µs;	T_{offset} = 2 Type-1 subframes; DL/UL split: 6:2 # of switching points = 2.
12	D D_s g_0 U U g_1 D D D D	g_0=102.86 µs; g_1= 62.86 µs;	T_{offset} = 4 Type-1 subframes; DL/UL split: 6:2 # of switching points = 2.
13	D g_0 U U_s g_1 D g_2 U U g_3 D D	g_0 = 50 µs; g_1= 32.86 µs; g_2 = 50 µs; g_3 = 32.86 µs;	T_{offset} = 2 Type-1 subframes; DL/UL split: 4:4 # of switching points = 4.
14	D D_s g_0 U g_1 D g_2 U U g_3 D D	g_0 = 50 µs; g_1= 32.86 µs; g_2 = 50 µs; g_3 = 32.86 µs;	T_{offset} = 2 Type-1 subframes; DL/UL split: 5:3 # of switching points = 4.
15	D D_s g_0 U g_1 D D g_2 U g_3 D D	g_0 = 50 µs; g_1= 32.86 µs; g_2 = 50 µs; g_3 = 32.86 µs;	T_{offset} = 2 Type-1 subframes; DL/UL split: 6:2 # of switching points = 4.

-- Text End ---

References

[1] IEEE 802.16m-08/003r5, "IEEE 802.16m System Description Document"

[2] IEEE 802.16m-07/002r6, "IEEE 802.16m System Requirements"