Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**OFDMA Frame Structures with Scalable Bandwidth and High Mobility Support for IEEE 802.16m**
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Re:	IEEE 802.16m-07/040 - Responds to Call for Contributions on Project 802.16m System Description Document (SDD)
Abstract	This contribution proposes new frame structures for IEEE 802.16m with the following salient features: backward compatible to the legacy IEEE 802.16 OFDMA system, support of lager, flexible bandwidth and support of services in high mobility environments.
Purpose	For 802.16m discussion and adoption
Notice	
Release	
Patent Policy	

OFDMA Frame Structures with Scalable Bandwidth and High Mobility Support for IEEE 802.16m

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1   Summary

IEEE 802.16m SRD (system requirement document) [1] describes that IEEE 802.16m shall support the legacy system with scalable bandwidths from 5 to 20 MHz and maintain connection under high mobility. This contribution proposes IEEE 802.16m TDD OFDMA frame structure to support bandwidth scalability for legacy user connectivity and high mobility connections for 16m users. Furthermore, we propose to adopt the guard band for transmission and reception in the frame structure such that better channel utilization is achievable.

2   Introduction

Concatenating multiple contiguous bands on frequency domain provides bandwidth scalability without loss of the backward compatibility. Fig. 1 depicts an example in which two contiguous bands are concatenated. The IEEE 802.16e frame structure camps in the proposed frame structure and the legacy user can access the system through the upper band or lower band to acquire the control messages. The control message for the 16m user is also hided in DL-MAP and the 16m user can read control message to access data. The 16m user receive/transmit in all region allocated for data transmission including guard band and the legacy user can only receive/transmit in the region designed for the IEEE 802.16e. Therefore the concatenation on the frequency domain resolves the bandwidth scalability without transmission loss in the guard band, and the legacy user can camp without any problem.
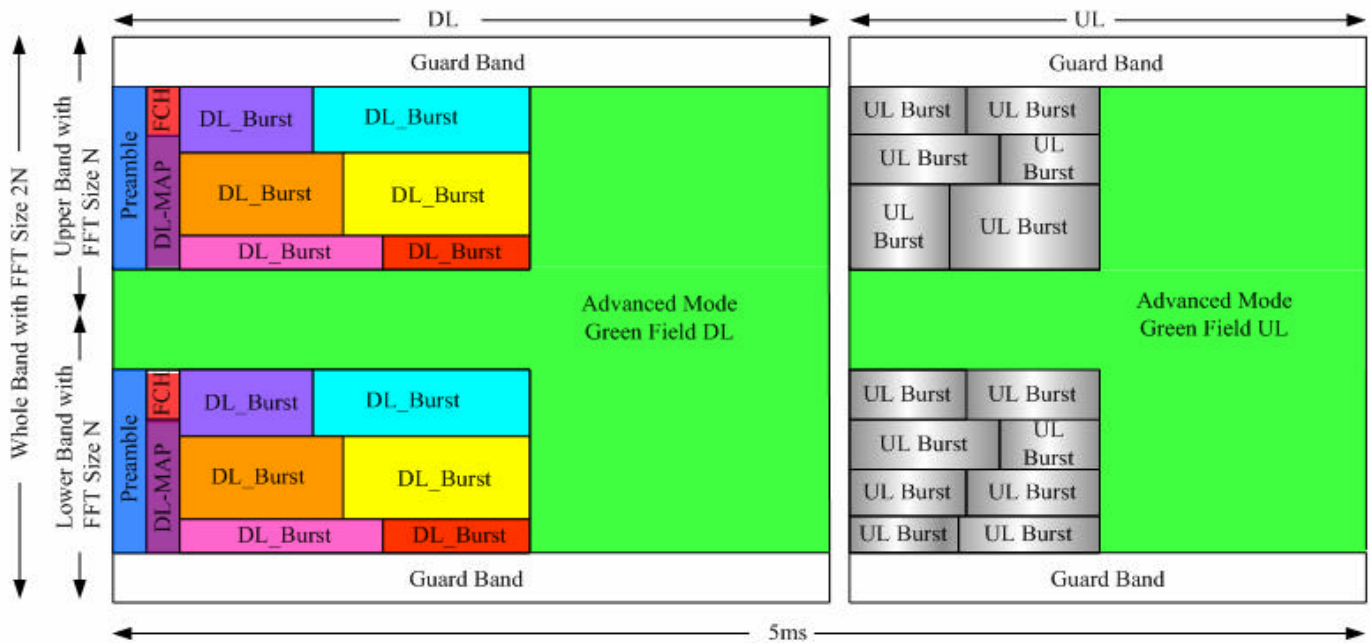
Figure 1: A TDD OFDMA frame structure for IEEE 802.16m with a contiguous larger bandwidth

Allocating an extra new zone for high mobility connections simplifies the system design and provides better optimality in both high and low mobility scenarios. When the mobility is high, inter-carrier interference influences performance significantly and larger carrier spacing can be applied to overcome. Furthermore, the channel varies fast on both time and frequency domain, and the mobile necessitates more pilot symbols to acquire better channel estimation. When the mobility is low, the channel varies slow and less pilot symbols are adequate to acquire precise channel estimation and high modulation order is usable for transmission. Therefore both scenarios need different design philosophies for the optimality and allocating an extra zone provide better trade-off.

Proposed Text

The following text is proposed to be captured in the IEEE 802.16m system description document (SDD).

-- Start of the proposed text --

X. Frame Structure

X.1 Multi-Channel for 16m Frame Structure

For supporting higher data rates, lager bandwidths than legacy systems should be used in 16m system. Lager bandwidths should be aggregated by several existing bandwidths in legacy system for legacy support. There are two kinds of situations for these existing bandwidths. One is that these existing bandwidths are contiguous and the other is that these existing bandwidths are not contiguous.

X.1.1 Contiguous Multi-Channels for 16m Frame Structure

If a contiguous larger bandwidth can be allocated, we call this situation as contiguous multi-channel. Fig. x depicts an example OFDMA frame structure composed of two contiguous bands, the upper band and lower band, and both bands are capable for the legacy system to transmit on the prior parts of both uplink and downlink intervals. The green field occupies the rest parts including the conventional guard band between the two bands. The green filed is only for the 16m users and need not to be understandable by the legacy users. In other words, a legacy user listens to the control messages and transmits/receives through either the upper band or lower band except the green field. The 16m user shall be able to listen to all system control messages and transmit/receive data in the all data regions. Basically, the example of new OFDMA frame structure is an aggregation of two legacy systems along with the green field for the 16m specific usage, e.g, throughput enhancement and high mobility support. The FFT size of the new frame structure is twice that of the legacy system in this example, and the guard band is used exclusively for the 16m system in the green field. Again, the sub-MAP may not be necessary depending on whether the DL-Map and UP-MAP are large enough to accommodate all the users or not. Obviously, the frame structure can be extended easily to more than two legacy systems. Note that the base-station and 16m users shall use lager FFT size 2N to transmit and receive this frame while the 16e user uses original FFT size N to receive signal.
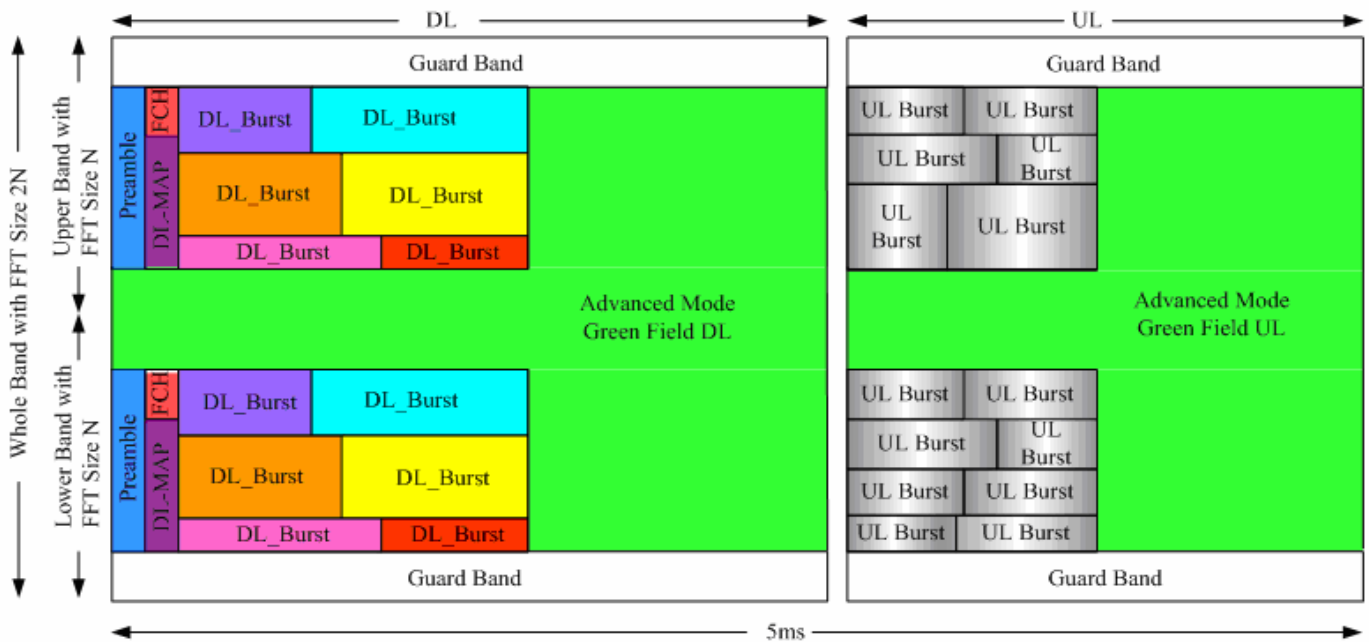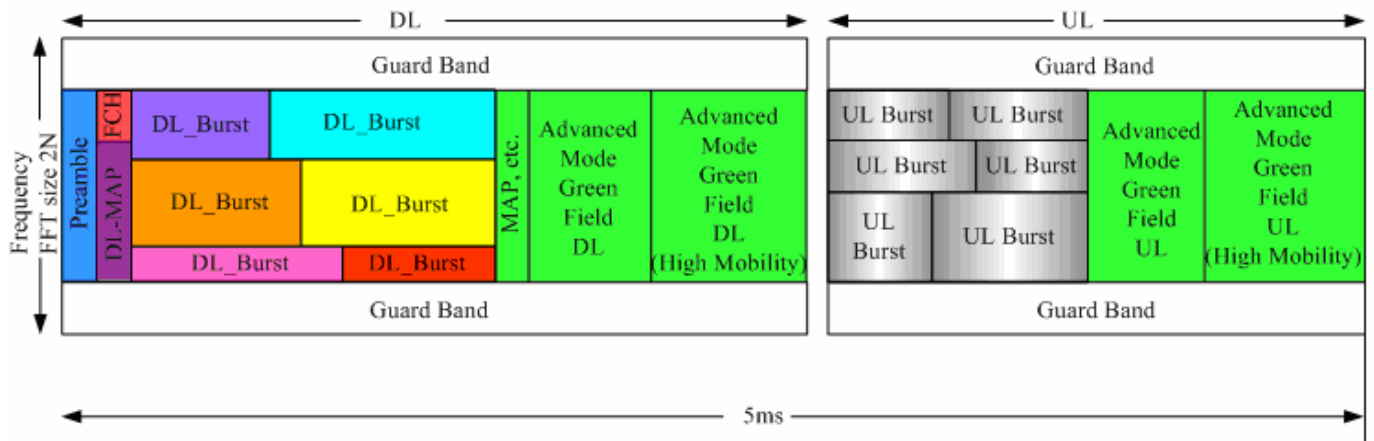
Figure x A TDD OFDMA frame structure for IEEE 802.16m with a contiguous larger bandwidth

X.2 Frame structures for high mobility and legacy support

In this section, frame structures for high mobility environments are discussed for IEEE 802.16m. Fig. xx depicts a frame structure to support high mobility connections with the same bandwidth as the legacy system. Compared to Fig. x, a new zone is designed exclusively for high mobility users. This high mobility zone may have new designs for improving performance in high mobility connections, including a shorter symbol period (larger carrier spacing, less FFT Size) for mitigation of inter-carrier-interference (ICI) due to high mobility, more pilots for accurate channel estimation, and/or specific pilots sequence for better ICI cancellation. In addition, a preamble and a MAP may be needed in high mobility zone for working in high mobility environments.

Figure xx A TDD OFDMA frame structure for IEEE 802.16m in high-mobility environment

-- End of the proposed text --

References

[1]   IEEE 802.16m-07/002r4, "IEEE 802.16m System Requirements".

[2]   IEEE 802.16m-07/037r2, "Draft IEEE 802.16m Evaluation Methodology".

[3]   IEEE 802.16m-07/263, "802.16m Frame Structure to Enable Legacy Support, Technology Evolution, and Reduced Latency".

[4]   IEEE 802.16m-07/295r1, "OFDMA Frame Structures with Scalable Bandwidth and High-Mobility Support for IEEE 802.16m".