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Title	**Backward Compatible Use of Larger Bandwidths for 802.16m**
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Re:	IEEE 802.16m-07/040 - Call for Contributions on Project 802.16m System Description Document
Abstract	A framework that allows use of greater bandwidths for 802.16m while preserving backward compatibility is described. It is proposed that the 802.16m SDD include a section on generic frame structure in a Physical layer chapter.
Purpose	Inclusion of a section on generic frame structure in a Physical Layer chapter of the 802.16m SDD. The generic frame structure section should in addition to a basic description of or reference to the legacy frame structure include proposed 802.16m additions including the proposal in this document.
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Backward Compatible Use of Larger Bandwidths for 802.16m

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Introduction

The requirements [1] for the IEEE 802.16m project include higher data rates than that currently supported by the WirelessMAN-OFDMA reference system[2,3]. The requirements also state that 802.16m should be capable of operating in bandwidths upto 20 MHz with other bandwidths being considered as operator or ITU-R requirements arise. Another goal of the 802.16m project is to preserve backward compatibility with legacy WirelessMAN-OFDMA reference system terminals. In this document we propose the integration of one or more WirelessMAN-OFDMA reference system channels within an 802.16m RF channel of larger bandwidth as a means to achieve all of the above goals. Various aspects of such a system required to facilitate co-existence between new and legacy subscribers are described.

It is proposed that a section on frame structure be included in the system description document. We recommend that the proposal to embed WirelessMAN-OFDMA reference system channels within an 802.16m channel of larger bandwidth be included in a sub-section within that section.

Proposed SDD Text

[Section] Frame Structure

[Sub-Section] Backward Compatibility with WirelessMAN-OFDMA Reference System

One or more WirelessMAN-OFDMA reference system channels may be integrated within an 802.16m RF channel of larger bandwidth when the 802.16m channel bandwidth is a multiple of the bandwidth used by the WirelessMAN-OFDMA reference system. Each sub-section of the 802.16m channel that spans the bandwidth used by the reference system is referred to as a *sub-band*. A sub-band within the channel may be used for legacy WirelessMAN-OFDMA reference system MS and new 802.16m MS or only for 802.16m MS. On the downlink, guard sub-carriers of the WirelessMAN-OFDMA reference system that are unused by legacy MS may be used by an 802.16m MS as long as the guard sub-carriers are not at the edges of the 802.16m channel. Parameters of the frame structure such as the number of sub-bands that form an 802.16m channel may be signaled to an 802.16m MS in a special sub-band called a *base sub-band*.

Bandwidth allocations to legacy WirelessMAN-OFDMA reference system MS are made within the legacy sub-bands with the allocations being signaled using UL-MAP messages within the corresponding sub-bands. Bandwidth allocations to 802.16m MS may be made across multiple sub-bands with all the allocations being combined and treated as one allocation potentially conveying a single MAC message. When all the sub-bands are used to serve WirelessMAN-OFDMA reference system MS, bandwidth allocations to an 802.16m MS in each sub-band are signaled individually in the same sub-band using legacy UL-MAP signaling. When one of the sub-bands is not used to serve WirelessMAN-OFDMA reference system MS, this sub-band is made the base sub-band and is used to signal bandwidth allocations to an 802.16m MS. These allocations include allocations

within legacy WirelessMAN-OFDMA reference system sub-bands.

Different preamble definitions may be used to distinguish the sub-bands used only for 802.16m MS from those that are used for WirelessMAN-OFDMA reference system MS as well. Different preamble definitions may also be used to differentiate a base sub-band from other sub-bands.

Detailed Description of Proposal to Embed WirelessMAN-OFDMA Reference System Subchannels in an 802.16m Channel

In the following, the 802.16m channel bandwidth is a multiple of the bandwidth occupied by an WirelessMAN-OFDMA reference system channel. Subsections of the whole channel bandwidth equal to the bandwidth used by a legacy WirelessMAN-OFDMA reference system MS, are referred to as *sub-bands*.

Figure 1 shows a configuration in which a single WirelessMAN-OFDMA reference system signal is supported within the whole 802.16m channel bandwidth. This is shown in the figure with bandwidths of 5 MHz and 15 MHz for the WirelessMAN-OFDMA reference system and 802.16m system respectively.

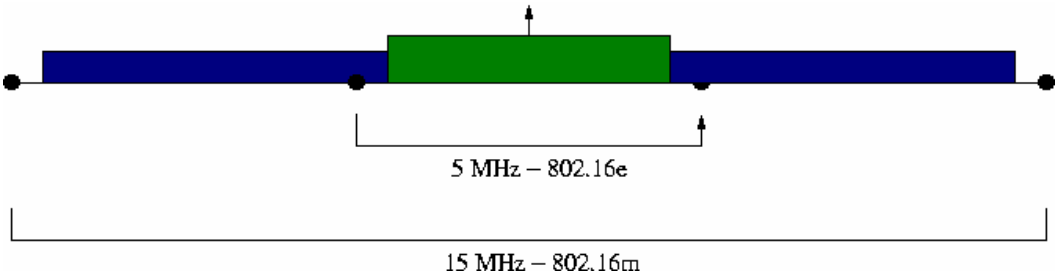

Figure 1

In the example shown in the figure, the center band of 5 MHz (in green) is used by 802.16e MS while the whole bandwidth of 15 MHz is used by 802.16m MS. It should be noted that the sub-carriers assumed by an WirelessMAN-OFDMA reference system MS to be guard sub-carriers at the edges of the center 5 MHz band are used for transmission of data to the 802.16m MS on the downlink. This most likely will not affect an WirelessMAN-OFDMA reference system MS since its receive filter will filter out these sub-carriers and ignore the data sent on them.

In the configuration shown in Figure 3, only a part of the bandwidth is allowed to be used by legacy MS. Therefore, such a configuration is suitable when the number of legacy WirelessMAN-OFDMA reference system MS is low.

Figure 2 shows a configuration in which multiple WirelessMAN-OFDMA reference system channels are supported within the whole 802.16m channel bandwidth. This is shown in the figure with bandwidths of 5 MHz and 20 MHz for the WirelessMAN-OFDMA reference system and 802.16m systems respectively. The configuration shown in

Figure could include up to four WirelessMAN-OFDMA reference system carriers within the 16m channel bandwidth. However, some part of the total bandwidth may optionally not be used for legacy WirelessMAN-OFDMA reference system subscribers.

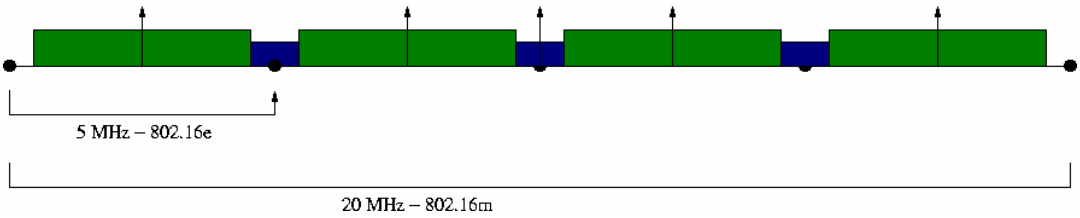

Figure 2

In the example shown in Figure 2, the center frequency for the 16m system lies in the guard sub-carriers at the edges of the WirelessMAN-OFDMA reference system channel bandwidths. However, all sub-carriers that lie within these legacy guard bands can be used for 802.16m subscribers on the downlink, except the center sub-carrier for the whole 16m bandwidth and sub-carriers belonging to the guard bands on the outer edges of the whole bandwidth.

To facilitate the use of these guard sub-carriers, different definitions of a subchannel in a legacy WirelessMAN-OFDMA reference system sub-band may be used for 802.16m mobile stations. Specifically, some subchannels in the WirelessMAN-OFDMA reference system sub-band may be interpreted by an 802.16m mobile station as having additional sub-carriers within the guard sub-bands. Thus, when an 802.16m mobile station is allocated such a subchannel in an WirelessMAN-OFDMA reference system sub-band, it receives data in some of the guard sub-carriers as well. The subchannel definition for 802.16m mobile stations dictating use of guard sub-carriers may vary depending on the location of the WirelessMAN-OFDMA reference system sub-band. If the WirelessMAN-OFDMA reference system sub-band is in the middle of two other sub-bands (WirelessMAN-OFDMA reference system or 16m), sub-carriers from the guard bands on the left and the right are included in the sub-channel definition. On the other hand, if the WirelessMAN-OFDMA reference system sub-band is at the edge of the whole channel, then only the sub-carriers from the guard band not at the edge are included.

Signaling of 802.16m System Parameters

The basic parameters of the new frame structure in the 802.16m only sub-bands can be signaled to an 802.16m MS in a *base sub-band* through a message directed only to 802.16m capable mobile stations. The base sub-band might be an WirelessMAN-OFDMA reference system sub-band or a sub-band used only for 802.16m mobile stations. The control signaling for 802.16m mobile stations in these base sub-bands will enable an 802.16m MS to determine which sub-bands together form an 802.16m signal

Bandwidth Allocations

For an 802.16m MS, bandwidth allocations may be provided across multiple sub-bands with the total set of allocations being treated as a combined allocation so that transmission of a single coded block may be possible over the combined allocation. It should be noted that bandwidth may be allocated in less than the maximum possible sub-bands to an 802.16m MS. For example, in Figure 2, the signaling in the base sub-band will inform an 802.16m MS that all four sub-bands are used to form an 802.16m signal. However, a particular bandwidth allocation to an WirelessMAN-OFDMA reference system MS might span less than four sub-bands.

Bandwidth allocations in the sub-bands used only by 802.16m MS are sent using new messages defined for 802.16m mobile stations. In addition, 802.16m mobile stations may also be given bandwidth allocations in WirelessMAN-OFDMA reference system sub-bands. Downlink bandwidth allocations for WirelessMAN-OFDMA reference system mobile stations are made in a single sub-band and are signaled in the same sub-band. Examples illustrating the proposed bandwidth allocation and signaling schemes are shown in Figures 3 and 4.

Case 1 - 802.16m only sub-bands present:: If the base sub-band is an 802.16m only base sub-band, a new

message that is equivalent to the 802.16e DL-MAP/UL-MAP message is transmitted in the 802.16m only sub-bands to indicate bandwidth allocations for 802.16m mobile stations. The allocations to the 802.16m MS in the WirelessMAN-OFDMA reference system sub-bands are also signaled using the new messages transmitted in the 802.16m only sub-bands. The BS ensures that the allocations made to WirelessMAN-OFDMA reference system mobile stations exclude the regions that are allocated to 802.16m mobile stations. Thus, overhead in the WirelessMAN-OFDMA reference system sub-bands is reduced by obviating the need to signal allocations to 802.16m mobile stations.

For example, in Figure 3, new signaling D1 in the 802.16m only sub-band signals allocations A1 (indicated in red) to an 802.16m MS in all sub-bands on the downlink, whereas allocations A1 to legacy WirelessMAN-OFDMA reference system MS in a sub-band (indicated in colors other than red) are signaled using DL-MAP signaling messages D1 within the same sub-band.

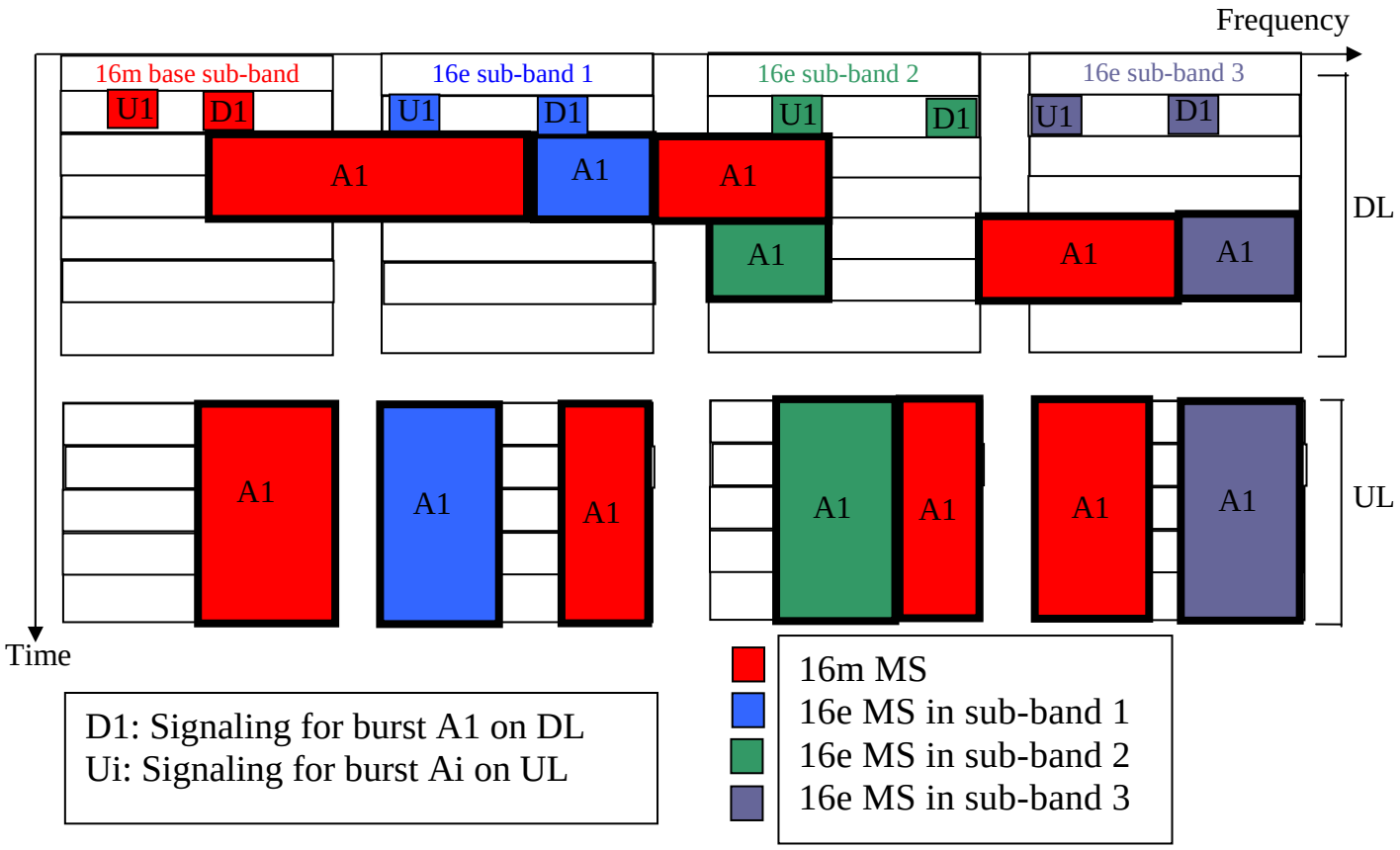

Figure 3: Bandwidth allocation mechanism when base sub-band is a 16m only sub-band. Burst allocations with same color belong to one common combined allocation.

Case 2 –No 802.16m only sub-bands: When all sub-bands are needed to serve legacy WirelessMAN-OFDMA reference system MS, the base sub-band is also an WirelessMAN OFDMA reference system sub-band. In this case, bandwidth allocations for the 802.16m MS in WirelessMAN OFDMA reference system sub-bands are made using legacy control messages in the same sub-bands. Thus, an 802.16m MS would read control messages in each of the WirelessMAN OFDMA reference system sub-bands to determine its allocation across the whole band and then treat all the allocations as one combined allocation. This is shown in Figure 4, where allocations A1 through A4 for an 802.16m MS on the uplink (shown in red) are signaled using UL-MAP signaling

messages U1 through U4 within the same sub-bands. That is, signaling message U1 in sub-band 1 signals allocation A1 in sub-band 1, signaling message U2 in sub-band 2 signals allocation A2 in sub-band 2 and so on. The allocations A1 through A4 in Figure 3 are treated as one combined allocation to the 16m MS.

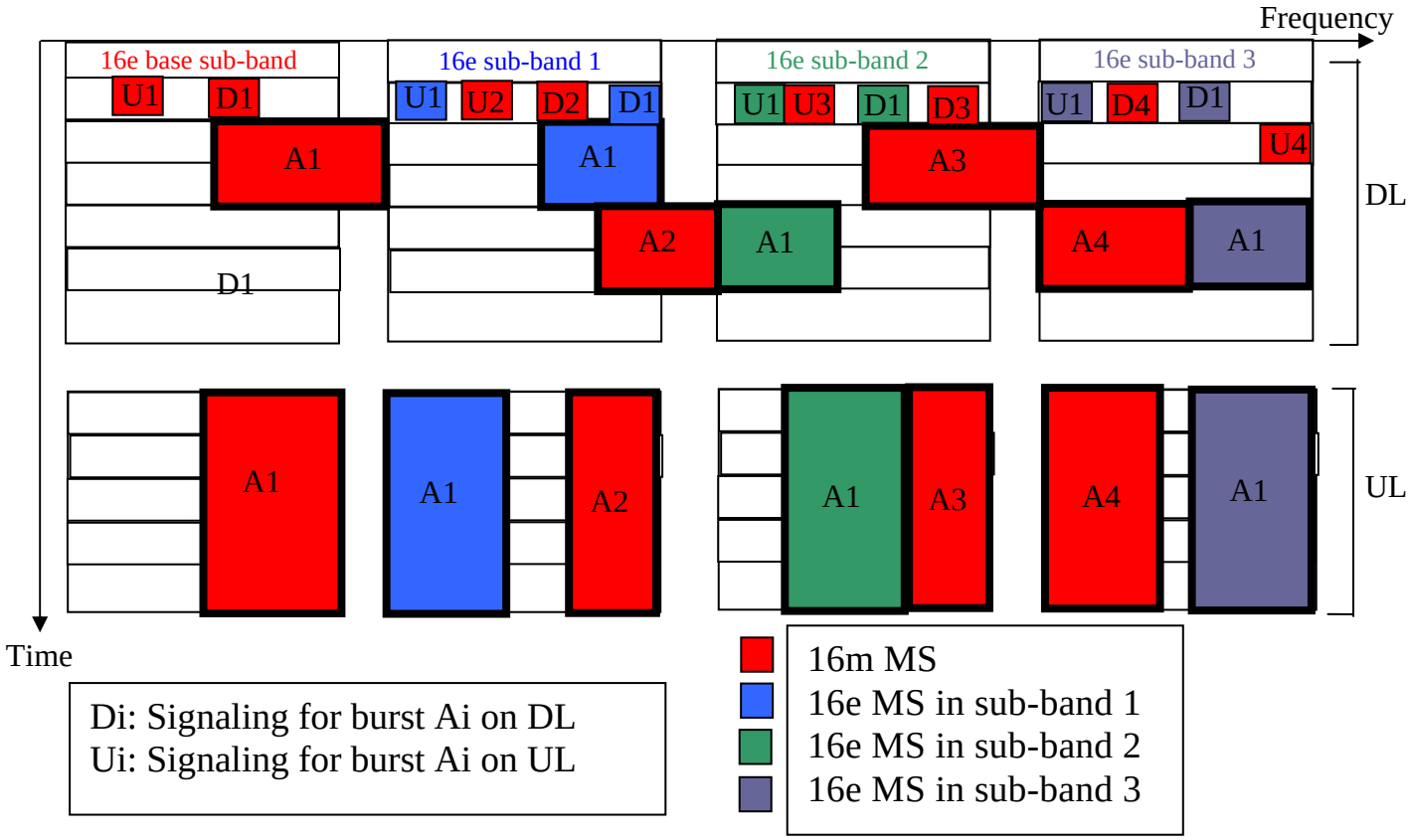

Figure 4: Bandwidth allocation mechanism when base sub-band is a 16e sub-band. Burst allocations with same color belong to one common combined allocation.

Preamble Definitions

The use of a subset of WirelessMAN-OFDMA reference system preambles for base sub-bands can be used to signal to an WirelessMAN-OFDMA reference system MS whether a given WirelessMAN-OFDMA reference system sub-band is a base sub-band or not. The use of selective preambles to indicate base sub-bands would reduce the complexity of the 802.16m MS since this would allow an 802.16m MS to find a base sub-band without scanning multiple WirelessMAN-OFDMA reference system sub-bands and looking for a control message indicating the 16m signal configuration.

Sub-bands where the WirelessMAN-OFDMA reference system may operate can be distinguished from sub-bands where only 802.16m MS operate by defining different preamble sequences for the two parts. The 802.16e sub-bands can use preamble sequences that are already defined for the WirelessMAN-OFDMA reference system, while different preamble sequences are used for the 802.16m system such that an WirelessMAN-OFDMA reference system MS would never find the 802.16m sub-band as a result of its cell search operation. Within the sub-bands designated solely for 802.16m mobile stations, a subset of the 802.16m preambles can be used to indicate which sub-band is a base sub-band.

References

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

[2] IEEE Std 802.16-2004: Part 16: IEEE Standard for Local and metropolitan area networks: Air Interface for Fixed Broadband Wireless Access Systems, June 2004

[3] IEEE Std 802.16e-2005 and IEEE Std 802.16-2004/Cor1-2005 (Amendment and Corrigendum to IEEE Std 802.16-2004), “IEEE Standard for local and metropolitan area networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in License Bands,” Feb 28, 2006