Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Comments on new Multicarrier text in SDD**
Date Submitted	**2008-07-07**
Source(s)	Ken Stanwood Voice: +1-858-480-3327 NextWave Wireless E-mail: kstanwood@nextwave.com
Re:	Call for Comments and Contributions on Project 802.16m System Description Document (SDD)
Abstract	This contribution addresses the newly added multicarrier text in sections 11.6.4 and 19 of the 802.16m SDD.
Purpose	Discuss as part of SDD call for comments and contributions and consider for adoption
Notice	*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.
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	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>. Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>.

Comments on new Multicarrier text in SDD

Ken Stanwood
NextWave Wireless

## 1	Rationale for proposed changes

While the multicarrier text provides the building blocks for simultaneous use of multiple channels, there are some minor contradictions and ambiguities in the current text. These stem primarily from not always precisely maintaining the distinction between the term "primary carrier" and the more general term "fully configured carrier".

There are also minor contradictions and unnecessary restrictions on the presence of control on secondary carriers.

Additionally, carriers are talked about as if they are entities that perform actions when it is really the BS and MS that perform the actions. This adds to confusion.

Finally, the opening text of section 19 is for a very specific boundary case of using the guard subcarriers of two adjacent carriers. It should not be the opening text of section 19, but should be a subsection of section 19.

## 2	Specific Editing Changes

Blue underlined text represents specific editorial additions.

Red strikethrough text is to be deleted.

Black text is text already in the draft.

Bold italic text is editorial instructions to the editor

Modify section 11.6.4 as indicated below.

11.6.4 Multi-carrier Control Structure

Editors' Notes :

This section is a placeholders for text to be developed based on SDD text that will be added to Section 19 of the SDD (Support for Multi-carrier Operation).

The carriers involve in a multi-carrier system, from one MS point of view, can be divided into two types:

- A Primary carrier is the carrier where used by the BS and the MS to exchange traffic and full primary PHY/MAC control information defined in 16m specification. Further, the primary carrier is in charge of delivering all used for primary control information functions for proper MS operation, such as network entry. Each MS shall have only one primary carrier it considers to be its primary carrier.

- A Secondary carrier is the an additional carrier which the MS may use for traffic, only per BS's specific allocation commands and rules, typically received from on the primary carrier. The secondary carrier

may also include control signaling to support multi-carrier operation and the transport of data on the same secondary carrier (e.g., HARQ feedback).

Based on the primary and/or secondary usage, the carriers of a multi-carriers system may be configured differently as follows:

- Fully configured carrier: A carrier for which all control channels including synchronization, broadcast, multicast and unicast control signaling are configured. Further, information and parameters regarding multi-carrier operation and the other carriers can also be included in the control channels.

- Partially configured carrier: A carrier with only essential control channel configuration to support traffic exchanges during multi-carrier operation.

A primary carrier shall be fully configured while a secondary carrier may be fully or partially configured depending on usage and deployment model.

19 Support for Multi-carrier

Move the opening text starting here and ending just prior to section 19.1 into a new section "19.2 Utilization of guard sub-carriers of adjacent frequency channels".

When multiple contiguous frequency channels are available, the guard sub-carriers between contiguous frequency channels can be utilized for data transmission only if the sub-carriers from adjacent frequency channels are well aligned. In order to align those sub-carriers from adjacent frequency channel, a frequency offset ($\Delta f'$) can be applied to its FA. The basic idea is shown by the example in Figure 1.
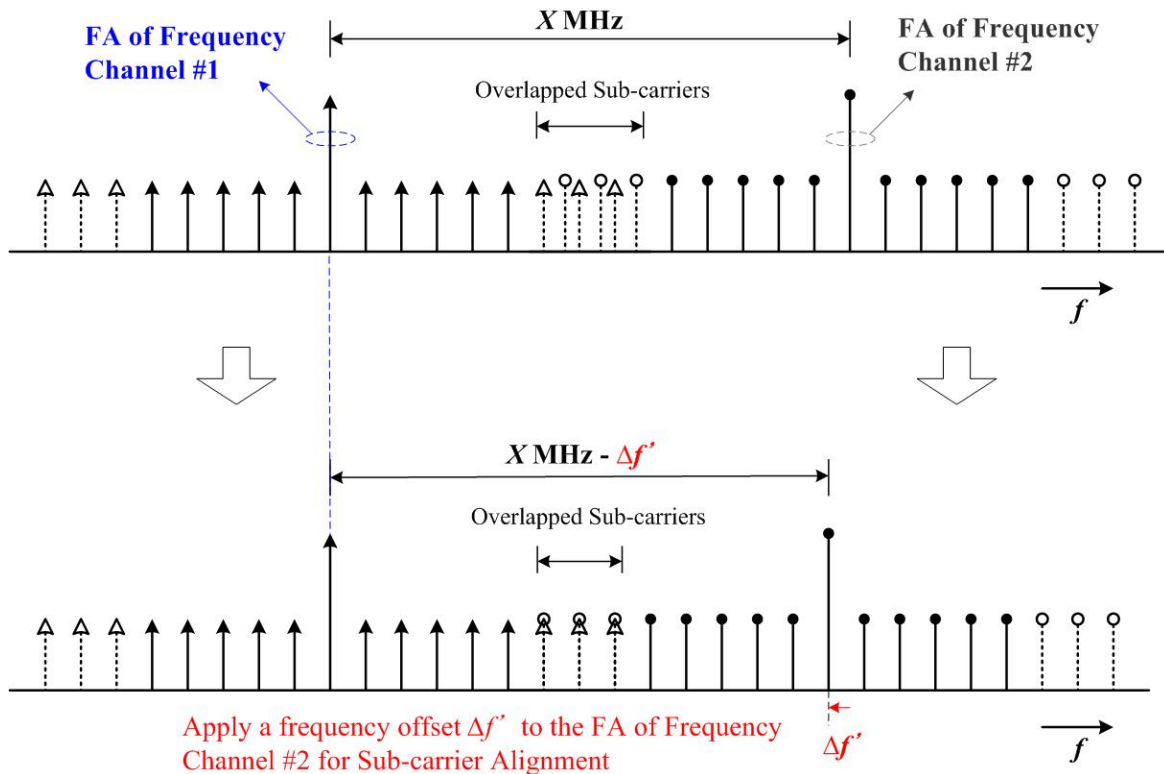
Figure 1 Sub-carrier alignment by applying a fraction of sub-carrier spacing to the FA of adjacent frequency channel

In order to utilize the guard sub-carrier for data transmission, the information of the available guard sub-carriers eligible for data transmission shall be sent to MS. This information shall include the numbers of available sub-carriers in upper side and in lower side with respect to the DC sub-carrier of each frequency channel.

Modify section 19.1 as indicated below.

19.1 Multi-carrier operation Principles

The following is common in all modes of multi-carrier operation:

- The system defines N standalone ~~primary~~ fully configured RF carriers as defined in section 11.~~x.6~~6.4, each fully configured with all synchronization, broadcast, multicast and unicast control signaling channels. Each MS in the cell is connected to and its state being controlled through only one of the fully configured carriers as its primary carrier~~s~~.

- They system defines M (M >= 0) partially configured RF carriers as defined in section 11.6.4, each configured with the essential control channel configuration to support traffic exchanges during multi-carrier operation.

- In the multicarrier operation a common MAC can utilize radio resources in one or more of the secondary carriers ~~as defined in section 11.4.6,~~ while maintaining full control of MS mobility, state and context through the primary carrier.

- Some information about the secondary carriers including their presence and location shall be made

4

available to the user through the primary carriers. The primary carrier may also provide user the information about the configuration of the secondary carriers.

- The resource allocation can span across a primary and multiple secondary RF carriers. Link adaptation feedback mechanisms ~~would need to~~ should incorporate measurements relevant to both primary and secondary carriers.

- ~~The~~ A multi-carrier system may ~~be used~~ assign secondary carriers to an MSS in the downlink and/or uplink asymmetrically based on system load (i.e., for static/dynamic load balancing), peak data rate, or QoS demand.

- ~~A~~ In addition to its primary RF carrier data transfer between a BS and an MS may dynamically utilize resources across multiple secondary RF carriers. Multiple MS, each with a different primary RF carrier~~s~~ may also share the same secondary carrier.

- The multiple carriers may be in different parts of the same spectrum block or in non-contiguous spectrum blocks. The use of non-contiguous spectrum blocks may require additional control information on the secondary carriers.

- Each ~~user~~ MS will ~~be connected to~~ consider only one fully configured RF carrier to be its primary carrier. A secondary carrier for a MS, if fully configured, may serve as primary carrier for other MS's.

- An MS may be dynamically assigned a different fully configured carrier as its primary carrier.

There are two scenarios to multicarrier deployment.

Scenario 1: All carriers in the system are fully configured to operate standalone and may support some users as their primary carrier and others as their secondary carrier.

Scenario 2: ~~In this case, in~~ In addition to fully configured and standalone RF carriers the system also utilizes additional partially configured supplementary radio carriers optimized as data pipes for certain services or traffic types using limited control signaling capability. Such supplementary carriers may be used only in conjunction with a primary carrier and cannot operate standalone to offer IEEE 802.16m services for a MS.

In multi-carrier operation, an MS can access multiple carriers. The following multi-carrier operations are identified:

- Carrier aggregation
  - MS shall always maintain its physical layer connection and monitor the control information on the primary carrier.

- Carrier switching
  - MS can switch its physical layer connection from the primary to the secondary carrier per BS' instruction. When the MS is connected to the secondary carrier, the MS doesn't need to maintain its physical layer connection to the primary carrier.
  - This mode may be used for the cases of single radio MS ~~or non-contiguous spectrum~~.

3   References

[1] IEEE 802.16m-08/003r3. See Section 11.6.4 and section 19.

[2] K. Stanwood and P. Piggin (NextWave), "Proposal to include channel aggregation in 802.16m SDD" (IEEE C802.16m-07/315), 12 November 2007.