Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Consolidation of CX Frames format and occupancy rules**
Date Submitted	**2007-01-07**
Source(s)	Mariana Goldhamer Voice: +972 3 6456241 Alvarion Fax: +972 3 645 6204 Tel Aviv, 21 HaBarzel Street mailto:marianna.goldhammer@alvarion.com Israel
Re:	[If this is a proposed revision, cite the original document.] [If this is a response to a Call for Contributions, cite the name and date of the Call for Contributions to which this document responds, as well as the relevant item number in the Call for Contributions. Contributions that are not responsive to this section of the template, and contributions which do not address the topic under which they are submitted, may be refused or consigned to the "General Contributions" area.]
Abstract	[Description of document contents.]
Purpose	[Description of what the author wants 802.16 to do with the information in the document.]
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) 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 and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Consolidation of CX Frames format and occupancy rules

Mariana Goldhamer

Alvarion

1   Introduction

This contribution has as target to address several comments in LB24:

- reducing the number of Coexistence Frame types from 2 to 1
- inclusion of rules for channel sharing with Bursty systems
- introducing power rules for the rotating priorities for Slave sub-frames

The comments of different participants in LE TG indicated that the preferred frame structure is Type 2, conducting to shorter MAC Frames and lower ARQ latency.

This MAC Frame structure, when using 5ms MAC Frames, will not allow Common/Master or Common/Slave partitions in up-link. Ideally, when operating as Slaves, and if a total STOP of operation will be required, would be desired to renounce to the Common sub-frames. On the other hand, all the MAC Frames need to start in the legacy mode, according to 802.16-2004 and 802.16e-2005. Similar problems appear with the MAC Frame start in licensed bands, for the Reuse 1 mode, when not all the MS/SS can hear the Frame Start. However, the MAC Frame start has to be transmitted by the BS. This is why the DL Common sub-frame was kept also in Slave DL sub-frames, while no Common sub-frame is defined for up-link.

We introduce here the power element, in addition to the transmission scheduling, to enable achieving the above desiderates. We also introduce the rules for making available transmission time to bursty systems, such that the 802.16 frame structure and reliable reception will not be violated.

2   Changes to the frame structure

Replace the text in 15.4.2.1.2 staring on page 89, row 4 and ending on page 90, row 28, with the following:

A CX Frame is created by a sequence of four 802.16 MAC frames and it is subdivided into specific sub-frames (see fig, h40).
The sub-frames are generally used for DL and UL activity. However, in some cases the spectral efficiency may be increased if the BS or a Relay will synchronize their transmissions with an already installed and co-located SS.

The CX Frame is composed of Common, Master, Slave and Shared sub-frames, which can be used for DL or for UL. In order to respect the 802.16 frame structure, every MAC Frame starts with a Common sub-frame.

The Common sub-frame is not used in UL.

During the Common and the Shared sub-frames may be scheduled the communication not affected by interference.
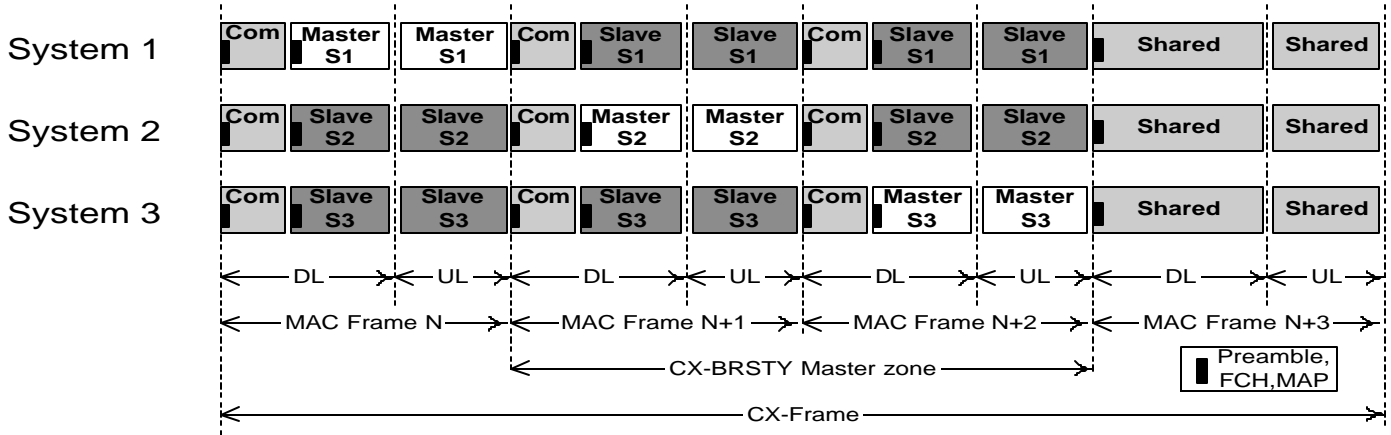

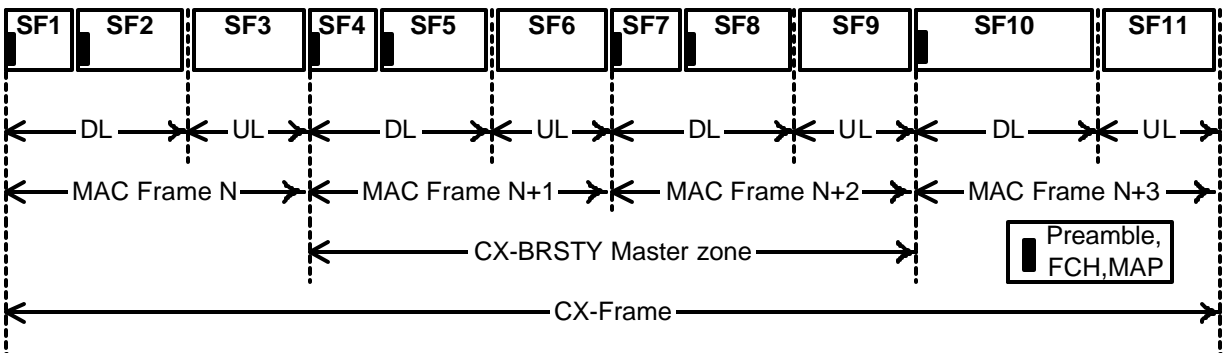**Figure h40—Coexistence Frame Functionality**

Figure h41—Sub-frame numbering within the CX Frame

The rules for occupying the Master sub-frames are:
-   Only systems synchronized with the GPS or equivalent time source can act as Masters
-   The first 802.16h system in an area will use the first Master sub-frame defined in the CX Frame, while the 2nd 802.16h system will use the second Master sub-frame.
-   The first Bursty system will use the third Master sub-frame defined in the CX Frame, while the 2nd bursty system will use the 2nd Master sub-frame, if it is not already claimed by a 802.16h system.
-   The Master systems will "claim" a Master sub-frame by inserting their Radio signature in the corresponding slots of the CXCC. No system is allowed to claim more than one Master sub-frame.

- If interference is detected during the CXCC slot named "No+I", SF8 and SF9 will be made available for those system creating the interference. These systems will be considered as the first Bursty system.
A system previously using these sub-frames as Master will have to find another sub-frame which can be used as Master.

The rules for operation during not-occupied yet sub-frames are:
- The non-occupied yet sub-frames are considered as Common sub-frames.

The rules for CX_BRSTY systems operating as Master are:
- The first CX_BRSTY system will use the CX_BRSTY_D1, respectively CX_BRSTY_U1 of the CXCC to signal its occupancy of the Master 3 sub-frames.
- The second CX_BRSTY system will use the CX_BRSTY_D2, respectively CX_BRSTY_U2 of the CXCC to signal its occupancy of the Master 2 sub-frames.
- The CX_BRSTY systems will limit their activity such that will not affect sub-frames not allocated for their operation.

The following rules apply to Slave systems, using Bursty technologies:
- A bursty system can use an 802.16h Master sub-frame as Slave, only if it has the ability to reduce its operating power when requested by the CXP messages.
- A bursty system can use a CX_BRSTY Master sub-frame as Slave, only if it has the ability of the carrier sense. The Master and Slave systems may use different min. values for the 802.11 Contention Window, such that the Master systems will have higher priority.

The following rules apply to Slave systems, using 802.16h technologies:
- The Slave systems to CX_Bursty Master, after transmitting the DL Common sub-frame have two possibilities:
  o If "Listen-before-talk" is not supported, an "Extended Quiet Period" will be applied until the beginning of the next MAC Frame.
  o If "Listen-before-talk" is supported, will have to implement a min. 50 us "Listen-before-talk" in order to sense the media before the 802.16 Frame start. If no carrier is detected, the 802.16h system will send a regular MAC Frame. If a carrier will be detected, 802.16 will suspend the activity during this MAC Frame.
- The Slave systems to 802.16h Masters may transmit only if are implementing the CXP and are able to reduce their operating powers, including the request to stop the operation.

The operational rules related to the power control are:
- The transmission power during the other Common sub-frames or during the Shared sub-frame will be at least 6dB less than the power in the Master sub-frame.

The detection of systems which are not WirelessMAN-CX compliant will be based on interference-measuring during CXCC slots for No+Io.

The operational rules related to adaptive modulation/coding and power control are:
- The modulation used during the Master/Slave sub-frames will be chosen such that the full sub-frame duration will be used for data transmission; this will protect the 802.16h Master sub-frames from the interference created by Bursty systems, which can detect short silence intervals, start their transmissions, and overlap with the next Master sub-frame. The power of the transmitters will be minimized to the level required by a stable data communication.
- If systems are detected during the No+I slots of the CXCC, the modulation/coding and the transmitted power will use the rules for Master/Slave frames; otherwise the target will be to minimize the transmission durations, such that Bursty systems can also operate.

The rules above allow for the initial spectrum sharing between 802.16h and Bursty systems. The spectral efficiency of both will be increased if only CX_Bursty systems will be deployed.

3   Text changes to Avi's text on Slave Hierarchy

Add at the end of the Avi's text related to slave hierarchy:

In the case that two systems create interference one to each other during their Slave sub-frames, the system having lower "rank" may be requested to reduce its operating power by the system having a higher rank.