Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Changes to IEEE 802.16h-06/004 relating to CMI Definition**
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Re:	Outcomes from Session 42
Abstract	This document contains changes in support of the decision to identify the CMI for same profile applications. Changes are to existing text and mostly editorial in nature.
Purpose	To harmonize contributions with existing text.
Notice	
Release	

Patent Policy and Procedures	

Changes to IEEE 802.16h-06/004 relating to CMI Definition

Overview: These are changes to existing text, with some clarifications. This is submitted based on the suggestions arising from the discussions in Session 42.

Proposed text changes

Add the following new text (in red) to the existing text found at the end of Section 15.2.1.1.3.

Add this as a new Section 15.2.1.1.3.1

15.2.1.1.3.1 Coexistence Messaging Interval

A ~~coexistence time slot (CTS)~~ Coexistence Messaging Interval (CMI) is a reserved physical frame used for the coexistence protocol signaling purposes. The CMI is used with systems having the same profile (15.2.2.3.1) and synchronized MAC frames. The position of the CMI and the subsequent IEEE 802.16 MAC frames are synchronized to a GPS timing signal (15.7.2.1.1). Furthermore, the CMI are identified by UTC time stamps (15.7.2.1.1.3). For example, the beginning of the first ~~CTS~~ CMI is at HH:MM:00 UTC, the second ~~CTS~~ CMI is at HH:MM:06 UTC, etc. The beginning of every ~~CTS slot~~ CMI is specified by a UTC message (time stamp) (Figure h 13).

The CMI ~~CTS could be used by ad hoc wireless LE systems~~ is used by WirelessMAN-CX systems (BSs and their SSs) to mediate their co-channel coexistence. The ~~CTS~~ CMI will be an opportunity for systems (BSs and their SSs) to indicate to other systems (BSs and their SSs) the extent of the interference they can cause; newly arriving interfering base stations (IBS) will use the ~~CTS~~ CMI to make themselves known to established communities of operating base stations (OBS). Newly entering SS will make their presence known when they are detected by base stations to which they are not associated (see Section TBD). Sporadic interference from BS or SS will also be detected by the same process.

A Coexistence Community can consist of a maximum of 9 systems (TBD). Each system claims a unique CMI by a process outlined in Section 15.2.1.3.1. There are a total of 10 CMI which repeat every minute (TBD), but since CMI_ID 54 is reserved for noise measurement and foreign system identification purposes, there are only 9 CMI available to the Coexistence Community. A system must broadcast its BSD and SSURF messages once a minute on its CMI; when it does this all other members of the Coexistence Community remain silent and monitor to detect the extent of the interference that is caused by this.

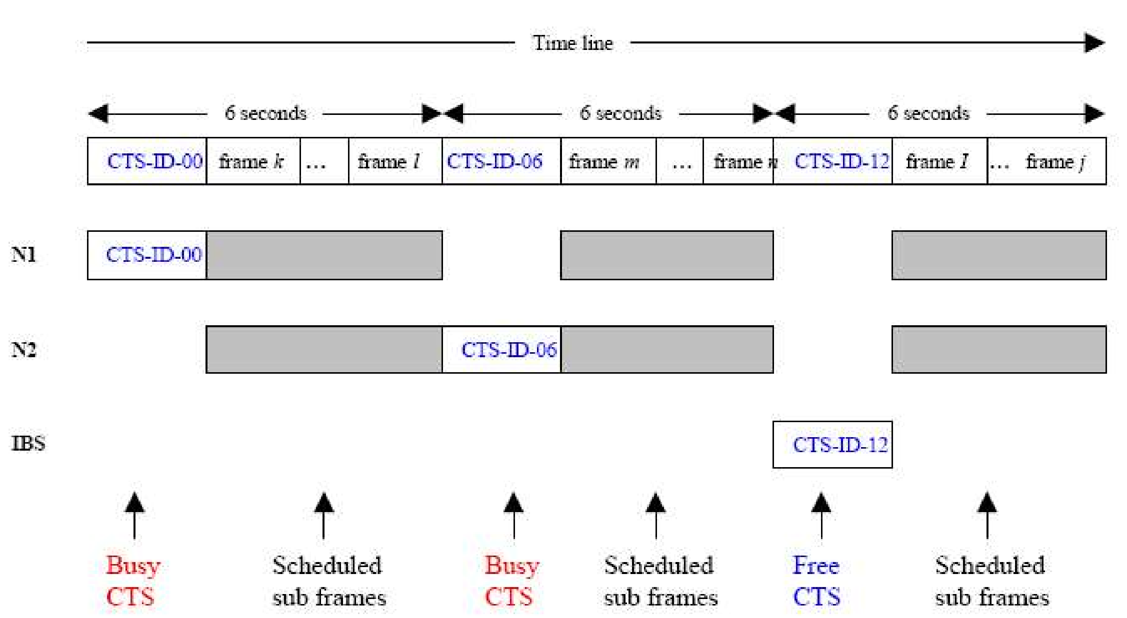

Figure h13 . ~~Alternative Timing of Coexistence Time Slot~~
CMI Timing (CTS should be changed to CMI)

This text exists in Section 15.2.2.3.1
Add this as a new Section 15.2.2.3.1.1

15.2.2.3.1.1 CMI Use for Same Profile Systems

The ~~CTS~~ CMI is the duration of a MAC frame (20 msec) and consists of ~~an~~ uplink and downlink intervals of equal size (10 msec) (TBD). Downlink messages carry information (~~Radio Signatures/~~BSD messages ~~TBD~~) unique to the identity of the base station controlling the ~~network~~ system ~~for~~ to which the particular ~~CTS~~ CMI is associated. Uplink messages carry information (~~Radio Signatures/~~SSURF messages ~~TBD~~) unique to the subscriber stations ~~associated~~ within the ~~network~~ system and base station associated with the same CMI ~~CTS~~. During a ~~CTS~~ CMI all other systems ~~networks~~, not associated with the particular CMI, remain silent and receive only.

Base station descriptor (BSD) messages (section 6.3.2.3.70 ~~15.6.1.2.2~~) are broadcast within the downlink portion of the ~~CTS~~ CMI every minute (TBD) by a base station. This is always done in the same CMI ~~frame~~, ~~ie the frame~~ claimed by the base station. In broadcasting in this manner the base station continually announces its (and its network's) existence. The BSD serves two purposes. First, it contains pertinent information related to the base station, allowing other base stations to identify it (via their SS). Secondly, it allows the differentiation of a CMI frame from a non- CMI frame. When it is received, SS associated with the BS will recognize the frame containing the BSD message as a CMI frame, and will transmit SSURF (uplink Radio Signature) messages (section 6.3.2.3.71) in response to it. Note that SSURF will use the uplink bandwidth granted only in the CMI frame, and is not transmitted in the data link.

Every BSD sent downlink has a BS_ID associated with it~~, it is always included in the DL_MAP message as specified in IEEE 802.16-2004.~~ This is thus a de facto tag to the downlink frame, and can be used as an interference identification tag as well. The message contains the UL-MAP, which addresses specific SS to send their SSURF messages. The duration of the BSD message is typically 1 msec (TBD).

There is only one downlink BSD PDU in the CMI and it is transmitted at random starting point within the downlink time interval of the CMI. The rationale for the random placement of the BSD within the downlink subframe is shown below:

There is the possibility that two or more potentially interfering base stations inadvertently choose the same CMI. Such base stations and the respective networks they control may coexist peacefully without causing interference to each other because of hidden SS or having no SS in the common coverage area. Essentially, such networks do not form an interference community because they do not interfere with each other. However, when the hidden SS or new SS enters into the common coverage area, co-channel interference will be detected at the new SS resulting in a situation that impacts the neighboring base stations having a common CMI. BSD collision occurs in this situation. ~~Two co-channel base stations, inadvertently and independently, have chosen the same CMI prior to interference being detected by the networks~~. To resolve this situation the start times of downlink sub frame PDU and uplink SSURF messages in the CMI are randomized. This reduces the possibility that two networks, sharing the same CMI will overlap in their downlink and uplink BSD or SSURF transmissions. Realize that the downlink slot will be 10 msec wide and that the downlink sub frame BSD PDU itself is only < 1 msec. For the worst BSD collision case, there are n base stations in the common coverage area, the successful (non-overlapping) BSD transmission probability is

$$p = 1 - \frac{1}{m} \bullet \frac{1}{m} \bullet C_n^2 = 1 - \frac{1}{m} \bullet \frac{1}{m} \bullet \frac{n!}{(n-2)! \bullet 2!}$$

$$m = \frac{t}{t_d}.$$

Where .Assume the ~~CTS~~ CMI downlink duration time length is t which is the uplink portion of a physical frame (physical frame duration is varying from 2, 2.5, 4, 5, 8, 10, 12.5, to 20ms), the ~~CTS~~ BSD downlink PDU time duration is d t , which is typically < 1 msec.

Make the following changes to 15.3.1.1.3.1

15.3.1.1.3.1 Non-IEEE 802.16 Systems (BSs and their SSs) capable of GPS/UTC Timing Recovery

Non-IEEE 802.16 LE systems (BSs and their SSs) that are capable of GPS/UTC timing recovery can monitor the ~~CTS~~ CMI intervals to determine the existence of co-channel IEEE 802.16 users. Monitoring the intervals and undertaking CCI measurements over ~~CTS~~ CMI cycles will allow a non-IEEE 802.16 system (BS and its SSs) to determine the occupancy on a channel and avoid settling on it. The CMI is ideal for this as it gives the opportunity for the single system occupying it to broadcast in both the uplink and downlink directions its interference contribution to adjacent co-channel networks, allowing them to ascertain individual system contributions in what is otherwise a crowded environment.

Additionally, [CMI _ID54] (TBD) will be left unoccupied by IEEE 802.16 systems (BSs and their SSs). Non-IEEE 802.16 systems (BSs and their SSs) occupying ~~LE spectrum~~ the same channel can insert downlink and uplink power bursts (TBD) into this interval. Such energy ~~can~~ would be detected by IEEE 802.16 systems (BSs and their SSs) which ~~will~~ would consequently avoid use of the given channel.

Make the following changes to 15.3.1.1.3.2

15.3.1.1.3.2 Non-IEEE 802.16 Systems(BSs and their SSs) not capable of GPS/UTC Timing Recovery

The majority of co-channel interferers will be systems (BSs and their SSs) and devices that cannot perform the rudimentary ~~of~~ signaling required for IEEE 802.16 coexistence and channel detection. To deal with such interferers the IEEE 802.16 ~~networks~~ systems will have to opt for avoidance of such users. To facilitate this IEEE 802.16 BS and SS will have the ability to undertake [Power Spectral Density mappings] of selected bandwidth and disseminate such information as part of their TBD inter–network messaging.
Sections 15.6.1.34. and 15.6.1.36 describe the instructions and formatting that will be used by the IEEE 802.16 systems(BSs and their SSs)to undertake [PSD] measurements of contented spectrum. These measurements should be undertaken by a BS prior to occupancy of spectrum space and they can be undertaken throughout the operational period of a network to determine encroachments and to identify other spectrum that may have to be used in the event of uncontrolled interference arising in the occupied spectrum. The [PSD] measurements will be undertaken by the SS as well and this sensor information will be sent to the BS. [PSD] measurement information forms part of the data base that is exchanged between networks as part of their mutual spectrum management tasks. SSURF messages (TBD) could be used to transport spectrum information. Additionally, using the CCD process detailed in 15.4.1.1 such interferers could also be discovered as part of the monitoring process associated with CMI_ID54.