Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	Consolidation proposal according to 4 frame structure	
Date Submitted	**2007-05-04**	
Source(s)	Wu Xuyong, Huawei	Voice: +86-755-28973547 Fax: wuxuyong@huawei.com，
Re:	IEEE 802.16-07/010：IEEE 802.16 Working Group Letter Ballot Recirc #24a: Announcement (2007-02-01)	
Abstract	According to 4 frame structure, some compliant consolidation should be made within CSI scheduling and the subframe reallocation mechanisms.	
Purpose	To consolidate the 16h draft.	
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Consolidation proposal according to 4 frame structure

Wu Xuyong

Overview

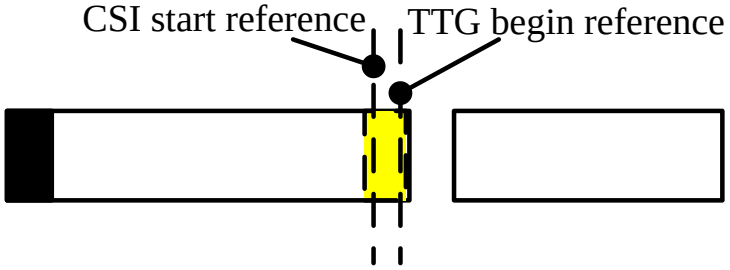
We have some discussion in meeting 48 about the allocation map about the CSI, according to comment 2096 and 2098 by Kenneth Stanwood:
Comment 2096:(awaiting resolution)
Page 80, Line 44, Subclause 15.3.1.1.1, Document P802.16h-D2
Comment: The allocation map is just information the BTS needs to maintain internally based on who transmits in which CMI or CSI. We shouldn't spec it in the standard.
Suggested Remedy: Delete at least from page 80, line 44 through page 81, line 43, maybe more.
Reply by Wu Xuyong: We need to rewrite this part according to fix frame structure assumption. It will be much more simplified in case the master system use the according coexistence interval, and may not necessary to seperate section for scheduling.
Let's move.
Group Decision: Accept-Modified
Group Resolution: AI taken by Xuyong to provide the text changes to revise the description of the allocation of CSI, according to the result of the Adhoc of CSI/CMI/CXCC.

Comment 2098: (already done in D2a)
Page 87, Line 38, Subclause 15.3.1.3, Document P802.16h-D2
Comment: The allocation map is just internally stored information and should not be spec'd..
Suggested Remedy: Delete the last sentence of the paragraph..
Reply by Wu Xuyong: see contribution C80216h-06_114r3.
Group Decision: Accept-Modified
Group Resolution: Delete "By recognizing the OCSI allocation map (See 15.3.1.1.1),"

While with the approach of fix 4 frame structure within the co-channel coexistence, the original allocation map of the CSI usage should be updated accordingly. And here is some necessary updating related. Pls see the slide S80216h-07_054 for case study examples.

CSI timing parameter refining:

Firstly, since the CSI timing is according to the current frame structure related to TTG, we need to finalize some timing parameter so that every system should be aware about the CSI effective time. So we define 2 new reference time points to ensure every system can use the CSI time within the same time position and duration.



1) TTG beginning reference time:
TTG shall start with the first symbol/PS start not earlier than this point;

It can be put in the middle of the frame or with some other unique DL/UL ratio within one band. This is necessary for the TTG allocation for synchronization of the TTG; it will help to eliminate DL/UL cross interference between neighbor system either in co-channel or adjacent channel.
For CSI timing, this reference is used for:
CSI shall end up with the last symbol/PS end not earlier than this point;
2) CSI start reference time: CSI shall start with the last symbol/PS start not later than this point.

CSI Scheduling Updating:

Now let's see the current frame structure according to 4 frame assumption.
For the 4 Frames which have CSI, the structure is shown below, while the abbreviation are SH-share; M1/2/3-Master1/2/3; DL/UL-Downlink/Uplink:

Figure1a: 4 Frame structure with CSI

For the 4 Frames which do not have CSI, (In these frames, using the parameter defined within the OCSI cycles, these CSI interval is dummy to allow the normal data transmition.) The structure for such 4-frame is shown below:

Figure1b: Frame structure with dummy CSI

Now let's considering some basic scenario of the usage of the 4-frame structure:
1) 1 system (S1) start in a blank area, it can occupy all the 4 frame for data usage but it can choose one of the OCSI for the active interference identification for its potential neighbor. Notice, the OCSI is always going with the master frame it chooses to use; the rest part of the frame is ready to abandon the usage on the request of neighbor.
2) When a neighbor system (S2) comes, after negotiate with S1, it chooses M2 as its master and interleaves the last frame occupation with S1.
3) When the 3rd system comes to join the party, all the 3 system can use only there Master resource and the OCSI. See below.

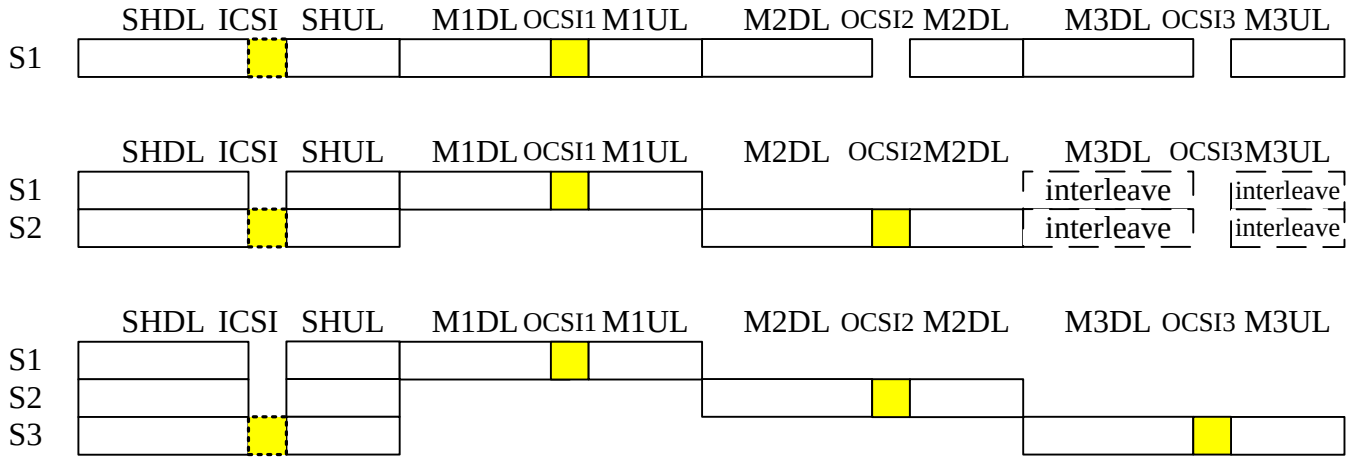


Figure2a: example for neighborhood frame and CSI occupation for 4frame structure

The rest 4-frames without CSI timing reservation is also periodically assigned by the same scheme as above. See below:

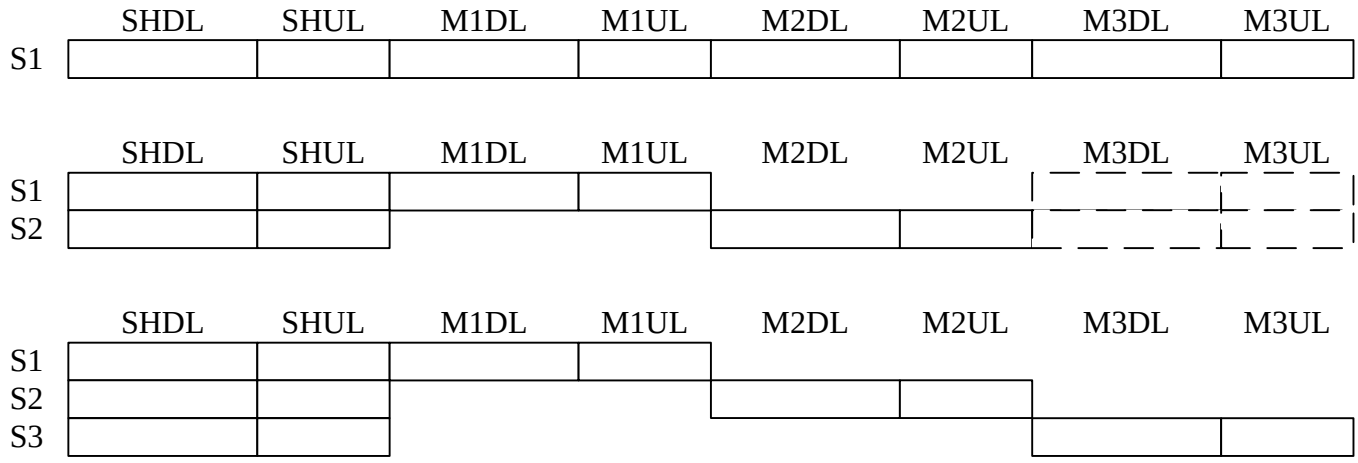


Figure2a: example for neighborhood frame occupation in 4frame structure

If we symbolize the figure above, we can see the scheme for frame assignment and the CSI assignment for each cycle of frame occupation and CSI allocation accordingly.

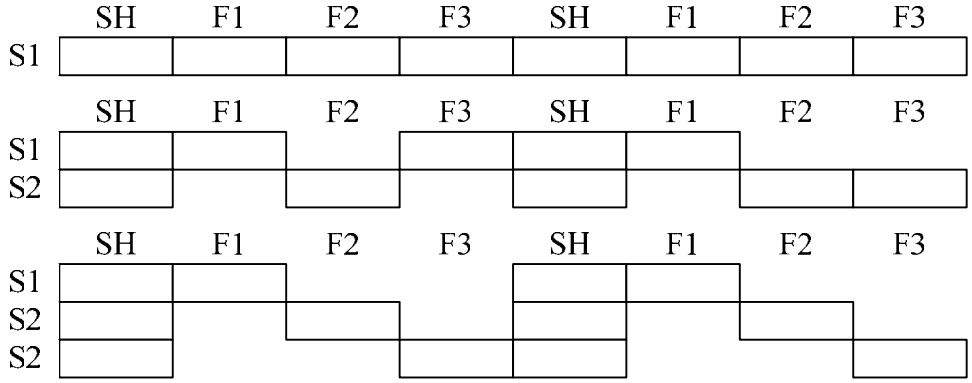


Figure 3a: example for 8 data frames allocation cycling for 4frame structure

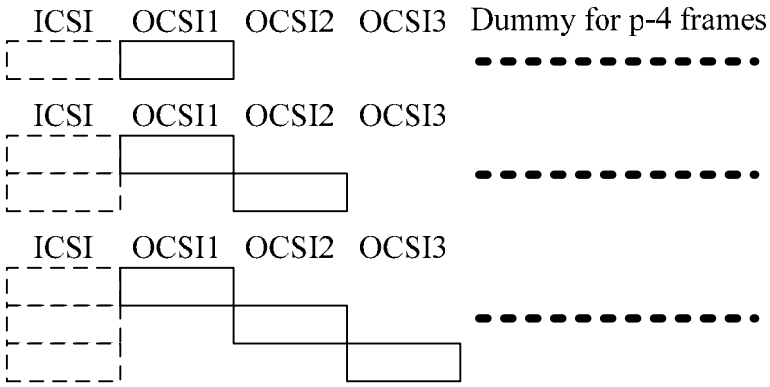


Figure 3b: example for CSI allocation cycling for 4frame structure

Reference:

[1] *IEEE 802.16-07/016r4: comment database of IEEE 802.16 LB24a (2007-04-12)*

[2] *IEEE P802.16h/D2a: (Temporary Editor's Draft) D2a for P802.16h (2007-03-28)*

[3] *IEEE 802.16-07/010： IEEE 802.16 Working Group Letter Ballot Recirc #24a: Announcement (2007-02-01)*

[4] *IEEE 802.16-2004: IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems (2004-10-01)*

[5] *IEEE 802.16e-2005: 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 Licensed Bands and Corrigendum 1 (2006-02-28)*

[6] *IEEE C802.16-07/020r1:* Action Items from Session #47 (Mariana Goldhamer; 2007-03-23)

[7] *IEEE C802.16h-07/082: Using energy pulses for interference identification between 802.16 systems. (Wu Xuyong; 2006-09-17)*

[8] *Calculating the Sensitivity of an ASK Receiver (MAXIM APPLICATION NOTE 2815 2003-11-05)*

[9] *IEEE C802.16h-06/054 Discussion on implementing the energy pulse (Wu Xuyong 2006-07-10)*

Proposed Changes accordingly:

Text below for clause 15 is copy from the D2a draft as place holder and to be modified according to the concept above.

15.3.1.1.1 CSI scheduling

Downlink CSI is used by the BSs to broadcast signaling to the neighbor systems (see *15.1.4.1.1*). These signals are used for interference identification and resolution. In order not to collide with the other neighboring interferers, the coordinated community should prevent neighboring BSs from using the same CSI.

There is one ICSI for IBS in an ICSI cycle, in the example figure below, each ICSI cycle has 4 CSIs and CSIN 0 indicate the CSI numbers of the ICSI. The other CSI is left to the OBS as OCSI, as shown in *Figure h33* . Every OBS needs to obtain an OCSI allocation in one OCSI cycle, which is formed by multiple ICSI cycles so that an IBS can get more opportunities than OBS. There are 1 ICSI cycles inside one OCSI cycle and 4 CSIs in each ICSI cycle in the example, so that there are 1 ICSI intervals for the IBS and 3 intervals for up to 3 OBSs.

Notice that the CSI allocation MAP should indicate all the CSI allocation in the uncoordinated channel as unusable. The uncoordinated channel information can be gathered in the DFS procedure or by the failure of coordination procedure in the interfered channel.

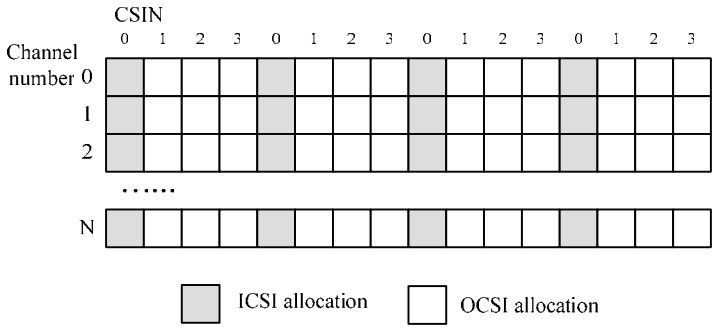


Figure h33 - format of ICSI/OCSI allocation MAP

In the initialization phase of a BS, before the BS has an OCSI allocation, the BS should use ICSI to advertise itself at each candidate channel sequentially one by one until it finds a proper channel. The neighbor OBS will then send their current OCSI allocation and current sub-frame allocation to the IBS using CXP message. After the IBS chooses the working channel for its radio link, the IBS shall choose a vacant CSIN for OCSI in this channel and inform other neighbors about this choice. Then, this BS will start using this OCSI allocation as its exclusive CSI allocation.

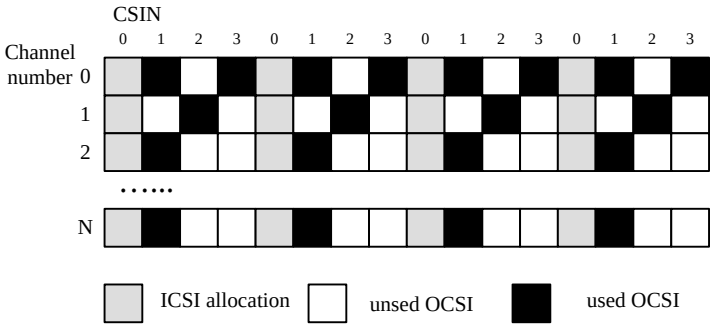


Figure h34_Example of CSI allocation MAP in one BS's database

Figure h34 illustrates an example of the CSI allocation MAP of one BS during his initialization phase by collecting the CXP message information from its neighbors. Assume this BS chooses channel 0 as its working channel, it can then choose any one of the CSIN 1/2/3 as its OCSI allocation number. Every BS will have its own CSI allocation map indicating the current situation of CSI occupancy by the neighbors in the working channel and potential neighbors in the potential working channel. The CSI allocation MAP table of potential working channel will be used when the BS moves to another channel, however, the switching BS shall acquire the new CSIN for the new channel. The CSI allocation MAP of the BS should be updated in time when any changes are informed by its neighbors in the working channel and potential neighbors in the potential working channel.

In the OCSI mapping table, every neighbor in the working channel or potential neighbor in potential channels is mapped to one OCSI allocation, every OCSI allocation will indicate its status as occupied or vacant. By inquiring the mapping table of the OCSI allocations to the BSs, one BS can recognize the source of the interference or signaling in each OCSI allocation.

The initializing BS uses the OCSI allocation table to find out its neighbors in the working channel. By the contact information it acquired from the CXP messages, the IBS will then use CXP messages to negotiate for interference resolution with its neighbors.

15.3.1.1.3 Energy keying in time domain

The information carried in the CSI slots shall be broadcast by the BS and received by the SSs in a coexistence neighbor system. The modulation technology of the interference source and victim system should be one of the following: SCa, OFDM or OFDMA, and may be different between the interference source system and interference victim system.

The information unit in the CSI slot is bit, carried by the timing of transmission in CSI. The duration of the CSI length is counted by symbols. The CSI shall be located right before the TTG Gap, and at the end of the last downlink burst send by BS. The BS shall set the transmission timing parameter (see *10.5.4*) according to the bit value that it is sending. And the SS in victim system is monitoring the signal strength in CSI duration to get each bit value within the CSI sequence (see *15.3.1.1.2*).

For the transmission side (BS), to use CSI duration as part of the data burst and continues to transmit indicates bit one, while to stop transmission at the beginning of CSI duration indicates bit zero. (See *Figure h* . below) While the receiver side is using the signal strength during the CSI duration to decode the carried bit, in periodical CSI slots allocated for each transmitter, the receiver is de facto demodulate energy keying or so called on/off keying signal. The detail of the receiving algorithm is out of the scope of this standard.

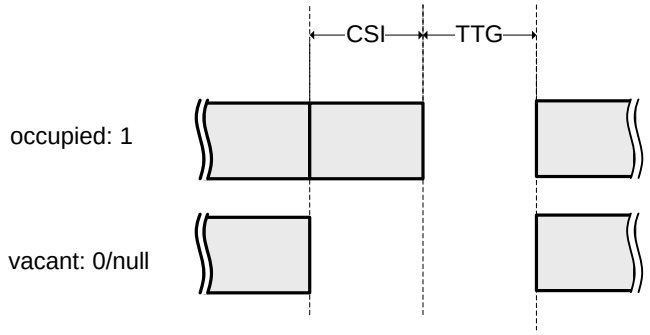


Figure h37- Timing of CSI bit unit

Change all the WirelessMAN-CX into WirelessCXMAN to make it a bit shorter.
Modify the text below in primary standard accordingly:

8.2 WirelessMAN-SCa PHY

Change the eighth paragraph as indicate:

A MAC frame refers to the fixed bandwidth intervals reserved for data exchange. For TDD, a MAC frame consists of one downlink and one uplink subframe, delimited by the TTG. For WirelessCXMAN systems, which are all synchronized in band, the TTG shall start with the first PS beginning not earlier than $T_{TTGSREF}$(10.1); For FDD, the MAC frame corresponds to the maximum length of the downlink subframe. FDD uplink subframes operate concurrently with downlink subframes but on a separate (frequency) channel.

8.3.5.1 PMP

Change the last paragraph before figure 207 as indicate:

In each TDD frame (see Figure 207), the TTG and RTG shall be inserted between the downlink and uplink subframe and at the end of each frame, respectively, to allow the BS to turn around.
For WirelessCXMAN systems, which are all synchronized in band, the TTG shall start with the first symbol beginning not earlier than $T_{TTGSREF}$(10.1);

8.4.4.2 PMP frame structure

Change the first paragraph as indicate:

When implementing a TDD system, the frame structure is built from BS and SS transmissions. Each frame n the downlink transmission begins with a preamble followed by a DL transmission period and an UL transmission period. In each frame, the TTG and RTG shall be inserted between the downlink and uplink and at the end of each frame, respectively, to allow the BS to turn around.
For WirelessCXMAN systems, which are all synchronized in band, the TTG shall start with the first symbol beginning not earlier than $T_{TTGSREF}$(10.1);

10.1 Global values

Add 2 rows in table 342 as indicate:

System	Name	Time reference	Minimum value	Default value	Maximum value
BS,SS	$T_{TTGSREF}$	TTG beginning reference time, as an offset from the starting point of the synchronized frame. 1) TTG shall start with the first symbol/PS start not earlier than the point; 2) CSI shall end up with the last symbol/PS end not earlier than this point;	0.4 frame duration	0.5 frame duration	0.6 frame duration
BS,SS	$T_{CSISREF}$	CSI start reference time, as an offset value from the starting point of the synchronized frame. 1) CSI shall start with the last symbol/PS start not later than this point.	$T_{TTGSREF}$ -25us	$T_{TTGSREF}$ -200us	$T_{TTGSREF}$ -1000us