Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Consolidated concept on minimal coexistence requirements, including the functional definition of the CX Control Channel**	
Date Submitted	**2006-09-28**	
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Re:	IEEE 802.16h-06/015r1 – Working Group Review	
Abstract		
Purpose		
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Consolidated concept on minimal coexistence requirements, including the functional definition of the CX Control Channel

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Introduction

The developments in the last months, such as the desire for providing basic coexistence operation without relaying on the Coexistence Protocol, the agreement on GPS-based synchronization, the limitation of the number of systems to co-exist during a MAC Frame to three (maximum three Master sub-frames), the creation of the Coexistence Control Channel to include as basing functionality the CMI and CSI procedures (for 3 systems in 12 sec period) allow to design a consolidated concept for the basic operation of the 802.16h.
This contribution provides the basic functional requirements for this concept, defines the concept, defines the Coexistence Control Channel functionality and clarifies the support of the FCC requirements in 3.65GHz (CBP).

***Insert new Chapter 15.1.5 (before Architecture*)**

15.1.5.1 Requirements for the basic and extended coexistence

We consider the spectrum as being constituted from frequency slots called “frequency channels” and repetitive time-slots called “sub-frames”.

Below are detailed the requirements for different levels of coexistence.

Requirements for basic coexistence
1. The systems sharing the spectrum shall synchronize their transmissions by using a GPS or equivalent absolute time indicator;
2. Every system shall have the opportunity to evaluate the maximum possible interference on a frequency channel and on a sub-frame within well-known time intervals;
3. Every operating system has the obligation to make known its maximum interference within well-known time intervals;
4. Every system shall have an opportunity to use well defined repetitive time intervals (Master sub-frames) for operating with none or limited interference
5. No system is allowed to create harmful interference to a system owning a Master sub-frame;
6. No system is allowed to operate in more than one sub-frame as Master
7. All the systems shall have the possibility to use well known time intervals in common (Common sub-frames), but their transmit powers shall be limited to minimize the accumulated interference.

Requirements for extended coexistence
1. Systems (Slave systems) may use the Master sub-frames own by other systems with the following conditions:
    a. The systems owning a Master sub-frame can identify the transmitter of a Slave system causing interference;

b. A Master System can communicate with a Slave system to require the reduction of the transmitted power of those units which create interference;

c. A Slave system will satisfy the requests of a Master system relative to the reduction of the transmit power.

5. Slave systems may get the Master systems allowance for non-restricted usage of their sub-frames for limited time intervals and if the other Master systems using the same sub-frames do not complain.

15.1.5.2 Master sub-frames and the Common sub-frame

The maximum number of different Master sub-frames is 3. They can optimally accommodate three systems sharing a frequency channel or a number of systems interfering on co-channel and adjacent channels.

The timing of the Master/Common sub-frames is provided in section 15.x for each regulatory frequency band.

15.1.5.3 Coexistence Control Channel

The CXCC provides for the following functionality:

1. Time-synchronization for systems failing to use a direct GPS absolute time source;
2. Measurement of cumulative interference
3. Identification of interference sources
4. Coordination of the operation of Ad-Hoc systems and facilitates the reservation of interference-free slots for mutual coexistence;
5. Broadcast of the IP Address of the Coexistence Proxi Server to enable IP level inter-system communication.

15.1.5.3.1 Composition of the CX Control Channel

The Coexistence Control Channel is composed from time-slots of [2]ms duration each for UL and DL, every [200]ms, constituting a multi-frame of [15]sec.
Every system will use its operating frequency channel to transmit or receive on the CX Control Channel.

The CX Control Channel is using slots as follows:

a. [6] slots / sub-frame shall be used by the Base Stations (DL) operating during the sub-frame as Master. Those Base Stations shall transmit their radio signatures with the maximum E.I.R.P. spectral density used during the operation. In this way the BSs will provide the other systems sharing the CX Control Channel with the maximum interference levels. Systems operating on adjacent frequencies and using the same sub-frame may also induce interference, such that the signal levels to be measured in a slot will provide the possibility to evaluate the cumulated interference. The radio signatures will be transmitted according to CMI or CSI procedures.

b. [6] slots / sub-frame shall be used by the SSs (UL) operating during the sub-frame as Master. Those Subscriber Stations shall transmit their radio signatures with the maximum E.I.R.P. spectral density used during the operation. In this way the BSs will provide the other systems sharing the CX Control Channel with the maximum interference levels..

[3] slots DL and [3] slots UL are provided for sensing the interference from systems not using the 802.16h CX approach.

15.1.5.4 Operation for Basic Coexistence

An IBS will listen to the media and to the CX Control Channel on all its operating frequencies and all the available sub-frames.
A BS will be able to determine a less-interfered sub-frame and its corresponding frequency channel.

The BS will occupy the chosen sub-frame and will start to operate as Master in the sub-frame. The system controlled by the BS will signal its presence by transmitting on the CX Control Channel its radio signatures and will be allowed to use the Common sub-frame.

15.1.5.5 Operation for Extended Coexistence

A system using the Coexistence Protocol can take advantage of the Extended Coexistence benefits: operation in parallel with the Master sub-frames and coordination regarding the usage of other system's Master sub-frames without the limitations imposed on Slave usage.

15.1.5.6 Compliance with the FCC Coexistence requirements in 3.65GHz-3.7GHz

FCC has defined the basic requirements for a Coexistence Protocol, called "CBP" as:
"Contention-based protocol. A protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate."

The operation of the systems using the 802.16h as Coexistence Protocol provides:

- Multiple systems can share the same frequency channel
- When two or more transmitters attempt to simultaneously access the same channel they will:
    - Find a suitable Master sub-frame for operation
    - Use a Common sub-frame
    - Use the CX Control Channel to measure the cumulated interference
- Rules providing reasonable opportunities for transmission:
    - The opportunities for transmission are based on Master sub-frame scheduling with GPS synchronization to provide a well known timing for all the systems
    - Every system can use the Common sub-frame with a power limitation
    - Every system can find a less-interfered sub-frame for its Master operation
    - Systems being able to coordinate their reciprocal interference receive increased opportunities for transmission.