Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**P802.16h Working Document structure and purpose clarification**
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Re:	Working Group Review of Working Document IEEE 802.16h-06/015r1
Abstract	This document proposes a revised structure of the P802.16h Working Document.
Purpose	
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P802.16h Working Document structure clarification

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Overview

Contributions C802.16h-06/072 [3], C802.16h-06/073 [4], and C802.16h-06/074 [5] at Session #45 suggest additions to the P802.16h Working Document [1] in a number of areas. This contribution considers the overall structure of the resulting document and where these changes are to be applied. It also provides an aid to understanding the wider goals of the group of contributions.

Structure clarification

The suggested document structure is shown diagrammatically in Figure 1.

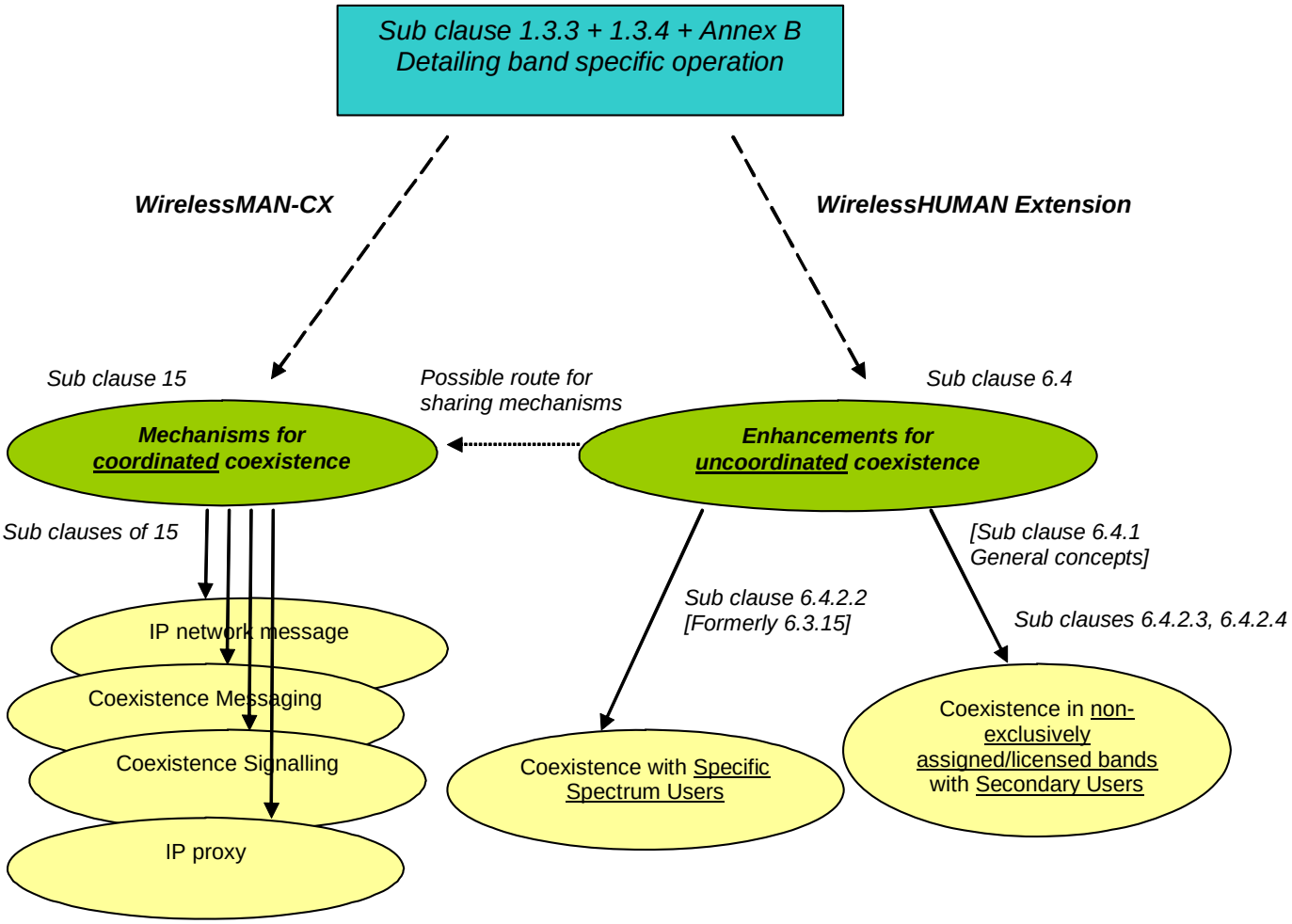

Figure 1: Representation of the suggested Working Document structure.

Per the definitions proposed below in this contribution, Clause 15 of [1] provides mechanisms of a coordinated nature. Subclause 6.4 of [1] addresses uncoordinated mechanisms. Contribution C802.16h-06/074 [5] proposes enhancements to those uncoordinated mechanisms. Contribution C802.16h-06/073 provides a summary of the band-specific operational requirements to be added to subclause 1.3.3 and Annex B. C802.16h-06/072 simply provides the definition of additional terms.

The current Working Document would add a line to Table 1 (subclause 1.3.4) of IEEE Std 802.16 designating the term WirelessMAN-CX, as shown in Figure 2:

Designation	Applicability	PHY	Additional MAC requirements	Options	Duplexing alternative
WirelessMAN-CX	Below 11 GHz license-exempt or when needed for inter-system improved coexistence	Section 8	MAC enhancements for coexistence (6.4)	Those applicable to PHY implemented. Section 15	TDD FDD

Figure 2: Designation of for WirelessMAN-CX from Table 1 of Working Document [1].

Noting, however, that the fourth column of Table 1 was deleted in IEEE 802.16e, this contribution proposes to revise that line as shown in Figure 3:

Designation	Applicability	PHY	Options	Duplexing alternative
WirelessMAN-CX	**Bands below 11 GHz subject to non-exclusive assignment or non-exclusive licensing**	**8.2, 8.3, 8.4**	**Coordinated coexistence mechanisms (Clause 15), as mandated by regulation**	**TDD** **FDD**

Figure 3: Proposed revised designation of WirelessMAN-CX entry in Table 1 of Working Document.

This contribution also proposes to revise the WirelessHUMAN line of Table 1, as shown in Figure 4:

Designation	Applicability	PHY	Options	Duplexing alternative
WirelessMAN-HUMAN	Bands below 11 GHz subject to non-exclusive assignment or non-exclusive licensing	8.2, 8.3, 8.4	AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) (with 8.3 only) STC (8.2.1.4.3/8.3.8/8.4.8) uncoordinated coexistence mechanisms (Subclause 6.4) as mandated by regulation	TDD

Figure 4: Proposed revised WirelessMAN-HUMAN entry in Table 1 of IEEE Std 802.16.

The following subclause ordering is proposed:

1.3.3 Non-exclusively assigned and licensed bands

6.4 Enhancements for *uncoordinated* coexistence

6.4.1 General concepts

6.4.1.1 Capability Negotiation

6.4.1.2 Extended channel numbering structure

6.4.1.3 MAX CX-Frame Numbering.

6.4.2 Uncoordinated coexistence mechanisms

6.4.2.1 Introduction

6.4.2.2 Coexistence with Specific Spectrum Users (SSUs)

6.4.2.3 Uncoordinated coexistence with *Non-specific Spectrum Users*

6.4.2.3.1 Introduction

6.4.2.3.2 Dynamic Channel Selection (DCS)

6.4.2.4 Uncoordinated Coexistence Protocol (UCP)

6.4.3 Support for uncoordinated coexistence

6.4.3.1 Coexistence zones

Specific editorial changes

This section provides a list of changes to the draft document based on the discussion above.

Blue 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.

Make the following changes to clause 1 'Overview'.

Aapplicability: This amendment improves the coexistence of 802.16 systems in non-exclusively assigned and non-exclusively licensed bands. ~~interference environments characteristic of license-exempt operation, including operation in lightly licensed situations where frequencies are not assigned exclusively.~~ Some of the defined procedures could be applied in other licensing cases, which require improved inter-system coexistence.

Make the following modification to subclause 1.3.3

Change the title of subclause 1.3.3 to 'Non-exclusively assigned and non-exclusively licensed bands'.

Replace 1.3.3 with the following:

The physical environment for ~~the license-exempt~~ *non-exclusively assigned* and *non-exclusively licensed* bands below 11 GHz is similar to that of the *licensed bands* in the same frequency range, as described in 1.3.2. However, the ~~license-exempt~~ non-exclusive nature introduces additional interference and co-existence issues,

whereas regulatory constraints limit the allowed radiated power as well as imposing other restrictions. In addition to the features described in 1.3.2, the ~~PHY and~~ MAC introduces mechanisms to facilitate the detection and avoidance of interference and the prevention of harmful interference into other users including specific spectrum users (SSUs) identified by regulation. This includes a mechanism for regulatory compliance called dynamic frequency selection (DFS). This is specified in sub clause 6.4.2.2 concerning coexistence with Specific Spectrum Users (SSUs).

~~Further enhancements to facilitate co-existence for license-exempt and uncoordinated systems in utilizing improved co-existence mechanisms is embodied in MAC enhancements specified in 6.4. This section provides a definition for the WirelessMAN-CX designation. WirelessMAN-CX operation is intended to cover a number of license-exempt and uncoordinated band operation scenarios. Section 6.4 describes support functions for WirelessMAN-CX operation for non-collaborative operation. These procedures provide robust coexistence operation in the presence of non-cooperative and unknown wireless technologies, together with application to interference avoidance of adjacent licensed and license-exempt bands.~~

~~Based on the WirelessMAN-CX designated section 15 provides enhancements to the MAC protocol to provide for better interference measurement, reporting and management; together with negotiation for spectrum sharing to allow different WirelessMAN-CX systems to coexist in the band of operation.~~

It is recognised that some administrations require notification of terminal location for certain services in some ~~license-exempt~~ bands, which is a form of licensing. Conversely, it is possible to have *uncoordinated* usage within a licensed allocation. In these and other similar cases the pertinent issues for ~~license-exempt~~ *non-exclusively assignment* and *non-exclusively licensing* usage remains as described in the preceding paragraph.

In the context of this standard the use of the general term “license-exempt” ~~frequencies" or "license-exempt bands"~~ should be taken to mean the situation where licensing authorities do not *coordinate* individual assignments to operators, regardless of whether the spectrum in question has a particular regulatory status as *license exempt* or *licensed*. An example is the use of the term *light licensing*, where terminal location registration may be required but assignments are not *coordinated*, and should be treated in the same way as *license-exemption* in this context.

Delete the final two paragraphs of 1.3.3

Replace the table in subclause 1.3.4 with:

Designation	Applicability	PHY	Options	Duplexing alternative
WirelessMAN-CX	**Bands below 11 GHz subject to *non-exclusive assignment* or**	**8.2, 8.3, 8.4**	**Coordinated coexistence mechanisms (Clause 15)**	**TDD** **FDD**

	non-exclusive licensing			

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Modify the sixth row of Table 1 as follows:

Designation	Applicability	PHY	Options	Duplexing alternative
WirelessHUMAN	~~Below 11 GHz license-exempt bands~~ Bands below 11 GHz subject to *non-exclusive assignment* or *non-exclusive licensing*	~~license-exempt~~ [8.2, 8.3 or 8.4] and 8.5	AAS (6.3.7.6) ARQ (6.3.4) Mesh (6.3.6.6) (with 8.3 only) STC (8.2.1.4.3/8.3.8/8.4.8) ~~DFS (6.3.15)~~ *Uncoordinated coexistence mechanisms* (Sub clause 6.4)	TDD

Make the following modifications to sub clause 1.3.4:

Implementations of this standard for ~~license-exempt~~ frequencies subject to *non-exclusive assignment* or *non-exclusive licensing* below 11 GHz ~~(such as those listed in B.1)~~ use the designation WirelessHUMAN and WirelessMAN-CX and shall comply with the WirelessMAN-SCa PHY as described in 8.2, the WirelessMAN-OFDM PHY as described in 8.3, or the WirelessMAN-OFDMA PHY as described in 8.4. WirelessHUMAN provides *uncoordinated coexistence mechanisms* (6.4) and WirelessMAN-CX provides *coordinated coexistence mechanisms* (15). ~~They shall further comply with the DFS protocols (6.3.15) (where mandated by regulation) and with 8.5.~~ Both designations shall support features that ensure mandatory compliance to regulation; such features are detailed in Annex B.1. Annex B.1 also lists optional features in support of coexistence.

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Make the following modification to subclause 6.4:

Change the title of subclause 6.4 from 'MAC enhancement for coexistence' to 'Enhancements for uncoordinated coexistence'.

Make the following changes to the text in subclause 6.4

This ~~section~~ sub clause describes ~~MAC~~ enhancements ~~for WirelessMAN-CX~~ in support of ~~license-exempt and uncoordinated bands~~ operation in *non-exclusively assigned* and *non-exclusively licensed* bands. Firstly, general concepts are described ~~which are general to the MAC, after which PHY specific interactions are considered. PHY specific discussion is required since WirelessMAN-CX operation is dependant on the features supported for a given PHY~~, after which details of support for *uncoordinated coexistence mechanisms* are presented. The mechanisms are related to bands containing *Specific Spectrum Users* and those containing *Non-specific Spectrum Users*. It shall be left to regulation to mandate such mechanisms for a particular band.

Delete the sentence in 6.4.1.

Within sub clause 6.4.1.1 replace all instances of 'WirelesMAN-CX' with 'WirelessMAN-CX/WirlessHUMAN'.

Delete subclause 6.4.2 and all its subclauses except subclause 6.4.2.1, which should be retained under a new subclause number (6.4.3.1).

Create a new subclause 6.4.2 with title 'Uncoordinated coexistence mechanisms'.

Create a new subclause 6.4.2.1 'Introduction', and include the following text.

This subclause details a number of *uncoordinated coexistence mechanisms*.

The mechanism overviewed in subclause 6.4.2.2 is intended to protect *Specific Spectrum Users* (SSUs) where regulation mandates. Subclause 6.4.2.3 provides a general *uncoordinated coexistence mechanism* suitable, for example, in bands where no mandatory coexistence behavior is required. In a band such as this, with assignments made in a non-exclusive manner, a mechanism is required to ensure a system possess the ability to satisfactorily coexist with other wireless users (*Non-specific Spectrum Users*) also using the band.

In bands containing both SSUs and *Non-specific Spectrum Users*, it can be expected that a combination of schemes presented in this subclause will be required to provide mandatory protection for the SSUs and as well as a means of coexistence with *Non-specific Spectrum Users*.

Move subclause 6.3.15 to 6.4.2.2 (deleting the existing 6.4.2.2) and renumber accordingly. Change the title of 6.3.15 to 'Coexistence with specific spectrum users (SSUs)'.

Change all references in the base standard and Working Document accordingly, i.e. 6.3.15 references become references to 6.4.2.2.

Create the following at subclause 6.4.2.3.

6.4.2.3 Uncoordinated coexistence with *Non-specific Spectrum Users*

6.4.2.3.1 Introduction

This subclause considers *uncoordinated coexistence mechanisms* for use in bands where *Non-specific Spectrum users* are present. The main distinction for *coexistence* with *Non-specific Spectrum users*, when compared with SSUs (6.4.2.2), is that there are no regulatory demands placed on the solution, such as monitoring requirements, probability of detection requirements, or time to vacate the operating *frequency*. When a *Non-specific Spectrum user* is detected it is not mandated that the operating *frequency* be vacated. One realization of *uncoordinated coexistence* with *Non-specific Spectrum users* is Dynamic Channel Selection (DCS).

6.4.2.3.2 Dynamic Channel Selection (DCS)

Dynamic Channel Selection (DCS) is a realization of an *uncoordinated coexistence mechanism* and provides the ability for a system to switch to different *logical channel* based on channel measurements and thus avoiding interference in *non-exclusively assigned* bands. *Logical channels* can be constructed from an operating *frequency* and time component, or a portion thereof. Channel measurement and interference avoidance provide a DCS algorithm with the means of obtaining interference isolation in time and frequency. This approach enables a number of systems to share a given *frequency*. The approach contrasts to that of subclause 6.4.2.2, which specifies SSUs avoidance in which the physical *frequency* is vacated due to the potential interference to the SSU.

Measurement periods are scheduled by the BS via the DL-MAP and the UL-MAP for the BS and SS respectively. This is achieved via measurement IEs (see for example 8.4.5.3.5). Mechanisms are supported with the REP-REQ/ REP-RSP (6.3.2.3.33) MAC messages to provide reports of interference and therefore *logical channel* usability. Once a logical channel unusable due to prevailing interference that has surpassed a predetermined threshold or degraded the BER sufficiently, the BS may chose to move to a new *logical channel*. This new *logical channel* may be unmeasured or a member of a backup list of available *logical channels* previously measured by the BS. Depending on the prevailing air interface resources, the number of backup *logical channels* may vary. Also the 'freshness' (in terms of when they were measured and how accurate the measurements is likely to be) may depend on available resources to accomplish this task. In the same way the interfered *logical channel* previously vacated may be monitored for usability after some defined period. Figure h1 (subclause 6.4.2.2), although specifically for SSUs, provides an example of how DCS can be used to provide resource management and backup operating channels.

A general example of a DCS solution is provided in figure xyz1 in which interference detection provides agility in frequency and time to reduce the effects of the incident interference. Figure xyz1 (a) indicates the events that happen after interference is detected at the BS. Since the interference is deemed not to be an SSU, and therefore not protected by regulation, the DCS algorithm has the choice to either clear the channel (as would be required for the detection of an SSU) or find a less interfered area of the frame. The DCD/UCD, containing the ExChNr

(6.4.1.2), is used to make the channel change, while the DL-MAP/UL-MAP provides a change of location in the frame. A similar procedure is followed for interference detection at the SS, illustrated in figure xyz1 (b), however in this case the REP-RSP, sent by the SS in an unsolicited manner, initializes the messaging undertaken by the BS.

The flowchart given in h1 (6.4.2.2) may be used to maintain a list of available backup channels for use in the event interference is detected on a channel and needs vacating due to high levels of interference.

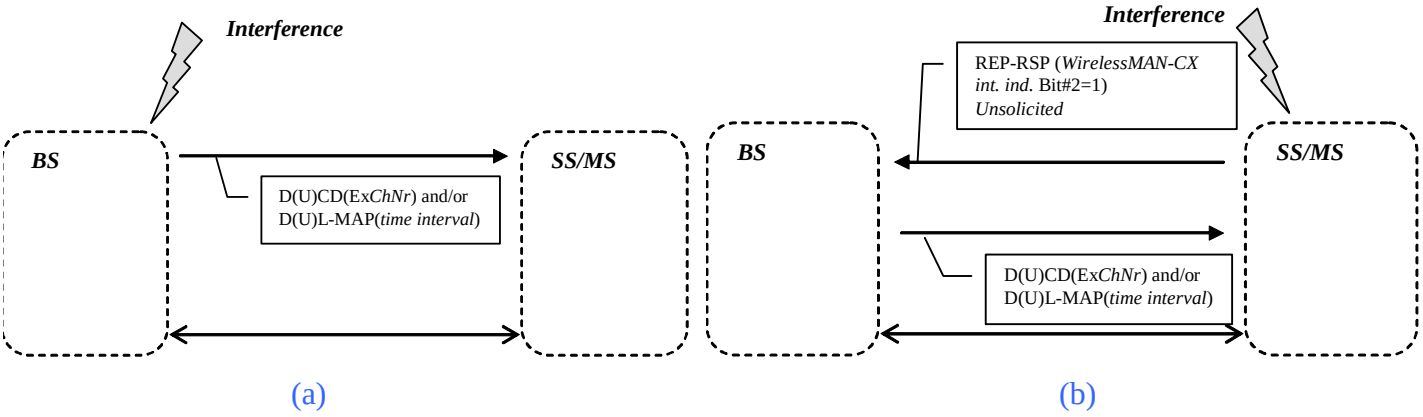

Figure xyz1 *Link level representation of DCS operation: (a) interference and remedial action at the BS, (b) interference reporting and remedial action at the MS/SS.*

Delete subclause 6.4.3 and its subclauses.

Create a new subclause 6.4.3 'Support for uncoordinated coexistence'. Move subclause 6.4.2.1 to a new subclause 6.4.3.1.

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In sub clause 11.7.8 SS capabilities encodings, insert the following in section:

11.7.8.15 WirelessHUMAN capability

Name	Type (1 byte)	Length (1 byte)	Value	Scope
WirelessHUMAN capability	48	1	Bit #0: No WirelessHUMAN capability Bit #1: WirelessHUMAN capability	REG-REQ

			Bits #2 - #7: *Reserved*	
Base Channel Reference (*BaseChRef*)	46	1	Base Channel Reference in MHz providing base reference to frequency range or deployment band	REG-RSP
Channel Spacing (*ChSp*)	47	1	Channel Spacing in 200kHz increments.	REG-RSP

Add the following to table 369a REG-REQ/RSP management message encodings

Type	**Parameter**
48	WirelessHUMAN capability

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Add the following definitions, in the correct position respecting alphabetic ordering, to Clause 3: 'Definitions'.

3.xx **Coordinated coexistence mechanism**: A coexistence mechanism relying on exchange of protocol-based messages among radios.

3.xx **Uncoordinated coexistence mechanism**: A mechanism by which a radio system attempts to achieve coexistence without exchanging messages with other spectrum users.

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Other editorial changes

- ***Global replace in preference to 'coordinated coexistence mechanisms' and 'uncoordinated coexistence mechanisms'.***

References

[1] IEEE 802.16h-06/015r1: *Air Interface for Fixed Broadband Wireless Access Systems: Amendment for Improved Coexistence Mechanisms for License-Exempt Operation*, Working Document.

[2] IEEE 802.16h-06/012r1: *Comments received in Working Group Review of Working Document IEEE 802.16h-06/010.*

[3] IEEE C802.16h-06/072: *Proposed P802.16h terminology definitions*, Paul Piggin.

[4] IEEE C802.16h-06/073: *Specification of operational environments for non-exclusively assigned and licensed bands*, Paul Piggin, Ken Stanwood.

[5] IEEE C802.16h-06/074: *Uncoordinated Coexistence Protocol (UCP)*, Paul Piggin, Lei Wang, and Ken Stanwood.