Uncoordinated Coexistence Protocol (UCP)

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

S802.16h-06/074r1

Date Submitted:

2006-09-27

Source:

Paul Piggin
NextWave Broadband Inc.
12670 High Bluff Drive
San Diego CA 92130 USA

Voice: **1 858 480 3100**
Fax: **1 858 480 3105**
E-mail: **ppiggin @ nextwave.com**

Venue:

Session #45

Base Document:

C802.16h-06/074

Purpose:

Uncoordinated Coexistence Protocol (UCP) [C80216h-06/074]

Paul Piggin

NextWave Broadband

Introduction

- Opportunistic use of a free (or virtually free) resource
- Expect presence of other 802.16 systems
- Expect presence of incumbents (primary users/SSUs)
  - Varies by band
  - Detect and avoid
- Expect presence of non-incumbent non-802.16 systems
  - 802.11 is most likely
  - Need for solution to pass IEEE 802 sponsor ballot
- Need regulatory OK
  - Implied need to play fair
  - Particular bands may have unique requirements
- Cost to solve coexistence problems must not kill business case
  - Introduce an *uncoordinated* mode of operation for LE operation
  - Provides robust operating mode

Overview

- Contribution C80216h-06/074 provides suggestions for a solution to CBP as part of a feature called *UCP (Uncoordinated Coexistence Protocol)*
- UCP itself relies on a number of tools – to be explained
- It is believed that the Uncoordinated Coexistence Protocol (UCP) defined here meets the FCC's definition of a CBP

Definition

- FCC definition of CBP:
  - "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 channel** and establishing the rules by which a transmitter **provides reasonable opportunities for other transmitters to operate**. Such a protocol may consist of procedures for initiating new transmissions, procedures for determining the state of the channel (available or unavailable), and procedures for managing retransmissions in the event of a busy channel."

- Industry Canada
  - Reuse the FCC definition and add clarification:
  - "Examples of protocols used in existing radio systems that the Department **would consider** as meeting the requirements of a contention-based system include the Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) protocol used in Wi-Fi gear or any other form of **Dynamic Frequency Selection (DFS) or listen-before-talk** approach."
  - Note the distinction between CSMA/CD and CSMA/CA.

802.11 variants

- To properly coexist with 802.11 systems need to understand how they detect and avoid other users.
- This is specified primarily by the Clear Channel Assessment (CCA) method and the timing between listening and talking.
- The algorithms differ depending on the 802.11 PHY mode:
  - High Rate DSSS (802.11b) in the 2.4 GHz band
  - Extended Rate PHY (802.11g) in the 2.4 GHz band
  - OFDM for the 5 GHz Band (802.11a/802.11j)
  - OFDM PHY for the 3650 MHz Band (P802.11y)

OFDM PHY for the 3650 MHz Band (P802.11y)

- The IEEE P802.11y project is developing enhancements for the 3.65-3.7 GHz band.
- This proposal would base the 3.65-3.7 GHz operation on the OFDM PHY mode.
- First, it introduces CCA/ED Modes 1, 4, and 5 which are patterned after the 802.11b CCA Modes 1, 4, and 5 except that the energy detection mode (CCA/ED Mode 1) must always be used.
- Additionally, one of the other two modes, timer or energy dropping below threshold, must also be used when the energy is also determined to be a valid 802.11 signal.
- The wait timer for CCA/ED Mode 4 is made channel bandwidth specific at 3.65 ms, 7.3 ms, or 14.6 ms for 20 MHz, 10 MHz, and 5 MHz channels, respectively.
- Most importantly, rather than discriminating between 802.11 and non-802.11 signals, the receive sensitivity for any signal must be 0 dBm above the minimum modulation and coding sensitivity of -82 dBm for 20 MHz channels, -85 dBm for 10 MHz channels, and -88 dBm for 5 MHz channels.
- The proposal would not alter the current 802.11 OFDM detection timing requirements.

- **This appears to have been specifically included for the purpose of enhanced coexistence with non-802.11 systems, given the low number of channels available at 3.65 GHz.**

Relationship of 802.11 methods to 802.16 coexistence

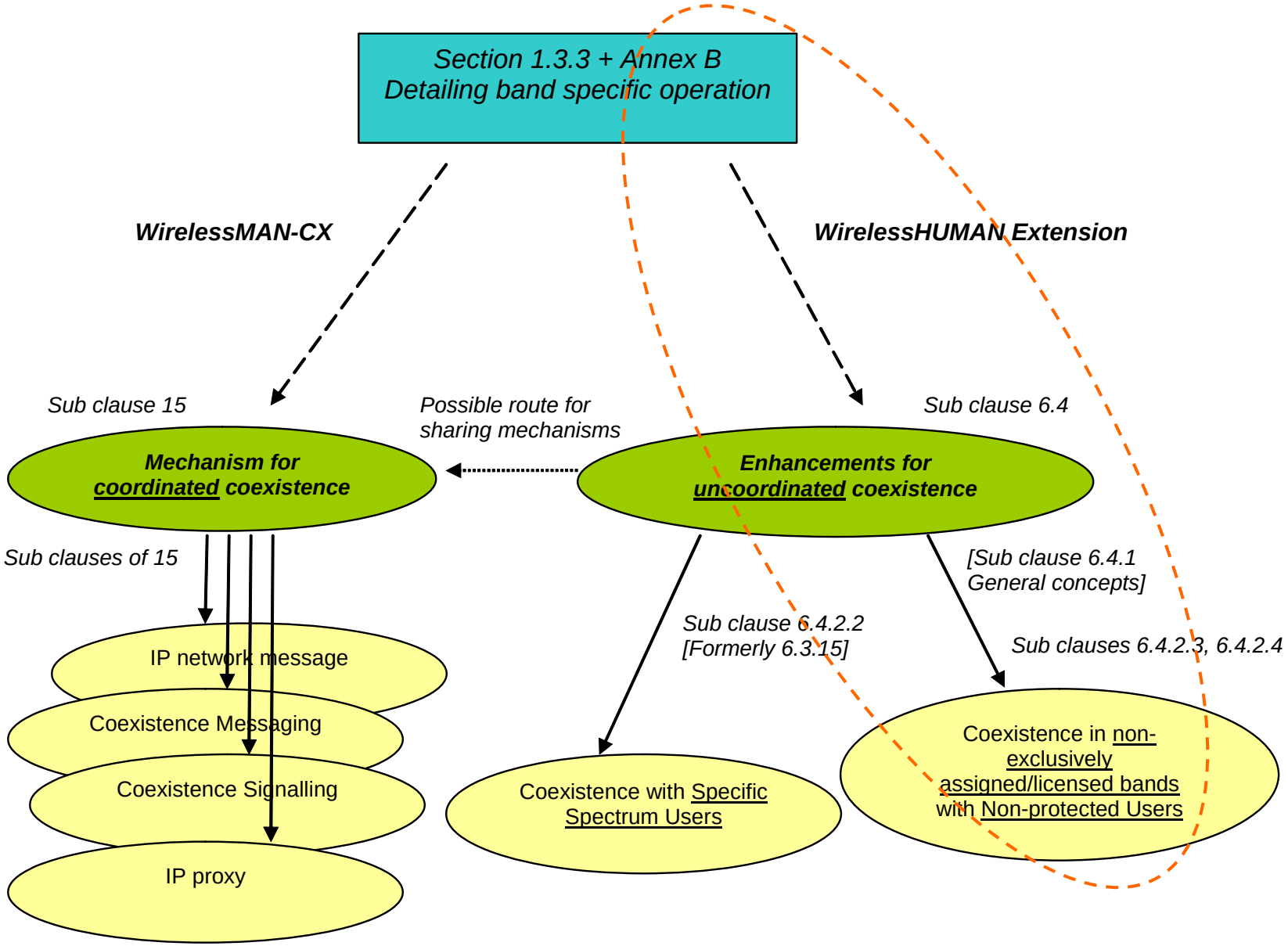
- Periodic quiet periods of duration sufficient to allow another system to transmit, coupled with 802.16's current measurement and reporting capabilities, should be sufficient to allow other 802.16 systems to operate in the bands. However, this is not sufficient for coexistence with 802.11 systems. To properly coexist, a *listen-before-talk* capability must also be added.
- The study group that proposed the 802.11y PAR determined that coordinated negotiation of spectrum usage was not practical. While coordinated methods are occasionally proposed to the P802.11y Task Group, we should assume that the original sentiment still holds and therefore that 802.11y systems, like all other current 802.11 specifications, will not implement any form of coordination that could interact with the method proposed in Clause 15 of the P802.16h Working Document [1].

Summary of Changes

- *Enhanced measurement and reporting* – in particular the suggestion to be able to positively identify a specific spectrum user, another 802.16 system, and 802.11 systems since the actions to be taken may be different with each one.
- *Extended quiet period* – allowing other systems an opportunity to transmit and avoiding unintentional synchronization of measurement period between neighboring systems.
- *Adaptive extended quiet periods* – augmenting the extended quiet period with an algorithm that allows better use of the spectrum when no other users are present and better protection for potentially synchronous users of the channel.
- *Listen-before-talk* – to allow detection of and protection for asynchronous users of the channel.
- *Uncoordinated Coexistence Protocol* – combining the other tools to facilitate operation in bands where the FCC has required a CBP.

- It is believed that the Uncoordinated Coexistence Protocol (UCP) defined here meets the FCC's definition of a CBP.

How does this fit in the Working Document?



- Backup

CCA modes

High-Rate DSSS (“802.11b”) system must use one of 3 CCA modes:

- In the first mode (CCA Mode 1), the channel is declared busy when any signal is detected above the energy detection (ED) threshold and declared not busy when energy drops below the ED threshold.
- In the second mode (CCA Mode 4), if a properly formed High Rate DSSS signal is detected, the device declares the channel busy and starts a 3.65 ms timer. When the timer expires, the channel is declared not busy, but only if no High Rate DSSS is detected. The timer duration is based on the transmit time of the longest possible PHY SDU in a 20 MHz channel.
- The third mode (CCA Mode 5), like CCA Mode 4, only declares the channel busy if a properly formed High Rate DSSS signal is detected, but declares it not busy as soon as energy drops below the ED threshold.