An overview of 802.16h 'uncoordinated' coexistence approach in 3.65-3.7GHz

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Purpose:

An overview of 802.16h ‘uncoordinated’ coexistence approach in 3.65-3.7GHz

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Presentation overview

- To facilitate an overview and discussion of issues related to protocols, methodologies, and parameter selection for 11y and 16h operation/co-existence in 3.65-3.7GHz band
- Overview of the relationship between *coordinated* and *uncoordinated* modes of operation within P802.16h/D1
- Specific details of *uncoordinated* procedures to address coexistence in 3.65-3.7GHz:
  - specifically FCC's definition of *CBP*
- Clarification of parameters for 11y and 16h coexistence

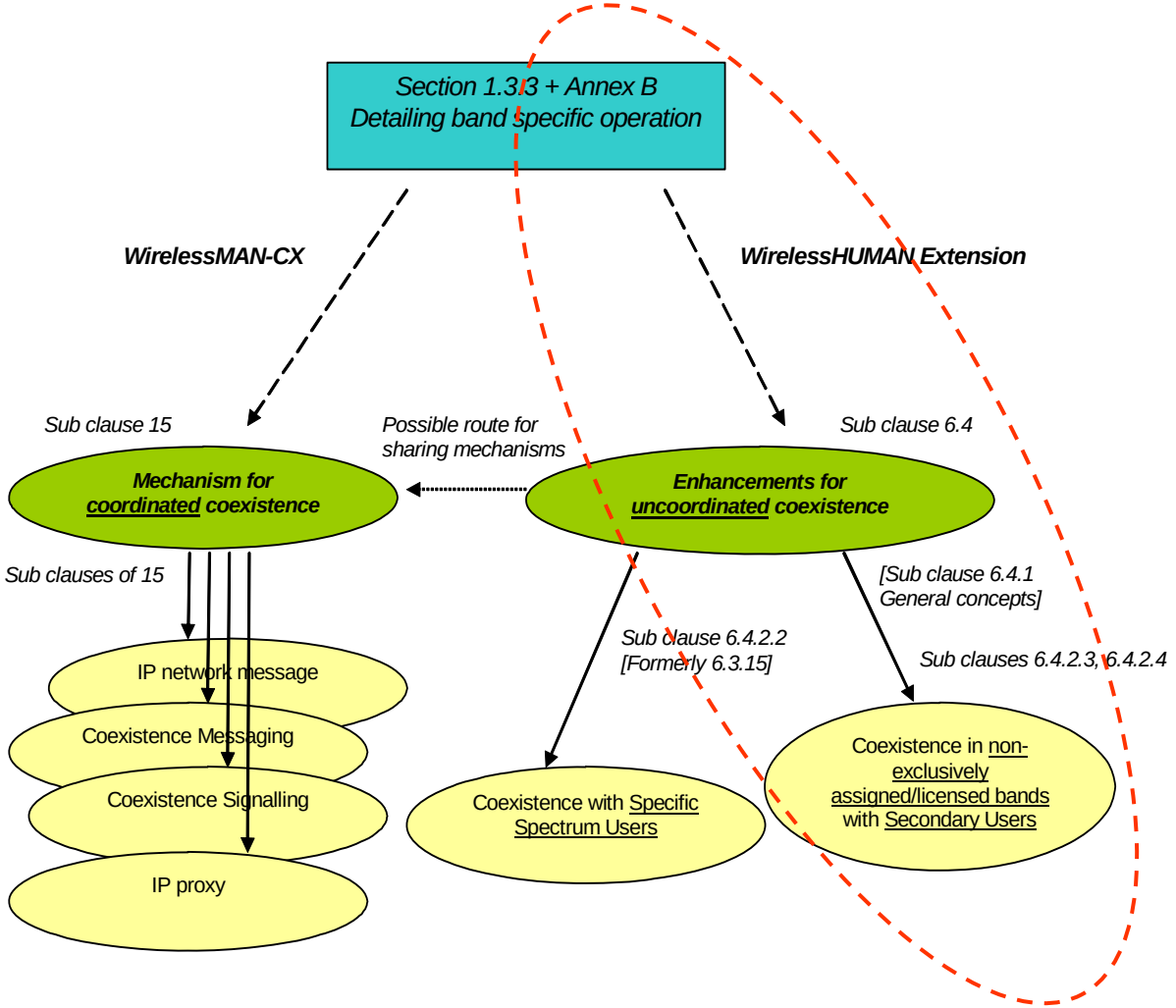
Overview of *Coordinated* and *Uncoordinated* co-existence in 802.16h

Definitions from (P802.16h/D1):

Coordinated Coexistence Mechanism: A coexistence mechanism relying on the exchange of protocol based messages among radios.

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

Coexistence: A state of acceptable operation of two or more radio systems (possibly using different wireless access technologies).



CBP – Contention Based Protocol

- 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 that they think Wi-Fi has CSMA/CD when it has CSMA/CA.

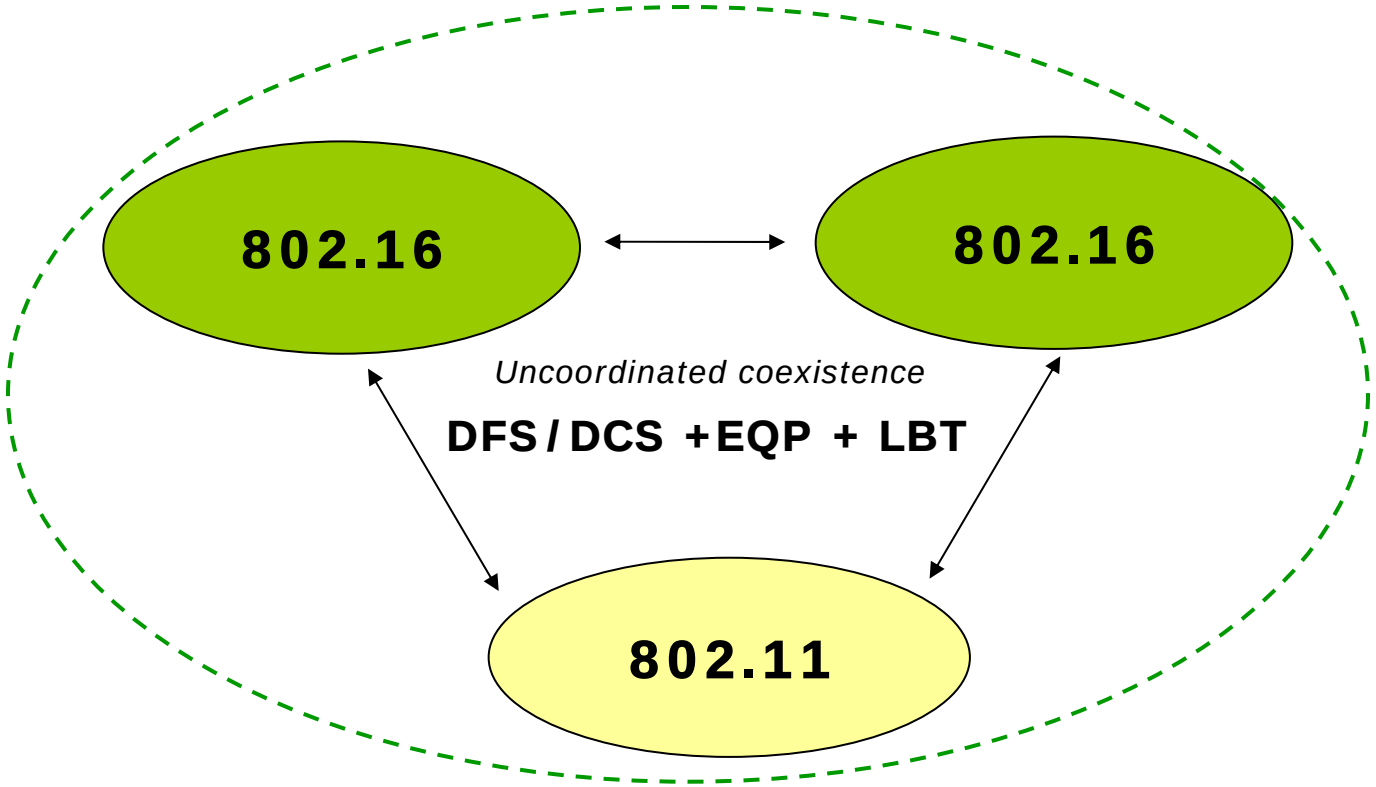
Salient aspects highlighted:

- *"Two or more transmitters attempt to simultaneously access the channel" -> Listen Before Talk (LBT) protocol*
- *"Provides reasonable opportunities for other transmitters to operate" -> Extended Quiet Period (EQP) protocol related to the 802.16 frame structure*

The *uncoordinated* coexistence situation in 3.65-3.7GHz

From the perspective of 802.16h, consideration needs to be taken of:

- CBP requirements
- Coexistence with other 802.16h devices
- Coexistence with 802.11y devices



UCP – Uncoordinated Coexistence Protocol P802.16h/D1

- UCP is the realisation of CBP as defined by 802.16h
- UCP is designed to meet CBP but is not limited to operation in 3.65-3.7GHz band
- UCP draws upon the following *tools*:
  - DFS/DCS
  - LBT
  - EQP (aEQP)

Table B1— Summary of non-exclusively assigned and non-exclusively licensed bands of operation

Band	Regulatory operational requirement, including reference to relevant sub clause	Additional features, including reference to relevant sub clause
902 - 928 MHz [US band]		Coexistence with *Secondary Users* (*6.4.2.3*) *Coordinated* operation (*15*)
2400 - 2483.5 MHz [US band]		Coexistence with *Secondary Users* (*6.4.2.3*) *Coordinated* operation (*15*)
3650 - 3700 GHz [US band]	UCP (*6.4.2.4*)	Coexistence with *Secondary Users* (*6.4.2.3*) *Coordinated* operation (*15*)
5150 - 5850 MHz [Parts of U-NII bands in the US]	DFS (*6.4.2.2*) [5470 – 5725 MHz only]	Coexistence with *Secondary Users* (*6.4.2.3*) *Coordinated* operation (*15*)
5725 - 5850 MHz [UK band]	DFS (*6.4.2.2*)	Coexistence with *Secondary Users* (*6.4.2.3*) *Coordinated* operation (*15*)

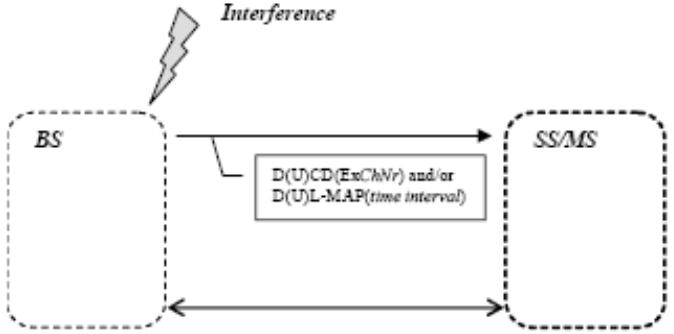
[P802.16h/D1]

- *DCS – Dynamic Channel Selection*
- *DFS – Dynamic Frequency Selection*
- *LBT – Listen Before Talk*
- *aEQP - Adaptive Extended Quiet Period*

DCS (Dynamic Channel Selection) & DFS (Dynamic Frequency Selection)

- ***Attempt to select a clear/least interfered channel***
- 802.16h uses DCS as a means of channel selection and avoidance of non-regulatory protected devices
- DFS is a similar mechanism for regulatory protected devices, e.g. radar
- In the context of UCP both DCS and DFS perform interference avoidance be means of a *frequency/physical* channel change
- This is an ongoing process based on prevailing conditions

(a) Interference and remedial action at the BS



(b) Interference reporting and remedial action at the MS/SS

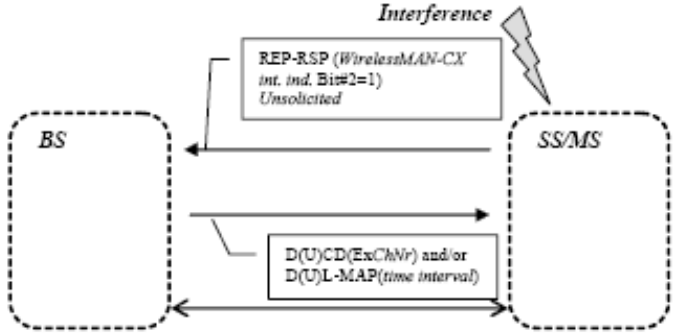


Figure h3—Link level representation of DCS operation

[P802.16h/D1 sub clause 6.4.2.3.2]

LBT (Listen Before Talk)

- CBP states: *"Two or more transmitters attempt to simultaneously access the channel"*
- BS allocates time between UL and DL subframe for measurement opportunities and reacts accordingly

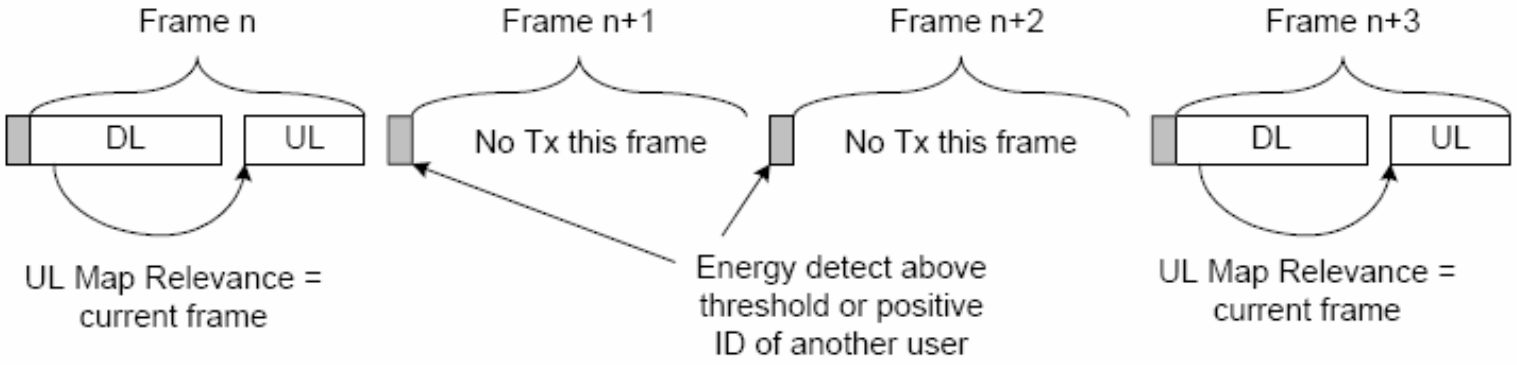
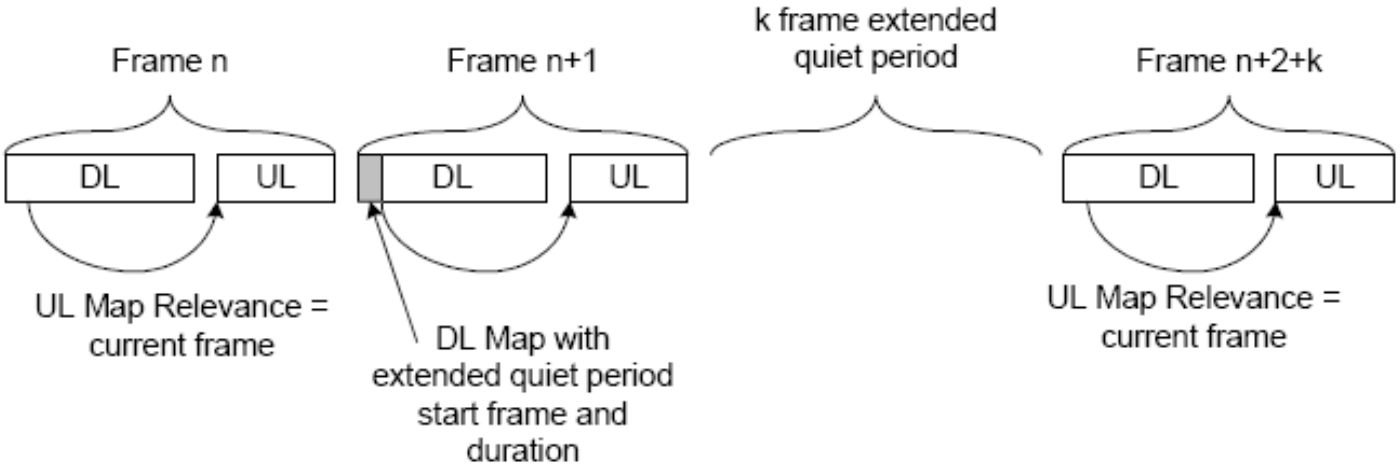


Figure h7—Listen-Before Talk

[P802.16h/D1 sub clause 6.4.3.3 and 6.4.3.4]

EQP (Extended Quiet Period) & aEQP (Adaptive EQP)

- CBP states: *"Provides reasonable opportunities for other transmitters to operate"*
- DFS/DCS undertaken first.
- EQP: suspends transmission on integer number of frames to provide these opportunities
- aEQP: A measurement based enhancement to EQP to optimise the duty cycle of the EQP based on prevailing channel occupancy estimates



[P802.16h/D1 sub clause 6.4.3.5]

Clarification of parameters for 11y and 16h coexistence

Clarification on which 11y features are mandatory and which are optional

- EQP assumes a minimum period of 4ms (bandwidth independent) based on 11y parameters – assumed to be normative for 11y?
- Threshold recommendation: 0dB 11y system, 0dB for other systems
- Use of the full 50MHz band in 3.65-3.7GHz with 5, 10, 20MHz channelisation

- How long does 11y monitor until the channel is assumed to be clear?
- How long does 11y monitor until the channel is assumed to be busy?

- WiMAX Forum TWG specifies (for 5 and 10MHz bandwidths) the following parameters for certification:
  - TTG = 105us (*related to the number of symbols per frame and cell size requirements*)
  - RTG = 60us
  - SSTTG = 50us
  - SSRTG = 50us