Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Regulatory Parameters Action Item**
Date Submitted	**2007-03-02**
Source(s)	Kenneth Stanwood Voice: +1 (858) 480-3327 NextWave Wireless Fax: +1 (858) 480-3105 12670 High Bluff Dr mailto:kstanwood@cygnuscom.com San Diego, CA 92130
Re:	Action item to provide resolution to letter ballot 24 comments 496, 517, 518, 1093, and 1094
Abstract	This document proposes a resolution to the above comments
Purpose	Use as the resolution of letter ballot 24 comments 496, 517, 518, 1093, and 1094
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Regulatory Parameters Action Item

Ken Stanwood
NextWave Wireless

Background

This contribution addresses an action item to resolve letter ballot 24 comments 496, 517, and 518. It also addresses related comments 1093 and 1094.

Comment 496 - Mariana Goldhammer

This comment addresses Table h62 of [1].

1) The comment suggests that the row marked 3 (there are actually 2 rows labeled 2) be duplicated but with a channel spacing of 12 MHz. Row 3 is already problematic in that we are not addressing any of the issues regarding operation in the TV White Space such as protection of broadcasters, wireless microphones, and consumer electronics equipment. Adding another row with a channelization spanning 2 TV channels further highlights that deficiency. I'm more of the mind that we should delete row 3 or at least not expand it until we address the issues for operation in that band. I'm certain that we will get such comments during sponsor ballot.

2) The comment also suggests duplicating row three and the newly inserted row, but with 8 MHz chanel spacing for the ECC. Duplicating row three and the newly inserted row would have the same problem of highlighting the fact that we don't meet the regulatory requirements for that band.

3) The comment also suggests adding 5, 10, and 20 MHz channels for the 2.4 GHz band. 802.11 doesn't allow for 5 and 10 MHz channels in the 2.4 GHz band. It suggested using FFT sizes that are not in line with what is common in industry for these channel bandwidths. I think we'll want to give set FFT sizes based on what the industry profiles typically use for a particular channel bandwidth rather than using special ones for these bands or give the flexibility of "up to" as is currently in the table.

Comment 517 - David Grandblaise

The comment suggested filling in some blank entries in Table B1.

The second column of the first two rows are blank because there are not regulatory requirements

that mandate features like there are for the other three rows which have explicit regulatory requirements for a CBP or DFS. Accepting the comment as stated would imply there are major regulatory hurdles when there are, in fact, none. I'd rather put "n/a" in those boxes. That indicates that we know there are no functions from the standard that are necessary to meet regulations.

Comment 518 - David Grandblaise

As with comment 517, this comment takes text that indicates what's minimally necessary to meet the regulations and expands it to require more. Everyone is, of course, free to implement functionality beyond what is minimally required by the regulations, but we shouldn't say they need to. I'd rather leave the text unchanged or reduce it to just say UCP from section 6.4.2.4. That way, if we change UCP based on the results of John and Paul's simulations, we won't need to change this text in the future.

Comment 1093 - Ken Stanwood

This comment suggest we channelize the 3.65 GHz band in the US to be compatible with coexistence with 802.11 rather than using channel bandwidth from an unassociated Euopean reglatory band of licensed spectrum.

Comment 1094 - Ken Stanwood

This comment suggested not supporting 20 MHz channels in the tables. On further thought , I withdraw comment 1094.

Additionally, the section has been modified to reflect the fact that their is now only subframe type 2 and common subframe duration is under debate and best left for that section.

Along with the above comments, the discussions made it clear that sections 15.6 and B.1 greatly overlapped and needed to be collapsed into a single section with the about issues addressed. This document attempts to do both.

While I personally prefer to separate this out into B.1, B.1 is informative and these parameters are normative if we want interoperability. Also, 802.16e-2004 [3] removed similar information from Annex B by deleting the previous B.1. Therefore, this document suggests combining 15.6 and B.1 into 15.6.

The framemaker version is available for the editor.

Specific Editorial Changes

This provides a list of changes to IEEE P802.16.D2 document [1].

Blue underlined 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.

Merge sections 15.6 and B.1 into a new section 15.6:

15.6 Relevant regulatory domains

The procedures described in chap.*15* mechanisms for improved coexistence may be used to improve coexistence interoperability in a high variety of regulatory scenarios. This section intentionally contains informative text regarding regulatory doamins in addition to normative text regarding requirements for 802.16 systems operating in those regulatory domains.

This subclause describes the operational environment for various bands of interest in which operation of an IEEE 802.16 system might require steps to ensure coexistence with other systems based on either IEEE 802.16 or other technologies. The purpose of this subclause is to provide guidance for regulatory approval of IEEE 802.16 operation in certain bands while also documenting the peculiarities of the bands.

A summary of applicable bands and features is given in *Table B1* below.

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]	N/A	Coexistence with *non-Specific Spectrum user* (*6.4.2.3*) *Coordinated* operation (*15*)
2400 - 2483.5 MHz [US band]	N/A	Coexistence with *non-Specific Spectrum user* (*6.4.2.3*) *Coordinated* operation (*15*)
3650 - 3700 GHz [US band]	UCP (*6.4.2.4*)	Coexistence with *non-Specific Spectrum user* (*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 *non-Specific Spectrum user* (*6.4.2.3*) *Coordinated* operation (*15*)
5725 - 5850 MHz [UK band]	DFS (*6.4.2.2*)	Coexistence with *non-Specific Spectrum user* (*6.4.2.3*) *Coordinated* operation (*15*)

Other features in subclause 6.4.1 may be used for operation in non-exclusively assigned and non-exclusively licensed bands.

15.6.1 eEssential CX parameters

In this chapter section we identify some essential requirements, such as as channelization and MAC Frame durations, to be used in a sample list of certain regulatory domains. In addition it is indicated that there may be a need for FFT size limitation, due to the fact that shorter sub-frames may require shorter OFDM symbol lengths.

Table h1— Relevant regulatory domains and essential CX parameters

Regulatory Index	Frequency band	Regulatory authority	Channel Spacing (MHz)	Channel centers (MHz)	CXZ Parameters	Recommendations
1	5.25 – 5.875GHz	FCC, ECC	10, 20	See chap. 8.5	MAC Frame duration: 5ms, RI=20ms Sub-frame type: 2 DL Common sub-frame: 1ms	FFT sizes: up to 1k
2	3.65 – 3.7GHz	FCC	75	3654, 3661, 3.668 3.675,3682,3689, 3696Base Frequency = 3.65 GHz. 3652.5, 3657.5, 3662.5, 3667.5, 3672.5, 3677.5, 3682.5, 3687.5, 3692.5	MAC Frame duration: 5ms, TDD split 60/40, synchronized, OFDMA FFT size 51210ms? RI=20ms, 30ms? Sub-frame type: 2? DL Common sub-frame: 1ms, 3ms?	FFT sizes: up to 512Channelization compatible with 802.11y
3	3.65 – 3.7GHz	FCC	10	Base Frequency = 3.655 GHz. 3660, 3670, 3680, 3690	MAC Frame duration: 5ms, TDD split 60/40, synchronized, OFDMA FFT size 1024.	Channelization compatible with 802.11y
24	3.65 – 3.7GHz (BWA)	FCC	20	3661, 3689Base Frequency = 3.655 GHz. 3665, 3685	IdemMAC Frame duration: 5ms, TDD split 60/40, synchronized, OFDMA FFT size 2048.	Channelization compatible with 802.11y
35	< 850MHz (TV Bands)	FCC	6	Centers of the TV channels	MAC Frame duration: 10ms Sub-frame type: 2? DL Common sub-frame: 3ms?	FFT sizes: up to 1k
6	< 850MHz (TV Bands)	FCC	12	Centers of the TV channels	MAC Frame duration: 10ms	
7	< 850MHz (TV Bands)	ECC	8	Centers of the TV channels	MAC Frame duration: 10ms	
9	< 850MHz (TV Bands)	ECC	16	Centers of the TV channels	MAC Frame duration: 10ms	
410	4.940-4990GHz (Public Safety)	FCC (03-99)	5	4942.5 +n*5MHz	MAC Frame duration: 5ms, RI=20ms Sub-frame type: 2 DL Common sub-frame: 1ms	FFT sizes: up to 512
411	4.940-4990GHz	FCC	10	4950, 4960, 4970, 4980, 4990	IdemMAC Frame duration: 5ms	FFT sizes: up to 1k
412	4.940-4990GHz	FCC	20	4955, 4975	IdemMAC Frame duration: 5ms	FFT sizes: up to 1k

~~**15.6.2 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 WirelessMAN-CX 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.~~

15.6.3 902 - 928 MHz in the US

The USA rules, including power levels, for this band are contained in FCC 47 CFR CH.I (10-1-02 Edition) CFR 15.247. It provides 26 MHz of spectrum for licensed-exempt use. There are no channelization requirements.

This band has no SSUs.

This band is currently heavily used by cordless telephones and some other data equipment.

For point-to-multipoint operation, radiated power is reduced by the amount that directional antenna exceeds 6 dBi (and applying the limits and measurement requirements in section 15.247(b)(1)-(3)).

Coexistence mechanisms in *6.4.2.3* and Clause *15* may be applicable.

15.6.4 2400 - 2483.5 MHz in the US

The USA rules, including power levels, for this band are contained in FCC 47 CFR CH.I (10-1-02 Edition) CFR 15.247. The rules provide 83.5 MHz of spectrum for licensed-exempt use. There are no channelization requirements.

This band has no SSUs.

This band is currently used by many systems including IEEE 802.11, IEEE 802.15 and cordless telephones. In addition, this band contains "unintelligent" radiators such as microwave ovens. IEEE 802.11 systems use a 20 MHz channelization but define the channels to overlap with 5 MHz carrier center frequency spacing.

Coexistence mechanisms in *6.4.2.3* and Clause *15* may be applicable.

15.6.5 3650 - 3700 MHz in the US

The FCC rules for this band are contained in 47 CFR, Part 90 ("Private Land Mobile Radio Services"). This provides 50 MHz of spectrum from 3.65 GHz to 3.70 GHz. It is licensed under a non-exclusive, nationwide basis for the entire 50 MHz. There are no channelization requirements. The power levels specified for this band are contained in 47 CFR 90.1321, which specifies 25W peak EIRP/25 MHz for fixed stations and 1W peak EIRP/25 MHz for mobile and nomadic stations. The emission masks are specified in 47 CFR 90.1323.

The regulations do not specify channelization requirements. However, for effective DCS, 802.16 systems operating in this band should use either 5 or 10 MHz non-overlapping channels (*note: normative statement*).

Two different types of *Specific Spectrum Users* exist in this band - Fixed Satellite Service (FSS) earth stations and three government operated radiolocation sites. These are protected through exclusion zones mandated in 47 CFR 90.1331, which provides for 150 km exclusion zones around the FSS stations and 80 km exclusion zones around the government radiolocation sites. Additional restrictions are placed on operation near the USA/Mexico border and the USA/Canada border. To ensure adherence to the exclusion zones, and to monitor the number of stations deployed under the non-exclusive licenses, fixed stations (both BS and SS) must have their location registered. Mobile stations (both BS and SS) are permitted to transmit only if they can hear and properly decode the downlink from a fixed base station. Operation within an exclusion zone is possible through coordination with and permission from the FSS operator. Outside of the exclusion zones, there are no SSUs, so there is no direct requirement for DFS in this band.

It is likely that an IEEE 802.16 system in this band will face the need to coexist with other 802.16 systems. Non-802.16 systems will likely be present as well. In particularly, the IEEE P802.11y project is developing an amendment to specifically address the changes necessary for IEEE 802.11 systems to operate in this band. The presence of other systems suggests the use of coexistence mechanisms, such as DCS to select the best channel for operation.

In 47 CFR 90.1319, the FCC requires the use of a contention-based protocol in the 3.65-3.7 GHz band. In order to satisfy this requirement and to coexist with 802.11 systems and other 802.16 systems, 802.16 systems operating in this band should use the uncoordinated coexistence protocol defined in section *6.4.2.4, including the DCS, extended adaptive quiet periods, and listen-before-talk features (note: normative statement)*.

Industry Canada has indicated that the rules for this band in Canada will be similar to those established by the FCC.

15.6.6 5725-5850 MHz in the UK

The minimum equipment requirements for operation within the UK in the band 5725-5850 MHz are given in *UK Radio Interface Requirement 2007: Fixed Broadband Services operating in the frequency range 5725-5850 MHz* (Version 1.00).

The services deployed in the band are fixed with a max EIRP of 2W with a PSD not exceeding 100mW/MHz. There are also restrictions of power transmission in the elevation plane. The duplex is TDD with no channelization requirements. DFS and TPC are mandated in this band. DFS is a specific realization concerning the identification and avoidance of SSUs. In this band, the SSUs are radar signals. The requirements say:

Equipment operating in this band must implement a random channel access mechanism capable of operating across all of the frequency range. Shall prevent co- channel operation in the presence of Radar signals. The DFS detection threshold shall be based upon:

— 67 dBm for devices with EIRP greater than 1W,

— 64 dBm for devices from 200mW to 1W EIRP,

— 62 dBm for devices with EIRP less than 200mW.

These thresholds represent the levels at the output of the antenna and are normalized to 0dBi antenna gain. For devices with a higher gain the threshold may be increased by 1dB for each dB of antenna gain.

Transmit Power Control (TPC) shall be employed with a dynamic range of at least 19dB relative to the maximum EIRP allowed. Stations with a maximum EIRP capability lower than the maximum allowed EIRP can reduce the TPC range accordingly.

15.6.7 Middle, WRC, and Upper U-NII Bands in the US

The Unlicensed National Information Infrastructure (U-NII) bands have the following major frequency bands:

— *Lower U-NII* (5150 - 5250 MHz),

— *Middle U-NII* (5250 - 5350 MHz),

— *WRC* (5470 - 5725 MHz),

— *Upper U-NII / ISM band* (5725 - 5850 MHz).

IEEE 802.11a systems are widely operated in the *Lower* and *Middle U-NII* bands. The *Lower U-NII* band requires use of an integrated antenna and is intended for indoor use, while the *Middle U-NII* band allows for a user installable antenna. The 5470-5725 MHz band provides for both outdoor and indoor use. Deployments in the *Upper U-NII* (5725 to 5850 MHz) band are for outdoor deployment power allowances are in the 2 to 4W range as compared to only 1W in the *Lower* and *Middle U-NII* bands. Many Wireless Internet service providers use 5725 - 5825 MHz. Sometimes this band is referred to as UNII/ISM due to regulatory overlap with the ISM band. Regulations allow for a user-installable antenna.

U-NII is an FCC regulatory domain for 5 GHz wireless devices. U-NII power limits are defined by the US CFR Title 47 (Telecommunication), Part 15 - Radio Frequency Devices, Subpart E - Unlicensed National Information Infra-structure Devices, Paragraph 15.407 - General technical requirements.

DFS (radar detection function) for U-NII devices operating in the *Middle U-NII* (5250 - 5350 MHz) and *WRC* (5470 - 5725 MHz) bands are required to detect the presence of radar systems (SSUs) and to avoid co-channel operation with radar systems (SSUs). The minimum DFS *detection threshold* for devices depends on the EIRP of devices oper-ating in the band.

Operation in this band should use coexistence with *Secondary Users* (*6.4.2.3*) or *Coordinated* operation (*15*) to find the best channel on which to operate (*note: normative statement*).

References

[1] IEEE P802.16h/D2: *Air Interface for Fixed Broadband Wireless Access Systems Improved Coexistence Mechanisms for License-Exempt Operation*, Draft Standard.

[2] IEEE 80216h-06_068r5: *Letter Ballot #24 Commentary file with resolutions from Session #47*.

[3] IEEEstd 802.16e-2004: *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;* February 2006.