IEEE 802.16 Working Group on Broadband Wireless Access

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Dear Andrew:

On behalf of IEEE 802.16, I thank you for the WCA's valuable comments on the working version of document IEEE 802.16.2 ("Recommended Practice for Coexistence of Broadband Wireless Access Systems"). 802.16's Task Group 2 on Coexistence of Broadband Wireless Access Systems reviewed these comments at our meeting in Tampa, Florida on 6-9 November 2000. I am happy to report that all comments have been resolved. A copy of the relevant resolution actions is attached.

We particularly appreciated the fact that three people representing your association (Jay Ramasastry, Brandon Hinton, and Reza Arefi) attended our meeting to present their concerns and discuss potential resolutions with us.

The draft document is currently the subject of the subject of a Working Group Letter Ballot. We will continue the work of finalizing the draft at 802.16 meetings taking place in January and March 2001.

Thanks again for your continued support.

Sincerely,

Dr. Roger B. Marks
Chair, IEEE 802.16 Working Group on Broadband Wireless Access

cc: Jim Carlo, Chair, IEEE 802 LAN/MAN Standards Committee
Demos Kostas, WCA Engineering Committee Liaison to IEEE 802.16

Original Comment	Resolution
Replace the text with the following. Recommendation 1 : Adopt a "6 dB below receiver thermal noise in the victim receiver criterion " as being a value of interference from the interfering operators, which is "acceptable." The document recommends this value in recognition of the fact that it is not practical to insist upon an "interference-free "environment. Having once adopted this value, there are some important consequences: Each operator acknowledges that he is willing to accept a 1 dB degradation in his receiver sensitivity from the operators. Depending upon the particular deployment environment, an operator may have a cumulative –6 dB contribution from multiple CoCh and AdjCh operators. Each operator should include design margin in his system which is capable of simultaneously accepting the compound effect of interference from all other relevant operators, at the –6 dB level. The design margin in (b)above should be included preemptively at initial deployment, even if the operator in question is the first to deploy in a region and is not experiencing interference. All parties should recognize that, in predicting signal levels, which result in the -6 dB interference value, it is difficult to be precise in including the aggregating effect of multiple terminals, the effect of uncorrelated rain, etc. The actual degradation in performance and the value of signal level below receiver noise in the victim receiver, need to be further studied in order to assure that high performance, high availability, BWA networks can be deployed with sufficient operational flexibility.	resolution: remove "any of" from line 2, resulting in "… from the neighbouring …"
Replace the text with the following. Recommendation 2 : [Each operator should take the initiative to collaborate with other known operators prior to initial deployment and at every relevant system modification. This recommendation should be followed even if an operator is the first to actually deploy in a region.] To encourage this behavior, the document introduces the concept of using specific received interference signal level (dBm) values to "trigger " different levels of initiatives taken by an operator to give notificationto other operators. If power spectral flux density values (psfd)are specified as trigger values, a translation methodology is utrilized (as given in Annex YYY) to convert the received signal levels into psfd values. The specific trigger values and their application to the two deployment scenarios are discussed in Recommendations 5 and 6 below and in Section 7.In some regulatory environments, the fact that the "triggers " were properly analyzed and that the proper cooperative initiative was made can be used as evidence of operating in good faith to promote coexistence.	rejected - consensus that "psfd" is the correct metric
Replace the text with the following. Recommendation 3 : Each operator should design and deploy his own system for the maximum amount of frequency reuse The logic behind this Recommendation is that the same techniques of base station site selection,antenna pattern management and emission control that must be employed to facilitate aggressive frequency reuse within a system will contribute to its coexistence with other systems. Recommendations 9,10 and 11 below and in Section 6 provide recommended minimum antenna patterns, spectral masks and maximum EIRP from the vantage point of coexistence. These do not, however, guarantee coexistence. Even the most dense frequency reuse system does not guarantee coexistence. However, starting from a foundation of a "better " engineered system can facilitate the later resolution of coexistence issues. Coexistence requirements will need to be carefully balanced with the operational and performance flexibility	issue resolved by earlier comment

requirements of BWA networks.	
Replace the text with the following. Recommendation 5 : No coordination is needed in any direction if the transmitter is greater than 16 km from either the service area boundary or the neighbor 's boundary (if known)in that direction.	no consensus. Vote 9 for original text, 0 for new text
Replace the text with the following. Recommendation 6: Recommendation 2 above introduced the concept of using interference signal levels (dBm) and/or power spectral flux density "triggers " as a stimulus for an operator to take certain initiatives to collaborate with his neighbor. The coordination trigger values (see Annex B)of –127 dBW/MHz/m2 (24,26,28GHz bands) and –127 dBW/MHz/m2 (38,42GHz bands)are employed in this document, in the initiative procedure described in Recommendation 7 below. These values were derived as that power spectral flux density values which, if present at an average base station antenna and average receiver, would result in approximately the – -6 dB interference value cited in Recommendation 1.It should be emphasized that the trigger values are useful only as thresholds for taking certain actions with other operators; they do not make an absolute statement as to whether there is, or is not, interference potential. Several administrations have permitted significant deployment of point-to-point links as well as point-to-multipoint systems, with psfd trigger levels of -127 dBW/MHz/m2at 38 GHz band.	added "point-to-multipoint" in line 6 and change the last sentence to Where there is significant deployment of point-to-point systems as well as point-to-multipoint systems and protection of the point-to-point systems is mandated, tighter psfd trigger levels will be appropriate (e.g. –125 dBW/MHz/m2 at 38 GHz band is applied by some administrations to protect point-to-point links) Similar changes will be needed to section 7.3
Replace the text with the following. Recommendation 7: Apply the "triggers " of Recommendations 5 and 6 prior to deployment and prior to each relevant system modification. Should the trigger values be exceeded, then the operator should try to modify the deployment to meet the trigger, and failing which the operator should coordinate with the affected operator.	already resolved by earlier comments
Replace the text with the following. Recommendation 8 : For same area /adjacent channel interference cases, deployment will usually benefit by having one guard channel between nearby transmitters. Where the transmissions are of different bandwidth, the guard channel could be equal to the wider channel. Where administrations do not require guard channels, the affected operators may reach agreement on how the guard channel is apportioned between them. However, setting aside a full or portion of a guard channel is not a requirement, as long as the emission mask requirement at the band edge is met. Careful and intelligent frequency planning and/or use of orthogonal polarization will significantly alleviate the need for this guard channel.	In line 9 add "channel" Editorial changes to final sentence to read: It is possible that by careful and intelligent frequency planning, coordination and/or use of orthogonal polarization or other mitigation techniques, all or partial use of this guard channel may be achieved.

Replace the text with the following. Recommendation 9: Utilize antennas for the base station and subscriber terminals at least as good as shown in Section 6.2.The coexistence simulations which led to the Recommendations contained herein revealed that a significant part of coexistence problems are the result of main-beam interference. The side lobe levels of the Base Station antennas are of a significant, but secondary influence. The sidelobe levels of the subscriber antenna are of tertiary importance. In the context of coexistence, therefore, antennas, such as those presented in Section 6.2 are sufficient. It should be emphasized that utilizing antennas with sidelobe (and polarization)performance better than the minimum will not degrade the coexistence performance and, in fact, are an effective mitigation technique for specific instances. In many cases, intra-system considerations may place higher demands on antenna performance than those required for inter-system coordination.	line 3, change "most" to "a majority of" line 10, change "will" to "may"
Replace the text with the following. Recommendation 10 : The utility of emissions masks for controlling adjacent channel coexistence issues is strongly dependent upon the separation of the two emitters in space and in frequency. In the case where there is large spatial separation between emitters, the opportunity exists for an interfering emitter to be much closer to a receiver than the desired emitter. This unfavorable range differential can overwhelm even the best emissions mask. Likewise, emissions masks are most effective when at least 1 guard channel exists between allocations. The emissions mask presented in Section 6.1.4 is most appropriate for the case where there is one guard channel between allocations and a modest separation of emitters. For cases where there no guard band is provided, it is recommended that co-location of emitters be considered before trying to improve emission masks. For operating frequencies above 15 GHz, the FCC Technical Rules already contain an emission mask requirement. This mask is more than adequate for adjacent channel coexistence.	Resolved. Add "A=" to the equation (1) in section 6.1.4.1
Replace the text with the following. Recommendation 11 : Utilization of EIRP and Subscriber Power control in accordance with Section 6.1.1 and 6.1.2,respectively, can be of help in meeting the coexistence criterion. The interests of coexistence are served by reducing the amount of EIRP emitted by base station, subscriber and repeater terminals.	in line 5, change "recommended" to "Proposed"
Replace the text with the following. Recommendation 12 : It will not be necessary to engage in extensive calculations if the received interference signal level at the service boundary is specified in dBm. However, in order to reconcile with psfd values prescribed by several regulatory regimes, it is useful to translate the psfd values into signal levels (dBm). This translation methodology is provided in Annex YYY (to be developed).	
In conducting analyses to predict power spectral flux density, the following considerations may be taken into account: · Path loss to a point on the border -Clear air (no rain)plus relevant atmospheric absorption -Intervening terrain blockage · For the purpose of calculating psfd trigger compliance level, the psfd level at the service area boundary should be the maximum value which occurs at some elevation point up to 500 m above local terrain elevation. · The actual electrical parameters (e.g.,EIRP, antenna patterns, etc.) Clear sky propagation (maximum path length) conditions should be assumed.	Change sentence 1 to: In conducting analyses to predict power spectral flux density and for coordination purposes, the following should be considered: add to bullet 2: Equations 8 and 9 in Annex B can be used to calculate the psfd limits. start bullet 4 with: · Clear sky propagation (maximum path length) conditions should be assumed. Delete "and rain fading statistics"

	Resolved by adding the following text "This subsection and Section 8, indicate some of the models, simulations and analysis used in the preparation of this Recommended Practice. While a variety of tools can be used, it is suggested that the scenarios studied below be considered when coordination is required." . Change title in section 4.2 to " Suggested Guidelines...." Inserted new title to recommendations " Section 4.2 Recommendations". Delete text, last sentence before recommendation 1.
Delete or significantly modify the model in section 4.2. The need for guard bands should be eliminated. Spacing for acceptable performance is subjective.	
In section 7.1.1 paragraph 3, replace the word “shall” with “should be” or restructure the sentence to incorporate this concept.	agreed
Annexes need to be updated and Recommendations need to be revised: There are several inconsistencies in the coexistence document. Some of these are: · The recommended values and suggestions are inconsistent with the analyses and assumptions contained in the Annexes; · The analyses in some of the Annexes are inconsistent with the FCC and ITU rules and recommendations. The FCC rules are in full operation and a full review of those technical rules, and related regulatory rules, is required in the presence of U.S. 38.6-40.0 GHz licensees before changes should be recommended. Similarly, coordination with the ITU format needs to be more fully discussed. · Several assumptions used in the analyses are not representative of operational broadband fixed wireless systems; and · There is no methodology provided in the document to assist the operators to translate psfd values into dBms.	Origional comment rejected. It is intended to be resolved by comment #183. Additional changes: deleted first sentence in Annex B. Add text in Recommendation #6 "It is recommended that the national regulators specify the applicable trigger values for each frequency band, failing which the following values may be adopted."
Make the necessary change: Please note that the assumption of very low remote terminal (subscriber) height with respect to very high hub (central station) radio height is not valid. This is not the case in many real world situations, and has an impact on the distance-spacing requirements provided in this section. So, the example is not representative enough.	Rejected comment,not related to section 4.2, but made changes to Annex B, last paragraph, 3rd sentence to ". Subscribers, on the other hand, tend to be situated at lower altitudes which reduces the probability of LOS (due to obstacles/clutter) to adjacent area systems.
Make the necessary change: There are situations where direct end-user-to-end-user traffic does exist. This factor should not be ignored when making assumptions about the network.	Accepted. Delete last two sentences in paragraph one in Section 5.0
Make the necessary change: Assumption is made that hubs always provide 360-degree, omni-directional coverage. This should be changed to, “up to 360 degrees of coverage.” Also note that inter-cell links cannot usually be “in-band.” They often will have to be low-frequency wireless links in order to support the inter-hub distances. The assumption may not be generic, and only an exception.	Accepted. Add the words 'up to' in section 5.1.1 paragraph 1. Changes to Section 5.2, paragraph 2, 2nd sentence "Inter-cell Links (ILs) may, in some cases, use in-band point to point (PTP) radios that provide a wireless backhaul capability between base stations at rates ranging from DS-3 to OC-3."
Make the necessary change: Assumption is made that all PTP systems use uplink power control. This is not the case. Many PTP and some PMP radios that are currently in use do not have this feature. Power control cannot be made a requirement, but an option only.	Resolved by adding "PMP" in section 5.3.1.3.1 Case B, 3rd sentence.

The statistical interference model needs to be updated to be more accurate. Although this section provides a good description of the available interference sources individually, not enough attention is provided to discussing the effects of all interference scenarios occurring concurrently. No explanation is given as to whether the interference is statistically additive. There should be an estimation that is more accurate. In addition, there is no reason to believe that all interferers would not be statistically additive: there are possibly multiple interferers emanating from multiple sources (PMP, PTP, satellite) from multiple paths. They will be statistically additive. Noted here again: One interferer at 6 dB below noise floor increases the noise floor 1 dB. Two interferers, each at 6 dB below noise floor, increases noise floor 2 dB. Three interferers, each at 6 dB below noise floor, increases noise floor 2.5 dB. Five interferers, each at 6 dB below noise floor, increases noise floor 3.5 dB. Ten interferers, each at 6 dB below noise floor, increases noise floor 5.5 dB.	Resolved by comment #158
Recalculate the target EIRP spectral density values, and provide a range of values based on assumptions. The numbers used to generate the target EIRP spectral density numbers are not valid. Specifically, STS antenna gains can be significantly higher than those stated: up to 44 dBi for 2-ft. dishes. Moreover, smaller beamwidth sector antennae can have gains up to 23 dBi. Since power spectral density EIRPs are provided, then power level densities for other bandwidths than 28 MHz should be provided as well (e.g., 50 MHz channel bandwidth for 39 GHz band, or subsequent subchannel bandwidth, e.g., 10 MHz).	Resolved by comment #167
Information on equipment specifications should include appropriate disclaimers. It should be mentioned that the parameters are typical examples of equipment parameters used to analyze the interference environment. Recommendations concerning equipment specifications for such items as power control fall well outside the scope of this document.	Resolved . Add the sentence "Simulation results described in other sections of this document demonstrates that such a range is necessary in order to facilitate coexistence." in section 6.1.2.1.
State the CW requirement and cite the source of information. Where does the CW interference requirement come from?. What is the source of this information?	Resolved . Delete section 6.3.3
Delete all discussions on using radio horizon as the distance trigger, and use a more reasonable model that results in 16 km as the distance trigger. We fail to see the logic in using radio horizon distance as a distance trigger. This factor does not take into account propagation or radio equipment characteristics, and therefore results in a highly conservative value of 60 km. Section 7.1.2 states that “propagation effect, and power flux density levels” should be used to determine the coordination trigger distance, but they are ignored: the only factor in deciding this distance appears to be the radio horizon.	Resolved . By vote in comment #161
All text implying requirement on operators to provide network coverage maps, etc., should be deleted. Requiring operators to provide network coverage maps to competitors is not a standard procedure, for obvious reasons. Indeed, the FCC does not impose such a requirement on broadband fixed wireless operators in the U.S.	Resloved by comment #81
Make the necessary change. It should be noted that the IFL cables transmit more than just the IF payloads; control and telemetry information and mains power are also transmitted at other frequencies as well.	Withdrawn

Use radio equipment parameters that are representative of BWA networks. Mention how PSFD B is derived. Include a caveat stating that psfd may not be the appropriate coordination trigger. Refer to a new Annex YYY (to be developed) that will provide the methodology to translate psfd values into signal level (dBm) values, and vice versa. The radio equipment specifications used in Annex B are not representative of what current technology supports. For example, the typical receiver noise figure of 6 dB is not a representative number, many radios currently in use have noise figures up to 10 dB, and in some cases of older equipment, 12 dB. In the psfd calculations for the 20-30 GHz range, a distance of 60 km was used, which we have already stated is not an appropriate number to use. In the 30-40 GHz range analysis, inappropriate specifications were used: hub antenna gains can be as high as 23 dBi, remote antenna gains can reach 44 dBi, and noise figures can exceed 10 dB. As a result, not only do we feel that the Interference Objectives stated in the table on page 74 are incorrect, but that the psfd values are inappropriate as well. Moreover, there is no explanation of how the PSFD B values in this table were obtained. (We used the ITU WRC-2000, GSO, maximum, low-angle psfd value of –127 dBW/MHz/m2. -127 dBW/MHz/m2 -8 dB (difference in gain from m2 to 2-ft. dish antenna) -3 dB (conversion between circular-to-rectangular polarization) -1 dB (atmospheric loss) +30 dB (dBW to dBm) +11 dB (typical PMP bandwidth of 12.5 MHz) +11 dB (I/N) = -87 dBm. This is the same value we propose in our comments to NSMA.	Resolved by comment #66
Indicate where the results indicated here are used in the report. Simulation results indicate that 40 km is a good hub-to-hub spacing, but this number is not used elsewhere when proper spacing requirements are provided.	Withdrawn. Not a dominant case.
Modify Annex D to indicate all findings based on ITU-R Recommendations or delete it. Annex D does not refer to any findings based on ITU recommendations. Annex D “Work of Other Bodies” should be deleted. The relevant works of other bodies may be referenced and contained in the bibliography, however the inclusion of text in an Annex implies an endorsement of the external works. In particular, the regulations created by Industry Canada are not applicable to operators in the UK or the US. Likewise, if such references are to be maintained, a thorough effort should be made to include language from the FCC and similar agencies from other countries.	Withdrawn.
Radio specifications and parameters should be more representative of BWA networks, in Annex E. We feel again that the radio specifications provided in Annex E are not valid numbers and may in part be based on radio path availability that do not coincide with requirements of high density BWA networks.	Withdrawn

Recommendation 4 : Delete. This recommendation goes beyond the intended purpose of a standard to specify inter-system co-existence criteria. Such policy issues as the current recommendation that “the incumbent/first-to-deploy carrier should have equal responsibility with carriers that deploy systems at a subsequent time,” are outside the scope of this organization. Further, this idea is at odds with current FCC and NSMA ideology. Forcing an incumbent operator to alter its existing network design while maintaining service to its customers could not be feasibly achieved. Moreover, the recommendation that operators should share all relevant system design parameters to its competitors is not a commercially acceptable proposition and is also outside the scope of work of this group.	Resolved . Delete 2 nd paragraph in section 4.1 recommendation 4. Change first sentence to "In the resolution of coexistence issues, in principle, incumbents/first movers should coordinate with operators who deploy at a later time.
Make necessary changes: Section 6.1.1.5 describes a “typical” in-band point-to-point link in the 28 GHz band, makes assumptions regarding the specific parameters, then draws a conclusion that all “In-band Inter-cell link stations” should meet or exceed this power spectral density number. This section does not take into account transmitters in other frequency bands or with other modulation schemes or bandwidths. This type of radio is not a BWA system and each deployment of such a system will have to be evaluated on its own merits and specific technical parameters.	Resolved. Delete all existing text and add new text "When point-to-point IILS are employed, if the recommendations for STS EIRP and Unwanted Emissions provided in Sections 6.1.1.2 and 6.1.4.1, respectively, are followed, the co-existence environment described elsewhere in this Recommended Practice should apply. If an operator elects to utilize an IILS which does not conform to the foregoing recommendations, one should be sensitive to situations where co-existence issues can arise. "
Make necessary changes. Section 8 describes the use of statistical simulations to predict the probability of interference; this is uncommon in frequency coordination arts; no specific, commonly available and consistent tools are available for engineers to economically set up and run simulations. Neighboring engineers should have reasonable access to standardized tools. This section provides only encouragement to run simulations, and does not add significant value to the recommended practice. This section should be deleted.	Resolved . Add text in section 8.1 "The following subsections indicate some of the models, simulations and analysis used in the preparation of this Recommended Practice. While a variety of tools can be used, it is suggested that the scenarios studied below be considered when coordination is required. "
Make necessary changes. Annex B, “Power Spectral Flux Density (psfd) calculations contains some of the most valuable information in a BWA spectrum engineering practice. In this section of the document, step-by-step calculations are described which engineers can apply to specific real or proposed designs. In the current form, however, the Annex makes assumptions about specific frequencies, transmit powers and antenna gains and then draws conclusions for broad ranges of frequencies. As a specific example, the calculation given on page 72 assumes an operating frequency of 27272 MHz (wavelength = 0.011) and a receive antenna gain of 20 dB. From this example, a conclusion is drawn for the frequency range of 20 to 30 MHz. Without changing other parameters, the variation in frequency results in a 2 dB difference in the calculated psfd. An assumption that the victim receiver will have an antenna gain of 20 dB is perhaps conservative when considering typical hub antenna gains offered today, but this is after all an assumption and a guess. Engineers should use the best available information and should not as standard practice blindly assume an arbitrary antenna gain. This same fault of assumption and conclusion also applies to the 30-40 GHz portion of this Annex.	already resolved, therefore withdrawn.

Make necessary changes. Annex C “Description of Calculation and Simulation Methods” should be deleted. While interesting and potentially useful to some operators, these results do not provide operators or engineers with guidance regarding how precisely to conduct a standard, repeatable simulation that would be mutually understood and agreed to by multiple parties in a coordination effort. Relevant works such as this should be externally published and referenced in the bibliography.	Resolved by the comment #189
Make necessary changes. In section 6.1.4.1 and other locations, quoted excerpts from draft CEPT or ETSI documents should be deleted as the referenced documents are not approved. References to other standards or documents should contain adequate information to refer the reader to the alternate text and not seek to duplicate the information.	Rejected, has been approved by the IEEE project editor