Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
License-exempt Operation in the TV Broadcast Bands	)	ET Docket No. 04-186
	)	
	)	ET Docket No. 02-380
Additional Spectrum for License-exempt Devices Below 900 MHz and in the 3 GHz Band	)	

Via the ECFS

COMMENTS OF IEEE 802

IEEE 802[1] hereby respectfully offers its Comments[2] on the Notice of Proposed Rulemaking (the "NPRM") in the above-captioned Proceeding.

The members of IEEE 802 that participate in the IEEE 802 standards process are interested parties in this proceeding. IEEE 802, as a leading consensus-based industry standards body, produces standards for wireless networking devices, including wireless local area networks ("WLANs"), wireless personal area networks ("WPANs"), wireless metropolitan area networks ("Wireless MANs"), and Wireless Regional Area Networks ("WRANs").

We appreciate the Commission's grant of the IEEE 802.18 Radio Regulatory Technical Advisory Group's request for an extension of the comment period in this proceeding, which enabled us to produce these timely-filed comments.

[1] The IEEE 802 Local and Metropolitan Area Networks Standards Committee ("IEEE 802" or the "LMSC")

[2] This document solely represents the views of IEEE 802. It does not necessarily represent the views of the IEEE as a whole or the IEEE Standards Association as a whole.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

In these comments, IEEE 802 applauds the Commission for exploring this unprecedented opportunity to broaden the economic and public interest benefits of license-exempt technology by proposing enabling changes to its Part 15 rules that would allow license-exempt devices to share unused TV spectrum with the licensed incumbents on a strictly non-interfering basis.

We also provide substantive comments and recommendations to the Commission, based on the results of a year of study of this topic by a study group chartered under our IEEE 802.18 Radio Regulatory Technical Advisory Group, which included active and cooperative participation by representatives from the TV broadcast, consumer electronics, wireless microphone, and public safety communities in an effort to bring the Commission a broad consensus view that addresses the needs and concerns of all stakeholders in the instant proceeding.

Given the depth of consideration, detail, and recommendations that these comments embody, we do not believe that our response to the NPRM in this proceeding can be adequately summarized in a single page executive summary, so we respectfully encourage all interested Commission personnel – including those who will ultimately make the final policy decisions that we anticipate will result in a Report and Order authorizing access to unused TV broadcast spectrum on a non-interfering basis – to study our comments in depth.

We would however, point out that our studies point to the conclusion that the use of cognitive radio techniques – radios that are "smart" enough to sense their spectral environment and, as a system, respond accordingly to make optimum use of unused spectrum while assuring non-interference – will be key to successfully accomplishing the Commission's underlying goal of allowing unlicensed devices to use this spectrum while preventing harmful interference to the existing licensed uses.

We would again like to thank the Commission for granting the extension of the comment period that was requested by IEEE 802.18 – without which this document would have been less comprehensive and consensus would have been more elusive.

INTRODUCTION

1. On May 13, 2004, the FCC adopted the instant NPRM, inviting comments to proposals for new rules allowing a new category of Part 15 devices to operate on a non-interfering, license-exempt basis in geographically unused spectrum allocated to the TV Broadcast Service and, in certain well-defined areas, the Private Land Mobile Radio Service under Part 90 of the Commission's rules.

2. IEEE 802 applauds the Commission for exploring this unprecedented opportunity to broaden the economic and public interest benefits of license-exempt technology by proposing enabling changes to its Part 15 rules that would allow license-exempt devices to share unused TV spectrum with the licensed incumbents on a strictly non-interfering basis.

3. We believe that, as appropriate technologies are developed and proven, the Commission's initiative will ultimately enable otherwise unused TV band spectrum to be put to important new uses in coming years, particularly the provision of broadband service in rural and other sparsely populated areas that cannot be economically served by wireline solutions such as DSL, cable modem, or "Access BPL" technology.

4. We support the Commission's objective of making more spectrum available for use by license-exempt devices on a non-interfering basis and intend to work with both the Commission and the incumbent licensed user communities in making effective use of this valuable spectrum.

5. IEEE 802 has formed a new working group IEEE 802.22, which is chartered to develop a standard for Wireless Regional Area Networks ("WRANs") that will focus on defining a standard for license-exempt, interoperable, non-interfering, fixed point to multipoint ("P2MP") systems using geographically unused TV channels. Other working groups in IEEE 802 may also have an interest in exploring other possible non-interfering uses of this spectrum, should it become available for unlicensed use.

6. In undertaking this goal, IEEE 802 has an unwavering commitment to both fully protect licensed services from harmful interference and at the same time make the most productive possible use of geographically unused TV channels, by taking advantage of advanced, but practical in the near term, technologies such as master-slave operation of base stations and user terminals and cognitive radio techniques.

7. It should be noted by the Commission that our activities in this area to date have included not only interested parties from within the "traditional" IEEE 802 network standards development community, but also representatives from the TV broadcast, consumer electronics, wireless microphone, and public safety communities. All interested participants have been working in a true spirit of cooperation, with the belief that practical solutions to successful sharing of the subject spectrum by license-exempt devices is possible, given the right technical parameters and protection mechanisms, and all parties have a common commitment to ultimately define the necessary mechanisms to provide viable, non-interfering solutions.

8. We believe the Commission's initiative will ultimately offer significant opportunities for implementing new, economically viable license-exempt technologies under Part 15, that can provide considerable societal and economic benefits, but that these goals can only be realized through the development of appropriate technical standards which will maximize the use of these bands for the public's benefit while affording robust protection from harmful interference to the licensed incumbents with which the subject spectrum would be shared.

USE OF CONTIGUOUS TV CHANNELS FOR INTENTIONAL RADIATORS

9. In Appendix B, Section 15.244 of the NPRM, use of contiguous TV channels for intentional radiators is raised. The view of IEEE 802 is that use of multiple 6 MHz TV channels should be allowed, but each 6 MHz channel should be independent from a modulation point of view. Hence different TV channels could be used for sectorized operation, FDD operation, and/or for capacity beyond that available from a single 6 MHz channel. As a result, the use of more than one TV channel should be possible as long as persistent channel bonding is not used (I.E. any 6 MHz channel may be vacated or removed without affecting the operation of the others.) As a result, interference protection will be based on a 6MHz TV channel.

WE APPRECIATE THE FCC'S DEFINITION AND DIFFERENTIATION OF THE TWO FUNCTIONAL CATEGORIES OF OPERATION DESCRIBED IN PARAGRAPH 19 OF THE NPRM FOR THE LICENSE-EXEMPT BROADBAND DEVICES SINCE THEY WILL LIKELY RESULT IN DIFFERENT OPERATIONAL REQUIREMENTS AND THE USE OF DIFFERENT MEANS OF AVOIDING INTERFERENCE TO INCUMBENTS

10. The Commission's proposed Fixed/Access category of license-exempt devices appears to be well suited for larger regional area networks (RAN) based on point-to-multipoint operation using higher power to extend the reach - especially in rural and remote areas. For this category of operation, we believe that interference avoidance will be based on RF sensing at the base station and at the Customer Premise Equipment (CPE) (i.e., user terminals), relying on cognitive radio techniques and intelligence at the network level, and be centralized at the base station which should be professionally installed, maintained, and operated. Currently, IEEE 802 is proposing 1W maximum conducted power, 4W maximum EIRP for the Fixed/Access category of devices (base stations and CPEs), but we believe that in the future, subject to further studies, it may be possible for the Commission to allow higher powers for the Fixed/Access base station.

11. In this scenario, all RF transmission characteristics of the CPE's should be controlled by the base station and interference potential will be assessed by mapping the results of the sensing of spectrum occupancy performed by the base station and the CPE's against information on their physical location acquired through registration information or other geolocation mechanisms. This will allow such systems to make decisions centrally at the base station to change the operating frequency in specific areas or sectors and have the CPE's track such changes to avoid interference to incumbent licensed services and to apply etiquette toward other spectrum users.

12. Beyond having access to an updated database of licensed operation in the area, the base station would request local interference sensing and channel scanning from the CPE's at any time, especially for a new CPE trying to get registered with a base station, to verify that its local interference situation would allow it to access the network. Special data packets would transit on the network to initiate such sensing, report on the results and remotely control the RF characteristics of the CPE's, and would use their idle transmission time to provide quick reaction to spectrum utilization changes. For the purpose of clarifying this Fixed/Access category of service, it is assumed that a typical CPE would consist of stationary outdoor transmit, receive, and sensing antennae (a common integrated antenna system would likely be used especially if the operation is

half-duplex) with relatively high gain aimed at the base station. The CPE would not transmit unless a signal giving all the necessary RF characteristics to be used is received from the base station.

13. The Commission's proposed Personal/Portable category of license-exempt devices appears to be aimed at small area networks, operating in client/server and/or peer-to-peer operation using low power transmission where interference avoidance will need to be based on advanced technologies.

14. The members of IEEE 802, who represent all the stakeholders in this proceeding, have worked diligently and collaboratively on the personal/portable class of devices. If the Commission elects to move forward to draft Rules for personal/portable devices, it should ensure that they do not operate co-channel within the Grade B contour of a licensed television station and comply with the same adjacent channel D/U ratios as proposed in the NPRM for Fixed/Access devices.

15. We have thoroughly discussed the Fixed/Access (point-to-multipoint) class of service and we agree that with appropriate regulations, proper mitigation techniques, and well-defined operational characteristics, this service can effectively co-exist with incumbent services without causing harmful interference. We believe that efficient harmless co-existence with incumbent services is possible because this class of service would require all base stations of the network to be professionally installed and to control the RF parameters of all associated CPEs. CPEs that have not received channel availability information from a base station would not be able, by design, to transmit.

WE HAVE CONCERNS ABOUT THE ADEQUACY OF CURRENTLY AVAILABLE PUBLIC OR PRIVATE DATABASE INFORMATION

16. We believe that the roll out of digital TV ("DTV"), and the transition to all digital service - at least in the near future - will create an unprecedented dynamic environment for licensed services. Specifically, the digital transition entails the elimination of analog TV transmissions and the relocation of TV operations currently operating above Ch 51 to lower channels (Ch 2 – Ch 51). Also, the possible implementation of new broadcast initiatives like on-channel DTV repeater systems and distributed transmission systems using the same TV channel to enhance the broadcast coverage while keeping the reception on one channel will result in additional dynamics, since distributed transmission may result in less TV-channels being needed, especially in hard-to-reach areas, compared to the current use of TV translators and TV boosters. These broadcaster initiatives

as well as other innovations still under consideration should be taken into account when establishing an unlicensed device service in these bands. .

17. We believe that the present state of database information on TV band operations is adequate for non-real-time tracking of license applications and approvals, general technical parameters, and the rough outlines of TV channel service areas that could be used for initial system planning in preparation for the deployment of license-exempt networks and periodic updates. However, we are uncertain that the current databases have the timeliness of updates, detail, and machine-readability to, by themselves, support the required accuracy and adaptability necessary to provide the required degree of protection from harmful interference to incumbent licensees.

18. Therefore, we have serious concerns as to the viability of an interference protection mechanism that relies solely, or primarily, on a database-driven approach. Never the less, timely maintenance of database accuracy and completeness will be helpful in system planning as mentioned above and will assist in later resolving potential interference occurrences.

19. In addition, relying solely on database information does not identify the number or extent of coverage holes in the published service area maps of active TV stations. This creates a situation where control channel based systems, or professional installers operating with poorly defined geographic information, may place off limits many square miles of useful geography for license-exempt systems where the TV stations cannot be received anyway or vice-versa. This issue is especially significant at the outskirts of major metropolitan areas, where overlapping service area maps may substantially underestimate or overstate the actual coverage of the TV stations, and in geographically diverse regions like the San Francisco Bay Area, Denver, CO, and other regions where mountain ranges can create considerable shadowed areas where license-exempt systems could operate.

INTERFERENCE MITIGATION TECHNIQUES THAT RELY SOLELY ON GPS-BASED GEOLOCATION MAY ALSO NOT BE SUFFICIENTLY ROBUST OR DEPENDABLE

20. Additionally, the use of GPS enabled geolocation by license-exempt devices and systems as a sole means of determining which channels would be available for use by license-exempt devices in a particular location may not be adequate to permit reliable system operation, since GPS receivers may not be able to function adequately in all circumstances, especially in shadowed areas and for indoor terminals.

21. GPS-based interference mitigation techniques would also depend on access to, and the real-time accuracy of a machine-readable on-line database, which introduces further issues, as outlined in the section above.

22. However, in the case of the Fixed/Access category, GPS-based geolocation could be used by operators of fixed base stations, intended to provide service to user terminals with a predictable service area, to do site surveys and determine the locations of such fixed base stations. The base station would not require an integral GPS receiver, but would simply be geolocated on a one-time basis by a professional installer using a stand-alone portable GPS receiver.

23. Finally, while we support the use of GPS geolocation as a means of determining the location of (and thereby predicting the service area and interference potential of) fixed base stations and as an optional augmentation to other interference mitigation techniques for other license-exempt devices, we question the need for, and practical benefit of, requiring 10 meter accuracy. We note that that level of accuracy can normally only be obtained by the use of differential GPS techniques or WAAS augmentation.

24. We note that inexpensive non-augmented, hand-held commercial GPS receivers using only "CA code" positioning information are universally capable of better than 30 meter Circular Error Probability ("CEP") (assuming that "selective availability" is not enabled by the operator of the GPS satellite constellation, which is normally the case – in fact, even with selective availability enabled, such receivers normally provide a CEP on the order of 30 meters), which is comparable to the positional accuracy that the Commission has typically required for the coordinates of fixed stations in licensed services. We therefore believe that that level of positional accuracy would be sufficient to accurately predict the coverage area of Fixed/Access base stations at these frequencies and urge the Commission to abandon its proposal to require 10 meter accuracy in this application as unnecessarily stringent and instead use the 30 meter standard.

25. With respect to protecting Part 90 operations in the areas where they have access to TV channels in the range of 14-20, when one considers the nature of these operations, GPS geolocation may never the less be the most practical means of preventing interference to those operations.

AGILITY OF FIXED/ACCESS BASE STATION TO PROTECT SPORADIC PART 74 DEVICE USE

26. We believe that Fixed/Access networks using professionally installed and operated base stations could react quickly to sporadic Part 74 devices operating in their vicinity by virtue of their 'master-slave' operation characteristics, but only if they are aware of the presence of these devices. One method that has been suggested for accomplishing this is the use of a database. For wireless microphone users, this approach is not sufficiently reliable since it is doubtful that an ENG (Electronic News Gathering) crew, for example, would have time (or perhaps even the means) to access a database to request the use of spectrum at a particular location. The first line of defense will be based on the distributed sensing capability proposed for Fixed/Access operation by having the CPE's sense the usage of spectrum by Part 74 devices and report it to the base station to redirect the fixed access network to vacate spectrum that is needed by Part 74 equipment. However, this technique will not provide protection if the interference range of the Fixed/Access devices is greater than its sensing range for Part 74 devices. In such case, the use of a beacon system may be the most practical and reliable method of preventing interference (see paragraph 37 herein).

LICENSE-EXEMPT OPERATION WILL HAVE TO CEASE IF NO CHANNEL BECOMES AVAILABLE

27. Part 74 devices, such as wireless microphones and intercoms, are frequently used to cover TV and radio broadcast and media events such as breaking news, sports or a political convention. In the event the Part 74 devices require spectrum that an unlicensed device network is using, the unlicensed device network is required to vacate the channel being used by the Part 74 devices and move to an open TV channel for the time of the event. If no open TV channels are available at that time, the unlicensed device network must cease operation for the duration of the event.

PROFESSIONAL INSTALLATION SHOULD BE REQUIRED FOR FIXED/ACCESS BASE STATIONS AND SOME FORM OF VERIFICATION OF THE ANTENNA INSTALLATION SHOULD BE REQUIRED FOR THE CUSTOMER PREMISE EQUIPMENT

28. Fixed/Access base stations should be professionally installed[3] to ensure that they do not cause interference to licensed incumbent services operating in the TV bands. In this context, "professional installation" means that the installation must be supervised or inspected by a trained, competent professional (such as e.g. a NARTE[4] Certified EMC[5] Engineer, an SBE[6] Certified Professional Broadcast Engineer, or a Registered Professional Engineer). The professional installer must determine that the installation will operate in compliance with all FCC Rules adopted for this service; e.g. that the transmissions will not cause interference inside the Grade B contour of a licensed television station. Professional installation of the base stations should include an initial planning of the available frequencies to be used based on the broadcast coverage in the area (i.e., the database), while incumbent signal sensing at the network level, both at the base station and reported to the base station by CPE's will allow the Fixed/Access base station service provider's system to progressively adjust to the local spectrum use by licensed services.

29. Fixed/Access CPEs would normally be installed by the end user who would provide the physical location of the installation through ZIP code and/or physical address when registering with the base station operator. Special attention will have to be given to the installation of the outdoor antenna to make sure that the sensing capabilities of the CPE are not impacted by local obstructions. This would avoid broadcast signals not reaching the omni-directional sensing antenna of the terminal, resulting in the terminal being allowed by the base station to transmit on a frequency that would impact reception on neighboring TV receivers, especially those close to the beam of the transmitting antenna. Verification that the CPE antennae are permanently installed outdoors on a fixed structure and properly aligned should be required. Alternatively, the broadband service subscriber may elect to have the equipment professionally installed. However, it is believed that assuming professional installation and maintenance for CPEs would be counter to the provision of low cost broadband access in the TV bands.

[3] Paragraph 26 of ET Docket 04-186
[4] National Association of Radio Telecommunications Engineers
[5] Electro Magnetic Compatibility
[6] Society of Broadcast Engineers

REGISTRATION OF THE FIXED/ACCESS BASE STATIONS WILL BE NEEDED

30. CPE's should be truly license-exempt devices, requiring no licensing or registration based on the fact that their RF characteristics will be totally controlled by the base stations. The base stations, however, will need to be registered somehow to provide a means for the incumbent services (TV broadcast and wireless microphone operators) to be able to identify the source of an interference problem and be able to contact the responsible Fixed/Access base station operator in order to resolve the issue. As a minimum, a registry of the base stations in operation in an area with their coordinates and operating characteristics should be constituted and made publicly available (e.g., on a Web site).

WE BELIEVE SPECTRUM SENSING TECHNIQUES OFFER THE FLEXIBILITY, ACCURACY, AND ROBUSTNESS NECESSARY FOR UNLICENSED OPERATION IN THE TV BAND

31. In our analysis, we have determined that it is possible for a Fixed/Access device to sense a DTV signal at -116 dBm, which is below thermal noise in a 6 MHz bandwidth, using spectrum analysis techniques to sense the pilot carrier of the digital TV signal in a 10 kHz effective bandwidth. A DTV signal is the worst case TV signal to sense due to the digital nature of the 8-VSB modulation and the relatively flat spectrum shape which spreads the signal power over most of the 6 MHz channel. The pilot carrier may offer a convenient signature, since, in a narrow measurement bandwidth, the pilot carrier sticks up above the rest of the DTV spectrum. In addition, the relationship between the pilot carrier power and the power of the entire TV signal is well established by the ATSC standard at -11.3 dB. In order to account for the potential impact of frequency fading on the DTV pilot carrier caused by time varying multipath, a sufficient time period should be allowed for sensing.

32. By comparison, an analog TV signal, where most of the power is in the video carrier, is a less problematic signal to sense, because, from a spectrum analysis standpoint, the signal is primarily confined to two peaks, the audio carrier being about 10 dB below the video carrier when measured in a narrow bandwidth. This is a particularly unique spectrum signature, and, as a result, easy to distinguish from random noise, or other signal signatures. In addition, there is no 11.3 dB penalty in sensing the analog TV video carrier level, unlike the DTV pilot carrier case, and the protected noise limited contour levels are higher for analog TV than for DTV.

33. We note that, arguably, decreasing the resolution bandwidth or the noise figure of the spectrum sensing receiver would lower the sensing threshold further. For instance, lowering the detection bandwidth to 1 kHz would seem to support a -126 dBm sensing threshold for a DTV signal. But, there are complicating factors, like the need to more tightly control the frequency stability of the unlicensed device to avoid measurement errors, which might make the device more difficult or expensive to develop, and external impairments, like man-made noise in the low VHF frequency range, which might make the additional sensitivity ineffective in actual operation.

34. We believe that there are many other techniques, for example correlation or other spectrum matching schemes, which may be applied with satisfactory results, but for the sake of this discussion, we felt that a familiar technique like spectrum analysis gives us a reasonable basis for the results we are presenting and the conclusions we draw.

35. We believe that the best way to proceed from a rules standpoint is to set spectrum sensing requirements that are sufficient to protect licensed operations in the TV band from harmful interference, rather than specifying a specific implementation. That way, industry can develop techniques that meet the requirements in the most effective way by balancing the tradeoffs of complexity, cost and accuracy in the product development process. We will propose specific sensing rules later in these comments.

SOME PROTECTION CAN BE AFFORDED TO WIRELESS MICROPHONES BY ESTABLISHING A -107 DBM SENSING THRESHOLD FOR PART 15.244 DEVICES

36. Looking at analog wireless microphone signals, in the CW case these signals are as detectable as DTV pilot tones or video carrier signals, but when modulated, the wireless microphone signal spreads over a 200 kHz bandwidth. This spreading varies with the content of the signal and introduces an additional random element in the spectrum. As a result, for good probability of detection, the signal to thermal noise ratio needs to be higher than that required for a CW like signal. We propose that the wireless microphone sensing threshold be set at -107 dBm at the output of the sensing antenna for gains of 0 dBi or greater on a channel by channel basis, and that the threshold decrease by 2 dB for every dB the antenna gain is less than 0 dBi. Again, to be effective, the sensing capability must be omni directional. Additionally, the unlicensed devices must sense for wireless microphones over the entire TV channel with an equal probability of detection over frequency since several wireless microphones can be operated in a single vacant TV channel and the microphone

channel spacings will vary from venue to venue. The sensing process of the unlicensed device should be aided by the fact that wireless microphones are required to exist on 25kHz channel centers within the vacant TV channel (except within 25kHz of the TV channel boundary, where microphones are not allowed to be operated).

ADDITIONAL PROTECTION CAN BE AFFORDED TO WIRELESS MICROPHONES THROUGH THE USE OF A BEACON SYSTEM

37. A beacon system could provide additional interference protection for wireless microphones on an "as-needed" basis within its radius of operation. Such a system would enable a wireless microphone system operator to electronically request the use of spectrum at the location and time it is needed, and release it for other purposes when the need has passed. A beacon system would be particularly important for large wireless microphone operations, whether fixed (as typified by a television studio) or itinerant (as typified by a large political convention or a major news or sports event). It is anticipated that the beacon signal would be transmitted continuously (or repetitively) only while the wireless microphones are in use. Beacon transmissions could utilize a low data rate digital modulation scheme such as FSK in order to keep the occupied bandwidth small and make detection simple. License exempt systems would need to monitor for the presence of the beacon signal and be prepared to cease or avoid operating on TV channels being used by wireless microphones at that location. It is important to understand that a beacon solution is intended as an additional means of protection against interference from unlicensed devices only. Since the wireless microphone users will be required to purchase a beacon, only a small percentage of these users will opt to spend additional money for this equipment. In order to be effective, the simple requirements for detecting a beacon signal will need to be codified into the FCC rules. By writing these modest requirements into the rules, all unlicensed device manufacturers will be able to implement a common detection scheme and provide wide-area protection to wireless microphone users that deploy a beacon solution. As a primary means of protection against unlicensed wireless devices, the wireless microphone industry would prefer to have a no-cost, distributed-sensing solution that the unlicensed devices implement in a consistent way across manufacturers. This type of protection is transparent and beneficial to the microphone users and does not burden them with additional cost of operation.

EXPERIENCE INDICATES THAT TRANSMIT POWER CONTROL ("TPC") TECHNOLOGIES WILL HELP MITIGATE INTERFERENCE

38. A TPC rule will offer multiple advantages:

- TPC reduces the interference range of any device in any scenario, increasing the range margin significantly, and, as a result, bolstering the impact of sensing.
- TPC promotes frequency reuse among subnets of a common network system, as well as reuse between different networks, making the best use of the sometimes scarce channel resources.
- TPC reduces the power available to couple into cable networks, TV tuners, and other electronic devices and systems.

39. For the Fixed/Access category of operation, TPC will be an inherent part of the master-slave relationship between the base station and the CPE's. The major impact of TPC, besides reducing the dynamic range of signals received at the base station, will be in areas where more than one broadband access system will be in operation on nearby channels because it will reduce large signal level differentials which could cause interference among operators.

CABLE READY DEVICE PROTECTION

40. A level of 100mV/m is specified in FCC Part 15.118 to evaluate the level of allowable ingress co-channel interference to cable ready devices. This corresponds to 100 dB uV/m. With a maximum CPE power of 4W EIRP protection of cable ready devices could be achieved by making sure that there is enough antenna discrimination toward the cable ready device and/or there is enough safe distance from the antenna, or some combination thereof. With no antenna discrimination and free space propagation, the distance would need to be approximately 110 m. Proper installation of the CPE minimizes the potential for this problem.

D/U PROTECTION RATIOS MAY NEED TO VARY DEPENDING ON THE MODULATION USED BY UNLICENSED DEVICES

41. We believe that the D/U protection ratios listed in the table under Paragraph 30 of the NPRM may need to vary depending on the modulation used by the desired and undesired signals. The D/U

protection ratios listed were derived from FCC OET-69, which is based on the use of 8VSB modulation. If another modulation is used by unlicensed devices, the D/U ratios may need to be modified. For example, a modulation scheme, such as COFDM, may be a more aggressive interferer than 8VSB and the D/U protection ratios listed in Paragraph 30 of the NPRM may need to be adjusted accordingly.

SUMMARY AND CONCLUSIONS

42. IEEE 802 applauds the Commission for exploring this unprecedented opportunity to broaden the economic and public interest benefits of license-exempt technology by proposing enabling changes to its Part 15 rules that would allow license-exempt devices to share unused TV spectrum with the licensed incumbents on a strictly non-interfering basis. This will offer significant opportunities for implementing new, economically viable license-exempt technologies under Part 15, providing considerable societal and economic benefits. This will maximize the use of these bands for the public's benefit while affording robust protection from harmful interference to the licensed incumbents with which the subject spectrum would be shared.

43. We believe that, as appropriate technologies such as Cognitive Radio are developed and proven, the Commission's initiative will ultimately enable otherwise unused TV band spectrum to be put to important new uses in coming years, particularly the provision of broadband service in rural and other sparsely populated areas that cannot be economically served by wireline solutions such as DSL, cable modem, or "Access BPL" technology.

44. We support the Commission's objective of making more spectrum available for use by license-exempt devices on a non-interfering basis and intend to continue working with both the Commission and the incumbent licensed user communities in making effective use of this valuable spectrum.

Respectfully submitted,

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APPENDIX B: PROPOSED RULES

Part 15 of Title 47 of the Code of Federal Regulations is proposed to be amended as follows:

1. The authority citation of Part 15 continues to read as follows:

   AUTHORITY: 47 U.S.C. 154, 302, 303, 304, 307, 336, and 544A.

2. A new Section 15.244 is proposed to be added to read as follows:

§ 15.244 Operation within the bands 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz

(a) The fundamental emissions from intentional radiators operated under this section shall be confined to one or more television broadcast channels as defined in part 73 of this chapter as long as the signal in each television broadcast channel can be made independent from a modulation point of view.

(b) For Fixed/Access operation, the maximum conducted output power for the consumer premise equipment (CPE) and the base station shall not exceed 1 watt peak and the maximum effective isotropic radiated power (EIRP) shall not exceed 4 Watts peak. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi;

(c) In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating but inside the TV broadcast channel(s) being used by the unlicensed device, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either an RF conducted or radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. Radiated emissions that fall outside the TV broadcast channel(s) where the device operates must comply with the radiated emission limits specified in §15.209(a).

(d) An intentional radiator used for Fixed/Access operation must comply with the following subparagraphs:

(1) The base station must be professionally installed by a party that will determine the device's geographic location and the available unused TV channels at that location. The location and technical parameters of the base station will be provided for inclusion in a database that will be publicly accessible. The installing party will configure the base station to operate on only unused channels. The base station or its operator must periodically access a TV channel availability database derived from current FCC data and computational software to ensure that the channels on which the device operates remain unused.

(2) The base station will regularly sense the spectrum usage by TV broadcast and wireless microphones and poll all connected CPE's for them to sense the spectrum occupation in their vicinity and report it to the base station to produce updates on the channels available in the area. The RF characteristics of the CPE's (power, frequency and transmit timing) will be remote controlled by the base station.

(3) A process, centralized at the base station and controlled at the network level, to decide on the frequency(ies) of the network operation will be used to limit the transmissions of the base station and the CPE's to only those channels that are identified as unused to avoid interfering with digital TV, analog TV, and wireless microphones. The operating conditions for this decision process are described in paragraph (j).

(4) Fixed/Access base stations and CPE's must employ Transmit Power Control (TPC) on a link by link basis such that all devices lower their transmit power to the minimum level sufficient to maintain the desired communications.

(5) The CPE shall not transmit unless it detects a base station transmission and is allowed to establish an association with this base station according to its operating rules and the interference environment. The CPE shall periodically scan the frequency ranges for channels that would transmit in a format that it could associate

with. The CPE shall then extract the necessary information to identify the identity of the service and the parameters that need to be used to transmit to this service. Upon request by the user of the CPE, the device may initiate transmission with the appropriate RF characteristics and establish a session with the service provider.

(6) Verification that the CPE antenna is installed in a fixed outdoor location, and remains in the location where it was installed shall be required. Verification that the CPE transmit antenna is oriented properly to minimize the CPE transmit power resulting from the use of local TPC shall be required.

(e) An intentional radiator must protect TV stations from harmful interference within the following service contours.

Type of station	Protected contour		
	Channel	Contour (dBu)	Propagation curve
Analog TV	Low VHF (2-6)	47	F(50,50)
	High VHF (7-13)	56	F(50,50)
	UHF (14-69)	64	F(50,50)
Analog Class A, LPTV, translator and booster	Low VHF (2-6)	62	F(50,50)
	High VHF (7-13)	68	F(50,50)
	UHF (14-69)	74	F(50,50)
Digital TV	Low VHF (2-6)	28	F(50,90)
	High VHF (7-13)	36	F(50,90)
	UHF (14-51)	41	F(50,90)
Digital Class A	Low VHF (2-6)	43	F(50,90)
	High VHF (7-13)	48	F(50,90)
	UHF (14-51)	51	F(50,90)

A TV channel will be considered vacant for use by an intentional radiator operating under the provisions of this section if the following Desired-to-Undesired (D/U) signal ratios between co-channel and adjacent channel TV stations and the intentional radiator are met at all points within the service area of the respective TV stations for the given location of the intentional radiator.

Type of station	Protection ratios		
	Channel separation	D/U ratio (dB)	Propagation curve
Analog TV, Class A, LPTV, translator and booster	Co-channel	34	F(50,10)
	Upper adjacent	-17	F(50,50)
	Lower adjacent	-14	F(50,50)
Digital TV and Class A	Co-channel	23	F(50,10)
	Upper adjacent	-26	F(50,50)
	Lower adjacent	-28	F(50,50)

(f) Operation is not permitted within the service contours of co-channel stations. Fixed/Access devices are not required to comply with the adjacent channel D/U ratios between channels 4 and 5, channels 6 and 7, and channels 13 and 14 because of the frequency separations that exist between those channels. For adjacent channel operation within the protected service contour of a television station, calculation of desired signal levels shall be based on FCC F(90,90) curves or the protected contour field strength value, whichever is higher. For unlicensed operation outside the protected contour of a television station, calculations of television (desired) signal levels would be based on the FCC F(50,50) curves. Calculations of unlicensed (undesired) signal levels would be based on the FCC F(50,50) curves or other appropriate models.

(g) Operation on a TV channel shared with the PLMRS or CMRS is permitted only if every point in the interference range of an unlicensed transmitter is separated by the following distances from the center coordinates of the metropolitan areas where shared operation is permitted: 134 kilometers for co-channel operation and 131 kilometers for adjacent channel operation.

(h) Operation of Fixed/Access devices under the provisions of this section is not permitted on VHF channels within 32 kilometers of the border with Mexico, on UHF channels within 40 kilometers of the border with Mexico, or on either VHF or UHF channels within 60 kilometers of the border with Canada.

(i) Devices operating under the provisions of this section shall be equipped with a means to automatically and periodically transmit a unique identification signal. Control of the selection of the transmit channel or output power shall not be available on the user terminal nor accessible to the user or any other party except in the case of the Fixed/Access CPE where this control will be done remotely from the base station and, at the base station, where this control shall be the responsibility of the base station operator. Devices must include features to ensure that only software that is approved with a device can be loaded into this device, and the software may not allow the user to operate the device with parameters outside those that were approved. "Software" in this context includes the software that selects a device's operating frequency, determines a device's geographic location, identifying TV channels that are vacant, and accesses information in a related database. The application for certification must describe how the device complies with these requirements.

(j) In the case of the Fixed/Access operation, the base station and the CPE's shall sense licensed transmissions using an omni-directional antenna with a gain of 0 dBi or greater where all losses between the antenna and the input to the receiver are included, in any azimuthal direction when receiving a horizontally polarized signal. The base station shall change the frequency of operation of the network if licensed signals are detected above the thresholds indicated below, referred to the receiver input:

(1) DTV threshold: -116 dBm (total DTV power in the 6 MHz channel)

(2) Analog TV threshold: -94 dBm (measured at peak of sync of the picture carrier)

(3) Wireless Microphone threshold: -107 dBm (measured in 200 KHz bandwidth)