

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

In the Matter of)
)
Additional Spectrum for Unlicensed Devices) ET Docket No. 02-380
Below 900 MHz and in the 3 GHz Band)
)
To: The Commission)

COMMENTS OF IEEE 802.18 IN ET DOCKET NO. 02-380

IEEE 802.18, the Radio Regulatory Technical Advisory Group (“RR-TAG”) within IEEE 802¹ hereby respectfully offers our comments in the above-captioned Proceeding.²

The members of the RR-TAG 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 IEEE 802 standards³ for wireless networking devices, including wireless local area networks (“WLANs”), wireless personal area networks (“WPANs”), and wireless metropolitan area networks (“Wireless MANs”), all of which require spectrum resources in order to provide the public with the benefits of wireless networking

The 802.18 RR-TAG appreciates the opportunity to provide these comments to the Commission.

¹ The IEEE Local and Metropolitan Area Networks Standards Committee (“IEEE 802” or the “LMSC”)

² This document represents the views of the IEEE 802.18 RR-TAG. It does not necessarily represent the views of the IEEE as a whole or the IEEE Standards Association as a whole.

³ IEEE 802 Standards currently operate predominantly in unlicensed Part 15 spectrum. More spectrum will be required to meet future needs for unlicensed devices and we commend the Commission for undertaking this Notice of Inquiry.

INTRODUCTION

1. The Commission has wisely instituted a Notice of Inquiry (the “NOI”) in this proceeding, seeking input on two issues:

- The possibility of making unused broadcast television spectrum available on a non-interference basis to unlicensed devices.
- The possibility of making the 3650-3700 MHz band available to unlicensed devices, subject to protecting FSS earth stations, three “grandfathered” US Government radar installations, and, potentially, a licensed service for which the Commission has proposed, but not yet adopted rules.⁴

2. The 802.18 RR-TAG again commends the Commission for recognizing the benefits of unlicensed devices to society as a whole⁵ and for seeking ways to provide more spectrum for unlicensed devices, both by seeking comment on the feasibility of such devices sharing unused broadcast television and the possibility of making the 3650-3700 MHz band available for unlicensed use.

3. Because the NOI is structured more or less in two parts corresponding to these two potential sources of additional spectrum for unlicensed devices, our Comments will be partitioned similarly, dealing with each option in its own section.

⁴ To the best of our knowledge, based on the information reviewed, since the proposed rules for this service have not yet been adopted, no licenses have been granted. Therefore, there would appear to be no incumbent licensees that would be adversely affected, should the Commission decide to take a different course as a result of this NOI and any resulting Rulemaking Proceeding.

⁵ See the NOI, FCC-03-328, at 7, where the Commission states, in part “*The success of our unlicensed device rules for the ISM bands shows that there could be significant benefits to the economy, businesses and the general public in making additional spectrum available for unlicensed transmitters.*”

UNLICENSED USE OF UNUSED TV SPECTRUM

4. The Commission wisely has recognized that “*The unused portions of the TV spectrum appear to be a suitable choice for expanded unlicensed operation for several reasons. There is significant bandwidth available because each TV channel is 6 MHz wide, and multiple vacant channels are generally available in an area to provide greater bandwidth. Allowing unlicensed devices to operate on TV channels that are not being used in a particular area would be a more efficient use of the spectrum.*”⁶

5. Since the Commission has asked a series of specific questions, we will respond to them directly, first listing the question *in italics*, and then offering our response in normal text.

6. The first group of questions from the Commission, and our responses follow:

- *Should new unlicensed devices be permitted to operate within any portions of the TV bands, and if so, which portions?*

Yes, to the maximum extent possible.

- *Are there any other bands where new unlicensed devices could be permitted to operate?*

Yes. In particular, the 5470-5725 MHz band for which access was requested in the pending “WECA Petition” and as is contemplated as a global allocation for “wireless access systems, including RLANs” in WRC-03 Agenda Item 1.5, and, additionally, any other spectrum below 6 GHz that can be identified. The global harmonization of the 5470-5725 MHz band for wireless access systems, including RLANs is crucial to the future ability of the IEEE 802 wireless community to continue to meet the public’s demand for such devices and services.

⁶ See the NOI, FCC-03-328, at 14.

- *Should the use of certain channels by unlicensed device not be permitted? For example, channel 37 is allocated for radio astronomy operations and the Wireless Medical Telemetry Service, and unlicensed operations on this channel may not be appropriate because of special interference concerns associated with the sensitive nature of radio astronomy reception and the critical safety function of medical telemetry equipment. In addition, there are concerns about possible interference to channels 2, 3 and 4 because they are used for, or are adjacent to, the output channels of VCRs and other set-top boxes.*

These modest restrictions seem reasonable in order to preclude the potential for interference to radio astronomy, the Wireless medical Telemetry Service, and to the plethora of consumer devices that use channels 2, 3, and 4.

- *Further, spectrum currently allocated to channels 52-69 (698-806 MHz) has been reallocated and has been or will be licensed for new services. Should unlicensed operations be permitted in the reclaimed spectrum?*

Yes, to the maximum extent possible.

- *Should there be geographic restrictions on where unlicensed operation in the TV bands is permitted, such as in areas where co-channel or adjacent channel television, Private Land Mobile Radio Service (PLMRS) or Commercial Mobile Radio Service (CMRS) is present, or in the border areas near Canada and Mexico?*

This issue would seem to best be solved by specifying that unlicensed equipment authorized to operate in this portion of the spectrum be capable of intelligently determining what channels may be used without causing interference to incumbent licensed operations, as purely geographical restrictions could be difficult to enforce.

- *What restrictions, if any, should be placed on the applications or numbers of unlicensed devices that would be permitted in the TV broadcast bands, and why would such restrictions be needed? For example, should applications be limited to fixed uses?*

Other than reasonable power limits, an appropriate spectrum mask to protect nearby occupied channels, and some basic spectrum etiquette requirements to ensure coexistence, applications should not be restricted. With these measures, coupled with the ability to determine that operation on a given channel (or channels) will not cause interference to licensed TV broadcast signals, there would also not appear to be any need to restrict operation to fixed uses. Under no circumstances should the numbers of devices be restricted.

- *Are any special, temporary restrictions needed to ensure that unlicensed devices do not impact the transition of television from analog to digital service? For example, as part of the transition process, television stations may be switching channels and modifying their service area. How can we ensure that unlicensed operation does not cause interference when stations make such changes or when new DTV stations commence operation?*

No, this issue would also seem to best be solved by specifying that unlicensed equipment authorized to operate in this portion of the spectrum be capable of intelligently determining what channels may be used without causing interference to either analog or digital television operations.

- *How would new unlicensed devices affect the ability of broadcasters to provide ancillary services such as data after the digital transition?*

We do not believe that there would be any adverse effect on broadcasters in this respect, given the technical means for sharing that we have recommended.

- *What power and/or field strength limits are necessary for unlicensed transmitters within the TV bands to prevent interference to TV reception? Could unlicensed devices operate in TV bands with a power greater than the 1 Watt maximum permitted for Part 15 devices in the ISM bands or power greater than the general Part 15 limit?*

Given the necessity to detect and avoid incumbent services, it is felt that the current rules of Part 15 could be applied here.

- *What separation distances or D/U ratios should be established between unlicensed devices and the service of analog, digital, Class A and low power TV and TV translator stations? What assumptions should be used to determine these protection criteria? Should TV stations be protected only within their grade B or noise limited service contours, or should unlicensed devices be required to protect TV reception from interference regardless of the received TV signal strength? Is protection necessary only for co-channel and adjacent channel stations? What special requirements, if any, are necessary to protect TV reception in areas where a station's signal is weak? Would minimum performance standards for receivers facilitate the sharing of TV spectrum with unlicensed devices?*

Current (1st Q 03) considerations for DFS/TPC (“Dynamic Frequency Selection” and “Transmit Power Control” ... interference mitigation techniques) would detect on channel TV signals, thereby moving the network to unoccupied channels. TPC would minimize potential impact on any low power translators that may be operational in the area. TV stations should only be protected within their grade B contours. Yes, minimum receiver performance standards for receivers would facilitate sharing opportunities.

- *What technical requirements are necessary to protect other operations in the TV bands, including the PLMRS and CMRS in the areas where they operate on TV channels and low power auxiliary stations such as wireless microphones and wireless assist video devices? Could technical requirements be developed that would allow unlicensed devices to co-exist with new licensed services on former TV channels 52-69? Should unlicensed transmitters be required to protect unlicensed medical telemetry transmitters operating on TV channels 7-46 from interference?*

DFS/TPC could be used to detect incumbent signals and relocate unlicensed devices to unoccupied spectrum. The sensitivity of this technique will identify local areas of signals such as would emanate from a wireless microphone. This technique would apply as well in the former TV channels 52-69.

- *What requirements, if any, are necessary to prevent interference to coaxial cable or other multi-channel video service providers using the TV bands or to prevent interference to TVs, VCRs and set-top boxes caused by direct pickup of signals from unlicensed devices?*

The conditions that would be required to cause interference between an unlicensed device and the TV would be under the control of the user. But given the power levels involved and the modulation techniques anticipated it is considered unlikely that interference would be detected at more than a few feet if at all. CATV systems are responsible for keeping their systems “tight” (leakage into/out of the coax). Likewise, the onus should be on manufacturers/operators of the sorts of systems mentioned to prevent signal ingress. Receiver standards for TVs, VCRs, and set-top boxes should mandate adequate shielding to prevent ingress of unwanted signals and if they fail to meet such standards they should have no expectation of protection.

- *Should any antenna requirements be imposed? Can technologies such as “smart antennas”, which automatically change their directivity as necessary, assist unlicensed devices in sharing the TV bands? Should unlicensed devices be required to use an integrated transmitting antenna and be prevented from using external amplifiers and antennas?*

Antenna requirements should not be imposed, but EIRP limits such as in Part 15 should be implemented. For example, point to point systems could use directional antenna systems that could reduce interference potential. Point to multipoint systems could use sector or "smart" antennas at the hub stations and directional antennas at user terminals to restrict the transmitted energies to the desired areas of coverage.

- *What are the specific capabilities that an unlicensed transmitter should have to successfully share spectrum with licensed operations in the TV broadcast band without interference? Are there transmission protocols that could enable efficient sharing of spectrum?*

Current (1st Q 03) considerations for DFS/TPC (“Dynamic Frequency Selection” and “Transmit Power Control” ... interference mitigation techniques) would detect on channel TV signals, thereby moving the network to unoccupied channels. Data transmission protocols typically listen prior to transmission, with reference to footnote 39, threshold levels would determine the cost of implementation of these interference mitigation techniques.

- *Could GPS or other location techniques be incorporated into an unlicensed device so it could determine its precise location and identify licensed users in its vicinity by accessing a database? Would such an approach be reliable, and could it be combined with other methods to prevent interference to licensed services? What specific methods could be used to protect low power auxiliary stations such as wireless microphones that are not listed in a database?*

Embedding GPS in such products is technically feasible, though indoor usage would typically result in the inability to receive the GPS signals necessary to make an “operate/do not operate” decision. Finally, the sort of low-cost consumer products that would likely be targeted to such a narrow band would likely not be able to bear the additional cost of an embedded GPS capability. Thus, the use of GPS should not be mandatory, but could be an alternative approach, for outdoor devices, to the primary approach of DFS/TPC for interference mitigation.

- *Once an unlicensed device commences transmissions on an open frequency, how can it ensure that interference will not be caused to a licensed user of that frequency who wishes to commence transmissions? Is there a mechanism that can avoid such “collisions” or mitigate their effect? For example, should these devices have limited “duty cycles” in a given frequency band?*

Current (1st Q 03) considerations for DFS/TPC (an interference mitigation technique) would detect on channel signals thereby moving the network to an unoccupied spectrum. Data transmission protocols typically listen prior to transmission, threshold levels would determine the cost of implementation of these interference mitigation techniques.

- *Is frequency agile equipment, as well as the protocols to enable efficient frequency sharing, feasible in the near-term?*

Yes. The current state of technology would support the development of equipment with such features, should the opportunity to make use of this spectrum become available.

- *How could the Commission enforce any rules that may be adopted for unlicensed devices to ensure that such devices do not cause interference to authorized users of the TV bands?*

Since the sharing mechanism for unlicensed devices would be enforced in hardware/firmware, the Commission's equipment authorization program will suffice. (control at point of manufacture) Such sharing methods should not only enforce protection from interference to the primary users of the TV bands, but also an equitable sharing of access, bandwidth, and capacity between unlicensed users.

- *Is it necessary to establish any standards to allow sharing between unlicensed users of the TV bands? If so, how do we arrive at standards and what process should be put in place to make certain that the standards remain current and support innovation?*

The E&UWG report recognizes the possible benefit of spectrum protocols and etiquettes, but expresses concerns as well. We would respectfully point out that the National Technology Transfer and Advancement Act ("NTTAA") requires federal regulatory agencies, such as the Commission, to take open industry consensus standards into account in their Rulemaking Proceedings. Requiring devices to adhere to some particular, detailed protocol will have an inhibiting effect on innovation, but fair, simple etiquettes, such as "listen before talk," DFS/TPC, etc. and power density limits (e.g. U-NII) will reduce the potential for wasteful use of spectrum. If standards bodies like IEEE 802, TIA, CEA, and others, are involved, the argument for "market forces" to control interference is stronger, since compatibility is an economic issue.

UNLICENSED OPERATION IN THE 3650-3700 MHz BAND

7. While the Commission's willingness to consider allowing unlicensed use in this band is laudable, the potential for widespread deployment of a licensed service of the nature proposed in the Commission's First Report and Order and Second Notice of Proposed Rulemaking in ET Docket No. 98-237 and WT Docket 00-32⁷ (the "R&O") could make sharing by unlicensed devices technically challenging, or even infeasible.

⁷ See First Report and Order and Second Notice of Proposed Rulemaking in ET Docket No. 98-237 and WT Docket 00-32, FCC 00-363, released October 24, 2000.

8. If the Commission were to abandon its proposal for the licensed use of this band as outlined in the R&O, it could be a much more valuable resource for some types of unlicensed operations, particularly if the Commission would also pair the band with the 4940-4990 MHz band as is suggested in the R&O.

9. In the instant NOI, the Commission also seeks comment on the following questions concerning permitting unlicensed operation in the 3650-3700 MHz band with minimal requirements.

10. Again, in the interest of preserving context, we will repeat the questions *in italics*, followed by our responses in normal text below:

- *What are the potential benefits and drawbacks of permitting unlicensed operation in this band subject to only the minimum rules necessary to avoid interference to licensed users?*

On the surface, it would appear difficult to underlay Part 15 devices under the proposed licensed service (FWA, local loop, and last mile data), based on the presumption that those services would rapidly become ubiquitous. For example, assuming wireless local loop or FWA terminals in (or on) many homes in a neighborhood, it is likely that even very low power unlicensed devices in those homes, or neighboring homes, would have difficulty avoiding interference to the licensed receiver, due to the “near/far” phenomenon (the unlicensed device would likely, in virtually all cases be much closer to the licensed service receiver than the licensed transmitter would be). Additionally, the lack of a globally-harmonized allocation for unlicensed devices in this band may reduce its attractiveness to some degree for some applications.

- *Is it viable to license fixed operations in this spectrum as proposed and permit operation of Part 15 devices in unused portions on a non-interference basis?*

Assuming, as stated above that the licensed services proposed do become ubiquitous, what unused portions would likely exist? Even if the licensed service were to grow at a modest rate, eventually it seems reasonable to expect that it would ultimately occupy the entire band rather ubiquitously, and due to the relative status of Part 15 devices they would likely ultimately be forced to cease operation. Thus, industry might have little incentive to develop standards and devices for this band.

However, if the Commission were to abandon its proposal for the licensed use of this band as outlined in the R&O, it could be a valuable resource for some types of unlicensed operations, and even more so if the Commission would also pair the band with the 4940-4990 MHz band as is suggested in the R&O.

- *Could power levels greater than 1 watt be permitted for such operations without causing interference to authorized users within the band? If so, what is the maximum power level that could be permitted? Would any restrictions on antenna gain or directivity be necessary?*

We believe that power levels below 1 Watt might be required to provide even a remote possibility of sharing with the proposed licensed service. If the Commission were to abandon its proposal for the licensed use of this band, power levels of 1 Watt, or perhaps more, could be feasible. We believe that the ability to use directional antennas could help to mitigate interference potential in some situations. The provisions for directional antennas in Part 15.247 of the Commission's rules would seem appropriate for this band as well.

- *What other requirements are necessary to protect FSS and Federal Government operations in the 3650 MHz band from interference? Are geographic restrictions on where an unlicensed device could operate necessary, and how could these be enforced? Could GPS be incorporated into a device so it could determine its precise location and distance from licensed users? Would such an approach be necessary or reliable?*

It appears from the discussion that some methods of protecting existing FSS earth station receivers and the three grandfathered USG radar sites would likely be required. Geographical restrictions would be difficult, if not impossible to enforce on unlicensed consumer products, unless the hardware and protocols enforced such exclusion zones. Embedding GPS in such products is technically feasible, though indoor usage would typically result in the inability to receive the GPS signals necessary to make an "operate/do not operate" decision. Finally, the sort of low-cost consumer products that would likely be targeted to such a narrow band would likely not be able to bear the additional cost of an embedded GPS capability. . Thus, the use of GPS should not be mandatory, but could be an alternative approach for outdoor devices, to other approaches for interference mitigation (for example DFS/TPC could potentially be used to protect the USG radar installations).

Other means of protecting existing FSS earth stations and the three grandfathered USG radar sites may be feasible, and proposals therefore could be entertained during a Rulemaking proceeding or a Further Notice of Inquiry.

- *What other requirements would be necessary to prevent interference to other authorized services, such as out-of-band emission limits? What types of licensed services could share the 3650 MHz band with unlicensed devices?*

This would depend on the characteristics and deployment of services in adjacent bands. It is likely that the existing Part 15 out of band emission limits would suffice, but further study could be necessary. Again, we believe that it might be

difficult for unlicensed devices to share the proposed band with the new licensed service that is currently proposed for this band.

- *Is it necessary to establish any standards to allow sharing between unlicensed users of the 3650 MHz band? If so, how do we arrive at standards?*

If standards are contemplated to facilitate sharing between diverse types of unlicensed devices, such standards could, and should, best be developed through an open industry consensus standards group. We would again respectfully point out that the National Technology Transfer and Advancement Act (“NTTAA”) requires federal regulatory agencies, such as the Commission, to take open industry consensus standards into account in their Rulemaking Proceedings. Requiring devices to adhere to some particular, detailed protocol will have an inhibiting effect on innovation, but fair, simple etiquettes, such as “listen before talk,” DFS/TPC, etc. and power density limits (e.g. U-NII) will reduce the potential for wasteful use of spectrum. If standards bodies like IEEE 802, TIA, CEA, and others, are involved, the argument for “market forces” to control interference is stronger, since compatibility is an economic issue.

- *Are there any other bands where unlicensed operation with minimal rules could be permitted without causing interference to authorized services? What other bands should we consider? What are the advantages of each?*

The band of choice for unlicensed broadband wireless access systems, including RLANs, is the extension of the U-NII bands to include 5470-5725 MHz, as requested in the Wi-Fi Alliance (formerly “WECA”) petition, which is also the subject of WRC-03 Agenda Item 1.5 and has already been allocated on a co-primary basis in the European Community under the ERC 99(23) Decision. Global harmonization of this spectrum is critical to the future growth and success of high data rate systems based on the IEEE 802 wireless standards.

SUMMARY

11. With respect to the potential for authorizing unlicensed devices to operate on a non-interference basis on unused spectrum in the TV bands, the IEEE 802.18 RR-TAG urges the Commission to consider our recommendations and comments herein and to promptly initiate a Notice of Proposed Rulemaking, or if the Commission deems it necessary, a Further Notice of Inquiry on this matter, with the goal of determining how best to enable such usage.

12. With respect to the Commission's questions regarding the authorization of unlicensed devices in the 3650-3700 MHz band, we would encourage the Commission to seriously consider abandoning its previous proposal for a licensed service in this band⁸ and instead allocate the band for use by unlicensed devices, subject to such minimal rules as it determines to be necessary to protect the incumbent FSS earth stations and the three grandfathered US Government radar installations. We believe that unlicensed devices can provide the same sorts of services to the public as the Commission has contemplated for the proposed licensed service, and that they could do so with greater flexibility and lower costs to the public as well as less administrative burden on the Commission.

13. Should the Commission decide to follow these recommendations, we would suggest that efforts be made to begin the process of harmonizing unlicensed use of the subject band(s) on a global basis. This would provide industry with the ability to address larger markets, which will promote further innovation and help to reduce costs to consumers through economies of scale.

14. Finally, we again point out to the Commission the importance of making the 5470-5725 MHz band available for use by unlicensed devices as an extension of the U-NII bands, as requested in the pending Petition of the Wi-Fi Alliance (formerly "WECA"). We also urge the Commission to continue to work with the NTIA and the international community towards global

harmonization of this band for wireless access systems, including RLANs, as contemplated in WRC-03 Agenda Item 1.5.

Respectfully submitted,

/s/

Carl R. Stevenson
Chair, IEEE 802.18 Radio Regulatory Technical Advisory Group
4991 Shimerville Road
Emmaus, PA 18049
610-965-8799
carl.stevenson@ieee.org

⁸ See First Report and Order and Second Notice of Proposed Rulemaking in ET Docket No. 98-237 and WT Docket 00-32, FCC 00-363, released October 24, 2000.