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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
Modification of Parts 2 and 15 of the Commission's Rules for unlicensed devices and equipment approval.	)))	ET Docket No. 03-201

MEMORANDUM OPINION AND ORDER AND

FURTHER NOTICE OF PROPOSED RULE MAKING

Comments of the Wireless ISP Association (WISPA)

WISPA hereby provides its comments in response to the Further Notice of Proposed Rulemaking in the above-captioned proceedings. WISPA basically responds that "spectrum etiquette" while impractical for already-certified devices in the 902-928 MHz band may promote more efficient spectrum utilization by reducing interference between different license-free and licensed operators and should be considered for newly-certified devices. WISPA also provides its response with regard to the questions of spectrum etiquette techniques, spectrum etiquette impacts, system synchronization, power level-duty cycle-bandwidth tradeoffs, frequency-hopping spread spectrum regulation, Part 15.249 rules, and the appropriateness of spectrum etiquette in the 2.4 and 5 GHz license-free bands.

I. Introduction

1. WISPA is a non-commercial trade organization represents the interests of the Wireless Internet Service Provider (WISP) community. WISPs have existed since 1995 and serve the needs of the public by providing broadband **wireless** Internet access, primarily by using the unlicensed 902-928 MHz, 2.4 GHz and 5 GHz ISM and U-NII bands. WISPs most frequently serve suburban and rural areas of the United States, often as the sole provider of broadband Internet access for the people living in these areas.

2. WISPA agrees with FCC's action in dismissing the two petitions for reconsideration of the rules adopted in the Report and Order in this proceeding. Further, we appreciate this opportunity to offer the following comments in reply to the questions that the Commission raised regarding the subject of possible "spectrum etiquette" requirements in the three aforementioned unlicensed frequency bands.

3. WISPA agrees with the FCC's assessment that the Part 15 rules have been highly successful in fostering the development of new unlicensed devices while protecting authorized users of the radio spectrum from harmful interference. We also believe that the benefit to the public from the availability and delivery of Internet access using unlicensed Part 15 frequencies is clear and undeniable. The huge success of Part 15 devices and the wide deployment of Part 15-based services have brought us to the point

today where most of the Part 15 bands are saturated with outdoor network users in many parts of the U.S. This saturation creates noise and interference problems that reduce the usefulness of these bands while limiting the provisioning of new services and diminishing the reliability of existing services. If anything, the Part 15 bands today are a victim of their own success.

II. WISPA Comments Regarding the Further NPRM

1. *Need for Spectrum Etiquette* - WISPA recognizes that, in the 900 MHz unlicensed frequency spectrum, the needs of the public to receive reliable wireless Internet access service must be balanced with the needs and interests of other outdoor wireless network users. The rapid growth of wireless applications and networks that use the unlicensed 902-928 MHz band has resulted in an increase in noise and interference that has lowered network reliability. The implementation of reasonable spectrum etiquette techniques could result in a lowering of this noise and interference level and a consequent improvement in the throughput and reliability of these outdoor networks. The regulatory challenge is to avoid having adverse impacts on the current users of these networks while at the same time encouraging the development and use of noise-reducing spectrum etiquette techniques by equipment manufacturers and network operators. We respectfully disagree with Motorola's previous comments that "spectrum etiquette and duty cycle limitations would have a negligible impact on the RF environment of unlicensed operations given the

current crowded use of this band by licensed, ISM, and unlicensed devices". We believe that new FCC policies that result in lowering the interference potential of newly certified wireless devices by giving wireless operators more flexibility to coordinate their noise reduction efforts is more beneficial than simply doing nothing and allowing the 900 MHz noise and interference levels to continue to increase without limit.

2. *Maximum Transmit Bandwidth* – There currently is no limitation on the maximum transmit bandwidth for digitally modulated 900 MHz devices other than the requirement to maintain the fundamental emissions within the authorized band of operation. Thus, there is a potential for a digitally modulated device to essentially occupy the entire 915 MHz band, leaving little or no opportunity for other devices to gain spectrum access and share the spectrum. To address this concern and to allow the opportunity for networks to be "good neighbors" and enjoy shared access to this spectrum, WISPA proposes that after an effective date specified by the FCC, all newly-certified 900 MHz digitally modulated equipment have a maximum transmit bandwidth narrow enough to allow at least three similar non-overlapping digitally modulated 900 MHz channels to be co-located without creating interference between the channels. In general, this corresponds to a maximum transmit bandwidth of approximately 8 MHz.

3. *Spectrum Etiquette Applicability*

a. *Applicability and Benefits for Wideband Digital Modulation Network Operators* – Many WISPs operate outdoor wideband wide-are digital modulation networks. These networks must deliver reliable broadband data to customers in real-time. Data delay and data latency caused by noise and interference affects the quality of service that these WISP customers receive. Because of their outdoor broadband nature, these networks are vulnerable to interference from both broadband (*i.e.,* digitally modulated) and narrowband (*i.e.,* frequency hopping) networks. When WISP network packet-error (retransmission) rates reach 5%, data delivery starts to slow. When retransmission rates reach 10%, data delivery becomes noticeably slower. When retransmission rates reach 15%, customers begin to cancel their service because of poor network performance. WISP operators must tolerate these service-reducing and potentially service-losing impacts from the operation of all other unlicensed wireless devices, both wideband and narrowband. To remain in business continuing to provide quality service to hundreds of thousands of citizens, we are ready to suggest new, reasonable, non-burdensome spectrum etiquette regulations that can help benefit all network operators by reducing the 900 MHz noise and interference levels. The ability to choose to exclude hopping on certain channels or in certain parts of the 900 MHz band is a very useful technique that allows a network operator to

avoid being interfered with and also to avoid causing interference to other network operators. We therefore ask that the following modifications to Part 15.247 be considered with respect to frequency hopping.

b. *Applicability and Benefits for Narrowband Frequency Hopping Network Operators* – Currently, Part 15.247(a)(1)(i) mandates that 900 MHz frequency hopping systems with a bandwidth of less than 250 KHz must hop on at least 50 hopping frequencies. We propose that newly certified narrow band equipment be required to provide network operators the option of excluding hopping on certain channels in the band. This will allow narrowband network operators the flexibility to configure their equipment to "hop around" the parts of the band that are in use by wide band network operators such as WISPs. Narrowband operators will thus be able to both reduce the interference that they receive from wideband network operators and reduce the interference that they would otherwise cause wideband network operators.

c. *Applicability and Benefits for Wideband Frequency Hopping Network Operators* – Currently, Part 15.247(a)(1)(i) requires that 900 MHz frequency hopping systems with a bandwidth greater than 250 KHz must hop on at least 25 hopping frequencies. This forces wideband frequency hopping network operators who may use equipment with wider bandwidths (1 MHz, for example) to effectively hop across the entire band. We recommend changing this section to allow frequency hopping systems with bandwidths greater than 250 KHz to hop on a minimum of at

least 15 hopping frequencies. This change will allow wideband network operators the flexibility to configure their networks to share the band by "hopping around" other wideband frequency hopping network operators, other wideband digitally modulated network operators and other narrowband frequency hopping operators.

4. *Cellnet's suggested etiquette requirements* - We agree with Itron's previous statement "digitally modulated devices are entering the band with maximum power and "always on" duty cycles". We also agrees with Cellnet's previous statement that it "has seen an increase in the number of digitally modulated devices using the 915 MHz band over the past year, including devices operating without any duty cycle limitation, and now believes that these devices present a threat of interference that requires Commission action". In many cases, the increase in digitally modulated devices is a result of WISPs who are provisioning new broadband wireless services to previously unserved Americans. We would like to respectfully remind Itron, Cellnet, and the FCC that WISPs are forced to provision broadband services in the 900 MHz band because 99.5% of currently operating WISPs have no option to provision services in any licensed frequency band. WISPs are, on average, very small companies having in many case fewer than a dozen employees, small operating budgets and only very limited access to operating capital. In contrast, large nationwide, incumbent wireless operators such as AT&T and Verizon have essentially limitless access to the operating capital needed to bid on and win licensed spectrum that is suitable for the delivery of broadband

wireless services. Under current U.S. law, 99.5% of WISPs have virtually no opportunity to use licensed broadband spectrum and are thus forced to use unlicensed spectrum. The automated meter reading (AMR) networks deployed by Cellnet and Itron handle very small amounts of end-user data when compared to the broadband Internet access data handled by WISP networks. Cellnet and Itron could, if they choose, use a licensed narrowband VHF or UHF frequency. This allows them the option of meeting their very limited data needs without subjecting themselves to interference from broadband network operators and without contributing to the noise levels in the overused, overly congested 900 MHz unlicensed spectrum. While narrowband AMR network operators certainly have the choice of using unlicensed spectrum, it may be a much wiser choice for them to consider the use of licensed spectrum which is available to them at low cost. We respectfully suggest that wise choices on their part would go a long way towards improving the reliability of their networks and reducing the over congestion currently present on the unlicensed bands. With regard to Cellnet's suggested spectrum etiquette proposal, WISPA again recognizes the benefits that spectrum etiquette can bring but respectfully disagrees with Cellnet's proposed requirements. Cellnet's proposal that digitally modulated spread spectrum transmitters must either remain silent 90% of the time or reduce power below the currently-allowed 1 watt (+ 30 dBm) level may be appropriate when applied to narrow-band low-bandwidth AMR networks such as Cellnet's "Utilinet" system but is totally inappropriate when applied to broadband wireless Internet access

WISP networks which must typically deliver 100 times more end-user throughput than Cellnet's networks. We do however recognize that being a "good neighbor" requires that transmitter not transmit with a 100% duty cycle when no end-user data is being handled. We therefore suggest that a much more reasonable spectrum etiquette requirement for newly certified digitally modulated transmitters is to limit their duty cycle to a maximum of 25% when they have no end-user data to transmit. This allows adequate bandwidth for network management, housekeeping and synchronization data while still allowing spectrum sharing with other network operators.

5. *Alternative Spectrum Etiquette and Noise Reduction Options* - Although it is beyond the scope of this document to exhaustively detail all of the many techniques that can together contribute to a reduction in unlicensed noise levels, we would like to suggest that the following techniques be considered.
   a. *Synchronization* – The synchronization of devices within a network has the capability to increase spectral efficiency because collisions between different devices and the resulting retransmissions will be minimized. This maximizes over-the-air data-delivery efficiency and promotes spectrum sharing.
      i. *Intra-Network Synchronization* - We recognize the FCC's concern that allowing one wireless operator to utilize synchronization between all of their transmit devices could allow that operator to stagger their device transmission time slots thereby essentially

allowing their network to transmit continuously and deny air-time access to other network operators.

ii. In the real world, it seems unlikely that a network operator would configure their network to transmit continually because by doing so they would deny themselves the benefits of synchronization, specifically the ability to minimize the interference that their own transmitters would cause for their own receivers. A digitally modulated network configured this way would receive very poorly because of this self-inflicted interference. Synchronization, used correctly, allows a network operator to substantially reduce self-interference between their own network devices thereby maximizing their network data delivery capabilities. For this reason, we believe that synchronization should be allowed and encouraged.

iii. *Inter-Network Synchronization* - As one part of a possible spectrum etiquette solution, an advanced version of synchronization could even be implemented **between** networks if agreed to by the respective network operators, even between networks that used different over-the-air time-division multiplex (TDM) protocols. Using the Network Time Protocol (NTP) distributed over the Internet or using GPS-derived timing slots, networks could coordinate their transmit and receive windows such that all outdoor network access points operating in the same

geographic area all transmit and receive during the same fractional part of each second. For example, all geographically-close outdoor network access points could transmit during the first 250 ms of each one-second interval and receive during the second 250 ms of each second. They would all then transmit during the third 250 ms interval and receive during the fourth 250 ms interval. Such coordination would have the practical effect of very substantially reducing network-to-network interference between access points, achieving greater spectrum efficiency because they would not be interfering with each other.

b. *Automatic Transmitter Power Control (ATPC)* – Very few network operators are aware of how much or how little transmitter output power is needed to operate a wireless link reliably. Even if network operators had this information, the real-world over-the-air variations caused by wireless propagation variables would act continuously to vary the amount of power needed. Because of these unknowns, we recommend requiring the inclusion of ATPC functionality in newly certified wireless equipment. This would have the following two benefits.

   i. *Noise Reduction* - The use of excessive transmitter output power would be minimized with a consequent reduction of interference to both nearby and distant wireless devices.

ii. *Improved Link Reliability* - Wireless link reliability would be increased as the ATPC adjusted the power to compensate for varying propagation conditions.

iii. *Reduced Adjacent Receiver Overloading* - The use of an adequate but not an excessive amount of transmit power could improve the performance of co-located wireless links by minimizing receiver overloading. The resulting decrease in receiver distortion would reduce data errors and reduce the need for packet retransmissions that cause unnecessary noise for wireless devices on other, more distant networks.

iv. *ATPC Incentives* - We recommend that the FCC consider providing wireless device manufacturers incentives to offer ATPC as part of their new equipment feature sets. As an incentive, we recommend that access points that implement ATPC be allowed to transmit at power levels up to 6 dB higher than the currently allowed power level; *i.e.*, at up to +36 dBm transmit power and at up to +42 dBm EIRP whenever ATPC determines that wireless conditions warrant.

c. *Listen-Before-Transmit* – Listen-before-transmit protocols are commonly in use today. The 802.11a, b, and g protocols based on carrier sense multiple access with collision avoidance (CSMA/CA) are familiar examples. Listen-before-transmit protocols are better than completely random (non-listen-before-transmit) protocols and although listen-before-

transmit protocols can play a role in reducing both intra and inter-network interference, they are not inherently efficient under high traffic conditions when compared to a scheduled timeslot protocol or a polled protocol. Although listen-before-transmit protocols may therefore be part of an overall spectrum etiquette solution, we recommend that they be used in combination with other more efficient interference-avoidance protocols and methods.

d. *Publicity and Enforcement* – Although not a wireless layer protocol, enforcement of the current FCC rules and regulations can be considered a societal-layer protocol. It's generally recognized that a law that is not enforced will usually become widely ignored and therefore widely ineffective. We suggest the FCC consider implementing **occasional** public enforcement of the Part 15 regulations that define and supposedly govern the unlicensed bands. We realize that the FCC is not in the business of protecting unlicensed users from interference caused by other unlicensed users and we also realize that the FCC budget will likely never be generous enough to allow widespread unlicensed rule enforcement however we respectfully suggest that the FCC consider occasionally being seen to provide some public enforcement of the Part 15 regulations. One example might be to demonstrate that it is illegal to market or sell an external RF power amplifier that is not marketed and sold as part of a certified system. Even given the FCC's extremely limited enforcement budget, a very small investment in enforcement time coupled with

widespread enforcement publicity could yield substantial dividends. Publicity about one or two enforcement actions could motivate many unlicensed users to check and confirm that their systems are in compliance thereby leading to a decrease in noise levels and increased usefulness of the unlicensed bands.

6. *Design Flexibility and Unlicensed Product Innovation.* WISPA believes that far from limiting design flexibility or stifling product innovation, the creation and enforcement of reasonable spectrum etiquette requirements would actually stimulate design flexibility and encourage product innovation. Few would deny that spectrum congestion is a problem today. Without the more sophisticated and creative equipment design that spectrum etiquette would stimulate, congestion will only continue to get worse. Just as the creation of freeways to handle automobile traffic more efficiently did not limit the design flexibility or product innovation of the automobile, the creation of reasonable spectrum etiquette requirements to handle wireless traffic more efficiently won't limit the design flexibility or product innovation of wireless equipment.

7. *Impact of New Spectrum Etiquette Requirements* – We believe that any possible adverse impact from new spectrum etiquette requirements would be minimized and mitigated as follows.

   a. *Already-Manufactured Equipment* – Allow already-manufactured equipment to be grandfathered and to remain in use for up to 10 years after the effective date of any new regulations.

b. *Not-Yet-Manufactured Equipment* – Allow already-certified but not-yet-manufactured equipment to continue to be manufactured for up to five years after the effective date of any new regulations and to remain in service for five years after the date of manufacture.

c. *Newly Certified Equipment* - Require that newly certified equipment meet any new spectrum etiquette requirements.

8. *Applicability of Spectrum Etiquette to Section 15.249* – Devices operating under Section 15.249 are limited to substantially lower output power levels than devices operating under Section 15.247. For this reason, we believe that devices operating under Section 15.249 need not be required to meet any new Section 15.247 spectrum etiquette requirements.

9. *Applicability of Spectrum Etiquette for the 2.4 GHz and 5.8 GHz Bands* – The 2.4 GHz and 5.8 GHz bands are the two unlicensed bands that have been in use the longest by WISPs. As such, they are very heavily used by WISPs to deliver services to the public. In light of this, and in light of the experimental nature of any spectrum etiquette regulations that may be imposed on the 900 MHz band, WISPA suggests that spectrum etiquette regulations **not** be imposed on these two bands until such time as the results of any new spectrum etiquette regulations on the 900 MHz band are fully evaluated. The imposition of new spectrum etiquette regulations simultaneously on all three bands carries too high a risk of simultaneously disrupting the current unlicensed broadband wireless infrastructure that has been put in place over a period of

the last 12 years. Such disruption could potentially deprive hundreds of thousands of Americans of their broadband Internet access and delay the introduction of service to hundreds of thousands of additional Americans.

III. Conclusion

WISPA appreciates this opportunity to provide comments in this further Notice of Proposed Rulemaking and to perform a constructive role in the improvement of our regulatory systems designed to share the unlicensed bands while providing quality Internet access services to millions of Americans. To sum up, we are suggesting that the FCC:

1. Limit new digitally modulated 900 MHz equipment to a maximum transmit bandwidth of 8 MHz to disallow one transmitter from monopolizing the entire band.
2. Require new 900 MHz narrowband frequency hopping equipment have the ability to be configurable to exclude certain channels and thereby able to hop around interference.
3. Allow new 900 MHz wideband frequency hopping equipment to hop on a minimum of 15 channels and thereby able to hop around interference.
4. Encourage operators of very low bandwidth 900 MHz networks to utilize available licensed frequencies.
5. Limit new 900 MHz digitally modulated transmitters to a maximum transmitter duty cycle of 25% when there is no end-user data present.
6. Encourage the development and use of synchronization both within and between 900 MHz networks.

7. Provide incentives for manufacturers to build and network operators to use 900 MHz equipment that includes automatic transmitter power control (ATPC).
8. Continue to allow listen-before-transmit protocols but don't rely on them as the exclusive spectrum-sharing solution.
9. Demonstrate occasional enforcement of Part 15 regulations to remind network operators to review and to bring their networks into compliance where necessary.
10. Grandfather existing 900 MHz wireless equipment for a period of up to 10 years.
11. Maintain the current Section 15.249 regulations.
12. Make NO change to the current 2.4 GHz and 5 GHz regulations until such time as the effect any new 900 MHz spectrum etiquette regulations can be fully evaluated.

Respectfully submitted for

WISPA

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