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

In the Matter of

Amendment of the Amateur Service )  
Rules to Provide For Greater ) WT Docket No. 97-12  
Use of Spread Spectrum ) RM-8737  
Communications Technologies )

To: The Commission

COMMENTS  
OF  
METRICOM, INC.

Metricom, Inc. ("Metricom"), by its attorneys, pursuant to the Notice of Proposed Rule Making released on March 3, 1997 in the above-referenced proceeding (the "Notice"), hereby submits these Comments. This proceeding results from a Petition for Rule Making filed by the American Radio Relay League ("ARRL") requesting expanded spread spectrum authorization for amateur operations. Despite the absence of strong record support for such amendment, the Commission nevertheless issued the Notice.

INTRODUCTION AND BACKGROUND

1. Metricom does not oppose the proposal to allow amateurs greater flexibility for spread spectrum operations; however, Metricom must strongly oppose amateur operations with 100 watts output power and *unlimited* antenna gain in the Industrial, Scientific and Medical ("ISM") bands because these bands are shared with Part 15. If amateurs are to conduct more flexible spread spectrum operations in these bands, they should be limited to Part

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15 power levels. Only with such limitations can the Commission assure that no harmful interference exists to other operations in these bands where the Commission has worked diligently to create a delicate balance so that all parties can share, and operate successfully.<sup>1/</sup> While the Commission's proposal in the Notice for automatic power control is a significant step in limiting amateur spread spectrum power and resultant harmful interference, it does not go far enough in limiting amateur power in the ISM bands.

2. Metricom is a young, rapidly growing, wireless telecommunications company based in California's Silicon Valley. Metricom is a pioneer in the development of state-of-the-art, spread spectrum, unlicensed data communications systems operating under Part 15 of the Commission's Rules and Regulations in the 902-928 MHz frequency band. Metricom's frequency hopping, spread spectrum systems -- at the leading edge of technology -- had their origins in amateur radio, and many of Metricom's engineers are active amateur operators. The experimentation done with spread spectrum amateur radio enabled Metricom to develop an innovative mesh network architecture that permits cost-effective, intelligent and flexible data communications operating at a gross over-the-air

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<sup>1/</sup>In its Reply Comments on the ARRL Petition, Metricom took the position that more flexible amateur spread spectrum operations should not be authorized in the ISM bands. Reconsidering its position, Metricom believes that more flexible amateur spread spectrum operations should be allowed in the ISM bands, *provided operations are limited to Part 15 power levels.*

transmission rate of 100 kbps -- the fastest wide area (regional) wireless data network available today.

THE COMMISSION MUST PRESERVE THE DELICATE BALANCE  
ESTABLISHED IN THE ISM BANDS

3. Metricom fully understands, supports and appreciates the need for experimentation in amateur spread spectrum and other operations. However, this need for experimentation cannot be met at the expense of the delicate balance the Commission has established in various shared bands. Because Amateurs are allowed to operate with 100 watts output power and *unlimited* antenna gain, Metricom is concerned that if Amateurs commence widely used, unlimited high power spread spectrum operations in the ISM bands, the careful balance which the Commission has developed for sharing in these bands could be destroyed.<sup>2/</sup>

4. A good example of the Commission's efforts to maintain this delicate balance is the proceeding styled: In re Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems, PR Docket No. 93-61, 10 FCC Rcd 4695 (1995) (the "LMS Proceeding"). The LMS Proceeding, involves, among other things, competing Part 90 and Part 15

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<sup>2/</sup> It should also be noted that the Commission recently established the UNII service which uses part of the 5.8 GHz ISM band (Report and Order, Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range, ET Docket No. 96-102, FCC 97-5 (rel. Jan. 9, 1997)). These newly created UNII operations could be severely impacted if the proposals in the Notice are adopted.

interests in the band. One of the major issues in the proceeding was that the low power (1 watt) Part 15 operations will interfere with the higher powered Part 90 licensed service. After a voluminous record was developed over a two-year period, the Commission ultimately fashioned a compromise permitting both types of operations to co-exist in the band, subject to the condition that testing be conducted to assure that no harmful interference would be caused to Part 15 operations. The Commission's Order was subject to numerous Petitions For Reconsideration which, to date, have not been resolved.

5. The delicate compromise constructed by the Commission in the LMS Proceeding is jeopardized by spread spectrum Amateur operations in the band with 100 watts output power and *unlimited* antenna gain. Obviously, Part 90 licensed services could experience significant interference: imagine the impact of wide-spread amateur spread spectrum operation at, for example, 1 kW EIRP (100 watts output power and 10 dB antenna gain).

6. Part 15 spread spectrum operations in the 902-928 MHz band would also experience significant interference if wide spread, more flexible amateur spread spectrum operations were allowed in the band. Even though both the Part 15 operations and the amateur operations are spread spectrum, because of the enormous difference

in authorized power, Part 15 operations would be severely impacted by significantly higher powered amateur spread spectrum operations.

7. Metricom recognizes that both high powered spread spectrum and non-spread spectrum operations are currently permitted in the ISM bands. However, in the case of spread spectrum operations, amateur operations are limited technically by the rules and there is no "off-the-shelf," commercially available equipment for amateur spread spectrum operations. Therefore, high powered amateur operations are not very likely to occur. The difference between the current situation and the newly proposed, more flexible amateur spread spectrum operations is that if the proposed rules are adopted, then equipment for amateur operations is inexpensive and readily available off-the-shelf from Part 15 suppliers. If amateur operators are permitted to use off-the-shelf equipment designed for low power operations in a shared, congested environment, and modify this equipment by boosting the output power up to as much as 100 watts, with unlimited antenna gain, there would undoubtedly be a severe negative impact on other operations in the band.

8. In the LMS Proceeding, the Commission did not ignore the fact that Part 15 products and services represent American jobs, investment, innovative technology and a significant benefit to the public. Likewise, the Commission must not ignore that fact in this

proceeding. Part 15 devices -- such as cordless phones, automatic meter readers, point-to-point data links, local and wide area networking, wireless PBXs and security systems -- provide a plethora of services to the public including NII access for schools, libraries and others. In addition, the Commission cannot ignore the fact that Part 15 low power technology also helps to mitigate the public's increased concern and awareness of exposure to RF radiation. In fact, the Commission's recent RF exposure standards categorically excluded Part 15 devices from their coverage because they offer little or no potential for exposure in excess of the specified guidelines.<sup>3/</sup> Therefore, increased usage of low powered devices should be encouraged by the Commission.

AUTOMATIC POWER CONTROL WILL NOT SIGNIFICANTLY  
LIMIT INTERFERENCE TO PART 15 OPERATIONS

9. The Commission takes a significant and necessary step in the Notice by requiring automatic power control ("APC"). Under the proposal, the signal-to-noise ratio (specified as  $E_b/(N_o+I_o)$ ) at the "intended receiver" must be automatically adjusted to maintain no more than 23 dB.<sup>4/</sup> This level still allows a strong signal (especially when compared to a one watt Part 15 signal) and this 23 dB threshold would, in most cases of usual and ordinary amateur operations, allow a much greater output power than one watt. As

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<sup>3/</sup> Report and Order, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, ET Docket No. 93-62, FCC 96-326 (Rel. Aug. 1, 1996).

<sup>4/</sup> See proposed rule § 97.311(g).

illustrated in the calculations appended as Attachment 1, based on empirical test data at 915 MHz and assuming a typical RF environment, an amateur path of only 10 miles would, under the Commission's proposal, allow a transmit power of 63 watts (see Attachment 1). This relatively short distance is not at all typical of amateur operations. It is obvious, therefore, that the APC proposed by the Commission will not significantly limit interference to Part 15 operations.

AMATEURS HAVE SEVERAL OTHER BANDS AVAILABLE  
FOR HIGH POWER SPREAD SPECTRUM OPERATIONS

10. Limiting the power of amateur spread spectrum operations in shared ISM bands would not work a hardship on amateurs. Precedent exists for limiting power of amateur spread spectrum operations as evidenced by the fact that existing spread spectrum operations are limited to 100 watts output power while non-spread spectrum operations are permitted generally to operate with 1,500 watts output power.<sup>5/</sup> In addition, there are sufficient frequency bands available for high power amateur spread spectrum operations outside of the shared ISM bands (e.g., 1240-1300 MHz, 3.3-3.5 GHz, 10-10.5 GHz) where higher powered spread spectrum operations could be conducted without affecting the delicate balance established in the ISM bands. Moreover, there is no question that spread spectrum operations work successfully in the 900 MHz, 2.4 GHz and 5.8 GHz bands. Experimentation in bands where spread spectrum operations

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<sup>5/</sup> See 47 C.F.R. § 97.13.

have not proven successful appears to be much more conducive to amateur operations and to maintaining the success thus far achieved in the 900 MHz, 2.4 and 5.8 GHz bands.

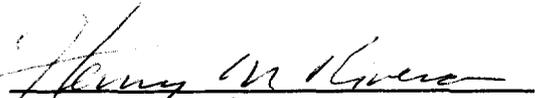
#### CONCLUSION

11. Because the automatic power control proposal in the notice will not sufficiently limit power in the ISM bands to Part 15 levels, and because there are other suitable frequency bands available for higher powered amateur spread spectrum operations, there are no sound public policy reasons to disturb the delicate balance the Commission has established in the ISM bands. The position advocated by Metricom herein will facilitate the successful coexistence of users in the ISM bands, and will avoid creating situations where conflict is both likely and difficult to resolve. Moreover, limiting amateur spread spectrum operations to Part 15 power limits will provide for the continued operation of products and services in which the American public has a significant interest and investment. Accordingly, the Commission should limit amateur spread spectrum operations in the ISM bands to

Part 15 power limits, and should adopt the remainder of the Notice as proposed.

Respectfully submitted,

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Dated: May 5, 1997

## ATTACHMENT 1

### **Calculations for two spread spectrum amateur stations at 10 miles separation in the 915 MHz band:**

Assumptions:

Required carrier to noise ratio	23 dB <sup>1</sup>
Path Loss Exponent	2.4 <sup>2</sup>
Receiver Noise Figure (NF)	3 dB
Antenna Gain at each end	3 dBi
Distance between stations	10 miles
System Bandwidth (BW)	2 MHz

#### **Receive Sensitivity (Rs) in dBm**

$$R_s = -174 + 10 \log (BW) + NF + C/N$$

Where

R <sub>s</sub>	Receive Sensitivity (dBm)
BW	Bandwidth
NF	Noise Figure
C/N	Carrier to Noise ratio

Given the above assumptions,  $R_s = -174 + 10 \log (2 \text{ MHz}) + 3 + 23$ ;  
Therefore, **R<sub>s</sub> = -85 dBm**

#### **Transmit Power Level Using APC at 23 dB Carrier to Noise**

Link Budget:

$$L_b (\text{dB}) = \text{Tr pwr} + \text{Tr ant gain} + \text{Rx ant gain} - (R_s)$$

Where

L <sub>b</sub>	Link Budget (dB)
Tr pwr	Transmit Power (dBm)
Tr ant gain	Transmit Antenna Gain (dBi)
Rx ant gain	Receive Antenna Gain (dBi)
R <sub>s</sub>	Receive Sensitivity (dBm)

$$L_b = \text{Tr pwr} + 3 + 3 - (-85);$$

$$L_b = \text{Tr pwr} + 91$$

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<sup>1</sup> Proposed Eb/(No+Io) from the ARRL NPRM is 23 dB.

<sup>2</sup> Data taken from an empirical study of the Los Angeles area at 902-928 MHz by Metricom. Other geographic areas have varying loss exponent values.

To determine the total Lb for a 10 mile range, the path loss at 915 MHz must be determined.

$$\text{Path Loss (dB)} = - 10 \log ( c / 4 * \pi * f * d )^{\text{exp}}$$

Where

Path Loss	dB
c	Speed of Light (1.8697e5 miles/second)
pi	3.14
f	Frequency (MHz)
d	Distance (miles)
exp	Loss Exponent

$$\text{Path Loss} = - 10 \log ( c / 4 * \pi * 915e6 * 10 )^{2.4}$$

$$\text{Path Loss} = 139 \text{ dB}$$

Substitute Path Loss for Link Budget above:

$$139 = \text{Tr pwr} + 91$$

$$\text{Tr pwr} = 139 - 91 = + 48 \text{ dBm} = 63 \text{ watts}$$