Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 15 of the	)	
Commission's Rules Regarding	)	ET Docket No. 99-231
Spread Spectrum Devices	)	
	)	
	)	

NOTICE OF PROPOSED RULE MAKING

Adopted: June 21, 1999 **Released: June 24, 1999**

Comment Date: [75 days after publication in the Federal Register]
Reply Comment Date: [105 days after publication in the Federal Register]

By the Commission:

INTRODUCTION

1. By this action, the Commission proposes to amend the Part 15 rules regarding the operation of non-licensed spread spectrum systems. Specifically, this *Notice* proposes to revise the rules for frequency hopping systems operating in the 2.4 GHz band (2400 - 2483.5 MHz) to allow for wider operational bandwidths. This *Notice* also proposes to refine the method for measuring the processing gain of direct sequence systems. We take this action to facilitate the continued development and deployment of spread spectrum technology, particularly for high data rate wireless applications.

BACKGROUND

2. The Commission permits operation of non-licensed radio frequency (RF) devices under Part 15 of the rules. Part 15 equipment operates on a non-interference basis to authorized radio services. That is, such devices must not cause interference to authorized services and they must accept any interference received from such services.[1] If a Part 15 device causes harmful interference to an authorized service, operation of the device must

[1] *See* 47 C.F.R. § 15.5.

cease until the interference is corrected.[2] To decrease the likelihood of interference, Part 15 transmitters are generally restricted to very low signal levels.

3. Non-licensed spread spectrum systems operating under Part 15 are allowed higher power levels than other Part 15 devices. This is because these devices have less potential to produce harmful interference than non-spread systems. Spread spectrum systems use special modulation techniques to spread the energy of the transmitted signal over a very wide bandwidth. This spreading reduces the power density of the signal at any frequency within the transmitted bandwidth, thereby reducing the probability of causing interference to other signals occupying the same spectrum. The Commission permits operation of frequency hopping and direct sequence spread spectrum systems under the Part 15 regulations. Frequency hopping systems spread their energy by changing, or "hopping," the center frequency of the modulated signal in accordance with a psuedorandomly generated list of channels. Frequency hopping systems require a range of frequencies sufficient to allow multiple carrier hops. Direct sequence systems, on the other hand, function by first modulating a message signal onto a carrier using conventional modulation techniques. The bandwidth of the composite signal is then widened by means of a high speed spreading code. The high speed spreading code dominates the "modulation function" and is the direct cause of the wide spreading of the transmitted signal.

DISCUSSION

4. Frequency Hopping Systems. Section 15.247 of the rules permits frequency hopping spread spectrum systems to operate in the 2.4 GHz band with a maximum output power of 30 dBm (1 watt). The rules specify that frequency hopping systems operating in this spectrum must use a minimum of 75 hopping channels with each channel having a 20 dB bandwidth not exceeding 1 MHz. The average time of occupancy on any frequency must not be greater than 0.4 second within a 30 second period.

5. On November 11, 1998 the Home RF Working Group ("HRFWG") filed a request that the Commission interpret Section 15.247 to allow frequency hopping systems in the 2.4 GHz band to operate with 3 MHz and 5 MHz bandwidths.[3] HRFWG proposes to allow systems with bandwidths of up to 3 MHz to operate with output power no more than 25 dBm and channel occupancy time no greater than 0.05 second per hop. Each of the 75 channels will be used at least once during a 3.75 sec period. Like existing 1 MHz systems, the average time of occupancy on any channel will not be greater than 0.4 second within a 30 second period. HRFWG's proposal will allow systems using 5 MHz channels to operate with output power no more than 23 dBm and channel occupancy time no greater than 0.02 second per

[2] *Id.*

[3] See letter from the HRFWG dated November 11, 1998. A copy of this letter is included in the docket file for this proceeding.

hop. Each of the 75 hopping channels will be used at least once during a 1.5 second period. Again, the average occupancy time on any channel will remain 0.4 second or less per 30 second period.

6. HRFWG claims that its proposal will not cause additional interference to existing users of the 2.4 GHz band. HRFWG asserts that the increased bandwidth is needed to meet business and consumer demand for high-speed data applications, such as access to the Internet. HRFWG adds that the higher data rates will facilitate the transmission of CD-quality audio and compressed MPEG2 video streams from home PCs to portable devices. HRFWG claims that these services could be implemented at lower costs and with greater interference resistance than existing direct sequence systems operating at comparable speeds.

7. Harris Semiconductors, Aironet Wireless Communications ("Aironet"), and Home Wireless Networks ("HWN") submitted letters objecting to the HRFWG proposal.[4] Harris argues that the changes requested by HRFWG will cause increased interference to Part 15 direct sequence spread spectrum systems operating in the 2.4 GHz band. Harris claims that the proposed power levels are sufficient to jam existing spread spectrum systems operating in accordance with the current rules. Harris also asserts that the requested change cannot be made through an interpretation because the existing rule specifically limits the bandwidth of frequency hopping systems to 1 MHz. Aironet and HWN express similar objections. Additionally, HWN argues that the proposed systems will not be able to achieve substantially higher data rates than current 1 MHz systems because of the affects of in-building multipath interference.

8. We agree that the HRFWG proposal cannot be implemented through a rule interpretation. However, we find that the HRFWG proposal has merit. The HRFWG proposal would provide considerable benefits to businesses and consumers by facilitating high speed data links for such applications as wireless LANs and a variety of other devices. We observe that the HRFWG proposal is supported by fifty-three wireless radio companies.[5] Accordingly, we are proposing to amend the Commission's rules to permit frequency hopping systems to use wider bandwidths under the conditions suggested by the HRFWG.

9. We do not believe these proposed rule changes will result in any significant increase in interference to direct sequence spread spectrum systems. We recognize that spectrum occupancy of frequency hopping systems in the 2.4 GHz band will increase as a result of the proposed changes. The existing rules require a minimum of 75 hopping channels each with a bandwidth of no more than 1 MHz. Given the 83.5 MHz of spectrum available in the 2.4 GHz band, no frequency is used more than once in the hop sequence. However, if

[4] See letters from Harris Semiconductors, Aironet, and HWN dated January 8, 1999; March 3, 1999; and March 25, 1999, respectively. Copies of these letters are included in the docket file for this proceeding.

[5] Fifty-four supporters are listed on the HRFWG proposal. However, Aironet stated its objection to the proposal in its March 3, 1999 letter.

the channel bandwidth is increased to 3 MHz or 5 MHz, overlapping channels will be needed to accommodate 75 hops. Accordingly, the average time of occupancy on any one frequency will increase. However, it appears that the proposed reduction in output power and time of occupancy would offset any potential increase in interference. Further, we observe that manufacturers of direct sequence systems that are concerned about interference can improve the robustness of their systems by increasing processing gain.[6] We invite comment on this analysis. We also invite comment as to any potential for increased interference to radio amateurs operating in this spectrum on a secondary basis.

10. We are not convinced by HWN's argument that wide band frequency hopping systems will be unable to consistently achieve substantially greater data rates than 1 MHz systems. HWN asserts that the systems will encounter excessive multipath interference caused by signal reflections. HWN claims that, in order to compensate for the lost data, HRFWG's proposed systems will need to retransmit information and reduce data transmission rates to those of existing 1 MHz bandwidth systems. We seek comment on HWN's assumption.

11. Direct Sequence Processing Gain. Under Section 15.247(e) of the rules, direct sequence systems are required to exhibit a processing gain of at least 10 dB. The 10 dB minimum was established to ensure that a system is, in fact, spread spectrum in nature. Absent this standard, there is potential for abuse of the Part 15 spread spectrum rules. Specifically, equipment manufacturers could possibly seek certification of non-spread systems in order to benefit from the increased output power afforded spread spectrum systems. Generally, systems employing a spreading rate of at least 10 chips/symbol meet the 10 dB processing gain requirement.[7]

12. The Commission allows processing gain to be determined by either of two methods. The first is a direct measurement taken from the demodulated output of the receiver. The processing gain is calculated as the ratio, in dB, of the signal-to-noise ratio with the system spreading code turned off to the signal-to-noise ratio with the system spreading code turned on.[8] Alternatively, in cases where the design of the system does not permit de-activation of the spreading code, an indirect measurement of processing gain, based

[6] Processing gain is a measurement of the improvement of signal-to-noise ratio of spread spectrum systems over non-spread systems. Processing gain accounts for the ability of direct sequence systems to reject undesired signals.

[7] The number of chips per symbol refers to the ratio of spreading imposed by the direct sequence high speed spreading code.

[8] *See* 47 C.F.R. § 15.247(e)(1).

on receiver jamming margin (the "CW jamming margin method"), is permitted.[9] The receiver jamming margin is representative of the ability of the receiver to reject other radio signals appearing on the same frequency. The test is generally viewed as an accurate measure of processing gain for systems employing spreading rates of at least 10 chips/symbol. However, in cases where the spreading rate is less, the results of the test are questionable.

13. Shortly after adoption of the *Report and Order* in ET Docket 96-8, the Commission began receiving comments regarding the validity of the CW jamming margin test results for systems employing fewer than 10 chips per symbol. On January 14, 1998, Microlor, Inc. filed a request for declaratory ruling that the Commission should either prohibit direct sequence systems that use fewer than 10 chips/symbol or modify the CW jamming margin test to provide an accurate determination of processing gain for systems that use fewer than 10 chips/symbol. The Office of Engineering and Technology (OET) denied the request for a declaratory ruling because the issue raised by Microlor required rule making.[10] In light of the continued interest in this issue, we are taking this opportunity to address this matter.

14. The current jamming margin test is based on use of a CW signal as an interference source. Some spread spectrum device manufacturers have suggested that the use of a Guassian noise interferer, instead of a CW interferer, would be more suitable for the jamming margin test. After reviewing the various submissions, we tentatively conclude that a Guassian interferer is likely to give a more accurate measure of processing gain because it is more closely related to the noise a system would encounter in a real-world environment. Therefore, we propose to permit the use of a Guassian interferer for determining receiver jamming margin. We request comment on the effect of using a Guassian interferer in the current jamming margin test set-up. Comments in support of this technique should include a detailed measurement procedure in their responses.

15. The Commission has also received comments from manufacturers asserting that the current jamming margin test, along with a mathematical calculation of processing gain, should be required to demonstrate that systems using fewer than 10 chips per symbol are in compliance with the rules. The mathematical calculation would take into account the "coding gain" achieved by modulating and spreading of the baseband signal. We believe that this

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[9] The CW jamming margin test was incorporated into the Commission's rules in the Report and Order in ET Docket 96-8, 12 FCC Rcd. 7488 (1997), adopted April 3, 1997. Processing gain is determined from the CW jamming margin test by stepping a signal generator in 50 kHz increments across the system passband. The jamming level required to produce the recommended Bit Error Rate (BER) and the system output power are recorded at each point. The "jammer to signal" ratio is then calculated from these measurements. Processing gain is calculated as: $G_p = (S/N)_o + M_j + L_{sys}$, where G_p=processing gain of the system, $(S/N)_o$ = signal to noise ratio required for the chosen BER, M_j = jammer to signal ratio, and L_{sys} = system losses (not more than 2 dB.)

[10] *See* letter from the Office of Engineering and Technology to Mr. James A. Kirkland, counsel for Microlor, Inc. dated February 13, 1998.

approach will provide greater assurance that the systems are in compliance. Accordingly, we propose to amend the rules to require manufacturers of direct sequence spread spectrum systems that use a spreading rate less than 10 chips per symbol to submit the results of the jamming margin test as well as a calculation of processing gain to verify compliance. We seek comment on this proposal. Commenters in support of the proposal should supply sample calculations of system processing gain using this procedure.

PROCEDURAL MATTERS

A. Regulatory Flexibility Act

16. As required by Section 603 of the Regulatory Flexibility Act, 5 U.S.C. § 603, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the expected impact on small entities of the proposals suggested in this document. The IRFA is set forth in Appendix A. Written public comments are requested on the IRFA. These comments must be filed in accordance with the same filing deadlines as comments on the rest of the *Notice*, but they must have a separate and distinct heading designating them as responses to the IRFA. The Secretary shall send a copy of this *Notice*, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration in accordance with Section 603(a) of the Regulatory Flexibility Act, 5 U.S.C. § 603(a).

B. *Ex Parte* Rules -- Permit-But-Disclose Proceedings

17. This is a permit-but-disclose notice and comment rule making proceeding. *Ex parte* presentations are permitted, except during any Sunshine Agenda period, provided they are disclosed as provided in the Commission's rules. *See generally* 47 C.F.R. §§ 1.1200(a), 1.1203, and 1.1206.

C. Authority

18. This action is taken pursuant to Sections 4(i), 301, 302, 303(e), 303(f), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 301, 302, 303(e), 303(f), and 303(r).

D. Comment Dates

19. Pursuant to Sections 1.415 and 1.419 of the Commission's rules, 47 C.F.R. §§ 1.415, 1.419, interested parties may file comments on before [75 days after publication in the Federal Register], and reply comments on or before [105 days after publication in the Federal Register]. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS) or by filing paper copies. See Electronic Filing of Documents in Rulemaking Proceedings, 63 Fed. Reg. 24,121 (1998).

20. Comments filed through the ECFS can be sent as an electronic file via the Internet to <http://www.fcc.gov/e-file/ecfs.html>. Generally, only one copy of an electronic submission must be filed. If multiple docket or rulemaking numbers appear in the caption of this proceeding, however, commenters must transmit one electronic copy of the comments to each docket or rulemaking number referenced in the caption. In completing the transmittal screen, commenters should include their full name, Postal Service mailing address, and the applicable docket or rulemaking number. Parties may also submit an electronic comment by Internet e-mail. To get filing instructions for e-mail comments, commenters should send an e-mail to ecfs@fcc.gov, and should include the following words in the body of the message, "get form <your e-mail address>." A sample form and directions will be sent in reply.

21. Parties who choose to file by paper must file an original and four copies of all comments, reply comments and supporting comments. If participants want each Commissioner to receive a personal copy of their comments, an original plus nine copies must be filed. If more than one docket or rulemaking number appear in the caption of this proceeding, commenters must submit two additional copies for each additional docket or rulemaking number. All filings must be sent to the Commission's Secretary, Magalie Roman Salas, Office of Secretary, Federal Communications Commission, 445 12th Street, SW, Washington, DC 20554. Comments and reply comments will be available for public inspection during regular business in the FCC Reference Center (Room TW-A306) , 445 12th Street, SW, Washington, DC 20554.

ORDERING CLAUSES

22. IT IS ORDERED that, pursuant to Sections 4(i), 301, 302, 303(e), 303(f), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 301, 302, 303(e), 303(f), and 303(r), this Notice of Proposed Rule Making is hereby ADOPTED.

23. IT IS FURTHER ORDERED that the Commission's Office of Public Affairs Reference Operations Division, SHALL SEND a copy of this Notice of Proposed Rule Making, including the Initial Regulatory Flexibility Act, to the Chief, Counsel for Advocacy of the Small Business Administration.

24. For further information concerning this *Notice*, contact Neal McNeil, Office of Engineering & Technology, (202) 418-2408, TTY (202) 418-2989, email nmcneil@fcc.gov.

FEDERAL COMMUNICATIONS COMMISSION

Magalie Roman Salas
Secretary

APPENDIX A

Initial Regulatory Flexibility Analysis

As required by Section 603 of the Regulatory Flexibility Act,[1] the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the expected significant economic impact on small entities by the policies and rules proposed in this *Notice of Proposed Rule Making (Notice).* Written public comments are requested on the IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments on the *Notice* provided above. The Commission shall send a copy of this *Notice*, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration in accordance with paragraph 603(a) of the Regulatory Flexibility Act.

A. Reason for Action.

This rule making proceeding is initiated to obtain comment regarding proposed changes to the regulations for non-licensed transmitters.

B. Legal Basis.

The proposed action is taken pursuant to Sections 4(i), 301, 302, 303(e), 303(f), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 301, 302, 303(e), 303(f), and 303(r).

C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules Will Apply.

For the purposes of this NPRM, the RFA defines a "small business" to be the same as a "small business concern" under the Small Business Act, 15 U.S.C. § 632, unless the Commission has developed one or more definitions that are appropriate to its activities.[2] Under the Small Business Act, a "small business concern" is one that: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) meets any additional criteria established by the Small Business Administration (SBA).[3] SBA has defined a small business for Standard Industrial Classification (SIC) category 4812 (Radiotelephone

[1] 5 U.S.C. § 603.

[2] *See* 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 5 U.S.C. § 632).

[3] 15 U.S.C. § 632.

Communications) to be small entities when they have fewer than 1500 employees.[4] Given this definition, nearly all such companies are considered small.

D. Description of Projected Reporting, Recordkeeping and Other Compliance Requirements.

Part 15 transmitters are already required to be authorized under the Commission's certification procedure as a prerequisite to marketing and importation. See 47 C.F.R. §§ 15.101, 15.201, 15.305, and 15.405. The changes proposed in this proceeding would not change any of the current reporting or recordkeeping requirements. Further, the proposed regulations adds permissible measurement techniques and methods of operation. The proposals would not require the modification of any existing products.

E. Significant Alternatives to Proposed Rules Which Minimize Significant Economic Impact on Small Entities and Accomplish Stated Objectives.

None.

F. Federal Rules that May Duplicate, Overlap, or Conflict With the Proposed Rule.

None.

[4] 13 C.F.R. § 121.201.

APPENDIX B

Proposed Rule Changes

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

We propose to amend Title 47 of the Code of Federal Regulations, Part 15, as follows:

Section 15.247 is proposed to be amended by revising paragraphs (a)(1)(ii), (b)(1), and (e); redesignating paragraphs (b)(2), (b)(3), and (b)(4) as (b)(3), (b)(4), and (b)(5), respectively; and by adding new paragraphs (a)(1)(iii), (b)(2), and (e)(3) to read as follows:

Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

(a) * * *

(1) * * *

* * * * *

(ii) Frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 75 hopping frequencies. The 20 dB bandwidth of the hopping channel may be 1 MHz, 3 MHz, or 5 MHz. If the 20 dB bandwidth of the hopping channel is 1 MHz, the average time of occupancy on any frequency shall not be greater that 0.4 seconds within a 30 second period. If the 20 dB bandwidth of the hopping channel is 3 MHz, the average time of occupancy on any frequency shall not be greater than 0.05 seconds within a 3.75 second period. If the 20 dB bandwidth of the hopping channel is 5 MHz, the average time of occupancy on any frequency shall not be greater than 0.02 seconds within a 1.5 second period.

(iii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(b) * * *

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band:
- (i) 1 watt if the 20 dB hopping channel bandwidth is 1 MHz.
- (ii) 0.32 watt if the 20 dB hopping channel bandwidth is 3 MHz.
- (iii) 0.20 watt if the 20 dB hopping channel bandwidth is 5 MHz.

(2) For frequency hopping systems operating in the 5725-5850 MHz band and for all direct sequence systems: 1 watt.

* * * * *

(e) The processing gain of a direct sequence system shall be at least 10 dB. The processing gain represents the improvement to the received signal-to-noise ratio, after filtering to the information bandwidth, from the information coding process and the spreading/despreading function. The processing gain may be determined using one of the following methods:

* * * * *

(3) For systems that employ a spreading rate less than 10 chips/symbol the results of the CW jamming margin test described in paragraph (2) must be supported by a separate mathematical calculation of system processing gain. Alternatively, processing gain may be determined by using the jamming margin test procedure described in paragraph (2), except that the interfering signal used must be Guassian noise.