DOCKET FILE COPY ORIGINAL

EX PARTE OR LATE FILED

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

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

To: The Commission

Reply Comments of Donald V. Lemke, WB9MJN

June 5, 1997

INTRODUCTION

I was first licencsed in 1973, and have been active in Amateur Radio since that time. I have held an Amateur Advanced class license for most of this time. I hold a BSEE degree from the University of Illinois at Urbana-Champaign. My activities in Ham Radio have included operation in the Shortwave (HF), VHF and Microwave portions of the Amateur allocations. Included in this activity has been Satellite communications, Terrestrial Weak Signal communications, Packet Radio (on HF and VHF) and technical developements (modifications of radios to data communications, radio system design for data and implementation, communication circuit system design and implementation, antenna design). I am a member of the Tucson Amateur Packet Radio Corporation. These comments are my own, however.

DISCUSSION

1) It has been apparent to me that the Commision's rules regarding Amateur Spread Spectrum have been so restrictive as to make Spread Spectrum an unviable technique in Ham Radio. Particularily the present limitation to a few particular spreading codes, reduces the possibilty of multiple access techniques using Spread Spectrum, to the impractical. In a frequency domain access world, the present Spread Spectrum limitations are akin to lumping all activity in a band of allocations, to a few of the frequencies clustered around the middle of the band. I support the NPRM's rule changes to allow the use of any spreading code, with any spreading technique.

2) I do not support narrow band forms of identification (ID) for Amateur Radio Spread Spectrum emissions. This would be a counter-productive decision. In addition to causing interferance to narrowband users and wasting the bandwidth-time-area resource, the ID function would become useless when more than one spread spectrum signal is in range. Since the intended applications for Amateur Spread Spectrum (at this time) is mostly for bursty data transmissions (carrying voice, data or video), the spread spectrum emissions would need to ID continuously, and at a rate beyond human capability to copy. Even with electronic aids to slow down the ID, the coincidence of two or more signals, while copied in the Coded domain , would interfere in the narrow band frequency domain, and eliminate the usefulness of the transmitted ID's. Thus, its apparent that the best place for identification, is in the Coded domain. Direction finding and transmitter hunting has always been the penultimate method of ID, and will suffice in the transition period as Spread Spectrum is adopted. As the Spread Spectrum technology becomes omnipresent, the capabilty to examine transmission contents will also become omnipresent.

3a) The interferance calculations presented by two of the commentors, references 1,1a,2

and 2a, I find to be in gross error. I recommend the Commission have those, and the following comments evaluated by its technical staff. The use of free space attenuation as the loss between a Spread Spectrum station and other stations is wrong. Since both these stations are terrestrially located, some correction for Fresnel Loss, or another propagation model needs to be included. The Fresnel loss in this situation is typically around 20 dB. Reference 3 and 4 gives a good overview of the Fresnel loss in terrestrial radio wave propagation. Additonally, the terrestrial noise enviorment is not taken into account at all. When an antenna is pointed to the horizon, it will receive energy from manmade noise sources, such as AC power transmission equipment, vehicles, appliance motors, arc welding equipment, and other sources. A good estimate of this noise level is found in Reference 4. In which, a suburban average noise level equivalent to an antenna noise temperature of 3000 degrees Kelvin is given for 440 Mhz. My calculations also include a 1 dB feed line loss between the antenna and a 1 dB NF Radio. The 1 dB feed line loss is representative of Transmit/Receive switching circuitry (or relay), and the connections from this circuitry (or relay) to the antenna. A 1 dB NF Radio was used in the calculations, in Reference 2a. Utilising the formula for Reciever Noise Power (reference 4) , for one Hz Bandwidth, I estimate the noise floor of a terestrially pointed antenna in the average suburban enviorment is different than in reference 2a. My estimate is 16.4 dB higher than that given in reference 2a.

Receiver Noise Temperature (Te, in degrees Kelvin) =

Tant + (LF-1) Tamb

where Tant is the Antenna Noise Temperature,
Tamb is the temperature of the ambient enviorment
L is the feedline loss between antenna and radio expressed in power ratio (L = Antilog (dB/10))
F is the noise factor of the radio expreseed in a factor of noise figure, ie (F = Antilog (NF/10))

Plugging in values:

Tant = 3000 degrees F,
Feedline Loss = 1 dB, thus L = 1.25
Noise Figure = 1 dB, thus F = 1.25

Te = 3000 + (1.6-1)290 = 3170 degrees Kelvin

Receiver Noise Power (in dBm/hz) = -198.6 + 10 LOG (Te)

= -198.6 + 10 LOG (3170)
= -163.6 dBm/hz
= -193.6 dBW/hz

3b) With a 20 dB fresnel loss, and the above, real world estimate of noise floor, we can see that the Spread Spectrum signal at 20 km, as described in reference 2a, results in a noise floor increase of 13.6 dB, versus the reference 2a value of 50 dB. 20 dB off-boresite antenna rejection, typical of the antennas used for weak signal comunication, will put the Spread Spectrum signal described in Reference 2a below the Weak Signal station receiver noise floor by 6.4 dB. This analysis shows that, on average, Spread Spectrum interferance is no more a problem for weak signal terrestrial, and horizon pointing space (satellite and EME) communications, than noise sources that already exist in the radio enviorment.

3c) It may be said that there are "quiet" rf locations that may have less than the 3000 degree Kelvin antenna temperature. But, there are also much noisier locations too. Quiet locations tend to be far removed from population centers, and thus also far removed from much of the forseen Spread Spectrum activity. Use of directional antennas, and Automatic Power Controlled power levels by the Spread Spectrum users, causes the analysis to predict even less interferance potential than shown above. Consequently, I believe that on average, the conclusion in the previous paragraph is a good judgement.

3d) Spread Spectrum does seem to be a problem for narrowband, high orbit and EME space communications with the highly economic antennas in typical ham usage. With the antenna pointed skyward, the noise power of a 1 dB NF radio, with a 1 dB feed line loss, would be: -198.6 + 10 LOG (464) = -171.9 dBm/Hz, or -201.9 dBW/Hz. Antenna rejection, remains at 20 dB, however. And thus the noise floor caused by the reference 2a example Spread Spectrum station would rise by 1.9 dB (including the antenna rejection). When a ham satellite is in high orbit, the signal from it is typically only 20 dB above the noise floor as received by a Ham Radio Earth station. I estimate that Spread Spectrum signal would cause narrowband space communications with high satellites to be effected in the 440 Band. At higher frequencies, superior antenna rejection is possible cheaply. Indeed, superior antenna rejection is possible on 440, but not with the presently deployed, highly economic antennas. Even the presently deployed antennas have directions that are up to 40 dB below the main beam, but not everywhere off the main beam. A 40 dB antenna rejection of the terrestrial Spread Spectrum signal, would put the Spread Spectrum Signal 18.1 dB below the noise floor of the receiver. An example of a 440 Mhz space communications antenna that has a 40 db rejection, off boresite is the "Helicone" antenna, as described in reference 5.

3e) In present circumstances, I would confine my 440 Band Spread Spectrum emissions main lobe to two portions of the 440 Band, 420 to 431 Mhz and 439 to 450 Mhz. Rather than to spread completely across the complete 420 to 450 band. Thus, a similar low power spectral density would occur on 432 and 435 to 438 Mhz. I would do this, mainly because of the problem with Space Communications, detailed in the previous paragraph. And altho, I do not predict that terestrial Weak Signal communications to be greatly impacted by Spread Spectrum on 432 Mhz, I still would avoid it. So as to minimise the chances that a Weak Signal Ham might take exception, and park their 200 watt high gain antenna equipped minivan in front of my residence, and send 8 KW of ERP into my residence as a way to make his point. The FCC does not need to regulate Spread Spectrum subbands, howerver. It already has made a rule that Amateur Radio Operators are to follow "good engineering practice". Hams have shown themselves capable of this. FM Operations do not occur on 432 Mhz to a degree that Weak Signal communications are effected. Hams can handle the use of Spread Spectrum, similarily. As time happens, and our service learns what Spread Spectrum is, and is not, things may change. The Commission should allow for practical Spread Spectrum to begin.

4) While this NPRM does not include provissions for Spread Spectrum at lower Amateur Radio allocations than 420 Mhz, there is also a point I would like to make about those bands, with regard to intereferance of weak signal operations. In 6 meters, 2 meters, and 1.25 meter band allocations, all the weak signal activity occurs on the lower edge of the band. This can easily be programmed out of a Frequency Hopping system, along the lines of coordination. Direct Sequence Spread Spectrum, has a spectral density on the band edges that is neccassarily low, so as to not bleed out of the band. Indeed, the main lobe of the SIN X/X power spectral density function, would typically have its first or second null set right on the band edge. Power spectral density of the modulation would then be 20 dB weaker, at those band edges, than the maximun amplitude. Thus, 6 meters and 1.25 meters could readily be used for Spread Spectrum, with even less interferance potential to Weak Signal activities than on the 440 Mhz Ham Band. Altho the 2 meter band is effectively split in two by the international space communications allocation. It can still be used for Spread Spectrum. Frequency Hopping is possible by programming hopping to avoids 144 to 144.3 and 145.8 to 146.0 Mhz. Direct Sequence is possible using a 2 Mhz maximun bandwidth emission. Such that the Direct Sequence emission main lobe edges with much less amplitude, occur at 144 and 146 Mhz (centered on 145 Mhz). These points are simply more of that "good engineering practice", which hams are capable of working out, without any more regulation, but the "good engineering practice" provisions of the rules.

CONCLUSION

The ARRL and the FCC are to be applauded for making an effort to reduce the regulatory limitations, that are holding back Amateur Radio Spread Spectrum experimentation and developement. The NPRM 97-12 needs a tweak. I do not believe that the ARRL forsaw that the narrowband ID, such as by CW, would represent a detriment to narrowband Amateur Radio users, when they proposed it. Nor that it would not work in a bursty transmissions

enviorment. The requirement for narrowband ID, such as by CW, should be dropped from the the final rule.

Comments to the Commission in this matter by Tynan, and those based on Tynan's calculations, should not be used as fact by the Commission. As shown by my numbers, Tynan has not modeled the terrestrial radio enviorment, to a useful accuracy.

The Commission already has a "Good Engineering Practice" provission within its regulations. There is no reason to limit Spread Spectrum operations to subbands by further regulation. This will allow for technological changes, and operational changes within the Amateur Radio service, as Spread Spectrum has an effect. It would be wise to reinforce the "Good Engineering Practice" provission, in the wording of the final report and order. It is sometimes neccassary to remind zealots, on both sides of an issue to be respectful of other people's interests and activities.

I believe that if the Commission were to act to allow for Spread Spectrum activity on 6 meter, 2 meter, and 1.25 meter Amateur Radio allocation, that minimul problems with interferance to present activities would occur. Given Spread Spectrum was used with "Good Engineering Practice".

References:

1) Comments of the Radio Amateur Satellite Corporation (in the matter of FCC WT Docket Number 97-12), May 5, 1997, Dr. Perry I. Klein, W3PK

1a) Reply Comments of the Radio Amateur Satellite Corporation (in the matter of FCC RM-8737), March 11, 1996, William A. Tynan, President

2) Comments of William A. Tynan, W3XO (in the matter of FCC WT Docket Number 97-12), May 2, 1997, William A. Tynan, W3XO

2a) Reply Comments of William A. Tynan, W3XO (in the matter of FCC RM: 8737), March 11, 1996, William A. Tynan, W3XO

3) "Radio Propagation Fundamentals", Kenneth Bullington; Bell Systems Technical Journal, Volume XXXVI, #3, May 1957

4) Reference Data for Radio Engineers, 6th Edition, Copywrite 1977, Howard W. Sams & Co., Inc.

5) "The Helicone - A Circularly Polarized Antenna with Low Sidelobe Level", Keith R. Carver - Ohio State University Radio Observatory, Proceedings of the IEEE, April 1967, Page 559.

RESPECTFULLY SUBMITTED,

Donald V. Lemke

Donald V. Lemke, WB9MJN
530 East Fifth Avenue, #12
Naperville, IL
60563