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Marlene H. Dortch, Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Washington, DC 20554

Subject: Petition for Rulemaking

Dear Ms Dortch::

Please find my petition for rulemaking proposing in the rules governing the Amateur Radio Service. I have enclosed the original unstapled petition and 4 copies. I have also enclosed an extra copy of the first page of the petition, and enclosed a postage stamped, self-addressed envelope. Please stamp the page and return it to me at your earliest possible convenience.

Best regards,

Mark Miller
Amateur Radio Operator N5RFX

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List ABCDE
WTB 07-19

Before the

Federal Communications Commission

Washington, D.C. 20554

In the Matter of AMENDMENT OF PART 97 OF THE COMMISSION'S RULES GOVERNING THE AMATEUR RADIO SERVICE TO IMPLEMENT CHANGES TO SECTION 97.3(c)(2), 97.221 AUTOMATICALLY CONTROLLED DIGTAL STATION 97.305 AUTHORIZED EMISSION TYPES, 97.307 EMISSION STANDARDS, AND 97.309 RTTY AND DATA EMISSION CODES.	)	RM-

To: The Chief, Wireless Telecommunications Bureau

PETITION FOR RULE MAKING

Mark Miller Amateur Radio Operator N5RFX pursuant to Section 1.401 of the Commission's Rules, 47 C.F.R. 51.401, hereby respectfully requests that the Commission issue at an early date a Notice of Proposed Rule Making, proposing changes requested herein in the rules governing the Amateur Radio Service

I. Introduction

1. PR Docket No 88-139 was released in 1988[1] and established the current methodology in separating inharmonious emissions in the Amateur Radio Service 80

[1] Reorganization and Deregulation of Part 97 of the Rules Governing the Amateur Radio Services.PR Docket No 88-139

through 10-meter bands. The recent Commission Report and Order FCC 06-149[2] released October 10, 2006 and FCC 06-178[3] released December 19, 2006 made some changes to the Amateur Radio service that affect the utilization of spectrum. This petitioner feels it is time that the Commission and the Amateur Radio Community re-evaluate bandwidths, station control, protocols, and modes. This petition specifically addresses narrow emissions in the 80 through 10-meter bands and changes to Part 97 made necessary due to changes in technology. Emissions have crept into the narrowband RTTY/Data subbands in the 80 through 10-meter bands that are not appropriate for the RTTY/Data subbands. Stations under automatic control have taken advantage of loopholes created by terminology in the commission's rules that is not applicable to new operating modes. The expected surge in operators authorized to operate in the H.F. bands due to the changes outlined in FCC 06-178[4], require us to look again at the current division between wide bandwidth and narrow bandwidth emissions to reduce interference among stations using narrow bandwidth communications, thereby benefiting all licensees.

II. Executive Summary

2. In this *Petition for Rule Making,* I recommend amending the Part 97 Amateur Radio Service rules as follows:

- 97.3(c)(2) to return to the definition of data prior to FCC 06-149
- 97.221 to clarify what is an automatically controlled digital station.
- 97.305 to enumerate bandwidths in the current RTTY/Data subbands along with the current ITU emissions designators.

[2] FCC 06-149 REPORT AND ORDER Adopted: October 4, 2006 Released: October 10, 2006
[3] FCC 06-178 REPORT AND ORDER Adopted December 15, 2006 Released December 19, 2006
[4] R&O for WT Docket 05-235

- 97.307(f) delete (3) through (13).

III. Background

A. Separation of Narrowband Emission Types

3. Historically mode emissions have been segregated to protect narrowband modes from interference. Communications modes and protocols have been introduced that do not fit the definition of the standard RTTY/Data emissions that have dominated amateur radio for many years. PR Docket No 88-139 was released in 1988 and from this docket we have the foundation of our current part 97 rules with respect to emissions. In this docket the Commission states: "We wish to recognize and encourage the experimental nature of the amateur service. It is appropriate to avoid, to the extent possible, placing in the rules detailed regulations and specifications for the configuration and operation of various amateur communications systems. Such regulations and specifications would reduce the flexibility that is a hallmark of a service free to branch out and follow an infinite number of paths.... This enables amateur operators to utilize their individual stations in creating and pioneering communication systems that are limited only by their personal interests, imagination and technical skills." Under advancing the radio art the Commission states: "It is our intent that amateur operators in the United States be allowed to experiment with the full range of modulation types." The Commission further states: " The principal use of emission designators in regulations for the amateur service is to relegate the transmission of certain inharmonious emission types to different segments of the frequency bands." Clearly the Commission intends to allow amateurs

latitude to experiment with differing modulation schemes, but it is also clear that the Commission intends to segregate emission types.

4. This methodology was followed in the recent Commission Report and Order FCC 06-149 released October 10, 2006[5]. The commission stated, "We believe that separation of emission types by bandwidth is accepted in the amateur service as a reasonable means to minimize interference on shared frequencies and bands and wide bandwidth emissions". Historically, the amateur radio community has resisted enumerating bandwidths as a means of mode separation. In 1977 the FCC issued Docket 20777[6] with the goal to de-regulate the amateur radio service and to streamline part 97. One aspect of Docket 20777 was to eliminate emission segregation and replace it with bandwidth segregation. One concern that Amateur radio operators had with docket 20777 was with the way the bandwidths were assigned. Certain emission types could not operate where they had traditionally operated. AM enthusiasts for example could only operate above 28 MHz. The amateur radio community filed comments with the Commission opposing the bandwidth segregation of docket 20777 and the commission did not adopt those changes. The resistance to segregation by bandwidth is greatest when it is applied to the Phone/Image bands[7]. There are two reasons for this. First, there is such a variety of equipment used in the Phone/Image bands, that enumerating bandwidths could be troublesome for vintage, homebrew (do it yourself), and high fidelity operators.

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[5] Amendment of Section 97.305(c) to Authorize Image Emissions in Additional High Frequency Segments FCC 06-149 REPORT AND ORDER Adopted: October 4, 2006
Released: October 10, 2006

[6] FCC Docket 20777

[7] Comments from Bob Heil, K9EID, Glen E. Zook, Brad Hollander, Andrew E. Howard, Sr. and Donald B. Chester, K4KYV to RM-10740 to Establish Technical Standards for Certain Amateur Radio Telephony Transmissions

Second, there exists a traffic leveling affect by not allowing data emissions in the Phone/Image sub-bands.[8] When only a bandwidth is enumerated data emissions become authorized and it is possible that there will be an increase in interference because of increased traffic.[9] The petitioner agrees that there could be some benefit to mixing data, phone, and image emissions, but the necessary tests have not been performed to insure that this mixing is will not cause interference because of an increase in traffic. For this reason, the petitioner chooses not to recommend any changes to the Phone/Image subbands, but chooses to concentrate the recommendations in the RTTY/Data subbands.

5. The commission provides bandwidth guidance for the RTTY/Data subbands in 97.307(f)(3) and 97.307(f)(4). When employing the formulae of Part 2.202 for a frequency modulation, signal with quantized or digital information, and telegraphy without error-correction, the necessary bandwidths derived are 1.5 kHz and 2.4 kHz respectively. 97.307(f)(3) and 97.307(f)(4) speak specifically about FSK[10]. Since 1988 when these clauses were written[11], other forms of digital emissions have become available to the amateur radio operator. This has created confusion because while 97.307(f)(3) and 97.307(f)(4) set a maximum Baud rate and shift, these terms are not clear when used with non-FSK emissions.[12] This has allowed a mode to proliferate that

[8] The 80 through 10-meter bands are separated into RTTY/Data and Phone/Image subbands by 47 CFR 97.3(c)

[9] by 47 CFR 97.3(c) does not authorize RTTY/Data emissions in the Phone/Image subbands

[10] FSK Frequency Shift Keying, frequency modulation in which the modulating signal shifts the output frequency between predetermined values. Usually, the instantaneous frequency is shifted between two discrete values termed the " mark " and "space" frequencies. A variation can use more than two frequencies.(4, 8, 16 and so forth) transmitted according to a group of consecutive data bits.

[11] PR Docket No 88-139

[12] Phase Shift Keying (PSK) is a digital transmission using angle modulation in which the phase of the carrier is discretely varied in relation either to a reference phase or to the phase of the immediately

does not comply with the intent of separation of emission types by bandwidth. We now find an emission in the RTTY/Data subbands that approaches the bandwidth of emissions found in the Phone/Image subbands. This type of modulation is excellent for recovering signals sent over a radio paths subject to multi-path and signal-fading due to the fact that all tones will not fade at the same time. When data is coded and spread over all the subcarrier tones, the performance can be better than the same radio circuit using only FSK modulation. Since the bandwidth is shared, there needs to some protection for the narrower bandwidth emissions. The Amateur Radio service would still rely on voluntary band planning to divide the amateur service spectrum among operating interests as new operating interests and technologies emerge or operating interests and technologies fall into disfavor. This is especially true in the RTTY/Data portions of the HF subbands. CW operators have always enjoyed preferred use of the spectrum in the lower parts of the RTTY/Data subbands, and there is no reason why this should not continue. Eventually the commission may be able to remove all regulatory segmentation, but this will have to be pursued slowly and with great care. This petitioner feels it is time to modify the rules for the RTTY/Data subbands to again provide for the protection of narrowband emissions from wideband emissions that is accepted in the amateur service as a reasonable means to minimize interference.

B. Automatically Controlled Digital Stations

6. The commission has set aside specific subbands for use by automatically controlled stations[13] in the Report and Order adopted April 17, 1995.[14] At that time the

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preceding signal element, in accordance with data being transmitted. Frequency shift does not apply to this type of modulation.

[13] 47 CFR 97.3(a)(6) The use of devices and procedures for control of a station when it is transmitting so that compliance with the FCC Rules is achieved without the control operator being present at a control point.

only emissions found in the RTTY/Data subbands were CW, RTTY.AMTOR, and PACTOR. Since 1995, the availability of personal computer sound cards and their flexibility in producing new emissions has increased the use of this spectrum. At the same time there has been a decrease in the use of AMTOR and PACTOR in traditional Amateur radio operations, with Pactor III being used nearly exclusively by digital stations under automatic control. The subbands set aside for use by automatically controlled stations are seeing increases in activity with newly developed modes that are not automatically controlled. When the Report and Order, FCC 95-163 was adopted, the Commission challenged the Amateur radio community to minimize interference with novel technical and operational approaches to the use of shared frequency bands[15]. To date, there have been no technical innovations to minimize interference. Quite the opposite has taken place. The primary emission for automatically controlled stations uses multiple bandwidth emissions during operation. During optimal conditions, the bandwidth increases from 500 Hz to 2.2 kHz without determining if the wider spectrum is occupied. The prevailing attitude has become "With NO channelization on the Amateur bands, anyone who purposely puts themselves into the Part 97.221 frequency range, expecting silence, is unaware of the purpose of the sub-band." The algorithms and attitudes of this small group are contrary to the accepted methods of spectrum sharing used by Amateur radio operators.

IV. Discussion

A. Separation of Narrowband Emission Types

[14] FCC 95-163 PR Docket 94-59
[15] FCC 95-163 PR Docket 94-59 paragraph 6.

7. The petitioner respectfully asks the commission in addition to enumerating specific emissions by ITU emissions designator also to enumerate a maximum necessary bandwidth in what is now known as the RTTY/Data subbands. Making this change will restore the separation of emissions by bandwidth that has been lost due to changes in technology. Emission enumeration using ITU emissions designators should continue in the Phone/Image subbands, until proper analysis of the affects of bandwidth enumeration have been made.[16] The commission has given Amateur radio operators guidance as to maximum bandwidths in the RTTY/Data subbands in 97.307(f)(3) and 97.307(f)(4). Since this guidance by the commission was written in 1988, when FSK was the only non-CW digital emission, it makes reference to Baud and maximum shift. Maximum shift is only applicable to FSK type emissions. Since the time that 97.307(f)(3) and 97.307(f)(4) were written, phase shift keying emissions have become available to Amateur radio operators because of the proliferation of digital signal processors[17]. These allow generation of parallel PSK signals that were not possible with hardware within the reach of Amateur radio operators in 1988.[18] This change in technology puts in question the definition of symbol, which is the basic unit of measure when using Baud[19], and it also puts into question the use of shift. 97.307(f)(3) and 97.307(f)(4) have served the amateur radio community well over the years, but can no longer be the recommendation for maximum bandwidth because of changes in emissions due to technology changes. 97.307(f)(3) and 97.307(f)(4) no longer provide the separation of certain inharmonious

[16] Discussion continues whether allowing data emissions in the Phone/Image bands will cause congestion and increase interference.

[17] a special type of coprocessor designed for performing the mathematics involved in manipulating analog information. Personal computer sound cards are an example of a digital signal processor.

[18] an example is Orthogonal frequency-division multiplexing (OFDM), a method of digital modulation in which a signal is split into several narrowband channels at different frequencies.

[19] Baud is symbols per second.. A symbol is a unique state of a channel, it may be the phase or frequency of a carrier. The question with OFDM is what constitutes a symbol?

emission types to different segments of the frequency bands. An example of a wideband emission found in the RTTY/Data subbands is PACTOR III. PACTOR III is designed specifically for the commercial market to provide higher throughput and improved robustness utilizing a complete SSB channel of 2.2 kHz. Up to 18 tones are used in optimum propagation conditions, spaced at 120 Hz.[20] The bandwidth of this commercial protocol is authorized today because the feeling among the Pactor III operators is that 97.307(f)(3) does not apply to Pactor III because of the meaning of Baud, Symbol and shift are in question. The physical data rate on all PACTOR III speed levels is 100 baud, but many Amateur radio operators feel that traditional bandwidth limits have been exceeded because parallel tones are being transmitted which circumvent the intention and spirit of 97.307(f)(3). During optimal conditions the bandwidth is 2.2 kHz, this is contrary to the accepted methods of spectrum sharing used by Amateur radio operators. When band conditions are optimal, more stations appear on the bands and bandwidth should be conserved. In the commercial services, such as those found in parts 80 and 90 of the Commission's rules, this type of emission would be acceptable due to the fact that these services are channelized. Because of the necessary bandwidth and protocol used to determine bandwidth, Pactor III is inharmonious and incompatible with the accepted operating principles of Amateur radio on the HF bands. Since the principal use of emission designators in regulations for the Amateur radio service is to relegate the transmission of certain inharmonious emission types to different segments of the frequency bands and separation of emission types by bandwidth is accepted in the amateur service as a reasonable means to minimize interference on shared frequencies, I

[20] The PACTOR-III Protocol Technical Description by Hans-Peter Helfert and Thomas Rink SCS GmbH & Co. KG, Hanau, Germany. See appendix B.

respectfully ask the commission in addition to enumerating specific emissions by ITU emissions designator also enumerate a maximum necessary bandwidth in what is now known as the RTTY/Data subbands.

8. Two bandwidths are appropriate for what is now the RTTY/Data subband, 1.5 KHz and 2.4 kHz. The selection of these two bandwidths should accommodate current modes and not prohibit any emissions currently found in the 80 through 10-meter bands. Pactor III would continue to be authorized, as long as speed levels 1 and 2 are used.[21] 1.5 kHz is appropriate because of the bandwidth guidance for the RTTY/Data subbands in 97.307(f)(3). As stated above when employing the formulae of Part 2.202 for amplitude or frequency modulation, with a signal with quantized or digital information, and telegraphy without error-correction, the necessary bandwidth derived is 1.5 kHz. 1.5 kHz will accommodate emissions in the RTTY/Data subbands where appropriate and is consistent with the intention of 97.307(f)(3). 2.4 kHz is also appropriate because of the bandwidth guidance for the RTTY/Data subbands in 97.307(f)(4). 1.5 kHz bandwidth is appropriate for the 80 through 12 meter bands and 2.4 kHz is appropriate for the 10-meter band. This action will restore the separation of emissions by bandwidth, which has been lost due to changes in technology. The definitions of data in 97.3(c)(2) can return to the definition of data prior to FCC 06-149 since bandwidths for the current RTTY/Data band will be enumerated.[22] Continuing to enumerate emissions by ITU emissions designator in the Phone/Image subbands will continue to prevent other data emissions from

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[21] Speed levels 1 and 2 are independent sub-protocols with distinct modulation and channel coding

[22] The definition of data was change in R&O FCC 06-149 to add image emissions designators to the definition and to set a 500Hz maximum occupied bandwidth for those image emissions.

migrating to the Phone/Image subbands. This action will restore the separation of emissions by bandwidth, which has been lost due to changes in technology..

9. Some Amateur radio operators may be concerned about how to calculate necessary bandwidth.[23] The formulae for calculating necessary bandwidth are in part 2 of the Commission's rules.[24] The most commonly used digital modes will easily meet the 1.5 kHz and 2.4 necessary bandwidth figures.

10. There also may be concern about spurious emissions such as intermodulation distortion affecting occupied bandwidth.[25] When using FSK or AFSK[26] this will not be an issue because FSK and AFSK do not have the same linearity requirements as PSK. For those emissions that do require linearity, reducing the transmitter power by 50 to 60% or until no ALC[27] action is indicated is a well known way to increase transmitter linearity[28]. For every 1 dB of power reduction you get a 3 dB reduction in each third order intermodulation products, and a 5 dB reduction in fifth order intermodulaton products.[29] Third order intermodulation ratio decreases by 2dB for every 1 dB of power reduction. Amateur radio operators are already required by 97.307 to reduce spurious emissions to the greatest extent practicable and for transmitters installed after January 1,

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[23] See example in the comments from Mark Francis KI0PF to RM-10740 to Establish Technical Standards for Certain Amateur Radio Telephony Transmissions

[24] 47CFR2.202

[25] Intermodulation distortion is a function of non-linearity in transmitters and amplifiers.

[26] AFSK (Audio Frequency-shift Keying) is a modulation technique by which digital data is represented as changes in the frequency of an audio tone, yielding an encoded signal suitable for transmission via the audio input of a radio.

[27] ALC Automatic Load (Level) Control maintains the peak R.F. output of a transmitter at a relatively constant level. No ALC action indicates that the transmitter R.F. output its below its peak power.

[28] http://www.arrl.org/tis/info/HTML/psk31/

[29] Mobile Radio Technology page 12 May 1, 2002

2003, the mean power of any spurious emission from a station transmitter or external RF amplifier transmitting on a frequency below 30 MHz must be at least 43 dB below the mean power of the fundamental emission. Whatever method Amateur radio operators are employing to comply with 97.307 today should be employed when limiting spurious emissions with respect to occupied bandwidth. Amateur radio operators, who choose to use emissions with a necessary bandwidth close to the maximum occupied bandwidth, will have to ensure that they are not exceeding the limitation. Few stations will require that type of testing.

B. Automatically Controlled Digital Stations

11. The recent Commission ruling R&O FCC 06-149 released October 10, 2006 expanded the Amateur Radio Service 75-meter band down to 3.6 MHz which compressed the 80 meter band. The commission later modified 97.221 to make the 80-meter digital automatic control subband 3.585 – 3.600 MHz. The increase in traffic expected from the R&O for WT Docket 05-535 and the limited spectrum available to these modes in all bands requires a revision to the authorization and placement of automatically controlled stations. I ask that 97.221 be amended as outlined in appendix A of this petition to limit all unattended operation of a digital station to the current automatically controlled subbands. Furthermore, an unattended station responding to interrogation by a station under local or remote control should continue to be considered an automatically controlled digital station. Unattended and automatic control, regardless of bandwidth, should cease to exist except in the 28.120-28.189 MHz, 24.925-24.930 MHz, 21.090-21.100 MHz, 18.105-18.110 MHz, 14.0950-14.0995 MHz, 14.1005-14.112 MHz,

10.140-10.150 MHz, 7.100-7.105 MHz or 3.585 – 3.600 MHz segments. Since this petition is asking the commission to set a maximum occupied bandwidth of 1.5 KHz in the RTTY/Data subbands of the 80 through 12 meter bands, a small number of wider bandwidth modes will not be authorized.. Pactor III is an example.

12. The design of Pactor III is appropriate for services whose authorized frequencies are channelized, and the authorized bandwidth is fixed.[30] This emission uses 6 speed levels (SL) with varying bandwidth. Table 1 shows the 6 speed levels of Pactor III and the spectral efficiency of each speed level[31]. Dividing the occupied bandwidth by the usable data rate derived the spectral efficiency.

Speed Level	Occupied Bandwidth	Raw Data Rate	Usable Data Rate (bits per sec.)	Spectral Efficiency
1	1000	200	76.8	0.0768
2	1480	600	247.5	0.16723
3	1720	1400	588.8	0.342326
4	1720	2800	1186.1	0.689593
5	1960	3200	2039.5	1.040561
6	2200	3600	2722.1	1.237318

Table 1Pactor III

When conditions are favorable, Pactor III is designed to use speed level 6, and then as propagation conditions become more difficult, the algorithms cause a reduction in speed level and also bandwidth. With Pactor III as propagation conditions worsen, the occupied bandwidth is smaller, and as propagation conditions improve the occupied bandwidth grows. This algorithm is correct for commercial services where channels are assigned and the bandwidths of those channels are fixed. The Pactor III protocol

[30] Services in Parts 80 and 90 examples

[31] Refer to Pactor III protocol definition in appendix B

algorithm is designed to maximize the authorized bandwidth. The Amateur Radio Service is a shared spectrum service where stations are not assigned channels, but are authorized to operate in certain frequency bands. This type of operation is very different from the commercial services. Amateur Radio operators make efficient use of spectrum based on analysis of the propagation conditions and the amount of traffic in the spectrum. Pactor III does not analyze the amount or the presence of traffic in the spectrum. An operator of a station in local or remote control normally performs the traffic analysis function. An operator in local or remote control has the ability to determine if the spectrum is occupied, and the density of the traffic using the spectrum. A station that is in automatic control where no control operator is present does not determine if the spectrum is occupied, and does not determine the density of other stations using the spectrum. Claims are made that an operator, who initiates a session with an unattended station, by default becomes the control operator of the unattended station using automatic control. This is impossible, since there is no mechanism for the initiating operator to determine the density of spectrum use at the untended automatically controlled station. Winlink 2000 is a system that claims to provide a control link to the remote unattended station. The control link does not include the ability for the operator to determine if the frequency at the unattended station is clear. Since the control operator of the initiating station cannot insure that the remote station is complying with the FCC Rules[32] the unttended station is under automatic control. For these reasons, Pactor III does not fit the model where each station licensee and each control operator must cooperate in selecting

[32] 97.3(a)(12)

transmitting channels and in making the most effective use of the amateur service *frequencies.*[33]

13. Pactor II in most cases offers equal spectrum efficiency when compared to the spectral efficiency of Pactor III. PACTOR-II uses various modulation schemes and different code rates, depending on propagation conditions. The bandwidth remains constant at nearly 500 Hz. Table 2 shows the 4 modulation modes of Pactor II and the spectral efficiency of each of those modes[34]. The spectral efficiency was derived from dividing the occupied bandwidth by the usable data rate.

Modulation	**Raw Data Rate**	**Usable Data Rate** (bits per sec.)	**Spectral Efficiency**
DBPSK	200	100	0.2
DQPSK	400	200	0.4
8DPSK	600	400	0.8
16DPSK	800	700	1.4

Table 2 Pactor II

Analysis of these protocols was performed by Rick Meuthing KN6KB and disclosed in a presentation named RF Footprints.[35] A copy of this presentation is included in Appendix D. Figure 1shows Signal to Noise Ratio (S/N) versus Net Bytes/Minute. Pactor I, II, and III were tested at –5, 0, 5, and 10 dB signal to noise ratio. The analysis consisted of sending data between two PTCII[36]modems, though PathSim[37]a PC soundcard channel emulator. PathSim analyzes the average power level of a signal, then calculates the

[33] 97.101(b)
[34] Refer to Pactor II protocol definition in appendix C
[35] http://home.earthlink.net/~k7bfl/RF_Footprints.pdf
[36] Modems from SCS Special Communications Systems GmbH & Co. KG
Roentgenstr. 36 63454 Hanau Germany
[37] PathSim is a Windows program that can be used to simulate radio propagation paths using a soundcard and/or wave files as the source and destination. http://www.qsl.net/ae4jy/pathsim.htm

amount of additive Gaussian White Noise (AGWN) that needs to be added to the signal to produce the proper signal to noise ratio. Mr. Muething averaged 4 channel cases to produce the graph in Figure 1. This graph can be used to show the relative parity between Pactor II and Pactor III with respect to spectrum efficiency. Table 3 summarizes the analysis of the Muething graph. Pactor II bandwidth is constant, while Pactor III bandwidth changes with speed level. Looking at the chart and finding the Net/Bytes per minute and then converting them to bits per second estimated the net data throughput numbers. Pactor II was given an average of 2dB increase in signal to noise ratio over Pactor III because of crest factor. Since these modes are PSK using multiple tones, the peak to average power ratio is always greater than 1. Pactor II has a peak to average ratio of 1.9 dB, while the maximum peak to average ratio for PIII is 5.7 dB for SL 6. Operators must insure that the RF gain in the transmitter is set to accommodate the peak to average ratio. When using a 100W PEP transmitter the PIII average power cannot be more that 27 Watts. The PII average power can be 65 watts, a 4 dB gain over PIII. The result of the analysis shows that on average, Pactor II is equally spectrum efficient as Pactor III. This is confirmed in the testing by Edwin C. Jones AE4TM. Mr. Jones states: "field collected data using amateur equipment (e.g. amateur radio operator transceivers and low gain amateur antennas) show that Pactor-III approaches a data speed of 650 cps and continues to work to an inaudible level of -18 dB S/N. Pactor-II approaches a speed of 140 cps and continues to work to an inaudible level of -18 dB S/N."[38] Figure 2 shows that with a S/N ratio greater than 30 dB, PIII approaches 650 characters per second throughput, and PII approaches 140 cps. Figure 2 also shows that when the signal to

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[38] http://ecjones.org/pactor.html

noise ratio is less than 20 dB, the spectral efficiency of Pactor II begins to exceed the spectral efficiency of Pactor III.

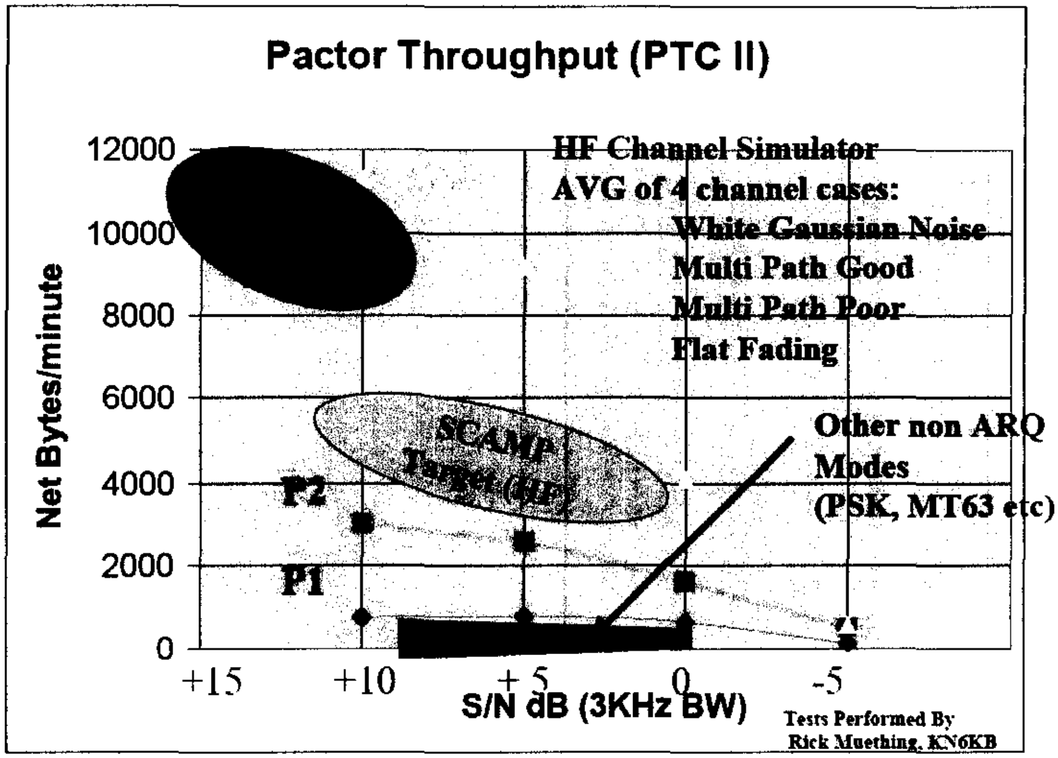

Figure 1 Pactor Mode Comarison

S/N Ratio (dB)	PII Bandwidth (Hz)	PII Net Data Throughput (Bits Per Second)	PII Spectral Efficiency %	PIII Bandwidth (Hz)	PIII Net Data Throughput (Bits per Second)	PIII Spectral Efficiency %	PII/PIII Spectral Efficiency Ratio %
0	500	253	36	1720	533	28	128
5	500	333	48	1720	1200	63	76
10	500	490	70	1960	1511	70	100
						Average Efficiency	102

Table 3 Pactor II and Pactor III Spectral Efficiency Comparison

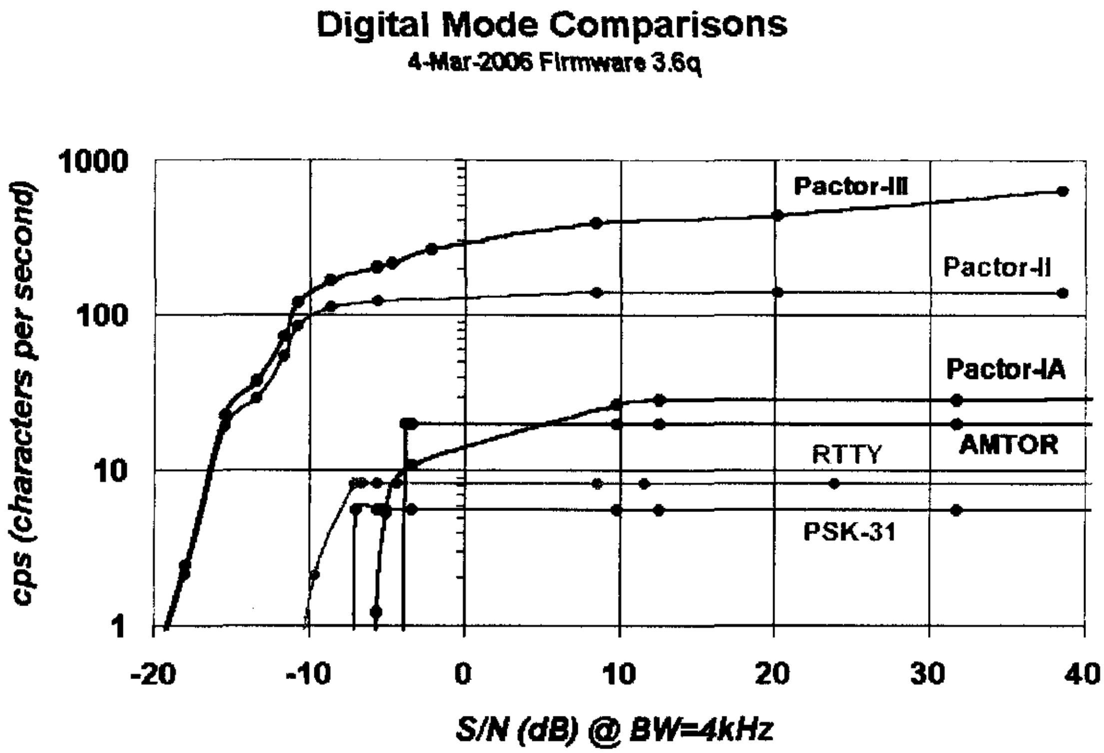

Figure 2 AE4TM Digital Mode Comparisons

S/N Ratio (dB)	PII Bandwidth (Hz)	PII Net Data Throughput (Bits Per Second)	PII Spectral Efficiency %	PIII Bandwidth (Hz)	PIII Net Data Throughput (Bits per Second)	PIII Spectral Efficiency %	PII/PIII Spectral Efficiency Ratio %
0	500	505	72	1720	842	44	163
8	500	589	84	1720	1263	66	127
20	500	589	84	1960	1684	78	108
38	500	589	84	2200	2737	114	74
						Average Efficiency	118

Figure 3 AE4TM Summary

14. Limiting maximum necessary bandwidth to 1.5 kHz will not be detrimental to the stations that use Pactor III. In fact, their spectral efficiency will improve, and the most robust speed levels of Pactor III (SL1 and SL2) will meet the 1.5kHz necessary bandwidth limit in the 80 through 12-meter bands. The 2.4 kHz necessary bandwidth limit in the 10 meter band will still allow all Pactor III maximum speed levels. Limiting

maximum necessary bandwidth to 1.5 kHz will end the use of spectrally inefficient modes and return the RTTY/Data portions of the 80 through 12-meter bands to narrow bandwidth operation. Limiting necessary bandwidth revising the definition and frequency authorization of automatically controlled digital stations will reduce interference among stations using digital communications, thereby benefiting all licensees.

V. Conclusions

15. Technology has changed the way that we look at bandwidths. 97.307(f)(3) does not limit the bandwidths of non-FSK type of emissions now found in the present RTTY/Data subbands, and thus does not provide the separation of certain inharmonious emission types to different segments of the frequency bands. Adding enumerated bandwidths will once again provide separation from wide and narrow bandwidth modes in the present RTTY/Data subbands. Revising the definition of automatic operation, and requiring all automatically controlled digital stations to operate in certain subbands, will reduce interference among stations using digital communications, thereby benefiting all licensees. The definitions of data in 97.3(c)(2) can return to the definition of data prior to FCC 06-149 since 2 bandwidths for the current RTTY/Data band would be enumerated. ITU emissions designators should continue to be used in the Phone/Image subbands to prevent increased traffic from data emissions that could migrate into the Phone/Image subbands.

16. Therefore, the foregoing considered, I Mark Miller Amateur radio operator N5RFX respectfully requests that the Commission issue a Notice of Proposed Rule Making at the earliest possible date, looking toward adoption of the rule changes set forth in the attached Appendix, and adopt the plan herein.

Respectfully yours,

Mark D. Miller
Amateur Radio Operator N5RFX
5612 Trail Crest Dr.
Arlington, TX 76017
(817) 561-5134
November 21, 2006

APPENDIX A

Part 97 of the Commission's Rules would be modified to read as follows:

Section 97.3(c)(2) *Data.* Telemetry, telecommand, and computer communications emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1 as the second symbol; D as the third symbol; and emission J2D. Only a digital code of a type specifically authorized in this Part may be transmitted.

Section 97.221 Automatically controlled digital station.

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(b) A station may be automatically controlled while transmitting a RTTY or data emission on the 6 m or shorter wavelength bands, and on the 28.120-28.189 MHz, 24.925-24.930 MHz, 21.090-21.100 MHz, 18.105-18.110 MHz, 14.0950-14.0995 MHz, 14.1005-14.112 MHz, 10.140-10.150 MHz, 7.100-7.105, or 3.585-3.600 MHz segments.

(c) A station responding to interrogation by a station under local or remote control for purposes of this part is an automatically controlled digital station.

Section 97.305 Authorized emission types.

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(c) Except as otherwise provided in this Section, a station may transmit the following emission types on the frequencies indicated, subject to the following bandwidth limitations where indicated.

Wavelength band	Frequencies authorized	maximum necessary bandwidth	Emission Types Authorized	Standards See §97.307(f) paragraph:
160 m	Entire band	-	RTTY/Data/Phone/Image	(1)
80 m	3.5-3.6 MHz	1.5 kHz	RTTY/Data/Image	
75 m	Entire band	-	Phone/Image	(1)
60 m	5.1675 MHz	2.87 kHz	2K8J3E	See §97.401(c)
-do-	5.332, 5.348, 5.368, 5.373 and 5.405 MHz	2.87 kHz	2K8J3E	See §97.301(s)
40 m	7.000-7.100 MHz	1.5 kHz	RTTY/Data/Image	
-do-	7.075-7.100 MHz	-	Phone/Image	(2)
-do-	7.100-7.150 MHz	1.5 kHz	RTTY/Data/Image	
-do-	7.150-7.300	-	Phone/Image	(1)
30 m	10.10-10.14 MHz	1.5 kHz	RTTY/Data/Image	

-do-	10.140-10.150 MHz	-	RTTY/Data/Image	
20 m	14.00-14.15 MHz	1.5 kHz	RTTY/Data/Image	
-do-	14.15-14.35 MHz	-	Phone/Image	(1)
17 m	18.068-18.105 MHz	1.5 kHz	RTTY/Data/Image	
-do-	18.105-18.110 MHz	-	RTTY/Data//Image	
-do-	18.110-18.168 MHz	-	Phone/Image	(1)
15 m	21.0-21.2 MHz	1.5 kHz	RTTY/Data/Image	
-do-	21.20-21.45 MHz	-	Phone/Image	(1)
12 m	24.89-24.93 MHz	1.5 kHz	RTTY/Data/Image	
-do-	24.93-24.99 MHz	-	Phone/Image	(1)
10 m	28.0-28.3 MHz	2.4 kHz	RTTY/Data/Image	
-do-	28.3-29 MHz	-	Phone/Image	(1)
-do-	29-29.7 MHz	16 kHz	Phone/Image	
6 m	Entire band	20 kHz		
2 m	Entire band	20 kHz		
70 cm	Entire band	-		
33 c	Entire band	-		
23 cm	Entire band	-		
13 cm	Entire band	-		
9 cm	Entire band	-		
5 cm	Entire band	-		
3 cm	Entire band	-		
1.2 cm	Entire band	-		
5 mm	Entire band	-		
4 mm	Entire band	-		
2.5 mm	Entire band	-		
1 mm	Entire band	-		
-	Above 300 GHz	-		

Section 97.307(f) is amended to read as follows:

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(f) The following standards and limitations apply to transmissions on the frequencies specified in § 97.305(e) of this Part.

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(3) through (13) (Deleted)

APPENDIX B

The PACTOR-III Protocol

Technical Description by Hans-Peter Helfert and Thomas Rink
SCS GmbH & Co. KG, Hanau, Germany

Please see the following pages.

The PACTOR-III Protocol

Technical Description by Hans-Peter Helfert and Thomas Rink

SCS GmbH & Co. KG, Hanau, Germany

1. Introduction

Similar to PACTOR-I and -II, PACTOR-III is also a half-duplex synchronous ARQ system. In the standard mode, the initial link setup is still performed using the FSK (PACTOR-I) protocol, in order to achieve compatibility to the previous systems. If both stations are capable of PACTOR-III, automatic switching to this highest protocol level is performed.

While PACTOR-I and -II were developed for operation within a bandwidth of 500 Hz, PACTOR-III is designed specifically for the commercial market to provide higher throughput and improved robustness utilizing a complete SSB channel. A maximum of 18 tones spaced at 120 Hz is used in optimum propagation conditions. The highest raw bit rate transferred on the physical protocol layer is 3600 bits/second, corresponding to a net user data rate of 2722.1 bits/second without compression. As different kinds of online data compression are provided, the effective maximum throughput depends on the transferred information, but typically exceeds 5000 bits/second, which is more than 4 times faster than PACTOR-II. At the low SNR edge, PACTOR-III also achieves a higher robustness compared to PACTOR-II.

The ITU emission designator for PACTOR-III is 2K20J2D.

2. Speed Levels and Bandwidth

Depending on the propagation conditions, PACTOR-III utilizes 6 different speed levels (SL), which can be considered as independent sub-protocols with distinct modulation and channel coding. The physical data rate on all speed levels is 100 baud. Up to 18 tones are used, spaced at 120 Hz. The maximum occupied bandwidth is 2.2 kHz (from 400 to 2600 Hz). The center frequency of the entire signal is 1500 Hz. The tone representing the "lowest" channel is sent at a frequency of 480 Hz, the highest tone is 2520 Hz. As tones are skipped on the two lowest speed levels, the gaps between them increase to N times 120 Hz in these cases. The following table illustrates the number and position of the used channels in the different speed levels.

	CN	0	1	2	3	4	5	6	7	8	9	10	11	12	12	14	15	16	17
SL																			
1							x							x					
2					x		x		x			x		x		x			
3				x	x	x	x	x	x	x	x	x	x	x	x	x	x		
4				x	x	x	x	x	x	x	x	x	x	x	x	x	x		
5			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
6		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	TF	480	600	720	840	960	1080	1200	1320	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520

SL = speed level, CN = channel number, TF = tone frequency [Hz], an "x" indicates that the tone is used in the respective SL