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George W. Henry, Jr.
616 W. Church Street
Champaign, IL 61820

May 14, 1993

Office of the Secretary
FEDERAL COMMUNICATIONS COMMISSION
1919 M Street N.W.
Washington, D.C. 20554

Re: Comments regarding RM-8218

Gentlemen:

Enclosed are comments regarding the Petition for Rule Making (RM-8218) filed by the American Radio Relay League (ARRL) on February 1, 1993. I respectively request that the Commission consider these comments during their evaluation of RM-8218.

George W. Henry, Jr.

enc: Comments Regarding Petition RM-8128 (original + 4 copies)
Certification of copies supplied to petitioner (ARRL)

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Champaign, IL 61820

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Office of the Secretary
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1919 M Street N.W.
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Re: RM-8218; Certification of Copy to Petitioner

Gentlemen:

I hereby certify that exact photostatic copies of my comments regarding petition RM-8218 have been provided to the American Radio Relay League (ARRL) at the following addresses:

The American Radio Relay League, Inc.
c/o Christopher D. Imlay
BOOTH, FRERET & IMLAY
1233 20th Street, N.W.
Suite 204
Washington, D.C. 20036

The American Radio Relay League, Inc.
225 Main Street
Newington, CT 06111
ATTN: David Sumner

George W. Henry, Jr.

Linda A. Scott
Notary Public

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

Comments Regarding:

In the Matter of	)	
Revision of Part 97 of the Rules	)	
Governing the Amateur Radio	)	RM-8218
Services Concerning High-Frequency	)	
Data Communications	)	

To: The Commission:

COMMENTS CONCERNING

PETITION FOR RULE MAKING RM-8218

George W. Henry, Jr.
616 West Church Street
Champaign, IL 61820

May 14, 1993

SUMMARY:

George W. Henry, Jr., amateur radio licensee K9GWT, requests that the following comments concerning petition RM-8218 be considered. I have been an active radio amateur since 1957. My major interest in amateur radio has always been "RTTY" and succeeding "digital modes". I hold BSEE and MSEE degrees from the University of Illinois and am President of HAL Communications Corp. in Urbana, Illinois. I have 30 years of experience in the

The following comments discuss deficiencies of the ARRL petition and offers suggestions for modification of the petition that this amateur believes will be in the best interests of both the government and radio amateurs.

PETITION RM-8218

COMMENTS

1. Proposed ARRL/IARU sub-band frequency allocations: Petition RM-8218 proposes the following sub-bands for operation of fully-automated digital radio stations:

TABLE 1

ARRL-Proposed HF Sub-Bands for Automated Digital Stations

3,620.000 - 3,635.000 kHz	(15 kHz bandwidth)
7,100.000 - 7,105.000 kHz	(5.0 kHz bandwidth)
10,140.000 - 10,150.000 kHz	(10 kHz bandwidth)
14,095.000 - 14,099.500 kHz	(4.5 kHz bandwidth)
14,100.500 - 14,112.000 kHz	(11.5 kHz bandwidth)
18,105.000 - 18,110.000 kHz	(5.0 kHz bandwidth)
21,090.000 - 21,100.000 kHz	(10 kHz bandwidth)
24,925.000 - 24,930.000 kHz	(5.0 kHz bandwidth)
28,120.000 - 28,189.000 kHz	(69 kHz bandwidth)

I do not believe that these specific sub-band frequencies should be mandated by U.S. law - incorporated in CFR47, Part 97 Rules and Regulations - for the following reasons:

1.1 The proposed sub-bands are poorly chosen:

Please note the proposed allocation for automatic digital station operation at 7,100 to 7,105 kHz. In the United States, this is the lower 5 kHz of the "40 Meter Novice Band". This is by far the most popular frequency range used by beginners for Morse code communications (CW). While the Novice sub-band extends from 7,100 to 7,150 kHz, most of the upper section is severely congested due to interference from short-wave broadcast stations - and SSB voice from non-U.S. amateur radio stations. Placing automated digital operations in the most desirable and most used section of the beginner's band has to rank as the most unfriendly

choice imaginable. By "gentlemen's agreement", data modes now operate below 7,100 kHz and do not interfere with Novice stations. There would seem to be little justification to change this practice.

Without a doubt, the most attractive and most usable frequency band for long distance amateur communications is "20 Meters".

The ARRL further proposes to mix completely incompatible modulation forms within these sub-bands. To avoid interference, stations using the sub-bands must therefore space themselves based on the occupied bandwidth of the *least bandwidth efficient* modulation form - HF packet radio. Well proven experience by the HF packet STA operators show that the minimum usable spacing is 2000 Hz between active HF packet stations. This translates to a total of only 14 "channels" that are available for world-wide automated HF digital stations (14 rather than 15 due to the "gap" in the 14 MHz sub-band).

True, the 3.6 MHz band may be used for a few hours each evening.

the range of frequencies used by automated HF packet stations has expanded with the number of stations. The present situation on 20 Meters is a clear illustration of the problem. The original intent was to limit automated station operation on 20 Meters to "14,100 to 14,110 kHz". Presently, automated HF packet signals may be heard from 14,090 kHz through 14,115 kHz. Moreover, many of the stations operating in the 14,090 to 14,100 kHz range are *not* U.S. amateur stations and therefore *not* controlled by U.S. FCC Rules and Regulations.

The proposed sub-bands are inadequate to support even current HF data network station activity. If the ARRL/IARU sub-bands are accepted for inclusion in the rules and regulations, the natural trend will be for U.S. and foreign stations to quickly expand operations above and below the proposed frequency limits. Due to the mixture of modes and conflicting identification requirements for each country of operation, monitoring and policing U.S. operations is a formidable, expensive, and impractical task for either the FCC or ARRL "Official Observer" stations ("OO"). FCC Rules and Regulations carry the force of law. It is not logical or productive to legislate limitations which are overly restrictive and cannot be enforced.

1.4 The ARRL asks that "voluntary" IARU agreements become law: The ARRL reports that the sub-band frequency limits requested in Petition RM-8212 were established via negotiations with other members of the International Amateur Radio Union (IARU) in September of 1992. In the footnote on page 15 of the ARRL

petition, it is noted that the IARU meets to develop *voluntary* regional band plans. The ARRL also notes that these band plans do not carry the force of either ITU recommendations or rules and regulations that may be issued by the *governments* of each nation.

1.5 Sub-band frequencies should not be legislated:

By their very nature, rules and regulations such as those in Part 97 of CFR47 must be general in nature. It is an impossible task to attempt to regulate in detail all the permutations and combinations that could arise from each rule or regulation. Moreover, since a primary purpose of the amateur radio service is "... to contribute to the advancement of the radio art" (97.1(b)), over-regulation is counterproductive and will tend to stifle amateur radio advancement. The U.S. amateur radio service has a long history of responsible self-regulation. There is no reason to believe that more rather than less regulation is required.

Specific designation of sub-bands also produces a logistical support requirement for the government in that as digital technology advances and station activities increase, the issue of sub-band limits and bandwidth will have to be debated again and again and again. Past experience has shown that 2 to 4 years may be required to implement each rule change - and such changes will probably be out of date by the time they can be enacted. This is an area where less rather than more regulation should be the goal. Sub-bands, frequency limits, and modes used are issues that to date have been governed by informal "gentlemen's agreements", the details of which change as technology and popular usage evolve. The informal "gentlemen's agreement" concept works and there is no reason to complicate the issue by creating regulations which must be frequently reviewed and revised.

2. Automated Stations Need to be Able to use New Technology:

The ARRL petition does not sufficiently address technology advances that are essential for improvement of automated stations. In particular, amateurs need the freedom to explore new techniques that will:

(1) Reduce the bandwidth required for each data signal (bandwidth efficiency)

(2) Increase the data throughput and therefore reduce the time required to send each message (time efficiency)

(3) Reduce data errors caused by propagation (error control)

(4) Compensate for varying propagation conditions (adaptive modulation control)

(5) Adjust transmitter power to the minimum amount necessary to maintain efficient communications (power control)

(6) Sense presence of other radio signals and minimize interference between stations (signature analysis and inter-station and inter-mode coordination).

The 1987 HF packet STA has proven conclusively that selection of suitable modulation formats and data protocols is essential for efficient HF operation. While the packet *network* as a whole itself is effective and efficient, the use of 300 baud FSK modulation and the AX.25 protocol on HF radio has limited the effectiveness of the data network for long distance communications. As implemented, HF packet radio has a wide occupied bandwidth, is not time efficient, and causes serious interference to other users. Many techniques have now been developed that use efficient modulation and protocols and

considerably reduce interference to other stations. While many different approaches may be used to improve HF data transfer, all depend upon using intelligent and sophisticated data coding. Moreover, modulation form, data protocol, bandwidth efficiency, time efficiency, and interference reduction are all inter-related parameters that depend upon use of robust error-free data coding.

At present 97.309(a) permits use of 5-unit ITA #2 code ("Baudot"), 7-unit CCIR-476 / CCIR-625 code ("AMTOR"), and 7-unit ANSI X.34-1977 / ITA #5 code ("ASCII"). Of these, only ASCII supports a full symbol set of upper/lower case letters, numbers, punctuation symbols, and control codes. Baudot and AMTOR as defined by ITA and CCIR support only one letter case, numbers, and a greatly reduced set of punctuation symbols. Only the AMTOR code includes error detection capability but the algorithm is primitive - flawed data frequently escapes detection and correction. Baudot does not include error detection and ASCII parity detection is insufficient for use on HF radio. AX.25 packet radio will send the full ASCII character set of characters, but the bit-pattern sent is not ASCII code due to "bit-stuffing" required during modulation. Also, as noted previously, AX.25 coding and protocol are not well suited for use over HF radio links.

However, a number of sophisticated data coding techniques now exist that will support a full symbol set and provide error correction. These codes can provide error correction *without* requiring re-transmission of the data packet. This both passes

error-free data *and* reduces the time required to send the data. While the data supplied to the modulator and data recovered by the demodulator may indeed use the ASCII code, the bit-by-bit sequence transmitted via HF radio does not use the ASCII code.

It should also be noted that portions of typical messages contain repetitive sequences and the text itself is biased to more frequent use of some characters more than others (e.g., "e", "t", etc. in the English language). The size of the message to be sent can often be reduced by 25 to 50% by using data compression techniques. Compressing the data reduces the time required to send the message. This reduces interference to other stations by either (1) reducing the time required for a station to pass a single message, or (2) increasing the traffic "load" on a given

there has not been a pattern of abuse of amateur privileges - 3rd party traffic or illegal use of assets. There is no reason to believe that use of other data codes will lead to abuses.

A few critics have mistakenly referred to error-control and compression data coding as *encryption*. This is NOT the case. It is not the *intent* of data coding to hide the content of the text. The full text contents are easily recovered when decoding is applied during reception. The text can be recovered by a listening station simply by using a modem that is designed to receive the transmitted waveform - just like an FSK modem is required to receive FSK RTTY and an AX.25 "TNC" is required to decode packet radio signals.

3. The Petition Does Not Address "Semi-Automatic" Operation:
The ARRL, via QST and RTTY Journal magazines, conducted a survey of amateur operators who use digital modes (Exhibit A of the ARRL Petition). The ARRL also appointed a committee of recognized experts in radio data communications to study the survey results and make recommendations to the ARRL Board of Directors. An overwhelming majority of the amateurs who responded to the survey favored "semi-automatic" over "fully-automatic" operation.

The distinction made in the survey is that "semi-automatic" operation involves communications between a manned station and an automated data storage station. The operator of the calling station listens and avoids interference; the semi-automatic station does not originate communications and does not transmit

unless called by a manually controlled station. In contrast, a "fully-automatic" station may originate communications and may establish communications with another fully-automated station, neither of which may have an operator present to listen for and attempt to prevent interference.

In line with the survey results, the ARRL Digital Committee recommended that "semi-automatic" network operation be permitted without restrictions beyond those that apply to all HF data stations. The ARRL Board of Directors ignored this recommendation and chose instead to request authorization for only "fully-automated" station operation.

In the opinion of this amateur, both "fully-automatic" and "semi-automatic" stations are necessary to obtain efficient HF data network operations. Messages entered into the network can be handled using "semi-automatic" operations. Entry traffic can then be screened and passed using full-automation to other network stations.

I am also of the opinion that "semi-automatic" operation is in fact in accordance with existing FCC rules and regulations since

4. The Interference Problem:

By far the greatest fear expressed by opponents to use of automated HF data stations is that their operation will cause great interference and disruption to other amateur stations. Most concerns are based on the assumption that automated stations will transmit without first listening to determine if the

to be a "clear channel" (no other users at that time). However, a station in Illinois may also be in communications with a California station - and be able to hear the Texas station.

instances and the FCC and ARRL should encourage development of adaptive transmitter power control techniques, using minimum transmitter power required to support efficient communications in line with rule 97.313(a). CLOVER modulation presently includes transmitter power control; two excellent articles on the topic were recently published in the March, 1993 issue of QST magazine. There is no technical reason why transmitter power control could not be used with virtually any ARQ-type digital protocol.

I further suggest that it is appropriate for the FCC and ARRL to encourage use and development of bandwidth efficient modulation forms, especially by automated stations. With the exception of HF packet radio as it is currently practiced, all modulation waveforms used for HF digital communications have an "occupied bandwidth" of 500 Hz or less (as defined in Part 2.202(a)).

Present users of HF packet radio may argue that their signals require 1500 or even 2000 Hz spacing between signals. A spectral plot of a typical TNC modulator output confirms the wide band nature of a typical HF packet signal. However, this is really caused by the high symbol rate used - 300 baud. I suggest that simply reducing the symbol rate to 75 or 100 baud will (1) reduce the occupied bandwidth to that of AMTOR and RTTY (500 Hz or less), (2) *increase* the data throughput by reducing the errors caused by multi-path distortion when 300 baud is used, and (3) allow use of narrow receiver filters that will both reduce receive interference sensitivity and improve the signal-to-noise ratio (S/N) by approximately 7 dB (500 Hz vs 2500 Hz BW). I do

not agree that wide band channels need to be provided in order to continue use of HF packet radio.

Also, adaptive control techniques should be strongly encouraged as a way to improve data station performance and reduce interference. As noted above, automatic transmitter power control has a direct impact on interference. Adaptive modulation control techniques used by Pactor and CLOVER have shown that the time efficiency of an HF communications channel can be greatly improved by simply adjusting data throughput to match propagation conditions.

In addition, intelligent use of frequency and band management by automated stations should be strongly encouraged. Frequency bands should be chosen to produce maximum data transfer over the path. The goal for automated stations must be to pass the waiting message traffic and then vacate the frequency for use by others. It is not logical for automated stations to simply stay on one frequency and transmit endless repeats when propagation conditions are not favorable. Rather, minimum performance criteria should be used to choose the operating frequency and make the "continue, wait until later, or change frequency" decision.

Federal Standard FS-1045 (also MIL-STD-188-141) describe the "ALE" (Automatic Link Establishment) system. This is a proven and very elegant system that controls multiple stations operating on multiple high frequencies and bands. A simpler system (and

possibly more practical for amateur use) takes advantage of the frequency scanning capabilities of most modern HF transceivers. This technique has been pioneered by semi-automatic AMTOR operators using APlink network software. These "frequency agile" techniques both improve network data transfer efficiency and reduce the potential for interference to other stations.

Finally, amateur experimenters should be encouraged to develop new techniques for automatic interference detection, avoidance, and reduction: for example, design new protocols that are both compatible with HF operations and conditions and allow shared use of the frequency channel. The AX.25 protocol allows many stations to share a channel but virtually all other aspects of AX.25 are incompatible with HF conditions. Also, modern DSP (Digital Signal Processing) technology will now support quite sophisticated "signature analysis" of received signals. One possible use of this technology might be to identify the waveform and mode used by interfering stations and adapt the mode(s) of operation to minimize interference (reduce power, pause, change modulation, or even coordinate between interfering stations to share the channel).

5. Recommendations:

In accordance with these comments, I suggest that the FCC act upon the ARRL Petition, including the following modifications:

(1) Delete all references to specific sub-band frequency allocations for operation of automated HF data radio stations. These sub-bands should not be fixed by rule or regulation.

(2) Permit operation of "full-" and "semi-automatic" HF data stations on all HF frequencies on which data modes may be used.

(3) To minimize interference, restrict all automatic station operations (fully-automatic and semi-automatic) to (1) 100 Watts maximum RF output power, and (2) 500 Hz maximum occupied bandwidth as defined in CFR47 Part 2.202 (a).

(4) Request the cooperation of the ARRL and their Digital Committee in the preparation of "Gentlemen's Agreements" which will recommend frequency ranges for operation of the various HF digital modes. *The ARRL should review these recommendations annually, revise as required, and present the plan to the FCC.* The FCC and ARRL should regularly evaluate the effectiveness of the "Gentlemen's Agreement". Suggestions for inclusion in the "Gentlemen's Agreement" include:

a. Specific frequency sub-bands for use of automated HF data radio network operations, frequencies for use for DX and "chat" operations, and frequencies which may be be used for experimental digital modes by amateurs.

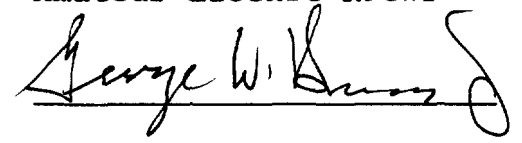
b. Agree that during special events, operators of one interest will give priority consideration to those of another interest. For example, greatly reduce automated station operation during weekends and during contests; reduce "chat" and DX activities during emergency and holiday periods when message traffic is heavy.

(5) Revise 97.309 to permit use of data codes other than Baudot, AMTOR, or ASCII on HF radio.

I respectively request that the Commission issue a Notice of Proposed Rule Making (NPRM) in response to the ARRL Petition (RM-8218) with the modifications noted in the attached Appendix.

Respectively submitted,

George W. Henry, Jr.
Amateur License K9GWT



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May 14, 1993

APPENDIX

1. Amend Sections 97.109(d) and (e) as follows:

Section 97.109 **Station Control**

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(d) When a station is being automatically controlled, the control operator need not be at the control point. Only Stations transmitting RTTY or data emissions, and stations specifically designated elsewhere in this Part, may be automatically controlled. Automatic control must cease upon notification by an EIC that the station is transmitting improperly or causing harmful interference to other stations. Automatic control must not be resumed without prior approval of the EIC. RTTY and data stations operating under automatic control must use a digital code permitted in Part 97.309(a) of these Rules, and must incorporate provisions for discontinuing transmitter operation in the event of malfunction, or interruption of communications with another station.

(1) Stations transmitting RTTY or data operated under automatic control in the 6 meter and shorter wavelength bands shall limit their transmitter RF power output to 100 Watts and the occupied bandwidth of the transmitted signal to 500 Hz as defined in Part 2.202 (a).

(e) Stations authorized by these rules to transmit RTTY or data communications under automatic control may transmit third party communications. Any retransmitted messages on behalf of any third party must originate at a station that is under local or remote control.

2. Change designation of 97.309(b) to 97.309(a)(4) and amend as follows:

Section 97.309 **RTTY and data emission codes.**

*****

(4) A station may transmit RTTY or data emissions using an unspecified digital code, except to a station in a country with which the United States does not have an agreement permitting the code to be used. RTTY and data emissions using unspecified digital codes must not be transmitted for the purpose of obscuring the meaning of any communication. When an unspecified digital code is used on frequencies below 30 MHz, each station shall transmit call sign identification using CW or any of the codes listed in sub-sections (1), (2), or (3) of this part. Station identification shall be in accordance with && 97.119 of this part. When deemed necessary by an EIC to assure compliance with the FCC Rules, a station must:

(a) Cease the transmission using the unspecified digital code;
(b) Restrict transmissions of any digital code to the extent instructed: