To The Commission,

These are two additional comments in response the Petitioner's reply comments filed January 7 in regard to RM-11708. I believe the Petitioner has misrepresented some of the opposing viewpoints in it summary and I wish to clarify as I am able. I realize that this proceeding is becoming long in the tooth, and I again thank the Commission for its time.

I. Regarding the suggestion of 2.2 KHz as a bandwidth limit, the Petitioner paints "counterproposals" with brush that is too broad:

> "The counterproposals contained in some opposing comments of a 1 kilohertz or 2.2 kilohertz limit are intended to preclude most data emissions at MF and HF. They are therefore unreasonable on their face, in light of the Commission's recent conclusion that it is undesirable to prohibit emissions that are currently permitted."

Unlike the Petitioner, I am not in a position to divine the intentions of all the opinions referenced in that statement, but both Mr. Kok Chen and I have suggested 2.2 kHz with the *explicit stated intention in our respective comments that it precludes nothing being done today*.[1] While I cannot speak for Mr. Chen, my basis for this is the description of Pactor 3 in ITU-R M.1798-1, p. 40, which clearly states and occupied bandwidth of 2.2 kHz. I am unaware of anything else commonly in use in the Amateur Service that approaches this bandwidth, and thus it sets a reasonable maximum bandwidth today. Furthermore, I believe it accomplishes the three goals listed in ¶8 of the January 7 Reply Comments of the Petitioner. The Petitioner does not say where its suggestion of 2.5 kHz originates. Perhaps it is concerned that such a limit precludes *future* waveforms, but we have already established that we are going to be precluding many future possibilities by establishing a bandwidth limit in the first place. In any event, precluding *future* possibilities is not the crime of which I am being accused. While we can reasonably discuss whether or not 2.2 kHz *does* preclude something currently in use, the stated intention is

[1] There may be others that make an explicit reference to their intention of 2.2 kHz, I have not the capacity for an exhaustive search.

quite the opposite and I find it troubling that that good faith effort to accomplish the same ends as the Petitioner is being interpreted otherwise without some basis in fact. What 2.2 kHz represents is a balanced approach that stems the tide of wider bandwidths that the Petitioner fears, accomplishes the same ends, and listens to voices that believe we may already have gone far enough.

II. Hitherto I have chosen not to address the interference concerns because, in general, past history shows that we have been able to adapt to technological changes in the realm of digital communications. That said, however, I believe the Petitioner is again misinterpreting the reasoning behind some of the objections, and moreover, has not considered the ramifications specific to the technology it is requesting:

> "The opponents say that this mixture will result in interference to those narrower emission types because licensees using HF data emissions have no concern with ongoing communications before commencing transmissions….ARRL believes that these fears are unwarranted, and that they reflect a misunderstanding of the limits of the proposal in the Petition and the current regulatory scheme in effect in those subbands."

As I understand commenters, the issue is with unattended operation *coupled with the nature of the technology*, not the belief that there is some malevolent being attempting to squash hapless radio operators from his volcano lair. There's *literally* nothing personal about it. Please let me explain.

The design of most modern waveform suites is that they auto-optimize for maximum data transfer over the channel. Pactor 3 is a good example since we have plenty of it today. The connection starts with a Pactor 1 connection using an FSK signal with 200 Hz shift. It then upgrades to Pactor 2, which is DPSK with 200 Hz tone separation—still roughly the same narrow bandwidth as when it started. Then it will upgrade to the Pactor 3 waveform suite which

starts with DPSK with an *800 Hz separation*, and adds tones and bandwidth if it can push more data through the channel by doing so, up to a potential maximum of 2200 Hz.

Notice that the occupied bandwidth is not constant but increases or decreases *to maximize data transfer*. The algorithms are designed to maximize data throughput, not necessarily be a good neighbor. If the algorithm decides that it can push a few more bits per second through the channel by running roughshod over that narrow band signal 1000 Hz away, it may very well do so. Thus, that poor hapless fellow who was 800 Hz away when the link was established at the Pactor 1 and 2 levels is now swamped by the expanded Pactor 3 signal taking up 2.2 KHz. To be clear, I have no idea what Pactor 3 and other "high speed" protocols do to mitigate this situation if anything, but generally speaking, *rejection of narrowband interference is a design goal of modern waveform suites.* This makes all the sense in the world where the primary application is in a channelized environment and thus assumes the right of way. Does the Commission understand why the hapless third party sees little distinction between "fully automated" and "unattended-responding-to-interrogation" in these scenarios?[2] There is no operator making the decisions to override the machine in deference to spectrum sharing with other users; interference to a third party is not a part of the decision.

Newer waveforms suites elaborate on this theme. The "two-tone chirp" mode in Pactor 4 is specially designed to deal with narrowband interference by taking a DPSK signal with less than 1 KHz spacing and slewing it across what appears to be a little over 2000 Hz of spectrum.[3] In other words, when there is narrow band interference it makes the transmitted signal much *wider* to increase throughput. Indeed, this will work for the transmitting station, but is this really

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[2] The nerd in me would like to know how the unattended station does the Turing test to ensure compliance, but we'll leave that for now.

[3] SCS claims that narrowband interference rejection is the *raison d'être* of the two-tone chirp mode. (See http://www.pactor4.com/en/PACTOR-4.html). There is no public specification, so this is a rough measurement taken off the air from a maritime service.

wise as the default behavior in the context of the Amateur Service? As crass as this may sound, "mutual assured destruction" is a powerful motivator to self-regulate and form our own bandplans because both parties, even if hostile toward each other, have reason to resolve interference. This works to the extent that the interference is mutual. As currently designed, many of these newer waveforms upset this balance. Note that some of the STANAG specs claim as much as a 40dB narrow-band-interference advantage.[4] This is in fact a side effect of the data randomization and spectrum spreading techniques generally employed—it comes along with the new technology. *In general the serial-tone methods that are being requested by this petition have the capability to vastly upset the one of the natural incentives for self-regulation.*[5] There, in a nutshell, is the technical evidence for increased interference concerns of which Petitioner claims there is none.[6]

Now, in principle this should not concern us. Why? *Because if the complete specifications are public, amateur operators will be able to adapt these technologies to fit the needs of their service.* This has a very long history in the Amateur Service. The AX.25 "packet" protocol was the Amateur adaptation to the ubiquitous X.25 protocol that ran concurrently in wired services in the 1980s. This adaptation was possible because it was a publicly specified protocol, openly available to anyone. Similar adaptations could be made to these newer technologies to address the above issues. Not only that, this is a place where the Amateur Service has the ability to contribute something new, by changing the optimization techniques toward better spectrum sharing in crowded environments. You have heard a few voices that

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[4] Johnson, et al., *Third-generation and Wideband HF Radio Communications*, p. 32.
[5] See Johnson, et al., p. 32. State of the art OFDM modes (like Pactor 3) generally have NBI specs around 0dB at best, so the principle of mutual assured destruction more or less represents the situation today. Moreover it illustrates my vehement objection to an argument based on "spectral efficiency" in my original comments. The definition put forth in the Petition simply does not take into account common situations such as this--one can be "efficient" with great opportunity cost that is unaccounted.
[6] ¶4 of January 7 Reply Comments.

claim to be working on exactly this technology. I hope they are serious. Indeed, if you really desire to see a significant technical contribution borne out of the Amateur service, attempting to find ways of balancing information rate and spectrum sharing with diverse interests has real potential. It may very well be that someone will learn from experience in the amateur service and actually go on to solve some of the Commission's bigger headaches…*and so we've come full circle to the absolute necessity of public and complete specifications as part of fulfilling the purposes of the service.* Without that guarantee, the technology in combination with some of the outside (or at the very least, secondary) interests gives some validity to the interference concerns.

While I am optimistic about the future of this, I do not believe the Petitioner has done due diligence to understand what it is asking. Nothing here is insurmountable, but there are dangers that have not been thought through. I mean that with all due respect to the Petitioner—we all have a very strong interest in the future of the Amateur Service. I believe that the Petitioner is trying to do the right thing, and like the Petitioner, I would like to see the symbol rate regulation *eventually* eliminated, but we would be irresponsible to put the cart before the horse as we are currently doing.[7] This is to say, I agree there are some "fundamental misunderstandings", but those misunderstandings are not confined only to the commenters. While it may appear like we are dealing with just a change to single, outdated rule, we are really asking for powerful tools that are ripe for abuse and for which we should be educated and prepared to use responsibly. Again, I recommend Mr. Ward Silver's comments that speak directly to that issue.

Respectfully Submitted,

Andrew T. Flowers, PhD

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[7] By way of apology for the Amateur Service, it should be noted that almost the entirety of the development of equalization techniques for high symbol rates on HF was government funded through the 1980's and continues to this day. It should reflect well on the Amateur Service that there is a desire to learn something about what is really a fascinating technology with very interesting applications, and that there are people who are proactively pursuing it.