



It Seems to Us

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Symbol Rate

“At its July meeting the ARRL Board of Directors acted to address a portion of the FCC Rules that advances in digital communications have rendered obsolete.”

Section 97.307(f) of the FCC Rules limits the digital data emissions of amateur stations operating below 28 MHz to a symbol rate not to exceed 300 bauds, and on 10 meters (28.0-28.3 MHz) to a symbol rate not to exceed 1200 bauds. In a digital system the symbol rate is the number of times per second that a change of state occurs. It should not be confused with data rate (also called bit rate) although in a binary system the values will be the same.

The symbol rate limits date back to the *Third Report and Order* in FCC Docket 20777 and became effective on March 17, 1980, when amateurs in the United States were authorized to use ASCII. Anyone familiar with the early modems used for data communication on telephone lines will recognize their origins. The April 1980 issue of *QST* observed that in the comments filed in this rulemaking proceeding “there was general agreement that the permissible bandwidths of ASCII or other radioteleprinter signals should be similar to the traditional bandwidths associated with the use of the Baudot Code in the various frequency bands.” By limiting the symbol rate the FCC thought it was achieving that objective.

Since that time the rationale for a regulatory limit on symbol rate has been eroded by advances in modulation techniques that have effectively divorced the bandwidth of a digital signal from the symbol rate. For example, in the words of the 2013 edition of *The ARRL Handbook for Radio Communications*, “By using multiple carriers each with multiple-bit-per-symbol modulation it is possible to obtain quite high data rates while maintaining the low symbol rates that are required to combat the effects of multi-path propagation on the HF bands.” The tradeoff is that multiple carriers mean greater bandwidth — and bandwidth is a precious commodity.

One implementation of our old nemesis, Broadband over Power Lines (BPL), took this to an extreme by generating thousands of carriers at intervals of 1.1 kHz across the entire HF spectrum. Of course, such a broad signal would not propagate uniformly via the ionosphere — but the example illustrates that there is no technological limit to the bandwidth of a digital HF signal. At the present time the only bandwidth limits on amateur HF digital transmissions that are contained in the FCC Rules are on automatically controlled digital stations operating outside narrow designated subbands (Section 97.221 imposes a 500 Hz bandwidth limit on these stations) and on stations operating in the five channels of the 60 meter band (up to 2.8 kHz bandwidth is permitted, per Section 97.303(h)).

The guiding principle for our use of the spectrum allocations to the Amateur Radio Service is cooperation in the sharing of access to a limited resource. Without defining the terms, the FCC Rules say that amateur stations “must be operated in accordance with good engineering and good amateur practice.” No

one could reasonably argue that a single amateur station or network ought to be able to occupy an entire amateur band or subband, nor has anyone attempted it. On the other hand, the state of the Amateur Radio art has advanced far beyond where it stood in 1980. Amateurs have developed a wide variety of digital data modes that make efficient use of the bandwidth of a typical SSB transceiver while being sufficiently robust to cope with the often-hostile HF environment. These developments are constrained unnecessarily by the 300-baud symbol rate limit.

Recognizing that the amateur community is not well served by the existing rules, at its January 2013 meeting the ARRL Board of Directors created an ad hoc committee to evaluate possible changes and offer recommendations for consideration at its July meeting. The committee recommended that a *Petition for Rule Making* be prepared seeking the deletion of all references to symbol rate from Section 97.307(f) and the adoption of a bandwidth limit of 2.8 kHz for amateur data emissions below 29.7 MHz. The Board adopted the committee’s recommendations. No timetable has been set for the filing of this petition, which first will be reviewed by the ARRL Executive Committee.

The limit of 2.8 kHz was not chosen arbitrarily. It is already used in Part 97 to set the maximum bandwidth of an amateur station in the 60 meter band and is a bit greater than the bandwidth of data modes now in widespread use on HF by amateurs. Unlike a petition filed by an individual amateur in 2007 that was denied by the FCC, it would not prohibit anything that is now commonly being done. It is important to note that the limit would apply only to data modes in the subbands where RTTY and data are authorized emission types and not to either analog or digital phone emissions.

While there is commercial and military interest in wider bandwidths that would allow higher HF data rates, in the Amateur Radio Service we must balance the desire for minimal regulation against the need for equitable access to limited spectrum by literally hundreds of thousands of amateur licensees — each of whom has the same right to operate. Some will argue that 2.8 kHz is too confining, others that it is excessive. Those positions were taken into account by both the ad hoc committee and the Board. Once the petition is filed and assuming the FCC does not dismiss it out of hand — as indeed it should not, given that the existing rules clearly need to be fixed — there will be additional opportunities for those arguments to be heard.

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