UPDATE ON DIGITAL VOICE TECHNOLOGIES

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Introduction

At the 1996 Digital Communications Conference, I presented a paper on "Amateur Radio Digital Voice Communications" with the intent of promoting interest among amateur experimenters. Not much progress has been made in developing amateur digital voice systems during the past year. Industry is still doing developmental work but standards are not easily achieved.

Spectrum Efficient Digital Land Mobile Systems for Dispatch Traffic

The 1996 paper appended an ITU-R draft new recommendation with the above title. It provided core parameters for VHF/UHF digital voice systems known as Project 25, TETRA, IDRA and DIMRS. At a Geneva meeting of ITU-R Study Group 8 (mobile, radiodetermination, amateur and related satellite services), this draft recommendation was delayed over a debate concerning intellectual property rights, and whether to include a French system TETRAPOL and an Ericsson technique known as EDACS. There were also objections expressed over the desirability of publishing recommendations having multiple annexes, the ideal being one global standard. (There are fundamental differences in views between Europe and the U.S. over single vs multiple standards, the U.S. view being "let many flowers bloom" or "let the market place decide," the European position being that it makes sense to have one world standard--preferably theirs.) These issues are to be brought before the ITU 1997 Radio Assembly in October.

Maritime Mobile Digital Voice Systems

ITU-R Study Group 8 took the view that the maritime mobile community should not develop its own digital voice standards but wait for a common land mobile standard to emerge. While the land mobile services could tolerate different digital voice standards in different parts of the world, this is not the case for ships which should use only one global standard for VHF/UHF.

HF Digital Broadcasting

HF broadcasting has used double sideband amplitude modulation (DSB AM) since its inception. Receivers are abundant and some are quite inexpensive. All is not well because HF radio propagation introduces multipath fading distortion. Furthermore, the other radio services using the HF bands have been urging the HF broadcasters to switch to single sideband (SSB) with reduced carrier to conserve bandwidth. Proper reception of RC-SSB requires synchonous detection, which tends to make receivers more expensive, at least until the day when critical mass has been reached. It's been a chicken-and-egg situation: HF broadcasters won't change to SSB until receivers abound; manufacturers can't reach the required economy of scale until all the broadcasters change to SSB.

HF SSB broadcasting may be at a dead end and broadcasters are now thinking of leap-frogging this technology and going digital. The problem is that the standards have yet to be developed and research still remains to be completed.

Fortunately, there is a development effort underway. Significant research work is being done by the NASA Jet Propulsion Laboratory under contract with the Voice of America. A wide number of organizations are interested: Motorola, National Association of Shortwave Broadcasters-USA, Telediffusion de France, RAI, Harris Corporation, Radio Nederland, Continental Electronics Corp, Telefunken, BBC, Sony, Australian Broadcasting Corporation, BBC, Detche Welle, and Sangean Corporation, to name some of the major players.

The technical challenge is difficult enough. The economics of HP digital broadcasting remain to be solved. The question remains: Why is it thought possible to get people to buy digital radios when they can't afford synchronous SSB receivers?

During 1996, VOA ran some on-the-air digital broadcasting tests from its Delano, California facility to Washington, DC. While there were problems, the results were sufficiently positive that further design was justified. The audio encoder chosen for these tests was the AT&T G728 (LD-CELP), which had been optimized for speech but not for music. Various modulation schemes up to 8PSK were tried and there are plans to experiment with modulation levels higher than 8PSK during the latter half of 1997.

The results of the VOA/JPL task may or may not be applicable to amateur HF digital voice. The general objective is the same--transmitting a digital voice signal and receiving it with results that are better than for AM DSB. However, some of the parameters are different, notably that an amateur digital voice signal would probably have to occupy no more bandwidth than an SSB signal, while HF digital broadcasting could use bandwidths comparable to those for DSB AM. Broadcasters have a lot of high power Class C finals; amateurs these days have linear power amplifiers designed for SSB.

We don't need to transmit music; they do. Broadcasters must design to low-cost receivers
intended for mass markets; amateurs can accept a design that costs a little more.

Amateur HF Digital Voice Design Objectives

- Like for SSB, it would desirable for an amateur HF digital voice radio also to be usable for commercial/government use, for reasons of economy of scale.
- Transmitter power should be comparable to that normally used for SSB, i.e., 100 watts. External linear amplifiers would be used when additional power is required.
- The recovered audio should be noticeably better than for SSB over a fading path.
- Some type of signal processing should be available to favor the desired signal and reject an interfering signal, whether in a two-way contact or in a net.
- The bandwidth should not exceed 3 kHz and preferably not more than that of existing amateur SSB, or about 2.4 kHz.
- In addition to digital modulation and demodulation, a. normal SSB mode should be provided.

Conclusion

HF digital voice experimentation is an area where amateurs can make a significant contribution to the radio art. HF is sufficiently different from VHF/UHF because of a channel subject to multipath fading and interference. The Amateur Radio requirement is somewhat different than that of HF broadcasting to at least modify the technical parameters and possibly use different design strategies.