Where is My High-Speed RF Part II

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Background

In 1986 this author presented a paper at the 5th ARRL Computer Networking Conference in Orlando, Florida regarding high-speed RF (or more accurately the lack of it,) That paper was meant to spurn on experimentation in the RF arena of packet radio.

The paper started with listings of several frequency coordinating bodies recommendations for packet radio operation. It then delved into the various channel access methods available, followed by a discussion of user versus backbone channel operation.

The last section described what was being used at that time, along with a few experiments being conducted in the high-speed arena.

This paper is meant to continue where that one left 0ff. It seems we have made some progress, but have also stood still. While the last statement at first appears contradictory, it does describe what has happened.

What's Happened Since 1986

After the 1986 Conference, several things have happened. The first to be discussed will be the hardware and technical achievements, followed by the political and economic conditions.

Hardware In 1986 Paper

The 1986 paper described a few experiments that were known at that time. Only one of those actually reached any level of operation. That was the Steve Goode, K9NG modem. Steve had described in a paper given at the Fourth ARRL Mamteur Radio Computer Networking Conference how to modify a Hamtronics FM-5 220 MHz radio for 9600 bps operation. It turned out that this modification required a spectrum analyzer to accomplish properly, and the Hamtronics radio tended to have problems with wide temperature variations (such as found on television towers). The most reliable method of runnung the K9NG modems was to reduce the data rate to 4800 bps.

The attempt by AMRAD to design high speed equipment for 220 MHz met an early demise, based primarily on a combination of the lack of access to test equipment plus lack of coordinated time between the people on the project. This is a common occurance in Amateur Radio, compounded within AMRAD by the number of interests key players are involved with.

The Gary Fields equipment mentioned in the 1986 paper also never materialized to my knowledge.

The last technical item mentioned in the 1986 paper wasn't equipment, but rather a specification dreamed up by the ARRL Digital Committee. It specified a device that was felt by that committee as necessary to expand to higher speeds on various bands. The specification called for 56 kbps 0peration, with an in/out IF frequency of 28 MHz, which could then be transverted to the band of choice. More on this shortly.

Progress Since 1986

Since the 1986 Conference, some progress has been made. Some has also been promised.

Kantronics 2400 bps

Over a year ago, Kantronics introduced their KPC-2400, which is a TNC with a modem designed to run at up to 2400 bps, or twice the rate most Amateurs use. While it has been met with a hugh collective yawn by the Amateurs, it seems to be selling in the commercial arena. Most Amateurs realize that the! Kantronics twice-the-speed-of-sound arguement doesn't quite ring true, especially when channel turn-around times, among others, are taken into consideration. An important point to be made is that they have been shipping KPC-2400 TNCs for over a year, it is for real.

AEA 9600 bps 220 MHz Radio

Almost since the 1986 Conference there have been rumors that AEA was coming out with a combination radio that ran both voice and 9600 bps packet on 220 MHz. It was talked about at the 1987 and 1988 Dayton Hamfests, and has appeared in their catalog as recently as this summer. The radio has not shown up in dealer showrooms this author watches, but will supposedly Real-Soon-Now, or RSN, as a famous author likes to say.

GLB 19,200 bps 220 MHz

Almost since the 1986 Conference there have also been rumors that GLB Electronics is coming out with a 220 MHz radio that is designed for packet operation at 19,200 bps. Orders have been in place for over a year and then cancelled. Once again, RSN.

Dale Heatherington 56kbps IF Modem

Last year, Dale Heatherington, WA4DSY, came up with an IF modem that operates suprisin 1 like the abstract device described by the AWRE Digital Committee. In his paper he describes the modem design and operation including scope pictures. It is a Minimum-Shift-Keyed (MSK) modem that uses a roughly 70 khz bandwidth channel. It puts out about 1 mw at 28-30 MHz. It contains both the modulator and demodulator.

The best part of this modem is that boards (and now kits) are available to build the units. It is not cheap to build one, the parts cost about $250. Then the unit must be assembled and aligned, which can also be tricky without proper instrumentation.

While Dale describes one design goal as having no exotic parts, there 'have been some problems obtaining a few of them.

Also, keep in mind that even after the modem is built and aligned, the output is still at 28 MHz. a transvertermust also be purchased to move the modem output to the frequency of choice.

While the above indicates the relatively complexity of obtaining high speed operation, it must be said that Dale amd his associates have come through with a real benefit to packet radio. Keep in mind these modems are not for everyone, but may help greatly in speeding up the inter-bulletin board traffic on backbone channels.

By the way, as Dale indicates, one of the toughest problems related his to high speed modems is the generation of real packets at that speed. Suddenly the shift is back to the digital people!!

Use of 900 MHz

Recently, an idea came to this author at one of the weekly AMRAD Taco meetings. By the way, a couple of years ago AMRAD decided to forego the standard pizza meetings in favor of something more spicy. It is unclear if this has helped to induce our present hopping from one project to another, but the suggestion has been made.

With the present Amateur band situation, it has come up once again that the 900 MHz Amateur band is almost devoid of use. Other than a few experimenters, not much is happening up there at least in the Washington D.C. area. The reason' for this is simple, no equipment is available off the shelf. Reality is that Amateurs today buy almost all of the RF equipment they use. If we are to rely on homemade equipment to populate a band, we will surely lose that band. There is over 20 MHz at 900 MHz just waiting for users, be they Amateurs or others.

Now for the idea. The idea actually was formed in two parts. The first was reading a Sunday paper, and the second was at a Taco meeting. The explosion of cellular and trunking radio systems has brought with it inexpensive RF equipment operating at 900 MHz. Up to 5 watts is generated in cellular telephones, cheaply. In several recent Sunday papers there were advertisements for new cellular telephones for as cheap as $399! Most Amateurs pay more than that for a decent HT and batteries! Imagine taking these cheap cellular telephones and cutting most of the digital electronics, then using the RF section on the 900 MHz Amateur band, with packet data sent instead of voice.

Or possibly a transverter that mixes the output of a Dale Heatherington 56 kbps modem with the RF from a low-level stage of a cellular telephone, and then amplifies the result with the rest of the telephone Rf circuitry (it should be broad enough). The opposite procedure might be usable in receive.

By the way, there maybe a market for these cellular phones in non-packet Amateur Radio. If someone could build an Amateur repeater or group of repeaters that takes advantage of the cellular ditigal and RF technology directly...

High Speed Voice-Grade Audio Modems

Another alternative for high speed packet is with the use of high speed audio modems, such as those presently being used over tele hone lines. If thesemodems really send data as 4ast as some claim over regular dial-up telephone circuits, the possibility exists for their use in Amateur Radio. There are some problems with this, but they may not be insurmountable.

The first and immediate problem is that of distortions created in the radio portion of the connection. Most Amateur rigs are not designed taking phase errors into account. Quite a few don't even perform well in frequency response. Most of the higher speed modems use some sort of phase, amplitude, or frequency modulation, or a combination of those. Any radio used with these modems must be capable of accurately reproducing the modem signals at least as well as a telco circuit.

Another problem with the use of these modems is that they typically needs some amount of time to lock to each other. Since phasing between data chunks is often used, not only must the frequency be correct, but a reference phase must also be generated. In full-duplex telephone lines, once the connection has been made at the beginning of the call and the modems have achieved lock, there is a constant reference to maintain lock. In the Amateur world of half-duplex, the modem signal is not always present. In addition, if a third station was to join the first two, it will confuse the other two, requiring a re-lock (sometimes referred to as the training period) each time a different station transmits. These training periods are based on the modem technology, and may not be directly related to data rate. Sometimes the training period can be in the order of many seconds. In that case, even though the data rate is quite fast, the training period is sufficiently long to offset it.

Given the above discussion, these audio modems do not appear to buy a lot of long-term speed. Considering they are also costly, they may not be a real alternative at this time. They should be monitored however for breaks in technology, or if conditions favor them (such as a direct path between only two stations with decent radios).

Politics and Frequencies

The reality is that we Amateurs enjoy a large amount of spectrum space, placed up and down the frequency spectrum. We also have had a great influence on the world of communications, due in large part to our experimentation within these bands. We HAVE paid the dues to justify the spectrum.

Some do not share this opinion. Others see a method of making money using *additional spectrum. Our contribution is not directly related to monetary gain (per FCC regulations), so in todays world we are often the odd man out. Do not believe for one minute the loss of a portion of the 220 MHz band is the end of raids upon us. Quite the opposite. If it is upheld, more may go. Precedents are dangerous things.

220 MHz Band

When the 1986 paperwas written, almost all packet activity was limited to the two meter band. Very few Amateurs had expanded beyond those frequencies. Since then there has been an explosion in the number of packet users, and the number of packet bulletin boards. Many of these bulletin boards have shifted to the 220 MHz band for message handling between themselves.

The recent action taken by the Federal Communications Commission that removed the lower 2 MHz of the 220 MHz band from Amateur service has thrown much of the orderly progression of packet radio right out the window. Up to the point that the FCC made this decision, there was real hope that the Amateur community might finally see some faster packet links. Now, the implementation of these high speed channels is in doubt.

This author is among the many Amateurs that now own useless 220 MHz radios if the FCC action stands. in my case three radios. Some Amateurs suggest we not give up on 220 MHz. We might get it back. My opinion is that we must start planning for the future. If we get to keep 220 MHz after all, so much the better. My 220 rigs aren't going anywhere. They can't. Nobodywants them. Oh well. And we just got in the right crystals too.

420-450 MHz Band

Due to the FCC action regarding 220 MHz, the 450 MHz Amateur band has suddenly resurfaced as a place to put high speed packet radio. Unfortunately, this band is already overcrowded in most metropolitan areas, especially with ATV onerations. It appears this band has too much activity already. Even so, some Amateurs are planning to move the existing 220 MHz links to 450 MHz if the FCC action is not reversed.

There are also persistent rumors regarding the loss of part of this band. In addition, the Canadian border has zones nearby where operation on 450 is restricted. It is this authors opinion that long term operation on 450 MHz is unlikely.

900 MHz Band

The next Amateur band is 900 MHz. As previously stated, the foremost problem here is the lack of equipment. In addition, path loss is greater. This can be offset somewhat with higher gain antennas if directionality in not a problem. Given the present state of politics, the 900 MHz band would most likely be the best spot for high speed packet operation if the equipment hurdle can be overcome. Another possibility for this band when equipment becomes available is to actually move the individual Amateurs to 900 MHz, allowing better cellular-type RF operation. Presently this is not possible, not only due to the lack of equipment, but also because of the lack of network resources to interconnect users.

1.2 GHz and Above

Frequencies above the 900 MHz band start getting scary to most Amateurs. Not only is the equipment difficult to understand and operate, test equipment becomes hard to locate and employ. Some Amateurs do not have these problems, but the number of these types are far too few to rely upon for building and maintaining packet network resources. Eventually, as speeds increase, we may need to use these higher frequencies for point-to-point microwave relays much as telco has for years. That time has not come yet, however. (Here's hoping someone proves me wrong!!)

Conclusion

While packet radio has been growing in numbers, not enough work has been done in the RF arena. In 1986, I was hoping we would be further along than we are. Because of the recent FCC action, we might even go backwards. The biggest single contribution made since my 1986 paper has to be the Dale Heatherington modem. It is almost exactly what the ARRL Digital Committee spelled out. It works, is reproducible, and can how be purchased in kit form. It is not limited to a single Amateur band. Some companion RF transverters would be a very welcome contribution.

Much more work still needs to be done. Several efforts have been started but not completed. The two commercial digital radios (AEA and GLB) may have to be re-engineered for a different band (thanks FCC!).

As I ended the 1986 paper, so too I end this one. If this sounds like I am begging, I am. I WANT FASTER RADIOS!!

References

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