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The NSF Wireless for Education Project

The details of the $460,000 three year (1995-1999) project can be read through this final report URL below. But below I will comment here on the significance of the project, which launched yet another Hughes Pioneering effort that culminated on the slopes of Mount Everest in 2004.

http://wireless.oldcolo.com/course/index.htm

As I had commented earlier, I kept casting around for some kind of a wireless solution to rural school net connectivity from the time I got involved with Big Sky Telegraph education for several reasons:

1. I saw that personal computers were going to revolutionize business, education, politics, culture. I could see that coming in 1979. For within 20 years of the arrival of the first 'personal' computer in 1977 all these areas have been profoundly affected. School children - including rural children needed to learn how to master and effectively use computers over networks from a young age. So they would use them as readily as their parents learned to write with pencils and typwiters and communicate by paper mail and fetch information from other than libraries and schools.

2. Personal computers would, over time, be evermore more affordable to individuals.

3. But the greatest revolution would come when all these small devices - and therefore the minds of persons using them - were connected together. While voice-grade telephone lines networked the nation, they were inherently limited in their bandwidth. And dedicated digital wiring was not likely to reach the whole country - wherever people live and work, for a very long time, if ever. The costs of extending such lines would be astronomical. 'Rural' is another word for 'space.'

4. In point of fact 25% of the population of the US lives on 97% of the land of the US, while 75% of the populaton - in relatively dense cities - live on only 3% of the land area. "Wiring up" dense cities is far more economically feasible than wiring up rural populations, both because of sheer distances between where people lived and work - and go to school - and the size of 'markets' to pay for advanced connectivity.

5. So wireless would be both desirable and needed to span the long distances between, and within, sparsely populated rural areas. While theoretically 'satellite' delivered Internet service is feasible - it will always be costly.

My First Digital Radio

I first read in one of the technical discussion groups on the Well - Stewart Brand's Computer Conferencing system where many techies - and 'digital minded ham radio operators - hung out about a new class of radios that the FCC had recently approved of. Radios whose signals were controlled by computer processor chips. The same computer chips that enabled personal computers to be made in mass.

They were called frequency hopping 'Spread Spectrum' radios, whose digitized signals rode on a wide band of frequencies - spectrum - and not just one radio frequency licenced- by the FCC - to use one narrow single-user frequency band. So more than one radio could be communicating on the same band 'frequency hopping' within that wider band while not interfering with each other. It was the magic and speed of computers processor chips that permited that radical change from all previous radios. Suddenly there was no more 'scarcity of spectrum' sold only to the highest bidders.

But THAT was not the news that caught my attention. That was that the FCC had ruled that frequency hopping radios made within certain specifications could use bands that long ago had been set aside for low power (and very short range) 'Industrial, Scientific, and Medical devices' the ISM Bands - WITHOUT A LICENCE!

In other words these new radios, which could carry digital - computer data from and to computers such as text, or programs, or graphics could communicate with other like radios without a requirement for an FCC licence for the USE of those particular frequencies. Only the radio had to meet specification such as how many hops the processor had to make, how errors were handled, and what maximum RF power could be put out the radio port. So the communications could be FREE - with only the one time cost of a pair of radios and the personal computers they were connected to involved.

The only limitation was that every user had to 'accept' any interference from other radios that were legally approved. That only would come if a local area had a huge number of radios operating in the same space. Statistically unlikely.

The first off-the-shelf radios operated in the 902-928Mhz band, with up to 4 watts of FCC permitted power, that could reach, depending on the size and shape of the antenna at both ends,, flawless line of sight communications for miles (I learned that 10 miles was easily obtained, and in my first NSF project I attained 30 miles of reliable connectivity.) And being Frequency Hopping where the computer chip controlled the hopping not only could many pairs of radios operate at the same time in the same space, but - without encryption of the data - it was so scrambled that intercepting what was being communicated was very difficult to unscramble (in fact that technology had been used for US Naval ship to ship radio secret communications since the late 1960s.)

The Global Wireless Revolution

I sensed a global revolution in the making. And a solution to the Rural School communications problem. I quickly looked for (1) radios I could use and (2) radio hackers whose knowledge I could use.

I found both when I first called by phone, then met Dewayne Hendricks - black engineer who had worked for a large computer company, was a 'digital' ham radio operator. Early Cylink radios were being used to span the Platte River in rural Kansas to carry only voice telephone traffic from a telephone office on each side of the wide river where stringing wires on poles was not feasible. The radios operating strictly under FCC rules which had to certify and approve the design of the radios before they could be sold in the marketplace, as well as used anywhere.

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Immediately I sensed a global communications revolution in the making. Dewayne sensed my enthusiasm for such rural educational use of Spread Spectrum unlicenced wireless and offered to come to Colorado Springs at my home, and install a pair of Cylink radios - one on my house roof, the other on the roof of the Templeton Building 1/2 mile away within which was my Old Colorado City Communications company and Server.

I also had learned - starting to do my radio theory and practice homework - that the lower the frequency the more amount of foliage, and thickness of walls the signal could punch thorough. The Cylink radios had no trouble going through the Bancroft Park Forest of trees to link up with each other.

It was that half mile spread spectrum FCC Part 15 Wireless Link that convinced Don Mitchell to award me as Principle Investigator, assisted by Dewayne Hendricks, and Dr Johnston ready to

deliver math education wirelessly over $400,000 to see how far the new technologies could reach school kids minds in very rural America.

I was off on another Pioneering journey.