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In This Issue...

President's Column

I want to spend some time in this issue of my column talking about paradigm shifts. I'll spend some time on organization issues at the end. I have had several members request that I spend more time on higher level issues and concepts in my column, so here we go!

The American Heritage dictionary gives the following definition of paradigm: "An example that serves as pattern or model." Another basic definition of paradigm states that it is representation or distillation of what we 'think' about the world — but cannot prove (Lincoln and Guba, 1985). Thomas Kuhn (1970) defines a paradigm as a way of breaking down the complexity of the real world. He points out in his book that any field eventually produces anomalies that cannot be fully contained by the prevailing paradigm. This then paves the way for a new paradigm that better explains the anomalies or enables a new phase termed as 'normal' to begin. This change is called a 'paradigm shift.' An example of this might be the change from the geocentric view of the universe to one of a heliocentric view. A classic Amateur radio paradigm shift might be that of AM to SSB operations. The problem lies in the fact that the shift from the old to the new paradigm is typically not smooth. The older, established proponents within a field have built their careers around the earlier paradigm, and they normally control the rules by which rules are changed and methods operate. The conflict continues until the emergent paradigm prevails, although

Look for TAPR at these Upcoming Events

May 17-19, 1996	Dayton HamVention
Sept. 20-22, 1996	ARRL and TAPR Digital Communications Conference in Seattle, WA
Oct. 11-13, 1996	ARRL Southwest Division Convention in Mesa, AZ

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usually not until the older paradigm has died, along with the last of the proponents who protected it.

In the past, paradigm shifts took centuries or decades to come fully about. In the last 50 years, paradigm shifts have been decreasing in duration and increasing in occurrence. One example is the paradigm shift from all positivistic research to more naturalistic or mixed method research in the last 10 years. Technology changes have had similar paradigm shifts, such as computers (main frames to personal computers or Macintosh to PCs) and now more recently telecommunications (national networks to home connections on the Internet). The controversy over parts of the recent telecommunications reform act shows some of the rough nature of a paradigm shift, that of the older paradigm trying to slow down the new paradigm by an attempt to control the nature of individual information access. I was attending a recent convention in Austin, where noted Sci-Fi author Bruce Sterling basically pointed out that many of the old paradigm structures are scared, because five years ago it was envisioned that AOL (Sears and IBM) would be the Internet world, nice, neat, packaged and controlled access from home...however, the Internet as it is today, arrived — not packaged by the Fortune 100.

Amateur radio is currently caught up in these shifts. The old ways of operational practices are under attack from the new and we will see the frustration in many Amateurs during the process. Logic does not prevail in many cases, see some of the comments on RM-8737. Personal interest and power bases are a key to trying to regulate new paradigms in order to stunt their growth. The next 10 years are going to be critical to Amateur radio as a hobby. Many hams want more rules and regulations at a time when Amateur radio requires less in order to adapt to the next paradigm. Traditionally, regulations are placed on areas that somehow need control or to break up a perceived injustice. The downside to regulations is that they become a large protector of the status quo later on. If we allow other Amateurs to place more regulations on what we do now in order to create some assumed equality or operating peacefulness, then we will be stuck trying to change those rules again in the future or possibly have them stifle the growth of Amateur radio as a hobby. While a good many Amateurs today enjoy operating their modes, in ten years the demographics of the hobby will change drastically. We must be thinking about the future of our, the entire, hobby instead of trying to protect small operating niches we do from day to day. If we do not, then Amateur radio might not be around in the form we enjoy today.

There are a lot of ways to look at the future of Amateur radio in light of paradigm shifts. What will happen in the next 10 years of Amateur radio? Future studies research says you can't predict the future, all that you can do is prepare different alternate realities and be best prepared for

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Article submission deadlines for upcoming issues:

Summer 1996	June 15, 1996
Fall 1996	September 15, 1996
Winter 1997	December 15, 1996
Spring 1997	March 15, 1997

Submission Guidelines:

TAPR is always interested in receiving information and articles for publication. If you have an idea for an article you would like to see, or you, or someone you know, is doing something that would interest digital communicators, please contact the editor so that your work can be shared with the Amateur community.

The preferred format for articles is plain ASCII text; the preferred graphic formats are HPGL or PCX. However, we can accept many popular word processor and graphic formats. All submissions on diskette should be formatted for MS-DOS.

thinking about different directions. Thus, when the future does arrive you have mentally prepared for it and can adjust your methods to deal with the new 'perceived nature' of the world. It is certain that unless we can somehow catch the current technology wave, we will be left behind as an activity that does important things. The last major Amateur operational advancements were new digital modes (mainly packet radio), which was built on 1970s technology, and the increase in ATV operations, which is an even older technology.

We are now faced with the fact that Amateur radio needs to shift to a new way of thinking about what it does. A traditional paradigm shift is in the making, or as we can see, the shift is already happening around us. Many of the things I hear Amateur radio touted for are in the past. I have read several times about the fact that at recent events where hams used to provide communications by ham radio, commercial trunking radios and other services have replaced hams. When I was a young ham, I participated in providing communications after the Wichita Falls, Texas tornado. Ham radio was used for several days to communicate information outside the area and provide communications in the damage area. Today, I see Amateurs providing short term communications here and there when an outage happens, until more modern commercial systems are brought back on-line or supplemented to handle the additional traffic of the emergency. Another few years, and Amateur radio will not even be doing this. I see storm spotters carrying their commercial pagers around to receive notification instead of using their radios. I see people with cellular phones making reports of accidents much faster than we can do on a phone patch. What Amateur radio 'brings to the party' is a radio-equipped volunteer group which can be called on short notice and used until no longer needed, and that use communications outside the commercial systems. There is a niche for Amateur radio in all this, but we must be aware of what is happening around us in order to be prepared for what will happen in the future.

I believe that there will still be an Amateur radio in the future. However, this could be the sunset or more likely a very cloudy day. Has anyone noticed that new Amateurs don't join clubs or social groups like older hams do? Amateur radio is going to change in the near future as compared to what has happened during the last 20-30 years for a majority of hams. I have heard many express this. The number of hobbyists will at some point decrease. I believe that we will see more experimentation and less operational usage in the future as our numbers start down. We will lose more frequencies. Money talks in Washington, and we are just fighting a delaying action to keep our frequencies. See the latest news about the analysis of Amateur frequencies and their utilization happening in Washington currently. Another thing that must be kept in mind is the FCC could easily deregulate Amateur radio. Based on what is happening in Washington and the recent history of the WTB (Wireless Telecommunications Bureau), deregulating Amateur radio could be forecast. What would happen then? With the ARRL and other lobby groups in place, this will not happen for some time, but it could happen.

Thus, how does TAPR fit into this long term? I believe, and thus far have the support of the Board of Directors, that TAPR must be involved in moving to one possible next stage in Amateur radio. This is Spread Spectrum development. Spread Spectrum is a classic paradigm shift technology. It breaks all the traditional 'perceived natural' rules of Amateur radio. You use as much bandwidth as you need to communicate, you transmit at the same times as others are transmitting, and other issues that go against analogy logic. Logic by analogy is a bad way to perceive technology. Currently with Narrow Band technology, many say the bands are 'fully occupied,' but if we take a spectrum analyzer and do an analysis of the band we see that they are hardly every 'fully utilized.' Several have noted this fact. Bob Bruninga, WB4APR, wrote an article in the 1995 ARRL Digital Communications Conference showing another way to try to utilize more of the narrow band frequency allocations. Robert Buaas, K6KGS, has built monitoring equipment to prove this fact in the supposedly 'very full' spectrum in his area of California. Spread Spectrum is one method in which we can contribute to enhance Amateur radio beyond what we are currently doing now on many of the bands.

I can't begin to explain the more technical issues of Spread Spectrum and I am learning as time permits during my dissertation writing, but when leaders in the Amateur community such as Phil Karn, Dewayne Hendricks, Robert Buaas explain things, I can easily see a vision of where this technology can take Amateur radio as a hobby. The major point to make is that this will not happen overnight. This is a very long-term goal to develop and support. TAPR will work on supporting individuals and groups that want to follow our vision. It would be our hope to eventually do something that supports this, but the future is again impossible to predict.

Spread Spectrum technology will allow Amateurs to drastically increase the way we utilize the bands and operate. I hate to talk about visions, especially in this column, because when something is mentioned, people have a natural tendency to think someone in TAPR is working on it and it should already be finished. So — let me state right up front "This is pie-in-the-sky stuff."

Imagine — your local club has an Amateur Spread Spectrum box (or several scattered around town). Connected to this box is maybe an RF link to another local repeater, and/or an Internet connection, and/or a phone patch, and/or any number of interconnections. The user, either at home or driving around, has their user radio equipped with a simple selector channel switch. Channel A is the general

voice calling frequency. I call Herb, get Herb, and we move to Channel B to talk or maybe Channel C, if B is busy. Let's say Herb and I are going to meet Bill on Channel D, because Channel D is linking several local (metro-area) repeaters via RF links. Then again, let's say we change to Channel E, which is connecting our system to our sister city's repeater several hundred miles away via the Internet. While this is all happening, my computer has been accessing a Web Interface or Eudora at 256Kbps or faster. Then, to make things even better, several such 'organization boxes' can be overlapping and not be interfering. How many clubs would like to have an audio or digital repeater, but can't find a frequency, because the 'band is full,' but 'under utilized'? Is this one possible reason why many of the traditional protectors of the status quo and recognized power structures are so against Spread Spectrum? Should Amateurs be coordinating operations or managing operations? Should our hobby be ruled by national regulations or by communications at the local and regional level?

Does this sound crazy? Does this sound like I have been drinking too many softdrinks late at night? Is this going to be here soon? Don't hold your breath, but this is something Amateur radio could be doing — absolutely!

Let's think about the above example in technical terms. Simply put, the SS box could be a linear transponder or an SS encoder/decoder of some type. The purpose of the SS box is that of a central link. In addition to providing traditional 'repeater like' operations for small cell-like areas, it is also providing connectivity away from the box. In the example above, the SS box was connected to the Internet (or some other wire line system), had a phone patch, had two or more RF links (in this example one was a repeater link and the other was a networking link to the local packet network). The users of the system had SS radios with a selector. As was discussed in Steve Bible's article in PSR #60, all the radios are on the same frequency. The selector just selects a spreading code to be used. Thus the cost and complexity of the user radio is reduced, although the expenses to add SS to the radio does raise the price back up again. How does the voice operations work? In the simplest form, the audio input (i.e. mic) would be translated to a digital signal using any of a variety of methods (check out http://www.qualcomm.com/people/pkarn/voicedemo/index.html). By adding FEC (Forward Error Correction) and all sorts of other techniques which are possible, we could have something that could change Amateur radio — do I hear paradigm shift?

With this technology, we are able to bring both digital and analog (voice) users together. No longer is the digital mode a second citizen on the band, but is able to provide capabilities that were not possible 5 years ago. I didn't even mention the capability of this technology for ATV users, EME operators, satellite stations and even weak signal enthusiasts. While Spread Spectrum might appear to be a threat to the way many operate — think about the possible new operations potential of this mode.

This is the reason why TAPR will be working on RM-8737 and other technical issues in the coming years. I can not stress the importance of the involvement of the digital community in the rules process. There were just a few comments to RM-8737 from the digital community in favor of the change. The opposition to changes in the rules are getting organized and we need to do the same. While TAPR can move the process forward working with the ARRL and others, it will eventually come down to who submits comments to the FCC. If Amateur comments in favor of change are in the majority, the FCC will change the rules. If they are not — then we will be very limited as to what the future will hold for this mode. If you want to get involved with the process, keep an eye on both the Spread Spectrum Special Interest Group and the Spread Spectrum Web Page.

I have been thinking about a lot of the items mentioned above for some time. Writing it all down has been a catharsis and I hope that it allows others to think about the future of Amateur radio as a whole.

Now to more mudane affairs of the organization:

The last issue of the PSR had the election ballot for Board of Directions. I would like to welcome back to the board Bob Hansen, N2GDE, and Gary Hauge, N4CHV. Joining the board as a new member is Steve Bible, N7HPR. Steve brings a lot of new energy and I look forward to working with him in the future. He is taking on a lead roll in the Spread Spectrum area and is working on bringing together materials for the TAPR Spread Spectrum Issues Book. Thanks to all the members who voted. Also, I would like to personally thank Keith Justice, KF7TP, for serving on the TAPR Board since 1993 and Vice President during 94-95. While Keith might be stepping down from the board he is remaining active on the ARRL and TAPR Digital Communications Conference coordinating committee. Keith's never failing upbeat attitude was always a comfort when I was feeling down about TAPR happenings. Thanks Keith.

I have received a few comments regarding the membership questionaire that appeared in the last issue. If you have a thought about what the responses were saying, please drop me a note.

If our publishing house can get it done in time, we should have Tom McDermott's, N5EG, book entitled Wireless Digital Communications: Design and Theory available at Dayton. In addition, the 9600 baud radio mods book is progressing again. We received the text from one of the two primary authors and should be getting the other text shortly. Our second author had a hard disk crash and is having to reenter several of the newer entries, since they were not backed up.

President's Corner, continued...

Not to overly focus on the spread spectrum issues, but if you haven't read yet, the process for changing the rules governing Amateur Spread Spectrum (RM-8737) is under way. I would like to thank those on the TAPR RM-8737 committee who have been working with Dewayne Hendricks, WA8DZP, chair of the TAPR FCC Regulatory Committee, on RM-8737. TAPR filed comments and reply comments and we are going to continue to take an active part in the rules process. The group has also spent time in developing a web page as part of the Amateur Spread Spectrum page that attempts to document all the comments and reply comments. Check http://www.tapr.org/ss to read all the latest information on the rules process. We believe this is the first time that an Amateur rule making has been made fully available for anyone to read. We hope to keep this page up to date, so you can see what others are saying about the issue of Spread Spectrum. I actually had one e-mail from an individual who filed comments state, 'You can't make my comments available like this...'. I replied that they are open records :-) Anyway, the Spread Spectrum issue continues and this process looks like we will be writing about the issue this time next year as well. Ever forward. Spread spectrum holds one of the few keys of really breaking past our current limitations. The TAPR FCC Regulatory Committee will also be bringing up the issue concerning message forwarding comments made last year. TAPR published Phil Karn's, KA9Q, petition for reconsideration last year, which left the door open to take another look at the issue and find better focus for the digital community. If you would like to donate money towards the TAPR FCC Regulatory Committee legal expenses, please contact Dorothy at the office. While we use our legal firm to a minimum in Washington, it does take money to play the game within the beltway with the other groups in order to get the rules changed in such a manner as to really allow Amateurs to utilize spread spectrum as a useful operational mode.

Last but not least. TAPR is doing a lot of work getting ready for both Dayton and the 15th Annual ARRL and TAPR Digital Communications Conferences. Of special importance is the 1st ever student paper awards for the DCC. Please take a gander at the information and check the web site or call Dorothy at the office for more details. We are awarding two $500 travel awards for papers in two areas. This is a first within Amateur radio; I believe and I think it could really help bring new Amateurs to the digital conference to join in the experience. Pass the word. Also, the deadline for the normal DCC papers is July 23rd. Seattle is shaping up for 1996!

Cheers - Greg Jones, WD5IVD

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A Short History of Spread Spectrum

by Steven R. Bible, N7HPR
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> "Whuh? Oh," said the missile expert. "I guess I was off base about the jamming. Suddenly it seems to me that's so obvious, it must have been tried and it doesn't work,"
>
> "Right, it doesn't. That's because the frequency and amplitude of the control pulses make like purest noise they're genuinely random. So trying to jam them is like trying to jam FM with an AM signal. You hit it so seldom, you might as well not try."
>
> "What do you mean, random? You can't control anything with random noise."
>
> The captain thumbed over his shoulder at the Luanae Galaxy. "They can. There's a synchronous generator in the missiles that reproduces the same random noise, peak by peak. Once you do that, modulation's no problem. I don't know how they do it. They just do. The Luanae can't explain it; the planetoid developed it."
>
> England put his head down almost to the table. "The same random," he whispered from the very edge of sanity.
>
> —from "The Pod in the Barrier" by Theodore Sturgeon, in Galaxy, Sept. 1957; reprinted in *A touch of Strange* (Doubleday, 1958).

Science fiction or science fact? It's uncanny how science fiction writers can glimpse the future. However, spread spectrum's beginnings date back to the 1920's with the advent of RADAR. Spectrum spreading for jamming avoidance and resolution, be it for location accuracy or signal discrimination, was a concept familiar to radar engineers by the end of the war. Spread spectrum was a natural result of the Second World War battle for electronic supremacy, a war waged with jamming and anti-jamming tactics [1]. In trying to combat this threat, scientists determined that:

...it can be stated that the best anti-jamming is simply good engineering design and the spread of the operating frequencies.

In the military, spread spectrum techniques were primarily used to combat enemy jamming since they tolerate much more interference than conventional means. Jamming of communication and navigation systems was attempted by both sides and the need for reliable communication and accurate navigation in the face of this threat was real. One major anti-jamming tactic of the war was to change carrier frequency often and force the jammer to keep looking for the right narrow band to jam.

Cloaked in secrecy and shrouded in mystery, spread spectrum has become one of the most misunderstood modulation techniques today. Perhaps because of spread

spectrum's lineage from intensive research during and after World War II, many people equate spread spectrum with an obscure modulation technique that cannot be understood and is used predominantly for secrecy. Perhaps no other technology developed out of the post WWII era carries such a stigma. Spread spectrum's stigma can be likened to the Manhattan Project. But as the Manhattan Project had many beneficial spin-offs that we take advantage of today, spread spectrum came out of its cloak of secrecy in the late 1970s when the Federal Communications Commission began exploring the concept of using wide band spread spectrum techniques for commercial uses.

So began a new paradigm in thinking concerning communications techniques. Now a third dimension, coding, was introduced in addition to frequency and time. Communications engineers had to rethink how information was transmitted over wire and wireless. It was Claude Shannon that introduced the concept of statistical concepts to information transfer. Thus was born a new area of research we know today as Information Technology.

Poisson, Shannon, and the Radio Amateur

In 1959 John Costas, K2EN, wrote a canonical paper [2] that challenged the conventional wisdom of the day that relief from congestion in the radio frequency spectrum was by dividing the available bandwidth into channels as small as possible. This is a principle we know today as frequency allocation and he argued that this principle was not based on any fundamental physical principles.

"The inherent communication capacity of the spectrum can be shared in ways other than by frequency allocation and for many applications the frequency division approach represents a very poor choice indeed."

Costas, using statistical methods applied to communications pioneered by Claude Shannon, first suggested that the best way to improve spectrum crowding was to use wide band techniques.

"The frequency diversity [SS] system is intuitively ridiculous because it apparently "wastes" bandwidth rather indiscriminately. As we shall see, intuition is a poor guide in these matters. The feeling that we should always try to "conserve bandwidth" is no doubt caused by an environment in which it has been standard practice to share the RF spectrum on a frequency basis. Our emotions do not alter the fact that bandwidth is but one dimension of a multidimensional situation."

Costas knew about the chaotic use of Amateur frequencies. Strangely enough, the only other communications service that closely resembles the Amateur service is the military. The Amateur bands are similar to military uses of the spectrum not so much in intentional jamming, but simply casual interference when two opposing forces attempt to operate independently using the electromagnetic spectrum.

Non-military Uses of Spread Spectrum

Given that spread spectrum techniques have evolved largely in response to military requirements, and in view of the fact that they require large bandwidths (relative to the information bandwidth), it is reasonable to ask why anyone would consider spread spectrum techniques for non-Government applications. Specifically, only the anti-jamming property of spread spectrum seems to be unique to military environments. The other uses, including resistance to unintentional interference, resistance to interception, discrete addressing, multipath resistance, multiple access and pulse compression all have potential civilian applications. In general terms, it is possible to identify four potential motivations for introducing a new communications or radiolocation technology [3]:

Reduced Cost - Because of the performance improvements that are possible with spread spectrum, it is conceivable that under certain conditions, a particular spread spectrum system could be less costly — due to reduced transmitter power or the elimination of ancillary circuits — than a narrowband system offering the same level of communication of ranging performance.

Improved Communication of Radiolocation Performance - Spread spectrum systems can provide significant resistance to unintentional interference and multipath fading. To the extent that error correction coding is used, spread spectrum systems provide improved performance against additive white Gaussian noise.

Expanded Capabilities - Spread spectrum systems can provide user privacy, discrete addressing, and multiple access on a transmit-at-will basis.

Improved Spectrum Utilization - The notion that spread spectrum techniques could provide improved utilization may be at first surprising. J. P. Costas was the first to raise this possibility. More recently, Cooper and Nettleton [4] have predicted improved spectrum efficiency for high-capacity spread spectrum mobile radio systems.

Amateur Experimentation

Amateur experimentation started innocently enough, with a short note in the June 1980 AMRAD newsletter. Paul Rinaldo, W4RI, spread the word that the FCC had some interest in Amateur radio experimenting with wide band techniques. Soon a special interest group formed for the purpose of exploring spread spectrum techniques in

the Amateur bands. The next step was to obtain a Special Temporary Authority (STA) which was granted on March 6, 1981. AMRAD experimentation is chronicled in The ARRL Spread Spectrum Sourcebook.

AMRAD's experimentation lead to the granting of spread spectrum emissions to Amateurs on May 1985 from Report and Order GEN Docket No. 81-414.

Unlicensed Spread Spectrum

One of the most rapidly developing and hotly contested areas of wireless data involves the use of spectrum that does not require the user to be licensed. In 1985, the FCC opened up three bands for unlicensed uses (data and other types of communications) based on a set of regulations designed to minimize interference and encourage the development of new services. Since then 130 companies have developed more than 200 systems and products for use in these bands — the 900 MHz band being the most popular — and more than 3 million devices are now in use by consumers and businesses [5].

Unlicensed systems and devices are widely known as Part 15 devices because they operate according to Part 15 of the FCC's rules. Some of the services that operate under Part 15 include automated utility readers, wireless LANs, cordless phones, wireless audio speakers, home security systems, and medical monitoring devices.

The FCC Part 15 rule has been a catalyst for innovative wireless applications and has stimulated the development of many new forms of low-cost spread spectrum radios. Perhaps the best protection for spread spectrum radios is their inherent robustness against interference and large multipath delays.

The FCC Part 15 rule has been adopted in part or completely by many other countries. Generally, North, Central, and South American countries have adopted these same rules. Most countries worldwide allow some form of unlicensed spread spectrum radios for commercial applications [6].

Part 15 is under revision by the FCC. On February 5, 1996, the FCC released ET Docket No. 96-8 (also known as FCC 96-36). Information is available from http://www.sss-mag.com/fcc1.html.

Wireless LANs

Wireless LANs closely approximate Amateur packet radio. It is perhaps in this technique that Amateurs will have the most interest. Wireless LANs operate in the 900 MHz, 2.4 GHz, and 5.7 GHz bands. They offer speeds up to 5.3 Mbps, although actual throughput is usually 1 to 2 Mbps. They use either direct sequence or frequency-hopping, spread spectrum transmission techniques. A number of wireless LAN products operate in the unlicensed bands, and the IEEE is currently developing industry standards for LANs as well as standards that will allow users' computers to communicate with each other directly — "ad hoc" or "peer-to-peer" networking. Development of products for the 2.4 GHz band has reportedly accelerated in anticipation of the IEEE standard for wireless LANs, the increasing congestion of the 902 to 928 MHz band, and the greater amount of bandwidth available compared to the 900 MHz band.

Conclusion

The history of spread spectrum dates back to the 1920s when scientist and engineers began using noise techniques to enhance ranging and resolution. Spread spectrum then became the natural engineering result of trying to solve the problem of reliable communications in an intentional jamming environment. Cloaked in secrecy until the late 1970s, spread spectrum came into the commercial realm in the 1980s. Amateurs began experimenting in 1981 and Part 97 of the rules permitted spread spectrum emissions for the Amateur service in 1985. The FCC also created Part 15 in 1985 to encourage development of new services for commercial uses. Part 15 devices today account for many of spread spectrum's uses.

For further reading on the fascinating subject of the origins of spread spectrum communications, readers should consult reference 1. For the history of Amateur spread spectrum, The ARRL Spread Spectrum Sourcebook is a good guide.

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Proposed Rule Changes For Spread Spectrum

On December 12, 1995, the ARRL petitioned the FCC for changes to the Amateur rules regarding spread spectrum communications. This is known as RM-8738. The following is an edited version of that filing followed by initial and reply comments by TAPR.

This is just the first step of the rule making process. By the time this *PSR* has been published, additional movement will have happened. For the latest information regarding RM-8737 and the full text of these filings, check http://www.tapr.org/ss

ARRL Petition For Rule Making Regarding Spread Spectrum Communications RM-8738

Summary

The American Radio Relay League, Incorporated (the League), the national association of amateur radio operators in the United States, respectfully requests that the Commission issue a Notice of Proposed Rule Making at an early date, looking toward the amendment of the Commission's Rules and Regulations regarding the Amateur Radio Service, in order to facilitate, to a greater extent than is done by the present rules, the contributions of the Amateur Service to the development of spread-spectrum communications.

The petition proposes (1) to permit brief test transmissions using SS emissions; (2) to permit international SS communications between United States' amateurs and amateurs in countries that permit amateur use of those emissions; (3) deletion of unnecessary restrictions on spreading codes and repetitive definitions of "harmful interference," and (4) to provide for automatic power control to insure use of minimum necessary power to conduct SS communications.

The League urges that the Commission propose and ultimately adopt these proposed rule changes.

These are, in the League's opinion, the minimum changes necessary in order to foster SS experimentation in the Amateur Service, while at the same time preserving those necessary existing protections against those who might conceivably exploit the amateur bands for non-amateur purposes. Spread-spectrum techniques are in regular use in Part 15 applications, but have not been given the attention deserved in other communications systems, such as the land mobile services, as a means of increasing the efficiency of use of crowded shared bands. The Amateur Service regularly functions as a provider of refinements of new technologies and provides means of deployment of those technologies on a cost-effective basis. In order to permit the degree of flexibility in use of this technology in particular, the Commission should provide the necessary regulatory environment to do so. These rule changes represent a conservative, and yet functional approach to reform of SS rules.

I. Introduction

1. Use of spread spectrum communications in the Amateur Service is relatively new. It was first authorized by the Commission by Report and Orders 58 RR 2d 328 (1985). The Commission authorized spread-spectrum communications in the Amateur Service in order to permit amateurs to develop, test and operate low-cost spread spectrum systems, thus to stimulate technical advances in radio technology, consistent with the basis and purpose of the Amateur Service (47 C.F.R. Section 97.1). The Specific Benefits to the public to be gained from amateur use of spread-spectrum (SS) communications as determined by the Commission included the following: Reduced power density and concomitant reduction of interference to narrow band communication systems; 2) Significant improvements in communication under conditions with poor signal-to-interference ratio; 3) Improved communication performance in selective fading and multipath environments; and 4) Ability to accommodate more communication channels functioning simultaneously in the same spectrum than is possible using frequency division multiple access exclusively.

2. Since the time SS communications were first authorized in the Amateur Service in mid-1985, there have been some experimental amateur operations using SS techniques, but its use has not been widespread. The League believes that one significant reason for this reduced level of experimentation is due to limitations in the rules governing SS communications in the Amateur Service. The proposed revised rules in the appendix are intended to provide increased flexibility in the use of this mode, to encourage amateurs to experiment and use SS communications, to develop new techniques for increased spectrum efficiency using this mode, and to improve compatibility with narrow-band modes.

II. Spread-Spectrum Communications Rules Should Be Flexible

3. Commission policy is and has been to encourage experimentation and to provide a Regulatory environment for the Amateur Service which encourages modern techniques, technology and uses of amateur radio.

4. SS communications are well-suited to the Amateur Service, especially in shared bands. Amateur experimentation in SS communications, in view of the apparent compatibility of SS communications and

narrow-band modes commonly used in the Amateur Service, is of potential benefit in terms of spectrum efficiency. This was noted by the Commission in Docket 81-414. There were some concerns expressed by commenters in that proceeding. These initial objections fell into three categories: 1) concern about intraservice interference; 2) concern about inter-service interference; and 3) concern about monitoring issues, and the ability to protect the Amateur Service against interlopers. These issues are not of practical concern now, and they are not anticipated to become significant under the proposed revised SS rules. There have not been, in the League's experience, any established instances of actual interference to narrow-band amateur communications from SS communications. Tests conducted by amateur groups have established that certain configurations of SS operations can, due to increased in-band noise, trigger amateur repeater inputs (if those repeaters are carrier-operated), but that potential interaction is easily avoided by selection of spread-spectrum parameters. There are potential interactions between SS and narrow-band modes in certain circumstances, depending on processing gain and the randomness of spreading codes, however. There have been no reported instances whatsoever in the League's experience, of interference to other radio services from amateur SS communications.

5. Notwithstanding the Commission's general support of Amateur SS communications, as stated in the Report and Order in Docket 81-414, the rules adopted in that proceeding were quite circumscribed. The limitations were principally aimed at facilitating station identification by other amateur stations, and limiting spreading sequences by specifying a limited number of linear feedback shift registers. SS communications are currently authorized only for domestic communications, and the frequencies available for SS communications were in the bands above 225 MHz. They remain as originally enacted, to the present date.

6. The Commission has generously granted and extended Special Temporary Authority (STA) for SS experimentation, however. The experiences of amateurs pursuant to these past Special Temporary Authorities indicate that the present rules include certain significant limiting factors which could be liberalized without detracting at all from other, narrow-band amateur communications.

It is the League's belief, and apparently that of Commission staff as well, that experimentation in the Amateur Service, and particularly further SS experimentation, should be accommodated by increased flexibility in the rules, and not by reliance on STAs. According to a report by Mr. Buaas, K6KGS, holder of a Commission STA, which report was filed with the Chief, Private Radio Bureau in March of 1993:

> Our work to date has focused on determining: a) what performance can be achieved utilizing several techniques in spectra already occupied by narrowband emitters, b) what level of interference results to existing users; c) what impact existing usage has on degrading SS performance; d) how much usage can be pressed into a given spectrum using CDMA; and e) what proposals we might make to change the Rules and thereby further encourage experimentation without the need for this STA.
>
> Several of our experiments have been particularly successful. We started with designs which would meet the limits set forth for Part 15 systems, and worked up from there. One hybrid design (DS coupled with slow FH) was particularly effective in minimizing interference...
>
> It is now clear to us that use of SS in the Amateur Service has been severely limited by the design restrictions in the Rules...

The League agrees that it is useful to relax somewhat the rules contained in Sections 97.305(b) and 97.311 governing amateur SS operation, to permit greater operating flexibility and the development of SS communications as a practical communications mode in the Amateur Service without adverse interaction with other modes.

III. Proposed Rule Changes

7. The first change proposed by the League is to permit brief test transmissions of SS emissions, as is permitted in Section 97.305(b) for other types of emissions, except that test transmissions using SS emissions would be limited to those frequency bands where SS emissions are authorized generally, as is the case with pulse modulation transmissions.

8. Second, it is proposed to amend Section 97.311(a) of the Rules to modify the requirement that SS communications be limited only to domestic communications. Amateur communications have always been permitted internationally between countries that permit it, and SS emissions should not be prohibited between United states amateurs and amateurs in countries where those emissions are permitted as well.

9. The reference in §97.311(b) to unintentional triggering of repeater inputs, a reference in the rules governing SS communications since 1984, is unnecessary because it is merely repetitive of existing definitions of "harmful interference" in the ITU Radio Regulations and in commission definitions and interpretations generally. Harmful interference for non-safety-of-life radio services does not include squelch breaks and repeater activation.

10. It is proposed to delete Subsections 97.311(c) and (d), in order to permit hybrid frequency-hopping (FH) and direct-sequence (DS) emissions, and spreading codes not currently permitted by the rules, but which are desirable. The current rules permit only two techniques, neither of which is optimal for sharing. There are newer codes,

including those used by Part 15 device manufacturers, which have been optimized to avoid interaction with shared users. These could be used if the rules were more flexible. Elimination of the rule limiting amateurs to specific spreading sequences is necessary to facilitate experimentation. The proposed rule changes would delete the limitations on SS configurations contained in the present Section 97.311(d). This modification is necessary to provide sufficient flexibility to experiment with other spreading sequences, tap settings and frequency hopping techniques. Nor will the changes create any difficulty with station identification, Amateur Service from commercial or unlicensed encroachment. The narrow-band identification requirement is sufficient, together with the documentation requirement in Section 97.311(e) of the Rules, to permit the degree of monitoring of SS activities of amateurs necessary to protect the Service. As the Commission appropriately recognized in addressing monitorability of unspecified digital codes in the Amateur Service, quoted in the Report and Order in Docket 81-414:

> In balancing our objectives of encouraging new technologies against ensuring our enforcement capability, it must be recognized that there is an incompatibility between authorizing experimentation with "exotic" technologies and the employment of channel monitoring as an enforcement tool. Our ability to verify that the content of messages complies with our rule requirements will be hindered by the broad relaxation of regulatory constraints that we are ordering in this proceeding. However, the Commission agrees...that special provisions we are including in the final rules, as well as existing provisions that identification be made in plain English or the international Morse code, should, when combined with the zealous effort of the amateur community to protect their allocated frequency bands, provide adequate protection against unauthorized operation in the service.

It is not proposed to modify the station identification provisions in Section 97.119(b)(5) which contains the CW identification requirement for SS communications. The League questions the practicality of the requirement, in view of the variability of frequency on which the narrowband CW identification requirement may be located. Nonetheless, it is not proposed to delete the requirement at this time.

11. Finally, the proposed appendix would amend Section 97.311(g), to provide for automatic transmitter power control which would limit output power to that which is required for the communication, when more than one watt of transmitter power is used. This is a simple matter to accomplish technically, and it will insure compliance with Section 97.313(a) of the rules, which requires the use of minimum transmitter power. It will also minimize any potential for interference to other amateur stations and insure maximum spectrum efficiency.

IV. Conclusion

12. The League urges that the Commission propose and ultimately adopt these proposed rule changes, which are in the League's opinion the minimum necessary changes in order to foster SS experimentation in the Amateur Service, while at the same time preserving those necessary existing protections against those who might conceivably exploit the amateur bands for non-amateur purposes. Spread-spectrum techniques are in regular use in Part 15 applications, but have not been given the attention deserved in other communications systems, such as the land mobile services, as a means of increasing the efficiency of use of crowded shared bands. The Amateur Service regularly functions as a provider of refinements of new technologies and provides means of deployment of those technologies on a cost-effective basis. In order to permit the degree of flexibility in use of this technology in particular, the Commission should provide the necessary regulatory environment to do so. These rule changes were developed by a dedicated committee of League staff and volunteers familiar with the technology, and represent a conservative, and yet functional approach to reform of SS rules.

Therefore, the foregoing considered, the American Radio Relay League, Incorporated respectfully requests that the Commission issue a notice of proposes rule making to implement the rules contained in the attached Appendix, and adopt the same after an opportunity for notice and public comment.

Appendix

Section 97.305(b) is amended to read as follows:

(b) A station may transmit a test emission on any frequency authorized to the control operator for brief periods for experimental purposes, except that no pulse or SS modulation emission may be transmitted on any frequency where pulse or SS is not specifically authorized.

Section 97.311(a) is amended to read as follows:

(a) SS emission transmissions by an amateur station are authorized only for communications between points within areas where the amateur service is regulated by the FCC and between an area where the amateur service is regulated by the FCC and an amateur station in another country which permits SS communications for its amateur licensees.

Section 97.311(b) is amended by deleting the last sentence thereof.

Section 97.311(c) and (d) are deleted in their entirety.

Section 97.311(g) is amended to read as follows:

(g) The transmitter power output must not exceed 100 W under any circumstances. If more than 1 W is used,

automatic transmitter control shall limit output power to that which is required for the communication. This shall be determined by use of the ratio, measured at the receiver, of the received energy per user data bit (Eb) to the sum of the received power spectral densities of noise (No) and co-channel interference (Io). Average transmitter power over 1 W shall be automatically adjusted to maintain an Eb/(No+Io) ratio of no more than 23 db at the intended receiver.

Comments Of Tucson Amateur Packet Radio Corporation

The Tucson Amateur Packet Radio Corporation (TAPR) submits these comments in response to RM-8737 Petition for Rule Making (the Petition) filed by the American Radio Relay League, Incorporated (ARRL).

Discussion

TAPR generally supports the recommendations made by the ARRL in its Petition. Spread Spectrum (SS) technology has not made great advances in the Amateur radio service since it was first permitted in 1985, in part due to the fact that, by today's standards, the Part 97 regulations on Amateur spread spectrum are extremely restrictive. In particular, the small number of fixed spreading codes permitted under Section 97.311(d)(1) inhibits the use and development of SS by Amateur radio stations. TAPR believes that it is in the public interest, and in the interest of the Amateur radio service, to change the rules for SS in order to accelerate the adoption of SS by the general Amateur community.

TAPR also supports many of the specific recommendations made by the ARRL.

First, TAPR supports the ARRL's request to modify Part 97.311(b) as it pertains to the unintentional triggering of repeater inputs. This section is redundant with other parts of the Commission's rules and, therefore, is unnecessary.

Second, TAPR supports the ARRL's request to delete sections 97.311(c) and (d), in order to permit SS emissions and spreading codes that are not currently authorized. Elimination of the rule that dictates specific spreading codes is necessary to facilitate further experimentation and to match the provisions allowed under an existing Amateur service SS STA, discussed below. In addition, it would facilitate the use and adoption by Amateur radio operators of Part 15 SS equipment and hardware.

Third, TAPR supports the ARRL's proposed change to 97.311(g), which would provide for automatic transmitter power control to limit the output power of an SS station to that which is required for communication, when more than one watt of output power is used. TAPR, however, differs with the ARRL as to just how simple this requirement would be to implement technically. While TAPR agrees that technically it is simple to control the output power of a transmitter, it is quite another matter to make this control automatic and foolproof. If the Commission decides to proceed with this particular change to the rules, it should phase the change in over some reasonable period of time, in order to give the Amateur community the opportunity to develop and deploy SS equipment that properly can meet this requirement.

While, as noted above, TAPR agrees with many of the ARRL's recommendations, it disagrees with a few of the proposals contained in the Petition.

In particular, TAPR differs with the ARRL with respect to the question of which frequencies should be authorized for SS emissions. In the Petition, the ARRL proposes that brief test transmissions of SS emissions be permitted only on those frequency bands in which SS emissions currently are authorized. TAPR believes that SS emissions should be allowed on all frequency bands covered by the SS STA currently held by Mr. Robert Buaas K6KGS (6m and 2m, in addition to the frequency bands currently authorized by Part 97). In addition, the Commission should allow SS emissions in the 219-220 MHz band, which was authorized for use by the Amateur radio service after the Buaas SS STA was originally granted in 1992. Finally, the Commission should not impose any restriction on the length of time SS emissions are transmitted. Ample time already has been provided for the experimental phase of SS usage in the Amateur service (five years of experimentation under the 1980 AMRAD STA and ten years under the current Part 97 rules), and it is now time to allow SS use without restriction.

TAPR also differs with the ARRL as to how station identification and documentation should be handled under a revised set of rules. The ARRL in its petition did not ask the Commission to delete sections 97.311(e) and 97.119(b)(5) of the rules, even though it questioned the practicality of the requirements set forth in these sections. TAPR, in contrast, recommends that the Commission delete these subsections of the rules. The interference and harm to the band in which an SS station is operating that would be caused by a requirement to use a CW identification outweighs the benefits that would accrue for monitoring purposes from the use of the ID.

As a result, the Amateur radio community should be permitted to develop an approach for handling the necessary functions of monitoring and identification. TAPR already is working on possible resolutions to this problem and in the near future will be in a position to make a proposal to the Commission on this matter.

Conclusion

SS technology can provide many useful benefits to the Amateur radio community if its use becomes more widespread and mainstream. In order to accomplish this, however, certain changes must be made to the Commission's rules governing the use of SS in the Amateur radio service. By making these changes, the Commission will create a regulatory environment that will give members of the Amateur radio service enough flexibility to develop innovative equipment and hardware employing SS technology.

For these reasons, TAPR urges the Commission promptly to issue a notice of proposed rule making to facilitate spread spectrum communications in the Amateur radio service, as proposed in the Petition and as modified herein.

Reply Comments Of Tucson Amateur Packet Radio Corporation

The Tucson Amateur Packet Radio Corporation (TAPR) submits the following reply comments regarding the Petition for Rulemaking (the Petition) filed by the American Radio Relay League (ARRL), which proposed certain changes in the rules governing spread spectrum operation in the Amateur Radio Service (ARS).

I. Permitting More Widespread Spread Spectrum Operation in the ARS Would Serve the Public Interest.

A number of the comments recognized the benefits that could be provided by more widespread use of spread spectrum technologies in the ARS. In addition to those that would accrue to ARS operators, as described in the Petition, increased use of spread spectrum in the ARS would contribute to the overall development of spread spectrum communications and, as a result, would provide benefits indirectly to commercial users as well.

Expanded use of spread spectrum in the ARS also would further the Commission's objective of promoting efficient spectrum use. At the FCC's March 5, 1996 en banc hearing on spectrum policy, Paul Barens, the "father" of one of the technologies that forms the basis of the Internet, made the following statement:

> What do we see today if we tune a spectrum analyzer or a radio receiver across most of the scarce spectrum bands? Mostly nothing. Dead air. This strongly suggests that most of our limited spectrum space is not being fully utilized and is going to waste. Specifically, with digital technology, spectrum bands can be more efficiently packed without interfering with existing services.

By increasing the ability of ARS operators to use spread spectrum technologies, the Commission would enhance their ability to use digital technologies to enhance spectrum efficiency, as recommended in the above passage. In turn, the Commission also would make it possible for the ARS to better accommodate the many new users seeking to use ARS bands, which are already congested due to the widespread use of non-digital equipment.

Although spread spectrum is not a panacea, it offers the promise of increased spectrum efficiency, reduced interference, and improved communication performance without adversely affecting other spectrum users. As a result, the Commission's rules governing spread spectrum operation should be modified to enable these technologies to flourish within the Amateur service community.

II. Expanded Spread Spectrum Operations Will Not Adversely Affect Other ARS Operations.

Several repeater coordinating organizations, who are responsible for the coordination of repeater operations in their regional areas of activity, filed comments opposing the Petition. These entities generally alleged that adoption of the ARRL's proposals would cause widespread interference to, and disruption of, existing operations.

The fears and concerns expressed in these comments defy the proven ability of properly designed and implemented spread spectrum systems to operate in harmony with other spectrum users, are based upon "worst-case" scenarios, and reflect a desire to maintain the status quo even at the cost of stifling new technologies and services. As a result, they should not be permitted to prevent the development of spread spectrum in the ARS.

First, as discussed by Robert Buaas, claims that spread spectrum operation will raise the noise floor ignore the fact that few real systems operate near the noise floor, and those that do would profit from applying spread spectrum technology.

Second, in the ten years since the Commission first allowed limited spread spectrum operation in the ARS, a great deal of work has been done to address concerns that more flexible spread spectrum operation would adversely affect other types of ARS operations. In particular, the 1991 Buaas spread spectrum STA has made it possible for experimenters to engage in widespread use of spread spectrum technologies in the Amateur band allocations below 450 MHz. Notably, operation under the existing spread spectrum rules and experimentation under the spread spectrum STA have not generated substantiated claims of objectionable interference. Finally, the successful operation of Part 15 spread spectrum systems provides substantial evidence of the ability of these devices to co-exist with other users. Today, millions of spread spectrum devices operating under Section 15.247 of the Commission's rules are being used to support end-user solutions in areas such as cordless phones, location monitoring devices, and local and

metropolitan-area networking. These devices have been deployed across the United States without any local coordination and without any licensing by the Commission. Yet despite this flexibility and extensive use, spread spectrum Part 15 devices have almost universally operated without causing objectionable interference to other Part 15 devices or to others operating in shared spectrum. This success story provides ample proof that when spread spectrum devices are properly designed, manufactured, and deployed, they can coexist successfully with many diverse applications and, in addition, can facilitate frequency reuse.

In light of this history of successful, non-interfering operation, the Commission should not permit unsubstantiated claims of potential interference to thwart the introduction and use of new spread spectrum technologies in the ARS.

TAPR believes that a program of continuing education to the ARS community on the merits and benefits of spread spectrum technology coupled with a wider use and deployment of equipment by Amateurs in various applications will go a long way towards resolving the concerns of many of the commenters who have filed in opposition. TAPR intends to use its resources to perform this function and service for the Amateur radio community in much the same fashion that it helped start the packet radio revolution in the ARS during the mid-1980s.

III. Section 97.119(B)(5) Of The Rules Should Be Deleted, As Suggested By NCS.

TAPR supports the suggestion made by the Manager of the National Communications System (NCS) to delete Part 97.119 (b)(5), which deals with the requirement for CW identification. TAPR agrees that no currently available commercial equipment implements such a function, and that deletion of this requirement will act to speed the rapid adoption of this equipment into use in the ARS.

Conclusion

TAPR congratulates the ARRL for its forward-looking proposal to liberalize the spread spectrum rules in the ARS. ARRL's proposal, if adopted, could provide a variety of benefits to both members of the Amateur service community and to the wider public.

Proposals to modify the status quo often generate opposition by those who are adequately served by it. Like the turmoil that occurred in the ARS during the transition from AM to SSB, the growing use of spread spectrum in the service will not be without incidents of disagreement and misunderstanding. For this reason, TAPR intends to use its resources during the rulemaking process to educate the ARS community on the theory, application, and practice of spread spectrum technology.

Yet while fear and opposition are understandable, they should not be permitted to stifle new developments. In light of spread spectrum's strong track record and proven benefits, unsubstantiated claims of potential interference should be discounted and the Commission should act promptly to issue a Notice of Proposed Rulemaking proposing to implement the changes sought by ARRL, modified as discussed in TAPR's earlier comments.

For More Information on RM-8737

The web page on RM-8737 concerning SS Amateur Rule Changes is updated regularly. Additional comments and reply comments will be added as time allows. It contains the following as of March 13th, 1996:

The initial ARRL filing, assigned as RM-8737

Comments to RM-8737

San Bernardino Microwave Society 2/20/96
Robert A. Buaas, K6KGS 2/23/96
Southern California Repeater and Remote Base Association (SCRRBA), 2/23/96
SouthEastern Repeater Association, Inc 2/23/96
TAPR Comments 2/26/96
National Communications System, 2/26/96
George Isely, WD9GIG, President, MACC, 2/26/96
Whit Brown, WB0CJX, Frequency Coordination Chairman, MACC, 2/26/96
The Indiana Repeater Council, 2/28/96
Henry Ruh, KB9FO, Publisher, Amateur Television Quarterly, 2/28/96
Charles M. Albert, Jr. KC6UFM, 3/4/96
Mike Cheponis, K3MC 3/4/96

Reply Comments to RM-8737

Mike Cheponis, K3MC 3/6/96
Bill Tynan, W3XO 3/11/96
AMSAT 3/11/96
TAPR 3/11/96
Phil Karn 3/11/96
Robert A. Buaas, K6KGS 3/11/96
Steven Bible, N7HPR 3/11/96
Naval Postgraduate School 3/11/96
Charles M. (Marty) Albert, Jr. KC6UFM 3/13/96

To review these, and any new submissions, you can check http://www.tapr.org/ss

Packet Radio in Education
Rapid City Area Schools, South Dakota

An example Proposal concerning utilizing Radio in the classroom.

Douglas Rowe

This is the fourth of several articles that will appear in the PSR concerning Amateur/packet radio and its potential in K-12 educational applications. These papers were assembled over several summers of teaching a graduate level course at the University of North Texas. Many thanks to the Texas Center for Educational Technology for allowing TAPR to reprint this information.

As part of TAPR's goal in education, we hope that these articles will be disseminated to a larger group that can take the concepts and ideas to a next step or final application/implementation. If you have a teacher or educator as a friend, please pass these articles along.
— Greg Jones, WD5IVD

Reprinted from:
Jones, Greg (ed). Infusing Radio-Based Communications Tools into the Curriculum. Texas Center for Educational Technology. 1995. 136 pages.

Introduction

Seven years ago our committee approached the school board for possible adoption of an exploratory block of classes to be offered as a segment of the 7th grade curriculum. The block of four classes, each for nine-weeks, was a combination of industrial art, home economics, art, and computers. This exploratory block has been extremely successful and has generated a positive consensus among the students, parents, and teachers.

Five years ago, due to the success of this exploratory block, a semester of computer literacy was developed and approved for the 9th grade. Two years ago, it was the students and parents who approached the board asking to expand the computer program to the 8th grade. Likewise, that program has been extremely positive and successful.

During this span of seven years, I have been repeatedly asked by the students in the gifted and talented program if there was a computer activity beyond the regular computer classes that they could become involved with. It wasn't until this summer when I completed a special telecommunications class at the University of North Texas that a perfect solution emerged for these students. The solution to their inquiries also will benefit the other students as it will provide enhancements to the curriculum of the existing computer classes as well as to other subject areas. Adoption of this proposal would be a perfect match in educational philosophy that will be implemented when our school district changes from the junior high concept to that of the middle school concept. Indeed, one of the goals of the middle school concept was to involve the students with activities and functions of the community. Again, this proposal is a perfect and a meaningful match with that philosophy.

Proposal

Thus at this time, I proposed that West Junior High pilot a program that develops an Amateur radio station with emphasis on Packet Radio. It would be a perfect addition to our curriculum program. In order to show its advantages and features, a rather lengthy background of this proposal is included.

Background

School systems throughout the United States are recognizing the need for educational instruction to expand beyond the parameters of the school building. It has become essential with our emergence into the "Information Age" that our concept of education be broadened to include the resources that are available outside of our immediate vicinity.

Sometimes we get so caught up in the new or recent developments of technology that we overlook the possibilities of past technology. They likewise have updated their capabilities with the advances of technology. With the increased sophistication of Amateur radio technology and with the increased number of satellites using radio-Amateur frequencies, the value of this technology as a teaching resource should not be overlooked. Indeed, the usefulness of incorporating Amateur radio into the educational system has become quite advantageous.

The purpose of this proposal is to clearly outline how Amateur radio technology can easily, effectively, and inexpensively enhance the educational environment of our students. Is there an actual need for the integration of information technology into the classroom curriculum as implied in this proposal? Yes indeed, it is important to familiarize our students with the rapidly advancing technologies of telecommunications and data handling which are in the process of transforming our lives. Implementation of this proposal would provide sufficient hands-on time to enable this technology to become meaningful and understandable within their environment.

Packet Radio and other segments of Amateur radio should be considered as a valuable solution to the problems associated with providing communications beyond and within our sparsely populated state. Its technology makes distance teaching and learning truly interactive in every sense. Its costs are certainly competitive with any present-day delivery system and its future is ensured because of a strong satellite program

utilizing Amateur radio. That is, what has always hampered the incorporation of telecommunications into our school system before has now been eliminated by radio communications.

Location & Operation Analysis

At West Junior High, an Amateur radio station emphasizing packet radio would be established in the library. A mobile packet radio unit would be used throughout the building. Since our school system can now be connected to the majority of the world, a whole new frontier beyond the classroom is now within our reach.

Probably your first impression is that this proposal sounds quite expensive and would also require extensive modifications to the building. However, the low costs associated with packet radio and other segments of Amateur radio have made it possible for the adoption of this proposal to easily fit within Rapid City's tight financial budget.

First, let's look at the expenses of other telecommunications systems that Packet Radio has eliminated. What has kept us from integrating telecommunications into the curriculum in the past has been both the high cost of telephone installation within the building and the high, ongoing monthly costs associated with connect-time via phone communications. Providing an independent phone line and the installation of a phone jack to each classroom desiring to use telecommunications was quite expensive. Likewise because of the installation cost, the number of classrooms available to use telecommunications was usually limited to one or two. And needless to say, school board members were not thrilled with the idea of a continuous cost associated with a monthly phone bill. Because of the remote location of South Dakota, we were all aware that this monthly phone bill would probably be in the range of one hundred dollars.

This proposal would eliminate all of the above costs. First, there would be no monthly phone bill as communications over the radio are free. With our main unit set-up in the library as a repeater-type system, every classroom could use the mobile packet radio unit without additional wiring or phone installation. That is, installation costs and ongoing monthly costs have been eliminated through the use of radio communications.

Since the library's unit and the mobile's unit at West Junior High would require only about the space of an average teacher's desk, no building modifications or additions would be needed. Because of the library's location on the second floor, installation of an antenna and then wiring the library's unit to the antenna would be minimal in both installation and cost.

You are probably in agreement that this proposal is sounding better and better already. Undoubtedly by now, you are starting to wonder whether or not there's a high cost associated with the initial purchase of this equipment. In actuality, you will soon learn that the cost is quite modest. In addition, there are possible resources within our community that could significantly reduce even these costs. Now that you are starting to become more interested, let's examine the potential that radio and satellite communications can offer toward enhancing the curriculum at West Junior High.

Curriculum Benefits

The ability to move this unit to other classrooms without having to worry about a phone jack is very important and greatly increases its usefulness. For in situation after situation the value of using microcomputers and modems was always limited or restricted to the nearest phone. Another major advantage of this proposal is that satellite time is also available at no cost. Yes, it will be possible to integrate satellite technology and data beamed directly from space into our curriculum. As you are beginning to see, the excitement and potential that can be generated via Amateur radio is immense.

Indeed, Packet Radio is ideally suited for use in remote, sparsely populated areas. South Dakota fits that description to a tee. Although Rapid City is the second largest city in South Dakota with its population of about 60,000; there isn't a similarly-sized city or town within a three hundred miles radius.

Satellite and radio communications can be used both as an object of study and as an enhancement to many different subject areas. However, my proposal has this technology initially beginning with the talented and gifted students (TAG). Let me explain the rationale behind this suggestion and how it in turn would branch off to the other curriculum areas.

In order to use radio telecommunications, the operator must have an FCC license. If I were the only one having a license then operation of the Amateur radio station would be limited to before and after school and also a limited segment of the school day when I wasn't teaching. Although a unit on Amateur radio would be presented in my computer literacy classes, the implementation of this technology into the curriculum of other subject areas couldn't be accomplished. Since this technology would serve as a valuable enhancement to other subjects, there needs to be a way it can be incorporated. Thus, by having gifted and talented students earn their licenses, this equipment could be officially operated by them throughout the school day. That is, instead of having just one class, mine, being able to use this technology; the entire school has the potential of using this technology.

What exactly could happen if radio communications was incorporated into our school's environment?

Imagine the thrill and educational value of the French, Spanish, and German classes communicating with someone fluent in the language they are studying. Yes, we should be able to reach segments of the society that have these languages as their native tongue. Okay, perhaps some of these contacts might reside right here in the United States. But either way, this technology without any additional cost has extended our resources beyond the regular classroom.

Obviously Math and Science classes would benefit from this technology. Appropriate, meaningful, and relevant problems are abundant and easily accessible with this technology. The ability for students to gather data transmission directly from current sources and then to analyze this data has tremendous potential. That is, by utilizing this technology, students would be doing the type of problems frequently encountered in the work environment.

Geography and History Classes would be enhanced. When you can actually communicate with someone that is residing in the area being studied it generates enthusiasm and interest. Also by having access to bulletin boards and databases via this technology, students would be able to gather pertinent data about related topics. Indeed, learning about the daily environments and activities of these people far exceeds the value gained merely by textbook reading.

One of the primary goals of the QUEST class is to promote communication and to develop communications within the community. This is one of the major operating functions of Amateur radio communications. Thus using this technology without any additional costs, the students can expand their communications skills with people scattered throughout the country. Again, all of this communication is free. No huge phone bill to be received and thus no reason for us to attempt to limit the students talking to others.

The fact that this technology could even be used by the typing classes shows the multiple facets of this technology. With the technology proposed, not all communication has to be transmitted and received via voice. Besides having the ability to function as a phone through an auto-patch, connecting the packet radio to the computer would establish the keyboard as the mode of communication. This would provide useful and meaningful typing practice for these students. (Note: such transmissions are classified as third party communications but are okay when a licensed TAG student is supervising).

Because this technology is a natural lead-in to various segments of the community (e.g. National Guard; Civil Defense; Ellsworth Air Force Base; weather, radio and television stations) both the students and the community can benefit in numerous ways. As school board members involved in the community, a lengthy discussion of the benefits of such activities is not needed as you can easily recognize the merits of this interaction. Included as part of the curriculum for the gifted and talented students will be field trips to different segments of our society.

Costs

Okay, you are now convinced that this is an extremely worthwhile project that should be adopted for use in the educational setting. Exactly what are the costs involved in the adoption of this proposal.

First of all, before purchasing this equipment, I would need to expand my present level of knowledge regarding this technology. Contacts could be made with Big Sky Telegraph of Montana, Frank and Reggie Odasz from the University of Wyoming, and Dave Hughes of Colorado Springs. Since the cost of this informative contact would be provided by our building level budget for professional growth and travel, its cost is not included as part of this proposal.

APRS Tracks

Stan Horzepa, WA1LOU
One Glen Avenue
Wolcott, CT 06716-1442
email: stanzepa@nai.net

What is APRS?

APRS is the acronym for Automatic Packet/Position Reporting System, a packet radio application that is probably the "hottest" packet radio application at this time. APRS is hot because it is different, useful, and fun!

Picture this. As you sit at your computer, it displays a map of your home town and your home state/province. On the map, in the exact location of your QTH, is an icon of a house labeled with your call sign. Other icons on the map indicate the positions of other active stations on frequency. Click on a WX icon and your monitor displays the weather conditions at the WX icon's location. A mailbox icon appears indicating that you have just received a message from another station on frequency. An icon of a jeep moves along the lines on the map that represent a nearby interstate highway.

In the jeep is a mobile APRS station. The mobile station may consist of a radio, TNC, and laptop computer running APRS. As the jeep travels along the interstate, the operator of the mobile APRS station updates the position of the jeep icon on the APRS map and APRS relays the new position to all other APRS stations on frequency to update the position of the jeep icon on their APRS maps.

Or the mobile station may consist of a radio, TNC, and a Global Positioning System (GPS) device. The GPS device uses signals from Earth orbiting satellites to calculate its location and then sends that information to the mobile station TNC, which relays it via radio to all the other APRS stations on frequency in order to update the position of the jeep icon on their APRS maps.

Put the mobile station in the lead car of a parade or marathon or in an emergency vehicle in a disaster area and the public service aspects of APRS become very apparent.

The potential of using packet radio as a tool for tactical tracking in public service and emergency situations is how APRS came about. APRS is Bob Bruninga's (WB4APR) baby. Bob brought APRS to life after years of developing a variety of tactical and mapping applications for packet radio. IBM-DOS-class personal computers was the vehicle that Bob chose for APRS because it was the most popular computer in ham radio at the time APRS was born. Bob has carefully nurtured his baby and new versions of APRS come out regularly, packed with new features that are the result of Bob's brainstorming and user wish lists.

Bob wrote recently, "Think of APRS as just a multi-user, distributed packet network with a map display for many exciting Amateur applications, such as network topology monitoring, direction finding, weather reporting, frequency coordination database, DX cluster monitoring, HF DX plotting, AMSAT ground station tracking, satellite tracking, search and rescue, special event tracking/organizing, boat/mobile/RV tracking, RF path estimating, local area chat mode, and telemetry displays."

A few years after the birth of APRS, the brothers Keith and Mark Sproul, WU2Z and KB2ICI respectively, ported APRS to the Macintosh computer platform and called it MacAPRS. Like WB4APR, the Sprouls have nurtured MacAPRS and new versions with new features appear regularly. Recently, the Sprouls began porting MacAPRS to Windows and expect to have WinAPRS ready for release at the Dayton HamVention in May 1996.

The Key to APRS

APRS uses UI (unnumbered information) packets, the same kind of packets you use to call CQ or send beacons. UI packets are not addressed to any specific station; they are intended for receipt by all stations on frequency, however, just as you can use digipeaters to propagate a CQ or beacon UI packet (via the TNC Unproto command), you can similarly propagate APRS UI packets (via the APRS Unproto command). And, instead of using digipeater call signs with Unproto, you use aliases like "wide" and "relay."

Typically, a mobile APRS station sets Unproto to "relay,wide." As a result, each packet transmitted by that station is digipeated initially by any station whose alias is "relay." Then, any station with an alias of "wide" that receives the packet digipeated by "relay" will digipeat the packet, too.

For this to work successfully, digipeaters must have aliases of "relay" and "wide" and wide area backbone stations must have an alias of "wide." Fixed non-digipeater APRS stations can augment the network, too, with aliases of "relay' and "wide."

Like standard packets, receiving stations check UI packets for errors and discard bad ones. If a packet is lost or discarded because of interference or collision with another packet, it is no problem because the receiving station is likely to receive it correctly as it is digipeated by another station in the APRS network.

Sources, Sites, and Support

This first installment of "APRS Tracks" is intended to whet your appetite sufficiently so that you will try APRS yourself. All versions of the software are shareware, so you can try APRS out at no cost. If you like it, you pay a reasonable shareware fee, and receive the keys to unlock all of the features of APRS.

You can download APRS from various ham radio telephone bulletin board systems including the ARRL BBS at 1-860-594-0306 and the KE6ET BBS at 1-410-280-2503. You can also ftp the software from ftp.tapr.org, path /tapr/SIG/aprssig/upload). The Macintosh and Windows versions are also available from aprs.rutgers.edu, path: /Pub/hamradio/APRS.

In addition to the software, you need a radio and a TNC. Any radio and TNC that works on packet radio will do. *[APRS may not work with some software-based TNCs.]* On 2-meters, tune to 145.79 MHz. It is recognized in most, but not all areas, as the APRS frequency. On 70 cm, try 445.925 MHz, and on HF, try 10.1515 MHz LSB.

To keep up with the latest APRS developments and discussions, you can join the TAPR APRS Special Interest Group (aprs-sig) list by sending e-mail to listserv@tapr.org. Leave the subject field blank and send the following one-line message:

subscribe aprssig your_name

Once you are part of aprs-sig, you can expect to receive 25 to 50 new messages per day concerning APRS and, if you ever get stuck using APRS, you can get unstuck quickly by presenting your problem to aprs-sig.

If you are in the Northeast, you can find my APRS station (WA1LOU) on 145.79 running some flavor of APRS 24-hours-per-day. Send me a packet and say hello. Good-bye, until then.

TAPR Dayton Activities '96

TAPR again will be very active at this year's HamVention. With the joining of the TAPR spring meeting with the ARRL Digital Communications Conference, TAPR Dayton activities now make up TAPR's Spring gathering. If you are attending Dayton, please take a look at the following schedule. We have tried to improve upon last year and we believe we have. Come join us at the Digital Forum on Friday and then come have Dinner and a good time that evening at the PacketBASH.

Our booth will be in its usual place and activity around the booth is expected to be high, with the APRS SIG and the Sproul brothers showing the latest in Windows and MAC APRS at one end of the booth. It is rumored that there will be a APRS CD-ROM made available at that time. So — if you are an APRS enthusiast, plan to stop by.

The dates for this year's Dayton Hamvention are May 17-19, 1996.

TAPR Schedule

Friday

12noon — Exhibit Area Opens
1:00pm — TAPR Digital Forum Begins
7:00pm — PacketBASH
(Dinner, Prizes, SIG meetings, Banquet Speaker!)

Saturday

8am — Exhibit Area Opens
6pm — Exhibit Area Closes
9pm — Informal SIG Meeting (TBD)

Sunday

8am — Exhibit Area Opens
2pm — Exhibit Area Closes

1996 TAPR Digital Forum (Friday)

The TAPR digital forum should be a great forum this year. If you have time at Dayton — be sure to attend the meeting!

1:00 - 1:45pm
Introduction to Digital Communications
Greg Jones, WD5IVD

1:45 - 2:30pm
Making 56K Operations a Reality!
Barry McLarnon, VE3JF

2:30 - 3:15pm
Spread Spectrum Technology and current issues in Amateur Radio
Phil Karn, KA9Q

3:15 - 3:45pm
DAS and PCON and their use in Emergency Communications
Paul Newland, AD7I

3:45 - 4:15pm
BBS Issues and Trends
Barry Buelow, WA0RJT

4:15 - 5:00pm+
APRS Update and SIG Meeting
Bob Bruninga, WB4APR and Keith Sproul, WU2Z

1996 Packet Bash! Friday, 7:00pm

The 1996 "Packet BASH" co-sponsored by TAPR and the Miami Valley FM Association, Dayton's packet radio club, will be held on Friday of the Dayton HamVention. The BASH will be moved this year to a much larger site! So, if you were one of the folks that felt it was just too crowded for dinner — you were not alone. The reason for the move was that TJ's Restaurant was just a little small for 1995. The event will be held at the NCR "Sugarcamp" Conference Center and will be catered. The dining room holds about 300 people! So the more the merrier! Dinner space will be limited, so make your reservations so that the correct number of dinners can be ordered in advance. To make the event even better — we can stay a lot later (until at least midnight) than at the TJ's site last year, so we should have time for informal discussions after dinner.

An event for the digitally-inclined ham, featuring:

- Buffet dinner,
- Nationally-known speaker holding forth on a current topic
- Raffle for some neat prizes,
- TAPR special interest group meetings
- "Birds of a Feather" gatherings

We hope that this will provide an opportunity for packet and digital radio enthusiasts to have a great night out while at HamVention.

The schedule of events for the PacketBASH is still tentative, but will look something like this:

19:00 — Doors Open
19:30 — Dinner
— Speaker, Raffle, and TAPR SIG Meetings after dinner
Talk-in will be on 146.415 simplex.

Directions:

Head South on I-75 from Hamvention (North of Dayton)
Take 35 to the East around the south part of Dayton
Take SR48 (also know as S. Main) South
Exit on West Schantz and head West
Site complex is on the North side of Schantz about 2

blocks from SR48. NCR "Sugarcamp" Conference Center, 101 W. Schantz Ave.

For more information, send email to "packbash@ag9v.ampr.org" or stop by the TAPR booth at Dayton for schedule and map. The maps are currently available on http://www.tapr.org

The cost is $20.00 per person, tax and tip included.

Banquet tickets can be ordered from the TAPR office. Reservations made before May 1st will have their tickets mailed to them. After May 1st, tickets purchased will be available for pickup at the TAPR booth. Walk-up to the event will be accommodated as best as possible. There is limited space (in the way of food ordered) for dinner. Amateurs who wish to hear the speaker and discussion are asked to arrive around 20:30 (8:30pm). All amateurs are welcome to attend, enjoy the speaker, and participate in the meetings, although only those purchasing a dinner can eat.

1996 ARRL and TAPR Digital Communications Conference

September 20-22, 1996
Seattle, Washington (minutes from SeaTac airport)

It's that time again! Time to make your travel plans and put the finishing touches on your work for the upcoming 15th Annual ARRL and TAPR Digital Communications Conference. This year marks the first year in which the ARRL Digital Communications Conference and TAPR Annual General Meeting have joined into one conference! A full conference flyer will appear in this and later issues of the *PSR* up until the conference.

The 1996 ARRL and TAPR Digital Communications Conference will be held on September 20-22, 1996 in Seattle, Washington. This year's conference location is just minutes away from the SeaTac (Seattle/Tacoma) Airport.

Not only is the Digital Communications Conference technically stimulating, it is a weekend of fun for all who have more than a casual interest in any of the ham digital communications modes. This includes BBS operators, networkers, DX-Cluster Sysops, software writers, modem designers, and digital satellite communications enthusiasts. The ARRL and TAPR Digital Communications Conference is for all levels of digital operators — a must conference to attend to get active on a national level. Now, more than ever, Amateur radio needs this great meeting of the minds, since it is important that we demonstrate a continued need for the frequency allocations we now have by pushing forward and documenting our achievements. The ARRL and TAPR Digital Communications Conference is one of the few ways to record our accomplishments and challenge each other to do more.

A Conference for the Beginner as well

The conference is not just for the digital expert. This year's conference will again provide an entire morning with beginning and intermediate presentations on selected topics in digital communications. Some of the topics will include: APRS, Satellite Communications, TCP/IP, Digital Radio, Spread Spectrum and other introductory topics. Come to the conference and hear these topics presented by the experts! Don't miss this opportunity to listen and talk to others in this area.

Workshops

In addition to the presentation of papers on Friday and Saturday, three workshops will be held during the conference. On Friday, Keith Sproul, WU2Z, will hold a workshop on APRS packet-location software. Keith is the Chair of the TAPR APRS Special Interest Group, developer of the Macintosh and more recently co-developer of the Windows95 version of APRS, and a leader in the area of APRS technology. This is a unique opportunity to gain insight into this fast growing new digital aspect of Amateur operations that combines computers, packet radio, and GPS (Global Positioning Satellites). On Sunday, Dewayne Hendricks, WA8DZP, will conduct a workshop focusing on "How to utilize Part 15 wireless Radios for Ham Applications." Dewayne is an expert in the area of commercial wireless systems; his company WarpSpeed Imagineering, focuses on wireless Internet connectivity. This workshop presents an opportunity to learn how Personal Communications Technology (handheld and small business wireless systems) can be used in the Amateur service. A second Sunday workshop will focus on Wireless Networking using the WA4DSY 56K RF modem Technology. This workshop will focus on the technology and accessories of creating and maintaining 56K networks using the WA4DSY modem and equipment compatible with it such as routers, digital driver cards, transverters, and repeaters. Use of WA4DSY 56K equipment in the 219-220 band will also be discussed.

1st Annual ARRL and TAPR DCC Student Papers Award

ARRL and TAPR especially welcome papers from full time students to compete for the first annual student papers award. Two $500 travel awards will be given, one in each of the following categories: a) best technical/theory-oriented paper by a student, and b) best educational or community-oriented application paper by a student. The paper should relate directly to a wireless digital communication topic (see guidelines for more information). Papers coauthored by educators or telecommunications professionals are also eligible for this award, as long as a student is the first author. First year awards have been funded through a grant by The ARRL Foundation, Inc. Deadline for receipt of finished

student paper manuscripts: June 11, 1996. Please note that this deadline is different than the general conference submission date. For full details and paper guidelines contact TAPR or check http://www.tapr.org. Also, see the article in this *PSR* for more details.

Call for Papers

Anyone interested in digital communications is invited to submit a paper for publication in the Conference Proceedings. Presentation at the Conference is not required for publication. If you know of someone who is doing great things with digital communications, be sure to personally tell them about this! Papers are due by July 23, 1996, and should be submitted to Maty Weinberg, ARRL, 225 Main Street, Newington, CT 06111 or via the Internet to lweinberg@arrl.org. Information on paper submission guidelines are available on-line (http://www.tapr.org).

General Conference Paper Guidelines

1. Papers should be on 8-1/2 X 11 inch paper with the following margins: left and right, 0.75 inch; top, 0.8 inch; and bottom, 1 inch (very important).

2. Structure of paper should be (see single column example below, two columns should follow a similar format):

Title
Author(s) with affiliation
Abstract
Key words (3-5)
Body
Reference List

3. Papers can be in one- or two-column format, your choice of type style. Be sure to send a good quality printout, either laser printed or a very dark dot-matrix printout.

4. Use 12-point Times Roman for the main body of text; do not number pages.

5. Photos should have good contrast and should not be pasted to the page. Leave a space in the text noting what goes there, and mark the photo appropriately. Drawings should be dark, either computer generated or hand drawn. Note: a photocopy gives a good indication of print quality.

6. Electronic submissions can be made in any of the following formats:

- ASCII text;
- WordPerfect 5.0/5.1/5.2;
- Microsoft Word for Windows (IBM);
- Microsoft Word (Macintosh);
- WordStar 4.0/5.0.

7. Reference citations and other topics not explicitly discussed in this list should follow a recognized standard format (APA, IEEE, etc).

8. A biographical page is to be included with the manuscript. It should contain Name, Address, Phone, and E-mail for each author as well as a short descriptive paragraph about the first author. The bio page will be used to contact authors concerning the conference and presentation schedule.

Release Form

A formal release form is not required, but indicate that the paper is being sent for use in the Proceedings of the 15th ARRL and TAPR Digital Communications Conference. You are only giving permission for your paper to be printed in the Proceedings. Additional clearance would be required before your work could be printed in any other publication.

Local Co-Hosts

The 1996 ARRL and TAPR Digital Communications Conference is co-hosted by the Puget Sound Amateur Radio TCP/IP Group and Boeing Employees Amateur Radio Society (BEARS).

The Puget Sound Amateur Radio TCP/IP group is an informal group involved in an ongoing project to build and expand an Amateur radio digital network in the greater Puget Sound area of the Pacific Northwest US. The Washington Experimenters TCP/IP Network (WETNET) uses TCP/IP as its primary transport protocol and currently has over 250 users. WETNET is linked to other Amateur radio TCP/IP networks via the Internet. The Boeing Employees Amateur Radio Society (BEARS) is a general interest Amateur radio club for employees of the Boeing Company, headquartered in Seattle, Washington. The BEARS are an active Amateur club, supporting radio classes, VHF/UHF repeaters, and digital communications. BEARS has been instrumental in the construction of the Evergreen Intertie, an extensive network of interconnected repeaters in the Pacific Northwest.

What can you expect during the 1996 ARRL and TAPR Digital Communications Conference ?

- A full day of papers and breakouts on Saturday for the beginner to the advanced Amateur digital enthusiast.
- Three workshops:
  - Friday (4pm) - APRS, Conducted by Keith Sproul, WU2Z
  - Sunday (8am) - How to utilize Part 15 Radios for Ham Applications, Conducted by Dewayne Hendricks, WA8DZP
  - Sunday (noon) - Wireless Networking using the WA4DSY 56K RF modem Technology
- The first annual Student paper session.
- A banquet with Special Guest Speaker Lyle Johnson, WA7GXD

Lyle was one of the founders of TAPR and instrumental in forming many of the current aspects of Amateur Digital Communications. He is currently very active in building several digital aspects of the upcoming Phase 3D satellite.

- SIGs (Special Interest Groups) on Saturday following the banquet.
- Informal get-togethers throughout the weekend.
- A meeting facility that is perfect for this type of meeting.
- Vendor area and informal engineering discussions/demonstrations.
- An event at which the most important new developments in Amateur digital communications are announced.
- Digital 'movers and shakers' from all over the world in attendance.
- Plenty of Washington State hospitality!

Conclusion

If you have attended a Digital Communications Conference in the past, just remember back to how much fun it was discussing the latest developments into the wee hours! If you have never been, then make your plans now to attend and find out how much fun the Digital Communications Conference can be.

There are few activities where the importance of your participation can be so much fun and important! What a great way to share and renew your enthusiasm for digital Amateur radio! Getting together with colleagues from all over the world and bringing each other up to date on your latest work. All this, and more, for an unforgettable weekend of ham radio and digital communications. Make your travel and lodging arrangements now. We hope to see you at the ARRL and TAPR Digital Communications Conference on September 20-22!

Full information on the conference and hotel information can be obtained by contacting Tucson Amateur Packet Radio, 8987-309 E. Tanque Verde Road #337, Tucson, AZ 85749-9399. Phone: (817) 383-0000. Fax: (817) 566-2544. Internet: tapr@tapr.org Web: www.tapr.org

Sincerely,

Steve Ford, WB8IMY, ARRL Conference Co-Chair
Keith Justice, KF7TP, TAPR Conference Co-Chair
Steve Stroh, N8GNJ, Local Host Liaison
Greg Jones, WD5IVD, President TAPR

Note: If you need handouts or flyers for meetings, contact TAPR about getting what you need!

Hotel Information

Conference presentations, meetings, and workshops will be held at the Quality Inn Seattle Airport, a complex co-located with the Radisson Hotel Seattle Airport. Rooms rates are $66/single-double and $76/triple. When making reservations with the hotel, be sure to indicate you are attending the ARRL and TAPR DCC conference. It is highly recommended that you book your room prior to arriving - a block of 75 rooms is reserved until September 6th, 1996. After the 75 rooms are booked, rooms will only be available in the Radisson hotel, but will be at a higher price. Be sure to book your rooms early! The hotel provides transportation to and from SeaTac Airport. You should contact the hotel to arrange airport transportation.

Quality Inn Seattle Airport (conference hotel)
17101 Pacific Highway South, Seattle, WA, 98188
(206) 246-7000, Fax (206) 246-1715
Radisson Hotel Seattle Airport (alternate hotel)
17101 Pacific Highway South, Seattle, WA, 98188
(206) 244-6000, Fax (206) 246-6835

Registration

Contact the TAPR office by Phone, Fax, or e-mail (Internet: tapr@tapr.org) to preregister or for additional meeting information. MasterCard and VISA accepted.

- Preregistration (before Sept 1st) $40.00 *
- Late Registration or at door $45.00 *

* - Conference Registration includes: Conference Proceedings, Sessions, Meetings, and Lunch.

- Saturday Evening Dinner (Limited Space) $19.00 **

** - Dinner, Speaker: Lyle Johnson, WA7GXD, Prize Drawing

Workshops

APRS Workshop Friday, 4pm - 7pm. Conducted by Keith Sproul, WU2Z
- Registration $15.00

How to utilize Part 15 Radios for Ham Applications Workshop, Sunday, 8:00am - 11:00am. Dewayne Hendricks, WA8DZP
- Registration $15.00

Wireless Networking using the WA4DSY 56K RF modem Technology Workshop Sunday, 12noon - 3pm.
- Registration $15.00

Contact TAPR to register for the DCC.

PSR Deadlines

Check page two for upcoming *PSR* deadlines. If you have something for publication, please contact Bob Hansen, *PSR* editor at psr@tapr.org. TAPR is looking for technical and introductory articles on the following subjects: information on general digital communications, applications using digital communications, equipment hints or modifications, future directions and standards, tutorials, and any regional packet news or information.

First Annual Student Paper Awards Guidelines

ARRL and TAPR Digital Communications Conference
September 20-22, 1996
Seattle, Washington

Overview of Student Paper Awards

ARRL and TAPR especially welcome papers from full-time students to compete for the first annual student papers award. Two $500 travel awards will be given, one in each of the following categories: a) best technical/theory-oriented paper by a student, and b) best educational or community-oriented application paper by a student. The paper should relate directly to a wireless digital communications topic. Papers co-authored by educators or telecommunications professionals are also eligible for this award, as long as the student is first author and has taken the primary role in developing the content. First year awards have been funded through a grant by The ARRL Foundation, Inc.

Submission Deadline

Deadline for receipt of finished student paper manuscript is June 11, 1996 and should be submitted to TAPR, 1418 Ridgecrest, Denton, Texas 76205. Full details are also available on http://www.tapr.org. Please note that this deadline is earlier than the general conference submission date. Also the manuscript must be received no later than June 11, 1996.

Suggested Topics

A wide range of topics related to wireless digital communications is encouraged. Papers should generally be of strong interest to the Amateur radio community. Technical/theory papers might cover topics such as spread-spectrum communications, mobile communication protocols, 56 Kbs line-of-sight hardware/software, Amateur frequency-to-Internet gateways, digital video applications and other technical topics.

Education/community-oriented papers might describe a classroom's use of packet radio to augment traditional curricular activities, BBS-based technical support provided by veteran Amateurs, elderly-student digital exchanges, or university or community club activities. These papers will typically include a description of the technology used, but the focus should be on the communication activities rather than the technology itself.

Note that for both categories, papers from teachers and community professionals who are themselves university students are welcome, as are papers from pre-university students (high school, junior high, etc). In the latter case, papers co-authored by teachers who served as mentors on digital communications projects would be especially appropriate.

Review and Publication Process

Each paper will be reviewed by two professionals in the field who are well versed in scholarly publication. A third reviewer will be utilized if necessary. All papers selected for publication in the proceedings will also be invited for presentation during the student-paper session at the conference. Award winners may also be asked to present their papers during the main conference session. It is anticipated that the review procedure will be completed by mid July 1996.

Review Criteria

Student papers will be rated in the following major categories.

- Technical quality and significance
- Originality
- Readability and organization
- Relevance to the Conference

Additional review criterion will include questions such as:

- Is the length adequate?
- Are the references sufficient?
- Is the abstract a good summary of the paper?

Also please note that the potential applicability of the student's work to the Amateur radio service will also be a criterion examined in the review process.

Manuscript Guidelines

1. Five pages maximum, including tables and references.
2. Structure of paper should be:
   Title
   Author(s) with affiliation
   Abstract
   Key words (3-5)
   Body
   Reference List
   (An example is provided on www.tapr.org)
3. Papers should be on 8-1/2 X 11 inch paper with the following margins: left and right, 0.75 inch; top, 0.8 inch; and bottom, 1 inch (very important).
4. Photos should have good contrast and should not be pasted to the page. Leave a space noting what goes there, and mark the photo appropriately. Drawings should be dark, either computer generated or hand drawn. A photocopy gives a good indication of print quality.
5. Cite acknowledgments and credits as footnotes to first page.
6. Single space paragraphs, skip blank line between paragraphs.
7. Center main headings (Abstract, Introduction, Conclusions, References, etc.)

8. Block left subheadings.
9. Use 12-point Times Roman for the main body of text; do not number pages.
10. Reference citations and other topics not explicitly discussed in this list should follow a recognized standard format (APA, IEEE, etc).
11. One original should be submitted camera ready, with tables and figures included at the proper locations in the text.
12. Three other copies should be submitted for review purposes. These should have any art or photos copied onto the pages.
13. Manuscripts should not have been previously published.
14. A formal release form is not required, but indicate that the paper is being sent for use in the Proceedings of the 15th ARRL and TAPR Digital Communications Conference. You are only giving permission for your paper to be printed in the Proceedings. Additional clearance would be required before your work could be printed in any other publication.
15. Publication in proceedings will not prohibit publication in a journal or other scholarly forums selected by the author(s) (the latter is encouraged).
16. A biographical page is to be included with the manuscript submission. It should contain Name, Address, Phone, and E-mail for each author as well as a short descriptive paragraph about the first author. The bio page will be used to contact authors concerning the conference and the travel awards upon selection.
17. A photocopy of the student's ID must be submitted along with the manuscript.

TEKK Radio Mods

John Bednar, WB3ESS

If you make these mods to the radio you will find an improvement in 9600 bps operation. Yes, the radio works right out of the box, but you **will** see an improvement if you perform these modifications. The modification was developed because this radio was not designed for 9600 bps service and I wasn't happy with the stock performance.

There are two styles of the Tekk radio. The older style radio (KS-900L) has a black case that only has a top cover. By adding two capacitors and one resistor. It's a very simple mod I can't understand why anyone wouldn't do it.

The newer style radio (KS-960L) has a chrome case. It uses chip components and the case has a top and bottom cover. The model numbering of this radio is very confusing. When these radios were originally shipped, the throughput at 9600 bps was poor (much worse than the older style radio) but they did work right out of the box. This modification is a little more detailed but don't let the quantity of text prevent you from performing the change.

TEKK KS-900L Receiver Modification

The KS900 recovered audio has a high frequency (2.2MHz) signal superimposed on the recovered audio. This high frequency signal causes jitter in the sliced output. To eliminate the unwanted signal, install a lowpass RC filter in the audio signal line with a corner frequency well above the frequencies of interest.

The modification: At the 9-pin interface connector add a 2.7k ohm resistor in series with the wire going to connector pin 5. Next, solder a 0.001uf capacitor between pin 2 and pin 5 of the same connector.

TEKK KS-900L Transmitter Modification

The stock KS900 transmit modulation response is not flat from "dc to 7.2 Khz." To correct this deficiency, the input coupling capacitor must be increased in value. I have found it easier to solder in the additional capacitor without removing the board from the case.

The modification: Solder a 3.3uf tantalum capacitor (observe the polarity) in parallel with capacitor C31. The transmit requirements are not changed so re-adjusting the transmit level will not be required.

TEKK KS-960L Receiver Modification

The un-modified KS960 recovered audio is attenuated by a single pole RC filter on the receiver output. The roll-off begins around 1200hz in an unmodified radio. Please note that a simple low-pass filter is required to eliminate a high frequency (2.2MHz) conversion product. The solution is to move the corner frequency of this RC filter well above the frequencies of interest.

The modification: Remove chip capacitor C18 and replace it with a 0.001uf leaded capacitor or chip capacitor.

TEKK KS-960L Transmitter Modification

The un-modified KS960 transmitter suffers from several problems. First, this radio contains an input amplifier, a limiter, and a reconstruction filter in the input of the transmit section. Secondly, the modulator frequency response is not flat from "dc to 7.2 Khz."

The solution is to bypass and ground the input to the existing limiter circuit and to modify the modulator to achive a flat frequency response. The modification:

1) Remove the wire attached to pin 4 of the 9-pin connector and solder it to ground.

2) Solder the (+) lead of a 10uf tantalum capacitor with 0.2" leads to the 9-pin connector, pin 4.

3) Prepare a 1.8" piece of wire with 0.2" ends and solder one end of the wire to the (-) lead of the capacitor added in step 2. Tuck the other end of the wire around the circuit board in the corner. Don't use the corner where the BNC is mounted.

4) Locate the junction of C43, C92, and R41. Form the wire, trim the end to 0.1" and solder it carefully to this junction.

5) Locate the junction of R43 and C47. Carefully remove the solder from that solder pad. With a sharp knife cut the trace diagonally between R43 and C47. Check your cut with an ohm meter to insure that the trace is open. If you break R43, C47, C48 or C49 don't worry because these parts are no longer used.

6) Locate potentiometer VR1 and turn it fully CW.

7) Re-adjust the transmit frequency and the transmit deviation.

Now here is the interesting part. I released the modification to Tekk around early January 1994. Naturally, it has found it's way to the other suppliers of Tekk radios. Based on correspondence, I believe that some suppliers are **not** making all the modifications. If you want the maximum performance at 9600 bps and near identical frequency response to the older style radio, I contend that all modifications must be completed. It is possible to complete some of the modifications and see a dramatic improvement in performance, but with all the changes, performance will improve even more.

I expect by now that Tekk is shipping radios that work well out of the box. There is no need to stay away from this radio on a frequency response standpoint.

P.S.

Does anyone want to work on a Tekk (19.2 k or 38.2 k) mod? I haven't done much work but having a buddy or two might keep the project moving. My internet address is aljkbe@attme.att.com.

RUDAK-U

Lyle Johnson, WA7GXD

The RUDAK project has been strangely silent these past few months for a number of reasons, but that mostly all boil down to people being too busy working to stop and write.

I apologize for this state of affairs.

The current status of the RUDAK project is:

Primary V53 CPU prototype is built and awaiting testing. The memory SIMMs have been built and tested. The prototype has been fitted into a flight case. This processor has 16 DMA channels and 16 megabytes of error-corrected memory.

The secondary CPU has been changed from an i386EX to a second V53. This is due to time pressures. The PCB has been layed out but not fabricated, awaiting test results of the primary CPU with which it shares about 98% commonality in design. The PCB design is radically different, however, due to mechanical constraints regarding memory placement.

The modem is broken into a pair of PC boards. The "upper" PC board contains 16 Analog Devices ADSP-2171 DSP chips, 8 Harris HSP50016 Digital Down Converter chips, 2 Analog Devcies AD9042 12-bit *FAST* A/D convertors and 8 Analog Devices AD7008 Direct Digital Synthesizers. This board was layed out, but the flight DSP chips have a different package than we anticipated, so the board layout has to be redone. This is in progress.

The "lower" PC board contains the hardware 9600 bit/sec and 153.6 kilobit/sec modems. This is still at the schematic stage. The remaining task is the transmit signal combiner and bandpass filter. This should be done very soon, and this board can go to layout. Once all boards have gone to layout, testing will commence to uncover the inevitable design errors and, if they are severe, do a PCB re-layout.

We expect to commence testing in April. Hopefully, we'll have more time to keep you informed of the project status very soon!

Thank you for your patience.

TAPR Offers Group GPS Purchase

TAPR, working with Bob Bruninga, WB4APR, will be making a group purchase on Garmin-20 GPS units.

For full details on the purchase as well as information regarding the unit, please see the following web page http://www.tapr.org/gps

The price will be:

$165.00 US for members of TAPR
or
$175.00 US for non-members

This kit will include:

- Garmin GPS-20 (MultiTrac8 sensor) engine (1.83" x 2.74" x .45") The Garmin GPS-20 is similar to the Garmin GPS-45
- RF pig tail with connector for unit
  (one end is the MCX male connector and the other end will be non-connected - see below)

- power/data cable with connector shell and pins (The connector is a subminiature PCB edge connector and will need to be built - see below)
- Documentation

TAPR will be taking orders for 50 units, which is the minimum purchase. Once 50 units have been purchased TAPR will order the Garmin units. TAPR will deposit money when the units are ordered from Garmin and ship when the units arrive from Garmin. It is expected that the demand will be high, thus a short period should be required to receive the 50 orders.

Please note: This is not an enclosed/sealed unit. It is assumed that the purchaser will be installing the unit in another enclosure for normal and experimental operations.

No 10% Discount for TAPR Members. Due to the nature of the purchase, TAPR can only make a limited discount on the purchase price, that of $10.00, to TAPR members.

These units will be useful with current APRS software and the upcoming TAC (Totally Accurate Clock) kit that Tom Clark, W3IWI, has begun discussing with TAPR to do as a kit in the future. For more on the TAC project check:
ftp://aleph.gsfc.nasa.gov/GPS/totally.accurate.clock/

Questions concerning the unit and details on the buy will be handled on the TAPR APRS Special Interest Group list. To subscribe, send e-mail to listserv@tapr.org. In the message, type subscribe aprssig YourFirstName YourLastName. The server will then send you a message back. Announcements on the status of the shipment will be made to the TAPR APRS-SIG and TAPR-BB lists.

Shipping and Handling

Shipping and Handling within the US will be $7.00 US by UPS Ground unless otherwise requested by purchaser.

International shipping will need to contact the TAPR office and get a quote on the shipping to your country. TAPR uses International Express Mail, unless the purchaser requires something else.

General Information

All Garmin engines come complete with DGPS input capability (see note below), PPS timing output and lithium 3V battery on board.

MultiTrac8: Tracks and uses up to 8 satellites for accurate, reliable GPS data at an incredibly low 1 watt power consumption. Unit has a real time clock, PPS timing and nonvolatile memory right on the board.

Footprint
1.83" x 2.74" x .45"

Architecture
Patented MultiTrac8

Time to first fix

reacquisition	2 sec
warm	20 sec
cold	2 min
sky search	15 min
update rate	1 sec continuous

Dynamics

velocity	999 knots
acceleration	3 g
jerk	20 m/s^3

Datums
102 predefined, 1 user defined

Electrical

input voltage	5.0V DC +- 5% regulated (a suitable regulator should be used)
power consumption	0.8 watts
backup	on board 3V lithium (10 year lifetime)
sensitivity	-166 dBW

Connector

antenna	50 ohm MCX female connector for active (5V DC @ 15ma) or passive antenna
power/data	single row, right angle 12-pin male

Physical

configuration	1 integrated board engine
size	1.83"W X 2.75"L X 0.45"H
weight	1.1 oz
op temp	-30 deg C to 80 deg C (remove Li battery for extended usage above 80 deg C)
storage temp	-40 deg C to 85 deg C

Interface

compatibility	2 RS-232 serial ports
data rate	User selectable baud rate 1200/2400(tx only)/4800/9600
format	NMEA 0183 v.2.0, ASCII
inputs	Initial position, date and time (not required), 2D/3D & earth datum command, RTCM-104 v.2.0 differential
outputs	Position, velocity & time, receiver and satellite status, geometry and error estimates
timing output	Timing output with +- 1 microsecond accuracy

Frequently Asked Questions

- Any altitude limitations? The GPS engines will deactivate themselves above 50,000 feet.
- The Garmins only send out final solutions (NMEA sentences). There is no other data available from them (including preprocessing data).
- The Multitrak8 has only one channel, but is multiplexed.
- The Multitrak8 can accept DGPS signals (see note below).
- Antenna options (which can be purchased directly from Garmin if required) include:
  - mag mount
  - flange mount (bolt to a car)
  - trunk clip
  - suction cup mounted

- The unit has true time clocks, PPS timing, and non-volatile memory on board.
- The interface is NMEA 0183 (TTL levels) and RS232 (+ and - 15 volts)
- The unit can be powered by AA batteries. Batteries or external supplies will require a suitable power regulator.
- The unit only gives NMEA sentences as output, no extraction of RTCM-104 data.
- There's no problem with the antenna being close to the board. All sensitive components are shielded.
- The unit has an LNA and you can use passive antennas. You need to keep the antenna runs short however.
- The antenna is attached with a MCX connector, which is a friction lock connector. A male MCX connector with short RF cable is included in the kit purchase.
- There's a header for connecting the data cables. A connector and cable will be included in the kit (they will need to be soldered). The connector is a sub-miniature PCB edge connector. This is not the same connector as used with many hand-held units.
- You cannot adjust the interval that the board outputs data. However, you can adjust its baud rate. At 4800, the board repeats data every 2 seconds. At 9600 baud, data is repeated every 1 second.
- The board does adjust for leap seconds (via the satellites).
- For DGPS, since these are just the boards, you can't use the Garmin DGPS receivers. The Garmin units get tuning instructions from the GPS keyboard (which are not on the boards). To receive DGPS signals, you'll need a tunable beacon receiver. Correction signals are sent in through the data in cable (just like the handhelds).

For More Information

There is no (official) Garmin web page, but here's one that I have found fun and interesting. It's called the "Garmin Hacking Project." Lots of useful links from it. Lots of information on Garmins 40 and 45.

http://www.inmind.com/~thogard/gps/grmnhack.html

TAPR Software Library

Current as of 13 March 1996.

Items with ** notation have been updated since the last listing in *PSR*. Disk numbers listed with an "A" are two-disk sets. All ftp filenames listed below should be preceeded with "/tapr/software_lib".

Disk No.	Name	Version	ftp Filename
1.	APLINK	Ver. 7.01	/bbs/apl701.exe
2.	AA4RE BBS	Ver. 2.12	/bbs/bb212.zip
3.	CBBS	Ver. 7.30	/bbs/cbbs73.zip
4.	EZPAC	Ver. 1.1	/misc/ezpac11.zip
5.	MONAX		/misc/monax.zip
	PRAFFIC	Ver. 2.05E	/misc/praf205e.zip
	PACKHACK	Ver. 8	/misc/phack8.zip
6.	Ham Comm	Ver. 3.0	/misc/hamcom30.exe
7.	TNC-2 Manual and EPROMs	Ver. 1.18A	/tnc/eproms.exe
			/tnc/hostmode.exe
			/tnc/tncdocs.exe
8.	Text conversion Utilities		
	7PLUS	Ver. 2.02	/utils/7plus20.exe
	LHA	Ver. 2.11	/utils/lha211.exe
	PKARC	Ver. 3.6	/utils/pk36.exe
	PKZIP/PKUNZIP	Ver. 2.04G	/utils/pkz204g.zip
	R95	Ver. 4.0	/utils/r9540.exe
	UUENCODE/UUDECODE	Ver. 5.40	/utils/uuexe540.exe
	ZOO	Ver. 2.10	/utils/zoo21.exe
9.	ROSERVER PRMBS	Ver. 1.73	/bbs/rsvr173.zip
10.	ROSE X.25 SWITCH	Ver. 3.7	/switch/rzsw37.zip
			/switch/rswd33.zip
11.	KA9Q NET	Ver. K36	
	Executable and Documentation		/tcpip/netk36ex.zip
	Source Code		/tcpip/netk36sr.zip
12.	WXN Weather Svr.	Ver. 5.11	/misc/wxn511.zip
13.	TNC1 CODE & TNC2 Notes		/tnc/tnc1src.zip
			/tnc/tnc2not.zip
14.	WINLINK	Ver. 1.2	/bbs/wnlink12.zip
15.	WA7MBL BBS	Ver. 5.14	/bbs/mbl514.zip
16.	WORLI BBS	Ver. 18.05	/bbs/rli1805.exe
17.	YAPP	Ver. 2.0	/terminal/yapp.zip
18.	INTRO TO TCP/IP		/tcpip/tcpintro.zip
19.	LAN-LINK	Ver. 2.32	/terminal/ll232.zip
20.	ARESDATA	Ver. 1.6	/misc/aresdata.zip
21A.	MSYS	Ver. 1.19**	/bbs/msys119.zip
22.	G8BPQ NODE	Ver. 4.08a	/switch/bpq408a.zip
23.	Utilities now on disk #8		
24.	THS	Ver. 2.50	/terminal/ths.zip
25.	VE4UB NTS	Ver. 091891	/misc/ntsve4ub.exe
26.	NM1D DOSGATE	Ver. 1.14	/misc/dosgate.zip
27.	SV7AIZ BBS	Ver. 4.51	/bbs/aiz451.exe
28.	TEXNET	Ver. 1.72**	/switch/tprs172.zip1
29.	Intro To Packet Radio, A Tutorial	06-16-95	/misc/intropkt.zip
30.	MICROSAT Ground-station Software		/sat/microsat.zip
	PB	04-30-92	
	PG	02-25-92	
	PFHADD	03-24-92	
	PHS	12-21-90	
31.	No Longer Available (see 38)		
32.	PAMS-Personal AMTOR Mailbox	Ver. 2.09	/bbs/pams209.zip
33.	TNC-2 Z-80 Monitor	Ver. 2.00	/tnc/monz80.zip
34.	GIL (Graphics Interchange Lang.)	Ver. 1.03	/misc/gil1-03.zip
35A.	PAKET	Ver. 6.1	/terminal/paket61.zip
36A.	F6FBB BBS	Ver. 5.15	/bbs/f6fbb515.zip
37.	TPK	Ver. 1.82	/terminal/tpk182.zip
38.	JNOS (Executables, docs.)	Ver. 1.10M**	/tcpip/jnos110m.exe
			/tcpip/docs110m.zip
39A.	JNOS (Source Code for 38)	Ver. 1.10M**	/tcpip/jn110m.zip
40.	SP Packet	Ver. 6.50	/terminal/sp650.exe
41.	TAPR Deviation Meter Source and Tools		/misc/devmtr.zip
42.	PCTOR/PC-PACTOR	Ver. 3.02	/terminal/pctor302.zip
43.	METCON ROM Code	Ver. 1.07	/misc/metcon.zip

Orders for any of the above disks should be sent to the TAPR office. New submissions or updates should be sent to the software librarian c/o the TAPR office.

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TAPR Price List / Order Form