T·A·P·R

PACKET STATUS REGISTER

Tucson Amateur Packet Radio Corporation

OCTOBER 1989
Issue #36

Published by:
Tucson Amateur Packet Radio
PO Box 12925
Tucson, AZ 85732
Phone: (602) 323-1710

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PRESIDENT'S CORNER

by Andy Freeborn, NØCCZ

Did you ever stop to wonder where packet radio would be today if it weren't for all the amateurs that made it happen?

Well, let's take a look. Doug Lockhart, VE7APU , started the action up in Vancouver in the early days with some fellow interested amateurs. Then TAPR came along with its volunteers to make packet radio equipment readily and inexpensively available. Then more volunteers carried the packet banner to every club and hamfest possible to introduce the new mode to amateurs everywhere. Soon others saw the potential of the mode and developed Bulletin Board Systems and all sorts of new software and hardware features. Today, many other volunteers continue to refine the packet system from both the hardware and software standpoint. Hundreds of volunteers in AMSAT have been hard at it for over a year to bring us the new PACSATs.

Generally speaking, there are two categories of amateur volunteer effort. One is the work that individuals can do - a person that writes software, a person that runs a BBS, or a person that puts up a digipeater. These individuals see a need and step forward to fill it. They spend countless hours, their own funds and dedicate their equipment to serve others.

The other category of volunteers, and what the rest of this article is about, includes those involved in group development efforts. This is a special breed of volunteer. These folks depend upon one another for the life or death of their project. One broken link in the volunteer chain can critically damage the work of many others. This is especially true when their project involves the development of both hardware and software. Some examples of this type of volunteer effort is the work done by TAPR development teams, AMSAT satellite development teams, and the Texas Packet Radio Society.

It has been my observation, that when a significant group project gets underway, the first to be called upon are those that have unselfishly and dependably worked in earlier volunteer efforts. One might get the impression that these projects are closed to outsiders from the beginning. Nothing could be further from the truth. New talents are constantly needed. Unfortunately the old-timer volunteers are ALWAYS too swamped with the work of the project itself, to say nothing of the pressures of neglected family obligations, to be able to spend much time "breaking in" new folks.

If you would like the opportunity to "prove yourself", what should you do? You should, first and foremost, be very candid with yourself in deciding how much of your time and talent you can devote to the project. Arrange to meet with some of the folks that are already involved and learn all that you can about the project. Learn what might be expected of you before committing yourself. Do not lead others to believe that you are "totally committed" when in fact the aura of excitement of a new development may be your motivation. Be sure to consider the impact upon your family. Determine the expected lifespan of the project. Consider your own future plans that, when realized, might cause you to become a broken link.

Look for a niche in the needed work that your special talents will let you fill. Volunteer to assist by doing some portion of the work. In the beginning, work towards establishing a reputation for quality work and dependability.

You should realize that amateur volunteer projects are seldom well-funded. Meeting your commitments may mean squeezing your amateur radio budget, or more. To meet your obligations may mean many nights until the wee hours. If you are the type that needs and expects continued recognition for your efforts you will be disappointed. The "thank you's" come later when the project is successfully completed. More important is the self satisfaction of having contributed some of yourself to a project which might alter amateur radio forever.

We owe a great deal to those volunteers who have gone before us; we owe much to today's volunteers. If the old military adage of "Never Volunteer" held true in amateur radio we would still be in the spark gap era.

NON-TECH TOPICS

by Andy Freeborn, N0CCZ

New Kits/Software

Since the first of the year, TAPR has produced five new kits for amateur packet radio use. Three new Data Carrier Detect TNC modification kits were the result of efforts by Eric Gustafson, N7CL, and Lyle Johnson, WA7GXD. Lyle also developed the upgrade kit for the TNC1 which adds full TNC2 capability to the venerable TNC1. The modification kit for the AEA PK-232 which provides a modem disconnect to that popular TNC was provided by Lyle as well.

A Frustration Solution

If you have been updating your TNC2 ROMs regularly, you have likely been through 1.1.3, 1.1.4, 1.1.5 and now 1.1.6. With each upgrade there have been the software notes that informed of the changes, additions, and deletions to the command set. Maintaining a file that showed only the commands in your current version was a pain. TAPR now has a booklet that gives the complete command set for version 1.1.6, all in one compact document. It is now included without charge in the TNC1 upgrade kit and is available separately from TAPR for $3.00. See the order form in this copy of PSR.

Kit/Software Order Form in this Issue

This issue of PSR contains a complete order form for ordering TAPR kits, firmware, and software. In addition, a brief description of each of the kits available from TAPR has been provided. Complete information has been provided on the order form to make it convenient for you to place an order. For those members residing outside the U.S. an information sheet will be inserted into your copy of PSR so that you can easily calculate the required postage for foreign airmail. When your order is filled, you will receive another copy of the order form (just like the REAL mail order houses!).

New TAPR Office Manager

In September, Cristina Kurz (Cris) informed us that she would not be returning to work following her maternity leave. Heather Johnson, N7DZU, has assumed the office manager duties. Heather's association with TAPR goes back to pre TNC1 beta test days. She was also TAPR Secretary for a period of time. Since assuming the job, Heather has made many changes to internal operating procedures at the office. All changes are aimed at improving efficiency and service to the membership. We are delighted to have Heather back on the TAPR management team (not that she was ever far away).

ARRL Computer Networking Conference

The 8th annual ARRL Computer Networking Conference took place the weekend of October 7th, 1989 in Colorado Springs, Colorado at the US Air Force Academy. The conference was sponsored by Tucson Amateur Packet Radio (TAPR), Academy Amateur Radio Club, USAFA Cadet Radio Club, Rocky Mountain Packet Radio Association (RMPRA) and the American Radio Relay League (ARRL). Most people thought the conference was the best network conference yet. In attendance were about 150 amateurs from across the country and the world. Amateurs from the Netherlands, Costa Rico, Italy, England, Australia, Sweden, and Mexico were in attendance. This year's proceedings encompassed HF packet, Networking, Application & Users, High Speed Packet, Satellites, and other general packet papers.

A group of conference attendees on Friday visited the Air Force Academy for a tour. The hospitality suite was well attended all day Friday at the Marriott and saw numerous packet and other discussions break out.

Saturday was the conference part of the weekend. Talks started promptly at 9:15am, after Andy Freeborn, N0CCZ, started off at 9am with the conference introduction. Paul Newland, AD7I, took on a new role, that of hi-tech Sergeant-at-Arms. With the use of a 'modern technology', Paul was able to let everyone know, in more than one way, before the trap door opened on speakers. The system worked very well and let everyone presenting have their fair share of time.

People presenting papers included: Paul Rinaldo, W4RI, Steve Hall, WM6P, Paul Newland, AD7I, Thomas Moulton, W1VY, Gordon Beattie, N2DSY, Chuck Hast, TI3DJT, Phil Karn, KA9Q, Doug Tom, N6OYU, Dewayne Hendricks, WA8DZP, Bdale Garbee, N3EUA, Robert Taylor, KA6NAN, Lyle Johnson, WA7GXD, Roy Goud, N5RG, Glenn Elmore, N6GN, Kevin Rowett, N6RCE, Mike Chepponis, K3MC, Gerald Knezek, KB5EWV, Greg Jones, WD5IVD, Jon Bloom, KE3Z, Pete Eaton, WB9FLW, Henk Peek, PA0HZP, R. Ramsey, and W. Kinsner.

The ATTITUDE ADJUSTMENT and TACO TUMULT following the conference was a big hit!

Sunday was a combined ARRL Digital Committee meeting and RMPRA sponsored conference.

Dealers present in the dealers' area Sunday were Kantronics, DRSI, and PacComm. Kantronics was showing its new dvr 2-2 9600 baud packet radio. Kantronics also demonstrated an alpha-test unit of the de 56, which is a future dual port data-over-radio platform. DRSI was showing layouts of the implementation of the "K3MC Awesome I/O Card." PacComm was also showing its product line. The Texas Packet Radio Society (TPRS) was present answering questions about TexNet and the Tucson Amateur Packet Radio was selling TAPR products. RATS members were available during the conference with their new software release.
A copy of the network proceedings may be obtained from the ARRL.

Board of Directors Actions

An office of Vice President was established in June and Bdale Garbee, N3EUA, was elected to fill it. TAPR now has 5 officer positions: President, Executive Vice President, Vice President, Secretary, and Treasurer.

In July, the TAPR Board of Directors voted to support the recommendations of the ARRL no-code study committee with a recommendation that the "new Tech" privileges be expanded to include the full 6 and 2 meter bands.

A proposal to initiate some organizational administrative changes was submitted to the board for discussion and was subsequently approved. In September, TAPR President - Andy Freeborn, N0CCW, spent several days in Tucson on administrative matters. Following this visit the board approved the acquisition of a copier for use in the office.

TAPR Board of Directors Elections

This issue of PSR carries the invitation for nominations of members to the Board of Directors. The next issue will contain the list of nominees and a voting ballot.

Tucson Amateur Packet Radio is a non-profit corporation licensed in the State of Arizona as a scientific and educational institution. It is recognized by the IRS as a 501(c)3 tax-exempt organization for these same purposes.

TAPR is governed by a 15 member Board of Directors. Each member of the Board serves a three year term, hence there are 5 positions to be filled each year. Board members are expected to attend the annual Board Meeting, normally held in Tucson. They participate in the decision making process and provide guidance to the officers. They receive no pay and they must defray their own expenses to attend meetings. Board members should be prepared to be active in the continuing board deliberations, which are conducted privately in a special conference section on Compuserve. Active participation in TAPR activities by board members is important to the furtherance of the objectives of TAPR.

The officers of the organization are elected by the members of the Board at the annual Board of Directors meeting.

The current members of the Board and the expiration dates of their terms follow:

Franklin Antonio N6NKF	1992
Mike Brock WB6HHV	1991
• Tom Clark W3IWI	1990
• Pete Eaton WB9FLW	1990
Andy Freeborn N0CCZ	1991
Bdale Garbee N3EUA	1992
Steve Goode K9NG	1992
• Bob Gregory KB6QH	1990
Eric Gustafson N7CL	1992
Skip Hansen WB6YMH	1991
Lyle Johnson WA7GXD	1992
Phil Karn KA9Q	1991
Dan Morrison KV7B	1991
• Harold Price NK6K	1990
• Dave Toth VE3GYQ	1990

Nominations are now open for the seats expiring in February 1990 (marked with an asterisk).

To place a person in nomination please remember that he/she must be a member of TAPR. Confirm with the individual that he/she is willing to have their name placed in nomination. Send that person's name (your own if you wish to nominate yourself) along with yours and their calls, telephone numbers, and addresses. The person nominated should submit a short biographical sketch to be published along with the ballots.

Nominations and biographical sketches should be submitted to the

TAPR office no later than 1 December 1989.

Ballots will accompany the next PSR or will be mailed directly to the membership. Results will be announced at the annual TAPR meeting in Tucson on 24 February 1990.

Since the Board will meet in Tucson the day before the annual meeting, all voting must be done by mail. Ballots will not be accepted at the meeting, so when you get your ballot be sure to mark it and mail it to the TAPR office.

Andy Freeborn N0CCZ
President

TAPR Annual Membership Meeting

The 1990 TAPR Annual Membership Meeting, as has been the case since the formation of the organization, will again be held in Tucson, Arizona.

The 1990 meeting will be held on Saturday and Sunday February 24th and 25th. For those of you attending these meetings in recent years, you won't have any trouble finding the meeting place, nor will anyone for that matter. It will be held at the same location as last year, The Inn At The Airport. The Inn is located a short distance from the airport terminal, at 7060 South Tucson Boulevard.

The Inn At The Airport again offers us special rates of $49.00 for either one or two persons in the room. Breakfast is included in the rate and there is a late afternoon cocktail hour free to those staying at the Inn. Reservations may be made by calling 1-800-772-3847. In Arizona call (602) 746-0271.

On Friday night we'll have our customary social session with lots of getting (re)acquainted; pizzas as usual. Following the pizza session, the would-be Indy 500 contestants will burn rubber at the Malibu Grand Prix. Last year's western meal in a dining room adjacent to the conference room proved to be quite popular. We'll do that again this year.

Expect to see many of the manufacturers of packet equipment present with displays and demos. Some have already contacted TAPR for arrangements. All the new TAPR kits will be shown and discussed.

Those wishing to be on the speaking agenda should advise the TAPR office as soon as possible. The Sunday session should be concluded near or shortly after noontime for those planning afternoon departures.

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packetRADIO

Pete Eaton, WB9FLW

The Beta Test version of the packetRADIO that was to be unveiled at the Computer Networking Conference didn't happen, the reason: it wasn't ready.

We could have thrown it together and taken folks money, however it was felt the amateur community deserved better. Packeteer's have put their trust in us many times and we felt the only responsible thing to do was to take a little more time and do it right. This was a tough decision, but we think it was the correct thing to do.

In the next 60 days, the circuit boards are going to be revised, and some tweaks will be made to the design. The end result hopefully will be something we can all be proud of.

Peoples offers of help have not gone unnoticed. Andy has a map of the U.S. on his wall, on it are all the callsigns of people who want to participate in the beta test. A dBase listings has been compiled as well. When looking at the map, database, and the forms prospective testers have filled out two things become clear.

1. There are a lot of talented people that want to help out.

2. Not everyone will get a radio.

Given that we only plan to produce 100 radios for testing, over half of the requests will have to be turned down. Beta testing should not be thought of as a way to be "first on the block" with the latest gear. Rather it is a serious part of the final review process before turning the design over to the amateur community.

The delays are frustrating, but being honest and up front with the folks that have volunteered to be Test Sites is the least we can do.

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packetRADIO Project

TAPR packetRADIO
Development Team

Written: Greg Jones, WD5IVD
Introductio: Andy Freeborn, N0CCZ
[Full Text and Figures can be found in the 8th ARRL Computer Networking Conference]

Introduction

It wasn't long after amateurs started beta testing the TAPR TNC-1 that it became apparent to many that there was trouble looming on the horizon. Even in the earliest days, visionary amateurs could see that 1200 baud packet would not accommodate the large numbers of packeteers operating in heavily populated areas. Within a very short time the larger metropolitan areas of the country were, in fact, experiencing crowded packet channels.

The adaptation of radios designed for voice use in the earlier packet radio days was acceptable. As the packet channels have become more crowded, the inefficiencies and economics of these voice radios have become a significant negative factor in packet radio's growth. However, designing a better radio for packet use was far down the list of projects for TAPR to pursue. A glance through the Table of Contents of papers of earlier ARRL Networking Conferences will refresh memories of what, in those years, were the more pressing issues.

During 1987 and 1988 the packet radio problem surfaced again and was discussed in earnest within TAPR. Finally, in hotel rooms at the 7th Networking Conference, a decision was made to go ahead with a program to develop a radio designed specifically for digital use. This paper will outline the project to date.

Andy Freeborn, N0CCZ
President Tucson Amateur Packet Radio

Design Goals
The purpose behind the packetRADIO project is to design a low cost, high speed rf box for the average Amateur. There were a number of design criteria set forth as goals from the start of the project. Figure A outlines the current specifications of the radio.

• Design a 9600+ high speed packet radio. Amateurs need faster local access than 1200 baud AFSK. While many will want to put the packetRADIO to work on their backbone links, it is the feeling of the development team that future network linking will be done at much higher speeds. By moving local network access to 9600 bps, our local packet frequencies will be better utilized.

• Low cost. The design should be simple and easy to reproduce. By using simple FSK techniques that are already in use, such a radio will be compatible with other designs (TAPR , TPRS TexNet , G3RUH). This also translated to less complexity than current commercial radios (i.e. no touch-tone, PLL, scanners, voice synthesizers, etc.)

• Fast turn around time between transmit and receive. This would allow the modem to operate as closely to 9600 bps as possible. The design now accommodates a one millisecond (mSec) turnaround compared to the average 150 mSec to 400 mSec of commercial voice radios. To maintain this fast turnaround time, the team felt that the radio needed a 25 watt output to be acceptable for the widest variety of applications. Having an amplifier outside of the unit would again increase the turnaround time, which is the critical factor for better performance.

• Include a 1200 baud AFSK modem to encourage the average Amateur to make the switch to the new design. This also allows compatibility with the existing standard.

• The design should allow for easy modifications to obtain different bands and speeds (i.e. 220 MHz and 19.2 Kbps). The design should also allow full-duplex operation.

A number of items were included on the wish list :
• Enhanced TNC built into the design which could also control the radio.
• 220 MHz capability in the initial test units.

Radio Technical Information
The TAPR packetRADIO is a crystal controlled, 2-meter four frequency radio designed specifically for 1200 and 9600 bps packet operation. The TAPR radio employs pin diode switching and an offset transmitter oscillator to provide fast turn-around between transmit and receive. A block diagram of the radio is shown.

Starting at the antenna :
The antenna is connected to a lowpass filter which attenuates the harmonics of the transmitter and provides high frequency selectivity for the receiver. The output of the lowpass filter is connected to the pin diode switch. This switch provides the transmit/ receive RF switching in the transceiver. A pin switch allows fast switching between transmit and receive.

Following the receive path:
The received signal from the pin switch is connected to a 2-pole LC filter providing RF selectivity for the receiver.

A FET preamp follows the LC filter providing a nominal 10 dB of gain and a 3 dB noise figure with a +30 dBm third order intercept point. The FET preamp output is fed to a 3-pole helical resonator which provides additional RF selectivity. The helical resonator output is fed to a FET mixer which provides a nominal 15 dB of gain with a +30 dBm intercept point.

The 45 MHz IF output of the first mixer is fed to a 2-pole Piezo technology model 2844 crystal filter. The crystal filter provides selectivity to protect the backend of the receiver. By using a crystal filter at this point in the receiver, the intercept point of the overall receiver is set by the preamp and mixer intercept points. The overall intercept point of the front end to the mixer output was measured to be -2 dBm. This intercept point provides better than 70 dB IM protection to the receiver.

The output of the 45 MHz crystal filter is fed to a Signetics NE605 IC which provides the second mixer, second local oscillator, 10.7 MHz IF amplifier and discriminator. The first 10.7 MHz crystal filter is a 4-pole Piezo Technology model 5182. The second 10.7 MHz filter is a 2-pole Piezo Technology model 2195. The combination of the 45 MHz and 10.7 MHz crystals provide tight selectivity for good adjacent channel protection with a flat group delay response.

Data carrier detect is provided from the RF level circuits of the NE605. A front panel control is provided for the operator to set the sensitivity level for the DCD.

The discriminator output of the NE605 is connected to the 1200 and 9600 bps modems. Each modem then provides the appropriate received data stream to the TNC interface.

Local Oscillator

The local oscillator board provides a local oscillator signal to the receiver and the transmitter. Four crystal oscillators are provided for up to four channel operation. The oscillator also acts as a tripler providing a 33 to 34.333 MHz drive signal to the tripler. The tripler takes the oscillator/tripler signal and multiplies it to the 99 to 103 MHz range.

The buffer amplifier provides gain to the 99-103 MHz signal to provide a nominal +10 dBm signal out of the LO board. The power splitter divides the RF output of the lo board equally between the receiver and the transmitter.

Exciter

The exciter board contains a frequency modulated crystal controlled 45 MHz offset oscillator. The modulation input for the oscillator is provided from the digital board transmit modem. The transmit modem contains a FIR filter to filter the 9600 bps transmit data. In the 1200 bps mode, the transmit modem uses the same ROM containing the 9600 bps FIR filter to generate the 1200 and 2200 Hz tones. The output of the 45 MHz oscillator is mixed with the output of the lo board in a NE602 mixer IC.

The 144-148 MHz signal out of the mixer is filtered in a 2-pole LC filter and then amplified using two MMIC amplifiers. The output of the MMIC amplifiers is then filtered in a 2-pole LC filter and sent to the PA board.

The exciter output is amplified by a Toshiba S-AV7 power amplifier on the PA board and then routed to the pin switch.

Modem Technical Information

The 1200 and 9600 bps modems designed for the TAPR packetRADIO are a culmination of years of experiments with 1200 and 9600 bps amateur packet operation. The 1200 bps modem incorporates all the information obtained from the TAPR TNC-1 and TNC-2 EXAR 2211 receive modem tests. The 9600 bps receive modem incorporates experience from the TAPR, TPRS TexNet, G3RUH, and GRAPES modems into a low cost, high performance FSK receiver. The selection of flat group delay filters in the IF of the packetRADIO simplifies the design of the 9600 bps modem by not distorting the data signal in the receiver IF filters.

In the 9600 bps receive mode, the radio discriminator output is sent to post detection filters and a limiter. In the 1200 bps mode, the discriminator output is de-emphasized and detected in an EXAR 2211 IC. The limited data from each modem is then sent to the digital board where clock is recovered from the received data stream. The reclocked data is then sent from the digital board to the TNC. The digital board also provides selectable rf or digital DCD.

The transmit modem incorporates digital signal processing (DSP) techniques to generate the filtered FSK signal for the 9600 bps modem and to generate the tones for the 1200 bps modem. This creates a modem which only requires setting the deviation in the transmitter.

The digital board contains the TNC interfacing circuitry. It also provides the transmit time-out function, data and control lines to and from the TNC and radio, and clock generation circuits used by both the radio and transmit modem. A 16 and 1 times clock is sent to the transmit modem along with the transmit data to operate the transmit ROM. The transmit ROM contains a finite impulse response (FIR) filter which filters the transmit data in the 9600 bps mode. The transmit ROM also contains a 1200 and 2200 Hz tone generator for use in the 1200 bps mode.

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Figure A : Specifications

General

Power: +10 to +17 VDC

Number of Channels: 1 to 4

Frequency of Range: 144-148 MHz

Transmitter

Power Output : 25 watts into 50Ω

Mismatch: Stable into a VSWR of 3:1

Modulation: 1200bps - 3 kHz deviation of 2200 Hz tone
9600 bps - filtered FSK, +/- 3 kHz deviation

Spurious output : -60 dBc

Keyup time : Less than 1 millisecond

Lineup : Modulated 45 MHz offset crystal oscillator mixed with receiver L.O. to produce output operating frequency.

Receiver
Sensitivity: -113 dBm (0.5 µV) into 50Ω for 10^{-3} BER
Intermodulation: -70 dB
Spurious response: -80 dB
Time to carrier detect:
3 millisecond (9600 bps)
15 millisecond (1200 bps)
Lineup:
FET preamp
One Crystal-controlled L.O. per channel
(for enhanced frequency stability).
45 MHz 1st I.F.
10.7 MHz 2nd I.F.
Linear phase response multi-pole filtering.

Bits in the Basement

by Bdale Garbee, N3EUA

(Adapted from the RMPRA>PACKET, newsletter of the Rocky Mountain Packet Radio Association)

In the last issue of PSR, I mentioned several projects that were underway. Before getting into what I want to talk about in this issue, let me give you a quick update on some of the things that have happened since that time.

Shortly after Dayton, the KA9Q TCP/IP package was updated to 890421.1. The '.1' reflects the fact that there were no major changes, and that this was a bug fixing release only. There are a variety of small bugs that have been reported in the "dot-one" revision, mostly related to incorrect handling of the end of line characters in text files. This affects text uploads in AX.25 mode, Finger, and a few other places. There are also a couple of problems with the size of timer value objects being wrong, meaning that as long as the timer is set to some value that will fit in 16 bits, all is well, but with timers having millisecond resolution.

My intention had been to issue a 'dot-two' release by now. Events in my personal life delayed the process, and discussion with other developers of the KA9Q package at the 8th ARRL Computer Networking Conference leads me to believe there would be little value to issuing such a release now. We will never touch the current version of the KA9Q package again, and all developers are migrating to the rewritten 'NOS' version for developing new applications. Expect the first public release of NOS to happen sometime late this fall.

The TAPR 9600 baud packetRADIO/modem project is still going full speed ahead. Several pieces of the final prototype circuit have been built up and tested, and all fundamental technological hurdles have been addressed and resolved. The project has taken a lot longer than originally anticipated, such that beta test is now not expected until the first of the year. But, great progress has been made, and several commercial outfits in the US and Japan have expressed a desire to see the project succeed. I continue to be excited about the prospects for 9600 baud as our next "slowest common denominator" packet speed in the coming months.

Glenn, N6GN, has frozen the design for our 10Ghz, 1Mbit/sec hardware. Kevin Rowett, N6RCE, spoke at the 8th ARRL CNC about progress to date, including an operational link in the San Fransicsco Bay area. John, WD0FHG, has the schematics in his CAD software, and has developed PC board layouts for the units. I will be fabricating samples of the PC boards for a test run. If all works well, and some gotchas discovered in the AFC circuit can be solved, we'll start thinking about how to kit the units. It appears that we may be unable to get more of the super-cheap NEC radar gun modules from Japan. There are other manufacturers making similar units, though. I'll keep you informed as the project progresses! If you haven't seen the October issue of 73, look at the cover! Glenn and Kevin have written a how-to article that will appear in an upcoming issue of Ham Radio.

Mike, K3MC, has frozen the design on his high-speed I/O card for the PC, and Kevin, N6RCE, is working on driver software for the KA9Q package. DRSI showed up at the ARRL conference with artwork, indicating they are very close to having production units available for testing. This card will be the ideal solution for PC users who want to try out the 56kb WA4DSY modems, or any of the things that N6GN and I are working on. They will also be a neat way to drive the TAPR 9600 baud modems, since there is a powerful processor on board (a NEC V40), that we can do a bunch of the packet processing with, leaving more of your computer power available for applications.

Now that N6GN has handed off the 10Ghz packet link design for other folks to develop into a kit, he has been concentrating on building prototypes of a direct FSK packet radio for the 900Mhz band, that will sport 250-500kbps operation, and cost about $200 per unit for parts. I have been pushing Glenn to follow the 900Mhz version with a 1.2Ghz version, since we don't have uniform access to 900Mhz in the Rocky Mountain region. These radios are made possible by two neat pieces of technology. One is the series of FSK receiver chips made by Motorola, of

Renew Your Membership!
TAPR doesn't send out constant reminders when your membership has expired. Our only way of communicating is the date on the address label for this issue. Please check it and renew if required. Your membership is very important.

which the 13055 used in our 10Ghz design is one example. The other is the Japanese oscillator, gain, and pin diode modules made originally for the Japanese 900Mhz "CB" band. The volume on these parts is high enough in Japan that the prices are very reasonable, and the process of design becomes mostly lashing the pieces together, coupled with filter and receiver front end design. Glenn plans to prototype enough units to build a full 250 kilobit TCP/IP backbone for the San Fransicsco Bay area. I'm hoping we can convince him to carry this project through the PC Board/Kit stage, so that we can all have access to this technology.

Another neat toy that showed up at the ARRL CNC was the new Kantronics box called a 'de 56'. While the 2 meter RF hardware got a lot of attention, the de56 excited me because it's somewhere in between a PS-186, and a next generation TNC. The unit is a V40 processor, RAM, ROM, an 8530 for two high speed modem channels, and several options for a third serial port to a host, or for a slow speed RF channel, or whatever. I think the initial software will make the unit play like a high-powered TNC, but I'm working on getting hold of a unit to port the NOS package along with the PS-186 and K3MC/DRSI card.

In fact, the availability, in about the same time frame, of the PS-186 Packetswitch board, the Kantronics de56, the N6GN 900Mhz/1.2Ghz radios, and the K3MC I/O card, means that all of a sudden, in one big ker-plunk, we're going to go from having TNC-2's with NET/ROM and 1200 baud radios as our best "bang for the buck" as a packet radio backbone to something truly astounding.

Imagine replacing all of the current 1200 baud NET/ROM sites with a set of hardware consisting of: a PS-186 that provides 4 radio ports (or de56 for 2 ports), the KA9Q NOS software that I'm working on porting to the PS-186 right now and which provides full NET/ROM and TCP/IP functionality, one or two N6GN 250 kbps radios on 1.2Ghz with gain antennas set up for point to point links between switches, and a 9600 baud and 1200 baud access port (or 56kb, or whatever!) for local connection. Think about it for a second. At work, for the last year or so our network connection for Internet to the rest of HP and the world was one 56kb link. We found that we could do file transfers of hundreds of kilobytes over lunch. Interactive logins to machines on the other side of the country were useable. Our mail was delivered to any machine in the company, including Europe and Japan, in a matter of a couple of minutes. What I'm talking about is almost 5 times faster!

Looking at it another way, I expect a PS-186 will cost about what 2 TNC-2's cost with networking firmware. The N6GN 250kbps radios will cost about the same money as a 2m or 70cm mobile rig on sale or used. Antennas all cost roughly the same amount of money. What this means is that we really could do a 250kbps backbone for about what it would cost us to do a 1200 baud backbone correctly, with dual-ported nodes at every site. There are some great side effects that cancels out any issues related to tuning, deviation, etc. It's very difficult for local operations to interfere with the backbone, and at 1.2Ghz we've reached a band where directional antennas can be of reasonable physical size.

If conditions allow, we could even use the N6GN 10Ghz 1Mbit/sec units for backbone links!

By the time the snow melts in the spring, we should have several new toys to play with. The TAPR 9600 baud packetRADIO modem (compatible with the K9NG, TPRS, and G3RUH/Paccomm units) should be available by then... and a full duplex repeater on 2m (or 220 or 440Mhz) for 9600 baud is pretty easy to build using our existing base of repeater expertise. AEA should have started shipping the PS-186, and my port of the KA9Q TCP/IP package complete with NET/ROM functionality, etc., should be pretty solid by then. The N6GN 10Ghz design (which I've been heavily involved with) for 1Mbit/sec or more will have been tested on-air, and kits for the electronics will likely be available. The N6GN 900Mhz/1.2Ghz units should be working well enough for us to duplicate in volume.

With all of this technology in hand, the "obvious" thing to do is to invest both the time and money required to upgrade our regional network backbones to a fundamentally new level of performance. The exact hardware configuration and frequency use will be dictated more by funding that is available than anything else, I imagine. A typical node might consist of a PS-186 or de56 with one or more backbone channels of 10Ghz/1Mbit or 900Mhz/250kbps RF.

For local access, we can keep the existing TNC-2 and RF gear, replacing the TNC-2 EPROM with a KISS-only ROM and plugging it into another port of the PS-186 as a KISS TNC... or, we can put together a simple 1200 baud modem daughter board for the PS-186, and remove the TNC-2's, reta doing this much will dramatically improve the long-haul operation of our network.

Next, we can take the TAPR 9600 baud packetRADIO modems (or any of the compatible FSK units), and build a full-duplex 9600 baud repeater for each local area. We either locate it at the same site as the switch, and install a "Y-cable" connection so the PS-186 can listen and transmit on the repeater, or put it at a better site for local use, and provide a simple half-duplex 9600 channel connected to the PS-186, to connect the local channel to the backbone. This choice should be made site by site, as in some cases the switch connecting to the backbone should be at a high altitude site, but the full duplex repeater channels might want to be at lower altitude, helping to limit them to local use.

Given my documented comments about how slow even 56kb is, I should probably explain my infatuation with 9600 baud. One of the things that has become very clear to me is that a large portion of the packet user community is not interested in investing in exotic equipment until/unless they can directly experience some undeniable benefit, and even then for some it may be a hard sell. I'm not talking about the experimenters here; I'm talking about the *users*. However, even the least demanding user quickly tires of the throughput provided by half-duplex 1200 baud technology. 9600 baud is a sufficient increase in raw speed, that when combined with the impressive throughput gains available with full duplex repeater technology, can help to satisfy many user's short term needs for faster packet, without requiring a large investment, or a fundamental change in operating habits. The same TNC can be used (by hooking the modem to the modem disconnect header), the same software, etc... everything is just *lots* faster.

Wherever there is an interested user base, addition of a 56kb port to the switch, or whatever else seems exciting, is more than possible with the 4 ports on the PS-186, and possibility of chaining units together. Phil Karn KA9Q (the author of most of the NET bits) is currently working on ways to run the 56kb WA4DSY modems cross-band full duplex. This will certainly be an exciting way to operate when the kinks are worked out... particularly since we can do real collision detection on a cross band repeater... the "/CD" part of "CSMA/CD" channel access protocols.

Where inter-switch distances are short, and environmental conditions allow, 10Ghz links can be used to provide even higher speed interconnections between switches. In addition, the N6GN design provides a "free" audio sub-channel on the microwave link, that is full duplex. This may be of use in special circumstances, such as possibly improving the quality or reducing the cost of a telephone autopatch at a remote repeater site that is shared by a packet switch.

Finally, one of the exciting things to me about the PS-186 is that it has a rich external expansion bus connector, that could easily be used (and for which I'd be willing to help support software) to hook up hardware for repeater control and/or telemetry (of the repeater, or even of weather monitoring gear?), or almost anything else a computer can do. This may make it *much* easier for us to get PS-186's installed at existing RF sites, by volunteering to provide some amount of control and monitoring via reliable, and *fast*, packet links. This kind of capability is also available on some of the Paccomm digital hardware, and it wouldn't be hard to add to other switch designs.

I hope I've at least whetted your appetite about what we can do in the next year if we set our minds to it. At the RMPRA Packetfest on Sunday following the 8th ARRL conference, I led an open discussion about what would be required to move us from where we are now in packet, to what many of us are starting to see as the "next logical step" from here... a truly fast nationwide digital network. To quote the well-worn phrase: "We have the technology." What is needed next is commitment, from both individuals and organizations, that we're willing and ready to work together to make great things happen!

I'd love to hear from you, whether related to an item in this article or because you're excited about helping us build the next generation packet network. I can be reached as bdale@col.hp.com on the Internet, or as N3EUA @ KA0WIE on packet.

Description of TAPR Packet Radio Kits

THE TAPR PSK MODEM

The TAPR PSK modem kit offers the potential for a 3 to 8 dB improvement in weak signal work over typical FSK modems. It is compatible with the FUJI (FO-12) satellite packet system as well as with the AMSAT Microsat satellites. It is also an excellent terrestrial point-to-point modem.

The modem is designed to easily interface to the TAPR TNC 1 and TNC 2 as well as their clones. Any TNC that provides a modem disconnect and a 16x or 32x data rate clock can also be used. This includes almost any TNC with "hardware HDLC" such as the PK-232. It does not include the Kantronics KPC-1, -2, -4, -2400 or KAM or the GLB PK-1 which use "software HDLC."

The kit contains three printed circuit boards. Two are installed in the modem. The third is an interface board that plugs into the TNC's modem disconnect.

The kit contains all parts and components necessary to fully populate all PC boards, as well as mating connectors, front panel switches and front and rear panel labels. It does NOT include the case, optional input level control, rear panel power connector, knobs, fuses or power supply. The PSK modem fits into a standard 4" x 2-3/8" x 6" enclosure and runs from a 12 volt DC source at under 100 mA.
Access to test equipment, including a voltmeter and a calibrated oscilloscope is required to align the modem and verify its performance. Use of a frequency counter and audio function generator is helpful.

UPGRADING THE TNC 1 TO THE TNC 2

The TNC 1 Upgrade adds an enhanced TNC 2 to the TNC 1 (or Heath HD-4040 or AEA PKT-1) chassis. When the upgrade is completed, the TNC will have all the capability of the original TNC along with that of the TNC 2.

Looking at it from the TNC 2 perspective, the upgraded TNC 1 provides all TNC 2 features plus the following new ones:

(a) Software selectable serial port (ABAUD) and radio port (HBAUD).
(b) Two sets of default parameters in battery-backed RAM (optional).
(c) Two sets of EPROM-based software (optional).
(d) Complete TNC2 firmware capability (NET/ROM, for example). This also "ensures" availability of firmware for the upcoming AX.25V2.1, etc.
(e) Two modem disconnect headers (one for the TNC 1, one for the TNC 2.
(f) Front panel RESET switch.
(g) A TNC 1!.

The upgrade is a kit that can be built in an evening or two.

After construction, the unit simply plugs into the TNC 1 chassis at the 6551 UART (U14) socket and the J5 modem disconnect (J5).

THE K9NG 9600 BAUD MODEM

This direct FSK modem is designed for the advanced experimenter. The kit is a semi-kit, including all hard-to-get components, PC board, EPROM, etc. It is a half-duplex design.

The FSK signal and randomizer algorithm is fully compatible with UoSAT-C'sPacket Communications Experiment as well as the G3RUH and TexNet 9600 bps modems.

You must have access to RF test equipment and be familiar with your radio to use this device. It will require "surgery" on your radio to interface the signals. Detailed directions are not provided for any particular radio.

THE 2211 DCD UPGRADE

For TNCs using the XR2211 demodulator such as:

TAPR Beta Board	TNC 1
GLB PK-1	TNC 2
GLB TNC-2A	MFJ 1270
Heath HD-4040	MFJ 1274
AEA PKT-1	AEA PK-80
PacCommTNC-200	
DRSI HF*MODEM	

The PC board is tiny and shaped to fit into a TNC 1 or TNC 2. After construction (an hour or so), you simply unplug the XR2211 chip from its socket, insert it into the socket on the upgrade board, then plug the upgrade board into the IC socket vacated by the XR2211 chip on the TNC.

If you are into HF operation, provision is made to connect a "Threshold" control onto the demodulator.

The result will be fast-attack, slow decay DCD with a hang time to compensate for temporary fades due to multipath. When all stations sharing a channel have proper DCD action, data flows more efficiently.

STATE MACHINE DCD UPGRADE

For TNCs with modems such as:

KPC-1	PacComm Tiny-2/Micro-2
KPC-2	DRSI PC*PA Type 1
KPC-4	DRSI PC*PA Type 2
KPC-2400	AIWA APX-25
KAM	AIWA APX-25M
AEA PK-87	TASCO TNC-20
AEA PK-88	TASCO TNC-20H
AEA PK-232	Heath HK-232
PacComm TNC-220	
Heath Pocket Packet	

The upgrade adaptor for these TNCs adds an EPROM-based State Machine to derive DCD based on lockup of a digital phase-lock loop. It is a small PC board assembly that mounts easily inside the cabinet of most any TNC (NOT the Heath Pocket Packet/TASCO TNC-u21).

This upgrade will DRAMATICALLY improve DCD operation, allowing you to run your radio unsquelched. This alone reduces other stations' TXDelay requirements, improving channel throughput.

For TNCs with "software HDLC," an optional clock generator may be included to provide this signal (KPC-1, KPC-2, HF channel of KAM).

THE STATE MACHINE DCD UPGRADE WITH INTERNAL CLOCK

This DCD upgrade adaptor is designed especially for the Packet Communicator and the KPC2. It will work with any TNC that doesn't have an easily available time-16 or times-32 data rate clock. It will work with ANY TNC, so, if you're not sure which one to get, get this one. (available November 1989)

THE HF TUNING INDICATOR

The TAPR HF tuning indicator is designed to operate with any XR2211-based FSK demodulator. Its primary use is for HF packet, where precise tuning is mandatory. With this kit, exact tuning is simple and fast. The bar-graph indicator tells you how far to tune and in which direction. The kit is complete, less cabinet.

THE PK232 MODEM DISCONNECT UPGRADE

This kit is a simple PC board assembly you can build in an evening and still have time left to operate your radio! Once completed, it simply plugs into an IC socket inside the PK232 and provides you with a "Standard" TAPR modem disconnect header (for plugging in the TAPR PSK modem for satellite operation, for example) as well as a convenient place to connect the DCD State Machine upgrade kit. The result is a no-holes enhancement of your PK-232 (or Heath HK-232).

TUCSON AMATEUR PACKET RADIO

P.O. BOX 12925 TUCSON, AZ 85732, (602) 323-1710

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(All prices include S&H except foreign air)

KITS/FIRMWARE

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	K9NG 9600 Baud Modem	$ 25.00	____	______
	TNC 2 Tuning Indicator	$ 25.00	____	______
	XR2211 DCD Mod	$ 11.00	____	______
	State Machine DCD Mod	$ 17.50	____	______
-NEW-	State Mach.DCD w/Internal Clock For Packet Communicator, KPC2, or ANY other TNC.	$ 21.00	____	______
	PK232 Modem Disconnect Upgrade	$ 17.50	____	______
	TNC 1 Upgrade to TNC 2	$ 59.00	____	______
	TNC 1 Upgrade Memory kit When purchased w/TNC 1 upgrade. Includes 32k RAM and 1.1.6 w/KISS EPROM FIRMWARE	$ 20.00	____	______
	32K RAM w/TNC2 update docs*	$ 20.00	____	______
	TNC 2 ver 1.1.6 w/kiss (27C256)* (includes new 1.1.6 Commands booklet)	$ 12.00	____	______
	* With TNC 1 Kit	$ 20.00	____	______
	TNC 2 WA8DED (27C256)	$ 12.00	____	______
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4. EZPAC11 - M. Imel - NTS formatter
5. MONAX - NK6K/WB6YMH - Gather network stats
6. Packet S/W - WB6UUT - for PK 87,88,232
7. PBBS Lists - W9ZRX - Master PBBS lists
8. R95 - WD5IVD - Binary conversion utility
9. ROSESERV - KA2BQE - BB and server for ROSE
10. ROSE Switch - W2VY - The Rose executibles

11/11a. TCP/IP Plug & Play - KA9Q - *(2 DISKS)*

Disk #

12/12a. TCP/IP Sources - KA9Q - *(2 DISKS)*

13. TAPR TNC-1 Source code TNC-1 Sources
14. TNC-2 Software notes - N2WX - 1.1.0 thru 1.1.6
15. WA7MBL BBS - WA7MBL - BB system
16. W0RLI BBS - W0RLI - BB system
17. YAPP - WA7MBL - Terminal program

18/18a. INTRO TO TCP/IP Much info on TCP/IP *(2 DISKS)*

19. LAN-LINK - G3ZCZ - Terminal program
20. ARES/Data - WN6I,N6KL - Emergency data system
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