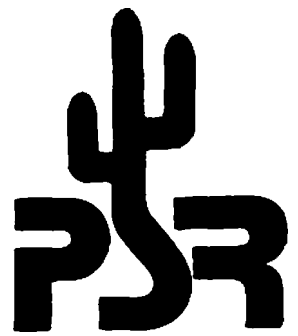# Packet Status Register

July 1983
Number 6

PSR

Tucson Amateur Packet Radio Corporation

--- THE TAPR TNC KITS ARE COMING ! ---

Beta test is nearly over, the new TNC's are on the way, and they're better than ever. See Lyle Johnson's announcement on page 3.

Phase III-B has officially become OSCAR 10! The launch was successful, but a problem with the attitude of the spacecraft has postponed the next significant milestone until it can be stabilized in the proper position. The latest information is that the kick motor will be fired to boost the satellite into its proper orbit around the weekend of July 2-4. Our heartiest congratulations go out to the AMSAT crew for a job well done, despite a multitude of setbacks.

The July issue of Ham Radio magazine has a full page color photo of the Beta TNC board on the front cover. Also inside is the first of two articles on the same subject. (courtesy of Pete Eaton, WB9FLW, via Compuserve Information Service)

For those in the group with Radio Shack equipment there is, or soon will be, a book available with software to simulate a TNC. Volume one of "Packet Radio - Software Approach" uses the VADCG protocol, volume two is to use AX.25. The author, Robert Richardson, delivered a paper on the subject at the 2nd ARRL Computer Networking conference and has now provided more detail in his book. Address: Richcraft Engineering Ltd. 1 Wahmeda Industrial Park, P. O. Drawer 1065, Chautauqa, NY. 14722...

The FCC has made some changes in the requirements for station identification, it seems that packet radio stations will no longer be required to ID in CW as we are currently doing. (Look for full details in QST) Even though it is no longer a requirment, it is strongly recomended by TAPR that we continue to identify each of our stations as usual so other non-packet amateurs will know who we are.

At approximately 23:00 UTC on May 27th a successful packet QSO was held between Tom Clark, W3IWI in Maryland, and Ian Ashley, ZL1AOX near Auckland, New Zealand, on 28 MHZ, using the TAPR TNC at 1200 baud. The 13850 KM path is the longest distance yet bridged using packet radio. Also participating in the test was Bob Diersing, N5AHD in Corpus Christi, TX. W3IWI and N5AHD previously held several successful packet QSO's on 10 meters. Several days later W3IWI and Vern Riportella, WA2LQQ, used the Memorial Day weekend to try ZL1AOX once again at 600 baud. Rip and Ian stayed connected for over an hour, enough time for a file transfer or two. In Washington K1HTV and KA1GD were SWLing and copied many of Ian's packets.

From Lynn Taylor, WB6UUT, Laguna Beach, CA.: Talks will take place on July 9th between San Diego, Los Angeles, Ventura and San Francisco to establish a dedicated packet linking system to connect these four sites.

The ARRL Southwestern Division convention is to be held at the Anaheim Marriott Hotel on September 2-4. Two packet radio presentations are scheduled, both Saturday the 3rd. The first is an introductory session that starts at 9 AM. The second runs from 2 till 4 PM and is more technical in nature. If you are going and need a room make your reservations now, also mention that they are for HAMCON to receive a convention discount.

Take a look on page 53 of the July 73, Bill Ashby and Son Eng. list a "PAC/NET" board. It is based on the VADCG TNC, although smaller at 4.5 by 6 inches. It is compatible with AX.25 on the Vancouver boards in Bill's area, but at this time has not made a connection to a TAPR TNC. Bill is also working up a BBS package based on the CP/M users group material. Send him an 8 inch disk and he will return all currently available programs. (This RBBS progam is also being used at SLAPR, it is CPMUG volume 62 or SIG/M volume 8. Programs 8.19-8.21, RBBS22.ASC, RBBS.DOC and RBSUTL.ASC.)

Thanks to everyone for looking over their TNC. The wayward 27C64 EPROM has found it's way home again and is resting peacefully in a cozy socket.

The Minnesota Amateur Packet Radio (MAPR) group has taken on the duties of editing PSR. This is our first time through the rigors of the job and we hope the results are of value to you all. Let us know of any changes or additions that you would like. We are constantly looking for material so whatever your group is involved in, be it some new application of the TNCs or an event designed to publicize packet radio, we want to be in touch with you about it.

Further, we ask any site that publishes its own newsletter to put MAPR on the mailing list. For those sites not printing their own, would it be possible to have a "reporter" in the group send news and notes to PSR on a regular basis? We can do this via the mail, on radio or via CompuServe.

Events across the country indicate rapid and sustained growth for Packet Radio. PSR is the return path on the feedback loop, we need you all in the loop... Thanks.

The President's Corner

by Lyle Johnson, WA7GXD

TAPR is ready to begin work on the high speed terrestrial linking hardware and software. The following is submitted for feedback so we can make the system as close (as practical) to everyone's perception of what such a system should do and get the tasks assigned.

Proposed Packet Radio High Speed Linking

Presently, about 300 packet stations in about 30 locations are communicating primarily on short-range VHF frequencies at a signalling rate of 1200 bits per second. Clearly, it would be desirable to establish inter-group packet communications, and the availability of non-local coverage would speed acceptance of packet radio as a primary mode of amateur radio communications.

Recently, experiments have been conducted with coast to coast and intercontinental HF links. A channel has been allocated to digital experimentation on OSCAR 10, and a packet radio satellite has been proposed and is in design at AHSAT. All of these methods are aimed at expanding the geographical coverage of packet radio stations, but the signaling rate is relatively slow.

One of the advantages of packet communications is the ability to share resources. A packet station should be able to use a gateway station to extend its own coverage, just as a user of a VHF rig can use a voice repeater to do so. Therefore, while AMSAT continues its satellite development, and AMRAD works on an adaptive modem for HF, TAPR is committed to development of high-speed UHF or microwave linking equipment. This concept is not new, but the amateur radio environment places unique constraints on the equipment required.

System Objectives

The current centers of packet operation are widely scattered geographically, but they are concentrated in areas of high population density. Some of these sites could easily link using UHF frequencies, such as LA/San Diego and Phoenix/Tucson. Other groups could link via one or two additional hops, such as LA/San Francisco.

In order to link existing sites and allow for anticipated growth, some estimate of traffic must be made. If we assume that packet radio is going to explode in the next few years (from 300 users now to 3000 in five years and 15000 in ten), then the traffic offered the system will likely be enormous in the near future. On the average, an active packeteer may be expected to operate a few nights a week, and be on an hour or so a night, generating a few thousand characters of data each time. Therefore, our typical packeteer may offer the larger network upwards of 10,000 bytes/hour in bursts, but only about 400 bytes/hour average on active days, or about 100 bytes/hour on long term average. This is well under 1 baud.

At the present packet population, this means the network may be offered a peak burst rate of 3,000,000 bytes/hour (about 50,000 bytes/min or about 6600 baud). In five years this can be expected to increase by an order of magnitude to about 66 kilobaud and in ten years to around 330 kilobaud. Naturally, this assumes that everyone is on at once and wants to use the network at the same time - not likely, but a place to start. If we assume that the more sophisticated amateurs will take advantage of packet radio's data integrity to ship files, as opposed to RTTY-like chit-chat, the system loading will increase even more dramatically. If every packeteer were to try to back up his disk, the system could experience severe constipation almost immediately!

In order to reduce system delays, it is common to design in excess capacity so that the system is lightly loaded. Assuming the users not on the system are compensated for by the file-dumpers, it would appear that a capacity to handle upwards of 50 kbaud is the minimum desirable for the "trunks" to meet the five-year demand, 250 kbaud being a better choice. As activity picks up, parallel trunks may be established, much as VHF FM repeaters often have similar coverage, which will distribute the load.

Hardware Requirements

The following specifications are offered as a guide in implementing a high speed packet radio linking system.

Each relay link will operate on 220 MHz or above. The FCC allows us a 100 kHz data bandwidth on this band. Above 1215 MHz, bandwidth is not limited. If a 50 kbaud link is to be built, 220 MHz is recommended because RF gear can be easily and cheaply built and maintained for this band. The 100 kHz bandwidth limitation will easily accomodate 50 kbaud, and use of fairly sophisticated modulation techniques could extend this data rate to around 200 kbps. If significantly higher data rates are desired, L-band (1215 MHz) is suggested due to less crowding than 440 MHz and practically no bandwidth limitations. However, equipment for this band is not cheap, and the RF circuitry is not as easily maintained (due to lack of familiarity with microwave techniques by most Amateurs).

Topology suggests that the high speed equipment be multiport to efficiently handle multiple branches. Further, an input port is needed for the local area to have access. Provision for up to four high speed channels is suggested.

This equipment must be easily duplicable, maintainable and cost effective. It would probably be supported by local groups much the same as repeater groups do today, and a total cost ceiling might be on the order of $1500 to $2000.

TNC Kits

by Lyle Johnson, WA7GXD

The Tucson Amateur Packet Radio Corporation has conducted extensive testing of a Terminal Node Controller (TNC) design over the last several months. 172 TAPR TNCs are in the field, and the "Beta" design has been in continuous testing since early November, 1982. In order to more fully discharge our charter in developing and refining packet radio communications, TAPR will soon release the TAPR TNC to the amateur community.

The TNC will be provided as a kit that includes all parts, a comprehensive manual (including detailed assembly instructions), a custom power transformer with multi-tap primary windings, a pretested printed-circuit board with silk-screened component locations, a built-in modem, power supply, RS-232 interface, and radio interface.

TAPR is currently writing an updated manual and revising the PC board layout. A trial run of 25 kits will be supplied to a limited number of Beta sites for evaluation and testing in mid-August. We are limiting this initial release to ensure a rapid turnaround in the testing. It is not our intent during the kit testing to bring up more sites. The kits will be made available when we have determined that the revised design is working properly, and that the documentation is adequate to allow a reasonably adept amateur to properly assemble, calibrate, interface and operate the TNC.

Distribution & Availability

Orders for the TAPR TNC will be filled on a first-come, first-served basis. TAPR members will have a degree of priority. Orders for multiple units will be spread somewhat, to prevent large orders from causing an imbalance in distribution.

To order, send your name, & shipping address to TAPR, along with $25 deposit. Upon receipt of your deposit (allowing 16 days for clearance of non-cashier's checks) your name will be placed into the queue. You will be advised by return mail of your expected shipping date. The balance of payment is due at least one week before scheduled shipping (or you may get bumped!).

Since many of the components used in the TNC are now on manufacturer's allocation, we have taken steps to schedule a number of kits. However, we need IMMEDIATE feedback on your expected needs, as well as deposits, so that we may better plan our production. Our present schedule calls for general kit deliveries starting in September. We are planning on 25 kits the first month, followed by 50 kits for each of the following three months. That is only 175 kits, so if you are interested, act promptly! If there is sufficient demand, we will increase production as quickly as possible.

Product Support

Please note that support of the TNC, including service bulletins and notices of hardware and software updates, will be provided via the Packet Status Register (PSR). Thus it is suggested that prospective purchasers of TNCs consider becoming members of TAPR.

PACtivities

by Pat Snyder, WAOTTW

The Minnesota site has been active the past few months showing and telling. Even before we received hardware, the group had completed several presentations about packet radio. A list of places visited include: Honeywell, Minneapolis, Anoka, Univac and Robbinsdale radio clubs and the local CP/M group. The series of visits generated quite a bit of interest in the Twin Cities amateur community as well as invitations to other clubs.

Another activity for us was Amateur Fair, a regional hamfest that draws from several surrounding states, this years attendance was some 2400 people. Here our principal goal was to inform the amateur community about Packet Radio and what it could do. To achieve this, we provided a handout containing a QST reprint and some locally produced material that included the TAPR and AMRAD addresses as well as phone numbers of those in our group. Two packet terminals were the focus of our booth, both being connected with stations outside the hamfest area. One was operating as a bulletin board and the other ran a game on an Apple computer. These terminals allowed visitors to actually use the systems and see and hear packet radio firsthand. Some had heard of packet but wanted more details, for others it was all new. This exposure produced more invitations for later demonstrations as well as new packeteers. The Amateur Fair operation required time and effort of all that were involved yet it has been well worth the work and is still returning benefits to us.

After the site received it's shipment of TNC's and we had recovered from the initial excitement, we found it would be helpful if we could keep in touch with each other when not near a terminal. At about this same time we provided a demonstration for the Honeywell radio club and mentioned this to them. Being interested in packet radio, they invited us to use their 04/64 voice repeater as an intercom among our membership. We are also running a weekly voice net to allow would-be packetteers to keep in touch with what is happenning and to help answer their questions. The Honeywell machine, being lightly used, is an excellent place for such sharing. The system is working well and provides the site with regular exposure to the outside world. For their assistance, I would like to thank Rick Whiting, WOTH, and the entire Honeywell Amateur Radio Club. Their help has been a great boost to MAPR.

I also need to thank the other members of the Twin Cities Beta site for all the hours of work that they nave been put forth to make things happen, for without them nothing would have. It has been great to work with them and see their various talents in action.

From the past and the present we come to the future. The site is busy on several fronts. There are many packet demonstrations yet to be given as well as more hamfests to attend. We are close to establishing a permanent bulletin board as well as a very well situated packet relay site to cover the entire metro area. Further down tne line we see a many-fold increase in our numbers as the TAPR kits arrive and are assembled. How we deal with this growth is a very important issue as well. We don't have all the answers but it is exciting to be involved in a bit of pioneering.

Hardware Happenings

by Clay Bartholow, KD0BY

On the heels of the U.S.-ZL packet exchanges comes an increasing feeling that the audio input to the TNC is quite sensitive. One of the problems resulting from an excess of audio drive is that the HDLC chip "thinks" that it is detecting a carrier most of the time. This is particularly apparent in the relatively noisy environment of HF. Tom Clark, W3IWI, and others have recommended the addition of an LED to monitor Carrier Detect activity at pin 39 of the HDLC chip. One point at which this signal is easily accessible is at the 4.7 kohm pull-up resistor at pin 5 of the 2211 demodulator (U18). Another handy place to pick off the CD is at pin 19 of J1, the parallel I/O connector. The signal here is the inversion of that applied to the HDLC chip. It may be wise to drive the LED via one of the two unused Darlington drivers of U21. When you have that connected, the appropriate audio level may be ascertained by viewing the pulse rate of the LED. In the absence of signal it should indicate Carrier Detect about ten percent of the time; with packets coming across the audio line CD should be on solid. If you look at the two LED's you've been using for setting the audio level I'd wager they are off. If you have the opportunity to view the audio at the junction of R35 and R36 with an oscilloscope, you should notice the difference in the signal using the CD LED vs. the original method of adjustment. While you have the 'scope out, Tom also suggests that you set the receiver audio so that the signal on U18 pin 3 is about 30 to 50 percent of the reference voltage on pin 10 of that IC.

While we are on the subject of audio input, the TAPR folks have recommended to all Beta testers the following modification:

Lift the leg of C13 presently connected between the 680 ohm and the 6.8 kohm resistors and run a jumper from this capacitor leg to the radio side of C14 (say at the connection at JP9). This removes the input amplifier from the audio channel, but allows it to run the LED's. The signal level, as indicated on the LED's, should now be set so that they are on slightly with valid data running into the audio input to the TNC.

An additional mod, suggested by TAPR, is to replace C19 by a .05 ufd cap, and, if your rig's mike input has high enough input impedance, also replace C18 with a .05 ufd cap.

As with any modification, whether it's TAPR's or your own, keep the feedback coming. Your input is extremely important. Send your hardware-related items to either TAPR directly, or to:

Clay Bartholow
2414 Pleasant Ave. So.
Minneapolis, MN 55404

Some of you who have had the opportunity to run through the calibration routines may have noticed a sixth choice in the menu options. This is the ROM checksum. In a manual update for Version 2 and Version 2.1 software the following information is given:

ROM checksum

To verify the ROM checksum, select option 6. A 16 bit hex number will be displayed for each ROM.

The correct sums for Version 2 are:

| A F083 | C AC41 | E D792 |

The correct sums for Version 2.1 are:

| A F0A6 | C AC41 | E D392 |

I hope you don't need those, but there they are for your reference. Put a copy of them with the section on calibration on Page 18 of your documentation.

Elsewhere in this issue of PSR is the announcement of the new kit TNC. How does it compare to the Beta boards? Here is a summary of the new hardware:

(1) 32 kbytes of EPROM (vs. Beta's 24 k);

(2) 8 kbytes of RAM (vs. Beta's 6 k);

(3) two 512-bit banks of NOVRAM (vs. Beta's single 256 bits);

(4) modem disconnect, with all applicable HDLC connections;

(5) improved modem design, with lower noise floor, greater input signal range, greater mic audio adjustment range, improved signal level indicator circuit, LED monitoring of additional signal lines (such as Data Carrier Detect), configuration of modem parameters via DIP carrier;

(6) serial I/O port access via a right-angle pc-mount DB25S connector at the edge of the board;

(7) parallel port access via a right-angle pc-mount DB25S connector at the edge of the board;

(8) radio I/O port access via a right-angle pc-mount DB9S connector at the edge of the board;

(9) power connection via an 8-pin "Molex" style connector;

(10) improved +5 volt power supply including additional connectors to support an off-board 5 volt regulator;

(11) redesigned power transformer with 105/115/125 volt AC primary windings;

(12) pull-up resistors on the serial I/O port handshake lines to facilitate use of abbreviated RS-232 interfaces;

(13) revised circuitry for calibrating the 1700 Hz PLL demodulator.

That's it for now. Keep the feedback coming. And if you have any suggestions for this neophyte conductor, send it along. Happy Packets!!!

(PACtivities continued from 3)
Dated June 16th Laguna Beach, California. I wanted to bring you up-to-date on what is going on in San Diego for inclusion in PSR. We have approximately 12 stations on the air, two or these are using S-100 boards with WD1933 HDLC chips and their own software written in C.

I am 60 miles from the San Diego area proper, and can connect with most of the stations there. We also have permission from a repeater organizations in Orange County to use their voice system, which covers San Diego and Los Angeles. While this is not an ideal link it serves well for now.

Further, San Diego would like to claim the first mailbox system designed from scratch for Packet Radio. This mailbox runs on the Apple If,

][+ and //e under UCSD PASCAL with either the CCS 7710 serial interface and Thunderware Thunder-clock, or with the Mountain Computer CPS card. The system requires assembly language drivers for the serial interface and a Library unit for the clock.

The first generation mailbox has been on the air since March, and a second generation is under development. The system will be made available to the public when I have completed my debugging. I will also assist anyone who would like to modify my clock and serial port drivers to fit their system. Drop me a postcard if interested and I will contact you when the system is available.

Lynn W. Taylor, WB6UUT
463 Myrtle Street
Laguna Beach, CA. 92651
(714) 497-2671

Points of Contact

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c/o Pat Snyder, WA0TTW
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University Computer Center
208 Union Street S.E.
227 Experimental Engineering Bldg.
Minneapolis, MN 55455

TAPR HF Net:
21.280 or 14.235 MHz
1900Z Sundays

PSR CompuServe Number:
Paul Barnett, N0CRN
70225,1252

The Tucson Amateur Packet Radio Corporation is a nonprofit scientific research and development corporation. the corporation is licensed in the State of Arizona for the purpose of designing and developing new systems for packet radio communication in the Amateur Radio Service, and for freely disseminating information acquired during and obtained from such research.

The officers of the Tucson Amateur Packet Radio Corporation are:

Lyle Johnson, WA7GXD	President
Den Connors, KD2S	Executive VP
Heather Johnson, N7DZU	Secretary
Chuck Green, N0ADI	Treasurer

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Membership Application

Tucson Amateur Packet Radio Corporation
P.O. Box 22888, Tucson, Arizona 85734

Name:_____

Call
Sign:_____ License
Class:_____

Address:_____

City &
State:_____

Zip (Postal) Code: _____

Home
Phone:_____ Work
Phone:_____

If you wish not to have any of the above items published in a membership list, indicate here which they are:

I hereby apply for membership in TAPR. I enclose $12.00 dues for one year.

Signature_____

Date_____

Which Beta Test area (if any) is closest to you?

_____

In the interests of spreading the design task around and flexibility a modular design is proposed. The modules are as follows:

(1) RF deck - a single-channel, crystal controlled unit of about 10-watts power output, class C, well protected from antenna faults and the like, using an IF signal of 10.7 MHz.

(2) IF deck - a modem to convert the necessary logic signals to and from a modulated 10.7 MHz signal.

(3) Digital deck - contains the microprocessor, memory and logic-level I/O ports. Due to the speeds involved, a fast 16-bit processor is suggested. Possible candidates include the 68000 and the 8086. The memory should be large enough to buffer the incoming channel(s) traffic. If half-duplex operation is required, then it must store up to 4 channels' worth of data at the maximum rate between channel turnaround. It is proposed that the RAM be error detecting, on the order of 256K bytes for half-duplex operation, and 64K to 128K bytes for full-duplex operation, with sufficient bytewide sockets provided for up to 64K bytes of EPROM.

Software Considerations

The first high-speed linking devices will by necessity be test-beds for protocol experimentation, and therefore must be very flexible. It is not inconceivable that software development tools may best reside on the digital unit itself, along with mass storage. Once things are defined and the network grows, the sophistication of the "linker" may be reduced by the removal of such features.

Alternatively, the linker may be tightly coupled to an accessable development system with upload/download capabilities. It is not practical to assume that the linker itself will be easily accessable if it provides wide-range coverage.

Any language selected should be capable of support and efficient compilation. The linker may have to perform routing decisions during peak traffic conditions, so slow, inefficient algorithms or compilers may not work.

Implementation

It is suggested that this proposal be reviewed by those with an interest, and investigations into modulation techniques and hardware begun. After about two or three months, TAPR should make some definite decisions and begin the design task.

By modular design, various hardware systems can be designed at various TAPR and TAPR-affiliated sites. Similarly, the software effort must be coordinated and tasks passed around to those with the ability to help. It is expected that TAPR will coordinate the efforts of the volunteer sites.

We have witnessed the birth of a new era in amateur radio communications. It is up to us to assure its continued health and growth. "PACLINK" is needed, and TAPR possesses the necessary skills and motivation to implement it. An opportunity to have a lasting impact on amateur radio beckons, and we must once again rise to the challenge.

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