December
1982

Packet Status Register

Number 3

Tucson Amateur Packet Radio Corporation

The first annual meeting of TAPR will be Saturday, February fifth. The Computer Center of the University of Arizona in sunny Tucson is to be the place, and 10 AM will be the nominal start time for the general meeting. There will be several reports given, and tutorials will be presented.

The schedule, subject to change, is something like this:

10 AM - welcome, reports of officers
10:30 - Board of Directors report
10:45 - updates on packet radio activiites
11:30 - tutorial on terminal node controllers
12:30 - lunch (on the house)
2 PM - announcement of election results
2:10 - tutorial on PACSAT
3:30 - general discussion & working groups meetings
5:30 - Mexican food outing

There will be a start meeting of the board of directors at 9 AM Saturday morning, and another following the dinner that evening. For people arriving early and/or staying late, this weekend will likely be full of working group meetings and work parties, so feel free to get involved in the activities of your choice.

> The first annual meeting of the Tucson Amateur Packet Radio Corporation will take place on February 5, 1983 in Tucson. We would like to see as many out-of-town members here as possible. Local members will be able to provide lodging for some visitors. If you intend to come to the meeting, please let us know as soon as possible if you want us to try to find you a place to stay. We would like at least a month's notice. Any one needing lodging or willing to provide same should contact Heather Johnson, N7DZU. Hotels and motels will also need some advance notice.

The first attempt at an HF SSB net to assist in the initial activities of the TNC beta testing will begin in January. It may be necessary to change the time, frequency or even band of operation. For a start, we'll try:

21.280 MHz, Sundays at 1900Z.

This is two o'clock EST and 11 AM on the west coast. Several factors suggest this channel, not the least of which is the AMSAT international net occuring on frequency just before the TAPR net. A large number of our members also belong to AMSAT, and the AMSAT net control stations do a good job of keeping the frequency clear.

There are two conferences of specific interest to packet radio experimenters this spring, both located on the West Coast.

On Saturday, March 19th, there will be a meting of the Second ARRL Packet Networking Conference, hosted by the League, the Pacific Packet Radio Society and the San Francisco Radio Club. This meeting will occur during the 1983 West Coast Computer Faire, as a special interest group. There should be packet radio get-togethers throughout the weekend. More details to come.

Additionally, the Institute of Electrical and Electronic Engineers (IEEE) is having its Second Annual Infocom '83 during the week of April 18th in San Diego. There will be a regular session of the conference devoted to a panel on Amateur Packet Radio. This session will happen on Thursday, April 21st from 8:30 AM to 10 AM, and tentatively features speakers from TAPR, PPRS, SLAPR and the Los Angeles packet group. Hams interested in attending this session only, or in getting together during the "bird-of-a-feather" sessions during the evenings should contact Den KD2S at the TAPR address.

Mel Whitten, K8PFX is working on getting us a custom enclosure for the terminal node controller. He is looking at a pre-punched and painted metal box for the beta board, which tentatively would be around three inches tall and ten inches square. We would like to know for many beta test participants are interested in aquiring a box, so we can get a cost-breakdown and delivery time. Please tell your area beta test coordinator of your interest, or contact directly:

Pete Eaton WB9FLW
35 Norspur, Route 4
Edwardsville, IL 62025
(618) 288-5432

We're keeping a list of hams who will be interested either in acquiring one of the (possible) spare beta test TNC boards, or in getting some of the first set of actual, non-test TNC's as they become available. We currently have sixty-one requests, and will advise all who ask of costs and deliveries, as more boards become available from the sources set up during beta testing. Just send a note to TAPR, or advise the nearest beta test coordinator.

For sites who are going to be accepting software modifications to the beta test TNC's by modifying EPROM's on-site, we will offer a PROM burner adapter for the TNC. To complement this unit, we suggest an EPROM eraser made from a General Electric G4T4 germicidal lamp as an inexpensive approach. See the article, "Faster Erase Times" by Mike L. Simon in the March 1978 issue of Microcomputing for details.

Tech Notes

By Lyle Johnson, WA7GXD

Beta is here! The culmination of many hundreds of hours of patient (and not-so-patient) labor, cajoling, sweat, and nail-chewing is about to descend on about 168 poor souls who think there is a future in Packet Radio!

I received a phone call a few weeks ago from San Diego member Leon Helms, WA5BNH, who said he was too excited about Packet to wait for the Beta boards, so he and some friends put their own system on the air. Noting the TECH/notes column in PSR #2 regarding the MODEM filtering problems, he offered to share with us the solution he came up with. Schematics are presented in Figures 1 and 2.

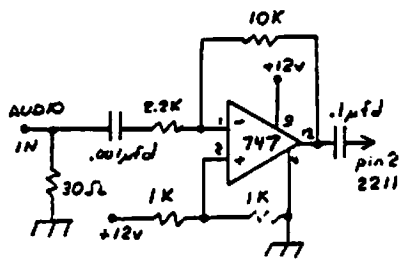

Figure 1

Figure 1 is the "linear" circuit being used as an input shaper for the Exar 2211 PLL demodulator. It has been used with the Drake UV-3, Icom 211 and Heath 2036 2-meter rigs. A "digital" implementation is obtained by inserting the IC in Figure 2 between the first circuit and the output capacitor. Change the feedback resistor in the first circuit to 2# K. This circuit has been used with the Yaesu FT-221 and Heath 2036 equipment.

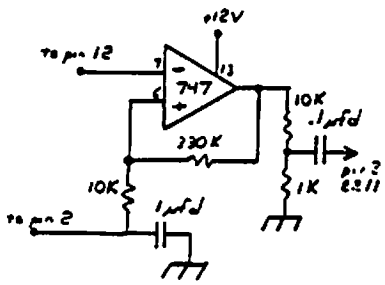

Figure 2

Leon reports highly successful communications both in simplex modes and through several 2-meter repeaters. In addition, tape recorded signals, both local and "off-the-air" have been used for testing.

Hopefully, some Beta testers will hook up one or both of these circuits in the wire-wrap area and report comparative findings against the MF-10 filter resident on the board. (Note that an MC1558 8-pin chip is equivalent to the 14-pin 747.)

New Products

Rockwell has announced a CMOS 6521 and 6551 (the latter are used on the TAPR TNC). Samples are being negotiated at this time.

INTEL has announced RUPI, which is an 8051-like single chip uP -- 4k ROM, 192 bytes RAM, advanced control-oriented CPU, parallel I/O -- and an 8273-like HDLC controller with PLL decoded for NRZI data. Almost a TNC on a chip! Needless to say, we now have Xeroxed copies of some INTEL preliminary (internal) data on this one!

Xicor has sampled a pair of X2616A 2k-by-8 5-volt only EEPROMs. Very slick for software updates.

The 6809 to Z8530 interfacing experiment is scheduled for the next couple months (this is an at-work project, meaning it will get done!) and a report will be forthcoming.

The AMD 7910 MODEM-on-a-chip, mentioned in the last PSR is about ready for interfacing -- this will be an interesting Beta experiment.

INTEL has announced a price reduction on the 2920 Analog processor from $120+ to $51. This chip is a great candidate for sophisticated filters, single-chip MODEMs, and so forth. We have access to a 2920 development system and hope to report on this device. This is also a candidate for the ground station design for PACSAT.

Correction: last issue we incorrectly stated that Motorola had announced a CMOS 6809 -- it is only a rumor at this point. What they did announce is a CMOS 6805 uP with EPROM on chip.

73 until next time.

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:

Den Connors, KD2S	President
Lyle Johnson, WA7GXD	Executive Vice-President
Margaret Morrison, KV7D	Vice-President
Mark Baker	Secretary

The members of the Board of Directors are:

Mark Baker
Marc Chamberlin, WA7PXW
Den Connors, KD2S
Chuck Green, N0ADI
Lyle Johnson, WA7GXD

The Packet Status Register is the official publication of the Tucson Amateur Packet Radio Corporation.

Black Thursday

by Lyle Johnson, WA7GXD

Everything was running on schedule. The Beta parts had all arrived within two or three days of deadline, the assembly facilities were busily stuffing the PC boards. All looked well.

Then a disturbing quality was noted on the PC boards. They weren't taking solder very well. A lot of rework was necessary, and when the rework was being done, the solderability problem got worse. By now it was 7 December, Pearl Harbor Day. It was agreed that the PC house would get us the first boards ASAP (they were all due on the 7th) so we could get rolling with testing.

More delays. More problems. More calls. The solderability of the boards was becoming a major production setback. The chief engineer at the PC fabrication facility was dispatched to one of the two assembly points (both were experiencing the same problems) to attempt to find the cause of, and hopefully a solution to, this problem.

Late Wednesday afternoon a batch of 19 Beta boards were delivered to the anxious checkout crew. Immediately Lyle, WA7GXD, and Pete, WB9FLW, (later joined by Den, KD2S and Dan KV7B) set to work on the boards. Test Number One was to apply power to the boards with no socketed ICs in place to ensure that the voltage regulators were working -- we didn't want to fry $150 worth of chips! All 19 boards passed with no problems.

The boards were then loaded with ICs along with some calibration/checkout software which was provided by Margaret, KV7D. The first board passed all tests with flying colors. The night passed. By 2:00 AM Thursday, December 9th, we knew we had a severe problem -- only three Beta boards out of fifteen tested were working!

Earlier, in November, Lyle had assembled a sample board provided by SLAPR, and it had worked perfectly. A second test board was hand assembled in November when the first production lot of Beta boards were shipped by the PC production facility. They had tested and calibrated with no problems.

After a brief, fitful rest, a meeting was held via telephone with Den KD2S, Lyle, WA7GXD, and Mark Baker, TAPR secretary and member of the Board of Directors. It was decided to temporarily halt Beta production and meet with the PC house.

This action was taken, and three TAPR executive officers hurried to the PC facility. After much discussion, a PC board was cross-sectioned and examined under a high-power magnifier.

The sight was sickening. A hairline crack encircled each plated-through hole near the pad on the solder-side of the Beta board. Further checks revealed the problem was a plague -- every board checked had the same problem.

This explained the solderability problem: abnormal heat transfer due to a break in thermal conductivity. It also explained the disastrous fallout rate of boards during testing. A few working boards were flexed, and experiments indicated that non-working boards could be made intermittently operational, while working boards could be made non-functional.

The problem was traced to a subcontractor to the PC house who had drilled the boards, and, for reasons of expediency, had also plated through the holes. The local PC house's work was not at fault.

A quick back-of-the-envelope calculation indicated that about $3600 worth of PC boards, $1400 worth of labor costs and $3600 worth of components would have to be scrapped -- a total of $8600!

TAPR does not have $8600. The Beta project is a non-profit activity, with perhaps a very few hundred dollars remaining for further R&D. The PC house agreed to immediately produce another set of boards -- at no additional charge -- and TAPR decided to attempt to mount a salvage operation to determine which components could be removed from the 119 boards that had already been soldered. The removed components would be subjected to a statistical sampling and analysis to weed out any potential reliability problems that might result from their use.

As a result, Friday night and all day Saturday various crews were assembled to unstuff, remove, categorize, test and otherwise process the Beta boards. The participants in this heart-breaking task consisted of: Lyle, WA7GXD, Pete, WB9FLW (who had flown in from St. Louis just to help in the big push to deliver Beta), Den, KD2S, Chuck, N6ADI, John, WB7CKY and Dan, KV7B.

The bottom line is that TAPR now has a shortfall of about $3000 to get the Beta project out. New boards will be ready during the week of 20 December. It is hoped that populated boards will be delivered to TAPR around 10 January, and we hope to ship by the 20th.

We appreciate your patience. We want these boards to be completely reliable. Meanwhile, the software group has more time to debug and enhance the initial Beta programming. A local area network will be established with a few boards that will be nursed along to help in the software effort.

While we are all disturbed by this delay, we are determined to complete development of the Beta boards and get them into the hands of the Packet Radio community as soon as possible. Maximum use of the delay will be made for software enhancement and testing, as well as initial hardware "beta testing". We think you will be very pleased with what you receive in January.

A Mid-Summer Night's Protocol

by Harold Price, NK6K

History now records the fact that during the second week of the month of October, 1982, a "national standard" for packet radio was agreed upon. What has not been recorded, until now, is that this protocol (with the exception of some bits in the address fields) had already been implemented by amateurs. It was, in fact, in actual use on the WB6YMH repeater in southern California that very weekend.

AX.25, the standard agreed to the fateful week in October, is based on LAPB, an industry standard implementation of AX.25 which defines level two of the seven layered ISO model. It was an asynchronous version of LAPB which was first implemented by Dave Henderson, KD4NL, and myself in Southern California begining in May 1982.

Let me set the record straight; I never wanted to implement LAPB. All I wanted was a simple file transfer mechanism, similar to Ward Christianson's MODEM software. I thought LAPB would be a lot of work, given that I would be writing it in Z-80 assembler, and that it had far more features than we needed. My crazy friend Dave (he prefers "ambitious") convinced me that it was easy, and that he had already implemented most of it. Easy is relative however, as he had done it in Pascal on an interrupt driven 6809 based system.

To compress a month into a sentence, we eventually got LAPB up and running, he in Pascal on a Southwestern Technical Products 6809 system, and I on a S-100 bus Z-80 system. This version used regular 8-bit async characters over surplus Bell 202 modems attached to a pair of Yaseu 200R two meter rigs. The format of the frame was identical to a standard HDLC frame except that the FCS field was a simple checksum, and special characters preceded the FCS and header fields. We used a one byte address field. Both sets of software could deal with seven frames in flight with full error recovery.

For those interested, the frames looked like this:

|FF's|DLE|STX|ADR|CTL|data|DLE|ETX|CHK2|CHK1|FF's|

The hex FFs were used to mark time until the RF finally got from the other guys receiver to his modem. DLE STX are ASCII control characters marking the start of the header, ADR and CTL and standard HDLC address and control fields. Data was up to 128 bytes of whatever. If the DLE character appeared as data, it was doubled. DLE ETX marked the start of the checksum. At least two FFs separated contiguous frames, and more were needed to make sure the transmitter stayed up long enough for the last bytes to make it all the way to the other side for the last packet.

Since the data was standard 8-bit ASCII with a start bit and a stop bit, anyone could have read the data as it flowed back and forth between our machines late at night. Several did, and this is an excerpt of what they saw:

The Cremation of Sam McGee

There are strange things done in the midnight sun
  by the men who moil for gold;
The Arctic trails have their secret tales
  That would make your blood run cold;
The Northern Lights have seen queer sights,
  But the queerest they ever did see
Was the night on the marge of Lake Lebarge
  I cremated Sam McGee.

- Robert Service

Around this same time, Dave picked up some $5.00 HDLC comm chips at a swap meet, the same chips that the Vancouver TNC uses. We went through a flurry of activity to design an interface to use the chips, each for his own computer. I went so far as to wire wrap a complete S-100 IO board to support the chip, but got sidetracked in the async project and set it aside. After the async project was finished, an event occurred that sent Dave and I scurrying for the HDLC chips, but here the plot thickens; allow me to introduce two new characters.

Wally Lindstruth, WA6JPR had started a packet radio group several months prior to most of the events in this story. He was Vancouver based, the only game in town at the time, and kept stirring the pot, trying to get some Vancouver activity worked up. Most of the folks he got active had their eyes hooked on a new board which was going to be available in late summer. The end result was that new interest was on hold, at least as far as activity on the air was concerned, except for the people who already had Vancouver boards (Wally), and the crazy (Dave and I).

In desperation, Wally sent a board (for free!) to another local packet activist, Skip Hansen, WB6YMH. With most hams, anything received free must be used, even if much time and money must be spent utilizing the free item. In a short time, Skip and Wally were on the air, talking back and forth using HDLC. Which Dave and I couldn't read. Not at all. Not even a little. Mixed in with the data was an occasional voice chuckle, cryptic yeses and noes, and yeps. Laugh at us would they? Out came the HDLC prototype boards. A little incentive was all we needed.

Soon we were running HDLC as well as async, in both the LAPB and Vancouver modes. Skip interfaced his remote CP/M bulletin board system to the Vancouver TNC. Basic programs were built and run via this path.

A great deal was learned during the several months of activity. We played with several error retry schemes, various packet size, number of frames in flight, large file transfer and RTTY-like typing back and forth. We played with different crashed-packet retry timeout values, transmitter and receiver lock up times, and repeater key up times. In short, we were practicing for the task of writing the TAPR AX.25 TNC software, although we didn't know it at the time.

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Beta Test Manual

by Chuck Green, N0ADI

A major objective of Beta test preparation is to provide participants with adequate documentation concerning the TNC and its software. A great deal of effort has gone into meeting this goal. Yes, there is still a lot of work to do, but I'm sure that when you see it, you will be pleased.

At this writing, the manual has twelve chapters and three appendixes. Some of these are short, while others are quite extensive.

To start things off, there are chapters describing the purpose of Beta test and a general description of the TNC and its purpose. This is followed by chapters on how to attach your radio and how to attach your terminal or computer. Although these are really very easy tasks, we wanted to be sure you are aware of all the options.

The last chapter of general interest contains a description of operation methods and procedures. This will probably be one of the most widely used chapters.

For those who want to get further into the details, there are additional chapters on protocols (both terminal interface and local area network), TNC hardware description (a detailed description of all major components on the board), and TNC software description (describing the internal workings of the software).

Also planned is a chapter which should be helpful if you are really adventurous and wish to modify the TNC software.

The final chapter is for those of you who have computers you plan to attach to your TNC. Your computer will need some software to communicate with the TNC. This software can be a general purpose terminal emulator or a customized whiz-bang which is only limited by your imagination and programming ability. These programs will have to be tailored for the most part to the particular model of computer you are using. If you do write such a program, please send it to us so that it can be shared with others having a computer like yours.

Appendixes contain useful tid-bits like schematics, block diagrams, component layouts, etc.

(continued from page 4)

Now that the stage has been set, let me describe recent activities. Try as I might, however, I can't remember exactly how it started. Maybe a historian better than I will someday correct these words, but this is my current recollection.

I called Den Connors one day late in September and asked what was happening on the TAPR TNC project. He said that their current plans were to do a Pascal implementation of a protocol in parallel with the Forth project to increase chances of having software ready when the hardware was. He also said that he was going to an AMSAT meeting where he hoped packet standards would be discussed. I reminded him that LA had some experience with LAPB, Pascal, and 6809s, wished him well, and forgot about it.

The next time we spoke he had a standard in hand, and he forwarded a copy to me. I took a look, said "Gee, this looks familiar", passed a copy to Dave who said, "Gee, we could write this code in 4 notes". I called Den, who passed me to the head of the TAPR Pascal effort, Margaret Morrison, KV7D. In short order we agreed that it was possible to come out with a full blown implementation of AX.25 by the time the TAPR TNC was ready in early December. With a preliminary division of labor defined, Den called and asked if we really and truly wanted to get involved in this. It was a very nice speech, full of warnings of tightness of schedule, no hardware available for testing until late in the game, it's a hard life we lead, etc., etc. Of course he hung up before I had a chance to answer (no fool, he) and the project was begun.

A future chronicle will describe who did what when as far as the current software project. I'd better wait until we see how it comes out. Even as I write this, Margaret is in Tuscon testing her IO drivers on one of the first-to-be-assembled beta boards, Dave is testing the latest integration of his protocol code and my command driver. So far, Dave and I have cranked out 2800 lines of Pascal code, most of which has already been checked out using a large mainframe Pascal environment with code to simulate the IO handlers.

I have more code to write now, so I'll leave you with the list of features which Margaret, Dave, and I are trying to implement this time around. ≈

Design Goals for Version Beta 1.0 of AMSAT/TAPR AX.25 for the TAPR TNC...

The primary goal is to provide the software necessary to support two TAPR TNC boards talking to each other using the AMSAT AX.25 protocol by early December. It is hoped that several other features will be available at that time. Short descriptions are given below. The following are expected to be available for first release.

- o Full support of AX.25 protocol (level 2).
- o Support of Vancouver protocol. The Vancouver board command structure and "host mode" capabilities will not be implemented. The intent is to allow TAPR TNCs to be used in a Vancouver environment, not that they be "plug-compatible" with the Vancouver TNC.
- o All operating parameters such as packet length, transmitter keyup delay, flow control, baud rates, etc. are adjustable by user command. Most will be stored in non-volatile memory, allowing board customization which is saved across power-off without requiring the user to reburn PROM.
- o Three basic modes of operation are supported...

  1) Command Mode. RF data exchange is suspended while basic operating parameters are changed. The board continues to digipeat if digipeat is enabled and is requested by another TNC.

  2) Conversation mode. The user interacts with the TNC to prepare a packet for transmission. Local echo, line editing, and line deletion capabilities are provided. The user forces packet transmission by entering a special character, previously selected by him. When in the conversation mode, the user may be connected, i.e. an AX.25 link exists between

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PACSAT Project

by Den Connors, KD2S PACSAT Project Manager

As experiments continue on ground-based packet radio local area networks, a new class of satellite is being considered to handle linking of both individual ground stations and local area networks. The PACket radio SATellite (PACSAT) system is designed to provide a store-and-forward digital repeater which is available to all groups around the world for fully global network coverage. The satellite provides this coverage by occupying a low-earth orbit (LEO), which has several benefits. The close proximity of passage, relative to geo-synchronous satellite, allows easy access, with good "link margins". There are thousands of amateur radio earth stations that are already configured to operate on this class of satellite. Additionally, proper choice of orbital parameters allows a sun-synchronous orbit, where passage of the satellite occurs at the same times each day, providing an easy means of scheduling transmissions. This orbit then provides both 100% global coverage and very fair access, and creates a powerful new use of a well-known class of amateur satellite.

There are several reasons for providing such a system in the Amateur Satellite Service. PACSAT will be a widely available vehicle for advanced amateur radio experimentation, as well as a prototype system for a new class of satellite service -- reliable transmission of data to remote sites and isolated users, regardless of location. It will also provide a new form of emergency communication -- a reliable, highly available link compatible with global mobile and portable radio service requirements. The PACSAT project will provide AMSAT with a new supply of engineering talent and expertise, fresh sources of funding and new ranks of members.

In addition to the primary use as a world-wide store-and-forward link, or "flying mailbox", the PACSAT experiment will serve a number of other functions. These include real-time regional linking in standard LEO amateur mode and versatile access using more traditional Amateur Radio digital modes. PACSAT will provide extended availability to users via ground stations with linking to local area networks and an opportunity for advanced testing of network systems concepts, hardware software and protocols.

Although time constraints could prevent multiple modes being implemented in the first of the PACSAT systems, it is envisioned that such techniques as Morse code (CW) , radio teletype (RTTY), and ASCII using audio frequency-shift keying modulation would all be possible. The satellite processor could accept such input, store the data in memory and later forward the messages in whatever mode the intended receiver would desire.

PACSAT System Description

The satellite will be an experimental package on one of several possible spacecraft. It would be in a full-earth coverage orbit with 2 to 4 passes per day appearing at the same time each day.

There will be two communications channels, each with multiple input signal capability and individually reconfigurable packet and non-packet modes. The multiple uplink frequencies will use frequency-selectable tracking phase-locked loops. The channels will be full duplex, with a data rate of 1200 bits/second.

The communications channels will use the standard mode B OSCAR configuration (435 MHz uplink, 145 MHz downlink). The satellite will be capable of frequency control of ground stations. and could also direct antenna pointing and predict orbit and pointing coordinates. Except for the modem and controller, hardware for ground stations is already available. The satellite may optionally use an LAN link for large group coverage.

The processor may use the AMSAT-standard 1802 configuration, or possibly another high-reliability CMOS microprocessor. There will be a well-defined interface with the spacecraft Internal House- keeping Unit. The main memory may be loaded from ground stations. There are up to 8 megabits of memory possible, using bubble memory or static CMOS. CMOS would be available in 16K or 64K packages. Bubble memory would require a custom MSI-level CMOS controller. Serial input and output to memory modules for data and addressing might be used. Modules not being addressed could be turned off.

Two modes will be available at any time--synchronous or asynchronous packet, ASCII, RTTY or CW. Packet transmissions could use either phase-shift keying (PSK) or minimum-shift keying (MSK) modulation, or both.

Packet protocol will include a multiple-access common uplink frequency to be used as a "calling channel" and multiple uplink frequencies to be used for working channels.

Transmission collisions will be detected through negative acknowledgement of missed or garbled messages. Frame protocol will use a high-level data-link control (HDLC), a synchronous bit-oriented protocol. Optional frame control sequences are specified in the AMSAT/AMICON Amateur International Computer Network system specifications (e.g., AX.25 level 2, TAPR/AMSAT). There will be opportunity for various experiments with higher-level protocols. A mailbox protocol with memory management and friendly, efficient user interface will be provided.

The primary use of PACSAT will be for store-on-uplink, forward-on-downlink full earth coverage communication. Secondary uses will be for direct (real time) signal regeneration, including bulletin broadcasts, group transmissions, telemetry, and user reconfiguration of the secondary mode.

Volunteer Efforts for PACSAT

The PACSAT idea has been mulling around in the heads of several people. This design phase is due to end by mid February. Most of the ground station hardware design to date has been done by Tucson Amateur Packet Radio (TAPR) and the Amateur Radio Research and Development Corporation (AMRAD), with further assistance from a strong AMSAT group in New Jersey.

Ground-side linking systems are being developed by the above groups, as well as by AMSAT

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Hardware Happenings

by Lyle Johnson, WA7GXD

The Hardware Committee has been hard at work on the Beta TNC project, and when I first wrote this, all appeared to be on schedule. Through the good auspices of SLAPR, our sister organization in St. Louis, the Beta layout was finished, and preliminary test boards had been cranked out by Pete, WB9PLW and Tom, WB8WRK. I assembled a board upon receipt and began testing it. Oddly enough, there was not much debugging time involved because the board worked!

Were there any problems with the Beta board? Frankly, that is what Beta test is all about. The only error a sharp-eyed Beta board checker will find is that the holes for the TO-3 case of the 5-volt regulator are off center with respect to the leads by about one-tenth of an inch. If you look really close, you may also note that C1 is actually 22 pf (instead of 20 pf) and the 0.05 ufd capacitors are really 0.047 ufd.

Component suppliers and manufacturers have been extremely generous to us in pricing, and all of the parts are in now. Two facilities are doing the board-stuffing and wave-soldering. Following the re-delivery of our boards, it will become the task of the hardware committee to check them, load the I.C. sockets, run a test program and then test them using the "real software". The final step will of course be packing the boards for shipment to the Beta sites.

There are 172 Beta test boards being fabricated, with 156 Beta testers and twelve boards to allow the Alpha testers to upgrade. This leaves four spares for possible future distribution. Please note that once the boards are shipped, the hardware chairman is taking a break! Don't expect those spares to be working for a while.

Pete Eaton will be returning for a week to assist in this job, and other volunteers in the Tucson area will be called upon to assist in this final push. A list of all of the people and organizations will have made the Beta test possible will be listed in BIG PRINT in the next PSR.

An EPROM programming adapter for the TNC will be made available for the Beta test sites needing one. Probable delivery is sometime in February.

On other fronts, the microwave committee, headed by Mike Parker KT7D, now has the Teflon boards fabricated for the L-band solid-state non-linear amplifier for AMSAT's phase III satellite uplink. The Motorola transistors are in hand. Thanks to Tom Clark, W3IWI, for the donation of P.C. board stock, Southwest Circuits for a donated etching job and Motorola for the negatives. Centralab donated some chip capacitors, but they won't take the operating current, so ATC capacitors are being procured.

At the AMSAT Phase III technical session at Johns Hopkins Applied Physics Laboratory in October, John DuBois, W1HDX, presented a design for an L-band 10 watt linear amplifier using NEC 900 MHz transistors. TAPR received a copy of the plans for this amplifier, and two sets of transistors are now ordered. It appears that Tucson will be irradiated with a large amount of L-band energy in the near future.

Preliminary Information

The TAPR TNC is a self-contained, microprocessor-based device intended to act as an intelligent interface between a user's ASCII communications system (terminal or personal computer) and a local area network (LAN) by way of a radio-based link. A summary of the TNC's vital statistics follows:

CPU - 6809

User I/O - (1) RS-232C serial port (50 baud to 19,200 baud), and (1) TTL-compatible handshaking parallel port

LAN I/O - Western Digital 1933B-XX HDLC controller, bit stream encoded as non-return-to-zero-inverted (NRZI) with phase-locked loop (PLL), and on-board 1200 baud modem using Bell-202 tone pair

ROM - 24K bytes of 2764 EPROM in 28-pin JEDEC byte-wide sockets

RAM - 6K bytes static RAM in 24-pin JEDEC byte-wide sockets (3 generic 2016 or 4016 2K-by-8 SRAMs provided)

Size - approximately 8" by 8" P. C. board

Power Supply - +/- 12 volt and +/- 5 volt regulated, on-board, with +/- 12 and + 5 rails in the wire-wrap area (power transformer off-board)

Other Features -
- 256-bit EEPROM for custom user interfacing
- on-board calibration of modem frequencies
- self-test at power-up (including RAM)
- hardware watchdog timer on transmitter PTT line
- custom wire-wrap area provided
- LED's provide status of modem calibration, receiver level set, transmitted data and CW ID
- bipolar PROM address-decoder for mixing of memory chips
- RAM/ROM ratio variable with byte-wide socket design (the six memory sockets are reconfigurable)

St. Louis and the Beta Test

by Pete Eaton, WB9PLW

This is not a technical article. Rather, it is a blow-by-blow account of how one unsuspecting soul (me) got so wrapped up in the TAPR Beta test project. Besides, Den threatened me with lots of his Mexican cooking if I didn't write down all the crazyness that has gone on between Tucson and St. Louis in the last few months.

To start, here is a brief history of the rise of St. Louis to Packetdom. As with many other folks, the October 1981 issue of QST was my introduction to packet radio. As I attempted in vain to get more information on the subject and get the system off of paper and into a real network, it became obvious to me that there was a lot of talk but little action.

Then on a fateful day last March I contacted Den in Tucson to ask about their activities. Den was excited about our interest in the St. Louis area, and I still have a letter dated March 2nd stating that we are really a bunch of good guys.

The TAPR Alpha-test TNC boards didn't even exist yet, but since I had endured so many trials and tribulations with the Vancouver boards I was very keen to see the TAPR boards succeed (as were many others). Through the months that followed we stayed in close contact, but the date for the Beta test release kept slipping as the reality of such a large project kept getting in the way. As the months passed, requests for help were responded to in the true spirit Ham Radio. It seemed that the Beta test circuit board layout was quite an undertaking. Being basically naive, I said that St. Louis would be interested in taking on the task of having the artwork drawn up and negatives shot. To say I underestimated the time, effort and money involved to get such a "simple" job completed is an understatement.

Den, Lyle and I agreed to meet at the annual AMSAT meeting in October to thrash out the details. During our stay in D.C. we went over the details of the board, and the possibility of us locating the elusive custom power transformer for the project, and again like a babe in the woods I said I would try.

Den approached me late on our last night in Washington outside his room in a poorly-lit parking lot, and questioned my sanity for undertaking this project. I in return brought to his attention their foolishness in trusting me, and as we shook hands I committed our group and burned all the bridges behind us.

As we parted company the next morning at the airport to head for home, I seem to remember Den comforting Lyle as I carried on board the St. Louis-bound airplane all the TAPR artwork, schematics and even an Alpha-test TNC board. I'm sure they were wondering if they had done the right thing.

When I returned home, the first inclination I had was to try to rework the Alpha layout, making the modifications necessary to transform it into a Beta-test board. I quickly found out this was no simple task. The time involved in such an effort was substantial, and we simply did not have enough real-estate on the Alpha board to "stuff-it" all on. My next surprise came in the attempt to locate someone to lay out the artwork in St. Louis. Plenty of printed-circuit fabrication houses existed in the metropolitan area, but their interested always seemed to wane when we informed them that all we wanted was to have the layout done. It seemed that their profit margin was better when they could also produce the boards and stuff the parts, something that I wasn't willing to undertake and Tucson wasn't interested in.

Things were looking bleak at this time until Bob Neil K9EID informed me of a chap that did some commercial layout work for him several years ago. I contacted this fellow, and he indicated that he no longer did such work but knew a young fellow who did. With that I was introduced to Jeff Eirvin of Interconnections Inc. We got together that evening and he not only agreed to take the job, but was willing to get it done by the 1st of November, something the big P.C. boys said they couldn't do.

Jeff started from scratch and laid out the whole board, and since he had 14 years of professional experience, I was able to learn a lot about how a professional lays out a board. Jeff was even gracious enough to attend our November St. Louis packet radio meeting and give a talk on the subject, which everyone enjoyed immensely. The "bottom line" on the layout was that Jeff delivered the Mylar layout a week ahead of schedule and under budget, after over forty hours of work. Negatives were shot after Lyle spent a weekend double-checking the artwork against the schematic.

While the circuit layout was being done in St. Louis, an Illinois firm had been contacted about producing the transformer needed for the project. Again, the ham fraternity pulled through when I reached Dennis Alscheid WD9FTA of Siemens Manufacturing. It seems Dennis had heard one of my talks on packet radio, and even after that ordeal had an interest. Not only did they design our custom transformer as required, but they also produced a prototype at no charge. Lyle had the prototype in his hands before the end of October.

This brings up another interesting and little-known point, that of communications between Tucson and St. Louis. Discussions were nearly continuous, as several individual phone bills will attest. Federal Express also got plenty of business as preliminary circuit layouts, negatives and boards were delivered for Lyle's inspection. Time was a critical factor if we were to pull this off by the end of the year. Anyone who has attempted anything like this before can appreciate the infinite number of questions that seem to come up.

After all this there was still an uneasy feeling: what had we forgotten? Certainly there was something we had missed, but what? The only way to find out was to make a Beta-test board and give it the smoke test. But where could we get some prototype boards without paying a fortune? In popped Tom Brickey WB0WRK with the same question, and a solution! With the help of some friends at C & C Industries in Fenton, Missouri, three prototype circuit boards were fabricated and in Tucson's hands on November 9th. Late on the evening of November 11th I received a call from Lyle to report that the prototype Beta-test board was up and running with no glitches. I slept very soundly that night.

In a nutshell, that's a behind-the-scenes look at what happened. It certainly has given a real boost to the St. Louis group to be actively involved in the project, and it didn't allow anyone the time to ask "hey, when are the boards going to get here?". The people purchasing a Beta-test board are in for an interesting and rewarding winter!

Software Update

By Margaret Morrison KV7D

This article is meant to be read after the one by Harold Price, which was written a few weeks ago; whereas this news is hot off the press. You will probably notice in Harold's article a rather extensive "wish list" of software features. Well, I am happy to report that virtually every feature mentioned in Harold's article will come to pass. In particular, command mode and conversation mode have been implemented, and we intend to have full support of transparent mode as well. The boards digipeat and should enable the extensive linking experiments everyone is looking forward to. The goal of implementing AX.25 protocol (level 2) has been achieved. The first release does not support higher level protocols, but we will probably be implementing them after some feedback on the present protocol. In fact, with a couple exceptions, every design goal has been achieved, and at this writing, actually tested on the air (this is not a paper TNC...).

Two extremely useful debugging tools have been developed to enable code development and observation of HDLC frames. The first of these, called DEBUG mode, is entered by typing <ctl-E>. At this point the user may examine any location in the entire address space, including all I/O and prom addresses, and may modify all writable addresses. In addition, code may be written in RAM which may then be executed as a subroutine from this mode. Needless to say, the primary impetus for this mode was the present development effort! The second debugging tool, courtesy of Harold and Dave, enables the user to observe HDLC operation independent of features requested during command mode. For instance, any frame, regardless of how garbled, may be observed provided the FCS is correct. This has proved useful for verifying the format of AX.25 and Vancouver packets, as well as providing a tool for tuning up the RF link.

All these things did not come to pass without a lot of effort. In fact the number of times Dan and I finished working after 3 AM is something I don't like to think about. Harold and Dave joined me in Tucson December 8 and stayed 5 days. That was probably the most hectic five days I've spent since being a student. Even as this article is being finished the software effort is still running full steam ahead. Still to be put in is the support for some of the features involved in transparent mode, and some of the timers required for CSMA and certain delay events. However, we don't anticipate problems with any of these items.

The software development project is greatly indebted to Professor Ted Williams and the University of Arizona Electrical Engineering Department for making available to us a Hewlett-Packard 64000 development system. This is being used for all low-level software development, as well as integration of the high-level software.

Several members of the TAPR Corporation Board of Directors are to be elected next month. As detailed in the last newsletter, there is to be an election via mail ballot of five members of the Board, each holding a one-year term of office. A ballot for each member is enclosed in the newsletter, and will be found directly below. These ballots must be in the hands of the current TAPR Board of Directors no later than the day of the annual meeting, Saturday February fifth.

The results of the election will be announced at the meeting. Also to occur at the meeting is an election by the current Board of the remaining five Board members; these people will serve a two-year term of office. Note that ballotting will no doubt be light, so every ballot cast will be very important. If you're interested in the direction of TAPR over the next year, you should take stock of the candidates and vote.

BALLOT FOR ELECTION OF MEMEBERS OF THE
TUCSON AMATEUR PACKET RADIO CORPORATION

Please vote for five of the following:

Tom Clark W3IWI, charter #45	-----
John DuBois W1HDX, member #118	-----
Pete Eaton WB5FLW, charter #32	-----
Fried Heyn WA6WZO, charter #22	-----
Margaret Morrison KV7D, charter #21	-----
Harold Price NK6K, member #86	-----

other: _____

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 published in a membership list any of the above items, indicate here which these are:

_____

I hereby apply for membership in T.A.P.R. I enclose $12 dues for one year.

Signature _____

Date: _____

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groups in New England, the Pacific Packet Radio Society (PPRS) and others.

A number of the same groups are also working on modem technology for the bandwidth-efficient packet channels required. There is also a group at the State University of New York at Stony Brook. The possible candidates for best memory technology are being investigated by AMSAT-related organizations in Canada and the U.S.

Problems associated with protocols, spacecraft operating systems, spacecraft-ground communication, and ground operating protocols have been looked at by almost all of the above groups. Other interested groups are in Los Angeles, St. Louis and in Lingkoping, Sweden.

(continued from page 5)
his TNC and some other TNC. Only data from that TNC is displayed. All frames received are ACKed, and all frames sent will be re-sent if not ACKed. The user may also chose to not be connected. In this case, packets sent are not expected to be ACKed. Packets from anyone are displayed, but they are not ACKed.

3) Transparent mode. The TNC becomes invisible, much like a standard modem in a terminal to host computer link. The TNC takes a stream of data from the ASYNC port, breaks it up into packets, and sends it out through the HDLC port. The packetization is invisible to the user, although it is controlled by user accessible parameters. Data received from the HDLC link is handled in the same way. Only data received is sent to the ASYNC port. This mode lends itself well to two way file exchange, or a user terminal <-> host computer link, where echoing occurs at the host end.

- Beacon. The user can request that beacon packets be sent either at regular intervals, or after some amount of time has passed with no activity on the link.

- Flow control. Two methods of flow control will be available, software via XON/XOFF characters or hardware via the CTS line. Flow control is full duplex, i.e. the TNC can stop terminal input and the terminal can stop TNC output.

- Digipeater. Any board will be able to act as a digipeater, concurrent with its ability to be an endpoint.

The following are extensions currently scheduled for future releases.

- Smart monitor mode. Lists of TO: stations whose packets are to be displayed by this TNC. Lists of TO: and FROM: stations whose packets are not to be displayed by this TNC. Concurrent connected mode with monitor mode.

- Support for level three and four protocols.

- Support of round-table nets, QST's, and other modes where there are several intended recipients.

Thanks for assistance with this issue of the newsletter to:

Rosemary Connors
Carol Downey, KA7MFW
Heather Johnson, N7D2U
Lyle Johnson, WA7GXD
Reynold Johnson

This issue was edited by Margaret Morrison, KV7D and Den Connors, KD2S.

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