Packet Status Register

NOVEMBER 1986 # 23

Tucson Amateur Packet Radio Corporation

PRESIDENT'S CORNER
Lyle Johnson, WA7GXD

CompuServe

TAPR is now "officially" on CompuServe.

The TAPR CompuServe ID Number is 76246,565. We will be found on HAMNET in Section 7.

The TAPR office account, usually handled by me, although others will be using it from time to time, is for business (ordering, inquiries, etc.) as well as technical questions of a general nature.

Let me emphasize general.

If you are having a problem hooking a TNC up to a TI-99/A computer and it loses every 27th character, asking for a solution to the TAPR account on Compu-Serve will probably not get you very far.

If, however, you want to know about HF modems, or OSCAR 12 operation, it may be an appropriate place to ask.

When making ANY inquiries, however, please leave your full name and mailing address. We have a tight budget, and it is usually cheaper to reply via US Mail. This is how ALL specific inquiries and orders will be handled.

This past month I have been very busy with the NNC digital and modem boards, the FUJI modem project, HF modem testing and a digital radio project.

NNC Update

I am pleased to report that the NNC hardware is functioning well with 32k-byte RAM chips, allowing it to run a RAMdisk for faster software development. Dave and Chris in Salt Lake have been busy wave-soldering modem boards, so the Alpha sites should have these in hand by the end of the month.

Howie Goldstein has a re-entrant HDLC interrupt handler running on a TNC 2 for use on the NNC.

Richard Green is busy debugging the hardware and software associated with the SCSI port.

Phil Karn reports that his C-code for TCP/IP is too large to compile and run in the NNC environment unless someone knows of a C compiler that can handle the expanded memeory capability of the HD64180 pro-cessor.

Other Alpha developers - let me hear from you!

FUJI MODEM PROGRESS

As reported elsewhere in this issue, TAPR is undertaking a project to make a 1200 baud PSK modem available for use with FUJI/OSCAR 12's Mode JD packet mailbox.

Tom Clark, W3IWI, has been doing some extensive testing and refining of the design, with inputs from other interested parties. Layout work is being handled by Jack Davis, WA4EJR, and Tom King, KA6SOX, building on previous work done by Chuck Green, NOADI.

If all goes according to schedule (it won't), full protoypes should be operational by early December, with deliverable kits in the very-early 1987 time frame.

Now, don't call the office to place your order yet!

Prices have not yet been determined, and no names will be placed on any waiting list until we are certain that we have a reproduceable kit.

Next month we should have more details for you.

HF Modems

See "Beginner's Corner" in this issue. I hope to be able to report on side-by-side HF testing compar-ing PLL and filter modems, as well as PLL vs. single-chip modems next time.

Digital Radios

Steve Goode is working out some preliminary designs on a 56 kbps radio, and there are several efforts on to get a 9600 bps radio going. There is even an effort to make a 1200 bps fast-switching radio.

Until next month, happy packeting! (and try 21.097 on 15 meters for some pleasant HF packet QSOs...)
- PRM -

PSX— TAPR's Packet Software Exchange

IBM-PC and MS-DOS

PAK/UNPAK $5 postpaid

This is a program for sending binary files between computers. Submitted by KA9AKM.

So far, this has been the only response to the call for PSX software. More titles will be added as you submit them to us!

BEGINNER'S CORNER:
MODEM DESIGN
Lyle Johnson, WA7GXD

The great debate rages on. Filters forever! Slicers never lie! PLLs work better! Get "true DCD" only with this design! Software DCD for HF operation!

Just what are the differences between filter-type and phase-locked-loop (PLL) modems? Why use one type over the other? Is one definitely superior?

If these, or similar, questions have aroused your curiosity, this article may help you decide which type of modem works best for your applications. At the least, it may help you sort out the various claims made by different advertisers.

MOs

The modulator (mo?) of most 300 and 1200 bit-per-second (bps) modems used in Amateur packet radio usually consists of a phase-coherent audio signal varying between two frequencies. (Phase coherent simply means that the signal switches cleanly between the two tones without clicks, thumps or other glitches.)

The most common modulator is the XR2206, which has the advantage of low cost, and the disadvantage of requiring calibration.

The next most common involves digital synthesis, often by lookup tables in a ROM. This has the advantage of not requiring tone calibration; however, post-filtering of the signal may be needed. A post filter may be as simple as a series resistor and shunt capacitor (L-network low-pass filter). And the relative complexity of this approach is often buried inside a single chip, or a small part of a single chip.

Either approach works well.

DEMs

The big difference lies in the demodulator (dem?).

The PLL units most often employ the XR2211. Again, this is a very low cost device that requires calibration. It works, however, and works pretty well.

The filter-type units typically employ two groups of op-amp filters with passbands centered around the two tone frequencies of interest. A "slicer" compares the relative amplitudes of the two channels and indicates which is the stronger of the two.

A third approach is sometimes taken using a digital signal processor to analyze the incoming information and make the decisions. Some single-chip modems use this approach.

Which is best? It all depends...

If the data you want to recover is typical RTTY, runnning at 45 bps and using a tone split of 170 Hz (or 850 Hz), a filter type modem is probably going to work the best, and a PLL probably will work the worst.

"Aha! Then the XR2211 is a bad idea for HF and I should trade in my TNC for a filter unit?" No, I didn't say that.

Consider the signal to be processed. At the slow data rate of 45 bps, the incoming signal will "dwell" on a particular tone for several cycles. At the common RTTY tones of 2125 and 2295 Hz, we will dwell on one tone for at least 22 mSec, or more than 5 cycles at the low tone. This gives the filter system plenty of time to settle down, meaning we can use pretty sharp filters. A spectrum analyzer looking at the RTTY signal might show a pattern like this:

```
          ____              ____
         |    |            |    |
     ____|    |____    ____|    |____
    ____/      \____/        _____
```

What we see is a lot of energy concentrated around the two tone frequencies, and virtually no energy in the space between them. The wider the shift (or the slower the data rate), the more apparent this becomes.

Now, as you increase the data rate, the space between the two tones begins to fill up with signal energy (information) and we have to widen our filters or suffer the consequences.

In this case the consequences are labelled "intersymbol distortion." Don't let the phrase bother you. If you have ever tried to listen to an SSB conversation with a sharp CW filter in line, you had a hard time understanding the words. Intersymbol distortion. Or maybe you heard ringing with a too-sharp (or overdriven) filter. This is also a form of intersymbol distortion.

It seems logical that at some point, there must be a data rate where the space between the two tones would fill up fairly uniformly and we would see a pattern something like this:

```
          _____
         /                  \
    ____/                    \____
```
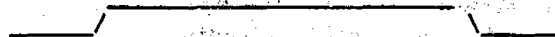
The peak amplitude is less, and the signal is broader. This results because there is less time per bit sent, so the energy per bit goes down. There is no free lunch; we need more margin for this faster data.

But a PLL demodulator can be set up to recover the information in this type of signal very efficiently. And this can be done quite easily.

Remembering the dwell time, at 1200 bps using a 1200 Hz low tone, we have only 1 cycle time in the worst case to base our decision. And the decision must be made much faster than one cycle (0.8 mSec) so we don't have a lot of "jitter" on our decoded signal going to the TNC (which has plenty of other chores to handle without being fed jittery data).

Oh, yes! The magic rate for reasonably flat response and easily decodable signals requires a shift of 2/3 the data rate in bps. Thus, for 300 baud HF operation, we want a shift of 200 Hz (sound familiar?) and 800 Hz for 1200 baud. Wider shifts (1000

HZ at 1200 baud) reduce the intersymbol distortion further, but at the expense of additonal bandwidth.

Of course, a filter-type modem can be set up to handle this 2/3 shift type of signal, too. The question becomes one of whether the PLL is any better, or any worse, than the filter modem. And that one is just plain hard to call. It depends a lot on the circuit used. And how well the operator understands the limits of the modem.

In Tucson, Eric, N7CL, with a little help from his friends, is conducting some very careful tests and measurements using a TNC-2 clone for the PLL and an AEA PM-1 for the filter unit. I hope to be able to bring you some results of that testing next month. It should prove VERY interesting...

DCD

Data Carrier Detect (DCD) is a signal fed to the TNC from the modem that tells the TNC that a signal is being received. This may not seem too important, since the TNC is getting data and the FCS will help a lot in separating data from noise, but it is more important than that.

Most of us have half-duplex radios. We can send data, or we can receive it, but not both at the same time. So, the TNC checks to see if the channel is busy before it transmits.

The simplest way to do this is by way of the DCD line. If the modem suspects that there is a valid signal coming in, it tells the TNC to hold off transmitting.

This is an area where PLL modems hold a definte edge.

Most modems were designed for telephone use. In most countries, when you have placed a phone call, the line is pretty quiet when neither party is talking. In radio terms, we would say there is a good signal-to-noise ratio.

So, most filter modems and single-chip modems use a circuit that simply looks for audio energy within a certain band of audio frequencies. If the energy level is above a certain amount (threshold), the DCD line is set and the TNC doesn't transmit.

Now, listen on a packet channel and open your radio squelch. Pretty loud? An FM receiver generates a lot of noise when no signal is present; this is the OPPOSITE of a telephone.

Thus, most filter and single-chip modems have a fairly useless DCD output when it comes to packet radio use.

Of course, you can use your squelch.

Unfortunately, most radio squelch circuits are very sssllloooooooowwww. They can cut your radio turnaround time down by 50 to 100 mSec (some radios take over 600 mSec to turn around, and the squelch is a big part of the reason). This impacts your data transfer rate on the packet channel, and makes you more likely to collide with another station's transmission.

The situation isn't much different on HF. Unless you set your audio and RF levels very carefully, you will get excessive DCD falsing. And this will cause your TNC to hold off a lot, causing the other station to retry unnecessarily.

A PLL demodulator, on the other hand, is less concerned about signal levels. It is trying to locate a coherent signal in all that audio energy. It is continually trying to lock on. If the DCD filter is set up correctly, there will be an amount of delay in the DCD output to ensure that the PLL has been locked onto a signal long enough for it to considered a true tone instead of simply noise.

WHAT TO DO?

As you can see from the above discussion, the lowly PLL demodulator in your stock TAPR TNC isn't too shabby, especially for radio use. When properly operated, it can give good performance in HF as well as VHF applications.

The key to success is careful setting of the audio input signal to the PLL.

A future article will give details on settings to use. This article should give you some background in understanding why the settings will be what they are.

Stay tuned!

– PRM –

NEW SOFTWARE
FOR THE TNC-2 (AND CLONES)

Howie Goldstein, N2WX, is at it again! He has prepared a new release of software for the TNC 2 to utilize the new 32k byte RAM chips. This results in bigger buffers.

The price of the new CMOS RAMs has dropped from $120 last year to $20 today!

TAPR has the new chips in stock and expects to have the 1.1.4 software release available for shipment by the 20th. As this is written, the software is being tested, so delivery may slip.

Then again, we may be on time!

See the price list in this PSR section for details.

– PRM –

RENEWAL REMINDER

Please check your mailing label on the front cover of this issue of PRM. If you are a TAPR member, there will be a number in the center of the top line. It indicates the month and year of your membership expiration.

If your expiration date is 02-87 or earlier, please take a moment to renew.

Don't put it off, or you may miss an issue or two of PRM and PSR!

– PRM –

TAPR ANNUAL MEETING

Tucson Amateur Packet Radio will be holding its annual meeting during the weekend on February 21 and 22, 1987.

Your Board of Directors plans to meet all day on Friday, the 20th.

Friday night activites will include the traditonal Pizza gathering, followed by racing at the Malibu Grand Prix.

Saturday, the Theatre Royale at the Embassy Suites Airport Inn (formerly Granada Royale) is reserved from 9 AM through 5 PM. The day's activities will include presentations from packeteers from various areas on numerous subjects. As in previous years, a catered lunch will be served.

Saturday night, we will gather at the Triple-C Chuckwagon Ranch for an old-fashioned western meal and entertainment.

Sunday morning the Theatre Royale is again reserved from 9 AM until 1 PM. This is to allow more and better presentations during the meeting.

The early afternoon adjournment should provide ample time for folks to drive home or catch a plane from Tucson International Airport.

More details will be published as the big weekend approaches. If you want to speak, contact the TAPR office and let us know so we can begin planning early.

See you in February!

NOTE: Since the Board will meet on Friday, all voting must be done by mail. No ballots will be accepted at the annual meeting, so those of you accustomed to procrastinating until then will be find yourselves disenfranchised! Please vote in a timely manner, using the ballot that will be found in your January PSR.

– PRM –

CONNECT INTERNATIONAL

The Radio Society of Great Britain (RSGB) has launched a brand new newsletter devoted entirely to Packet Radio. "Connect International" will run about twelve pages monthly. Delivery outside Europe will be by air mail.

Content will cover a wide range; full length technical articles, discussions on packet hardware, software, protocols, networks and standards, digipeaters and packet switches, mailboxes, news and views, bugs and fixes, beginners column, reference documentation, packet operation, special interest groups, international packet register, satellite and emergency data communication, plus a truly international coverage with up to the-minute news of activity and developments from packet groups and individuals throughout the world.

TAPR PRICE LIST

The following price list is current for November, 1986.

Memberships:
  Associate (no PSR/PRM)
    $5.00/year
  Full (PSR/PRM included)
    $15.00/year in the US
    $18.00/year in Canada
    $25.00/year elsewhere

Accessories:
  HF Tuning Indicator Kit
    $25.00 postpaid in the US
    (see October 1985 PSR for circuit)
  FUJI/OSCAR 12 PSK Modem
    To Be Announced
  9600 baud Modem Semi-Kit *
    $25.00 postpaid in the US
    (see K9NG article in 4th ARRL Proceedings)
  FADPAD Xerox 820 Adapter *
    $25.00 postpaid in the US
    (PC board and data only)
  LSC-10 Coffee Mug
    $5.00 (only at Hamfests!)
    (and the Annual Meeting...)

* These products are for experimenters and are neither complete nor supported by TAPR.

Education:
  Introduction to Packet Video
    $10.00 postpaid in the US
    (available in VHS format only)

TNC 2 Software/Hardware:
  TNC 2 Software Upgrades
    1.1.3 uses 16k RAM
    1.1.4 requires 32k RAM chip
    $12 postpaid
  Reprogram your EPROM
    $2 plus postapid return mailer
  32k byte RAM chip, low power, 150 nSec
    $20 postpaid

OEM Packages:
  TNC 1 OEM package
    $500 one-time charge
  TNC 2 OEM package
    $5,000 one-time charge plus royalties

In addition, we stock spare parts for TNC 1 and TNC 2 units. Call or write for your specific requirements.

– PRM –

"Connect International" will be edited by Ian Wade, G3NRW, the well-known compiler of the "Data Comms" feature in Radio Communication and will be produced and circulated by the RSGB.

Be among the first to receive this exciting new publication. Please write to RSGB Headquarters to subscribe to the new publication. Enclose payment with your application. Funds should be in pounds sterling. North American rates: L6.93 for the first nine issues.

RSGB, Lambda House, Cranborne Road
Potters Bar, Hertfordshire, England EN6 3JE

NOMINATIONS ARE NOW OPEN

It is that time of year again. Now that your TV screen is clear of the usual mud-slinging, acrimonious political advertising, it is time to consider something really important. I am referring to your TAPR Board of Directors.

As you probably know (but some of you newer members may not), TAPR is governed by a fifteen-member (15 -count 'em! That's more than General Motors!) Board of Directors. Each Director serves a term of three (3) years, and, due to staggered terms, one-third of the Board, or five (5) Directors, are elected every year.

The current Directors' terms expire as follows:

Mike Brock, WB6HHV Feb 1988
Tom Clark, W3IWI * Feb 1987
Pete Eaton, WB9FLW * Feb 1987
Andy Freeborn, N0CCZ Feb 1988
Steve Goode, K9NG Feb 1989
Eric Gustafson, N7CL Feb 1989
Skip Hansen, WB6YMH Feb 1988
Lyle Johnson, WA7GXD Feb 1989
Scott Loftesness, W3VS Feb 1989
Dan Morrison, KV7B Feb 1988
Margaret Morrison, KV7D * Feb 1987
Harold Price, NK6K * Feb 1987
Bill Reed, WD0ETZ Feb 1988
Gwyn Reedy, W1BEL Feb 1989
Pat Snyder, WA0TTW * Feb 1987

Nominations are now open for the seats expiring February, 1987 (marked with an asterisk - *).

Any member of TAPR may nominate any member for the Board.

To place a name in nomination, just send a letter to the TAPR office with the name of the person you wish to nominate (including yourself, if you like). It would be helpful if you would also provide us with your nominees telephone number and any qualifications you think your nominee has for the office.

We will then get in touch with him (or her) and obtain the person's direct consent to run. At that time we will ask for a statement from the nominee for publication in PSR. (We won't print your picture, so don't let that stop you!)

"What is required of a Director?" you ask.

A Director is expected to attend the Board of Director's meeting and TAPR Annual Meeting in February of every year in which he (or she) holds office. The meetings are held in Tucson, and TAPR does not reimburse expenses for this trip. This means, depending on where you live, a commitment of a few hundred dollars per year.

The Board of Directors reviews the previous year, establishes goals, elects the Officers, and generally guides the organization.

The schedule for this term's election process is as follows:

Event	Time
Request for Nominations	November 1986
Deadline for Nominations	December 15th, 1986
List of candidates and ballot	January 1987

So, submit the name of someone you think will do a good job and get it in to the TAPR office today!

— PRM —

TAPR MEMBERSHIP APPLICATION

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

Name:_____

Callsign:_____ License Class:_____

Address:_____

City & State:_____ ZIP:_____

Home Phone:_____ Work Phone:_____

If you wish to have any of the above information not be published in a membership list, indicate the items you wish supressed: _____

I hereby apply for (select one) full / associate membership in Tucson Amateur Packet Radio Corp. I enclose $15.00 (full) / $5.00 (associate) for one year's membership dues. I understand that $10.00 of my dues (full members) are for subscription to the PACKET RADIO MAGAZINE (PRM). Associate members do not receive any publication. The entire amount of the associate membership dues and $5.00 of the full membership dues go to support TAPR's research and development activities in packet radio. My signature indicates that I desire to become a TAPR member, and subscribe to PRM (full members only).

Signature:_____ Date:_____

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
Pete Eaton, WB9FLW . . . . Executive VP
Heather Johnson, N7DZV . . . . . Secretary
Terry Price, N6HBB . . . . Treasurer

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