Packet Status Register

Number 21

Tucson Amateur Packet Radio Corporation

PRESIDENT'S COLUMN

Lyle Johnson, WA7GXD

We hear and obey!

The April PSRQ questionnaire was responded to by nearly one-fourth of all TAPR members. This level of response is very unusual. And most gratifying.

As a part of your recommendations, PSR has merged with PRM. Beginning with this issue, PSR will be coming to you every month, along with a lot of information from regional packet groups and general packet information. Please see the Cactus Corner column in the PRM section of this magazine for a little more information on the merger.

With the increased circulation for both publications, I hope that more of you will submit material for inclusion in PRM or PSR. Please note that you can mark the submission for PSR and it will appear in the PSR section of PRM.

Elsewhere in this issue of PSR you will find an article declaring the end of DRNET and the beginning of an "official" TAPR presence on CompuServe.

TAPR may have CompuServe "Starter Kits" available at a discount (for members only) to get you up and running on CompuServe. Watch the October PSR for details.

A tutorial article on Manchester Encoding also appears for those of you curious about this method of sending your packet signals to the packet experiment (Mode JD) now orbiting as part of JAMSAT-OSCAR 12 (also known as JAS-1, JO-12 and Fuji).

TAPR volunteers are busy preparing a kit to allow you to interface a TNC 1, TNC 2 or clone to a 2 meter FM transmitter and a 70 cm receiver and work Mode JD on the newest OSCAR. Look for an update in the October PSR.

San Diego and the ARRL Nationals!

The weekend of September 5 through 7 found a lot of packeteers gathered in San Diego for the ARRL National Convention. And the Nationals.

The packet booth was manned by SANDPAC (San Diego Packet Group) volunteers with some help from out-of-towners. There was a LOT of interest in packet at this convention.

Three hours of packet forums (tutorials, introductory material, HF, emergency operation, networking, etc.) on Saturday afternoon were very well attended. I want to thank Mike Brock, WB6HHV, for his considerable efforts at coordinating the packet presence at the convention.

Many of our newer members may not realize that TAPR moved from being a loose collection of Arizonans to a serious, regional group at the ARRL Southwestern Division Convention held at the very same location as this year's national back in June of 1982!

At that time the TAPR ALPHA TNC was displayed, running a crude prototype and testing protocol over a wire link (on the air packets weren't sent successfully until a week or two later).

Being a low-budget operation, those of us who came from Tucson to San Diego that year camped on the beach. Yes, camped. In tents.

I will always remember the sight of extension cords running into a small two-man (well two-person, I shared it with my wife) tent into which were crammed two trerminals, two ALPHA TNCs and about 3 people feverishly fiddling with things to get the demo in working order.

And I will never forget seeing TAPR President Den Connors, KD2S, sitting in a lawn chair halfway between the men's room and a public telephone booth (San Diego beaches are well equipped!).

What's so odd about that?

On his lap was a TI Silent 700 printing terminal. There was an extension cord running from the terminal, through the window of the men's room, to an AC outlet. On the side of the terminal was a handset from the telephone booth. Den was plugged into an on-line database service (a forerunner of DRNET)!

Anyway, we got the demo running, borrowed a portion of the SCARCC booth to set it up, hung a sign that said TAPR and signed up almost 100 members! We met a fellow named Harold Price and another named Dave Henderson. These two guys teamed up with Margaret Morrison and wrote some real packet software for the Beta TNC and later TNC 1 kits.

That was also the one time I met Vic Clark, then President of the ARRL.

In 1982, no manufacturer made packet gear for the Amateur market.

Continued on page 12

BEGINNER'S CORNER:

MANCHESTER ENCODING AND OSCAR 12

Lyle Johnson, WA7GXD

JAS-1 is in orbit!

This newest Amateur satellite, designed by Japanese Amateurs and launched by NASDA, the Japanese space agency, was lifted into orbit on an experimental H-1 rocket on August 12, 1986.

Carried aboard JO-12, as it is now designated, is a packet experiment called Mode JD.

Briefly, Mode JD is a digital packet bulletin board system. The uplink is on two meters, of which there are four channels (145.850, 145.870, 145.890 and 145.910 MHz) and the downlink on 70 cm (435.910 MHz). The uplink to a satellite is the frequency used to send information from the ground to the satellite; the downlink is the frequency used to send information back to the earth from the satellite.

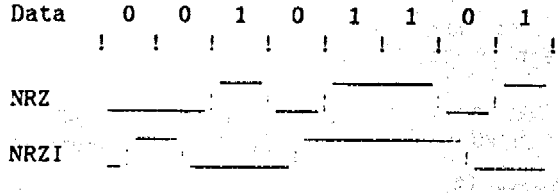
All channels run at 1200 baud, and the uplink channels are 2 meter FM! The uplink uses FM, in part because most packeteers already have accesss to suitable 2 meter FM gear.

The downlink channel uses phase-shift keying (PSK) modulation and will require the use of an SSB receiver and a special demodulator. This may be the subject of another article in a future PSR.

Unfortunately, a satellite is a very complex device, and an Amateur satellite is usually constrained by weight and size to be very, very small.

For the designers of Mode JD, it was important to make the circuitry as straightforward as possible. And when JAS-1 was designed, there were no CMOS HDLC chips like the SIO chip used in the TNC 2. Thus, they had to make the HDLC encoder and decoders with standard CMOS chips. To simplify the design (and save about 24 ICs!), they decided to require Manchester encoding by ground stations wishing to send data to JAS-1 on the Mode JD uplink.

Now, AX.25 is supposed to be encoded in HDLC frames and we usually send these frames at 1200 baud using FSK modems and a format called NRZI (non return to zero, inverting). As you probably recall, NRZI encodes a zero as a change in state (or tones) and a one as no change in state (the tone remains steady, whether it is a high tone or a low tone). This is illustrated below:

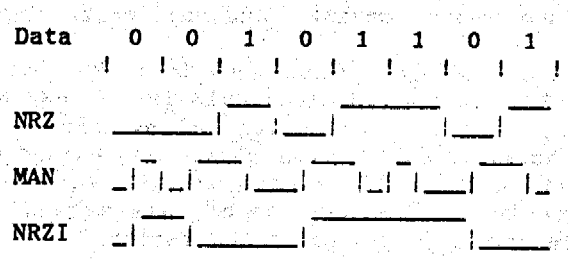


With Manchester encoding (or, more precisely, Manchester II encoding), the clock information for the data is mixed with the data and sent every bit time. A one or a zero is determined by the fact that a one has a positive-going edge in the middle of a bit and a zero has a negative-going edge in the middle of the bit.

The advantage for the satellite designers is a simplified clock recovery system. Fewer parts to find room for, and fewer parts to fail.

The disadvantage for the packeteer is that he must now have a special adapter to change his data from NRZI to Manchester format. As it turns out, JAS-1 expects the Manchester encoding to be done after the NRZI encoding. This simplifies things for us considerably!

Let's look at the same data as before, but with Manchester encoding shown as well:



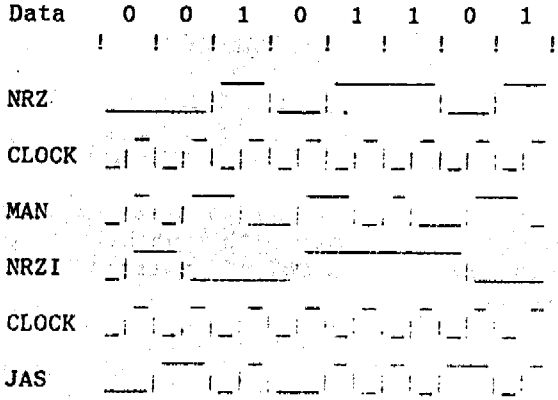
Notice that a low-going edge occurs in the middle of every 1 and a rising edge occurs at the center of every 0.

If you look carefully at the back-to-back 0s at the beginning of the data stream (left end), you will note that the Manchester data looks like a square-wave at twice the frequency of the NRZI data. In fact, Manchester encoding uses more bandwidth than NRZI for sending the same data.

However, a typical 2 meter FM transceiver can usually send Manchester-encoded 1200 baud data. Notice further that the Manchester signal has an exactly equal amount of time spent in the high and low states. This means that there is no "residual" DC component of the data, which can also help in the desig' of the modulator and demodulator.

"This is all well and good," you may say, "but how can I genrate a Manchester signal for JAS-1? And do it cheaply!"

Let's look at our data one more time, but this time let's put our 1200 baud clock in the diagram:



The line labelled "JAS" shows Manchester encoding of the NRZI data. The line labelled "MAN" shows Manchester encoding of the NRZ data.

If you look carefully, you may notice that the JAS data is (logically speaking) the result of an exclusive-oring of the clock and NRZI data.

The truth table for an EXCLUSIVE-OR gate is:

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	0

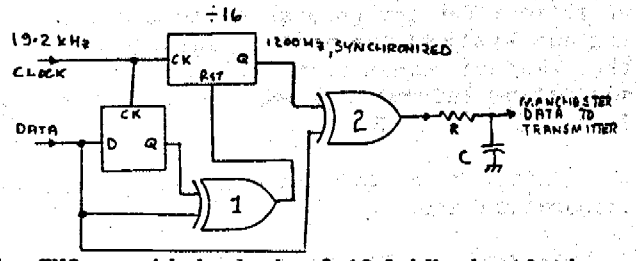
So, all we have to do is take our 1200 baud clock, exclusive-or it with our NRZI data, and apply it to our transmitter.

If you think about the waveform a little more, you will realize that it consists of pieces of square waves that are either 1200 Hz (when 0s or 1s are strung together) or 600 Hz (when 0s and 1s alternate). So, since we have no dc component, and our frequencies of interest are within the passband of a typical FM transmitter's audio response, we can simply shape the digital data itself and transmit it! We don't need any FSK modulators, or tone generators at all!

Of course, there are plenty of sidebands generated at our audio baseband, but by and large we can get the most important ones through our audio system.

Finally, in order to minimize the bandwidth required and meet other requirements of the demodulator, our clock and data must be well synchronized.

Fortunately, the modem disconnect on TNC 1s and TNC 2s provides a signal that can be easily manipulated to provide such a synchronized clock. This is shown schematically below:



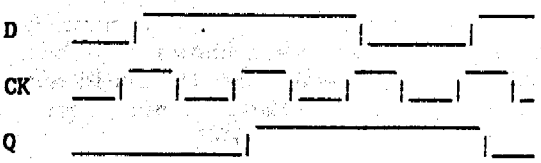
The TNC-provided clock of 19.2 kHz is 16 times the desired 1200 Hz clock signal. So, we apply the clock to a divide-by-16 counter and voila! we have our 1200 Hz clock.

Unfortunately, even though the TNC also derives its internal 1200 Hz clock from the same source, the output of our divider has a one in 16 chance of being in the right time relationship to our data, or a 94% chance of being in the wrong phase (before the Murphy factor which guarantees that the phase will be right during prototype testing and wrong when the units are shipped to customers in the field).

This is clearly unacceptable.

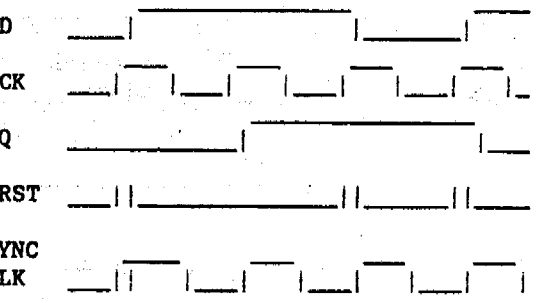
So, we use a D-type flip-flop and an EXCLUSIVE-OR gate to generate a reset pulse to our counter to ensure that it is synchronized with the rising and falling edges of our data.

A "D" flip-flop makes the output line (Q) the same logic level as its input line (D) with every rising edge of the the clock line (CK). When our input data changes state (from a 0 to a 1 or vice versa), the output (Q) and input (D) will be of opposite levels for one clock pulse.



Another way of stating this is that the Q output lags the D input by one clock pulse.

EXCLUSIVE-OR gate 1 compares the D and Q levels. If they are the same, the exclusive-or output is low. If they differ (which happens whenever the data changes betwen 0 and 1), the output of EXCLUSIVE-OR gate 1 goes high, resetting the divide-by-16 counter at the time of the data change. Thus, the counter output is synchronized to the data. This circuit only requires one data transition to lock the clock to the data.



Next, the synchronized clock is applied to one input of EXCLUSIVE-OR gate 2, with the data applied to the other input. The output is Manchester encoded data suitable for JAS-1.

Finally, the 5-volt square-wave output from EXCLUSIVE-OR gate 2 is attenuated and shaped by filter R1 and C1 to provide a low-level audio signal suitable for application to the microphone input of a transmitter.

There you have it. Simple and cheap!

Next month I hope to get the second installment of the state machine article ready for you. Until then, keep those packets flying!

*****

TAPR MOVES TO COMPUSERVE

Pete Eaton, WB9FLW

Effective 1 November 1986, TAPR will move its telecommunications from DRNET to Compuserve's HamNet Special Interest Group.

Over the last two years DRNET has served as a critical link during several R & D projects. Unfortunately, due to the limited accounts available on the system, many folks felt left out. In fact in TAPR's recent poll of members a large percentage of those responding urged TAPR to move DRNET's function to a more public forum. Of all the alternatives, Compuserve's Hamnet was by far the most popular, and has established itself as a prime source of packet information.

With this move TAPR hopes to make its activities and projects more well known to others around the country. At the same time it should make communications between all Packeteers more open.

- PRM -

President's Column continued from page 9

In 1986, every manufacturer is aware that packet is a very important force in Amateur radio. Four packet manufacturers had gear displayed at their booths. And distributors came with lots of TNCs. Many left with none...

What are the Nationals? (or, Packet in the Fast Lane, or Exec VPs Seem to Have All the Luck)

Unlike the Wouff Hong initiation, the Nationals are not (yet) an ARRL-sanctioned event.

Last year, in Louisville, several of us got lost on the freeway (we were "exploring" the driver said) and noticed a sign for a Malibu Raceway. We stopped in.

A Malibu Raceway is a racetrack with small, high-performance racing cars. Top speed is about 35 mph, but it seems a lot faster! We raced and decided to do it again the next night.

So we did.

The winner? None other than Dave Sumner, K1ZZ, ARRL Exec VP and General Manager. Don't let Dave's quiet, dignfied manner fool you...

Anyway, there is a Malibu at San Diego, so we held the ARRL Nationals. This year's winner was Pete Eaton, WB9FLW. (Dave failed to come this year.)

Please note that Malibus are operating at Miamisburg (near Dayton and the scene of a heat won by PSR and PRM Editor Gwyn Reedy, W1BEL, during the Hamvention) and Tucson (won this year by Chris Clark, N7GNT, of Salt Lake City).

Next offical race to held in Tucson at the Annual Meeting on Friday, February 20th, 1987.

*****

TAPR MEMBERSHIP APPLICATION

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**) standard/associate membership in Tucson Amateur Packet Radio Corp. I enclose $15.00 (standard) / $5.00 (associate) for one year's membership dues. I understand that $10.00 of my standard dues 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 standard 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 (standard 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

TAPR membership and PSR subscription mailing address:

Tucson Amateur Packet Radio Corp.
P.O. Box 22888
Tucson, AZ 85734
(602) 746-1166