BEGINNER'S CORNER:

NCHESTER ENCODING AND OSCAR 12

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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.

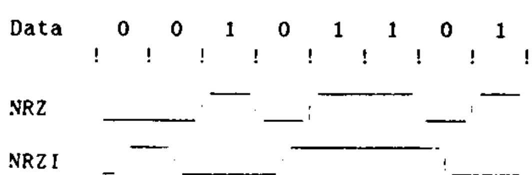
All channels run at 1200 baud, and the uplink channels are 2 meter FM! The uplink uses FM, in part because most packeteers already have accesss to suitable 2 meter FM gear.

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: