Packet, GPS, APRS and the Future

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Abstract

The Global Positioning System produces wider ranging applications every day. The relatively easy hook-up to amateur radio devices makes it the ideal experimenter's "toy" and tool. The benefits it can provide the world of amateur radio are numerous, not least of which is the way in which it brings that element of experimentation back into the hobby AND impresses the "authorities" whenever it is demonstrated or used in disaster situations.

Introduction

GPS and packet radio - experimenter's paradise!

The advent of inexpensive Global Positioning Satellite receivers means that many applications either not thought of or out of reach previously are now becoming possible. The focus of activity has shifted from simple stand-alone GPS receiver units available at first, to the use of remote data gathering in conjunction with radio links. The introduction of the differential GPS service (applying local correction data over a low frequency radio link) to improve accuracy seems to have been the trigger which is causing experimentation with GPS and data links. One thing is very clear - like video recorders and CD players before them, GPS receivers will soon be with us ALL in one form or another. Even the industry itself probably doesn't realize the impact it will have.

Getting it together

Amateurs were perhaps a little slow to exploit the scope of GPS applications, but this is excusablein view of the initial cost of GPS receivers. Now that several GPS engine manufacturers have produced OEM (board level) receivers, cost is reduced and experimentation is enhanced (the previously hidden features of the cards can now be accessed). In addition, very aggressive marketing by one particular GPS manufacturer in the "consumer" nautical market has resulted in obsolete (but none-the-less usable) units being available for several months at "rock bottom" prices. The knock-on effect is that the next generation of hand-held, plotting, differential ready, miniature receivers have hit the market at even lower prices!

One of the more frustrating things about modem systems is that protocols are hard coded into hardware/firmware i.e. on the serial links to many units, very particular command structures have to be used and a specific flow of data and acknowledgment is needed. This makes hooking units together very difficult for the kitchen table experimenter. Luckily, a substantial number of amateurs have the hardware and software available to them to be able to write software which can provide this "connectivity". More importantly, because their programming time is substantially "free" many hours can go into code writing without it becoming an impossibly expensive task.

Now that amateurs have their hands on GPS receivers in increasing numbers they are moving quickly in this area and most significantly they are working on disaster awareness programmes with high levels of mobility/portability. A major spur to this is that it is exceptionally useful during a disaster preparedness exercise AND the real thing, to know where your roving helpers are without having to ask them all the time. The typical ham HT can be used for both the voice communications and the GPS data gathering.

The major amateur experiment is being spearheaded by Bob Bruninga WA4APR and his Automatic Position Reporting System (APRS) software. In this, the original communication with the GPS receiver was using one of the PC serial ports and communicating position data out via packet radio by using a packet TNC attached to a second serial port. The main reason for doing it this way being that, as we said above, interfacing the data directly between the output of the GPS and the input of the TNC was tricky.

Some important information and the "down" side of GPS data.....

There are numerous GPS Receiver output formats, the simplest to handle being pure ASCII strings and the NMEA-0183 format. Additional complication occurs because the serial leveling may be either TTL or RS-232 whichcancause some interfacing problems. Also, the baud rates can be different, mostly 4800 Baud is used right now, but 9600 Baud is also common too. When purchasing a GPS receiver the buyer must be very careful to make sure that all these factors are taken into account. Unfortunately, the receivers are marketed as black boxes and the sales people at your local store are extremely unlikely to know what you're talking about, or worse still, guess with plenty of "yes" answers in order to make a sale! Very few manufacturers put data of this detail on their product sheets. When they do it is not to be trusted. A very famous receiver product brochure picked up recently actually listed the output strings it would produce - the only problem was that in practice it was wrong!

There are numerous output formats, rates and physical types. They are

broken down (mostly) into the following:

Serial: TTL (OEM units generally) or RS-232 (most consumer units).

Baud rate: 4800 (generally) or 9600 (sometimes).

Format:NMEA-018 1, NMEA-0182, NMEA-0183, binary, TSIP, etc.

$GPGGA - Gives HMS, Lat, Long, #satellites, Altitude.

$GPRMC - Gives HMS, Lat, Long, Bearing, Speed, Date.

$GPLLA - Gives Lat, Long.

$GPVTG - Gives Bearing, Speed.

There are some overall guidelines for the sentence structure: $GP is for GPS, $LC for LORAN and proprietary strings from manufacturers, normally starting with a short form of the manufacturers name ($MG is for Magellan, etc.) are used.

The industry seems to have gone out of it's way to spread a web of confusion over every possible aspect of output data. It rivals the RS-232 "standard" Video2000/BetaMax/VHS and UNIX fiascoes in it's complexity. One can't help feeling that in several years there will be a process of "re-standardization" just to make things work! Fortunately, there is enough commonalty left in the system to provide workable solutions for the amateur experimenter and hopefully it will stay that way.

One threat is that NMEA propose to adopt a licensing/royalties system for use of it's format - this is bound to push the industry into completely proprietary (and arbitrary) formats.

Unless the industry giants form a close knit circle and co-operate there exists a real danger that life will not be so easy in the future in matters GPS.

The "up" side of GPS data.....

Fortunately, TNCs are now available which eliminate the need for a PC in the system. In their latest guise (firmware version 3.2), all PacComm TNCs contain a GPSTExt command into which can be placed any string that a parser should look for. That string may be $GPGGA, $GPRMC, or indeed anything (allowing forward compatibililty and also the ability to work with LORAN strings too). When the presence of that text is seen, the parser loads the whole string into the LTEXT, CTEXT and STEXT with periodicity of the Location beacon set in the same way as normal beacon text is handled The BTEXT is left available to beacon out any other useful beacon text required. Furthermore, the LPATH command sets the destination for the LTEXT UI frame (the default is GPS, but may be changed to APRS, etc.) including digipeat path(s).

Certainly, for now, the method of using a parser in the TNC code is the simplest route to reducing the amount of air time required for each position report. It is used to throw away about 95% of the typical output from the GPS receiver. It also makes sure that it doesn't matter what the periodicity of the output data from the GPS receiver is (if it can be set), a frequent problem in early experiments which limited receiver choice or increased channel clutter.

Differential GPS over the air

Taking the technology to the next step naturally entails the provision of a more accurate system using differential GPS. Differential base stations are expensive, but there are several appearing on 145.79MHz. The good news is that the serial output from the differential base station is simply "piped" into a TNC and allowed to broadcast. The differential equipped GPS receiver at the other end does all the work, throwing away the packet header and swallowing the data wholesale. What looked originally like a tricky problem actually works like a dream!

One very important factor for the amateur world to consider is that the provision of the US Coast Guard MF DGPS service is being looked upon increasingly as an expensive (to the user) and potentially unreliable service. Likewise, other commercially available systems using encryption and sub-carriers on FM broadcast stations look like an expensive subscription "cable TV" type option. That commercial users are buying 2m receivers and TNCs and are eavesdropping on the APRS channel is a certainty. Suddenly, that puts amateur radio in a different light for a lot of people as a real service provider in. both emergency and normal times.

Conclusion

There :is no doubt that GPS and APRS have caused a great stir in a very short time. The commercial world has it's eyes on this technology, and well it might because it is so powerful. Many TNCs are out there simply listening to what's going on on 145.79MHz, many in the hands of non-amateurs who cannot believe what they see! It gets rarer these days to see-amateur radio really at: the forefront of technology, but this is certainly attracting attention!