The Radio Active Pilot
Part 3: Amateur Radio and the US Nationals

Text by Rich Parry

Abstract - In this installment of the series on radios and paragliding, we describe an advanced application in which amateur radio was used for position tracking of pilots during the 2004 US Hang Gliding Nationals held in Big Spring, Texas in August.

"Hi, this is David Glover", the voice on the phone said. "I'm the coordinator for the 2004 US Hang Gliding Nationals and I need your help." You must have the wrong number I thought to myself, I'm a paragliding pilot. I couldn't image why a hang gliding pilot was calling. He continued, "I think you can help me. I want to display real-time flight tracks of pilots during the US Hang Gliding Nationals (http://w9if.net/iweb/nationals2004/index.php). It's going to be held next month in Big Spring, Texas. We are expecting a hundred or more pilots to attend the competition and want to display flight paths on the web for the world to see". I was polite and agreed it would be interesting, but where do I come in. He mentioned he had heard I was an amateur radio operator and paraglider and thought I could help. To pull this off, he proposed I develop and host the web page and he would provide tracking hardware to the pilots during the event. We spoke a little longer about the project, set a few milestones and I hung up.

Displaying flight tracks is easy, most Varios that connect to a GPS receiver can store position coordinates during a flight. When the flight is complete the data can be downloaded to a computer. Using special flight mapping software, the path of the flight and altitude profile can be displayed. However, our goal was much different, we wanted to display the flight paths in real-time and to make it available on the web. Fortunately, amateur radio provides the perfect solution. The Automatic Position and Reporting System® (APRS) was developed for applications just like this. I have used APRS for years to track my car (http://w9if.net/iweb/myaprspackets/index.html). Other amateur radio operators have used it to track trains, boats, satellites, balloons, runners, bicycles, and just about anything else that moves, including Rose Bowl parade floats. Tracking a hang glider should be a piece of cake.

I know this is a paragliding magazine, but stick with me, everything discussed here applies equally to paragliders. So what is APRS and how did we do it?

APRS

APRS was developed by Bob Bruninga, WB4APR, over a decade ago. It is a protocol (http://www.tapr.org/tapr/html/Faprswg.html) used to transmit data over the air. In our case, the data is a pilot's latitude and longitude.

The equipment used to transmit pilot position data is called a tracker. Figure 1 shows one of the trackers used during the US Hang Gliding Nationals. The tracker consists of three components: a two-meter transceiver, a GPS receiver, and a Terminal Node Controller (TNC). The transceiver is identical to the two-meter transceiver hang gliding and paragliding pilots use for voice communication. The transceiver transmits the data on a nationally allocated frequency of 144.39 MHz. If you tune your radio to this frequency and listen you should be able to hear bursts of APRS traffic. It's not very exciting, but it may give you a sense of the other things that are going on in the two-meter band besides voice communication. The data, more commonly referred to as a "packet", sounds like a short FAX machine transmission.

The GPS receiver is also similar to those used by pilots. The receiver measures precision timing signals from the GPS constellation of satellites and outputs a text string containing latitude and longitude data. The GPS receiver sends the data stream to the TNC.

The TNC is the unique component. It is similar to a computer modem. It accepts digital data and translates that data into tones that can be transmitted by a two-meter transceiver. Each data transmission

is a burst lasting a few seconds. Bursts are sent periodically. For moving objects such as a hang glider, the period between transmissions is one or two minutes. For stationary or slow moving objects, the duration between data bursts is longer. For example, I broadcast the position of my home every 30 minutes (http://www.findu.com/cgi-bin/find.cgi?call=W9IF). Unless there is an earthquake here is southern California, the house isn't going anywhere. For this reason, there is no need to provide frequent position updates. Reducing the number of packet sent also helps reduce network traffic and increases network reliability.

An APRS receiving system located within a few miles of the pilot, called an IGATE (Internet Gateway) relays the data to the APRS Internet System (http://www.aprs-is.net/) which makes the data available everywhere on the Internet. The IGATE also has a two-meter transceiver and TNC like the tracker. The receiver portion of the transceiver sends tones to the TNC, which translates the tones to data. This data containing the pilot's position is passed to a computer with Internet access. Special software is used to direct the data to the APRS Internet System. A nationwide network of APRS IGATEs and servers make the data available anywhere on the Internet.

US Nationals Web Page

It was David's job to attach the trackers to participating hang gliders and my job to display it. Using javAPRS (http://www.aprs-is.net/javAPRS/), a java computer program developed by Steve Demise, K4HG and Pete Loveall, AE5PL I was able to do just that.

For the Nationals, we were interested in displaying packets from trackers in the area of Big Spring, Texas. Designing the layout for the web page was a major part of the project. Emails flew back and forth during this period while we weighed the advantages and disadvantages of different layouts. We eventually agreed upon two maps placed side by side. A wide area map, covering 1,000 sq. mi., would be well suited for days when pilots travel long distances. A smaller map, covering 25 sq. mi., would be ideal for displaying air traffic near the Big Spring airport where the event was taking place.

With the web page layout set, all that was left was to add a few bells and whistles to the page. A hit counter was added to measure visits to the web page and a visitor counter to keep track of the number of different users visiting the page.

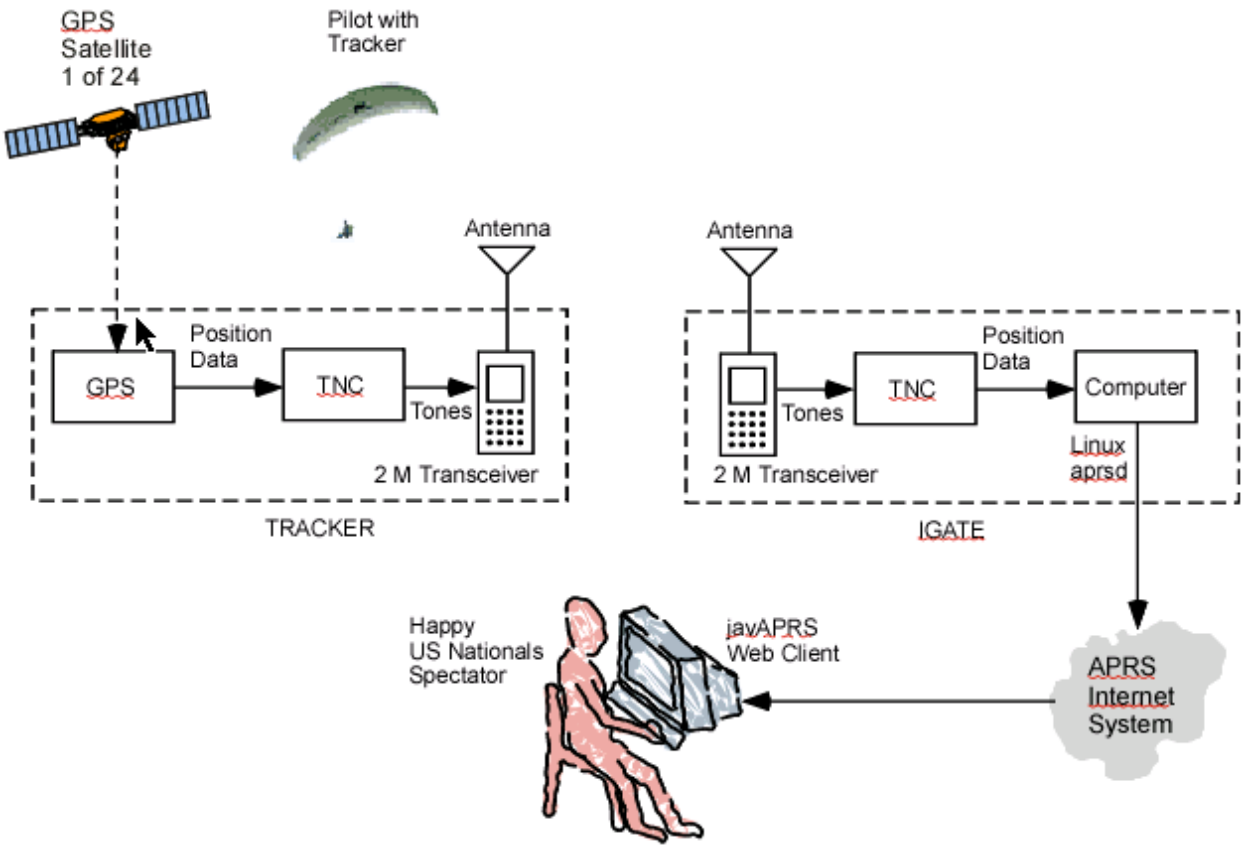
Figures 3 and 4 shows screenshots of hang glider flight paths taken from the web page during the Nationals. Each time the hang glider transmits his or her position; an icon is marked on the map. When these points are connected, they show the pilot's flight path.

Judging from the success of the web page, it was well received and appreciated by armchair pilots. I look forward to doing it again next year.

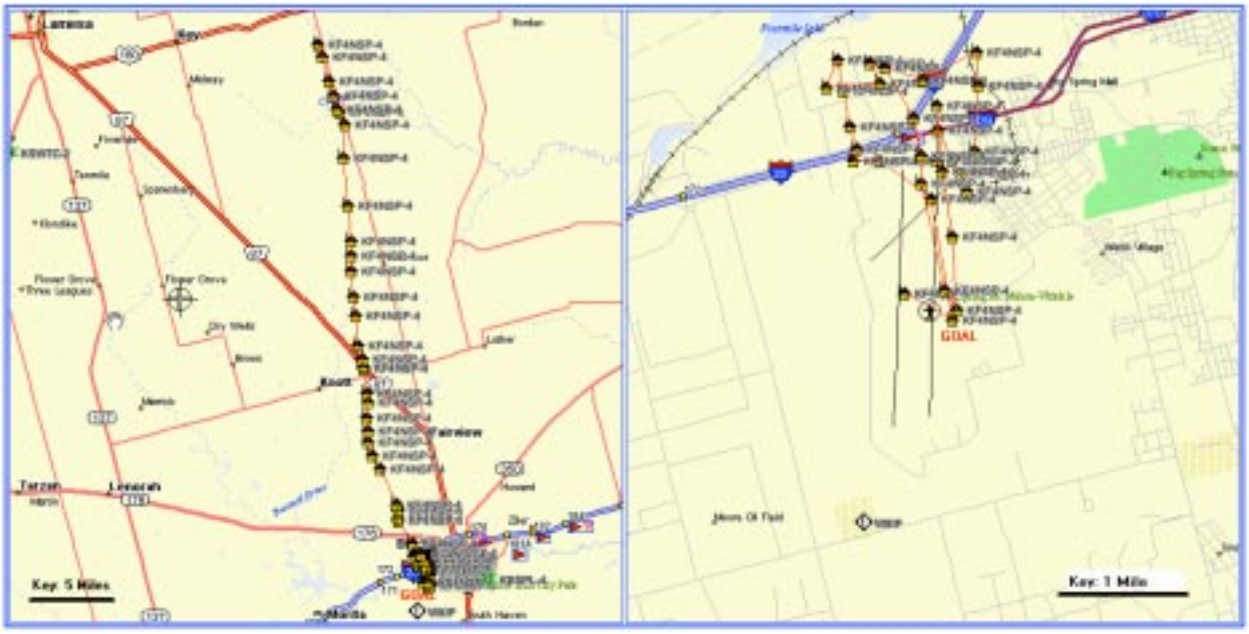
CONCLUSION

In previous articles in this series, we discussed the steps necessary to get an amateur radio license and how amateur radio can be used to compliment paragliding. However, we limited our discussion to voice communication. In this issue, we showed how data, rather than voice, could be transmitted to enhance our sport. This project would not have been possible without amateur radio. Next time we will show how weather data, rather than position data, can be sent using APRS to provide remote weather flying conditions (http://w9if.net/cgi-bin/torreywx/wx.pl). Until next time, safe flying!

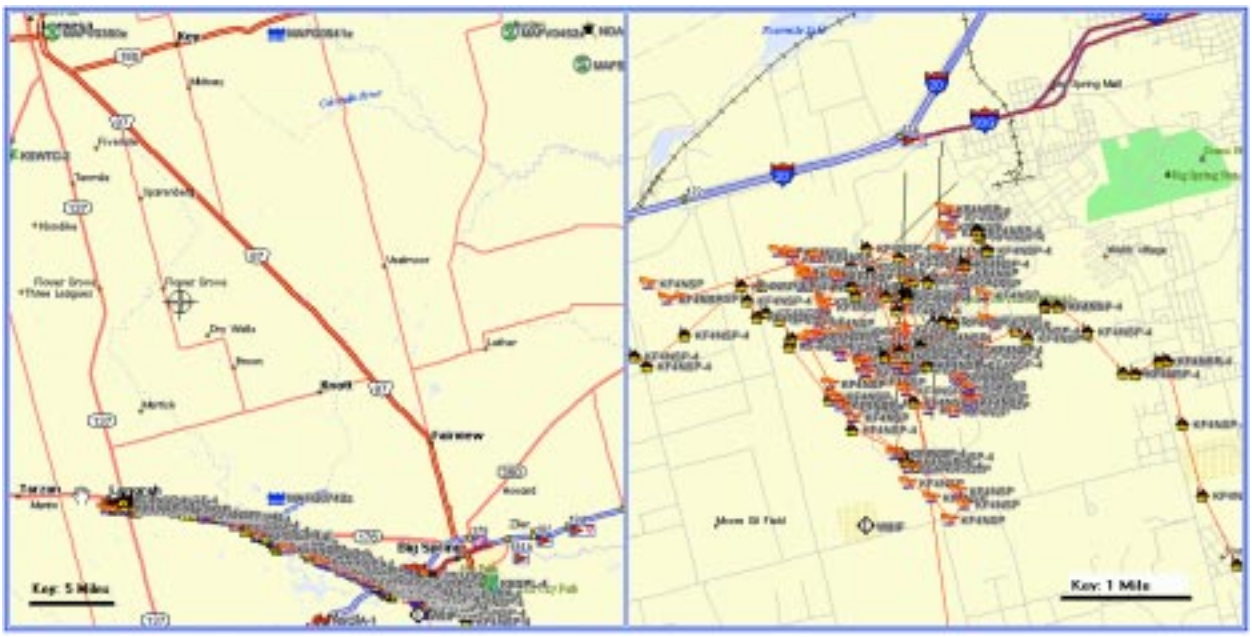
Part 3 - Figure 1. Tracker hardware used during competition. An amateur radio transceiver is located at the top with GPS receiver at bottom. Sandwiched in-between is the TNC. Photo courtesy of David Glover.



Part 3 - Figure 2. US Nationals System Architecture.



Part 3 - Figure 3. On this day of the competition, the goal was to the north. A 20-mile flight path is shown in the left pane map, while local tracks are displayed in the right pane. Computer screenshot courtesy of Cary Kendziora.



Part 3 - Figure 4. The wide area coverage map on the left shows flight paths on this day of the US Hang Gliding Nationals were westward. The right map shows a flurry of activity at the Big Spring, Texas airport. Computer screenshot courtesy of Cary Kendziora.