APRS 101

What is APRS?

Officially, APRS stands for Automatic Packet Reporting System; however, because it is so frequently used for position reporting, it is commonly referred to as Automatic Position Reporting System. APRS was developed in the late 1970's by Bob Bruninga, WB4APR. His goal was to develop a tactical, real-time information distribution system.

APRS is a network for transporting packets from a sending site to one or more receiving sites. These packets also can be passed on to Internet sites that display global information about APRS reports. APRS packets can be used to send telemetry information, weather conditions, status and emergency signals, short text messages, and even short e-mails. However, the overwhelming majority of APRS sites transmit position reports. Now days, the position information is usually collected from GPS receivers, but it is possible to manually enter positions and use other navigation devices.

For our purpose, APRS is an excellent vehicle tracking system. This is very important in a real emergency scenario or during public service events such as our recently completed HOW-100 bike ride.

WCARES involvement with APRS

WCARES began using APRS about four years ago when APRS was part of our Digital Initiative along with WINLINK. We had a map of Williamson County on one of the computers in the WC4EOC radio room and during the exercise we were able to keep track of the APRS equipped vehicles as they moved throughout the county. This feature is especially beneficial to the net control operator because you can see the location of the various units instead of tying up the repeater system by asking the various units for their location.

Currently there are 15 WCARES members who have APRS units in their cars. You can see by looking at the map and watching the automobile or truck icons how easy it is to see the location of these mobile stations.

In case of an emergency or public service event we would not use the standard frequency of 144.39, but instead we would go to a discreet frequency where the WCARES mobiles would be the only ones shown. We plan on having the capability of having enough digipeters to cover the county as well as having our own I-Gate link to the internet.

Some of the WCARES members have already started on these projects and are donating their own equipment to the cause.

Equipment needed to use APRS

A basic APRS setup consists of a 2 meter radio, GPS receiver, a TNC which encodes the position, and the associated cables. Some of the higher priced dual band radios such as the Kenwood D-700 and D-710 have a built-in APRS TNC position encoder. But the least expensive approach is to purchase a GPS receiver and APRS TNC and connect them to a radio you pick up at a hamfest or eBay.

There are two primary vendors that have reasonably priced GPS receivers and TNC position encoders. One is Byonics, www.byonics.com, and the two products of interest are the TinyTrak3Plus and the TinyTrak4. The other company is Argent Data Systems, www.argentdata.com, and the unit they have is the Tracker2. Assembled and tested APRS GPS-TNC units can be purchased for about $110 (less if you can build a kit).

APRS packet transmission

Within the United States, the standard frequency for all APRS packet transmissions is 144.39 (simplex). If you monitor 144.39, you will hear APRS packets. However, it is possible to use an alternate frequency to set up a local APRS network. Since all stations are transmitting on the same frequency, consideration must be given to the possibility of having packet collisions. TNCs monitor incoming signals and hold off on transmitting their own packets if they hear another APRS packet coming in. However, even with this technique, collisions do occur, and one or more packets are corrupted and lost. The assumption is that stations will transmit updated information in a short while, so when packets are lost they are not retransmitted until the next scheduled time. Unlike TCP/IP Internet connections, APRS does not provide delivery guarantee with retry of lost packets for position reports.

APRS also supports two-way, semi-reliable text messaging. You can send a short text message to a specific station, and that station, upon receipt of the message, will send back a delivery acknowledgement. The sending station will retransmit the message several times (typically 5) until a delivery acknowledgement is received.

Digipeaters: APRS repeaters

It is possible to directly receive APRS packets from the originating stations and display the packet information on a computer screen. Similar to voice repeaters, digipeaters are used to

expand the coverage of APRS areas. However, unlike a voice repeater, a digipeater retransmits the packet on the same frequency it received it.

By convention, there are two classes of digipeaters: (1) fill-in digipeaters that have limited coverage, and (2) wide area digipeaters that have the height and power to cover a large area.

I-Gates and Internet sites

Some digipeaters are connected to I-Gates which pass incoming APRS packets on to APRS Internet servers ("APRS-IS"). If you have an Internet connection, you can view the positions of APRS-equipped vehicles anywhere in the world by connecting to these servers. In addition to displaying vehicle positions, most APRS servers display other useful information such as repeater frequency/tone, WINLink nodes, weather information, etc. A popular APRS server is http://aprs.fi You can tell it to search for a specific call sign, or you can enter a zip code or city name, and it will display all vehicles in that area.

There are two digipeters in the middle Tennessee area, one near Joelton and the other one is southeast of Franklin. There is an I-Gate located in the Spring Hill area.

If you would like to see the actual APRS traffic around our area right now, go to http://www.aprs.fi. On the right side of the screen, in the "Show Last" field, select whatever time frame you would like cover. I would suggest 1 hour for a start. In the "Address" field, type in a Nashville zip code, for example 37220. After you make both of these entries then click on Search. The screen will now display any mobile stations and a "bread trail" of their movements for the last hour. If you put your cursor over a station, it will draw a line to the digipeter that is hearing the station and then to the I-Gate. If you would like to search for just one station, then put their call in the "Track callsign" field and select Search. Put a zip code in for your home town and see what is happening. Neat, hunh?

TNC: Terminal Node Controllers

The "brains" of an APRS system is the TNC (Terminal Node Controller). The TNC accepts position information from a GPS receiver, creates APRS packets, and uses the attached radio to transmit them.

TNCs can be divided into two groups: (1) transmit-only, and (2) transmit and receive. A transmit-only TNC is well suited for installation in a car, a weather station, or other telemetry applications. As the name implies, it transmits position or other information, but it does not receive or decode incoming APRS packets. A TNC that can transmit and receive decodes the incoming APRS packets and passes them to a computer or a specialized display unit such as a Garmin Nuvi 350 GPS unit. Software on the computer (such as UI-View) can then display the position of vehicles whose packets are received. Transmit-Receive TNCs also can function as digipeaters.

APRS Transmission paths

When configuring a TNC, one of the parameters is the APRS packet "path". The path specifies what type of digipeaters should relay the packets and how many hops should be permitted. Only two types of entries are routinely used with path specifications: "WIDE1", which denotes a local area digipeater, and "WIDE2" which denotes a wide-area digipeater. The number of hops requested is specified using a dash and a digit following the digipeater type. For example, WIDE2-2 requests that wide-area digipeaters relay the packet up to two times. Each time a digipeater relays a packet, it decrements the hop count in the outgoing packet. For urban locations, the recommended path is WIDE1-1,WIDE2-1. For rural areas, the recommended path is WIDE1-1,WIDE2-2.

Transmission periods

The period between packet transmissions is a TNC setup parameter. For a solar powered weather station, a transmission period of a half hour or longer may be appropriate. But for moving vehicles, the period is usually set between 30 seconds and 2 minutes. Most TNCs have a "Smart Beaconing" feature that adjusts the transmission period based on the speed of the vehicle and detection of turns. Some TNCs include relays that can power down the radio to conserve power between transmissions.

Getting started with APRS

Fifteen or more WCARES members already have APRS systems installed in their vehicles, and more are coming on line every day. WCARES has set up an APRS information committee to help more members get set up. Phil Sherrod (W4PHS, PhilSherrod@comcast.net) and Randy Armour (KI4LMR, Randy.Armour@nashville.gov) are coordinating the committee. Please feel free to contact Phil or Randy for more information about APRS and help configuring TNCs.