Tracking and Telemetry with Amateur Radio

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Agenda

APRS tracking

APRS telemetry

AX.25 telemetry

hardware

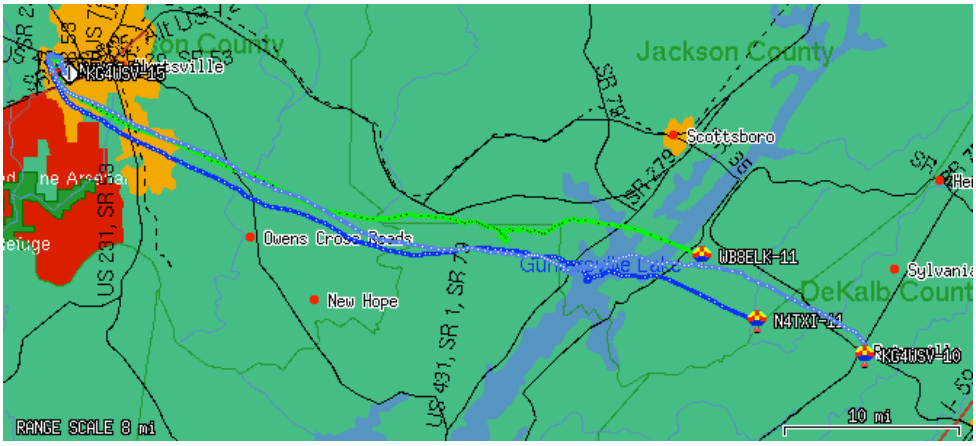
direction finding

resources

APRS – Automatic Position Reporting System

APRS is a real-time tactical digital communications protocol for exchanging information between a large number of stations covering a large local area.

Developed by Bob Bruninga, WB4APR, USNA



Kenwood TM-D700

mobile APRS transceiver

APRS Telemetry

APRS telemetry format

T#005,199,000,255,073,123,01101001

report Sequence Number, typically a 3-digit number

five 8-bit unsigned analog data values (expressed as 3-digit decimal numbers in the range 000 – 255)

single 8-bit digital data value (expressed as 8 bytes, each containing 1 or 0)

AX.25 Protocol

AX.25 protocol, aka packet radio

includes error detection (16 bit CRC)

can use many existing hardware components

example: implement ADC, AX.25 encoder on microcontroller, connect to standard ham handheld transceiver

use existing hardware to receive and decode packets

typically 1200 baud, some 9600 baud hardware

AX.25 example

example: custom AX.25 telemetry format

- four 12-bit ADCs, 10Hz
- one packet/s
- 10 measurements + sequence number = 81 bytes
- fits in 1200 baud channel

AX.25 Station Components

TNC – terminal node controller

- implements AX.25 protocol
- provides data link layer for packet communications
- audio + control to radio
- RS232 to application

Radio

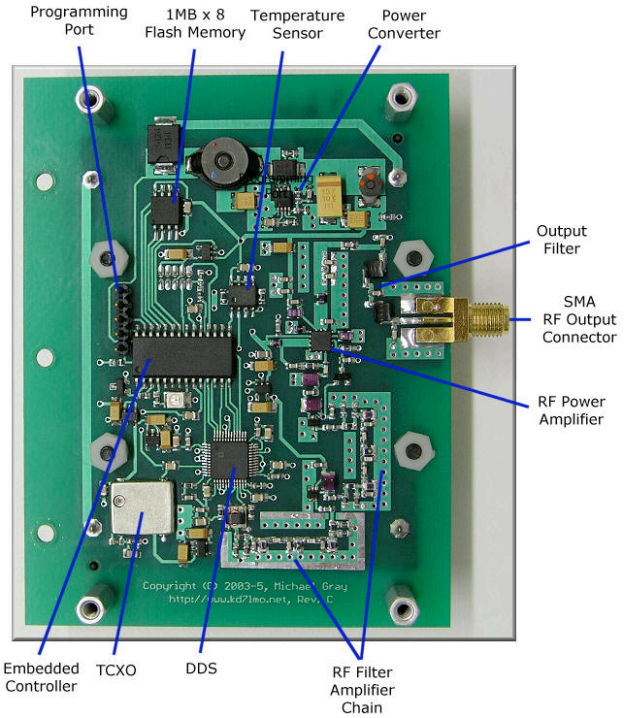
- standard handheld/mobile/base for ground station
- small handheld
- custom transmitter
- ISM device (433MHz data transmitter/receiver pair)

Pico Beacon

ambitious project: the Pico Beacon

The ultimate balloon tracker: flight computer, data recorder, GPS, APRS tracker, transmitter on one 3" x 3.5" board

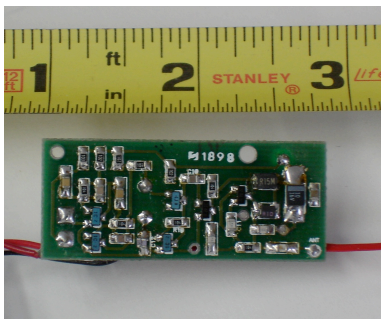
developed by Michael Gray, KD7LMO

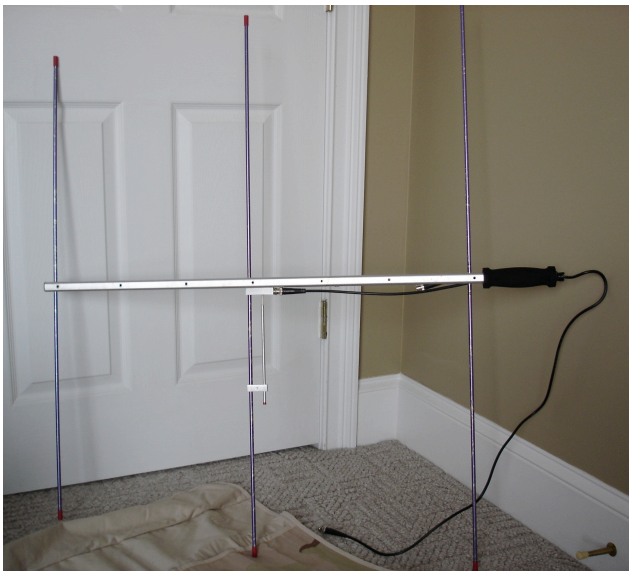


Direction Finding equipment

low power tracking beacon

direction finding (triangulation)





other issues

GPS – limitations: 1000kt / 60k feet
Garmin GPS18 is a good receiver

batteries – lithium primary cells (e.g. Energizer e^2 Lithium)

ATV – television for amateur radio, use existing TV

on-board antenna should be omnidirectional

ham radio – more power!

must be licensed, but exam is cheap and easy

ham volunteer base

Retrieval

now what?

photo by Gary Dion, N4TXI