

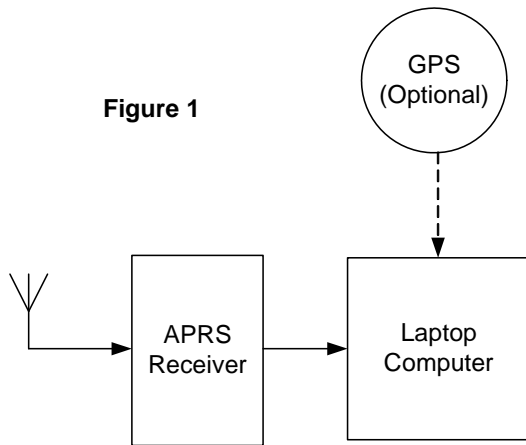


Ground Tracking Stations

Ground tracking stations are used for real-time or near real-time tracking during flight operations. The most common types of ground tracking include mobile, stationary, and spotters. Mobile tracking stations, also known as Chase Vehicles, are used for chase and recovery of the payload. Stationary tracking stations monitor and collect data. Spotters visually track the payload and can be mobile or stationary. The roles and responsibilities of ground tracking can be divided among several teams or consolidated to a few individuals depending on available resources and personnel.

Mobile Tracker

Mobile tracking stations are used to chase and recovery the payload and are typically equipped with an [APRS](#) receiver, Cell phone and/or HAM radio, GPS, and a laptop computer running appropriate mapping software as shown in figure 1.



The APRS receiver can be any type of radio that can process APRS data packets. A HAM license is not required for receiving data packets.

The [Kenwood TM-D710A](#) mobile radio is a good choice for a receiver with it's built in Terminal Node Controller (TNC). This is a dual band transceiver. The dual band allows APRS data to be capture to a computer on one band while providing a second band for ground communications with other stations.

Use of the second band to transmit would require a licensed HAM operator to be present in the chase vehicle.

Another option would be to use the [Kentronics KPC-3+ TNC](#). The KPC-3+ is designed to process APRS packets. A simple handheld radio is required to receive and transmit the radio signal. The KPC-3+ and radio would make up the APRS Receiver portion of the tracking station referred to in figure 1.

A cell phone and/or HAM radio is used to communicate with other tracking stations. Updates can be provided to team members of the current status of the payload and other vital information. If there are numerous tracking stations used during flight operations communications can be coordinated via a designated central command station. All tracking stations would report there status and provide updates to the coordinator who in

turn would direct tracking activities to ensure proper team member placement and performance of duties during flight ops.

The optional GPS can perform several functions depending on the type of GPS unit(s) used during flight operations. The driver of the chase vehicle can use a standard car GPS to determine best possible route to the predicted and actual landing site. This increases the chance of being present when the payload lands and prevents getting lost in rural areas. The same or separate GPS can also be connected to a laptop computer running tracking software allowing the team to quickly determine their location with respect to the payload. The Garmin StreetPilot III gives the driver routing capabilities with voice navigation while providing a data feed to a laptop. Garmin no longer sells the StreetPilot III and has discontinued this dual functionality in their newer models, however, the unit can be found on e-bay but any USB GPS can be connected to the laptop. A handheld GPS can be very useful to the trackers if the payload has landed in a heavily wooded area or where there are no roads available to the recovery site. The navigation feature or “Go-To” feature of the handheld GPS is used to direct the trackers to the last known location. This is accomplished by inputting the last known position report from the payload into the GPS and following the GPS direction finder.

A laptop computer running tracking software allows the tracker to follow the payload during flight more easily. The computer would be connected directly to the APRS receiver and allow the tracker to record incoming data directly to a file and provide visual indication of the payload in real-time. The most popular software package used in the HAM community for tracking is [UIView32](#). This is a free software package designed by a Roger Barker G4IDE SK. A valid HAM license is required to register and use the package. There are numerous add-ons that provide increase functionality to the software and are described on the UIView32 website.

UIView32 is used in conjunction with other map programs to provide updated street information. There are a number of mapping programs that will work and descriptions can be found on the UIView32 website, however, [Precision Mapping 8](#) is a good choice and is inexpensive. Complete descriptions of the software are available on there website.

A computer with 2 serial ports running UIView32 is capable of handling a GPS and APRS incoming data as shown in figure 1. The dual input provides the trackers with vital real-time information during flight operations. The incoming data can be recorded, downloaded, and played back at a later date. In addition to tracking the payload and vehicle on the same map the software can be setup to monitor other trackers if the vehicles are using APRS to broadcast their positions.

Stationary Tracker

Stationary tracking stations can consist of the same setup as mobile stations providing them with the same capabilities as chase vehicles. If this type of setup is use it can be designated the command center and can coordinate all tracker activities.

A scaled down version of stationary tracker can use a computer connected to the Internet with tracking software. No radio or APRS devices are required. There are numerous free

software packages available for tracking. Two of most popular packages are from [FINDU.COM](http://www.findu.com) and [Google Earth](http://www.google.com/earth) which provide near real-time tracking capabilities and data acquisition.

Google Earth is becoming the standard and provides additional services that are unique. Raw packet data is available online for up to 24 hours and can be retrieved by the team during or after recovery operations. KML files can be created from the raw data and viewed with Google Earth. A KML can be opened with a text editor and they look like XML files. Enhanced services include importing data points, faster performance, real-time GPS tracking and track/waypoint import, better screen-resolution printing, annotations, presentations,. These advanced features are considered a subscription service and available in two packages. The advanced subscription services are required for individuals who wish to make high resolution data available to others; they are not required for tracking or viewing.

Spotters

Spotters are the third type of trackers and are individuals who are not assigned to monitoring computer screens, collect data, or coordinate activities. Their duty is to scan the skies and look for the payload. Spotters should be provided with binoculars or telescopes to help them locate the payload, however, payloads can be seen at extreme altitudes without the aide of optics depending on sky conditions. Spotters can make the difference for a team speculating where the payload landed and actually watching the payload land.

All the roles and responsibilities of ground tracking should be incorporated in flight operations whenever possible. In a larger environment with appropriate resources and people, activities can be coordinated and roles designated making it an effective teaching and learning experience for all involved. If resources and personnel are limited the roles can be consolidated and distributed between two or three team members properly equipped with a single mobile tracking station. Good ground tracking using real-time or near real-time monitoring is the key to a successful recovery.

Links:

APRS: <http://aprs.org/>

Kenwood TM-D710A:

http://www.kenwoodusa.com/Communications/Amateur_Radio/Mobiles/TM-D710A

Kentronics KPC-3+: <http://www.kantronics.com/products/kpc3.html>

UIView32: <http://www.ui-view.org/>

Precision Map 8: <http://www.undertowsoftware.com/PMSAT/PMSAT.htm>

FINDU.COM: <http://www.findu.com>

Google Earth: <http://earth.google.com>