

An Automated, Real-Time, Search and Rescue Team Tracking System

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**An MRA research and development grant
proposal submitted by the San Bernardino
County Sheriff's Cave Rescue Team**

Objective

Design and implement a system for the use of APRS to track SAR teams in the field. The hardware will be field-ruggedized and the method simplified such that practical application can be realized in the SAR environment.

Background

Next to communication, the most important requirement of SAR teams in the field is an ability to provide their current position and status. The proliferation of the GPS has greatly improved the ability of a team to report its position in such a manner that a search manager can pin-point this location on a map. Our proposal seeks to adapt the automated position reporting system (APRS) developed by the amateur radio service to the rigors of the SAR environment.

Attempts to effectively implement APRS in SAR have had mixed success. One example in Sandia, New Mexico has several engineers from the Robotics division at Sandia National Laboratory getting involved with the local Sandia SAR team to assist them in developing an APRS system that the SAR team could use. Sandia National Laboratories took it a step further and donated Internet connectivity to merge the SAR APRS data with outside agencies, with a resounding success.¹

1. *Sandia Lab News*, Vol. 52, No. 18 September 8, 2000

Approach

In Howard County, Arkansas, a demonstration of APRS by a SAR team assisted in a real SAR scenario that occurred during the demo. The tracking of the teams worked well in the dense Arkansas forest, however ham radio operators were needed due to the complexity of the setup and difficulty of gear management with larger APRS “parts”¹.

Onondaga County SAR in New York, reports that the difficulty of wilderness applications of APRS include the lack of accurate topographic maps, and the lack of wilderness software maps available for use with APRS software. Onondaga County SAR also stated difficulties with tracking in varying terrain.²

All of the examples outlined above have several challenges in common that this proposal seeks to address:

1. Portability and durability (rugged design)
2. Simplicity
3. Effective APRS integration with topographic map software.
4. Establishing a position report protocol and method that works in the SAR environment and in challenging terrain.

Approach

We will build six TinyTrak GPS position encoders³, which will be connected to type-accepted radios to transmit position data to a base station (command post) that is equipped with a laptop computer and mapping software. Telemetry is not allowed on 155.160 MHz, the MRA frequency. Therefore, to reduce costs and expedite development this project will use existing Amateur Service frequency allocations for the transmission of data (144.390 MHz).

The Communications Committee Chairman of the MRA has located potential VHF frequencies that could be licensed by individual units and/or the MRA for the transmission of position data for future production systems placed in the field by MRA teams. The frequency would have low potential for interference with existing transmissions on 155.160 MHz and would require a modification to existing team licenses. The propagation characteristics of this frequency are similar to the frequency that will be used in this proposal, so that proof of concept efforts will not be compromised by using Amateur Service frequency allocations.

1. J Scott Ratchford, June 4, 2001, *APRS in the News*, <http://wes.johnston.net/aprs/aprs14.htm>

2. Onondaga County New York SAR & APRS website <http://home.twcny.rr.com/aprs/page4.html>

3. These encoders can be found at <http://www.byonics.com/tinytrak/tinytrak.html>

Budget

We have three principle questions:

- What is the best method for position reporting: beacon, or mic unkey upon radio transmission?
- What is the best hardware enclosure for the position encoder?
- What hardware and software configuration is best suited for the needs of SAR personnel in the field?

We plan to test our arrangement in three phases. First, we will test in a training search in a variety of terrain and environments. This will allow us to evaluate the enclosures and software. The second phase will consist of deployment in the field on an actual search. This second phase will allow us to evaluate the best position reporting format (beacon or mic unkey) in an actual SAR scenario. The third phase will consist of deploying the system with a number of SAR teams who do not have previous experience with the hardware arrangement. This will allow us to determine the level of training required to operate the system with the goal of not requiring more than the instructions, “Plug this in here, and that in there”.

Budget

The budget itemized in Table 1 allows for the construction of six complete systems.

TABLE 1. Proposed Budget

Qty	Item Description	Cost	Extension
6	TinyTrakII position encoder & enclosure	\$50.00	\$300.00
4	PC Data cable for Garmin eTrex	\$35.00	\$140.00
4	PC Data/Power cables for Garmin eTrex	\$50.00	\$200.00
1	Garmin eTrex GPS receiver	\$130.00	\$130.00
1	TNC for command post	\$200.00	\$200.00
1	Antenna and mast for command post decoding station	\$150.00	\$150.00
	Connectors and misc. cable	\$80.00	\$80.00
2	Yaesu VX-150 2m hand held radios	\$135.00	\$270.00
1	Map Software	\$210.00	\$210.00
		Total	\$1680.00

Each system that is to accompany teams in the field will consist of a TinyTrack position encoder with enclosure and a radio with appropriate data and power connectors. In addition a terminal node controller (TNC) is required for the base station (command post) to decode the position reports from the TinyTraks as well as map software to overlay the position data.

Our team currently owns five Garmin eTrex GPS receivers and four Yaesu VX-150 handheld radios. The additional GPS receiver and two radios will allow a complement of six tracking units to be deployed in the field.

Evaluation

Four of the data cables will be ordered with power connectors as well. This will give flexibility for long-term operation or for operation from a vehicle where auxiliary power is available.

Evaluation

The goal of this project is to effectively track SAR teams in the field in a variety of conditions automatically using APRS. A successful use of APRS is that which occurs when equipment is given to a team unfamiliar with APRS and GPS operation, and that team is tracked effectively during a SAR mission.

Project Participants

The following team members are those that will take an active role in building and developing the hardware and integrating the software. All of the people mentioned below are team members of the San Bernardino County Sheriff's Cave Rescue Team. It is understood that additional team members not mentioned here on the Cave Team as well as other teams operating in the county will participate in the evaluation and implementation of the project outlined in this proposal. It is also understood that only licensed amateur radio operators will transmit their position while operating on amateur frequencies.

Mark Kern. Amateur radio operator (KE6QXF), National Cave Rescue Commission Level II certified, EMT, NASAR SAR Tech Level II certified. 5 years SAR experience

Mark Kinsey. Amateur radio operator (KG6JZX), National Cave Rescue Commission Level I certified, NASAR SAR Tech Level II certified. San Bernardino County Sheriff certified for technical rope rescue intermediate and winter/alpine travel basic. 1.5 years SAR experience.

Bryan Lavender. Coordinator of San Bernardino County Sheriff's Cave Rescue Team, National Cave Rescue Commission Level IV certified, NASAR SAR Tech II certified/Instructor, San Bernardino County Sheriff certified for technical rope rescue, advanced/instructor, winter/alpine travel intermediate, serves on San Bernardino County Sheriffs Rope Rescue Oversight Committee (founding member), member of National Cave Rescue Commission Education Board. 17 years SAR experience.

Jeff Lehman. Amateur radio operator (KD6DHB), National Cave Rescue Commission Level II certified, NASAR SAR Tech Level II certified, San Bernardino County Sheriff certified for technical rope rescue advanced. 6 years SAR experience.

Tad Gallistel. Amateur radio operator (KG6ANQ), National Cave Rescue Commission Level III certified, NASAR SAR Tech Level II certified, San Bernardino County Sheriff certified for technical rope rescue advanced. 5 years SAR experience.

Francis Upton. Amateur radio operator (W6FRU). NASAR SAR Tech Level II certified, member of California Office of Emergency Services Auxiliary Communication Service. 5 years SAR experience.

John Norman. Amateur radio operator (KF6DPJ). NASAR SAR Tech II certified. San Bernardino County Sheriff certified for technical rope rescue, basic. 1 year SAR experience.