

2008 RAAM GPS Navigation Support

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An essential prerequisite to a successful Race Across America is to be able to comply explicitly with the Route Book, that is, to stay on the specified route. Since inception this has always been done by checking visible landmarks and a support vehicle odometer against specific directions in the book. For some this is a tedious and tiring task, while for others it's the perfect means to pass RAAM time. Using a Global Positioning System (GPS) device to keep track of where you are on the route and advise of upcoming turns and time stations can make this task easier and free Crew members for the many other requirements of Racer support.

What follows is a brief explanation of how GPS functions in the RAAM environment, which devices and associated computer software have proven to be most useful, and some suggestions as to how to prepare them before the race and use them effectively during the event.

This information is largely the result of more than 10 years of experimentation, use and play by Peter Moffett and his interactions with others and their experience of GPS on RAAM. Be aware that GPS devices and mapping technology continue to evolve despite our best efforts to keep up. The choice to use GPS is up to you. You should choose a device and method that works best for you and your crew. While the devices are not difficult, they are not trivial either. They take a little time to master and explain to your crew.

GPS basics:

GPS receivers constantly receive signals from numerous satellites which contain data enabling the location (latitude, longitude, and altitude) to be known almost instantaneously independent of weather conditions or operator actions. Location and time data can be presented to the operator as a track across a road or terrain map with time and distance to destinations ahead while preserving a record of where that receiver has actually been and when.

The cost effectiveness and reliability of GPS support for following a RAAM route are obvious, but the RAAM task is so different from normal GPS use that we have to understand which of the gadgets designed to get you back to a camp in the woods, or to get your car to the market and home again, can be configured for RAAM and then how to do it.

GPS Navigation Terms

There are three navigation terms that have specific meanings when used in a GPS context:

- A “**point of interest**” or “**waypoint**” is simply one location uniquely defined by latitude, longitude, and some descriptive name.
- A “**route**” to the GPS is either a set of directions to a destination in automobile devices or a sequence of waypoints to be reached in proper order in handheld devices. Routes in both kinds of devices can be straight lines (visualize an airline route of legs between turns at specific landmarks) or can follow mapped roads. Don’t confuse “route” used in the general context of GPS with the specific “RAAM route” defined in the hardcopy, published Route Book.
- A “**track**” is a very, very large number of unnamed waypoints close enough together than on handheld units it appears as a line that conforms to every turn of a route. On larger automobile GPS or PC screens a track may look like a series of points along a route, a trail of “breadcrumbs.”

GPS systems come in different sizes:

GPS receivers are packaged in various useful ways. Since the signal requires calculations to produce an actual location, a portable “handheld” GPS receiver the size of a cell phone has a built in computer, input buttons and a small output display screen. Memory is included so the screen can display maps. Places you want to go can be keyed in so the built in computer can provide a continuous output of where you are in relation to where you want to go and may even show you how to get there.

Larger than the battery operated “handheld” units, GPS receivers with larger screens are incorporated in dashboards of cars and in portable automobile navigation systems which can be moved from car to car, to assist drivers to get to a desired destination. These units normally have spoken output so the driver can get directions without taking his eyes off the road. Most come preloaded with a library of millions of suggested business, recreation, and entertainment destinations.

Some very basic GPS receivers, sometimes incorrectly referred to as just an antenna because they have no input buttons or output screens, are intended just to receive satellite information and pass it to an attached computer, most commonly a notebook computer in which a mapping program is running. The computer can display the satellite position on a full screen map with annotated terrain features, points of interest, and planned routes in addition to roads.

RAAM 2008 is defined by a series of about *400 waypoints* where the Route Book specifies a turn or time station report. The “RAAM route” requires that you reach each of these in correct order. To avoid having to upload data to a GPS gadget during the race it must have enough memory for all the waypoints organized into one or more “GPS routes.” (For example, a handheld GPS receiver with a capacity for 500 waypoints and 20 routes each with 30 of those waypoints meets RAAM 2008 needs.)

To be unambiguous the RAAM route is a “breadcrumb trail” *track* of almost *20,000 points*. Not every GPS device has the memory capacity for all this data but many do.

(Most handheld units are limited to 1000 or 2000 points. Automobile GPS navigation systems can normally handle a great many points but may divide them up into 10,000 point sections.)

To be useful the latitude and longitude of each waypoint and track point, each of the pair a ten digit numbers, as well as the names of all waypoints, must be entered into the GPS computer memory as well as the order in which you want to go through the waypoints. There is no way to do this manually with the GPS gadget data entry buttons without human error producing unusable results due to the huge number of keying operations necessary, To be useful in RAAM the route data must be able to be uploaded from a personal computer. GPS gadgets without data cable or wireless PC connections are of little use in RAAM.

Handheld, automobile, or PC GPS for RAAM?

Beyond just the obvious difference in equipment size, each GPS output format has advantages and disadvantages in the RAAM application:

The **handheld** units can be passed to Racers if they are going to be on their own during the day or want something for amusement. With it they can be reminded of when and where the next turn is and which way to go. These units if equipped with an auto power cable, to avoid frequent battery changes, can provide follow vehicle driver assistance while taking up minimal dashboard space but have a display screen which is usually too small to show maps clearly so an available numeric display with audible alarm options is often preferred. Suitable handhelds are available for about \$100 or even less and can last for many years (and RAAMs). Avoid units with fancy add-ons that aren't essential in RAAM (such as color screens that require backlighting during the day, MP3 players, and camera capabilities) which reduce battery life unacceptably for use by a RAAM Racer or may require exotic, high cost, short lived batteries.

Car units have useful maps but will route you via built in criteria (shortest distance, quickest, not toll roads, and so forth) from point to point but usually NONE of these will be the route RAAM specifies. They may, however, be able to display the "breadcrumb trail" and sound an alarm as each required turn is approached. The size and short battery life of portable car units make them less suitable for the Racer to have on the bike even for short periods without a follow vehicle. Some, particularly those built into dashboards by car manufacturers, do not have cable/wireless computer links for uploading data and would not be of much help in RAAM.

A **PC running mapping software** with input from a handheld or basic GPS receiver is the most elegant way to go, has virtually no waypoint or track data limitations, and can be the least costly if you already have the notebook computer for other RAAM uses (email and web race status reports) but the size makes it almost prohibitive where the driver in a follow vehicle can see it. Often if a notebook is available the space and external power to run continuously is more likely to be available in an RV or auxiliary support vehicle it can be used to upload the data to smaller units for the follow vehicle or Racer as well as

run mapping software to get the support vehicle with only a driver on board back to the race after a provisioning side trip.

RAAM's experience with GPS (what's been found to work):

In the mid 90s RAAM was sponsored in part by the Chicago Map company (now Undertow Software) which packaged a Lowrance GPS handheld receiver with their Precision Mapping software which uploaded the RAAM data to the GPS unit when running in the then bulky desktop PCs. Precision Mapping "Streets and Traveler" supported Garmin and Magellan handheld receivers as well as Lowrance and RAAM users become comfortable with one of these devices on the dashboard in front of the driver where it counted down miles to the next turn or time station and indicated which turn in the Route Book that would be. While there are now more GPS brands and software titles that do the job, using a handheld device to free up the follow car navigator for other RAAM tasks or a "power nap" has become a popular option.

In the early years of the new century DeLorme offered sponsorship which included their Street Atlas full featured mapping software for laptop and notebook users and added a DeLorme Earthmate simple GPS receiver. In most cases the whole package obscured the driver's view of the road in crowded follow vehicles but the software included the ability to upload RAAM data to any of many brands of handheld GPS receivers with their own small displays for follow car drivers to use.

The popular and economical Microsoft Streets and Trips software can display data from a basic or handheld GPS receiver on a moving map to which a RAAM breadcrumb trail had been added but does not have the capability to directly upload data to a handheld or automobile navigation device.

In recent years built in navigation systems have been included in many new cars and portable units have been marketed for cars without installed GPS packages. This is a booming market but so far with little RAAM experience. If a built in unit can be uploaded with RAAM data it could reduce dependency on dash mounted handheld units. In scouting the new sections of the 2008 RAAM route a portable automobile GPS unit was useful in following a "trail of breadcrumbs" (marks about a quarter mile apart often on roads not displayed on the GPS map) to make the desired turns but the GPS routing functions of the device could not be made to conform to the RAAM route so verbal directions from the device were turned off and the system became much like a small version of a PC running Microsoft Streets and trips but without the detailed map. This area of product development is evolving rapidly so that new gadgets may soon appear which will be more useful in RAAM.

RAAM GPS Support:

What follows are links to various computer files which you may download from this web site and use in your GPS devices. If changes are made to the RAAM route these file will be updated.

The files are in ASCII text comma separated variables format (indicated by the .CSV file name) and may be opened in any text editor (notepad, etc.) or word processor or as spreadsheets with Excel or compatible software for editing and sorting. Many of the GPS devices have vendor proprietary data formats which only their units will accept so the files supplied here will in most cases have to be translated before being uploaded to a GPS processing handheld/automobile receiver. Programs to do this are normally provided on an installation CD that accompanies GPS receivers with data upload capability. For those with some computer expertise, and lacking the vendor installation CD, GPSBable is a free downloadable program which translators to and from a great many GPS data formats.

The **R08-turns-ts.CSV** waypoint file contains, not surprisingly, the latitude/longitude of all the turns and time stations specified in the RAAM 2008 Route Book. Each has a name which is referenced in the book and also allows you to put them in the proper order when building routes in “handheld” or PC supported GPS systems. The reference point names for time stations are TS01 through TS54. Reference names for turns (e.g., **06F-BR**) start with the two digit number of the *next* time station and a letter which allows you to sort up to 26 turns between two time stations into the proper order. Then comes a dash (hyphen) and a one or two letter abbreviation of what is to be done at that turn (L, R, or S for Left, Right, or Straight; BR, BL for bear right or left). These turn directions are only reminders, Crews and Racers are expected to check for the complete explanation in the Route Book.

(Download the R08-turns-ts.CSV link goes here)

The R08-track.CSV file contains the latitude/longitude of a set of almost 20,000 points at intervals from a few hundred feet to about a quarter mile along the route specified in the RAAM 2008 Route Book. These form the “bread crumbs” marking the track when displayed as part of GPS maps.

(Download the R08-track.CSV link goes here)

More GPS file info and help:

In preparing the route for 2008, handheld GPS receivers and PC notebook programs were extensively used to avoid the errors of drifting odometer calibration and measuring distances on flat paper maps. In the process data files for Magellan Explorist, and Roadmate GPS receivers as well as DeLorme “Street Atlas”/”Topo” and Microsoft “Streets and Trips” were produced and will be kept up to date here.

(Links to MGLN, UPT, EST, DMT and other files)

The route designer will also try to answer specific questions about GPS and RAAM 2008 sent to (gps@raceacrossamerica.org) or posted to the ultracyclists@googlegroups.com.