It knows where you are

Magellan's global-positioning radio receiver is a lot of fun for not a lot of money / **Simson L. Garfinkel**

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ON A RECENT flight to Oakland I took out an electronic device the size of a paperback book, hooked it up to an antenna I taped to the window, and pressed a button. In less than a minute I knew the aircraft was precisely 527 nautical miles from the airport at an altitude of 10,731 feet. Traveling at 406 m.p.h., we had an estimated time of arrival of 1 p.m.

The device in my hand was a Magellan Skyblazer XL GPS receiver, a low-cost radio that listens to the US Defense Department's Global Positioning System network. Started in 1973, the GPS system has been up and running since December 1993.

The GPS system consists of 26 satellites, each continuously transmitting a radio beacon that tells earth-based receivers the satellite's position and the exact time that the radio message was transmitted. My GPS receiver has a built-in high-speed computer and its own highly accurate clock.

When the receiver hears a signal from the satellite, it calculates how long the radio wave was traveling through space, which tells the receiver how far it is from the satellite. When the receiver can hear signals from three satellites, it can use those three sets of distances to triangulate on its exact longitude and latitude. If the receiver can hear four satellites, it can also compute its altitude.

The actual GPS calculation is far more complicated than this, of course. For example, the actual frequency on which each satellite is transmitting shifts slightly depending on whether the satellite is moving toward the receiver or away from the receiver – an effect called Doppler shift. The GPS receiver has to account for this fact when it listens for each satellite. The receiver also uses Doppler shift to figure out how fast it is moving. And the receiver uses the signals from the satellite to set its own internal clock.

The GPS satellites actually transmit two signals: the Standard Positioning Signal, designed for use by civilians, and the Precision Positioning Signal, a specially coded signal that can only be used by the US military.

The standard signal has intentional errors that are introduced into it so that enemy nations can't use the GPS system for guiding missiles toward US installations. Because of "selective availability," GPS receivers are only accurate to roughly 75 feet.

As GPS has been used for more and more safety-critical applications, like guiding aircraft, the selective availability policy has come under increasing attack. As a result, the Clinton administration recently issued a directive that selective availability will be turned off by 2006. Once it is gone, civilian GPS receivers will be as accurate as military ones – approximately 50 feet or better.

I've wanted a GPS receiver for years, but I've always found them too expensive. No longer. You can now buy the Magellan GPS 2000 XL, a 10-ounce, waterproof GPS the size of a flashlight for roughly $150.

The Magellan GPS 2000 XL weighs 10 ounces, is waterproof, and costs roughly $150.

Designed for hikers and boaters, you can take the GPS 2000 camping. Press a button at your base camp and then go for a walk, and the GPS 2000 will tell you how far you have traveled and will draw you a map that shows you how to get back. The unit is powered by four AA batteries that last for roughly 24 hours of continuous use.

I have been carrying my GPS 2000 around with me for a few weeks. I have programmed into it waypoints for my home and office as well as the best coffee shops around town. The 2000 told me how far apart each place is and revealed that I walk at roughly 2.3 m.p.h.

There's also an attachment you can use to connect the GPS 2000 to the dashboard of your car or the handlebars of your bike, although I think that would be asking for trouble: The thing is so much fun to play with that I'd likely be watching its screen when I should be avoiding traffic. What's missing from this $150 unit is the ability to connect it to your computer so that you can upload or download information. That feature is on Magellan's more expensive models, such as the GPS 4000, which lists for $659.

Magellan's Skyblazer is designed for use primarily by pilots. Besides a fully-functional GPS receiver, it's got a database that lists every airport in the United States with a runway of more than 1,600 feet, as well as radio navigation beacons and information about the controlled airspace that's around many metropolitan areas. Since most cities have their own airports, this database is also useful on long road trips as well, although you need to know the airport's three-letter code.

The Skyblazer is dramatically more sensitive than the GPS 2000: Whereas I had a hard time getting more than four satellites at a time with the GPS 2000, the Skyblazer routinely pulled in six or more. Unfortunately, you pay for this sensitivity: The three AA batteries only last for three hours of continuous use.

If you are going to be doing a lot of driving, you might want to look into a GPS that has a street atlas programmed in. Hertz and Avis now rent luxury cars with built-in navigation systems that track the car's location and give directions. Unfortunately, most of these systems cost thousands of dollars and are relatively difficult to install.

Another solution is DeLorme's Tripmate, which combines DeLorme's Street Atlas USA 4.0 with a small bright yellow GPS receiver. I've seen the Tripmate advertised for as low as $154 on the Web. You'll need to provide your own laptop computer, of course, as well as a cigarette-lighter adapter. Although this is surely the geek's solution, I don't like it, because I can't fit my laptop in my back pocket when I go hiking.

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