NAVIGATION

GPS's 'Dress Rehearsal' For Year 2000 Problem

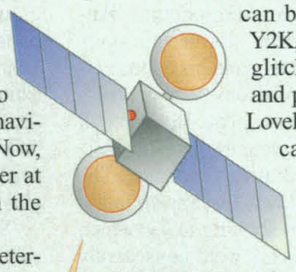
It's a glaring Sunday in August, somewhere in the trackless wastes of Nevada beyond Death Valley, and you've had enough geological mapping for one day. Ready to head home, you check your GPS (Global Positioning System) receiver for the shortest route back to the truck. Surprise! You're not in Nevada anymore, the readout informs you, but close to downtown Los Angeles. Welcome to the Week Zero Problem, a design glitch that will befuddle thousands of GPS receivers come the 21st of this month. "It's serious enough to be called a 'dress rehearsal' for Y2K," says John Lovell, director of quality at Trimble Navigation Ltd. in Sunnyvale, California. "Users who depend on GPS for geographic locations on land, at sea, or in the air could face serious safety hazards." The receivers depend on knowing the time to function properly, and on the 21st, timepieces on the fleet of GPS satellites will roll over to zero like car odometers hitting 100,000 miles. Manufacturers believe they've got the problem well in hand with software fixes for the receivers, but they expect some older receivers to act up—and advise caution during that last week of August.

Like the Y2K problem, the Week Zero Problem has its origins in an early programming decision. Just as the first computer software designers economized on computer memory by recording only the last two digits of the year, designers of the U.S. military's GPS opted to track time on the satellites by counting weeks—using only 10 bits in a binary code of 1's and 0's. That meant the GPS week counter could tally up to 2^{10}, or 1024, weeks before rolling over to week zero. The clock started on 6 January 1980, and since then GPS has penetrated all sorts of civilian markets, from monitoring earthquake faults to surveying roads, tracking freight, and navigating cars, ships, planes, and hikers. Now, the satellites' week counters will roll over at midnight, Greenwich Mean Time, on the night of 21 to 22 August.

When operating properly, GPS can determine geographic positions anywhere in the world to within 100 meters by triangulating on at least three satellites. Each satellite beams a radio signal to a receiver, specifying the satellite's orbit and the precise time the signal set out. By checking three satellites and calculating how long each signal took to arrive, a receiver can triangulate its position. But when the rollover happens, the satellites will send out 19-year-old dates.

Exactly how a receiver reacts will depend on the model. Receiver manufacturers began building in fixes in the early 1990s that prevent confusion over what week it is, so most receivers will do fine. But some units will try to track satellites with the schedule of the original Week Zero and so may take from a few seconds to as much as 20 minutes longer than usual to locate satellites, warned the U.S. Department of Transportation (DOT) in early June. Spokesperson Sara Beane of Garmin Corp. in Olathe, Kansas, a leading GPS manufacturer, says that less than 20% of their GPS receivers—those more than 3 or 4 years old—have this problem, and Garmin offers a free software patch to fix it.

Other GPS receivers will fare worse. They may never locate satellites and fail to work at all, says the DOT, or they may appear to work but display the wrong position. No one knows for sure just how many of the world's 10 million to 15 million GPS receivers will turn into pumpkins. The DOT maintains a Web site of contact information for more than 60 manufacturers worldwide,* but it's up to each manufacturer to test its products and provide upgrades. Magellan Corp. spokesperson James White in San Dimas, California, says that 99% of their GPS products should perform normally and that word is getting out to users about the problem. White sees the response to the rollover as an example of what can be done when, as in Y2K, people know about a glitch and can test for it and provide a fix. Still, as Lovell points out, "No one can predict precisely how GPS satellites and GPS technology will function in each and every application." So when you go out that Sunday, you might want to bring the old map and compass.



–RICHARD A. KERR

*www.navcen.uscg.mil/gps/geninfo/y2k/gpsmanufacturers/manufacturers.html

ENVIRONMENTAL SCIENCE

Science Board Floats $1 Billion Trial Balloon

After years of complaints from scientists and activists that it pays environmental research short shrift, the National Science Foundation (NSF) heard a similar message last week from its own governors. The National Science Board (NSB) issued a report recommending that NSF ramp up spending on environmental science from $600 million in 1999 to $1.6 billion in 5 years.

Such a boost would jibe with the direction in which NSF director Rita Colwell, an ecologist, is steering the agency. Last year, she proposed a network of "biodiversity observatories" to study interactions among organisms (*Science*, 25 September 1998, p. 1935), a project that could get under way in 2000. But although NSF takes advice from the science board seriously, the prescribed boost is far from a fait accompli: Congress must approve any increase, and early indications are that NSF's overall budget request could face a tough time this year (see p. 813).

The NSF panel that produced the report,* chaired by marine ecologist Jane Lubchenco of Oregon State University in Corvallis, reviewed scores of reports on environmental policy as well as hundreds of comments from organizations and individuals. It says NSF devotes about $600 million, or 20% of its budget, to worthwhile environmental research projects ranging from microbes that thrive in hot springs to field sites that collect data on long-term trends, such as acid rain's effects on forest growth. But that's not near-

* Environmental Science and Engineering for the 21st Century: The Role of the NSF, www.nsf.gov/nsb/tfe/nsb99133/start.htm

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