A Brief History of GPS

Hikers do it. Ambulance drivers do it. Even fighter pilots do it. Around the world, millions of people use the global positioning system, or GPS, to know where they are and where they're headed. The satellite-based navigation system has become an indispensable tool for everyone from cell-phone manufacturers to oil drillers, which explains why a government report on GPS released this month prompted a tide of concern. The Government Accountability Office warned of "significant challenges" to maintaining the system at full strength beginning as soon as next year, due to technical problems and delays in a $5.8 billion plan to upgrade the system with next-generation satellites.

Satellite navigation owes a debt to *Sputnik*, the pioneering Soviet satellite launched in 1957. U.S. scientists learned they could track the satellite's orbit by listening to changes in its radio frequency, relying on the same principle that explains why the pitch of a car's horn seem to change as the car speeds by. The Navy's TRANSIT navigation system was developed in the 1960s, relying on six satellites and designed originally for use by submarines. More than 10 satellites were eventually launched, though ground units had to wait up to several hours to pick up a signal. Meanwhile, engineers Ivan Getting and Bradford Parkinson began leading a Defense Department project to provide continuous navigation information, leading to the development of GPS (formally known as NAVSTAR GPS) in 1973.

The military launched the first GPS satellite in 1978 and completed the system in 1995. GPS uses a "constellation" of 24 satellites orbiting 12,000 miles high, each circling the globe every 12 hours. The 2,000-lb satellites broadcast radio signals to Earth with information about their location and the exact time the signal was transmitted (each satellite carries an atomic clock). By calculating the difference between radio signals received from four or more satellites, GPS receivers on the ground can determine their own location, speed and elevation with great accuracy — usually within a few meters or even less. Satellites are regularly replaced as they age and fail; there are currently more than 30 in space, with the extras used as spares and backups.

GPS plays a major role in American military combat, guiding missiles and bombs to their destinations in Iraq, Afghanistan and elsewhere. President Reagan opened the fledgling navigational system to nonmilitary uses in 1983 after Soviet fighter jets shot down Korean Air flight 007, a passenger jet that had accidentally strayed into Soviet airspace, killing all 269 on board.

Civilian demand for GPS products surged in 2000, when the military ended its practice of intentionally fuzzing the satellite's signals for security purposes. Overnight, navigation devices became 10 times more accurate and swiftly became standard equipment in a slew of industries, from commercial fishing to freight-hauling. Consumers have also rushed in as the size and price of GPS receivers have dropped; they're growing increasingly common in phones, wristwatches and even dog collars. Adventure seekers use GPS for a game called geocaching, a kind of satellite-based treasure hunt that currently boasts more than 800,000 active "caches" waiting to be found around the world. One market-research firm estimates the worldwide GPS market will total $75 billion by 2013. Scientists are continually finding new uses for GPS, as well.

Meteorologists gauge wind speed and other variables by measuring satellite signals as they pass through the atmosphere; geologists study earthquakes using GPS receivers placed along fault lines; and technicians synchronize computer networks for everything from power grids to financial networks using the satellite signals' precise timing.

The GAO's report does not predict that the GPS system will fail outright; it offers a more mild (and vague) warning, suggesting only that a delay in replacing satellites may impede "the level of GPS service that the U.S. government commits to." But given the world's growing dependence on the space-age compasses, the military scrambled to quell any concerns. "The issue is under control. We are working hard to get out the word," Air Force Col. Dave Buckman wrote to worried questioners on a military Twitter account May 20. "GPS isn't falling out of the sky."