Global Positioning System & EMS

By William E. Ott

Last month, I wrote about the benefits of using geographical information systems (GIS) to assist in modeling EMS data. This month, I thought I'd expand on that by giving you an overview of a national asset that can be quite useful in conjunction with a GIS system for response modeling and for many other public safety applications. The asset I'm referring to is a global positioning system (GPS). With the rapidly growing use and proliferation of GPS-enabled equipment in EMS, I thought some background information was in order.

The official name for GPS is Navigation Satellite Timing and Ranging Global Positioning System (NAVSTAR GPS). It was developed and continues to be funded by the U.S. Department of Defense (DOD). Through 2003, the United States has spent approximately $22 billion on the system. Its development dates back to the 1960s, when the DOD was looking for a hyper-accurate navigational information system to guide U.S. military forces on land, sea and air. It would also guide ballistic missiles, especially those launched from submarines, which are constantly moving around without a fixed point of reference.

A specific requirement of the navigation system was that it had to be available anywhere on the globe, function in any weather conditions, and resist enemy jamming and interception. To best accomplish this, designers determined the navigation tool should be space-based.

The Air Force and Navy began experimenting with small-scale projects in the late 1960s and early '70s with programs known as Transit and Timeation. In 1973, Congress gave the go-ahead to build a full GPS system.

The first GPS satellite was launched in 1978. The program reached limited operational capacity in time for the Persian Gulf War in 1991 and was declared fully operational in 1993.

New GPS satellites (now in their third generation of improved capabilities) are launched at regular intervals to replace aging satellites. The satellites have an expected life span of eight to ten years, although several launched in the mid ’80s are still operational.

The GPS system consists of 21 operational satellites and three “hot” spares, forming a 24-satellite constellation surrounding the earth. Approximately 44 satellites are currently in orbit, but the extras are “cold” spares, typically either the oldest, now obsolete satellites or the newest ones that are still being tested.

The satellites travel at a height of 20,200 km above the earth and complete one orbit every 11 hours and 58 minutes. Each satellite transmits a unique, 10w signal toward the earth. The signal contains many things, but most importantly, it contains what satellite it is, where the satellite is located in the constellation and the time of its transmission.

You need to lock your receiver on at least three satellites to get accurate horizontal positioning and on at least four satellites to get accurate vertical positioning. The GPS provides standard accuracy of 15–20 meters horizontally and 25–30 meters vertically. Add-ons can bring this accuracy to centimeter level.

The U.S. Air Force controls and monitors the GPS system around the clock. Because GPS is closely tied to national security issues, the Air Force can turn off civilian GPS signals in certain areas of the world as required.

As a safety measure, civilian GPS receivers cease to function at altitudes higher than 60,000 feet or speeds exceeding 1,000 mph. This is to keep inexpensive receivers from being used to guide ballistic missiles. Russia has a technically inferior GPS system known as GLONASS and the European Union is hoping to build their own system known as Galileo.

The GPS system is designed using complex mathematics known as orbital mechanics and geodetic algebra; however, from the user perspective, GPS is easy to use and understand.

Its full scope is obviously beyond this article, but a GPS receiver determines its position by a mathematical process known as trilateration. The receiver picks up signals from available satellites and calculates how long each signal took to reach the receiver from each satellite's location in orbit, to ascertain a precise location.

The GPS has assumed a much larger civilian and public safety role than its creators ever anticipated. In fact, civilian use has eclipsed military use. You can now buy personal GPS receivers at Wal-Mart for under $100.

GPS will continue to proliferate. One GPS equipment company even predicts GPS will be the next utility because the masses will come to expect or demand that it be in a multitude of products.

Within the next eight to 10 years, GPS (along with nice, color mapping) will likely be a standard feature in all vehicles. EMS and law enforcement will greatly benefit from this. Protocols already exist that allow public safety radio systems to tie into individual vehicle GPS systems, sending a precise vehicle location to 9-1-1 dispatchers.

I recently spoke with a biomedical company that's contemplating building a sub $1,000 AED that would include a built-in GPS receiver and wireless phone. When activated, the unit would place a call over any available wireless system to 9-1-1 and allow speakerphone-type communication while sending its location information to a communications center.

Perhaps the biggest lifesaving use is likely the new GPS-enabled wireless phones that will allow 9-1-1 centers to see exactly where callers are located. With nearly a third of 9-1-1 calls nationally coming from wireless phones, this has tremendous potential to identify a patient's exact location and reduce emergency response times.

GPS use is here to stay and growing. If you don't know much about it yet, you'll likely need to gain a basic understanding of it in the future as more equipment and processes involve GPS.