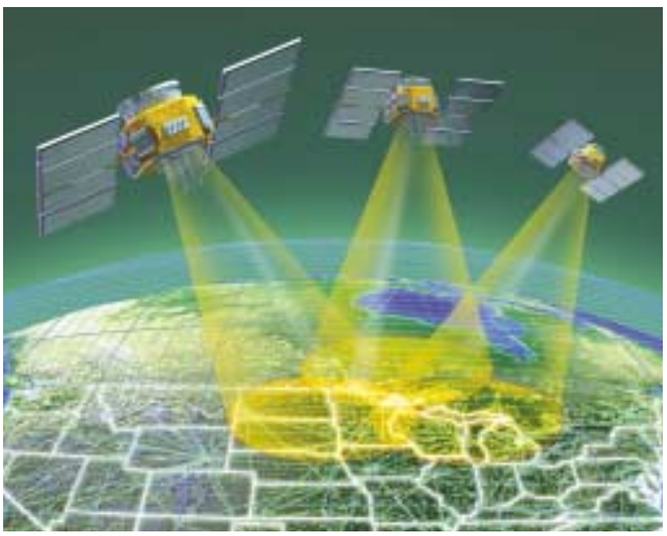
TECHNOVATIONS

SATELLITE NETWORK

GLOBAL POSITIONING SYSTEMS PINPOINT THE PLANET

Once under the dictates of the government, research shows Global Positioning System (GPS) technology is now a part of daily life for millions of people who use it while driving across America or bird watching in Finland. Corporations too are adapting the technology to increase their efficiencies by tapping satellite signals from almost 11,000 miles away.

The U.S. military says it originally developed the GPS receivers to locate soldiers and vehicles, monitor enemy maneuvers in a battlefield and detect nuclear missile explosions. A 1996 presidential directive made signals more accurate and accessible for commercial and scientific use in the spring of 2000.



Rockwell International Corp. (ROK) says it launched the first satellites in 1978 and built and tested the second generation. **Lockheed Martin Corp. (LMT)** reports that it has launched third-generation satellites to replace old ones. **The Boeing Co. (BA)**, which acquired Rockwell's aerospace division, has produced fourth-generation satellites, which the airforce says it expects to begin launching in the fall of 2005.

The Pentagon confirms it once degraded civilian satellite signals so the closest civilians could get to pinpointing a position was a daunting 300 to 500 feet. Now that new regulations have narrowed the distance to an average of 20 to 40 feet, and many hand-held receivers cost less than $100, GPS has become an estimated $12 billion to $15 billion industry. Research firm Allied Business Intelligence's "GPS World Markets 2002" study expects it will grow to as much as $41 billion by 2006.

Today a constellation (called NAVSTAR) of 24 U.S. satellites—each weighing between 2,175 and 3,758 pounds depending on the generation—circles the earth, sending radio signals back to receivers at the speed of light. Of the seven or so satellites usually "visible" to a receiver at any given moment, receivers need to view at least three to work.

Using a geometric principle called trilateration, a receiver measures the time the signals take to travel from each satellite and then calculates the latitude, longitude and altitude of its current position. (Quartz clocks in the receivers and atomic clocks in satellites synchronize their time together.) Most receivers then combine this location data with digital maps stored in their memory or accessed through a computer to help users verify their position.

Companies including Boeing and Lockheed Martin maintain the satellite system. **Harris Corp. (HRS)** says it is proposing unfurlable, mesh antennas for the satellites that will supply extra power and more accuracy because signals will be stronger and better able to move effectively through solid obstacles.

Analysts confirm the most popular consumer use for GPS is in vehicle navigation systems. **General Motors Corp. (GM)** says it introduced its OnStar system in 1996 and now offers the feature in more than 60% of its models. With the growing number of cars using GPS technology, analysts predict the auto market will represent 41% of total GPS usage by 2006.

The wireless communications market has also embraced GPS. **Motorola Inc. (MOT)** says it is building GPS-equipped cell phones due out by year end that, working together with the wireless network, will provide emergency-response agencies with callers' locations.

Motorola has partnered with **Orbital Sciences Corp.**'s **(ORB)** transportation management system division, which reports creating a GPS system that tracks bus locations in most of the U.S.'s largest metropolitan areas. "Combined with intelligent vehicle technologies, this system is accelerating societal benefits like timeliness and increased safety for vehicle operators and passengers," says Orbital's Dave Mathisen, general manager of the division. "GPS brings the benefits of space technology to consumers."

BY KAREN A. FRENKEL | ILLUSTRATION BY BRYAN CHRISTIE

digiPlanet

Using Geographic Information System (GIS) technology, maps combining layers of data (such as census information) can be digitally draped over one another to create a superimposed map for a specified purpose. Analysts estimate that GIS services revenues now top $7 billion annually. Global Positioning System (GPS) technology is like a high-tech arrow that pinpoints specific locations within these maps.

IN-VEHICLE NAVIGATION SYSTEMS

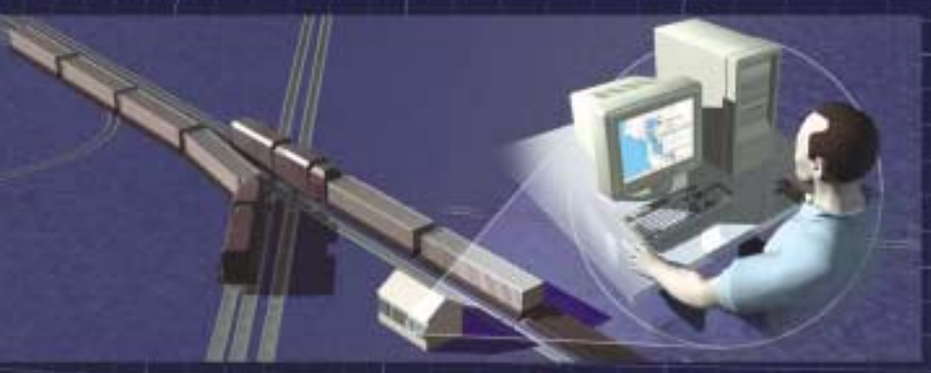
DaimlerChrysler AG (DCX), Ford Motor Co. (F), General Motors Corp. (GM)

GPS can be used with off-the-shelf or built-in navigation systems to map routes and track locations. Cellular car phones and a subscription service such as OnStar can go even further, says GM, automatically locating automobiles involved in accidents. A microcomputer in the car monitors the airbags. If it detects that an airbag has deployed, the computer calls a service center over the car's cell phone, passing on the last known location of the car as determined by the GPS receiver. Drivers too can contact the service center with their vehicle code if the car is stolen or if they are locked out. GM explains that the center can locate the car through GPS and unlock doors by sending a signal through the cellular network. GM says drivers can also receive directions, traffic information and weather reports.

LAND MANAGEMENT

Forest Technology Group subsidiary, Mead Westvaco Corp. (MWV)

Web-based GIS software allows forest managers and others to access GIS as they would on a personal computer, but without requiring specialized hardware or software. Forest Technology Group says computer simulations allow the forest to be viewed in its present condition and how it might appear in the future if subjected to a change in harvest and management activities. Custom maps of forest areas, a principal tool of foresters and wildlife biologists, can be produced as well, the company says.



TRACKING SHIPMENTS

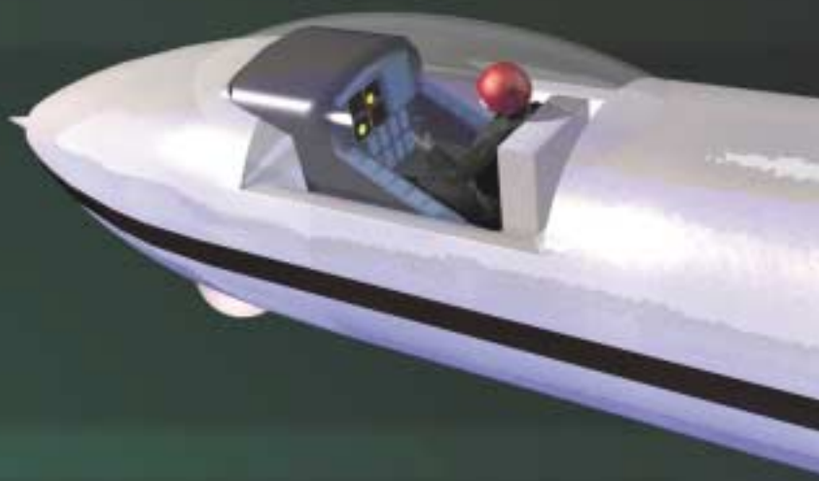
Nexterna Inc., a subsidiary of Union Pacific Corp. (UNP)

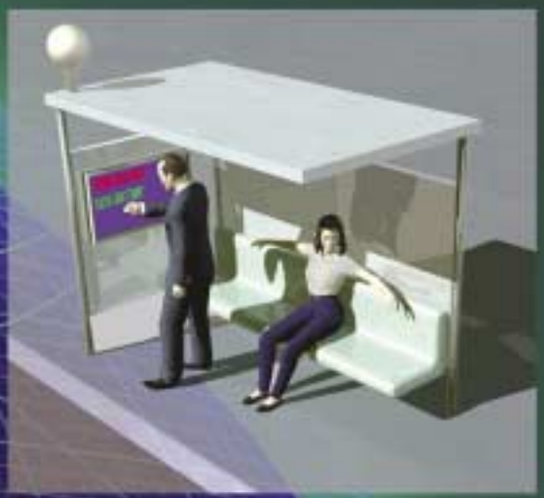
Onboard computers integrated with Web-based software and wireless GPS communications help railroads monitor and increase productivity for 2,000 locomotives on 33,000 miles of track and cut down on the number of locomotives required, says Nexterna. Charles Eisele, senior vice president, strategic planning, says: “We are using this information to improve locomotive utilization. The GPS deployed in 20% of our fleet so far has resulted in a one-time cost-avoidance of $100 million.”

MILITARY APPLICATIONS

Integrated Defense Technologies Inc. (IDE), United Defense Industries Inc. (UDI)

GIS and GPS are integrated into combat aircrafts for the armed services so that the military can communicate between the aircrafts, according to Integrated Defense Technologies and United Defense Industries. Integrated Defense says it also helps train military pilots with an electronic pod under the aircraft wing that simulates flying by recording training sessions with GPS positions.





TRANSPORTATION SYSTEMS

Orbital Sciences Corp. (ORB), Motorola Inc. (MOT)

GPS navigation systems help public transit systems offer safer and more efficient travel, according to Orbital and Motorola, which have partnered to provide major metropolitan areas of the U.S. with a system that transmits bus positioning information to dispatchers in real time. In an emergency, drivers press a footswitch enabling the dispatch center to listen through a concealed microphone. People at bus stops are warned of delays with signs and wireless devices that display next arrival times. Orbital says the technology can also be used for road maintenance fleets to determine which areas are the most affected in a snowstorm and need to be plowed first.

PRECISION FARMING

Deere & Co. (DE)

Farmers electronically enter field information, such as weather conditions, seed varieties, populations, and tillage practices using an in-cab display found in a sprayer, tractor or combine. As farmers make notations in the field, Deere says, the GPS receiver records the precise location, in sections as small as 10 inches. The information gathered is saved on a portable PC Data card and can then be uploaded into a personal computer using mapping software to create yield maps and reports, Deere explains.

WASTE MANAGEMENT

Caterpillar Inc. (CAT)

Many landfill sites must undertake the costly task of importing extra soil to cover shortages, says Caterpillar, explaining that its onboard software and GPS technology helps operators monitor land grade and determine how many passes are necessary to cover and smooth an area with the right amount of soil. Systems then transmit terrain changes to the office. Caterpillar reports this has allowed one landfill site to save 30% in soil replacement costs.

MESSAGING SYSTEMS

Hewlett-Packard Co. (HPQ)

Birdwatchers in Helsinki, Finland have access to a mobile messaging system called Bird Observation Service. Subscribers enter information on bird sightings and at the push of a button, the GPS-powered system transmits species details, the time of sighting, and the location of the observer to registered users in real time with support from a Website, says HP. The company reports teaming up with an independent mobile phone manufacturer to build the GPS navigator and mobile maps service into durable phones for wilderness use. HP says that next-generation phones will be capable of recording videos and still pictures.