

## 13. Global Positioning System



**Figure 5.14.1** Positioning signals broadcast from three Global Positioning System satellites are received at a location on Earth

*Credit: U.S. Federal Aviation Administration, 2007b*

**The Global Positioning System (GPS) employs trilateration to calculate the coordinates of positions at or near the Earth's surface.** Trilateration refers to the trigonometric law by which the interior angles of a triangle can be determined if the lengths of all three triangle sides are known. GPS extends this principle to three dimensions.

A GPS receiver can fix its latitude and longitude by calculating its distance from three or more Earth-orbiting satellites, whose positions in space and time are known. If four or more satellites are within the receiver's "horizon," the receiver can also calculate its elevation and even its velocity. The U.S. Department of Defense created the Global Positioning System as an aid to navigation. Since it was declared fully operational in 1994, GPS positioning has been used for everything from tracking delivery vehicles, to tracking the minute movements of the tectonic plates that make up the Earth's crust, to tracking the movements of human beings. In addition to the so-called **user segment** made up of the GPS receivers and people who use them to measure positions, the system consists of two other components: a **space segment** and a **control segment**. It took about \$10 billion to build over 16 years.

Russia maintains a similar positioning satellite system called [GLONASS](#). Member nations of the European Union are in the process of deploying a comparable system of their own, called [Galileo](#). The first experimental GIOVE-A satellite began transmitting Galileo signals in January 2006. The goal of the Galileo project is a constellation of 30 navigation satellites by 2020. If the engineers and politicians succeed in making Galileo, GLONASS, and the U.S. Global Positioning System interoperable, as currently seems likely, the result will be a **Global Navigation Satellite System (GNSS)** that provides more than twice the signal-in-space resource that is available with GPS alone. The Chinese began work on their own system, called Beidou, in 2000. At the end of 2011, they had ten satellites in orbit, serving just China, with the goal being a global system of 35 satellites by 2020.

In this section you will learn to:

1. Explain how radio signals broadcast by Global Positioning System satellites are used to calculate positions on the surface of the Earth; and
2. Describe the functions of the space, control, and user segments of the Global Positioning System.

The Nature of  
Geographic  
Information

 

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