GARMIN

GPS Beginner's Guide

Contents

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Introduction

Global Positioning System (GPS) technology is changing the way we work and play. You can use GPS technology when you are driving, flying, fishing, sailing, hiking, running, biking, working, or exploring. With a GPS receiver, you have an amazing amount of information at your fingertips. Here are just a few examples of how you can use GPS technology.

- Know precisely how far you have run and at what pace while tracking your path so you can find your way home
- Pinpoint the perfect fishing spot on the water and easily relocate it
- Get the closest location of your favorite restaurant when you are out-of-town
- Find the nearest airport or identify the type of airspace in which you are flying

What is GPS?

The Global Positioning System (GPS) is a satellite-based navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides you with information. Using GPS technology, you can determine location, velocity, and time, 24 hours a day, in any weather conditions anywhere in the world—for free.

GPS, formally known as the NAVSTAR (Navigation Satellite Timing and Ranging) Global Positioning System, originally was developed for the military. Because of its popular navigation capabilities and because you can access GPS technology using small, inexpensive equipment, the government made the system available for civilian use. The USA owns GPS technology and the Department of Defense maintains it.

GPS technology requires the following three segments:

- Space segment (Page 4)
- Control segment (Page 4)
- User segment (Page 5)

Space Segment

At least 24 GPS satellites orbit the earth twice a day in a specific pattern. They travel at approximately 7,000 miles per hour about 12,000 miles above the earth's surface. These satellites are spaced so that a GPS receiver anywhere in the world can receive signals from at least four of them.

Each GPS satellite constantly sends coded radio signals (known as *pseudorandom code*) to the earth. These GPS satellite signals contain the following information:

- The particular satellite that is sending the information
- Where that satellite should be at any given time (the precise location of the satellite is called ephemeris data)
- Whether or not the satellite is working properly
- The date and time that the satellite sent the signal

The signals can pass through clouds, glass, and plastic. Most solid objects such as buildings attenuate (decrease the power of) the signals. The signals cannot pass through objects that contain a lot of metal or objects that contain water (such as underwater locations).

The GPS satellites are powered by solar energy. If solar energy is unavailable, for example, when the satellite is in the earth's shadow, the satellites use backup batteries to continue running. Each GPS satellite is built to last about 10 years. The Department of Defense monitors and replaces the satellites to ensure that GPS technology continues to run smoothly for years to come.

Control Segment

The control segment is responsible for constantly monitoring satellite health, signal integrity, and orbital configuration from the ground. The control segment includes the following sections:

- Master control station
- Monitor stations
- Ground antennas

Monitor Stations
At least six unmanned monitor stations are located around the world. Each station constantly monitors and receives information from the GPS satellites and then sends the orbital and clock information to the master control station (MCS).

Master Control Station (MCS)
The MCS) is located near Colorado Springs in Colorado. The MCS constantly receives GPS satellite orbital and clock information from the monitor stations. The controllers in the MCS make precise corrections to the data as necessary, and send the information (known as ephemeris data) to the GPS satellites using the ground antennas.

Ground Antennas
Ground antennas receive the corrected orbital and clock information from the MCS, and then send the corrected information to the appropriate satellites.

User Segment
The GPS user segment consists of your GPS receiver. Your receiver collects and processes signals from the GPS satellites that are in view and then uses that information to determine and display your location, speed, time, and so forth. Your GPS receiver does not transmit any information back to the satellites.

How Does GPS Technology Work?

The following points provide a summary of the technology at work:

- The control segment constantly monitors the GPS constellation and uploads information to satellites to provide maximum user accuracy.
- Your GPS receiver collects information from the GPS satellites that are in view.
- Your GPS receiver accounts for errors. For more information, refer to the Sources of Errors (Page 7) section.
- Your GPS receiver determines your current location, velocity, and time.
- Your GPS receiver can calculate other information, such as bearing, track, trip distance, distance to destination, sunrise and sunset time, and so forth.
- Your GPS receiver displays the applicable information on the screen.

Who Uses GPS?

GPS technology has many amazing applications on land, at sea, and in the air. You might be surprised to learn about the following examples of how people or professions are already using GPS technology:

Agriculture
In precision farming, GPS technology helps monitor the application of fertilizer and pesticides. GPS technology also provides location information that helps farmers plow, harvest, map fields, and mark areas of disease or weed infestation.

Aviation
Aircraft pilots use GPS technology for en route navigation and airport approaches. Satellite navigation provides accurate aircraft location anywhere on or near the earth.

Environment
GPS technology helps survey disaster areas and map the movement of environmental phenomena (such as forest fires, oil spills, or hurricanes). It is even possible to find locations that have been submerged or altered by natural disasters.

Ground Transportation

GPS technology helps with automatic vehicle location and in-vehicle navigation systems. Many navigation systems show the vehicle's location on an electronic street map, allowing drivers to keep track of where they are and to look up other destinations. Some systems automatically create a route and give turn-by-turn directions. GPS technology also helps monitor and plan routes for delivery vans and emergency vehicles.

Marine

GPS technology helps with marine navigation, traffic routing, underwater surveying, navigational hazard location, and mapping. Commercial fishing fleets use it to navigate to optimum fishing locations and to track fish migrations.

Military

Military aircraft, ships, submarines, tanks, jeeps, and equipment use GPS technology for many purposes including basic navigation, target designation, close air support, weapon technology, and rendezvous.

Public Safety

Emergency and other specialty fleets use satellite navigation for location and status information.

Rail

Precise knowledge of train location is essential to prevent collisions, maintain smooth traffic flow, and minimize costly delays. Digital maps and onboard inertial units allow fully-automated train control.

Recreation

Outdoor and exercise enthusiasts use GPS technology to stay apprised of location, heading, bearing, speed, distance, and time. In addition, they can accurately mark and record any location and return to that precise spot.

Space

GPS technology helps track and control satellites in orbit. Future booster rockets and reusable launch vehicles will launch, orbit the earth, return, and land, all under automatic control. Space shuttles also use GPS navigation.

Surveying

Surveyors use GPS technology for simple tasks (such as defining property lines) or for complex tasks (such as building infrastructures in urban centers). Locating a precise point of reference used to be very time consuming. With GPS technology, two people can survey dozens of control points in an hour. Surveying and mapping roads and rail systems can also be accomplished from mobile platforms to save time and money.

Timing

Delivering precise time to any user is one of the most important functions of GPS technology. This technology helps synchronize clocks and events around the world. Pager companies depend on GPS satellites to synchronize the transmission of information throughout their systems. Investment banking firms rely on this service every day to record international transactions simultaneously.

How Accurate Is GPS?

GPS technology depends on the accuracy of signals that travel from GPS satellites to a GPS receiver. You can increase accuracy by ensuring that when you use (or at least when you turn on) your GPS receiver, you are in an area with few or no obstacles between you and the wide open sky. When you first turn on your GPS receiver, stand in an open area for a few moments to allow the unit to get a good fix on the satellites (especially if you are heading into an obstructed area). This gives you better accuracy for a longer period of time (about 4-6 hours).

It takes between 65 and 85 milliseconds for a signal to travel from a GPS satellite to a GPS receiver on the surface of the earth.

The signals are so accurate that time can be figured to much less than a millionth of a second, velocity can be figured to within a fraction of a mile per hour, and location can be figured to within a few meters.

WAAS/EGNOS

The Wide Area Augmentation System (WAAS) is a system of satellites and ground stations that provides even better position accuracy than the already highly accurate GPS. Europe's version of this system is the European Geostationary Navigation Overlay Service (EGNOS).

The Federal Aviation Administration (FAA) developed the WAAS program. It makes more airspace usable to pilots, provides more direct en route paths, and provides new precision approach services to runways, resulting in safety and capacity improvements in all weather conditions at all locations throughout the U.S. National Airspace System (NAS).

Although it was designed for aviation users, WAAS supports a wide variety of other uses, for example, more precise marine navigation. To take advantage of WAAS technology, you must have a WAAS-capable GPS receiver in an area where WAAS satellite coverage is available such as North America. No additional equipment or fees are required to take advantage of WAAS.

Sources of Errors

Errors can affect the accuracy of the GPS signal. Take your GPS receiver to an area with a wide and unobstructed view of the sky to reduce the possibility and impact of some errors. Here are some of the most common GPS errors.

- **Ionosphere and Troposphere Delays**—the satellite signal slows down as it passes through the atmosphere. The system uses a built-in model that calculates an average delay to partially correct this type of error.
- **Orbital Errors**—this terminology refers to inaccuracies of the satellite's reported location.
- **Receiver Clock Errors**—the GPS receiver has a built-in clock that can have small timing errors.
- **Number of Satellites Visible**—obstructions can block signal reception, causing position errors or no position reading. The more satellites that your GPS receiver can view, the better the fix is.
- **Satellite Geometry/Shading**—refers to the relative position of the satellites at any given time. Ideal satellite geometry exists when the satellites are located at wide angles relative to each other. Poor geometry results when the satellites are located in a line or in a tight grouping.
- **Signal Multipath**—the GPS signal bounces off of objects, such as tall buildings or large rock surfaces, before it reaches the GPS receiver. This increases the travel time of the signal and, therefore, causes errors.

Buying a GPS Receiver

Deciding which GPS receiver to buy can be overwhelming. Think about how you want to use the unit, for example, traveling or running. Keep the following considerations in mind:

- **Product Level**—do you want the basics, or do you want all of the bells and whistles? You can find a unit that fits your needs and budget.
- **Power Source**—will you be using the unit away from an auxiliary power source? You might need to carry extra batteries. With some units, you can use a vehicle adapter or AC power source.
- **Portability**—do you have a preference between a portable or a built-in unit? Some units mount directly in the dashboard of your boat, car, or aircraft.
- **Mapping Capability**—do you want to know the general direction or street-level details of your chosen path? Map data can include streets, restaurants, tourist attractions, marine data, topography, and so forth.
- **Mounts**—a mount for your GPS can be useful to keep your hands free while navigating your bike, boat, car, or airplane. Many units come with a mount, and several additional mounts are available.
- **Ease of Use**—some receivers provide a tutorial or an easy-to-use touchscreen interface. Some even have turn-by-turn voice instructions as you are navigating your route.
- **Antenna Configuration**—where are you going to use the unit? With some units, you use only the built-in antenna. With other units, you can attach an external antenna to give you better reception.
- **Price**—which units fit your price range? An inexpensive entry-level unit can be a great way to enter the GPS world.
- **Software**—whether you want to save your favorite locations or plan a trip, map software can help. You can use your PC or go directly to

your GPS receiver. Your preference for map detail and your specific activities determine which software is right for you.

Complementary Navigation Aids

Remember, a GPS receiver is a complement to navigation and should not be the only navigational tool that you use. Using a paper map, a simple compass, and having knowledge of manual navigation is a good, safe practice.

Why Choose Garmin®?

Garmin designs, manufactures, and markets leading-edge Global Positioning System (GPS) technology and other navigation and communication products. Here are a few of the reasons you might choose Garmin:

- A wide variety of products to fit your needs
- User-friendly products
- Products that have rugged exteriors built to handle tough situations
- Free product manual downloads
- Free downloads of the latest operating software for your unit
- A vast selection of maps and charts
- Dedicated and knowledgeable product support assistance, available Monday through Friday, 8AM—7PM CST, toll-free
- Free product support assistance, even after the product warranty period ends

Garmin Product Overview

You can find a Garmin product to improve your everyday life (and to make it more fun). Garmin offers products for the following categories:

Avionics

Garmin leads the market in a wide variety of panel-mount and portable aviation products.

Marine

On the water, you can use marine networking, chartplotters, GPS sounders, fishfinders, hand-held GPS units, two-way radios, and more.

Outdoor

Garmin's rugged outdoor products include basic GPS, GPS mapping, two-way communications, and fitness products.

Mobile Electronics

Our streetwise GPS electronics include automotive, mobile phone, handheld GPS, PDA, and PC.

Getting More Information

For more information about GPS technology and Garmin, refer to www.garmin.com. This Web site includes the following information:

- Links to learn more about GPS technology
- A glossary of GPS-related terms
- Frequently Asked Questions (FAQs) and answers
- Specifications on Garmin's entire line of products
- Online product registration and product testimonials
- A cartography section to preview map detail
- A list of available offshore and inland charts

- An online store where you can purchase accessories
- A dealer locator to help you find Garmin products
- Free downloads of product manuals
- Free downloads of the latest unit operating software

For more detailed information on GPS technology, refer to the following Web sites:

- For more information about GPS technology, visit http://gps.faa.gov.
- For more information about the current status of the GPS satellites, visit http://tycho.usno.navy.mil/gpscurr.html.

GARMIN™

For the latest free software updates (excluding map data) throughout the life of your Garmin products, visit the Garmin Web site at www.garmin.com.

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