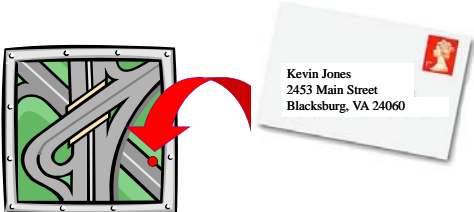


An Introduction to GPS

- ### Outline
- Why GPS?
 - What is GPS?
 - How GPS Works.
 - What you need to know about GPS.
 - What can you do with GPS?
 - Applications of GPS.

Why GPS?

- Many features have addresses and landmarks that are associated with a destination.



The diagram consists of a square map on the left with a grid of letters 'C' and 'L' around its perimeter. A red arrow points from a specific location on the map to an envelope on the right. The envelope has a red stamp and an address label that reads: "Kevin Jones, 2453 Main Street, Blacksburg, VA 24060".

Why GPS?

- Many features have addresses and landmarks to get you to a destination.
- However, there are many features that do not have addresses...



Why GPS?

- Many features have addresses and landmarks to get you to a destination
- However, there are many features that do not have addresses...
- There are many MAJOR cities that do not even have STREET NAMES!

Why GPS?

- Many features have addresses and landmarks to get you to a destination
- However, there are many features that do not have addresses...
- There are many cities that do not even have STREET NAMES!
- And then there is the open ocean and sky...



Why GPS?

Location, Location, Location
and
INFORMATION!!!

Pre-GPS

- Navigation is critical!!!
- Historical Navigational tools have limits:
 - The Sextant – contingent on weather



Pre-GPS

- Navigation is critical
- Historical Navigational tools have limits:
 - The Sextant – contingent on weather
 - Radionavigation (Lowrance): only works near land...



Pre-GPS

- Navigation is critical
- Historical Navigational tools have limits:
 - The Sextant – doesn't work if it is cloudy
 - Lowrance – radionavigation: only worked near land...
- The military had its own reasons for determining location...
 - Identify targets
 - Friendly fire issues
 - "smart bombs"

What is GPS...

And how does it work?

What is GPS?

- GPS is not a single UNIT!
- GPS = Global Positioning **SYSTEM**
- GPS was developed by the Department of Defense at a cost of >\$12 billion
- Funding for the GPS was contingent on making the system available to the public.



GPS is a SYSTEM

There are three major components in this system:

1. Satellites
2. Ground Control Stations
3. GPS Receivers (or units)





Satellites



- There are 24-32 satellites up there at any given time orbiting the earth at ~11,000 naut. miles.
- The DOD knows the EXACT location of each of the satellites at any given moment.
- These satellites have VERY accurate clocks on board.
- The satellites continuously send radio signals towards earth.
- These radio signals are picked up by GPS receivers.



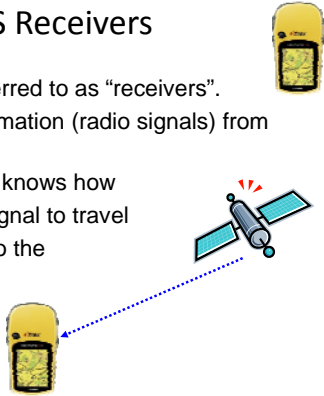
Control Stations



- There are five control stations that monitor the satellites.
- Control stations enable information on Earth to be transmitted to the satellites (updates and fine tuning).
- Control stations continuously track satellites, and update the positions of each satellite.
- Without control stations, the accuracy of the system would degrade in a matter of days.

GPS Receivers


- GPS units are referred to as “receivers”.
- They receive information (radio signals) from satellites.
- The GPS receiver knows how long it takes the signal to travel from the satellite to the receiver.



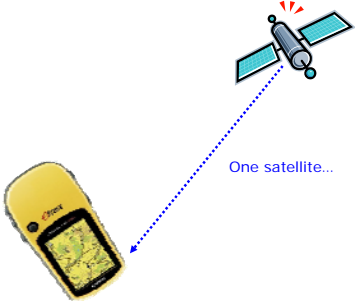
The diagram shows a satellite in space with two solar panels and a central antenna. A blue dotted arrow points from the satellite down to a yellow GPS receiver on the ground. A small red antenna icon is also shown near the satellite.

GPS Receivers

- The GPS receiver knows how long it takes the signal to travel from the satellite to the receiver.
- The Receiver is therefore able to calculate its distance from the satellite.
 - Distance = **time x velocity**
 - Distance = **time x 186,355 mi./sec.**
- The receiver can calculate the time that signal traveled from the satellite to the receiver.
- The receiver is therefore able to determine its exact distance from the satellite.

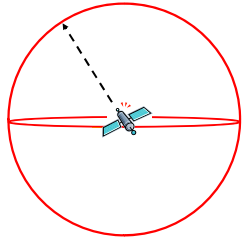


How GPS Works



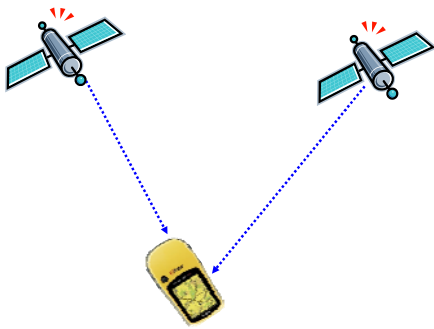
The diagram shows a satellite in space with two solar panels and a central antenna. A blue dotted arrow points from the satellite down to a yellow GPS receiver on the ground. The text "One satellite..." is written next to the arrow.

How GPS Works

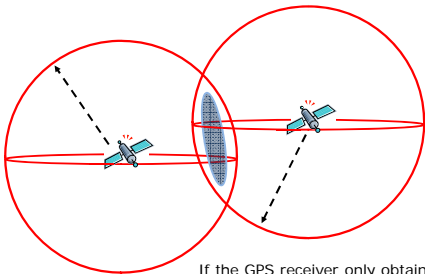


If the GPS receiver only obtains signals from 1 Satellite, then it "knows" that it is located somewhere on this sphere...

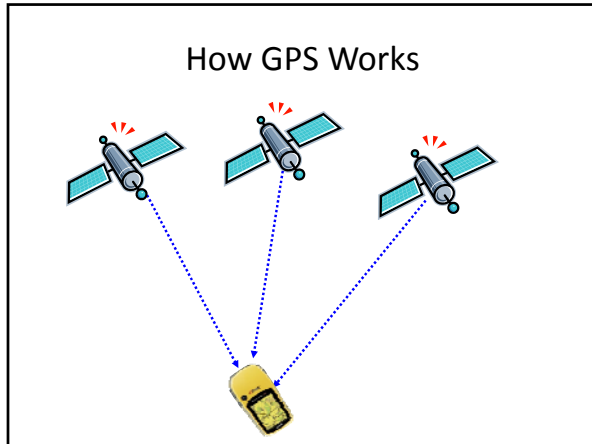
How GPS Works

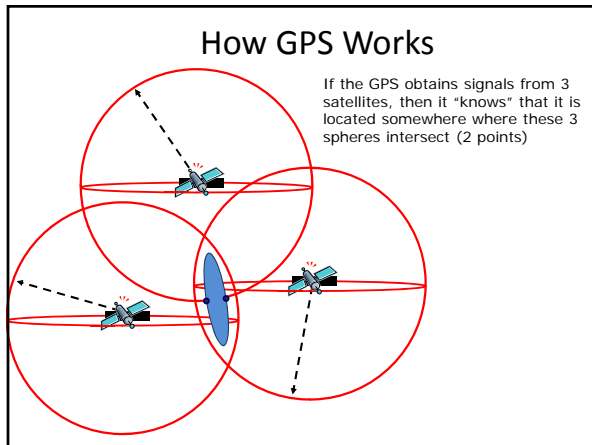


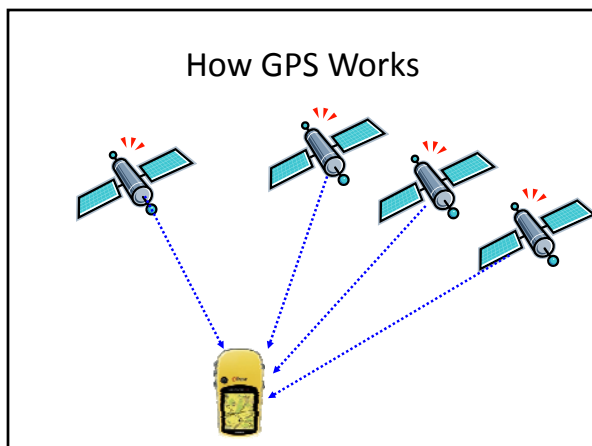
How GPS Works

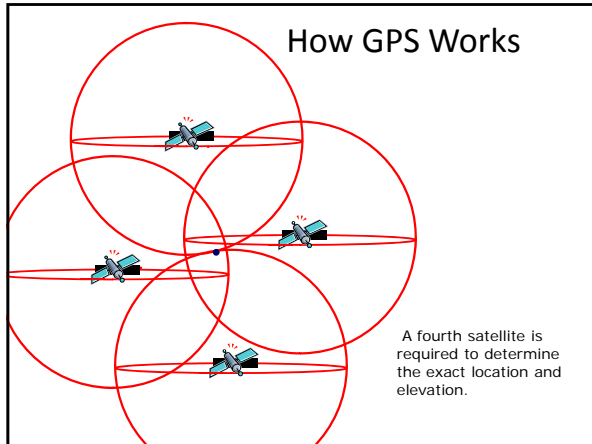


If the GPS receiver only obtains signals from 2 satellites, then it "knows" that it is located somewhere where these 2 spheres intersect












What do you need to know about GPS...

Different "Grades" of GPS receivers

- **Recreational Grade GPS**
 - Accurate to within 5 meters (could be better, but don't rely on it)
 - Suitable for hunting, recreational, and some business use.
 - Lowest cost (smallest, and easiest to use): ~\$100-\$800
- **Mapping Grade GPS**
 - Accurate to within 1 meter (3 feet)
 - Requires differential processing (from a base station)
 - Suitable for many natural resource applications, city planning
 - \$3,000-7,000
- **Survey Grade GPS**
 - Accurate to within 1 cm
 - Suitable for building bridges...
 - ~\$20,000

What you need to know about GPS

- Signal Accuracy Issues
- Selective Availability
- Tricks of the Trade
- Current Applications of GPS
- Future applications of GPS

Signal Accuracy

There are 2 types of GPS Signals:

P-code: ("Precise" code)

- This is only available to the military and some selected public officials.
- Very precise, not degraded.

C-code: ("Civilian" Code).

- Less precise
- Signal can be degraded (by scrambling the signal) especially in times of conflict.
- This is what the GARMIN Legends (and all public GPS receivers) work with...

Selective Availability (SA)

- For national security reasons, the military sometimes degrades the C-code signal. This is called selective availability.
- These errors are random
- Errors can be as high as +300 feet

Never say never.... But SA Will probably not be "turned on" again....

Selective Availability

- SA errors can put you on the wrong side of a stream, or even a different city block or street!
- 300 feet is a lot of real

The GPS tells you that you are located here...



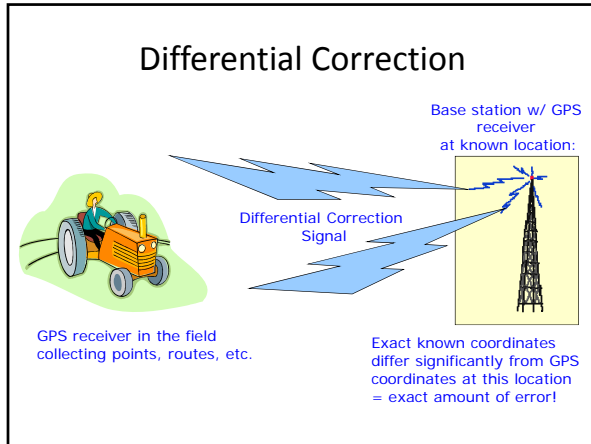
But your real location is here...

Selective Availability

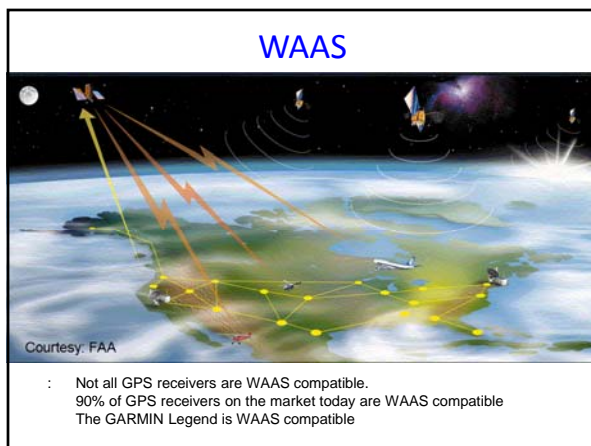
- It is possible to correct for Selective Availability (as well as other inherent signal errors).
- This process is called *Differential Correction*
- Here's how it works...

Differential Correction

- There are already established base stations established around the U.S.
- Surveyors have determined the precise location of these base stations.
- Each base station has a GPS receiver, which collects incoming (scrambled) signals.
- The true (surveyed) location is then compared to the GPS coordinates.
- The correction values are then sent to other GPS receivers in the field.



- ### WAAS
- The **Wide Area Augmentation System** (WAAS) is a differential GPS system that is being constructed to support GPS accuracy in aircraft.
 - WAAS also provides additional accuracy "on the ground"
 - The GPS receivers that we are using are WAAS compatible



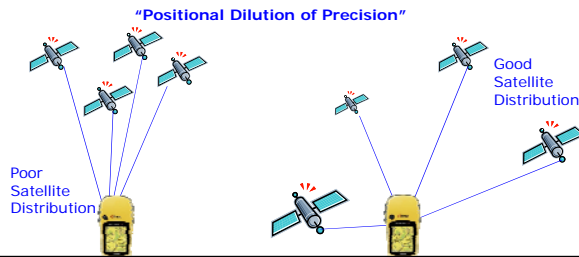
Other Tricks of the Trade: Averaging

- Averaging: A GPS receiver can collect points continuously for 15-30 seconds. The receiver can then average all these locations together
- This only works when you are standing still!!



Other Tricks of the Trade: Satellite Distribution

- It is better for your receiver to get a fix on "distributed" satellites, then poorly distributed satellites.



Other Tricks of the Trade: MultiPath Errors

Try and stay away from buildings and other structures when using a GPS receiver
Satellites may not be visible...
This can introduce error...



Other Tricks of the Trade: Tracking Satellites

GPS has worldwide coverage...

HOWEVER...

You can lose satellite coverage (or received degraded signals) in areas with dense foliage, in "urban canyons", etc.

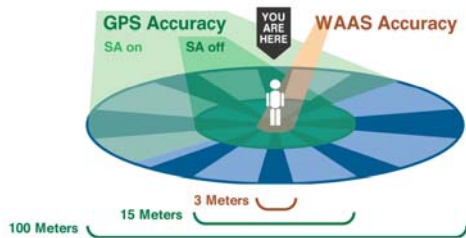
You may also lose satellite coverage (or receive degraded signals) in deep valleys or gorges.

How accurate is a \$130 GPS?

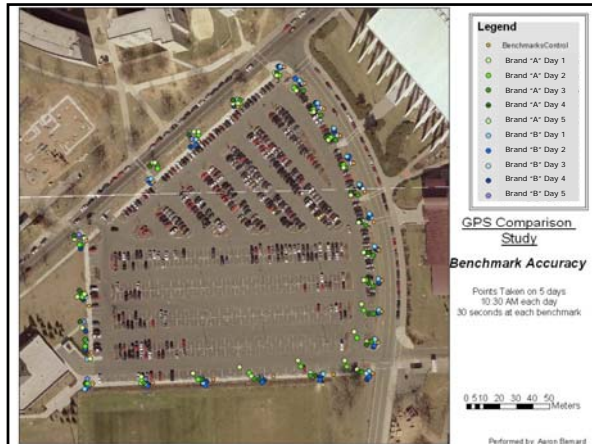
- That's the million dollar question...



It depends...



Acknowledgements: Dr. Phillip Rasmussen, Utah Geospatial Extension Specialist

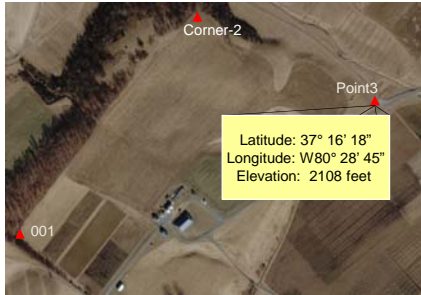




What can you do with a GPS?

- Collect and store points (positions)
These are called **WayPoints**.
Field corners, insect infestation areas, crop damage, individual trees, trail heads, creek crossings, point source pollution, etc.
- Download the points onto your computer and integrate them with other mapping programs

Waypoints



What can you do with a GPS?

- Collect and store the path that you have walked / driven
- These paths are called **TRACKS**.
- Calculate the distance of a track (i.e. perimeter around a field)
- Calculate AREA measurements within a TRACK (after walking around a field)
- Save and Download TRACKS onto your computer.

Tracks (just start walking...)



What can you do with a GPS?

- Collect and store ROUTES
- Routes are similar to TRACKS, but are created by Waypoints
- Routes can be handy for measuring “square fields” and “straight lines”
- You can measure the length and area (acreage) of a Route.

Routes



1. Establish Waypoints at strategic locations
2. The GPS Receiver “Connects the dots”
3. Area and perimeter measurements are generated

What can you do with a GPS?

- The GOTO function
Using the ‘GOTO’ function, the GPS will guide you to a predefined Waypoint (you choose which one...) using a compass and “pointer”
- The GOTO/FIND function is like using “Autopilot”
You can program the GPS to “beep” when you are within a certain distance of a selected Waypoint

What can you do with a GPS?

- Tide Tables
- Many of the marine GPS's have built in tide tables. They provide tidal information and ranges for any date and any place...
- The GARMIN Legend does not have tide table information...

What can you do with a GPS?

- Speed
GPS's calculate your ground speed as you walk, run, drive, or fly

What can you do with a GPS?

- Elevation
In addition to providing you with your latitude and longitude, GPS provides you with elevation information. Elevation is not as accurate as X,Y information.

Some GPS's have built in barometric altimeters (to increase accuracy of z values).

What can you do with a GPS?

- Measure Area / perimeter

Farmers can use a GPS to measure the area of a pasture or a field of corn...

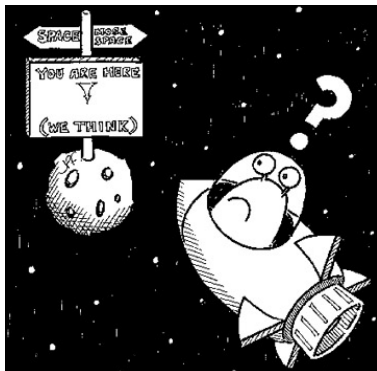
Natural Resource Agents can measure the area of a proposed conservation easement...

Current Application Areas of GPS

- Public Safety
- Environmental resource management
- Aviation
- Military
- Local planning
- Surveying
- Recreation
- Business



The Future of GPS



The Future is bright...

- The DoD is in the process of upgrading the existing GPS satellite constellation
 - better coverage availability (i.e. in forested areas)
 - anticipated greater accuracy (even for the recreational grade GPS receivers)

WAAS Satellites

- Historically, some areas in Virginia have had trouble acquiring the WAAS satellite
- A new WAAS satellite was launched in Fall 2006
- Better coverage for Virginia and higher accuracy levels

The Russian GPS System

- Is called GLONASS
- Has fallen into "disrepair".
- New Russian GLONASS satellites are now being launched
- Impacts: Potentially increased accuracy for US receivers that receive both US and Russian GPS satellite signals (the private sector follows demand...)

The European GPS System

- Galileo will be Europe's own global navigation satellite system
- More accurate than the U.S.'s current GPS system (~4 feet)
- Better coverage area than the U.S.'s current GPS system
- Compatible and interoperable with the American global positioning system

Area	GPS	Galileo	GPS + full Galileo
Rural	100	100	100
Towns	50	80	100
Large cities	30	40	70

Source: EADS-Astrium

GPS Receivers

- Continue to get better and better
 - better antennae,
 - more efficient power consumption,
 - smaller
 - increasingly more “bells + whistles” (maps, hard drives, etc.)
 - inexpensive

Purchasing a GPS? Check out the specs.!

Navigation features	Waypoints/coos: 1000 with name and graphic symbol, 10 named automatic, 10 proximity Routes: 50 reversible routes with up to 250 points each, plus MOI and TrackBack™ modes Tracks: 10K point automatic track log, 20 saved tracks, 500 points each let you retrace your path in both directions Trip computer: Current speed, average speed, resettable max. speed, trip timer and trip distance Alarms: Anchor drag, approach and arrival, off-course, proximity to waypoint, shallow water and drag water Tables: Built-in nautical tables for best times to fish and hunt, sun and moon rise, set and location Map database: More than 100 plus user datum Position format: Lat/Lon, UTM/UPS, Maidenhead, MGRS, Lotus TDs and other grids, including user UTM grid only	Electronic compass feature: (GPSMAP 60CS only) Accuracy: ±2 degrees with proper calibration (Typically ±5 degrees extreme northern and southern latitudes) Altimeter feature: (GPSMAP 60CS only) Resolution: 1 foot Range: -2,000 to 30,000 feet Elevation computer: Current elevation, resettable minimum and maximum elevation, ascent/descent rate, total ascent/descent, average and maximum ascent/descent rate Pressure: Local pressure (in bar/inches HG)
GPS performance	Receiver: 12 channel SSBitar III™ high-sensitivity GPS receiver (WAAS-enabled) continuously tracks and uses up to 12 satellites to compute and update your position Acquisition times:	Power Source: Two "AA" batteries (not included) Battery life: 18 hours, typical, up to 30 with battery saving Physical Size: 2.4W x 6.1W x 1.3D inches (61mm x 155mm x 33mm) Weight: 7.5 oz. (213 g) est. Display: 1.5 x 2.2 inches (38.1mm x 56mm) 256-color transreflective TFT (160 x 240 pixels) Case: Waterproof to IPX-7 standards Temp. range: 5°F to 130°F (-15°C to 50°C)

The applications are endless...
...and keep in mind that there are ~253,476,000 cell phone subscribers in the U.S.
-Source: <http://www.ctia.org>



GPS recreational uses
Geocaching....

- Geocaching is an entertaining adventure game for gps users.
- The idea is to “hunt” for objects (prizes) that have been placed in the landscape (virtual orienteering).
- Pick a prize, and leave a prize...

<http://www.geocaching.com>

but Geocaching is so passé...

- But have you ever tried [Geodashing?](#)
- In this game, a list of coordinates is presented to all users and teams, selected at random from around the globe.

Requirements:

- somebody with a lot of free time on their hands,
- a GPS,
- extra batteries,
- a new pair of sneakers,
- a passport,
- and your dad's VISA Card (or a trust fund)....

Some GPS Applications are "innovative"

- Use GPS to locate 'the loo'!

<http://www.cnn.com/2007/WORLD/europe/11/29/sat.lav.ap/index.html>

New 'SatLav' system tracks toilets

LONDON, England (AP) -- A new service promises Londoners they'll never have to spend much time looking for the loo



The 'SatLav' system covers 40 toilets in the center of London.

Westminster City Council, which covers London's bustling Oxford Street, the West End, Big Ben and the Houses of Parliament, on Thursday launched "SatLav" -- a toilet-finding service for cell phone users.

Tourists, theatergoers, shoppers and pub patrons in London's West End can now text the word "toilet" -- and receive a text back with the address of the nearest public facility.

The system, which covers 40 public toilets, pinpoints the caller's position by measuring

GPS-based buddy stalkers

(oops, I mean buddy tracking)...



Here's an International 'cell phone locator'

- <http://www.satellite-gps-locator.com/>

Satellite GPS Locator

Track a phone number here

UNITED STATES Select Country

Enter Number Phone Number

Start Searching

WE GUARANTEE OUR FREE SERVICE WORKS SO WELL THAT IF IT DOES NOT PROVIDE AN ACCURATE RESULT WE WILL PAY YOUR MORTGAGE OR RENT FOR AN ENTIRE MONTH!

Other GPS Data Loggers and Tracking Devices...


- We all know that UPS / FedEx and the major freight haulers use GPS...
- Other folks are tracking people too!



TEENSURANCE.
POWERED BY SAFARIUM

Safety Beacon™ Notifications

Letting your teen drive without you is an important step, but can be stressful for you as a parent. The Safety Beacon Convenience and Protection System uses a professionally installed GPS-based vehicle monitoring device that delivers real time notifications to help keep you aware of the habits of your new driver. Safety Beacon also allows your teen to show you they can act responsibly and earn your trust.



HOT DEAL!!!

THIS WEEK ONLY

LiveWire Real-Time GPS Tracking Unlimited

Deal

With a simple installation LiveWire will send you its location every 5-10 seconds for a true real-time GPS tracking system. Perfect for tracking teen drivers, company cars or track.

Our Sale Price: \$439.95
You Save 37%

🔴 Necessary: \$1000

[View All Teesur Tracked >>](#)

Car Navigation Systems are getting into buddy tracking as well

- Garmin and TomTom have well established systems in place...

TomTom tracks other TomTom GPS users
March 9, 2006



TomTom unveiled a "buddy list" GPS tracking system. Too bad it doesn't incorporate my GPS-GPS traffic monitoring idea, which uses a peer-to-peer network of GPS users to track traffic patterns and alert you if there is traffic jam and automatically re-route. This TomTom GPS news simply says you can track other users, or each other, exchange POIs. In any event, check out the news from [TomTom](#).

TomTom's just unveiled a bunch of new and updated features for its iconic GO software, including an intriguing friend tracking mode.

Called TomTom Buddies, the feature lets you track your mates wherever you go – and in return, they get to track you too.

All you do is invite other TomTom users – you'll have to share your Garmin and Navman phones – to be your authorized "buddy." The idea is that the Buddies service will be like an exclusive club through which you can send each other text messages and locations you think are interesting.

If you feel like being a loner for a bit you can select the privacy option which lets you hide your location.

Car Insurance companies have been looking at this technology for a while...

GPS-Tracked Car Insurance


By Erick Schonfeld
January 1, 2005



(Business 2.0) – What if liability premiums were based not on demographics and DMV records but on actual driving habits? That's the idea behind Norwich Union's newest business. In a pilot program launched last year, the British insurer began to track 5,000 customers by placing GPS receivers in the trunks of their cars. Data from the devices will be used to adjust drivers' premiums from month to month. "We calculate everything from speed and acceleration to whether they're braking too early or too late at intersections," says project manager Robert Ledger. So far Norwich Union has collected data on about 1 million journeys, and its statisticians are using the information to recalculate its insurance tables. Next year it will make the technology available to the rest of its 3.5 million auto customers, hoping that the feedback will lead to fewer accidents—and thus higher profits. "Over time," Ledger says, "we think we can change people's behavior and make them safer drivers." — ERICK SCHONFELD

Progressive's "pay-as-you-drive" auto insurance poised for wide rollout

GPS-based tracking, routing, and fleet management



Oakland Port Uses GPS to Track Cargo Trucks
 3/28/2007
 OAKLAND, Calif. - The Port of Oakland has begun using GPS technology to track the flow of cargo trucks in the area, with the goal of moving goods more efficiently while reducing air pollution.

The fourth busiest port in the country pumps out some of the most polluted air in the Bay Area. But that will be reduced dramatically by cutting the waiting time of trucks which can idle an average of two-and-a-half hours to pick up a single container, said Omar Benjamin, the port's executive director.

The port has employed other measures to reduce air pollution. Over the last few months, it has replaced dozens of old big rigs with low-sulfur diesel trucks under a \$9 million settlement made with West Oakland neighborhood groups that sued the port for polluting the area.

GPS Fights Crime!

Missing Toilet Paper Found by GPS



Near Petersburg, Virginia a man was arrested for stealing \$22,000 worth of toilet paper. He was tracked down via the GPS fleet tracking system installed in the truck.

"The trailer had a GPS tracker on it and when the trailer began moving it started and tracked it to the 2100 block of Washington Street, to the Fair Trade Supermarket," said Sgt. Tommy Young, spokesman for Petersburg police. "Whoever stole it took it back and parked it in a different parking space and that's how they found out."

No word how much he was able to use before the GPS fleet tracking system caught up to him.

url [coordinates](#).

Snow Magazine Online Magazine » News »

Massachusetts Snow Plow Contractors Indicted In Scheme to Evade State GPS

A state-contracted snow plow driver and his employees were indicted earlier this month on charges they allegedly ran a scheme to evade the state's GPS tracking system while operating a private plowing business on state time, according to the Massachusetts Attorney General.

Paul V. Gratta, 50, of Cohasset, and Frank J. Eddy, 33, of Hull, were indicted by the Norfolk County Grand Jury on June 9 in Quincy District Court. Gratta faces two counts each of larceny and conspiracy and one count each of procurement fraud and false claims. Eddy was indicted on one count each of procurement fraud and larceny and two counts of conspiracy, according to the attorney general's office.

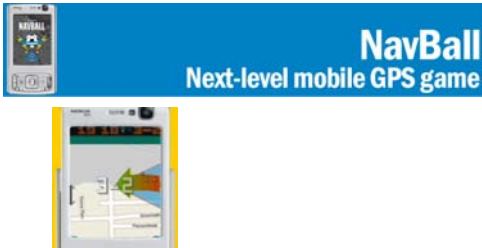
Gratta owns and operates Hub Construction, a home improvement contracting business based in Cohasset. For many years, Gratta has worked as an independent snow plow contractor for the state.

As a plowing contractor, Gratta was frequently called to duty by the Mass Highway Department to plow, sand and salt the road assigned to him - a stretch of Route 3A north and south from the Hingham rotary to the Weymouth line.

During a March 1 snow storm which produced whiteout conditions in many areas on the South Shore, state police assigned to the attorney general's office observed Gratta plow and salt his route on 3A before allegedly leaving the GPS device assigned to him by Mass Highway in a snow bank on the side of the road in a white paper bag. Once the GPS device was out of his snow plowing truck, Gratta allegedly plowed a private institution, using the salt provided by the state. He then allegedly retrieved the GPS and returned to plowing 3A.

Recreational Opportunities – Virtual Soccer

- <http://navball.wordpress.com>



The Degree Confluence Project

<http://confluence.org/>

- The "world's largest distributed expedition project".
- Goal: to visit each of the latitude and longitude integer degree intersections in the world, and to take pictures at each location.



There's a Variety of Software Products Available to Support GPS

- GPS Utility (free)
- DNR Garmin (free)
- USA PhotoMaps (free)
- Photo2GPS (free)
- Terrain Navigator (~\$89)

Additional Resources for your Use

Virginia Cooperative Extension

2007

PUBLICATION 303-204

Virginia Geospatial Extension Program

The Garmin eTrex Legend: An Introductory Handbook for Natural Resource Professionals and Educators

*John McGee, Extension Geospatial Specialist, Virginia Tech
Mike Clifford Sr., Extension Agent Emeritus*

GPS: An Introduction and the Basics

This handbook is intended to provide users with a basic understanding of how your Garmin Legend GPS receiver can help to support your day-to-day business needs. For detailed information about this receiver, refer to the owner's manual that is included with your

Marketing material suggests that the Legend GPS receiver will require new batteries (2 AAAs) after approximately 32 hours of use. Personal experience, however, suggests that batteries last for approximately 12 to 17 hours of use. You may want to keep spare batteries handy.

Your GPS receiver comes with a detailed owner's man-

Virginia Cooperative Extension

2007

PUBLICATION 303-202

Virginia Geospatial Extension Program

GPS Utility: a User Guide for Natural Resource Professionals and Educators

John McGee, Extension Geospatial Specialist, Virginia Tech

Overview

GPS Utility is an easy-to-use software application that allows you to manage, manipulate, and map your GPS information. This is a "point-and-click" software package that is fairly user-friendly.

While there are a number of things that GPS Utility software can do, some of the functions most applicable to natural resource management include the following:

you are using a different GPS receiver, then refer to the GPS Utility documentation, or your GPS manual user's guide. GPS Utility is a free software program that can be downloaded from: www.gpsu.co.uk

The free version is fully functional, but limited to 100 waypoints, 500 trackpoints, five routes. You can register the software and eliminate this limitation. Refer to the Virginia Geospatial Extension Program's website for links to this and other URLs associated with free geospatial software tools: www.enr.vt.edu/gep/tools.html

DNR Garmin A User Guide for Educators

Prepared by: The Virginia Geospatial Extension Program

Overview

DNR Garmin is an easy-to-use software application that allows you to manage, manipulate and save your GPS information for use in GIS programs such as ArcMap. This is a "point and click" software package. While there are a number of things that DNR Garmin software can do, some of the functions most applicable to extension agents include the following:

- Educators can use this software package to transfer GPS data between a Garmin GPS re-

Before Using DNR Garmin

The instructions in this handbook assume the following:

1. You have already installed DNR Garmin software on your computer. If you do not have it installed you can download the program at <http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html>
2. You have already collected GPS Data (i.e. waypoints, routes, tracks, etc.), and have stored the GPS data on your GPS receiver *if not re-*

Virginia Cooperative Extension
2007 PUBLICATION 303-203

Virginia Geospatial Extension Program
USA PhotoMaps: a User Guide for Natural Resource Professionals and Educators
John McGee, Extension Geospatial Specialist, Virginia Tech

Background
 USAPhotoMaps requires that you know how to operate a GPS unit and organize and collect field data associated with a GPS unit. This free software package enables you to download GPS waypoints (or tracks) from your GPS receiver onto your computer and to superimpose the collected data on top of aerial photographs.

USAPhotoMaps prompts you for a single waypoint (for reference purposes). The software then "goes out" onto the Internet (i.e. TerraServer), finds the associated

Getting Started
 Before you can actually get started using USAPhotoMaps, you need to do a few things.

1. Install USAPhotoMaps software on your computer. (www.jdmccs.com)
 - a. Set up USAPhotoMaps software.
 - b. Reboot your computer (not always necessary).

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Virginia Geospatial Extension Program
Terrain Navigator: a User Guide for Natural Resource Professionals
John McGee, Extension Geospatial Specialist, Virginia Tech

Overview
 Terrain Navigator (standard edition) is an easy-to-use mapping program that allows you to manage and manipulate your topographic maps and GPS information. This software costs under \$100 and can be purchased on the Internet from various vendors.

While there are a number of features included in Terrain Navigator software, some of the functions most applicable to average users include:

- Terrain Navigator can be used to find locations quickly and view and print topographic maps in 2-D and 3-D.
- Map datum and coordinates can be specified in a

Terrain Navigator has some very good mapping capabilities. These provide you with confidence that the data you have collected with your GPS "looks correct" on topographic maps. Also, the software can help to identify ambiguous GPS points that you collected. Terrain Navigator works with a variety of GPS receivers. This guide is written to support the Garmin Legend GPS receiver. Most Garmin GPS receivers will follow the same protocols. If you are using a different GPS receiver, refer to the Terrain Navigator documentation or contact the Virginia Geospatial Extension Program.

Before Using Terrain Navigator
 The instructions in this handbook assume the following:



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Things to remember...

- GPS can serve as an accurate data collection tool for GIS applications;
- GPS applications are becoming increasingly prevalent in our society, and support a variety of applications;
- With GPS receivers, you (more or less) get what you pay for (w/ prices ranging from \$59 - \$20,000+)
- This technology is going to take over our lives!
- **Knowing how to use a GPS does not make you a surveyor!!!**

Any Questions?

Virginia Geospatial Extension Program

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