

Global Positioning Systems (GPS)



***"Where am I going? How do I
get there? Where am I?"***

Peter Hirsch

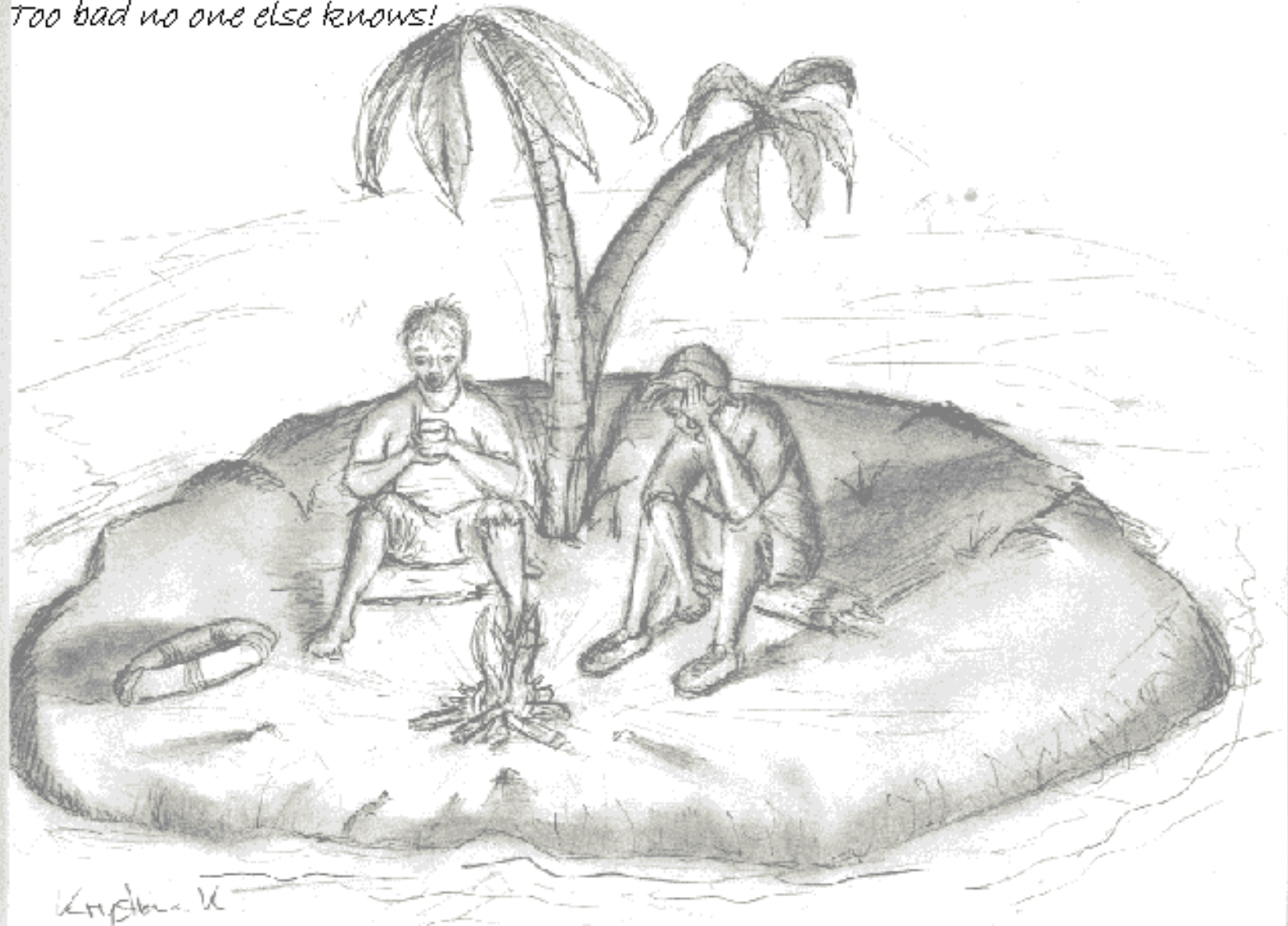


Applications of GPS

- **Mobile Navigation**

- Handheld GPS for Hiking
- Marine GPS for Boating/Fishing
- Airplane Navigation, Accident Avoidance
- Tracking Vehicles/Articles/Kids
- Military (warheads, missiles, soldiers....)
- Specialized Applications...
 - Tracking birds, elephants
 - Precision farming: Plowing fields, Picking cotton
 - Surveying
 - Detect Earth's crust shift, monitor the movement of ice sheets in Greenland
 - Sports: (golf, cycling, running)

*With this GPS, we know exactly where we are.
Too bad no one else knows!*



GPS Satellite Networks

- U.S. GPS, Navstar, 24 Satellites
- GLONASS, Russian
- Galileo project, Europe Planned for 2013, 30 Satellites





GPS (Navstar) Signal



- GPS orbit 11,000 miles from earth
- 24 Satellites orbiting 9,000 mph
- Earth rotating 1,000 mph
- Car moving 60 mph
- Output power from satellite is 25 watts
- GPS receiver must find and decode signal from 3-12 satellites



GPS System Cost

- The system hardware
 - Satellites, Ground stations and Antennas
 - Valued at \$2.4 billion
- 120 people operate the GPS
 - The annual budget is \$5 million
 - Paid by the federal government
- The cost to GPS users for this service is free



Inventors and Key Dates

- First experiment developed in 1964
 - Bradford Parkinson, US Air force retired, Stanford University
 - William Guier, Retired Physicist
 - First system called Transit
- First military system designed in 1973
- Commercial availability started in 1994
- Selective Availability removed in May 2000



Major GPS Manufacturers

Garmin	Alpine
TomTom	Jensen
Navigon	Motorola
MIO	Sony
ETAK	Thales (Magellan, Hertz Neverlost)
Rand McNally	Trimbel
Many Others....	

Types:

- Stand-alone/Portable
- Connected to PC
- Integrated into Vehicle
- Built into cell phones

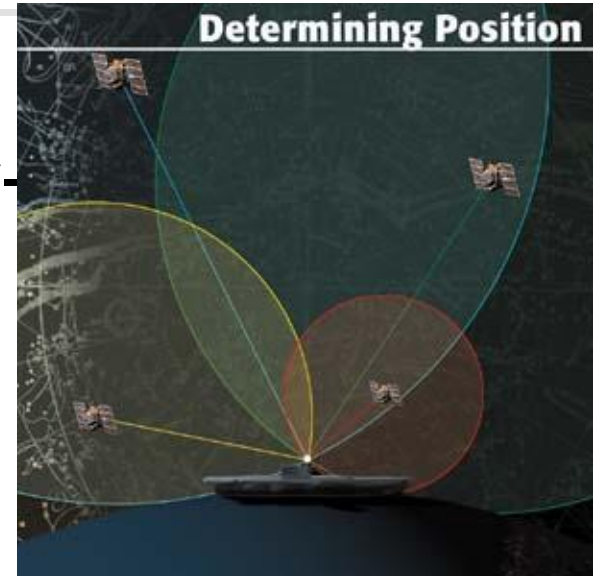


Maps for GPS

- Most GPS maps are made by Tele Atlas or NAVTEQ
 - Including Yahoo Maps and Google Maps
 - Navteq a US company and has better US Maps
 - Tele Atlas is a Dutch company and has better Europe maps
- A Tele Atlas subsidiary of TomTom
- Garmin, Magellan, Yahoo and Google uses NAVTEQ
- www.teleatlas.com
- www.navteq.com
- [Comparison discussion](#)

GPS Message

- Each satellite sends a message,
ephemeris (pronounced: ee-fem-er-
is)
 - I'm satellite #X (a number 1-32)
 - My position is currently Y
 - This message was sent at time Z
- GPS receiver
 - Compares time received with GPS time sent
 - Uses three satellites to triangulate position
 - Uses four satellites to locate altitude
 - <http://www.youtube.com/watch?v=iInmjjQ0oBE>





Automobile Navigation

Common Features

- **12 channel parallel receiver system**
- **Built in road Maps (highway and street maps)**
- **Route capability**
- **Enter Waypoints (Locations)**
- **Points of Interest (POI), Parks, Museums, Restaurants, Gas stations, Motels, shopping centers**
- **Mounting**
- **Turn Here**
- **Destination address entry**
- **Car Mount (bean bag, suction cup, glue-on)**
- **DC charger**
- **USB cable**



Automobile Navigation

Common Features

- **Voice Instructions**

- Communicate the distance, and the direction of the next turn automatically as you approach each turn
- **Street name of next turn (text to speech (tts))**

- **Maps for Personal Computer**

- Enter Waypoints
- Download Waypoints
- Save Waypoints

- **Route Preferences**

- Straight Line
- Shortest distance
- No freeway



Automobile Navigation

Additional Features on Some Models

- Detour
- MP3 player
- Traffic alerts
(recalculate to avoid heavy traffic)
- Weather
- Radio
- Multi-language,
Female or Male voice
- Waterproof
- Support Card for
Additional Storage of
Maps, Music, Photos...
- Bluetooth
- Custom POI (safety
cameras, school zones
with proximity alerts)
- Lane assist
- Voice recognition
- Includes maps/POI of
Europe and Canada
- Multiple point routing
- 3D maps
- Calculator
- ...



GPS Receiver Costs

- \$100 - \$1,000
- Average Price for a reasonable unit \$300-\$400
- Map Updates
 - About every 18 months
 - \$60-\$70 to update
- Available at:
 - Electronic Stores
 - Fry's, Best Buy, Radio Shack...
 - Internet (Best prices)
 - Froogle, E-Bay, CNET, Amazon, TVNAV...



GPS Benefits

- Better than using maps at night
- Better than using maps as a single driver
- Audio as well as visual cues
- Rerouting if you miss a turn
- Locate nearest restaurant or gas station
- You do not have to stop and ask for directions
- Efficient, good route, to location saving time



GPS Problems

- Hard to enter street address without a keyboard
- Entering incorrect address takes you to the wrong location
- Easily stolen
- More bulk than maps and needs cables
- Does not know about red lights, stop signs
- May take a few seconds to locate satellites when coming out of a garage
- Locating satellites a problem in large cities and wooded areas



Three Garmin GPS Receivers Evolving with Time

- Street Pilot III
 - 2001
- Street Pilot C340
 - 2006
- Nuvi 755T
 - 2009

Garmin StreetPilot(SP) III



2001

Cost: \$800-\$1200

Unlock all US: \$200



Garmin SP III Features

- **12 parallel channel GPS receiver, differential-ready**
- **Rugged, fully gasketed construction**
- **Stores 500 waypoints with name & symbol, 2000 track log points**
- **Automatic track log saves up to 10 tracks to retrace your path**
- **Stores 50 routes**
- **High-contrast 16-color LCD display with bright backlighting**
- **Compact size: 3.2 x 6.8 x 2.6 inches (8 x 17.3 x 6.5 centimeters)**
- **Weights only 1.4 lbs (635 grams)**



Garmin SP III Features (cont.)

- **2-20 hours use on 6 "AA" batteries (based on backlight setting)**
- **Multiple map zoom levels**
- **Detachable antenna with standard BNC-type connector**
- **Limited one-year warranty**
- **Package contains GPS, automotive mounting bracket, 12-volt adapter**
- **Cable with external speaker, 32 MB data card, USB Data Card Programmer, MapSource City Navigator CD-ROM, PC interface cable, Manual and Quick Reference Card**



Garmin SP III Features (cont.)

- **Built-in routable basemap (North America and South America) contains state and country boundaries, lakes, rivers, streams, airports, cities, towns, coastlines, state and interstate highways, local thoroughfares and secondary roads within metro areas, federal interstate highway exit information for services such as food, lodging and truck, RV and automotive service stations**
- **Accepts downloadable map detail from GARMIN PC-based MapSource™ CD-ROMs which provide street-level detail, addresses, listings of nearest restaurants, hotels, gas stations, ATMs and more.**
- **Trip computer provides resettable odometer, timers, average and maximum speeds**



Accuracy

- Horizontal - 7m to 15m (21' to 45')
- Vertical - 35m (105')

Garmin Street Pilot C340

- Maps for all U.S. and Canada
- Text to speech
- Touch screen interface
- Portable/Bean Bag Mount
- 64,000 color screen
- 6 million points of interest (POI)
- \$527.00 (\$200 today)
- May 2006



Garmin Nuvi 755T



- Demo
 - <http://www8.garmin.com/buzz/demos/765demo/>
- Information
 - <https://buy.garmin.com/shop/shop.do?cID=134&pID=14933>
- 2008
- \$370



Garmin Nuvi 755T

Advance Features

- Text to speech
- Lane assist
- Touch screen
- Lifetime Traffic Updates
- Remembers position when removed from car
- Sorts multiple destination
- Wide screen
- MP3, Audio Books through car speaker
- 3D building view
- High-Sensitivity GPS Receiver For Improved Performance & Reception



Technology Improvements

- More Memory
 - SP III – Only California/Nevada
 - C340, 755T –
 - All United States, some include Europe
 - More Waypoint, POI stored
- Faster CPU
 - SP III – Minutes to calculate 1,000 mile route
 - C340, 755T – Seconds to calculate the same route
- More Functions
 - SP III – Calculates routes, time to next street change
 - Nuvi 755T – Lane assist, traffic, 3D View
- Smaller Packaging , Faster, More Memory, Cheaper



Web sites

- <http://joe.mehaffey.com>
- <http://www.cnde.iastate.edu/staff/swormley/gps/gps.html>
- <http://www.gpseducationresource.com/>
- <http://www.gpsworld.com>
- <http://www.confluence.org/index.php>
- <http://www.tvnav.com>



User Groups

- <http://groups.google.com>
 - **Satellite Navigation Newsgroup**
 - <http://groups.google.com/group/sci.geo.satellite-nav/topics?lnk=rgh>
 - **Garmin News Group**
 - <http://groups.google.com/group/alt.satellite.gps.garmin/topics?lnk=srg>
 - **Magellan New Group**
 - <http://groups.google.com/group/alt.satellite.gps.magellan/topics?lnk=rgh>



Demo Links

- Garmin GPS 660

- http://www.youtube.com/watch?v=IP5pDIq10yk&feature=PlayList&p=E2557906FDD1E68F&playnext=1&playnext_from=PL&index=25

- TomTom ONE XLS

- <http://www.youtube.com/watch?v=o0EjfxgXlxE>

- Comparison Garmin, Dash, Harmon-Kardon

- <http://www.youtube.com/watch?v=fWtGcE-tZtA&NR=1>

- Fun ones

- <http://www.youtube.com/watch?v=H9gbExDH-Ss>
- <http://www.youtube.com/watch?v=-GsHnxylLok&feature=related>
- <http://www.youtube.com/watch?v=vhSA740F6HI&feature=related>

4/20/2009

Done

Done



Other GPS Review Web Sites

- http://www.rated4stars.com/html/session-start.php?source=rated4stars1101-20&dest=gpsreviews&gclid=CMG_wszSy5kCFShRagodVBNquQ
- <http://reviews.cnet.com/gps/?tag=mncol;pm>