GPS ON YOUR MOBILE DEVICES

- Basics of how GPS works !

- How “mapping apps” integrate w/ GPS

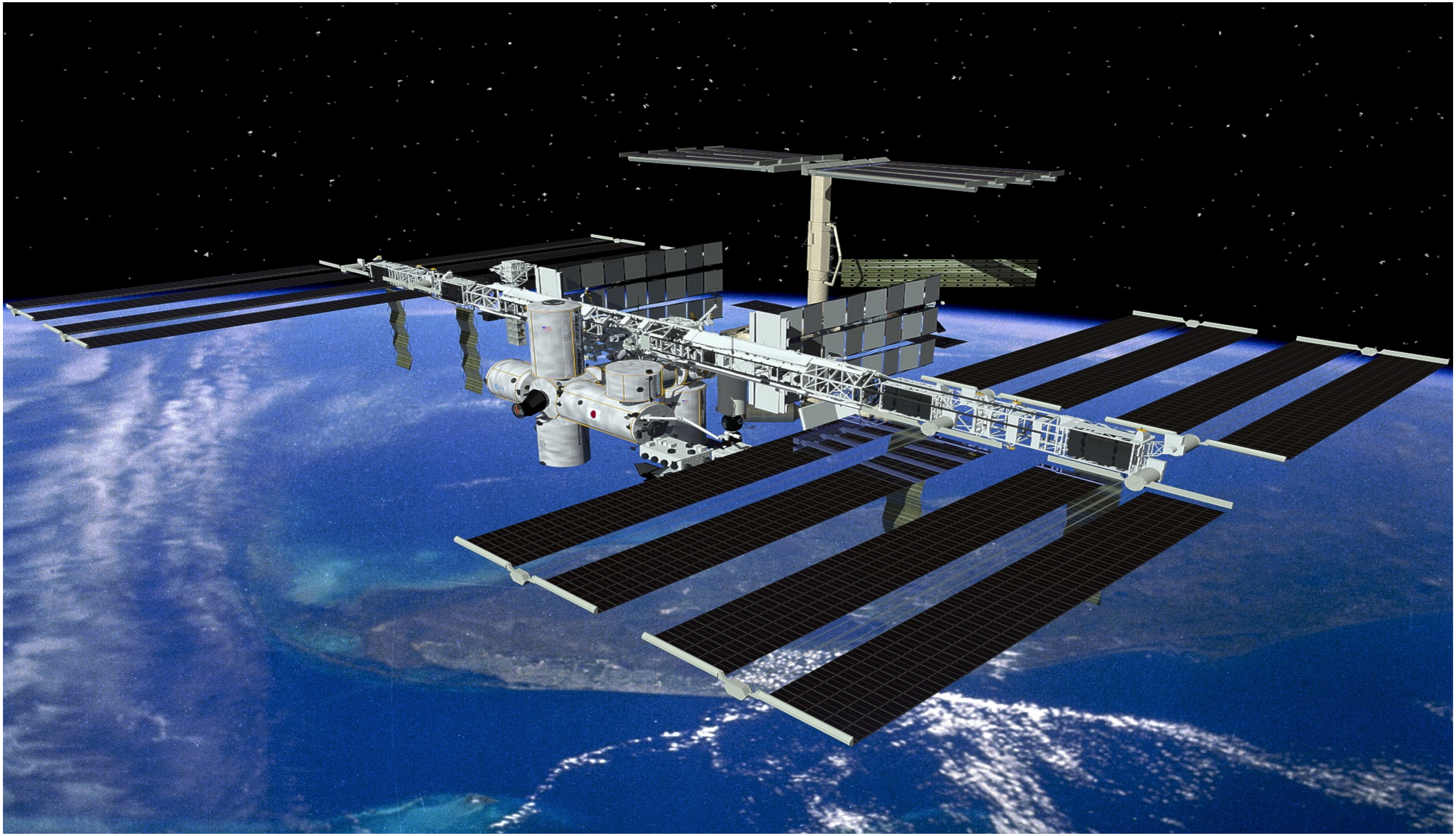
- I get a quick location on my smartphone or cellular tablet but it takes 7-10 minutes when I've just started my handheld GPS ?

- How does GPS location work on my tablet when it doesn't have the GPS function ?

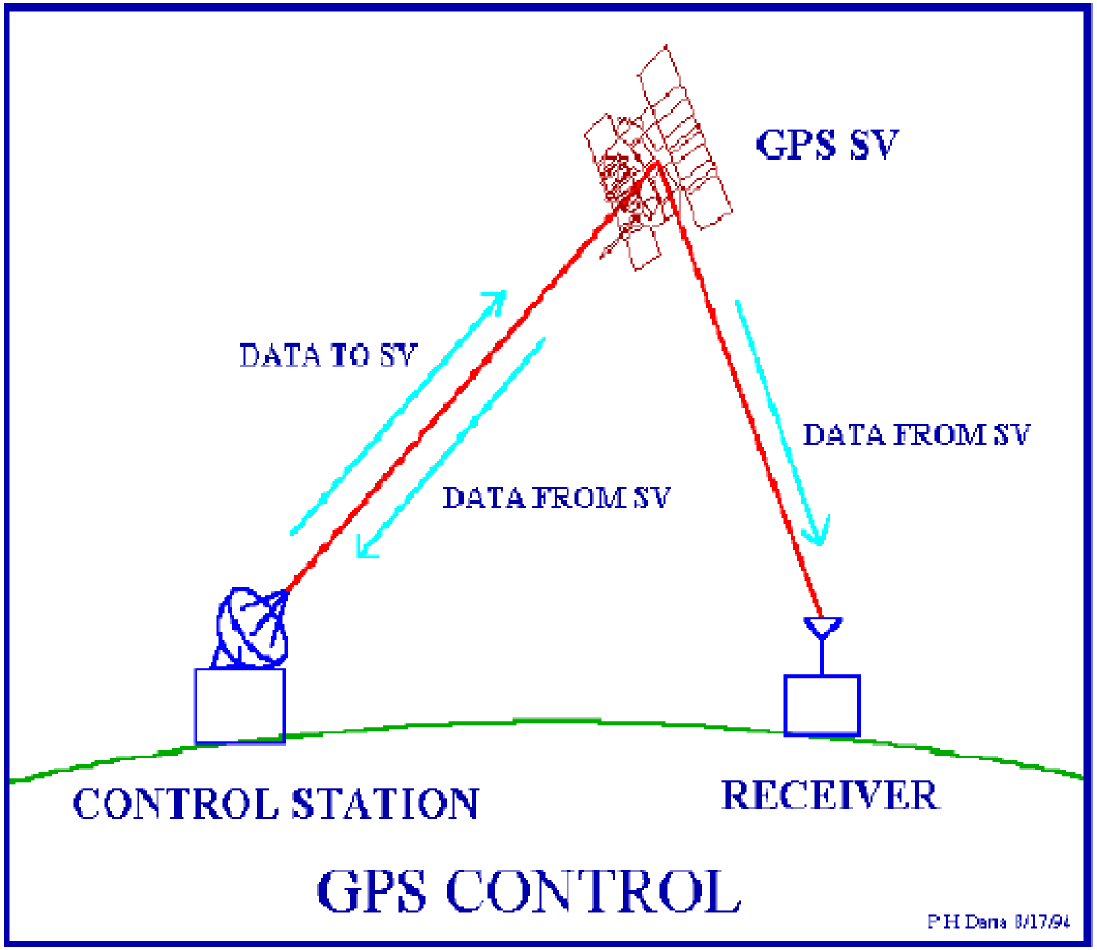
- GPS uses a lot of battery power.
  http://www.wikihow.com/Save-Battery-Power-on-an-Android

- Graphic animation of GPS Satellite Positions
  http://en.wikipedia.org/wiki/File:ConstellationGPS.gif

GPS Satellite

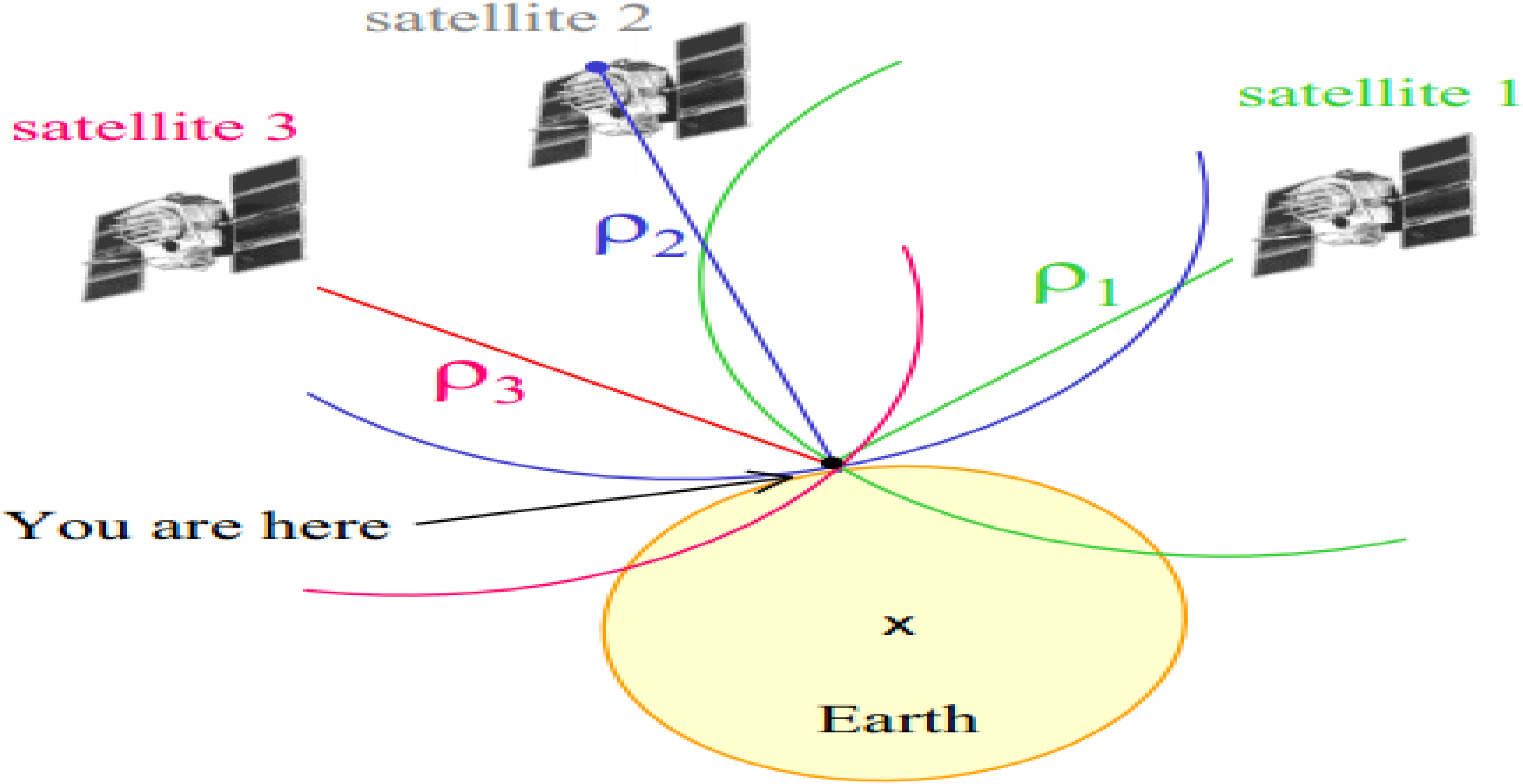


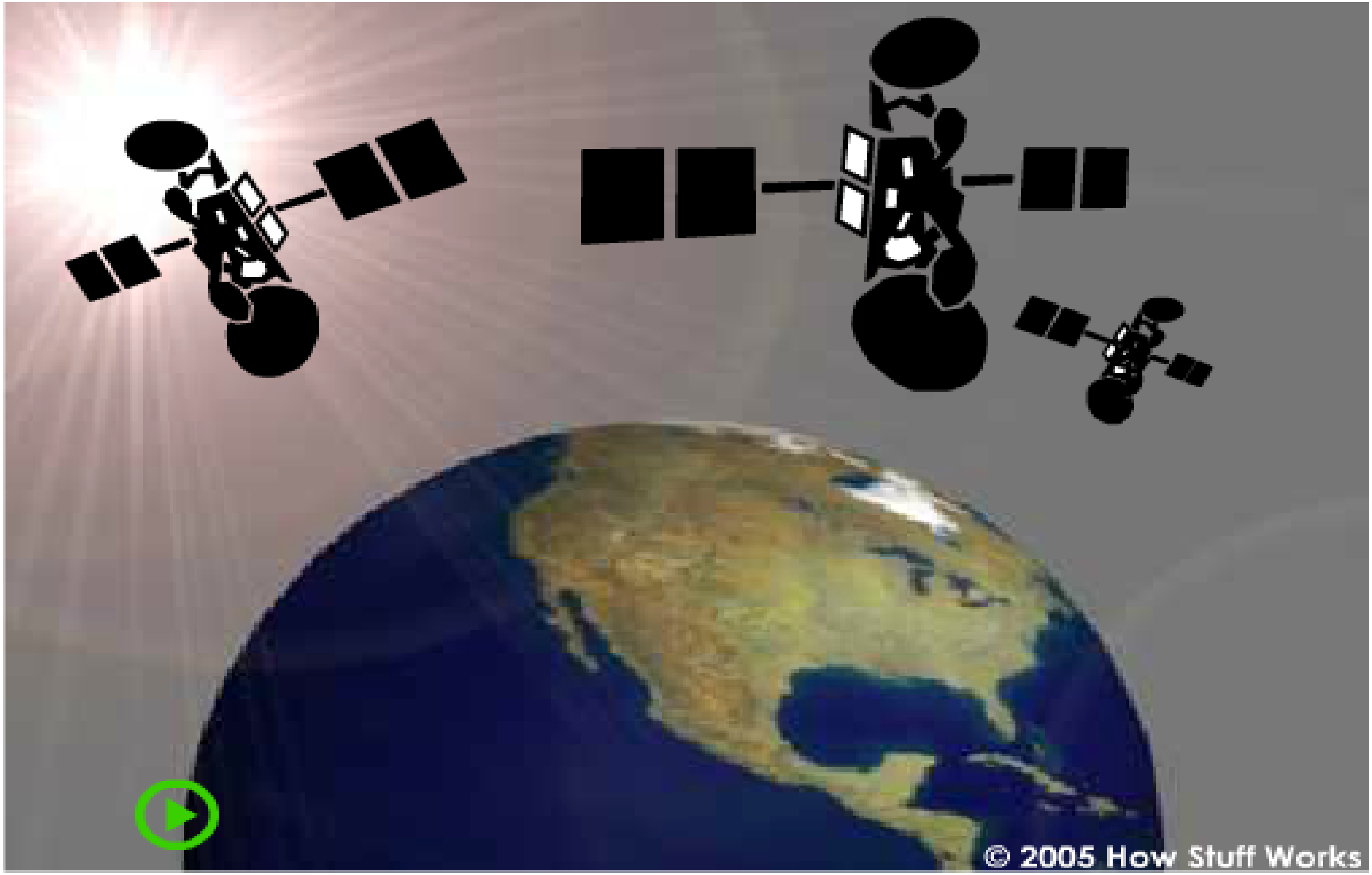
Three "segments"



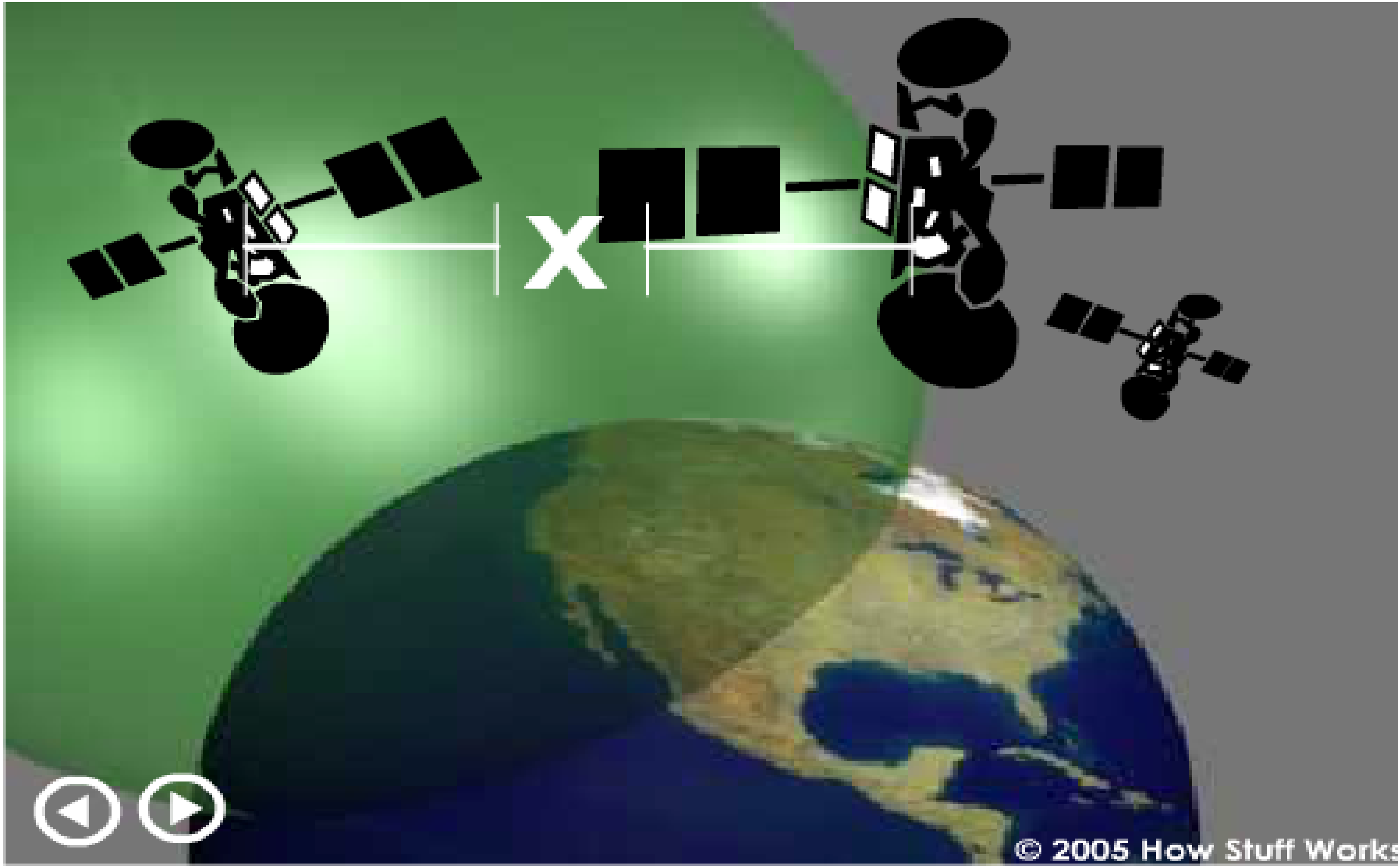
- The **space segment** = satellites:
  - Broadcast radio signals toward users on the Earth
  - Receive commands from the ground.
- The **control segment**: monitors the space segment and send commands to satellites
- The **user segment**: receivers record and interpret the radio signals broadcast by the satellites

GPS positioning: A simple principle

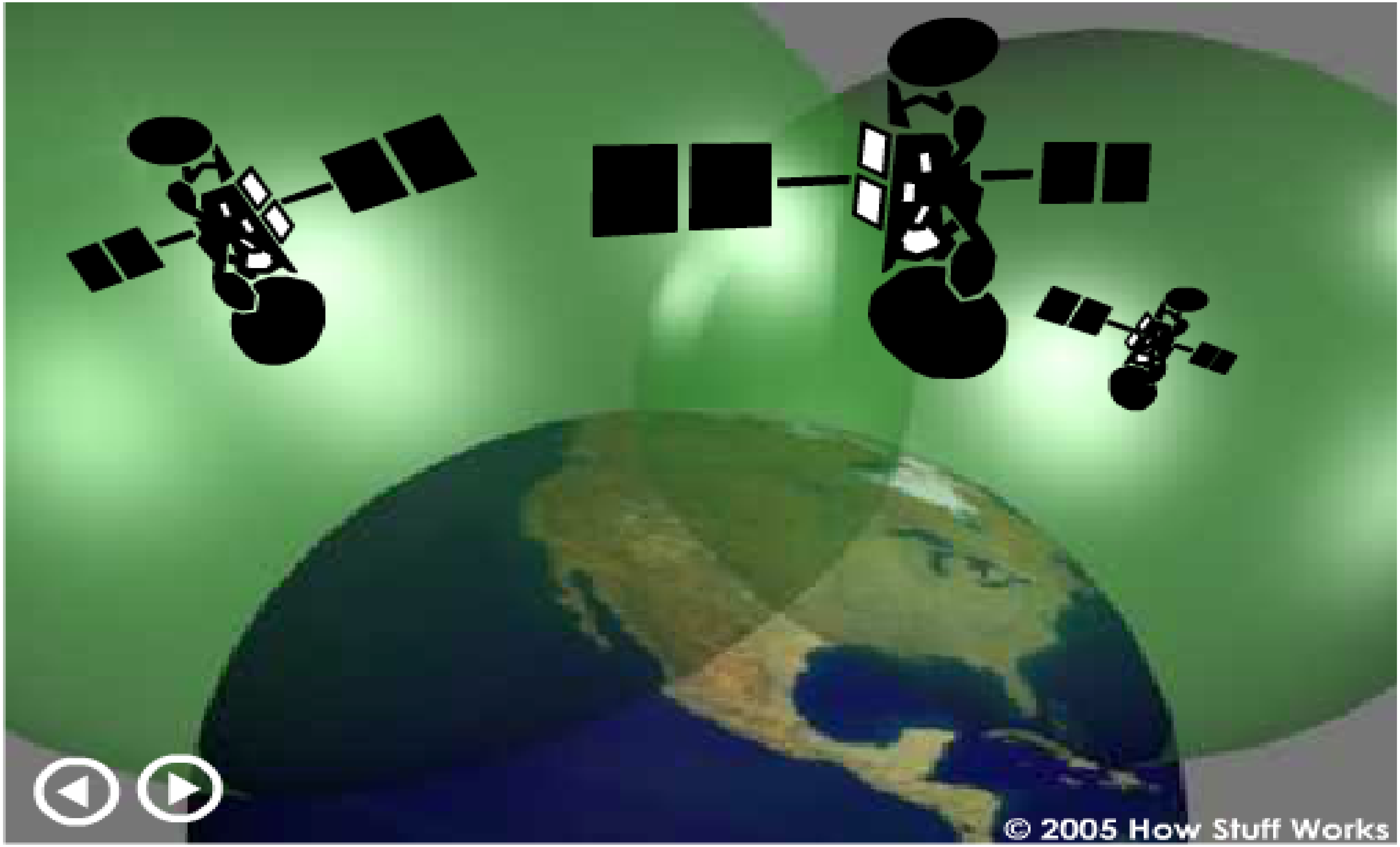




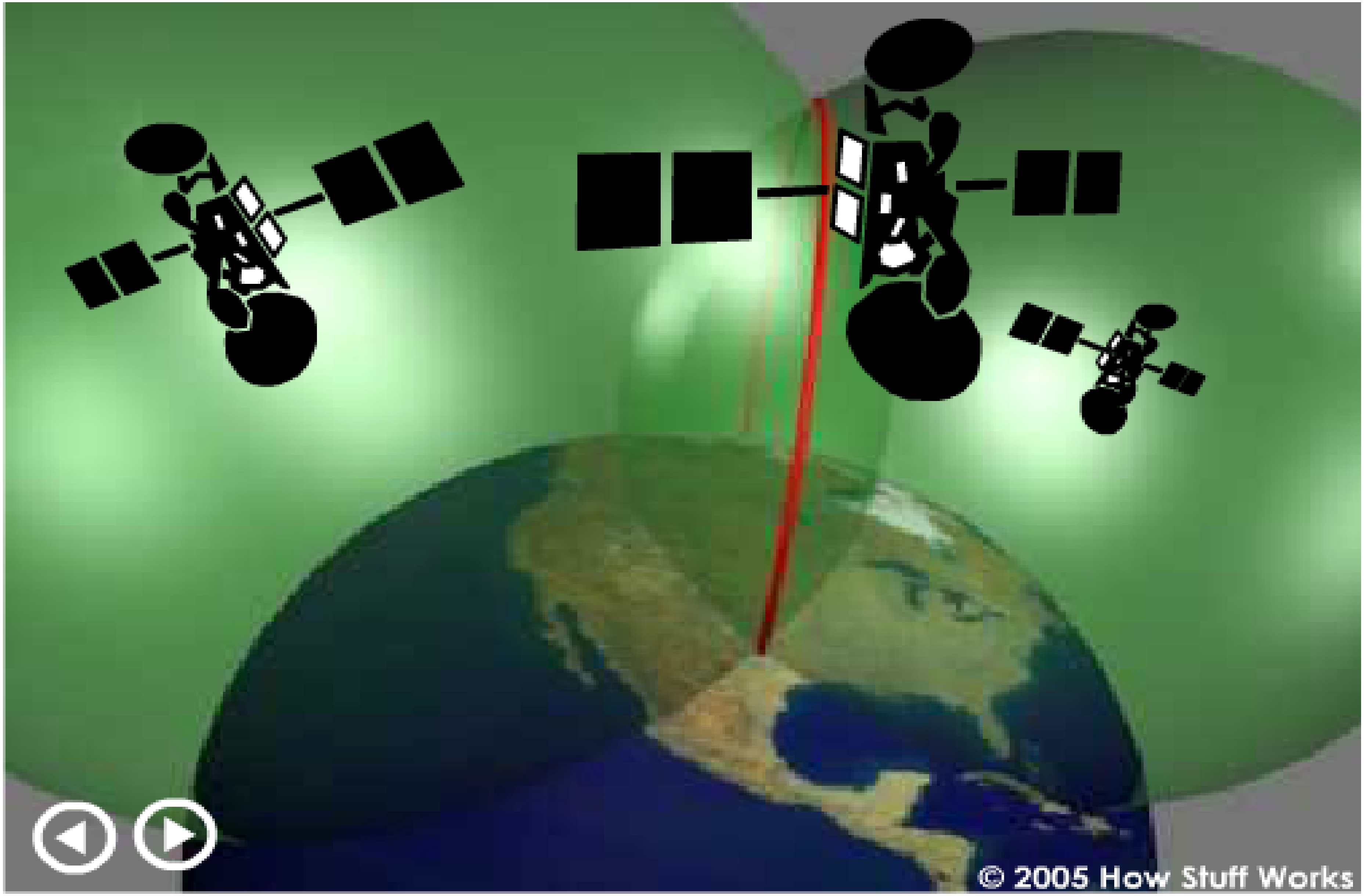
To locate itself, a GPS receiver must find the distance to three satellites of known positions.



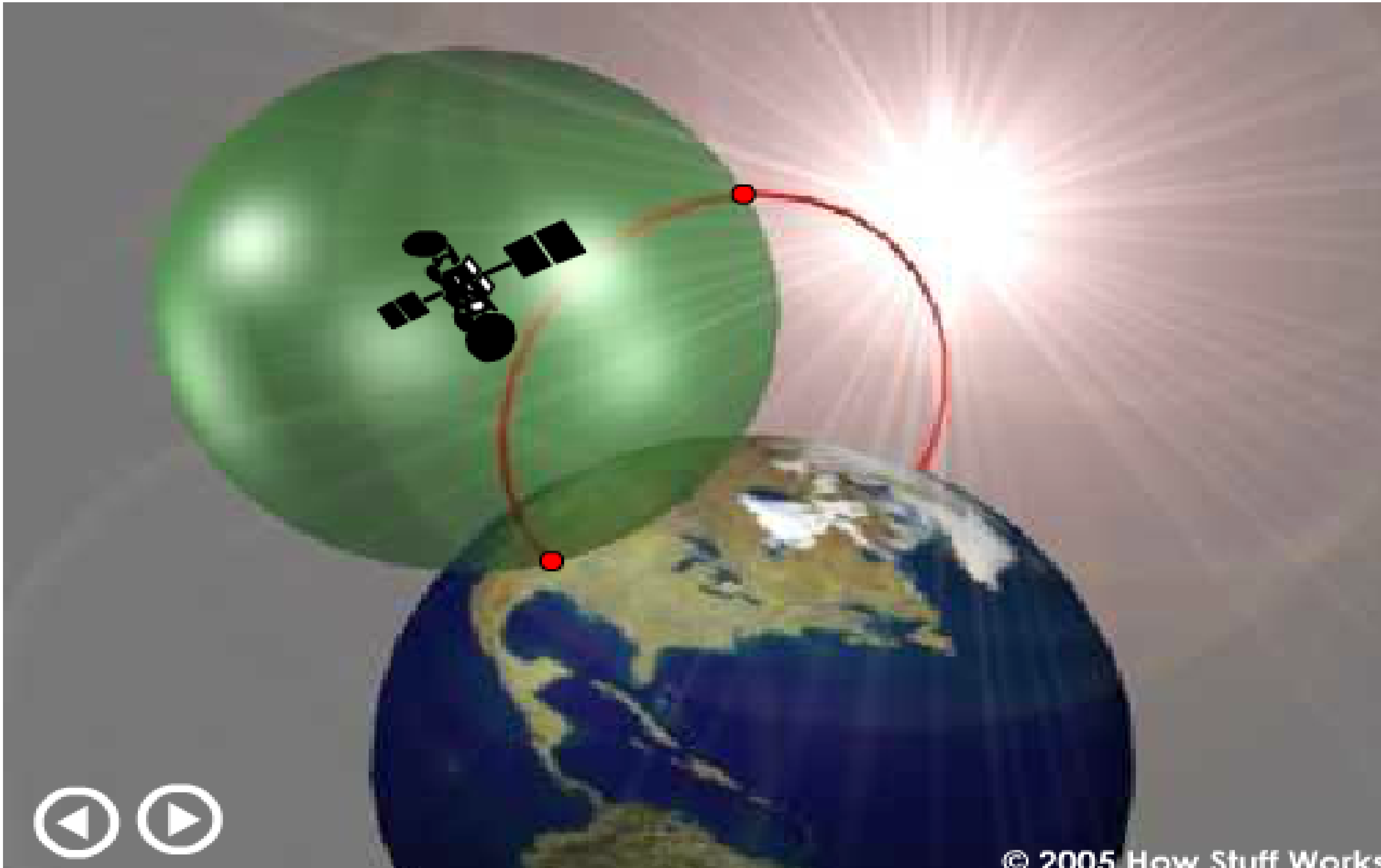
If the receiver finds that it is X miles from one satellite, it knows that it must be somewhere on an imaginary sphere, with the satellite as the center and a radius of X.



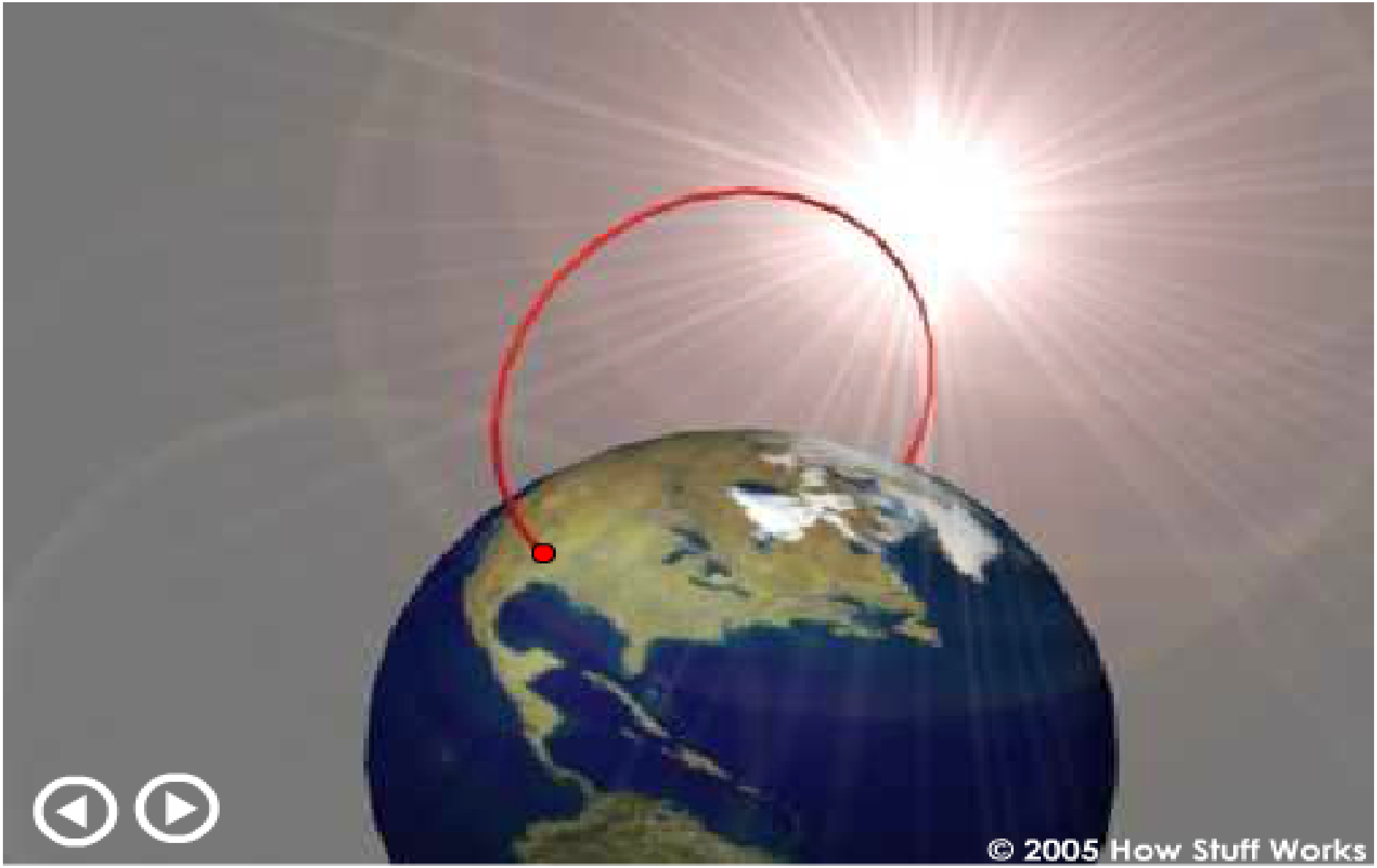
If the receiver can generate these spheres for two satellites, it knows it can only be located where the surfaces of the two spheres intersect.



The two spheres overlap in a ring of possible receiver positions.

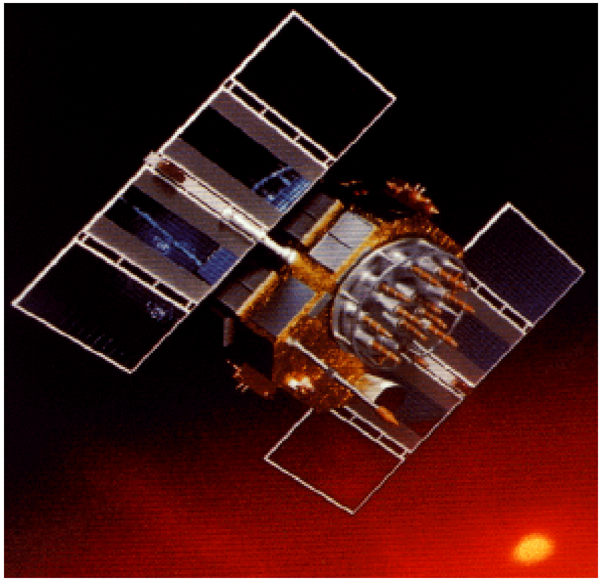


By generating a sphere for a third satellite, the receiver narrows its possible positions down to two points.

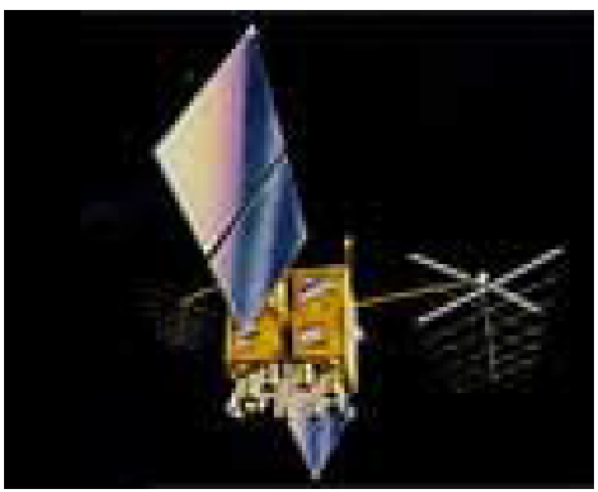


The receiver dismisses the point located in space,
leaving only one possible position.

The GPS satellites



Block II satellite

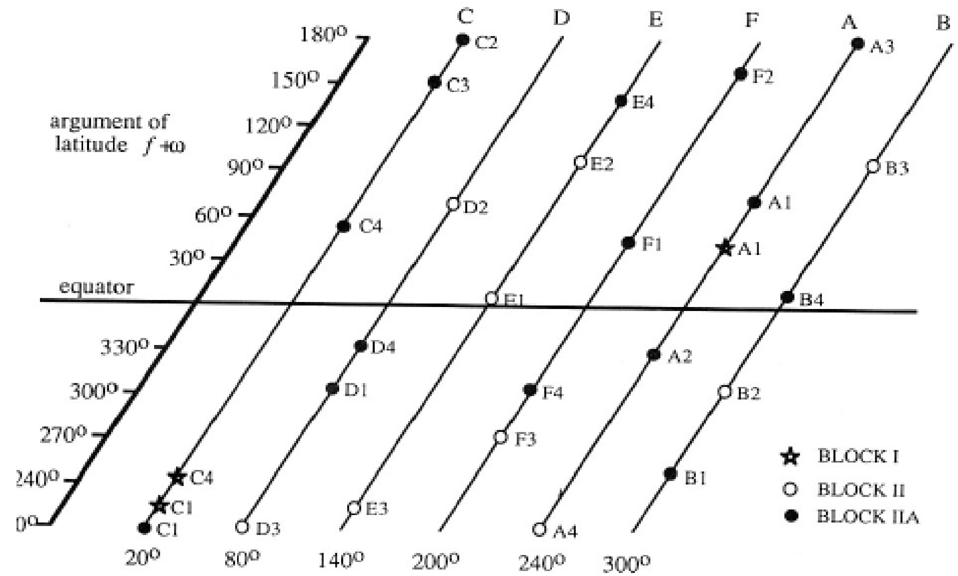


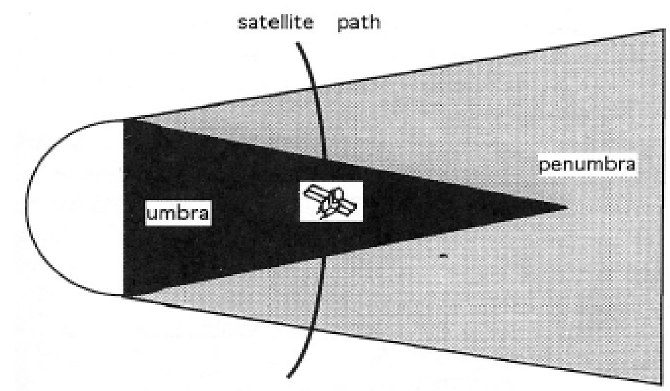
Block IIR satellite

- Four classes (=generations): blocks I, II, IIA, IIR,and IIF:
  - Block I:
    - 11 satellites launched between 1978 and 1985 on Atlas F rockets
    - Life expectancy = 4.5 years, actual mean life = 7.1 years
    - Signal entirely accessible to civilian users
    - Last block I satellite died on Feb. 28, 1994
  - Block II (II-R and II-F):
    - Possibility to degrade the signal for civilian users
    - 1 satellite ~ 25 million dollars
    - Life expectancy = 10 years
    - 5 m^3, 2 tons, solar panels, boosters
- New launches on a regular basis
- Monitored and controlled from the ground

Orbital constellation

- 27 satellites (24 operational + 3 spares)
  - Quasi-circular orbits, mean altitude 20200 km
  - 6 evenly spaced orbital planes (A to F), inclination 55°
  - 4-6 satellites per plane, spacing for optimized visibility
  - Period = 12 sidereal hours (= 11h58mn "terrestrial" hours) ⇒ in a terrestrial frame, the constellation repeats every 23h56mn.
  - As Earth orbits around the Sun ⇒ eclipse periods (solar radiation pressure = 0, transition to shadow difficult to model, often simply edited out)
- In practice, 6-12 satellites are visible simultaneously, depending on:
  - Constellation geometry
  - Elevation cut-off angle (chosen by the user)





Summary of satellites[27]

Block	Launch Period	Satellite launches				Currently in orbit and healthy
		Suc-cess	Fail-ure	In prep-aration	Plan-ned	
I	1978–1985	10	1	0	0	0
II	1989–1990	9	0	0	0	0
IIA	1990–1997	19	0	0	0	9
IIR	1997–2004	12	1	0	0	12
IIR-M	2005–2009	8	0	0	0	7
IIF	From 2010	3	0	10	0	3
IIIA	From 2014	0	0	0	12	0
IIIB	—	0	0	0	8	0
IIIC	—	0	0	0	16	0
Total		61	2	10	36	31

(Last update: October 8, 2012)

PRN 01 from Block IIR-M is unhealthy
PRN 25 from Block IIA is unhealthy
PRN 32 from Block IIA is unhealthy
PRN 27 from Block IIA is unhealthy
[28] For a more complete list, see *list of GPS satellite launches*

Summary of GPS Error Sources

Typical Error in Meters (per satellites)	Standard GPS	Differential GPS
Satellite Clocks	1.5	0
Orbit Errors	2.5	0
Ionosphere	5.0	0.4
Troposphere	0.5	0.2
Receiver Noise	0.3	0.3
Multipath	0.6	0.6

GPS Approach of a Jetliner

- Example of how it is used by the airlines.
- Autopilot is coupled to the GPS receivers.
- Autopilot will fly the approach/glideslope to the runway “touchdown point”. “Autoland” is engaged (autopilot will control the flight controls, engine throttles, descent rate and landing of the airplane to touchdown).
- Pilot will take over after “touchdown” !!

Instrument Approach (EWR) in Fog

Boeing 747-400 airplane

Category III Approach (“AutoLand” is on)

Nighttime with Heavy Fog

Minimums (100 Feet Min. Descent Altitude)

Runway Visual Range (200 Feet)

View (20 secs to touchdown)

View (15 secs to touchdown)

View (8 sec's to touchdown)

DECISION TIME (ABORT OR LAND)

“What the heck happened we're lined up on the left edge of the runway!”

"Hand Fly the Approach or Abort"

- "**Let's salvage this landing the captain says.** "
- " **Captain has the airplane. Turning off the autopilot.** Ding sound. **Coming right to get back on the runway centerline. Co-pilot you handle the throttles, thrust reversers and call the descent rate and speed. I'll call the power settings and changes I want."**
- " 'Altimeter chimes 90 Feet'. *Descent rate ' 500 feet/minute'.* **We're back on the runway centerline. Power to 20 %. Flaring the plane.**
- "Altimeter chimes 60 feet. *Descent now '200 feet /minute*.' "
- "Altimeter chimes 30 feet. *Descent now100 feet /minute*."
- "*Touchdown. Speed now 100 Knots*. Spoilers deployed. **Deploy the reverse thrusters.**
- *Thrusters deployed. Speed now 70 knots.*
- *Speed now 30 knots . We can take the next turn-off !*!

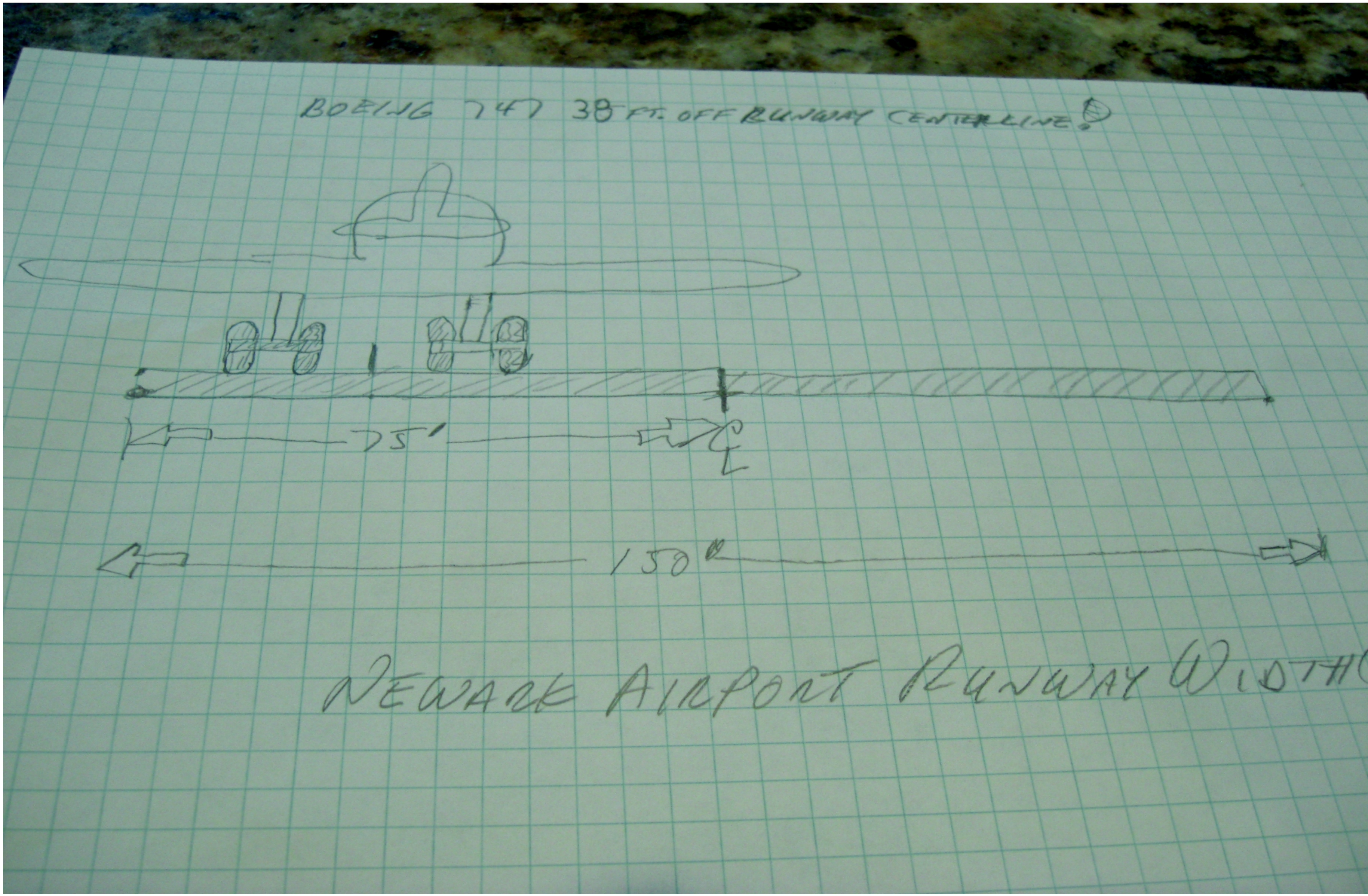
THE REAL STORY BEHIND A GPS APPROACH

- Autopilot must be coupled to the I(nstrument) L(anding) S(ystem) not the GPS.
- 100 Foot MDA & 200 foot visibility not allowed. Must be made to the ILS minimums (~~ 200 Foot MDA & ~~ 1000 foot visibility).
- ILS approach on captains panel. GPS readout on copilots panel. Allows comparison during approach. Would have shown the difference much earlier in the approach. This likely would have led to a “Go Around Commitment” before the runway lights were even spotted !!

“WHAT HAPPENED”

- D-GPS (Differential GPS) wasn't working !
- D-GPS is a GPS receiver located close to or at the airport that has a specific surveyed location down to less than a foot accuracy.
- Filters out the major part of the GPS errors and passes the corrections to the planes GPS receivers to get the accuracy down to 1.5 meters (~~ 5 feet location accuracy) .
- BUT this would have had an audio alert and annunciation on the airplane instrument panel.
- See next slide for sketch !!

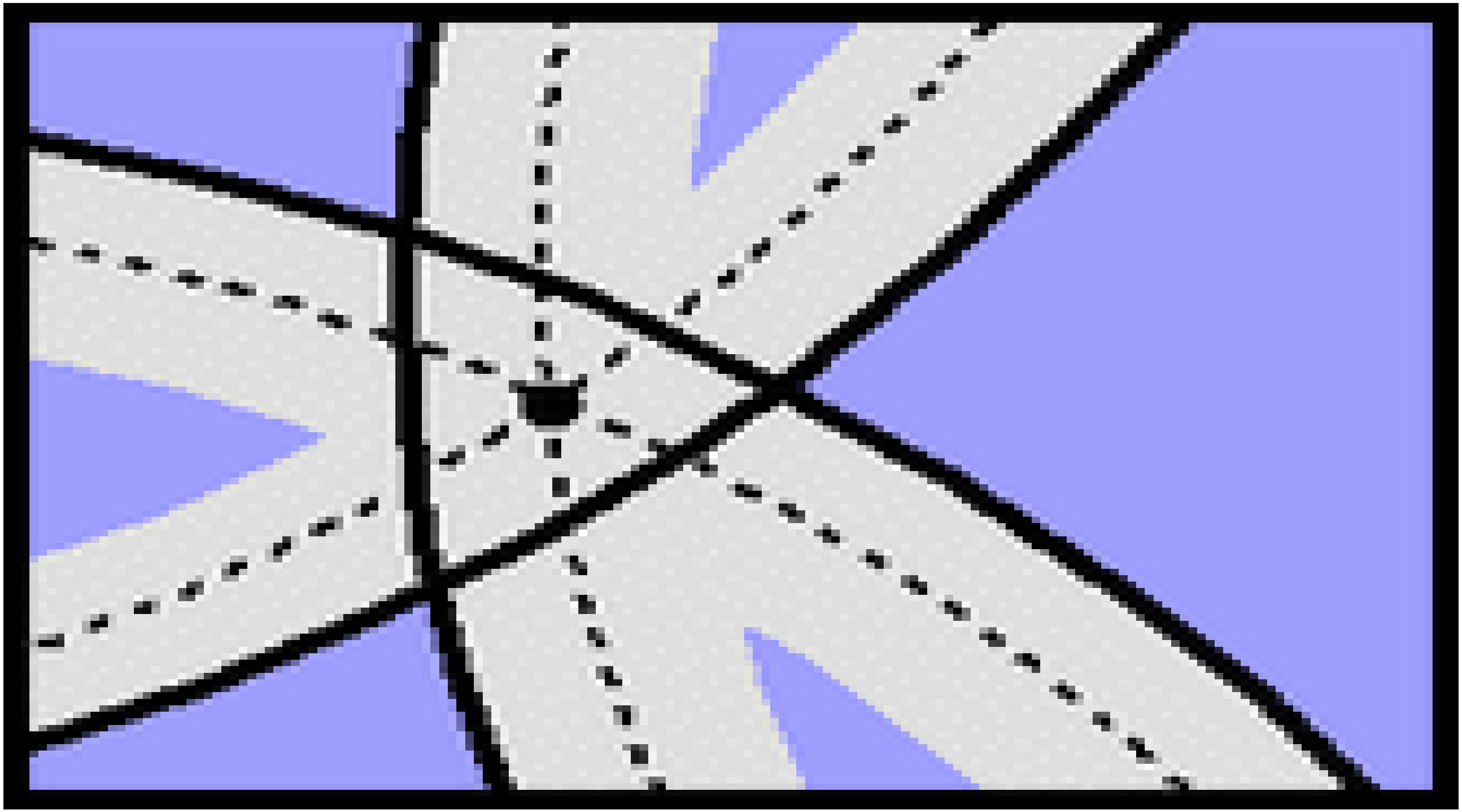
10.5 METER GPS ERROR !!



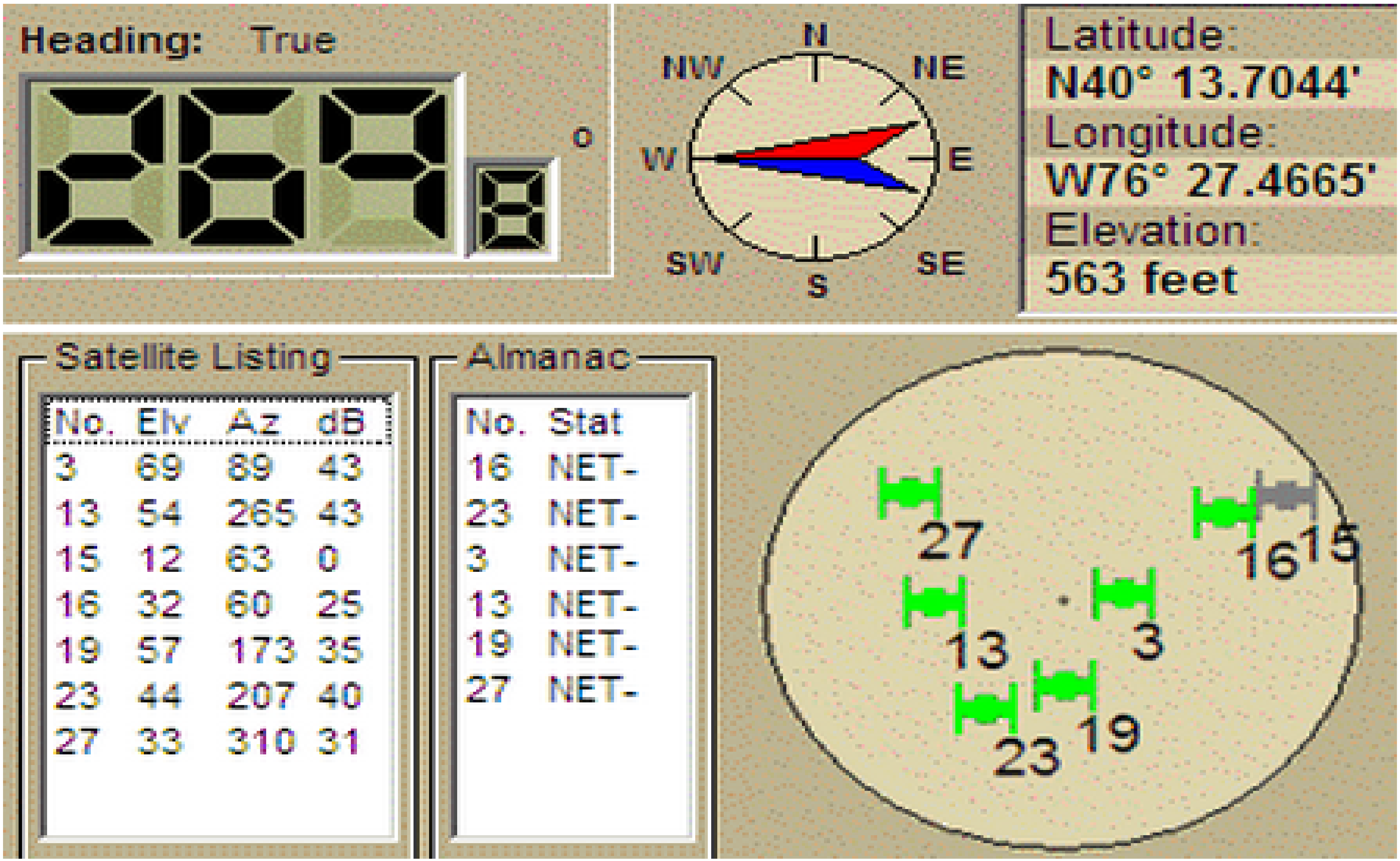
GPS Math Facts

- Atomic clocks (1 sec. Error in 30,000 years)
- 1/1000 sec. Difference in (Satellite vs. Rcvr. Clock) = ~~ 180 mile error in position.
- Receiver clock sync'd to satellite by receiver re-calculation of “perfect solution”
- Three satellite solution gives 2D position
- Four satellite solution gives 3D position.
- Almanac (catalog of Sat's) and Ephemeris (that Sat's detail data) must be available before position calculation can be done (TTFF delay ??).

GPS 3D INTERSECTION



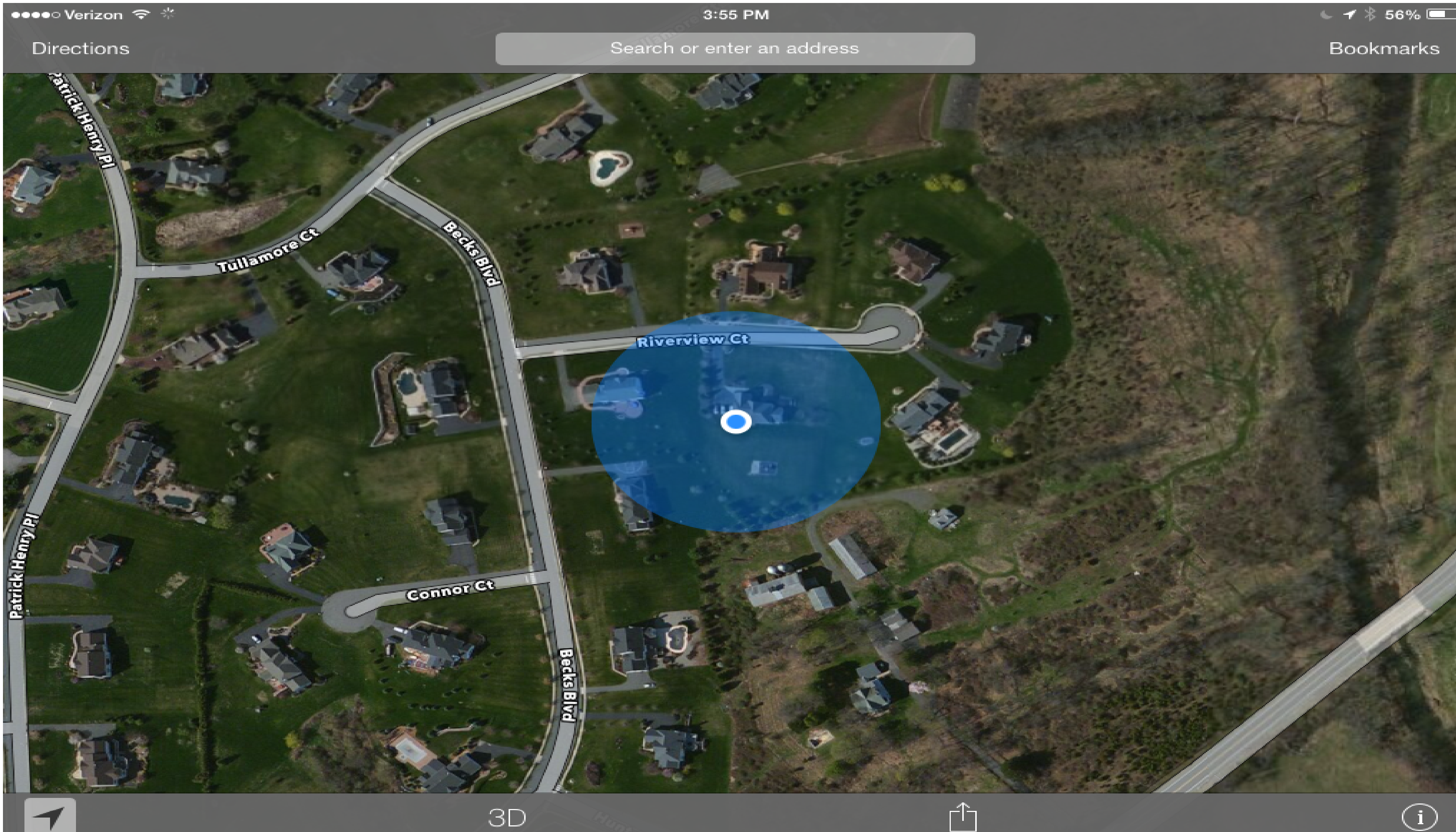
Basic GPS Data



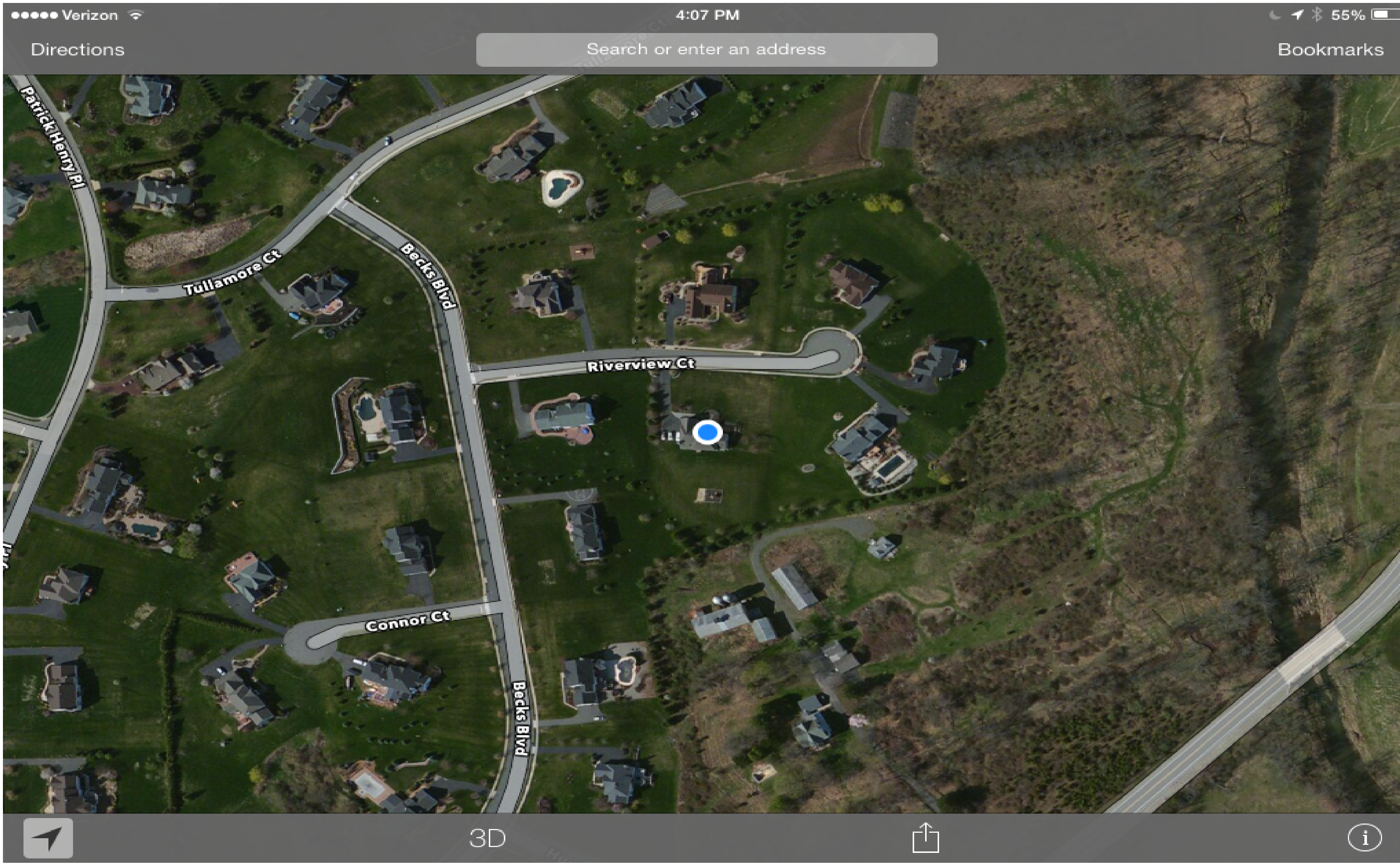
MAPPING/LOCATION ISSUES

- “Live Maps” feature requires cellular access and a “Mapping App program”
- Devices with Wi-Fi only don't have access to “Live Maps” unless they stay in Wi-Fi contact
- “Crowd Sourcing “ techniques used to show road traffic issues/delays
- “Crowd Sourcing” being used to determine location of Wi-Fi signal source
- a-GPS used to accelerate TTFF (Time To First Fix) while GPS is calculating location

“ Loc'n (Wi_Fi) only”



Final Location(w/GPS)



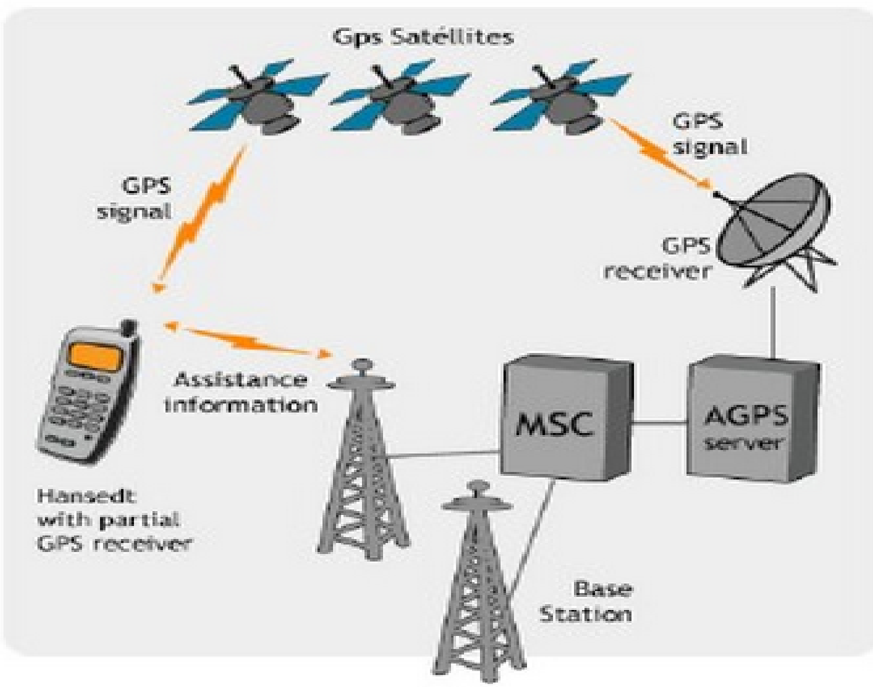
“Find my iPad”


Riverview Ct
Riverview Ct
Riverview Ct
Beck Blvd
Beck Blvd
Beck Blvd
Jeannette's iPad
Yesterday at 11:58 AM

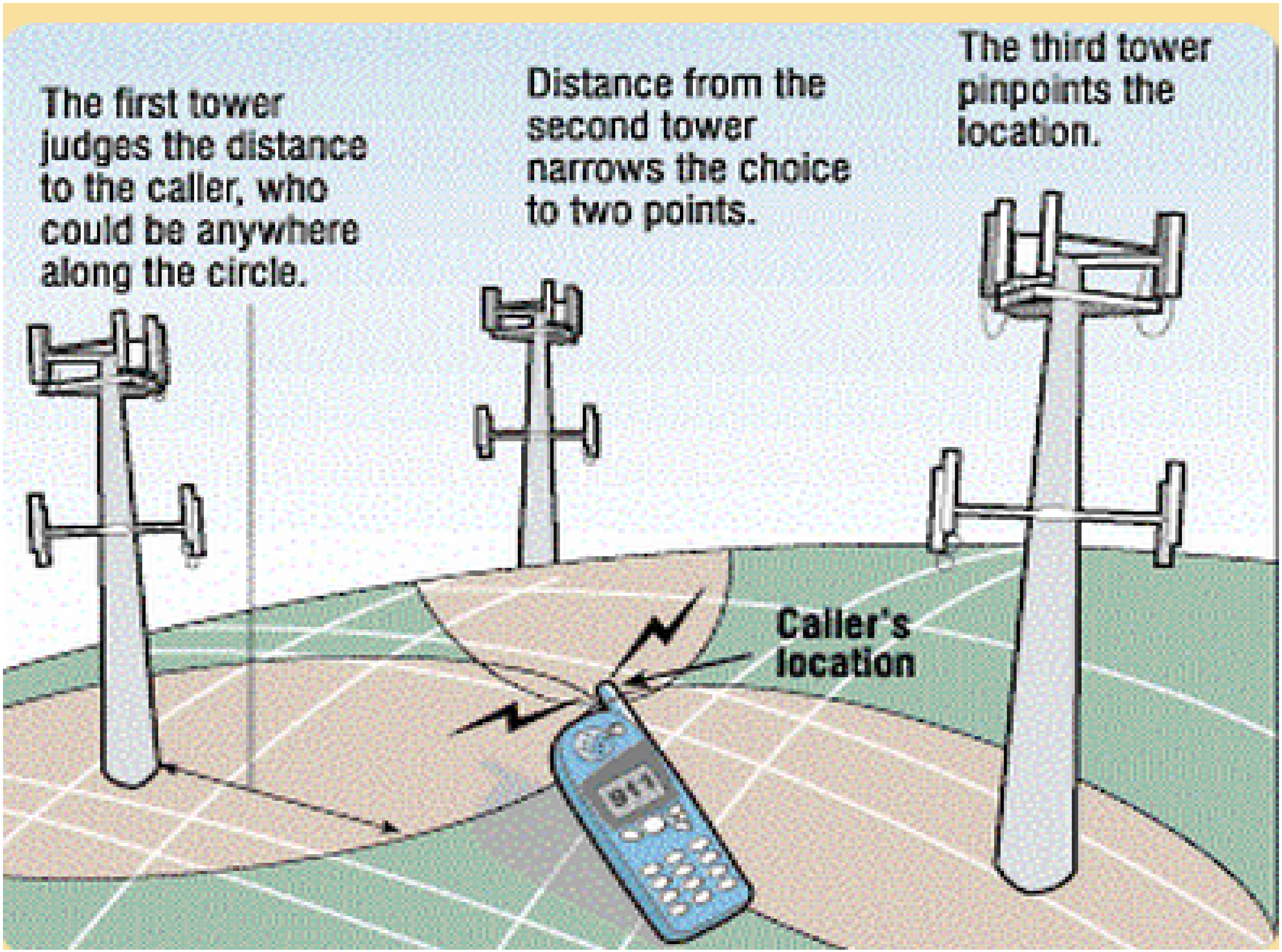
GPS vs. aGPS: A Quicl ×

www.wpcentral.com/gps-vs-agps-quick-tutorial

- Faster location acquisition
- Less processing power is required by the device
- Saves battery life
- Location acquisition indoors or in non-optimal environmental settings



Sprint describes how their system is supposed to work from their online FAQ:


The first tower judges the distance to the caller, who could be anywhere along the circle.
Distance from the second tower narrows the choice to two points.
The third tower pinpoints the location.
Caller's location
911

MotionX-GPS Drive v15
Optimized for iPhone 5 & iPad

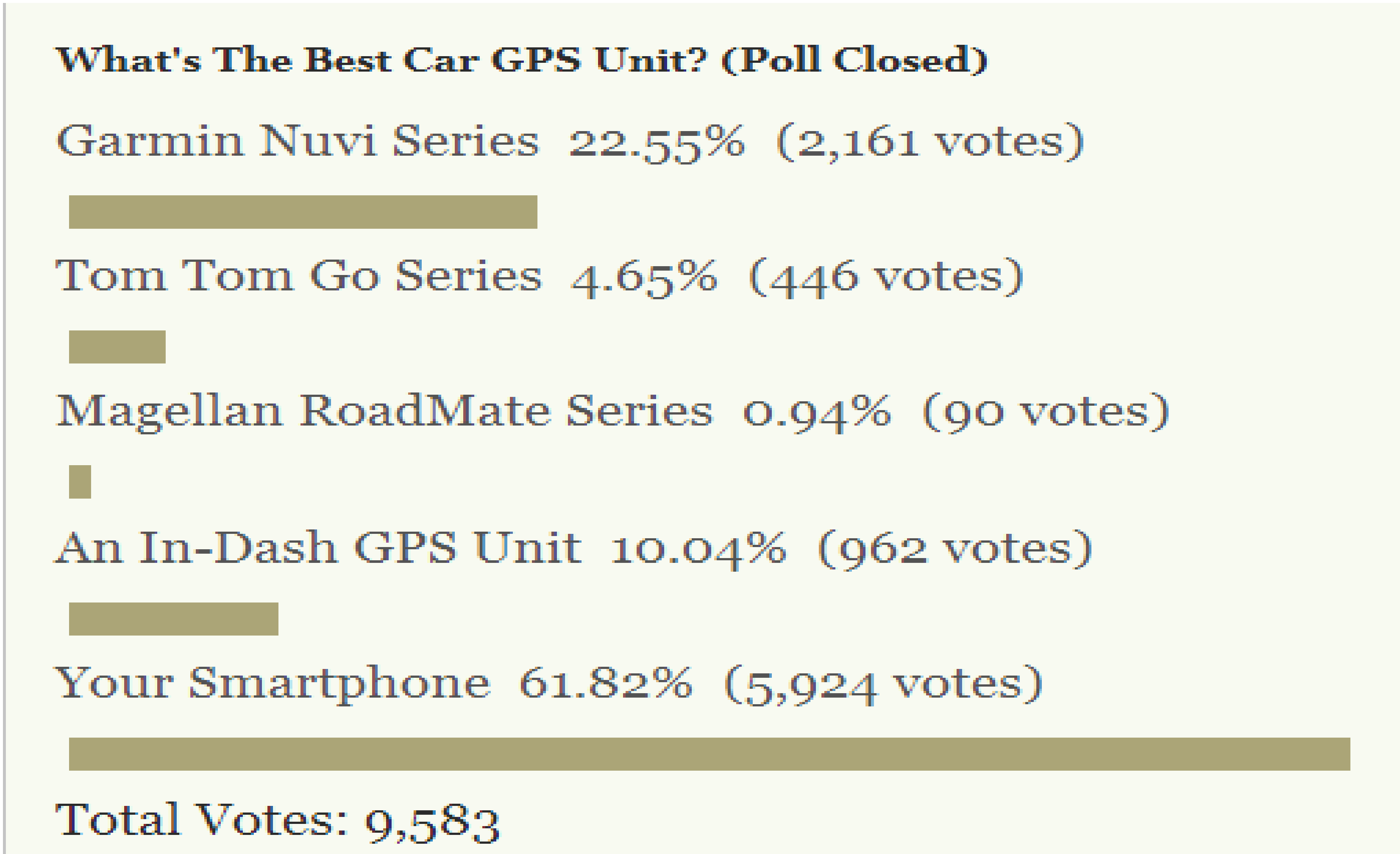
New

Available on the App Store

MotionX®

TRAFFIC DISPLAY

GPS FOR YOUR CAR



BATTERY DRAIN OF GPS

GPS's battery draining behavior is most noticeable during the initial acquisition of the satellite's navigation message: the satellite's state, ephemeris, and almanac. Acquiring each satellite takes 12 to 30 seconds, but if the full almanac is needed, this can take up to **12 minutes**. During all of this, your phone is unable to enter a deep sleep. A-GPS (Assisted GPS) partially solves this, by sending the navigational message to your mobile device over your cellular data network or even Wi-Fi. As the bandwidth of either of these greatly dwarves the 50bps of the GPS satellites, the time spent powering the GPS antenna or avoiding deep sleep is greatly reduced.

FARMING

- Field layout , sizing, tractor patterns
- Field leveling, appraisal, irrigation, fertilizing, plowing, weed control
- Farm tractor “autopilot control”
- Specialized “D-GPS” with accuracy down to ~~ 4 inches

OTHER USES FOR GPS

GPS Tracking Devices

- Large leased capital equipment

- Position reporting of “over the road trucks” , “delivery trucks” and sales/service vehicles

- “ On Star” General Motors service assistance

- “Surreptitous “ (ie law enforcement or personal use)

QUESTIONS

- I'll distribute the presentation through the “clubs' Yahoo groups address”

- Thanks for your attention . I'll will try to answer any questions you have.

- If you have other questions after reviewing the presentation I E-mail we can cover them during the “Q & A Session” at the next club meeting.

VNAV PTH
33000
STD
HDG 102 MAG
VIXUN
100
33000
LX-TCV
DQ-BL
BEFORE TAKEOFF
FLAPS
AFTER TAKEOFF
LANDING GEAR ___UP AND OFF
FLAPS___UP
DESCENT
___CHECKED
1
2
3
4

Captains Panel

AUTOLAND SYSTEMS:

Autoland systems were designed to make landing possible in visibility too poor to permit any form of visual landing, although they can be used at any level of visibility. They are usually used when visibility is less than 600 meters RVR and/or in adverse weather conditions, although limitations do apply for most aircraft—for example, for a Boeing 747-400 the limitations are a maximum headwind of 25 kts, a maximum tailwind of 10 kts, a maximum crosswind component of 25 kts, and a maximum crosswind with one engine inoperative of five knots. They may also include automatic braking to a full stop once the aircraft is on the ground, in conjunction with the autobrake system, and sometimes auto deployment of spoilers and thrust reversers.

Autoland may be used for any suitably approved Instrument Landing System (ILS) or Microwave Landing System (MLS) approach, and is sometimes used to maintain currency of the aircraft and crew, as well as for its main purpose of assisting an aircraft landing in low visibility and/or bad weather.

Autoland requires the use of a radar altimeter to determine the aircraft's height above the ground very precisely so as to initiate the landing flare at the correct height (usually about 50 feet (15 m)). The localizer signal of the ILS may be used for lateral control even after touchdown until the pilot disengages the autopilot. For safety reasons, once autoland is engaged and the ILS signals have been acquired by the autoland system, it will proceed to landing without further intervention, and can be disengaged only by completely disconnecting the autopilot (this prevents accidental disengagement of the autoland system at a critical moment). At least two and often three independent autopilot systems work in concert to carry out autoland, thus providing redundant protection against failures. Most autoland systems can operate with a single autopilot in an emergency, but they are only certified when multiple autopilots are available.

Bad Elf GPS for iPad ×

www.pilotshop.com/bad-elf-gps-for-ipad-iphone-ipod-p-9969.html?utm_campaign=google-simple&utm_medium=product_search&utr

Categories

- iPad / iPhone / Android
- **Aviation GPS**
  - Panel Mount
  - GPS Handhelds
  - **iPad GPS + Weather**
  - Pre-Owned GPS
  - Garmin Accessories
  - Bendix King Accesories
  - Lowrance Accessories
  - Other Accessories
  - Manuals / Tutorials
- Aviation Headsets
- Aeronautical Charts
- Aircraft Supplies
- Airport Supplies
- Books, Videos, Software
- Crew Gear
- ELTs and PLBs
- Flight Planning
- Flight Simulation
- Gifts for Pilots
- Gift Vouchers
- Pilot Supplies
- Radios Transceivers
- Traffic Alert

ID# 9969: .Bad Elf GPS for iPad / iPhone / iPod $99.95

Bad Elf provides GPS information to popular aviation apps using a high quality 66 channel WAAS GPS. It works with all iOS devices such as iPad, iPhone and iPod Touch. Bad Elf plugs into the bottom of the iPad or iPhone and includes a USB port which can be used to sync and charge the iPad or iPhone. Furnished with a detachable lanyard. Compatible with iPad 1 and 2, iPhone 3G, 3GS, 4GS, and iPod Touch 1G-4G.

Specifications:

- 66-channel MTK GPS chipset
- Fast GPS lock times
- Up to 10Hz update rate
- SBAS/WAAS/EGNOS/MSAS
- Assisted GPS (when network available)
- Micro-USB port and 6ft cable provided for charging / syncing during use
- App available to update satellite data and firmware
- Max altitude: 60K feet
- Max speed: 1000 mph

Compatibility:

- iPod touch (1st, 2nd, 3rd, 4th generation)
- iPhone 4, iPhone 3GS, iPhone 3G, iPhone
- iPad 1 and 2

Compatible Apps

or questions?
new window)

Laser Cutting
encils

ducts

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Kits with
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Kits without
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Robot Kits

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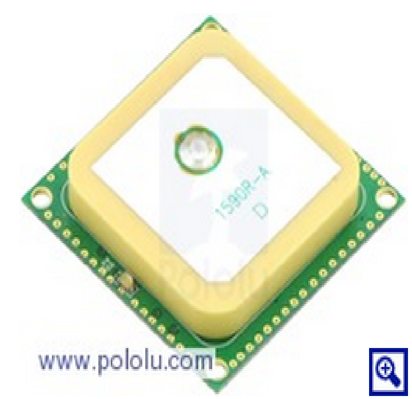
Control

Electronics » Sensors »

66-Channel LS20031 GPS Receiver Module (MT3339 Chipset)



Pololu item #: 2138 — 43 in stock

Price break	Unit price (US$)
1	**49.95**
10	44.95

Quantity: 1

Add to cart

backorders allowed

Add to wish list

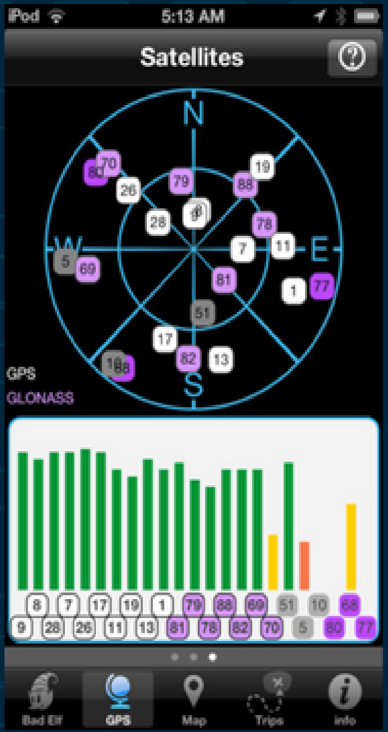
The Locosys LS20031 GPS receiver integrates a MediaTek MT3339 66-channel GPS chip with a ceramic antenna to create a complete GPS module that can track up to 66 GPS satellites at a time. The GPS module supports up to a 10Hz update rate, a built-in rechargeable battery for rapid satellite acquisition (external power is still required for normal operation), and more than 6 different NMEA ASCII sentences that are output to a TTL-level serial port.

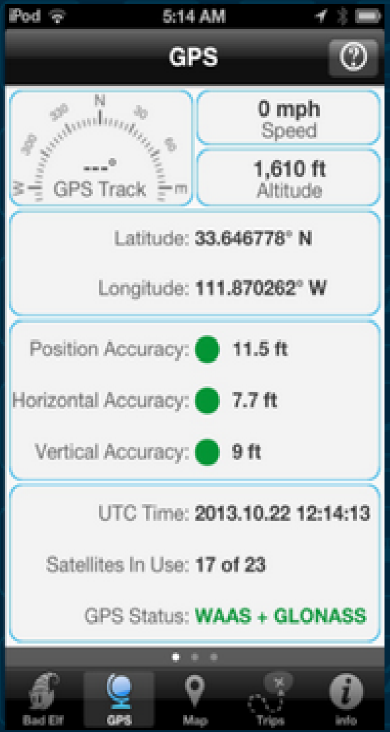
Features

- Instantly add GPS & GLONASS location support to your iPad Wi-Fi or iPod touch device with Lightning Connector.
- High performance 66-channel WAAS enables GPS provides latitude, longitude, altitude, speed, and GPS track.
- Accurate to 2.5m (9ft) up to 60,000ft and 1,000mph.
- Quickly acquire satellite lock without cell tower assistance. Hot start time in as little as 2 seconds.
- Sleek design, great fit, and an internal LED that does not protrude from the case.
- Plugs into the iPad/iPod touch either way. And because the passthrough charging cable socket is on the side, you can direct the charge cable to either side of the iPad/iPod touch.
- Built-in micro-USB port allows for pass through charging while in use.
- No internet connection or monthly subscription required.
- Download the free Bad Elf app from the App Store for firmware updates and device configuration.
- Includes free upgrade to CoPilot Premium app for voice-guided turn-by-turn vehicle navigation support (USA purchases only).

Specifications

- 2.5m (9 ft) positional accuracy with MTK chipset
- 66 channel GPS & GLONASS Receiver
- WAAS compatible, SBAS/EGNOS/MSAS support
- Up to 10MHz sample rate
- Lock times: 2s (hot), 15s (warm), 33s (cold)
- Size: 1.1" x 1.1" x 0.25" / 28mm x 28mm x 7mm (WxHxD)
- Weight: 0.3oz / 8g - full package 3oz / 85g





In the Box

- Bad Elf GPS & GLONASS Receiver for Lightning Connector
- 3 ft (1m) micro-USB cable for pass through charging
- detachable keychain lanyard

Made for These Apple Devices

- iPod touch (5th generation)
- iPhone 5
- iPad (4th generation)
- iPad mini