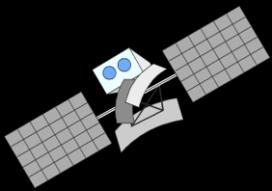


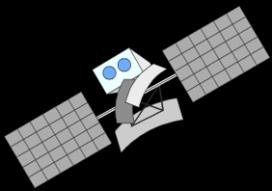


Introduction to GPS



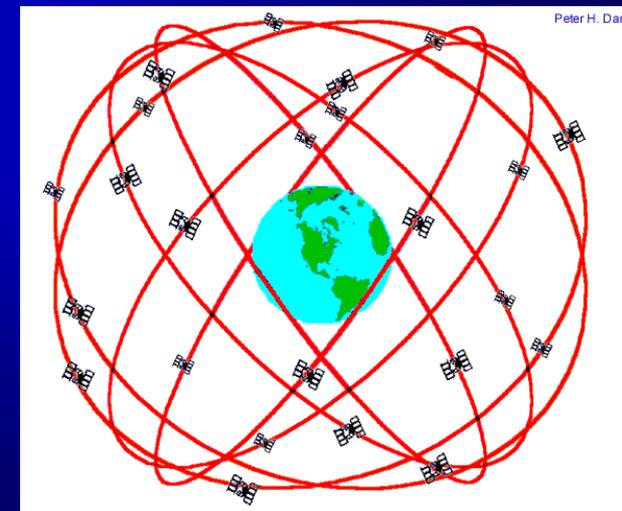
Global Positioning System:

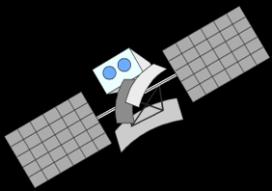
- **developed by the US Dept. of Defense**
- **satellite-based**
- **designed to provide positioning and timing information:**
 - **24 hours/day, 7 days/week**
 - **under any weather conditions**
 - **anywhere in the world**
- **Three components: space, ground, user**



1. Space component

- 24 satellites in constellation
- orbit every 12 hours at 11,500 miles
- 4 satellites in each of 6 orbital planes
- transmit a uniquely coded radio signal
- equipped with onboard atomic clock

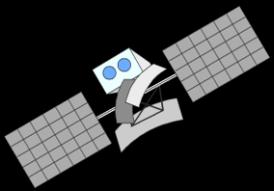




2. Control component

- ground-based monitoring and upload stations
- control orbit and timing information

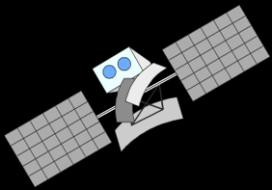




3. User component

- military and civilian users
- navigation and positioning applications on land, sea, in the air and in space



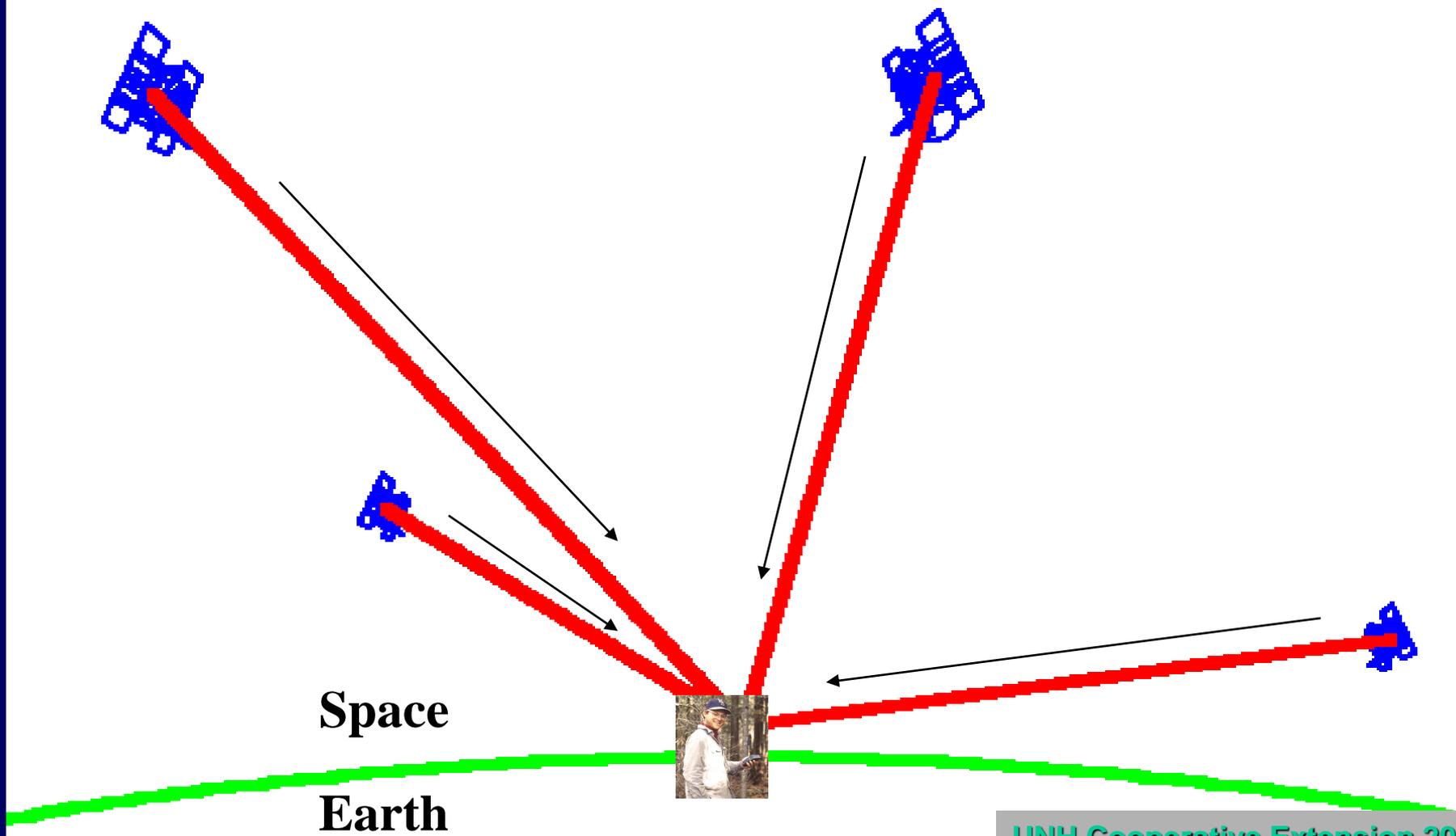


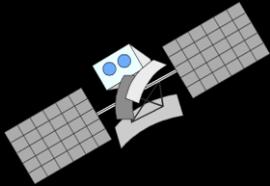
How does GPS work?

1. the receiver picks up the signals from the satellites
2. uses signal travel time to calculate distance to the satellites
3. triangulates to determine position of the receiver

How does GPS work?

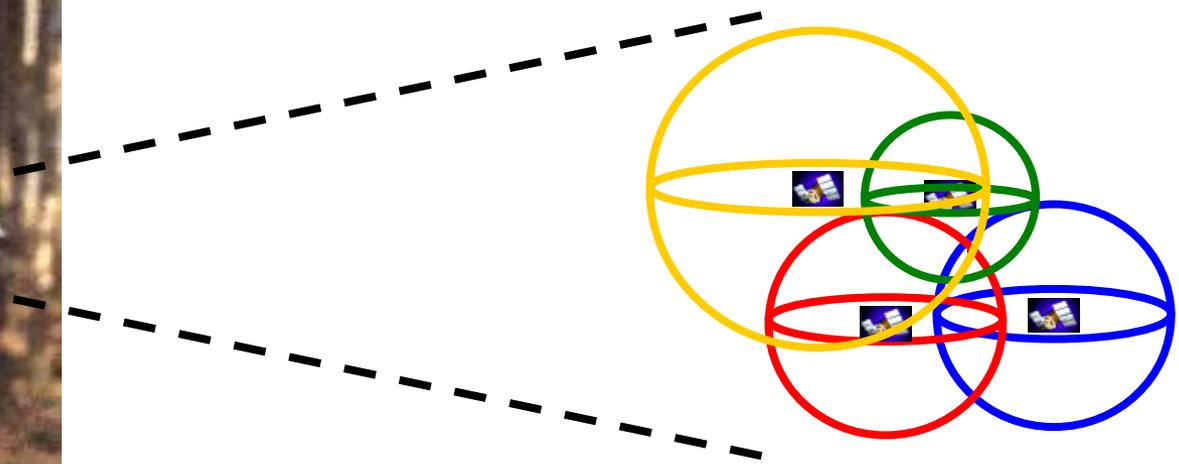
1. The receiver picks up the signals from the satellites





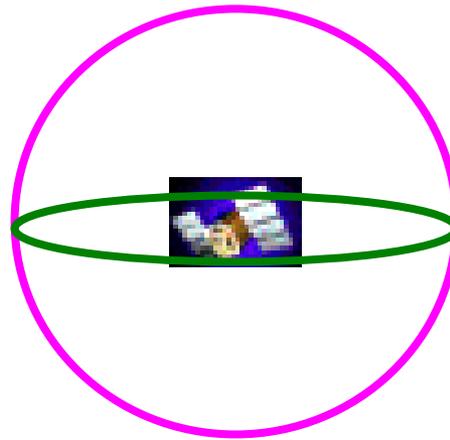
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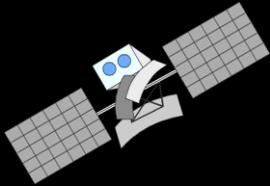
3. Receiver triangulates to determine position of the receiver



How does GPS work?

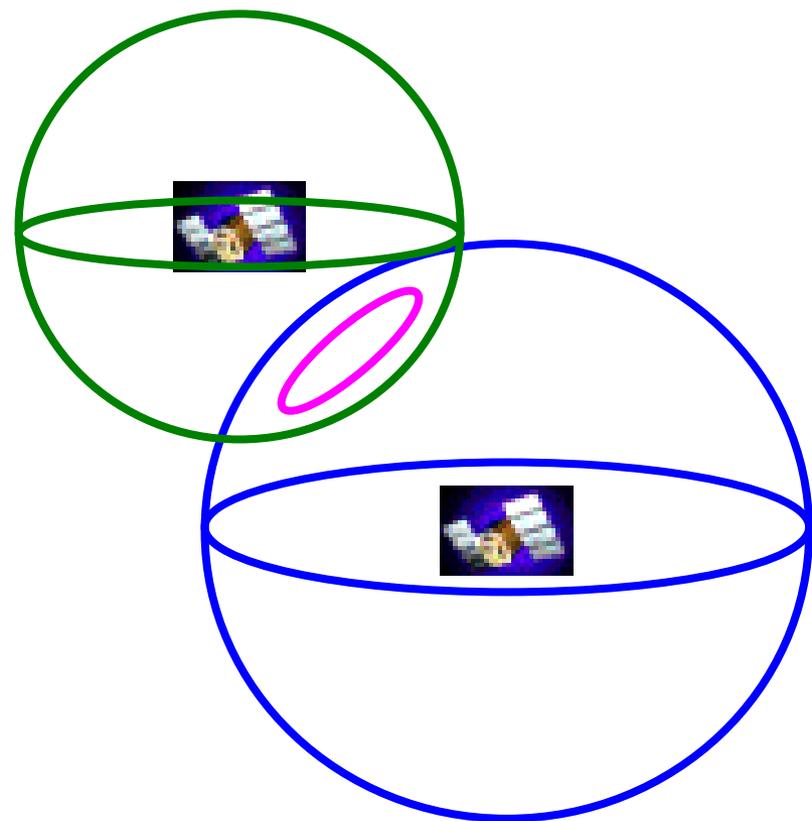
3. Receiver triangulates to determine position of the receiver

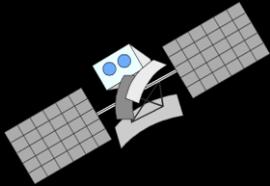




How does GPS work?

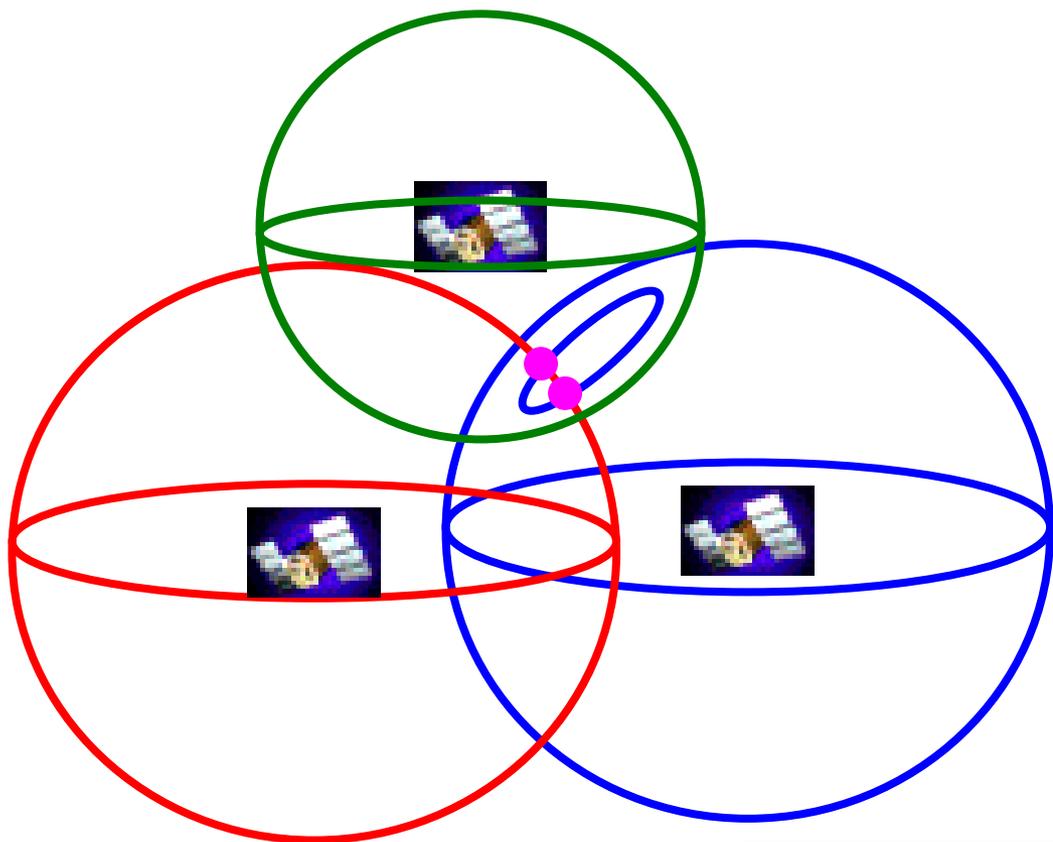
3. Receiver triangulates to determine position of the receiver

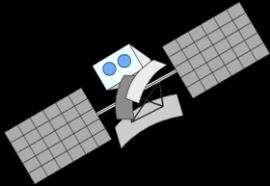




How does GPS work?

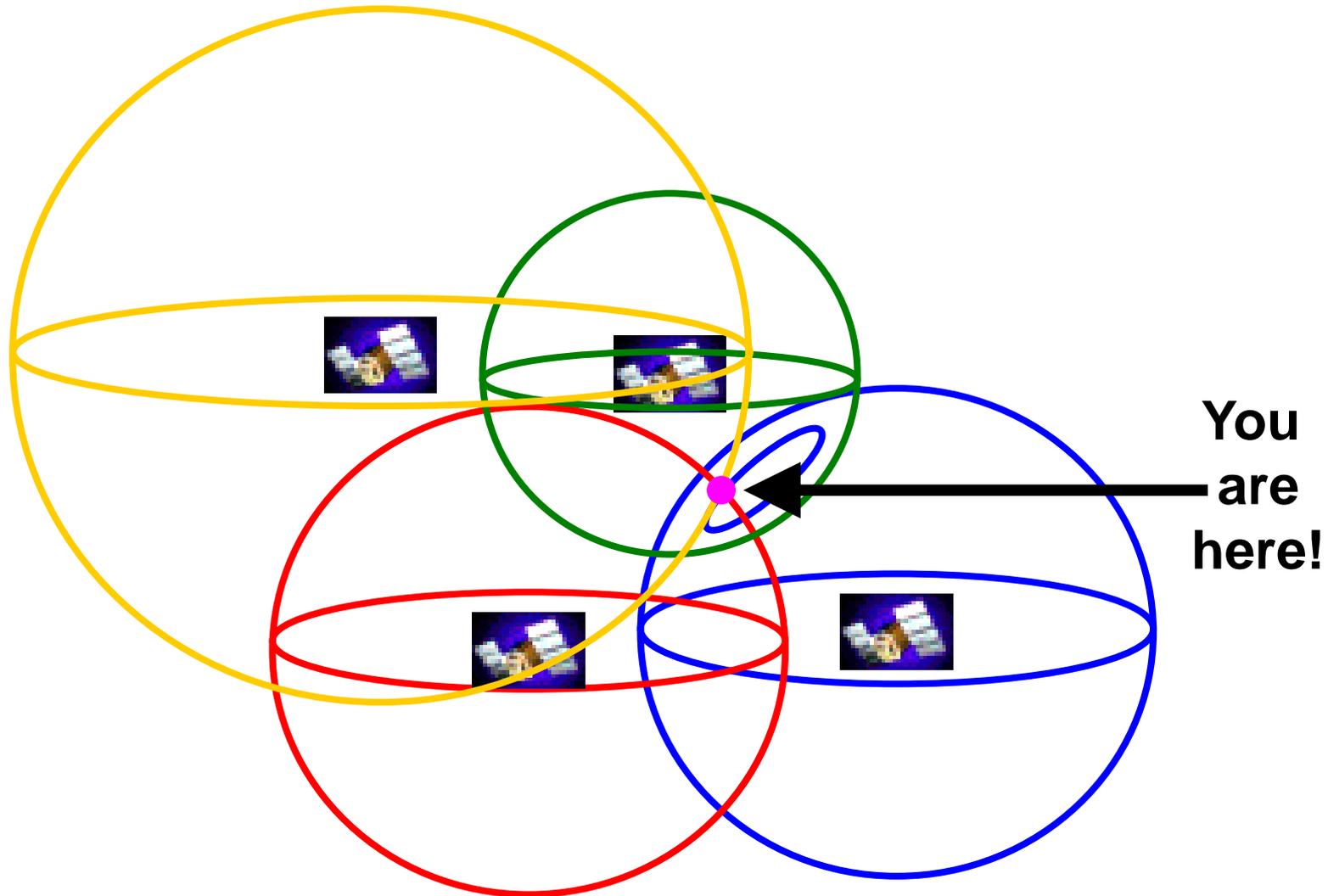
3. Receiver triangulates to determine position of the receiver

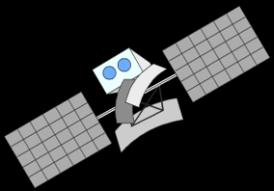




How does GPS work?

3. Receiver triangulates to determine position of the receiver

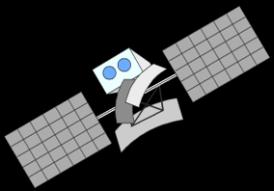




1. Geodetic GPS receivers

- capable of sub-centimeter accuracy
- bulky, expensive
- high-precision applications such as surveying, geodetics

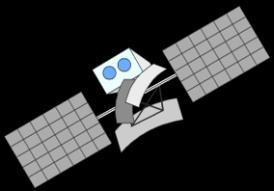




2. Mapping GPS receivers

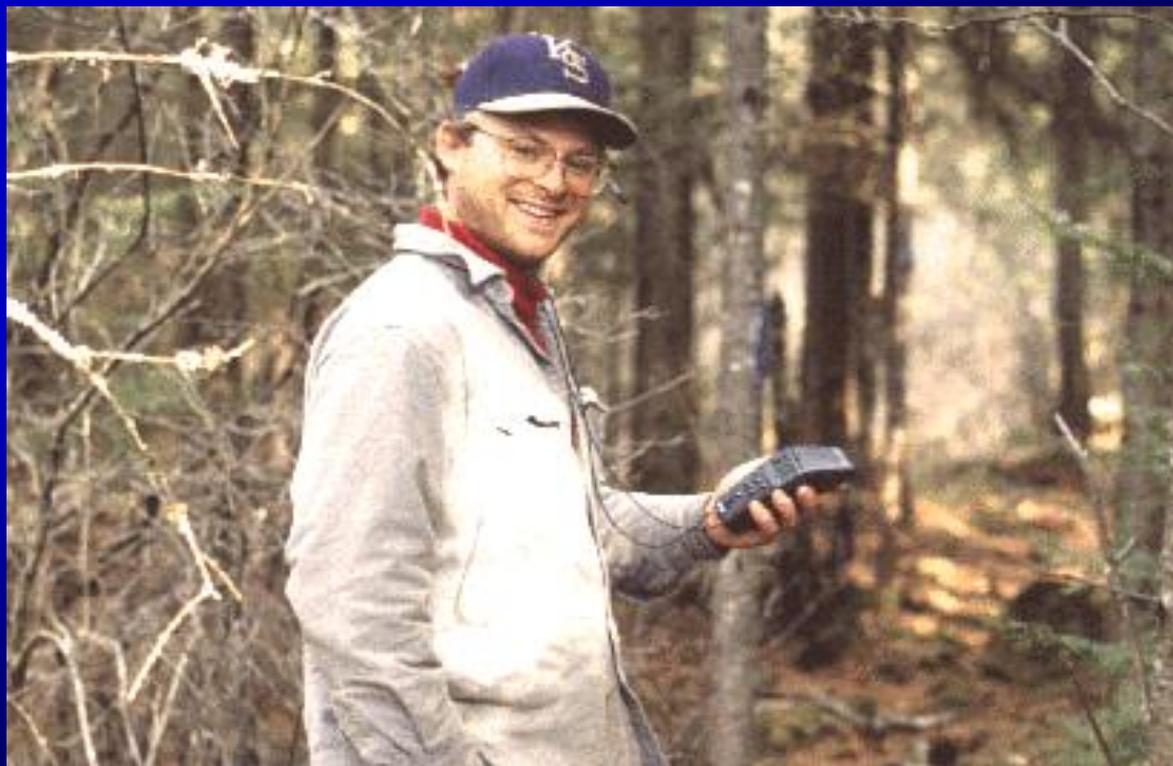
- capable of 10 meter accuracy (<1 meter with differential)
- light-weight, portable, less expensive
- resource mapping and navigation applications

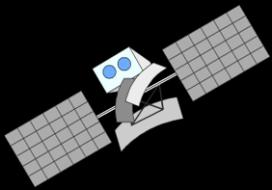




3. Handheld GPS receivers

- capable of 10 meter accuracy (capable of $<3\text{m}$ with differential)
- light-weight, cheap!
- navigation applications and basic mapping applications





Choose your weapon...

1. Geodetic

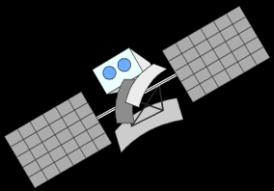
High quality surveying of fixed positions

2. Mapping

Collection of GPS data with large amounts of auxiliary data and strict data quality control

3. Handheld

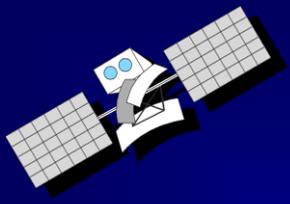
Collection of GPS data with good data quality for more limited budgets



Navigation

***Don't forget your
map and compass!***

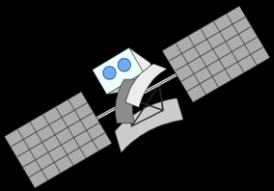




Questions?

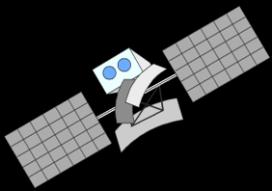


GPS Accuracy



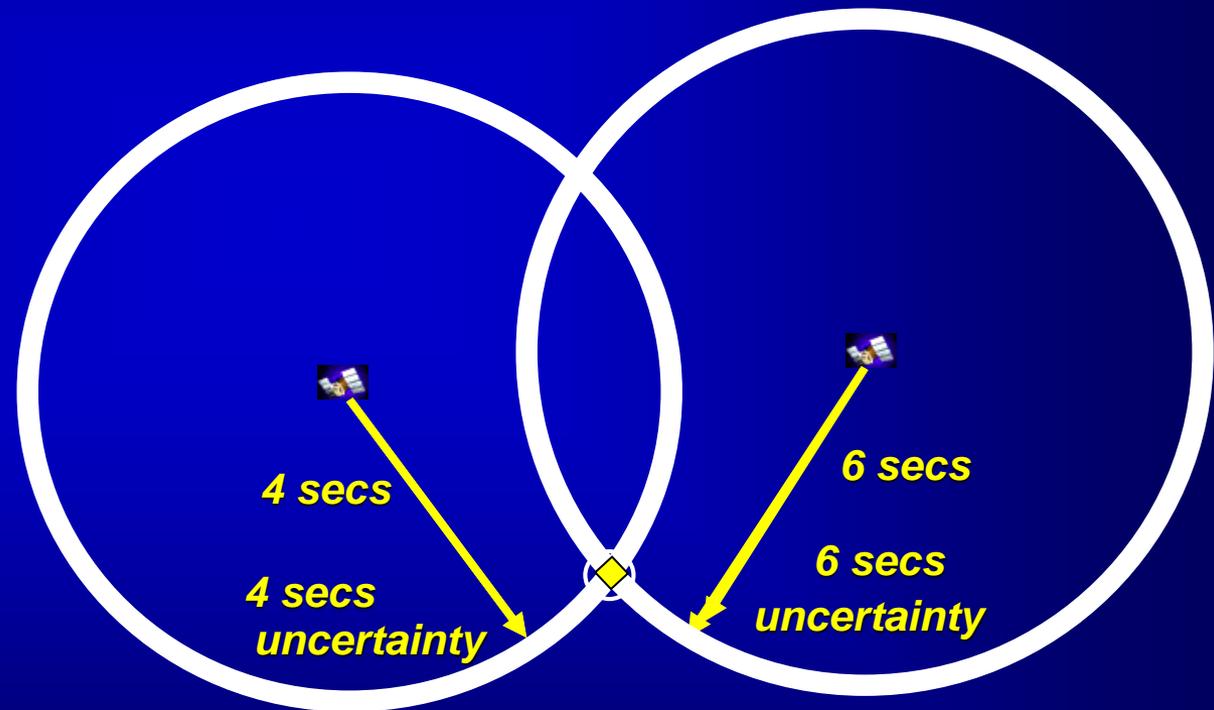
GPS Accuracy: what are your needs?

- How accurate does your GPS data need to be?
- Is vertical accuracy important?
- What are the ways to improve accuracy?

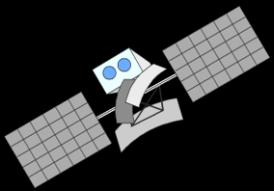


GPS Accuracy: signal delay

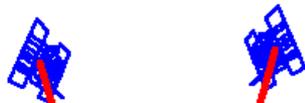
- atmosphere, clock errors, multipath error



real situation

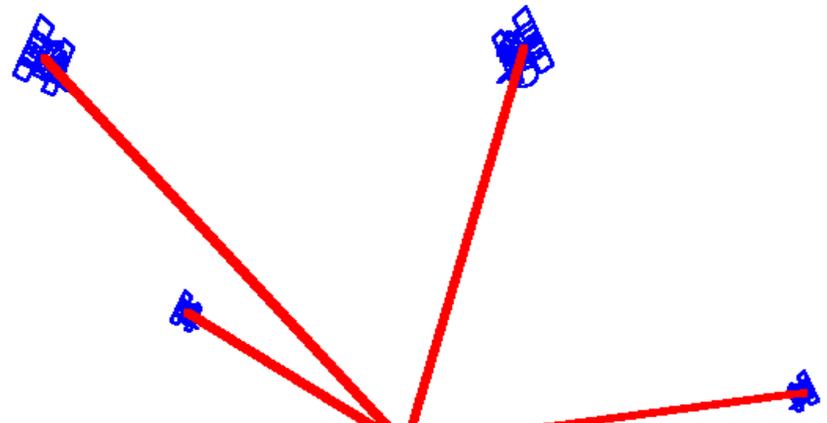


GPS Accuracy: satellite arrangement



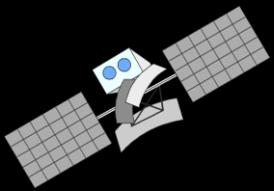
bad arrangement

P.H. Dana 8/17/94



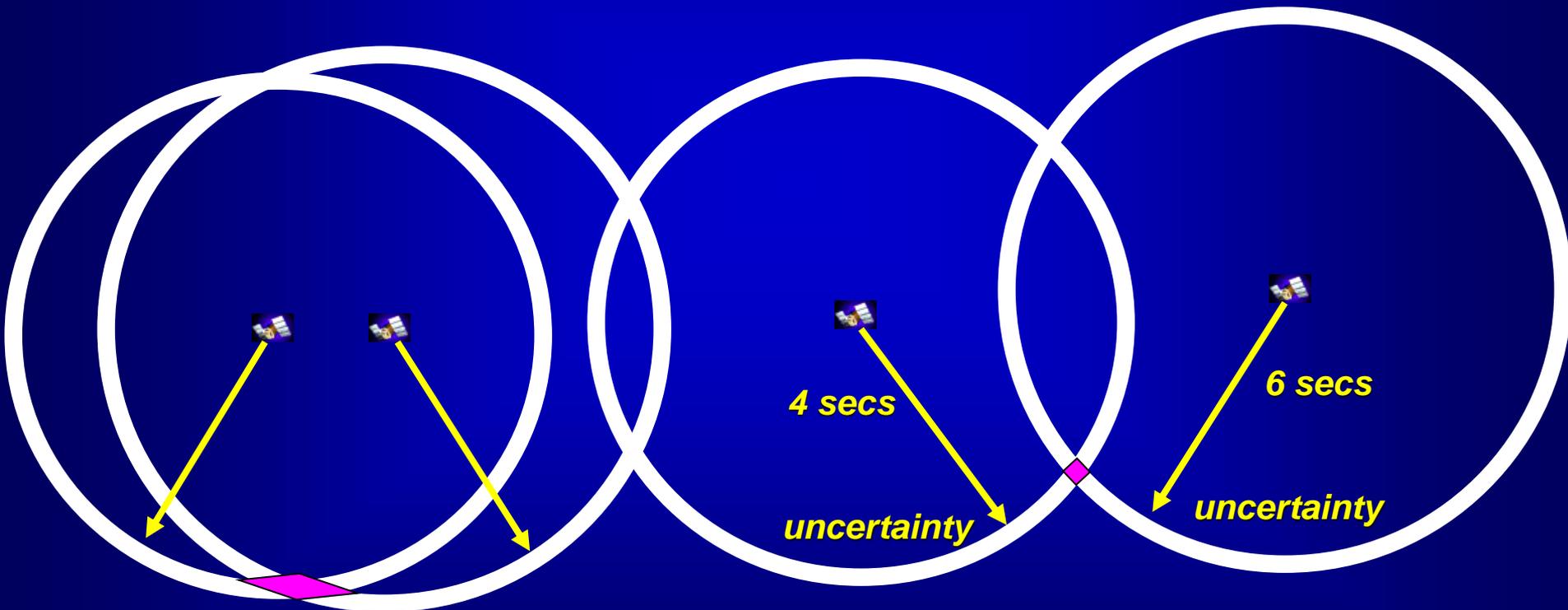
good arrangement

P.H. Dana 8/17/94



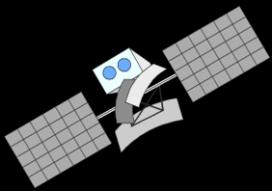
GPS Accuracy: satellite arrangement

- Geometric arrangement of satellites in space



bad constellation

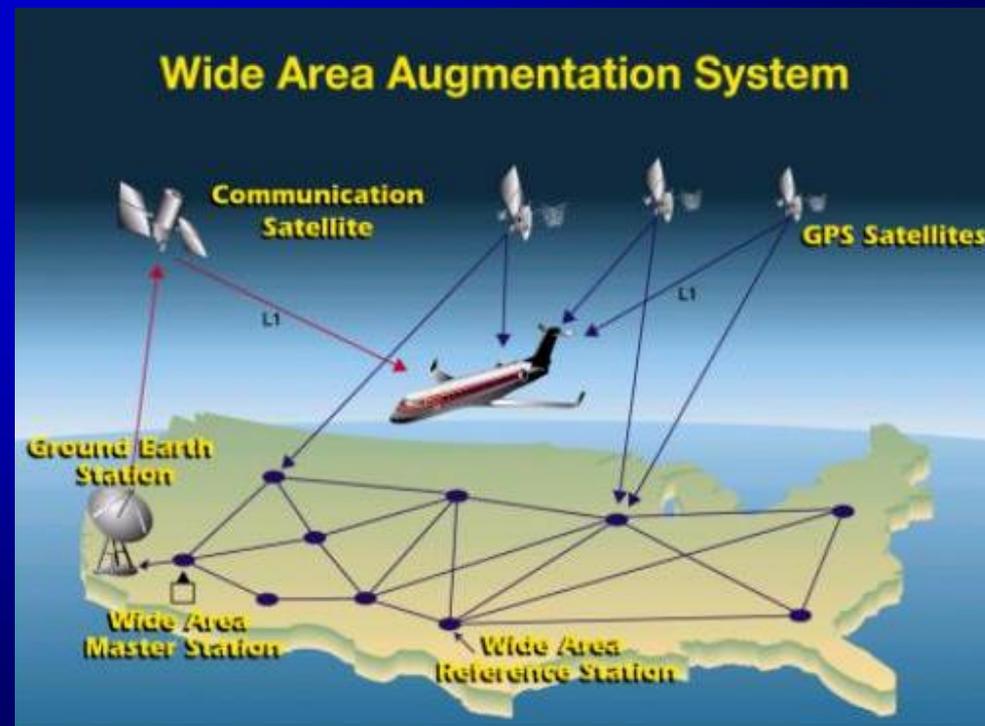
good constellation

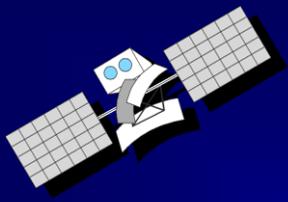


GPS Accuracy: differential correction

- base stations measure inaccuracies and send out correction signal
- 15m: typical handheld GPS accuracy without corrections
- 3m: typical handheld GPS accuracy with corrections
- WAAS: Most common handheld correction

<http://www.ae.utexas.edu/~shep/>





This GPS presentation includes slides from Trimble Navigation and Tom Luther, USDA Forest Service.