

# **Spatial Data acquisition through Global Positioning System (GPS)**

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# Classification of geographic data for data collection purposes

**Raster**

**Vector**

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## **Primary**

Digital remote-sensing images

GPS  
measurements

Digital aerial photographs

Survey  
measurements

## **Secondary**

Scanned maps of photographs

Topographic maps

Digital elevation models for maps

## GPS(Global Positioning System)

- A worldwide radio navigation system
- Collection of 27 NAVSTAR\* satellites orbiting the earth at a height of 12, 500 miles, five monitoring stations, and individual receivers.
- GPS funded by U.S. department of Defense, and for many years military users had access to only the most accurately data.
- The selective availability was removed in the year 2000 so that now civilian and military users can fix x, y, z locations of objects relatively easily to an accuracy of better than 10 m with standard equipment.

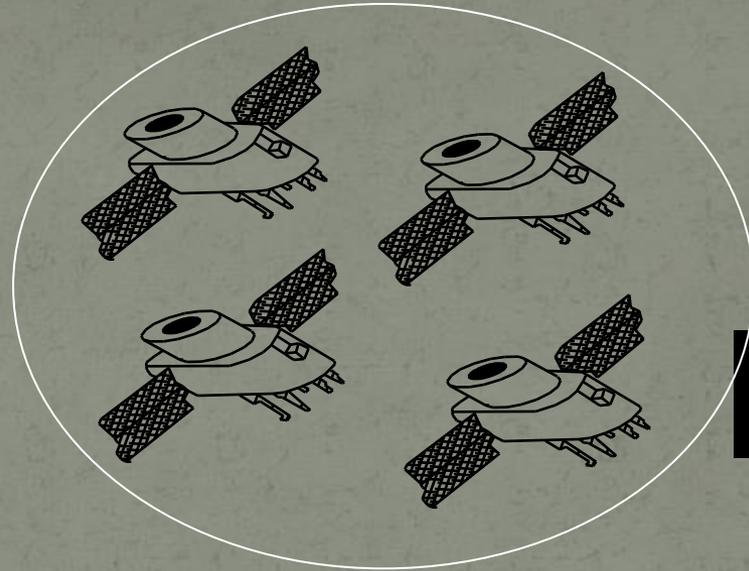
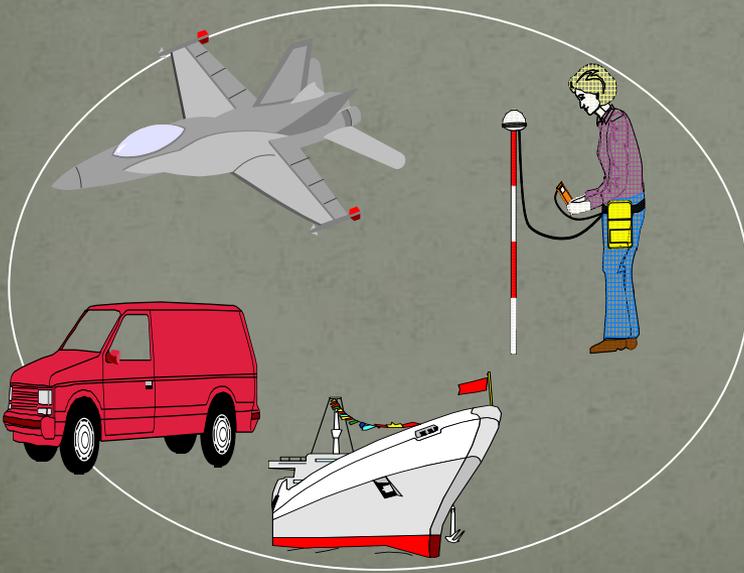
\*Navigation Satellite Timing and Ranging

- It is an Earth-Orbiting \_Satellite based system
- Signals available anywhere on or above the earth, twenty-four hours a day
- Those Signals are used to determine precise time and the position of a GPS receiver in three dimensions.
- GPS is increasingly used as an input for Geographic Information Systems particularly for precise positioning of geospatial data and the collection of data in the field.

# How Does it Work?

## *The GPS Segments*

**User**



**Space**



Colorado Springs

**Control**

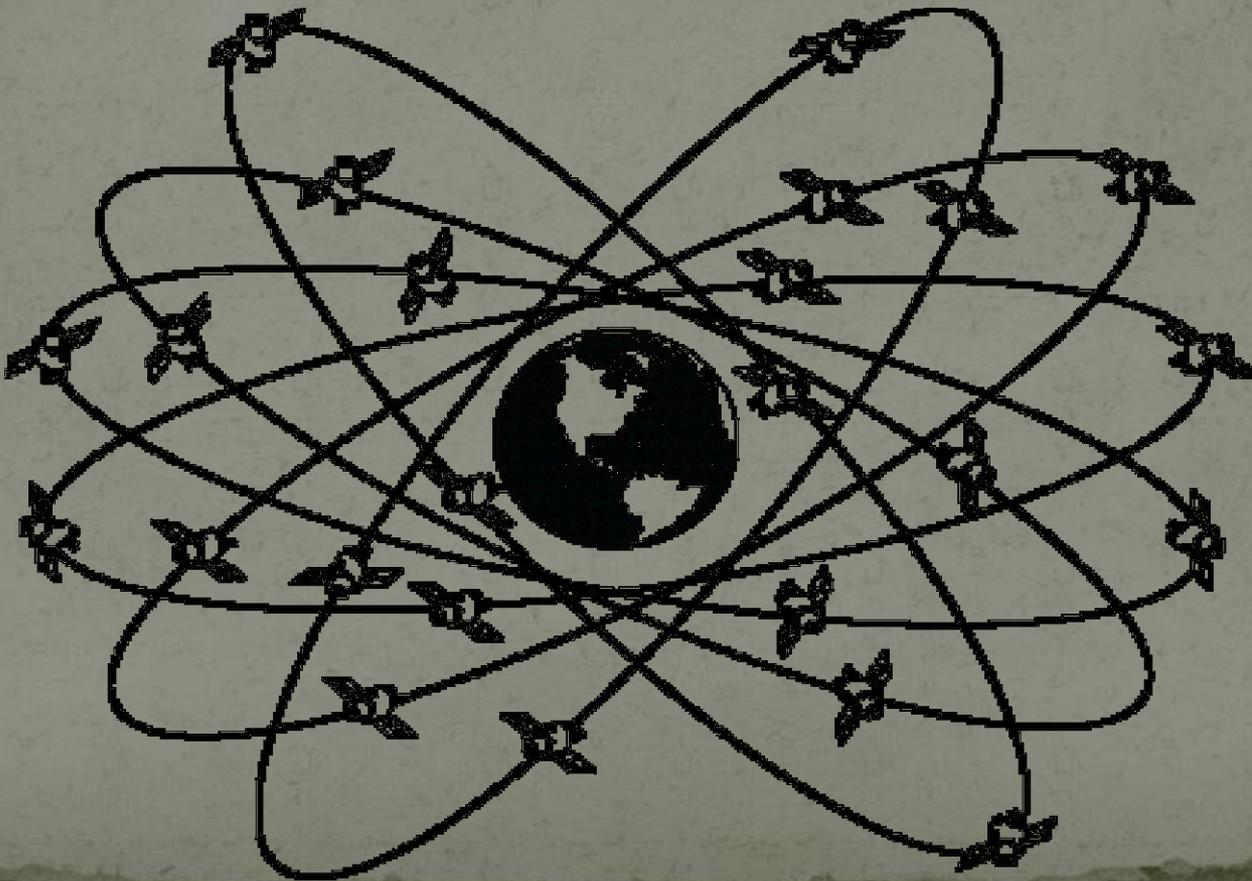
- **Segments of the Global Positioning System**

- **Space Segment**

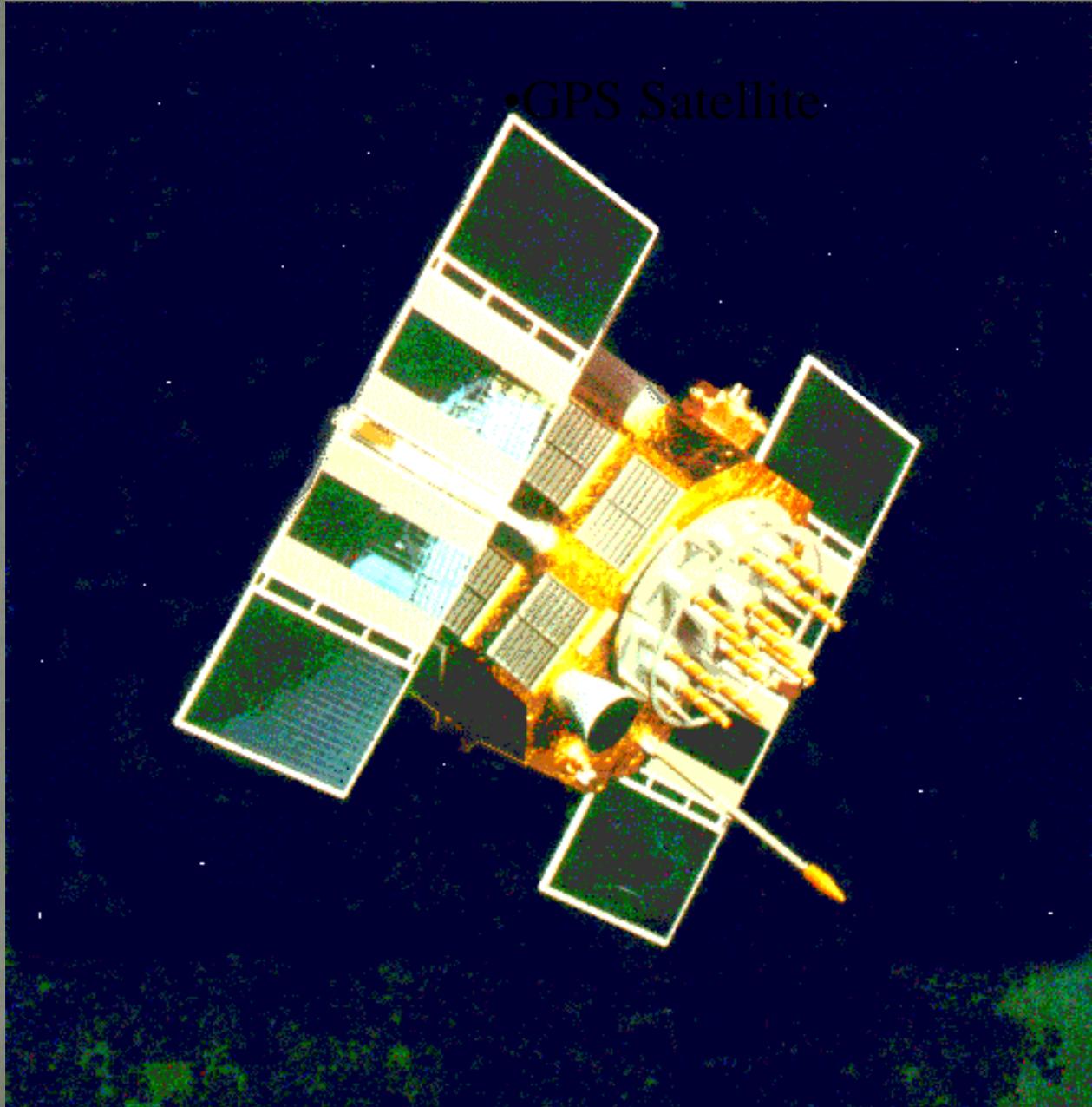
- Consist of the 24 GPS satellites.
- Send radio signals from space.
- Their configuration provides user with between 5 and 8 Satellite visible from any point on the earth.

# Space Segment

- 24 satellites in 6 inclined orbits
- 4 satellites per orbit - 12 hour revolutions
- 12,600 miles (20,000 km) altitude



•GPS Satellite



# Control Segment

- Managed by the U.S. Air Force
- 4 monitoring and 3 upload stations
- Daily location updates
- Transmits clock and orbit corrections
- Disable use of satellites
- Degrade accuracy of the signals

# User Segment



- Military



- Civilian shipping



- Scientific applications



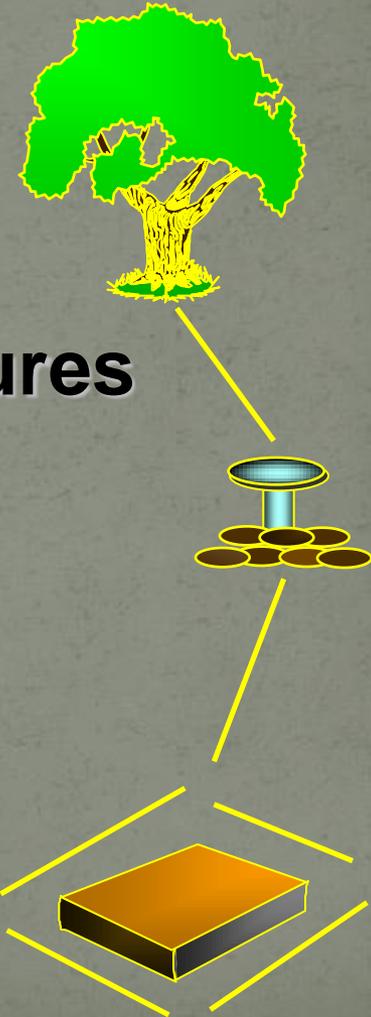
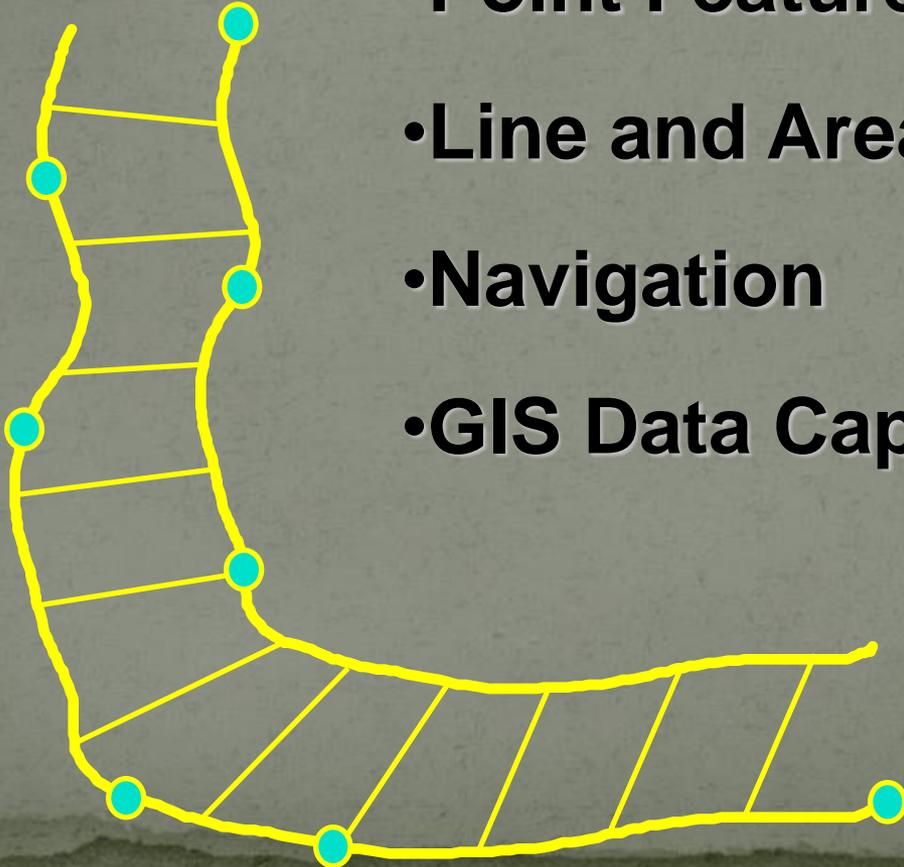
- Geosciences



- Survey and mapping control

# Uses of GPS

- **Point Features**
- **Line and Area Features**
- **Navigation**
- **GIS Data Capture**



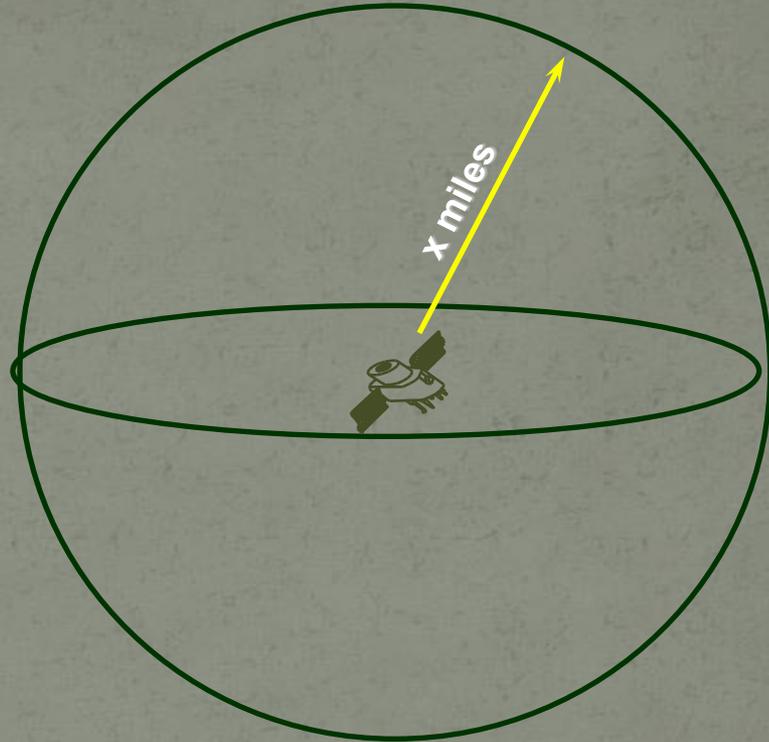
# Navigation

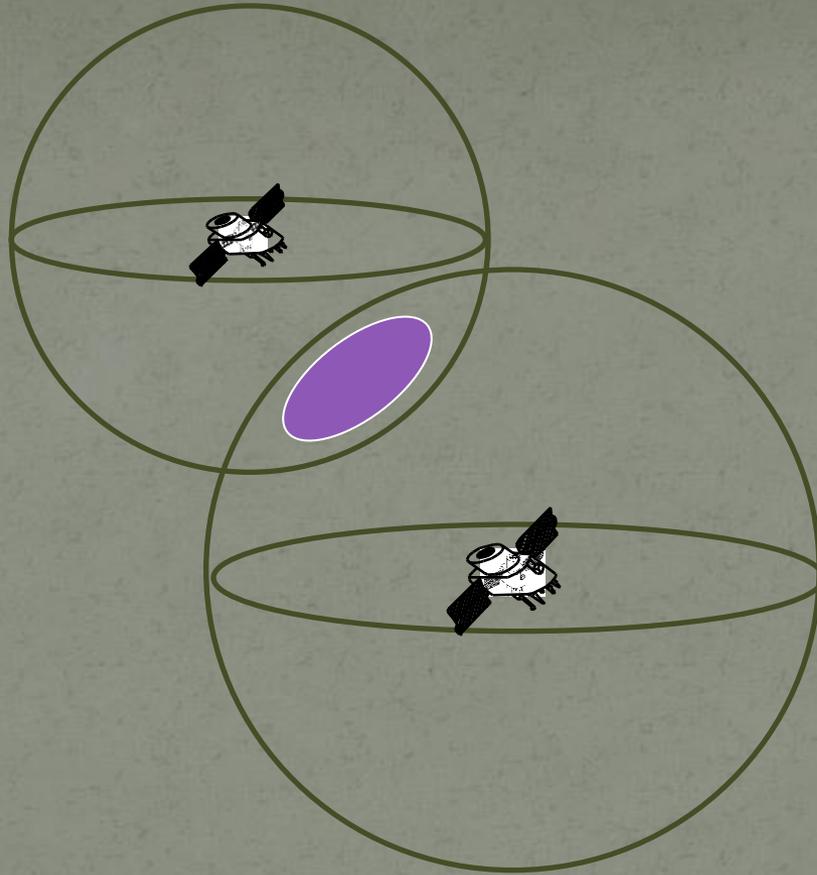
- Relocate points of interest with known coordinates

# GIS Data Capture

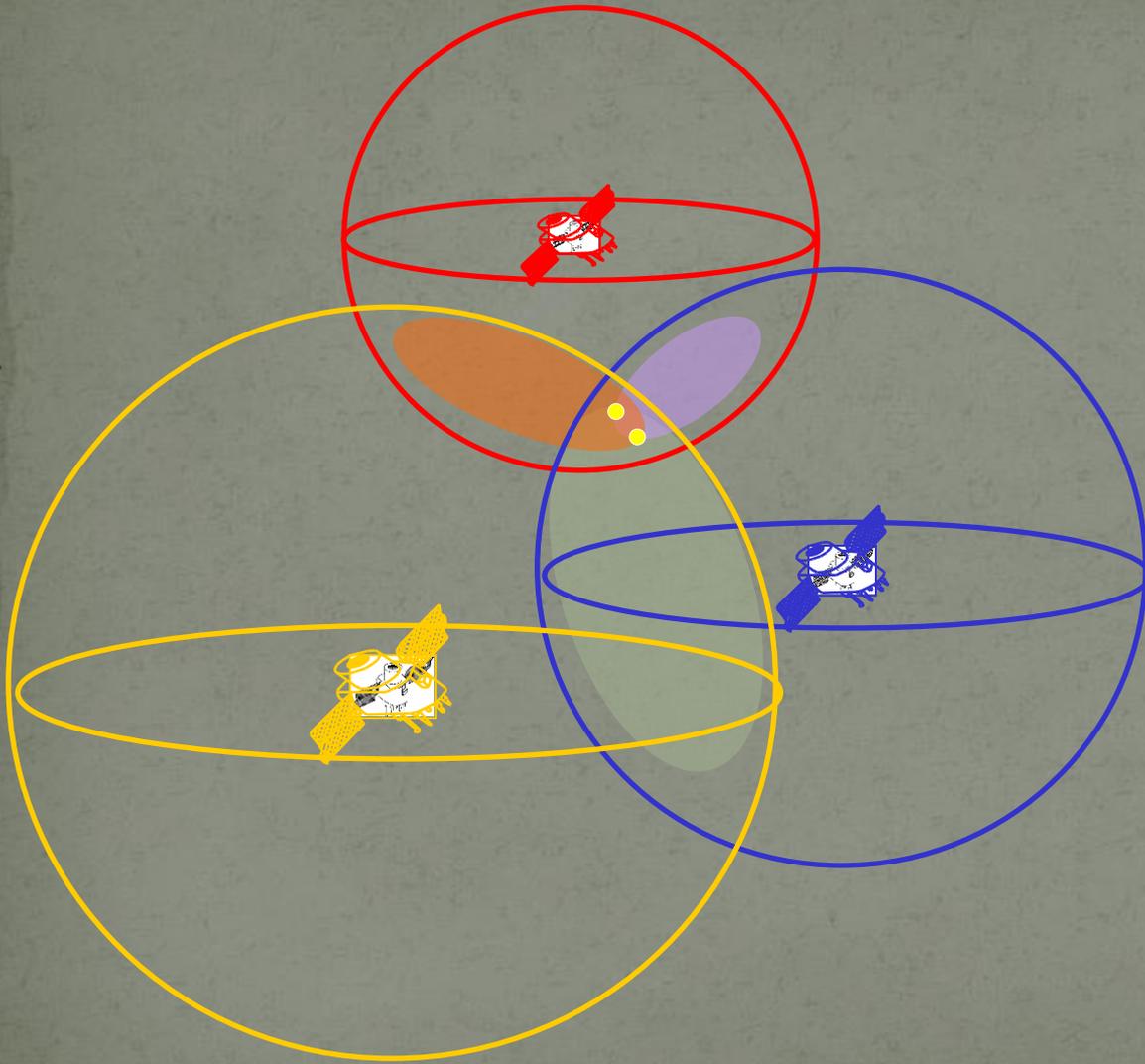
- Associate GPS positions with feature and attribute data
- Define features of interest prior to field work
- Collect data in a GIS-compatible format
- Generate all files needed to drive GIS data loading

The distance ( $x$ ) from one satellite tells us we're located somewhere on the surface of an imaginary sphere centered on that satellite with a radius of  $x$ .



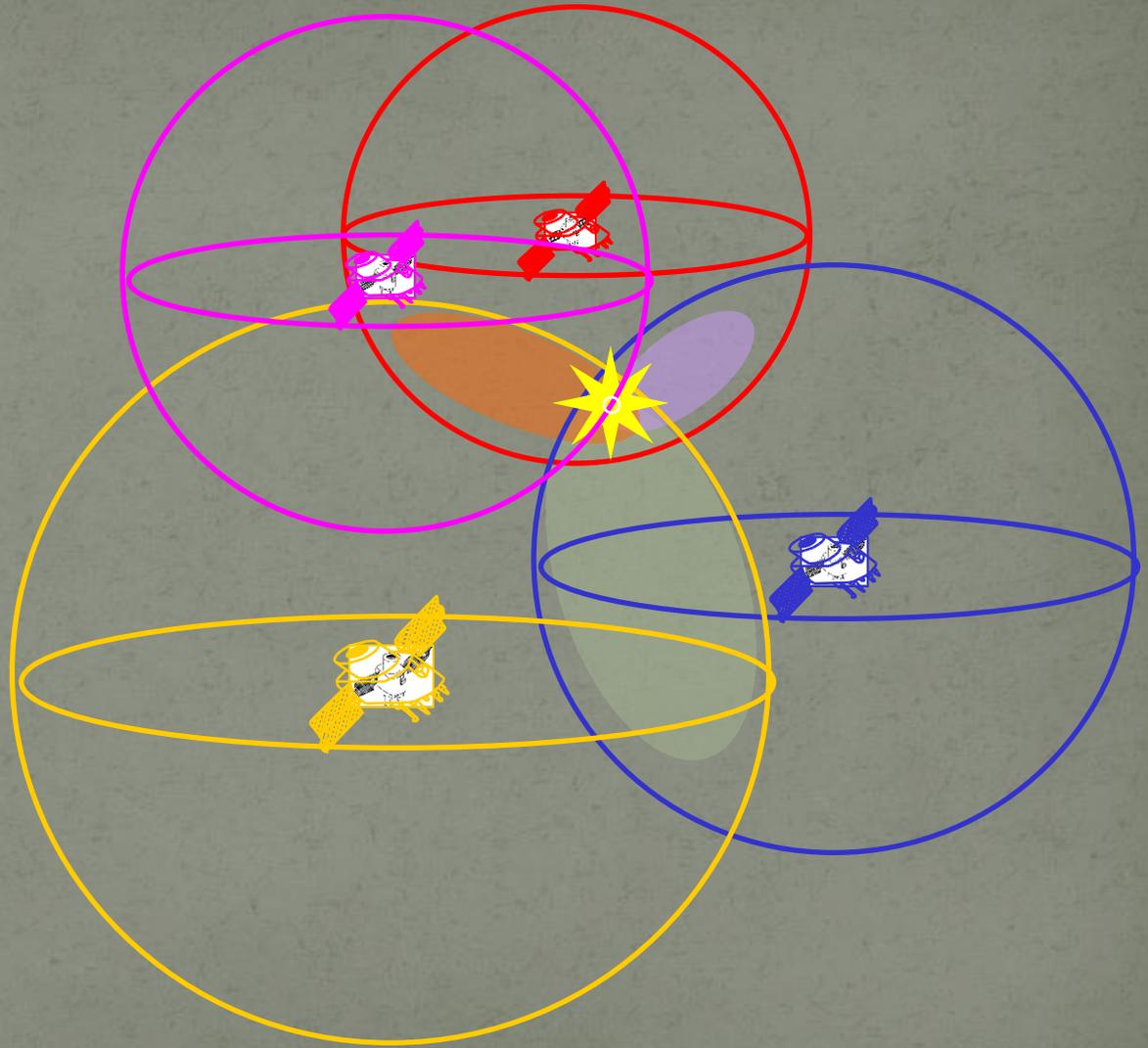


- Distance measurements from two satellites limits our location to the intersection of two spheres, which is a circle.



- A third measurement narrows our location to just two points.

- A fourth measurement determines which point is our true location



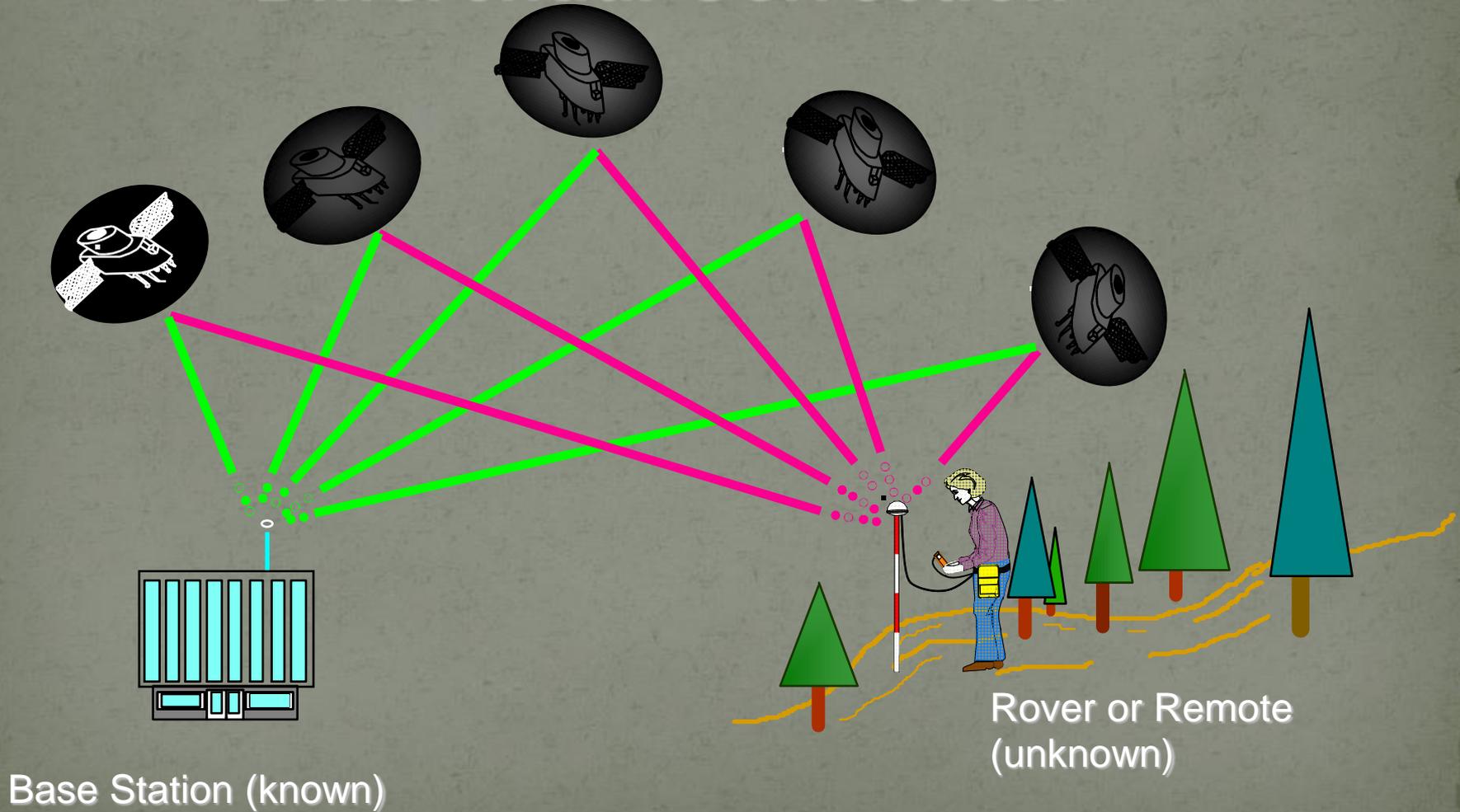
# GPS Position Accuracy

- **Many factors can affect the accuracy of GPS data. Accuracy can range from mm to over 40 meters**

## Significant Parameters:

- Number of visible satellites
- Satellite Geometry
- Occupation time
- Multipath
- Satellite Clock Errors
- Ephemeris Errors
- Atmospheric Effects
- Receiver Errors
- Operator knowledge and awareness

# Increasing GPS Accuracy through Differential Correction



# Integration of GPS data with GIS Using ArcGIS

## How to create a shapefile from XY coordinates using Excel and ArcMap:

- Open ArcMap.
- Go to File -> Add Data -> Add XY Data.
- In the "Add XY Data" dialog box, browse to your Excel file (can be in Excel 97-2003, 2007, or 2010), and select the worksheet that contains your table of coordinates.
- The X Field should be Longitude and the Y Field should be Latitude.

- If you know the spatial reference of the input coordinates, click the "Edit..." button and select it, then click OK.

*For example, if your coordinates are based on a WGS84 Geographic Coordinate System,*

*Click the "Edit..." button, then the "Select..." button, Geographic Coordinate Systems -> World -> WGS 1984.prj -> OK.*

If you do not select a spatial reference, the shapefile may have an Unknown Coordinate System, or take the incorrect one from the data frame's properties.

- The coordinates should plot as a point event theme. Note that it is not a shapefile, just an event theme.

- To create a shapefile from the event theme, right-click the layer in the TOC and select **Data -> Export Data....** Then select a location for the new shapefile, name it and click OK.