

Getting the Map into the Computer: GIS Data Development

- 4.1 Analog-to-Digital Maps
- 4.2 Finding Existing Map Data
- 4.3 Digitizing and Scanning
- 4.4 Field and Image Data
- 4.5 Data Entry
- 4.6 Editing and Validation

GIS maps are digital not analog

- Maps have a **communications function** but...
- A map has a **storage function** for spatial data
- Somehow, the visually “stored” data must **get digital**
- **Real and Virtual** maps

GIS Data Conversion

- Traditionally **most of the cost** of a GIS project
- This is a **one-time cost**
- Depends on **reuse**
- Requires **maintenance**

GIS Data Development Approaches

- Research for **existing** data
- If analog maps exist, **convert analog maps to virtual maps** (GIS data)
- If no analog maps, **aerial photography, remote sensing, GPS and ground survey** usually are obtained.

Finding Existing Map Data

- Map libraries
- Reference books
- State and local agencies
- Federal agencies
- Commercial data suppliers e.g. GDT, Thompson, ETAK

Existing Map Data

- Existing map data can be found through a **map library**, via network searches, or on media such as CD-ROM and disk.
- Many major data providers make their data available via the **World Wide Web**, a network of file servers available over the Internet.
- GIS vendors **package data** with products.

Commercial vendors



A screenshot of the Magellan Geographix website. The page features a navigation menu on the left with options for Region Maps, Country Maps, City Maps, State Maps, and All Maps. The main content area displays a map of North America with the text "Maps of North America". Below the map, there are several promotional banners for "RED Online Atlas", "Learning Center", "Maps for Business", "Buy Maps Here", and "Map Collections". A phone number "1-800-929-4 MAPS" is prominently displayed at the bottom.

A screenshot of the Delorme website. The browser address bar shows the URL "http://www.delorme.com/newsmaps/olympic.htm". The page features the Delorme logo and the text "Maps in the News". The main content is a map of Atlanta, Georgia, with a red box highlighting the "Centennial Olympic Park, Site of the Bomb Blast" and a green box highlighting the "Olympic Village at Georgia Tech". An "Overview Map" window is open, showing a larger view of the Atlanta area. Below the map, there is a link for "MapDoc version for Street Atlas USA 3.0 owners" and a news article snippet: "Two people died and dozens more were injured when a bomb exploded at Centennial Olympic Park early Saturday, July 27. The park is several blocks away from the heavily-guarded Olympic Village at Georgia Tech, where most of the athletes are staying during the games." A CNN logo is also visible.

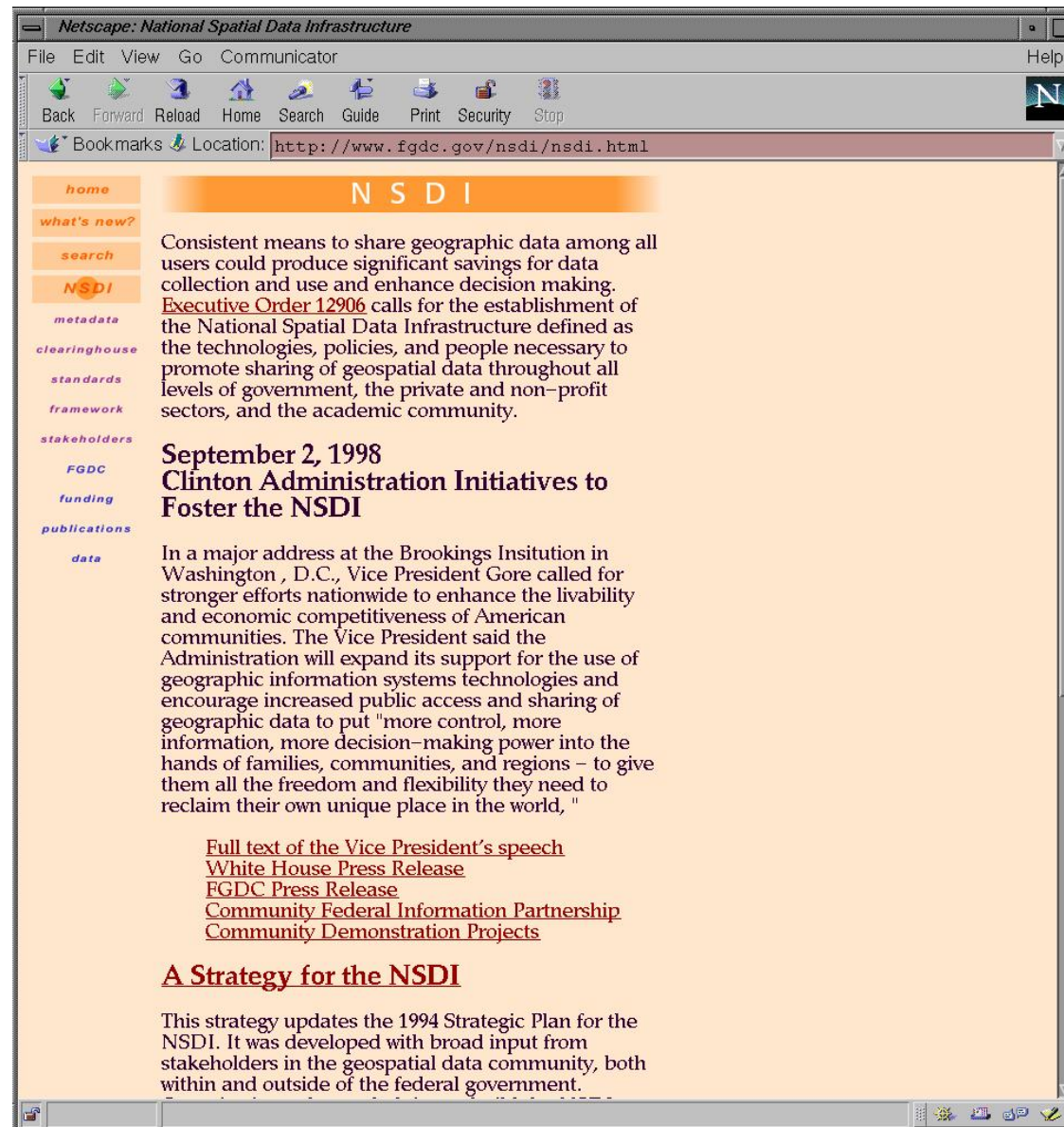
Commercial vendors

- www.navteq.com
- www.teleatalas.com
- www.geographynetwork.com
- www.google.com
- www.mapquest.com

Federal Data Agencies

- USGS
- NOAA
- Census Bureau
- NIMA
- EPA
- many more...

National Spatial Data Infrastructure



National Spatial Data Clearinghouse

Netscape: MetaStar Gateway - Test Search Page

File Edit View Go Communicator Help

Back Forward Reload Home Search Guide Print Security Stop

Bookmarks Location: <http://130.11.52.184/servlet/PGDCServlet>

Anywhere AND

Title AND

Edition AND

Abstract AND

Anywhere AND

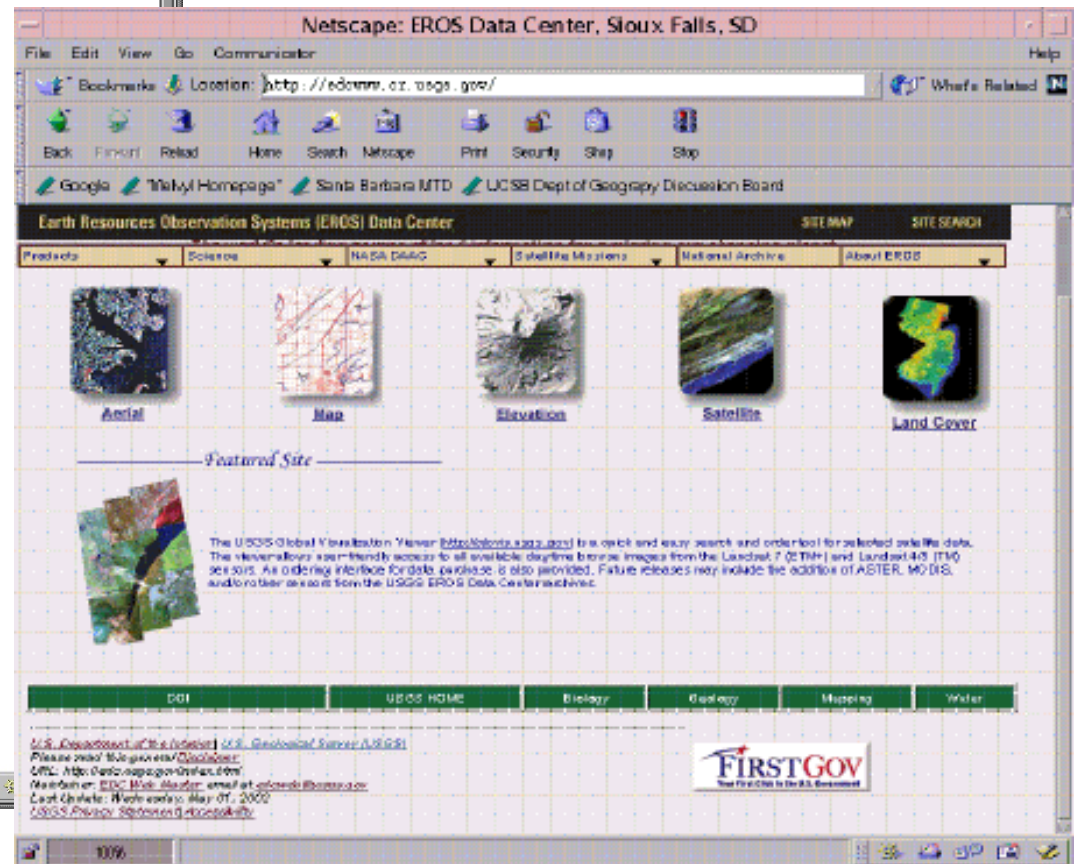
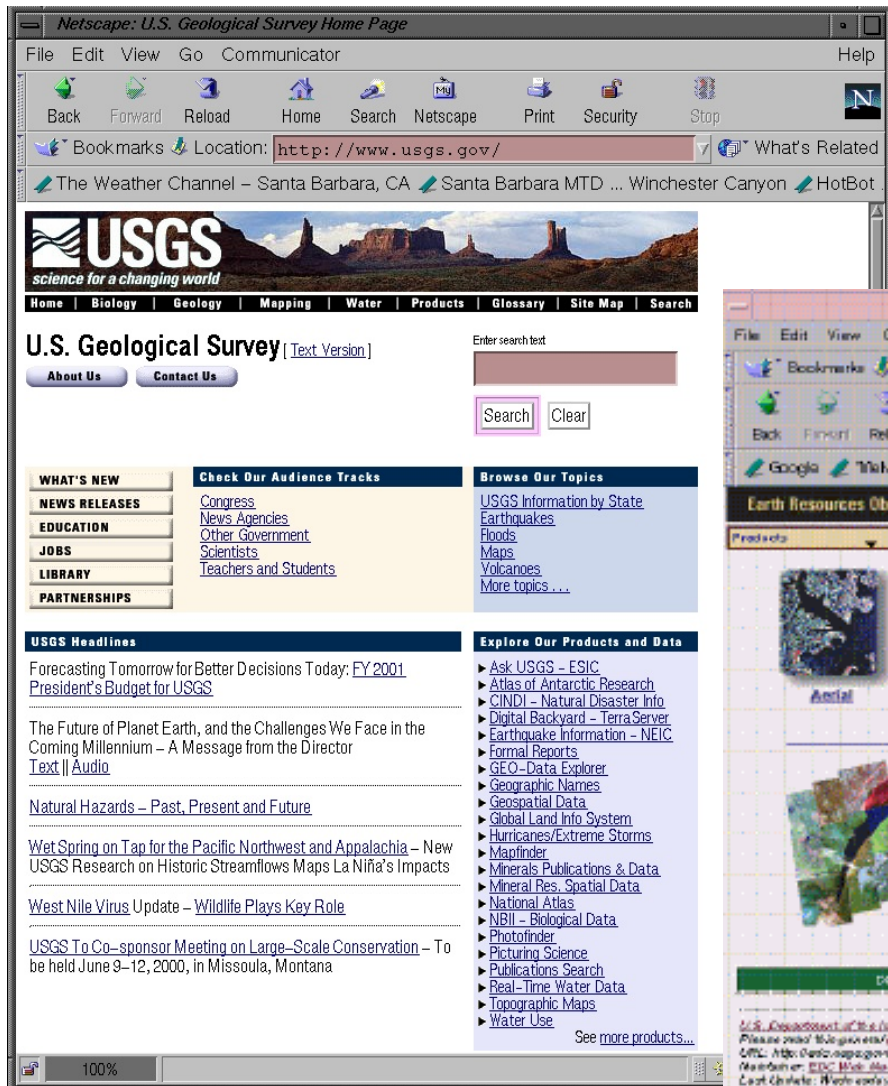
Step 3 - Numeric Query Terms (Optional):

Field	Relation	Criteria	Boolean
Scale of Source <input type="text"/>	Equal To <input type="text"/>	<input type="text"/>	AND <input type="text"/>
Cloud Cover <input type="text"/>	Equal To <input type="text"/>	<input type="text"/>	

Step 4 - Select Databases:

- Africa Data Dissemination Service
- AGDC Alaska Geospatial Data Clearinghouse**
- Australia - ERIN Environmental Data Directory
- Australia - ERIN Index
- Australia - Victorian Spatial Data Directory
- Australia - Western Australia WALIS Interrogator Online
- BTS National Transportation Atlas Database
- Biological Resource Maps, Costa Rica
- California CERES/CGIA Test Server
- Caribbean Environment Programme
- Chicago Metro Area Multi-Organizational Clearinghouse
- CIESIN/EPA - Federal Facilities Public Health Assessment Data Access System Catalog
- CIESIN/USDA - Global Environmental Change Data Assessment and Integration Catalog
- CIESIN/EPA - Great Lakes Environmental Information System Catalog
- CIESIN/NASA - Socioeconomic Data and Applications Center (SEDAC)

USGS: National Mapping



U.S. Bureau of the Census

Netscape: U.S. Census Bureau - TIGER/Line

File Edit View Go Communicator Help


Bookmarks Netsite: <http://www.census.gov/geo/www/tiger/index.html> What's Related

Back Forward Reload Home Search Netscape Print Security Stop Stop

Google "MelnykHomepage" Santa Barbara MTD UCSB Dept of Geography Discussion Board

U.S. Census Bureau

[Census 2000 Overview](#) | [U.S. Overview](#) | [Census 2000 Geographic Overview](#)



TIGER[®], TIGERLine[®] and TIGER-Related Products

TIGER

Topologically Integrated Geographic Encoding and Referencing system

TIGERLine[®] Files

- [U.S. Census 2000 TIGERLine[®] Files](#)
- [2000 TIGERLine[®] File Information](#) **NEW!**
- [Census 2000 TIGERLine[®] Files](#)
- [Redistricted Census 2000 TIGERLine[®]](#)
- [Redistricting Census 2000 TIGERLine[®] Files and User Notes](#)
- [TIGERLine[®] 1990](#), A Link Between 1990 and 2000 Census Geography
- [TIGERLine[®] Metadata](#)
- [Census TIGERLine[®] Files](#)
- [Product and File Information](#)
- [TIGER Vendor](#)
- A list of companies providing products and services related to TIGER

TIGER[®]-Related Products

- [Census 2000 Boundary Files](#)
- [Census 2000 Map Service, Online Mapping, Boundary Files and 2000 Census of Population](#)
- [Geographic Boundary Files](#)
- [Generalized Boundary Files \(.shp\), \(.shp\) and \(.shp\) formats](#)
- [Census 2000 Block Data Tables Files](#)
- [Census 2000 Census Tract Data Tables Files](#)
- [Land Use](#)
- [A File\(s\) Geographic Data Viewer](#)
- [TIGER/Line[®]](#)
- [Census Tract Street Index[®] Version 4](#)
- A tool for HUD/CRA reporting

Future of TIGER[®]

- [MAINTENANCE Milestones, Progress](#)
- [CRA TIGER Accessory Analysis Tool \(CRA TIGER\)](#) Evaluation and Test Results

The TIGER[®] Database

- [What are the TIGERLine[®] Files and How are they Used?](#)
- [Overview and Trade work information](#)
- [TIGER Files](#)

What's New

- [TIGERLine[®] Files](#)
- [Census 2000 TIGERLine[®] Files](#)
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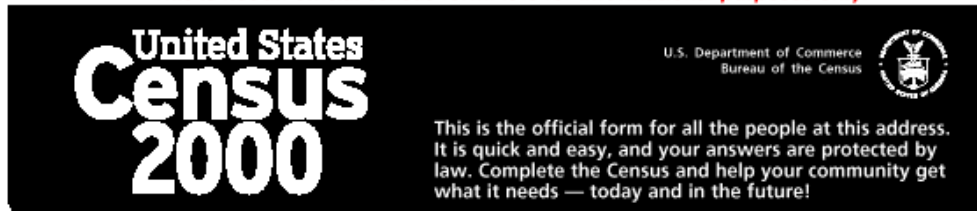
The Decennial National Census

- This is a **survey based, national-scale** collection of data, conducted by the U.S. Census Bureau (a Federal agency) every 10 years
- This provides a snapshot of a wide range of **socio-economic data for the entire nation**, that can be used in two ways:
 - Comparisons can be made to conditions as captured by a previous census so that **change in time** can be studied **AND**
 - The data can be analyzed **spatially**, using levels of geography from local to national scales

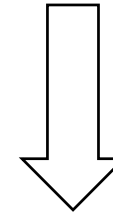
Census 2000

Short Form and Long Form

PLEASE DO NOT FILL OUT THIS FORM.
This is not an official census form. It is for informational purposes only.



Short form



The "Informational Copy" shows the content of the United States Census 2000 "long" form questionnaire. Each household will receive either a short form (100-percent questions) or a long form (100-percent and sample questions). The long form questionnaire includes the same 6 population questions and

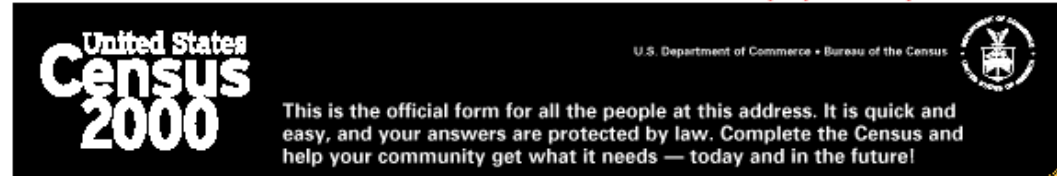
Start Here

1 How many people were living or staying in this house, apartment, or mobile home on April 1, 2000?

Number of people

- INCLUDE** in this number:
- foster children, roomers, or housemates
 - people staying here on April 1, 2000 who have no other permanent place to stay
 - people living here most of the time while working, even if they have another place to live

PLEASE DO NOT FILL OUT THIS FORM.
This is not an official census form. It is for informational purposes only.



Start Here

Please use a black or blue pen.

1. How many people were living or staying in this house, apartment, or mobile home on April 1, 2000?

Number of people

- INCLUDE** in this number:
- foster children, roomers, or housemates
 - people staying here on April 1, 2000 who have no other permanent place to stay
 - people living here most of the time while working, even if they have another place to live

- DO NOT INCLUDE** in this number:
- college students living away while attending college

4. What is Person 1's telephone number? We may call this person if we don't understand an answer.

Area Code + Number

Print numbers in boxes

5. What is Person 1's sex? Mark ONE box.

Male Female

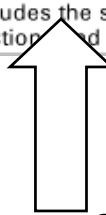
6. What is Person 1's age and what is Person 1's date of birth?

Age on April 1, 2000

Print numbers in boxes

Print numbers in boxes

Long form

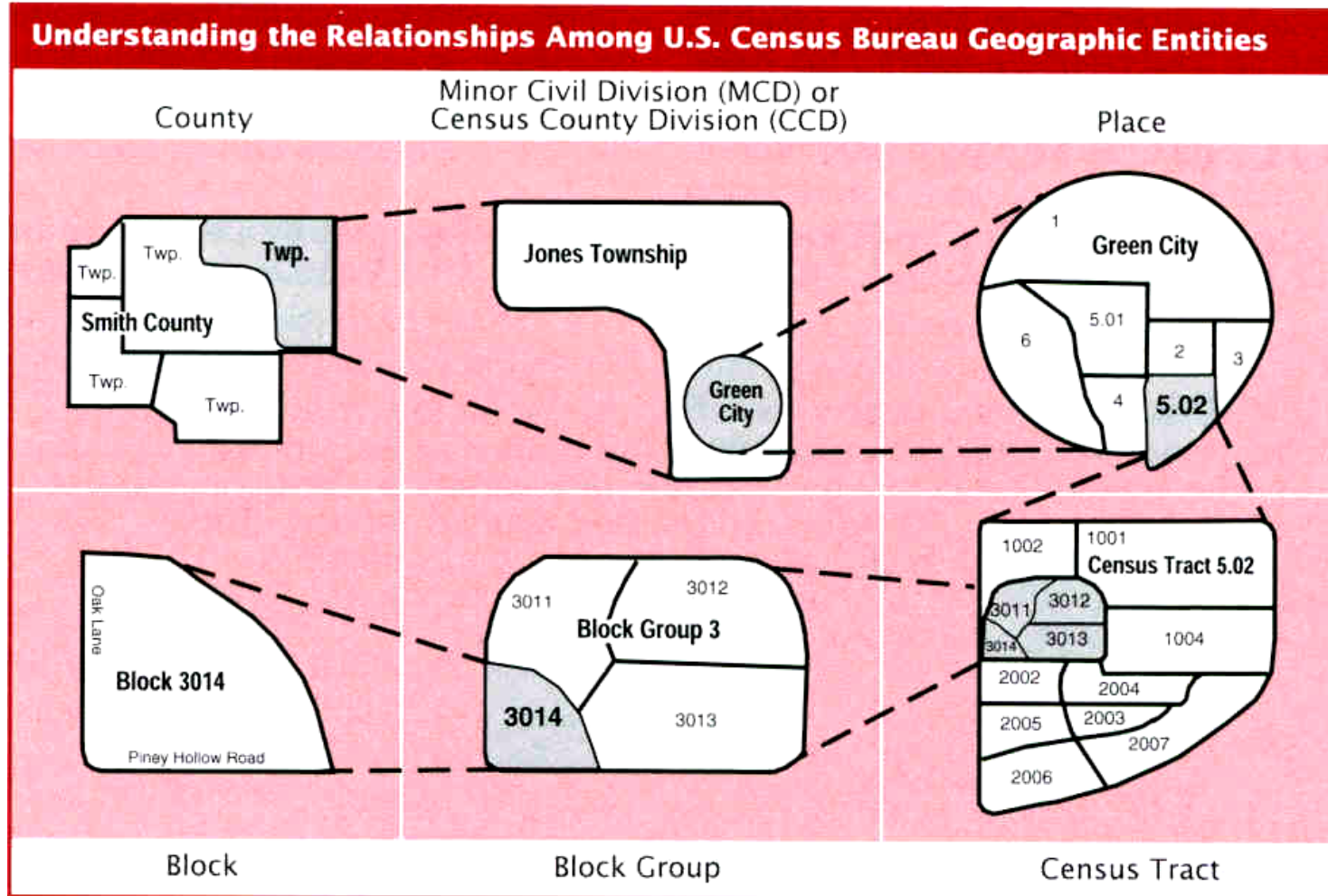


Census Data as Spatial Data

- The information collected on the surveys form the **attribute part** of the data
- Individual surveys are aggregated spatially to **geographic units**, at the various levels of census geography, that uses a nested scheme that builds higher-level units out of lower ones

Small-Area Geography Overview

Census Small-Area Geography



Geographic Products: The TIGER Data Base

Topologically

Integrated

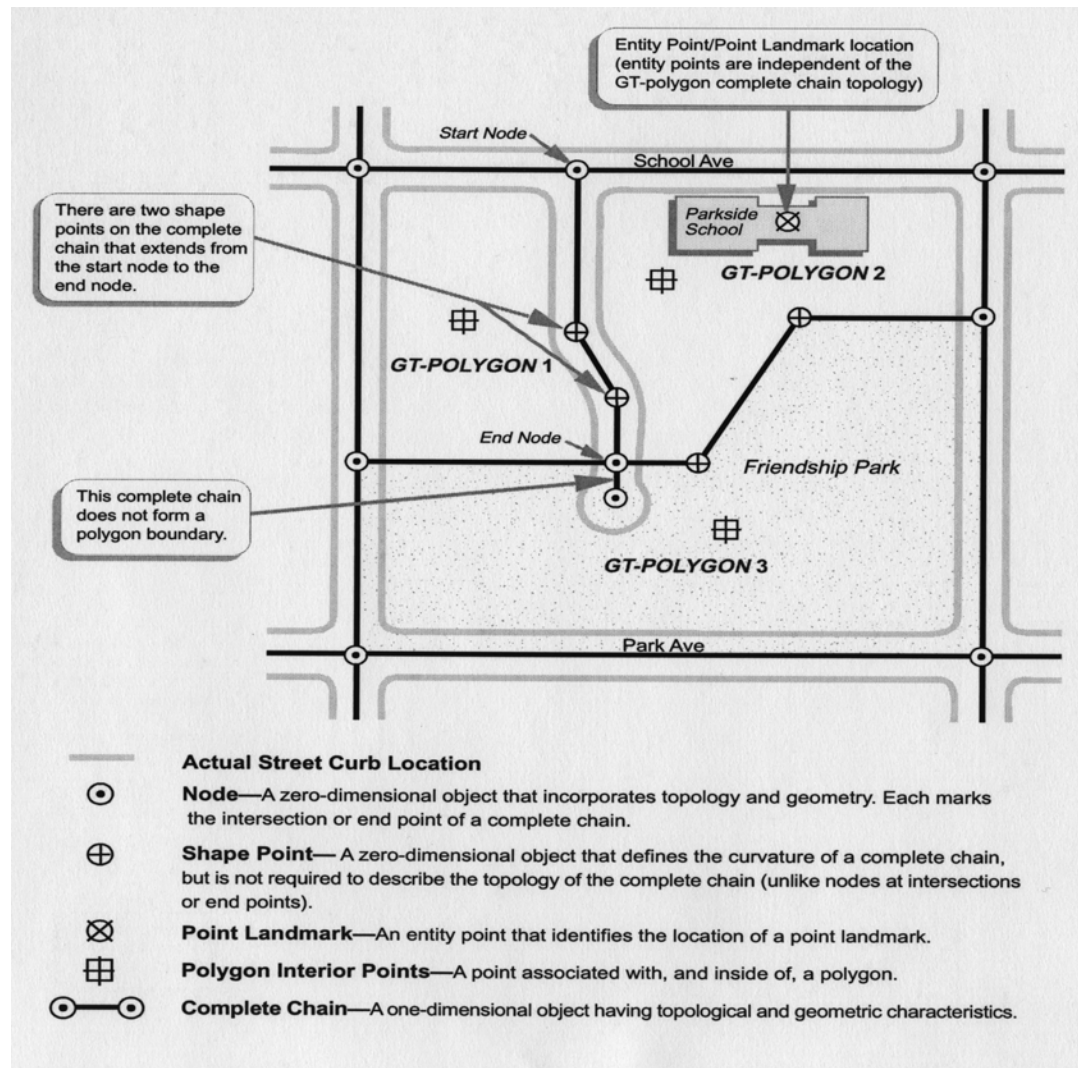
Geographic

Encoding &

Referencing

The source of **ALL** census
geographic products

Basic TIGER/Line File Topology



One census block:
 3 GT-polygons
 1 point landmark
 (school)
 1 area landmark
 (park)


NOAA Weather and other data

The screenshot shows the NOAA Home Page in a Netscape browser window. The address bar displays <http://www.noaa.gov/>. The page features a blue header with the NOAA logo and navigation links for HOME, Site Map, Contacts, and Search. Below the header is a large image of a diver underwater. The main content area includes a "NOAA News" section with a featured article titled "NOAA Unveils New Heat Wave Index" accompanied by a "HOT" graphic. To the right, there is a "MISSION OF THE MONTH" section with a question mark icon and a "NOAA Magazine" link. At the bottom, there are three columns of smaller news items: "Arizona" with a satellite image, "USA Warmer & Drier" with a map of the USA, and "USA Drought Update" with a map of the USA. A sidebar on the right contains an "About NOAA" section with various links.

The screenshot shows the NOAA Operational Significant Event Imagery (OSCI) page in a Netscape browser window. The address bar displays <http://www.noaa.gov/OSCI/osc.html>. The page is titled "The OSCI Image of the Day" and features a large satellite image of the southwestern United States, specifically showing Arizona and New Mexico. The image is overlaid with a grid and a red circle highlighting a specific area. The page includes a sidebar with a navigation menu and a main content area with text and a small inset map of the USA.

Eros Data Center

- Distributed active archive center
- Sioux Falls, SD
- Operated by USGS




The screenshot shows a web browser window with the address bar containing <http://edcwww.cr.usgs.gov/landdaac/>. The page features a navigation menu with tabs for "What's New?", "What's Cool?", "Destinations", "Net Search", "People", and "Software". Below the navigation is a header area with two images: an aerial view of a facility and a logo for "NASA'S MISSION TO PLANET EARTH" featuring a sun, mountains, and waves, with the text "EOS EARTH OBSERVING SYSTEM" and "EARTH PROBES DATA INFORMATION SYSTEM".

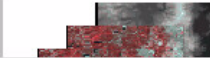
Welcome to the EDC DAAC

The Earth Resources Observation Systems (EROS) Data Center Distributed Active Archive Center (EDC DAAC) was established as part of NASA's Earth Observing System Data and Information System (EOSDIS) initiative to promote the interdisciplinary study and understanding of the integrated Earth system. Access to land processes data, including satellite- and aircraft-acquired data stored in the EDC DAAC's archives, plays an important role in promoting such study and understanding.

Research performed by Earth and global change scientists investigating the conditions and processes that affect land-atmosphere and land-ocean interactions is supported by enhanced access to archived data and data products. Information about and procedures for obtaining these data are provided through the EOSDIS Information Management System.

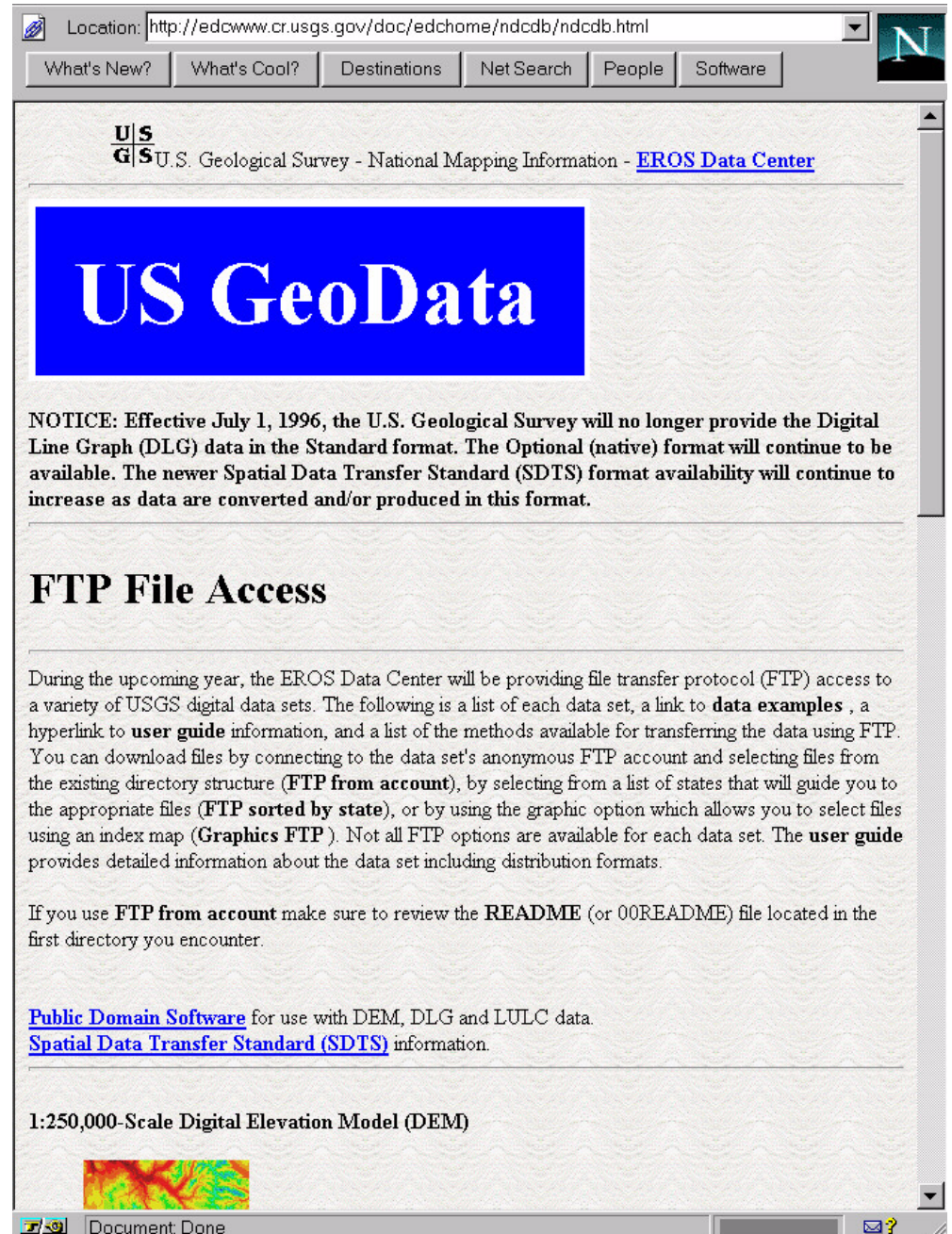
Products

 [Global 1KM AVHRR Data](#)



The browser's status bar at the bottom shows "Document Done" and a help icon.

US GeoData
ftp access to
DEM
DLG
GNIS
GIRAS
etc.



Location: <http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html>

What's New? What's Cool? Destinations Net Search People Software

U|S
G|S U.S. Geological Survey - National Mapping Information - [EROS Data Center](#)

US GeoData

NOTICE: Effective July 1, 1996, the U.S. Geological Survey will no longer provide the Digital Line Graph (DLG) data in the Standard format. The Optional (native) format will continue to be available. The newer Spatial Data Transfer Standard (SDTS) format availability will continue to increase as data are converted and/or produced in this format.

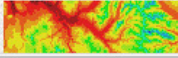
FTP File Access

During the upcoming year, the EROS Data Center will be providing file transfer protocol (FTP) access to a variety of USGS digital data sets. The following is a list of each data set, a link to **data examples**, a hyperlink to **user guide** information, and a list of the methods available for transferring the data using FTP. You can download files by connecting to the data set's anonymous FTP account and selecting files from the existing directory structure (**FTP from account**), by selecting from a list of states that will guide you to the appropriate files (**FTP sorted by state**), or by using the graphic option which allows you to select files using an index map (**Graphics FTP**). Not all FTP options are available for each data set. The **user guide** provides detailed information about the data set including distribution formats.

If you use **FTP from account** make sure to review the **README** (or **00README**) file located in the first directory you encounter.

[Public Domain Software](#) for use with DEM, DLG and LULC data.
[Spatial Data Transfer Standard \(SDTS\)](#) information.

1:250,000-Scale Digital Elevation Model (DEM)



GNIS Feature locations

Location: http://www-nmd.usgs.gov/cgi-bin/wow/gnisweb.feattqy?f_name=university+of+califor

What's New? What's Cool? Destinations Net Search People Software

U/S
GIS [U.S. Geological Survey](#) - [National Mapping Information](#)

Geographic Names Information System Query Results

UNIVERSITY OF CALIFORNIA, SANTA BARBARA COUNTY, CALIFORNIA -- SCHOOL

Feature Name: University Of California At Santa Barbara

Feature Type: school

State	County
California	Santa Barbara

Latitude	Longitude	USGS 7.5' x 7.5' Map
342458N	1195053W	Goleta

[Show Feature Location](#) using maps produced from the U.S. Census Bureau's Tiger Map Server. If this site is busy, try this [alternate map site](#).

[Find the Watershed](#) for this feature using the U.S. Environmental Protection Agency's [Surf Your Watershed](#) site.

[GNIS Query Form](#) [Mapping Information Home Page](#)

URL: <http://www-nmd.usgs.gov/cgi-bin/wow/GNISweb.DisplayCnty>
Maintainer: gnis_manager@usgs.gov
Last modified: 24SEP1996 rlb

Document Done

GIRAS Land Use and Land Cover Data

Location: <http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/exampleslulc.html>

What's New? What's Cool? Destinations Net Search People Software

U.S. Geological Survey - National Mapping Information - [EROS Data Center](#)

Examples of 1:250,000-Scale Land Use and Land Cover (LULC) data.



Spokane, WA.
Land Use/Land Cover, Census, and Political Units



Spokane, WA.
Land Use/Land Cover, Hydrologic and Political Units

[Go to Previous Page.](#) [Go to EDC Home Page](#)

<URL:<http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/exampleslulc.html>>
Page owner: <edcweb@edcwww.cr.usgs.gov>
Last modified: 31 December 1994.

Document Done

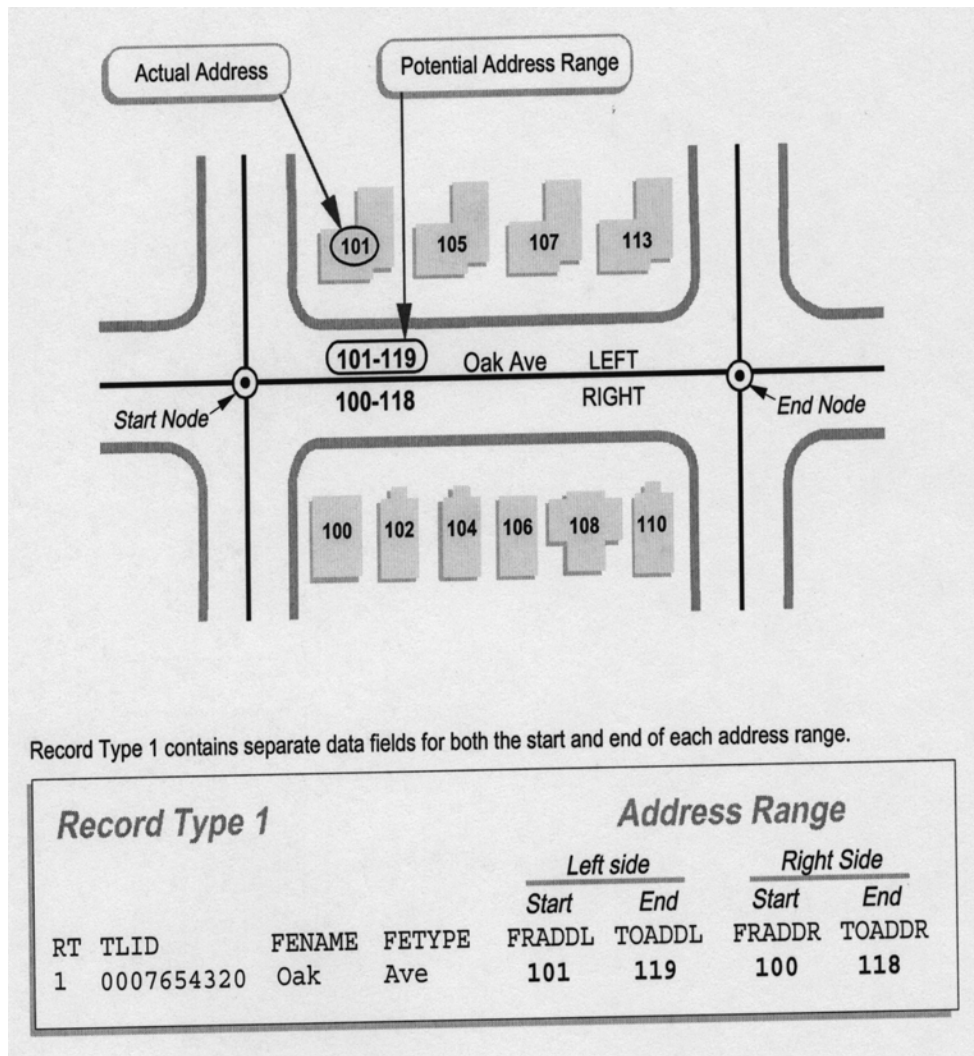
GEOCODING

- Geocoding is the **conversion of spatial information** into **digital form**
- Geocoding involves **capturing the map**, and sometimes also **capturing the attributes**
- Often involves **address matching**

Address Matching

- Most GISs contain capability for **address matching**
- **Start with** 100 Morrissey Boulevard, Boston, MA 02125
- **End with** coordinates (lat-long for UMB)
- May need to **interpolate along blocks**
- Street number range, **left and right side**
e.g. 101-199

TIGER/Line Address Range Basics



The complete chain has two address ranges:
 left: odd-numbered
 right: even-numbered.

Potential address ranges along a complete chain have values that encompass the addresses of existing structures, as well as those not yet built

GEOCODING LEAVES A “STAMP” ON DATA

- The **method** of geocoding can influence the **structure and error** associated with the spatial information which results
- **Examples:** scanning (raster), digitizing (vector)

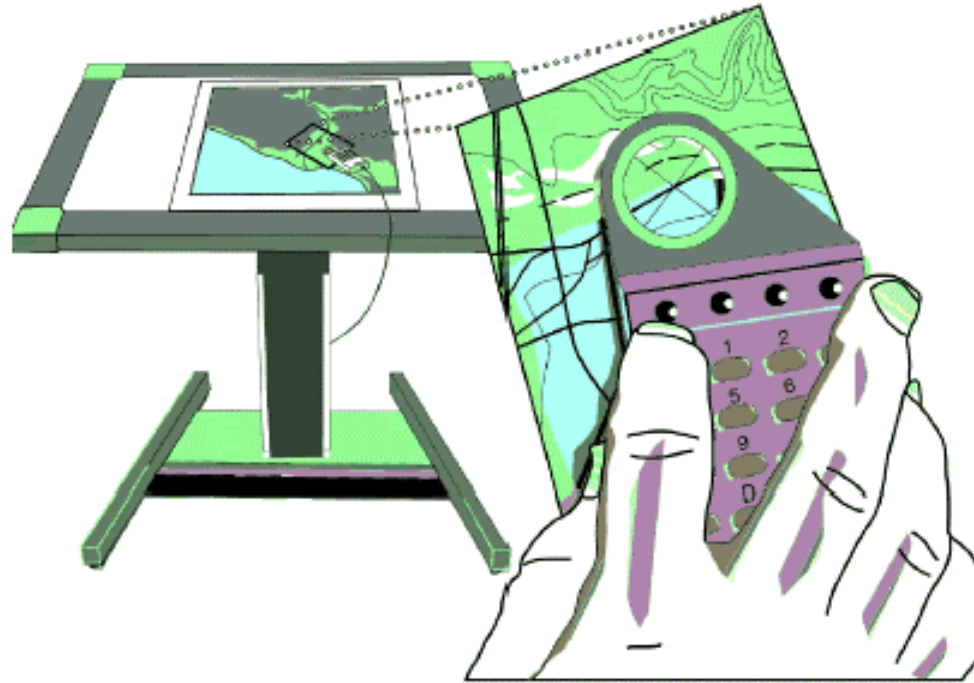
Geocoding methods for maps

- Digitizing
- Scanning
- Field data collection

Digitizing

- Captures map data by **tracing lines** from a map by hand
- Uses a cursor and an electronically-sensitive **tablet**
- Result is a **string of points** with (x, y) values

The Digitizing Tablet



1. Digitizer cursor transmits a pulse from an electromagnetic coil under the view lens.
2. Pulse is picked up by nearest grid wires under tablet surface.
3. Result is sent to computer after conversion to x and y units.

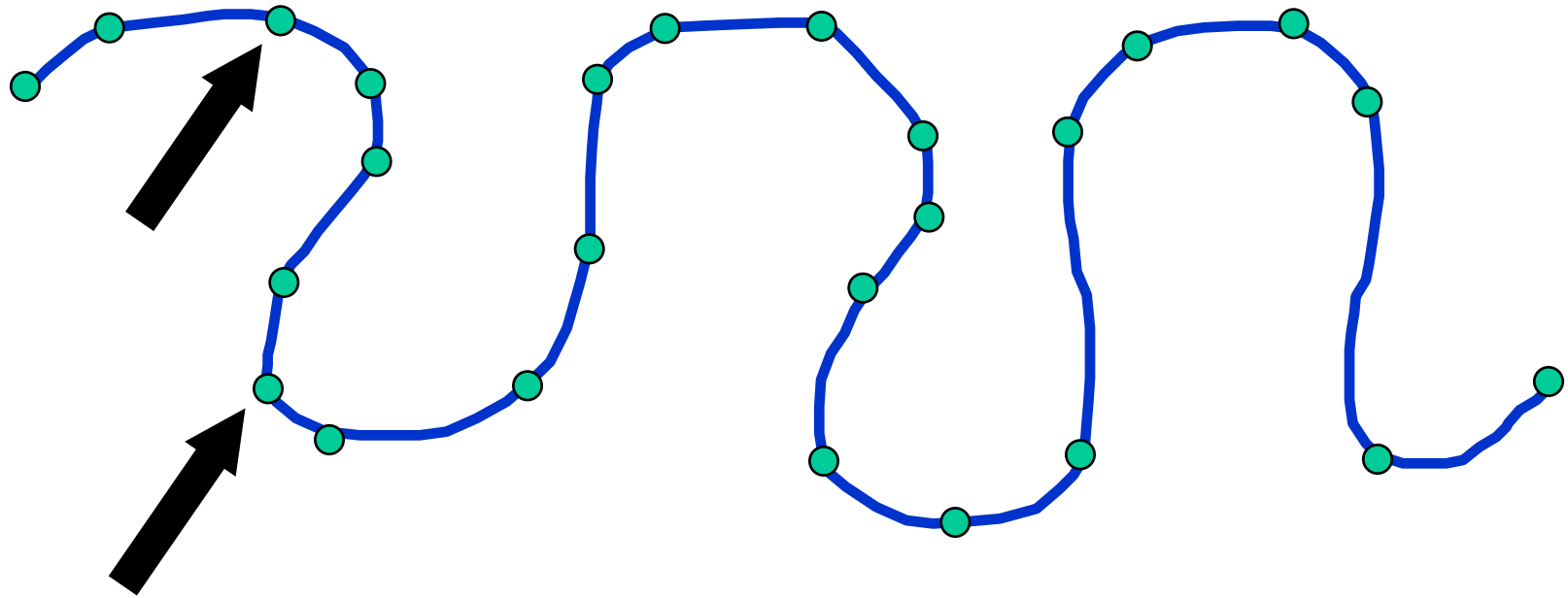
Digitizing

- Stable base map
- Fix to tablet
- Digitize control
- Determine coordinate transformation
- Trace features
- Proof plot
- Edit
- Clean and build

Digitizing

- Cursor data entry
- Secondary tablet
(menu/template)
- Voice command entry
- Point select
- Stream mode
- Distance mode

Selecting points to digitize



Some common digitizing errors

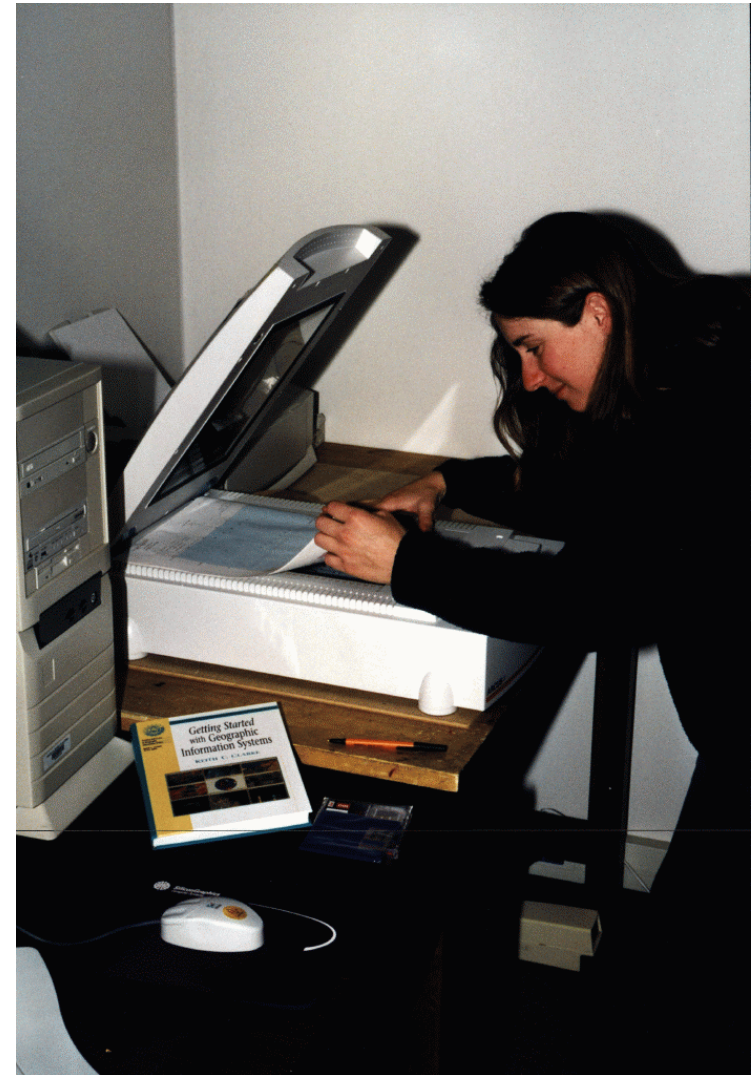
- Slivers
- Duplicate lines
- Duplicate nodes
- Unended lines
- Gaps
- Zingers

Scanning

- Places a **map on a glass plate**, and passes a **light beam** over it
- Measures the **reflected light** intensity
- Result is a **grid of pixels**
- **Image size** and **resolution** are important
- Features can **“drop out”**

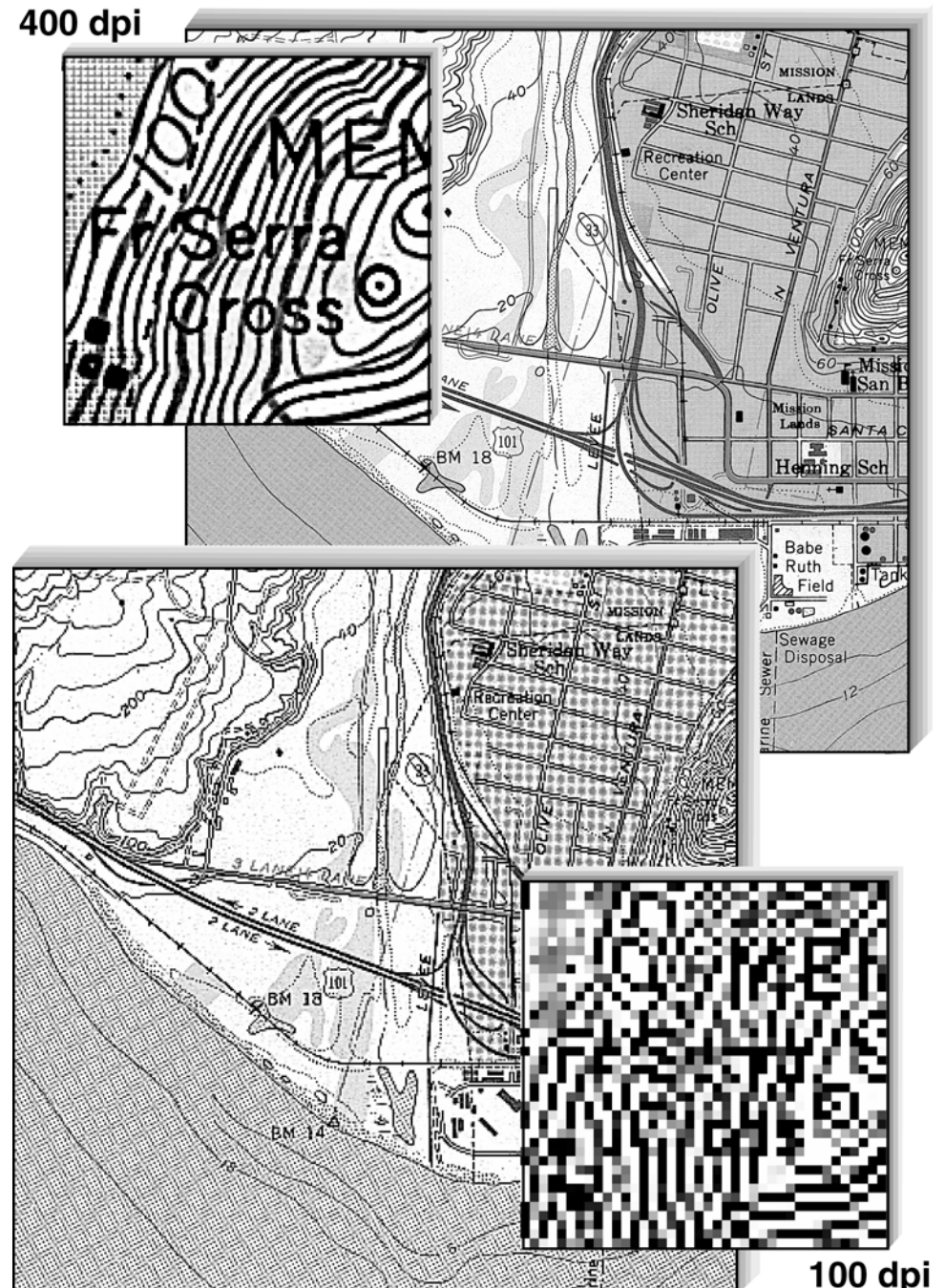
Scanning

- **Types** of scanners:
 - Flat bed vs. Drum
- **Characteristics**
 - DPI & File size



Scanning example

- 15 x 15 cm (3.6 x 3.6 km)
- grid is 0.25 mm
- ground equivalent is 6 m
- 600 x 600 pixels
- one byte per color (0-255)
- 1.08 MB



Field data collection

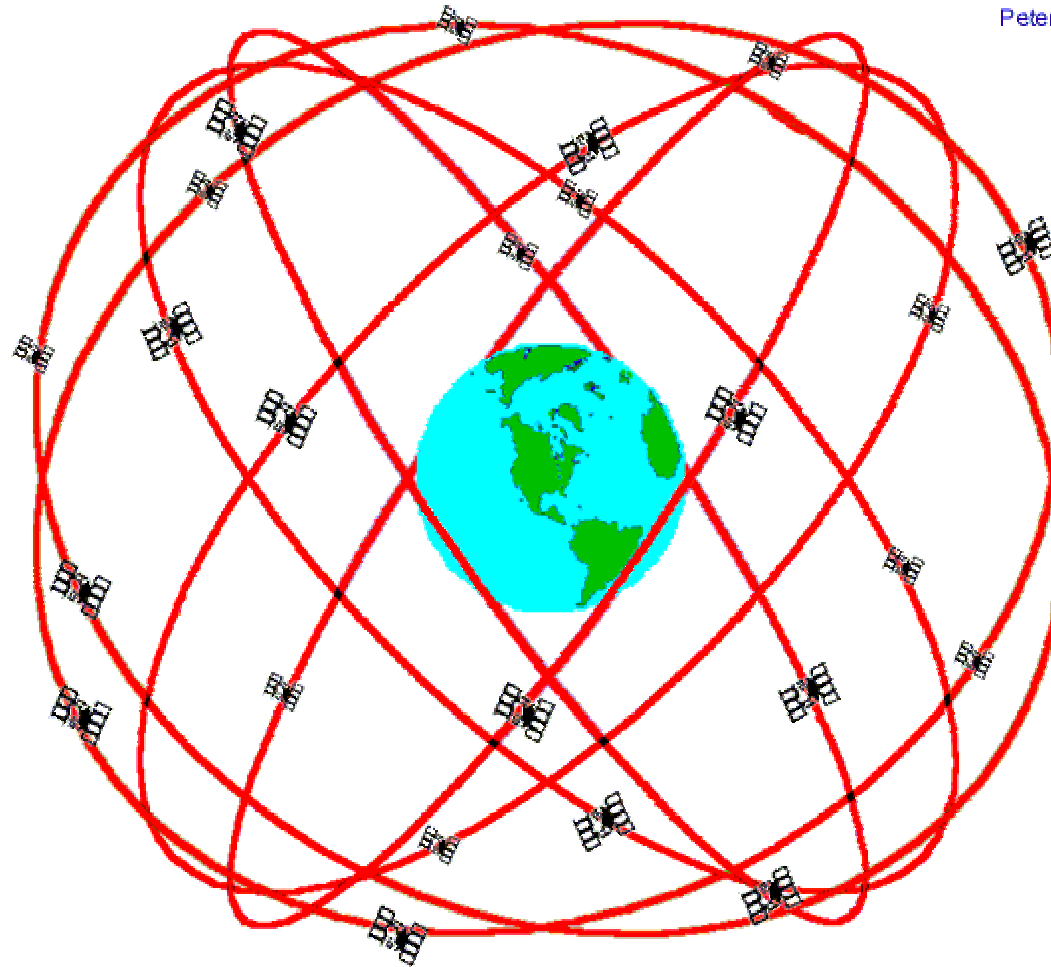


Global Positioning System (GPS)

- A space-based 3-dimensional **measurement and positioning system** that operates using radio signals from satellites orbiting the earth
- Created and maintained by the US Dept. of Defense and the US Air Force
- The system as a whole consists of three **segments**:
 - satellites (space segment)
 - receivers (user segment)
 - ground stations (control segment)
- Note: Russia and a European consortium are implementing similar systems.

GPS – Space Segment (Satellites)

- **24 NAVSTAR satellites** in the GPS constellation
 - orbit the Earth **every 12 hours**
 - ~11,000 miles altitude (a very **high orbit**)
 - positioned in **6 orbital planes** (4 per plane)
 - orbital period & planes are designed to keep **4-6 satellites above the horizon** at any time everywhere on the planet
 - controlled and monitored by five ground stations around the globe



GPS Nominal Constellation
24 Satellites in 6 Orbital Planes
4 Satellites in each Plane
20,200 km Altitudes, 55 Degree Inclination

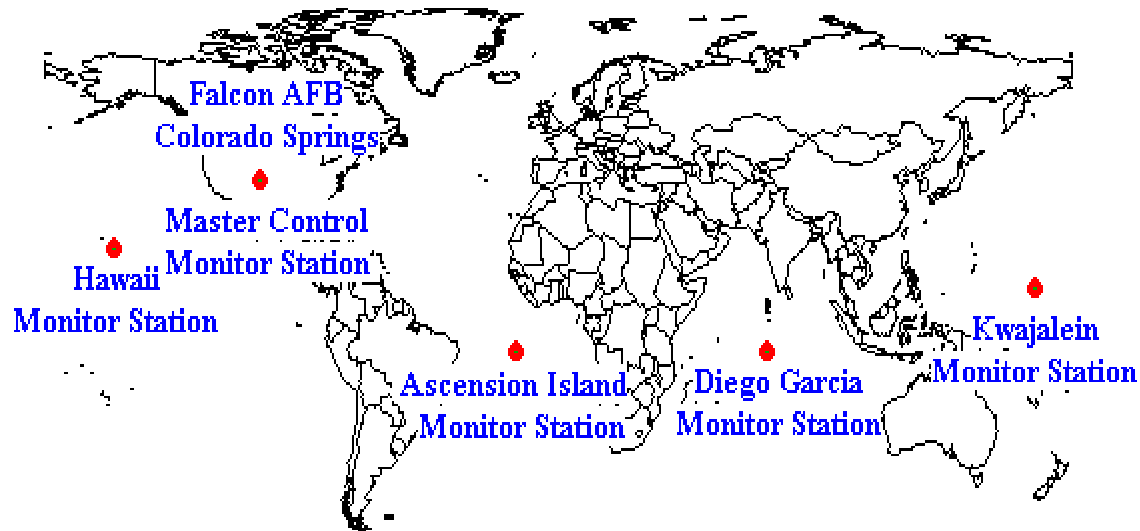
GPS – User Segment (Receivers)

- Ground-based devices that can read and **interpret the radio signals** from several of the NAVSTAR satellites at once
- Use **timing** of radio signals to calculate the receiver's **position** on the Earth's surface
- Calculations result in varying **degrees of accuracy** that depend on:
 - quality of the receiver
 - user operation of the receiver
 - local & atmospheric conditions
 - current status of system



GPS – Control Segment (Ground Stations)

Peter H. Dana 5/27/95

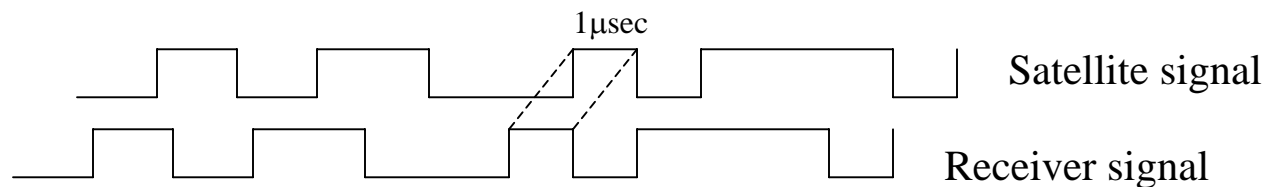


Global Positioning System (GPS) Master Control and Monitor Station Network

- Five control stations
 - master station at Falcon (Schriever) AFB, Colorado
 - **monitor** satellite orbits & clocks
 - **broadcast** orbital data and clock **corrections** to satellites

GPS - How Does it Work?

- GPS allows us to determine a position by calculating the **distance** between a receiver and multiple satellites
 - Distance is determined by **timing** how long it takes the signal to travel from satellite to receiver
 - Radio signals travel at **speed of light**: 186,000 mi / sec
 - Satellites and receivers generate **exactly the same signal** at exactly the same time
 - Signal travel time = delay of satellite signal relative to the receiver signal

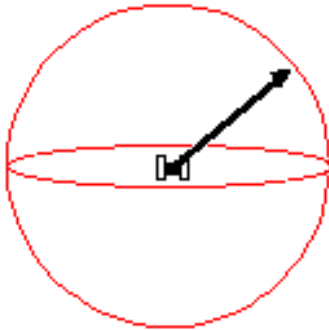


GPS - Satellite Signals

- Satellites have accurate **atomic clocks** and all 24 satellites are transmitting the same time signal at the same time
- The satellite signals contains information that includes
 - Satellite number
 - Time of transmission
- Receivers use an **almanac** that includes
 - The **position** of all satellites every second
 - This is updated monthly from control stations
- The satellite signal is received, compared with the receiver's internal clock, and used to calculate the **distance** from that satellite
- **Trilateration** (similar to triangulation) is used to determine location from multiple satellite signals

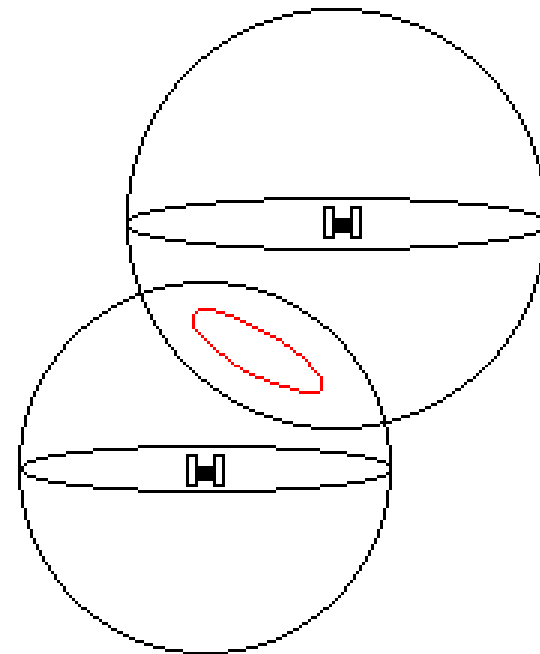
GPS - Trilateration

Start by determining the distance between a single GPS satellite and your position (**a sphere**)



1 satellite = sphere

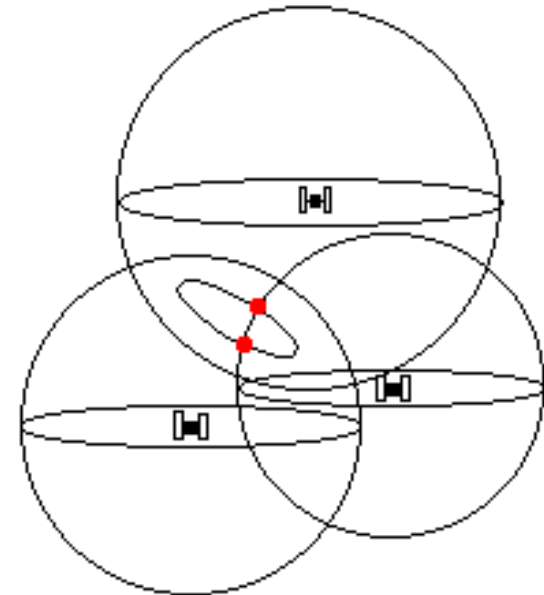
Adding a second distance measurement to another satellite narrows down your possible positions to **a circle** where the spheres intersect



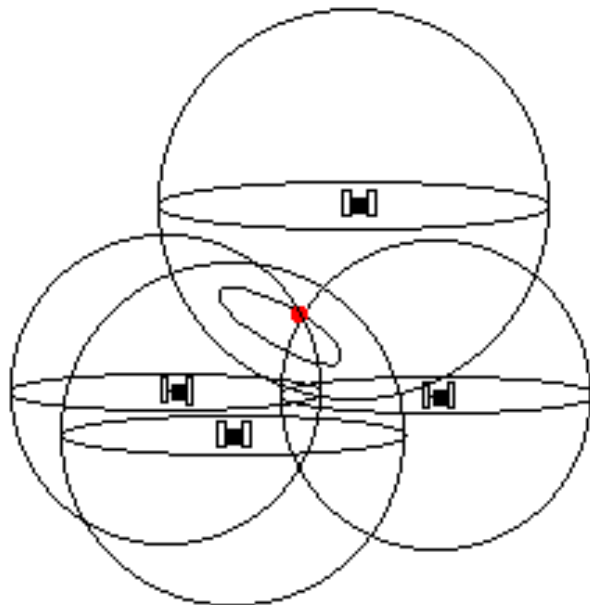
2 satellites = circle

GPS - Trilateration Cont.

Adding a third satellite narrows down the position to **two points** where the three spheres intersect, and usually only one point is a **'reasonable'** answer



3 satellites = 2 points



4 satellites = 1 point

The intersection of four spheres occurs at **one point**, but the 4th measurement is not needed, and is used for **timing** purposes instead

GPS - Using the 4th Signal

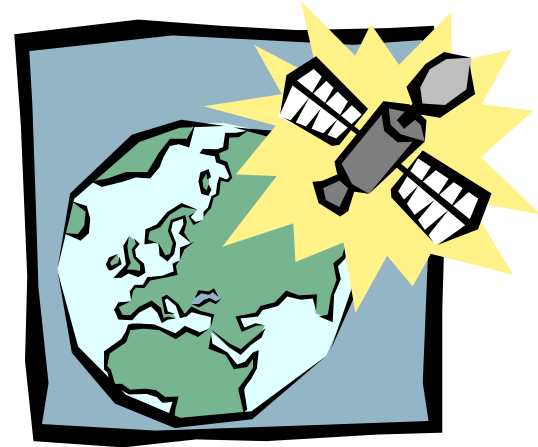
- How do we know that satellites and receivers generate the **same signal** at the **same time**?
 - The satellites have **atomic clocks**, so we know they are accurate
 - But **receivers do not** -- so can we ensure they are exactly accurate? No! If the receiver's timing is off, the location in 3-D space will be off slightly...
- So: We use the 4th satellite to **resolve any signal timing error** instead by
 - determining a **correction factor** using the 4th satellite
 - (like solving multiple equations ... there will only be one solution that satisfies all equations)

GPS - Sources of Error

- Satellite errors
 - satellite position / orbit error
 - satellite clock error
- Atmospheric errors
 - Speed of electromagnetic waves in the atmosphere
 - Path taken by the signal
- Multi-path distortion errors
- Receiver errors
- (Selective availability)

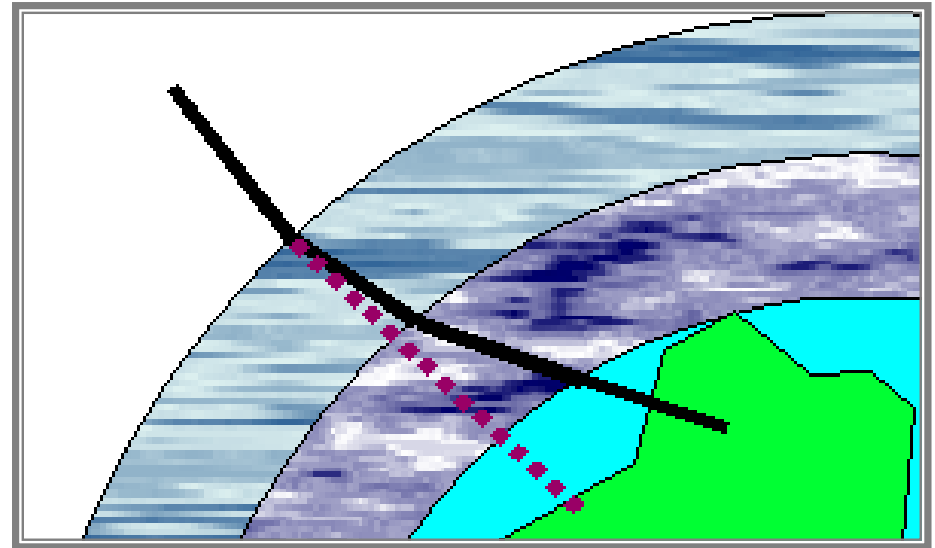
GPS - Sources of Error

- Satellite Errors
 - Although the satellites are in high orbits to minimize their deviations, sometimes there is a slight **‘wobble’** due to local gravitational forces
 - While the atomic clocks used in the satellites are extremely accurate (and quadruple redundant), sometimes clock errors can occur
- These can contribute up to **1-5 meters** of error



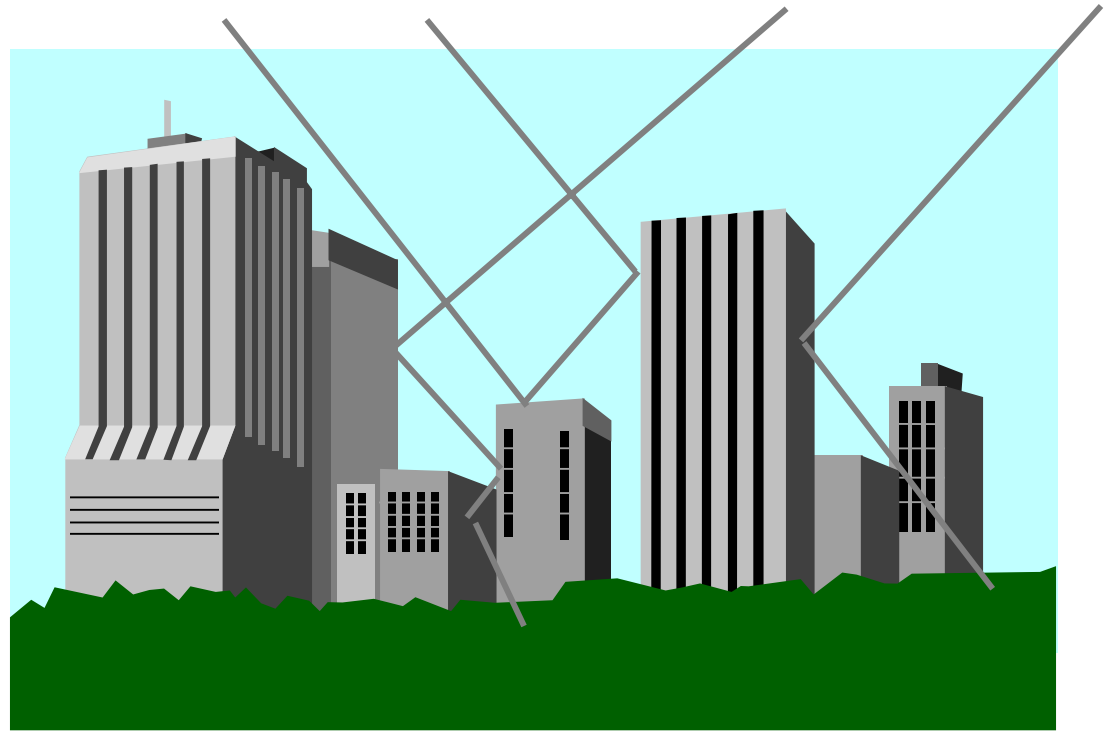
GPS - Sources of Error

- Atmospheric Delays/Bending
 - The speed of light is only precisely 186,000 miles per second in a vacuum, and is slightly **slower in the atmosphere**, varying by composition
 - The signal can be **bent** as it moves through the atmosphere (sphere size based on a straight path)
- **Up to 30m** of error



GPS - Sources of Error

- Multi Path Interference
 - The signal can **bounce off** of buildings, trees, etc. and this again distorts the time and distance between the receiver and the satellite
- **Up to 1m** of error



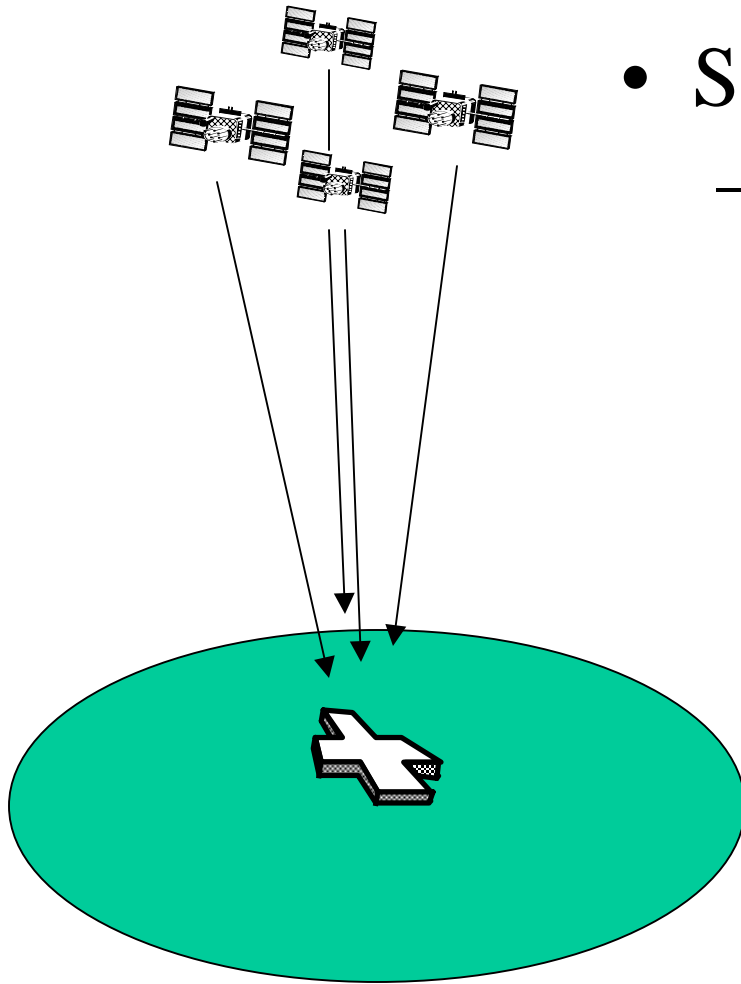
GPS - Sources of Error

- Receiver Errors (Timing/Rounding)
 - Satellites have quadruple redundant atomic clocks that are **accurate to nanoseconds** (about \$800,000 of clock hardware on each satellite), e.g. “the time is 2:02:01.23456789012”
 - Receivers are powered by 4 AA batteries worth about \$2.99, generate their clock signal with an oscillating crystal that is sensitive to battery current, e.g. “the time is 2:02:01.2345”
- **Up to 10 meters** of error

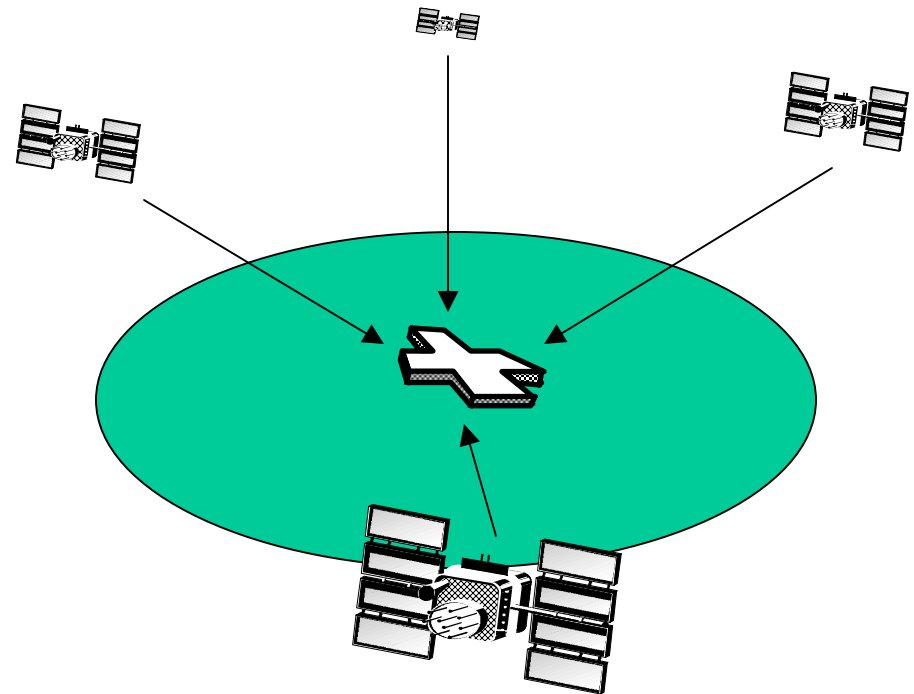


GPS - Sources of Error

- Satellite Coverage in Sky
 - Position Dilution of Precision (**PDOP**)



Poor



Ideal

The Role of Error

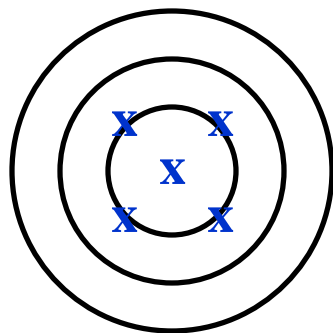
- **Enforcement** for map data is usually by **using topology**
- Map and attribute data errors are the **data producer's responsibility**, but the GIS user must understand error
- **Accuracy and precision** of map and attribute data in a GIS **affect all other operations**, especially when maps are compared across scales

Precision and Accuracy

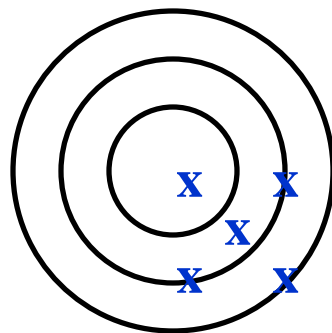
- When describing error we need to distinguish between **two characteristics**:
 - **Accuracy** refers to the **amount of distortion** from the true value in a measurement
 - Precision refers to the **variation among repeated measurements**, and also to the **amount of detail** in the reporting of a measurement

Precision and Accuracy

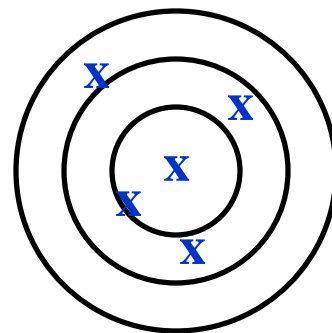
- These related concepts are often confused:
 - **Precision** refers to the exactness associated with a measurement (i.e. closely clustered)
 - **Accuracy** refers to the extent of systematic bias in the measurement process (i.e. centered on the middle)



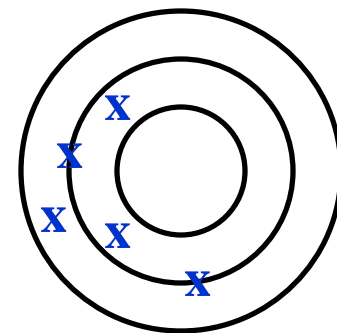
Precise &
Accurate



Precise &
Inaccurate



Imprecise &
Accurate



Imprecise &
Inaccurate

Getting the Map into the Computer: GIS Data Development

- 4.1 Analog-to-Digital Maps
- 4.2 Finding Existing Map Data
- 4.3 Digitizing and Scanning
- 4.4 Field and Image Data
- 4.5 Data Entry
- 4.6 Editing and Validation

Next Topic:

What is where?