How Do Geographers Describe Where Things Are?

CHAPTER 1, KEY ISSUE ONE

What is Geography?

- *Geography* is the study of where things are found on Earth's surface and the reasons for the locations.
- Human geographers ask three questions…
  1. Where are people and activities found on Earth?
  2. Why are they found there?
  3. So what?

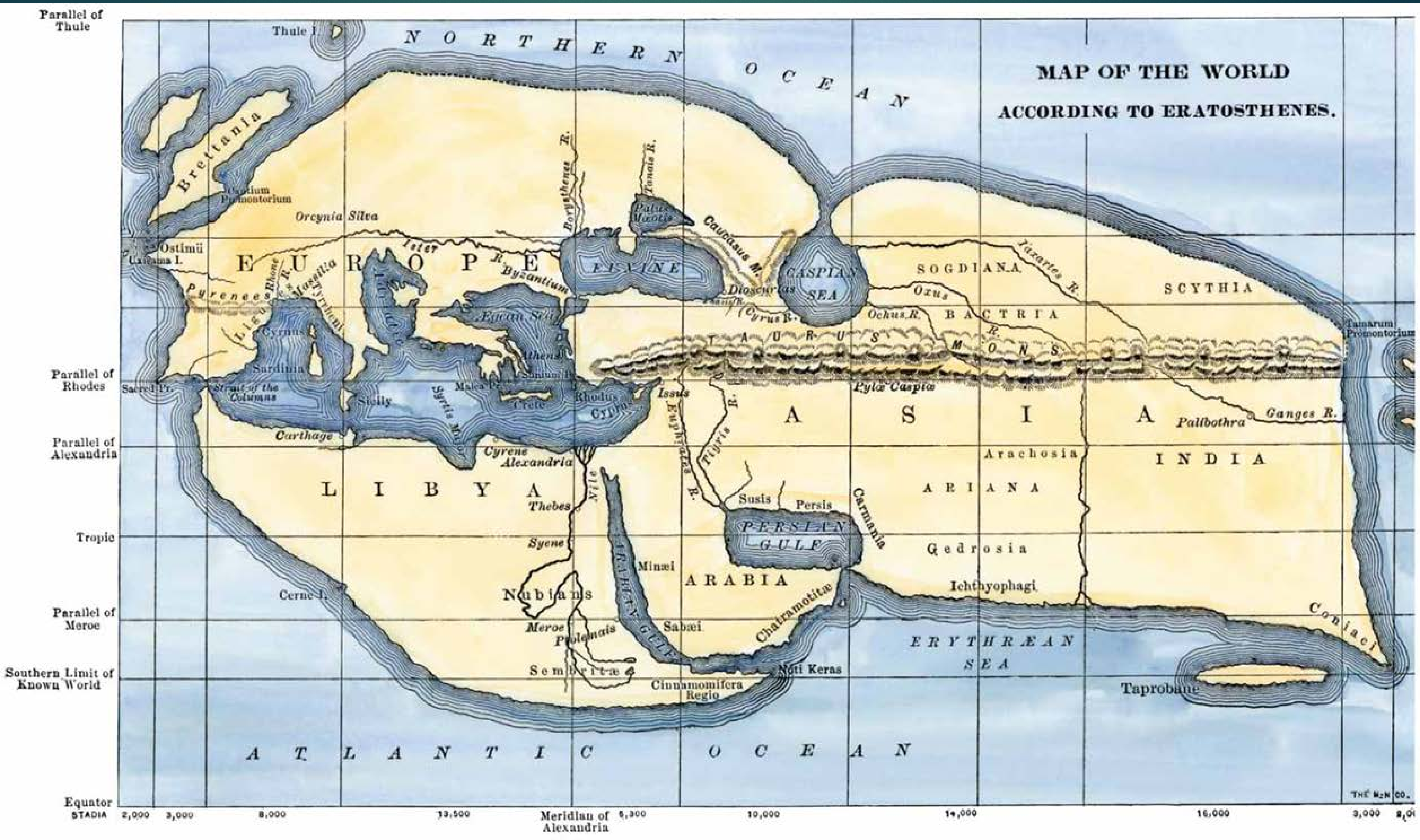
Maps

- A *map* is a two-dimensional or flat-scale model of Earth's surface, or a portion of it.
- *Cartography* is the science of mapmaking.
- Maps serve two purposes…
  1. As a reference tool to identify an object's absolute and relative location.
  2. As a communications tool to convey the distribution of human activities or physical features.

Early Mapmaking

- Earliest maps were reference tools—simple navigation devices to show a traveler how to get from Point A to Point B.
- First world map prepared by Eratosthenes (276–194 B.C.)
  - Improvements to world map later made by Ptolemy.
  - After Ptolemy, advancements in cartography primarily made outside of Europe by Chinese and Islamic world.
    - Mapmaking revived during the Age of Exploration and Discovery.

World Map by Eratothenes, 194 B.C.



World Map by al-Idrisi, 1154

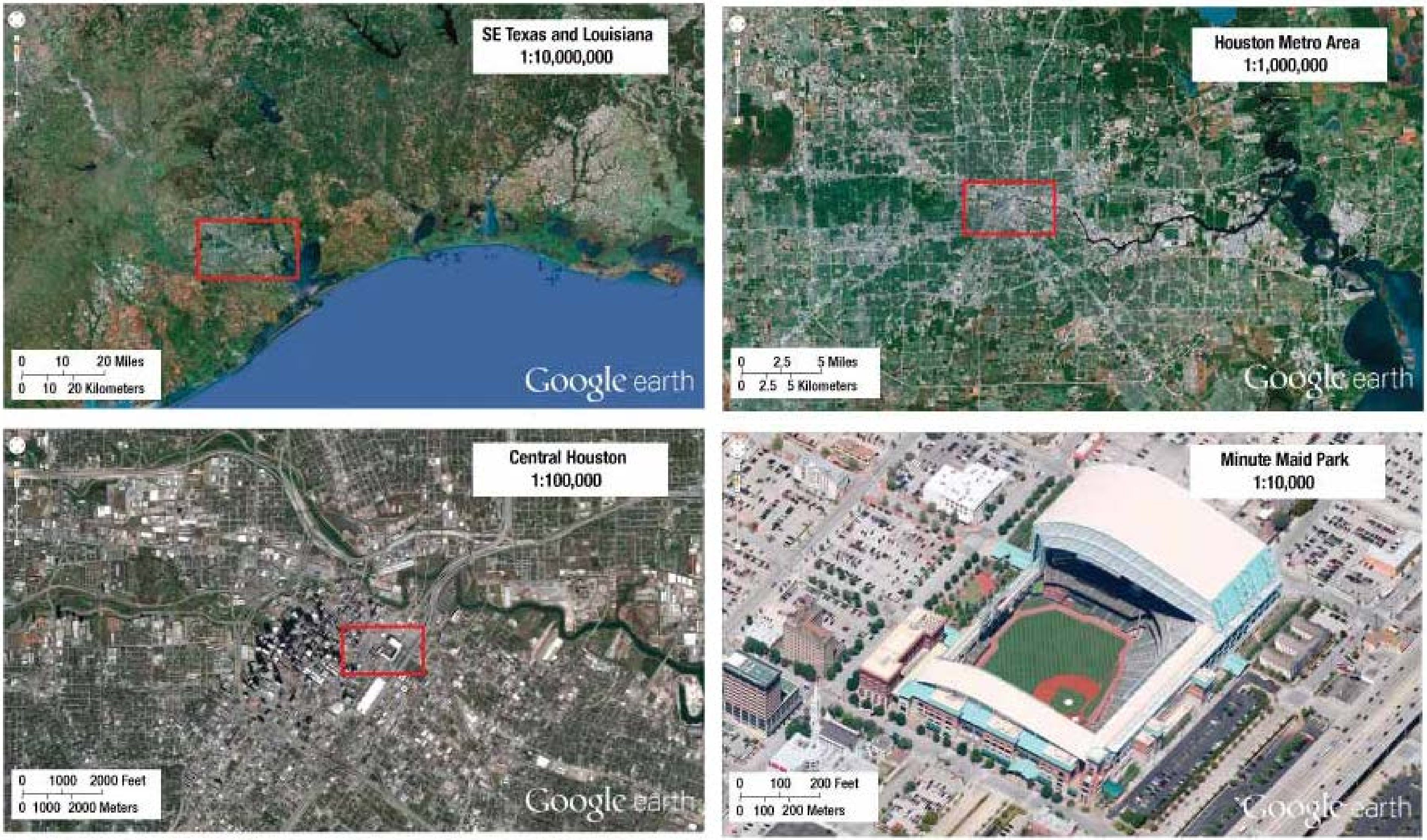
World Map by Ortelius, 1571

Map Scale

- Level of detail and the amount of area covered on the map depend on its *map scale*.
  - Relationship of a feature's size on a map to its actual size on Earth
    - A **small scale** map shows a **larger** area of the Earth
    - A **large scale** map shows a **smaller** area of the Earth

Map Scale

- Map scale is presented in three ways…
  1. Ratio or Fraction Scale: Ex. 1:24,000 or 1/24,000
     - Number on left is one unit of distance, while number on right represents same unit of distance on Earth's surface.
  2. Written Scale: Ex. 1 inch equals 1 mile
     - Number on left is one unit of distance, while number on right represents a different unit of distance on Earth's surface.
  3. Graphic Scale: Usually consists of a bar line marked to show distance on Earth's surface
     - Distance between two points can be overlaid on the scale bar to determine the distance on Earth's surface


SE Texas and Louisiana
1:10,000,000
0 10 20 Miles
0 10 20 Kilometers
Google earth
Houston Metro Area
1:1,000,000
0 2.5 5 Miles
0 2.5 5 Kilometers
Google earth
Central Houston
1:100,000
0 1000 2000 Feet
0 1000 2000 Meters
Google earth
Minute Maid Park
1:10,000
0 100 200 Feet
0 100 200 Meters
Google earth

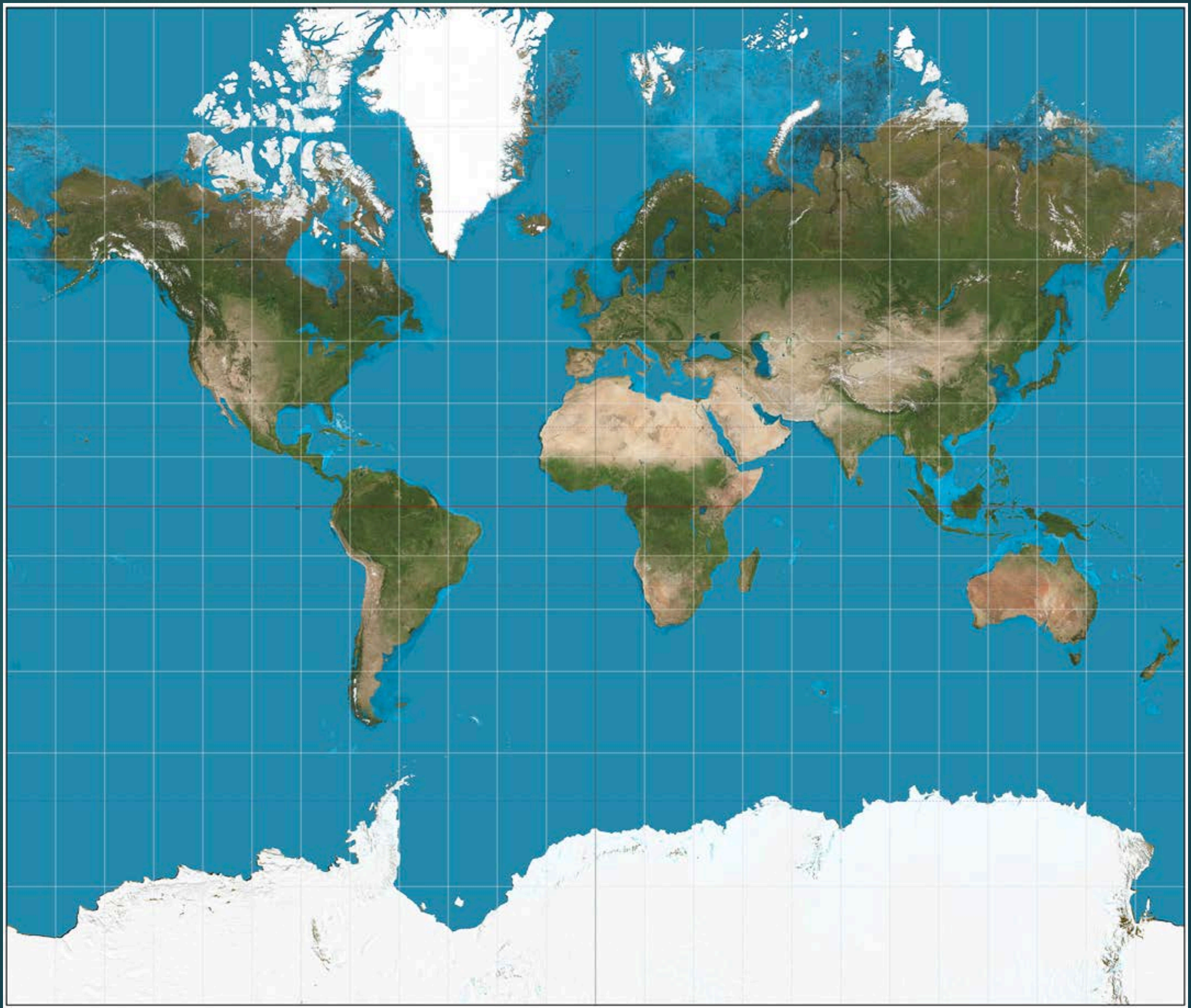
Map Projections

- Basics
  - The earth is nearly a sphere and best represented on a globe.
  - Causes several problems:
    - Small globe is difficult to write on, photocopy, display on a computer screen, etc.
    - Large globe is bulky or cumbersome to use
  - A projection is the scientific method of transferring locations on the Earth's surface to a flat map.

Map Projections

- Problems
  - **All** projections suffer from distortion:
    - **Shape** of an area can be distorted, so it appears more elongated or squat than in reality.
    - **Distance** between two points may become increased or decreased.
    - **Relative Size** of different areas may be altered, so that one are may appear larger than another on a map but is in reality smaller.
    - **Direction** from one place to another can be distorted.

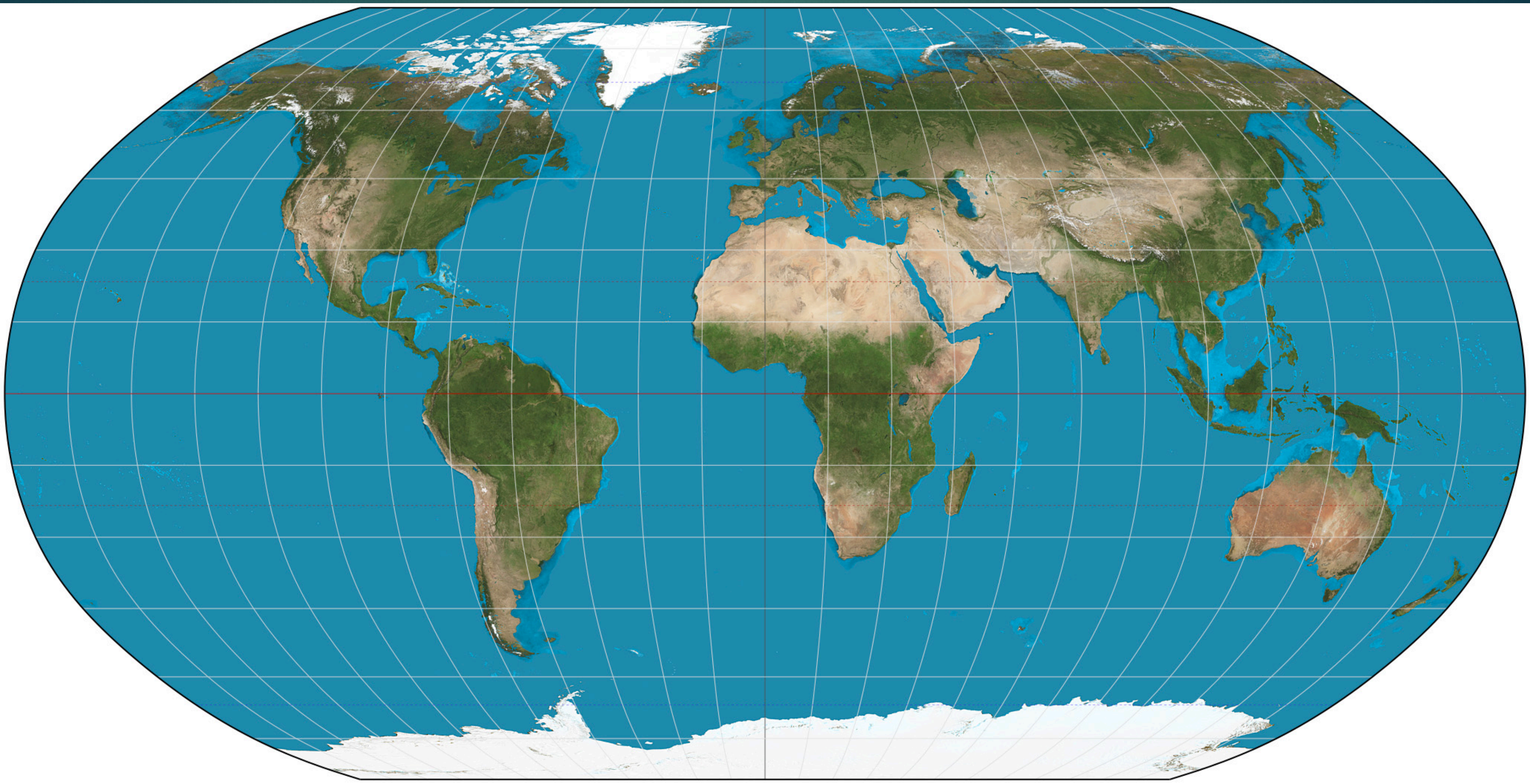
Mercator Projection



Mercator Projection - Details

- **Distorts:** Distance, shape, and relative size
- **Maintains:** Direction
- **Strengths:**
  - Navigating the oceans
  - Not much else (unless you count being rectangular)
- **Weaknesses:**
  - You rarely see Mercator projections showing all the way to the poles because it is so distorted at the poles.
  - Africa is actually 14x larger than Greenland.
  - Antarctica is only the 5th largest continent, not ginormous.

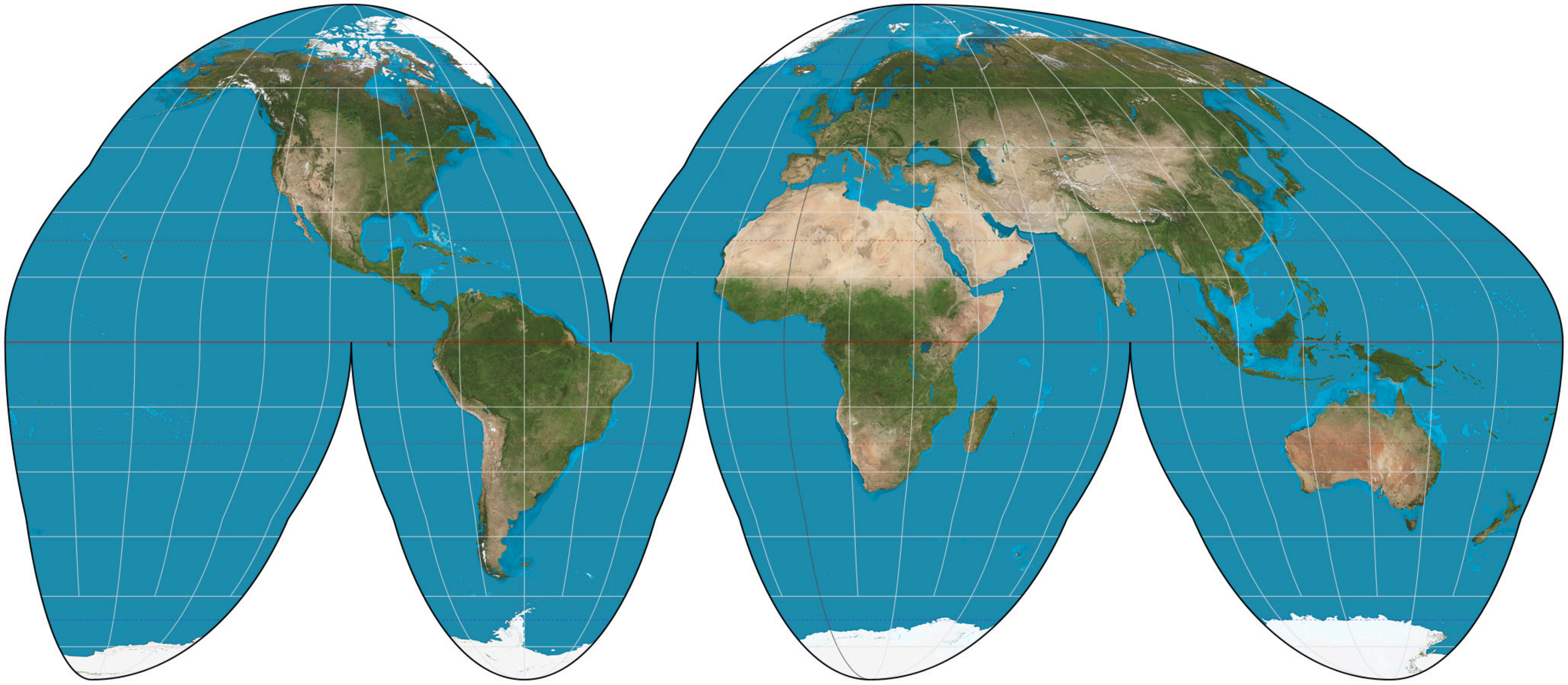
Robinson Projection



Robinson Projection - Details

- **Distorts:** Everything! (but only a little)
- **Maintains:** Nothing! (It's a compromise)
- **Strengths:**
  - Still distorted at poles, but as you move towards the equator, it quickly becomes much less distorted.
    - And who really cares about the poles anyway? (REALLY, not too many people do)
    - As a compromise it does everything pretty well, but nothing great.
- **Weaknesses:**
  - As a compromise it does everything pretty well, but nothing superb.

Interrupted Goode Homolosine Projection



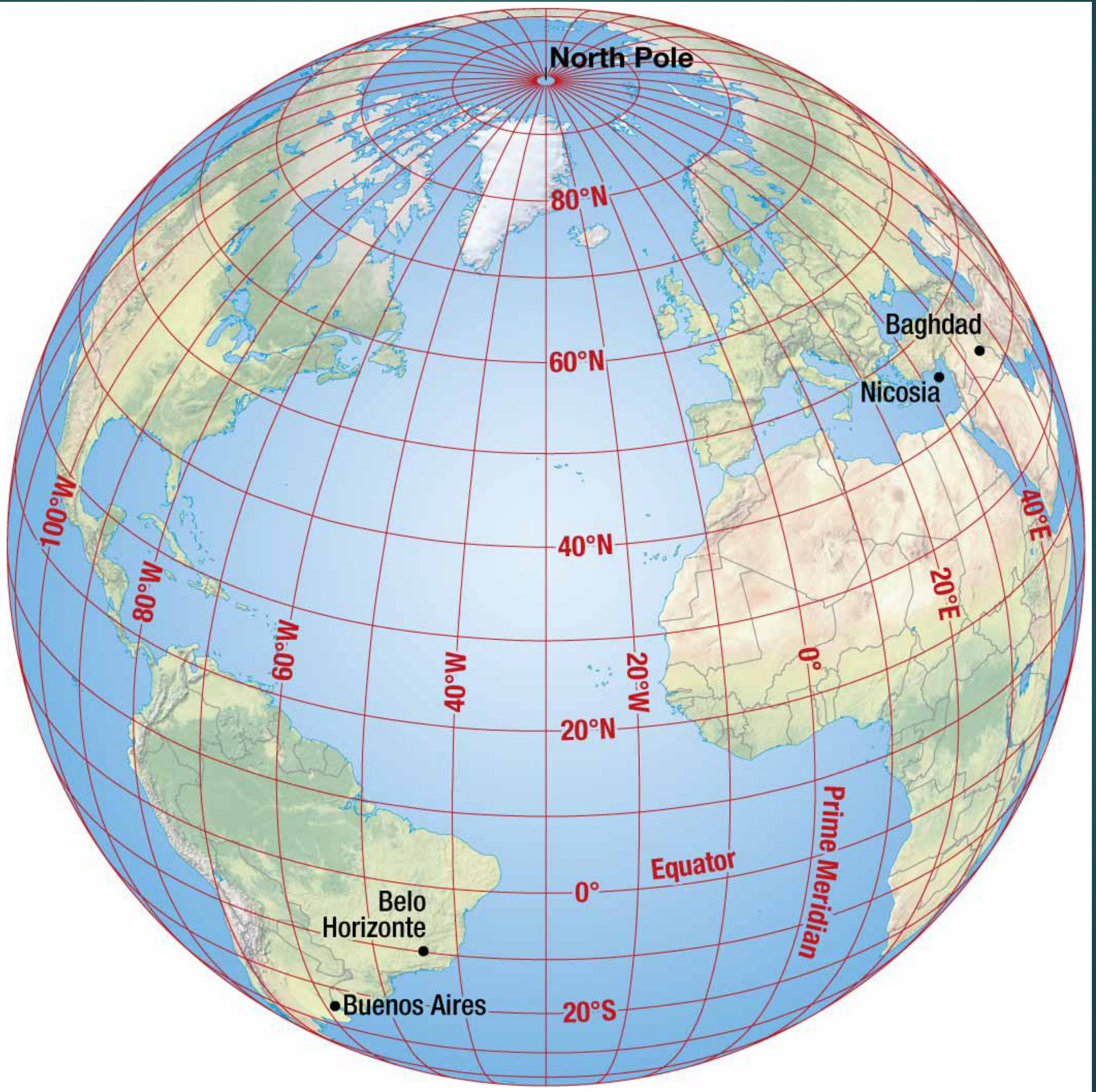
Interrupted Goode Homolosine Projection - Details

- **Distorts:** Most obviously, the surface of the Earth is not divided into chunks, also distance, direction, shape
- **Maintains:** Relative size
- **Strengths:**
  - Very useful in human geography because of lack of concern about the ocean.
  - Thematic maps about language, population, or government
  - Or it can be great for ocean geography too!
- **Weaknesses:**
  - The “orange peel” problem is obvious – the map is not continuous.

Geographic Grid

- Geographic grid is a system of imaginary arcs drawn in a grid pattern on Earth's surface.
  - *Meridians* are arcs drawn between the North and South poles. Each is numbered, according to a system known as *longitude.*
    - Values range from 0º (*prime meridian)* to 180º east or west longitude.
  - *Parallels* are arcs drawn parallel to the equator and at right angles to meridians. Each is numbered, according to a system known as *latitude.*
    - Values range from 0º (equator) to 90º north or south.

Geographic Grid



Geographic Grid

- Points on Earth’s surface can be communicated by referencing points of latitude and longitude intersection.
  - Ex. Denver, Colorado’s location is 40º north latitude and 105º west longitude.
- Further accuracy can be achieved by dividing each degree into 60 minutes and each minute into 60 seconds.
  - Ex. Denver, Colorado’s state capital building is 39º42’2” north latitude and 104º59’04” west longitude.

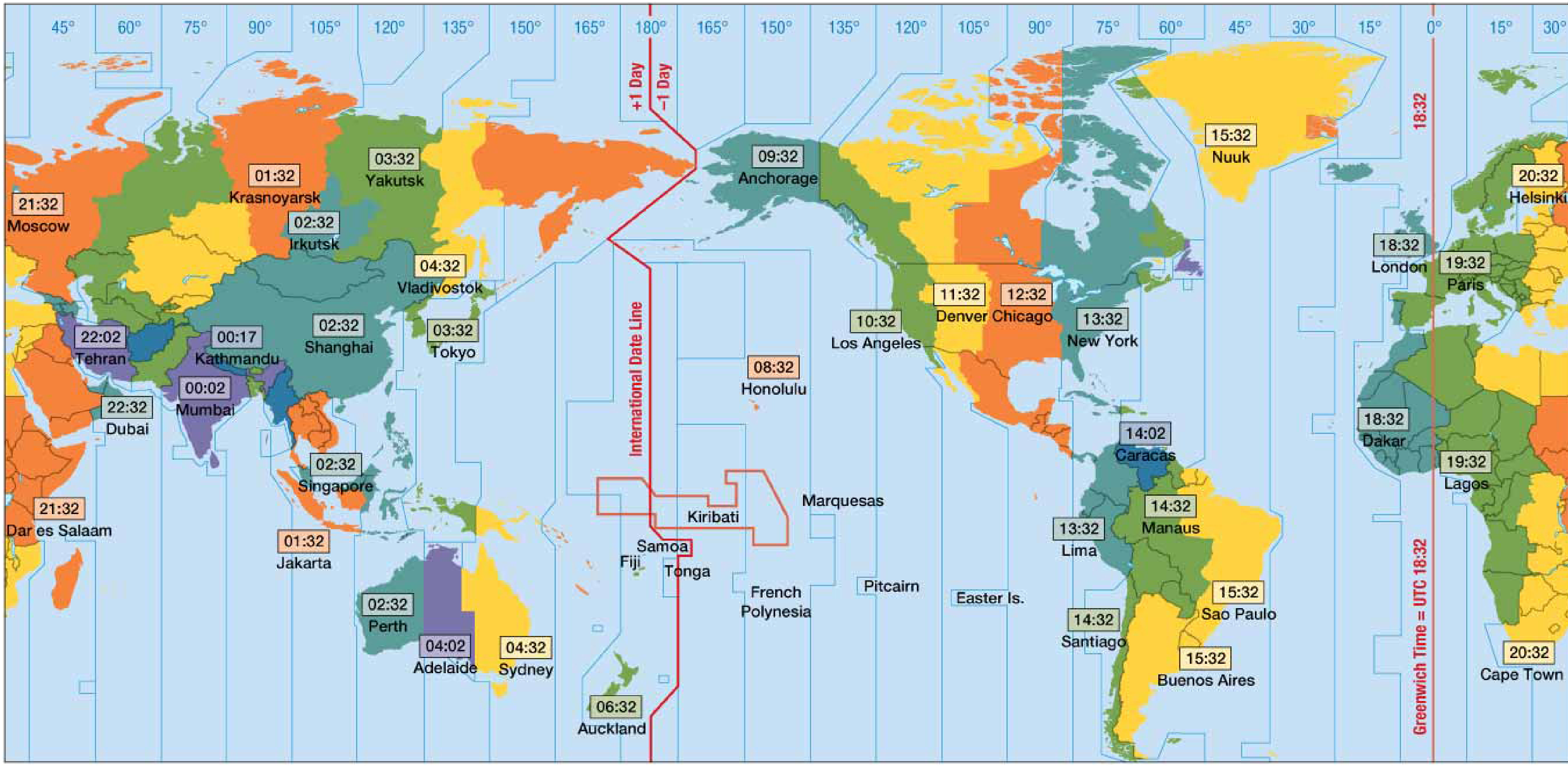
Telling Time

- Earth as a sphere is divided into 360º of longitude.
  - Divide 360º by 24 time zones (one for each hour of day) equals 15º.
    - Each 15º band of longitude is assigned to a standard time zone.
- *Greenwich Mean Time (GMT)* is…
  - Located at the prime meridian (0º longitude).
    - Passes through Royal Observatory at Greenwich, England
  - Master reference time for all points on Earth.

Telling Time

- The *International Date Line* is…
  - Located at 180º longitude.
    - Position deviates from 180º longitude at times to accommodate various nearby nation-states.
  - Point you move the clock back 24 hours (one day), if you are heading eastward toward America.
  - Point you move the clock ahead 24 hours (one day), if you are heading westward toward Asia.

Time Zones



45°
60°
75°
90°
105°
120°
135°
150°
165°
180°
165°
150°
135°
120°
105°
90°
75°
60°
45°
30°
15°
0°
15°
30°
+1 Day
−1 Day
International Date Line
Greenwich Time = UTC 18:32
18:32
21:32
Moscow
01:32
Krasnoyarsk
02:32
Irkutsk
03:32
Yakutsk
04:32
Vladivostok
22:02
Tehran
00:17
Kathmandu
02:32
Shanghai
03:32
Tokyo
00:02
Mumbai
22:32
Dubai
02:32
Singapore
21:32
Dar es Salaam
01:32
Jakarta
02:32
Perth
04:02
Adelaide
04:32
Sydney
06:32
Auckland
Samoa
Fiji
Tonga
Kiribati
Marquesas
French
Polynesia
Pitcairn
Easter Is.
09:32
Anchorage
08:32
Honolulu
10:32
Los Angeles
11:32
Denver
12:32
Chicago
13:32
New York
15:32
Nuuk
14:02
Caracas
13:32
Lima
14:32
Manaus
14:32
Santiago
15:32
Sao Paulo
15:32
Buenos Aires
18:32
London
19:32
Paris
20:32
Helsinki
18:32
Dakar
19:32
Lagos
20:32
Cape Town

Contemporary Tools

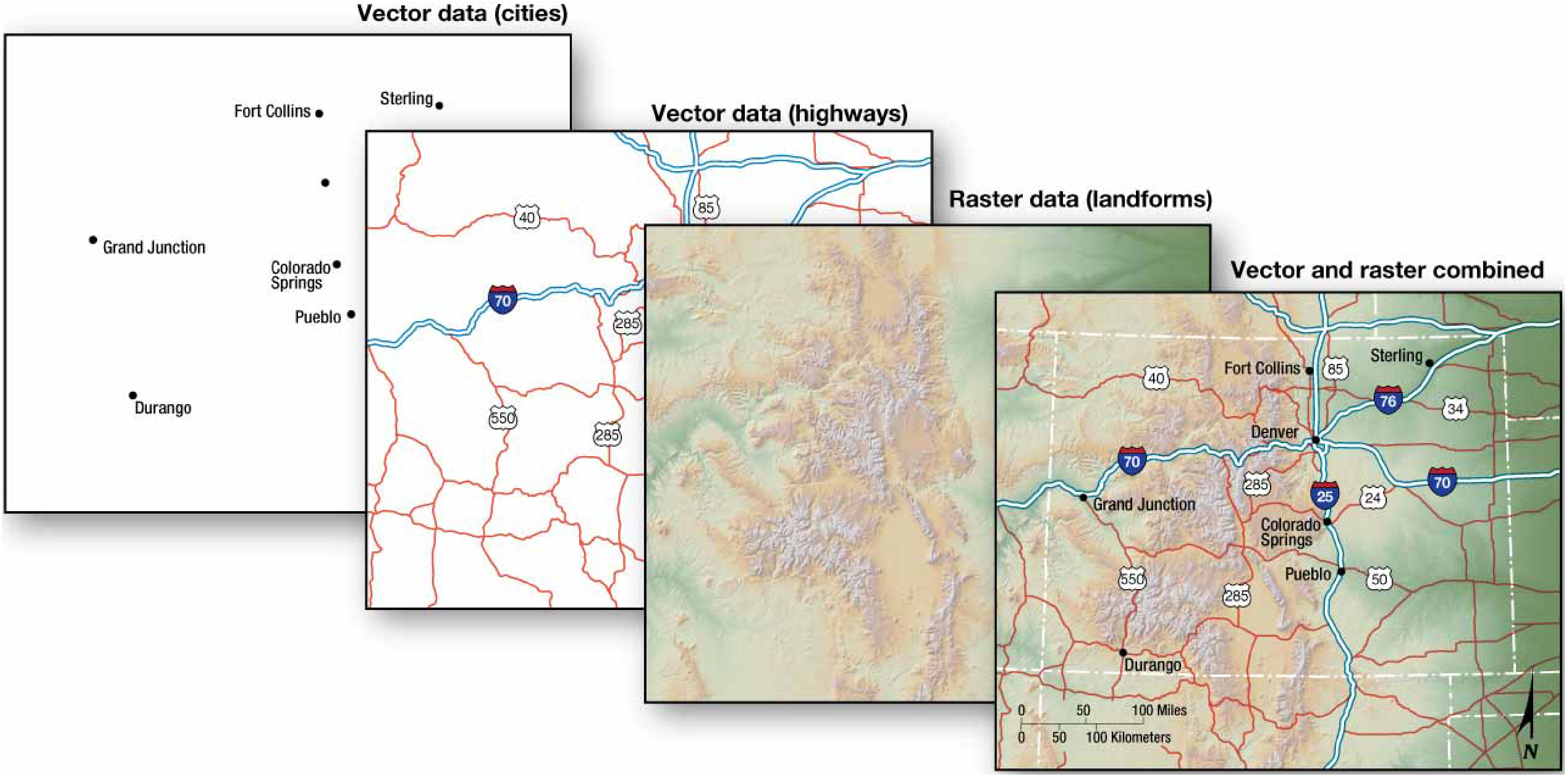
- Geographic *Information Science (GIScience)* involves the development and analysis of data about Earth acquired through satellite and other electronic information technologies.
- Collecting Data: Remote Sensing
  - Acquisition of data about Earth’s surface from a satellite orbiting Earth or from other long distance methods is known as remote-sensing.
  - After sensors scan Earth’s surface, the individual pixels are transmitted to a receiving station on Earth where a computer assembles each of them into an image.
    - Map created using remotely sensed data is essentially a grid of rows and columns of pixels; each representing the radiation being reflected on Earth’s surface at a specific point.

Contemporary Tools

- Pinpointing Locations: GPS (Global Positioning System)
  - System that accurately determines the precise position of something on Earth
  - GPS in the U.S. includes three elements
    1. Satellites placed in predetermined orbits
    2. Tracking stations to monitor and control satellites
    3. Receiver that can locate at least four satellites, figure out its distance from each, and use the information to calculate its precise location
  - Applications

Contemporary Tools

- Layering Data: GIS
  - A *geographic information system* (GIS) is a computer system that captures, stores, queries, analyzes, and displays geographic data.
  - Data are stored in layers.
  - Layers can be compared to show relationships among different kinds of information.
  - Data can be overlaid in one GIS from a variety of different sources through a process known as a *mashup.*

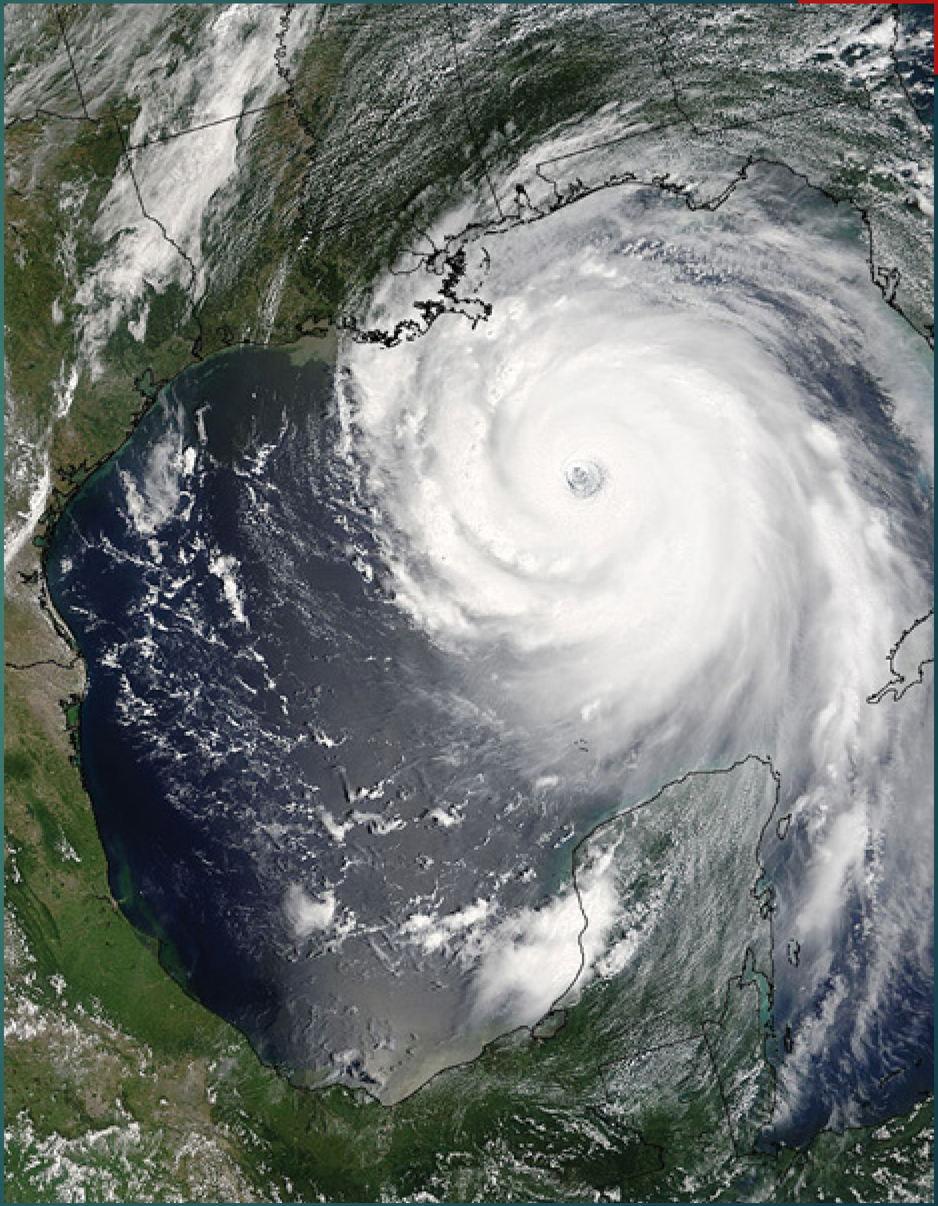

Vector data (cities)
Fort Collins
Sterling
Grand Junction
Colorado Springs
Pueblo
Durango
Vector data (highways)
40
85
70
285
550
Raster data (landforms)
Vector and raster combined
Sterling
Fort Collins
85
40
76
34
Denver
70
285
25
24
Grand Junction
Colorado Springs
Pueblo
50
550
Durango
0 50 100 Miles
0 50 100 Kilometers
N

Modern Day Mapping!

Remote Sensing:

Monitoring the Earth's surface from a distance.

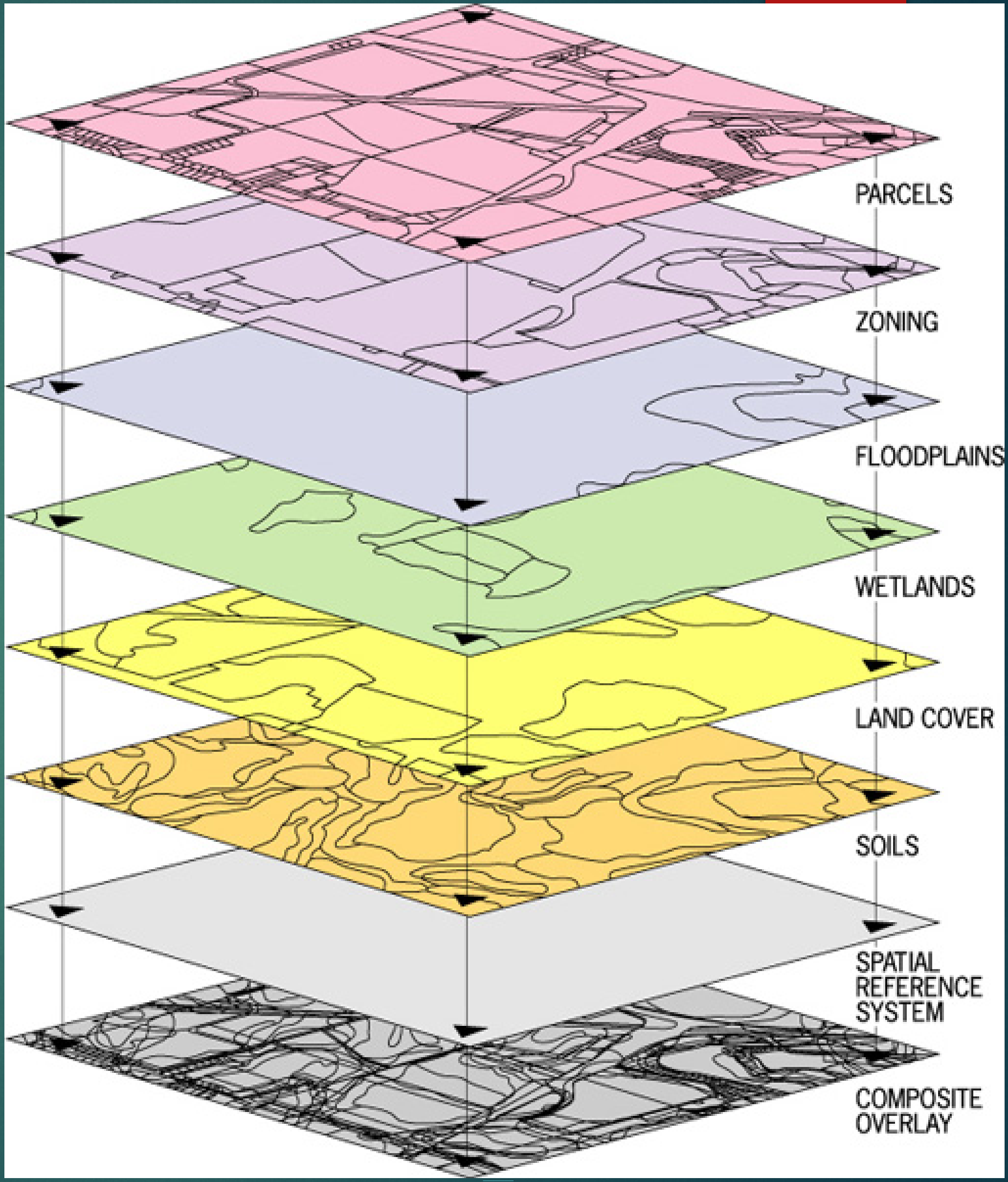
Ex: Satellite, weather balloon, aircraft



GIS

Geographic Information System

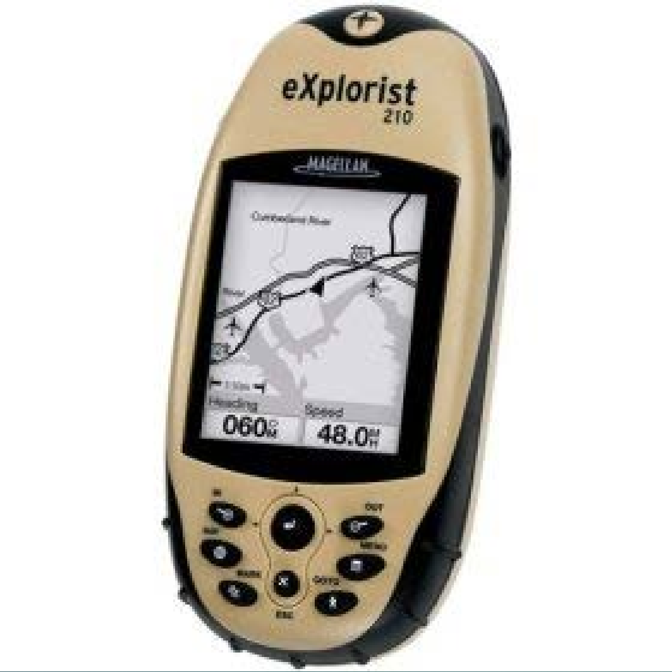
Why have 8 maps when you can combine them into one (with layers)!



A GIS "Mash-Up" (data+mapping)

ZILLOW.COM

Global Positioning System (GPS)

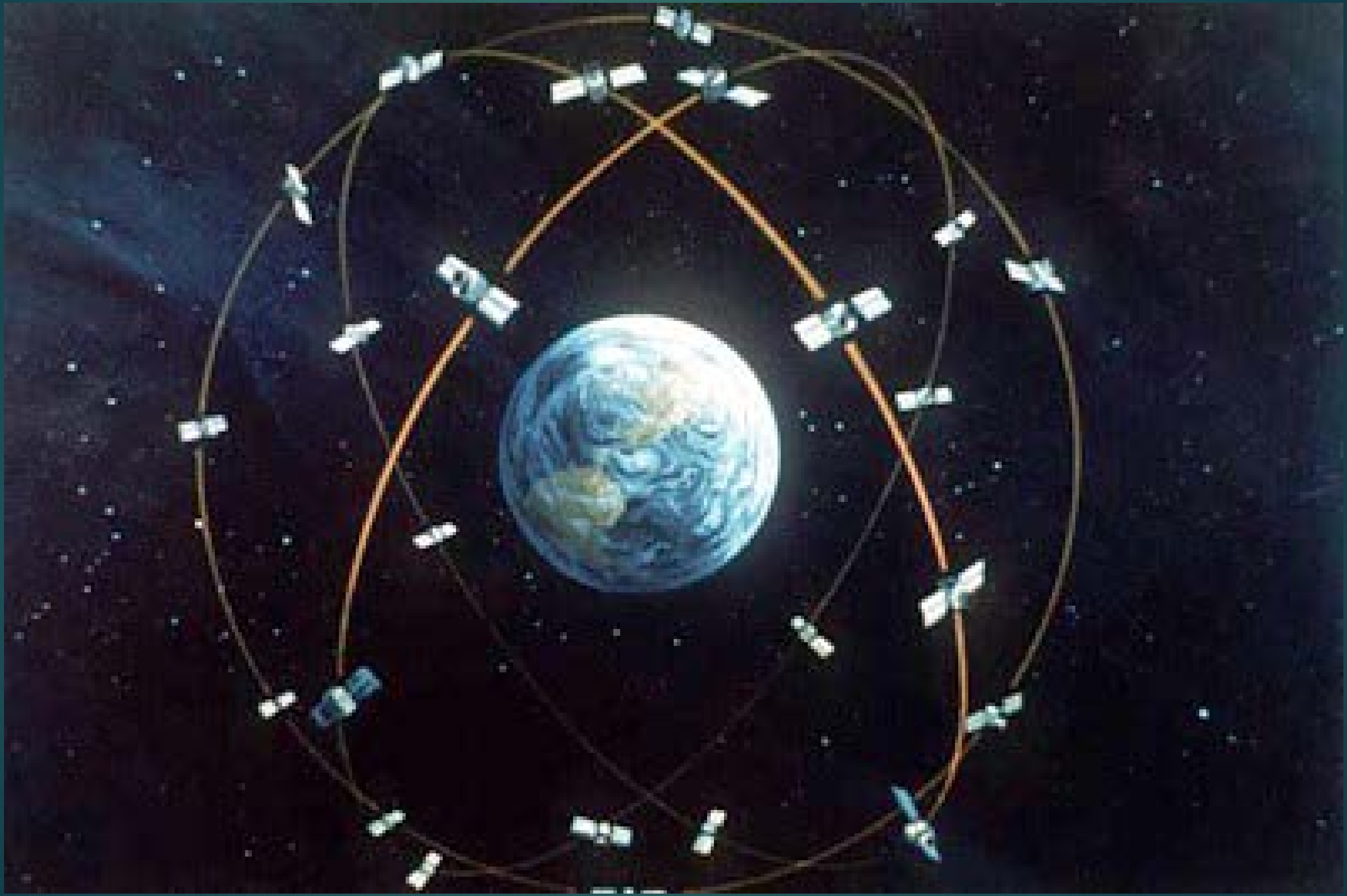


Military Technology

($12 billion)

turned civilian toy?

A Constellation of 27 Satellites (24+3 extra)



A GPS Receiver’s job is to:

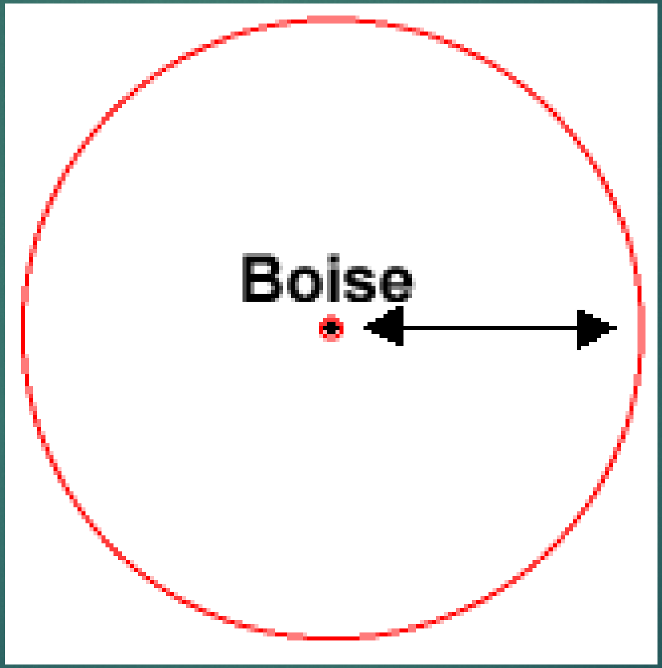
• locate satellites…

• figure out how far away it is from each satellite…

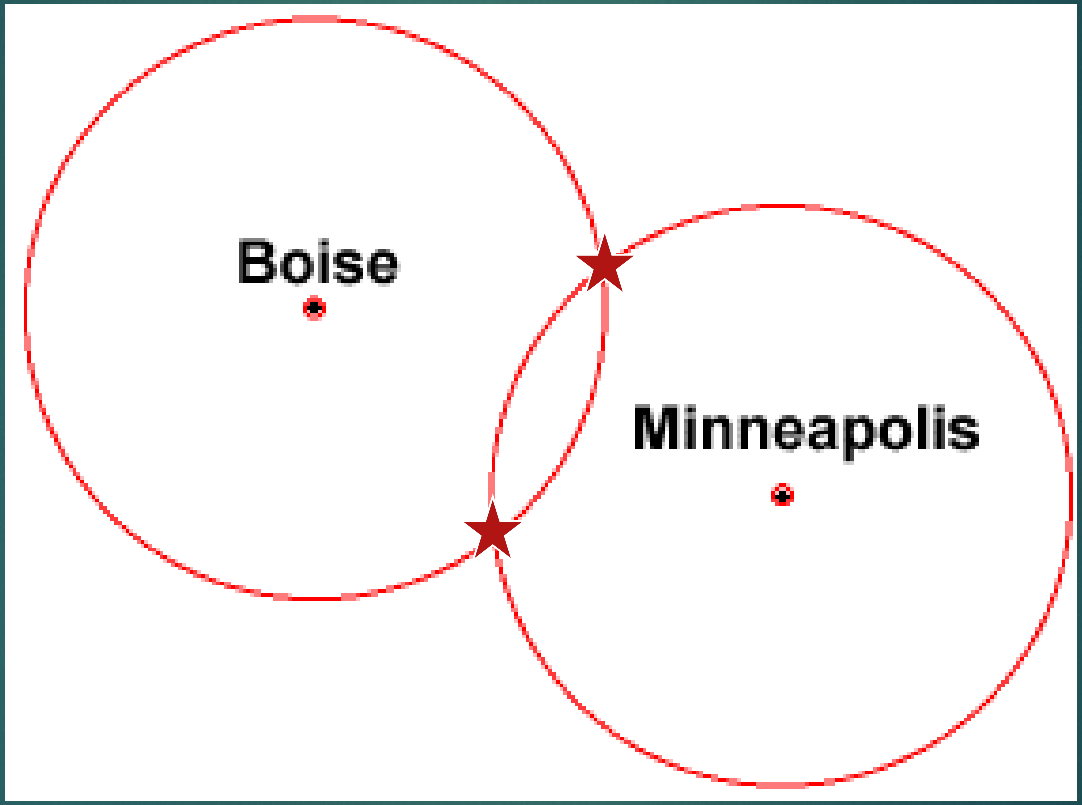
• and then determine its own position using triangulation (actually trilateration).

To simplify this lets try 2-D Triangulation first.

Assume you are lost, but someone tells you that you are 625 miles from Boise, Idaho.



Lets say someone else tells you that you are 690 miles from Minneapolis.

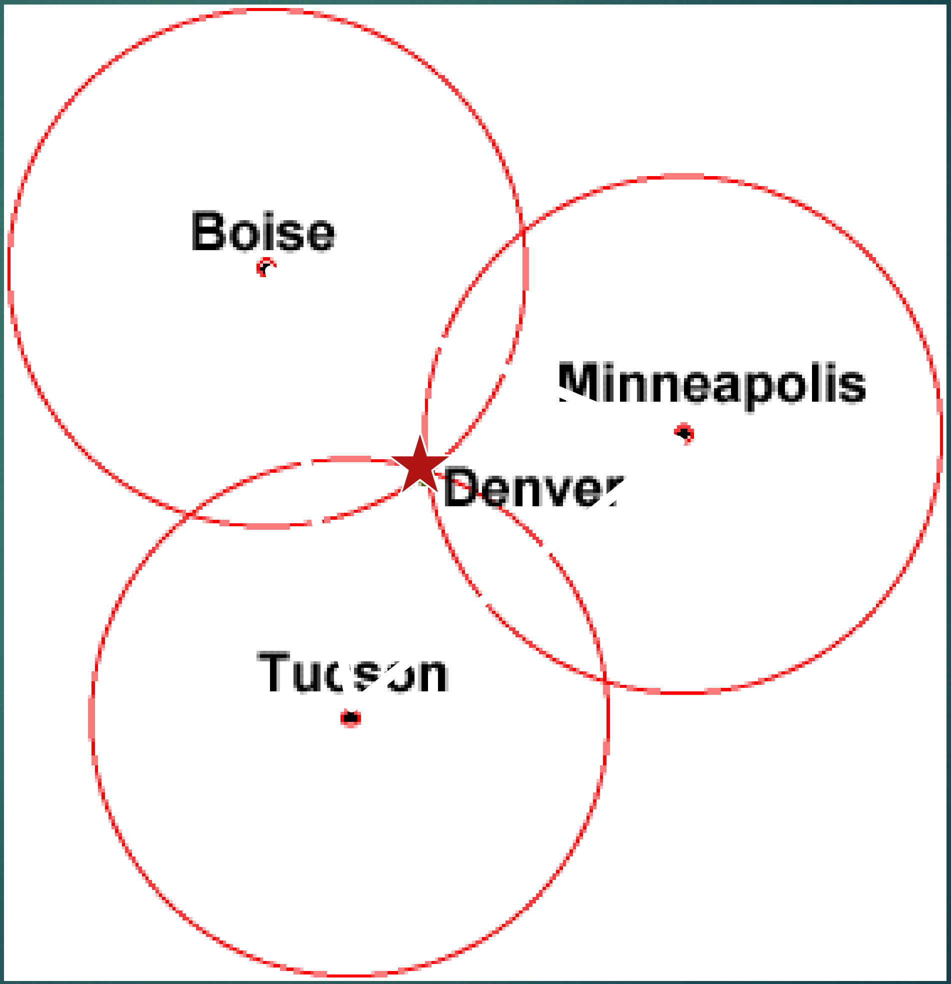


You must be at one of the intersection points!

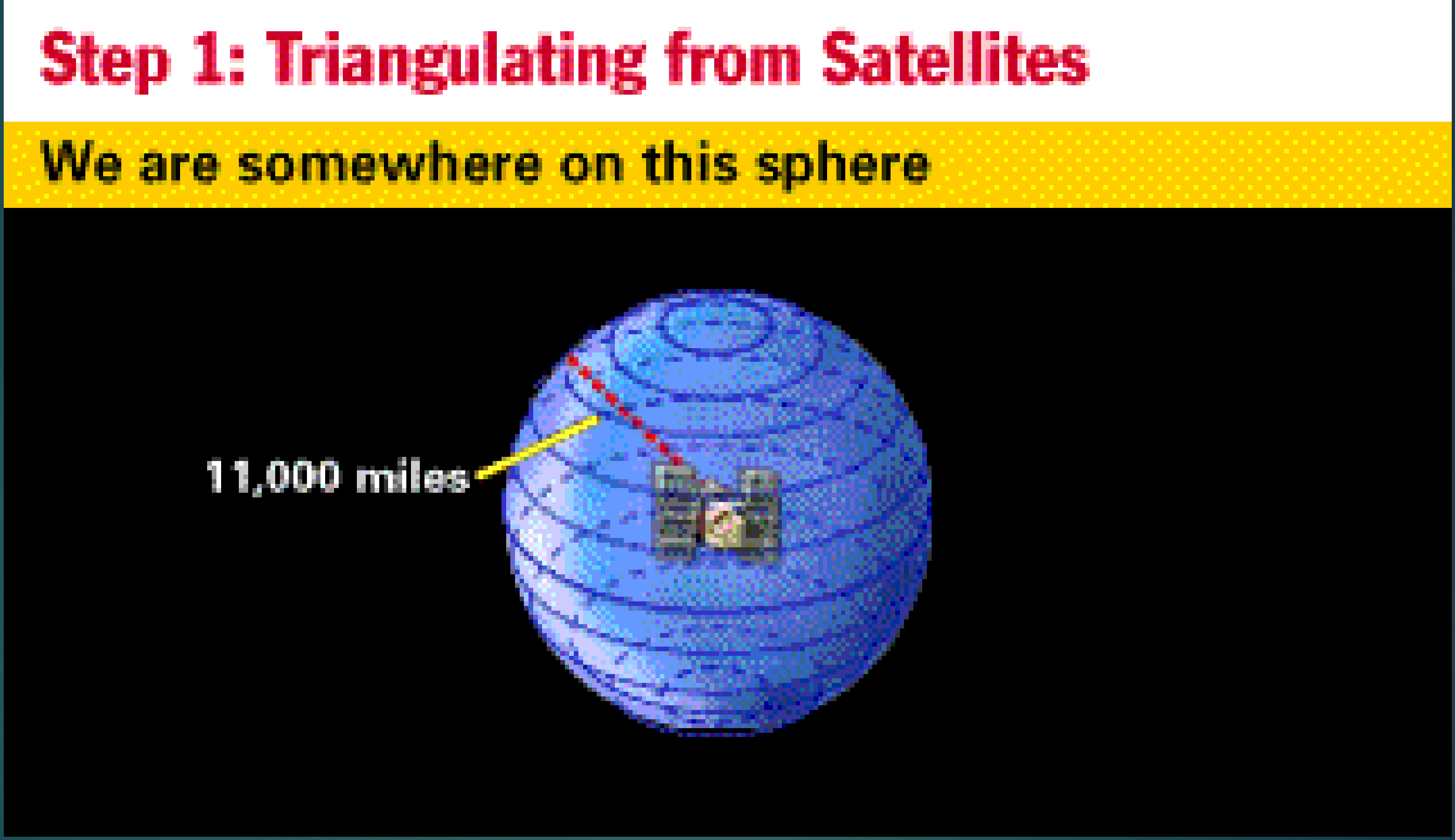
Now if a third person tells you that you are 615 miles from Tuscon, Arizona…

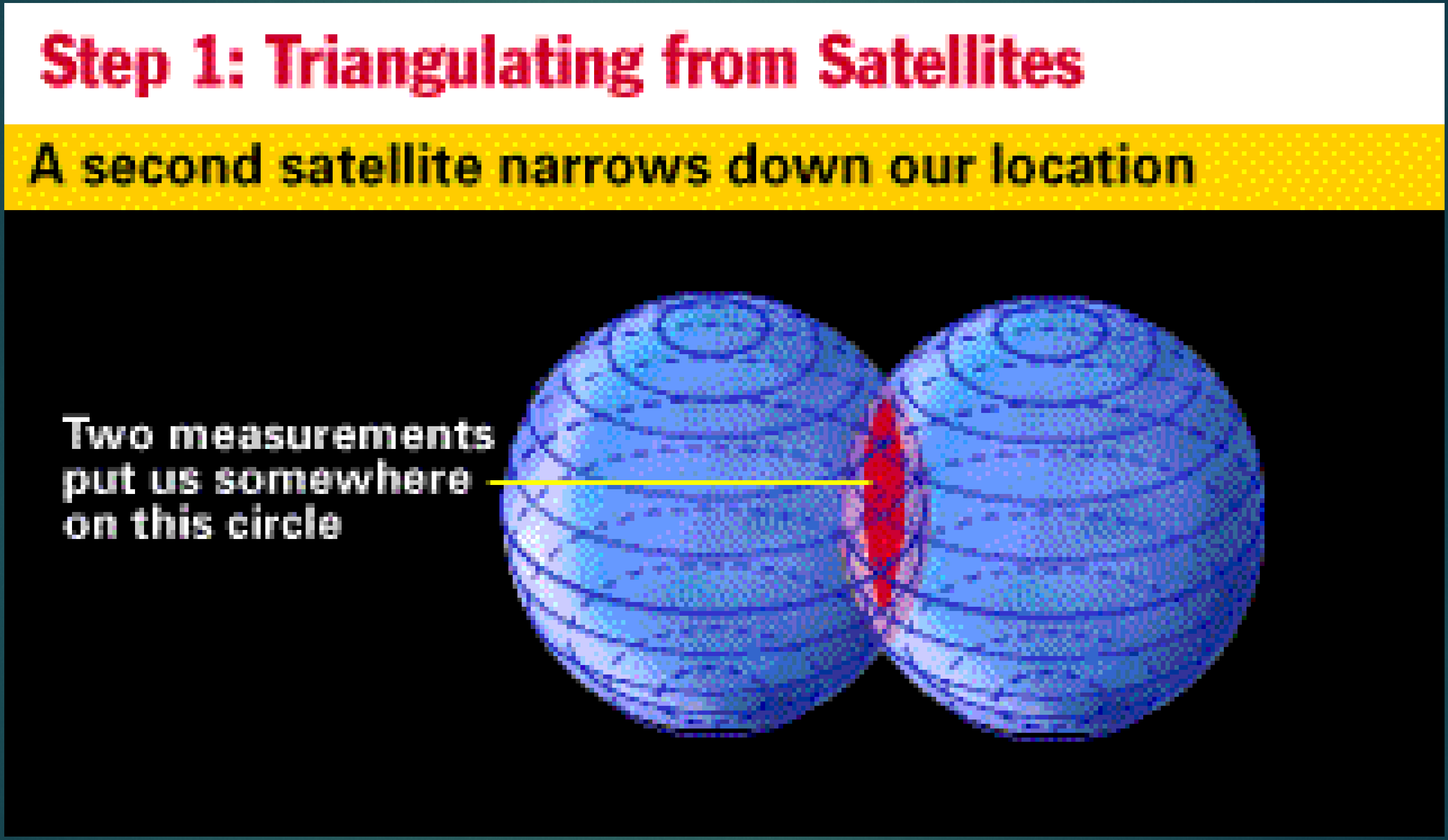
You are in Denver!

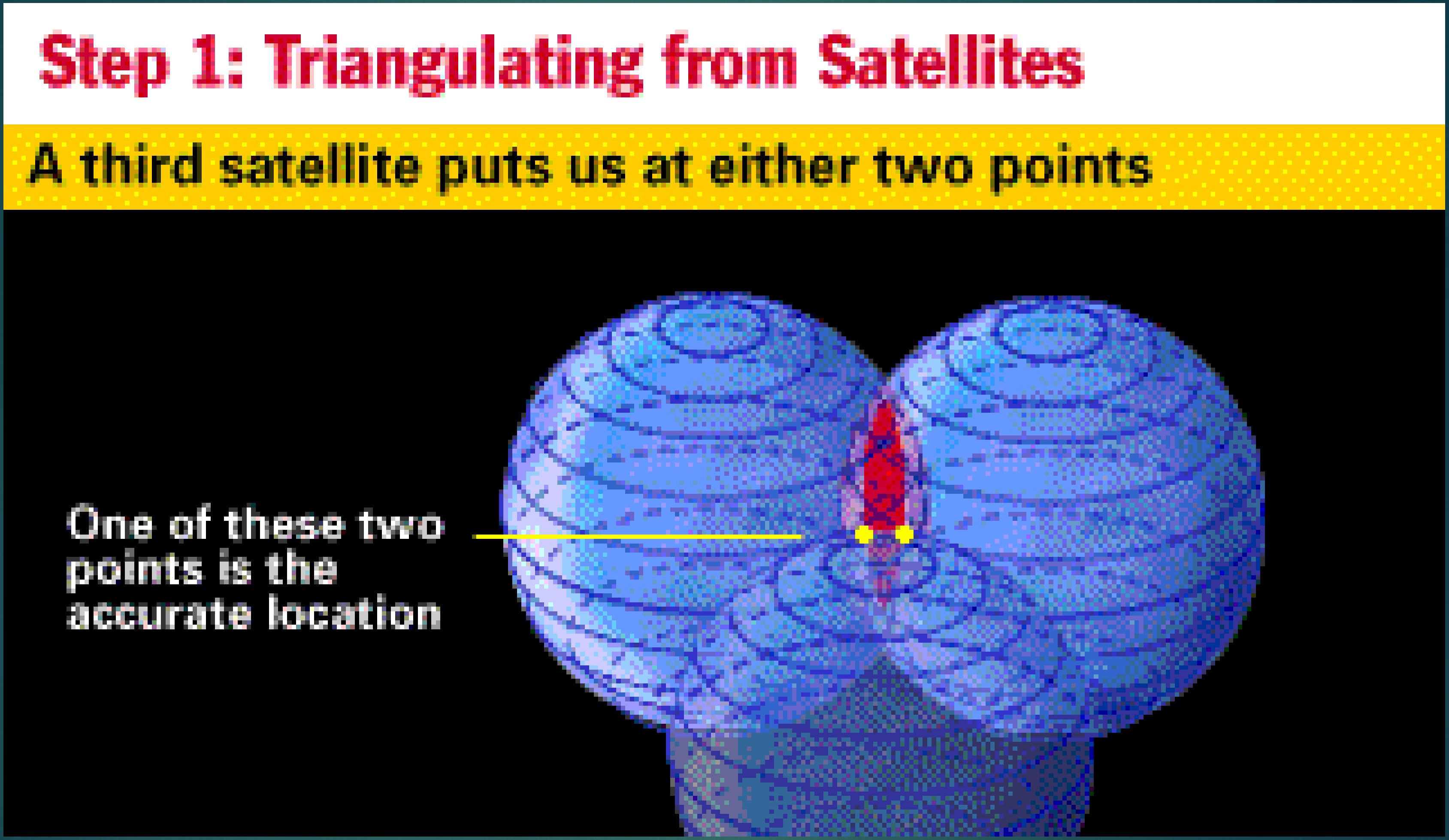
You've been Triangulated!



3 D Triangulation = Uses spheres not circles.




Step 1: Triangulating from Satellites
A second satellite narrows down our location
Two measurements put us somewhere on this circle

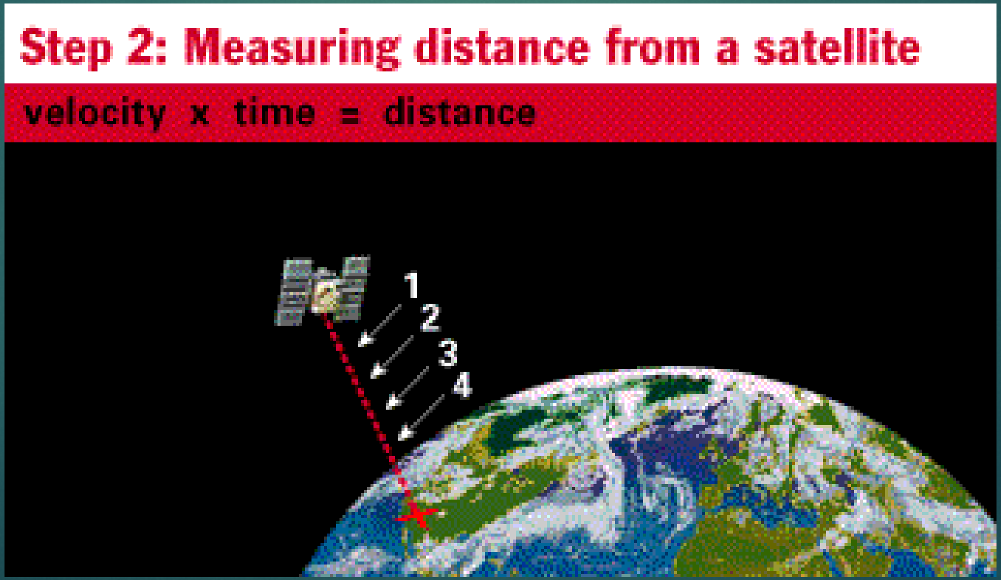

Step 1: Triangulating from Satellites
A third satellite puts us at either two points
One of these two points is the accurate location

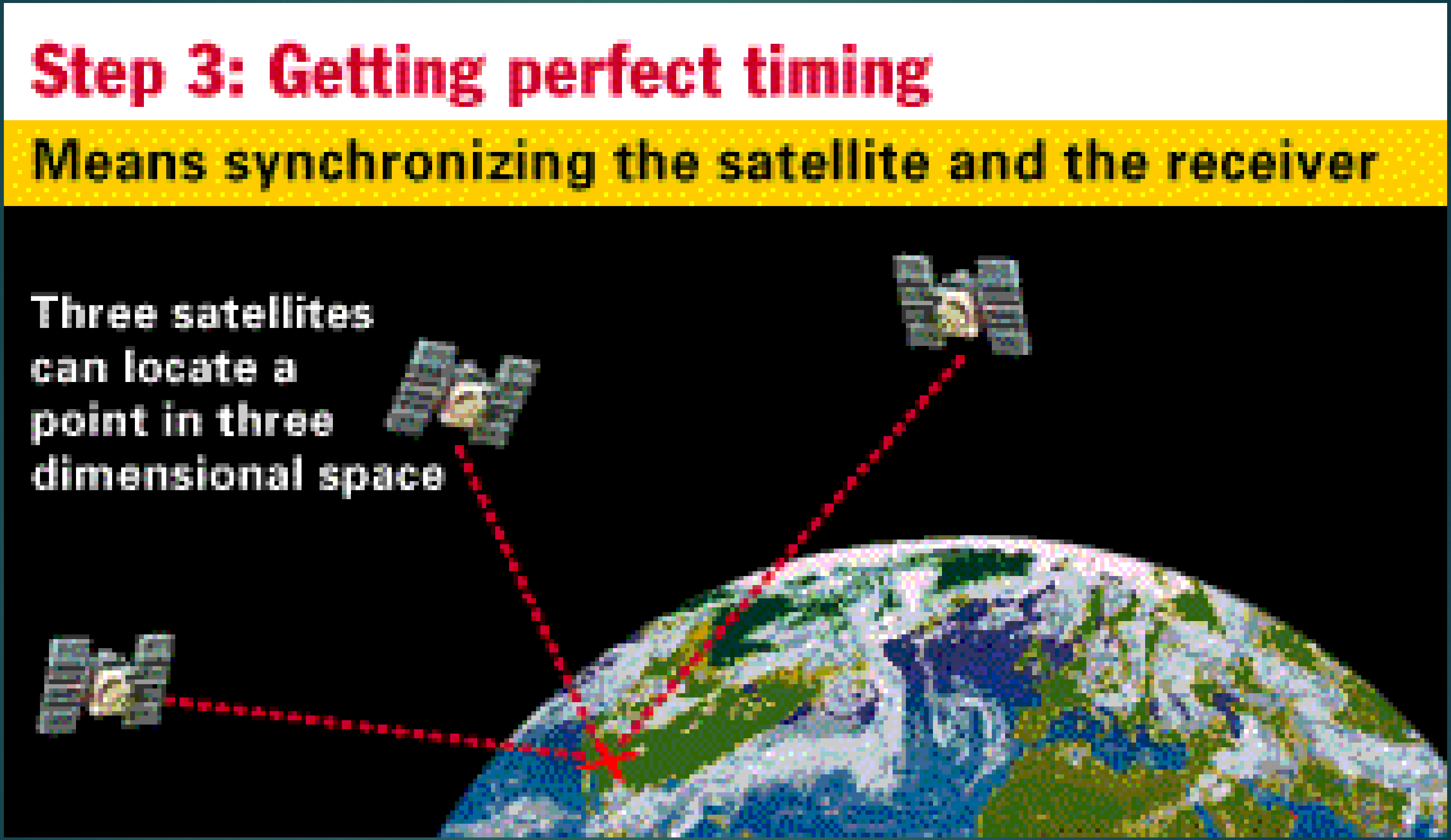
How does a GPS determine distance?

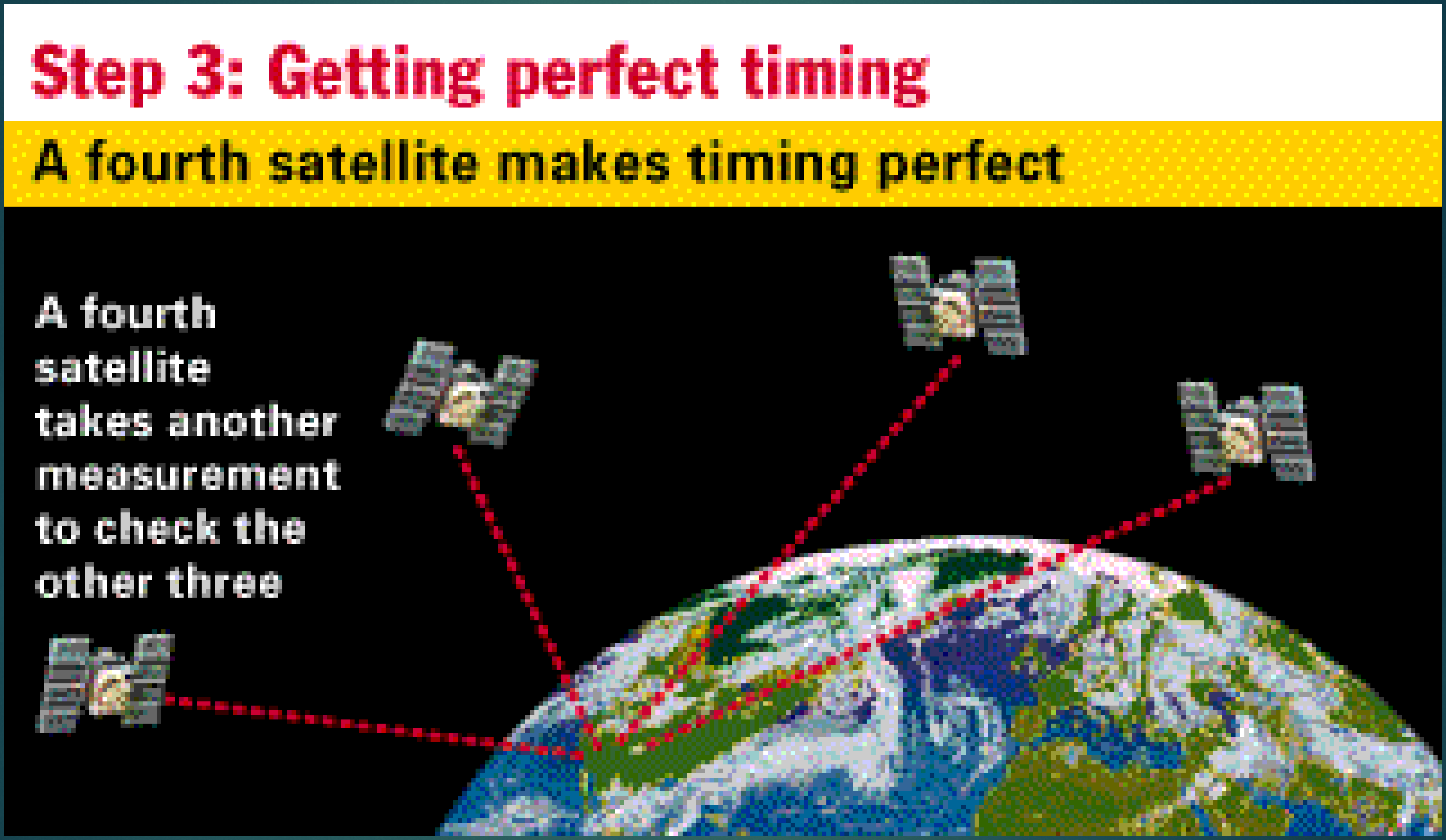
Satellite with atomic clock sends time stamped signal.

GPS receiver determines amount of time traveled.

Multiply time by the speed of light and get distance.




Step 3: Getting perfect timing
Means synchronizing the satellite and the receiver
Three satellites can locate a point in three dimensional space


Step 3: Getting perfect timing
A fourth satellite makes timing perfect
A fourth satellite takes another measurement to check the other three

The Main Uses of GPS

- **Locating** (Where am I?)
- **Navigating** (Where am I going?)
- **Tracking** (Where is my truck/package?)
- **Mapping** (Where is everything else?)

Is It Perfect?

- Selective Availability (error of 100 meters)
  - Turned off in May 2000 (error of 15 meters)
- Wide Area Augmentation System (WAAS)
  - Uses extra geo stationary satellites to improve data
  - Usually only special circumstance (error of 3 meters)