Introduction to GIS

Lecture 1

Aug. 24, 2006

What is GIS?

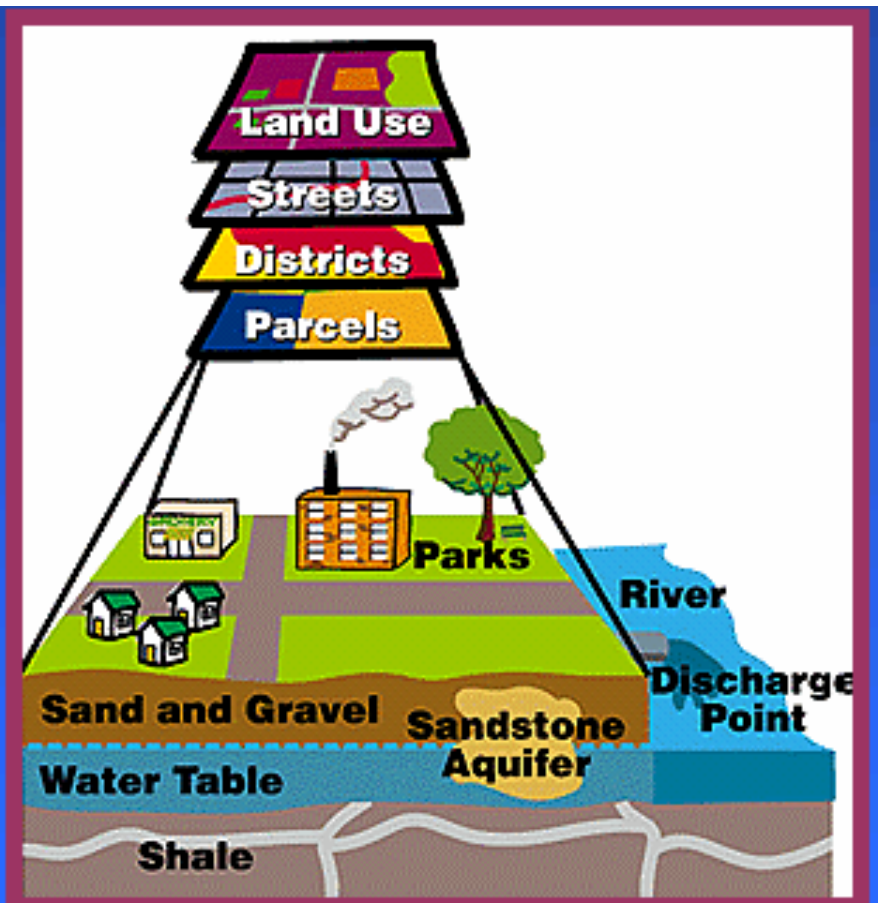
G stands for geographic, so we know that GIS has something to do with geography.

I stands for information, so we know that GIS has something to do with information, namely geographic information.

S stands for system, so we know that GIS is an integrated system of geography and information tied together.

- Most people agree that over 80% of the information related to government operations have a geographic component. Therefore, a system that integrates this information together is quite valuable. We shall see how a geographic information system tied geography and information together....

What is GIS ?



- *A computer system for*
  - *collecting,*
  - *storing,*
  - *manipulating,*
  - *analyzing,*
  - *displaying, and*
  - *querying*

  geographically related information.

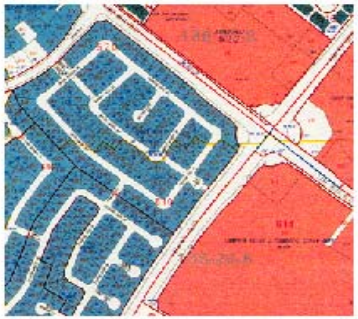
In general GIS cover 3 components

- Computer system
  - Hardware
    - Computer, plotter, printer, digitizer
  - Software and appropriate procedures
- Spatially referenced or geographic data
- People to carry out various management and analysis tasks

Well-designed GIS should provide

- Quick and easy access to large volumes of data
- The ability to:
  - Select detail by area or theme
  - Link or merge one dataset with another
  - Analyze spatial characteristics of data
  - Search for particular characteristics or features in an area
  - Update data quickly and cheaply
  - Model data and assess alternatives
- Output capabilities tailored to meet particular needs

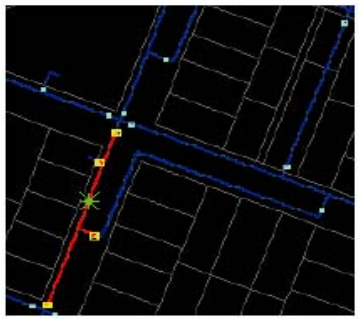
What can you do with ArcGIS?



A tax assessor's office produces land use maps for appraisers and planners.

An engineering department monitors the condition of roads and bridges and produces planning maps for natural disasters.

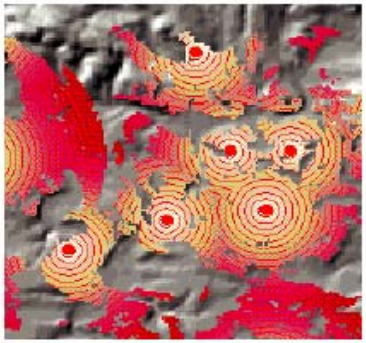
A water department finds the valves to isolate a ruptured water main.



A transit department produces maps of bicycle paths for commuters.

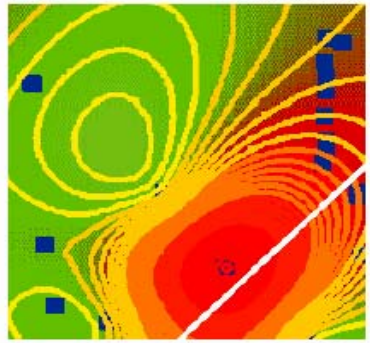
A police department studies crime patterns to intelligently deploy its personnel and to monitor the effectiveness of neighborhood watch programs.

A wastewater department prioritizes areas for repairs after an earthquake.

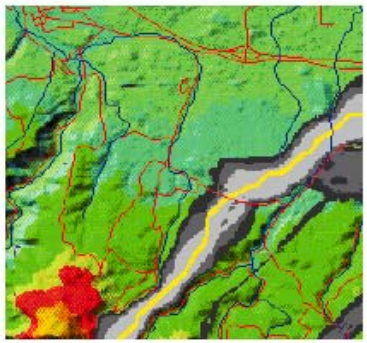


A telecommunication company studies the terrain to find locations for new cell phone antennae.

A hydrologist monitors water quality to protect public health.



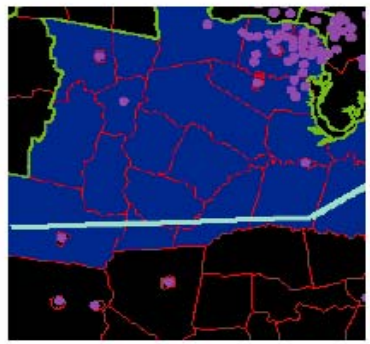
A pipeline company finds the least-cost path for a new pipeline.

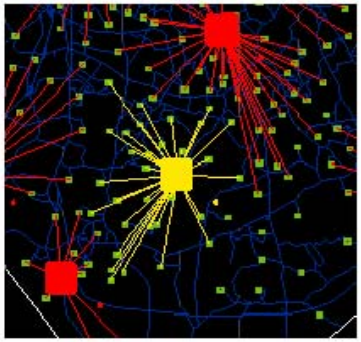


A biologist studies the impact of construction plans on a watershed.

An electric utility models its circuits to minimize power loss and to plan the placement of new devices.

A meteorologist issues warnings for counties in the path of a severe storm.

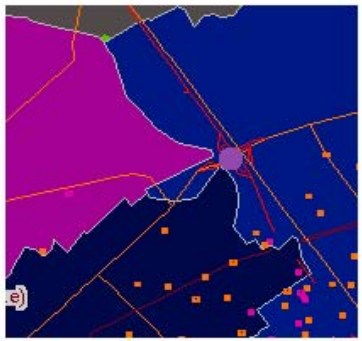


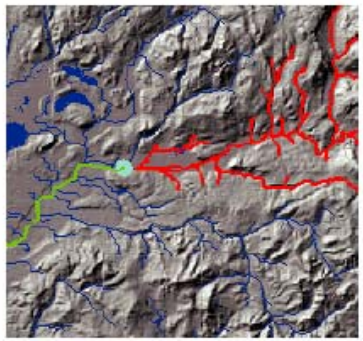


A business evaluates locations for new retail outlets by considering nearby concentrations of customers.

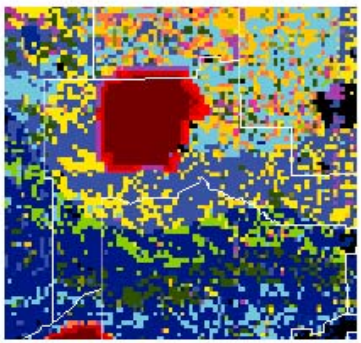
A police dispatcher finds the fastest route to an emergency.

An emergency management agency plans relief facilities by modeling demand and accessibility.



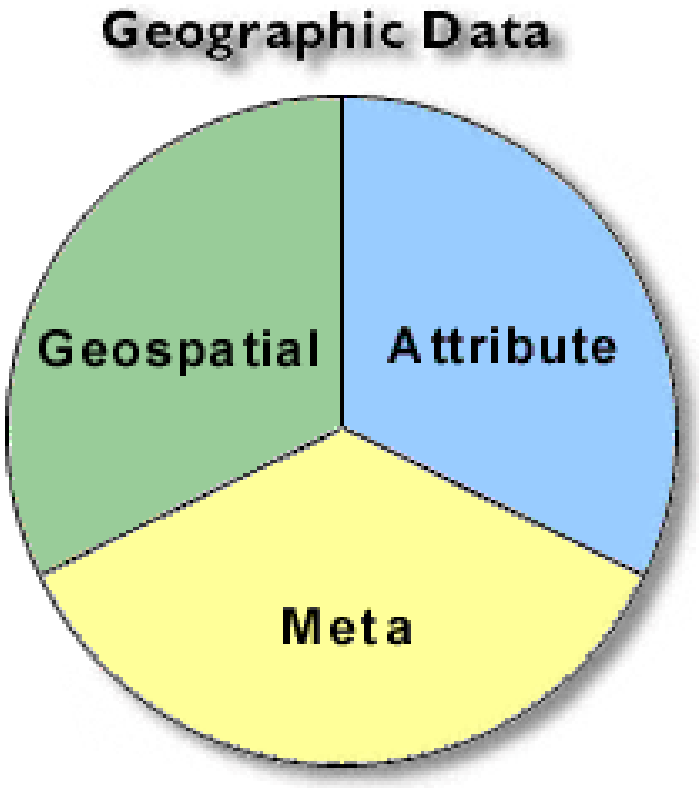


A water resource manager traces upstream to find the possible sources of a contaminant.



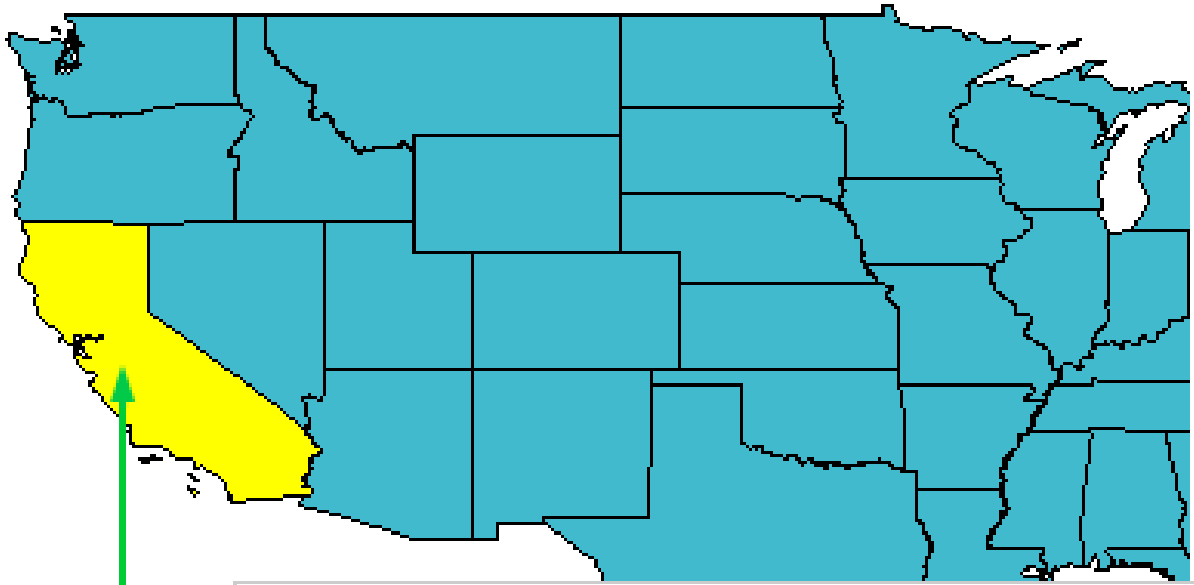
A fire fighting team predicts the spread of a forest fire using terrain and weather data.

Geographic Data



- Geospatial data tells you where it is and attribute data tells you what it is. Metadata describes both geospatial and attribute data.

In GIS, we call geographic data as GIS data or spatial data



Attributes of Lower48.shp

Shape	State Name	Abbreviation	Pop1990
Polygon	Connecticut	CT	3287116
Polygon	Rhode Island	RI	1003464
Polygon	New Jersey	NJ	7730188
Polygon	Indiana	IN	5544159
Polygon	Nevada	NV	1201833
Polygon	Utah	UT	1722850
Polygon	California	CA	29760021
Polygon	Ohio	OH	10847115
Polygon	Illinois	IL	11430602
Polygon	District of Columbia	DC	606900
Polygon	Delaware	DE	666168
Polygon	West Virginia	WV	1793477

Traditional method

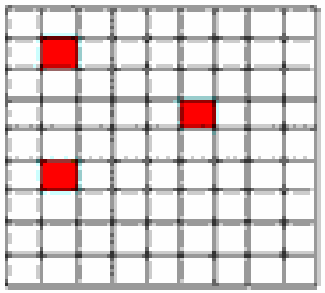
- To represent the geographic data is paper-based maps
  - Geology map
  - Topographic map
  - City street map (we still use it a lot)
  - ...

In GIS: new fashion

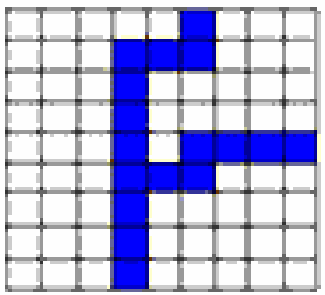
Raster

Vector

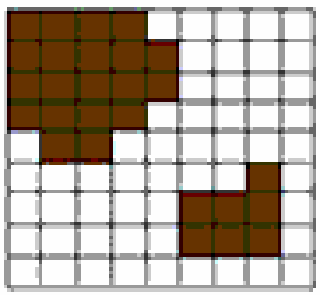
Points



Lines

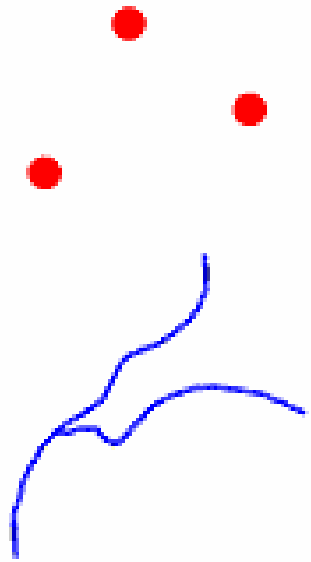


Areas



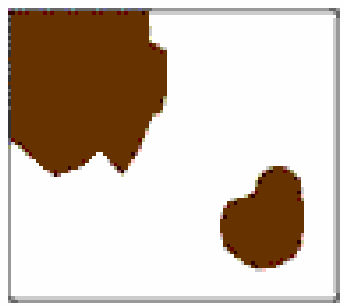
Raster:

• is a grid consisting of individual cells or pixels. Each cell holds a value (elevation, radiance, reflectance, rainfall, or land use type,…). the resolution of the data is the size on the ground by each cell.

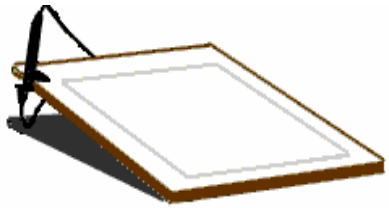


Vector:

• points, lines, and polygons

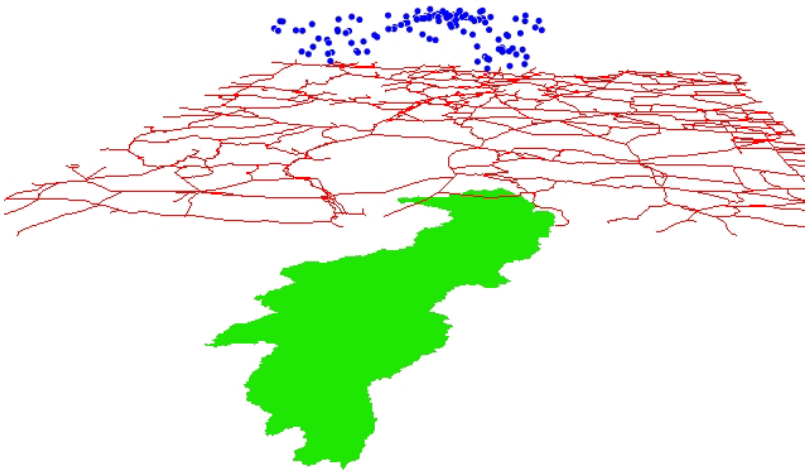


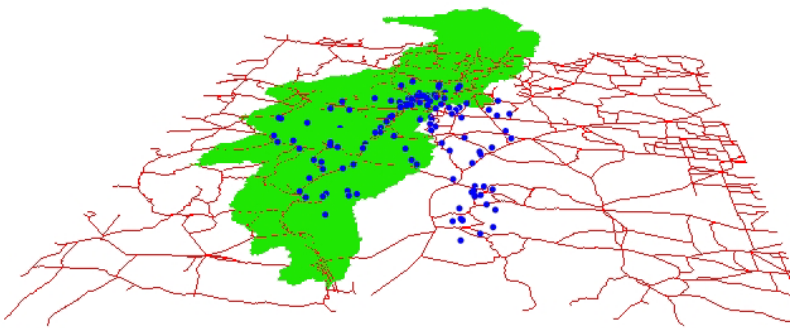
Ways for Collecting GIS Data

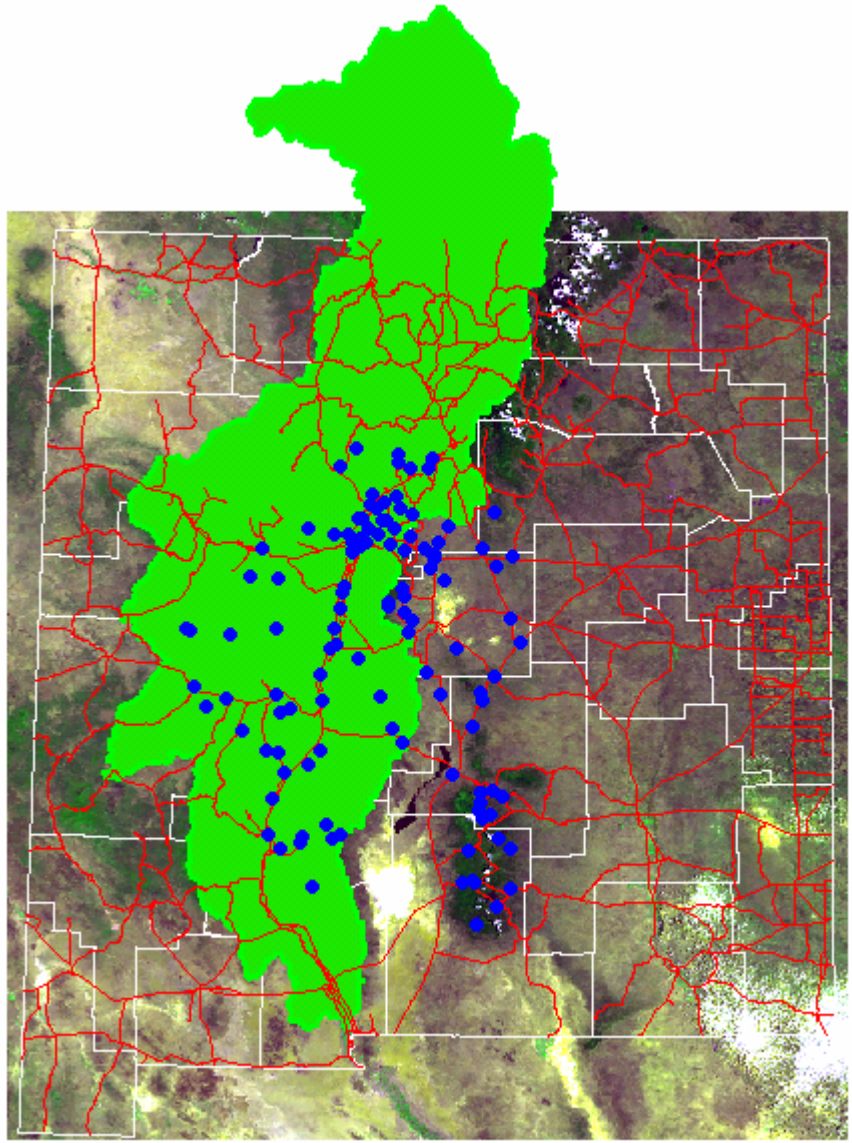


And many more such as
weather station observations
water meter readings,
sampler analysis results,
daily sale amounts
census results
.....

Power of GIS - integration







Why GIS ?

- Provides powerful tools for
  - data process, analysis, and visualization
  - data management and retrieval

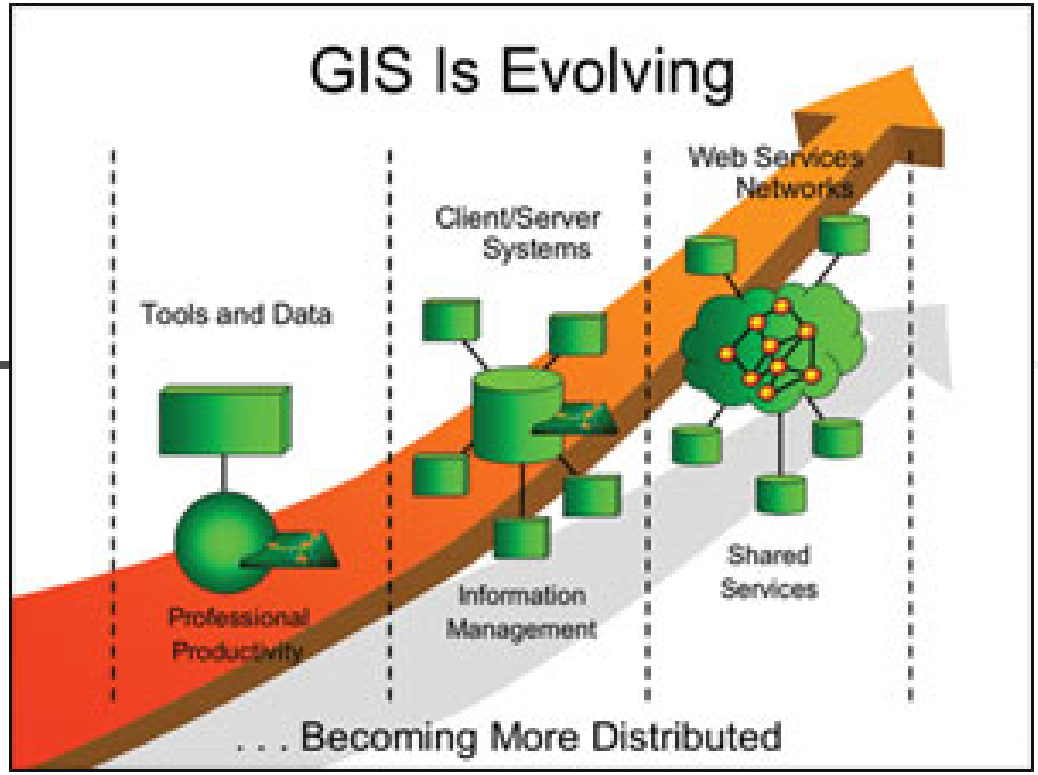
- One of the fastest growing high-tech career fields

GIS growing very fast

- 1981, 1st ESRI user conference only 18 people
- 2003, 23rd .... 12,000 people, the theme of the year is “serving our world with GIS”

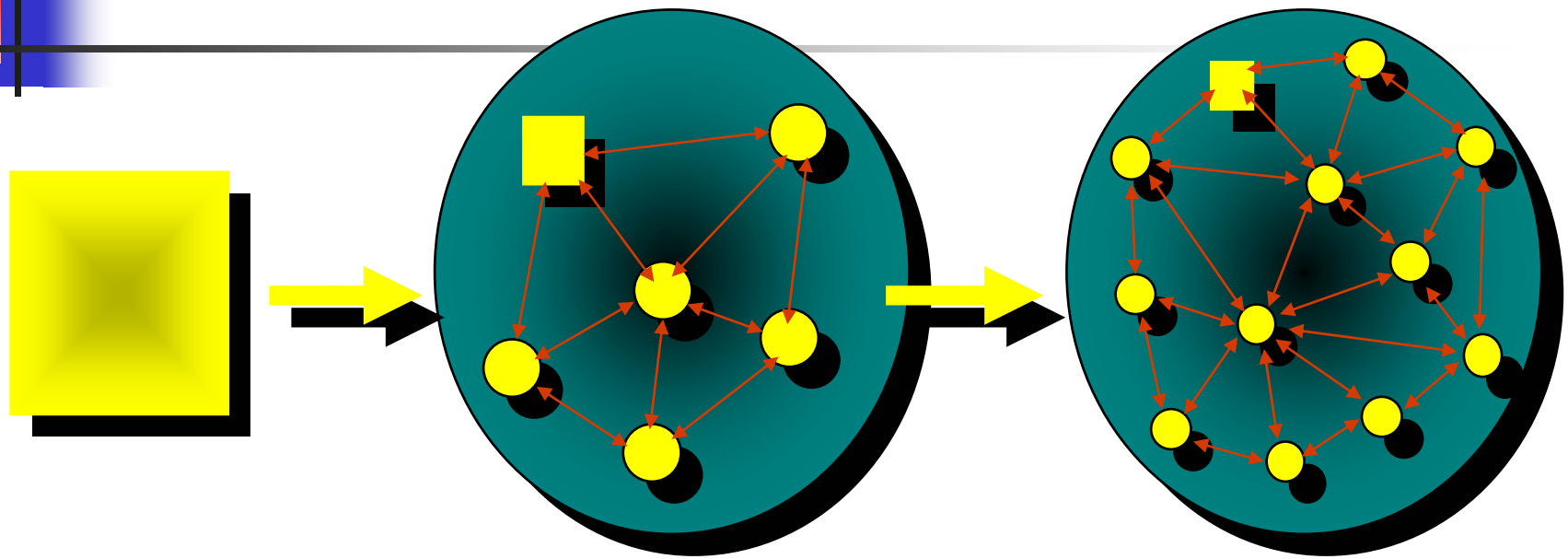
Historical Development of GIS

- "Pioneer" research period (late 1950's to early 1970's)-- advances in computer technology
- Gov't. Agency research and development (1970's to early '80's)
- Commercial development period (1980's to present)



Source: http://www.esri.com/news/arcnews/fall03articles/serving-our-world2of2.html

- desktop, which supports enhanced professional productivity;
- multipurpose and database systems with many clients accessing, updating, and using them; and
- distributed and shared Web services

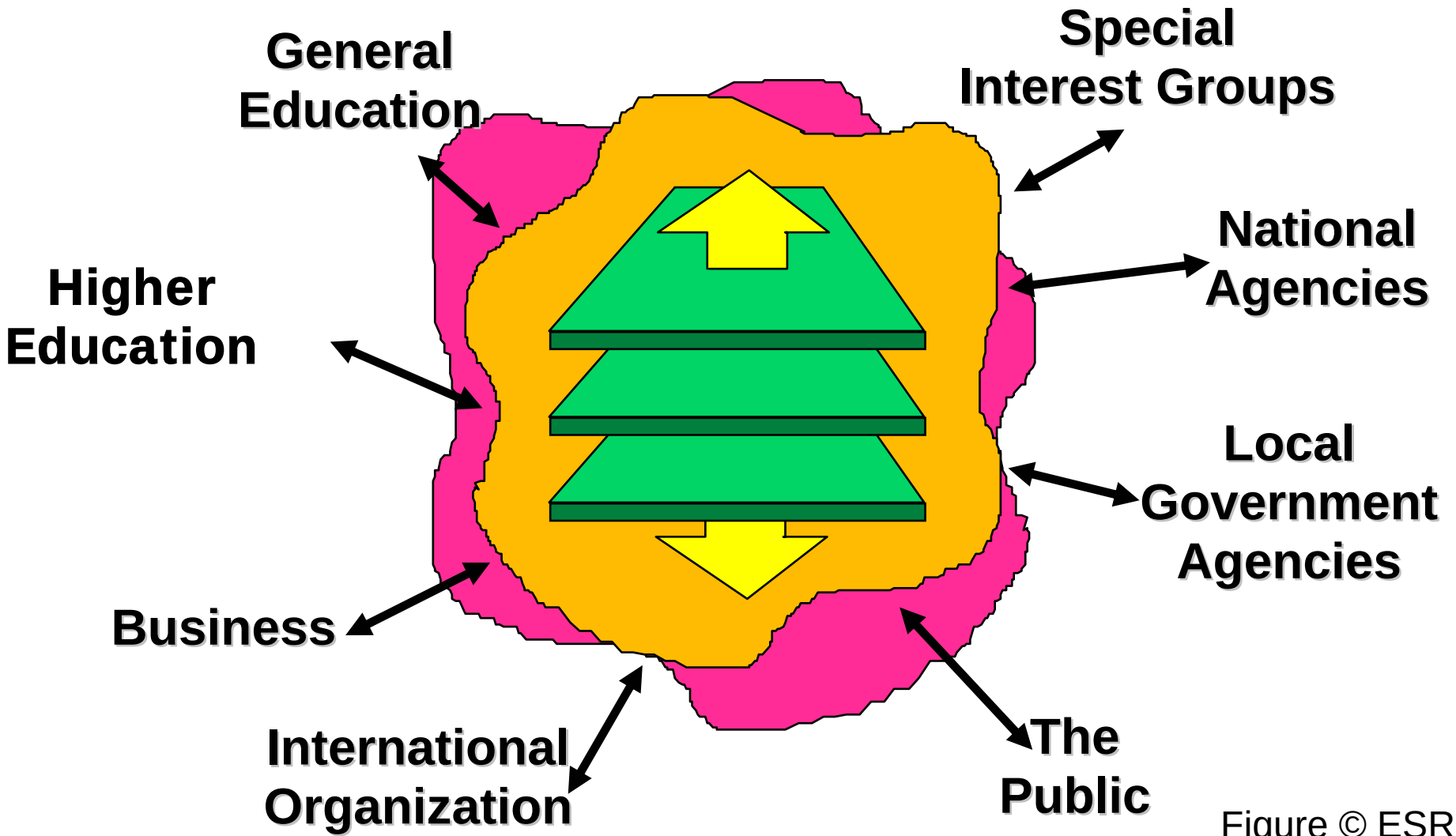


Stand Alone GIS

Networked GIS (Local)

Networked GIS (Global)

Geographic Information Will Be Increasingly Available and Interrelated



Product families of main GIS software providers

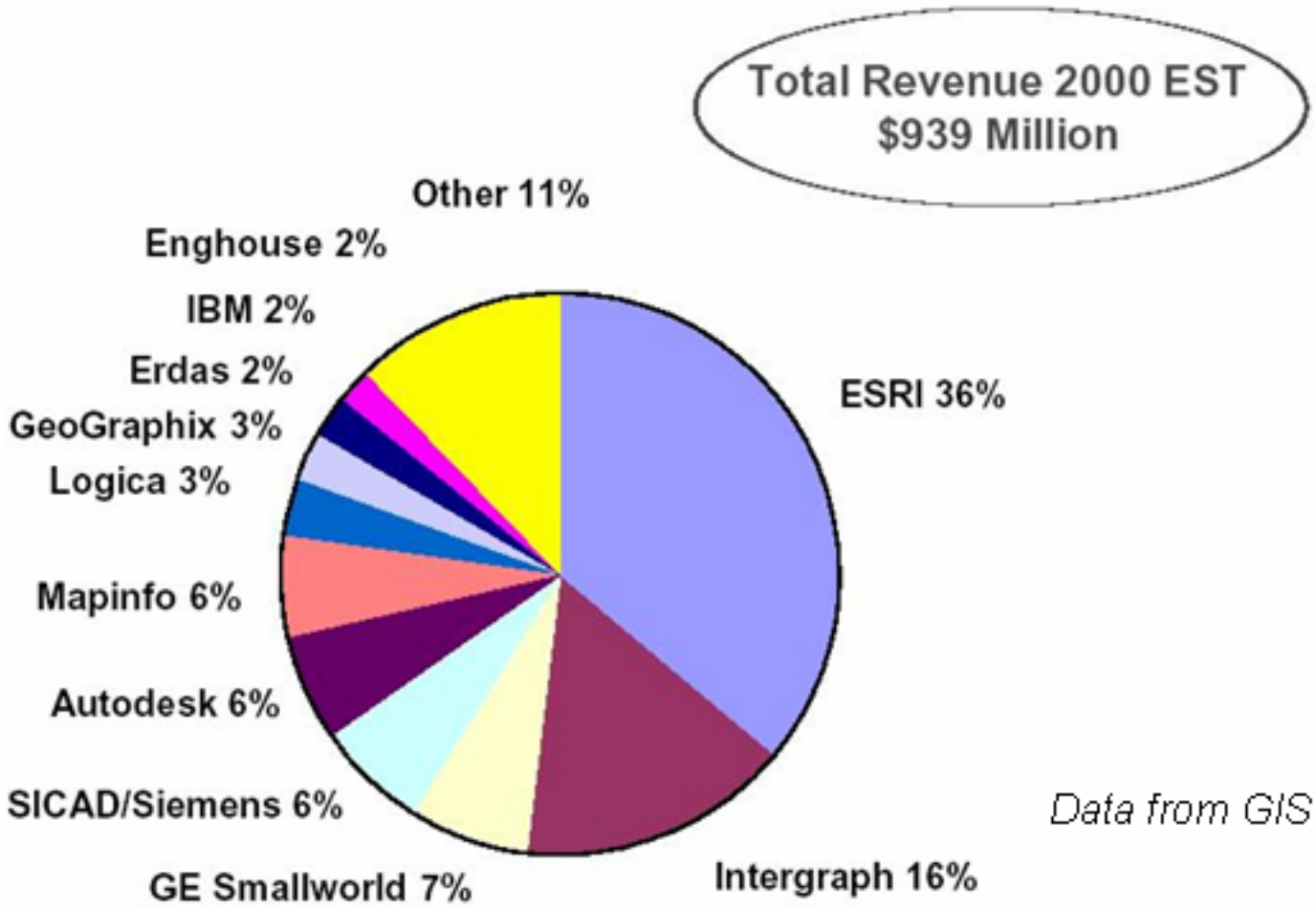
	Autodesk	ESRI	Intergraph	MapInfo	GE Smallwold
Professional	AutoCAD/World	ArcInfo	GeoMedia Pro	Mapinfo Professional	Smallworld GIS
Desktop	World	ArcView, ArcGIS	GeoMedia	MapInfo Professional	Spatial intelligence
Viewer	AutoCAD LT	ArcExplorer	GeoMedia Viewer	ProViewer	Custom
CAD	AutoCAD MAP	ArcCAD	*	*	Part of Smallworld GIS
Hand-held	OnSite	ArcPad	In development	MapXtend	Scount
Component	*	MapObjects	Part of GeoMedia	MapX, MapJ	Part of Smallworld GIS
DB server	Vision	ArcSDE	Uses Oracle Spatial	SpatialWare	Part of Smallworld GIS
Internet	MapGuide	ArcIMS	GeoMedia Web Map	MapXtreme and	Smallworld internet
			and Web Enterprise	MapXsite	application server

* Featured in several products

Modified from: p171 of Longley el al. 2001

GIS Market Share - 2000

2000 EST GIS Worldwide Core Business Software Only

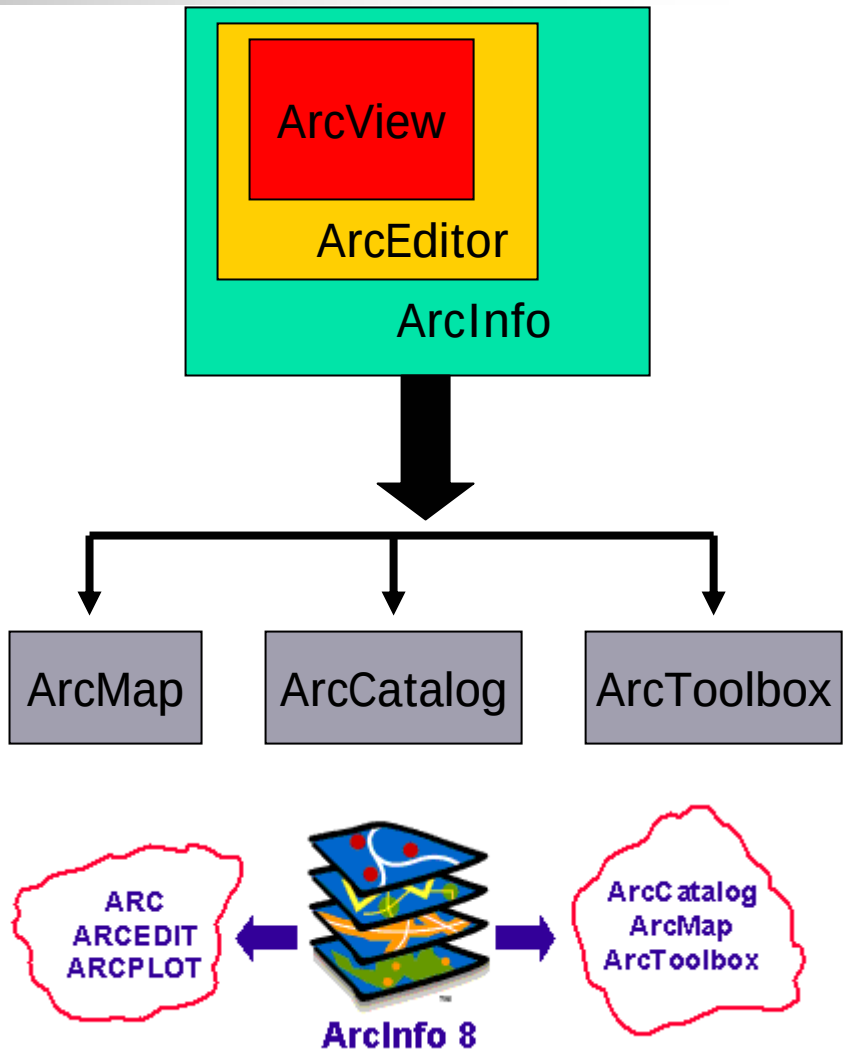


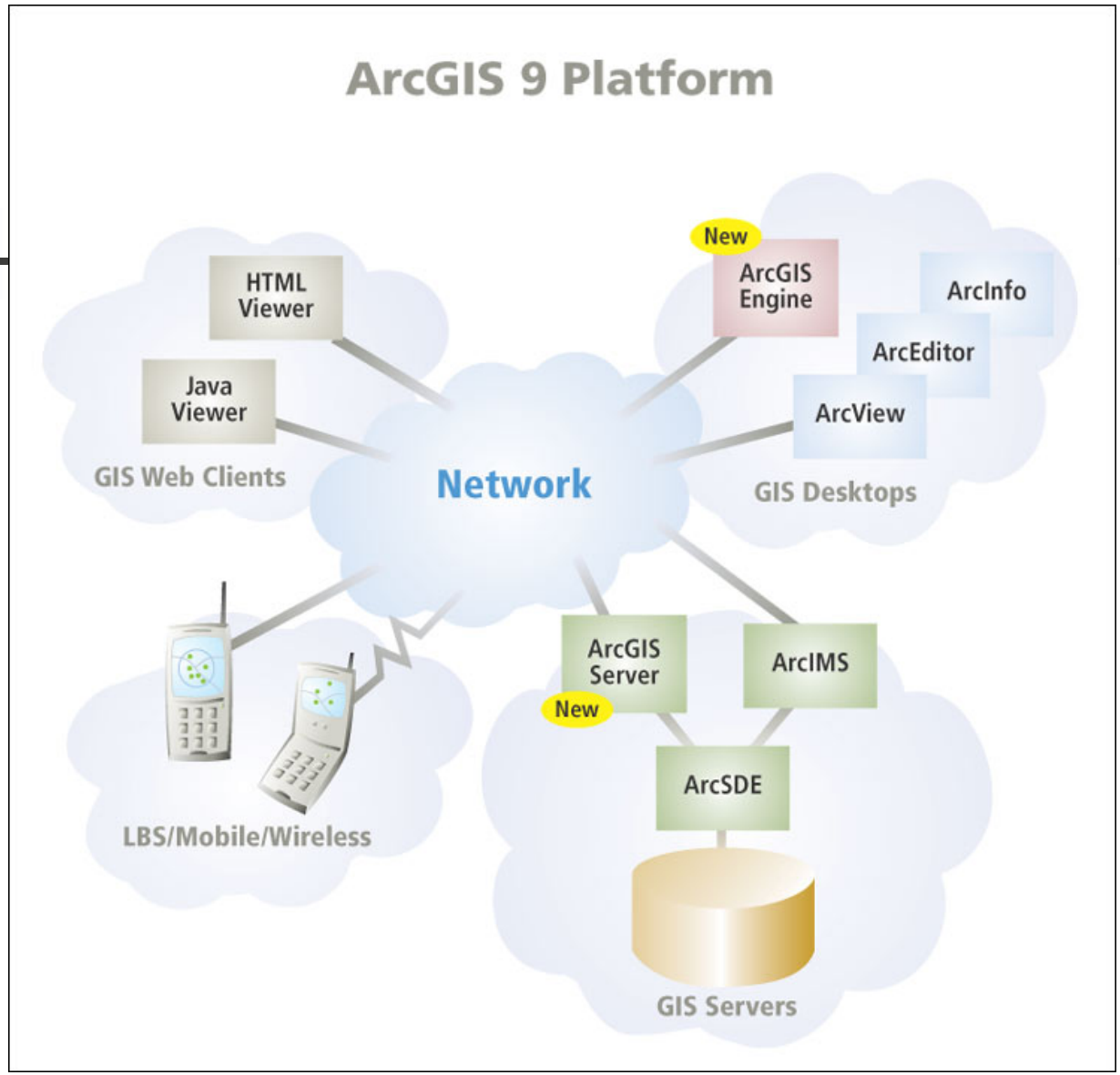
Data from GIS Monitor

Family of ArcGIS Desktop

- ArcView 8.x
- ArcEditor 8.x
- ArcInfo 8.x

1. These products have the same interface and share much of their functionality. ArcEditor does everything ArcView does and goes beyond it; ArcInfo does everything ArcEditor does and goes beyond it
2. ArcEditor can create and edit certain spatial data formats, but ArcView can not
3. ArcInfo can edit more spatial data formats, with a ArcInfo workstation together





Source: http://www.esri.com/news/arcnews/fall03articles/arcgis9-is-the.html

GIS Applications

- Agriculture
- Archaeology
- Business
- Environment
- Geology
- Health
- Hydrology
- Land Information System
- Military
- Natural Hazard Management
- Natural Resource Management
- Urban Planning
- Many more ……

http://www.gisdevelopment.net/application/index.htm

Main References

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- GIS development, http://www.gisdevelopment.net/application/index.htm
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- Arthur Lembo, http://www.css.cornell.edu/courses/420/css420.html
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