

7. GIS Software

Geographic Information Systems and Science

SECOND EDITION

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Overview

- Evolution of GIS software
- Architecture of GIS software
- Building GIS software systems
- Types of software
- Example products
- GIS software use



GIS Software

- The geoprocessing engines of GIS
- Major functions
 - Collect, store, manage, query, analyze and present
- Key terms
 - **Program** – collections of instructions to manipulate data
 - **Package** – integrated collection of programs
 - **Component** – self-contained, reusable software building blocks

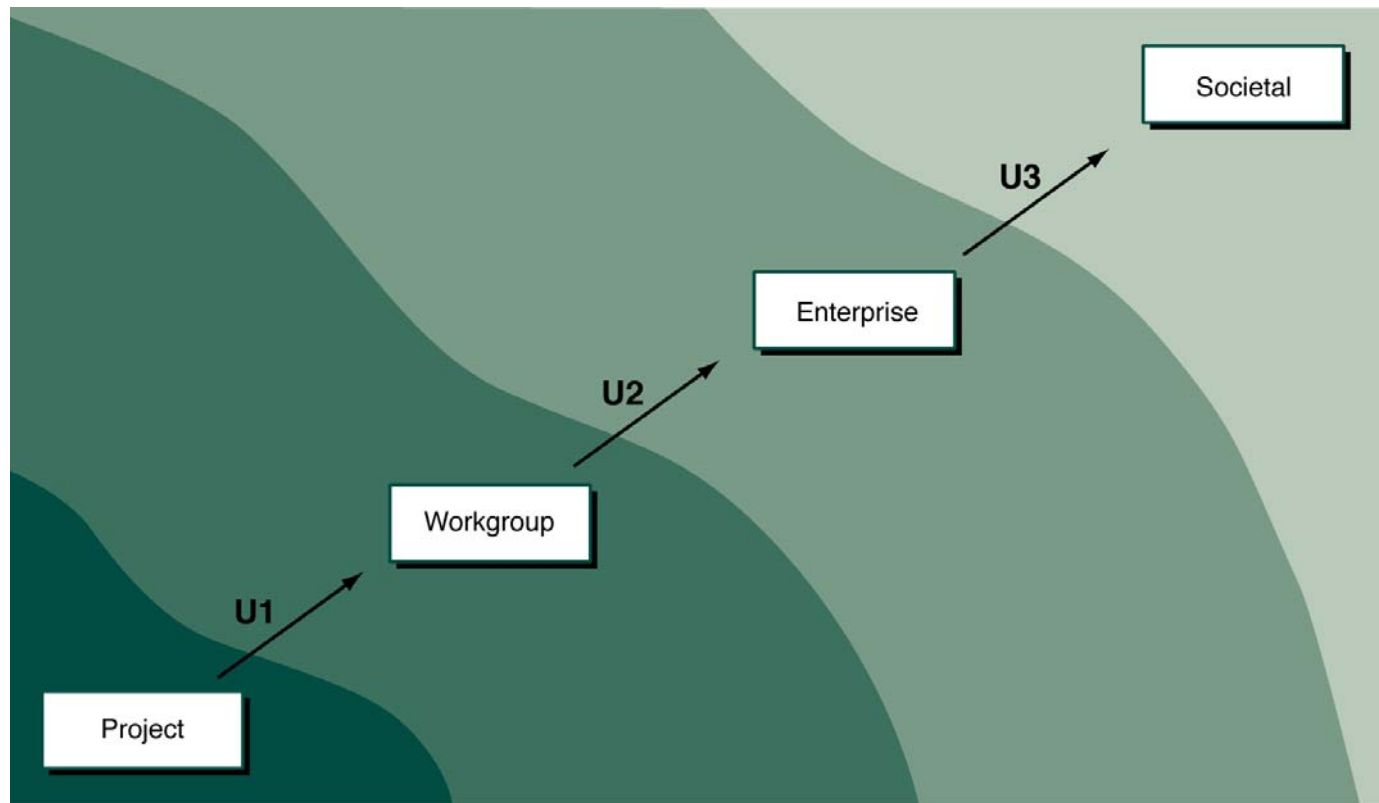


Evolution of GIS Software

- Sub-routine libraries (60s/70s)
 - ❏ Libraries of small programs (sub-routines)
 - ❏ Required advanced programming skills
- Tool box with CLI (70s/80s)
 - ❏ Basic package with Command Line Interface
 - ❏ Required advanced technical skills
- Task-oriented system (90s/00s)
 - ❏ Graphical User Interface (GUI)
 - ❏ Customization capabilities to create specific-purpose applications

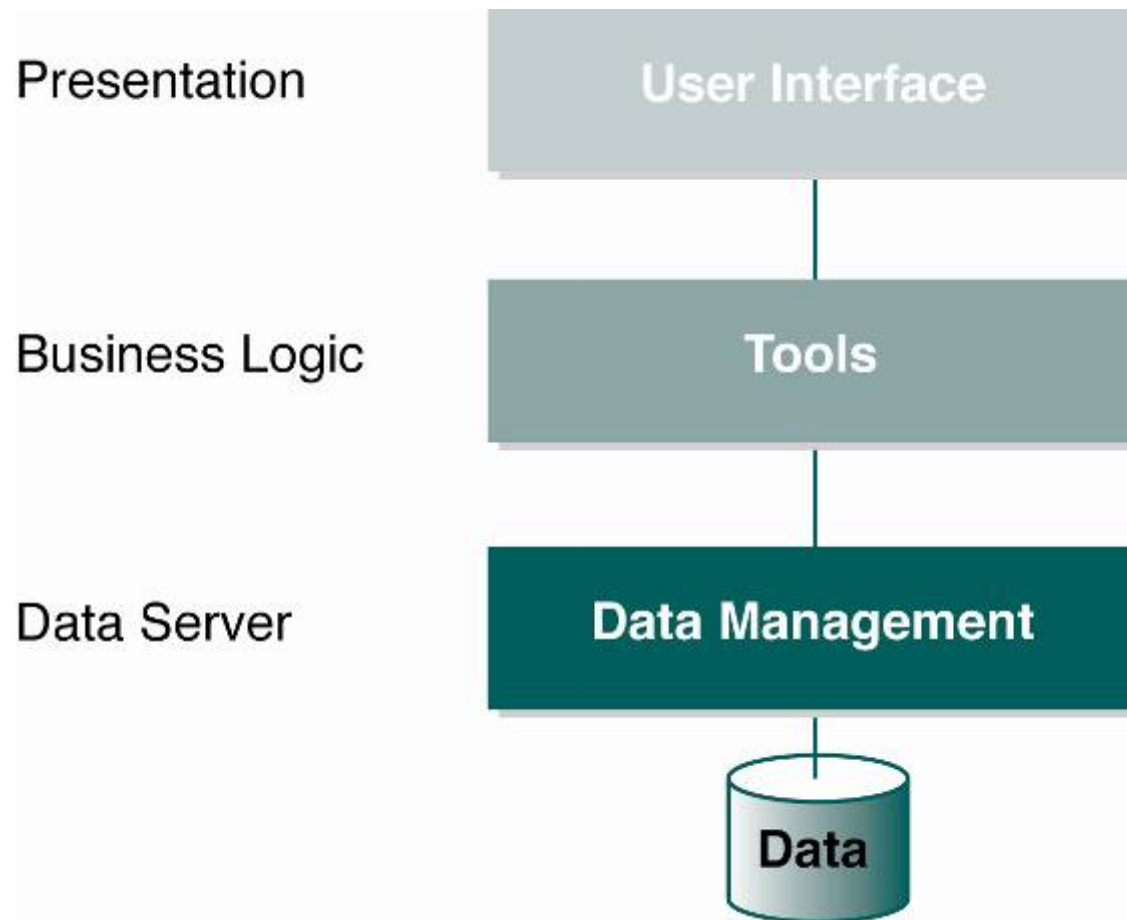


Types of GIS Implementation





Three-tier Architecture





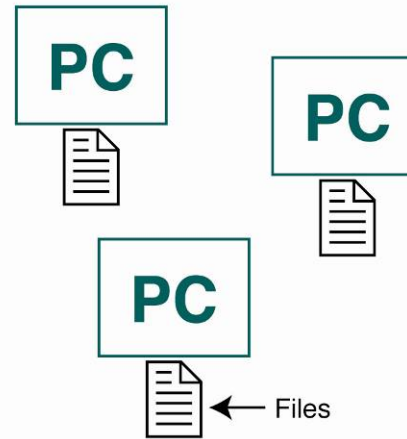
GS Software Architectures

- Desktop
- Client-server
- Centralized
 - Desktop/Citrix
 - Server

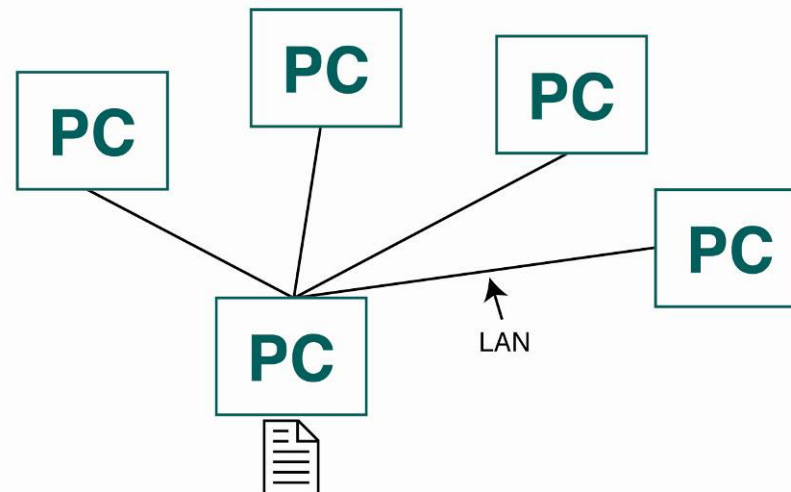


(A) Stand-alone desktop GIS on PCs each with own files

Desktop GIS

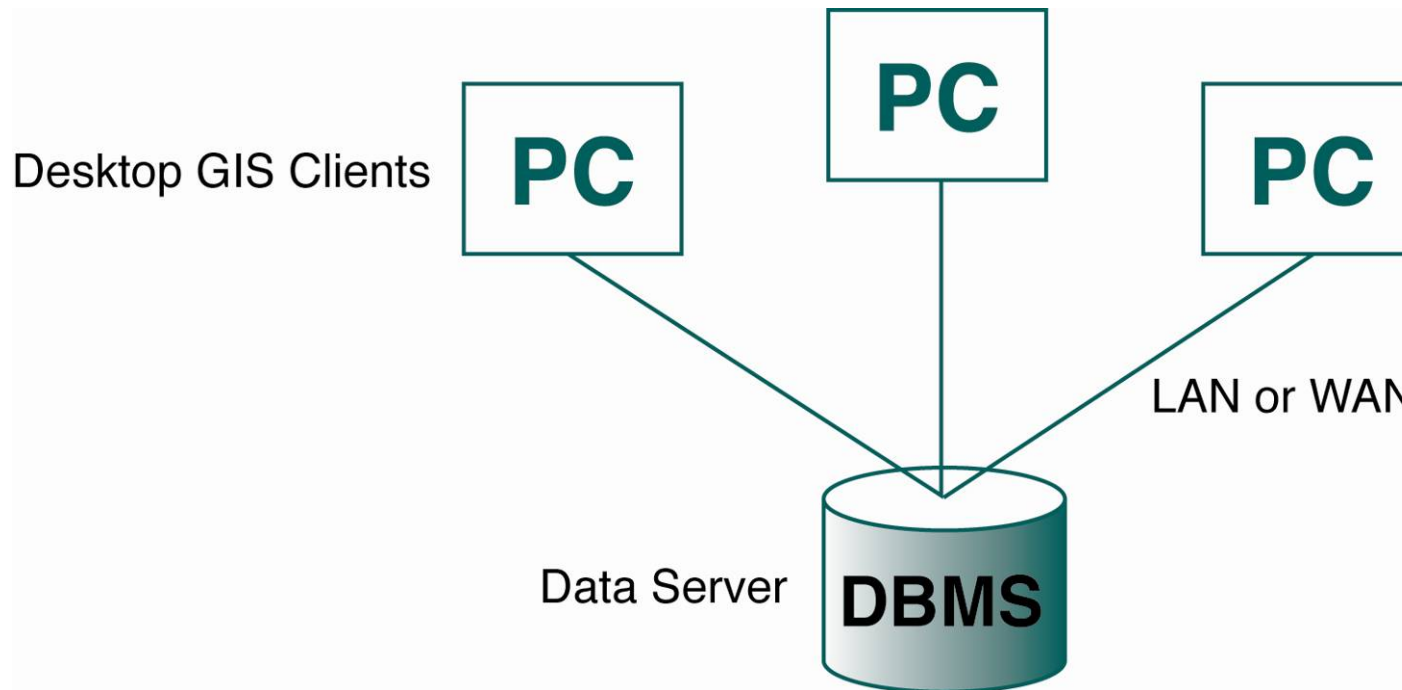


(B) Desktop GIS on PCs sharing files on a PC file server over a LAN



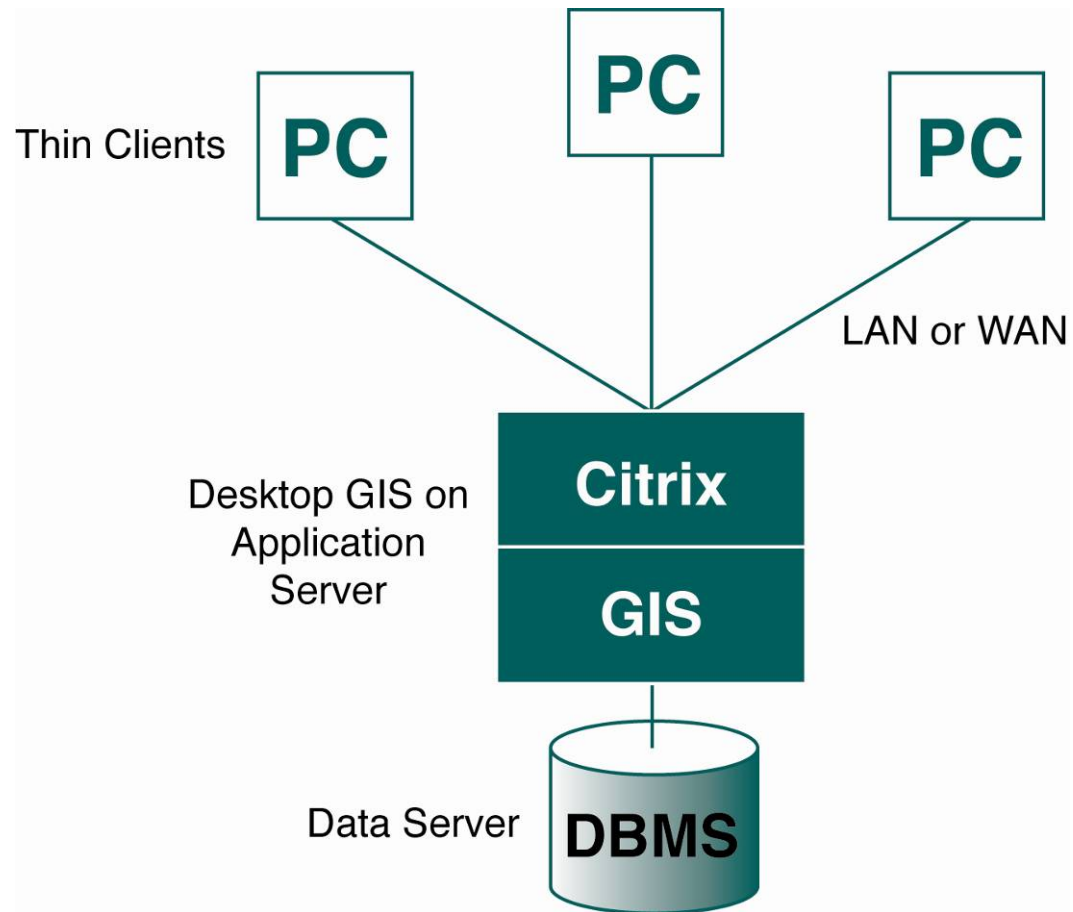


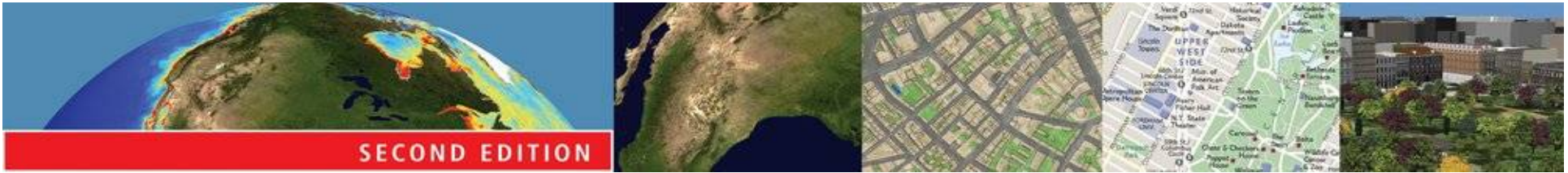
Client-server GIS



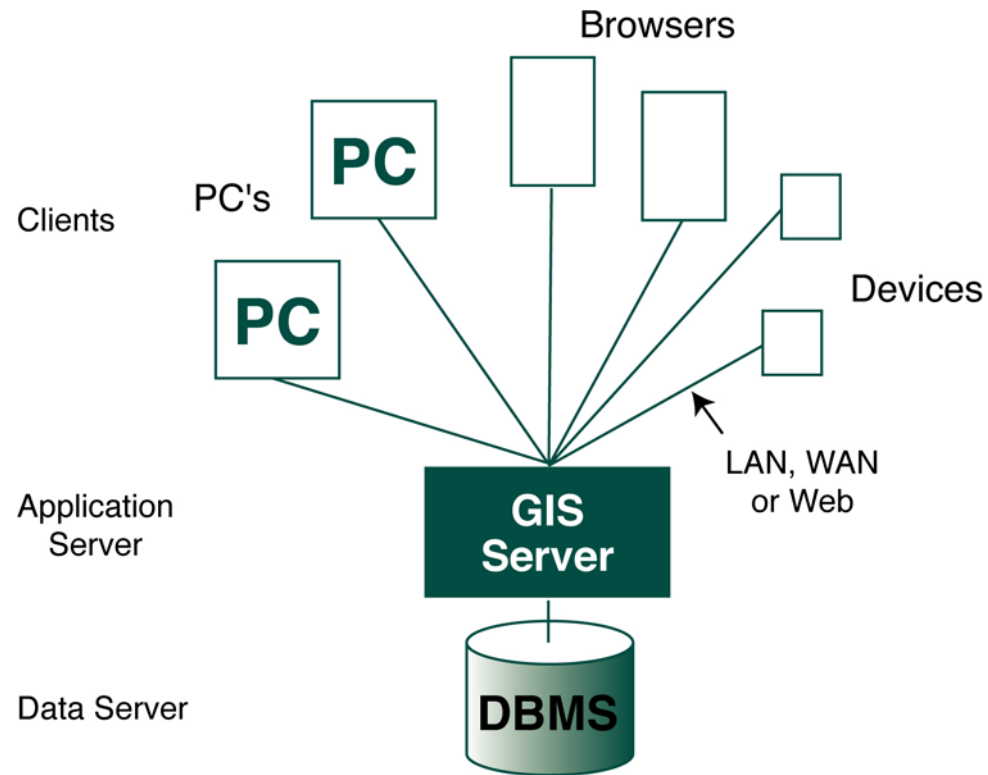


Centralized Desktop GIS





Centralized Server GIS





CustomIndia.mxd - ArcMap - ArcInfo

File Edit View Insert Selection Tools Window Help

Scale: 1:10,944,832 Layer: districts Labeling

Layers

- indiatowns
 - TOT_POP
 - 0 - 86112
 - 86113 - 294427
 - 294428 - 666279
 - 666280 - 1140605
 - 1140606 - 2493987
 - 2493988 - 5421985
 - 5421986 - 12596243
- indrailmain
- nathighs
- districts
 - TOT_LIT / AREA
 - 0.000000043 - 0.0001052
 - 0.0001053 - 0.0002396
 - 0.0002397 - 0.0005173
 - 0.0005174 - 0.001099
 - 0.001100 - 0.002474
 - 0.002475 - 0.006074
 - 0.006075 - 0.02277
- india1.img
- World 150m (india)

Microsoft Visual Basic - CustomIndia.mxd

File Edit View Insert Format Debug Run Tools Add-Ins Window Help

Project - Project

Object Browser

Classes

- <globals>
- AbridgedMolodensky
- ACAcetateLayer
- ACCalloutMarkerSym
- acCapType
- Accelerator
- AcceleratorTable
- AccessWorkspaceF
- ACConnector
- ACFeatureLayer
- acFillType
- acFontStyle
- acGeometryType
- ACGradientFillSymb
- acGradientFillType
- ACGroupRenderer
- ACHashLineStyle
- acHashLineStyle
- acHTextAlignment
- ACImageLayer
- acIndexStatus
- acJoinType
- acLabelMode
- acLabelWeight
- acLineLabelPosition
- acLineType

Members of

- Abs
- acAILL
- acAIRC
- acAIIU
- acBac
- acBDI
- acBDI
- acBev
- acBoli
- acBott
- acButt
- acCer
- acCirc
- acDas
- acDas
- acDia
- acDot
- acCro
- acDar
- acDas
- acDas
- acExa
- acFDI
- acFDI

Properties - MultiPage1

MultiPage MultiPage

Alphabetic Categorized

Style 0 - fmTab:

TabFixedHe 0

TabFixedWf 0

TabIndex 0

TabOriental 0 - fmTab:

TabStop True

Tag

Top 54

Value 0

CustomIndia.mxd - This Document (Code)

(General) AddShapeFile

```

Public Sub AddShapeFile()
    Dim pWorkspaceFactory As IWorkspaceFactory
    Dim pFeatureWorkspace As IFeatureWorkspace
    Dim pFeatureLayer As IFeatureLayer
    Dim pMxDocument As IMxDocument
    Dim pMap As IMap

    'Create a new ShapefileWorkspaceFactory object and
    Set pWorkspaceFactory = New ShapefileWorkspaceFact
    Set pFeatureWorkspace = pWorkspaceFactory.OpenFrom
    'Create a new FeatureLayer and assign a shapefile
    Set pFeatureLayer = New FeatureLayer
  
```

CustomIndia.mxd - UserForm1 (UserForm)

UserForm1

Select A File

Page1 Page2

OptionButton1

OptionButton2

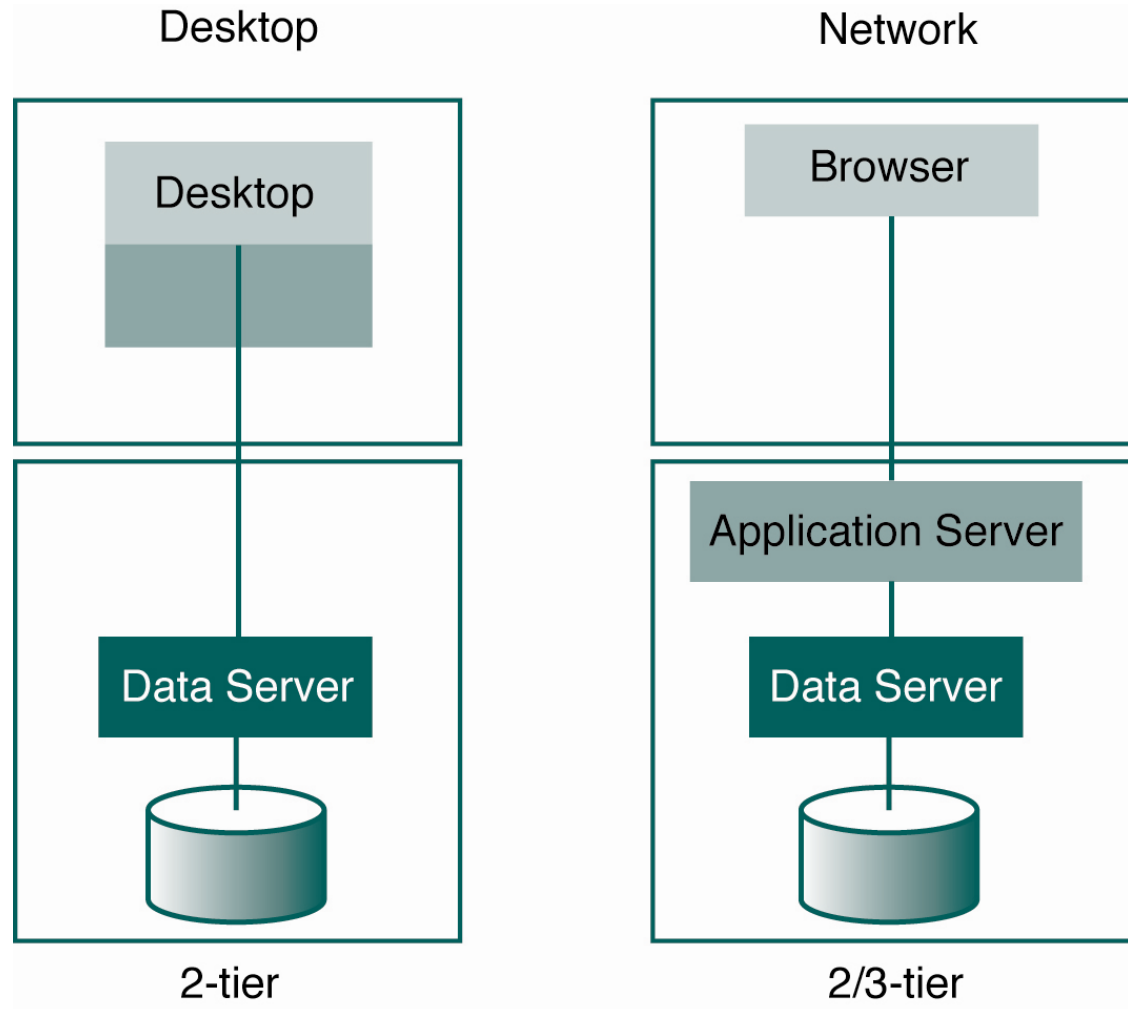
Display Source Selection

Drawing Arial 10 B I U

71°17'54.06"E 10°19'16.59"N



Desktop and Network GIS





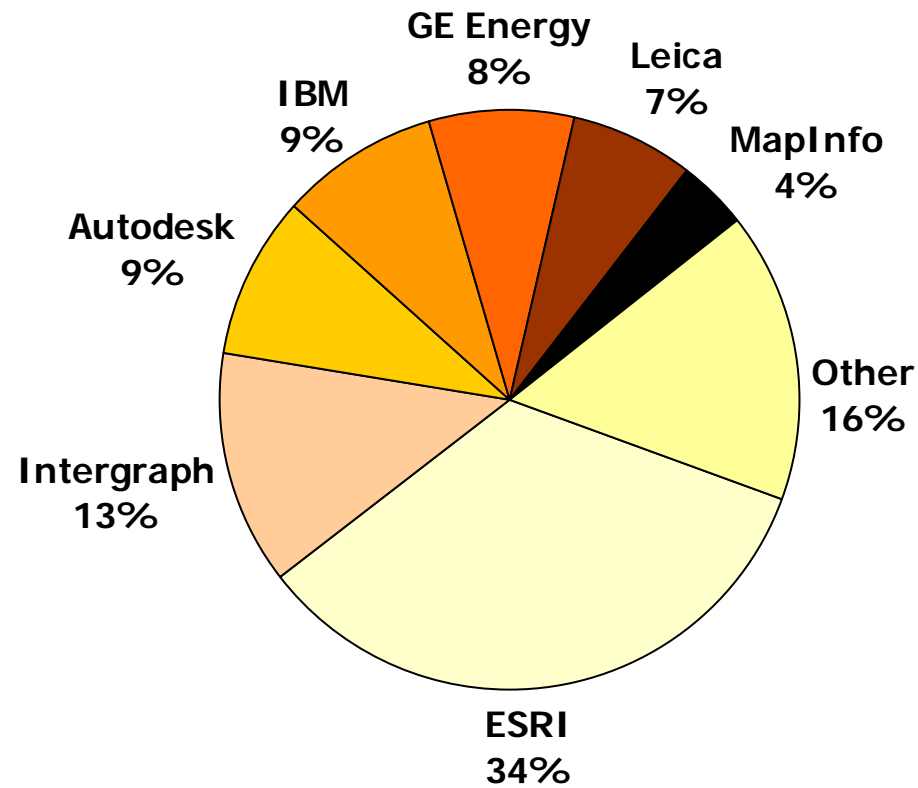
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Desktop and Internet GIS

Feature	Desktop	Network
Client Size	Thick	Thin
Client platform	Windows	Browser
Server size	Thin/thick	Thick
Server platform	Windows/Unix/ Linux	Windows/Unix/ Linux
Network	LAN/WAN	Internet



Daratech Market Share 2003





Desktop GIS

Data exploitation

- Data access
- Query
- Spatial Analysis
- Simple editing

- Visualization
- Mapping
- Customization
- \$1500

Figure 7.11 GeoMedia

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The screenshot displays the GeoMedia Professional interface for the file 'USSampleData.gws'. The main window is titled 'DataWindow2' and contains a table titled 'Query - Cities of California'. The table lists various cities in California with their respective IDs, names, populations (POP), and other attributes (WHPOP, BI). Major cities like Sacramento, San Francisco, Oakland, and San Jose are highlighted on the map. The interface includes a menu bar (File, Edit, View, Insert, Tools, Analysis, Warehouse, Data, Window, Help), a toolbar with various GIS tools, and a legend in the bottom-left corner. The legend identifies symbols for 'Query - Cities of Califor' (green dots), 'Attribute Query of State' (blue square), 'Labels of Major Cities' (white square), 'State Name Labels' (black square), 'Highway Marker Numbe' (red square), and 'Major Cities' (black circle). The status bar at the bottom shows coordinates '-124:22:01.196, 38:08:55.808' and a scale of '1:1,405,746'.

ID	CITY_NAME	POP	WHPOP	BI
7	AVENAL, CA	9770	4767	1826
14	AZUSA, CA	41333	31388	992
21	BAKERSFIELD, CA	174820	124352	13035
22	BALDWIN PARK, CA	69330	42359	2614
28	BANNING, CA	20570	14124	1893
37	BARSTOW, CA	21472	15536	1910
68	ADELANTO, CA	8517	6231	907
71	AGOURA HILLS, CA	20390	18490	308
98	ALHAMBRA, CA	82106	33850	1462
110	ALPINE, CA	9895	8853	121
113	ALTA SIERRA, CA	5709	5540	13
135	ANAHEIM, CA	266406	196822	5905
138	ANDERSON, CA	8299	7914	29
152	ANTIOCH, CA	62195	53376	1668



STREETMAP USA.MXD - ArcMap - ArcInfo

File Edit View Insert Selection Tools Window Help

1:386,785 Layer: Large Cities (National) Labeling

StreetMap USA Data

- StreetMap USA
 - Basemap Layers
 - Cities (Points)
 - Large Cities (National)
 - Over 250,000
 - Major Cities (State)
 - State Capital
 - Major City
 - Landmarks (Points)
 - Natural Landmarks
 - Cultural Landmarks 1
 - Cultural Landmarks 2
 - Schools
 - Streets and Highways
 - Freeway System (National)
 - Freeway System (State)
 - Major Highways (Regional)
 - Limited Access
 - Highway
 - Major Road
 - Local Road
 - Minor Road
 - Other Road
 - Ramp
 - Ferry
 - Pedestrian Way
 - Minor Highways (Regional)
 - Streets (Local)
 - Limited Access
 - Highway
 - Major Road
 - Local Road
 - Minor Road
 - Other Road
 - Ramp
 - Ferry
 - Pedestrian Way
 - Streets (Detailed)
 - Railroads
 - Railroads (Regional)
 - Major Railroad Lines
 - Railroads (Local)
 - Airports
 - Runways (Regional)
 - Airports (Regional)
 - Airports (Local)
 - Landing Fields (Detailed)
 - Water
 - Rivers
 - Lakes
 - Major Lakes (National)

Selected Attributes of Airports (Regional)

ObjectID	NAME	FCC	LOC_ID	USE	OWNER
179	Heber City Muni - Russ Mcdonal	D58	36U	PU	Heber City
1979	Carbon County	D58	PUC	PU	Carbon County
1995	Provo Muni	D58	PVU	PU	City Of Provo
2146	Salt Lake City Intl	D58	SLC	PU	Salt Lake City
2620		D58	36U	PU	Heber City

Record: 0 | Show: All Selected | Records (8 out of 4917 Selected.)

Airports Elevations

Airports Elevations

110°46'47.48"W 40°14'26.92"N



Autodesk MapGuide Sample World Map - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address: http://mapper/mapguide6.3/sample_world/Sample_World.Mwf

autodesk

- World Cities
 - National Capitals
 - Major Cities by Pop.
 - 0 - 500000
 - 500000 - 1000000
 - 1000000 - 2000000
 - 2000000 - 4000000
 - 4000000 - 8000000
 - 8000000 - 16000000
 - 16000000 +
 - All Others
- World Countries
 - Land Area (km²)
 - Population Density
 - 0 - 50
 - 50 - 100
 - 100 - 150
 - 150 - 200
 - 200 - 250
 - 250 - 300
 - 300 - 350
 - 350 - 400
 - 400 - 450
 - 450 +
 - World DEM

Map Context Menu:

- Pan
- Reload
- Print
- Copy
- Zoom
- Bookmarks
 - Add Bookmark...
 - Delete Bookmarks...
 - 1 Gulf of Mexico
 - 2 Alaska
 - 3 Africa
 - 4 Europe
- Select
- View
- Help

Map Labels: Oslo, Norway; Helsinki, Finland; Tallinn, Estonia; Riga, Latvia; Vilnius, Lithuania; Berlin, Germany; Warsaw, Poland; Praha, Czech Repub; Vienna, Austria; Budapest, Hungary; Bern, Switzerland; Zagreb, Croatia; Beograd, Serbia; Sarajevo, Bosnia Herz; Sofia, Bulgaria; Roma, Italy; Tirane, Albania; Madrid, Spain; Lisbon, Portugal; Rabat, Morocco; Algiers, Algeria; Tunis, Tunisia; Tripoli, Libya; Athens, Greece.

0 feature(s) selected | 1 : 25,062,704 | 2,975 x 2,402 (mi) | Local intranet



Server GIS

- Centralized GIS
 - ▣ Deploy multi-user desktop
 - ▣ Internet GIS
 - ▣ Enterprise GIS Servers
- Manage/deploy centrally
- Low cost of ownership
- Good for data exploitation



Hand-held

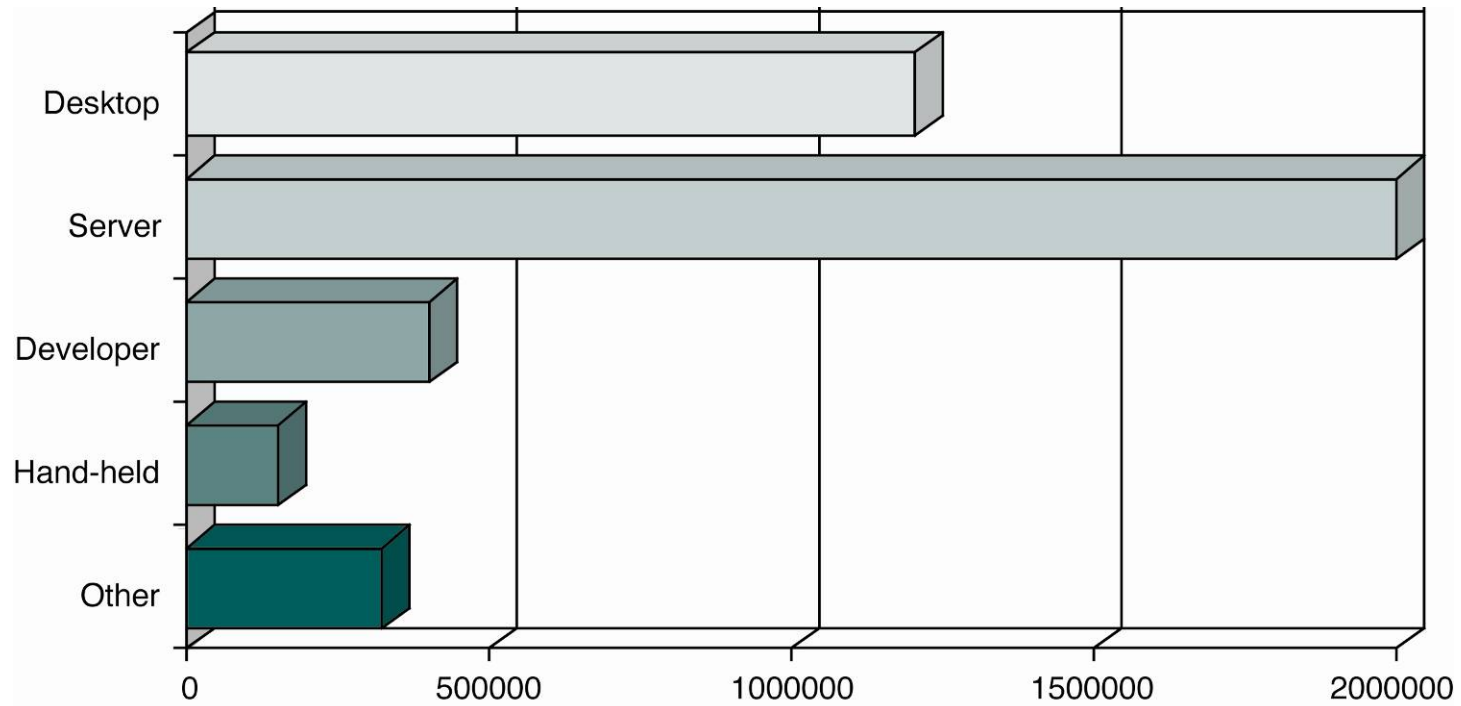
Field-based GIS

- Lightweight hardware
- Extension of desktop
- Limited capabilities
- Data collection
- Mobile mapping
- \$500





Estimated GIS Users





Summary

- GIS software is developing fast
- Consistent GIS architecture
- Major development areas
 - Internet
 - Hand-held
- Increasingly standards-based
- Very wide ranging
- Rationalization of vendors