

Integration of Generalization and Text Placement in ArcGIS

ICA MPMG Seminar, Sept. 2000

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Topics

- **GIS-based cartography with ArcGIS**

*Multi-purpose, multi-scale mapping from master databases
ArcGIS - the new generation of ESRI GIS software*

- **Map generalization**

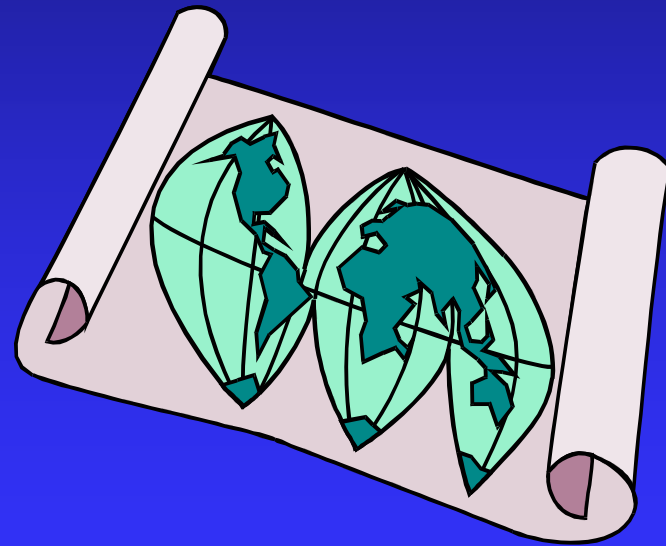
In Workstation ArcInfo, ArcToolbox, and ArcGIS

- **Text placement**

Dynamic labeling, feature linked annotation, and Maplex

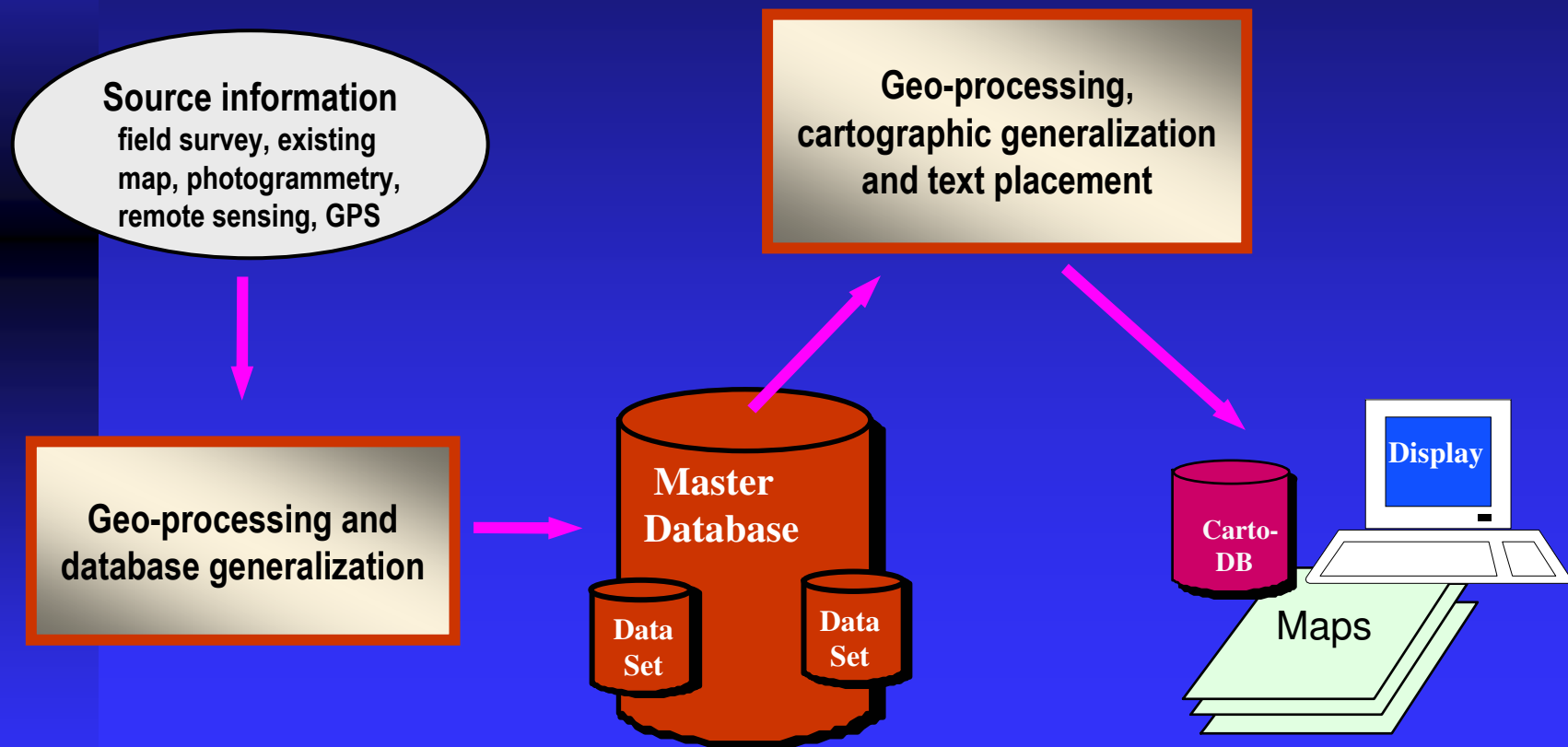


GIS-based Cartography with ArcGIS



GIS-based cartography

Today's cartographers compile databases and maps

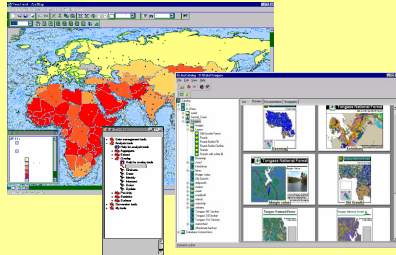


ArcGIS

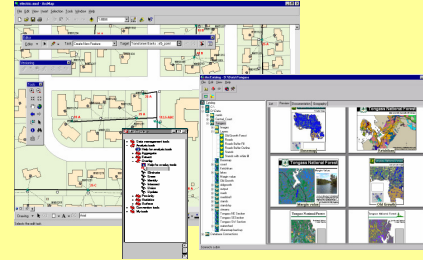
single, scalable, unified GIS software

Clients

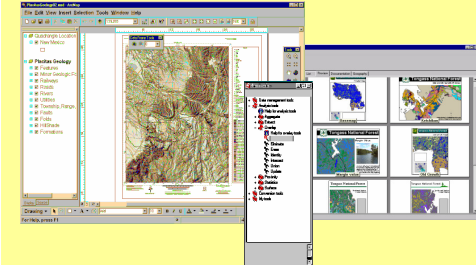
ArcView



ArcEditor



ArcInfo



ArcExplorer

Web Apps

Data

pGDB

CAD

Tin

Image

Grid

Shapefile

Coverage

ArcSDE

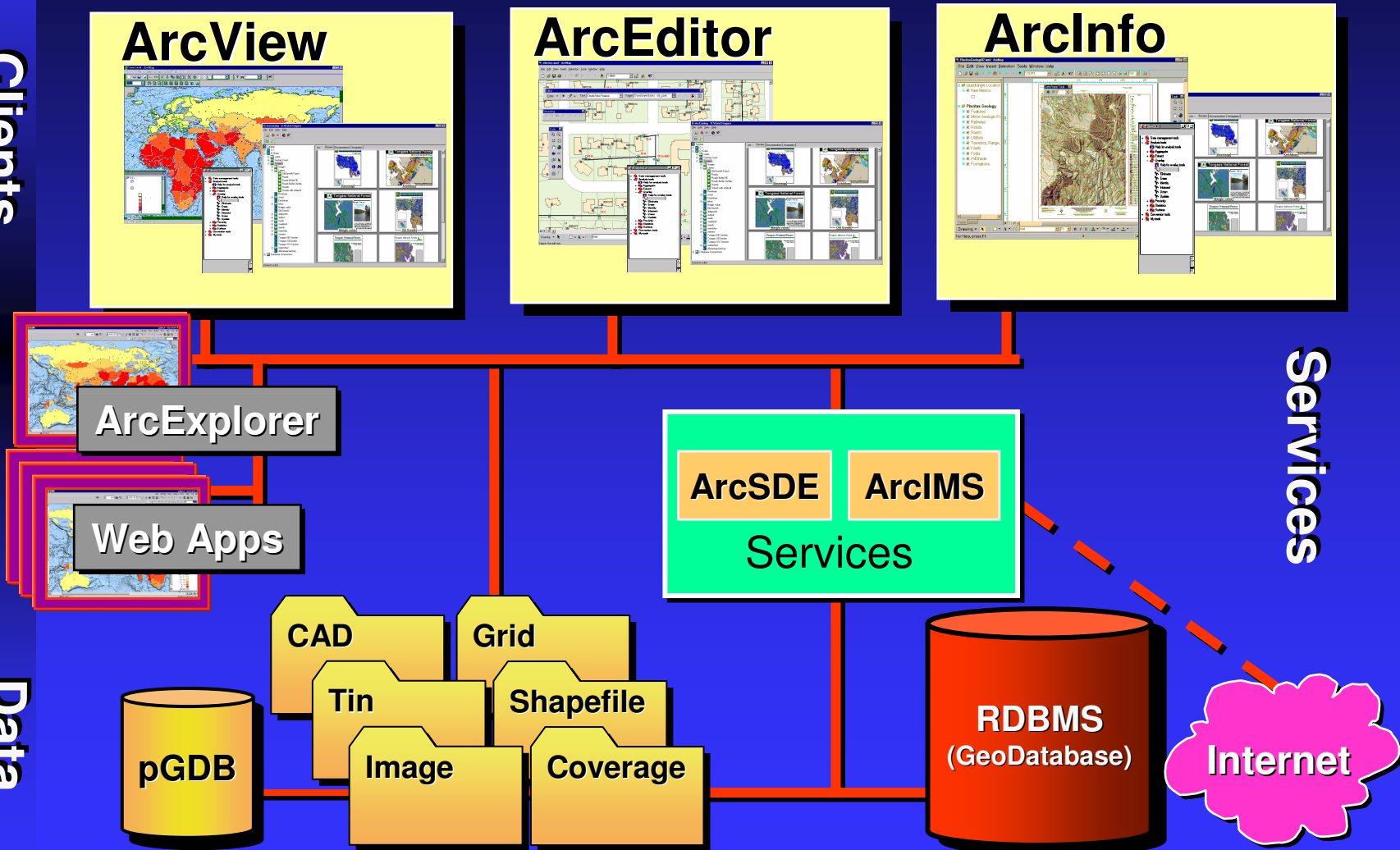
ArcIMS

Services

Services

RDBMS
(GeoDatabase)

Internet



ArcView 8.1

Desktop mapping GIS software,
a powerful tool for the management, display,
query, and analysis of spatial information

ArcMap

ArcCatalog

ArcToolbox

the map-centric application for
editing, displaying, querying

the data-centric application that locates,
browses, and manages spatial data

environment for performing the
hundreds of rich geoprocessing
operations provided by ArcInfo

ArcEditor 8.1

Define and edit custom features and
object classes

ArcMap

ArcCatalog

ArcToolbox

And:

- Coverage Editing
- Enterprise Geodatabase Editing
- Utility Network Solvers
- Dimensions
- Feature Linked Annotation

ArcInfo 8.1

the full-featured GIS with tools for automation, modification, management, analysis, and display of geographic information

ArcMap

ArcCatalog

ArcToolbox

And:

- Advanced Geoprocessing
- Advanced ArcToolbox
- Advanced Editing
- Workstation ArcInfo

And:

- Coverage Editing
- Enterprise Geodatabase Editing
- Utility Network Solvers
- Dimensions
- Feature Linked Annotation

Geodatabase concept

Feature datasets

Spatial reference

Object classes subtypes

Feature classes subtypes

Relationship classes

Geometric networks

Planar topologies

Domains

Validation rules

Raster datasets

Rasters

TIN datasets

nodes edges
 faces

Locators

Addresses
x,y locations
ZIP Codes
Place names
Route locations

Creating a geodatabase

The screenshot displays the ArcInfo - ArcCatalog interface. The main window shows a tree view of a geodatabase structure. The 'Location' field is set to 'D:\master25k.mdb\source1\vegpoly25k'. The 'Stylesheet' is set to 'ESRI'. The tree view shows a folder 'source1' containing a feature class 'vegpoly25k'. The 'Preview' pane shows a map of a geographical area. The 'Feature Class Properties' dialog box is open, showing the 'General' tab. The dialog box contains a table of fields and their data types, and a section for field properties.

ArcInfo - ArcCatalog - D:\master25k.mdb\source1\vegpoly25k

File Edit View Go Tools Help

Location: D:\master25k.mdb\source1\vegpoly25k

Stylesheet: ESRI

Contents Preview

Database Connections

Preview: Geography

Choose how you want to preview the selected item

Feature Class Properties

General Fields Indexes Subtypes Relationships

Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
AREA	Float
PERIMETER	Float
VEG1_	Long Integer
VEG1_ID	Long Integer
F_CODE	Text
ARA	Long Integer

Click any field to see its properties.

Field Properties

Alias	F_CODE
Allow NULL values	Yes
Default Value	
Domain	
Length	5

Import...

To add a new field, type the name into an empty row in the Field Name column, click in the Data Type column to choose the data type, then edit the Field Properties.

OK Cancel Apply

Map Generalization

Support multiple-purpose, multiple-scale data transformation and map production

Recent releases in Workstation ArcInfo

- Focus on database generalization
- Support attribute transfer
- Facilitate post-processing and editing

BENDSIMPLIFY operator—ArcInfo 7.1.2

ORTHOGONAL operator —ArcInfo 7.2.1

BUILDINGSIMPLIFY command —Workstation ArcInfo 8.0.1

FINDCONFLICTS command —Workstation ArcInfo 8.0.1

CENTERLINE command —Workstation ArcInfo 8.0.1

AREAAGGREGATE command —Workstation ArcInfo 8.0.2

Enhancements to the GENERALIZE command

a minor enhancement for Workstation ArcInfo 8.0.1;

a major enhancement to be released in Workstation ArcInfo 8.1

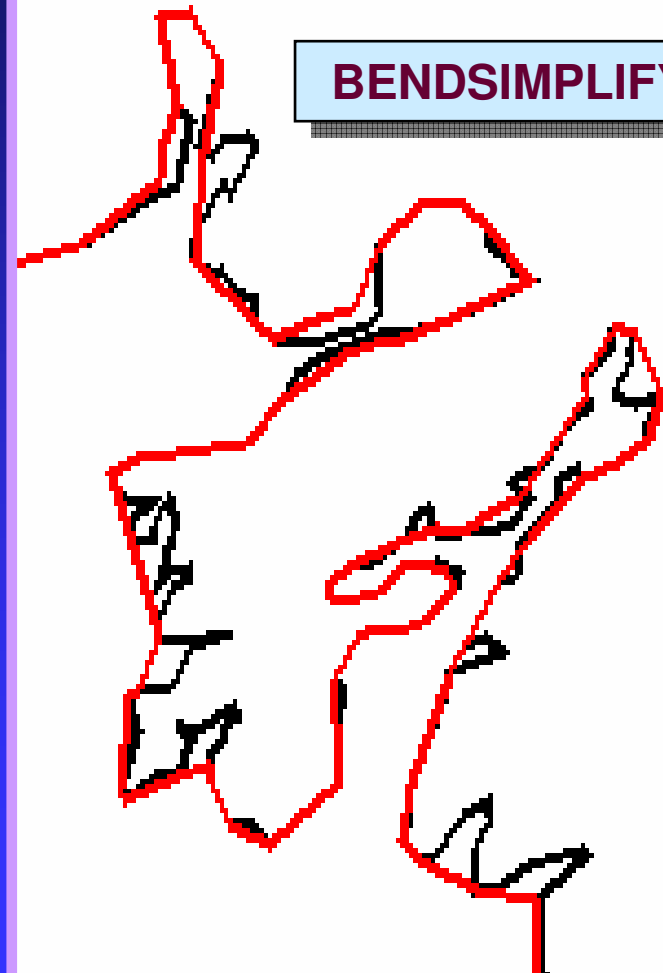
GENERALIZE

(pointremove vs. bendsimplify)

POINTREMOVE



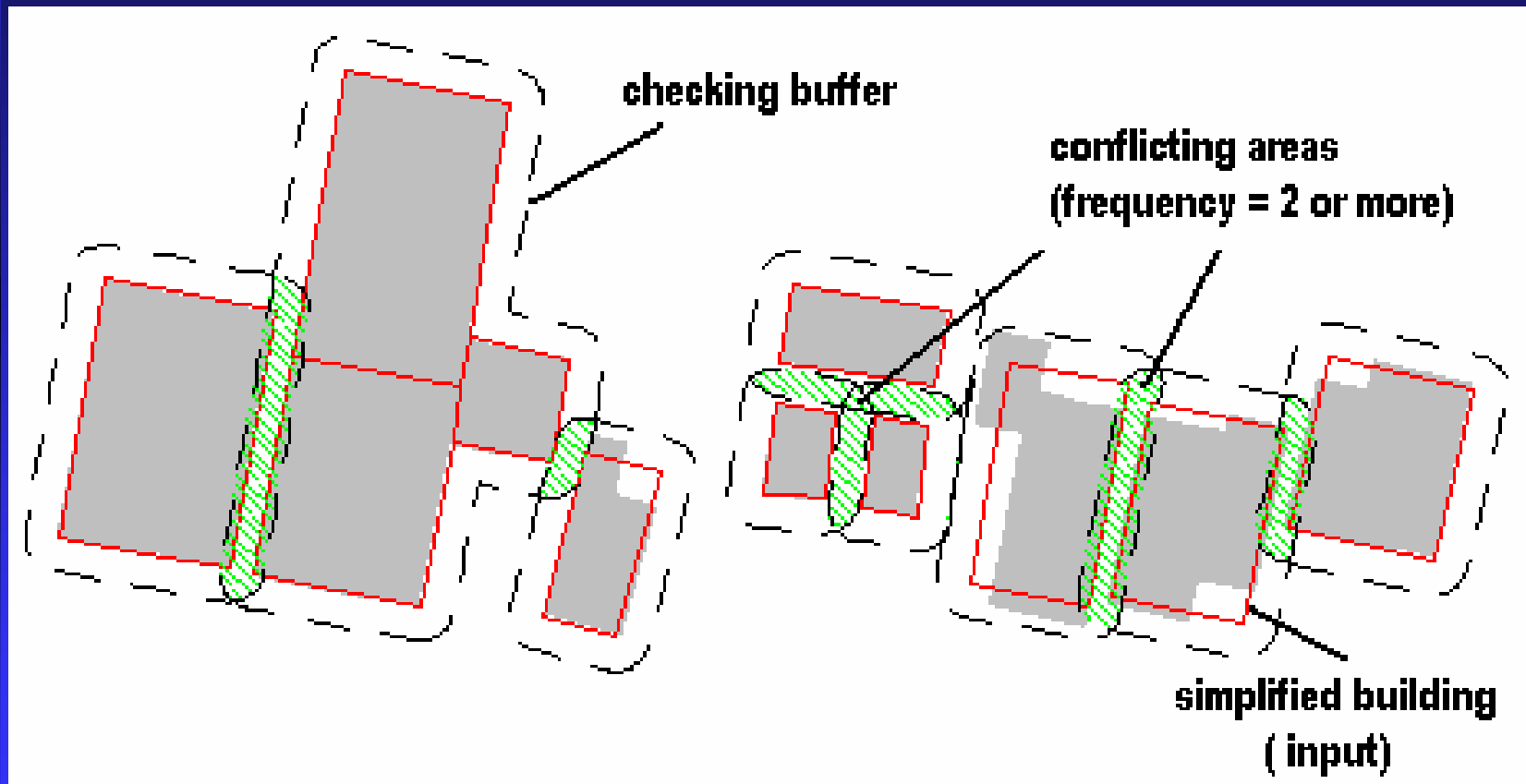
BENDSIMPLIFY



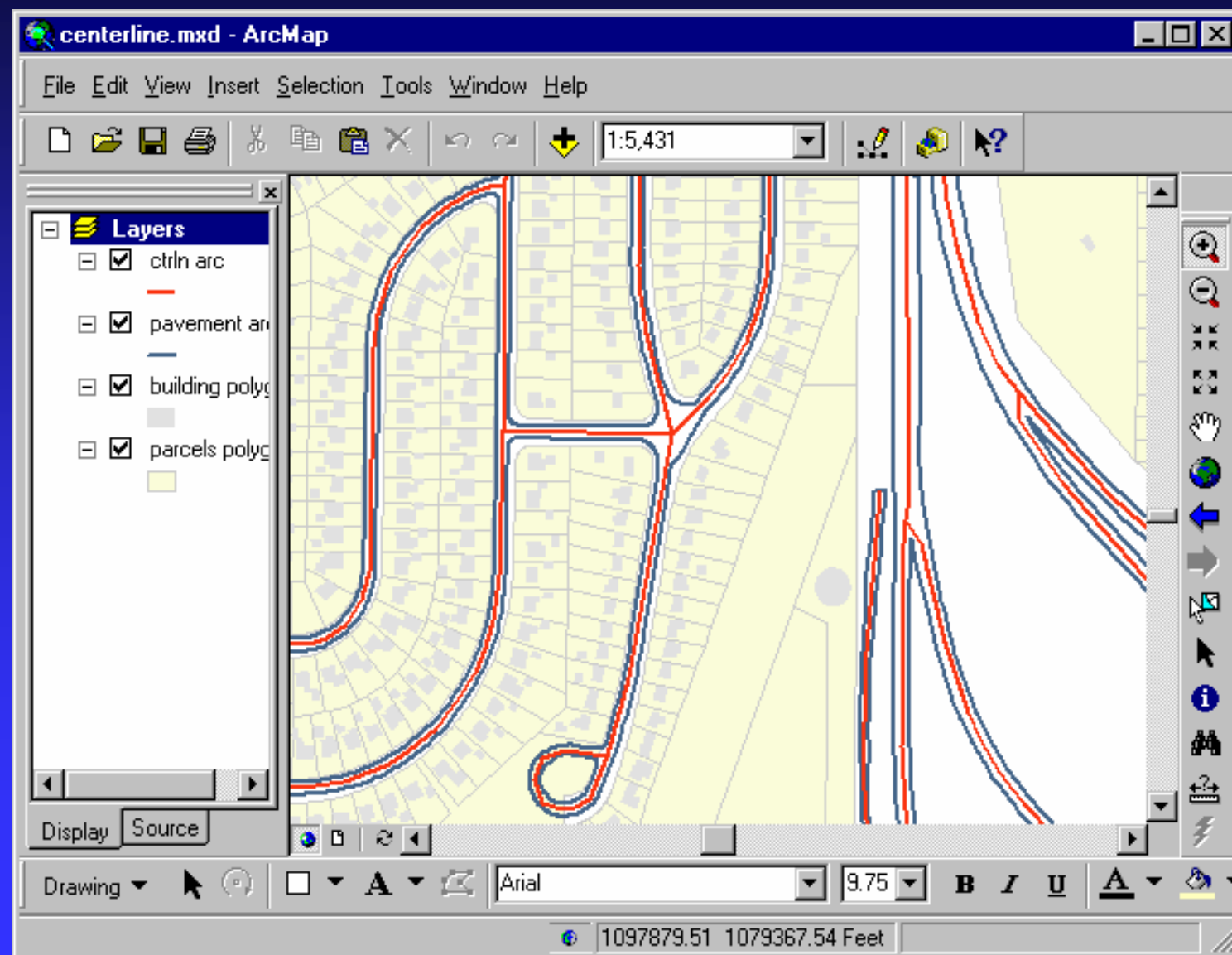
BUILDINGSIMPLIFY



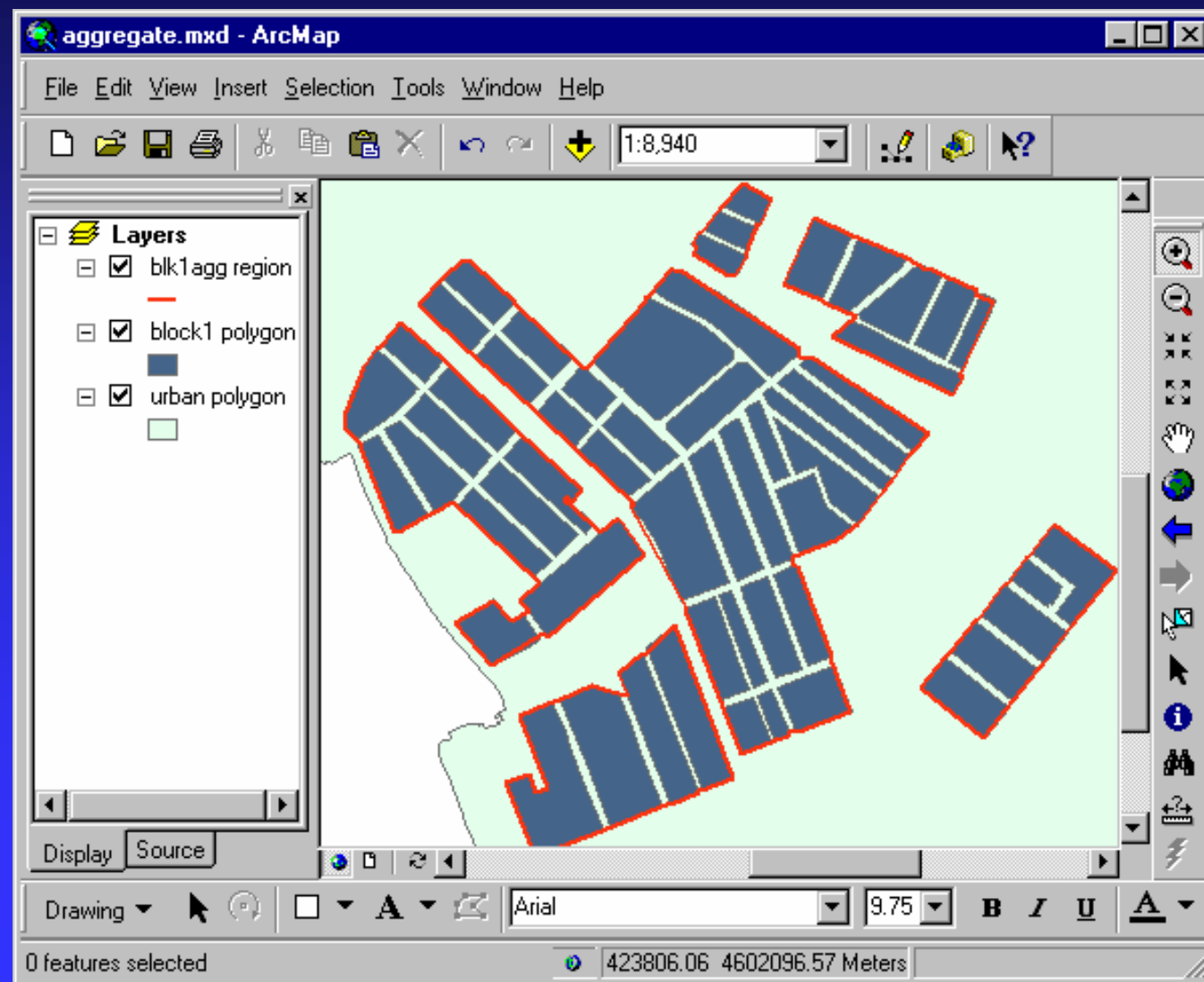
FINDCONFLICTS



CENTERLINE

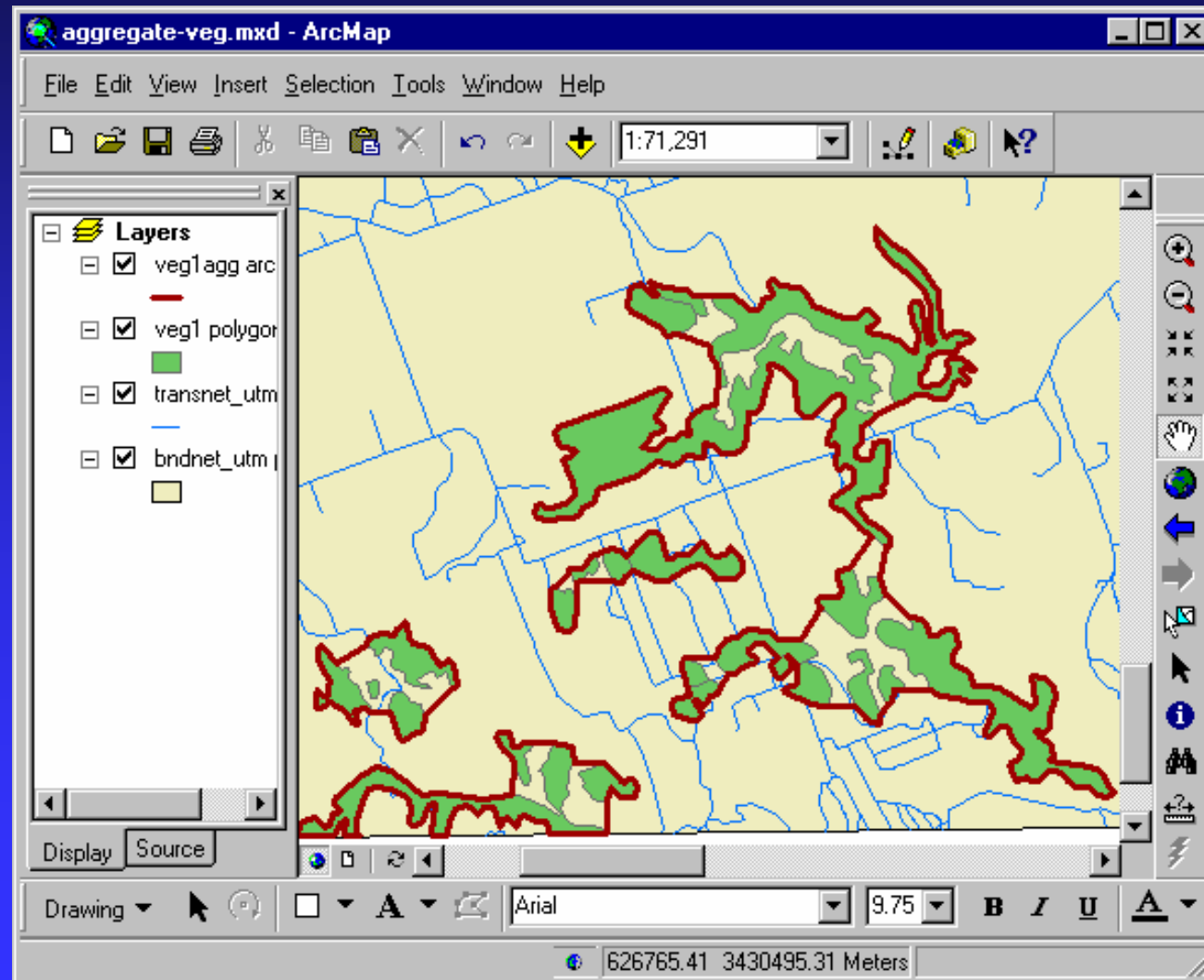


AREAAGGREGATE (orthogonal)

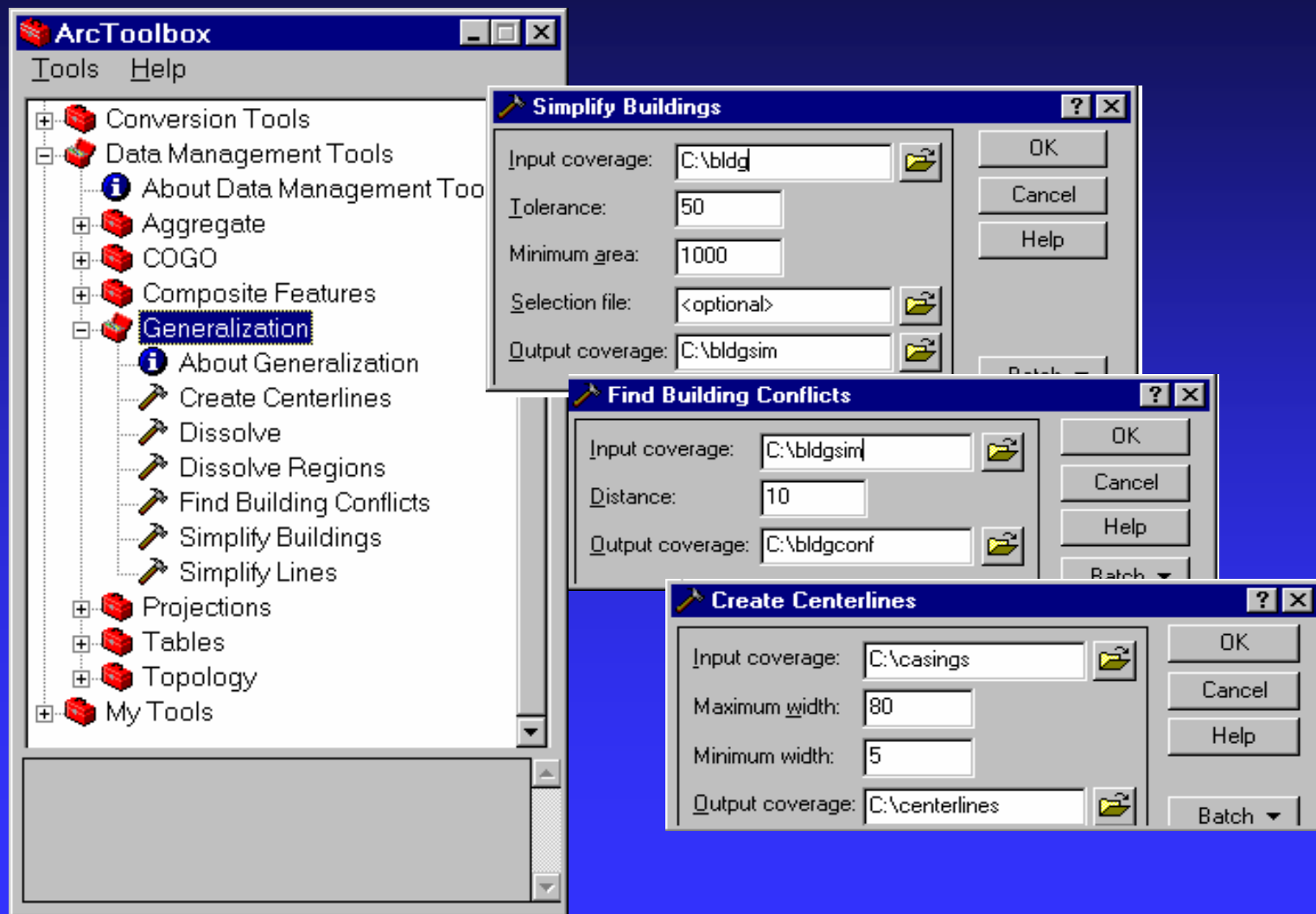


AREAAGGREGATE

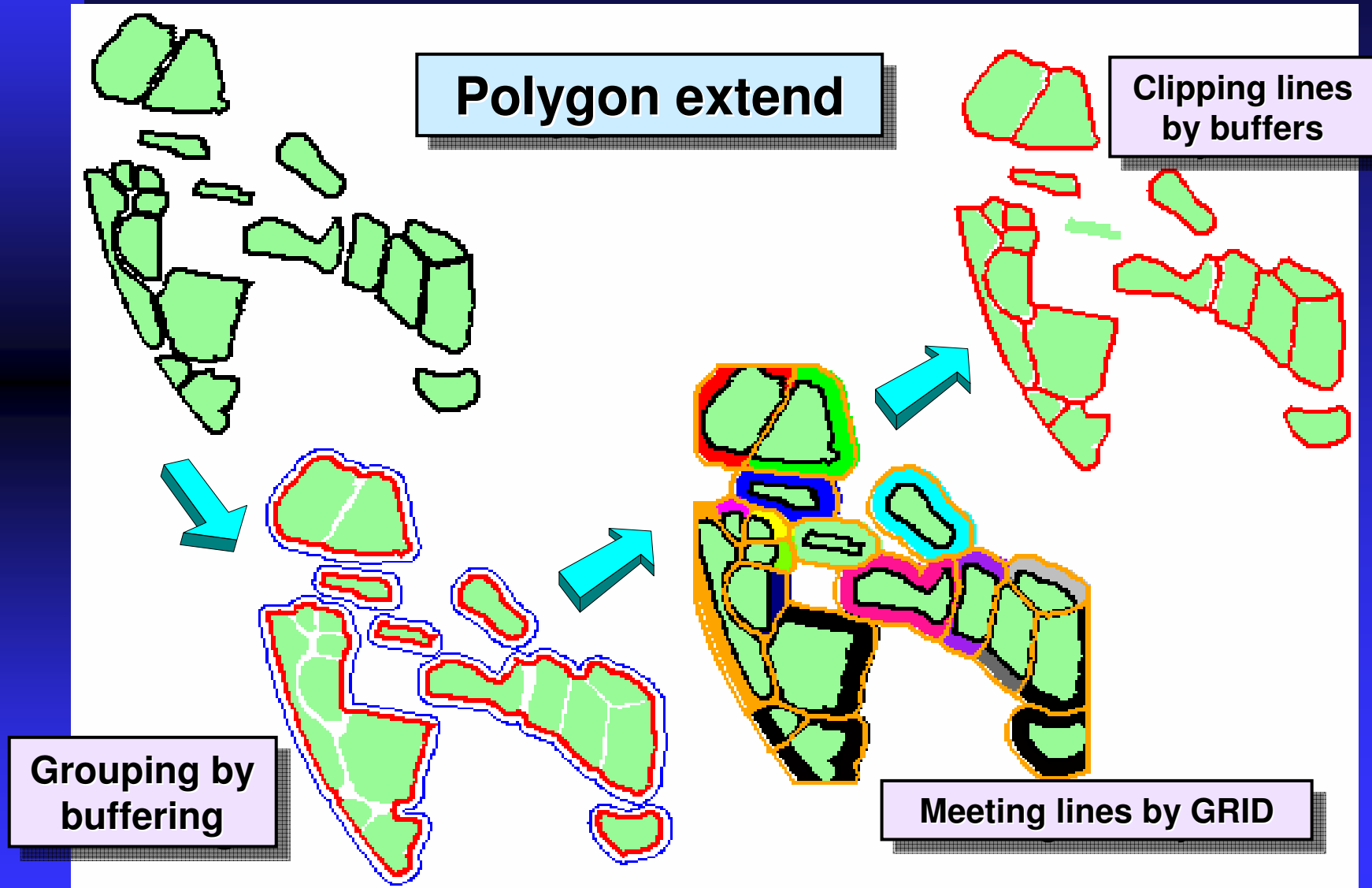
(non_orthogonal)



Gen-tools in ArcToolbox



Example of Macro- procedures



Development of generalization tools for ArcGIS

More functions, flexibility, and productivity

Extending the following areas:

- **Geodatabase tools**
 - Derive target schema, feature classification and extraction;
 - Maintain feature links between source and target data
- **Geometry processing**
 - Add generalization operators
- **Editor tools**
 - Allow interactive generalization and queued edit
- **User interface**
 - Add a gen-toolbar, menus, forms, and controls

Database generalization

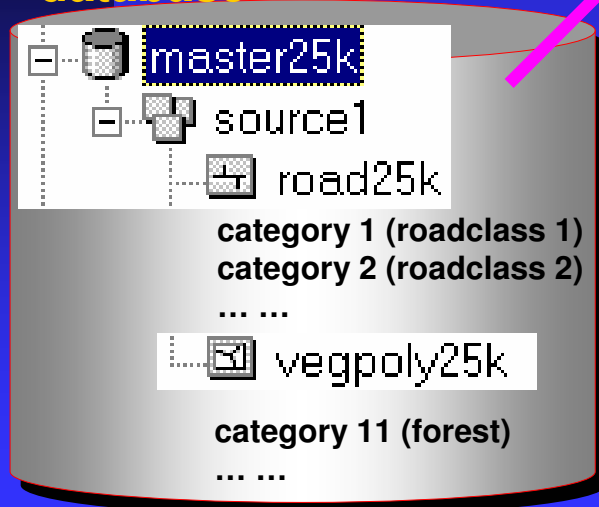
Define/create target feature classes
(attribute fields and domains)

Define and link source feature categories to target features

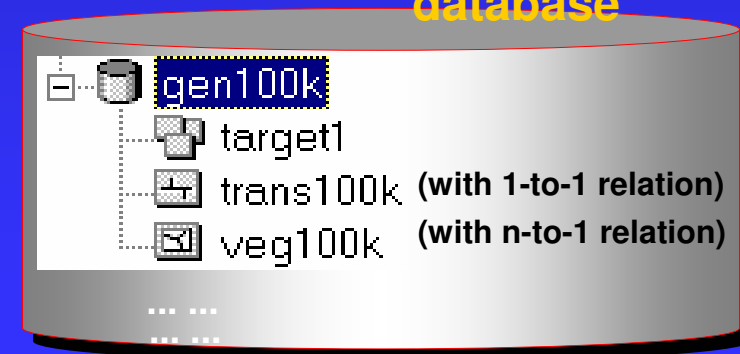
Transforming source features to generalized features (in batch)

<u>Source feature</u>	<u>Output feature</u>	<u>Steps</u>
category 1	trans100k-fr001	simplification, elimination
category 2	trans100k-fr002	typification, simplification
...	
category 11	veg100k-fv011	aggregation, smoothing

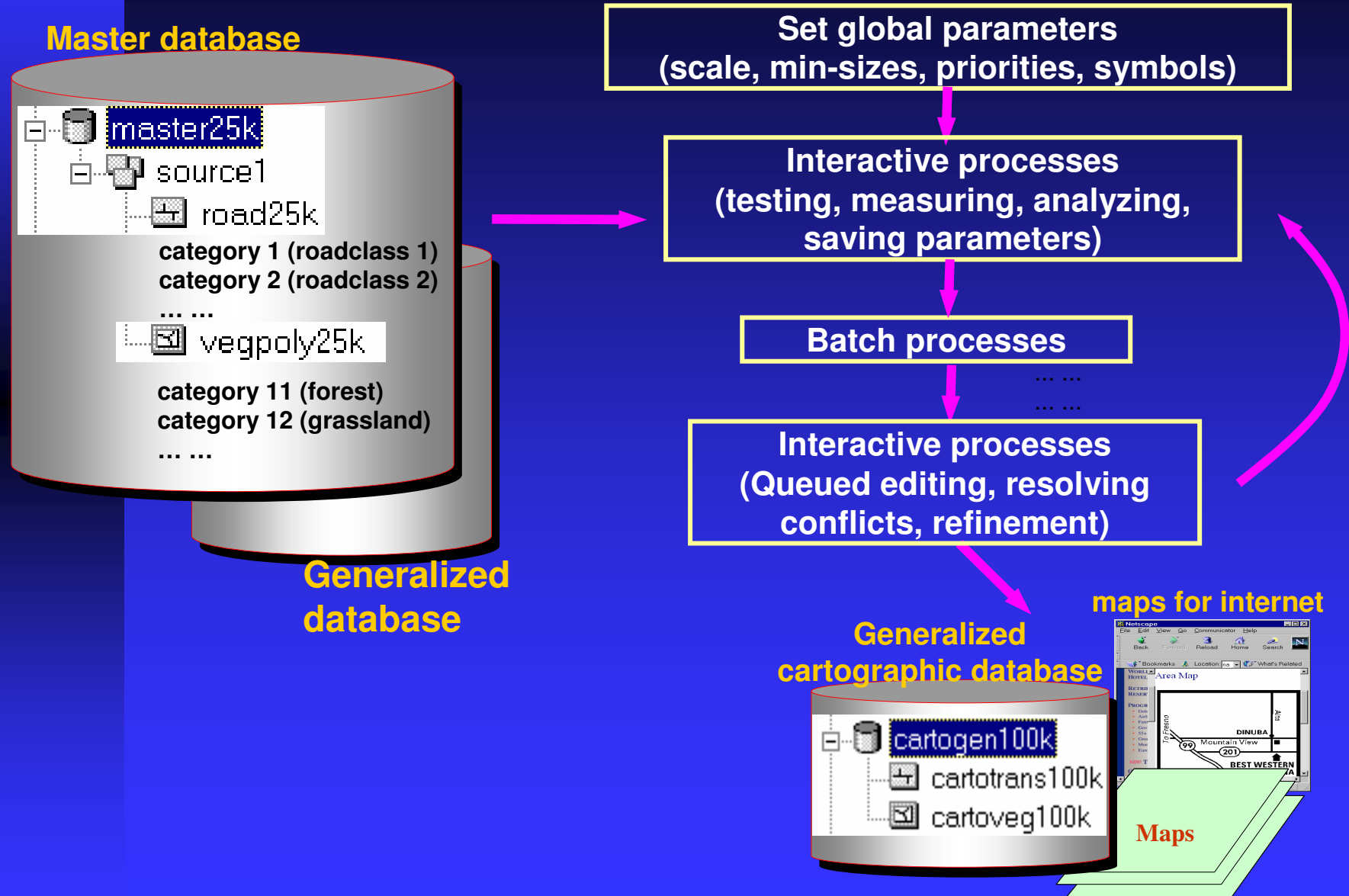
**Master
database**



**Generalized
database**



Cartographic generalization



Linking source and target features

Feature link specification

Derive source feature list

☐ From current TOC +

☒ From maps

D:\genprojects\maps25k.mxd Browse

☐ From .lyr files

D:\genprojects\maps5k.lyr Browse

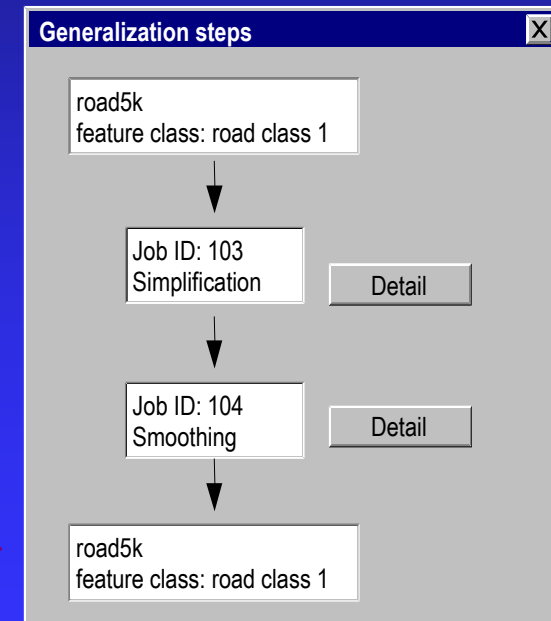
Default target dataset location

D:\genprojects\maps100k Browse

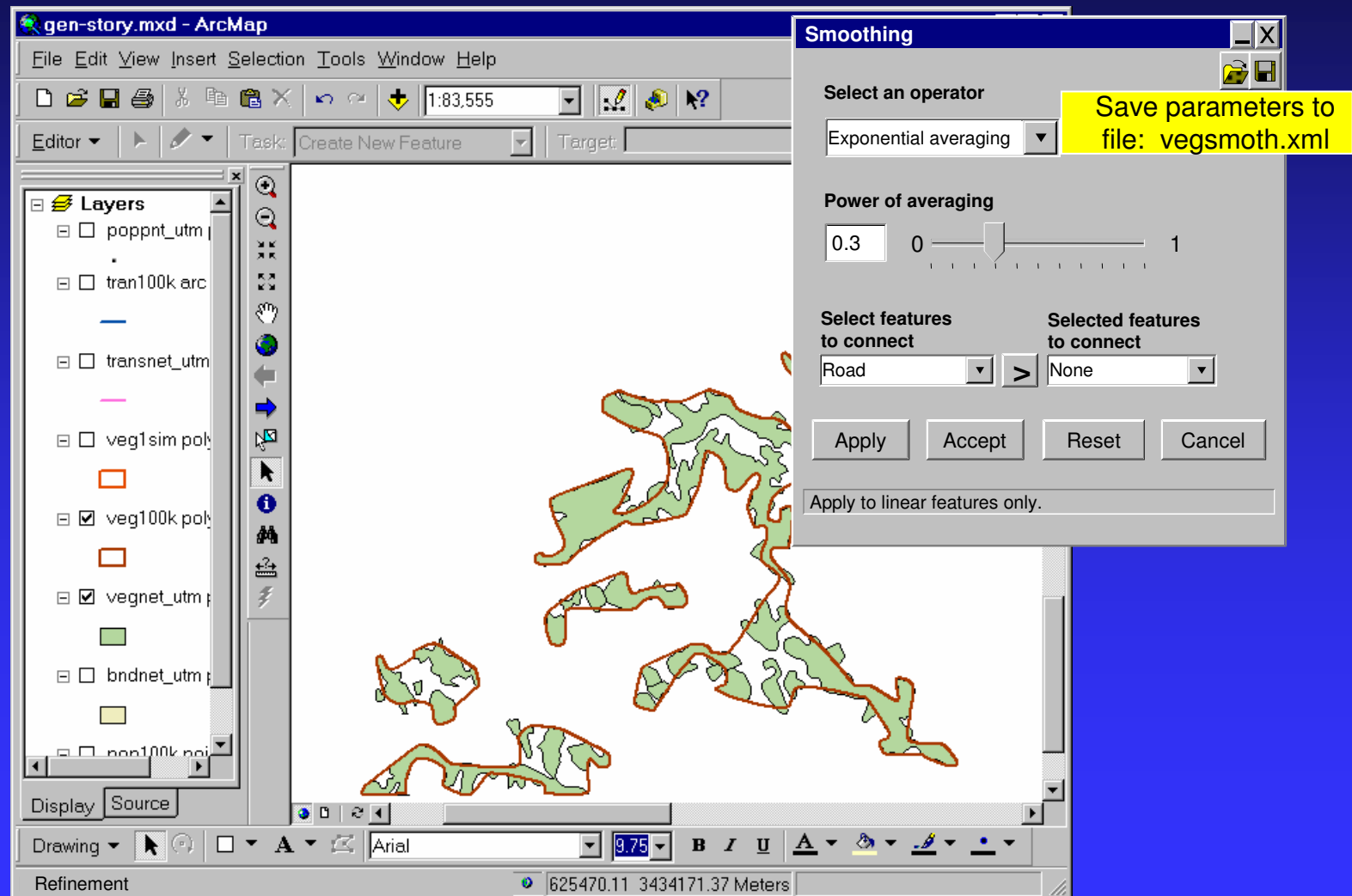
Source		Target		
Feature class	Feature category	Feature class	Field	Value
bndnet25k	commercial bldg	bndnet100k	f-code	boundary
vegnet25k	post offices	vegnet100k	f-code	vegetation
transnet25k	railroad	transnet100k	f-code	rail
popnet25k	residential house	popnet100k	f-code	building
transnet25k	road class 1	transnet100k	f-code	road class 1
transnet25k	road class 2	transnet100k	f-code	road class 2
elevation25k	spot elevation	reliefpt100k	f-code	spot-elevation

+ - Clear all Reset View steps

OK Cancel



Interactive tools



Queued editing

The screenshot shows the ArcMap interface with a map titled 'gen-story.mxd'. The 'Layers' panel on the left lists several layers, including 'popnt_utm', 'tran100k', 'transnet_utm', 'veg1simp', 'veg100k', 'vegnet_utm', and 'pop100k'. A 'View 1' window is open, showing a zoomed-in view of a green area with a blue line. The 'Queued Edit' dialog box is open, displaying a table of editing tasks. The table has columns for ID, Flag, Operator, Processing time, and Status. The status of each task is shown in a dropdown menu. The 'Problem Description' section provides details for the selected task (ID 2).

Queued Edit

Generalized layers:

Specify an area:

Number of records: 37 **Display:** ☒ Selected ☐ Previous ☐ Next ☐ All

ID	Flag	Operator	Processing time	Status
1		Exaggeration	03:15:00, Mon 7/17/00	
2		Simplification	11:10:00, Mon 7/17/00	Unresolved
3		Aggregation	08:30:30, Thu 7/13/00	Delete
4		Simplification	17:50:38, Thu 7/13/00	Unresolved
5		Refinement	01:20:45, Tue 7/18/00	Unresolved
6		Displacement	14:55:10, Tue 7/18/00	Unresolved
7		Typification	20:40:14, Mon 7/17/00	Unresolved

Problem Description

Operator name: bendsimplify
Parameters: distance = 80; min. area = 200 map units
Description: a line segment was under-generalized due to conflicts

Text Placement

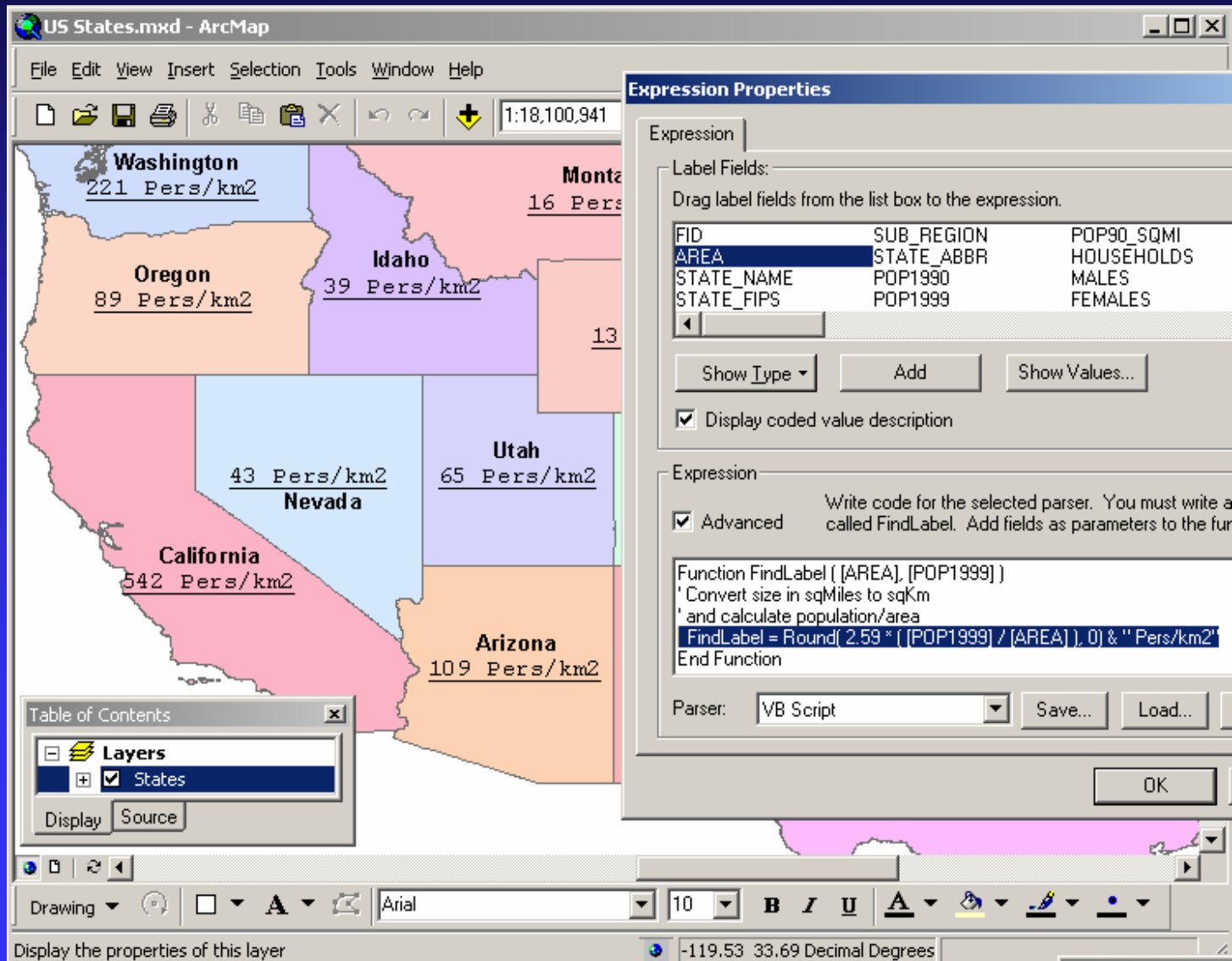
A major component of cartography



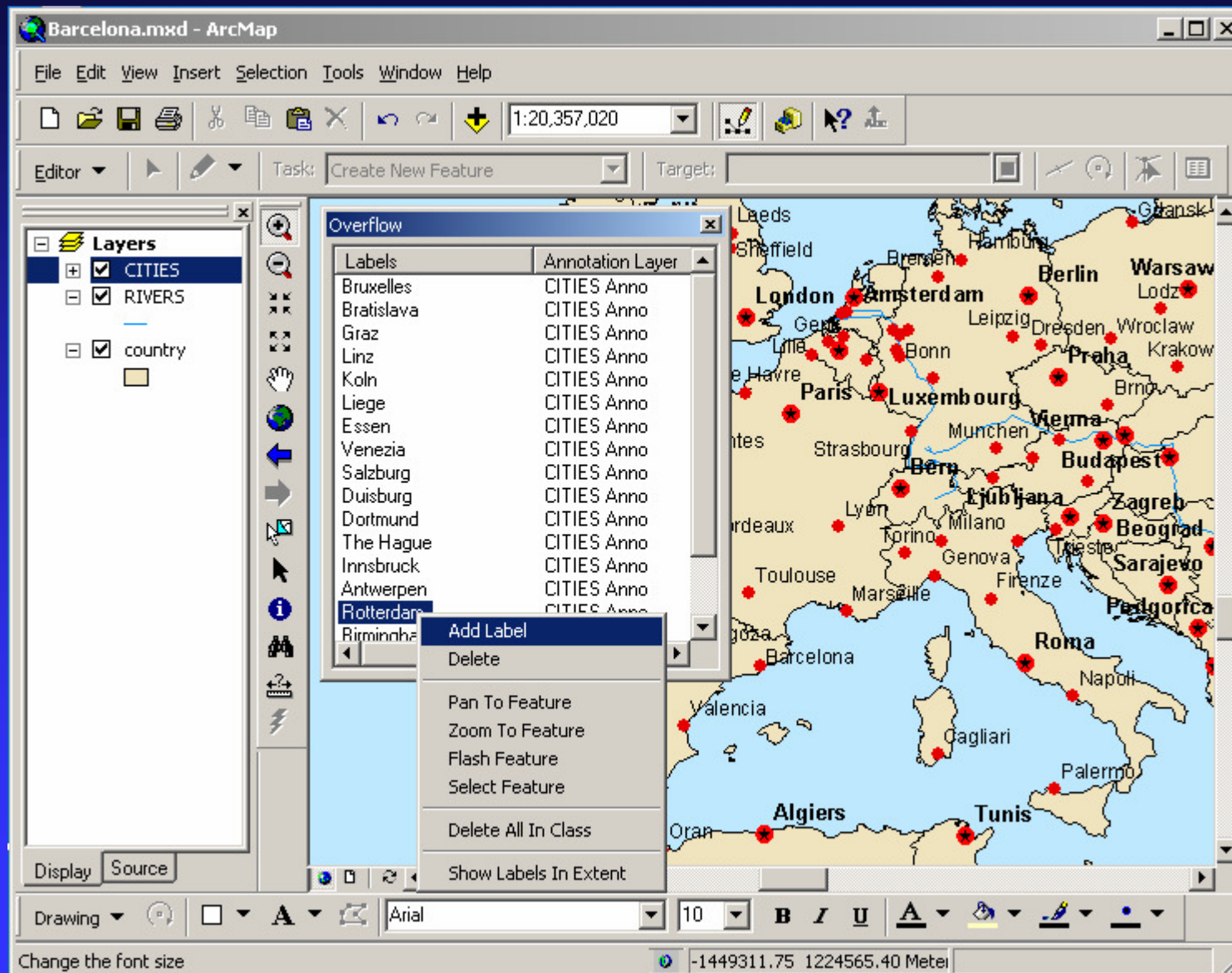
Dynamic labeling in ArcMap

- Places labels at "ideal" location on the fly
- For on-line display or as batch process for creating persistent annotation
- Can place multiple labels / feature

- Uses expression based on VB- or Java-script to derive text



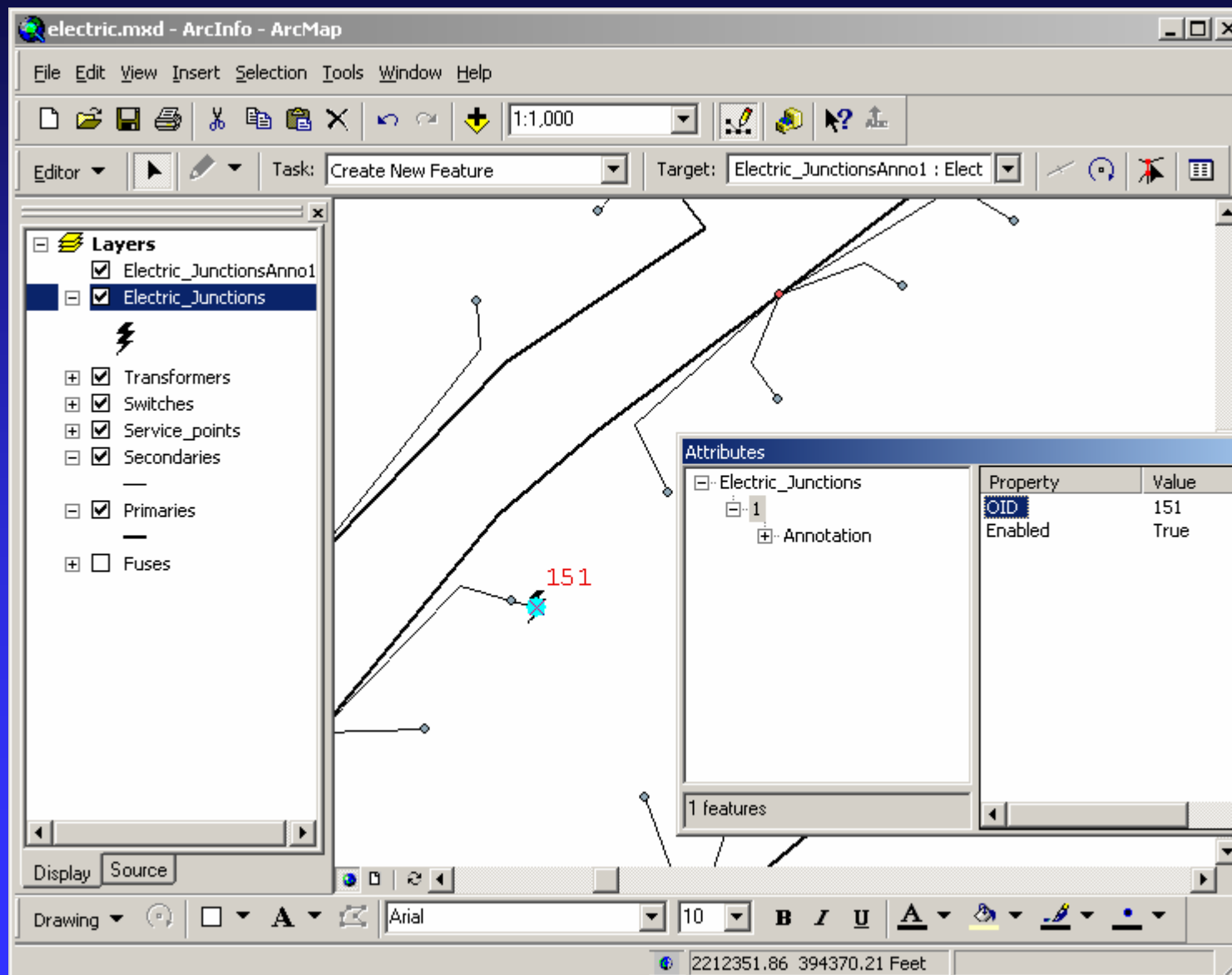
■ Handles overflow (unplaced) labels



Feature-linked annotation in ArcGIS

- A geodatabase feature class with custom behavior
- One or more annotations linked to a feature (point, line, polygon, ...)
- Annotation text derived from feature attribute
- Position maintained in relation to feature
- Updating the feature automatically updates the linked annotation

Feature-linked annotation



Maplex

Currently a separate product
Will be integrated with ArcMap in future

Cartographic Design

Many input and output formats
Standard carto symbology built-in
Custom symbology easily added
Rule-based projects allow repeatable design styles

Automated Text Placement

Unambiguously label all features
Conflict Resolution Between Placements
User-specified Rules
Prioritization of features, labels
Label Points, Lines, Area, Streets, Parcels

The data manager

Data Manager - F:\gdt_demo\default.d

Data Set Edit

	Shapefile Name	Loading Switch	Feature Class Field Name	Label Field Name
1	F:\gdt_demo\Dcwashin.shp	<input checked="" type="checkbox"/>	inst"FCC"	"NAME"
2	F:\gdt_demo\Dcwashpk2.shp	<input checked="" type="checkbox"/>	park	"NAME"
3	F:\gdt_demo\Dcwashr.shp	<input checked="" type="checkbox"/>	rails	"NAME"
4	F:\gdt_demo\Dcwashs.shp	<input checked="" type="checkbox"/>	str"FCC"	"NAME2"
5	F:\gdt_demo\Dcwashtr.shp	<input checked="" type="checkbox"/>	trans	"NAME"
6	F:\gdt_demo\Dcwashw.shp	<input checked="" type="checkbox"/>	w"FCC"	"NAME"
7	F:\gdt_demo\Dcwashwp.shp	<input checked="" type="checkbox"/>	wp"FCC"	"NAME"
8	F:\gdt_demo\Dcwashal.shp	<input checked="" type="checkbox"/>	lm"FCC"	"NAME"
9	F:\gdt_demo\pkbldgs.shp	<input checked="" type="checkbox"/>	pkbldgs	"NAME"

Format: **ESRI Shapefile Format** Map Scale 1: **15000**

Units

☐ Map Units (ie data has already been projected)

Units: **Meters**

Conversion Factor To Meters: **1**

☒ Decimal Degrees **Projection Parameters ...**

Map Extent

West: **-5195**

South: **-13537**

East: **382**

North: **-9717**

Set To Full Extent **Set To Zoom Extent**

Loading Options ... **Add Codes ...** **Add File ...** **SDE Server ...** **Open** **Cancel**

Feature Class Codes and Label Field are specified here.

Projections, Units, Scale and Map Extents are also set at load time

The rule-base parameters

Symbology (style, color, size...)

Labels (font, color, size, box...)

Placement (the label in relation to its feature)

Priorities (features/labels importance ordering)

Stacking (breaking up multi word labels)

Multi-labels (> one label per feature)

Deletion (what to do if no label is placed)

Export (create layered export files)

The screenshot shows the 'Rulebase Editor' dialog box with the 'Label' tab selected. On the left is a table with 20 rows, each containing a Code, a Description, and a checkbox. The 'Label' tab on the right contains several sub-sections: 'Labelling Style' with a dropdown set to 'Offset' and a preview box; 'End of Street Clearance' with 'Preferred' and 'Minimum' set to 2mm and 1mm respectively; 'Label Offset' with 'Distance' at 20% and 'Alternative' at 100%; 'Maximum Shift' with 'Horizontal' and 'Vertical' both at 0; 'Label Buffers' with 'Feature' at 10% and 'Label' at 20%; 'Weights' with 'Feature' and 'Label' both at 100; 'Label Repetition' with 'Unambiguous' selected and 'Min Interval' at 24in; and 'Other' with 'Gaticule Alignment' and 'Label Overrun' checked, 'Maximum Overrun' at 2in, 'Background Label' unchecked, 'Exclude Other Labels' unchecked, and 'Max Label Angle' at 90. At the bottom, there is a 'Preferred Label Positions' dropdown set to '05 04 06 03 07 02 08 01 09 10 11 12 13 14 15 16'. A 'Table View' button is also present. A footer note explains the label box width parameter.

	Code	Description
3	ImD82	cemeteries
4	ImD43	Universities
5	ImD67	Major landmarks
6	pkbldgs	Buildings in parks
7	ImD65	US Capitol Bldg
8	strA10	Primary Hwy
9	strA11	Primary or hwy,unsep
10	strA12	Pri or hwy,unsep,tun
11	strA15	Pri. or Int hwy, sep
12	strA20	Primary
13	strA21	Pri. or US fwy,unsep
14	strA25	Pri. or US fwy, sep
15	strA30	Secondary
16	strA32	Sec or fwy,unsep,tun
17	strA35	Secondary,St hwy,sep
18	strA40	Local Road
19	strA41	Local, unseparated
20	strA42	Local, in tun, unsep

Labelling Style: Offset

End of Street Clearance: Preferred: 2mm, Minimum: 1mm

Label Offset: Distance: 20%, Alternative: 100%

Maximum Shift: Horizontal: 0, Vertical: 0

Label Buffers: Feature: 10%, Label: 20%

Weights: Feature: 100, Interior Area: 0, Label: 100

Label Repetition: Unambiguous, Minimize Labels, Min Interval: 24in

Other: Gaticule Alignment, Label Overrun, Maximum Overrun: 2in, Background Label, Exclude Other Labels, Max Label Angle: 90

Preferred Label Positions: 05 04 06 03 07 02 08 01 09 10 11 12 13 14 15 16

The width of the label box when the longest line in the label has two characters; the box graphics are scaled horizontally to fit this width. You can specify this as a % of the nominal box width. (Applies for complex box shapes only).

Placement styles and strategies

Point Features

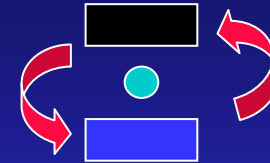
Centered



Offset (freedom to move)



Offset (with preferred zones such as east or north side)



Line Features

Centered

Horizontal



Curved

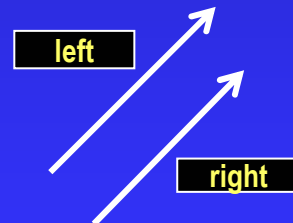


Straight



Offset

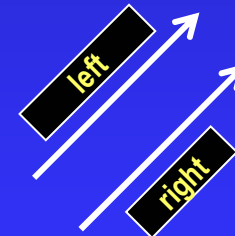
Horizontal



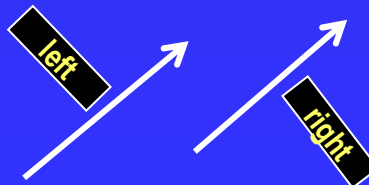
Curved



Straight

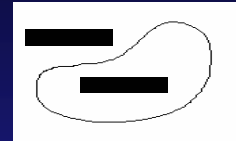


Perpendicular

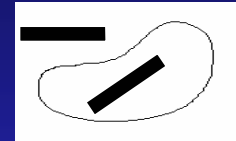


Area features

Center horizontal or Offset



Center straight or offset



Center curved or offset



Placement strategies

- US-Style Streets
- European-Style Streets
- Parcels
- Petroleum
- Atlases
- Standard point, line, polygon

Production workflow

