StatGis Team

2nd StatGIS conference

Vector vs. Raster in Network Analysis

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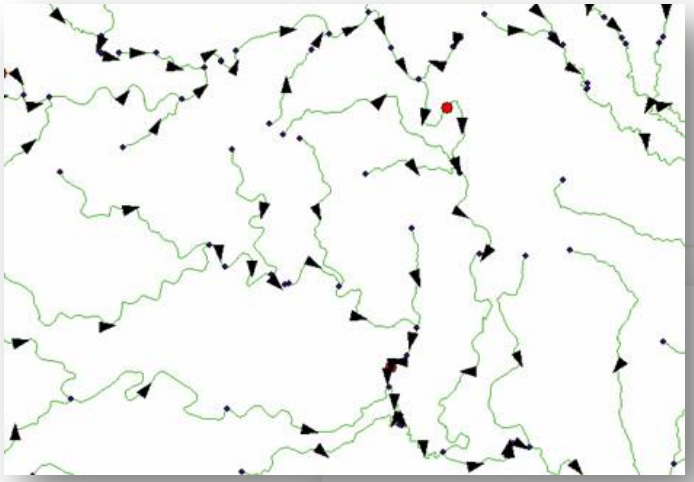
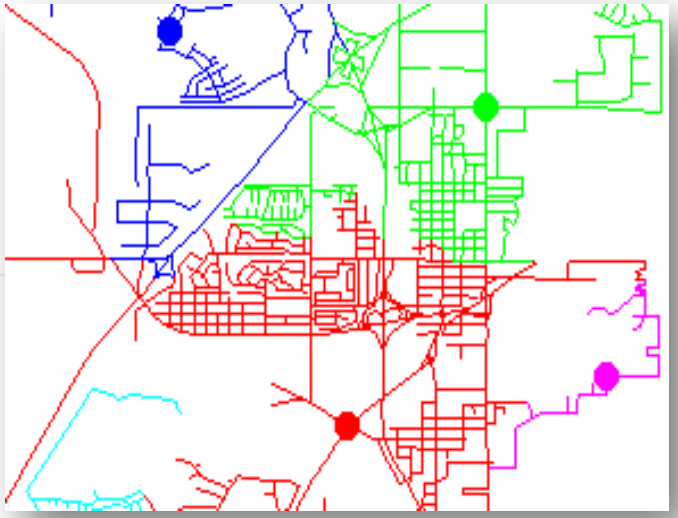
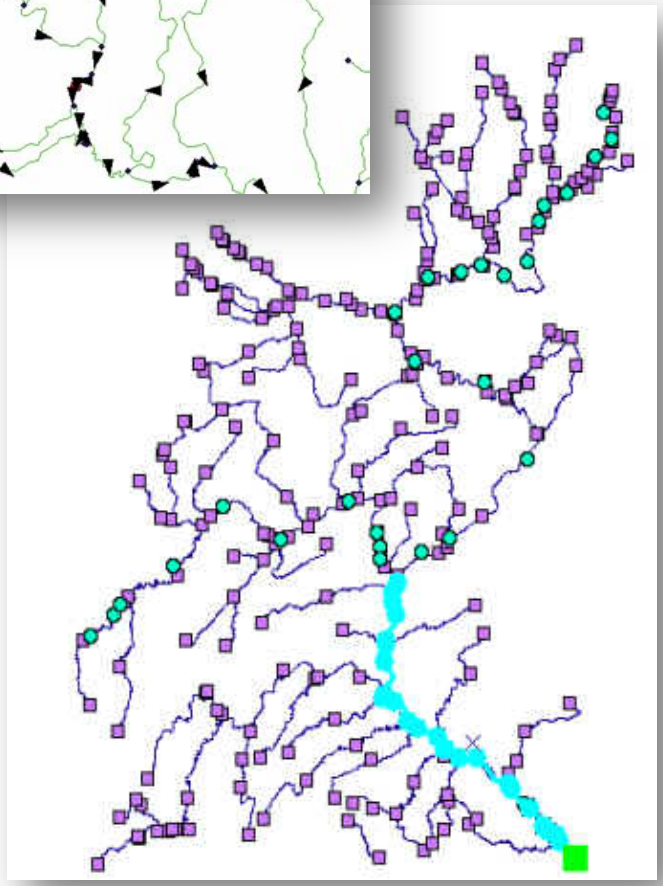
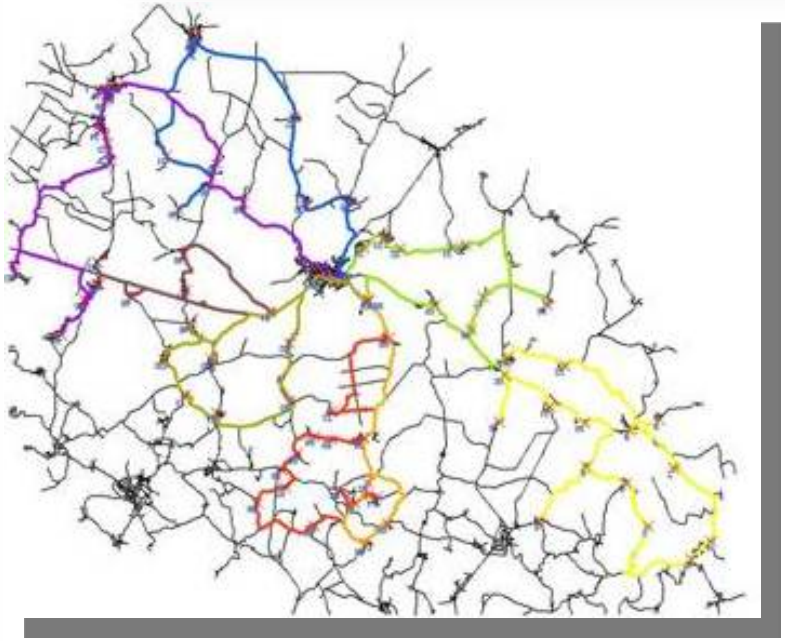
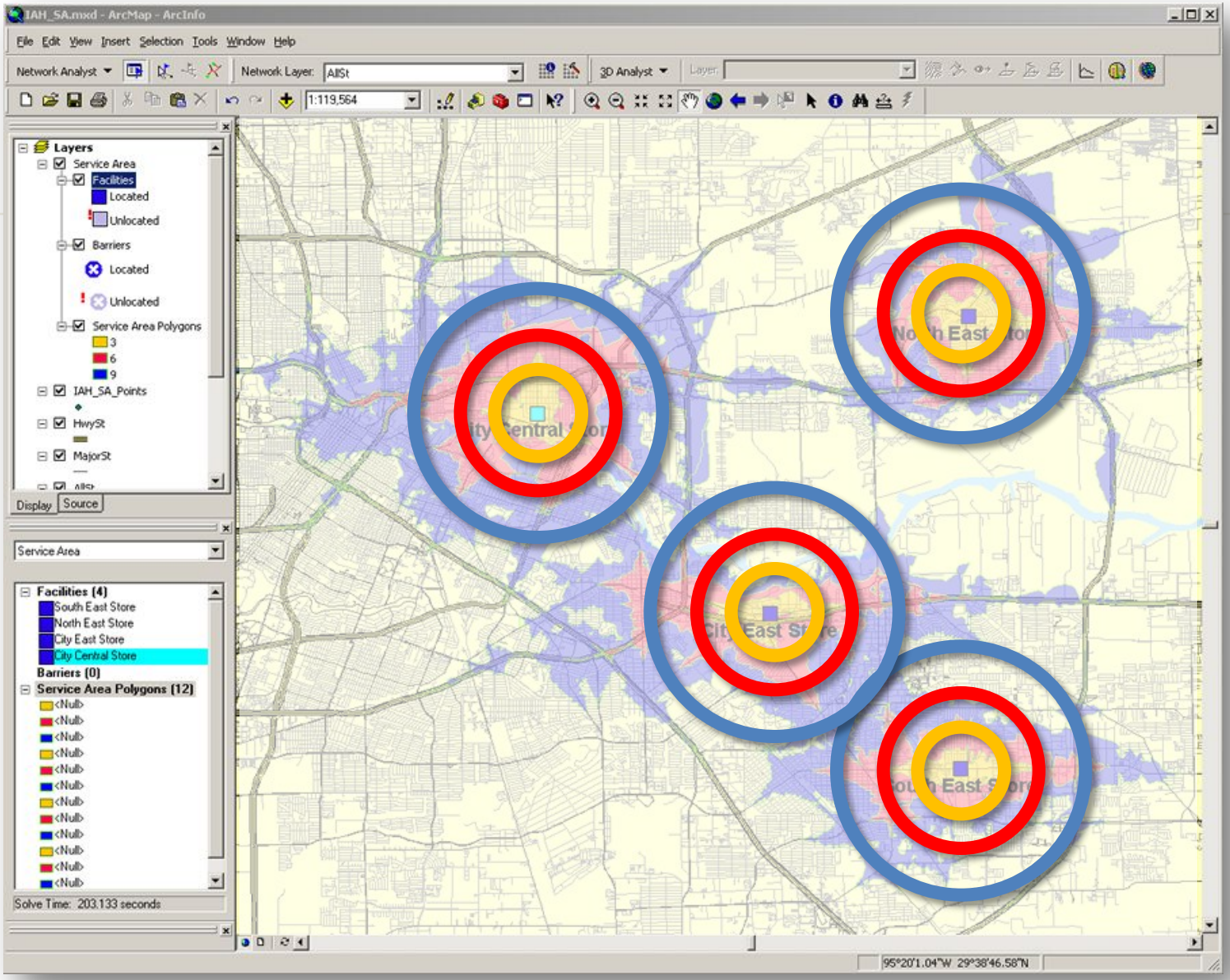
Nov 10–13, 2014, Olomouc







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Network Analysis

- for solving routing and logistical problems on a network of connected lines in a vector object
  - to determine the optimal route connecting stops
  - to allocate different parts of the network to service areas around individual facility locations
- it utilizes the topology of the network and properties of the lines and intersections (such as one-way directions and impedance and demand values)
  - **city streets**, **state highways**, **water or sewer pipelines**, or some other **utility** network

Network modelling in vector GIS

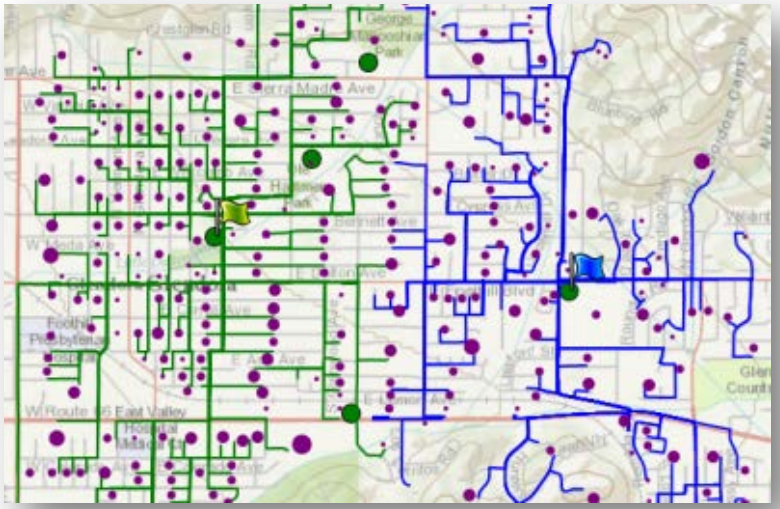
Optimized Route

- to find the quickest, shortest, cheapest, most scenic route …
- cost values: time, distance, time, slope, impression etc.
- just two stop locations or many stops in the best order

Network modelling in vector GIS

Closest Facilities

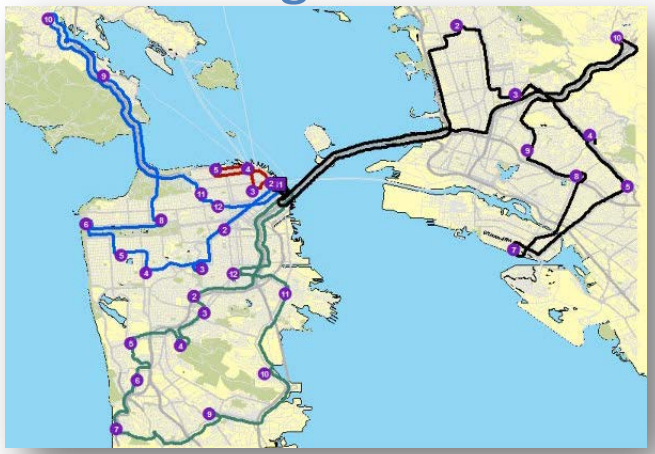
- to measure the cost of traveling between incidents and facilities to determine which are nearest to one other
- to specify how many to find, whether the direction of travel is toward or away, and other constraints like search cutoff thresholds



Network modelling in vector GIS

Multi-Vehicle Routing Problem

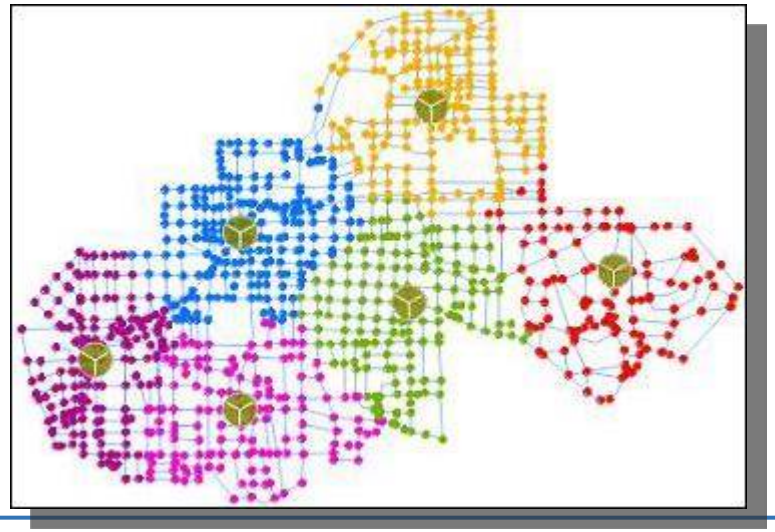
- to determine what stops should be serviced by each route and in what sequence the stops should be visited
  - given a set of work locations and a fleet of vehicles
- the solution minimizes the overall operating cost for the entire fleet while considering business rules you define



Network modelling in vector GIS

Location Allocation

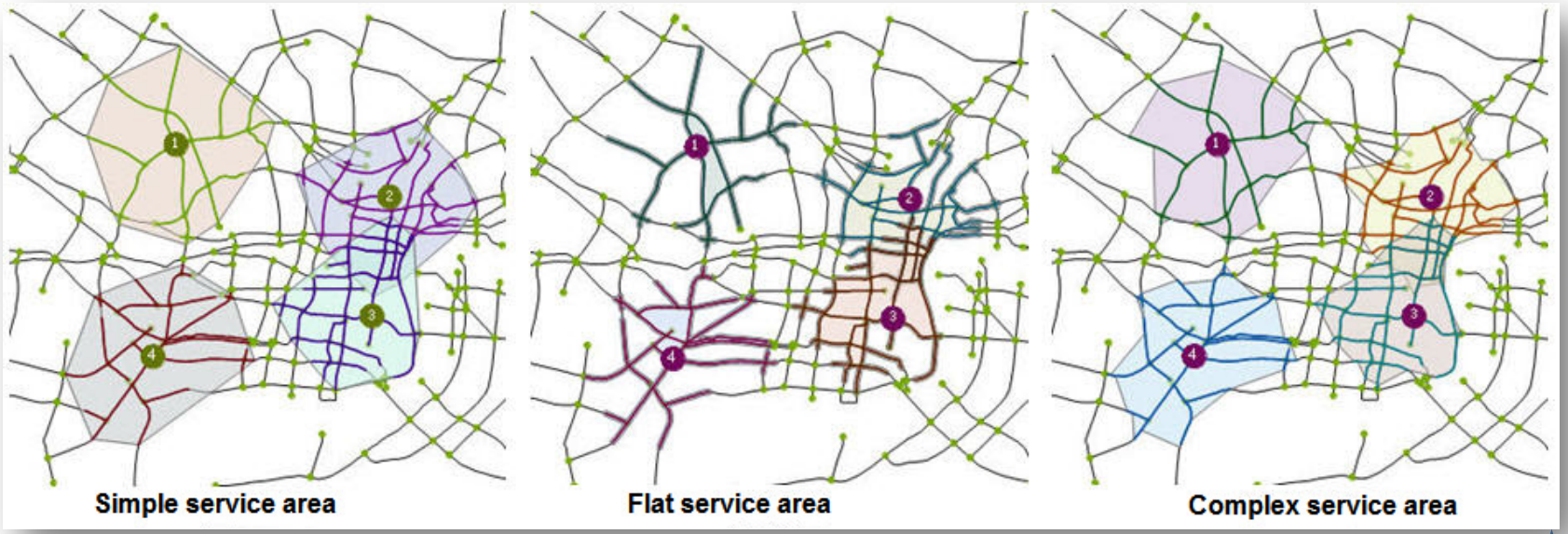
- a right location keeps costs low and accessibility high, for maximizing profit and high-quality service
- the analysis takes into account facilities that provide goods and services, and where those good and services are consumed



Network modelling in vector GIS

Service Area

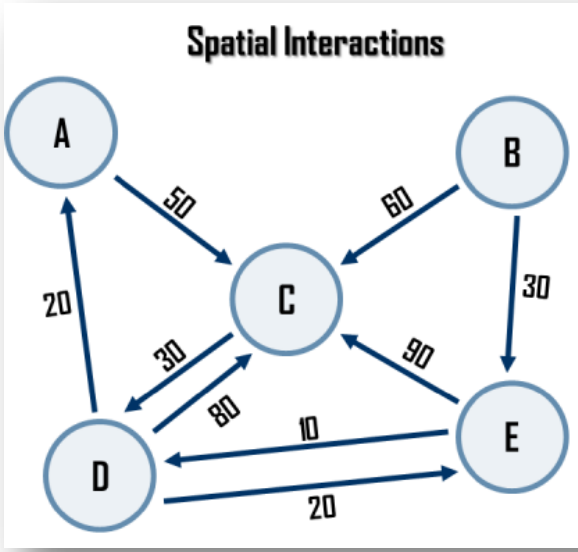
- a network service area is a region that can be reached from a location within a given travel time or travel distance



Network modelling in vector GIS

Origin–Destination (O-D) Cost Matrix

- the O-D cost matrix produces a distance table, with least-cost paths along the network from many origins to many destinations
- the cost values reflect the network distance, not the straight-line distance

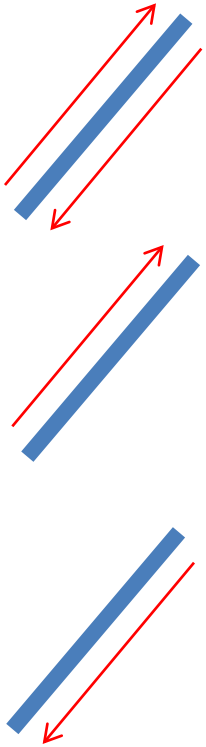


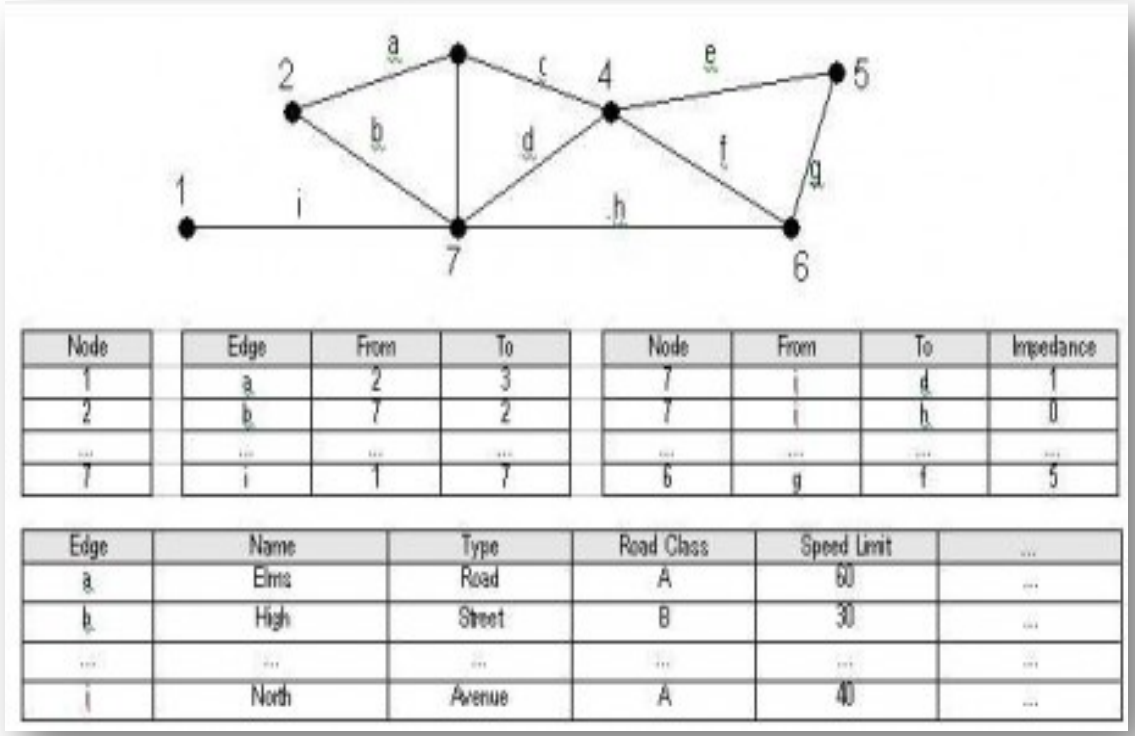
O/D Matrix

	A	B	C	D	E	Ti
A	0	0	50	0	0	50
B	0	0	60	0	30	90
C	0	0	0	30	0	30
D	20	0	80	0	20	120
E	0	0	90	10	0	100
Tj	20	0	280	40	50	**390**

Network modelling in vector GIS

Arcs and nodes [stops, centres, turns, barriers] + topology

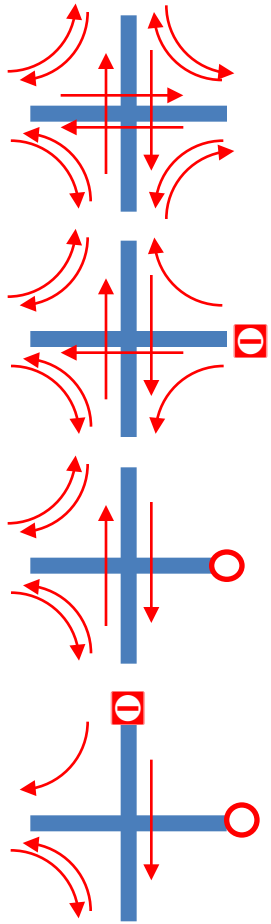




Node	Edge	From	To
1	a	2	3
2	b	7	2
...	...	...	...
7	i	1	7

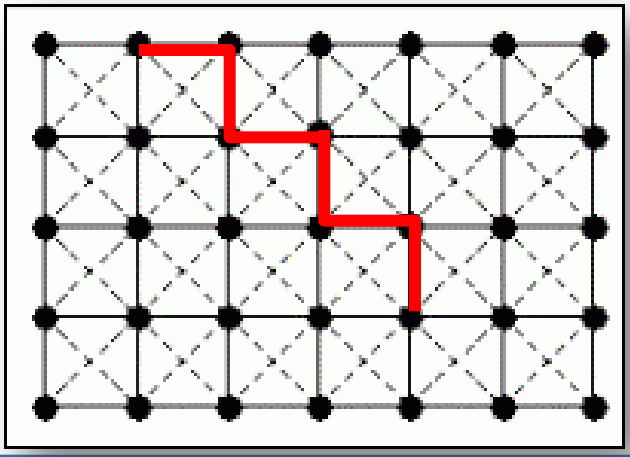
Node	From	To	Impedance
7	i	d	1
7	i	h	0
...	...	...	...
6	g	f	5

Edge	Name	Type	Road Class	Speed Limit	...
a	Elms	Road	A	60	...
b	High	Street	B	30	...
...	...	...	...	...	...
i	North	Avenue	A	40	...



Network modelling in raster GIS

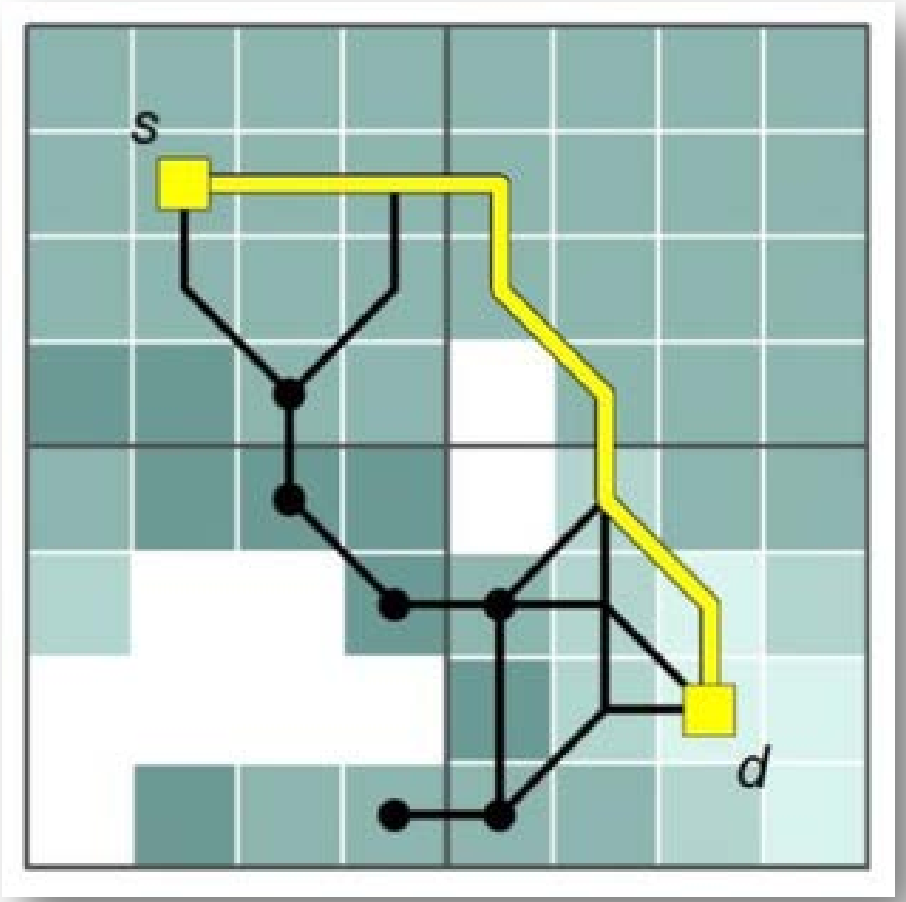
- the grid cells only approximate the exact shapes of the lines in the network
- direction is not explicitly given
- the line and node attributes must be stored as a separate layer for each attribute (a network normally consists of a vast number of layers)
- a grid is in fact a graph representing a network, with 8 possible directions from each node



Network modelling in raster GIS

Layers needed:

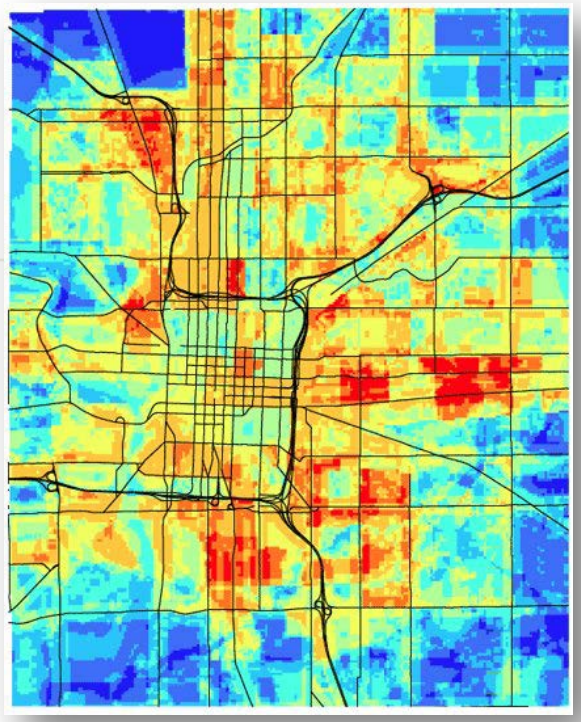
- network
- cost surface
- origin and destination point

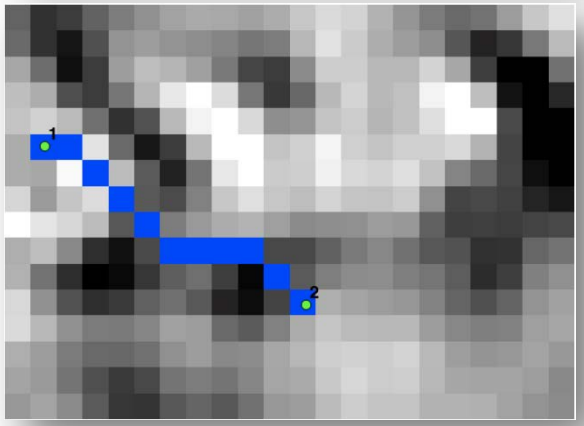


Path finding in raster GIS

Raster GIS software computes the least path as follows:

- the spread function employs the **cost surface** to calculate the cost of passing from the origin outward towards the destination and assigns the accumulated value to each cell that is passed
- the reverse is done, going from destination to origin
- adding the two accumulated together yields the least-cost path





Conclusions

- **vector** data model is **feature** oriented
- **raster** data model is **location** oriented
- **vector-based network model** is more suitable for analysing **precisely defined paths**, such as roads and rivers or drainage canals (discrete entities that derive mainly from the built environment, and where attributes play a major role in determining the network)
- **raster-based network model** is more fit, when the problem is concerned with finding **a path across terrain** (that does not have predefined paths and where the network does not consist of many attribute layers and artificial directional constraints) because that will make the modelling process more complex

DĚKUJI ZA POZORNOST.