# Spatial Networks

Learning Objectives

- After this segment, students will be able to
    - Describe societal importance of spatial networks
    - Limitations of spatial querying for spatial networks

Navigation Systems

- Historical
  - Navigation is a core human activity for ages!
  - Trade-routes, Routes for Armed-Forces
- Recent Consumer Platforms
  - Devices: Phone Apps, In-vehicle, "GPS", …
  - WWW: Google Maps, MapQuest, …
- Services
  - Display map around current location
  - Compute the shortest route to a destination
  - Help drivers follow selected route
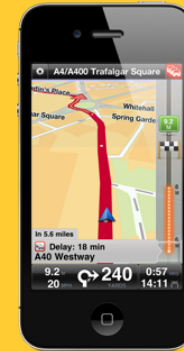
Location Based Services

- <u>Location:</u> Where am I ?
  - Geo-code: Place Name (or Street Address) → <latitude, longitude>
  - Reverse Geo-code: <latitude, longitude> → Place Name

- <u>Directory:</u> What is around me?
  - Where is the nearest Clinic? Restaurant? Taxi?
  - List all Banks within 1 mile.

- <u>Routes:</u> How do I get there?
  - What is the shortest path to get there?
  - …

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Spatial Networks & Modern Society

- Transportation, Energy, Water, Communications, …

Source: http://www.dhs.gov/files/programs/gc_1189168948944.shtm

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Limitations of Spatial Querying

- ## OGIS Simple Feature Types
  - Supports Geometry (e.g., Points, LineStrings, Polygons, …)
  - However, lack Graphs data type, shortest_path operator

- ## Traditional SQL
  - Supports select, project, join, statistics
  - Lacked transitive closure, e.g., network analysis (next slide)
  - SQL3 added recursion & transitive closure

Spatial Network Analysis

- <u>Route</u> (A start-point, Destination(s))
  - What is the shortest path to get there?
  - What is the shortest path to cover a set of destinations?

- <u>Allocation</u> (A set of service centers, A set of customers)
  - Assign customers to nearest service centers
  - Map service area for each service center

- <u>Site Selection</u> (A set of customers, Number of new service centers)
  - What are best locations for new service centers ?