Spatial Analysis and Visualization

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Spatial Analysis

Most human activities and interests are related to locations.

Areas and buildings have specific purposes.

So, most created data are related to location in some way.

Location-related data is also called spatial data or geospatial data.

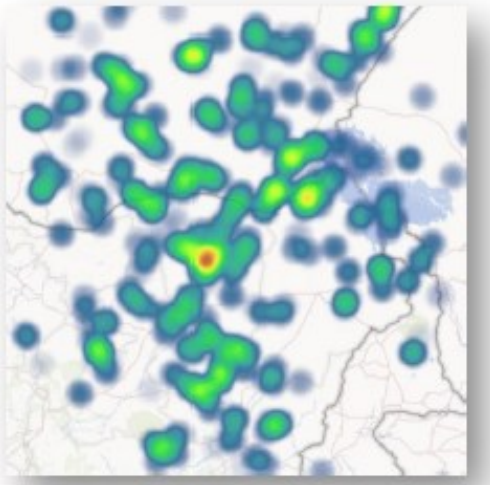
Spatial analysis is a process to gain insight from location-related data and solve location-related problems.

"Everything is related to everything else, but near things are more related than distant things."
The first law of geography, Waldo Tobler, 1970.

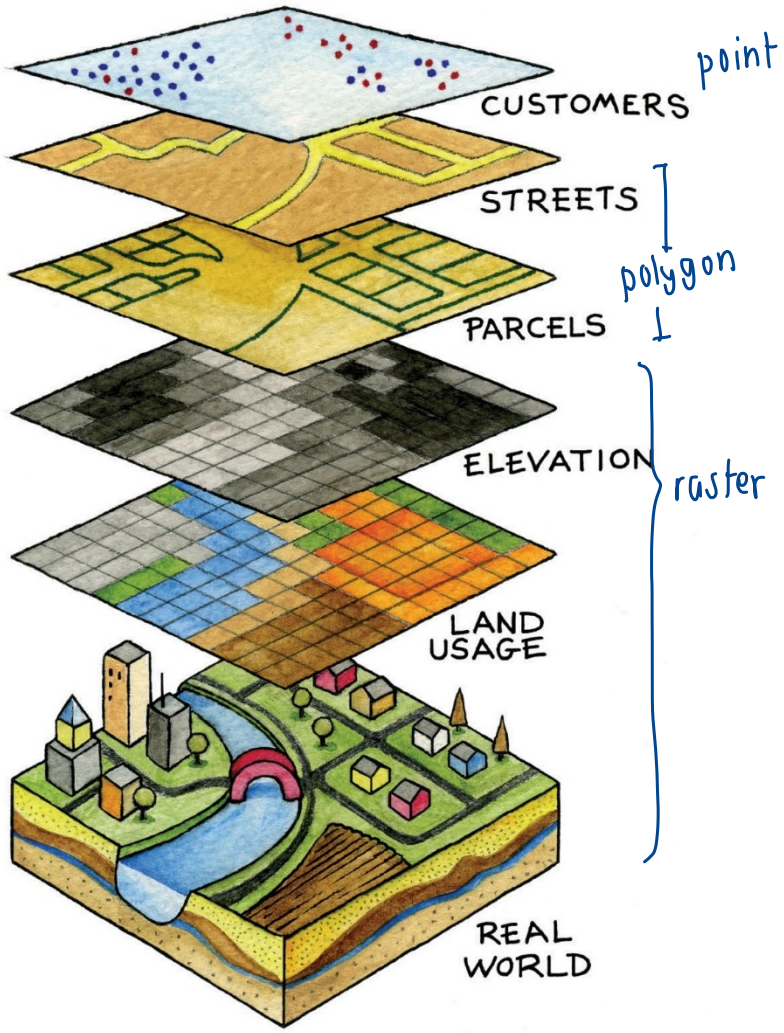
Map

Map is the primary visualization method for spatial data and an effective tool for spatial analysis.

Latitude	Longitude	PlaceName	Death
13.58801	11.0956	P1	0
9.878124	12.55918	P2	4
14.65398	10.18044	P3	0
15.22057	9.993003	P4	5
13.16265	12.96319	P5	4
13.80617	8.889046	P6	2
13.10214	10.56081	P7	4
11.00403	11.86713	P8	2



Geospatial Data Layers



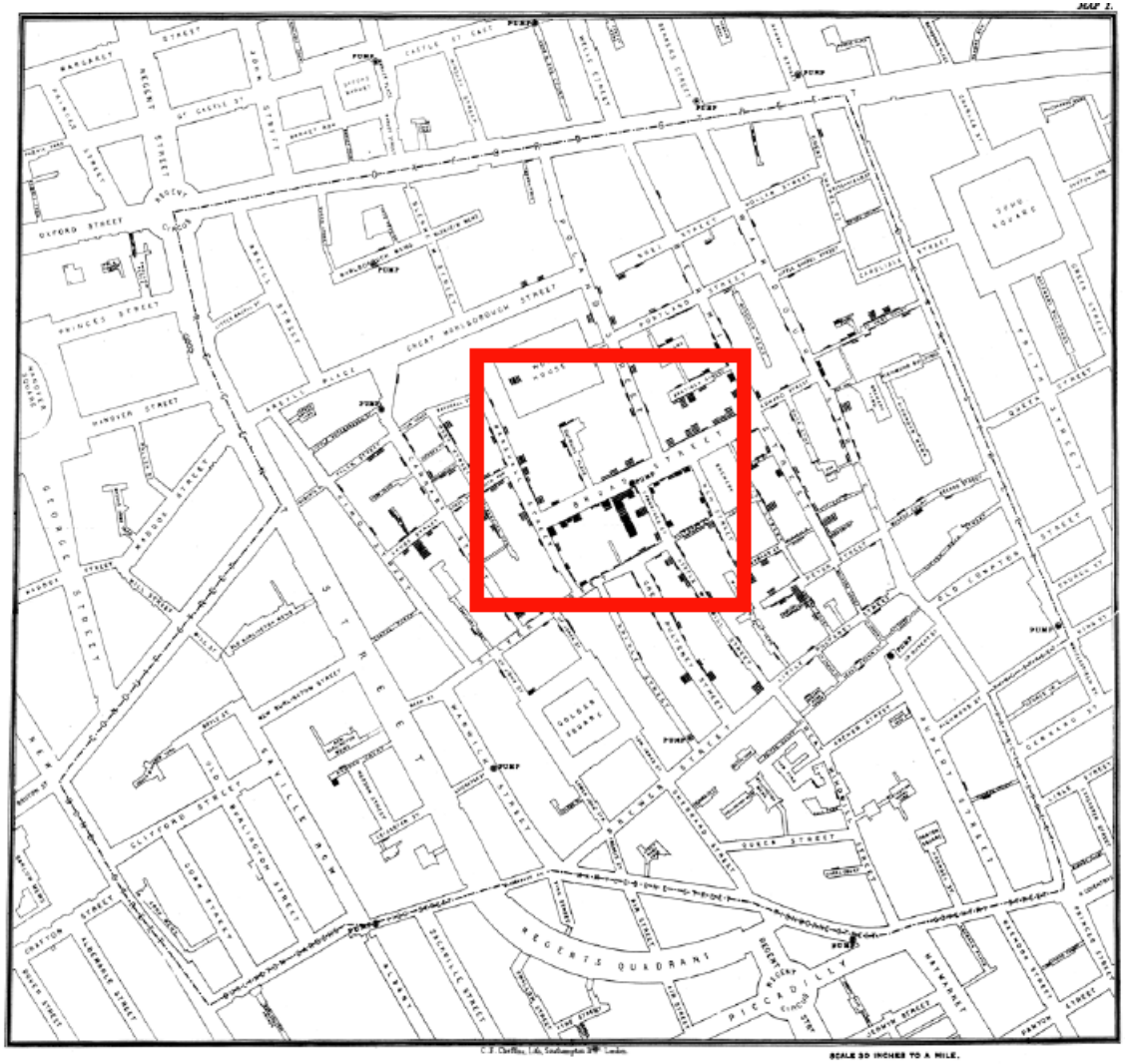
All geospatial datasets refer to locations on Earth.

So, they can be overlaid.

Basic Types of Spatial Data

- Points
- Lines
- Polygons
- Raster (image)

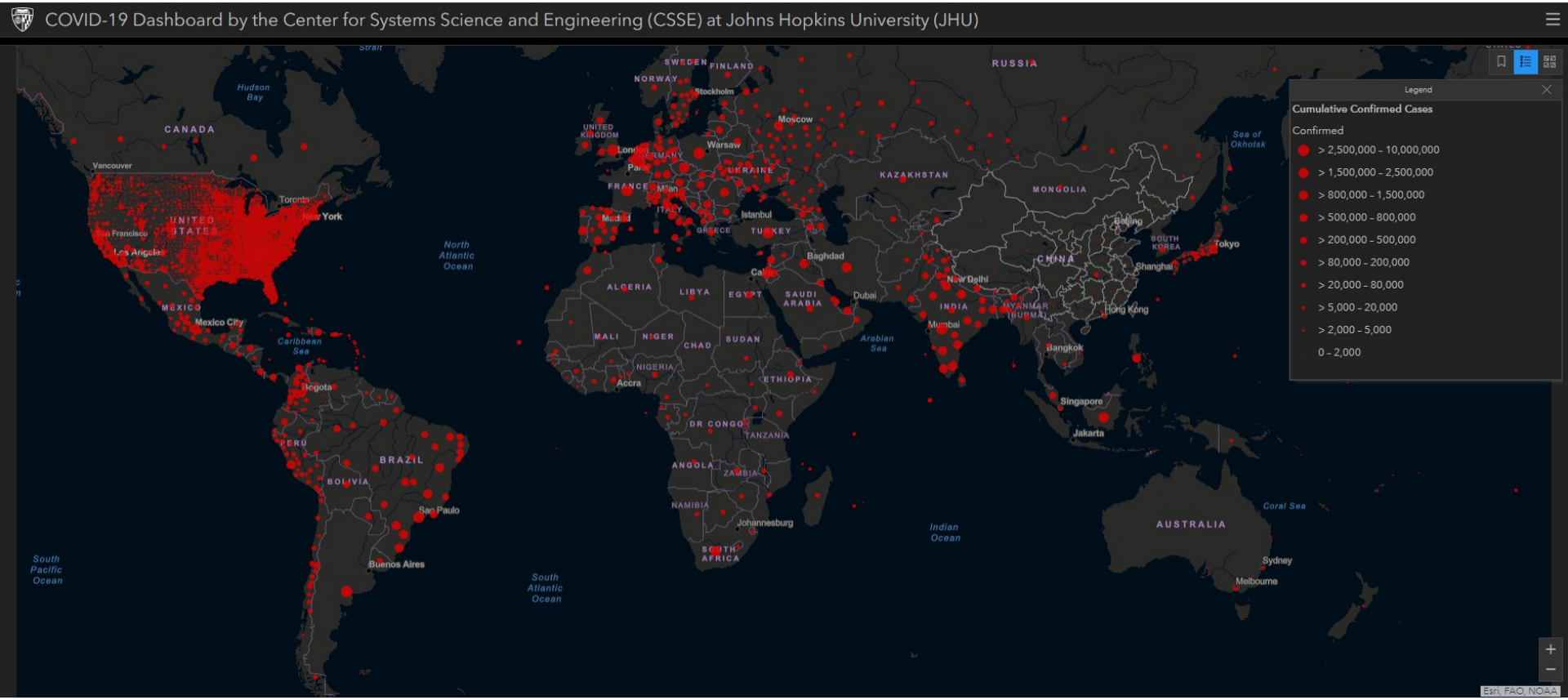
Classic Example: Dr.John Snow's Cholera Map (1855)



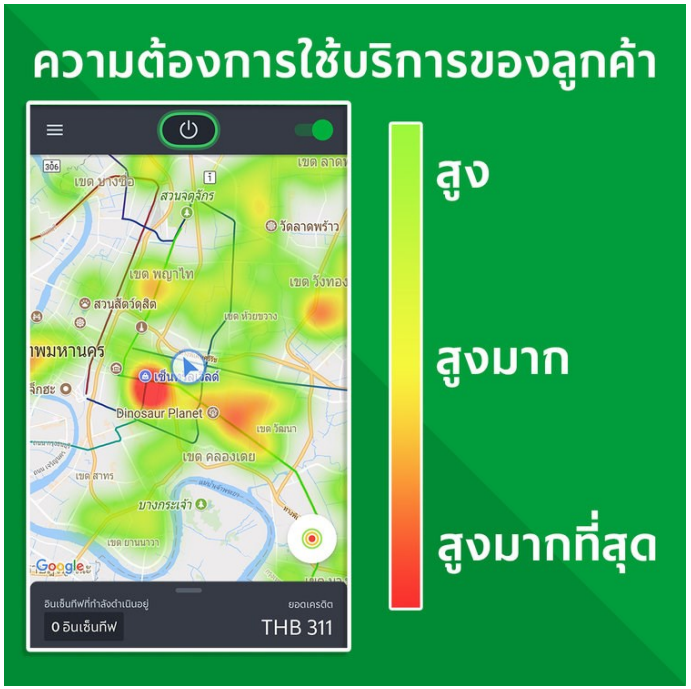
To stop the outbreak of cholera in London in 1854, **Dr. John Snow marked the cholera deaths on a map**. This map visualization indicated that the water from a pump on **Broad Street** was to blame as a large number of deaths were marked close to that pump. Snow's visualization is one of the most important early examples of epidemiology, that **clearly linked cholera's spread to water and not air**.

Snow, 1855 in
On the Mode of Communication of Cholera

COVID-19 Map (2021)



HeatMap of service demands for Grab drivers



https://grabdriverth.com/grabschool-2/heatmap

With modern mapping techniques, everywhere, out-door and in-door, will be on high-resolution map.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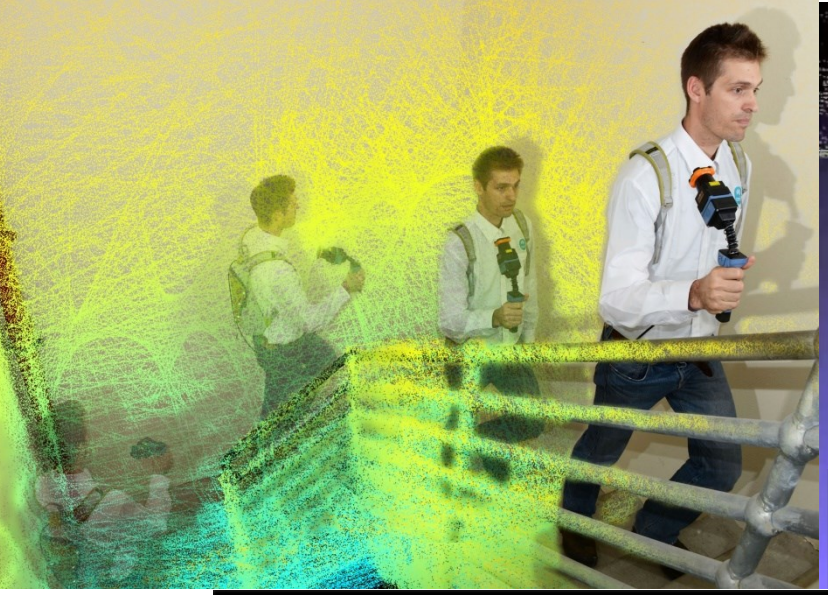
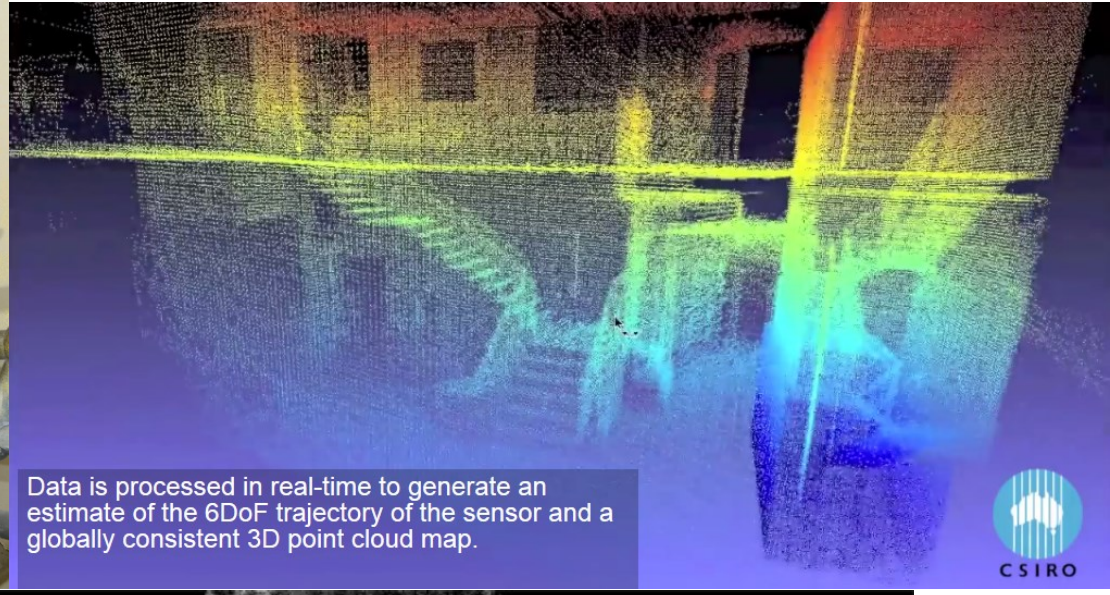
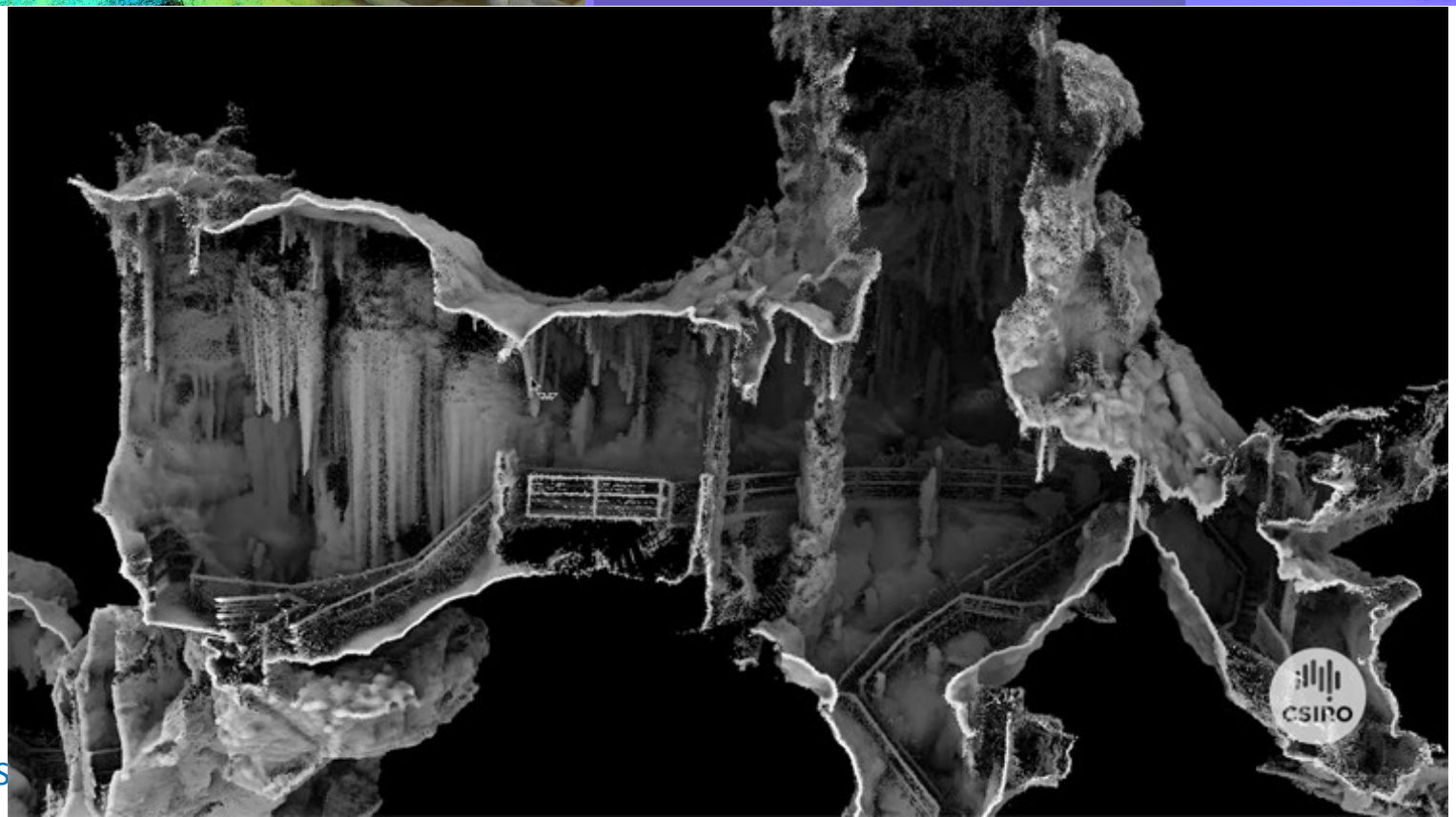
Google maps
Street View



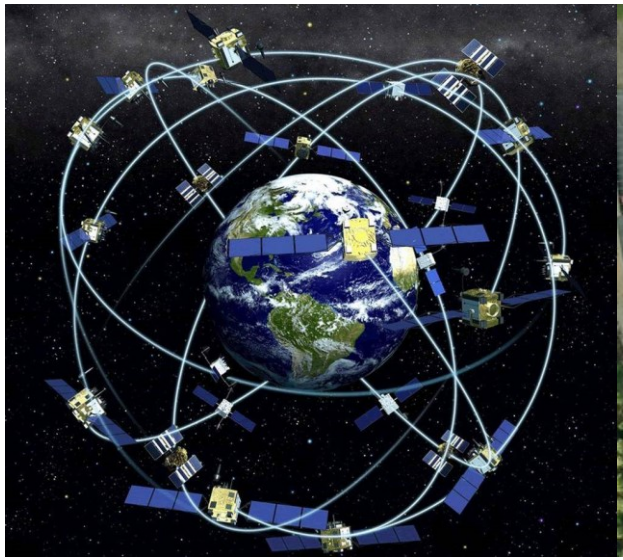

Data is processed in real-time to generate an estimate of the 6DoF trajectory of the sensor and a globally consistent 3D point cloud map.
CSIRO


CSIRO

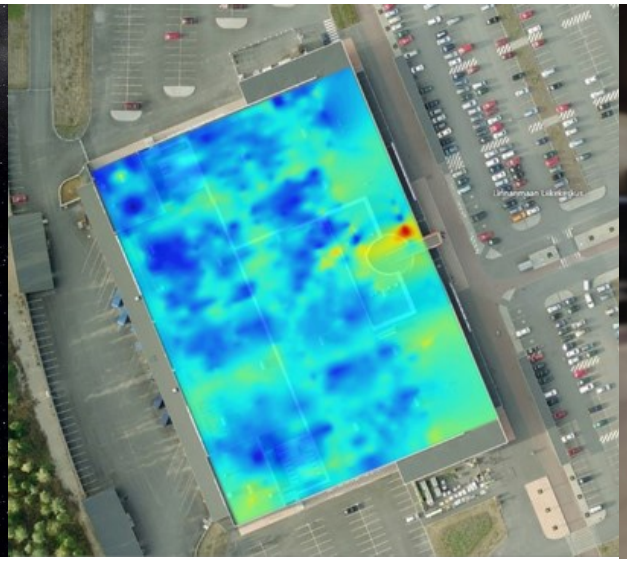
With modern positioning techniques, everything can be located.

Location Technologies

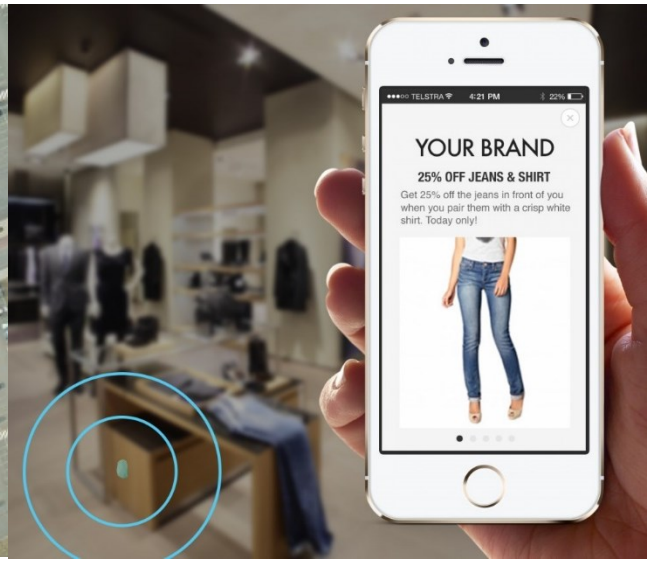
GPS



WiFi



Bluetooth/Beacon



Types of Location Data

- Coordinates (latitude, longitude)
- Place name, street address
- Proximity of reference point (WiFi access point id, cell tower id)

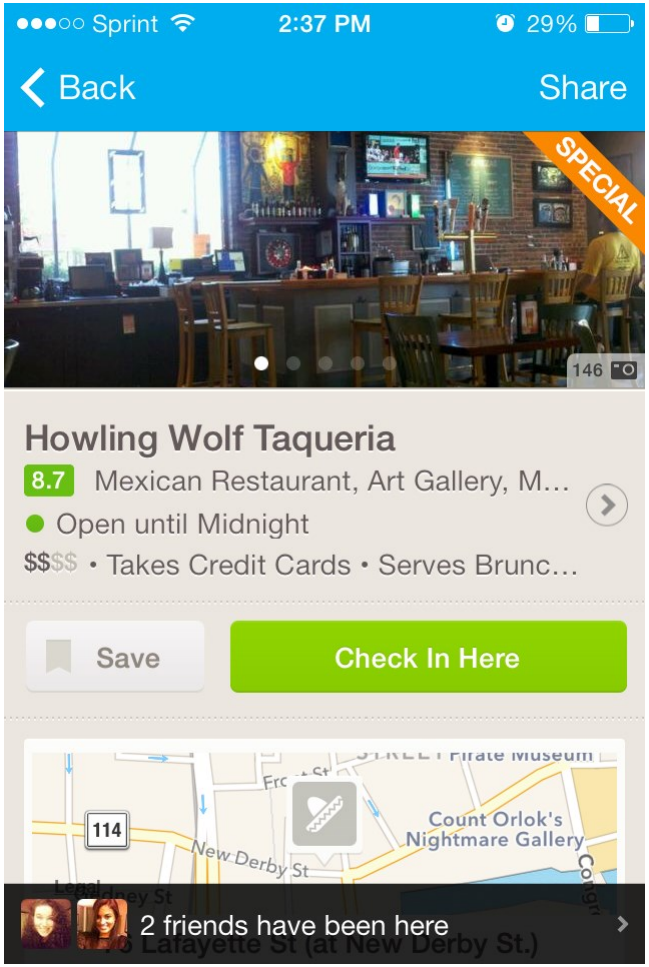
- Location + Time → changes, movement

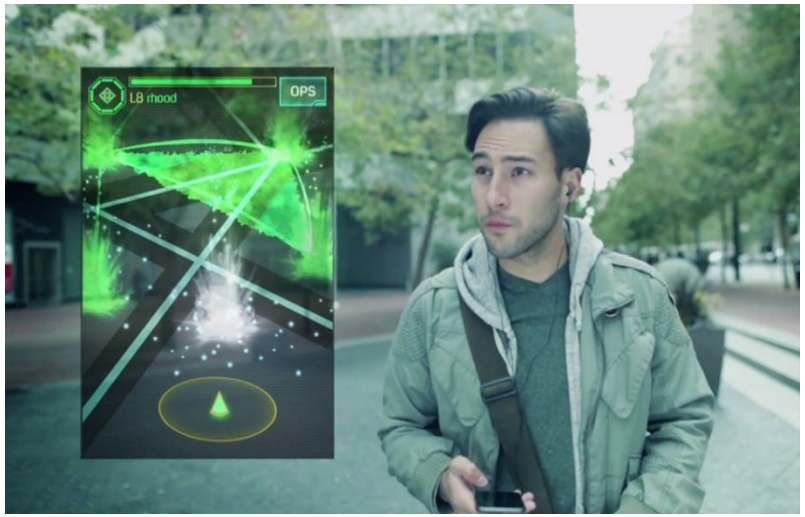
Sources of Location Data

- Moving sources
  - People (carry-on and wearable devices)
  - Vehicle
  - Robot
- Stationary sources
  - Sensor
  - Network Access Point
  - Point of Sale

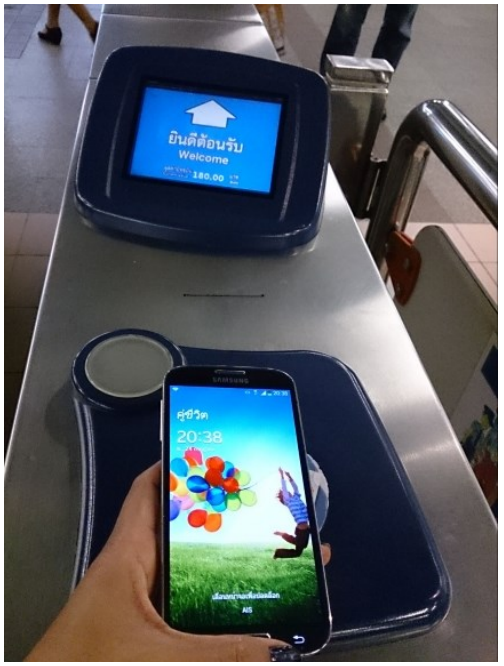
Any kind of smart devices with known locations can be used as **sensors** that collect geospatial data.

People as Sensors





Sensors in Transportation



Financial Activity Sensors

GZPDA07

1. Wifi
2. Bluetooth
3. 3G/4G
4. Printer
5. NFC
6. GPS
7. Camera

Geospatial Applications

- Navigation, route planning
- Customer geodemographic segmentation
- Targeted marketing
- Branch/facility location selection
- Real estate valuation / risk assessment
- …