How to Use APIs to Build GIS, Mapping and Location Applications

ProgrammableWeb recently published an article featuring the [top 10 mapping category APIs](). Most of the APIs featured in the article are for accessing map libraries or geographic data/content. However, the [mapping category]() includes APIs for programmatically accessing map libraries, geographic data sources, geographic information system and spatial analysis software, location intelligence solutions, indoor venue maps and more.

Many companies not only provide APIs for developers, but also provide easy-to-use [GIS]() and mapping solutions that make it possible for users with very little technical knowledge to create beautifully designed static, interactive or animated maps. No matter where you go on the Web these days you're bound to find a map, all thanks to the availability of easy-to-use GIS solutions and APIs.
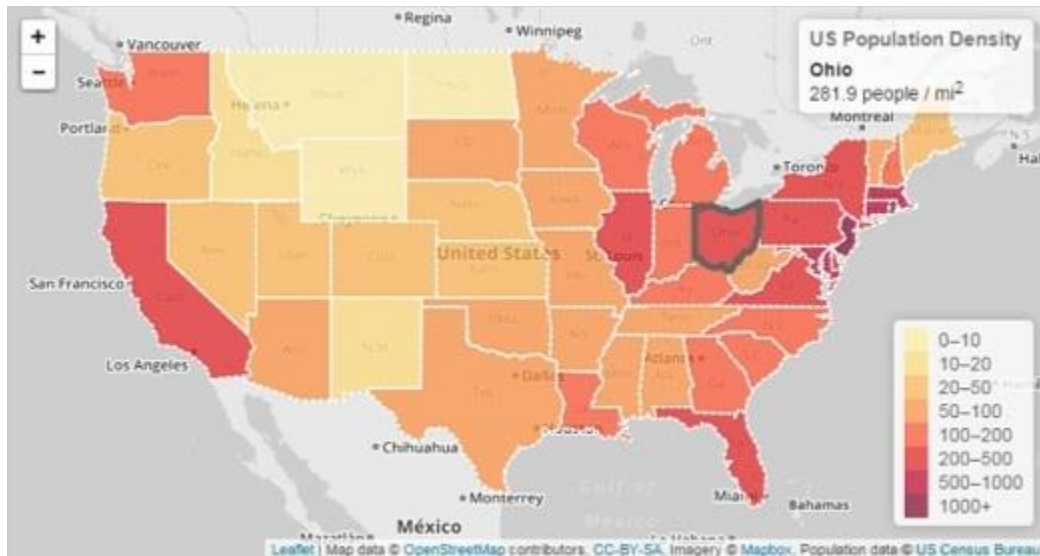
You can find maps on government open data websites like the [DublinDashboard](), which features a variety of Web maps that provide information for public transportation, housing, city planning and more. The [city of Boston website]() features a nice selection of city data Web maps and a mapping application that citizens can use to estimate the cost of installing rooftop solar panels.

You can find maps in applications for calculating commuting distances like the [EV Explorer Web app](), which uses maps to help calculate how much money people would save if they drove an electronic vehicle. [ORBIS: The Stanford Geospatial Network Model of the Roman World]() Web app uses maps to provide the costs of different types of travel in antiquity across the Roman Empire.

Maps are everywhere and not just all over the Web. Maps can be found on smartphones, smartwatches, automobile dashboards, indoor kiosks, outdoor kiosks and more. Maps are being used by millions of people around the world every day.

This article highlights different types of GIS, mapping and location-based solutions. This article does not highlight low-level libraries such as [D3.js]() and [Three.js](), which can also be used for map visualization.
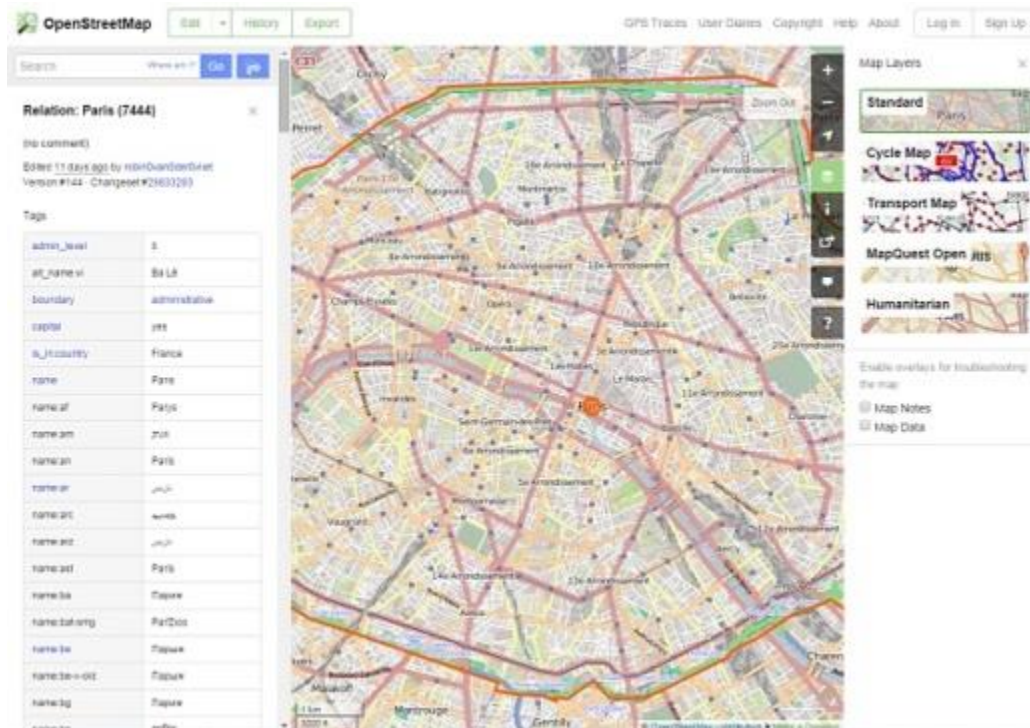
Map Libraries

[Leaflet](#) is an open source JavaScript library for building interactive maps. A [Leaflet API](#) can be used with other map libraries.

Most map libraries have a basic display model of one basemap with options that can include map layers, cartographic styles, map controls, customization via CSS and zoom animation. Map layers can include vector objects, image overlays, tiles, markers pop-ups and other features.

Many companies provide map libraries that can be used to add interactive maps to Web pages and mobile applications. Popular map libraries include [amMap](#), [ArcGIS](#), [CartoDB](#), [GIS Cloud](#), [Google Maps](#), [HERE](#), [Leaflet](#), [Mapbox](#), [MapQuest](#) and [OpenLayers](#).
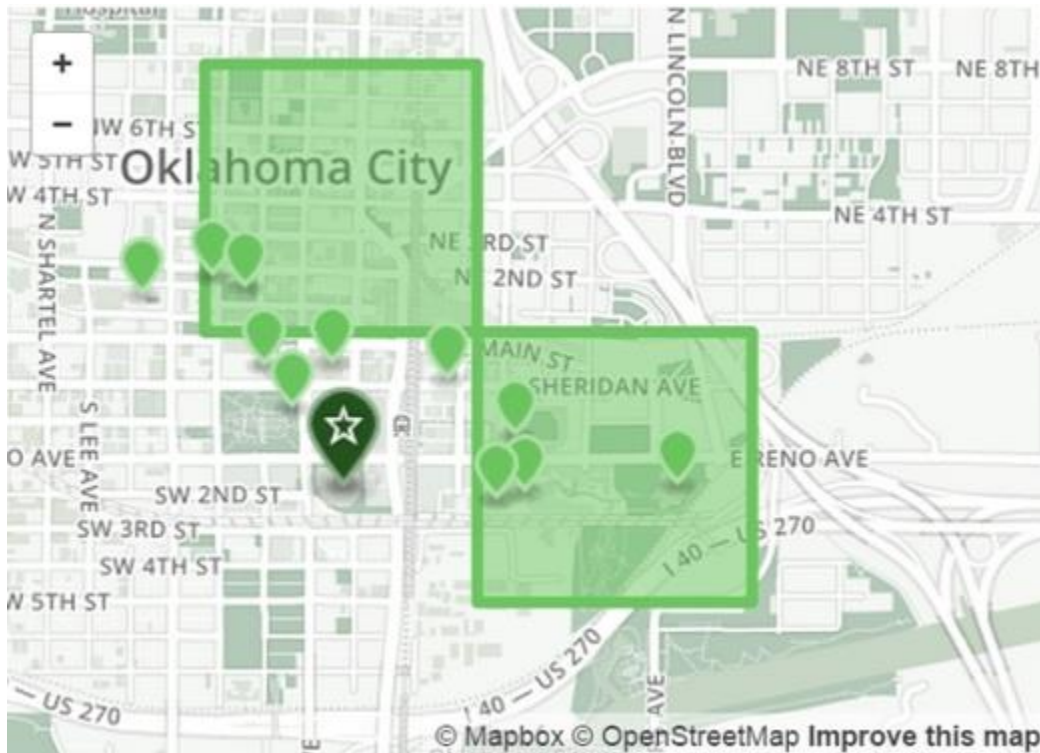
Geographic Data/Content and Services

OpenStreetMap is an open-content, collaborative project that provides a free, editable map of the whole world. The OpenStreetMap API can be used to retrieve and/or save raw geodata to the OpenStreetMap database.

Many companies provide geocoding services, routing services and/or geographic content. Geocoding takes location information like a street address and converts it into spatial data that can be displayed as a feature on a map. Routing services are used primarily for turn-by-turn directions and sometimes include detailed road attributes.

Content can include ready-to-use maps and data sets containing various types of information such as demographic, transportation, terrain and imagery.

A few examples of platforms that provide geocoding services, routing services and/or geographic content
include ArcGIS, Foursquare, HERE, Mapbox, MapQuest, OpenStreetMap and Yahoo BOSS.
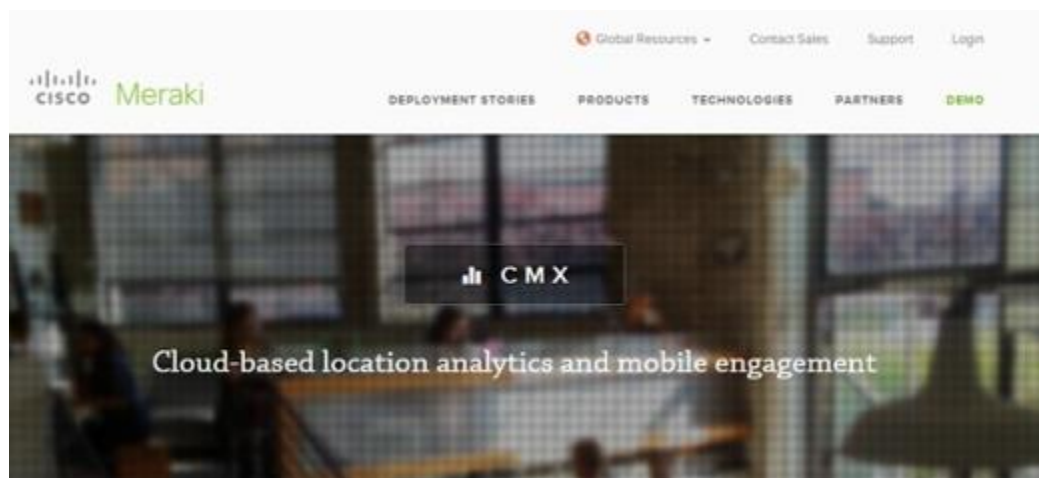
GIS and Spatial Analysis

Turf is a JavaScript library for advanced geospatial analysis. The Turf APIcan perform a wide variety of aggregation, measurement and transformation functions.

Geographic information system software allows users to capture, store, analyze, visualize and manage geographic information. Most GIS solutions feature spatial analysis capabilities and are able to analyze spatial data to uncover patterns, relationships, trends and other new information. GIS and spatial analysis software examine locations, objects, object attributes and relationships of features in spatial data using a variety of analytical techniques in order to provide valuable insights or address specific questions.

Applied Geographics, ArcGIS, CartoDB and Mapbox are just a few examples of platforms that feature GIS and spatial analysis capabilities. Open source jQuery plug-in jQuery Geo also includes geospatial functions. Turf is a JavaScript library for advanced geospatial analysis for browsers and Node.js.

Location Intelligence and Analytics

[Cisco CMX](#) (Connected Mobile Experiences) is a location analytics platform built into Cisco Meraki APs. The [Cisco CMX API](#) is a real-time, cloud-based API that allows feed data to be integrated with third-party applications.
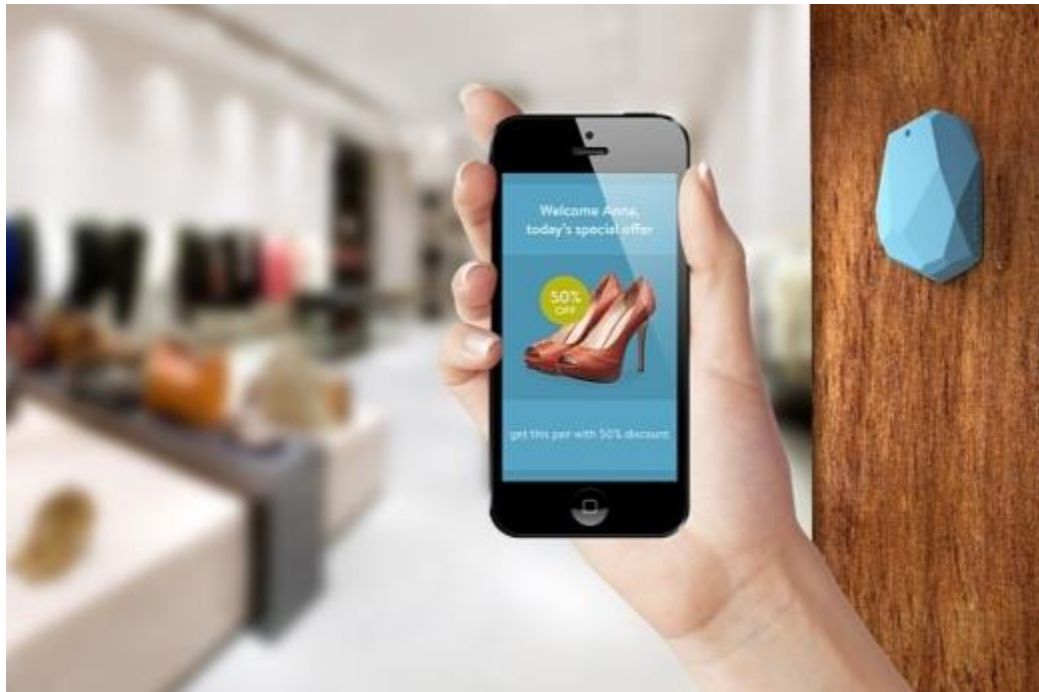
Location intelligence software is used to discover meaningful insights from the geographical relationships found in most information. Objects such as businesses, points of interest and geographic regions are analyzed along with their spatial attributes.

Most location intelligence solutions feature location analytics capabilities. Location analytics is used to find new patterns, geographical trends, location-based behaviors and other geographical/location-based insights from data.

Companies that provide location intelligence and/or analytics platforms include [Cisco](#), [Esri](#), [Galigeo](#), [GIS Cloud](#), [HERE](#), [Pitney Bowes](#), [SAP](#), [SAS](#), [Tableau](#), [Tibco](#) and [Ubisense](#).
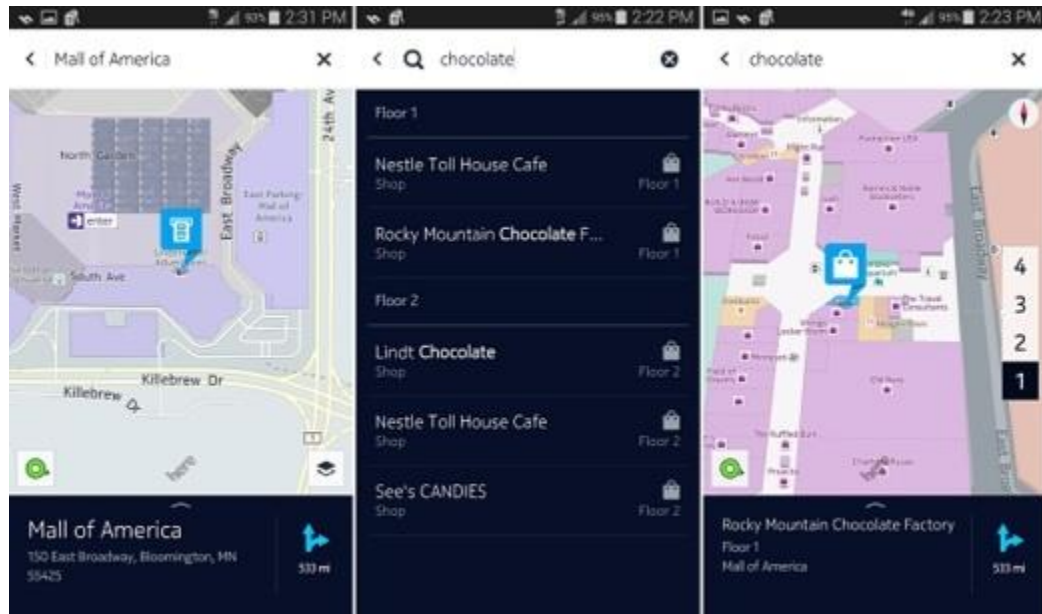
Indoor Positioning

Estimote provides beacons and stickers, which are wireless sensors that can be attached to any location or object. They broadcast tiny radio signals that can be picked up by smartphones, and a compatible app then triggers different actions (welcome to store, etc.). Estimote provides an API and several SDKs. Image credit: Estimote

A recent MarketsandMarkets report estimates that the global indoor location market will reach $3.9 billion by 2019. This market includes indoor positioning, navigation, maps, location-based analytics and other applications. The widespread adoption of smartphones by consumers worldwide has led to the advent of new indoor location technologies and an increased demand for indoor location-based applications. Indoor positioning technologies allow the location of a person or an object to be detected using GPS, Wi-Fi, Bluetooth, beacons, magnetic fields and other location-detection methods.

Many companies provide indoor positioning solutions, such as Apple, Cisco, Esri, Estimote, GISi Indoors, Google (Project Tango), IndoorAtlas, Meridian Apps, Micello, Qualcomm, VisioGlobe and Wifarer.

Indoor Venue Maps

HERE (a Nokia company) provides indoor maps for more than 90,000 buildings across 11,000-plus venues. HERE also powers Bing and Yahoo maps. HERE provides JavaScript APIs, REST APIs, Mobile SDKs and other tools for developers.

The widespread adoption of smartphones by consumers worldwide has not only led to the advent of new indoor location technologies but also the increasing popularity and use of indoor venue maps. In the last several years, leading mapping technology companies have been competing to bring tens of thousands of high-quality indoor venue maps to smartphone users. There are indoor venue maps for thousands of museums, airports, shopping malls, restaurants and other venues.

A few examples of companies that provide indoor venue maps are Google, HERE and Micello. At the time of this writing, Apple was working on building iBeacon, a technology to extend location services in iOS that can be used to create indoor venue maps.
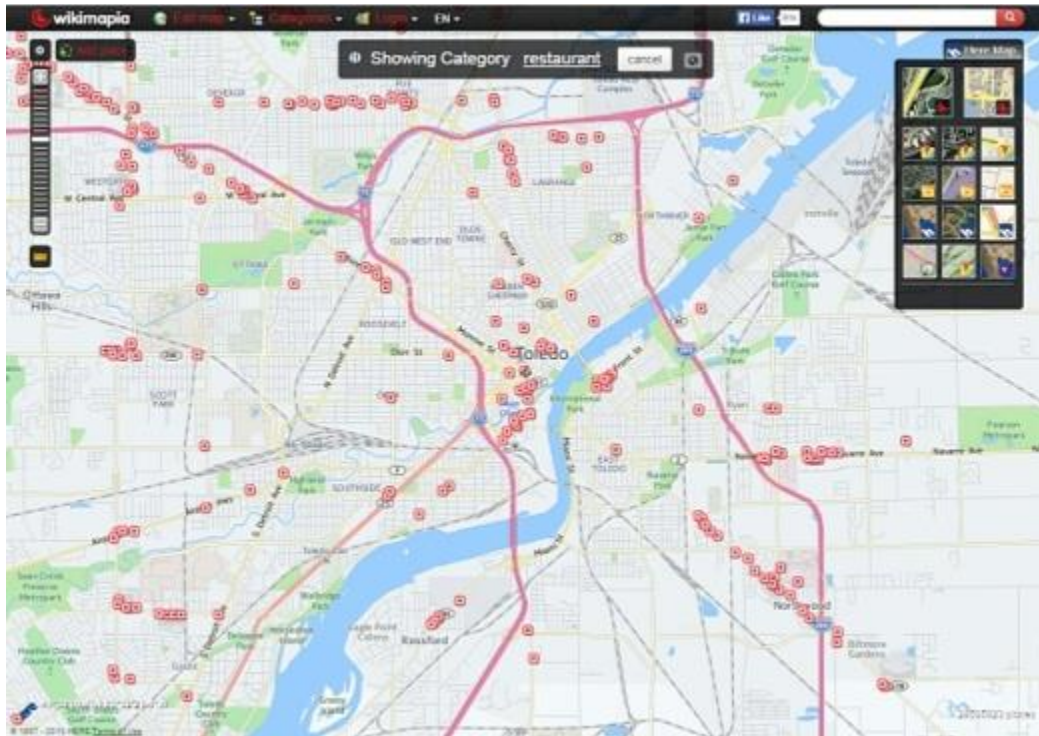
Story Maps

The Geological Society of London used the ArcGIS Story Map App to create a story map that features geosites located in the U.K. and Ireland. ArcGIS for Developers features a JavaScript API, REST APIs, runtime SDKs and more.

A story map is an interactive presentation that can be used to tell a story in a geographic context. Story maps include Web maps and text and often include other digital content such as video, images and audio. Quite a few story map products are available, and many are free to use. Some story map products include a variety of templates and an easy-to-use story map builder for nontechnical users. Some story map products include features for developers such as JSON data import, customization using CSS or JavaScript, and an API for embedding the story map in a Web page or application.

ArcGIS Story Map App, NatGeo Mapmaker Interactive, Odyssey.js, StoryMap JS, TimeMapper and uMap are just some examples of story map products available today.

Crowdsourced Mapping Projects

[Wikimapia](#) is an open-content collaborative mapping project where participants can add or edit place tags and descriptions. Place tag categories include stores, restaurants, parks and lakes. The [Wikimapia API](#)allows applications to retrieve data from Wikimapia maps.

A relatively recent and increasingly popular trend is the crowdsourcing of applications and devices. Crowdsourced projects related to [weather](#) and mapping are especially popular. Many crowdsourced mapping projects have very large and active communities that range from hobbyists to seasoned GIS professionals. Crowdsourced mapping projects can involve contributing imagery, basemap layers, demographics, transportation and other content, as well as map data such as roads, trails, buildings and waterways.

There are quite a few active collaborative mapping projects, such as [ArcGIS Living Atlas of the World](#), [Google Map Maker](#), [HERE Map Creator](#), [OpenStreetMap](#), [Urban Observatory Project](#) and [Wikimapia](#).

3-D Visualization

The *Berliner Morgenpost* used ViziCities to demonstrate the potential redevelopment of an airfield in Berlin. ViziCities is an open source JavaScript 3-D city and data visualization platform. There is a ViziCities Blueprint API that is used to control data input and visualization output.

In recent years, 3-D modeling software has been growing in popularity right along with 3-D printing technology. 3-D modeling software can be used to build 3-D visualizations of cities, topographic maps, globes, and the interiors of buildings and other structures. Esri CityEngine and MapInfo Vertical Mapper (Pitney Bowes) are examples of 3-D modeling/mapping software.

JavaScript 3-D visualization libraries such as Cesium and ViziCities render maps with WebGL. Tangram is a mapping library that also renders 2-D and 3-D maps with WebGL. The Amazon Maps API v2 allows developers to create applications for Amazon devices that feature interactive 3-D maps and graphics.

Conclusion

The availability of APIs from companies like the ones mentioned in this article has allowed developers to build many innovative and engaging GIS, mapping and location-based applications. Thanks to the availability of easy-to-use GIS and mapping solutions, more and more people are building their own creative maps and sharing them on the Web or on mobile devices.

This is a great time for developers who want to use GIS and maps, and the future is going to be even greater.