

WEB TECHNOLOGY

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Geolocation & Location-based services

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Outline

1. Geolocation
2. Location Determination
3. Location-based services
4. Approaches

Geolocation



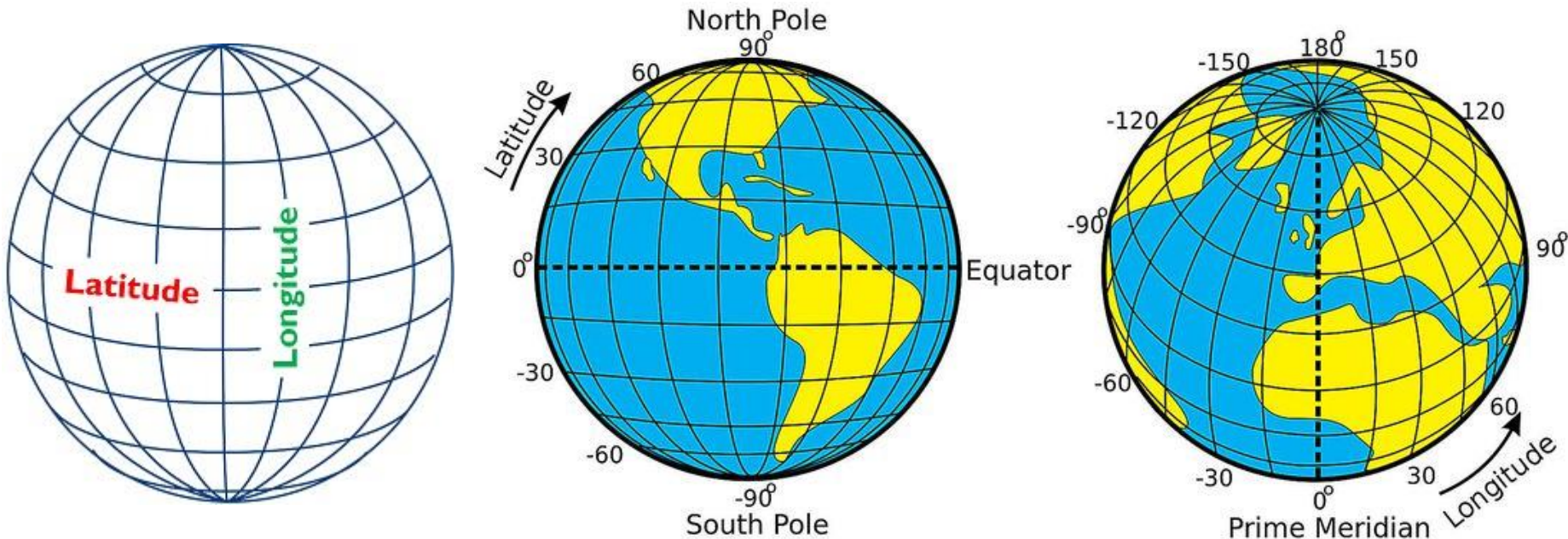
Geolocation is the identification or estimation of the real-world geographic location of an object, such as a radar source, mobile phone, or Internet-connected computer terminal.

Geolocation involves the generation of a set of geographic coordinates and is closely related to the use of positioning systems, but its usefulness is enhanced by the use of these coordinates to determine a meaningful location, such as a street address.

Latitude & Longitude Coordinates

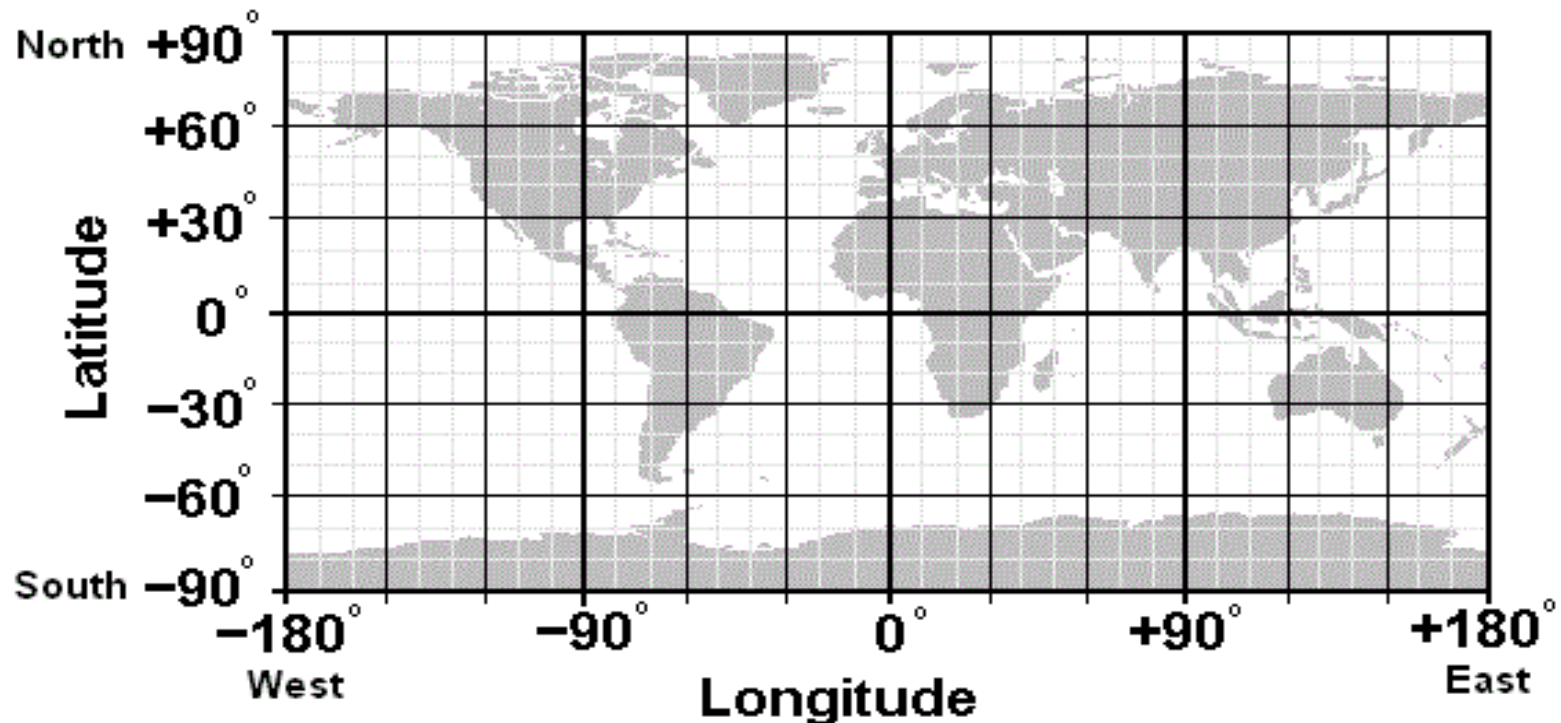
The location information consists primarily of a pair of **latitude** and **longitude** coordinates like the ones shown in the following example, which shows the coordinates for Faculty of Information Technology, located on the Lat Krabang district, Bangkok:

Latitude: 13.729418 , Longitude: 100.7830935



Latitude & Longitude Coordinates

The latitude (the numerical value indicating distance north or south of the equator is 13.729418) and the longitude (the numerical value indicating distance east or west of Greenwich, England) is 100.7830935.



Latitude & Longitude Coordinates

Latitude and longitude coordinates can be expressed in different ways:

- Decimal format (for example, 13.731154, 100.776809)
- Degree Minute Second (DMS) format (for example, 13°43'52.2"N 100°46'36.5"E)

In addition to latitude and longitude coordinates, **Geolocation** always provides the [accuracy](#) of the location coordinates. Additional metadata may also be provided, depending on the device that your browser is running on. These include altitude, altitude accuracy, heading, and speed.

Location Determination

2

Determining the location of a mobile device can be done in a variety of ways. The position is provided to the browser by the underlying device (for example, a laptop or a mobile phone).

The **Geolocation API** does not specify which underlying technology a device has to use to locate the application's user. Instead, it simply exposes an API for retrieving location information. What is exposed, however, is the level of accuracy with which the location was pinpointed. **There is no guarantee that the device's actual location returns an accurate location.**

Location Determination

A device can use any of the following sources:

- 1. IP address-based geolocation** works by automatically looking up a user's IP address and then retrieving the registrant's physical address. Therefore, the location is often resolved to the physical address of your service provider that could be **miles away**.
- 2. Wi-Fi-based geolocation** information is acquired by triangulating the location based on the user's distance from a number of known Wi-Fi access points, mostly in **urban areas**.

Location Determination

- 3. Global Positioning System** (GPS) can provide **very accurate location** results. A GPS fix is acquired by acquiring the signal from *multiple GPS satellites*. However, it can take awhile to get a fix, which does not lend itself particularly well for applications that must start up rapidly.
- 4. Cell phone-based geolocation** information is acquired by triangulating the location based on the user's distance from a number of cell phone towers. This method provides a general location result that is **fairly accurate**. This method is often used in combination with Wi-Fi- and GPS-based geolocation information.

Location Information

The pros and cons of geolocation data

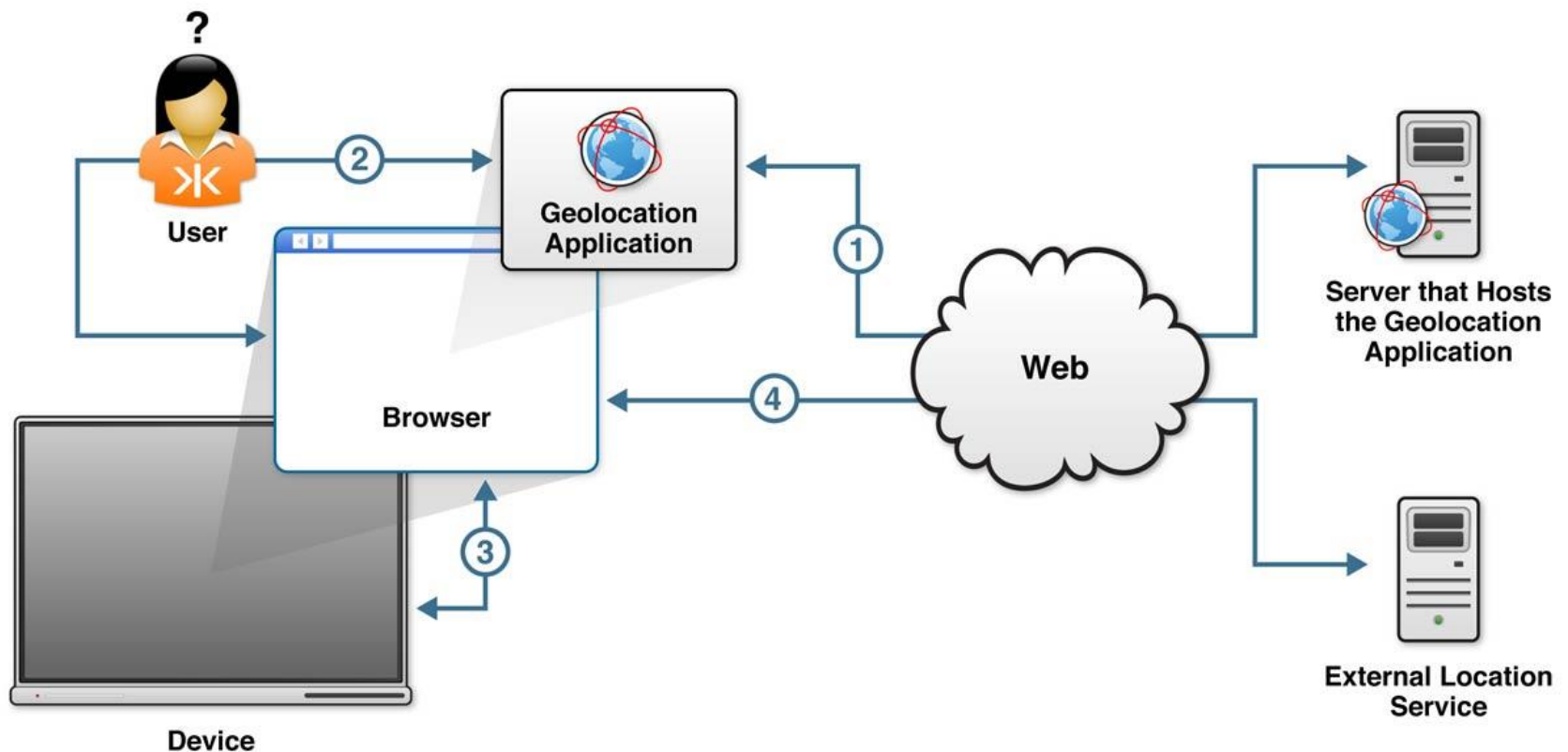
	Pros	Cons
GPS	<ul style="list-style-type: none">• Very accurate	<ul style="list-style-type: none">• Take a long time, can drain a user's device's batteries• Does not work well indoors• May require additional hardware
Wi-Fi	<ul style="list-style-type: none">• Accurate• Works indoors• Fix quickly & cheaply	<ul style="list-style-type: none">• Not good in rural areas with few wireless access points
Cell Phone	<ul style="list-style-type: none">• Fairly accurate• Works indoors• Fix quickly & cheaply	<ul style="list-style-type: none">• Requires a device with access to a cell phone or cell modem• Not good in rural areas with fewer cell phone towers
IP Address	<ul style="list-style-type: none">• Good enough for broad categorization such country, state, and city.• Available everywhere.• Processed on the server side	<ul style="list-style-type: none">• Not very accurate (wrong many times, but also accurate only to the city level)• Can be a costly operation

Browser Support & Privacy

- ❑ **Geolocation** was one of the HTML5 features to be fully embraced and implemented, and it is available in all the major browsers now.
- ❑ The Geolocation specification mandates that a mechanism is provided to protect the user's privacy. Furthermore, location information should not be made available unless the application's users grant their express permission.
- ❑ Location data of individuals must be considered as a constituent of privacy data, because data matching of location data with user ID or device ID, the location of a specific person would be specified.

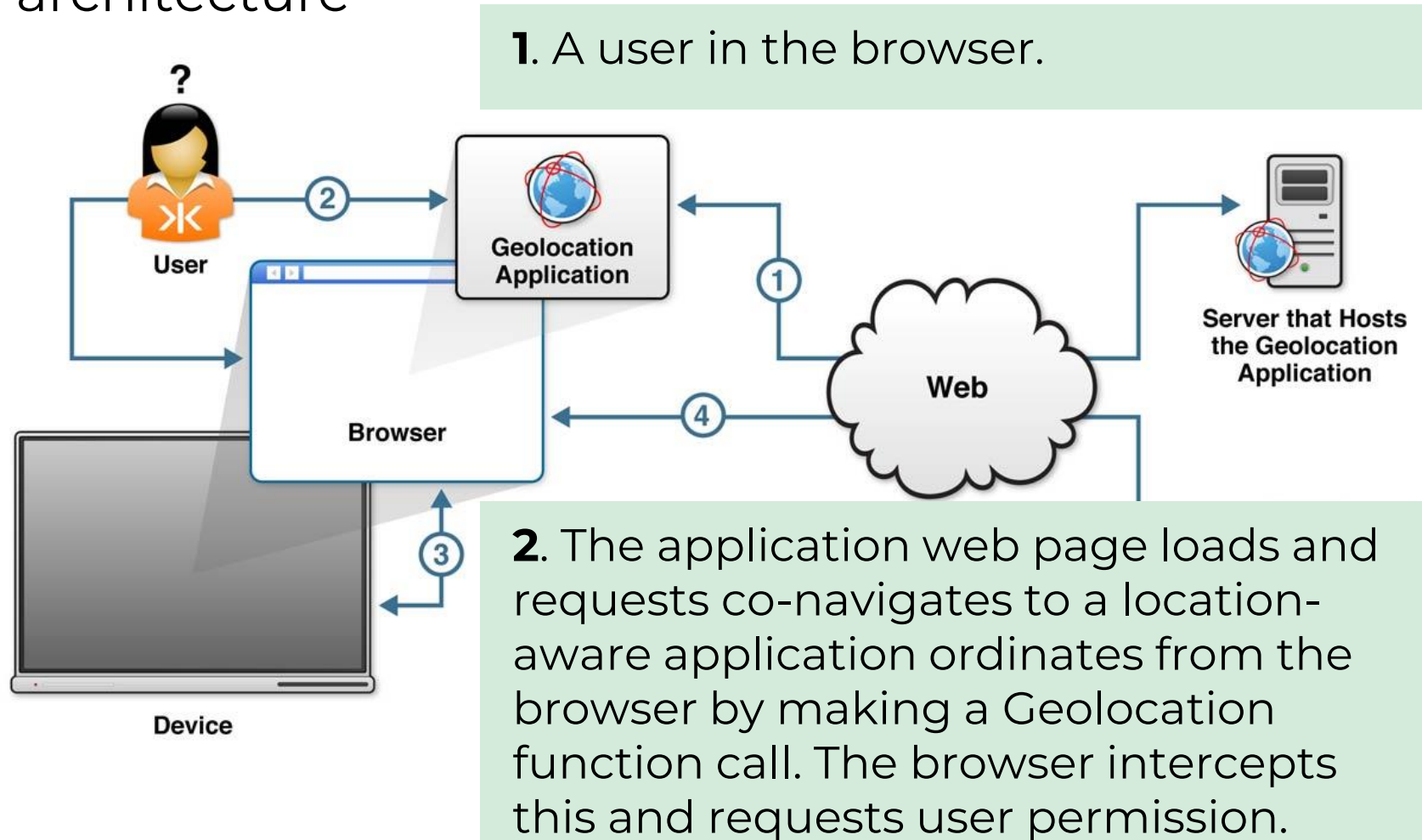
Browser Support & Privacy

Figure : Geolocation browser and device privacy architecture



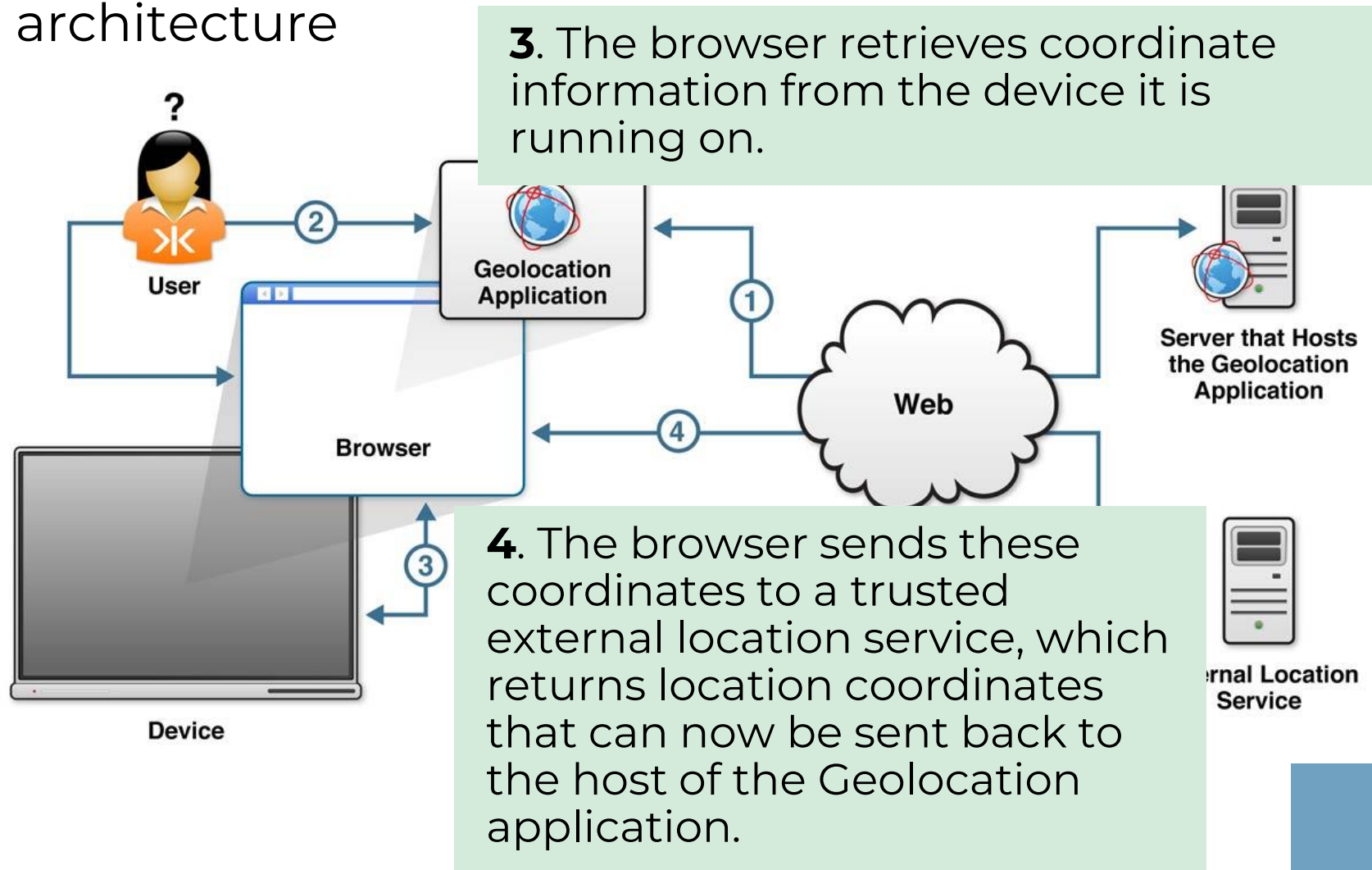
Browser Support & Privacy

Figure : Geolocation browser and device privacy architecture



Browser Support & Privacy

Figure : Geolocation browser and device privacy architecture



Geocoding & Reverse Geocoding

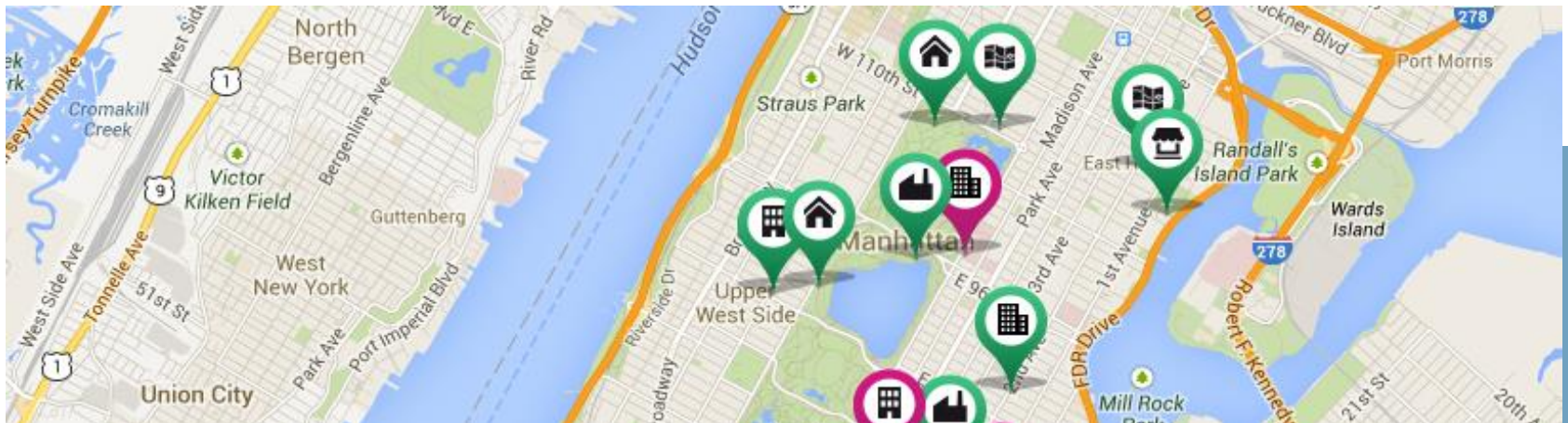
- **Geocoding** is the process of converting addresses (like a street address) into geographic coordinates (like latitude and longitude), which you can use to place markers on a map, or position the map.
- **Reverse geocoding** is the process of converting geographic coordinates into a human-readable address.

Location-based service (LBS) is the software-level services that provide for accessing data, files, and online services. The access policies are controlled by location data and/or time-of-day constraints, or a combination thereof.

- **LBS** use a smartphone's GPS technology to track a person's location, if that person has opted-in to allow the service to do that. The service can identify his or her location down to a street address without the need for manual data entry.
- **LBS** include services to identify a location of a person or object, such as discovering the nearest banking cash machine (ATM) or the whereabouts of a friend.

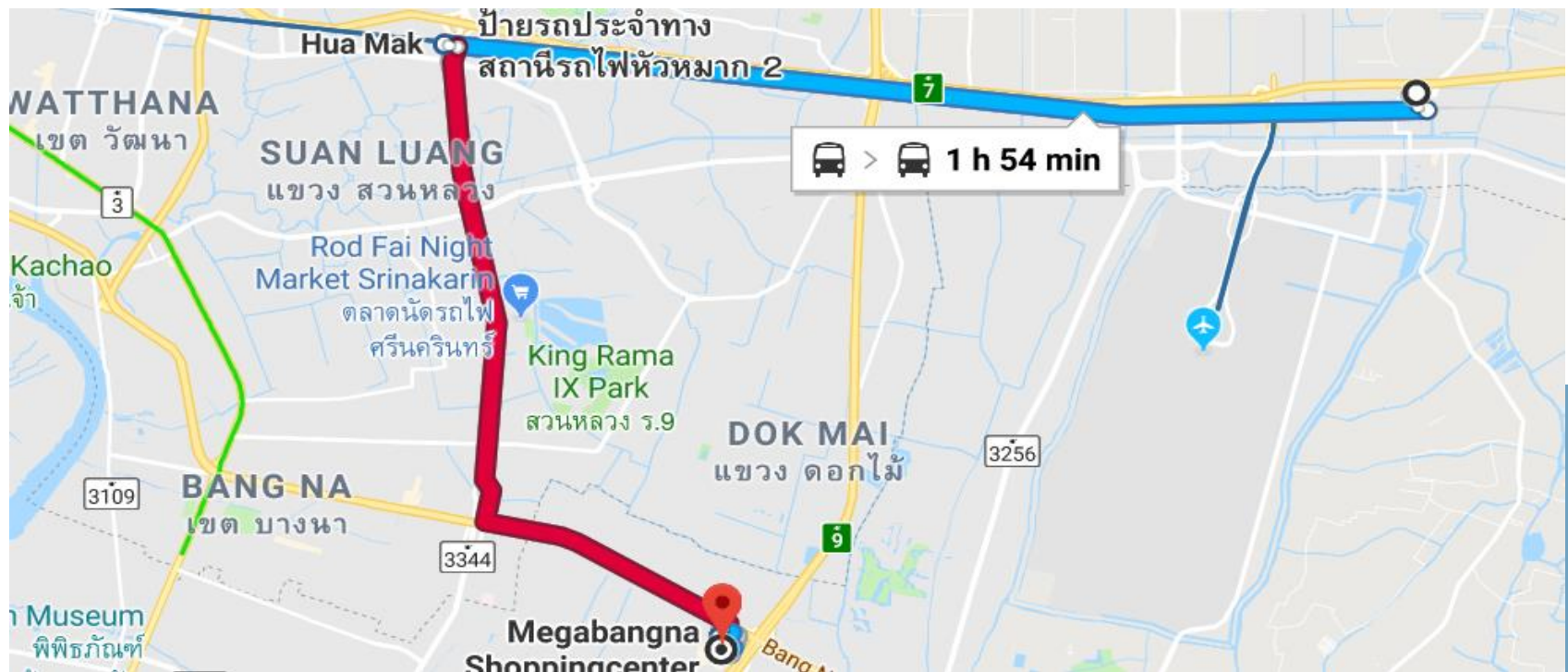
Maps

- ❑ A **map** is a symbolic depiction emphasizing relationships between elements of some space, such as objects, regions, or themes.
- ❑ Digital mapping is the process by which a collection of data is compiled and formatted into a virtual image. The primary function of this technology is to produce maps that give accurate representations of a particular area, detailing major road arteries and other points of interest.



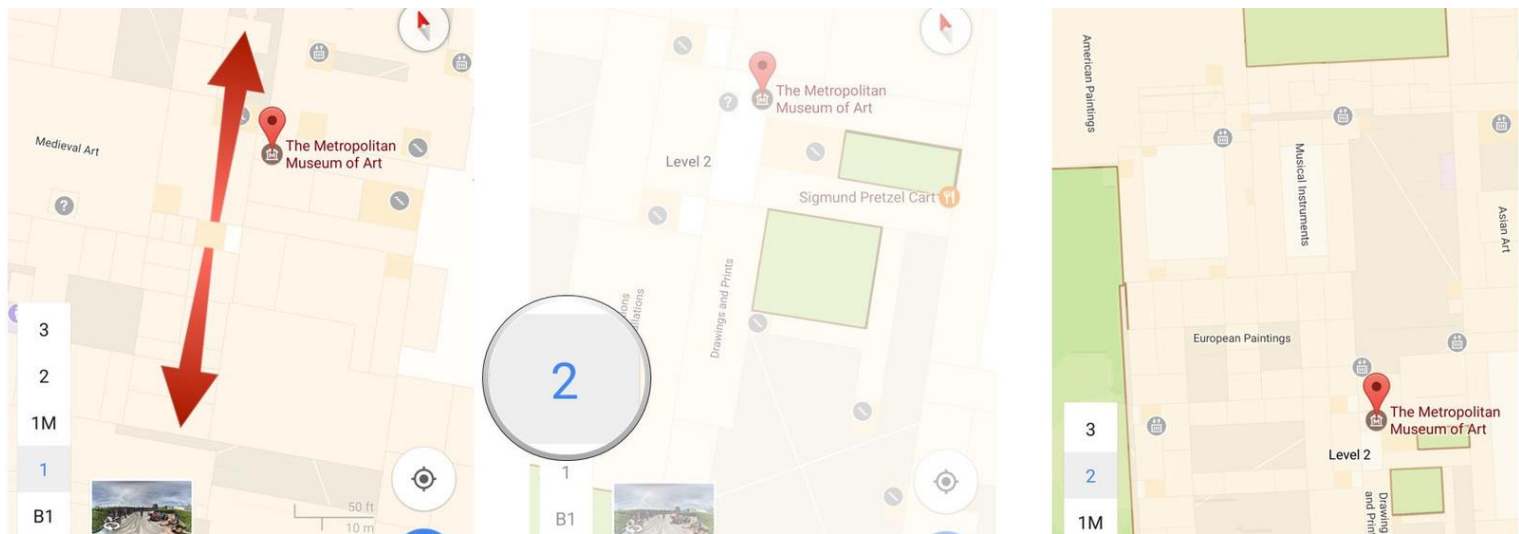
Maps

- ❑ The technology also allows the calculation of distances from one place to another.
- ❑ Finding the current location of a user cannot be expressed by any means better than the famous close-in circle on a map.



Maps

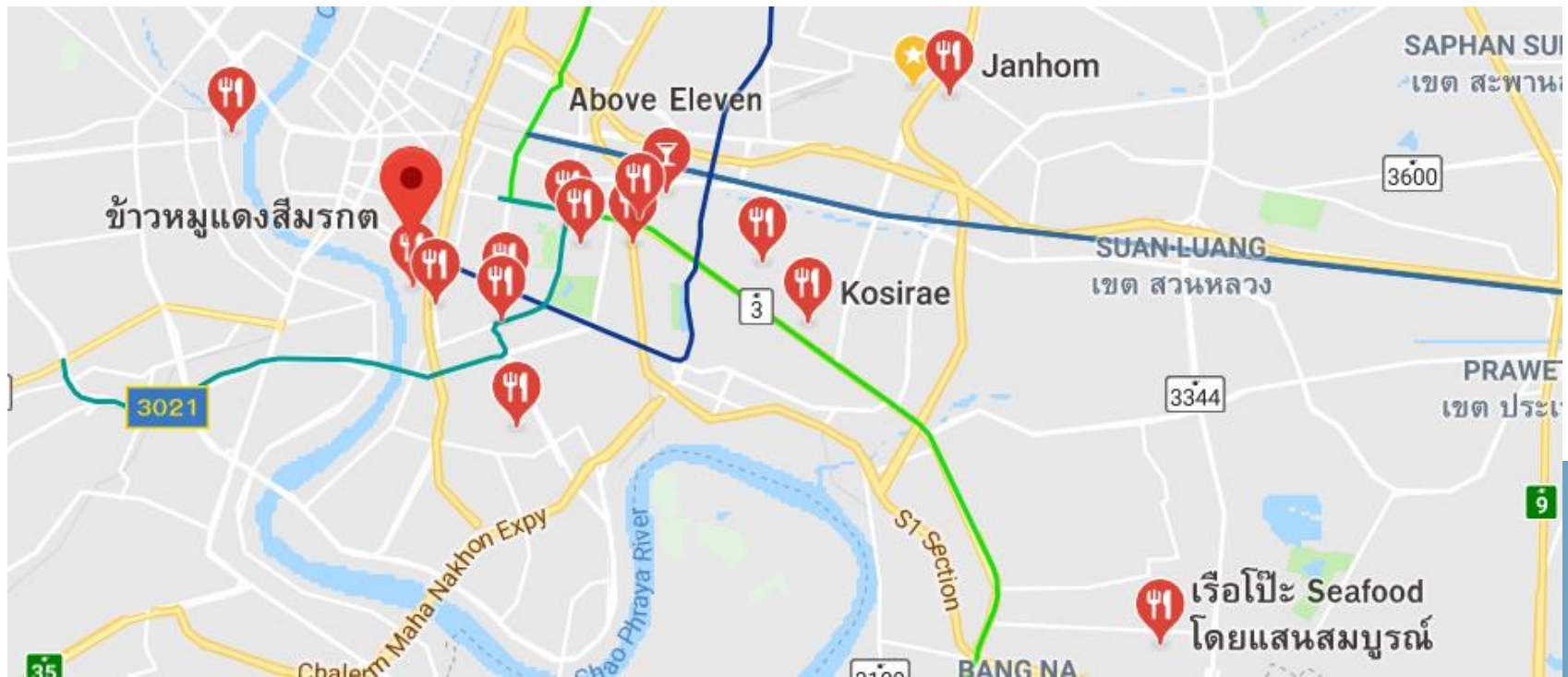
- ❑ Google maps power the majority of map-based online services thanks to its API, which allows a third party to embed Google maps on their web sites. Google Maps for Mobile supports many platforms, including Android, iOS, and Blackberry.
- ❑ Indoor maps are being created. This includes major airports, shopping malls, stadiums, resorts and other complex architectural spaces.



Uses of location-based services

There are several ways to use a device's location:

- ❑ **Store locators** : Using location-based intelligence, retail customers can quickly find the nearest store location.



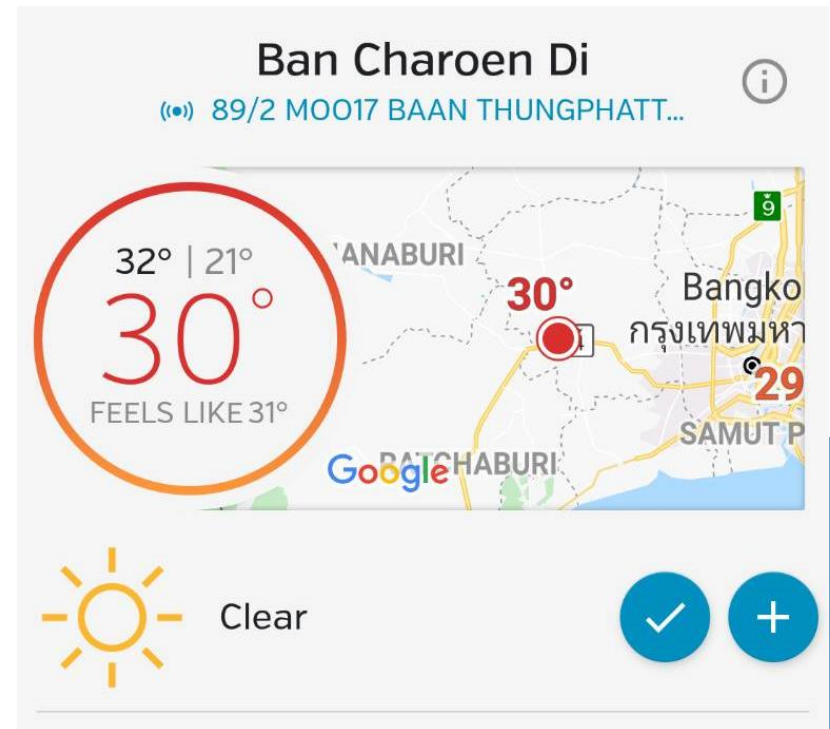
Uses of location-based services

□ **Proximity-based marketing** : Local companies can push ads only to individuals within the same geographic location. Location-based mobile marketing delivers ads to potential customers within that city who might actually act on the information.

- LBS can include mobile commerce when taking the form of coupons or advertising directed at customers based on their current location.

Uses of location-based services

❑ **Travel information** : An LBS can deliver real-time information, such as traffic updates or weather reports, to the smartphone so the user can plan accordingly. They include personalized weather services and even location-based games.



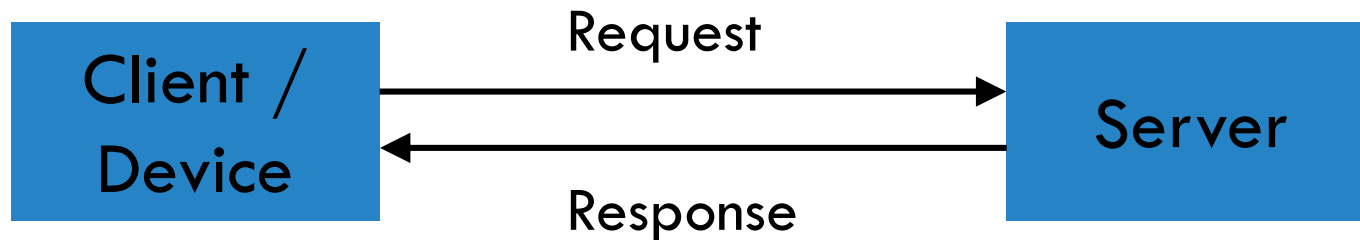
Uses of location-based services

- ❑ **Mobile workforce management** : For logistics-dependent companies that employ individuals out in the field or at multiple locations, an LBS allows employees to check in at a location using their mobile device. LBS include parcel tracking and vehicle tracking services.
- ❑ **Fraud prevention** : An LBS creates another level of security by matching a customer's location through the smartphone to a credit card transaction.
- ❑ **Roadside assistance** : In the event of a blown tire or accident, many roadside assistance companies provide an app that allows them to track your exact location without the need for giving directions.

Location-based services

Types of application design

❑ **Pull Service** is a style of network communication where the initial request for data originates from the client, and then is responded to by the server.



❑ **Push Service** is where the server pushes data to clients.



Using HTML Geolocation

The *getCurrentPosition()* method is used to return the user's position.

The example below returns the latitude and longitude of the user's position:

```
<script>
var x = document.getElementById("demo");
function getLocation() {
    if (navigator.geolocation) {
        navigator.geolocation.getCurrentPosition(showPosition);
    } else {
        x.innerHTML = "Geolocation is not supported by this browser.";
    }
}
function showPosition(position) {
    x.innerHTML = "Latitude: " + position.coords.latitude +
        "<br>Longitude: " + position.coords.longitude;
}
</script>
```

Resources

- Wireless Location Technology: The Ultimate Challenge to Privacy
By Evan Hendricks (Founding Member, US Privacy Coalition)
Before the XXIII International Conference Of Data Protection Commissioners
http://www.paris-conference-2001.org/eng/contribution/hendricks_contrib.pdf
- Public Workshop: The Mobile Wireless Web, Data Services and Beyond: Emerging Technologies and Consumer Issues
Federal Trade Commission (February 2002)
<http://www.ftc.gov/bcp/reports/wirelesssummary.pdf>