THE WORLD OF GEOLOCATION DATA

Information about where devices are located can serve as a proxy for where individuals are located over time, which can be very revealing of individual behavior, interests, or beliefs. How is location data generated, who has access to it, and how is it used?

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HOW A DEVICE LOCATES ITSELF

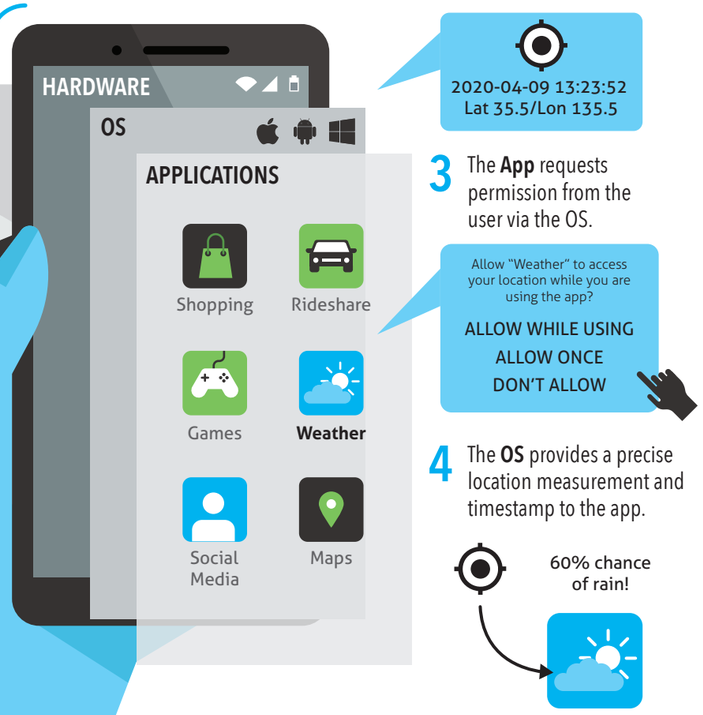
Mobile devices contain hardware sensors that allow them to detect a wide variety of signals.

HOW LOCATION DATA IS COLLECTED

Collecting location data from a device usually requires a coordinated interaction between the user, the operating system (OS), and the physical hardware. Here is how those layers interact:

1 The **device hardware** detects signals from surroundings.

2 The **OS** analyzes the signals and provides the technical permission layer for Apps to request access to a precise location measurement.



3 The **App** requests permission from the user via the OS.

4 The **OS** provides a precise location measurement and timestamp to the app.

ENTITIES THAT ACCESS, USE, OR SHARE LOCATION DATA

Different entities provide services that require or use location data for a wide range of purposes. Here are some examples:

Carriers

Cell phone carriers generally know where devices are located because they direct calls and content to phones through local cell towers. This information is collectively known as cell site location information (CSLI).

- Terms and Privacy Policies
- Telecommunications Laws

Operating System (OS)

Providers of mobile operating systems may know where devices are located as a result of providing services or enabling location features.

- Terms and Privacy Policies
- User Controls

Apps and App Partners

Many apps provide location-based features, such as weather alerts. In addition, many share location data with partners, for example to detect fraud, provide analytics, or to target ads. Most apps use Software Development Kits (SDKs), or code developed by third parties, to enable features and allow partners direct access to data.

- Terms and Privacy Policies
- Contracts
- App Store Policies
- User Controls

Data Brokers, Aggregators, and Other Third Parties

Location data may be licensed, sold, or otherwise disclosed to a variety of downstream entities that do not have a direct relationship with the user, for example: advertising networks, hedge funds, consumer data re-sellers, traffic and transportation analytics firms, or government buyers.

- Terms and Privacy Policies
- Contracts

Location Analytics Providers

Many airports, stadiums, and stores analyze signal data emitted by connected devices (mobile phones, fitness trackers, etc.) to better understand their busiest hours or in-store foot-traffic.

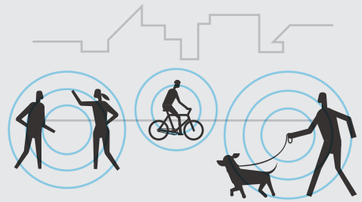
- Terms and Privacy Policies
- Contracts

POTENTIAL SAFEGUARDS

Different entities are subject to different restrictions. Broadly applicable privacy and consumer protection laws may also apply. Here are some examples:

DETERMINING RISK IN LOCATION DATASETS

Location datasets may reveal personal behavior and impact the privacy of individuals or groups. Here are some factors to consider when evaluating privacy risks:



Proximity vs. Location

Proximity to nearby devices or signals can be measured without revealing a device's actual location. The use of nearby signals (such as Bluetooth) can be less risky than collecting a detailed location history of a device.

Precision and Accuracy

Location data can be **accurate** (revealing of a device's "true location") or **inaccurate**, as well as **precise** (such as a street corner), or **imprecise** (such as a city or country).

Persistence and Frequency

Prolonged location tracking is more revealing of individual behavior. A persistent **identifier** (such as an IMEI number or an advertising ID) usually creates more risk than a **random, rotating identifier**.

Sensitive Locations

Known locations (such as a person's **home or workplace**), or **sensitive locations** (such as schools or clinics) can increase risk of re-identification or reveal intimate information.

De-identifying Techniques

Many techniques can be applied to reduce the risk of identifying individuals within a location dataset, including **aggregating** the data, or applying computational methods such as **differential privacy**. Risk can also be reduced through **administrative access controls**.