

BTS TRANSPORTATION PROBE DATA GUIDE: FLEET GPS DATA

Fleet GPS (Global Positioning System) data are a form of probe data generated by systems of hardware and software installed on and connected to a trucking fleet's tractors. Fleet owners rely on these data—which are generated via onboard diagnostics (OBD) units that can be embedded in their trucks at manufacture or installed in cabs already on the road—to provide near-real-time information to track, monitor, and manage their vehicles and assets. The primary output of OBD units is GPS-derived location information, produced as a series of messages (commonly also known as “pings” or “traces”) indicating the precise location of the truck at a given timestamp, although these messages are often accompanied with information uniquely identifying the truck or driver and vehicle-sourced telematics data summarizing other aspects of the truck tractor's performance (e.g., speed, harsh driving events, fuel consumption, and engine diagnostics).

Third-party manufacturers produce and sell OBD units, which contain the hardware and software needed to transmit data from a vehicle to its corresponding receiver. The same manufacturer may additionally maintain a secure, cloud-based fleet-management platform to store, analyze, and display the transmitted information, thereby supplying fleet owners with real-time and historic spatiotemporal information on each of their drivers and vehicles. Uses for these data vary by owner but may include enhancing operational efficiency, reducing costs through fuel and maintenance optimization, improving driver safety, ensuring regulatory compliance, and bolstering security against theft and unauthorized use.

While these data are primarily for internal consumption at each fleet, many companies realize their value for transportation planners and engineers (e.g., observed truck speeds, stop locations, and trip patterns) and have sought to capitalize on this market. As a result, fleet owners work with their OBD unit provider to anonymize their data (i.e., remove business-sensitive elements in their data related to their trucks and drivers, including any personally identifiable information [PII]) and sell them to transportation analytics companies and planners, who use them to build statistical products for public consumption. While the end user sees less information on each truck than the corresponding fleet owner, the remaining GPS points and attributes are a reservoir of data on freight mobility and fluidity for modeling, visualizations, policies, planning, and operations that are entirely unavailable from any other source.

This data guide summarizes both flavors of fleet GPS probe data: the more detailed, business-sensitive information used internally by trucking fleets and the anonymized and masked data points available to external consumers. The origins, uses, and applications of fleet GPS data are much broader than those for Electronic Logging Devices (ELDs), which—despite having a similar reliance on GPS-enabled devices embedded into trucks—singularly produce data to ensure truckers' compliance with hours-of-service (HOS) regulations.

1. CAPABILITIES

Fleet GPS probe data offer distinct advantages for generating transportation statistics:

- They allow for the detection and reconstruction of actual, vehicle-specific stops and trips using algorithms that analyze the movement patterns observable from trucks' GPS ping data points.
- When GPS connections are strong, they offer high-precision information on observed truck locations, speeds, site visits, and vehicle types.

2. LIMITATIONS

Known limitations of fleet GPS probe data for the generation of transportation statistics include the following:

- They only depict vehicle-based movements and may not have any supplementary data on the people, goods, or equipment inside the truck, tractor, or trailer.
- They predominantly represent fleets of trucks, although they sometimes include non-fleet-owned vehicles (i.e., independently owned and operated vehicles).
- They only represent and measure work-based trips; drivers' personal, nonworking movements are not intentionally captured.
- They provide limited information on driver demographics or vehicle characteristics; while this information is known to the fleet for its internal use, it is not commonly released in public derivative products.

3. VENDORS

Fleet GPS probe data are primarily available from private vendors. The characteristics of each vendor's data (e.g., precision of GPS-derived coordinates, level of spatial or temporal aggregation, available truck or vehicle attributes), however, vary based on the fleet owners or OBD unit manufacturers that supply their data. Data-sharing agreements between vendors and data suppliers as well as the amount of control a data supplier has over their data may affect what data a specific vendor will have available.

Illustrating the different relationships between data suppliers and aggregators, fleet GPS probe data vendors can be categorized as follows:

1. Those that both sell the OBD units that produce fleet GPS data points and process, anonymize, and sell the data produced by their units to public consumers in the transportation sector. Their data may be sold in an aggregate or disaggregate format.
2. Those that manufacture and sell OBD units to fleets but do not directly sell the data produced from their units to public consumers. Instead, they might sell these data (or work with their fleet partners to facilitate their sale) to transportation-oriented data analytics companies as inputs for the products they will subsequently sell to the public.
3. Those that only sell output fleet GPS data. These entities process, anonymize, aggregate, and sell the data, which they receive from a third-party source with direct access to the disaggregate data produced off an OBD unit (i.e., specific fleets or unit manufacturers with whom they have a relationship or contract).

4. MARKETS

The primary market for fleet GPS probe data is the community of truck fleets that want to use data to improve their operations (i.e., monitor driver performance and safety, ensure regulatory compliance, and help with operational efficiencies). Because the fleet operators in this market intend to primarily use these data for internal purposes, they have access to the GPS ping attributes that are masked or aggregated when the data are eventually made available to public customers (i.e., specific driver information, commodities under transport, safety incidents, etc.). As such, they have many unique use cases for these data that are only pertinent to those operating a fleet of trucks.

A secondary market for these data developed over time among transportation agencies and planners interested in using fleet GPS data to better understand truck travel behavior. While the data available to these entities are different from what each fleet receives internally (i.e., scrubbed of any business-sensitive information and potentially aggregated from their latitude–longitude coordinates to larger geographic units), they are helpful for quantifying and characterizing actual movements of freight across the highway network. Few alternate sources for observed freight movements are available to transport researchers.

5. SCALE OF TRANSPORTATION USES

Fleet GPS technology will produce messages anywhere on Earth if satellite coverage is sufficient to determine a truck's coordinates, so these data can be available for any road in the entire United States and any neighboring country with commensurate satellite availability.

6. GENERAL DETAILS

The following subsections detail background information on how fleet GPS data are generated, why they exist as a data type, and the pieces of information represented in their data points.

6.1. How Are Data Captured

The following subsections detail the generation, capture, conveyance, and protection of fleet GPS data points.

6.1.1. Trigger Mechanisms and Frequency

Fleet GPS data points are generated through the following circumstances:

- When the truck's ignition is turned on or off
- Over regular temporal intervals (i.e., 30 seconds–5 minutes or longer), a frequency traditionally set in the OBD unit's settings
- Over a regular spatial distance, in miles, driven by the vehicle, a frequency traditionally set in the OBD unit's settings
- After or during event-based triggers (i.e., entry or exit from a fleet-specific geofenced boundary area, speeding, harsh driving events, etc.) traditionally set in the OBD unit's settings in coordination with the fleet owner

6.1.2. Location Determination Technology

The location components of fleet GPS data points are generated under these conditions:

- Coordinates are primarily determined through GPS tracking technology embedded in the OBD units, which are either built directly into the vehicles by the original equipment manufacturers or installed as aftermarket devices [Powerfleet 2025].
- The GPS device has a receiver that communicates with a constellation of 24 or more GPS satellites orbiting the Earth [Space Geodesy Group n.d.].
- The device calculates its precise position—latitude, longitude, and altitude—and the exact time by measuring the time it takes for signals to travel from at least four satellites. The more satellites it can connect with, the more accurate the positioning. The device can alternatively reference a cellular-based position if a GPS location cannot be determined (due to urban canyons and rural areas with minimal satellite availability), but it is less accurate.

6.1.3. Data Transmission

Fleet GPS data points are transferred from the original device through the following procedures:

- The collected data are transmitted from the GPS tracking device to a secure cloud server.¹ This transmission typically occurs in near real-time via cellular networks (like a nano SIM [Subscriber Identity Module] card in the device) or, in remote areas without cellular coverage, through satellite networks.
- The frequency of transmission from a device to the cloud varies based on each ping's trigger mechanism:
 - Active GPS tracking continuously sends pings to the cloud, allowing for immediate alerts and up-to-the-second tracking [MICHELIN Connected Fleet 2025].
 - Passive GPS tracking records ping at intervals or upon specific events (e.g., entering or leaving a geofenced area). These data are then uploaded for analysis later, typically when the vehicle returns to a central location or establishes connectivity. While these records provide greater data coverage at specific sites of interest, they cannot support real-time analyses.

Most fleet-tracking systems blend both methods, using real-time tracking when network connectivity is strong and passive tracking to ensure data are not lost in areas without coverage, due to weather, or due to a signal canyon.

6.1.4. Identifiers and Privacy

Identifying information on the driver or truck emitting fleet GPS data points is available through the following procedures:

¹ The transportation industry uses multiple models of OBD units, data, servers, and/or analytics ownership, but the contract team does not know where the different actors lie along this continuum.

- Devices are tracked using Vehicle Identification Numbers (VINs), internal fleet identifiers (IDs), or GPS device serial numbers.²
- Every cellular-enabled GPS device has a unique, unchangeable 15-digit International Mobile Equipment Identity number, like those assigned to mobile phones. This number helps fleet-management software distinguish between devices and keep each device linked to its vehicle.

Identifying data, especially those that invoke PII or other business-sensitive details, are only made available to the fleet owner and are typically scrubbed or anonymized before the data are provisioned to any publicly available statistical products based on the GPS pings.

Consumers of fleet GPS data should engage with their vendor to learn about the availability of information that uniquely identifies each vehicle. Depending on the vendor's degree of access to the original GPS pings, they may be able to provide their end users with more information about the vehicle that produced each data point.

6.1.5. Observation Unit

The unit of analysis for truck fleet GPS data is defined as a single vehicle (i.e., cab or tractor). Whether OBD units can be transferred between vehicles, whereby a single device produces data points for separate trucks or cabs over its existence, is uncertain; as such, the impacts of such occurrences on subsequent analyses are also unknown.

6.2. Data Source Background

The following subsections provide background on the history, development, and application of fleet GPS probe data, especially vis-à-vis the generation of transportation statistics.

6.2.1. Original Purpose

The original use cases for fleet GPS data center on fleet owners' needs to monitor the following information about their vehicles:

- Real-time location and tracking
- Route monitoring
- Emergency response (i.e., finding vehicles during emergencies)
- Route optimization strategies
- Fleet dispatching and asset utilization
- Idling reduction
- Fuel management
- Driver safety and monitoring

6.2.2. Transportation Focus

The use of fleet GPS data for transportation statistical purposes is centered on the needs of the planning and modeling communities. These users are interested in using the data to detect and derive truck stop, speed, and trip information from the fleet GPS data that vendors make

² Fleet users will use VINs, fleet IDs, or GPS device serial numbers, but third-party users might have completely different IDs not connected to any of these IDs.

available to public consumers either as disaggregate, anonymized GPS pings or as aggregate data products. These products provide unique insight into observed vehicle travel behavior, illustrating actual freight movements that would otherwise have to be modeled.

6.3. Data Contents

The following subsections note the pieces of information contained in fleet GPS data points, including those generated initially by the OBD unit and the non-native attributes that must be estimated using contextual information.

6.3.1. Core Attributes

Data elements that are available for all fleet GPS data points generated by the OBD unit by default as the truck is running include the following:³

- Timestamp, provided in Coordinated Universal Time (UTC) or local time
- GPS coordinates, provided in units of latitude and longitude⁴
- Speed
- Heading and/or direction

6.3.2. Non-Universal Attributes

Non-universal attributes of fleet GPS data are truck, driver, or commodity characteristics that are not available to public consumers from all vendors (i.e., attributes that are reported from the OBD unit to the fleet owner but thereafter are anonymized or obfuscated when the data are provisioned for public users). Most often, these attributes are related to private or business-sensitive attributes of the vehicle, driver, or truck contents that would be harmful to release in their original form. Whether any of these attributes are included in a publicly consumable product depends entirely on the relationship between the vendor and the fleets supplying their data.

Examples of non-universal attributes include the following:

- Harsh braking events
- Excessive idling events
- Aggressive cornering/turning events
- Vehicle performance and health data
- Collision event detection
- Rollover event detection
- Driver PII
- Commodities or cargo
- Trailer or chassis information
- Odometer readings, truck lifetime or trip specific [Geotab 2025]

³ All core attributes are generated by telematics native to the OBD unit.

⁴ One way to determine if the GPS value is off is based on unusual signatures in the data.

6.3.3. Derived Attributes

Fleet GPS data elements that are not inherently generated by the OBD unit, but instead require subsequent derivation or estimation using contextual variables (i.e., changes in time and space between consecutive GPS pings and supplemental geographic information systems [GIS] layers), include the following:

- Speed based on changes in time and distance between consecutive GPS pings, contrasted against speedometer readings from the truck's internal equipment
- Heading and/or direction based on changes in distance between consecutive GPS pings, contrasted against the compass direction produced by the truck's internal equipment
- Trip starts and ends, including their times and locations
- Route or tour history
- Dwell times within facilities or polygonal areas of interest
- Stop durations
- Speeding, as paired with linear referencing system road network data
- After-hours or unauthorized use, compared against HOS regulations
- Estimated point-of-interest or land-use data
- Estimated commodity or cargo information
- Estimated road-network information

6.3.4. Sample Characteristics

The sample penetration of fleet GPS data vis-à-vis the population of trucks in the United States is overwhelmingly biased toward trucks from fleets, so they tend to underrepresent short-haul and individual owner–operator trips. Owner–operators, as implied by the name, do not have the same need as fleet owners to track their vehicles via real-time GPS data and will typically not incur the cost of installing OBD units that would otherwise ensure their inclusion in commercially available fleet GPS data products.

In some scenarios, however, an individual owner–operator may require GPS tracking, so their data may not be wholly absent from a given product. Still, consumers should be aware that different vendors will have different levels of access to nonfleet trucks and are encouraged to discuss their sample penetration before making a data purchase. The sample penetration of these nonfleet trucks (i.e., individual owner–operators), represented by each vendor's product, may ultimately be difficult to independently verify.

6.3.5. Data Quality

Concerns about the quality and usability of truck GPS probe data include the following:⁵

- They are susceptible to GPS drift, a common phenomenon in urban canyons (i.e., unusual jumps between consecutive pings).
- They can send inaccurate GPS readings due to environmental factors (i.e., rain or other weather conditions that prevent data transmittal or capture).

⁵ No public information is available regarding how the data may be validated and/or corrected after they are validated.

- Their GPS pings can be lost due to poor satellite signals or general device failures.
- They are vulnerable to the incorrect installation of the OBD unit (i.e., improper data readings encountered by an analyst and fixed by a technician) or other software or hardware problems related to the OBD unit.
- They may induce behavioral choices that result from a driver knowing that their movements are being tracked by the fleet owners (i.e., fewer incidents of illegal parking).

Many of the shortcomings of fleet GPS data also apply to other GPS-based probe data types and are not wholly unique to this one form of probe data.

Quality validation methods for fleet GPS data include the following:

- GPS jumps (i.e., the GPS canyon effect) can be detected via observation of long or unusual spatial or temporal gaps between pings. These jumps are potentially fixable by using route information and making assumptions about the speed but need to be accounted for in trip- and stop-detection algorithms.
- Pattern consistency analysis can be performed by observing anomalies between expected and observed timestamps and locations (i.e., a driver's nighttime patterns approximating home locations or depots).
- Cross-referencing with other ground-truth data sources (e.g., driver logs or ELD data, fuel card data, facility visits, weigh-in-motion station counts, and truck parking counts) can help identify, remove, or adjust data anomalies.
- Comparison can be made with fleet operational benchmarks (e.g., route consistency and driver benchmarking) to detect anomalies, although this option is only available when a user has access to public metrics from a fleet operator.

7. TEMPORAL AND SPATIAL SCALES OF THE DATA

The following subsections characterize the historical, temporal, and spatial coverage, availability, and precision of fleet GPS data.

7.1. Temporal Coverage

Details on the historical penetration and availability of fleet GPS data in the United States include the following:

- Availability varies significantly by vendor and region, with the oldest data coming from the late 2000s.
- Historical archiving policies vary by aggregator and/or vendor.⁶ Customers should inquire into the availability of archived GPS data points from their vendor before making a purchase if comparisons against historic trends are required.

⁶ Different parts of the process will be more or less knowable to the vendor based on the agreements between the different parties (e.g., the fleet, OBD unit manufacturer, software platform vendor) along the way. The customer should ask questions about the generation and transfer of GPS pings from the OBD unit, OBD unit manufacturer, software developer, and fleet owner even if they are unlikely to get an answer. No public document is available on how the data change at each step (e.g., company to vendor to user).

7.2. Temporal Resolution

Details on the precision of temporal information generated with fleet GPS data points include the following:

- Disaggregate GPS data include timestamps that are typically precise to the second. Time zones may be UTC or local time, depending on aggregator.
- Data delivery from the device to the fleet owner is close to real time. Some analytics vendors can provide anonymized data onward to third parties in near-real time. Customers should inquire with vendors about their ability to transmit anonymized or aggregate GPS pings to them in real time after they are first received by the fleet.

7.3. Spatial Coverage

Details on the geographic coverage and availability of fleet GPS data in the United States include the following:

- Geographic distribution is nationwide but dependent on fleet coverage. Some fleets cover the entire Nation, and some are regional in nature. Customers should inquire with their vendor about the geographic coverage of their data when making a purchase.
- Data availability is limited to geographic areas where trucks can travel (i.e., some roads are not publicly accessible and may not feature any GPS data pings).
- GPS readability and precision are not equal across the whole United States, so availability of high-quality pings will be poorer in areas where GPS coverage is already poor or unreliable.

7.4. Spatial Resolution

The spatial resolution of fleet GPS data is accurate at the latitude–longitude point level.⁷ Different vendors may be able to deliver disaggregate GPS data at different levels of precision. Customers should verify the coordinate reference system of the GPS pings from their vendor before mapping data points.

Because vendors have data from specific fleets, purchasers of disaggregate truck fleet GPS data may be prevented from publishing subsequent products with small spatial scales, at which the operations of a specific company, business, or driver could be detected. Public products below certain scales (i.e., a Census tract) could indirectly reveal business-sensitive information about a specific fleet and its customers. Customers should discuss their freedom to generate public statistical products using their purchased disaggregate fleet GPS data with their vendors.

8. USE CASES OF THE DATA

The following subsections list documented use cases and applications of fleet GPS data. Specific attention is given to uses related to transportation planning and statistics.

⁷ GPS quality is not something provided to third parties or end users, but users should keep in mind the GPS quality issues noted in [Section 6.3.5](#) and look for them.

8.1. Transportation Use Cases

Examples of transportation-centric applications of fleet GPS data include the following:

- Origin–destination studies to understand observed travel patterns between regions (i.e., the volume of trucks that move between any pair of geographies)
- Traffic operations management and traffic monitoring
- Freight mobility analysis,⁸ combining fleet GPS data with data from other modes (i.e., rail, marine, commodity flow, etc.) to analyze how freight is observed moving across the country
- Trip detection, using algorithms that identify spatial–temporal clusters by drawing polygonal geofences known points of interest
- Travel-time estimation and route-choice analysis, measuring truck travel time along different routes and corridors to determine optimal routing

8.2. Nontransportation Use Cases

Examples of nontransportation-centric applications of truck GPS probe data include the following:

- Asset utilization studies
- Financial analysts for understanding broader macroeconomic trends

⁸ Freight carried by a truck will not be knowable from land-use or point-of-interest data. It can only be inferred if the Bill of Lading information is available. One example is when the North Jersey Transportation Planning Authority linked truck GPS data to Rakuten e-commerce data [NJTPA 2020].

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