

Truck parking information service, SID – Methodology and accuracy

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1. SID methodology

Source: <https://company.toll-collect.de/de/produkte-loesungen/daten-geoinformationssysteme/lkw-stellplatzinformationsdienst/methodik/>

Toll Collect's Stellplatz-Informationsdienst (SID) calculates the occupancy of rest areas on federal motorways as well as registered private parking sites on the basis of GPS data from the truck tolling system. The method runs in seven steps - from data capture in the vehicle to publication in Mobilithek every minute.

How the SID determines rest area occupancy

Data capture: GPS capture and capacity data

GPS position data from toll-liable trucks is captured and transmitted to Toll Collect. At the same time, geodata and regular and tolerated parking-space capacities are stored for each rest area.

Evaluation: geofencing and extrapolation

Based on digital polygons, entries and exits are captured for each rest area. The determined occupancy can then be statistically extrapolated to compensate for vehicles that were not captured.

Result: occupancy information and publication

The occupancy is published in Mobilithek in three formats and updated every minute: unprocessed, as a percentage relative to the total parking-space capacity, and in comparison with thresholds in the three categories "spacesAvailable", "almostFull", or "full".

The seven steps in detail

1. GPS capture in the truck

As part of satellite-based toll collection in Germany, more than 99.9 percent of all trips by toll-liable trucks on toll-liable routes are captured, provided that the vehicles are equipped with an on-board unit that is ready for toll collection. The on-board unit captures the trucks' position data during the trip. This data produces vehicle traces that represent vehicle movements. These are evaluated in the SID.

The evaluation also includes position data from vehicles that use on-board units from EETS providers. EETS stands for European Electronic Toll Service and refers to providers through which tolls can also be collected electronically. When EETS providers are connected to Toll Collect's toll collection service, this position data is also transmitted to Toll Collect.

Depending on the provider, the transmission intervals in which data is sent to Toll Collect differ. Many vehicle traces are transmitted continuously at intervals of five to ten minutes. Other vehicle traces are transmitted event-based, for example when the vehicle stops or starts moving again after being stationary. Individual providers transmit their data only in larger batches.

As a result, this data is not always available in time for current occupancy, but it can be used for statistical extrapolation.

2. Capacity data for rest areas

For every rest area, two capacities are stored in the SID's static data. Static data is information that does not change continuously, such as information on location, equipment, and capacity.

A distinction is made between regular parking-space capacity and tolerated capacity. Regular parking-space capacity describes the number of trucks that fit on the officially marked truck parking spaces of the rest area. Tolerated capacity describes how many additional trucks can fit on areas that are not designated as truck parking spaces but can generally be used without endangering or obstructing traffic.

All values are coordinated with Autobahn GmbH. Theoretical capacities that could arise from parking on areas that would endanger traffic are not taken into account.

3. Geofencing and occupancy-count determination

In the SID system, each rest area has a digital polygon that covers the entire area of the rest area, including driving and parking areas that are not designated as truck parking spaces.

Through geofencing, the vehicle traces of trucks with active on-board units are intersected with these polygons. This allows the SID to continuously determine which vehicles have entered a rest area polygon and which have left it.

For each rest area, the SID maintains an internal list of vehicles that, based on a difference calculation of entries and exits, are assumed to currently be located at the rest area. This list is not published directly. The number of these vehicles is referred to and published as the "occupancy count". It is also the basis for all further calculations.

For data-protection reasons, a minimum cohort size is applied when stating the occupancy count. If between one and three present vehicles are known at a rest area, the occupancy count of this rest area is stated as three, so that no data about individual vehicles is published.

4. Extrapolation of the occupancy count

The determined occupancy count can be extrapolated using statistical methods in order to take delayed vehicle traces into account. No compensation is made for other factors, such as cars parked in truck parking spaces.

The statistical methods take into account, per rest area:

- the currently determined occupancy count;
- the historical development of the occupancy count at this rest area;
- where applicable, further information from received vehicle traces.

5. Percentage occupancy

In addition to the occupancy count, a percentage occupancy is published. This indicates how high the occupancy is in relation to the sum of regular and tolerated parking-space capacity.

The percentage occupancy is rounded up and output in five-percentage-point increments. Values above 100 percent are permitted.

6. Three-level occupancy information

The extrapolated occupancy count is compared with the capacity values stored for each rest area. The occupancy state of the rest area is derived from this. The basis is two thresholds:

- Threshold 1 is the minimum of: a) the regular capacity figure and b) 80 percent of the sum of regular and tolerated capacity.
- Threshold 2 corresponds to the sum of regular and tolerated capacity.

The occupancy information is output in the standardized DATEX II format in three categories:

- spacesAvailable - the (extrapolated) occupancy count is below threshold 1: parking spaces are expected to be available.
- almostFull - the (extrapolated) occupancy count is between threshold 1 (inclusive) and threshold 2: the rest area is almost at capacity.
- full - the (extrapolated) occupancy count reaches or exceeds threshold 2: the capacity limit has been reached or exceeded.

7. Publication of the data

The data for the occupancy of rest areas is updated as soon as the occupancy count changes at least for one rest area - but no more than once per minute. The basis for the update is all vehicle traces received up to that point and the entries and exits derived from them within the defined polygons.

The data is provided unchanged via the Mobilithek of the Federal Ministry of Transport (BMV) using the publish-subscribe method. Registered users can retrieve the data through a machine account.

Special cases

For some rest areas, the SID statement is determined using a differing methodology. These include rest areas with Autobahn GmbH sensor systems, border rest areas, and rest areas without truck parking-space capacity.

2. Remarks on SID data accuracy

Source: <https://company.toll-collect.de/de/produkte-loesungen/daten-geoinformationssysteme/lkw-stellplatzinformationsdienst/genauigkeit/>

The data published by the Stellplatz-Informationsdienst (SID) does not represent the actual situation at rest areas down to the exact vehicle. The information is based on a technical process that derives occupancy from entry and exit data and statistical methods. As a result, deviations can occur between the occupancy count published in the SID and the actual situation on site.

Why can deviations occur?

1. Master data for rest area may be outdated or incomplete

For rest areas on motorways, the SID publishes static data such as name, location, and some attribute data. This data comes from the “Bundesinformationssystem Straße (BISStra): Erfassungstool für Rastanlagen und Querungshilfen” and is adopted by Toll Collect into the SID. Toll Collect does not perform additional quality assurance for this data.

Construction changes or changes in the marking of truck parking spaces may therefore become known to Toll Collect only with a delay and be reflected in the SID only after a corresponding time lag.

2. Parking-space capacities may be overestimated or underestimated

Both the regular and the tolerated truck parking-space capacity of a rest area are stored in the SID. The regular capacity is taken from BISStra.

The tolerated capacity is determined using aerial images. Areas that could potentially be used without endangering or obstructing traffic are marked. A number of possible truck parking spaces is then assigned to these areas. Deviations can occur, for example due to calculation assumptions such as an assumed truck length of 20 meters. As a result, the SID may display the status “full” too early.

Conversely, capacity may also be overestimated if areas are occupied for other purposes, for example by construction works or non-toll-labile vehicles, and Toll Collect is not aware of this. In this case, the status “full” may be displayed too late.

For quality assurance, observed SID occupancy counts are regularly compared with the capacities. The capacities are also reviewed regularly with Autobahn GmbH.

3. No direct measurement of free individual parking spaces

The SID does not show which individual truck parking spaces or areas are free or occupied. The occupancy of a rest area is derived from entry and exit data of vehicles with on-board units ready for toll collection. The information relates to the rest area as a whole. Deviations can therefore occur on site, for example if a vehicle occupies several parking spaces.

4. Not all parked vehicles are captured

Not all vehicles that are allowed to park in truck parking spaces or that actually park there are included in data determination. The SID can take into account only vehicles whose position data is transmitted to Toll Collect via an on-board unit.

Examples not taken into account include:

- vehicles excluded from tolling such as motorhomes;
- users of the manual tolling procedure;
- vehicles with faulty on-board units;
- other vehicles without transmitted position data, such as passenger cars.

If such vehicles park in truck parking spaces, the SID cannot capture those parking events. This can lead to differences between the published SID occupancy count and the actual situation on site.

5. Position data and publication may be delayed

Position data from toll-liable trucks with on-board units is sent to Toll Collect at regular intervals. As a rule, this data is available to Toll Collect a few minutes after a parking event.

In individual cases, it may take longer for vehicle traces to be transmitted to Toll Collect. This effect is taken into account statistically when determining occupancy, for example on the basis of historical occupancy states.

After the position data is processed in the SID, the service publishes the new information within one minute. Because of the time offset between the arrival of vehicle traces and publication of the data, a difference can nevertheless arise between the SID occupancy count and the actual occupancy count.

6. Statistical extrapolations may fluctuate

The SID uses various statistical extrapolation methods to reduce certain inaccuracies. Fluctuations may occur in this process.

Even with high average accuracy, larger deviations are possible. This may depend in particular on the location of the rest area (for example an urban area or proximity to a border) and on the point in time of the information (for example peak times on weekends or at the start of holidays).

Toll Collect regularly compares the occupancy counts and methods determined in the SID with occupancy data from other sources in order to continuously improve the quality of extrapolation.