



Department  
for Transport

## Road congestion and travel time statistics: Background quality report

This document sets out the methodology used to calculate the Department's estimates of vehicle speeds on 'A' roads managed by local authorities and the Highways England (HE) managed Strategic Road Network (SRN). It also provides some indication as to the quality of the estimates produced, how the data is used, and alternate data sources.

This publication supports the latest statistics on road congestion and travel time measures. It is part of the [Road Congestion](#) series. Detailed [Data Tables](#) are available from the website. For a more detailed commentary on road congestion statistics, see the [annual release](#). This release and the accompanying statistics series only cover England, as responsibility for the Welsh and Scottish transport policies are devolved to their respective governments.

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## 1.0 Background to the Statistics

### 1.1 Definitions

#### Definition of congestion

Traffic congestion is an difficult concept to define as it has both physical and relative dimensions.

At its simplest, it can be explained in physical terms as the way in which vehicles interact to impede each others' progress. These interactions and their influence on individual journeys usually increase as demand for the available road space approaches capacity or when capacity itself is reduced through road works or closures for example. In addition, one-off events such as bad weather or road traffic accidents can also have a significant impact on congestion.

However, this purely physical definition ignores the fact that congestion can mean very different things to different people. For example, a person living in a rural area might regard an unusually long queue of traffic experienced on their daily commute as severe congestion. Whereas someone living in an urban area might experience much longer hold-ups on a daily basis and regard the same length queue as being uncongested. In relative terms, congestion can therefore also be defined in terms of the difference between users' expectations of the road network and how it actually performs.

#### Effects of congestion

Regardless of whether it is defined physically or relatively, the effects of increased congestion can have **economic** and **environmental** effects.

#### Economic effect of congestion

- Congestion can hold back economic growth as goods, services and people are unable to travel around the country.
- Inability to predict journey times which may result in wasted time as individuals may arrive too early or too late to their appointments

#### Environmental effect

- Increased congestion can lead to increased pollution and carbon emission as vehicles spend more time stationary or at very low speeds, where engine efficiency is lower.

### 1.2 Publications

Currently we publish statistics on the two main road networks in England: the Strategic Road Network (SRN) that includes all trunk motorway and 'A' roads, and the local 'A' road network which includes all local motorways and principal 'A' roads. The statistics are published quarterly, with an annual release following the final quarter of the calendar year.

Due to the varying interpretations of congestion the data published includes average speed of vehicles across the network and average delay of journeys compared to free flow conditions. For the SRN we also publish a reliability measure for journey times. The reliability statistics interpret this as being the proportion of additional time needed to guarantee arriving on time for 95% of journeys.

The statistics are currently only available for those 'A' roads in England that are managed by local authorities and the Strategic Road Network managed by Highways England (HE).

### 1.3 Defining the network

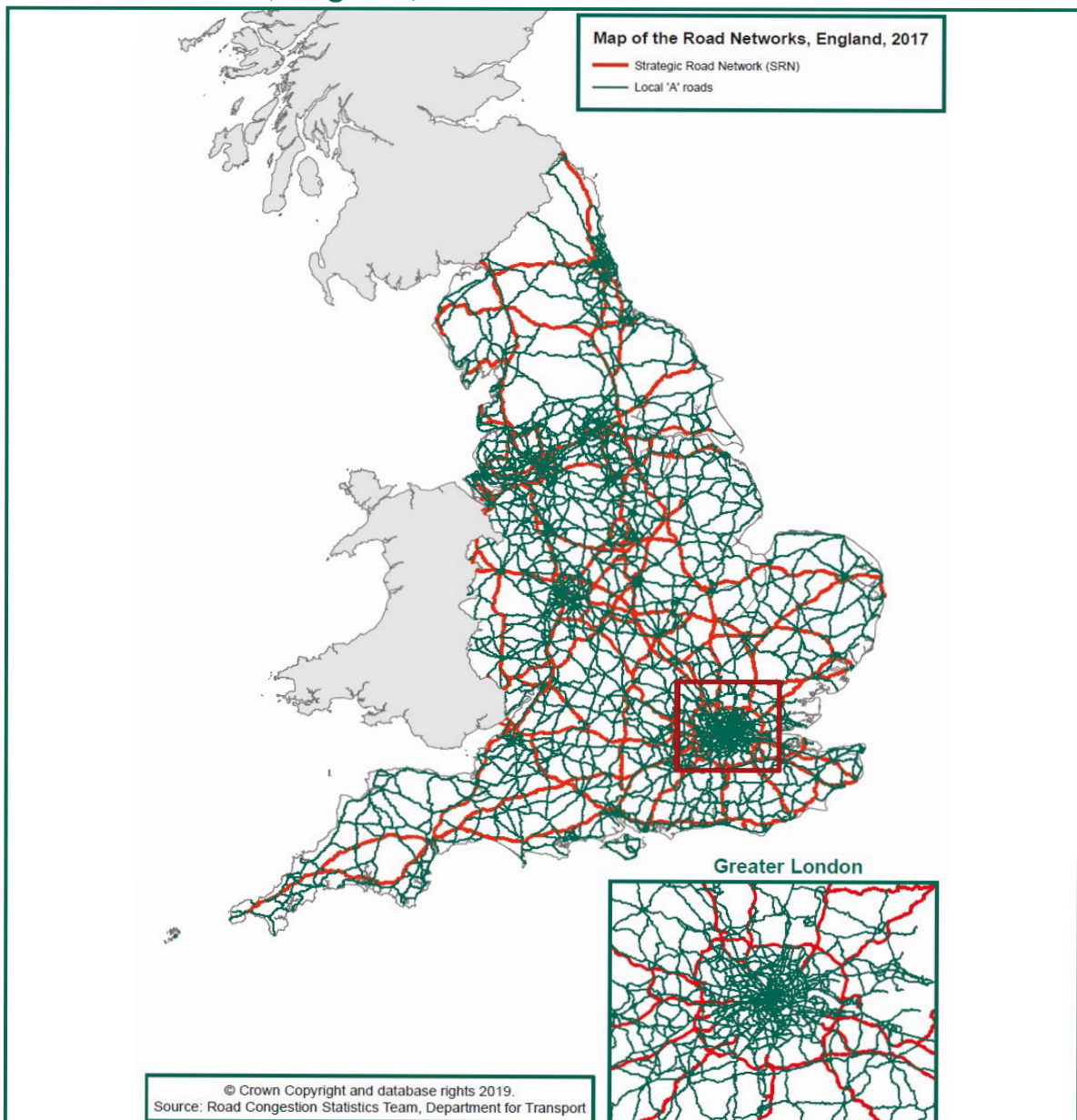
The local 'A' roads account for around 10% of all roads in England, but carry around a third of all traffic. However, the SRN accounts for less than 3% of the network and carries around a third of all traffic.

The complete network for England consists of around 8 million separate road sections, or so-called 'links'. Most links are bi-directional, and are therefore ideal for matching high resolution GPS data to in order to estimate average traffic speeds on any given part of the actual road network.

The congestion data is published, for a given year, quarterly and based on calendar year. However, we only receive the finalised Integrated Transport Network (ITN) in the spring (usually around April). Therefore, the GPS data is mapped to the previous year's ITN, due to this time lag. Analysis of the option to change ITN half way through the year, in order to always use the most recent network, shows it does not have a significant effect or improvement of the National Statistics. Yet it does lead to the greater possibility of processing errors, which is why this has been deemed undesirable.

The two networks described are illustrated below.

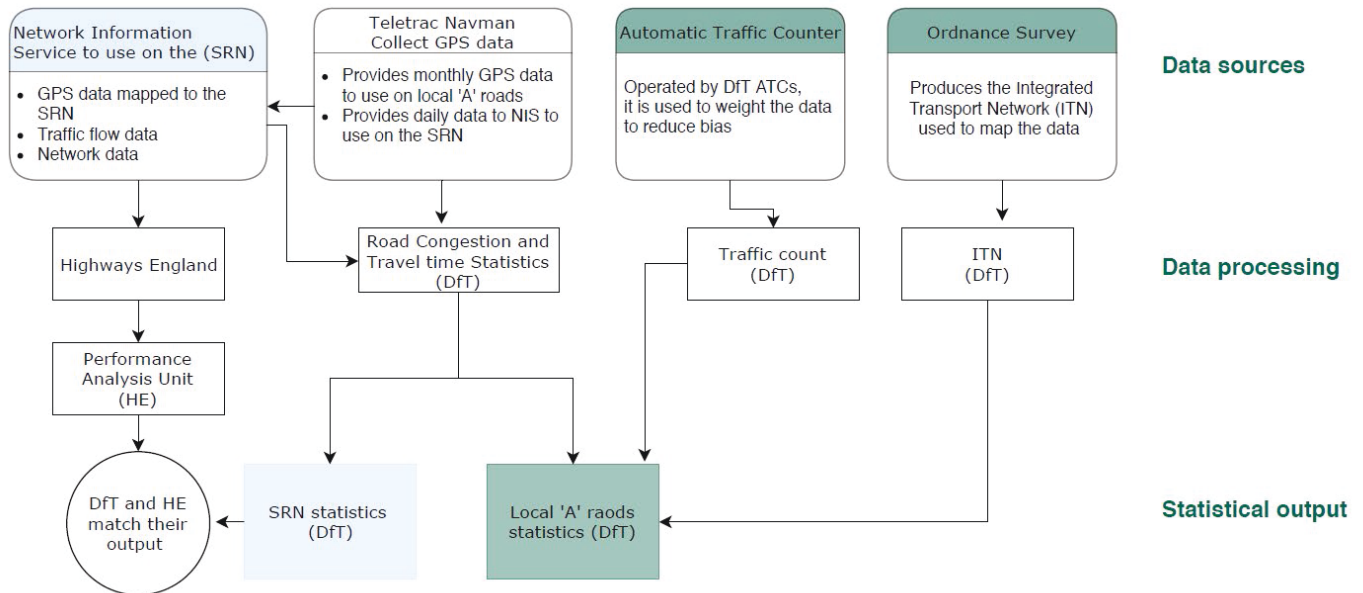
#### Map of the road networks, England, 2017



## 1.4 Methodology

The Department currently monitors the effects of congestion on the two main road networks; the Strategic Road Networks (SRN) and the local 'A' roads network. Estimates of average speed and delay are produced for both networks; however it is important to note that they are not directly comparable due to differences in the methodology used for the two networks.

These differences are summarised in the flowchart and table below.



### Methodological differences between the SRN and local A roads

Methodological differences	SRN	Local 'A' roads
Geography Network	The data is matched to the NTIS network model developed by Highways England	The data is matched to the Ordnance Survey ITN Master Map
Sample fleet size and composition	Travel time from up to 35,000 cars	Travel times from around 100,000 cars and light commercial vehicles
Definition of free flow on each network link	Free flow travel times are currently calculated using the national speed limit	Free flow travel times are currently calculated using the 85th percentile speed observation. These are 'capped' at national speed limit (i.e. 60 mph for single carriageway and 70mph for dual carriageway). As such there may be cases where the free flow speeds are greater than the legal speed limit on some road sections.
Weighting	Measures are weighted by profile flow. Profile flows are created by averaging observations from Highways England's automatic traffic counts for each link and time period.	Measures are weighted by annual average traffic flow from DfT count points network. These are indexed weighted flow for each hour, day type, month, road type and urban/rural classification for each link.

## 1.5 Calculating congestion

There are a number of calculations used by DfT to review the performance across the country's road network. The formulae do not include any specifics on the imputations or flow weighting applied to the data.

Note: the calculations include adjustments of changing the measures from metres to miles.

### Average speed

This measure estimates the average speed achieved by vehicles. We calculate it as follows:

$$\text{Average Speed (mph)} = \frac{\text{sum}\left(\left(\frac{\text{Link Length}_{\text{metres}}}{1609.344}\right) * N\right)}{\text{sum}\left(\left(\frac{\text{Average Journey Time}_{\text{secs}}}{360000}\right) * N\right)}$$

### Average travel time

The average travel time is the time it takes to travel through a link.

$$\text{Average Travel Time(secs)} = \frac{\left(\frac{\text{Link Length}_{\text{metres}}}{1609.344}\right)}{\left(\frac{\text{Average Speed}_{\text{mph}}}{3600}\right)}$$

### Average delay

The current congestion statistics release uses an estimate of free-flow speed of the 85th percentile of speeds and speed limit for each road link (where known) and calculate the difference to the reported average travel time.

$$\text{Average Delay (secs)} = \frac{\left(\frac{\text{Link Length}_{\text{metres}}}{1609.344}\right)}{\left(\frac{\text{Speed Limit or Free Flow Speed}}{3600}\right)}$$

### Reliability

Reliability is measured by calculating the proportion of additional time required to arrive on time for 95% of journeys recorded compared to the average journey time for a given link. This measure is only used on the SRN across daytime hours (6am to 8pm) where the network demand is at its highest. We are currently exploring the best way to implement reliability measure on the local 'A' roads.



## 2.0 Quality Assessment

### 2.1 Relevance

*Relevance is the degree to which a statistical product meets user needs in terms of content and coverage.*

#### What we publish

The road congestion release brings together figures from the SRN and local 'A' roads. It presents an overview of the national measures for congestion across the two road networks. The data is received monthly and the statistics are published quarterly. An annual report for the previous calendar year is released in February each year and subsequent table updates are published in May, September and December.

The statistical measures calculated for both networks are shown in the table below.

	SRN	Local 'A' roads
<b>Measures</b>		
Average delay	✓	✓
Average speed	✓	✓
Reliability	✓	-
<b>Breakdowns</b>		
Urban/Rural	-	✓
AM/PM peak	-	✓
Off peak/Inter peak	-	✓
Region/Local Authority	-	Annually (Feb)
Road level/ Junction Level	Annually (Feb)	Annually (Feb)

#### Users of the statistics

The congestion statistics on the SRN are used predominantly by Highways England (HE) to assess how the network they are responsible for is performing. The statistics are also used by policy makers within the Department in assessing the overall level of performance on the SRN. The detailed data for individual road sections are also used operationally by HE. These indicators are intended to help the public assess the effects of our policies and reforms on the cost and impact of public services.

The statistics about congestion on locally managed 'A' roads are mainly used by local authorities to monitor average peak-time speeds on the roads under their control. Some local authorities use the statistics more widely, for example to help monitor the performance of bus services or to identify congestion 'hotspots'. The statistics also provide useful evidence for national policy makers about the overall level of congestion on the local 'A' road network and where any particular issues lie.

Further to this, both the reliability and congestion statistics are useful to academic researchers, the media and the general public in providing an objective view as to the current levels of congestion on the road network – both nationally, in specific local authorities, and even on individual roads or junctions. The raw journey time data underpinning the congestion statistics also contribute to published journey time information on [data.gov.uk](https://data.gov.uk), which is useful for research and other related purposes.

## Improvements to the Publication

Recent changes to the data published, as requested by users, have included:

- Maps representing demand on the network to understand the data visually.
- Road and junction level average speed and delay on the two networks, to see changes in congestion at a more granular level.
- Inclusion of weekday inter-peak (10am-4pm) and off-peak (7pm-7am) average speed and delay on local 'A' roads to improve understanding of trends in travel patterns throughout the day.

Planned work for further development is a review of the measure of reliability in line with changes by Highways England of their own measure and to support Local Authorities with their own analysis. Current plans include the improvement of the road level data for local 'A' roads to include directionality.

## 2.2 Accuracy

*Accuracy refers to how close the estimated value in the output is to the true result.*

The travel times are estimated using Global Positioning Systems (GPS) data. All measures use real, observed travel time data with a good temporal match, where available.

The data is quality assured at different stages of the statistics production to identify data processing errors and to ensure good quality statistical outputs.

When we receive the data from Teletrac Navman, we do data validation checks on the vehicles counts, link counts and traffic flows. Different breakdowns of the data are done, including year-on-year and month-on-month data comparisons, with missing or abnormal observations investigated and possibly imputed or revised by the data provider.

Imputation is applied to links and count points where insufficient data is available. Data is infilled based on a number of ranked rules and depending on the information available. Imputation options include infilling with links on either side of the missing link, infilling surrounding links of similar road types, or using the regional/national average.

For local 'A' roads, where there is insufficient data for individual road sections for a particular time period, travel times are imputed using corresponding monthly and hourly averages from individual road sections with similar road characteristics. Imputation figures can be found [here](#).

For the SRN, where there is insufficient data for individual road sections, national daytime and night-time averages, for each road type ('A' road single carriageway, 'A' road dual carriageway and motorway) are used for these measures. For the reliability measure, national daytime (6am to 8pm) averages, by road type, are used to impute individual road sections with fewer than 100 car observations, during the daytime, in the month. Imputation figures can be found [here](#).

The ITN is quality assured by the Road Network Size and Condition team, to make sure it represents the road network as accurately as possible. The traffic count data is quality assured by the Road Traffic Statistics team before they are supplied to our team.

In addition to these periodic deliveries we answer bespoke requests for specific roads or junctions, but again this is subject to necessary licence agreement between the requestor and Teletrac Navman.

## 2.4 Accessibility & Clarity

*Accessibility is the ease with which users are able to access the data, also reflecting the format in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the metadata, illustrations and accompanying advice.*

### Accessibility

The [outputs](#) are published on the gov.uk DfT statistics page in accessible formats:

- Statistical releases are available as PDFs, which are made accessible for those who use assistive technologies.
- Data tables are available in ODS file format, which can be accessed by using freely available software.

Part of our contract with Teletrac Navman means that we can share the data for free with the following types of organisations, and any contractors doing work on their behalf, once the relevant licencing has been arranged:

- Crown Bodies
- Local Highway Authorities
- Integrated & Combined Transport Authorities
- Passenger Transport Executives
- Transport for London
- Highways England

DfT is the main point of contact for these organisations looking to get access to the data. Due to the commercial nature of this data, it cannot be shared publicly. Academics wishing to access the data would need to have their research sponsored by DfT or one of the other licenced bodies. Others would need to consider their own commercial arrangement with Teletrac Navman or one of its competitors.

### Clarity

The statistical releases use plain language, in which technical terms, acronyms and definitions are defined where appropriate. The main findings are presented using a series of text, charts and maps.



Checks are done at different stages of the data analysis, to make sure we have the correct number of GPS records per link per day. The trends and numbers are checked throughout the process to ensure the data behaves as anticipated, and represents a fair picture of actual conditions.

An example of our vigorous quality assurance includes the identification of vehicle classifications as a possible area of inaccuracy in 2018. Initial estimated vehicle type is confirmed once a driver within the sample has returned paperwork to Teletrac Navman. Therefore, there may be a lag of up to six weeks of a vehicle entering the sample and the classification being confirmed. Previously updates were applied to only the Origin Destination (OD) dataset on an annual basis. Now these are applied monthly to both the OD and GPS datasets. However, this means that up to 25 vehicles within the sample may have the wrong vehicle classification for up to six weeks and this may not be rectified in time for the quarterly publication.

Steps have been taken to reduce the level of misclassifications within the data and all in year quarters are considered provisional until the annual publication to remove these inaccuracies. The impact of these vehicle misclassifications is negligible, as the historic classification revision in 2018 resulted in a change to average speed of less than 0.2 mph and less than 0.5 seconds per vehicle per mile on both the SRN and local 'A' roads. The 2018 revision updated the vehicle type for over 4,000 vehicles.

## 2.3 Timeliness & Punctuality

*Timeliness describes the time between the date of publication and the date to which the data refers, and punctuality describes the time between the actual publication and the planned publication of a statistic.*

Congestion statistics are currently published quarterly, with an annual statistical release in February. These are usually published in conjunction with the quarterly traffic statistics. The production of these tables commences after the final month's data for a given quarter is received. Publication dates for these statistical releases are agreed at least 2 months in advance and dates are published on the GOV.UK release calendar.

We aim to publish the statistical releases within 10 weeks after the end of the period to which the statistics relate. For example, statistics covering the period July to September 2018 were published in early December 2018. To date, all congestion statistics have been published to the scheduled pre-announced date.

### Data Deliveries

As part of the Teletrac Navman contract the AGPS data for their local authority can be shared with each local authority to enable more detailed analysis. There are a number of regular data deliveries, the largest is the annual delivery to Local Highway Authorities after the annual publication in February. The OD data are available on request.

Each year, local authorities receive AGPS data for each month and the corresponding shape file containing all roads in the local authority, plus a 10km buffer. This was deemed frequent enough following discussions with local authorities at user groups.

However, for the 10 major urban areas in England the AGPS data is sent quarterly – specifically Greater London, Greater Manchester, Nottingham, Merseyside, South Yorkshire, West Yorkshire, West Midlands, Tyne and Wear, Leicester and Bristol.

## 2.5 Coherence & Comparability

*Comparability is the degree to which data can be compared over time and domain. Coherence is the degree to which data that are derived from different sources or methods, but refer to the same topic, are similar.*

### Comparability

The statistics currently produced for the SRN and local 'A' roads are not comparable due to methodological differences (outlined on page 5). This is due to the differences in the performance of the individual networks and creating a consistent measure of the SRN with Highways England's KPI's.

The statistical release covers trends from April 2015. This new time series followed a methodological and sample review. This means the current data is not comparable to historic National Statistics. Previously data for the SRN was published for the 'On Time Reliability Measure (OTRM), the previous reliability methodology. Historically, the local 'A' roads data was published down to road level monthly, but only for weekday morning peak times.

Users should exercise caution when reviewing the statistics over short periods of time when temporary factors such as road works or bad weather may have had an impact on the measures reported. This is particularly important when interpreting the data for relatively small areas where a small change on one or two roads may have a relatively large effect on the overall speeds or delays presented. In addition, users should be cautious when comparing road travel time measure outputs reported for different local authorities or regions as a measure of the relative levels of congestion within these areas. Physical differences in the types of roads in these areas and their speed limits will also have a large bearing on travel times.

### Coherence

#### Scotland and Wales Congestion Data

Responsibility for their respective transport policies have been devolved to the Welsh and Scottish Government.

- Congestion statistics on vehicle speed on Welsh motorways are published here: <https://gov.wales/statistics-and-research/vehicle-speeds-welsh-motorways/?lang=en>
- Attitudes to congestion are collected in the Scottish Household Survey (SHS) published here: <https://www.transport.gov.scot/publication/transport-and-travel-in-scotland-2017/>
- International statistics about congestion can be found here: <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC69961/congestion%20report%20final.pdf>

#### Other Sources of Traffic Data

In addition to congestion statistics the department produces a number of statistics on related topics:

- [Road Traffic statistics](#) are the estimated journey miles travelled in Great Britain by vehicle type, road category and region.

- [Vehicle Speed Compliance statistics](#) are the estimated speed compliance on roads in Great Britain by vehicle type, road category and region.
- [Journey Time statistics](#) - These provide estimates of journey times to key local services (food stores, healthcare, education, town centres & employment centres) and to key strategic locations (e.g. transport hubs like major airports).
- Attitudes on road congestion can be found in the [British Social Attitudes Survey](#).

## 2.6 Output / Quality Trade Offs

*Trade offs between output quality components describes the extent to which different aspects of quality are balanced against each other.*

The main trade off in relation to this statistics release is the inaccuracy of vehicle classifications (mentioned on page 9). DfT, Highways England and Teletrac Navman were all involved in finding a way to minimise the impact. The effect of this is reduced accuracy for a small number of vehicles (<25 vehicles out of a sample of over 100,000) for a very limited period of time (up to 6 weeks before being classified correctly). Waiting until a sample set is completely accurate would have implications on processing and timeliness of releases.

The current sample of around 100,000 vehicles is used to estimate the average speed and delay for a total vehicle population of over 38 million vehicles in Great Britain. However, the coverage determined by the contract requirements ensures every link on the SRN and local 'A' roads has a reported figure for every 24 hour period. The minimum number of reported readings per year for each link ensures robustness, otherwise the link is imputed. Research in 2019 by Microsoft labs has shown that a sample of just 20 vehicles on a given junction is necessary to estimate average speed. The paper is published here: <https://www.microsoft.com/en-us/research/publication/traffic-updates-saying-a-lot-while-revealing-a-little/>

## 2.7 Assessment of User Needs & Perceptions

*Assessment of user needs and perception covers the processes for finding out about users and uses, and their views on the statistical products.*

The Department engages with users of congestion statistics in a number of ways to understand how the data is meeting user needs and if that can be improved. These include:

- Attending, and occasionally presenting at, user groups such as the [Transport Statistics User Group](#) (TSUG) and the [Transport Statistics sub-group of the Central and Local Information Partnership](#) (CLIP-TS).
- Sending regular updates to and seeking views from local government users of the statistics. Regular discussions as to requirements with policy colleagues in the Department and Highways England.
- Utilising social media to promote and raise awareness of the statistical release, through Twitter. Online analytics of activity are regularly reviewed to identify areas of particular interest.
- Including a continuous request for feedback section within each release of congestion statistics (via [congestion.stats@df.gov.uk](mailto:congestion.stats@df.gov.uk)). These requests are regularly reviewed to understand how we develop the outputs.

## 1.4 Data Sources

All the statistics in the road congestion series are derived from data purchased from Teletrac Navman by DfT on behalf of the Government, HE and Crown Bodies.

We have a sample of over 100,000 vehicles – 32% cars, 65% LGVs, 2% HGV and 1% other type vehicles. This is not representative of the vehicle population in England. There is an underrepresentation of cars, while light vans are overrepresented. The local 'A' roads statistics are based on data from both cars and vans. However, the SRN analysis uses cars only. This is rooted in a practical reason: on the SRN the maximum speed limit is higher than what some vans can achieve due to speed delimiters being fitted.

Teletrac Navman vehicles have Global Positioning System (GPS) units fitted. They are 'fixed', which means they are built in and cannot be removed (unlike a mobile phone or removable sat nav). This is also known as telematic data. The Department receives location reports using "geodetic" or "geocentric" coordinates of their location, speed and bearing for direction of travel at each reporting stage. Vehicle type is provided in a separate file monthly.

Teletrac Navman provides multiple datasets – all based on the "UGPS" (Unprocessed GPS). The UGPS is a file containing recorded movements of individual vehicles, at a maximum of 15 second reporting intervals. The UGPS file is processed, by Teletrac Navman, into a number of other files (Aggregated GPS data (AGPS), Processed GPS data (PGPS) and Origin and Destination data (OD)), which are used for analysis and data deliveries. These processed files are aligned to the ITN using the coordinates recorded at a given reporting interval.

In line with the Code of Practice for Official Statistics, users will be informed about any changes or revisions to the data series.

## 2.8 Performance, Cost & Respondent Burden

*Performance, cost and respondent burden describes the effectiveness, efficiency and economy of the statistical output.*

The statistics are based on data procured from Teletrac Navman. The Crown Commercial basis of this contract ensures that the department receives the data necessary to estimate congestion for the best value for money from those tendering.

Performance of the contract is monitored regularly between DfT, Highways England and Teletrac Navman.

## 2.9 Confidentiality, Transparency & Security

*Confidentiality, transparency and security refers to the procedures and policy used to ensure sound confidentiality, security and transparent practices.*

All the data received by DfT are anonymised and individuals and their vehicles are not identifiable from the data. The first and last 500 metres of all journeys in all GPS datasets (UGPS, AGPS, PGPS) are removed by Teletrac Navman before they transfer the files to us for data protection reasons. The OD data is rounded up to Lower Super Output Area (LSOA) – therefore, the first and last 500 meters are not removed, but this makes it impossible to identify where someone lives.

This level of anonymisation was reviewed by the Information Commissioner's Office prior to the enforcement of the General Data Protection Regulations 2018 and was deemed suitable to not identify individuals within the sample.

DfT aims to make as much information available within the limitations of the contract. Greater granularity of data is now being published and where possible AGPS and OD data is shared with organisations under licencing agreements.

DfT adheres to the principles and protocols laid out in the Code of Practice for Official Statistics and comply with pre-release access arrangements. The pre-release access lists are available on the DfT website.



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