**US Department of Transportation**

Research and Technology Innovation Administration

Intelligent Transportation Systems --Joint Program Office

ITS Technical Support Services

Data capture and management promgram: Datasets task

**Safety Pilot Model Deployment –Sample Data environment**

**Data Handbook**

Version 1.3

December 17, 2015

**Prepared by:**

Description: bah_logo2

8283 Greensboro Drive

McLean, VA 22102

Version History

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| --- | --- | --- | --- |
| **#** | **Date** | **Author (s)** | **Summary of Changes** |
| 1.0 | 2013-07-08 | D. Henclewood (BAH)  B. Yelchuru (BAH) | Initial Version |
| 1.1 | 2014-05-01 | D. Henclewood (BAH)  M. Abramovich (BAH) | Included data descriptions for data collected by Roadside Equipment. Weather data elements were also presented here along with some general direction as to how to obtain additional contextual data. |
| 1.2 | 2014-06-18 | D. Henclewood (BAH) | Included text to highlight subtle differences between the handbook’s applicability to the Safety Pilot Model Deployment (SPMD) Sample data environment and when the full data set is available for the Complete SPMD data environment. |
| 1.3 | 2015-10-28 | D. Henclewood (BAH)  S. Rajiwade (BAH) | Updated text to map to the “new” data files that is available via the RDE. |

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# INTRODUCTION

## Background

The vision of the U.S. Department of Transportation’s (USDOT) Real-Time Data Capture and Management program is to enhance current operational practices and transform future transportation systems management through the active acquisition and systematic provision of integrated data from infrastructure, vehicles, and travelers. These data will be made available to researchers, application developers, and system operators via the Research Data Exchange (RDE). The RDE is the central component of USDOT’s Data Capture and Management Program. This repository aims to serve as the premier location for high-fidelity, high-resolution transportation data, which will in turn support the continued development of transportation applications, tools, and strategies to increase efficiency with which the transportation system is used and managed. To help fulfill the vision of Data Capture Management program, this data handbook will accompany the multimodal, multidimensional datasets that were collected as a part of the Safety Pilot Model Deployment (SPMD) and the Safety Pilot Contextual Data Collection effort.

The SPMD is a part of the Connected Vehicle Safety Pilot Program. This program is a research initiative that features real-world implementation of connected vehicle safety technologies, applications, and systems using everyday drivers. The effort will test performance, evaluate human factors and usability, observe policies and processes, and collect empirical data to present a more accurate, detailed understanding of the potential safety benefits of these technologies. This empirical data will support the National Highway Traffic Safety Administration’s (NHTSA) decision on vehicle communications for safety. To support this initiative, the SPMD is a comprehensive data collection effort, under real-world conditions, at a test site, with multimodal traffic, hosting approximately 3,000 vehicles equipped with vehicle-to-vehicle (V2V) communication devices.

The goals of the SPMD are[[1]](#footnote-1):

* Demonstrate connected vehicle technologies in a real-world, multimodal environment
* Determine driver acceptance of vehicle-based safety systems
* Evaluate the feasibility, scalability, security, and interoperability of Dedicated Short-Range Communications (DSRC) technology
* Assess options to accelerate safety benefits

In achieving the goals of the SPMD, a number of different entities are involved in executing this field experiment. These entities include the University of Michigan Transportation Research Institute (UMTRI); the field test conductor, Battelle; Southwest Research Institute; the Crash Avoidance Metrics Partnership (CAMP), in conjunction with Virginia Tech Transportation Institute (VTTI); and Mixon Hill, Inc. The datasets that these entities will provide include basic safety messages (BSM), vehicle trajectories, and various driver-vehicle interaction data, as well as contextual data that describes the circumstances under which the Model Deployment data was collected.

The primary goal of the contextual data collection effort is to supplement the vehicle-based data that has been collected through the SPMD. This data collection effort will provide contextual mobility and environmental data to further describe the surroundings in which Model Deployment data was collected. These datasets will include traffic flow, signal operation, weather, and transit schedule information. In addition to being the test conductor, UMTRI will also be the main provider of not only contextual data but also of vehicle-based data.

A significant portion of the data that are collected through the SPMD will be stored in the RDE. In the RDE, data collected through this effort will be referred to as the Safety Pilot Data Environment. Figure 1 previews the datasets that are encapsulated within this environment.

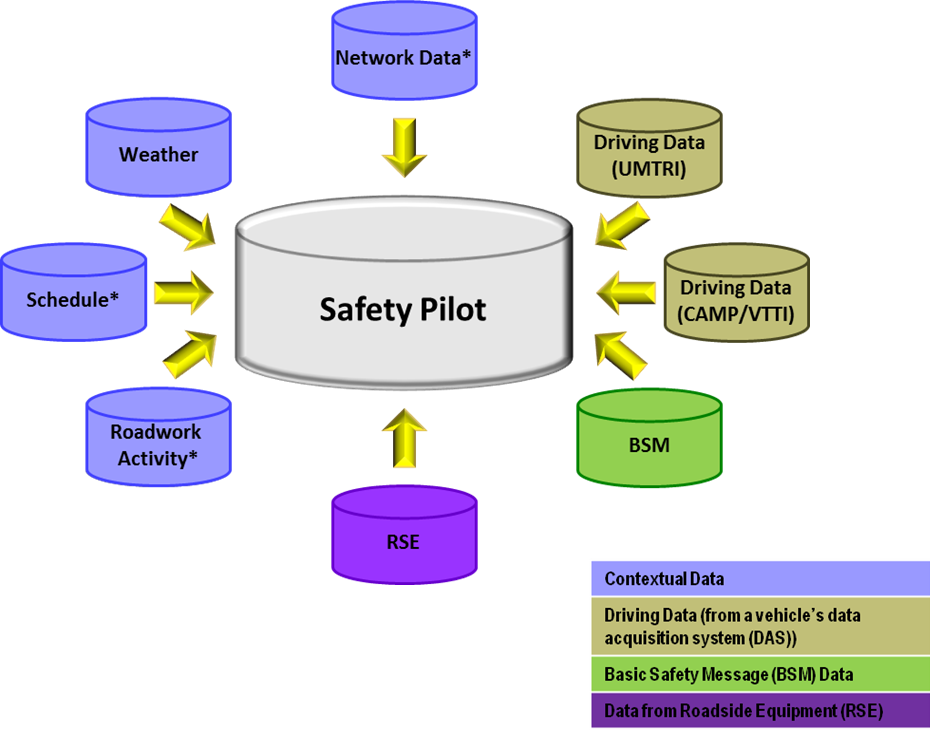


Figure 1: Potential Contents of the Research Data Exchange’s Safety Pilot Data Environment

**\*** Datasets to be populated as soon as (additional) data becomes available

The above datasets are populated by the year and half-long SPMD exercise, which started in August 2012. The model deployment was conducted in Ann Arbor, Michigan. The field test includes 75 miles of instrumented roadway. Approximately twenty-six roadside units (roadside equipment - RSE), which are capable of communicating with appropriately equipped vehicles, and devices via DSRC, were installed throughout the network. A majority of the RSEs were placed signalized intersections while the others were strategically installed and (horizontal) curves (to provide curve speed warnings), and freeway locations. These devices and other similar devices, which are termed data acquisition systems (DAS), were installed in vehicles participating in the model deployment to facilitate vehicle-to-vehicle and vehicle-to-infrastructure communications. Figure 2 illustrates the proposed layout of the test site and the location of the roadside equipment that is capable of communicating via DSRC.

This figure shows a map for the northeast section of the city of Ann Arbor, MI. This is the location of the execution of the Safety Pilot Model deployment.  The map area highlights a few notable roadways in this section of the city.  Some of these roadways include U.S. 23, U.S. 23 Business, Michigan 14, Washtenaw Avenue, Plymouth Road, Huron Parkway, Glazier Way, Nixon Road, Green Road, Dhu Varren Road, Pontiac Trail, Whitmore Lake Road, Barton Drive, Maiden Lane, Fuller Road, Geddes Road, Geddes Avenue, Glen Court, Depot Street, and East Stadium Boulevard. In the upper right quadrant there is an icon signifying the location of the University of Michigan Transportation Research Institute – the conductors of this field experiment.  A hospital icon is in the center of the figure and represents the location of the University of Michigan Campus / Medical Center.  The legend in the map highlights a number of key features of the field test site.  Included among these features is demarcation of the study’s primary routes, which are along U.S. 23, U.S. Business 23, MI 17, MI 14, Plymouth Road, Fuller Road, Huron Parkway, and Geddes Road.  Three curve speed warning locations were also presented in this figure; one along Plymouth Road and two along Fuller Road. Two of the four roadside equipment (RSE) co-located with freeway ITS installation are located along the eastern end of the looping U.S. 23, while the other two are located along the northern portion of U.S. 23 / MI 14.  Four of the seven RSEs co-located with actuated traffic signals are located along Washtenaw Avenue close to the on/off ramps of U.S. 23.  As for the other 3 of these RSEs, one is located at the intersection of Huron Parkway and Geddes Road; another is located at the intersection of Fuller Street and Glen Court, and the other is located at the intersection of U.S. 23 Business and Depot Street. Twelve RSEs / signal time and phase (SPaT) – enabled traffic signals are located through the field test area.  Six are along Plymouth Road and the other six are located along Fuller Road.  The test site also identifies the location of a prototype solar / cellular RSE installation.  In the lower left quadrant of the figure there is a note that states that the Safety Pilot Model Deployment area includes more than 73 lane-miles of instrumented roadways.   

Figure 2: Safety Pilot Model Deployment Site Plan, Ann Arbor, Michigan[[2]](#footnote-2)

Approximately 3,000 instrumented vehicles participated in this study. The vehicles include light (passenger) vehicles, heavy/commercial trucks, and busses—all equipped with various advanced safety features and/or DSRC capabilities. There are four types of available device installation packages, and each vehicle is outfitted with one of the four. The device packages are referred to as Integrated Safety Device (ISD), Aftermarket Safety Device (ASD), Retrofit Safety Device (RSD) and Vehicle Awareness Device (VAD). Each of the device packages provides a series of data elements, communicating a vehicle’s location and motion. The central difference amongst these devices is the amount of information collected by each and ability to receive transmitted messages. Vehicles with ISD, ASD, and RSD collect, receive, and transmit the most comprehensive set vehicle-based data. This is due in part to the advanced safety features with which these vehicles are equipped and the video data files that are also being collected to aid in the NHTSA decision regarding the impact of connected vehicles on safety.

VAD is the most basic of all the device packages. Vehicles with VAD are not able to receive transmitted messages from other vehicles; they are only able to transmit the data being generated and collected by their host vehicle. The primary function of these equipped vehicles, which make up more than 75 percent of the total equipped vehicles in this study, is to transmit “here I am” messages while increasing the probability of V2V and vehicle-to-infrastructure (V2I) interactions. For additional details regarding the test location, the vehicles, and the equipment used, please consult the test conductor’s web page.[[3]](#footnote-3)

## Purpose of This Data Handbook

The purpose of this data handbook is to document the limited data elements that were collected during SPMD and sent to the USDOT Data Capture and Management program to support the development of mobility applications. This handbook attempts to make it easy for individuals who are unfamiliar with SPMD to become familiar with this research endeavor program, and use the data to conduct research and develop applications to further improve mobility (and transportation safety).

This data environment houses data from one of the more comprehensive data collection efforts to be undertaken in the transportation community. This environment does not only include hyper-accurate, hyper-frequent that communicates vehicle motion, but there are data that describe driver behavior, transportation infrastructure operation, namely traffic signals, and V2V and V2I interactions. Some of these high resolution data do contain and / or can potentially lead to uncovering (Sensitive) Personally Identifiable Information ([S]PII). In order to protect the privacy of SPMD participants this document along with the data that will be posted to the RDE will be void of data elements that either contain (S)PII or that may lead to the discovery of PII. Additionally, because the intent of this deployment exercise is to support NHSTA’s decision regarding road user safety and V2X technologies, a number of the data elements that communicate specific safety-related information will not be available via the RDE.

Data elements that describe mobility are a majority of the elements that are included in the Safety Pilot data environment. In addition to supporting general transportation research, this data environment is geared toward supporting the development of mobility applications, in line with the goals of programs such as the Dynamic Mobility Application (DMA), and Application for the Environment: Real-Time Information Synthesis (AERIS) programs.

## Document Overview

Section 2 provides the general framework used to store, organize, and present the SPMD datasets. Section 3 and 4 details the data elements contained in the Data Acquisition System (DAS) datasets, which describe the motion of the vehicles that participated in the model deployment as collected from DAS1 and DAS2, respectively. Section 5 presents the BSM dataset, which contains BSMs that were sent and received by participating vehicles and roadside equipment. Section 6 describes the dataset corresponding to data collected by Roadside Equipment (RSE), while Section 7 details the contextual dataset, which may include information regarding weather, roadway network performance, and schedules relating to special events and transit operation. To date, the contextual dataset includes weather information and points readers to resources that they may consult to obtain information regarding the transportation network (description and performance) and transit schedules.

# Safety Pilot Model Deployment Proposed General Data Framework

## Structuring SPMD Datasets

As illustrated in Figure 1, the Safety Pilot environment contains eight datasets:

* Driving dataset
  + DAS1
  + DAS2
* BSM dataset
* RSE dataset
* Contextual data dataset
  + Weather
  + Network
  + Schedule

The data elements that are included in these datasets were collected and are stored in a series of relational databases. Each database has a number of different tables, each pertaining to a specific set of collected data. Most of the data elements in each dataset are collected at a frequency of 10Hz. This frequency results in a number of the tables being very large, restricting the tables’ ease of use. To this end, each dataset has been logically subdivided to create more manageably sized files to promote efficient data usage. The data is divided into 24-hour periods, meaning that each table in a database, which has been converted into individual flat or comma separated files (.csv) files, includes data that has been collected during a given day. Figure 3 illustrates the general framework that has been developed to organize and structure the data that has been collected during the SPMD.

The following highlights a few points regarding the aforementioned framework. The Driving Dataset is composed of data that has been collected from two different Data Acquisition Systems (DAS). DAS1 represents the data collected by the DAS developed by UMTRI, and DAS2 represents the data collected by the DAS developed by VTTI. The basic safety message (BSM) dataset includes BSMs that were transmitted and/or received by a participating vehicle, irrespective of the DAS that was installed. The Roadside Equipment (RSE) dataset contains data that was received and transmitted by roadside units that were equipped with DSRC capabilities. The Contextual datasets include data that communicate the conditions under which the Safety Pilot data were collected. They include data elements that describe network configuration and performance, weather, schedules (transit and special events), roadwork activity, and traffic incidents. Greater details for each of these datasets are provided in subsequent sections.

This figure illustrates the generalized file structure for the data files that will be stored in the Safety Pilot Model Deployment data environment.  There are three column areas that are used to help define the structure of this environment. These three areas are titled “Data Environment”, “Data Sets”, and “Data Files.”  In the “Data Environment” column, there is one box titled “Safety Pilot Environment”.  This box represents the root of this file system, hence the root folder. From this box there are four connecting lines to four boxes which form the root of the “Data Sets” column area. The titles of these four boxes / sub folders are “Driving Data”, “Basic Safety Message”, “Roadside Equipment”, and “Contextual”.  The “Driving Data” box is connected two boxes titled “DAS #1” and “DAS #2”.  DAS #1 is then connected to a rectangle labeled Month, which is then connected to another titled “Week” which then connects to two rectangles in the “Data Files” column area labeled “Day…” and “Summary”. Similarly, the “DAS #2” rectangle is connected to a rectangle labeled “Month”, which is then connected to another titled “Week” which then connects to two rectangles in the in “Data Files” column area labeled “Day…” and “Summary”. The “Basic Safety Message” rectangle, which is directly connected to the “Safety Pilot Environment” root folder, is connected to a rectangle titled “Month”, which is then connected to a rectangle titled “Week” and then connects to two rectangles, titled “Day…” and “Summary”, in the “Data Files” column area.  The “Roadside Equipment” rectangle, which is also directly connected to the “Safety Pilot Environment” root folder, is connected to a rectangle titled “Month”, which is then connected to a rectangle titled “Week” and then connects to two rectangles, titled “Day…” and “Summary”, in the Data File column area. The “Contextual” rectangle is directly connected to the “Safety Pilot Environment” root folder.  The “Contextual” rectangle is then connected to four other rectangles, titled “Network”, “Weather”, “Schedule” and “Roadwork Activity”.  Each of these four rectangles is then connected to their own rectangle titled “Month” and which is then subsequently connected to a rectangle titled “Week”.  Each rectangle titled “Week” per these four rectangles connected to the “Contextual” rectangle connects to a “Day ...” and “Summary” rectangle in the data file column area.     

Figure 3: Generalized Data Framework the SPMD Data Environment

As previously mentioned, data were not only grouped based on their natural grouping, but also based on a 24-hour period, indicated by the rightmost field of text boxes in Figure 3. In the rightmost text boxes, the label “**Day…**” represents a number of files, belonging to a particular dataset that was collected within given 24-period. The files included under the “**Day…**” designation vary according to the dataset being explored. Table 1 presents each dataset and a list of the (potentially) accompanying files represented by the **Day…** designation.

Table 1: Files Included under the “Day …” Designation for Each Dataset

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **SPMD Environment** | | | | | | |
| Driving Data | | Basic Safety Message | Roadside Equipment | Contextual | | |
| **DAS1** | **DAS2** | **Basic Safety Message** | **Roadside Equipment** | **Weather\*** | **Network** | **Schedule** |
| AudioTimes | HV\_Radar | BrakeByte1Events | BSM | Weather/climatic data | Pointer to Resources | Pointer to Resources |
| DataFrontTargets | HV\_Primary | BrakeByte2Events | Geometry |  |  |  |
| DataLane | DAS2\_Trip\_Summary | BsmP1 | Lane |  |  |  |
| DataWsu |  | ExteriorLightsEvents | LaneNode |  |  |  |
| DAS1\_Trip\_Summary |  | PosAccurByte1Events | MAP |  |  |  |
|  |  | PosAccurByte2Events | Packet |  |  |  |
|  |  | PosAccurByte3Events | PCAPFile |  |  |  |
|  |  | PosAccurByte4Events | SPAT |  |  |  |
|  |  | SteerAngleEvents | SPATMovement |  |  |  |
|  |  | ThrottlePositionEvents | TIM |  |  |  |
|  |  | TransStateEvents | TIMRegion |  |  |  |
|  |  | WiperStatusFrontEvents | TIMRegionNode |  |  |  |
|  |  | BSM\_Trip\_Summary |  |  |  |  |

\* Definitions for the column abbreviations are given in the corresponding section(s)

The text boxes labeled “DaySummary” represent a file that presents a few summary measures that describe the contents of the files from a particular dataset. The “DaySummary” file for the Driving, BSM and RSE dataset may contain information such as the name of each file contained in the dataset and the number of rows, fields, vehicles, and unique trip numbers, as well as the size of the file. Greater details regarding the “DaySummary” file will be presented in subsequent iterations of this handbook as the most informative set of data that summarizes a day’s activity is still being determined.

## SPMD File Naming Convention

The following section presents the file naming convention that is used for the various datasets and their files. Recall that each file in a dataset is broken into 24-hour periods. For each day of the SPMD, two files are immediately available to be downloaded from the RDE. One file will be that day’s “Summary” file, and the other is a zip file that contains all other files belonging to the dataset. (See Table 1 for a list of files belonging to the various datasets.) The name of each “DaySummary” file will follow the following naming convention:

spmd\_NameOf Dataset\_ DaySummary\_MM\_DD\_YY.csv

where:

spmd – Safety Pilot Model Deployment

NameOfDataSet – name of one of the eight datasets

DaySummary – file name/type of file

YY – two-digit year

MM – two-digit month

DD – two-digit day

csv – file extension (comma-separated file)

For example, the file spmd\_Das1\_DaySummary\_11\_01\_12.csv represents a comma-separated file that contains a summary of the files from the DAS1 dataset that capture the activities from November 1, 2012.

The name for each zip file will follow the following naming convention, which is similar to the naming convention for the “DaySummary” file:

spmd\_NameOfDataset\_MM\_DD\_YY.zip

where:

spmd – Safety Pilot Model Deployment

NameOfDataSet – name of one of the eight datasets

YY – two-digit year

MM – two-digit month

DD – two-digit day

zip – file extension (zip file)

For example, the file spmd\_Das1\_11\_01\_2012.zip represents a zipped folder that contains all the files that belong to the DAS1 dataset that were populated with data that was collected on November 1, 2012.

After downloading and unzipping a dataset’s zipped file for a given 24-hour period, the unzipped folder will contain a series of comma-separated files that contain the collected data elements. The naming convention for these file is as follows:

spmd\_NameOf Dataset\_NameOfFile\_MM\_DD\_YY.csv

where:

spmd – Safety Pilot Model Deployment

NameOfDataSet – name of one of the eight datasets

NameOfFile – name of one of the files contained in preceding dataset

YY – two-digit year

MM – two-digit month

DD – two-digit day

csv – file extension (comma-separated file)

For example, the file spmd\_Das1\_DasData\_11\_01\_12.csv represents the comma-separated file, DasData, which belongs to the DAS1 dataset. The DasData file contains data that was collected on November 1, 2012.

The file names for files in the Network, Weather, Schedule, and Road Work Activity datasets may differ slightly for the above naming convention. The difference in naming convention will largely be due to the fact that not all files in these datasets can be presented in a comma-separated file format. In cases where file formats differ from a comma-separated format, a special note will be made in that regard.

## Detailing the Contents of Each SPMD Dataset

The details of each dataset will be presented through the use of a series of tables that communicate different aspects of the data elements contained in each dataset. To provide an overview of each dataset, the first presented table lists the files contained in the dataset and gives a brief description of each file. The next table presents a sample “Summary” file that communicates the amount of activity that occurred over a particular 24-hour period.

A series of three to four tables will be presented describing the contents of that file. The first table will present a file’s data elements, along with their units and a brief description of each element. The second table will present any data elements that are enumerated, their values, and associated meaning and description. This table will not be included for each file, as not all files from the various datasets contain enumerated data elements. The third table presents a small sample of the file being described; usually it is the first ten rows of the file, populated with data from a selected 24-hour period.

The fourth table provides a few summary measures for each data element of a given file, derived from data collected over a 24-hour period. These summary values include: number of unique values, sample values, minimum and maximum values, and the number of rows contained in the file being explored. The number of unique values in this table will take on different meanings depending on whether the data element being described is discrete or continuous.

For instance, if the variable being summarized is continuous, such as a measure of time that constantly updates at a predefined frequency, the number of unique values does not communicate a significant amount of information. However, if the variable were discrete, for example, device IDs, the number of unique states will communicate the number of vehicles that participated in the Model Deployment effort during the selected 24-hour period. The sample value fields present five different values of each data element, unless the data has fewer than five unique values. In this case, all the values for that data element will be presented. The minimum and maximum values and the number of rows (in the file being explored) is just that, for each data element over the selected 24-hour period.

## Data Framework Modifications due to Sanitization of the SPMD Sample

The above section detailed the framework for the entire set of data elements available from the SPMD. For the SPMD sample, some of the aforementioned structure and naming convention is slightly different as the data will be less complex versus the complete SPMD dataset. For instance, the file name “spmd\_Das1\_ DataLane\_11\_01\_12.csv” will be transformed to “DataLane\_11\_01\_12.csv”. The primary reason for this is that the month-week-day structure is not the most effective means to present the “Sample” – as it only includes data collected for a single day.

Some other changes were made to this data environment to protect participant privacy. In general, data such as audio and video data have been remove from this data environment as (S)PII may be obtain from these recordings. Additionally, making these recordings available to the public, prior to the realization of the original objectives of the study, may compromise the intent of the study that was conducted. Other files and specific data elements, within a number of files, were also deleted to protect participant privacy. These other measures were taken to prevent the identification of a participant’s origin and destination for a given trip or trip segment.

# DAS1 DATASET

The DAS1 dataset contains data that is collected by the Data Acquisition System (DAS) developed by UMTRI. This DAS collects audio and video data as well as text. However, given the presence of (S)PII in the video and audio data, only text-based data are available via the RDE. The DAS1 dataset contains 9 comma-separated files. Names and brief descriptions of each file are presented in Table 2.

Table 2: Description of the Files in the DAS1 Dataset

|  |  |  |  |
| --- | --- | --- | --- |
| **File Number** | **File** | **Description** | **Sample Rate** |
| 1 | DataFrontTargets | Log of the data collected by the Mobileye sensor which is a part of the DAS; largely includes data about the (vehicle) object that is in front of the host vehicle | 10Hz |
| 2 | DataLane | Logs quality of the lane markings next to the host vehicle as well as the distances between each side of the vehicle and each lane line | 10Hz |
| 3 | DataWsu | Log of GPS and CAN Bus data obtained via the onboard WSU | 10Hz |
| 4 | DAS1\_Trip\_Summary | A list of summary measures for each trip completed by a vehicle equipped with DAS1 | 1 per trip |

By way of providing an overview of the DAS1 dataset, Table 3 presents a summary for all the files contained in this dataset. This table presents the size, number of vehicles, and number of trips in each file in the DAS1 dataset. The table below is similar to the “Summary” file that can be found on the RDE. The table below summarizes the DAS1 files that were populated with data that was collected on November 1, 2012.

Table 3: File Summary for DAS1 Dataset for November 1, 2012

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **File No.** | **File Name** | **No. of Rows** | **No. of Columns** | **No. of Vehicles** | **No. Unique Trip IDs** | **File Size (KB)** |
| 1 | DataFrontTargets\_11\_01\_12.csv | 884,802 | 11 | 10 | 47 | 47,884 |
| 2 | DataLane\_11\_01\_12.csv | 1,401,111 | 8 | 10 | 51 | 57,470 |
| 3 | DataWsu\_11\_01\_12.csv | 3,228,080 | 27 | 8 | 411 | 463,475 |
| 4 | DAS1\_Trip\_Summary\_11\_01\_12.csv | 52 | 23 | 10 | 51 | 8 |

For the above table, the “No. of Unique Trip IDs” does not reflect the number of trips that contributed to a particular file. This is because different device/vehicle IDs can be assigned the same trip ID. To get a sense of number of trips that are sufficiently detailed for the data being explored, users are advised to explore the spmd\_Das1\_Summary\_11\_01\_12.csv file, which summarizes all trips taken by equipped host vehicles for which the most comprehensive data are available. For the day being explored here, November 1, 2012, there are 51 trips for which detailed host vehicle driving data is available. This is according to the above spmd\_Das1\_Summary\_11\_01\_12.csv file, which has 52 rows, each representing a single trip, and one representing the header row.

The details for each of the files belonging to the DAS1 dataset are presented below, and reference data collected on November 1, 2012.

## DataFrontTargets File

Elements in the DataFrontTargets file are populated with the aid of Mobileye’s vision-based Advanced Driver Assistance Systems. This system collects information from the scene in front of the vehicle, and uses a series of algorithms to communicate measures and warnings to drivers as appropriate.[[4]](#footnote-4) Table 4 briefly describes a few of the data elements collected by the Mobileye sensor, which are used to populate the *DataFrontTargets* file.

Table 4: Data Elements of the DataFrontTargets File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| Device | Integer | none | - | A unique, numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| Trip | Integer | none | - | Count of ignition cycles—each ignition cycle commences when the ignition is in the on position and ends when it is in the off position |
| Time | Integer | centiseconds | - | Time in centiseconds since DAS started, which (generally) starts when the ignition is in the on position |
| TargetId | Integer | none | - | Numeric ID assigned by the Mobileye sensor to distinguish between the different objects being tracked; the closest obstacle is given a TargetId value of 1 |
| ObstacleId | Integer | none | - | ID of new obstacle, as assigned by the Mobileye sensor, and its value will be the last used free ID |
| Range | Integer | m | - | Longitudinal position of an object, typically the closest object, relative to a reference point on the host vehicle, according to the Mobileye sensor |
| RangeRate | Real | m/sec | - | Longitudinal velocity of an object, typically the closest object, relative to the host vehicle, according to the Mobileye sensor |
| Transversal | Real | m | - | The lateral position of the obstacle, as determined by the Mobileye sensor |
| TargetType | Integer | none | 409 | Classification of an identified obstacle/target as a car, truck, pedestrian, etc. |
| Status | Integer | none | 410 | Classification of the motion (kinematic state) of an identified obstacle/target as stopped, moving, etc. |
| CIPV | Integer | none | 1 | Field communicating whether an obstacle is the closest in a vehicle’s path |

While Table 4 contains a number of enumerated elements whose values are associated with different meanings, Table 5 presents each of these data elements and their various enumerations.

Table 5: Enumeration Table for DataFrontTargets File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| TargetType | 409 | 0 | Car | Mobileye sensor has identified an obstacle/target as a car |
| 1 | Truck | Mobileye sensor has identified an obstacle/target as a truck |
| 2 | Motorcycle | Mobileye sensor has identified an obstacle/target as a motorcycle |
| 3 | Pedestrian | Mobileye sensor has identified an obstacle/target as a pedestrian |
| 4 | Bicycle | Mobileye sensor has identified an obstacle/target as a bicycle |
| Status | 410 | 0 | Undefined | Mobileye sensor is unable to determine the kinematic state of the identified obstacle/target |
| 1 | Standing | Mobileye sensor has determined that the identified obstacle/target is standing |
| 2 | Stopped | Mobileye sensor has determined that the identified obstacle/target is stopped |
| 3 | Moving | Mobileye sensor has determined that the identified obstacle/target is moving |
| 4 | Oncoming | Mobileye sensor has determined that the identified obstacle/target is oncoming |
| 5 | Parked | Mobileye sensor has determined that the identified obstacle/target is parked |
| 6 | Unused | Value saved for future assignment |
| CIPV | 1 | 0 | False | Identified obstacle/target is not the closest in a vehicle’s path |
| 1 | True | Identified obstacle/target is the closest in a vehicle’s path |

Table 6 provides a 10-record sample from the DataFrontTargets file.

Table 6: Sample Records for DataFrontTargets File

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Device** | **Trip** | **Time** | **TargetId** | **ObstacleId** | **Range** | **RangeRate** | **Transversal** | **TargetType** | **Status** | **CIPV** |
| 10204 | 510 | 1400 | 1 | 1 | 52.9125 | -4.08972 | -0.8 | 0 | 4 | 0 |
| 10204 | 510 | 1410 | 1 | 1 | 52.33333 | -6.52678 | -0.65625 | 0 | 4 | 0 |
| 10204 | 510 | 1420 | 1 | 1 | 51.60714 | -8.06545 | -0.51786 | 0 | 4 | 0 |
| 10204 | 510 | 1430 | 1 | 1 | 50.64844 | -10.0794 | -0.35938 | 0 | 4 | 0 |
| 10204 | 510 | 1440 | 1 | 1 | 49.72222 | -12.4183 | -0.21528 | 0 | 4 | 0 |
| 10204 | 510 | 1450 | 1 | 1 | 48.23611 | -15.1649 | 0.0625 | 0 | 4 | 0 |
| 10204 | 510 | 1460 | 1 | 1 | 46.60417 | -18.0417 | 0.333333 | 0 | 4 | 0 |
| 10204 | 510 | 1470 | 1 | 1 | 44.625 | -19.9445 | 0.604167 | 0 | 4 | 0 |
| 10204 | 510 | 1480 | 1 | 1 | 42.50694 | -21.4514 | 0.868056 | 0 | 4 | 0 |
| 10204 | 510 | 1490 | 1 | 1 | 40.3125 | -22.5556 | 1.118056 | 0 | 4 | 0 |

Table 7 provides a few summary measures of the DataFrontTargets file that were obtained on November 1, 2012.

Table 7: Summary Measures for Data Elements of the DataFrontTargets File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Column Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
| Device | 10 | 10204, 10205, 10207, 13000, 13103 | 10204 | 17103 | 884801 |
| Trip | 47 | 131, 334, 162, 141, 133 | 2 | 1117 |
| Time | 166407 | 715390, 905680, 1028050, 661510, 1757480 | 200 | 2871440 |
| TargetID | 9 | 1, 2, 3, 5, 6 | 1 | 10 |
| ObstacleID | 64 | 26, 5, 15, 62, 1 | 0 | 63 |
| Range | 57650 | 71.16964, 85.65179, 101.6979, 35.97321, 110.55 | 0.7125 | 159.8 |
| RangeRate | 197014 | -2.241074, 4.055298, -,.7177575, 2.036324, 1.155552 | -92.68056 | 111.9236 |
| Transversal | 18589 | 25.03472, 10.53906, -.015625, -13.59375, -16.00893 | -32 | 31.9375 |
| TargetType | 5 | 0, 1, 2, 3, 4 | 0 | 4 |
| Status | 6 | 0, 1, 2, 3, 4 | 0 | 5 |
| CIPV | 2 | 0, 1 | 0 | 1 |

## DataLane File

The *DataLane* file is a log of lane-based information collected by the onboard Mobileye sensor. These data communicate the vehicle’s position relative to the lane boundaries of its travel lane. A quality measure associated with the estimated information regarding the vehicle’s lane boundaries is also presented in this table. This file contains eight fields, presented in Table 8, along with a brief description of each. While Table 8 contains a number of enumerated elements whose values are associated with different meanings, Table 9 presents these data elements and their various enumerations.

Table 8: Data Elements of the DataLane File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| Device | Integer | none | - | A unique numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| Trip | Integer | none | - | Count of ignition cycles—each ignition cycle commences when the ignition is in the on position and ends when it is in the off position |
| Time | Integer | centiseconds | - | Time in centiseconds since DAS started, which (generally) starts when the ignition is in the on position |
| LaneDistanceLeft | Real | m | - | Distance between the left side of the vehicle and the left boundary of the travel lane |
| LaneDistanceRight | Real | m | - | Distance between the right side of the vehicle and the right boundary of the travel lane |
| LaneHeading | Real | degrees | - | Direction in which the vehicle is traveling |
| LaneQualityRight | Integer | none | - | Quality of the estimated boundary measure of the travel lane’s left boundary |
| LaneQualityLeft | Integer | none | - | Quality of the estimated boundary measure of the travel lane’s right boundary |

(It is intended that the following table will be populated after further conversation with UMTRI)

Table 9: Enumeration Table for DataLane File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| LaneQualityRight | ?? | 0 |  |  |
| ?? | 1 |  |  |
| ?? | 2 |  |  |
| ?? | 3 |  |  |
| LaneQualityLeft | ?? | 0 |  |  |
| ?? | 1 |  |  |
| ?? | 2 |  |  |
| ?? | 3 |  |  |

Table 10 provides a 10-record sample from the DataLane file.

Table 10: Sample Records for DataLane File

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Device** | **Trip** | **Time** | **LaneDistanceLeft** | **LaneDistanceRight** | **LaneHeading** | **LaneQualityRight** | **LaneQualityLeft** |
| 10204 | 512 | 210 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 220 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 230 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 240 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 250 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 260 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 270 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 280 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 290 | -1.875 | 1.875 | -1.024 | 0 | 0 |
| 10204 | 512 | 300 | -1.875 | 1.875 | -1.024 | 0 | 0 |

Table 11 provides a few summary measures of the DataLane file obtained from the data collected on November 1, 2012.

Table 11: Summary Measures for Data Elements of the DataLane File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Column Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
| Device | 10 | 10204, 10205, 10207, 13000, 13103 | 10204 | 17103 | 1401110 |
| Trip | 51 | 141, 162, 334, 512, 131 | 2 | 1117 |
| Time | 288468 | 1833670, 737700, 763170, 2642450, 2669260 | 200 | 2884870 |
| LaneDistanceLeft | 4248 | 6.59375, -8.242188, 8.566406, 2.722656, 1.253906 | -9.972656 | 9.984375 |
| LaneDistanceRight | 4215 | -1.808594,-5.015625, 4.121094, 5.472656, -5.648438 | -9.996094 | 9.996094 |
| LaneHeading | 992 | 0, 0.09200001, 0.2, -0.019, 0.226 | -1.024 | 0.6305 |
| LaneQualityLeft | 4 | 0, 1, 2, 3 | 0 | 3 |
| LaneQualityRight | 4 | 0, 1, 2, 3 | 0 | 3 |

## DataWsu File

Data from the onboard WSU populates the *DataWsu* file. This file primarily consists of GPS-based data elements and those that are obtained from the vehicle’s Controller Area Network (CAN) Bus. In addition to GPS-based data, there are a series of data elements that present vehicle performance information and the state of a few of its components. The *DataWsu* file has the most fields, 27, of any file in the DAS1 dataset. Table 12 contains the list of fields in the *DataWsu* file, along with a brief description of each.

Table 12: Data Elements of the DataWsu File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| Device | Integer | none | - | A unique numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| Trip | Integer | none | - | Count of ignition cycles—each ignition cycle commences when the ignition is in the on position and ends when it is in the off position |
| Time | Integer | centiseconds | - | Time in centiseconds since DAS started, which (generally) starts when the ignition is in the on position |
| GpsValidWsu | Integer | none | 1 | Communicates whether a GPS data point is valid or not |
| GpsTimeWsu | Integer | millisecond |  | Epoch GPS time received from the remote vehicle that has been targeted by the host vehicle’s WSU |
| LatitudeWsu | Float | deg | - | Latitude from WSU receiver |
| LongitudeWsu | Float | deg | - | Longitude from WSU receiver |
| AltitudeWsu | Real | m | - | Altitude from WSU receiver |
| GpsHeadingWsu | Real | deg | - | Heading from WSU GPS receiver |
| GpsSpeedWsu | Real | m/sec | - | Speed from WSU GPS receiver |
| HdopWsu | Real | none | - | Horizontal dilution of precision |
| PdopWsu | Real | none | - | Position dilution of precision |
| FixQualityWsu | Integer | none | - | GPS Fix Quality |
| GpsCoastingWsu | Integer | none | - | GPS Coasted |
| ValidCanWsu | Integer | none | 1 | Valid Vehicle CAN Bus message to WSU |
| YawRateWsu | Real | deg/sec | - | Yaw rate from vehicle CAN Bus via WSU |
| SpeedWsu | Real | kph | - | Speed from vehicle CAN Bus via WSU |
| TurnSngRWsu | Integer | none | 11 | Right turn signal from vehicle CAN Bus via WSU |
| TurnSngLWsu | Integer | none | 11 | Left turn signal from vehicle CAN Bus via WSU |
| BrakeAbsTcsWsu | Integer | none | - | Brake, ABS, and traction control from vehicle CAN Bus via WSU |
| AxWsu | Real | m/sec2 | - | Longitudinal acceleration from vehicle CAN Bus via WSU |
| PrndlWsu | Integer | none | 403 | Current transmission state (Park, Reverse, Neutral, Drive, Low) from vehicle CAN Bus via WSU |
| VsaActiveWsu | Integer | none | - | Stability control active from vehicle CAN Bus via WSU |
| HeadlampWsu | Integer | none | - | Headlamp state from vehicle CAN Bus via WSU |
| WiperWsu | Integer | none | - | Wiper state from vehicle CAN Bus via WSU |
| ThrottleWsu | Real | none | - | Throttle position from vehicle CAN Bus via WSU |
| SteerWsu | Real | deg | - | Steering angle/position from vehicle CAN Bus via WSU |

Table 12 contains a number of enumerated elements whose values are associated with different meanings. Table 13 presents each of these data elements and their various enumerations.

Table 13: Enumeration Table for DataWsu File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| GpsValidWsu | 1 | 0 | False | Invalid data from GPS unit |
|  | 1 | 1 | True | Valid data from GPS unit |
| ValidCanWsu | 1 | 0 | False | Invalid data from vehicle CAN bus |
|  | 1 | 1 | True | Valid data from vehicle CAN bus |
| TurnSngLWsu | 11 | 0 | Off | Left turn signal is off |
|  | 11 | 1 | On | Left turn signal is on |
| TurnSngRWsu | 11 | 0 | Off | Right turn signal is off |
|  | 11 | 1 | On | Right turn signal is on |
| PrndlWsu | 403 | 0 | Shifting | Shifting gears |
|  | 403 | 1 | Park | Transmission is in the Park position |
|  | 403 | 2 | Reverse | Transmission is in the Reverse position |
|  | 403 | 3 | Neutral | Transmission is in the Neutral position |
|  | 403 | 4 | Drive | Transmission is in the Drive position |
|  | 403 | 5 | Drive4 | Transmission is in the Drive4 position |
|  | 403 | 6 | First | Transmission is in the first gear |
|  | 403 | 7 | Second | Transmission is in the second gear |
|  | 403 | 8 | Third | Transmission is in third gear |
|  | 403 | 9 | Fourth | Transmission is in fourth gear |

Table 14 provides a 10-record sample from the DataWsu file.

Table 14: Sample Records for DataWsu File

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Device** | **Trip** | **Time** | **GpsValidWsu** | **GpsTimeWsu** | **LatitudeWsu** | **LongitudeWsu** | **AltitudeWsu** | **Gps**  **HeadingWsu** | **Gps**  **SpeedWsu** | **HdopWsu** | **PdopWsu** | **FixQualityWsu** |
| 10204 | 509 | 23650 | 1 | 1.35E+12 | 42.28868 | -83.7482 | 203.8 | 106.88 | 6.780764 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23660 | 1 | 1.35E+12 | 42.28868 | -83.7482 | 203.8 | 107.2572 | 6.821229 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23670 | 1 | 1.35E+12 | 42.28868 | -83.7482 | 203.8 | 108.58 | 6.910778 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23680 | 1 | 1.35E+12 | 42.28867 | -83.7482 | 203.8 | 109.0787 | 6.959002 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23690 | 1 | 1.35E+12 | 42.28867 | -83.7482 | 203.7 | 108.64 | 7.036681 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23700 | 1 | 1.35E+12 | 42.28867 | -83.7482 | 203.7 | 109.0606 | 7.090995 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23710 | 1 | 1.35E+12 | 42.28867 | -83.7482 | 203.7 | 109.51 | 7.119417 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23720 | 1 | 1.35E+12 | 42.28866 | -83.7482 | 203.7 | 109.9133 | 7.170913 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23730 | 1 | 1.35E+12 | 42.28866 | -83.7482 | 203.6 | 111.39 | 7.220139 | 0.8 | 1.4 | 1 |
| 10204 | 509 | 23740 | 1 | 1.35E+12 | 42.28866 | -83.7482 | 203.6 | 111.915 | 7.27073 | 0.8 | 1.4 | 1 |

Table continued …

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Gps**  **CoastingWsu** | **Valid**  **CanWsu** | **Yaw**  **RateWsu** | **SpeedWsu** | **Turn**  **SngRWsu** | **Turn**  **SngLWsu** | **Brake**  **AbsTcsWsu** | **AxWsu** | **PrndlWsu** | **Vsa**  **ActiveWsu** | **Head**  **lampWsu** | **WiperWsu** | **ThrottleWsu** | **SteerWsu** |
| 0 | 1 | 3.385353 | 24.2392 | 0 | 0 | 0 | 0.397074 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 3.771652 | 24.41075 | 0 | 0 | 0 | 0.404651 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 3.771652 | 24.55643 | 0 | 0 | 0 | 0.404651 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 4.987145 | 24.8788 | 0 | 0 | 0 | 0.482242 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 4.987145 | 25.05241 | 0 | 0 | 0 | 0.482242 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 4.205868 | 25.33205 | 0 | 0 | 0 | 0.543147 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 4.205868 | 25.52758 | 0 | 0 | 0 | 0.543147 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 4.03274 | 25.6299 | 0 | 0 | 0 | 0.51496 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 4.03274 | 25.81528 | 0 | 0 | 0 | 0.51496 | 5 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 5.250378 | 25.9925 | 0 | 0 | 0 | 0.505906 | 5 | 0 | 0 | 0 | 0 | 0 |

Table 15 lists summary measures of the DataWsu file obtained from data collected on November 1, 2012.

Table 15: Summary Measures for Data Elements of the DataWsu File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Column Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
| Device | 10 | 10204, 10205, 10207, 13000, 13101 | 10204 | 17103 | 999440 |
| Trip | 51 | 162, 104, 513, 1113, 141 | 2 | 1117 |
| Time | 241151 | 1376130, 2409830, 743900, 683800, 382610 | 900 | 2412510 |
| GpsValidWsu | 1 | 1 | 1 | 1 |
| GpsTimeWsu | 594964 | 1351822952900  1351827345200  1351764713500  1351808299200  1351783875200 | 1351737667700 | 1351829139600 |
| LatitudeWsu | 748803 | 42.2785019210991  42.2773747970819  42.293050752057  41.7330789462533  42.2813880226503 | 41.7318741083832 | 42.4484912629007 |
| LongitudeWsu | 760267 | -83.7265748282363  -83.692588300285  -83.7233979177803  -83.7356074898158  - 83.7338702147645 | -83.7879927971741 | -83.4309751827293 |
| AltitudeWsu | 2504 | 213.82, 224.72, 194.6, 212.75, 233 | 166.75 | 268.42 |
| GpsHeadingWsu | 314804 | 260.06, 178.3642, 68.39957, 333.1638,  209.5879 | 0 | 359.9996 |
| GpsSpeedWsu | 338569 | 9.114333, 11.89754, 16.85081, 5.285861, 13.21384 | 0 | 40.07752 |
| HdopWsu | 17 | 0.7, 0.8, 0.9, 1, 1.1 | 0.7 | 2.5 |
| PdopWsu | 29 | 1.1, 1.2, 1.3, 1.4, 1.5 | 1.1 | 4.9 |
| FixQualityWsu | 1 | 1 | 1 | 1 |
| GpsCoastingWsu | 1 | 0 | 0 | 0 |
| ValidCanWsu | 2 | 0, 1 | 0 | 1 |
| YawRateWsu | 314618 | 1.49246, 0.7796845, 0.03145057, 3.345737, 2.400542 | -219.3898 | 638 |
| SpeedWsu | 317743 | 43.9116, 33.5072, 115.7111, 72.96955, 95.49178 | 0 | 144.2791 |
| TurnSngRWsu | 1 | 0 | 0 | 0 |
| TurnSngLWsu | 1 | 0 | 0 | 0 |
| BrakeAbsTcsWsu | 2 | 0, 64 | 0 | 64 |
| AxWsu | 315044 | -0.04029475, -.5697368, -0.3275318, 1.030152, -0.5303813 | -7.655474 | 5.025188 |
| PrndlWsu | 1 | 5 | 5 | 5 |
| VsaActiveWsu | 1 | 0 | 0 | 0 |
| HeadlampWsu | 1 | 0 | 0 | 0 |
| WiperWsu | 1 | 0 | 0 | 0 |
| ThrottleWsu | 1 | 0 | 0 | 0 |
| SteerWsu | 1 | 0 | 0 | 0 |

## DAS1 Trip Summary File

The DAS1 Trip Summary file contains trip-level summaries, from each instrument vehicle, for each trip taken during the selected time period of the Model Deployment. The trip summaries include details such as trip start and end times, distance traveled, and the number of time a driver applied the brakes during the trip. Also captured in the trip summary file is the distance driven while the vehicle speed was greater than 25 mph. This data element is of interest not only because it further details the trip, but also because it provides a sense of the conditions under which data, for a particular trip, were collected. The Summary file contains 15 fields; below is a list of these fields and a brief description of each.

Table 16: Data Elements of the Summary Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| DeviceID | Integer | None | - | This field contains the unique, numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| TripID | String | None | - | This field contains a count of ignition cycles—each ignition cycle commences when the ignition is in the on position and ends when it is in the off position |
| Epoch Start Time | Integer | seconds | - | This field contains the epoch start time stamp, in seconds, of a trip. Epoch time, which is sometimes referred to as Unix time, is the number of seconds that has elapsed since midnight January 1, 1970 |
| Start Date | Date | date | - | The m/d/yyyy on which the trips started |
| Start Time | Time | time | - | This field contains the wall clock time stamp of the start of a trip, in the form of hh:mm:sss |
| Epoch End Time | Integer | seconds | - | This field contains the epoch end time stamp, in seconds, of a trip. Epoch time, which is sometimes referred to as Unix time, is the number of seconds that has elapsed since midnight January 1, 1970 |
| End Date | Date | date | - | The m/d/yyyy on which the trips ended |
| End Time | Time | Time | - | This field contains the wall clock time stamp of the end of a trip, in the form of hh:mm:sss |
| Total Trip Distance | Integer | m | - | This field contains the total distance traveled, in miles, covered in a trip |
| Distance Travelled w/ Speed >= 25mph | Real | m | - | This field contains the distance traveled in a trip but only when the vehicle’s speed is greater than or equal to 25 mph. |
| Trip Duration | Real | m | - | This field contains the total time duration, in seconds, of a trip. 999999 – data unavailable |
| Average Speed | Real | m/s | - | This field communicates a vehicle’s average speed over the entire length of the trip. 999999 – data unavailable |
| Maximum Speed | Real | m/s | - | This field contains the maximum speed reached during a trip |
| Brake Count | Integer | none | - | This field contains an indication of the number of times the driver applies the brake during a trip |
| Wiper Activated | String | none | - | This field indicates whether or not the wipers were activated during a trip |

Table 17 provides a 10-record sample from the Summary file.

Table 17: Sample Records for Summary File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DeviceID** | **TripID** | **Epoch Start Time** | **Start Date** | **Start Time** | **Epoch End Time** | **End Date** | **End Time** | **Total Trip Distance** | **Distance Travelled w/ Speed >= 25mph** |
| 10106 | 297 | 1365680194 | 4/11/2013 | 7:27:49 | 1365680194 | 4/11/2013 | 7:36:33 | 5.124307 | 4.393447 |
| 10106 | 300 | 1365712962 | 4/11/2013 | 16:33:57 | 1365712962 | 4/11/2013 | 16:42:41 | 5.837012 | 4.617299 |
| 10116 | 716 | 1365685699 | 4/11/2013 | 8:57:23 | 1365685699 | 4/11/2013 | 9:08:18 | 12.994089 | 12.197617 |
| 10116 | 718 | 1365698544 | 4/11/2013 | 12:40:12 | 1365698544 | 4/11/2013 | 12:42:23 | 6.432951 | 6.432951 |
| 10116 | 719 | 1365703393 | 4/11/2013 | 14:01:02 | 1365703393 | 4/11/2013 | 14:03:13 | 0.647246 | 0.603726 |
| 10116 | 720 | 1365735768 | 4/11/2013 | 22:51:52 | 1365735768 | 4/11/2013 | 23:02:48 | 10.487535 | 9.914046 |
| 10118 | 771 | 1365682553 | 4/11/2013 | 8:00:35 | 1365682553 | 4/11/2013 | 8:15:52 | 7.422556 | 6.164827 |
| 10118 | 772 | 1365706146 | 4/11/2013 | 14:44:43 | 1365706146 | 4/11/2013 | 14:49:05 | 3.312033 | 2.608147 |
| 10118 | 773 | 1365714403 | 4/11/2013 | 17:00:10 | 1365714403 | 4/11/2013 | 17:06:43 | 3.980565 | 3.355532 |
| 10120 | 671 | 1365681111 | 4/11/2013 | 7:32:11 | 1365681111 | 4/11/2013 | 7:51:51 | 26.373104 | 24.054027 |

Table continued …

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Trip Duration** | **Average Speed** | **Maximum Speed** | **Brake Count** | **Wiper Activated** |
| 524.288 | 35.185822 | 17.785469 | 4 | No |
| 524.288 | 40.079584 | 20.322571 | 11 | No |
| 655.36 | 71.378664 | 34.94302 | 10 | No |
| 131.072 | 176.686287 | 32.364101 | 0 | No |
| 131.072 | 17.777129 | 19.83666 | 1 | No |
| 655.36 | 57.609751 | 22.45439 | 4 | No |
| 917.504 | 29.123799 | 20.85228 | 16 | No |
| 262.144 | 45.483846 | 20.987221 | 13 | No |
| 393.216 | 36.443159 | 20.735519 | 8 | No |
| 1179.648 | 80.484327 | 35.382179 | 9 | No |

Table 18 provides a few summary measures of the Summary file from April 11, 2013.

Table 18: Summary Measures for Data Elements of the Summary File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
| DeviceID |  | 10204, 10205, 10207, 13000, 17101 | 10106 | 17103 | 278 |
| TripID |  | 41, 71-A, 50, 167, 87 | 24 | 2271 |
| Epoch Start Time | Continuous | 1365711651, 1365712175, 1365679407, 1365679669, 1365680980 | 1365652800 | 1365652800 |
| Start Date | 1 | 4/11/2013 | 4/11/2013 | 4/11/2013 |
| Start Time |  | 6:52:52, 11:34:40, 13:04:14, 17:48:13, 18:27:32 | 0:02:10 | 23:59:59 |
| Epoch End Time | Continuous | 1365737341, 1365684781, 1365693170, 1365703655, 1365706801 | 1365739199 | 1365739199 |
| End Date | 1 | 4/11/2013 | 4/11/2013 | 4/11/2013 |
| End Time |  | 12:40:12, 6:20:06, 11:19:22, 13:34:49, 16:38:19 | 0:02:10 | 23:59:59 |
| Total Trip Distance | Continuous | 26.816043, 29.563191, 8.294983, 11.286039, 1.165109 | 0.014572 | 339.5202 |
| Distance Travelled w/ Speed >= 25mph | Continuous | 28.814616, 22.377494, 1.025562, 8.281198, 7.480304 | 0 | 333.0411 |
| Trip Duration | Continuous | 917.504, 786.432, 131.072, 393.216, 393.216 | 131.072 | 999999 |
| Average Speed | Continuous | 0, 1352.01794433594, 3653.50708007812, 4117.85302734375, 4156.54296875 | 0.005718 | 999999 |
| Maximum Speed | Continuous | 0, 3.57740211486816, 723.406127929688, 3300.6240234375, 3698.57104492188 | 1.538876 | 42.25568 |
| Brake Count | Continuous | 0, 1104.56298828125, 2801.86206054688, 3296.44897460938, 4322.8818359375 | 0 | 345 |
| Wiper Activated | 2 | Yes, No | 0 | 0 |

# DAS2 DATASET

The DAS2 dataset catalogs the vehicle operation data of Crash Avoidance Metrics Partnership CAMP’s 64 vehicles that are equipped with integrated safety devices (ISD) and the data acquisition system developed by Virginia Tech Transportation Institute (VTTI) (DAS2). This DAS serves as the primary means by which vehicle operation data is being collected and stored. Although “DAS2” also captures text- and video-based data, only the text-based data will be available via the Research Data Exchange (RDE), as (Sensitive) Personally Identifiable Information ((S)PII) is in the video (and audio) data. As a result, the following sections will detail only text-based data. The DAS2 dataset contains four individual \*.csv files. Table 19 presents the seven files and a brief description of each.

Table 19: Summary of the Files Contained in DAS2 Dataset

|  |  |  |  |
| --- | --- | --- | --- |
| **File Number** | **File** | **Description** | **Sample Rate** |
| 1 | HV\_Primary | Main log file for the data acquisition system that logs vehicle position and motion data | 10Hz |
| 2 | HV\_Radar | Registered information from the host vehicle’s radar unit | 10Hz |
| 3 | DAS2\_Trip\_Summary\_File | A list of summary measures for each trip completed by a vehicle equipped with DAS2 | 1 per trip |

By way of providing an overview of the DAS2 dataset, Table 19 presents a summary for all the files contained in this dataset. This table illustrates the contributions made that populate each file in DAS2 dataset. Table 20 is similar to the “Summary” file that can be found on the RDE; it summarizes DAS2 files populated with data collected on September 6, 2012.

Table 20: File Summary for DAS2 Dataset for September 6, 2012

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **File No.** | **File Name** | **No. of Rows** | **No. of Columns** | **No. of Vehicles** | **No. Unique Trip IDs** | **File Size (KB)** |
| 1 | HV\_Primary | 2,160,912 | 53 | 51 | 246 | 576,041 |
| 2 | HV\_Radar | 3,404,787 | 11 | 50 | 234 | 171,731 |
| 3 | DAS2\_Trip\_Summary\_File | 245 | 15 | 245 | 53 | 8 |

For Table 20, the “No. of Unique Trip IDs” does not reflect the number of trips that contributed to a particular file. This is because the different device/vehicle IDs can be assigned the same trip ID. To get a sense of number of trips that are sufficiently detailed for the data being explored, users are advised to explore the DAS2\_Trip\_Summary\_File\_2012\_09\_06.csv file, which summarizes all the trips taken by equipped host vehicles, for which the most comprehensive data are available. For the day being explored here, September 6, 2012, there are 244 trips for which detailed host vehicle driving data is available. This is according to the above DAS2\_Trip\_Summary\_File\_2012\_09\_06.csv file, which has 245 rows, each representing a single trip, and one representing the header row.

Similar to the presentation of all the files within the DAS1 dataset, the following sections will detail the contents of each file in the DAS2 dataset. To accomplish this, three or four tables will be presented to communicate the various aspects of each file, as was the case when describing the files of the DAS1 dataset.

## HV\_Primary File

The HV\_Primary file is the main file that contains the performance and operation details of vehicles with ISDs. This file contains 52 fields detailing elements such as vehicle position and speed, fidelity measures of GPS-based data elements, and vehicle operation data such as steering and throttle position. Table 21 presents the fields of the HV\_Primary file as well as a few descriptors for each.

Table 21: Data Elements of the HV\_Primary File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| DeviceID | Integer | none | - | A unique numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| Trip | Integer | none | - | Count of ignition cycles—each ignition cycle commences when the ignition is in the on position and ends when it is in the off position |
| Time | Integer | centiseconds | - | Time in centiseconds since DAS started, which (generally) starts when the ignition is in the on position |
| GPS\_Elevation | Float | m | - | Elevation of vehicle according to GPS |
| GPS\_Fix\_Quality | Integer | None | 2 | Quality of GPS information |
| GPS\_Hdop | Float | None | - | Horizontal Dilution of Precision, used to determine position accuracy; the lower the number, the better |
| GPS\_Heading | Float | degrees | - | Heading of vehicle according to GPS |
| GPS\_Latitude | Float | degrees | - | Latitude of vehicle according to GPS |
| GPS\_Longitude | Float | degrees | - | Longitude of vehicle according to GPS |
| GPS\_Number\_Satellites | Integer | satellites | - | Number of satellites used in GPS solution |
| GPS\_Pdop | Float | none | - | Positional Dilution of Precision, used to determine position accuracy; the lower the number, the better |
| GPS\_Speed | Float | meters/second | - | Speed of vehicle according to GPS |
| GPS\_UTC\_Time | Integer | milliseconds |  | UTC Time of vehicle according to GPS |
| GPS\_Valid | Integer | None | 3 | Validity of GPS data |
| DAS\_Pitch\_Rate | Float | degrees/seconds | - | Vehicle angular velocity around the lateral axis |
| DAS\_Roll\_Rate | Float | degrees/seconds | - | Vehicle angular velocity around the longitudinal axis |
| InVehicle\_ABS\_State | Character | none | 4 | Provides ABS state of the vehicle |
| InVehicle\_Brake\_Status | Character | none | 5 | Provides brake status of the vehicle |
| InVehicle\_Headlight\_Status | Integer | none | 6 | Provides status if headlights are currently in use |
| InVehicle\_Longitudinal\_Accel | Float | meter /second^2 | - | Vehicle acceleration in the longitudinal direction |
| InVehicle\_Longitudinal\_Speed | Float | meters/second | - | Vehicle speed sampled from the vehicle network (CAN bus) |
| InVehicle\_PRNDL | Integer | None | 7 | Vehicle transmission state |
| InVehicle\_Stability\_Control\_Status | Integer | none | 8 | Vehicle stability control status |
| InVehicle\_Steering\_Position | Float | degrees | - | Vehicle steering wheel position in degrees |
| InVehicle\_Throttle\_Position | Float | None | - | Vehicle throttle position |
| InVehicle\_Traction\_Control\_Status | Character(10) |  | 4 | Vehicle traction control status |
| InVehicle\_Turn\_Signal\_Left | Integer | None | 6 | Vehicle left turn signal status |
| InVehicle\_Turn\_Signal\_Right | Integer | None | 6 | Vehicle right turn signal status |
| InVehicle\_Wiper\_Status | Integer |  | 9 | Vehicle wiper status |
| InVehicle\_Yaw\_Rate | Float | degrees/second | - | Vehicle yaw rate |
| LaneTrack\_Crossing\_Left | BIT | None | 10 | There is an exit on the left side of the road |
| LaneTrack\_Crossing\_Right | BIT | None | 10 | There is an exit on the right side of the road |
| LaneTrack\_Distance\_Left\_Marker | Float | Millimeter | - | Distance from vehicle centerline to inside of left-side lane marker based on vehicle-based machine vision |
| LaneTrack\_Distance\_Right\_Marker | Float | Millimeter | - | Distance from vehicle centerline to inside of right-side lane marker based on vehicle-based machine vision |
| LaneTrack\_Lane\_Width | Float | Millimeter | - | Distance between the inside edge of the innermost lane marking to the left and right of the vehicle |
| LaneTrack\_Probability\_Left\_Exist | Integer | Percent | - | Probability that vehicle-based machine vision lane marking evaluation is providing correct data for the left-side lane markings; values from 0-1024, thus 100/1024 = 0.0977% per 1 |
| LaneTrack\_Probability\_Right\_Exists | Integer | Percent | - | Probability that vehicle-based machine vision lane marking evaluation is providing correct data for the right-side lane markings; values from 0-1024, thus 100/1024 = 0.0977% per 1 |
| LaneTrack\_Shift\_Aborted | BIT | None | 10 | The driver aborted crossing a line; a line was crossed, then the driver crossed back over it |
| LaneTrack\_Shift\_Left | BIT | None | 10 | The vehicle is crossing a line on the left (cannot be STATUS\_RIGHT also) |
| LaneTrack\_Shift\_Right | BIT | None | 10 | The vehicle is crossing a line on the right |
| LaneTrack\_Shift\_Successful | BIT | None | 10 | The vehicle lies in the lane between the painted lines |
| LaneTrack\_Type\_LeftLane\_LeftMarker | Integer | None | 11 | The type of left-most marker toward the left of the vehicle |
| LaneTrack\_Type\_LeftLane\_RightMarker | Integer | None | 11 | The type of right-most marker toward the left of the vehicle |
| LaneTrack\_Type\_RightLane\_LeftMarker | Integer | None | 11 | The type of left-most marker toward the right of the vehicle |
| LaneTrack\_Type\_RightLane\_RightMarker | Integer | None | 11 | The type of right-most marker toward the right of the vehicle |

Table 62 contains a number of enumerated elements whose values are associated with different meanings. Table 63 presents each of these data elements and their various enumerations.

Table 22: Enumeration Table for HV\_Primary File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| GPS\_Fix\_Quality | 2 | 0 | invalid | Quality of GPS information |
| 1 | GPS fix | Quality of GPS information |
| 2 | dgps fix | Quality of GPS information |
| GPS\_Valid | 3 | 0 | Valid | Validity of GPS data |
| 1 | invalid | Validity of GPS data |
| InVehicle\_ABS\_State | 4 | 0 | Unavailable | Provides ABS state of the vehicle |
| 1 | Off | Provides ABS state of the vehicle |
| 2 | on (but not engaged) | Provides ABS state of the vehicle |
| 3 | engaged | Provides ABS state of the vehicle |
| InVehicle\_Brake\_Status | 5 | 0 | Not active | Provides brake status of the vehicle |
| 15 | Active | Provides brake status of the vehicle |
| InVehicle\_Headlight\_Status | 6 | 0 | Not active | Provides status if headlights are currently in use |
| 1 | Active | Provides status if headlights are currently in use |
| InVehicle\_PRNDL | 7 | 0 | Neutral | Vehicle Transmission State |
| 1 | Park | Vehicle Transmission State |
| 2 | Drive | Vehicle Transmission State |
| 3 | Reverse | Vehicle Transmission State |
| 4 | Reserved1 | Vehicle Transmission State |
| 5 | Reserved2 | Vehicle Transmission State |
| 6 | Reserved3 | Vehicle Transmission State |
| 7 | Unavailable | Vehicle Transmission State |
| InVehicle\_Stability\_Control\_Status | 8 | 0 | Unavailable | Vehicle stability control status |
| 1 | off | Vehicle stability control status |
| 2 | on or active (engaged) | Vehicle stability control status |
| InVehicle\_Wiper\_Status | 9 | 0 | off | On or off |
| 5 | on | On or off |
| LaneTrack\_Crossing\_Left/Right  LaneTrack\_Shift\_Aborted/Successful  LaneTrack\_Shift\_Left/Right | 10 | 1 | LANE |  |
| 2 | RIGHT |  |
| 4 | LEFT |  |
| 8 | ABORT |  |
| 10 | SHIFT |  |
| 20 | CROSS\_SOLID |  |
| 40 | CALIBRATE |  |
| 80 | LOW\_SUN |  |
| 100 | NIGHTTIME |  |
| 200 | EXIT\_RIGHT |  |
| 400 | EXIT\_LEFT |  |
| 800 | SCAN\_TILT |  |
| 1000 | CAM\_TILT |  |
| 2000 | NO\_VIDEO |  |
| 4000 | CAM\_SKEW |  |
| 8000 | CALIBRATE\_SKEW |  |
| LaneTrack\_Type\_LeftLane\_Left/RightMarker  LaneTrack\_Type\_RightLane\_Left/RightMarker | 11 | 0 | SOLID | Type of marker |
| 1 | DASH | Type of marker |
| 2 | UNSURE | Type of marker |
| 3 | DARK\_SOLID | Type of marker |

Table 64 provides a 10-record sample from the HV\_Primary File.

Table 23: Sample Records for HV\_Primary File

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DeviceID** | **Trip** | **Time** | **GPS\_**  **Elevation** | **GPS\_**  **Fix\_Quality** | **GPS\_**  **Hdop** | GPS\_  Heading | **GPS\_**  **Latitude** | **GPS\_**  **Longitude** | **GPS\_Number\_**  **Satellites** | **GPS\_**  **Pdop** | **GPS\_**  **Speed** | **GPS\_**  **UTC\_Time** | **GPS\_**  **Valid** | **DAS\_**  **Roll\_Rate** |
| 11 | 61062 | 477818 | 201.993 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 477918 | 201.993 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478018 | 201.993 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478118 | 201.993 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478218 | 201.993 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478318 | 201.993 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478418 | 201.993 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478518 | 202.093 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478618 | 202.093 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |
| 11 | 61062 | 478718 | 202.093 | 2 | 1.03 | 231.85 | 42.28913 | -83.7394 | 9 | 2.06 | 0 | 1.35E+12 | 1 | 0 |

Table continued …

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DAS\_**  **Pitch\_Rate** | **InVehicle\_**  **ABS\_State** | **InVehicle\_**  **Brake\_Status** | **InVehicle\_**  **Headlight\_Status** | **InVehicle\_**  **Longitudinal\_Accel** | **InVehicle\_**  **Longitudinal\_Speed** | **InVehicle\_**  **PRNDL** | **InVehicle\_**  **Stability\_Control\_Status** | **InVehicle\_**  **Steering\_Position** | **InVehicle\_**  **Throttle\_Position** |
| 0 | 2 | 15 | 0 | -0.4522 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.4522 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.4522 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.3746 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.4522 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.3746 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.4522 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.3746 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.3746 | 0 | 2 | 1 | -1.28125 | 0 |
| 0 | 2 | 15 | 0 | -0.3746 | 0 | 2 | 1 | -1.28125 | 0 |

Table continued …

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **InVehicle\_**  **Traction\_Control\_Status** | **InVehicle\_**  **Turn\_Signal\_Left** | **InVehicle\_**  **Turn\_Signal\_Right** | **InVehicle\_**  **Wiper\_Status** | **InVehicle\_**  **Yaw\_Rate** | **LaneTrack\_**  **Crossing\_Left** | **LaneTrack\_**  **Crossing\_Right** | **LaneTrack\_Distance**  **\_Left\_Marker** | **LaneTrack\_Distance**  **\_Right\_Marker** | **LaneTrack\_**  **Lane\_Width** |
| 2 | 0 | 0 | 0 | 0.011659 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | 0.011659 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | 0.111659 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | 0.311659 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | -0.18834 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | 0.011659 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | 0.111659 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | -0.08834 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | 0.311659 | 0 | 0 | -4414 | 2169 | 6583.675 |
| 2 | 0 | 0 | 0 | 0.011659 | 0 | 0 | -4414 | 2169 | 6583.675 |

Table continued …

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **LaneTrack\_**  **Probability\_Left\_Exist** | **LaneTrack\_**  **Probability\_Right\_Exists** | **LaneTrack\_**  **Shift\_Aborted** | **LaneTrack\_**  **Shift\_Left** | **LaneTrack\_**  **Shift\_Right** | **LaneTrack\_**  **Shift\_Successful** | **LaneTrack\_Type\_**  **LeftLane\_LeftMarker** | **LaneTrack\_Type\_**  **LeftLane\_RightMarker** | **LaneTrack\_Type\_**  **RightLane\_LeftMarker** |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 336 | 212 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |

Table continued …

|  |
| --- |
| **LaneTrack\_Type\_RightLane\_RightMarker** |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |

Table 24 provides a few summary measures of the HV\_Primary file that are based on data collected on September 6, 2012.

Table 24: Summary Measures for Data Element of the HV\_Primary File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
| Device | 51 | 0, 11, 13, 14, 15 | 0 | 87 | 2,160,912 |
| Trip | 246 | 52672, 52762, 53327,  53472, 54464 | 52672 | 211231 |
| Time | 587812 | 2967, 2992, 2994,  2998, 3000 | 2967 | 5292093 |
| GPS\_Elevation | 6157 | 0, 22.1000003814697,  23.2999992370605,  24.3999996185303,  26 | 0 | 315.2000122 |
| GPS\_Fix\_Quality | 2 | 1, 2 , | 1 | 2 |
| GPS\_Hdop | 434 | 0.639999985694885,  0.649999976158142,  0.660000026226044,  0.670000016689301,  0.680000007152557 | 0.639999986 | 12.93000031 |
| GPS\_Heading | 58253 | 0,  0.00100000004749745,  0.00300000002607703,  0.00700000021606684,  0.00999999977648258 | 0 | 359.9899902 |
| GPS\_Latitude | 184390 | 0,  41.8953475952148,  41.8953514099121,  41.8953552246094,  41.8953590393066 | 0 | 43.17897415 |
| GPS\_Longitude | 125898 | -84.5110397338867,  -84.5110321044922,  -84.5110244750977,  -84.5110168457031,  -84.5110092163086 | -84.51103973 | 0 |
| GPS\_Number\_Satellites | 10 | 3, 4, 5, 6, 7 | 3 | 12 |
| GPS\_Pdop | 767 | 1.10000002384186,  1.11000001430511,  1.12000000476837,  1.12999999523163,  1.13999998569489 | 1.100000024 | 21.98999977 |
| GPS\_Speed | 14880 | 0,  0.00833300035446882,  0.0166669990867376,  0.025000000372529,  0.0333329997956753 | 0 | 121.3200073 |
| GPS\_UTC\_Time | 1 | 2147483647 | 2147483647 | 2147483647 |
| GPS\_Valid | 2 | 1 | 1 | 1 |
| DAS\_Roll\_Rate | 110 | -0.325195,  -0.650391,  -0.975586,  -1.300781,  -1.625977 | -0.325195 | 9.755859 |
| DAS\_Pitch\_Rate | 147 | -0.325195,  -0.650391,  -0.975586,  -1.300781,  -1.625977 | -0.325195 | 9.755859 |
| InVehicle\_ABS\_State | 4 | 0, 1, 2, 3, | 0 | 3 |
| InVehicle\_Brake\_Status | 3 | 0, 1, 15 | 0 | 15 |
| InVehicle\_Headlight\_Status | 2 | 0, 1 , | 0 | 1 |
| InVehicle\_Longitudinal\_Accel | 72471 | -9.89999961853027,  -9.88059997558594,  -9.8612003326416,  -9.84179973602295,  -9.70600032806396 | -9.899999619 | 4.863399982 |
| InVehicle\_Longitudinal\_Speed | 15236 | 0,  0.00833300035446882,  0.0166669990867376,  0.025000000372529,  0.0333329997956753 | 0 | 436.7520142 |
| InVehicle\_PRNDL | 5 | 0, 1, 2, 3, 7 | 0 | 7 |
| InVehicle\_Stability\_Control\_Status | 2 | 0, 1 , | 0 | 1 |
| InVehicle\_Steering\_Position | 10643 | -539.5,  -538.375,  -536.1875,  -531.375,  -531.28125 | -539.5 | 536.59375 |
| InVehicle\_Throttle\_Position | 100 | 0, 1, 2, 3, 4 | 0 | 100 |
| InVehicle\_Traction\_Control\_Status | 3 | 0, 1, 2 | 0 | 2 |
| InVehicle\_Turn\_Signal\_Left | 2 | 0, 1 , | 0 | 1 |
| InVehicle\_Turn\_Signal\_Right | 2 | 0, 1 , | 0 | 1 |
| InVehicle\_Wiper\_Status | 3 | 0, 5, 6 | 0 | 6 |
| InVehicle\_Yaw\_Rate | 94419 | -327.670013427734,  -52.4900016784668,  -51.8400001525879,  -51.8300018310547,  -51.2999992370605 | -327.6700134 | 47.65000153 |
| LaneTrack\_Crossing\_Left | 2 | 0, 1 , | 0 | 1 |
| LaneTrack\_Crossing\_Right | 2 | 0, 1 , | 0 | 1 |
| LaneTrack\_Distance\_Left\_Marker | 10454 | -1, -10, -100, -1000, -10002 | -1 | 999 |
| LaneTrack\_Distance\_Right\_Marker | 10081 | -1, -10, -100, -1000, -10012 | -1 | 9997 |
| LaneTrack\_Lane\_Width | 121898 | -1015.992981,  -10165.075195,  -1041.39917,  -10551694,  -10647.668945 | -1015.992981 | 9998.285156 |
| LaneTrack\_Probability\_Left\_Exist | 1027 | 0, 1, 10, 100, 1000 | 0 | 999 |
| LaneTrack\_Probability\_Right\_Exists | 1026 | 0, 1, 10, 100, 1000 | 0 | 999 |
| LaneTrack\_Shift\_Aborted | 2 | 0, 1 , | 0 | 1 |
| LaneTrack\_Shift\_Left | 2 | 0, 1 , | 0 | 1 |
| LaneTrack\_Shift\_Right | 2 | 0, 1 , | 0 | 1 |
| LaneTrack\_Shift\_Successful | 2 | 0, 1 , | 0 | 1 |
| LaneTrack\_Type\_LeftLane\_LeftMarker | 4 | 0, 1, 2, NULL, | 0 | 2 |
| LaneTrack\_Type\_LeftLane\_RightMarker | 4 | 0, 1, 2, NULL, | 0 | 2 |
| LaneTrack\_Type\_RightLane\_LeftMarker | 4 | 0, 1, 2, NULL, | 0 | 2 |
| LaneTrack\_Type\_RightLane\_RightMarker | 4 | 0, 1, 2, NULL, | 0 | 2 |

## HV\_Radar File

The HV\_Radar file is populated with data collected from a radar unit that is part of a vehicle’s integrated safety device unit. The radar unit performs a number of functions, including estimating the type of object that is in front of the host vehicle, as well as that object’s speed and distance location relative to the host vehicle. Table 25 presents the fields of the HV\_Radar file as well as the associated descriptions.

Table 25: Data Elements of the HV\_Radar File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| DeviceID | Integer | None | - | A unique numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| Trip | Integer | None | - | Count of ignition cycles – each ignition cycle commences when the ignition is in the on position and end when it is in the off position |
| Time | Integer | None | - | Time in centiseconds since DAS started, which (generally) starts when the ignition is in the on position |
| Object\_Type | Enumerated | None | 14 | Estimate of the object type, based on the size of the raw RADAR cluster of returns. Evolution of Object\_Length\_TX. |
| Range\_X | Float | meters | - | Range to forward radar target measured longitudinally from the radar. |
| Range\_Y | Float | meters | - | Range to forward radar target measured laterally from the radar. |
| Speed\_X | Float | meters/second | - | Range rate to forward radar target measured longitudinally from radar. |
| Speed\_Y | Float | meters/second | - | Range rate to forward radar target measured laterally from radar. |
| Target\_InPath | ENUM | None | 15 | Compute from Object\_ID - verify ID=1 is in path |
| Target\_Moving | ENUM | None | 16 | Whether the object detected is moving or not. It is moving if it’s Relative Speed - RADAR speed is equal to zero. |
| TargetID | Integer | none | - | Numeric value used to differentiate one radar target from others |

Table 25 contains three enumerated elements whose values are associated with different meanings. Table 26 presents each of these data elements and their various enumerations.

Table 26: Enumeration Table for HV\_Radar File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| Object\_Type | 14 | 0 | Unclassified | The radar unit estimates that there is an unclassified object detected in front of the host vehicle |
| 1 | Pedestrian | The radar unit estimates that there is a pedestrian object detected in front of the host vehicle |
| 2 | Bike | The radar unit estimates that there is a bike object detected in front of the host vehicle |
| 3 | Light\_Vehicle | The radar unit estimates that there is an light vehicle object detected in front of the host vehicle |
| 4 | Heavy\_Vehicle | The radar unit estimates that there is an heavy vehicle object detected in front of the host vehicle |
| 5 | Tractor\_Trailor | The radar unit estimates that there is a tractor trailer object detected in front of the host vehicle |
| Target\_In\_Path | 15 | 1 | Lead\_Vehicle | Computed from Object\_ID - verify ID=1 is in path |
| Target\_Moving | 16 | 0 | Stationary | The object detected in front of the host vehicle is not moving |
| 1 | Moving | The object detected in front of the host vehicle is moving |

Table 27 provides a 10-record sample from the *HV\_Radar* file.

Table 27: Sample Records for the HV\_Radar File

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DeviceID** | **Trip** | **Time** | **TargetID** | **Object\_**  **Type** | **Range\_X** | **Range\_Y** | **Speed\_X** | **Speed\_Y** | **Target\_**  **InPath** | **Target\_**  **Moving** |
| 20 | 209423 | 7798 | 0 | 3 | 8.928 | -2.528 | 1.7 | -0.9 | 1 | 1 |
| 20 | 209423 | 7898 | 0 | 3 | 8.992001 | -2.784 | 1.8 | -0.8 | 1 | 1 |
| 20 | 209423 | 7998 | 0 | 3 | 9.184 | -3.232 | 1.9 | -0.6 | 1 | 1 |
| 20 | 209423 | 8098 | 0 | 3 | 9.280001 | -3.424 | 1.9 | -0.6 | 1 | 1 |
| 20 | 209423 | 8198 | 0 | 3 | 9.408 | -3.552 | 1.9 | -0.5 | 1 | 1 |
| 20 | 209423 | 8298 | 0 | 3 | 9.632001 | -3.84 | 2 | -0.4 | 1 | 1 |
| 20 | 209423 | 8398 | 0 | 3 | 9.76 | -3.936 | 2 | -0.4 | 1 | 1 |
| 20 | 209423 | 8498 | 0 | 3 | 9.856001 | -4.064 | 2 | -0.3 | 1 | 1 |
| 20 | 209423 | 8598 | 0 | 3 | 10.144 | -4.192 | 2 | -0.2 | 1 | 1 |
| 20 | 209423 | 8698 | 0 | 3 | 10.272 | -4.224 | 2 | -0.2 | 1 | 1 |

Table 28 provides a few summary measures of the HV\_Primary file that were obtained from data collected on 09/06/2012

Table 28: Summary Measure for the HV\_Radar File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
|  |  |  |  |  | 3,404,787 |
| Device | 50 | 0, 11, 13, 14, 15 | 0 | 87 |
| Trip | 234 | 52672, 52762, 53327, 53472, 54464 | 52672 | 211231 |
| Time | 487352 | 3353, 3392, 3398, 3399, 3453 | 3353 | 5292093 |
| TargetID | 256 | 0, 1, 2, 3, 4 | 0 | 255 |
| Object\_Type | 5 | 0, 1, 3, 4, 5 | 0 | 5 |
| Range\_X | 6394 | -7.3600001335144, -6.6560001373291, -5.9520001411438, -5.76000022888184, -5.21600008010864 | -7.36 | 199.9680023 |
| Range\_Y | 2673 | -46.7519989013672, -44.992000579834, -44.9599990844727, -44.9280014038086, -44.8959999084473 | -46.8 | 45.85599899 |
| Speed\_X | 967 | -72, -71.9000015258789, -71.8000030517578, -70.8000030517578, -70.6999969482422 | -72 | 31.60000038 |
| Speed\_Y | 441 | -33.5999984741211, -33.0999984741211, -32.5999984741211, -32.0999984741211, -31.6000003814697 | -33.6 | 18.20000076 |
| Target\_InPath | 2 | 0, 1 , | 0 | 1 |
| Target\_Moving | 2 | 0, 1 , | 0 | 1 |

## DAS2 Trip Summary File

The DAS2 Trip Summary file is similar to the DAS1 Trip Summary File. As a result of this similarity, the tables below are the same as the files presented in the section detailing the contents of the DAS1 Trip Summary file. The DAS2 Trip Summary file contains trip-level summaries, from each instrument vehicle, for each trip taken during the selected time period of the Model Deployment. The trip summaries include details such as trip start and end times, distance traveled, and the number of time a driver applied the brakes during the trip. Also captured in the trip summary file is the distance driven while the vehicle speed was greater than 25 mph. This data element is of interest not only because it further details the trip, but also because it provides a sense of the conditions under which data, for a particular trip, were collected. The Summary file contains 15 fields; below is a list of these fields and a brief description of each.

Table 29: Data Elements of the DAS2 Trip Summary file

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| DeviceID | Integer | None | - | This field contains the unique, numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| TripID | String | None | - | This field contains a count of ignition cycles—each ignition cycle commences when the ignition is in the on position and ends when it is in the off position |
| Epoch Start Time | Integer | seconds | - | This field contains the epoch start time stamp, in seconds, of a trip. Epoch time, which is sometimes referred to as Unix time, is the number of seconds that has elapsed since midnight January 1, 1970 |
| Start Date | Date | date | - | The m/d/yyyy on which the trips started |
| Start Time | Time | time | - | This field contains the wall clock time stamp of the start of a trip, in the form of hh:mm:sss |
| Epoch End Time | Integer | seconds | - | This field contains the epoch end time stamp, in seconds, of a trip. Epoch time, which is sometimes referred to as Unix time, is the number of seconds that has elapsed since midnight January 1, 1970 |
| End Date | Date | date | - | The m/d/yyyy on which the trips ended |
| End Time | Time | Time | - | This field contains the wall clock time stamp of the end of a trip, in the form of hh:mm:sss |
| Total Trip Distance | Integer | m | - | This field contains the total distance traveled, in miles, covered in a trip |
| Distance Travelled w/ Speed >= 25mph | Real | m | - | This field contains the distance traveled in a trip but only when the vehicle’s speed is greater than or equal to 25 mph. |
| Trip Duration | Real | m | - | This field contains the total time duration, in seconds, of a trip. 999999 – data unavailable |
| Average Speed | Real | m/s | - | This field communicates a vehicle’s average speed over the entire length of the trip. 999999 – data unavailable |
| Maximum Speed | Real | m/s | - | This field contains the maximum speed reached during a trip |
| Brake Count | Integer | none | - | This field contains an indication of the number of times the driver applies the brake during a trip |
| Wiper Activated | String | none | - | This field indicates whether or not the wipers were activated during a trip |

Table 30 provides a 10-record sample from the Summary file.

Table 30: Sample Records for Summary File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DeviceID** | **TripID** | **Epoch Start Time** | **Start Date** | **Start Time** | **Epoch End Time** | **End Date** | **End Time** | **Total Trip Distance** | **Distance Travelled w/ Speed >= 25mph** |
| 10106 | 297 | 1365680194 | 4/11/2013 | 7:27:49 | 1365680194 | 4/11/2013 | 7:36:33 | 5.124307 | 4.393447 |
| 10106 | 300 | 1365712962 | 4/11/2013 | 16:33:57 | 1365712962 | 4/11/2013 | 16:42:41 | 5.837012 | 4.617299 |
| 10116 | 716 | 1365685699 | 4/11/2013 | 8:57:23 | 1365685699 | 4/11/2013 | 9:08:18 | 12.994089 | 12.197617 |
| 10116 | 718 | 1365698544 | 4/11/2013 | 12:40:12 | 1365698544 | 4/11/2013 | 12:42:23 | 6.432951 | 6.432951 |
| 10116 | 719 | 1365703393 | 4/11/2013 | 14:01:02 | 1365703393 | 4/11/2013 | 14:03:13 | 0.647246 | 0.603726 |
| 10116 | 720 | 1365735768 | 4/11/2013 | 22:51:52 | 1365735768 | 4/11/2013 | 23:02:48 | 10.487535 | 9.914046 |
| 10118 | 771 | 1365682553 | 4/11/2013 | 8:00:35 | 1365682553 | 4/11/2013 | 8:15:52 | 7.422556 | 6.164827 |
| 10118 | 772 | 1365706146 | 4/11/2013 | 14:44:43 | 1365706146 | 4/11/2013 | 14:49:05 | 3.312033 | 2.608147 |
| 10118 | 773 | 1365714403 | 4/11/2013 | 17:00:10 | 1365714403 | 4/11/2013 | 17:06:43 | 3.980565 | 3.355532 |
| 10120 | 671 | 1365681111 | 4/11/2013 | 7:32:11 | 1365681111 | 4/11/2013 | 7:51:51 | 26.373104 | 24.054027 |

Table continued …

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Trip Duration** | **Average Speed** | **Maximum Speed** | **Brake Count** | **Wiper Activated** |
| 524.288 | 35.185822 | 17.785469 | 4 | No |
| 524.288 | 40.079584 | 20.322571 | 11 | No |
| 655.36 | 71.378664 | 34.94302 | 10 | No |
| 131.072 | 176.686287 | 32.364101 | 0 | No |
| 131.072 | 17.777129 | 19.83666 | 1 | No |
| 655.36 | 57.609751 | 22.45439 | 4 | No |
| 917.504 | 29.123799 | 20.85228 | 16 | No |
| 262.144 | 45.483846 | 20.987221 | 13 | No |
| 393.216 | 36.443159 | 20.735519 | 8 | No |
| 1179.648 | 80.484327 | 35.382179 | 9 | No |

Table 31 provides a few summary measures of the Summary file from April 11, 2013.

Table 31: Summary Measures for Data Elements of the Summary File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
| DeviceID |  | 10204, 10205, 10207, 13000, 17101 | 10106 | 17103 | 278 |
| TripID |  | 41, 71-A, 50, 167, 87 | 24 | 2271 |
| Epoch Start Time | Continuous | 1365711651, 1365712175, 1365679407, 1365679669, 1365680980 | 1365652800 | 1365652800 |
| Start Date | 1 | 4/11/2013 | 4/11/2013 | 4/11/2013 |
| Start Time |  | 6:52:52, 11:34:40, 13:04:14, 17:48:13, 18:27:32 | 0:02:10 | 23:59:59 |
| Epoch End Time | Continuous | 1365737341, 1365684781, 1365693170, 1365703655, 1365706801 | 1365739199 | 1365739199 |
| End Date | 1 | 4/11/2013 | 4/11/2013 | 4/11/2013 |
| End Time |  | 12:40:12, 6:20:06, 11:19:22, 13:34:49, 16:38:19 | 0:02:10 | 23:59:59 |
| Total Trip Distance | Continuous | 26.816043, 29.563191, 8.294983, 11.286039, 1.165109 | 0.014572 | 339.5202 |
| Distance Travelled w/ Speed >= 25mph | Continuous | 28.814616, 22.377494, 1.025562, 8.281198, 7.480304 | 0 | 333.0411 |
| Trip Duration | Continuous | 917.504, 786.432, 131.072, 393.216, 393.216 | 131.072 | 999999 |
| Average Speed | Continuous | 0, 1352.01794433594, 3653.50708007812, 4117.85302734375, 4156.54296875 | 0.005718 | 999999 |
| Maximum Speed | Continuous | 0, 3.57740211486816, 723.406127929688, 3300.6240234375, 3698.57104492188 | 1.538876 | 42.25568 |
| Brake Count | Continuous | 0, 1104.56298828125, 2801.86206054688, 3296.44897460938, 4322.8818359375 | 0 | 345 |
| Wiper Activated | 2 | Yes, No | 0 | 0 |

# Basic Safety Message (BSM) Dataset

A BSM is one of the messages belonging to the Society of Automotive Engineers (SAE) J2735 Standard. This standard is geared toward supporting the interoperability of DSRC applications through the use of a standardized message set and its data frames and data elements. A BSM, which is at times referred to as a “heartbeat” message, is a frequently transmitted message (usually at approximately 10Hz) that is meant to increase a vehicle’s situational awareness. These messages are intended to be used for a variety of applications to exchange safety data regarding a vehicle’s state. As such, they are an integral part of the SPMD and will be instrumental in the evaluation in the various safety applications being examined during model deployment.

A BSM contains up to two parts. Part I, the binary large object (blob), is included in every BSM. It contains the fundamental data elements that describe a vehicle’s position (latitude, longitude, elevation) and motion (heading, speed, acceleration). Part II of a BSM contains optional data that is transmitted when required or in response to an event. Typically Part II contains data that serves as an extension of vehicle safety information (path history, path prediction, event flags) and data pertaining to the status of a vehicle’s components, such as lights, wipers, and brakes.

The BSM data are collected by WSUs that were installed on all the vehicles that participated in the model deployment. Several different brands of WSUs were employed through the deployment effort, but all data were stored in a single dataset. This highlights the interoperability goal set forth by the SAE J2735 Standard. This is unlike the case with the “driving” data, which were stored in two separate datasets: one for data collected by DAS1 and another for DAS2.

The BSM dataset includes 22 files, which are listed and briefly described in Table 32.

Table 32: Description of the File Contained in the Basic Safety Message Dataset

|  |  |  |  |
| --- | --- | --- | --- |
| **File Number** | **File** | **Description** | **Sample Rate** |
| 1 | BrakeByte1Events | Status of the vehicle’s primary brake system | On Event |
| 2 | BrakeByte2Events | Status of the vehicle’s system control/advance breaking features (e.g., antilock brake system, stability control) | On Event |
| 3 | BsmP1 | Part I of the BSM, primarily vehicle position and motion data | 10 Hz |
| 4 | ExteriorLightsEvents | Provides the status of all exterior lights on the vehicle | On Event |
| 5 | PosAccurByte1Events | Accuracy of the positional determination with respect to each given Axis – semi-major | On Event |
| 6 | PosAccurByte2Events | Accuracy of the positional determination with respect to each given Axis – semi-minor | On Event |
| 7 | PosAccurByte3Events | Accuracy of the positional determination with respect to each given Axis – orientation of semi-major axis | On Event |
| 8 | PosAccurByte4Events | Accuracy of the positional determination with respect to each given Axis – orientation of semi-minor axis | On Event |
| 9 | SteerAngleEvents | The angle of the steering wheel (signed value) | On Event |
| 10 | ThrottlePositionEvents | Throttle position, expressed in units of 0.5 percent of range of travel | On Event |
| 11 | TransStateEvents | Current state of a vehicle’s transmission | On Event |
| 12 | WiperStatusFrontEvents | Current state of the wiper system at the front of the vehicle | On Event |
| 13 | BSM\_Trip\_Summary\_File | A list of summary measures for each trip per transmitted BSMs | Per trip |

## BSM Dataset Timestamps

Each file in the BSM dataset contains a time field, either a “Gentime” or a “StartTime”, and “EndTime” field. Entries in the “GenTime” field mark the time stamp at which an event was recorded, while “StartTime” and “EndTime” are the minimum and maximum “GenTime” for a given event. The values for each time entry are informed by the 1609.2 Security Services for Applications and Management Messages layer, a member of the IEEE 1609 family standards for the management and security of networks—vehicle network, specifically. The secured time stamp is an Epoch-based time measurement, measuring the number of milliseconds (or microseconds) elapsed since midnight, January 1, 2004 (2004-01-01-00:00:00). In addition, these timestamps were supposed to be relative to UTC, but due to some inaccuracies in the 1609.2 documentation there is a 35-second offset with respect to UTC (which also includes the recent addition of another leap second during the summer). Timestamps in the BSM dataset also include a factor of 1,000,000 that needs to be accounted for in order to use these time stamps.

To convert these timestamps to a more standard format, facilitating their usage with other datasets, the following formula can be used to convert the timestamps to the number of seconds elapsed since January 1, 2004 at 00:00:00.

# of seconds since 2004-01-01 00:00:00 = (Gen/Start/End Time)/1,000,000 - 35

The results from the above formula can then be used to further convert BSM timestamps into Epoch timestamps by adding it to 1072933200 (seconds).

## Mapping BSM Dataset Files to SAE J2735 Data Frame

The files, and their names, contained in the BSM dataset are based on the data frame dictated by the SAE J2735 Standard. Therefore for additional details for some of the above files, please consult the SAE J2735 Standard.[[5]](#footnote-5) However, to make use of the documentation, Table 33 maps files names to data frame names that are used by the J2735 Standard.

Table 33: J2735 Mapping of Data Frames to File in the BSM Dataset

|  |  |
| --- | --- |
| **Model Deployment Name** | **J2735 Standard (Data Frame) Terminology** |
| BrakeByte1Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-BrakeAppliedStatus |
| BrakeByte1Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-WheelBrakesUnavailable |
| BrakeByte1Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-SpareBit |
| BrakeByte1Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-TractionControlState |
| BrakeByte2Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-AntiLockBrakeStatus |
| BrakeByte2Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-StabilityControlStatus |
| BrakeByte2Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-BrakeBoostApplied |
| BrakeByte2Events | MSG\_BasicSafetyMessage-BSMblob-BrakeSystemStatus-AuxiliaryBrakeStatus |
| ExteriorLightsEvents | MSG\_BasicSafetyMessage-VehicleStatus-ExteriorLights |
| PosAccurByte1Events | MSG\_BasicSafetyMessage-BSMblob-PositionalAccuracy-MajorAccuracy |
| PosAccurByte2Events | MSG\_BasicSafetyMessage-BSMblob-PositionalAccuracy-MinorAccuracy |
| PosAccurByte3Events | MSG\_BasicSafetyMessage-BSMblob-PositionalAccuracy-HeadingPA |
| PosAccurByte4Events | MSG\_BasicSafetyMessage-BSMblob-PositionalAccuracy-HeadingPA |
| SteerAngleEvents | MSG\_BasicSafetyMessage-VehicleStatus-Steering-SteeringWheelAngle |
| TransStateEvents | MSG\_BasicSafetyMessage-BSMblob-TransmissionAndSpeed-TransmissionState |
| WiperStatusFrontEvents | MSG\_BasicSafetyMessage-VehicleStatus-Wipers-WiperStatusFront |

The following sections will detail each of the aforementioned files while providing samples of each to equip users with the requisite knowledge to extract insights from the BSM dataset.

## BsmMD File

The BsmMD File is the BSM metadata file for the transmitted BSMs from a single vehicle. All transmitted BSMs are embedded in a frame with security and communication layers. The basic function of this file is to be a pointer into the file that contains all the BSMs transmitted by each participating vehicle. The file contains device IDs, certification IDs, and offsets; these elements are a part of the security and communication layer that is required for the V2V/V2I network. As a part of the security layer, the BsmMD file contains a set of randomly generated device IDs that mask the true ID of a transmitting antenna (“TxRandom”). These randomly generated device IDs are also accompanied by the unmasked ID of transmitting antenna and the ID receiving antenna. An additional security layer is attached to a transmitted BSM by way of a certificate ID. The certificate ID (CertID) protects transmitted BSMs throughout the connected vehicle environment and enables connected vehicles (and roadside equipment) to accept only messages of entities with valid certificate IDs. For additional information regarding security measures incorporated into the connect vehicle network, review the Certificate Management Entities for a Connected Vehicle Environment document produced by RITA/USDOT.[[6]](#footnote-6)

In addition to the various security details, the BsmMD file also contains time offset values for the various parts of a BSM as well as the frame offsets to allow BSMs to be synced with associated video recordings. These frame offsets will be of limited value to RDE users as the RDE will not host such recordings. Including the aforementioned data elements of the BSM metadata file, there are a total of 13 fields. Table 34 provides a brief overview of each of these fields.

Table 34: Data Elements of the BsmMD File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| Gentime | Integer | milliseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| CertId | Integer | None |  | Numeric value attached to BSMs to verify that the source of the message is valid |
| TxRandom | Integer | None |  | Randomly assigned ID to mask the device ID of the transmitting device for security purposes |
| FrameOffset | Integer |  |  | (to be filled in pending input from Safety Pilot Test Conductor) |
| FrameSize | Integer |  |  | (to be filled in pending input from Safety Pilot Test Conductor) |
| BsmPIRelOffset | Integer | sec/msec |  | (to be filled in pending input from Safety Pilot Test Conductor) |
| BsmPIIRelOffset | Integer | sec/msec |  | (to be filled in pending input from Safety Pilot Test Conductor) |
| BsmPIIIRelOffset | Integer | sec/msec |  | (to be filled in pending input from Safety Pilot Test Conductor) |
| GenTimeRelOffset | Integer | sec/msec |  | (to be filled in pending input from Safety Pilot Test Conductor) |
| PsIdByte | Integer | None |  | (to be filled in pending input from Safety Pilot Test Conductor) |

Table 35 provides a 10-record sample of the contents of the BsmMD file.

Table 35: Sample Records for *BsmMD* File

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **Gentime** | **CertId** | **TxRandom** | **FrameOffset** | **FrameSize** |
| 10 | 13963 | 10 | 278802340808876 | -4449541671506560000 | 0 | 40 | 292 |
| 10 | 13963 | 10 | 278802340908860 | 4846661789333420000 | 0 | 348 | 363 |
| 10 | 13963 | 10 | 278802341008885 | -4449541671506560000 | 0 | 727 | 292 |
| 10 | 13963 | 10 | 278802341108882 | -4449541671506560000 | 0 | 1035 | 292 |
| 10 | 13963 | 10 | 278802341208958 | -4449541671506560000 | 0 | 1343 | 292 |
| 10 | 13963 | 10 | 278802341309002 | -4449541671506560000 | 0 | 1651 | 292 |
| 10 | 13963 | 10 | 278802341408935 | 4846661789333420000 | 0 | 1959 | 363 |
| 10 | 13963 | 10 | 278802341508966 | -4449541671506560000 | 0 | 2338 | 292 |
| 10 | 13963 | 10 | 278802341608941 | -4449541671506560000 | 0 | 2646 | 292 |
| 10 | 13963 | 10 | 278802341708937 | -4449541671506560000 | 0 | 2954 | 292 |

Table continued …

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BsmPIRelOffset** | **BsmPIIRelOffset** | **BsmPIIIRelOffset** | **GenTimeRelOffset** | **PsIdByte** |
| 69 | 109 | 109 | 218 | 32 |
| 140 | 180 | 180 | 289 | 32 |
| 69 | 109 | 109 | 218 | 32 |
| 69 | 109 | 109 | 218 | 32 |
| 69 | 109 | 109 | 218 | 32 |
| 69 | 109 | 109 | 218 | 32 |
| 140 | 180 | 180 | 289 | 32 |
| 69 | 109 | 109 | 218 | 32 |
| 69 | 109 | 109 | 218 | 32 |
| 69 | 109 | 109 | 218 | 32 |

Table 36 provides a few summary measures of the BsmMD file that was populated with data collected on November 1, 2012.

Table 36: Summary Measures for Data Elements of the *BsmMD* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 90 | 10 | 2896 | 52, 83, 62, 11, 2133 | 4402115 |
| FileId | 531 | 13965 | 83928 | 45247, 22166, 21648, 48238, 24906 |
| TxDevice | 312 | -32438 | 32364 | -31579, -15567, 9757, -30470, -18888 |
| GenTime | 69010 | 278809095 | 278895493 | 278833433  278873173  278814106  278860048  278812391 |
| CertID | 2133 | -9220360569067272308 | 9211289221355773666 | 795103942098043545  4603058481584197546  -1749524897943679860  7304383493594146308  -232168673156436312 |
| TxRandom | 783 | -32659 | 32703 | -9031, 30935, 12994, -11635, 26668 |
| FrameOffset | 3034419 | 40 | 26784154 | 4661438, 1976180, 1993160, 897190 |
| FrameSize | 266 | 193 | 505 | 230, 298, 366, 434, 481 |
| BsmPIRelOffset | 16 | 50 | 141 | 50, 51, 52, 53, 67 |
| BsmPIIRelOffset | 16 | 90 | 181 | 90, 91, 92, 93, 107 |
| BsmPIIIRelOffset | 16 | 90 | 181 | 90, 91, 92, 93, 107 |
| GenTimeRelOffset | 266 | 119 | 431 | 162, 251, 319, 387, 141 |
| PsIdByte | 1 | 32 | 32 | 32 |

## BsmP1 File

The BsmP1 file can be considered as the main BSM file. It contains BSM measures that change frequently, approximately 10 Hz. These measures mainly include motion (speed and acceleration) and location (longitude and latitude) elements. The BsmP1 file contains both Part I and Part II elements of the BSM. The majority of the data elements in this file are defined in Part I of the BSM structure; however, elements such as PathCount, RadiusOfCurvature, and Confidence are defined in Part II of the BSM.

The BsmP1 file primarily gets populated with data that is obtained through the vehicle’s CAN bus and then transmitted via an onboard WSU. This file contains a field that communicates elapsed time, “Gentime”; it is important to note that the above discussion regarding BSM timestamps does apply to this measure.

In total there are 19 fields in the BsmP1 file. A brief description of each is given in Table 37.

Table 37: Data Elements of the BsmP1 File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| Gentime | Integer | milliseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| TxRandom | Integer | None |  | Randomly assigned ID to mask the device ID of the transmitting device for security purposes |
| MsgCount | Integer | None |  | Message ID that gets incremented by one with each BSM |
| DSecond | Integer | Deciseconds |  | Time in deciseconds since ignition started |
| Latitude | Float | Degrees |  | Current latitude of the vehicle |
| Longitude | Float | Degrees |  | Current longitude of the vehicle |
| Elevation | Float | Meters |  | Current elevation of vehicle according to GPS |
| Speed | Real | m/sec |  | Vehicle speed |
| Heading | Real | Degrees |  | Vehicle heading/direction |
| Ax | Real | m/sec^2 |  | Longitudinal acceleration |
| Ay | Real | m/sec^2 |  | Lateral acceleration |
| Az | Real | m/sec^2 |  | “Vertical” acceleration |
| Yawrate | Real | Deg/sec |  | Vehicle yaw rate |
| PathCount | Integer | None |  | Number, between 1 and 23, representing a group of points that communicate a vehicle’s position and motion. Each group of points is of non-uniform size. |
| RadiusOfCurve | Float | Centimeter |  | Estimate of the radius of a curve being negotiated, which is derived from a number of systems and sensors. Positive and negative values reflect right and left turns, respectively, and +/- 32767 for straight paths. |
| Confidence | Integer | Percent |  | Signals the accuracy and non-steady state and steady state of curvature estimate. In steady state (straight roadways or curves with constant radius of curvature), a high confidence value is reported. |

Seeing that the BsmP1 file does not contain any enumerated values, no such table will be presented here. Table 38 presents a 10-record sample of the contents of the BsmP1 file.

Table 38: Sample Records for *BsmP1* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **FileId** | **TxDevice** | **Gentime** | **TxRandom** | **MsgCount** | **DSecond** | **Latitude** | **Longitude** | **Elevation** | **Speed** |
| 13963 | 10 | 278802340808876 | 0 | 76 | 14700 | 42.29717 | -83.7013 | 239.4 | 0.86 |
| 13963 | 10 | 278802340908860 | 0 | 77 | 14800 | 42.29717 | -83.7013 | 239.4 | 0.72 |
| 13963 | 10 | 278802341008885 | 0 | 78 | 14900 | 42.29717 | -83.7013 | 239.4 | 0.66 |
| 13963 | 10 | 278802341108882 | 0 | 79 | 15000 | 42.29717 | -83.7013 | 239.4 | 0.52 |
| 13963 | 10 | 278802341208958 | 0 | 80 | 15100 | 42.29717 | -83.7013 | 239.4 | 0.46 |
| 13963 | 10 | 278802341309002 | 0 | 81 | 15200 | 42.29718 | -83.7013 | 239.3 | 0.38 |
| 13963 | 10 | 278802341408935 | 0 | 82 | 15300 | 42.29718 | -83.7013 | 239.3 | 0.3 |
| 13963 | 10 | 278802341508966 | 0 | 83 | 15400 | 42.29718 | -83.7013 | 239.3 | 0 |
| 13963 | 10 | 278802341608941 | 0 | 84 | 15500 | 42.29718 | -83.7013 | 239.3 | 0.14 |
| 13963 | 10 | 278802341708937 | 0 | 85 | 15600 | 42.29718 | -83.7013 | 239.3 | 0 |

Table continued …

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Heading** | **Ax** | **Ay** | **Az** | **Yawrate** | **PathCount** | **RadiusOfCurve** | **Confidence** |
| 9.9375 | -1.07 | 0.01 | -10 | -0.6 | 11 | 3276.7 | 100 |
| 9.9375 | -1.15 | 0.01 | -10 | -1.1 | 11 | 3276.7 | 100 |
| 9.9375 | -1.07 | 0.01 | -10 | -0.5 | 11 | 3276.7 | 100 |
| 9.9375 | -1.07 | 0.01 | -10 | -0.5 | 11 | 3276.7 | 100 |
| 9.9375 | -0.91 | 0.01 | -10 | -0.69 | 11 | 3276.7 | 100 |
| 9.9375 | -0.68 | 0.01 | -10 | -0.3 | 11 | 3276.7 | 100 |
| 9.9375 | -0.52 | 0.01 | -10 | -0.1 | 11 | 3276.7 | 100 |
| 9.9375 | -0.45 | 0.01 | -10 | -0.3 | 11 | 3276.7 | 100 |
| 9.9375 | -0.29 | 0.01 | -10 | 0 | 11 | 3276.7 | 100 |
| 9.9375 | -0.45 | 0.01 | -10 | -0.1 | 11 | 3276.7 | 100 |

Table 39 provides a few summary measures of the BsmP1 file that was populated with data collected on November 1, 2012.

Table 39: Summary Measures for Data Elements of the *BsmP1* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 100 | 10 | 17103 | 47, 2170, 2740, 10, 2175 | 6208811 |
| FileId | 607 | 1 | 83928 | 14573, 38271, 53362, 30700, 52526 |
| TxDevice | 322 | -32438 | 32364 | -14396, -12341, 47, 2170, 2740 |
| GenTime | 77258 | 278809095 | 278895493 | 278867928  278826637  278889886  278821991  278814712 |
| TxRandom | 1058 | -32659 | 32703 | 0, 20252, 8722, 10709, -14715 |
| MsgCount | 128 | 0 | 127 | 31, 26, 94, 99, 5 |
| DSecond | 3256 | 0 | 65535 | 29999, 35526, 50800, 13700, 25230 |
| Latitude | 381503 | 39.22074 | 90 | 42.3905, 41.22485, 42.29181, 42.60708,  42.20224 |
| Longitude | 154894 | -84.55163 | 180 | -83.70036, -83.78992,  -83.52829, -83.87242,  -83.61079 |
| Elevation | 2586 | 120.7 | 6144.1 | 256.5, 156.6, 328.8, 138.8, 228.9 |
| Speed | 2245 | 0 | 163.82 | 1.14, 19.72, 24.68, 25.16, 32.88 |
| Heading | 28801 | 0 | 360 | 351.225, 62.5, 179, 297.1625, 171.775 |
| Ax | 1489 | -20 | 20.01 | 0, -13.15, 4.66, 6.19, 1.45 |
| Ay | 547 | -9.89 | 20.01 | -9.88, 1.11, -1.3, -3.22, 1.08 |
| Az | 152 | -10 | 1.54 | -1.64, -1.9, -1.44, -2.32, -1.78 |
| Yawrate | 23015 | -327.67 | 327.67 | 0, 192.99, -30.07, -41.28, -22.99 |
| PathCount | 24 | 0 | 23 | 0, 1, 2, 3, 4 |
| RadiusOfCurve | 49872 | -2499.9 | 3276.7 | -1912.3, -1305, -33.8, 1521.3, 517.3 |
| Confidence | 101 | 0 | 100 | 31, 52, 10, 89, 0 |

## BrakeByte1Events File

The BrakeByte1Events file is one of 19 files in the BSM data that has the same structure. These files log only the change of a particular data element. This is unlike the aforementioned files that are populated in a time history format. These 19 files end with “events” in their file names (see Table 32 above). Some of these files contain BSM data elements that do not change frequently, such as a vehicle’s front bumper height or length, while others are empty as they were not populated with their corresponding data element as they change even less frequently (e.g. vehicle type).

The BrakeByte1Events file communicates the states of half of the BSM’s data elements that describe the overall brake system status of a vehicle. The brake system elements being presented in this file include the brake applied status, the availability of the wheel brakes, and the state of the traction control system. The BrakeByte1Events contain six fields, each of which is briefly described in Table 40.

Table 40: Data Elements of the BrakeByte1Events File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Details the current state of specific components of the brake system |

Note, as mentioned in the BSM Dataset Timestamp section, StartTime and EndTime are, respectively, minimum and maximum values of Gentime—the time at which a vehicle measure changes.

To determine the meaning of the entries in the “Value” field of the BrakeByte1Events file, the entries have to first be converted into an 8-bitstring (00000000). This string will then be partitioned in accordance with the J2735 Standard to communicate the relevant information regarding the state of a vehicle’s brake system.

From the J2735 Standard, the first 4 bits in the 8-bitstring (**0000**0000) indicate the brake being applied to a particular wheel of a vehicle. The first four bits communicate the BrakeAppliedStatus, the terminology used by the J2735 Standard. The bits are assigned wheels Left Front, Right Front, Left Rear, and Right Rear, respectively. If the brakes are applied on a particular wheel, the designated bit will change from 0 to 1. For vehicles with fewer than two front or rear wheels and those with more than two front or rear wheels, the following J2735 excerpt details how the BrakeAppliedStatus is communicated in the first four bits.

On a vehicle with only one front wheel, the brake-applied status is represented by the Left Front wheel indicator and the Right Front indicator is always set to zero. Similarly, on a vehicle with only one rear wheel the brake-applied status is represented by the Left Rear wheel indicator and the Right Rear indicator is always set to zero. If a vehicle has more than two front wheels (respectively more than two rear wheels) with independent braking, the collective brake-applied status of these wheels is mapped to the Left Front and Right Front (respectively Left Rear and Right Rear) indicators in a locally defined manner.

—Society of Automotive Engineers J2735 Standard, 2009

The fifth bit (0000**0**000) communicates the availability of brake information. When this bit is set to 1, it represents that data regarding the brake system is currently unavailable. The sixth bit (00000**0**00) is a reserved bit and is set to zero. The last two remaining bits (000000**00**) communicate the state of the traction control system (TCS). This information in turn informs others if one or more of a vehicle’s drive wheels are slipping during acceleration and whether a vehicle is equipped with a traction control system. The four permutations of these two bits are as follows:

00 – TCS is unavailable – a vehicle is not equipped with TCS/TCS is unavailable

01 – TCS is off – TCS is available but in the off position

10 – TCS is on – TCS is on but not engaged

11 – TCS is engaged – TCS is on and engaged

As an example, if the entry in the “Value” field of the BrakeByte1Events file is 2, its 8-bitstring is 00000010. This means that brake is not being applied to any of the wheels of the vehicle (**0000**0010), data regarding the brake system is available (0000**0**010), and the TCS is on but not engaged (000000**10**). However, if the entry were 242, its 8-bitstring is 11110010. This string means that brake is being applied to all four wheels of the vehicle, data is available, and the TCS is on but not engaged.

Table 41 provides a 10-record sample from the BrakeByte1Events file.

Table 41: Sample Records for the BrakeByte1Events File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13963 | 10 | 278802340808876 | 278802342808914 | 242 |
| 10 | 13963 | 10 | 278802342908861 | 278802345408999 | 2 |
| 10 | 13963 | 10 | 278802345508924 | 278802346908867 | 242 |
| 10 | 13963 | 10 | 278802347008853 | 278802393409013 | 2 |
| 10 | 13963 | 10 | 278802393508969 | 278802408009037 | 242 |
| 10 | 13963 | 10 | 278802408109073 | 278802408109073 | 2 |
| 10 | 13963 | 10 | 278802408208995 | 278802408208995 | 242 |
| 10 | 13963 | 10 | 278802408308994 | 278802409908997 | 2 |
| 10 | 13963 | 10 | 278802410009005 | 278802445409010 | 242 |
| 10 | 13963 | 10 | 278802340808876 | 278802342808914 | 242 |

Table 42 provides a few summary measures of the BrakeBytes1Events file that was populated with data collected from November 1, 2012.

Table 42: Summary Measures for Data Elements of the *BrakeByte1Events* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 100 | 10 | 17103 | 46, 17101, 1111, 2196, 2030 | 39321 |
| FileId | 607 | 1 | 83928 | 64600, 37756, 46, 47125, 24904 |
| TxDevice | 322 | -32438 | 32364 | -3237, 46, 32014, 4460, -2479 |
| StartTime | 23343 | 278809095 | 278895493 | 278878856  278850469  278864532  278819165  278822082 |
| Endtime | 23411 | 278809103 | 278895650 | 278871938  278867610  278813232  278820892  278874855 |
| Value | 10 | 0 | 243 | 0, 3, 241, 1, 242 |

## BrakeByte2Events File

The BrakeByte2Events file is another of 19 files in the BSM data that has the same structure. This file is similar to the BrakeByte1Events file as it too communicates the state of some of the component of the vehicle’s brake system. The brake system components described in this file include the state of the antilock brakes, the state of the stability control system, the application of the brake boost, and the state of the auxiliary brake system. The six fields of the BrakeByte2Events file are briefly described in Table 43.

Table 43: Data Elements of the BrakeByte2Events Events File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Details the current state of specific components of the brake system |

Similar to the BrakeByte1Events file, the meaning of an entry in the “Value” field is also based on the conversion of that entry into an 8-bit string. However, this 8-bit string communicates the state of four brake-related components of a vehicle—each using two bits to present the status of the each component. The first two bits in this string (**00**000000) pertain to the state of the vehicle’s antilock brake system (ABS), and their permutation is as follows:

00 – ABS is unavailable – a vehicle is not equipped with ABS/ABS is unavailable

01 – ABS is off – ABS is available but in the off position

10 – ABS is on – ABS is on but not engaged

11 – ABS is engaged – ABS is on and engaged

The next two bits (00**00**0000) pertain to state of the vehicle’s stability control unit (SCU), with the following permutations:

00 – SCU is unavailable – a vehicle is not equipped with a SCU/SCU is unavailable

01 – SCU is off – ABS is in the off position

10 – SCU is on – ABS is on or engaged

Bits five and six (0000**00**00) communicates whether BrakeBoost in being applied. *BrakeBoost* is a part of a system that detects the potential of a situation in which maximum brake power will be required and pre-charges the brake system even before the driver depresses the brake pedal. The application of the *BrakeBoost* indicates a situation that warrants emergency braking. Note, not all vehicles are equipped with *BrakeBoost* capability. The meaning associated with the permutations of the fifth and sixth bits are as follows:

00 – BB is unavailable – a vehicle is not equipped with a BB/BB is unavailable

01 – BB is off – BB is in the off position

10 – BB is on – BB is on/is being applied

The last two bits of the 8-bit string (000000**00**) for the *BrakeByteEvents* file present the state of the auxiliary brake system. The auxiliary brake system is often called the *parking brake*. The permutations of these two bits are presented below:

00 – AuxB is unavailable – vehicle is not equipped with AuxB/AuxB is unavailable

01 – AuxB is off – AuxB is in the off position

10 – AusB is on – AuxB is on/active

11 – BB is reserved

As an example, if the entry in the “Value” field of the BrakeByte2Events file is 144, its 8-bit string is 10010000. This means that the vehicle’s ABS is on but not engaged, the SCU is in the off position, and both the vehicle’s brake boost and auxiliary brake are either not available and/or the vehicle is not equipped with these features.

Table 44 provides a 10-record sample from the BrakeByte2Events file.

Table 44: Sample Records for the BrakeByte2Events File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13963 | 10 | 278802340808876 | 278802520009075 | 144 |
| 10 | 13964 | 10 | 278803558516008 | 278804514215589 | 144 |
| 10 | 13965 | 10 | 278854062239425 | 278855117939037 | 144 |
| 10 | 13966 | 10 | 278870906321203 | 278871005121203 | 144 |
| 10 | 13967 | 10 | 278872010004714 | 278872100404846 | 144 |
| 11 | 14568 | 11 | 278799446199882 | 278800288900170 | 144 |
| 11 | 14569 | 11 | 278800952575137 | 278801225474269 | 144 |
| 11 | 14570 | 11 | 278870852228655 | 278871965128293 | 144 |
| 11 | 14571 | 11 | 278873307709346 | 278873906309349 | 144 |

Table 45 provides a few summary measures of the BrakeBytes2Events file that was populated with data collected on November 1, 2012.

Table 45: Summary Measures for Data Elements of the *BrakeByte2Events* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 99 | 10 | 17103 | 46, 17101, 1111, 2196, 2030 | 783 |
| FileId | 598 | 1 | 83928 | 1, 3, 4, 32, 33 |
| TxDevice | 321 | -32438 | 32364 | -1048,40,42,43,44 |
| StartTime | 720 | 278809127 | 278895473 | 278809127  278809531  278809565  278809713  278809737 |
| Endtime | 726 | 278809286 | 280509908 | 278809286  278809938  278809992  278810498  278810519 |
| Value | 9 | 0 | 224 | 0, 192, 32, 144, 224 |

## ExteriorLightEvents File

The ExteriorLightEvents file communicates the state of all the vehicle’s exterior lights. The structure of this file is similar to that of the 19 files in the BSM dataset whose titles end with “events.” This file has six fields; each is presented with a brief description in Table 46.

Table 46: Data Elements of the ExteriorLightEvents File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Details the current state of specific components of the brake system |

The “Value” field in this file relates the states of the nine exterior lights via an 8-bit string (converted into an integer). Table 101 presents these nine exterior light events and their 8-bit string representation.

Table 47: 8-Bit String Represent for the ExteriorLightEvents File

|  |  |  |  |
| --- | --- | --- | --- |
| **J2735 Exterior Light Terminology** | **Meaning** | **8-Bit String Representation** | **Decimal Representation** |
| allLightsOff | All exterior lights are off | 00000000 | 0 |
| lowBeamHeadLightsOn | Low beam headlights are on | 00000001 | 1 |
| highBeamHeadLightsOn | High beam headlights are on | 00000010 | 2 |
| leftTurnSiganlOn | Left turn signal is on | 00000100 | 4 |
| righTurnSignalOn | Right turn signal is on | 00001000 | 8 |
| hazardSignalOn | Hazard signal is on | 00001100 | 12 |
| automaticLightControlOn | Lights are on due to automatic light control | 00010000 | 16 |
| daytimeRunningLightsOn | Day time running lights are on | 00100000 | 32 |
| fogLightOn | Fog lights are on | 01000000 | 64 |
| parkingLightsOn | Parking lights are on | 10000000 | 128 |

If an entry in the “Value” field is not listed in the above table’s “Decimal Representation,” convert the entry to an 8-bit string and use Table 101 to decode the 8-bit string. For example, if 5 is an observed entry in the ExteriorLightEvents file, its 8-bit string representation is 00000101. Using Table 101, the observed entry means the low-beam headlights are on in addition to the left turn signal.

Table 48 provides a nine-record sample from the ExteriorLightEvents file.

Table 48: Sample Records for the ExteriorLightEvents File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 40 | 29940 | 40 | 278857974767108 | 278857974767108 | 0 |
| 40 | 29940 | 40 | 278858005867415 | 278858005867415 | 8 |
| 40 | 29942 | 40 | 278859611925347 | 278860354738625 | 1 |
| 42 | 30702 | 42 | 278879388463735 | 278879520336919 | 0 |
| 43 | 31324 | 43 | 278803586567422 | 278804702215551 | 0 |
| 43 | 31325 | 43 | 278854793993369 | 278854793993369 | 1 |
| 44 | 31777 | 44 | 278800446845062 | 278800446845062 | 8 |
| 44 | 31780 | 44 | 278851760521604 | 278851761021581 | 1 |

Table 49 provides a few summary measures of the ExteriorLightEvents file that was populated with data collected from November 1, 2012.

Table 49: Summary Measures for Data Elements of the *ExteriorLightEvents* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 67 | 40 | 17103 | 46, 17101, 1111, 2196, 2030 | 1515 |
| FileId | 388 | 1 | 83928 | 64600, 37756, 46, 47125, 24904 |
| TxDevice | 289 | -32438 | 32364 | -3237, 46, 32014, 4460, -2479 |
| StartTime | 1413 | 278809127 | 278895389 | 278809127  278809164  278809187  278809269  278809277 |
| Endtime | 1421 | 278809164 | 280509908 | 278809164  278809187  278809269  278809277  278809286 |
| Value | 8 | 0 | 11 | 0, 11, 3, 5, 9 |

## PosAccurByte1Events File

The PosAccurByte1Events is one of four files that consist of various parameters of quality used to model the accuracy of the positional determination with respect to each given axis. The PosAccurByte1Events file communicates a quality measure, reflecting the accuracy of a vehicle’s estimated position with respect to the semi-major axis. This accuracy measure aims to reflect the error of a vehicle’s position within one standard deviation, 0–12.7m, of the vehicle’s true position, and with the least significant bit being equivalent to 0.05m. The structure of this file is also similar to that of the 19 files in the BSM dataset whose titles end with “events.” This file has six fields; each is presented in Table 50 with a brief description.

Table 50: Data Elements of the PosAccurByte1Events File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Quality measure, reflecting the positional accuracy with respect to the semi-major axis |

The “Value” field in this file relates the aforementioned quality measure of a vehicle position relative to the semi-major axis. The maximum value that entries in the “Value” field can take on is 255. This value represents the unavailability of a measure for the semi-major axis, and therefore an accuracy measure is not able to be obtained for that entry. A value of 254 reflects that the associated accuracy of the estimate of a vehicle’s position is equal to or greater than 12.70m. All other values less than 254 represent the accuracy/proximity, between 0m and 12.65m. The vehicle’s estimated position is with respect to its actual position.

Table 51 provides a 10-record sample from the PosAccurByte1Events file.

Table 51: Sample Records for the PosAccurByte1Events File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13963 | 10 | 278802340808876 | 278802520009075 | 255 |
| 10 | 13964 | 10 | 278803558516008 | 278804514215589 | 255 |
| 10 | 13965 | 10 | 278854062239425 | 278855117939037 | 255 |
| 10 | 13966 | 10 | 278870906321203 | 278871005121203 | 255 |
| 10 | 13967 | 10 | 278872010004714 | 278872100404846 | 255 |
| 11 | 14568 | 11 | 278799446199882 | 278800288900170 | 255 |
| 11 | 14569 | 11 | 278800952575137 | 278801225474269 | 255 |
| 11 | 14570 | 11 | 278870852228655 | 278871965128293 | 255 |
| 11 | 14571 | 11 | 278873307709346 | 278873906309349 | 255 |
| 11 | 14572 | 11 | 278877489317501 | 278878647117698 | 255 |

Table 52 provides a few summary measures of the PosAccurByte1Events file that was populated with data collected from November 1, 2012.

Table 52: Summary Measures for Data Element of the *PosAccurByte1Events* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 99 | 10 | 17103 | 46, 17101, 1111, 75, 2196 | 763 |
| FileId | 598 | 1 | 83928 | 1, 3, 4, 32, 33 |
| TxDevice | 321 | -32438 | 32364 | -1408, 10, 11, 12, 13 |
| StartTime | 708 | 278809127 | 278895473 | 278809127, 278809731, 278809565, 278809713, 278809737 |
| Endtime | 710 | 278809286 | 280509908 | 278809286, 278809938, 278809992, 278810498, 278810519 |
| Value | 1 | 255 | 255 | 255 |

## PosAccurByte2Events File

The PosAccurByte2Events is one of four files that consist of various parameters of quality used to model the accuracy of the positional determination with respect to each given axis. The PosAccurByte2Events file is very similar to PosAccurByte1Events. The difference between these two files is that the former communicates a quality measure, reflecting the accuracy of a vehicle’s estimated position with respect to the semi-minor axis, rather than the semi-major axis. As with the PosAccurByte1Events file, this accuracy measure aims to reflect the error of a vehicle’s position within one standard deviation, 0m–12.7m, of the vehicle’s true position. This file consists of six fields, and their names and descriptions are presented in Table 53.

Table 53: Data Elements of the PosAccurByte2Events File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Quality measure, reflecting the positional accuracy with respect to the semi-minor axis |

The “Value” field in this file relates the aforementioned quality measure of a vehicle position relative to the semi-minor axis. The maximum value that entries in the “Value” field can take on is 255. This value represents the unavailability of a measure for the semi-minor axis, and therefore an accuracy measure is not able to be obtained for that entry. A value of 254 reflects that the associated accuracy of the estimate of a vehicle’s position is equal to or greater than 12.70m. All other values less than 254 represent the accuracy/proximity, between 0m and 12.65m. The vehicle’s estimated position is with respect to its actual position.

Table 54 provides a 10-record sample from the PosAccurByte2Events file.

Table 54: Sample Records for the PosAccurByte2Events File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13963 | 10 | 278802340808876 | 278802520009075 | 255 |
| 10 | 13964 | 10 | 278803558516008 | 278804514215589 | 255 |
| 10 | 13965 | 10 | 278854062239425 | 278855117939037 | 255 |
| 10 | 13966 | 10 | 278870906321203 | 278871005121203 | 255 |
| 10 | 13967 | 10 | 278872010004714 | 278872100404846 | 255 |
| 11 | 14568 | 11 | 278799446199882 | 278800288900170 | 255 |
| 11 | 14569 | 11 | 278800952575137 | 278801225474269 | 255 |
| 11 | 14570 | 11 | 278870852228655 | 278871965128293 | 255 |
| 11 | 14571 | 11 | 278873307709346 | 278873906309349 | 255 |
| 11 | 14572 | 11 | 278877489317501 | 278878647117698 | 255 |

Table 55 provides a few summary measures of the PosAccurByte2Events file that was populated with data collected on November 1, 2012.

Table 55: Summary Measures for Data Elements of the *PosAccurByte2Events* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 99 | 10 | 17103 | 46, 17101, 1111, 75, 2196 | 763 |
| FileId | 598 | 1 | 83928 | 1, 3, 4, 32, 33 |
| TxDevice | 321 | -32438 | 32364 | -1408, 10, 11, 12, 13 |
| StartTime | 708 | 278809127 | 278895473 | 278809127, 278809731, 278809565, 278809713, 278809737 |
| Endtime | 710 | 278809286 | 280509908 | 278809286, 278809938, 278809992, 278810498, 278810519 |
| Value | 1 | 255 | 255 | 255 |

## PosAccurByte3Events File

The PosAccurByte3Events is one of four files that consist of various parameters of quality used to model the accuracy of the positional determination with respect to each given axis. The PosAccurByte3Events file communicates the orientation of semi-major axis relative to true north (0~359.9945078786 degrees). To get a sense of the orientation of the semi-major axis, an entry from this file’s “Value” Column is combined with a similar entry from the “Value” column from the PosAccurByte4Events file. The values from these two files are combined using the formula below to give axis orientation:

AxisOrientation = ((...Byte3Value\*256) + ...Byte4Value)\*0.0054932479

The structure of this file is also similar to that of the 19 files in the BSM dataset whose title end with “events.” This has six fields; each is presented in Table 56with a brief description.

Table 56: Data Elements of the PosAccurByte3Events File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Orientation measure of semi-major axis relative to true north |

The “Value” field in this file relates the aforementioned values to be used to determine semi-major axis orientation.

Note: Least significant bit (LSB) units = 0. 0054932479 and

0 = 0 degrees

1 = 0. 0054932479 degrees

65534 = 359.9945078786 degrees

65535 = orientation unavailable

Therefore, the maximum value that entries in the “Value” field can take on is 65535. This value represents the unavailability of a measure for the orientation of the semi-major axis.

Table 57 provides a 10-record sample from the PosAccurByte1Events file.

Table 57: Sample Records for the PosAccurByte3Events File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13965 | 10 | 278854062239425 | 278855117939037 | 255 |
| 10 | 13966 | 10 | 278870906321203 | 278871005121203 | 255 |
| 10 | 13967 | 10 | 278872010004714 | 278872100404846 | 255 |
| 10 | 13968 | 10 | 278892652834177 | 278893745083482 | 255 |
| 10 | 13969 | 10 | 278894110846835 | 278894294046104 | 255 |
| 11 | 14570 | 11 | 278870852228655 | 278871965128293 | 255 |
| 11 | 14571 | 11 | 278873307709346 | 278873906309349 | 255 |
| 11 | 14572 | 11 | 278877489317501 | 278878647117698 | 255 |
| 11 | 14573 | 11 | 278894637641410 | 278895427341752 | 255 |
| 12 | 19024 | 12 | 278809748617439 | 278810027316786 | 255 |

Table 58 provides a few summary measures of the PosAccurByte1Events file that was populated with data collected on November 1, 2012.

Table 58: Summary Measures for Data Elements of the *PosAccurByte3Events* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 99 | 10 | 17103 | 46, 17101, 1111, 75, 2196 | 763 |
| FileId | 598 | 1 | 83928 | 1, 3, 4, 32, 33 |
| TxDevice | 321 | -32438 | 32364 | -1408, 10, 11, 12, 13 |
| StartTime | 708 | 278809127 | 278895473 | 278809127, 278809731, 278809565, 278809713, 278809737 |
| Endtime | 710 | 278809286 | 280509908 | 278809286, 278809938, 278809992, 278810498, 278810519 |
| Value | 1 | 255 | 255 | 255 |

## PosAccurByte4Events File

The PosAccurByte4Events is one of four files that consist of various parameters of quality used to model the accuracy of the positional determination with respect to each given axis. The PosAccurByte3Events file communicates the orientation of semi-major axis relative to true north (0~359.9945078786 degrees). To get a sense of the orientation of the semi-major axis, an entry from this file’s “Value” Column is combined with a similar entry from the “Value” column from the PosAccurByte3Events file. The values from these two files are combined using the formula below to give axis orientation:

AxisOrientation = ((...Byte3Value\*256) + ...Byte4Value)\*0.0054932479

The structure of this file is also similar to that of the 19 files in the BSM dataset whose title end with “events.” This file has six fields; each is presented in Table 59 with a brief description.

Table 59: Data Elements of the PosAccurByte4Events File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Orientation measure of semi-major axis relative to true north |

The “Value” field in this file relates the aforementioned values to be used to determine semi-major axis orientation.

Note: Least significant bit (LSB) units = 0. 0054932479 and

0 = 0 degrees

1 = 0. 0054932479 degrees

65534 = 359.9945078786 degrees

65535 = orientation unavailable

Therefore, the maximum value that entries in the “Value” field can take on is 65535. This value represents the unavailability of a measure for the orientation of the semi-major axis.

Table 60 provides a 10-record sample from the PosAccurByte4Events file.

Table 60: Sample Records for the PosAccurByte4Events File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13965 | 10 | 278854062239425 | 278855117939037 | 255 |
| 10 | 13966 | 10 | 278870906321203 | 278871005121203 | 255 |
| 10 | 13967 | 10 | 278872010004714 | 278872100404846 | 255 |
| 10 | 13968 | 10 | 278892652834177 | 278893745083482 | 255 |
| 10 | 13969 | 10 | 278894110846835 | 278894294046104 | 255 |
| 11 | 14570 | 11 | 278870852228655 | 278871965128293 | 255 |
| 11 | 14571 | 11 | 278873307709346 | 278873906309349 | 255 |
| 11 | 14572 | 11 | 278877489317501 | 278878647117698 | 255 |
| 11 | 14573 | 11 | 278894637641410 | 278895427341752 | 255 |
| 12 | 19024 | 12 | 278809748617439 | 278810027316786 | 255 |

Table 61 provides a few summary measures of the PosAccurByte1Events file that was populated with data collected on November 1, 2012.

Table 61: Summary Measures for Data Elements of the *PosAccurByte4Events* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 99 | 10 | 17103 | 46, 17101, 1111, 75, 2196 | 763 |
| FileId | 598 | 1 | 83928 | 1, 3, 4, 32, 33 |
| TxDevice | 321 | -32438 | 32364 | -1408, 10, 11, 12, 13 |
| StartTime | 708 | 278809127 | 278895473 | 278809127, 278809731, 278809565, 278809713, 278809737 |
| Endtime | 710 | 278809286 | 280509908 | 278809286, 278809938, 278809992, 278810498, 278810519 |
| Value | 1 | 255 | 255 | 255 |

## SteerAngleEvents File

The SteerAngleEvents is another of 19 files in the BSM data that has the same structure. The file however communicates the angle of the steering wheel, expressed in a signed (to the right being positive) value with units of 1.5. This file consists of six fields; their names and descriptions are presented in Table 62.

Table 62: Data Elements of the SteerAngleEvents File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | Microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Value to be converted to degrees to communicate steer angle |

The “Value” field in this file captures a vehicle’s steering wheel angle. However these values have to be converted before the steering wheel angle can be determined. The LSB units = 1.5 degrees and entries in this field have a range of -126 to +127, which facilitates steering angles between -/+189 degrees and a value signifying that the steering angle is unavailable. For example:

0 = +1.5 degrees

-126 = -189 degrees and beyond

+126 = +189 degrees and beyond

+127 = unavailable steering angle

More generally, for values between 0 and 126 you simply multiply by 1.5 degrees. However for value between 129 and 255, maskoff the highest bit (which is being used as a sign bit) by doing a bitwise AND with a value of 127. Then swap the remaining bit values by doing a bitwise exclusive OR with a value of 127 and then multiply by -1.5. Table 63 provides a 10-record sample from the SteerAngleEvents file.

Table 63: Sample Records for the SteerAngleEvents File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13969 | 10 | 278894114346925 | 278894114546893 | 2 |
| 10 | 13969 | 10 | 278894114646943 | 278894114746870 | 3 |
| 10 | 13969 | 10 | 278894114846848 | 278894114846848 | 4 |
| 10 | 13969 | 10 | 278894114946836 | 278894115746864 | 5 |
| 10 | 13969 | 10 | 278894115846910 | 278894115846910 | 3 |
| 10 | 13969 | 10 | 278894115946834 | 278894115946834 | 0 |
| 10 | 13969 | 10 | 278894116046815 | 278894116046815 | 251 |
| 10 | 13969 | 10 | 278894116146874 | 278894116146874 | 243 |
| 10 | 13969 | 10 | 278894116246976 | 278894116246976 | 234 |
| 10 | 13969 | 10 | 278894116346968 | 278894116346968 | 225 |

Table 64 provides a few summary measures of the SteerAngleEvents file that was populated with data collected from November 1, 2012.

Table 64: Summary Measures for Data Elements of the *SteerAngleEvents* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 100 | 10 | 17103 | 46, 17101, 1111, 75, 2196 | 398026 |
| FileId | 600 | 1 | 83928 | 64600, 32678, 37756, 46, 21649 |
| TxDevice | 322 | -32438 | 32364 | -3237, 46, 32014, 4460, -2479 |
| StartTime | 52712 | 278809099 | 278895493 | 278821468  278879330  278828607  278889958  278819115 |
| Endtime | 52772 | 278809100 | 280509908 | 278816509  278884429  278869725  278875916  278812974 |
| Value | 254 | 0 | 255 | 0, 238, 23, 215, 46 |

## ThrottlePositionEvents File

The ThrottlePositionEvents file presents the relative position of the throttle over a given trip. Throttle position is measured in percent, communicating the displacement of the throttle from its default position to it maximum displacement during a particular trip. This file has six fields; their names and meaning are presented in Table 65.

Table 65: Data Elements of the ThrottlePositionEvents File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None |  | Details the relative position of the throttle over a given trip |

The LSB units = 0.5, therefore the entries for the “Value” ought to range from 0 to 200, and to get the relative throttle position, multiple each entry by 0.5. However, in exploring of the data, the values only range for 0 to 100. This signifies that the devices that capture the measure, already took into account the 0.5 factor. Table 66 provides a 10-record sample from the ThrottlePositionEvents file.

Table 66: Sample Records for the ThrottlePositionEvents File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 60 | 37756 | 60 | 278820631933209 | 278820632033193 | 24 |
| 60 | 37756 | 60 | 278820632133238 | 278820632133238 | 23 |
| 60 | 37756 | 60 | 278820632233308 | 278820633133245 | 22 |
| 60 | 37756 | 60 | 278820633233312 | 278820633533266 | 20 |
| 60 | 37756 | 60 | 278820633633260 | 278820633633260 | 19 |
| 60 | 37756 | 60 | 278820633733234 | 278820633733234 | 17 |
| 60 | 37756 | 60 | 278820633833217 | 278820635233306 | 16 |
| 60 | 37756 | 60 | 278820635333289 | 278820635333289 | 14 |
| 60 | 37756 | 60 | 278820635433285 | 278820635433285 | 10 |
| 60 | 37756 | 60 | 278820635533258 | 278820635533258 | 2 |

Table 67 provides a few summary measures of the ThrottlePositionEvents file that was populated with data collected from November 1, 2012.

Table 67: Summary Measures for Data Elements of the *ThrottlePositionEvents* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 67 | 40 | 17103 | 46, 17101, 1111, 2030, 2196 | 64845 |
| FileId | 389 | 1 | 83928 | 64600, 47125, 37756, 46, 161 |
| TxDevice | 289 | -32438 | 32364 | -3237, 46, 32014, 4460, -2479 |
| StartTime | 18465 | 278809115 | 278895425 | 278884429, 278810675, 278864532, 278872256, 278850469 |
| Endtime | 18456 | 278809115 | 280509908 | 278884429  278810675  278858959  278864532  278878856 |
| Value | 91 | 0 | 100 | 0,23, 46, 69, 29 |

## TransStateEvents File

The TransStateEvents file provides the current state of the vehicle’s transmission. Similar to the previously presented files ending with “…events,” this file has the same structure with the same six fields. The only difference occurs as the meaning of the entries in the “Value” field. Table 68presents the names and meaning of each of the fields.

Table 68: Data Elements of the TransStateEvents File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None | 2 | Details the current state of specific components of the transmission |

Currently, there are eight values assigned to communicate the state of a vehicle’s transmission. However, three of these values are reserved for future assignments. Table 69 presents these values and their associated meaning.

Table 69: Enumeration Table for TransStateEvents File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| TransState | 2 | 0 | Neutral | Transmission is in the neutral position |
| 1 | Park | Transmission is in the park position |
| 2 | Forward | Transmission has engaged one of its forward gears |
| 3 | Reverse | Transmission has engaged one of its reverse gears |
| 4 | Reserved1 | Reserved for future use |
| 5 | Reserved1 | Reserved for future use |
| 6 | Reserved1 | Reserved for future use |
| 7 | Unavailable | Unavailable value or not equipped with a transmission |

Table 70 presents a 10-record sample of the TransStateEvents file.

Table 70: Sample Records for *TransStateEvents* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 10 | 13965 | 10 | 278854062239425 | 278854144339437 | 1 |
| 10 | 13965 | 10 | 278854144439436 | 278854144439436 | 2 |
| 10 | 13965 | 10 | 278854144539436 | 278854153039506 | 3 |
| 10 | 13965 | 10 | 278854153139456 | 278855104639016 | 2 |
| 10 | 13965 | 10 | 278855104739046 | 278855104739046 | 3 |
| 10 | 13965 | 10 | 278855104839016 | 278855104839016 | 2 |
| 10 | 13965 | 10 | 278855104939016 | 278855108939022 | 3 |
| 10 | 13965 | 10 | 278855109039022 | 278855109039022 | 2 |
| 10 | 13965 | 10 | 278855109139022 | 278855109139022 | 0 |
| 10 | 13965 | 10 | 278855109239058 | 278855113739063 | 2 |

Table 71 provides a few summary measures of the TransStateEvents file that was populated with data collected from November 1, 2012.

Table 71: Summary Measures for Data Element of the *TransStateEvents* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 100 | 10 | 17103 | 46, 17101, 1111, 75, 2196 | 2405 |
| FileId | 600 | 1 | 83928 | 64600, 32678, 37756, 46, 21649 |
| TxDevice | 322 | -32438 | 32364 | -3237, 46, 32014, 4460, -2479 |
| StartTime | 1576 | 278809127 | 278895473 | 278809127, 278809271, 278809272, 278809274, 278809281 |
| Endtime | 1561 | 278809271 | 280509908 | 278809271, 278809272, 278809992, 278809274, 278809281 |
| Value | 5 | 0 | 7 | 0, 3, 7, 1, 2 |

## WiperStatusFrontEvents File

The contents of the WiperStatusFrontEvents file is intended to communicate whether it is raining or snowing at the vehicle’s current location and how hard it is raining it is raining or snowing. If the wipers are in the “On” position, it serves as a proxy for whether or not it is raining or snowing. The wipers’ “swipes per minute” also serves as a proxy for how hard it is raining or snowing. Similar to the previously presented files, ending with “…events,” this file has the same structure with the same six fields and the only difference being the meaning of the entries in the “Value” field. Table 72 presents the names and meaning of each of the fields.

Table 72: Data Elements of the WiperStatusFrontEvents File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumID** | **Description** |
| RxDevice | Integer | None |  | ID (number) of the device that logs a BSM |
| FileID | Integer | None |  | Reference number to locate the source of the data in its original file |
| TxDevice | Integer | None |  | ID (number) of the device that transmits a BSM |
| StatTime | Integer | Microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| EndTime | Integer | Microseconds |  | A more secure form of Epoch time, which is influenced by 1609.2 of the IEEE 1609 family of standards-related network management and security |
| Value | Integer | None | 3 | Details the current state of vehicle’s front wipers |

Currently, there are seven values assigned to communicate the state of a vehicle’s front wipers. Table 73 presents these values and their associated meaning.

Table 73: Enumeration Table for WiperStatusFrontEvents File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **StyleName** | **Value** | **Name** | **Description** |
| WiperStatusFront | 3 |  | 0 | Unavailable | The status of the vehicle wiper is unavailable or the vehicle is not equipped with the wiper sensor status. |
|  | 1 | Off | Front wipers are not activated |
|  | 2 | Intermittent | Front wipers are operated at an intermittent frequency |
|  | 3 | Low | Front wipers are operated at a low frequency |
|  | 4 | High | Front wipers are operated at a high frequency |
|  | 126 | Washer in use | Wipers are active due to the use of the washer fluid |
|  | 127 | AutomaticPresent | The wipers have the ability to be automatically turned on |

Table 74 presents a 10-record sample of the WiperStatusFrontEvents file.

Table 74: Sample Records for *WiperStatusFrontEvents* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RxDevice** | **FileId** | **TxDevice** | **StartTime** | **Endtime** | **Value** |
| 40 | 29940 | 40 | 278857974767108 | 278858005867415 | 1 |
| 40 | 29942 | 40 | 278859611925347 | 278860354738625 | 1 |
| 42 | 30702 | 42 | 278879388463735 | 278879520336919 | 1 |
| 43 | 31325 | 43 | 278854793993369 | 278854793993369 | 1 |
| 44 | 31780 | 44 | 278851760521604 | 278851761021581 | 1 |
| 44 | 31782 | 44 | 278891818788784 | 278891818987946 | 1 |
| 46 | 32676 | 46 | 278853353372476 | 278853367472437 | 1 |
| 60 | 37756 | 60 | 278820631933209 | 278821026336242 | 1 |
| 60 | 37757 | 60 | 278821840332029 | 278822201434111 | 1 |
| 60 | 37758 | 60 | 278855422332110 | 278856316838843 | 1 |

Table 75 provides a few summary measures of the WiperStatusFrontEvents file that was populated with data collected on November 1, 2012.

Table 75: Summary Measures for Data Elements of the *WiperStatusFrontEvents* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| RxDevice | 67 | 40 | 17103 | 40, 42, 43, 44, 46 | 566 |
| FileId | 388 | 1 | 83928 | 1, 3, 4, 32, 33 |
| TxDevice | 289 | -32438 | 32364 | -1048,40,42,43,44 |
| StartTime | 512 | 278809127 | 278895366 | 278809127, 278809737, 278809966, 278810233, 278810236 |
| Endtime | 513 | 278809286 | 280509908 | 278809286, 278809938, 278810458, 278810498, 278810519 |
| Value | 4 | 0 | 3 | 0, 1, 2, 3 |

## BSM Trip Summary File

The BSM Trip Summary is similar to both summary files for the DAS1 and DAS2 datasets. As a result of this similarity the tables below are the same as those presented in the section detailing the DAS1 Trip Summary File. The BSM Trip Summary file contains trip-level summaries, from each instrument vehicle, for each trip taken during the selected time period of the Model Deployment. The trip summaries include details such as trip start and end times, and total trip distance. Also captured in the trip summary file is the distance driven while the vehicle speed was greater than 25 mph. This data element is of interest not only because it further details the trip, but also because it provides a sense of the conditions under which data, for a particular trip, were collected. The Summary file contains 13 fields; below is a list of these fields and a brief description of each.

Table 76: Data Elements of the Summary Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| DeviceID | Integer | None | - | This field contains the unique, numeric ID assigned to each DAS. This ID also doubles as a vehicle’s ID |
| TripID | String | None | - | This field contains a count of ignition cycles—each ignition cycle commences when the ignition is in the on position and ends when it is in the off position |
| Epoch Start Time | Integer | seconds | - | This field contains the epoch start time stamp, in seconds, of a trip. Epoch time, which is sometimes referred to as Unix time, is the number of seconds that has elapsed since midnight January 1, 1970 |
| Start Date | Date | date | - | The m/d/yyyy on which the trips started |
| Start Time | Time | time | - | This field contains the wall clock time stamp of the start of a trip, in the form of hh:mm:sss |
| Epoch End Time | Integer | seconds | - | This field contains the epoch end time stamp, in seconds, of a trip. Epoch time, which is sometimes referred to as Unix time, is the number of seconds that has elapsed since midnight January 1, 1970 |
| End Date | Date | date | - | The m/d/yyyy on which the trips ended |
| End Time | Time | Time | - | This field contains the wall clock time stamp of the end of a trip, in the form of hh:mm:sss |
| Total Trip Distance | Integer | m | - | This field contains the total distance traveled, in miles, covered in a trip |
| Distance Travelled w/ Speed >= 25mph | Real | m | - | This field contains the distance traveled in a trip but only when the vehicle’s speed is greater than or equal to 25 mph. |
| Trip Duration | Real | m | - | This field contains the total time duration, in seconds, of a trip. 999999 – data unavailable |
| Average Speed | Real | m/s | - | This field communicates a vehicle’s average speed over the entire length of the trip. 999999 – data unavailable |
| Maximum Speed | Real | m/s | - | This field contains the maximum speed reached during a trip |

Table 77 provides a 10-record sample from the Summary file.

Table 77: Sample Records for Summary File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DeviceID** | **TripID** | **Epoch Start Time** | **Start Date** | **Start Time** | **Epoch End Time** | **End Date** | **End Time** | **Total Trip Distance** | **Distance Travelled w/ Speed >= 25mph** |
| 10106 | 297 | 1365680194 | 4/11/2013 | 7:27:49 | 1365680194 | 4/11/2013 | 7:36:33 | 5.124307 | 4.393447 |
| 10106 | 300 | 1365712962 | 4/11/2013 | 16:33:57 | 1365712962 | 4/11/2013 | 16:42:41 | 5.837012 | 4.617299 |
| 10116 | 716 | 1365685699 | 4/11/2013 | 8:57:23 | 1365685699 | 4/11/2013 | 9:08:18 | 12.994089 | 12.197617 |
| 10116 | 718 | 1365698544 | 4/11/2013 | 12:40:12 | 1365698544 | 4/11/2013 | 12:42:23 | 6.432951 | 6.432951 |
| 10116 | 719 | 1365703393 | 4/11/2013 | 14:01:02 | 1365703393 | 4/11/2013 | 14:03:13 | 0.647246 | 0.603726 |
| 10116 | 720 | 1365735768 | 4/11/2013 | 22:51:52 | 1365735768 | 4/11/2013 | 23:02:48 | 10.487535 | 9.914046 |
| 10118 | 771 | 1365682553 | 4/11/2013 | 8:00:35 | 1365682553 | 4/11/2013 | 8:15:52 | 7.422556 | 6.164827 |
| 10118 | 772 | 1365706146 | 4/11/2013 | 14:44:43 | 1365706146 | 4/11/2013 | 14:49:05 | 3.312033 | 2.608147 |
| 10118 | 773 | 1365714403 | 4/11/2013 | 17:00:10 | 1365714403 | 4/11/2013 | 17:06:43 | 3.980565 | 3.355532 |
| 10120 | 671 | 1365681111 | 4/11/2013 | 7:32:11 | 1365681111 | 4/11/2013 | 7:51:51 | 26.373104 | 24.054027 |

Table continued …

|  |  |  |
| --- | --- | --- |
| **Trip Duration** | **Average Speed** | **Maximum Speed** |
| 524.288 | 35.185822 | 17.785469 |
| 524.288 | 40.079584 | 20.322571 |
| 655.36 | 71.378664 | 34.94302 |
| 131.072 | 176.686287 | 32.364101 |
| 131.072 | 17.777129 | 19.83666 |
| 655.36 | 57.609751 | 22.45439 |
| 917.504 | 29.123799 | 20.85228 |
| 262.144 | 45.483846 | 20.987221 |
| 393.216 | 36.443159 | 20.735519 |
| 1179.648 | 80.484327 | 35.382179 |

Table 78 provides a few summary measures of the Summary file from April 11, 2013.

Table 78: Summary Measures for Data Elements of the Summary File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Sample Values** | **Min. Value** | **Max. Value** | **No. of Rows** |
| DeviceID |  | 10204, 10205, 10207, 13000, 17101 | 10106 | 17103 | 278 |
| TripID |  | 41, 71-A, 50, 167, 87 | 24 | 2271 |
| Epoch Start Time | Continuous | 1365711651, 1365712175, 1365679407, 1365679669, 1365680980 | 1365652800 | 1365652800 |
| Start Date | 1 | 4/11/2013 | 4/11/2013 | 4/11/2013 |
| Start Time |  | 6:52:52, 11:34:40, 13:04:14, 17:48:13, 18:27:32 | 0:02:10 | 23:59:59 |
| Epoch End Time | Continuous | 1365737341, 1365684781, 1365693170, 1365703655, 1365706801 | 1365739199 | 1365739199 |
| End Date | 1 | 4/11/2013 | 4/11/2013 | 4/11/2013 |
| End Time |  | 12:40:12, 6:20:06, 11:19:22, 13:34:49, 16:38:19 | 0:02:10 | 23:59:59 |
| Total Trip Distance | Continuous | 26.816043, 29.563191, 8.294983, 11.286039, 1.165109 | 0.014572 | 339.5202 |
| Distance Travelled w/ Speed >= 25mph | Continuous | 28.814616, 22.377494, 1.025562, 8.281198, 7.480304 | 0 | 333.0411 |
| Trip Duration | Continuous | 917.504, 786.432, 131.072, 393.216, 393.216 | 131.072 | 999999 |
| Average Speed | Continuous | 0, 1352.01794433594, 3653.50708007812, 4117.85302734375, 4156.54296875 | 0.005718 | 999999 |
| Maximum Speed | Continuous | 0, 3.57740211486816, 723.406127929688, 3300.6240234375, 3698.57104492188 | 1.538876 | 42.25568 |

# Roadside Equipment Dataset

The RSE dataset includes 13 files, which are listed and briefly described in Table 79.

Table 79: Description of the File Contained in the Roadside Equipment Dataset

|  |  |  |  |
| --- | --- | --- | --- |
| **File Number** | **File** | **Description** | **Sample Rate** |
| 1 | BSM | BSM data including motion and location elements | 10 Hz |
| 2 | Geometry | Describes intersection detail at locations where RSE were placed | N/A |
| 3 | Lane | Describes lane attributes in the vicinity of the RSE, which is often located at an intersection with multiple (lane) approaches | N/A |
| 4 | LaneNode | Describes lane descriptors as they relate to nodes (ground reference points), usually near an intersection | N/A |
| 5 | Map | Wrapper object for map data. Includes complex intersection descriptions, high speed curve outlines, and segments of roadway. Sometimes referred to as the GID layer | N/A |
| 6 | Packet | Provides details for every packet transmission. Packet includes fileIDs, sources, and time stamps | 10 Hz |
| 7 | PCAP | Describes packet capture header information and specifies listening setup used to capture all vehicle to vehicle communications | 10 Hz |
| 8 | SPAT | Contains basics of a SPAT message including intersection details | 10 Hz |
| 9 | SPATMovement | Describes signal and timing information for movements at intersections | 10 Hz |
| 10 | TIM | Contains Traveler Information Message information which transmits advisory and road sign messages to vehicles | 10 Hz |
| 11 | TIMRegion | Specifies types of regions to which TIMs apply | N/A |
| 12 | TIMRegionNode | Specifies types of regions to which TIMs apply in terms of offsets from a give node | N/A |
| 13 | TIMRegionXRef | Maps TIMs to the regions in which messages are applicable | N/A |
| 14 | WeatherData | Specifies surface weather data at stations of interest | Varies |

## BSM File

The BSM file is populated with basic safety messages received from equipped vehicle within the communication range of an RSE. These basic safety messages do not only contain both Part I and Part II elements. These BSMs also contains elements that communicate additional details about the vehicle that is used for vehicle safety applications, and elements that communicate specific items of a vehicle‘s status that are used in data event snapshots which are gathered and periodically reported to an RSEs or as part of the BSM Part II content.

These BSMs are transmitted at a rate of 10 Hz. Some of the more pertinent data contained in these BSMs include motion (speed and acceleration) and location (longitude and latitude) elements. The RSEs BSM file primarily gets populated with data that is obtained through the vehicle’s CAN bus and then transmitted via an onboard WSU.

In total there are 28 fields in the RSE’s BSM file. A brief description of each is given below. For a more detailed description of each field / attribute consult the J2735 Standard.

Table 80: Data Elements of the BSM File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| BSMID | Integer | None |  | ID (number) of message transmitted from equipped vehicle |
| DSRCMsgId | Integer | None | 1 | Details the type of message that follows |
| MsgCount | Integer | None |  | Sequence number within stream of messages with the same DSRCMsgId and from the same sender |
| TemporaryID | Integer | None |  | 4 byte random device identifier. Changes periodically to ensure anonymity of vehicle |
| DSeconds | Integer | Milliseconds |  | Time in milliseconds (up to a minute). Range is 0 – 60999 |
| Latitude | Integer | 1/10th integer microdegrees |  | 32 bit value of current latitude of the vehicle with reference to horizontal datum in use. 90000001 is used when unavailable |
| Longitude | Integer | 1/10th integer microdegrees |  | 32 bit value of current longitude of the vehicle with reference to horizontal datum in use. 180000001 is used when unavailable |
| Elevation | Integer | 1/10th integer meters |  | Current elevation of vehicle above or below reference ellipsoid (typically WSG-84). Range is 0 to 61439 (6143.9 m) and -4095 to -1 |
| PositionalAccuracy | Hexadecimal | None |  | Data indicating accuracy of positional determination of vehicle with respect to each given axis. Full explanation follows table |
| TransmissionState | Integer | None | 2 | Vehicle transmission state |
| Speed | Integer | 0.02 m/sec |  | Vehicle speed in 0.02 m/sec unsigned units. 8191 indicates speed is unavailable |
| Heading | Integer | 0.0125 degree units |  | Vehicle heading/direction in 0.0125 degree units from North (e.g 28799 units = 359.9875 deg). North is defined as the axis from WSG-84 coordinate system and its reference ellipsoid. Headings east are positive. 28800 used when unavailable. Heading data sent by a vehicle indicates the orientation of the front of the vehicle |
| SteeringWheelAngle | Integer | 1.5 degree units |  | Steering wheel angle in 1.5 degree units. Right is positive. |
| LongitudinalAcceleration | Integer | 0.01 m/sec^2 |  | Longitudinal acceleration (along x axis or parallel to the vehicle’s direction of travel with a front to rear centerline) in 0.01 m/sec^2 units. Negative values indicate braking. Permitted range is over 2Gs. |
| LateralAcceleration | Integer | 0.01 m/sec^2 |  | Lateral acceleration (along y axis or perpendicular to the vehicle’s direction of travel with a left to right centerline) in 0.01 m/sec^2 units. Negative values indicate braking. Permitted range is over 2Gs |
| VerticalAcceleration | Integer | 0.02 G |  | Vertical acceleration (along vertical axis) in 0.02 G units. Permitted range is -3.4 – 1.54 G |
| YawRate | Integer | 0.01 deg/sec |  | Vehicle yaw rate in 0.01 deg/sec units. Yaw to the right is positive. |
| BrakeAppliedStatus | Hexadecimal | None |  | Indicates whether brakes are being applied to any of the four wheels. Full explanation follows table |
| wheelBrakesUnavailable | Integer | None | 3 | Communicates availability of brake system data |
| TractionControlState | Hexadecimal | None | 4 | Indicates whether or not vehicle has a traction control system and whether or not one or more wheels are slipping during acceleration. Hex string is converted to binary bits to extract values |
| AntilockBrakeStatus | Hexadecimal | None | 5 | Communicates state of vehicle’s anti-lock braking system. Hex string is converted to binary bits to extract values |
| StabilityControlStatus | Hexadecimal | None | 6 | Communicates state of vehicle’s stability control status. Hex string is converted to binary bits to extract values |
| BreakBoostApplied | Hexadecimal | None | 7 | Emergency braking indicator communicating state of vehicle’s brake boost system (which may pre-charge the brake system before driver presses brake pedal). Hex string is converted to binary bits to extract values |
| AuxiliaryBrakeStatus | Hexadecimal | None | 8 | Communicates state of vehicle’s auxiliary brake system (i.e. parking brake). Hex string is converted to binary bits to extract values |

To extract the data from the PositionalAccuracy field in Table 80, the hexadecimal string may be divided into four octets (0xB4 0xB3 0xB2 0xB1). Each octet should be converted to decimal to obtain its value. Byte 1, converted to decimal denotes the semi-major accuracy at one standard deviation in 0.05 m units. For example, 0xA1 is 161 in decimal and denotes an accuracy of 8.05 m. The permitted range is 0-12.7 meters. A hex value of 0xFE = 254 denotes any value equal to or greater than 12.7 m while a hex value of 0xFF = 255 indicates an unavailable semi-major value. Byte 2 denotes the semi-minor accuracy at one standard deviation and is mapped in the same way as byte 1. Bytes 3 and 4 are read together and, converted to decimal, represent the orientation of the semi-major axis relative to true north in 360/65535 deg = 0.0054932479 deg units. For example, a hex string of 0xC57A is 50554 in decimal and denotes an orientation of 277.7057 deg. The maximum orientation permitted is 0xFFFE = 65534. A hex value of 0xFFFF = 65535 is used for unavailable orientations.

Table 80 contains a number of enumerated elements whose values are associated with different meanings. Table 81 presents each of these data elements and their various enumerations.

Table 81: Enumeration Table for BSM File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** | |
| DSRCMsgId | 1 | 0 | Reserved | Reserved for future use | |
| 1 | A La Carte Message (ACM) |  | |
| 2 | Basic Safety Message (BSM) | Heartbeat message | |
| 3 | Basic Safety Message Verbose | Message used only for testing | |
| 4 | Common Safety Request (CSR) |  | |
| 5 | Emergency Vehicle Alert (EVA) |  | |
| 6 | Intersection Collision Alert (ICA) |  | |
| 7 | Map Data (MAP) | For GID and intersections | |
| 8 | nmea Corrections (NMEA) |  | |
| 9 | probe Data Management (PDM) |  | |
| 10 | probe Vehicle Data (PVD) |  | |
| 11 | Roadside Alert (RSA) |  | |
| 12 | rtcm Corrections (RTCM) |  | |
| 13 | Signal Phase and Timing Message (SPAT) |  | |
| 14 | Signal Request Message (SRM) |  | |
| 15 | Signal Status Message (SSM) |  | |
| 16 | Traveler Information (TIM) |  | |
| TransmissionState | 2 | 1 | Neutral | Vehicle transmission state | |
| 2 | Park | Vehicle transmission state | |
| 3 | Forward gears | Vehicle transmission state | |
| 4 | Reserve gears | Vehicle transmission state | |
| 5 | Reserved1 | Vehicle transmission state | |
| 6 | Reserved2 | Vehicle transmission state | |
| 7 | Reserved3 | Vehicle transmission state | |
| wheelBrakesUnavailable | 3 | 0 | Available | Communicates availability of brake system data | |
| 1 | Not available | Communicates availability of brake system data | |
| TractionControlState | 4 | 00 | Unavailable | Vehicle not equipped with traction control or unavailable | |
| 01 | Off | Vehicle equipped with traction control, not active | |
| 10 | On | Vehicle equipped with traction control, active | |
| 11 | Engaged | Vehicle equipped with traction control, engaged | |
| AntilockBrakeStatus | 5 | 00 | No antilock system | Vehicle not equipped with antilock brakes | |
| 01 | Off | Vehicle equipped with antilock brakes, not active | |
| 10 | On | | Vehicle equipped with antilock brakes, active |
| 11 | Engaged | | Vehicle equipped with antilock brakes, engaged |
| StabilityControlStatus | 6 | 00 | Unavailable | | Vehicle not equipped with stability control system or unavailable |
| 01 | Off | | Vehicle equipped with stability control system, not active |
| 10 | On or engaged | | Vehicle equipped with stability control system, active or engaged |
| BrakeBoostApplied | 7 | 00 | Unavailable | | Vehicle not equipped with brake boost or unavailable |
| 01 | Off | | Vehicle equipped with brake boost, not active |
| 10 | On | | Vehicle equipped with brake boost, active |
| AuxiliaryBrakeStatus | 8 | 00 | No auxiliary braking system | | Vehicle not equipped with auxiliary braking system |
| 01 | Not applied | | Vehicle equipped with auxiliary braking system, not applied |
| 10 | Applied | | Vehicle equipped with auxiliary braking system, applied |
| 11 | Reserved | |  |

A 10-record sample for the BSM file is given in Table 82.

Table 82: Sample Records for *BSM* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| BSMID | DSRCMsgId | MsgCount | TemporaryId | DSeconds | Latitude | Longitude | Elevation | Positional  Accuracy | TransmissionState |
| 1738218409 | 2 | 36 | -1275975333 | 59800 | 423091009 | -836928071 | 2510 | 0xFFFFFFFF | 7 |
| 1738218417 | 2 | 126 | 738663065 | 0 | 423051742 | -836925983 | 2436 | 0xFFFFFFFF | 7 |
| 1738218423 | 2 | 109 | -1157424605 | 59900 | 423072124 | -836847010 | 2401 | 0xFFFFFFFF | 7 |
| 1738218430 | 2 | 127 | 738663065 | 100 | 423051743 | -836925983 | 2436 | 0xFFFFFFFF | 7 |
| 1738218439 | 2 | 110 | -1157424605 | 0 | 423072179 | -836846806 | 2401 | 0xFFFFFFFF | 7 |
| 1738218447 | 2 | 38 | -1275975333 | 0 | 423091256 | -836928078 | 2510 | 0xFFFFFFFF | 7 |
| 1738218455 | 2 | 0 | 738663065 | 200 | 423051741 | -836925983 | 2436 | 0xFFFFFFFF | 7 |
| 1738218464 | 2 | 1 | 738663065 | 300 | 423051741 | -836925983 | 2436 | 0xFFFFFFFF | 7 |
| 1738218474 | 2 | 2 | 738663065 | 400 | 423051741 | -836925982 | 2436 | 0xFFFFFFFF | 7 |
| 1738218483 | 2 | 41 | -1275975333 | 300 | 423091626 | -836928087 | 2511 | 0xFFFFFFFF | 7 |

Table continued …

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Speed | Heading | Steering  WheelAngle | Longitudinal  Acceleration | Lateral  Acceleration | Vertical  Acceleration | YawRate | Break  AppliedStatus | wheelBrakes  Unavailable | Traction  ControlState |
| 176 | 28708 | 127 | 16 | 11 | 45 | 46 | 0x00 | 0 | 0x00 |
| 0 | 19316 | 127 | -1 | -1 | 43 | 0 | 0x00 | 0 | 0x00 |
| 381 | 5586 | 127 | 30 | 1 | 42 | 9 | 0x00 | 0 | 0x00 |
| 0 | 19316 | 127 | -1 | -1 | 43 | 0 | 0x00 | 0 | 0x00 |
| 383 | 5586 | 127 | 30 | 1 | 42 | 9 | 0x00 | 0 | 0x00 |
| 174 | 28702 | 127 | -15 | 7 | 45 | 33 | 0x00 | 0 | 0x00 |
| 0 | 19316 | 127 | -3 | -1 | 43 | 0 | 0x00 | 0 | 0x00 |
| 0 | 19316 | 127 | -3 | -1 | 43 | 0 | 0x00 | 0 | 0x00 |
| 0 | 19316 | 127 | -1 | -1 | 43 | 0 | 0x00 | 0 | 0x00 |
| 173 | 28704 | 127 | -9 | 7 | 45 | 30 | 0x00 | 0 | 0x00 |

Table continued…

|  |  |  |  |
| --- | --- | --- | --- |
| Antilock  BrakeStatus | Stability  ControlStatus | Brake  BoostApplied | Auxiliary  BrakeStatus |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |
| 0x00 | 0x00 | 0x00 | 0x00 |

Table 83 provides a few summary measures of the BSM file that was populated with data collected on April 11, 2013.

Table 83: Summary Measures for Data Elements of the *BSM* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| BSMID | 16095310 |  |  | 1738218409,  1801843621, 1801843622,  1920703252,  1920703253 | 16095310 |
| DSRCMsgId | 1 |  |  | 2 |
| MsgCount | 128 |  |  | 108,42, 0, 1, 2 |
| TemporaryID | 11587 |  |  | -1275975333, 738663065, -1157424605, 738663065, -1157424605 |
| DSeconds | 2194 | 0 | 65535 | 0, 100, 200, 400, 59900 |
| Latitude | 456480 | 0 | 900000001 | 423091009,  423051742,  423072124,  423051743,  423072179 |
| Longitude | 640092 | -840921953 | 180000001 | -836928071,  -836925983,  -836847010,  -836925983,  -836846806 |
| Elevation | 1775 | -12773 | 7315 | 2510, 2436, 2401, 2436, 2511 |
| PositionalAccuracy | 5 |  |  | 0xE4FFFFFF, 0xFFFFFFFF, 0xE5FFFFFF, 0xFE000000, 0xFFFFFF2F |
| TransmissionState | 5 |  |  | 0,1,2,3,7 |
| Speed | 512 | 0 | 511 | 398, 177, 0, 381, 471 |
| Heading | 28805 | -34 | 28805 | 13870, 28708, 28704, 5586, 28702 |
| SteeringWheelAngle | 254 | 0 | 255 | 78, 144, 41, 47, 67 |
| LongitudinalAcceleration | 1385 | -2000 | 2001 | -707, 1368, 282, -194, 289 |
| LateralAcceleration | 667 | -16769 | 2001 | 480, 509, 451, 472, -686 |
| VerticalAcceleration | 123 | 0 | 255 | 12, 15, 75, 209, 78 |
| YawRate | 36164 | 0 | 32767 | -11718, 14858, 7649,  -10037, 13826 |
| BrakeAppliedStatus | 3 |  |  | 0x0F, 0x00, 0x01 |
| wheelBrakesUnavailable | 2 |  |  | 0,1 |
| TractionControlState | 3 |  |  | 0x00, 0x01, 0x03 |
| AntilockBrakeStatus | 3 |  |  | 0x00, 0x01, 0x03 |
| StabilityControlStatus | 1 |  |  | 0x00 |
| BreakBoostApplied | 1 |  |  | 0x00 |
| AuxiliaryBrakeStatus | 2 |  |  | 0x00, 0x02 |

## Geometry File

The Geometry captures a few descriptive fundamentals of the intersections that were accompanied by RSEs, during the Safety Pilot Model Deployment. This file contains descriptors such as intersection and geometry direction IDs, as well as longitude, latitude, and elevation of the intersection.

Table 84: Data Elements of the Geometry File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| GeometryId | Integer | None |  | Unique ID (number) of the geometry element |
| IntersectionId | Integer | None |  | Global ID number of intersection within country or region. Assignment of IDs is done by regional schema. Follows SAE J2735 Standard |
| GeometryDirectionId | Integer | None |  | Unique ID (number) used to relate one or more motor vehicle lanes for an intersection approach or egress description with any associated pedestrian or special purpose lanes. Also may be used to describe one or more barriers at an intersection |
| Longitude | Integer | 1/10th integer microdegrees |  | Geographic longitude of the intersection with reference to horizontal datum in use. 180000001 is used when unavailable |
| Latitude | Integer | 1/10th integer microdegrees |  | Geographic latitude of the intersection with reference to horizontal datum in use. 900000001 is used when unavailable |
| Elevation | Integer | 1/10th integer meters |  | Geographic elevation of the intersection above or below reference ellipsoid (typically WSG-84). Resolution is to 1 decimeter. ). Range is 0 to 61439 (6143.9 m) and -4095 to -1. Elevations above 61439 are represented by the hex string 0xEFFF and those lower than -4095 are represented by the hex string 0xF000 |

No enumerations are present in the *Geometry* file.

A 10-record sample for Geometry file is given in Table 85.

Table 85: Records for *Geometry* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GeometryId | IntersectionId | GeometryDirectionId | Longitude | Latitude | Elevation |
| 1 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 2 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 3 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 4 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 5 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 6 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 7 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 8 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 9 | 126 | 1 | -2005985330 | 422864680 | 0 |
| 10 | 126 | 1 | -2005985330 | 422864680 | 0 |

Table 86 provides a few summary measures of the Geometry file.

Table 86: Summary Measures for Data Elements of the *Geometry* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| GeometryId | 46309 |  |  |  | 46309 |
| IntersectionId | 6 |  |  | 173, 175, 170, 172, 126 |
| GeometryDirectionId | 1 |  |  | 1 |
| Longitude | 6 | -2005985330 | 1416436686 | -2005985330, 1354701006, 75045326, 3476090806, 1416436686 |
| Latitude | 6 | 422808140 | 422873350 | 422873350, 422871420, 422864680, 422808140,  422872330 |
| Elevation | 4 | -13816 | 24585 | -13816, 0, -1016, 24585 |

## Lane File

The “Lane” file details the attributes of lanes in the vicinity of the RSE, which is often located at an intersection with multiple (lane) approaches. The primary information that the Lane file communicates are the intersection to which that lane belongs, the numbers of lane and allowable vehicle maneuvers.

Table 87: Data Elements of the Lane File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| LaneId | Integer | None |  | Unique ID (number) of the lane element |
| GeometryId | Integer | None |  | Unique ID (number) of the geometry element |
| LaneNumber | Integer | None |  | Unique index value which specifies a lane or other characteristic at an intersection. Barrier and other specialty lanes may be included. The IntersectionId and LaneNumber together specify a regionally unique way to address a specific lane at a specific intersection |
| LaneTypeId | Integer | None | 1 | Specifies type of lane being traveled along. Includes motorized vehicle, pedestrian, and dedicated train and transit lanes |
| LaneAttributes | Hexadecimal | None | 2 | Specifies possible movements from a motorized vehicle lane. Full explanation follows table |
| Width | Integer | Centimeters |  | Specifies width of a lane. Maximum width is 32767 cm |
| ReferenceLaneNumber | Integer | None |  | A reference lane is a lane drivable by motorized vehicle traffic which contains detailed geometric information (center line path and width) and basic lane attributes (permitted maneuvers). Data may be shared with a nearby “computed” lane in the same intersection. ReferenceLaneNumber indicates which lane the computed lane parallels |
| LateralOffset | Integer | None |  | Specified by Cartesian coordinates as offsets from an intersection with a northern orientation: eastern and northern offsets are therefore positive |
| NodeAttributes | Integer | None |  | Specifies the attribute of the node that the lane is associated with |
| ManeuverCode | Integer | None | 3 | Defines specific use of a single lane. Use of values within a set of lanes need not be exclusive. Each lane may be of only one type (have one ManeuverCode) at a time. |

To extract the data from the LaneAttributes field in Table 87, the hexadecimal string is converted to binary. Each logical bit of the binary string specifies a characteristic of the lane (which may be cumulative) if it is logically true. LaneTypeId enumerations are provided in Table 88 by specifying the relevant bit from least significant (bit 0) to most significant (bit 15). For example, a LaneAttributes of 0x4000 has a binary representation of 0100000000000000 (bit 14 logically true) and specifies a two way left turn lane. A bit string of 0010000010000000 (bits 13 and 7 true) specifies a maneuverHOVLane and a maneuverNoStop.

Table 87 contains a number of enumerated elements whose values are associated with different meanings. Table 88 presents each of these data elements and their various enumerations.

Table 88: Enumeration Table for Lane File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** | |
| LaneTypeId | 1 | 1 | Vehicle | Motorized vehicle lane | |
| 2 | Computed | Computed lane | |
| 3 | Pedestrian | Pedestrian lane | |
| 4 | Special | Special purpose lane | |
| LaneAttributes | 2 | 0 | noLaneData VehicleLaneAttributes | (No bits in logical true position) | |
| Bit 0 | egressPath | Two-way path or outbound path described | |
| Bit 1 | maneuverStraightAllowed |  | |
| Bit 2 | maneuverLeftAllowed |  | |
| Bit 3 | maneuverRightAllowed |  | |
| Bit 4 | Yield |  | |
| Bit 5 | maneuverNoUTurn |  | |
| Bit 6 | maneuverNoTurnOnRed |  | |
| Bit 7 | maneuverNoStop |  | |
| Bit 8 | noStop |  | |
| Bit 9 | noTurnOnRed |  | |
| Bit 10 | hovLane |  | |
| Bit 11 | busOnly |  | |
| Bit 12 | busAndTaxiOnly |  | |
| Bit 13 | maneuverHOVLane |  | |
| Bit 14 | maneuverSharedLane | TWLTL - Two way left turn lane | |
| Bit 15 | maneuverBikeLane |  | |
| ManeuverCode | 3 | 0 | Unknown |  | |
| 1 | uTurn |  | |
| 2 | leftTurn | |  |
| 3 | rightTurn | |  |
| 4 | straightAhead | |  |
| 5 | softLeftTurn | |  |
| 6 | softRightTurn | |  |
| 7-127 | Reserved | | Reserved for standard use |
| 128-255 | Reserved | | Reserved for local use |

A 10-record sample for the Lane file is given in Table 89.

Table 89: Sample Records for *Lane* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| LaneId | GeometryId | LaneNumber | LaneTypeId | LaneAttributes | Width | Reference  LaneNumber | Lateral  Offset | Node  Attributes | ManeuverCode |
| 1 | 13 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 2 | 4 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 3 | 12 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 4 | 16 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 5 | 1 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 6 | 6 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 7 | 14 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 8 | 15 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 9 | 5 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |
| 10 | 11 | 1 | 1 | 0x00E2 | 335 | 0 | 0 | 0 | NULL |

Table 90 provides a few summary measures of the Lane file.

Table 90: Summary Measures for Data Elements of the *Lane* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| LaneId | 694595 |  |  | 67453, 217273, 504266, 149916, 511389 | 694595 |
| GeometryId | 46309 |  |  | 7569, 3444, 12166, 22538, 21970 |
| LaneNumber | 15 |  |  | 3,1, 14, 4, 11 |
| LaneTypeId | 3 |  |  | 1, 2, 3 |
| LaneAttributes | 12 |  |  | 0x00E2, 0x00EA, 0x00E6, 0x00A2, 0x00AA |
| Width | 11 | 227 | 671 | 260, 268, 305, 318, 396 |
| ReferenceLaneNumber | 5 | 0 | 4 | 0, 1, 2, 3, 4 |
| LateralOffset | 11 | -731 | 366 | -518, -366, -335, 0, 366 |
| NodeAttributes | 2 | 0 | 2 | 0, 2 |
| ManeuverCode | 1 |  |  | NULL |

## LaneNode File

The LaneNode file captures lane descriptors as it relates to a node (a reference point on the ground) which is often times at or near an intersection. The point may also be referring to the location of an RSE or data collection / sensor point. This file contains data elements, whose values describe various positions within / along a lane.

Table 91: Data Elements of the LaneNode File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| LaneNodeId | Integer | None |  | Unique ID (number) representing the point on the ground which is associated with the lane being described. Usually specified at an intersection |
| LaneId | Integer | None |  | Unique ID (number) used to specify a lane at a given location |
| EasternOffset | Integer | None |  | Specified by Cartesian coordinates as offsets from an intersection with a northern orientation: eastern and northern offsets are therefore positive |
| NorthernOffset | Integer | None |  | Specified by Cartesian coordinates as offsets from an intersection with a northern orientation: eastern and northern offsets are therefore positive |
| ElevationOffset | Integer | None |  | Positive ElevationOffsets indicate rises in elevation (while negative values indicate a drop). Specified relative to the intersection’s reference point |
| Width | Integer | Centimeters |  | Specifies width of a lane. Maximum width is 32767 cm |

No enumerations are present in the *LaneNode* file.

A 10-record sample for LaneNode file is given in Table 92.

Table 92: Sample Records for *LaneNode* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LaneNodeId | LaneId | EasternOffset | NorthernOffset | ElevationOffset | Width |
| 409896 | 159642 | -245 | -3 | 0 | 0 |
| 1506452 | 586810 | -1498 | -855 | 0 | 0 |
| 936856 | 364942 | 301 | 40 | 0 | 0 |
| 1440598 | 561159 | 44 | -228 | 0 | 0 |
| 668001 | 260189 | 191 | 139 | 0 | 0 |
| 1657136 | 645507 | 606 | 194 | 0 | 0 |
| 1267606 | 493791 | 71 | -159 | 0 | 0 |
| 1536030 | 598319 | -211 | -155 | 0 | 0 |
| 1644877 | 640733 | 191 | 139 | 0 | 0 |
| 963924 | 375495 | -162 | 151 | 0 | 0 |

Table 93 provides a few summary measures of the LaneNode file.

Table 93: Summary Measures for Data Elements of the *LaneNode* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| LaneNodeId | 1000000 |  |  | 802778, 672499, 1542964, 220088, 749685 | 1000000 |
| LaneId | 382157 |  |  | 646786, 185509, 523316, 154556, 108784 |
| EasternOffset | 143 | -2090 | 1200 | 59, -199, -245, -203, 202 |
| NorthernOffset | 152 | -855 | 1169 | 50, 280, -236, 88, -343 |
| ElevationOffset | 41 | -28 | 103 | -22, 58, 10, -4, -7 |
| Width | 1 | 0 | 0 | 0 |

## Map File

The intersections map message provides the geometric intersection description (GID) data that defines a digital map of an intersection down to the lane level. The extent of the map in each direction depends on factors such as topology, signal reception, and other intersections in the area. The MAP message provides local geo-referenced coordinates of the intersection, vehicle, pedestrian, and special lane geometry, and permitted navigation maneuvers.

Table 94: Data Elements of the Map File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| MAPID | Integer | None |  | Unique ID (number) of the map element |
| IntersectionId | Integer | None |  | Global ID number of intersection within country or region. Assignment of IDs is done by regional schema. Follows SAE J2735 Standard |
| ContentVersion | Integer | None |  | Indicates change in message content. Has meaning relative to last message broadcast. Applications must only read a message if ContentVersion has changed from the previous message. Takes on values from 0 to 255 |
| MessageAttributes | Hexadecimal | None | 1 | Specifies format and content of the rest of the MAP message. Full explanation follows table |
| SignalScheme | Hexadecimal | None | 2 | Specifies signal scheme element used to select which preempt or priority controller sequence is to be activated to provide service to one or more intersection lanes. Full explanation follows table |
| PreemptLaneNumbers | Integer | None |  | Relates intersection approach lanes with a number system used by an approaching vehicle to assert a priority or preempt service request |

To extract the data from the MessageAttributes field in Table 94, the hexadecimal string is converted to binary. Each logical bit of the binary string specifies a characteristic of the MAP message if it is logically true. MessageAttributes enumerations are provided in Table 95 by specifying the relevant bit from least significant (bit 0) to most significant (bit 7). For example, a MessageAttributes of 0x03 has a binary representation of 0100 (bit 2 logically true) and specifies that the MAP message contains the intersection’s geometric data. Note bit 1 specifies the node offset resolution and, unlike other bits, is not interpreted on a logically true/logically false basis.

Similarly, the SignalScheme data is obtained by converting the 8 character hexadecimal string binary bits 76543210. Bits are then read in groups and converted to decimal. Bits 0-3 are grouped, as are bits 4-6 and bit 7. For example, a bit string of 11110101 has a decimal value 1 for bit 7, a decimal value of 7 for bits 4-6, and a decimal value of 5 for bits 0-3. These decimal values are interpreted according to their enumerations in Table 95.

Table 95: Enumeration Table for Map File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| MessageAttributes | 1 | Bit 0 |  | Elevation data is included |
| Bit 1 | Node offset resolution | Logical 0 indicates centimeter resolution, while logical 1 indicates decimeter resolution |
| Bit 2 |  | Message contains intersection’s geometric data |
| Bit 3 |  | Message contains navigational movement data |
| Bit 4 | Reserved |  |
| Bit 5 | Reserved |  |
| Bit 6 | Reserved |  |
| Bit 7 | Reserved |  |
| SignalScheme | 2 | Bits 0-3 | | |
| 0 |  | No defined strategy |
| 1-7 |  | Desired strategy if available |
| Bits 4-6 | | |
| 0 | Reserved |  |
| 1-6 |  | Desired strategy if available |
| 7 | Cabinet flash |  |
| Bit 7 | | |
| 0 | Priority |  |
| 1 | Preempt |  |

A 10-record sample for Map file is given in Table 96.

Table 96: Sample Records for *Map* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| MAPID | IntersectionId | ContentVersion | MessageAttributes | SignalScheme | PreemptLaneNumbers |
| 1267877462 | 172 | 0 | 0x0F | 0x00 | NULL |
| 1338659683 | 172 | 0 | 0x0F | 0x00 | NULL |
| 1055736053 | 171 | 0 | 0x0E | 0x00 | NULL |
| 2797092098 | 172 | 0 | 0x0F | 0x00 | NULL |
| 2006429938 | 173 | 0 | 0x0F | 0x00 | NULL |
| 2139414204 | 172 | 0 | 0x0F | 0x00 | NULL |
| 1250085587 | 171 | 0 | 0x0E | 0x00 | NULL |
| 1224574257 | 172 | 0 | 0x0F | 0x00 | NULL |
| 2884960490 | 172 | 0 | 0x0F | 0x00 | NULL |
| 1033606944 | 126 | 0 | 0x0E | 0x00 | NULL |

Table 97 contains a few summary measures of the *Map* file.

Table 97: Summary Measures for Data Elements of the *Map* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| MAPID | 1000000 |  |  | 2707235687, 2097016008, 2406120781, 2629156953, 2145552940 | 1000000 |
| IntersectionId | 5 |  |  | 172, 126, 173, 171, 175 |
| ContentVersion | 1 |  |  | 0 |
| MessageAttributes | 2 |  |  | 0x0F, 0x0E |
| SignalScheme | 1 |  |  | 0x00 |
| PreemptLaneNumbers | 1 |  |  | NULL |

## Packet File

This file provides the associated details for each packet. Details captured in this file include the PCAP fileID in which the transmitted packet is stored, along with the source and time stamp of the transmitted packet.

Table 98: Data Elements of the Packet File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| PacketId | Integer | None |  | Unique ID (number) for every captured packet |
| PCAPFileId | Integer | None |  | Contains the file ID in which the transmitted packet is stored |
| PacketNumber | Integer | None |  | Specifies the packet number of the packet contained in the *PCAP* file |
| PacketLocation | Integer | None |  | Specifies the location of a packet within the *PCAP* file (or within a blob within the *PCAP* file) |
| PacketDataLength | Integer | None |  | Number of bytes of packet data captured and saved in the file. |
| PacketTimestamp | String | None |  | Year-month-day-hour-minute-second timestamp when packet was captured. GMT is used |
| TimestampMicroseconds | Integer | Microseconds |  | Microsecond offset from PacketTimestamp. Further details when packet was captured. Given PacketTimestamp has a resolution to seconds, TimestampMicroseconds should not exceed 1 second (1000000 ms) |
| IncludedLength | Integer | None |  | Number of bytes of packet data captured and saved to file. IncludedLength should not exceed OriginalLength or SnapLen (from *PCAP* file) |
| OriginalLength | Integer | None |  | Number of bytes of packet data on the network when data was captured. If SnapLen (from *PCAP* file) is less than OriginalLength, IncludedLength saved to file will be smaller than OriginalLength |
| SourceIPAddress | Integer | None |  | Specifies the (non-constant) IP address of the on-board vehicle unit that transmitted a packet to the RSE |
| EtherType | Integer | None |  | Specifies the transmission protocol used in the payload (of an Ethernet Frame) |
| WSMPVersion | Integer | None |  | Communicates the Wave Short Message Protocol that is being employed within the transmitted packet |
| Channel | Integer | None |  | Specifies the channel on which a packet is transmitted |
| DataRate | Integer | MB/s |  | Specifies the transfer rate (amount of data transmitted per second) with respect to a given channel |
| PowerUsed | Integer | dBm |  | Specifies the amount of power required to transmit a packet. Units are specified in dBms, where a dBm is the power ratio in decibels of the measured power referenced to one milliwatt (mW) |
| PSID | Hexadecimal | None |  | Specifies the type of message sent. For example, a PSID of 0x20 (32 in decimal) indicates a Basic Safety Message. 0x8003 (32771) specifies a Traveler Information Message (TIM), 0xBFE0 (49120) and 0x8002 (32770) specify Signal Phase and Timing (SPAT) messages, 0xBFF0 (49136) and 0x8002 (32770) specify MAP messages (or GIDs), 0x23 (35) specifies a Security Credential Management message, and 0xBFE1 (49121) specifies a General IP Data Exchange message |

No enumerations are present in the *Packet* file.

A 10-record sample for Packet file is given in Table 99.

Table 99: Sample Records for *Packet* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PacketId | PCAPFileId | Packet  Number | Packet  Location | Packet  DataLength | Packet  Timestamp | Timestamp  Microseconds | Included  Length | Original  Length | Source  IPAddress |
| 3038534630 | 899948 | 1 | 24 | 364 | 5/1/2013 12:02:24 AM | 257510 | 364 | 364 | 0x9DA58E226EF3 |
| 3038534631 | 899948 | 2 | 404 | 364 | 5/1/2013 12:02:24 AM | 356483 | 364 | 364 | 0x9DA58E226EF3 |
| 3038534632 | 899948 | 3 | 784 | 364 | 5/1/2013 12:02:24 AM | 557771 | 364 | 364 | 0x9DA58E226EF3 |
| 3038534633 | 899948 | 4 | 1164 | 435 | 5/1/2013 12:02:24 AM | 658162 | 435 | 435 | 0x9DA58E226EF3 |
| 3038534634 | 899948 | 5 | 1615 | 364 | 5/1/2013 12:02:24 AM | 756790 | 364 | 364 | 0x9DA58E226EF3 |
| 3038534635 | 899948 | 6 | 1995 | 364 | 5/1/2013 12:02:24 AM | 858257 | 364 | 364 | 0x9DA58E226EF3 |
| 3038534636 | 899948 | 7 | 2375 | 364 | 5/1/2013 12:02:25 AM | 358629 | 364 | 364 | 0x9DA58E226EF3 |
| 3038534637 | 899948 | 8 | 2755 | 364 | 5/1/2013 12:02:25 AM | 455012 | 364 | 364 | 0x9DA58E226EF3 |
| 3038534639 | 899950 | 1 | 24 | 263 | 5/1/2013 1:55:19 AM | 92435 | 263 | 263 | 0x6E85F92816F4 |
| 3038534640 | 899951 | 1 | 24 | 230 | 5/1/2013 2:50:39 AM | 438348 | 230 | 230 | 0x3ED0C57C42F0 |

Table continued …

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| EtherType | WSMPVersion | Channel | DataRate | PowerUsed | PSID |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 22 | 32 |
| 35036 | 2 | 172 | 12 | 20 | 32 |
| 35036 | 2 | 172 | 12 | 20 | 32 |

Table 100provides a few summary measures of the Packet file that was populated with data collected between April 30 and May 1, 2013.

Table 100: Summary Measures for Data Elements of the *Packet* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| PacketId | 1000000 |  |  | 3038979454, 3039377400, 3040420746, 3039667714, 3039297609 | 1000000 |
| PCAPFileId | 82 |  |  | 900506, 900683, 899953, 900172, 900287 |
| PacketNumber | 689508 |  |  | 4170, 59623, 2089, 61515, 36044 |
| PacketLocation | 952145 | 24 | 19999427 | 9515526, 1075885, 432416, 390378, 1830106 |
| PacketDataLength | 270 | 171 | 505 | 210, 383, 252, 465, 372 |
| PacketTimestamp | 26558 |  |  | 2013-05-01 11:09:00.000,  2013-05-01 05:54:52.000,  2013-05-01 12:47:59.000,  2013-05-01 12:34:16.000,  2013-05-01 10:51:27.000 |
| TimestampMicroseconds | 572393 | 15 | 999991 | 720184, 515681, 125539, 188156, 253930 |
| IncludedLength | 270 | 171 | 505 | 306, 214, 268, 375, 471 |
| OriginalLength | 270 | 171 | 505 | 225, 450, 296, 395, 210 |
| SourceIPAddress | 1642 |  |  | 0x822FED0D7991, 0x9A7D939A0A20, 0xC697D337B20D, 0x4283192A994A, 0x31822D2E2D63 |
| EtherType | 1 |  |  | 35036 |
| WSMPVersion | 1 |  |  | 2 |
| Channel | 1 |  |  | 172 |
| DataRate | 1 |  |  | 12 |
| PowerUsed | 6 | 10 | 32 | 18, 22, 32, 21, 10 |
| PSID | 1 |  |  | 32 |

## PCAP File

The PCAP file is populated with packet capture header information, specifying the listening setup used to capture all vehicle to vehicle communications.

Table 101: Data Elements of the PCAP File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| PCAPFileID | Integer | None |  | Unique ID (number) for every packet header |
| Filename | String | None |  | Specifies the name of the PCAP file. Filename contains the name of the RSE manufacturer, the RSE’s location ID and name, and the data and timestamp. |
| FileTimeStampDate | String | None |  | Specifies the month-day-year on which the packet header was created |
| FileTimeStampTime | String | None |  | Specifies the hour-minute-second time when the packet header was created |
| VersionMajor | Integer | None |  | Major version number of the *PCAP* release |
| VersionMinor | Integer | None |  | Minor version number of the *PCAP* release |
| ThisZone | Integer | Seconds |  | Correction time between GMT and local time zone. Timestamps usually in GMT such that ThisZone is usually 0 |
| SigFigs | Integer | None |  | Number of significant figures in the timestamp capture. However, usually set by capture tools to 0 |
| SnapLen | Integer | None |  | Maximum (snapshot) length of captured packets in octets – usually 65535 |
| Network | Integer | None |  | Specifies link-layer header type used in the packet. A complete enumeration is not provided as many types are possible. For example, Network is 1 for Ethernet or 255 for Bluetooth |

No enumerations are present in the *PCAP* file.

A 10-record sample for the PCAP file is given in Table 102.

Table 102: Sample Records for *PCAP* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PCAP  FileID | Filename | FileTime  StampDate | FileTime  StampTime | Version  Major | Version  Minor | This  Zone | Sig  Figs | Snap  Len | Network |
| 588302 | Savari-LocID0172-B\_dsrc1\_in\_2013\_04\_11\_00\_21\_34.pcap | 4/11/2013 | 0:21:34 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588319 | Savari-LocID0194\_dsrc1\_in\_2013\_04\_11\_00\_19\_34.pcap | 4/11/2013 | 0:19:34 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588343 | Savari-LocID0137\_dsrc0\_out\_2013\_04\_11\_00\_07\_34.pcap | 4/11/2013 | 0:07:34 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588362 | Savari-LocID0038\_dsrc1\_out\_2013\_04\_11\_00\_03\_41.pcap | 4/11/2013 | 0:03:41 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588366 | Savari-LocID0038\_dsrc1\_in\_2013\_04\_11\_00\_03\_41.pcap | 4/11/2013 | 0:03:41 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588371 | Savari-LocID0038\_dsrc0\_out\_2013\_04\_11\_00\_03\_41.pcap | 4/11/2013 | 0:03:41 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588374 | Savari-LocID0170\_dsrc1\_in\_2013\_04\_11\_00\_28\_42.pcap | 4/11/2013 | 0:28:42 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588378 | Savari-LocID0076\_dsrc0\_out\_2013\_04\_11\_00\_09\_18.pcap | 4/11/2013 | 0:09:18 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588391 | Savari-LocID0076\_dsrc1\_out\_2013\_04\_11\_00\_09\_18.pcap | 4/11/2013 | 0:09:18 | 2 | 4 | 0 | 0 | 65535 | 1 |
| 588398 | Savari-LocID0081\_dsrc1\_in\_2013\_04\_11\_00\_12\_21.pcap | 4/11/2013 | 0:12:21 | 2 | 4 | 0 | 0 | 65535 | 1 |

Table 103 provides a few summary measures of the PCAP file that was populated with data collected on April 11, 2013.

Table 103: Summary Measures for Data Elements of the *PCAP* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| PCAPFileID | 2503 |  |  | 590575, 592026, 590454, 592039, 591835 | 2503 |
| Filename | 2503 |  |  | Not included for brevity |
| FileTimeStampDate | 1 |  |  | 4/11/2013 |
| FileTimeStampTime | 1045 |  |  | 13:17:53, 13:31:50, 5:54:15, 2:08:30, 20:07:39 |
| VersionMajor | 1 |  |  | 2 |
| VersionMinor | 1 |  |  | 4 |
| ThisZone | 1 |  |  | 0 |
| SigFigs | 1 |  |  | 0 |
| SnapLen | 1 | 65535 | 65535 | 65535 |
| Network | 1 |  |  | 1 |

## SPAT File

The SPAT (Signal Phasing and Timing) file contains the basics of a SPAT message. This file includes SPAT message and intersection IDs, and the timestamp of the SPAT message.

Table 104: Data Elements of the SPAT File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| SPATID | Integer | None |  | Unique ID (number) for every SPAT message |
| CurrentVersion | Integer | None |  | Indicates change in message content. Has meaning relative to last message broadcast. Applications must only read a SPAT message if CurrentVersion has changed from the previous message |
| IntersectionId | Integer | None |  | Global ID number of intersection within country or region. Assignment of IDs is done by regional schema. Follows SAE J2735 Standard |
| IntersectionStatus | Hexadecimal | None | 1 | Specifies Advance Traffic Controller status on the intersection. Full explanation follows table |
| MsgTimestamp | String | None |  | Year-month-day-hour-minute-second-tenth of second timestamp when message was generated. GMT is used |

To extract the data from the IntersectionStatus field in Table 104, the hexadecimal string is converted to binary. Each logical bit of the binary string specifies a characteristic of the intersection (which may be cumulative). IntersectionStatus enumerations are provided in Table 106 by specifying the relevant bit from least significant (bit 0) to most significant (bit 15). For example, an IntersectionStatus of 0x03 has a binary representation of 00000011 (bits 0 and 1 logically true) and specifies that manual control is enabled and Stop Time is activated and all counting/timing has stopped. A 0x00 hex value (or 00000000 bit string) indicates the intersection is operating normally.

Table 105: Enumeration Table for SPAT File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| IntersectionStatus | 1 | 0 | Normal | Intersection operating normally |
| Bit 0 | Manual | Manual control enabled |
| Bit 1 | Stop Time activated | All counting/timing has stopped |
| Bit 2 | Conflict flash | Intersection in conflict flash state |
| Bit 3 | Preempt active |  |
| Bit 4 | Priority active |  |
| Bit 5 | Reserved |  |
| Bit 6 | Reserved |  |
| Bit 7 | Reserved |  |

A 10-record sample for SPAT file is given in Table 106.

Table 106: Sample Records for *SPAT* File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SPATID | CurrentVersion | IntersectionId | IntersectionStatus | MsgTimeStamp |
| 3040841724 | 33 | 126 | 0x00 | 2013-04-30 20:41:57.800 |
| 3040841732 | 34 | 126 | 0x00 | 2013-04-30 20:41:57.900 |
| 3040841739 | 35 | 126 | 0x00 | 2013-04-30 20:41:58.000 |
| 3040841756 | 36 | 126 | 0x00 | 2013-04-30 20:41:58.100 |
| 3040841763 | 37 | 126 | 0x00 | 2013-04-30 20:41:58.200 |
| 3040841771 | 38 | 126 | 0x00 | 2013-04-30 20:41:58.300 |
| 3040841781 | 39 | 126 | 0x00 | 2013-04-30 20:41:58.400 |
| 3040841790 | 40 | 126 | 0x00 | 2013-04-30 20:41:58.500 |
| 3040841795 | 41 | 126 | 0x00 | 2013-04-30 20:41:58.600 |
| 3040841805 | 42 | 126 | 0x00 | 2013-04-30 20:41:58.700 |

Table 107 provides a few summary measures of the PCAP file that was populated with data collected between April 30 and May 1, 2013.

Table 107: Summary Measures for Data Elements of the *SPAT* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| SPATID | 1000000 |  |  | 3042889811,  3043234510,  3043103347,  3043183081,  3042991778 | 1000000 |
| CurrentVersion | 256 |  |  | 195, 139, 62, 16, 87 |
| IntersectionId | 1 |  |  | 126 |
| IntersectionStatus | 1 |  |  | 0x00 |
| MsgTimestamp | 429117 |  |  | 2013-04-30 22:04:48.000,  2013-04-30 23:23:35.200,  2013-05-01 01:39:53.000,  2013-04-30 23:06:42.800,  2013-05-01 08:48:35.900 |

## SPATMovement File

The SPATMovement file provides the signal phase and timing information for one or more movements at an intersection.

Table 108: Data Elements of the SPATMovement File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| MovementId | Integer | None |  | Unique ID (number) for every movement |
| SPATID | String | None |  | Unique ID (number) for every SPAT message |
| CurrentState | Hxadecimal | None | 1 | Defines the current state of a particular known movement and depends on the type of lane that the CurrentState applies to. Full explanation follows table |
| MinTimeremaining | Integer | 0.1 second units |  | Specifies minimum guaranteed time remaining before signal change to next phase. Maximum value is 1200 (2 minutes). Enumerations of 1201 and 1202 indicate an indefinite time remaining (greater than 2 minutes) and an unknown amount of time remaining, respectively |
| MaxTimeremaining | Integer | 0.1 second units |  | Specifies anticipated maximum time remaining before signal is expected to change to next phase. Anticipated time subject to change. Times are provided relative to *SPAT* MsgTimestamp. Maximum value and bounds are identical to MinTimeremaining |
| YellowState | Hexadecimal | None | 2 | Specifies next (yellow-only) state of all possible lights pertaining to a movement. Interpretation of YellowState depends on the type of lane that the movement is applied to. |
| YellowTime | Integer | 0.1 second units |  | Specifies duration of a yellow signal phase |
| PedestrianDetect | Integer | None | 3 | Indicates possible presence of pedestrians in the movement’s walk area |
| VehiclePedestrianCount | Integer | None |  | Indicates estimated count of vehicles (for vehicle lanes) or pedestrians (for pedestrian lanes) within a predefined time period |
| LaneSet | Hexadecimal | None | 4 | Specifies movement within lanes at an intersection. Full explanation follows table |

Data from the CurrentState field in Table 108 is interpreted differently for vehicle, pedestrian, and special lanes. For vehicle lanes, the hexadecimal string is read as character pairs that map to lighting combinations. For example, a vehicle CurrentState of 0x04080200 is read as 0x04000000, indicating a red U-Turn arrow, 0x00080000, indicating a flashing soft left arrow, and 0x00000200, indicating a yellow right arrow. All three of these lighting arrangements are present, such that the CurrentState hexadecimal characters apply cumulatively. Similarly, a vehicle CurrentState of 0x01 is read as 0x00000001 and indicates a solid green ball.

For pedestrian lanes, CurrentState defines the current signal state of crosswalk indicators for a particular known pedestrian movement. For pedestrian lanes, the CurrentState is always a 2 character hexadecimal string with a leading 0 which may be enumerated directly.

Finally, for special lanes, CurrentState defines the current signal state of a special movement, such as a train crossing. For special lanes, the CurrentState is always a 2 character hexadecimal string which may also be enumerated directly.

For vehicle lanes, YellowState also maps in the same fashion as CurrentState, although only yellow lightings may apply. As with CurrentState, YellowState is always a 2 character hexadecimal string with a leading 0 which may be enumerated directly for pedestrian lanes. YellowState does not apply to special lanes.

Data from the LaneSet field in Table 108 is provided as a sequence of movement/lane pairs. Each movement/lane pair is provided as a double-octet (four-character) hex string. The first two characters represent the movement, while the last two characters represent the lane. The movement is obtained by converting the hexadecimal value to an 8 bit binary string with bits 76543210. A movement is present with a logical 1 for any given bit. For example, a LaneSet string of 0x0703 has the movement characters 07, which are written as 00000111 in binary. Bits 0, 1, and 2 are in the logical 1 position, indicating straight, left, and right movement. The string has lane characters 03 which directly indicate lane 3. Therefore, a LaneSet of 0x0703 indicates straight/left/right movement on lane 3. There is no limit to the number of movement lane/pairs possible. For example, a LaneSet of 0x08040302 indicates a U-Turn on lane 4 (with movement string 00001000 in binary) and straight/left on lane 2 (with movement string 00000011 in binary).

Table 108 contains a number of enumerated elements whose values are associated with different meanings. Table 109 presents each of these data elements and their various enumerations.

Table 109: Enumeration Table for SPATMovement File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| CurrentState | 1 | Vehicle Lanes | | |
| 0x00000001 | Green ball |  |
| 0x00000010 | Green left arrow |  |
| 0x00000100 | Green right arrow |  |
| 0x00001000 | Green straight arrow |  |
| 0x00010000 | Green soft left arrow |  |
| 0x00100000 | Green soft right arrow |  |
| 0x01000000 | Green U-Turn arrow |  |
| 0x00000002 | Yellow ball |  |
| 0x00000020 | Yellow left arrow |  |
| 0x00000200 | Yellow right arrow |  |
| 0x00002000 | Yellow straight arrow |  |
| 0x00020000 | Yellow soft left arrow |  |
| 0x00200000 | Yellow soft right arrow |  |
| 0x02000000 | Yellow U-Turn arrow |  |
| 0x00000004 | Red ball |  |
| 0x00000040 | Red left arrow |  |
| 0x00000400 | Red right arrow |  |
| 0x00004000 | Red straight arrow |  |
| 0x00040000 | Red soft left arrow |  |
| 0x00400000 | Red soft right arrow |  |
| 0x04000000 | Red U-Turn arrow |  |
| 0x00000008 | Flashing ball |  |
| 0x00000080 | Flashing left arrow |  |
| 0x00000800 | Flashing right arrow |  |
| 0x00008000 | Flashing straight arrow |  |
| 0x00080000 | Flashing soft left arrow |  |
| 0x00800000 | Flashing soft right arrow |  |
| 0x08000000 | Flashing U-Turn arrow |  |
| Pedestrian Lanes | | |
| 0x00 | Unavailable | Current state unavailable or not equipped |
| 0x01 | “Do not walk” |  |
| 0x02 | “Flashing, do not walk” |  |
| 0x03 | “Walk” |  |
| Special Lanes | | |
| 0x01 | Unavailable | Current state empty or not in use |
| 0x02 | Being Occupied | Special lane about to be occupied |
| 0x03 | Occupied | Special lane is occupied |
| 0x04 | Emptying | Special lane about to be empty |
| YellowState | 2 | Vehicle Lanes | | |
| 0x00000002 | Yellow ball |  |
| 0x00000020 | Yellow left arrow |  |
| 0x00000200 | Yellow right arrow |  |
| 0x00002000 | Yellow straight arrow |  |
| 0x00020000 | Yellow soft left arrow |  |
| 0x00200000 | Yellow soft right arrow |  |
| 0x02000000 | Yellow U-Turn arrow |  |
| Pedestrian Lanes | | |
| 0x00 | Unavailable | YellowState unavailable or not equipped |
| 0x01 | “Do not walk” next | Next YellowState is “do not walk” |
| 0x02 | “Flashing, do not walk” next | Next YellowState will be “flashing, do not walk” |
| 0x03 | “Walk” is next | Next YellowState will be “walk” |
| PedestrianDetect | 3 | 0 | Unavailable | Detection unavailable |
| 1 | None | No pedestrians detected |
| 2 | One or more | One or more possible pedestrians detected |
| LaneSet | 4 | Movement characters (mapped to bits) | | |
| Bit 0 | Straight motion |  |
| Bit 1 | Left turn |  |
| Bit 2 | Right turn |  |
| Bit 3 | U-Turn |  |
| Bits 4-7 | Not used |  |
| Lane characters directly indicate lanes | | |

A 10-record sample for the SPATMovement file is given in Table 110.

Table 110: Sample Records for SPATMovement File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MovementId | SPATID | Current  State | Min  Timeremaining | Max Timeremaining | YellowState | YellowTime | Pedestrian  Detect | Vehicle  Pedestrian  Count | LaneSet |
| 3680586804 | 3040841724 | 0x04 | 362 | 1018 | NULL | 0 | 0 | 0 | 0x01010504 |
| 3680586824 | 3040841724 | 0x04 | 67 | 293 | NULL | 0 | 0 | 0 | 0x02010701 |
| 3680586845 | 3040841724 | 0x04 | 208 | 948 | NULL | 0 | 0 | 0 | 0x03010904 |
| 3680586848 | 3040841732 | 0x04 | 361 | 1017 | NULL | 0 | 0 | 0 | 0x01010504 |
| 3680586869 | 3040841724 | 0x01 | 147 | 643 | 0x02 | 36 | 0 | 0 | 0x04010B01 |
| 3680586872 | 3040841732 | 0x04 | 66 | 292 | NULL | 0 | 0 | 0 | 0x02010701 |
| 3680586890 | 3040841724 | 0x40 | 208 | 704 | NULL | 0 | 0 | 0 | 0x06020A02 |
| 3680586894 | 3040841732 | 0x04 | 207 | 947 | NULL | 0 | 0 | 0 | 0x03010904 |
| 3680586917 | 3040841724 | 0x40 | 656 | 1201 | NULL | 0 | 0 | 0 | 0x0802 |
| 3680586918 | 3040841732 | 0x01 | 146 | 642 | 0x02 | 36 | 0 | 0 | 0x04010B01 |

Table 111**Error! Reference source not found.** provides a few summary measures of the SPATMovement file that was populated with data collected between April 30 and May 1, 2013.

Table 111: Summary Measures for Data Elements of the *SPATMovement* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| MovementId | 1000000 |  |  | 3681632666,  3682128383,  3682180361,  3682320967,  3682175869 | 1000000 |
| SPATID | 109247 |  |  | 3040970421,  3041042888,  3040896184,  3040892366,  3040875722 |
| CurrentState | 9 |  |  | 0x11, 0x20, 0x10, 0x02, 0x01 |
| MinTimeremaining | 1058 | 0 | 1057 | 185, 563, 968, 28, 955 |
| MaxTimeremaining | 1202 | 0 | 1201 | 1109, 1193, 229, 994, 23 |
| YellowState | 3 |  |  | NULL, 0x02, 0x20 |
| YellowTime | 6 | 0 | 36 | 19, 31, 0, 14, 17 |
| PedestrianDetect | 3 | 0 | 2 | 0, 1, 2 |
| VehiclePedestrianCount | 1 | 0 | 0 | 0 |
| LaneSet | 102 |  |  | 0x01010504, 0x04010B01,  0x0802,  0x06020A02, 0x03010904 |

## TIM File

The TIM file is populated with details pertaining to Traveler Information Message (TIM). This message is used to send various types of messages (advisory and road sign types) over the WSM stack to vehicles. It makes heavy use of the ITIS encoding system to send well known phrases, but allows limited text for local place names. The supported message types specify several sub-dialects of ITIS phrase patterns to further reduce the number of bytes to be sent. The expressed messages are active at a precise start and duration period, which can be specified to a resolution of a minute. The affected local area can be expressed using either a radius system or a system of short defined regions which is similar to the way roadway geometry is defined in the map fragment messages.

Table 112: Data Elements of the TIM File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| TIMID | Integer | None |  | ID (number) of TIM message. May be either “advisory” or “road sign” type. If advisory, TIMID is a two byte Advisory Number which connects to additional message content transmitted in ATIS message format over the IP stack, if available. Advisory Numbers are always present and unique, even if no information is available. If road sign, TIMID is a combination of 3D position, direction, and a MutCDCode |
| TIMPacketID | String | None |  | Unique ID (number) for every packet of messages sent by roadside equipment |
| URLBase | Integer | None |  | Internet-style URI/URL string which links to a designated resource when combined with URLShort. Protocol to be used should be given in the string. Last letter of the string may be used to differentiate multiple URLBase values in a single system. 26+10=36 base addresses may exist. The last letter then matches up with the first letter of the URLShort value. These letters are stripped from both the base and short elements before being combined to obtain the final URL/URI value |
| MessageIdData | Hexadecimal | None |  | Communicates several attributes of the transmitted TIM. Using a tag/type-length-value/data structure, MessageIdData provides information pertaining to the 3D position of the object, which has latitude, longitude, elevation, heading (slice) and mutcdcode components. See corresponding metadata document for additional information. |
| FurtherInfold | String | None |  | Provides a link number to other messages which relate to the same event according to the DSRC SAE J2735 Standard. 0 is used when FurtherInfold is unknown or not present |
| Latitude | Integer | 1/10th integer microdegrees |  | 32 bit value of current latitude of the vehicle with reference to horizontal datum in use. 90000001 is used when unavailable |
| Longitude | Integer | 1/10th integer microdegrees |  | 32 bit value of current longitude of the vehicle with reference to horizontal datum in use. 180000001 is used when unavailable |
| Elevation | Integer | Decimeters |  | Current elevation of vehicle above or below reference ellipsoid (typically WSG-84) in decimeters when converted to decimal from hex. Range is 0 to 61439 (6143.9 m) and -4095 to -1. An elevation above 6143.9 m is coded 0xEFFF and an elevation below -409.5 m is coded 0xF001. A missing elevation is specified by 0xF000. |
| ViewAngle | Hexadecimal | None | 1 | Specifies permitted travel or motion in a direction specified as an angle of a circular arc. Usually used to indicate a gross direction of travel to which the enclosed message or data frame applies. Full explanation follows table |
| MutCDCode | Integer | None | 2 | Defines basic MUTCD type |
| MsgIdCRC | String | None |  | Defines a two byte data element calculated over the payload bytes of the message. Generated according to CRC-CCITT polynomial x16 + x12 + x5 + 1. An initial seed value of 0 is used. Note that no framing errors may occur because the first byte of every DSRC message is never zero (but 0x30). The most significant bit is always transmitted first in the typical ASN bytes order. A well-formed DSRC message, when decoded and input to the CRC process, should always result in a CRC value of 0. |
| StartTime | String | None |  | Specifies time that the TIM message will become valid. Time is specified in a minute of the year format. A year attribute is optional. StartTime is found in the data frame header of a TIM message |
| Duration | Integer | Minutes |  | Specifies the length of time that the TIM message will be valid after the StartTime. Duration is found in the data frame header of a TIM message |
| SignPriority | Integer | None |  | Indicates the relative importance of a sign on a scale from 0 (least important) to 7 (most important) |
| AnchorLatitude | Integer | 1/10th integer microdegrees |  | Specifies latitude of a location from which offsets may be used to create additional data using a flat-early projection centered at this location. The WSG-84 coordinate system is used. AnchorLatitude is typically used in descriptions of maps, intersections, signs, and traveler data. The AnchorLatitude is specified with reference to the horizontal datum in use. All of the AchorLatitude (4 bytes), AnchorLongitude (4 bytes), and AnchorElevation (2 bytes) data may be used to build a complete10-byte 3D position. 90000001 is used when unavailable |
| AnchorLongitude | Integer | 1/10th integer microdegrees |  | Specifies longitude of a location from which offsets may be used to create additional data using a flat-early projection centered at this location. The WSG-84 coordinate system is used. AnchorLongitude is typically used in descriptions of maps, intersections, signs, and traveler data. The AnchorLongitude is specified with reference to the horizontal datum in use. All of the AnchorLatitude (4 bytes), AnchorLongitude (4 bytes), and AnchorElevation (2 bytes) data may be used to build a complete10-byte 3D position. 180000001 is used when unavailable |
| AnchorElevation | Integer | 1/10th integer microdegrees |  | Specifies elevation of a location from which offsets may be used to create additional data using a flat-early projection centered at this location. The WSG-84 coordinate system is used. AnchorElevation is typically used in descriptions of maps, intersections, signs, and traveler data. The AnchorElevation is specified with reference to the horizontal datum in use. All of the AnchorLatitude (4 bytes), AnchorLongitude (4 bytes), and AnchorElevation (2 bytes) data may be used to build a complete10-byte 3D position. |
| CommonLaneWidth | Integer | Centimeters |  | Specifies width of a lane. Maximum width is 32767 cm |
| DirectionOfUse | Integer | None | 3 | Specifies allowed direction of travel on a street lane or path described by shape points. Default direction is outward, away from an initial set of points. |
| URLShort | String | None |  | Internet-style URI/URL string which links to a designated resource when combined with URLBase. The first letter of the string may be used to differentiate multiple URLBase values in a single system. 26+10=36 base addresses may exist. The first letter then matches up with the last letter of the URLBase value. These letters are stripped from both the base and short elements before being combined to obtain the final URL/URI value |
| TIMContentTypeId | Hexadecimal | None |  | Specifies the type of content in the TIM |
| ITISCodesAndText | Integer | None |  | Specifies the ITIS code(s) associated with the TIM. A code indicates an event or lists an ITS-related item. See Volume 2 of the J2450 Standard for a complete set of ITIS codes |

To extract the data from the ViewAngle field in Table 112, the hexadecimal string is read character by character and mapped to degree ranges specified in Table 113. For example, a ViewAngle string of 0x8181 corresponds to enumerated values 8000, 0100, 0080, and 0001 and therefore identifies that permitted travel is in directions of 0 to 22.5 degrees, 157.5 to 180 degrees, 180 to 202.5 degrees, and 337.5 to 360 degrees. 0 degrees is due east, so a ViewAngle of 0x8181 specifies permitted travel in the east and west directions. Any number of four-character groups may be specified within ViewAngle to permit travel in additional degree ranges.

Table 112 contains a number of enumerated elements whose values are associated with different meanings. Table 113 presents each of these data elements and their various enumerations.

Table 113: Enumeration Table for TIM File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| ViewAngle | 1 | 0001 | 0 to 22.5 degrees |  |
| 0002 | 22.5 to 45 degrees |  |
| 0004 | 45 to 67.5 degrees |  |
| 0008 | 67.5 to 90 degrees |  |
| 0010 | 90 to 112.5 degrees |  |
| 0020 | 112.5 to 135 degrees |  |
| 0040 | 135 to 157.5 degrees |  |
| 0080 | 157.5 to 180 degrees |  |
| 0100 | 180 to 202.5 degrees |  |
| 0200 | 202.5 to 225 degrees |  |
| 0400 | 225 to 247.5 degrees |  |
| 0800 | 247.5 to 270 degrees |  |
| 1000 | 270 to 292.5 degrees |  |
| 2000 | 292.5 to 315 degrees |  |
| 4000 | 315 to 337.5 degrees |  |
| 8000 | 337.5 to 360 degrees |  |
| 0000 | No ViewAngle |  |
| FFFF | All ViewAngles |  |
| MutCDCode | 2 | 0 | Reserved | Reserved for future use |
| 1 | A La Carte Message (ACM) |  |
| 2 | Basic Safety Message (BSM) | Heartbeat message |
| 3 | Basic Safety Message Verbose | Message used only for testing |
| 4 | Common Safety Request (CSR) |  |
| 5 | Emergency Vehicle Alert (EVA) |  |
| 6 | Intersection Collision Alert (ICA) |  |
| 7 | Map Data (MAP) | For GID and intersections |
| 8 | nmea Corrections (NMEA) |  |
| 9 | Probe Data Management (PDM) |  |
| 10 | probe Vehicle Data (PVD) |  |
| 11 | Roadside Alert (RSA) |  |
| 12 | rtcm Corrections (RTCM) |  |
| 13 | Signal Phase and Timing Message (SPAT) |  |
| 14 | Signal Request Message (SRM) |  |
| 15 | Signal Status Message (SSM) |  |
| 16 | Traveler Information (TIM) |  |
| DirectionOfUse | 3 | 0 | Forward | Direction of travel follows node ordering |
| 1 | Reverse | Direction of travel is the reverse of node ordering |
| 2 | Both directions | Direction of travel allowed in both directions. |

A 10-record sample for the TIM file is given in Table 114.

Table 114: Sample Records for *TIM* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TIMID | TIMPacketID | URLBase | Message  IdData | Further  InFold | Latitude | Longitude | Elevation | View  Angle | MutCDCode |
| 1097789045 | 0x000000000000001500 | NULL | Lengthy hexadecimal string | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789049 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789052 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789056 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789060 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789064 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789068 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789072 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789077 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |
| 1097789081 | 0x000000000000001500 | NULL | 0x00 | 422982950 | -837274060 | 2545 | 0x0006 | 2 |

Table continued …

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MsgIdCRC | StartTime | Duration | SignPriority | Anchor  Latitude | Anchor  Longitude | Anchor  Elevation | Common  LaneWidth | Direction  OfUse | URLShort |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |
| 0x00000000 | 10/5/2011  12:01:00 AM | 32000 | 2 | 422986840 | -837268780 | 2551 | 351 | 0 | NULL |

Table continued …

|  |  |
| --- | --- |
| TIMContentTypeId | ITISCodesAndText |
| 1 | 13609 |
| 1 | 13609 |
| 1 | 13609 |
| 1 | 13609 |
| 1 | 13609 |
| 1 | 13609 |
| 1 | 13609 |
| … | … |

Table 115 provides a few summary measures of the TIM file that was populated with data collected on April 11, 2013.

Table 115: Summary Measures for Data Elements of the *TIM* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| TIMID | 6878065 |  |  | 1458173277,  2766900943,  1182074471,  1127471206,  2819481532 | 6878065 |
| TIMPacketID | 4 |  |  | 0x000000000000001100, 0x000000000000001600, 0x000000000000001200, 0x000000000000001500 |
| URLBase | 0 |  |  | NULL |
| MessageIdData | 4 |  |  | 0xA010800419348ECE  8104CE1A320E820209  A681020018820102, and other long hex strings |
| FurtherInfold | 1 |  |  | 0x00 |
| Latitude | 4 | 422874830 | 422983370 | 422874830, 422983370, 422982950, 422879440 |
| Longitude | 4 | -837274060 | -837144050 | -837189730, -837144050,  -837274060, -837223200 |
| Elevation | 4 | 2444 | 2671 | 2545, 2671, 2444, 2470 |
| ViewAngle | 4 |  |  | 0x0018, 0x8001, 0x0006, 0x6000 |
| MutCDCode | 1 |  |  | 2 |
| MsgIdCRC | 1 |  |  | 0x00000000 |
| StartTime | 1 |  |  | 10/5/2011 12:01:00 AM |
| Duration | 1 | 32000 | 32000 | 32000 |
| SignPriority | 1 |  |  | 2 |
| AnchorLatitude | 4 | 422874830 | 422987809 | 422887080, 422874830, 422987809, 422986840 |
| AnchorLongitude | 4 | -837268780 | -837131366 | -837131366, -837268780,  -837191798, -837229965 |
| AnchorElevation | 4 | 2471 | 2644 | 2644, 2473, 2551, 2471 |
| CommonLaneWidth | 3 | 335 | 366 | 335, 351, 366 |
| DirectionOfUse | 1 |  |  | 0 |
| URLShort | 1 |  |  | NULL |
| TIMContentTypeId | 1 |  |  | 1 |
| ITISCodesAndText | 2 |  |  | 13609, 13610 |

## TIMRegion File

This file outlines the region for which the TIM is applicable. Thus far, there are 6 regions presented.

Table 116: Data Elements of the TIMRegion File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| TIMRegion | Integer | None |  | Specifies a given region for which a TIM message is valid. Up to 16 valid regions may be used to geographically define where each message is useful to the driver. Multiple regions are used to describe precise segments of roadway to which a message applies, such as east- and west-bound lanes approaching an intersection or interchange |
| Direction | Hexadecimal | None | 1 | Specifies the direction of travel for which a message is valid. Unless a region is defined as omnidirectional, the vehicle must be traveling in a designated direction – vehicle physically being within the area described by AreaType is not enough to make a message valid for display. Mapping follows that of the ViewAngle field within the *TIM* file |
| Extent | Integer | None | 2 | Specifies spatial distance over which the TIM applies and is presented to the driver. Under certain conditions, some messages may never be sown to the driver of a vehicle if they are short in duration and other conflicting needs supersede the display for long enough that the Extent message is no longer relevant |
| TIMAreaTypeId | Integer | None | 3 | Provides a description of the region in which the message broadcast is valid. |
| Latitude | Integer | Centimeters |  | 32 bit value of current latitude of the vehicle with reference to horizontal datum in use. 90000001 is used when unavailable |
| Longitude | Integer | 1/10th integer microdegrees |  | 32 bit value of current longitude of the vehicle with reference to horizontal datum in use. 180000001 is used when unavailable |
| Elevation | Integer | Decimeters |  | Current elevation of vehicle above or below reference ellipsoid (typically WSG-84) in decimeters when converted to decimal from hex. Range is 0 to 61439 (6143.9 m) and -4095 to -1. An elevation above 6143.9 m is coded 0xEFFF and an elevation below -409.5 m is coded 0xF001. A missing elevation is specified by 0xF000. |
| LaneWidth | Integer | Centimeters |  | Specifies width of a lane. Maximum width is 32767 cm |
| DirectionOfUse | Integer | None | 4 | Specifies allowed direction of travel on a street lane or path described by shape points. Default direction is outward, away from an initial set of points. |
| RadiusSteps | Integer | 2.5 centimeter units |  | Defines one of three possible measures of the radius of the circular area for which the TIM is valid. Range is 0 to 32767 units |
| Miles | Integer | Miles |  | Defines one of three possible measures of the radius of the circular area for which the TIM is valid. Range is 1 to 2000 miles |
| Kilometers | Integer | Kilometers |  | Defines one of three possible measures of the radius of the circular area for which the TIM is valid. Range is 1 to 5000 kilometers |

Table 116 contains a number of enumerated elements whose values are associated with different meanings. Table 117 presents each of these data elements and their various enumerations.

Table 117: Enumeration Table for TIMRegion File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | **Description** |
| Direction | 1 | 0001 | 0 to 22.5 degrees |  |
| 0002 | 22.5 to 45 degrees |  |
| 0004 | 45 to 67.5 degrees |  |
| 0008 | 67.5 to 90 degrees |  |
| 0010 | 90 to 112.5 degrees |  |
| 0020 | 112.5 to 135 degrees |  |
| 0040 | 135 to 157.5 degrees |  |
| 0080 | 157.5 to 180 degrees |  |
| 0100 | 180 to 202.5 degrees |  |
| 0200 | 202.5 to 225 degrees |  |
| 0400 | 225 to 247.5 degrees |  |
| 0800 | 247.5 to 270 degrees |  |
| 1000 | 270 to 292.5 degrees |  |
| 2000 | 292.5 to 315 degrees |  |
| 4000 | 315 to 337.5 degrees |  |
| 8000 | 337.5 to 360 degrees |  |
| 0000 | No Direction |  |
| FFFF | All Directions |  |
| Extent | 2 | 0 | Use message for… | an instant only |
| 1 | 3 meters only |
| 2 | 10 meters only |
| 3 | 50 meters only |
| 4 | 100 meters only |
| 5 | 500 meters only |
| 6 | 1000 meters only |
| 7 | 5000 meters only |
| 8 | 10,000 meters only |
| 9 | 50,000 meters only |
| 10 | 100,000 meters only |
| 127 | ever |
| TIMAreaTypeId | 3 | 1 | Circular region | Simplest region and is effective in covering a large area that is not restricted to one specific road segment. |
|  | Polygon region | Used to describe complex regions, such as an agency’s jurisdictional coverage |
|  | Shape point set | Allows a spline-like representation of a road segment using the same concepts developed for DSCR map fragments and is intended to tightly bind the region to the contour of a particular road. Described segments use a node list to efficiently describe the contour of the roadway center line as well as any changes in width and elevation |
| DirectionOfUse | 4 | 0 | Forward | Direction of travel follows node ordering |
| 1 | Reverse | Direction of travel is the reverse of node ordering |
| 2 | Both directions | Direction of travel allowed in both directions. |

A 10-record sample for the TIMRegion file is given in Table 118.

Table 118: Sample Records for *TIMRegion* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TIMRegionId | Direction | Extent | TIMAreaTypeId | Latitude | Longitude | Elevation | LaneWidth | DirectionOfUse | RadiusSteps |
| 1 | 0x0006 | 0 | 1 | 0 | 0 | 0 | 0 | NULL | 0 |
| 2 | 0x6000 | 0 | 1 | 0 | 0 | 0 | 0 | NULL | 0 |
| 3 | 0x1800 | 0 | 1 | 0 | 0 | 0 | 0 | NULL | 0 |
| 4 | 0x8001 | 0 | 1 | 0 | 0 | 0 | 0 | NULL | 0 |
| 5 | 0x0070 | 0 | 1 | 0 | 0 | 0 | 0 | NULL | 0 |
| 6 | 0x8001 | 0 | 1 | 0 | 0 | 0 | 0 | NULL | 0 |

Table continued …

|  |  |
| --- | --- |
| Miles | Kilometers |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |
| 0 | 0 |

Table 119 provides a few summary measures of the TIMRegion file.

Table 119: Summary Measures for Data Elements of the *TIMRegion* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| TIMRegion | 6 |  |  | 1, 2, 3, 4, 5, 6 | 6 |
| Direction | 5 |  |  | 0x0006, 0x8001, 0x6000, 0x1800, 0x0070 |
| Extent | 1 |  |  | 0 |
| TIMAreaTypeId | 1 |  |  | 1 |
| Latitude | 1 | 0 | 0 | 0 |
| Longitude | 1 | 0 | 0 | 0 |
| Elevation | 1 | 0 | 0 | 0 |
| LaneWidth | 1 |  |  | 0 |
| DirectionOfUse | 1 |  |  | NULL |
| RadiusSteps | 1 | 0 | 0 | 0 |
| Miles | 1 | 0 | 0 | 0 |
| Kilometers | 1 | 0 | 0 | 0 |

## TIMRegionNode File

The TIMRegionNode file defines the applicable region of a TIM in terms of offsets from a given node, which may be at an intersection or a point on the ground near an RSE.

Table 120: Data Elements of the TIMRegionNode File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| TIMRegionNodeId | Integer | None |  | Unique ID (number) used to demarcate the point of a region for which a TIM is applicable |
| TIMRegionId | Integer | None |  | Specifies a given region for which a TIM message is valid. Up to 16 valid regions may be used to geographically define where each message is useful to the driver. Multiple regions are used to describe precise segments of roadway to which a message applies, such as east- and west-bound lanes approaching an intersection or interchange |
| XOffset | Integer | Centimeters |  | Specifies the latitudinal offset from an anchor point of a given node within a shape point set that defines the valid region for a message. Ranges from -32767 to 32767 cm |
| YOffset | Integer | Centimeters |  | Specifies the longitudinal offset from an anchor point of a given node within a shape point set that defines the valid region for a message. Ranges from -32767 to 32767 cm |
| ZOffset | Integer | Centimeters |  | Specifies the elevation offset from an anchor point of a given node within a shape point set that defines the valid region for a message. Ranges from -32767 to 32767 cm |
| Width | Integer | Centimeters |  | Specifies width of a lane. Maximum width is 32767 cm |

No enumerations are present in the *TIMRegionNode* file.

A 10-record sample for the TIMRegionNode file is given in Table 121.

Table 121: Sample Records for *TIMRegionNode* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TIMRegionNodeId | TIMRegionId | XOffset | YOffset | ZOffset | Width |
| 1 | 1 | 3388 | 3547 | 0 | 0 |
| 2 | 1 | 3563 | 2524 | 0 | 0 |
| 3 | 1 | 3542 | 1450 | 0 | 0 |
| 4 | 1 | 3536 | 650 | 0 | 0 |
| 5 | 1 | 3540 | -65 | 0 | 0 |
| 6 | 1 | 3539 | -785 | 0 | 0 |
| 7 | 1 | 3537 | -1608 | 0 | 0 |
| 8 | 1 | 3400 | -2607 | 0 | 0 |
| 9 | 1 | 3643 | -3420 | 0 | 0 |
| 10 | 2 | -3497 | 3267 | 0 | 0 |

Table 122 provides a few summary measures of the TIMRegionNode file.

Table 122: Summary Measures for Data Elements of the *TIMRegionNode* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| TIMRegionNodeId | 46 |  |  | 5, 10, 11, 18, 20 | 46 |
| TIMRegionId | 6 |  |  | 1, 2, 4, 5, 6 |
| XOffset | 46 | -9688 | 5010 | -3461, -3400, 3536, 3537,- 3391 |
| YOffset | 46 | -13310 | 15817 | 3016, -195, 2420, 1486, -150 |
| ZOffset | 1 | 0 | 0 | 0 |
| Width | 1 | 0 | 0 | 0 |

## TIMRegionXRef File

The TIMRegionXRef file maps each traveler information message, via its ID, to the region in which the message is applicable.

Table 123: Data Elements of the TIMRegionXRef File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| TIMID | Integer | None |  | ID (number) of TIM message. May be either “advisory” or “road sign” type. If advisory, TIMID is a two byte Advisory Number which connects to additional message content transmitted in ATIS message format over the IP stack, if available. Advisory Numbers are always present and unique, even if no information is available. If road sign, TIMID is a combination of 3D position, direction, and a MutCDCode |
| TIMRegionID | Integer | None |  | Specifies a given region for which a TIM message is valid. Up to 16 valid regions may be used to geographically define where each message is useful to the driver. Multiple regions are used to describe precise segments of roadway to which a message applies, such as east- and west-bound lanes approaching an intersection or interchange |

No enumerations are present in the *TIMRegionXRef* file.

A 10-record sample for the TIMRegionXRef file is given in Table 124.

Table 124: Sample Records for *TIMRegionXRef* File

|  |  |
| --- | --- |
| TIMID | TIMRegionId |
| 3085023 | 1 |
| 1545102108 | 1 |
| 1687513910 | 4 |
| 2320093427 | 1 |
| 1544638550 | 2 |
| 2203708619 | 5 |
| 2325473736 | 5 |
| 290377092 | 2 |
| 341192918 | 5 |
| 1308996291 | 5 |

Table 125 provides a few summary measures of the TIMRegionXRef file.

Table 125: Summary Measures for Data Elements of the *TIMRegionXRef* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| TIMID | 28950989 |  |  | 2036947172, 615289040, 755910678, 399394297, 3009958123 | 57901980 |
| TIMRegionId | 6 |  |  | 1, 2, 4, 5, 6 |

# Contextual Data

Contextual data is intended to communicate the state of surrounding systems and elements that may impact transportation performance and operation. The goal of providing these data is to give data users a complete as possible picture state of the transportation system during the collection of vehicle-based and RSE-based data. The contextual data is also meant to provide insights into how various components of the system interact with, and impact vehicle operations.

The contextual data may include network descriptors and network performance, weather, incident and road-work activity, and scheduling data. The RDE will provide weather data and a thorough description of the elements provided. As for other contextual data, readers are directed to other portals. See section following after the description of the weather data elements below.

## Weather Data

Given the significant impact that weather events have on transportation system performance and operation, an integral component of the contextual dataset are data elements that describe the weather condition under which vehicles are operating. These data element include temperature, precipitation, wind speed, cloud coverage, and when available road surface temperature and precipitation readings. Data provided via the RDE was obtained from the National Climatic Data Center. The following will detail the weather data elements that is include in the Safety Pilot Model Deployment data environment.

Table 126 contains a number of enumerated elements whose values are associated with different meanings. Table 127 presents each of these data elements and their various enumerations.

Table 126: Data Elements of the WeatherData File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| USAF | Integer | None |  | Air Force Catalog station number |
| WBAN | Integer | None |  | National Climate Data center WBAN number |
| YR-MODAHRMN | Integer | None |  | Specifies year-month-day-hour-minute of the weather observation in Greenwich Mean Time. |
| DIR | Integer | Compass Degrees |  | Specifies wind direction. 990 is used to report variable wind, while \*\*\* is used to report calm air (with wind speed 0) |
| SPD | Integer | Mph |  | Wind speed |
| GUS | Integer | Mph |  | Wind gust |
| CLG | Integer | Hundreds of feet |  | Specifies cloud ceiling given by the lowest opaque layer with 5/8 or greater coverage. A CLG value of 722 is used to indicate an unlimited ceiling |
| SKC | String | None | 1 | Specifies sky cover |
| L | Integer | None | 2 | Specifies low cloud type |
| M | Integer | None | 3 | Specifies middle cloud type |
| H | Integer | None | 4 | Specifies high cloud type |
| VSB | Real | Statute miles |  | Specifies the visibility, rounded to the nearest tenth of a statute mile. For some weather stations, visibility is reported to a maximum of 7 to 10 miles in metar observations, but to higher values in synoptic observations, which causes the visibility value to fluctuate from one data record to the next. Also, VSB values of 10 may be reported as 10.1 due to being archived in metric units and then reconverted to English units. |
| MW (4 columns) | Integer | None |  | Specify manually observed present weather according to a digit code. A table of weather codes follows the enumeration table |
| AW (4 columns) | Integer | None |  | Specify auto-observed present weather according to a digit code. A table of weather codes follows the enumeration table |
| W | Integer | None | 5 | Past weather indicator. |
| TEMP | Integer | Degrees Fahrenheit |  | Temperature |
| DEWP | Integer | Degrees Fahrenheit |  | Dew point |
| SLP | Real | Millibars |  | Sea level pressure, rounded to the nearest tenth of a millibar |
| ALT | Real | Inches |  | Altimeter setting, rounded to nearest hundredth of an inch |
| STP | Real | Millibars |  | Station pressure, rounded to the nearest tenth of a millibar |
| MAX | Integer | Degrees Fahrenheit |  | Maximum temperature over a defined time period |
| MIN | Integer | Degrees Fahrenheit |  | Minimum temperature over a defined time period |
| PCP01 | Real | Inches |  | Specifies the amount of liquid precipitation occurring over the last hour, rounded to the nearest hundredth of an inch |
| PCP06 | Real | Inches |  | Specifies the amount of liquid precipitation occurring over the last six hours, rounded to the nearest hundredth of an inch |
| PCP24 | Real | Inches |  | Specifies the amount of liquid precipitation occurring over the last 24 hours, rounded to the nearest hundredth of an inch |
| PCPXX | Real | Inches |  | Specifies the amount of liquid precipitation occurring for a period other than the last 1, 6, or 24 hours. Usually a 12 period for stations outside of the US and a 3 hour period for stations within the US. 0.00T is recorded as the PCPXX value if only trace amounts of precipitation were recorded |
| SD | Integer | Inches |  | Specifies the snow depth |

Table 127: Enumeration Table for WeatherData File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Element** | **EnumId** | **Value** | **Name** | | **Description** |
| SKC | 1 | CLR | Clear | | Clear sky |
| SCT | Scattered | | 1/8 – 4/8 coverage |
| BKN | Broken | | 5/8 – 7/8 coverage |
| OVC | Overcast | | Overcast sky |
| OBC | Obscured | | Obscured sky |
| POB | Partial obscuration | |  |
| L | 2 | 0 | No low clouds | |  |
| 1 |  | | Cumulis humulis or Cumulus fractus other than of bad weather |
| 2 |  | | Cumulus mediocris or congestus, with or without Cumulus of species fractus or humulis or Stratocumulus, all having bases at the same level |
| 3 |  | | Cumulonimbus calvus, with or without Cumulus, Stratocumulus or Stratus |
| 4 |  | | Stratocumulus cumulogenitus |
| 5 |  | | Stratocumulus other than Stratocumulus cumulogenitus |
| 6 |  | | Stratus nebulosus or Stratus fractus other than of bad weather, or both |
| 7 |  | | Stratus fractus or Cumulus fractus of bad weather, or both (pannus) usually below Altostratus or Nimbostratus |
| 8 |  | | Cumulus and Stratocumulus other than Stratocumulus cumulogenitus, with bases at different levels |
| 9 |  | | Cumulonimbus capillatus (often with an anvil), with or without Cumulonimbus calvus, Cumulus, Stratocumulus, Stratus or pannus |
| M | 3 | 0 | No middle clouds | |  |
| 1 |  | | Altostratus translucidus |
| 2 |  | | Altostratus opacus or Nimbostratus |
| 3 |  | | Altocumulus translucidus at a single level |
| 4 |  | | Patches (often lenticular) of Altocumulus translucidus, continually changing and occurring at one or more levels |
| 5 |  | | Altocumulus translucidus in bands, or one or more layers of Altocumulus translucidus or opacus, progressively invading the sky – these Altocumulus clouds generally thicken as a whole |
| 6 |  | | Altocumulus cumulogentis (or cumulonimbogentus) |
| 7 |  | | Altocumulus translucidus or opacus in two or more layers, or Altocumulus opacus in a single layer, not progressively invading the sky, or Altocumulus with Altostratus or Nimbostratus |
| 8 |  | | Altocumulus castellanus or floccus |
| 9 |  | | Altocumulus of a chaotic sky – generally at several levels |
| H | 4 | 0 | No high clouds | |  |
| 1 |  | | Cirrus fibratus, sometimes uncinus, not progressively invading the sky |
| 2 |  | | Cirrus spissatus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a Cumulonimbus; or Cirrus castellanus or floccus |
| 3 |  | | Cirrus spissatus cumulonimbogenitus |
| 4 |  | | Cirrus unicinus or fibratus, or both, progressively invading the sky; they generally thicken as a whole |
| 5 |  | | indicates Cirrus (often in bands) and Cirrostratus, or Cirrostratus alone, progressively invading the sky – they generally thicken as a whole, but the continuous veil does not reach 45 degrees above the horizon |
| 6 |  | | Cirrus (often in bands) and Cirrostratus, or Cirrostratus alone, progressively invading the sky; they generally thicken as a whole; the continuous veil extends more than 45 degrees above the horizon, without the sky being totally covered |
| 7 |  | | Cirrostratus covering the whole sky |
| 8 |  | | Cirrostratus not progressively invading the sky and not entirely covering it |
| 9 |  | | Cirrocumulus alone, or Cirrocumulus predominant among the high clouds |
| W | 5 | 0 |  | Clouds covering 1/2 or less of the sky throughout the appropriate period | |
| 1 |  | Clouds covering more than 1/2 of the sky during part of the appropriate period and covering 1/2 or less during part of the period | |
| 2 |  | clouds covering more than 1/2 of the sky throughout the appropriate period | |
| 3 | Sandstorm, Duststorm or blowing snow |  | |
| 4 | Fog, ice fog, or thick haze |  | |
| 5 | Drizzle |  | |
| 6 | Rain |  | |
| 7 | Snow, or rain and snow mixed |  | |
| 8 | Shower | Shower or showers | |
| 9 | Thunderstorms | Thunderstorm or thunderstorms with or without precipitation | |

The list of weather codes for the MW and AW fields within the weather data file are given in Table 128.

Table 128: Weather codes for MW and AW fields

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 00-49 No precipitation at the station at the time of observation | 20-29 Precipitation, fog, ice fog or thunderstorm at the station during the preceding hour, but not at the time of observation | 40-49 Fog or ice fog at the time of observation | 60-69 Rain | 80-99 Showery precipitation, or precipitation with current or recent thunderstorm |
| 00-19 No precipitation, ice fog (except for 11 and 12), duststorm, sandstorm, drifting or blowing snow at the station at the time of observation or, except for 09 and 17, during the preceding hour | 20: Drizzle (not freezing) or snow grains not falling as shower(s) | 40: Fog or ice fog at a distance at the time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer | 60: Rain, not freezing, intermittent, slight at time of observation | 80: Rain shower(s), slight |
| 00: Cloud development not observed or not observable | 21: Rain (not freezing) not falling as shower(s) | 41: Fog or ice fog in patches | 61: Rain, not freezing, continuous, slight at time of observation | 81: Rain shower(s), moderate or heavy |
| 01: Clouds generally dissolving or becoming less developed | 22: Snow not falling as shower(s) | 42: Fog or ice fog, sky visible, has become thinner during the preceding hour | 62: Rain, not freezing, intermittent, moderate at time of observation | 82: Rain shower(s), violent |
| 02: State of sky on the whole unchanged | 23: Rain and snow or ice pellets not falling as shower(s) | 43: Fog or ice fog, sky invisible, has become thinner during the preceding hour | 63: Rain, not freezing, continuous, moderate at time of observation | 83: Shower(s) of rain and snow mixed, slight |
| 03: Clouds generally forming or developing | 24: Freezing drizzle or freezing rain not falling as shower(s) | 44: Fog or ice fog, sky visible, no appreciable change during the preceding hour | 64: Rain, not freezing, intermittent, heavy at time of observation | 84: Shower(s) of rain and snow mixed, moderate or heavy |
| 04: Visibility reduced by smoke, e.g. veldt or forest fires, industrial smoke or volcanic ashes | 25: Shower(s) of rain | 45: Fog or ice fog, sky invisible, no appreciable change during the preceding hour | 65: Rain, not freezing, continuous, heavy at time of observation | 85: Show shower(s), slight |
| 05: Haze | 26: Shower(s) of snow or of rain and snow | 46: Fog or ice fog, sky invisible, has begun or has become thicker during the preceding hour | 66: Rain, freezing, slight | 86: Snow shower(s), moderate or heavy |
| 06: Widespread dust in suspension in the air, not raised by wind at or near the station at the time of observation | 27: Shower(s) of hail (Hail, small hail, snow pellets), or rain and hail | 47: Fog or ice fog, sky invisible, has begun or has become thicker during the preceding hour | 67: Rain, freezing, moderate or heavy | 87: Shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed, slight |
| 07: Dust or sand raised by wind at or near the station at the time of observation, but no well-developed dust whirl(s) or sand whirl(s), and no duststorm or sandstorm seen or, in the case of ships, blowing spray at the station | 28: Fog or ice fog | 48: Fog, depositing rime, sky visible | 68: Rain or drizzle and snow, slight | 88: Shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed, moderate or heavy |
| 08: Well developed dust whirl(s) or sand whirl(s) seen at or near the station during the preceding hour or at the time of observation, but no duststorm or sandstorm | 29: Thunderstorm (with or without precipitation) | 49: Fog, depositing rime, sky invisible | 69: Rain or drizzle and snow, moderate or heavy | 89: Shower(s) of hail (hail, small hail, snow pellets), with or without rain or rain and snow mixed, not associated with thunder, slight |
| 09: Duststorm or sandstorm within sight at the time of observation, or at the station during the preceding hour | 30-39 Duststorm, sandstorm, or blowing snow | 50-99 Precipitation at the station at the time of observation | 70-79 Solid precipitation not in showers | 90: Shower(s) of hail (hail, small hail, snow pellets), with or without rain or rain and snow mixed, not associated with thunder, moderate or heavy |
| 10: Mist | 30: Slight or moderate duststorm or sandstorm has decreased during the preceding hour | 50-59 Drizzle | 70: Intermittent fall of snowflakes, slight at time of observation | 91: Slight rain at time of observation, thunderstorm during the preceding hour but not at time of observation |
| 11: Patches of shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 meters on land or 10 meters at sea | 31: Slight or moderate duststorm or sandstorm no appreciable change during the preceding hour | 50: Drizzle, not freezing, intermittent, slight at time of observation | 71: Continuous fall of snowflakes, slight at time of observation | 92: Moderate or heavy rain at time of observation, thunderstorm during the preceding hour but not at time of observation |
| 12: More or less continuous shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 meters on land or 10 meters at sea | 32: Slight or moderate duststorm or sandstorm has begun or has increased during the preceding hour | 51: Drizzle, not freezing, continuous, slight at time of observation | 72: Intermittent fall of snowflakes, moderate at time of observation | 93: Slight snow, or rain and snow mixed or hail (hail, small hail, snow pellets), at time of observation, thunderstorm during the preceding hour but not at time of observation |
| 13: Lightning visible, no thunder heard | 33: Severe duststorm or sandstorm has decreased during the preceding hour | 52: Drizzle, not freezing, intermittent, moderate at time of observation | 73: Continuous fall of snowflakes, moderate at time of observation | 94: Moderate or heavy snow, or rain and snow mixed or hail (hail, small hail, snow pellets) at time of observation, thunderstorm during the preceding hour but not at time of observation |
| 14: Precipitation within sight, not reaching the ground or the surface of the sea | 34: Severe duststorm or sandstorm no appreciable change during the preceding hour | 53: Drizzle, not freezing, continuous, moderate at time of observation | 74: Intermittent fall of snowflakes, heavy at time of observation | 95: Thunderstorm, slight or moderate, without hail (hail, small hail, snow pellets), but with rain and/or snow at time of observation, thunderstorm at time of observation |
| 15: Precipitation within sight, reaching the ground or the surface of the sea, but distant, i.e., estimated to be more than 5 km from the station | 35: Severe duststorm or sandstorm has begun or has increased during the preceding hour | 54: Drizzle, not freezing, intermittent, heavy (dense) at time of observation | 75: Continuous fall of snowflakes, heavy at time of observation | 96: Thunderstorm, slight or moderate, with hail (hail, small hail, snow pellets) at time of observation, thunderstorm at time of observation |
| 16: Precipitation within sight, reaching the ground or the surface of the sea, near to, but not at the station | 36: Slight or moderate drifting snow generally low (below eye level) | 55: Drizzle, not freezing, continuous, heavy (dense) at time of observation | 76: Diamond dust (with or without fog) | 97: Thunderstorm, heavy, without hail (Hail, small hail, snow pellets), but with rain and/or snow at time of observation, thunderstorm at time of observation |
| 17: Thunderstorm, but no precipitation at the time of observation | 37: Heavy drifting snow generally low (below eye level) | 56: Drizzle, freezing, slight | 77: Snow grains (with or without fog) | 98: Thunderstorm combined with duststorm or sandstorm at time of observation, thunderstorm at time of observation |
| 18: Squalls at or within sight of the station during the preceding hour or at the time of observation | 38: Slight or moderate blowing snow generally high (above eye level) | 57: Drizzle, freezing, moderate or heavy (dense) | 78: Isolated star-like snow crystals (with or without fog) | 99: Thunderstorm, heavy, with hail (hail, small hail, snow pellets) at time of observation, thunderstorm at time of observation |
| 19: Funnel cloud(s) (Tornado cloud or waterspout) at or within sight of the station during the preceding hour or at the time of observation | 39: Heavy blowing snow generally high (above eye level) | 58: Drizzle and rain, slight | 79: Ice pellets |  |
|  |  | 59: Drizzle and rain, moderate or heavy |  |  |

A 10-record sample for the WeatherData file is given in Table 129.

Table 129: Sample Records for *WeatherData* File

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| USAF | WBAN | YR-MODAHRMN | DIR | SPD | GUS | CLG | SKC | L | M |
| 725374 | 94889 | 201304110053 | 60 | 7 | \*\*\* | 6 | OVC | \* | \* |
| 725374 | 94889 | 201304110140 | \*\*\* | \*\*\* | \*\*\* | 6 | OVC | \* | \* |
| 725374 | 94889 | 201304110153 | \*\*\* | \*\*\* | \*\*\* | 6 | OVC | \* | \* |
| 725374 | 94889 | 201304110244 | 70 | 10 | \*\*\* | 4 | OVC | \* | \* |
| 725374 | 94889 | 201304110253 | 80 | 9 | \*\*\* | 4 | OVC | \* | \* |
| 725374 | 94889 | 201304110313 | 40 | 14 | \*\*\* | 4 | OVC | \* | \* |
| 725374 | 94889 | 201304110322 | 50 | 8 | \*\*\* | 4 | OVC | \* | \* |
| 725374 | 94889 | 201304110353 | 40 | 10 | 18 | 4 | OVC | \* | \* |
| 725374 | 94889 | 201304110446 | 70 | 10 | \*\*\* | 4 | OVC | \* | \* |
| 725374 | 94889 | 201304110453 | 70 | 13 | 21 | 4 | OVC | \* | \* |

Table continued …

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| H | VSB | MW (1) | MW (2) | MW (3) | MW (4) | AW (1) | AW (2) | AW (3) | AW (4) |
| \* | 8 | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* |
| \* | 10 | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* |
| \* | 10 | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* | \*\* |
| \* | 2.5 | \*\* | \*\* | \*\* | \*\* | 10 | \*\* | \*\* | \*\* |
| \* | 2.5 | \*\* | \*\* | \*\* | \*\* | 10 | \*\* | \*\* | \*\* |
| \* | 1.8 | \*\* | \*\* | \*\* | \*\* | 10 | \*\* | \*\* | \*\* |
| \* | 2 | \*\* | \*\* | \*\* | \*\* | 10 | \*\* | \*\* | \*\* |
| \* | 2 | \*\* | \*\* | \*\* | \*\* | 10 | \*\* | \*\* | \*\* |
| \* | 3 | \*\* | \*\* | \*\* | \*\* | 10 | \*\* | \*\* | \*\* |
| \* | 3 | \*\* | \*\* | \*\* | \*\* | 10 | \*\* | \*\* | \*\* |

Table continued…

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| W | TEMP | DEWP | SLP | ALT | STP | MAX | MIN | PCP01 | PCP06 |
| \* | 41 | 39 | 1014.9 | 29.96 | 984.1 | \*\*\* | \*\*\* | 0 | \*\*\*\*\* |
| \* | 41 | 39 | \*\*\*\*\*\* | 29.94 | 983.5 | \*\*\* | \*\*\* | \*\*\*\*\* | \*\*\*\*\* |
| \* | 41 | 39 | 1013.9 | 29.93 | 983.1 | \*\*\* | \*\*\* | 0 | \*\*\*\*\* |
| \* | 39 | 39 | \*\*\*\*\*\* | 29.95 | 983.8 | \*\*\* | \*\*\* | \*\*\*\*\* | \*\*\*\*\* |
| \* | 40 | 39 | 1014.9 | 29.95 | 983.8 | \*\*\* | \*\*\* | 0 | \*\*\*\*\* |
| \* | 39 | 37 | \*\*\*\*\*\* | 29.95 | 983.8 | \*\*\* | \*\*\* | \*\*\*\*\* | \*\*\*\*\* |
| \* | 39 | 37 | \*\*\*\*\*\* | 29.96 | 984.1 | \*\*\* | \*\*\* | \*\*\*\*\* | \*\*\*\*\* |
| \* | 40 | 38 | 1014.8 | 29.95 | 983.8 | \*\*\* | \*\*\* | 0 | \*\*\*\*\* |
| \* | 39 | 37 | \*\*\*\*\*\* | 29.92 | 982.8 | \*\*\* | \*\*\* | \*\*\*\*\* | \*\*\*\*\* |
| \* | 39 | 38 | 1013.3 | 29.91 | 982.5 | \*\*\* | \*\*\* | 0 | \*\*\*\*\* |

Table continued…

|  |  |  |
| --- | --- | --- |
| PCP24 | PCPXX | SD |
| \*\*\*\*\* | \*\*\*\*\* | \*\* |
| \*\*\*\*\* | \*\*\*\*\* | \*\* |
| \*\*\*\*\* | \*\*\*\*\* | \*\* |
| \*\*\*\*\* | \*\*\*\*\* | \*\* |
| \*\*\*\*\* | \*\*\*\*\* | \*\* |
| … | … | … |

Table 130 provides a few summary measures of the WeatherData file.

Table 130: Summary Measures for Data Element of the *WeatherData* File

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Field Name** | **No. of Unique Values** | **Min. Value** | **Max. Value** | **Sample Values** | **No. of Rows** |
| USAF | 1 |  |  | 725374 | 44 |
| WBAN | 1 |  |  | 94889 |
| YR-MODAHRMN | 18 |  |  | 201304110322, 201304000000, 201304110446, 201304110313, 201304110653 |
| DIR | 9 | 40 | 990 | 990, 90, \*\*\*, 60, 80 |
| SPD | 13 | 7 | 20 | 7, 10, 15, 16, 20 |
| GUS | 10 | 18 | 28 | 20, 21, 25, 28, \*\*\* |
| CLG | 4 | 4 | 8 | \*\*\*, 4, 6, 8 |
| SKC | 2 |  |  | \*\*\*, OVC |
| L | 1 |  |  | \* |
| M | 1 |  |  | \* |
| H | 1 |  |  | \* |
| VSB | 12 | 2 | 10 | 1.8, 2.5, 3, 7, 9.1 |
| MW (4 columns) | 2 |  |  | \*\*\*, 10 |
| AW (4 columns) | 5 |  |  | 10, 61, 62, 63, \*\*\* |
| W | 1 |  |  | \* |
| TEMP | 6 | 37 | 41 | 37, 38, 39, 40, \*\*\* |
| DEWP | 6 | 35 | 39 | 35, 36, 37, 38, \*\*\* |
| SLP | 21 | 1006.8 | 1014.9 | 1013.9, 1010, 1012.2, 1012.4, 1009.6 |
| ALT | 18 | 29.72 | 29.96 | 29.76, 29.72, 29.93, 29.81, \*\*\* |
| STP | 18 | 976.2 | 984.1 | 983.3, 982.2, 976.5, 981.8, 978.8 |
| MAX | 6 | 38 | 48 | 38, 39, 40, 42, \*\*\* |
| MIN | 3 | 37 | 39 | 37, 39, \*\*\* |
| PCP01 | 15 | 0 | 0.46 | 0.11, 0.24, 0.37, 0.00T, \*\*\* |
| PCP06 | 3 | 1.04 | 1.04 | 0.00T, 1.04, \*\*\* |
| PCP24 | 3 | 0.36 | 1.33 | 0.36, 1.33, \*\*\* |
| PCPXX | 3 | 0.64 | 0.64 | 0.00T, 0.64, \*\*\* |
| SD | 1 |  |  | \*\* |

Additional weather data may be obtained from Weather Underground (<http://www.wunderground.com/>). This data repository provides weather data from specific weather stations, which one may use to learn of weather in a more localized area.

## Other Contextual Data

### Network Data

Network data references in terms both a description of the physical network from which the data was collected and additional performance measures detailing the efficiency with which people and goods are transported throughout the system. One of the more detailed repositories of network data in which the Safety Pilot Model Deployment was executed is the website of the Michigan Department of Transportation (MDOT) (http://www.michigan.gov/mdot/). From MDOT’s website a detailed functional classification (road) map is available at http://www.miwats.org/s/Appendix-B-Washtenaw-County-NFC-map.pdf. In terms of network performance, MDOT provides a web based, geospatial tool that provides a layer of average daily traffic counts at http://www.mcgi.state.mi.us/ntfa/. Other network performance supplemental data can be obtained from MDOT’s main page as well as the Federal Highway Administration - Highway Statistics Series (http://www.fhwa.dot.gov/policyinformation/statistics.cfm).

The Network data set contains two data files. One of these files presents Annual Average Daily Traffic (AADT) along select roadways in Washtenaw County, Michigan. The data in this file were obtained from the Traffic Count Database System (TCDS). The TCDS is a tool for the traffic engineer or planner to organize an agency's traffic count data. This tool also allows user to upload data from a traffic counter; view graphs, lists and reports of historic traffic count data; search for count data using either the database or the Google map; and print or export data to your desktop. The database can be accessed via http://washtenaw.ms2soft.com/tcds/tsearch.asp?loc=Washtenaw&mod=. The data range for these data is 01/01/1999 – 01/01/2015.

The second data file in the data set presents traffic count samples collected throughout Washtenaw County over a 24 or 48 hour period. This data was obtained from the Washtenaw Area Transportation Study (http://www.miwats.org/traffic-counts/). These count data are collected by road agencies and used in monitoring the performance and needs of the transportation system. The data range for these data is 08/08/1985 – 06/06/2013.

The data in these files spans 1985 – 2015. Data beyond the years of the Safety Pilot Model Deployment were included to support researchers in having a comprehensive view of the road network in the Ann Arbor / Washtenaw County area. While traffic count data is collected rather infrequently, across the network, having data the spans multiple years, and are collected along different roadways, these data are intended to provide supplemental data to communicate network-wide flow estimates.

### NetworkAADTCount File

The NetworkAADTCount file presents traffic counts from Washtenaw County in Michigan. This data in this file was obtained from The Traffic Count Database System (TCDS). The following sections presents a brief description of each data element in the network file.

Table 131: Data Elements of the NetworkAADTCount File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| Loc ID | String | None |  | This field contains the location’s ID number for a given count value. |
| County | String | None |  | The county where the record resides |
| Community | String | None |  | The community where the record resides. |
| On | String | None |  | The street where the record is located. |
| From | String | None |  | One of the endpoints of the record’s link. |
| To | String | None |  | The other endpoint of the record’s link. |
| Approach | String | None |  | Direction from street, in Column H, that the record resides. |
| At | String | None |  | Name of the nearest cross street to the record. |
| Dir | String | None |  | The flow direction of this record (for example, EB, WB, NB, SB). |
| Latitude | Float | None |  | Latitude of the record(er) |
| Longitude | Float | None |  | Longitude of the record(er). |
| Latest | Integer | None |  | The most recent count data. |
| Latest Date | Date | None |  | The most recent count data date. |

A 10-record sample for the NetworkTrafficCount file is given in Table 132

Table 132: Sample Records for NetworkTrafficCount File

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Loc ID** | **County** | **Comm** | **On** | **Fr.** | **To** | **Approach** | **At** | **Dir** | **Lat.** | **Lon.** | **Latest** | **Latest Date** |
| 0010210001 | Washtenaw | Salem Twp | Currie Rd |  |  | NORTH OF | Eight Mile Rd | 2-WAY |  |  | 1040 | 1/1/2008 |
| 0010210001\_NB | Washtenaw | Salem Twp | Currie Rd |  |  | NORTH OF | Eight Mile Rd | NB |  |  |  |  |
| 0010210001\_SB | Washtenaw | Salem Twp | Currie Rd |  |  | NORTH OF | Eight Mile Rd | SB |  |  |  |  |
| 0010220002 | Washtenaw | Salem Twp | Currie Rd |  |  | SOUTH OF | Eight Mile Rd | 2-WAY |  |  | 3875 | 1/1/2014 |
| 0010220002\_NB | Washtenaw | Salem Twp | Currie Rd |  |  | SOUTH OF | Eight Mile Rd | NB |  |  | 2093 | 1/1/2014 |
| 0010220002\_SB | Washtenaw | Salem Twp | Currie Rd |  |  | SOUTH OF | Eight Mile Rd | SB |  |  | 1782 | 1/1/2014 |
| 0010230003 | Washtenaw | Salem Twp | Eight Mile Rd |  |  | EAST OF | Currie Rd | 2-WAY |  |  | 6690 | 1/1/2014 |
| 0010230003\_EB | Washtenaw | Salem Twp | Eight Mile Rd |  |  | EAST OF | Currie Rd | EB |  |  | 3454 | 1/1/2014 |
| 0010230003\_WB | Washtenaw | Salem Twp | Eight Mile Rd |  |  | EAST OF | Currie Rd | WB |  |  | 3236 | 1/1/2014 |

### NetworkTrafficCount File

The NetworkTrafficCount file presents traffic count samples collected throughout Washtenaw County over a 24 or 48 hour period. This data was obtained from the Washtenaw Area Transportation Study (http://www.miwats.org/traffic-counts/). These count data are collected by road agencies and used in monitoring the performance and needs of the transportation system. The data range for these data is 08/08/1985 – 06/06/2013.

Note to readers and users of the data and the definitions below: At the time of publication of this document the Research Data Exchange team did not receive the official definitions for the attributes in this file. The definitions below represents the team’s attempt at defining these attributes based on context and experience in the field.

Table 133: Data Elements of the NetworkTrafficCount File

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Field Name** | **Type** | **Units** | **EnumId** | **Description** |
| TrafficCountDataID | Integer | None |  | This field contains a unique ID for each traffic count record. |
| CountID | Integer | None |  | This field contains an assigned ID for each set of traffic count records collected at the same location on the same date. |
| Count Date | Date | None |  | Date on which the traffic count data was collected |
| StreetName | String | None |  | The name of the street on which the traffic count was collected. |
| DirectionFromCross | String | None |  | The direction of the data collection (street) location from the reference / closest cross street. |
| CrossStreet | String | None |  | Closet or reference cross street to the street on which traffic count data is being collected. |
| TravelDirection | String | None |  | Corresponding travel direction to traffic count value; for the street that the traffic count data is being collected. |
| 24HourCount | Integer | None |  | Number of vehicles detected over a 24-hour period at the data collection location. |
| PeakHourCount | Integer | None |  | Highest number of vehicles is detected in an hour during the data collection period. |
| PeakHourTime | Integer | None |  | The specific hour, of the day, during which the highest number of vehicles is detected during the data collection period |
| 5PMCount | Integer | None |  | The specific hour, of the day, during which the highest number of vehicles is detected during the data collection period |
| Source Agency | String | None |  | The agency that collected the corresponding count data |
| 48HourAverage | Integer | None |  | Indicator as to whether or not an average over a 48 hour period was used to derive the corresponding traffic count value. |
| CityTwp | String | None |  | City / Township in which the data is being collected. |

A 10-record sample for the NetworkTrafficCount file is given in Table 134

Table 134: Sample Records for NetworkTrafficCount File

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| TrafficCountDataID | CountID | Count Date | StreetName | DirectionFromCross | CrossStreet | TravelDirection | … |
| 13854 | 26871 | 6/6/2013 | CLARK | W | HEWITT | 2way | … |
| 13855 | 26871 | 6/6/2013 | CLARK | W | HEWITT | EB | … |
| 13856 | 26871 | 6/6/2013 | CLARK | W | HEWITT | WB | … |
| 13846 | 26868 | 6/5/2013 | BURNS | E | EDISON | EB | … |
| 13845 | 26868 | 6/5/2013 | BURNS | E | EDISON | 2way | … |
| 13847 | 26868 | 6/5/2013 | BURNS | E | EDISON | WB | … |
| 13848 | 26869 | 6/5/2013 | BURNS | E | EDISON | 2way | … |
| 13849 | 26869 | 6/5/2013 | BURNS | E | EDISON | EB | … |
| 13850 | 26869 | 6/5/2013 | BURNS | E | EDISON | WB | … |
| 13851 | 26870 | 6/5/2013 | BURNS | W | EDISON | 2way | … |

…

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24HourCount | PeakHourCount | PeakHourTime | 5PMCount | Source Agency | 48HourAverage | CityTwp |
| 13623 | 1082 | 1700 | 1082 | WCRC | FALSE | Superior Twp |
| 6452 | 571 | 1700 | 571 | WCRC | FALSE | Superior Twp |
| 7171 | 552 | 800 | 511 | WCRC | FALSE | Superior Twp |
| 177 | 20 | 1600 | 14 | WCRC | FALSE | Ypsilanti Twp |
| 316 | 40 | 1600 | 28 | WCRC | FALSE | Ypsilanti Twp |
| 139 | 20 | 1600 | 14 | WCRC | FALSE | Ypsilanti Twp |
| 316 | 40 | 1600 | 28 | WCRC | FALSE | Ypsilanti Twp |
| 177 | 20 | 1600 | 14 | WCRC | FALSE | Ypsilanti Twp |
| 139 | 20 | 1600 | 14 | WCRC | FALSE | Ypsilanti Twp |
| 342 | 35 | 1600 | 24 | WCRC | FALSE | Ypsilanti Twp |

### Transit Schedule Data

The SPMD data includes data that were obtained from transit vehicles and they traverse Ann Arbor. More specifically, a significant portion of these data were collected while transit vehicles were servicing the University of Michigan. If transit schedule data is required for a research task, the transit mobility data that is included in the SPMD data environment maybe complimented by the transit schedule information that is found at <http://pts.umich.edu/taking_the_bus/routes/>.

1. Source: UMTRI Safety Pilot - www.safetypilot.us [↑](#footnote-ref-1)
2. UMTRI Safety Pilot – How it works - http://www.safetypilot.us/how-it-works.html [↑](#footnote-ref-2)
3. UMTRI Safety Pilot – How it works - http://www.safetypilot.us/how-it-works.html [↑](#footnote-ref-3)
4. Mobileye, http://www.mobileye.com/ [↑](#footnote-ref-4)
5. Dedicated Short-Range Communications (DSRC) Message Set Dictionary, http://standards.sae.org/j2735\_200911/ [↑](#footnote-ref-5)
6. Certificate Management Entities for a Connected Vehicle Environment: http://www.its.dot.gov/connected\_vehicle/ cm\_connected\_ vehicle.htm [↑](#footnote-ref-6)