Notes from the Field…**KeepTruckin ELD Study**

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Testing Team:
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Introduction

Commercial vehicle fleet managers use advanced technology including Global Positioning Systems (GPS) in near real time for monitoring asset tracking, electronic logs, vehicle diagnostics, fleet safety and driver behavior. KeepTruckin ELD is FMCSA approved and one of the top fleet management platforms. The system was designed to enhance safety and efficiency within a trucking company.

Because of the widespread use of the KeepTruckin ELD device, SRI studied the system to determine its use as an element piece of physical evidence used in a traffic crash reconstruction. SRI studied the KeepTruckin ELD system to evaluate the accuracy of vehicle speed, vehicle location, mileage, and bread crumb data. SRI also wanted to determine if the system's dash camera stored any images, how the fleet console worked and what information the management/dispatchers could access from GPS bread crumb data.

Test Vehicle

2006 Ford F-450 with a 6.0-liter International engine, VIN 1FDXF46P36ED51808.

The KeepTruckin ELD was mounted near the midline of the truck for testing purposes.

The truck was equipped with a KeepTruckin drive camera. A Garmin Dash Cam 65W was also used to collect data simultaneously with the KeepTruckin system.

SRI used a Ford F-450 for testing the system. Keep Truckin utilizes the same system for class 3 through class 13 vehicles. The cable connecting the Keep Truckin ELD to the vehicle's diagnostic link is the only change in the various vehicle classes.
See Appendix B for the FHWA vehicle classifications.

Methodology

The KeepTruckin ELD system was installed near the midline of SRI's Ford F-450 CMV and was then placed in service for 30 days. The driving was captured with the KeepTruckin Drive Camera and with the Garmin 65W Dash Cam activity to document the location and the speed of the Ford F-450.

The data collected from this testing was then analyzed in the office. The videos from the Garmin 65W Dash Cam were compared to the speed and location data of the breadcrumb time, location, and speed points from the KeepTruckin system.

SRI plotted many of the GPS points on Google Earth to identify the accuracy of the GPS that was documented in the bread crumb data, which was recorded by the system, as well as the Garmin 65W Dash Cam.

GPS Reliability and How It Works

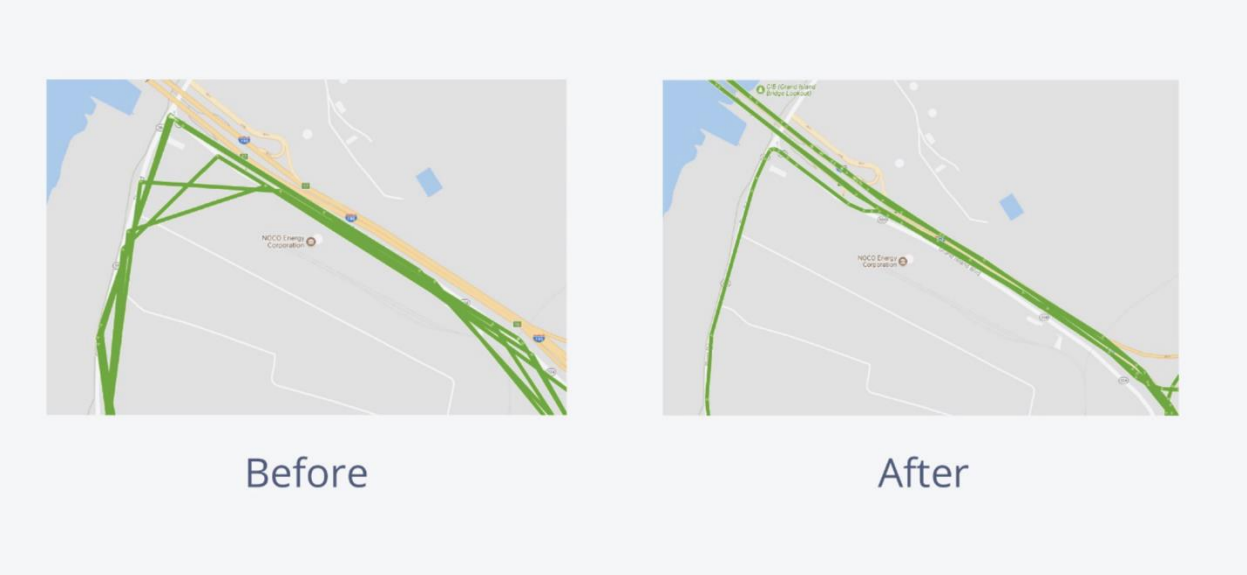
GPS is an acronym for Global Positioning System. GPS was developed primarily by the U.S. military throughout the 1980's but was available for civilian and non-government use by the late 1990's. Since then, GPS has been used by a wide range of technologies to provide accurate positioning information for a variety of commercial and private purposes.

GPS works through a network of satellite broadcasting signals that a ground antenna can receive and then transmit to a receiver. The receiver can then process the data into location information. The GPS receiver can determine the distance from each individual satellite based on the timing of the signals and uses trilateration, a form of geometric triangulation, to analyze the relationship between the distance of each satellite and the receiver's location on Earth.[1] Accuracy of that location information depends on a variety of factors, including, but not limited to weather, number of available satellites in line of sight, the technology/quality of the GPS antenna and receiver. Regarding the quality of the GPS signal, the U.S. government has committed to broadcasting the GPS signal in space with a global average user range error (URE) of ≤7.8 m (25.6 ft.), within a 95% probability. However, actual average URE was measured as low as ≤0.715 m (2.3 ft.) in May 2016.[2] (https://www.gps.gov/systems/gps/performance/accuracy/).

KeepTruckin in March 2018 announced that they were redefining GPS Tracking. In their release KeepTruckin identified that they were now recording the GPS location of their vehicles every 30 seconds, but more often when the bearing or speed changes.

[1] https://www.trimble.com/gps_tutorial/howgps.aspx
[2] https://www.gps.gov/systems/gps/performance/accuracy/

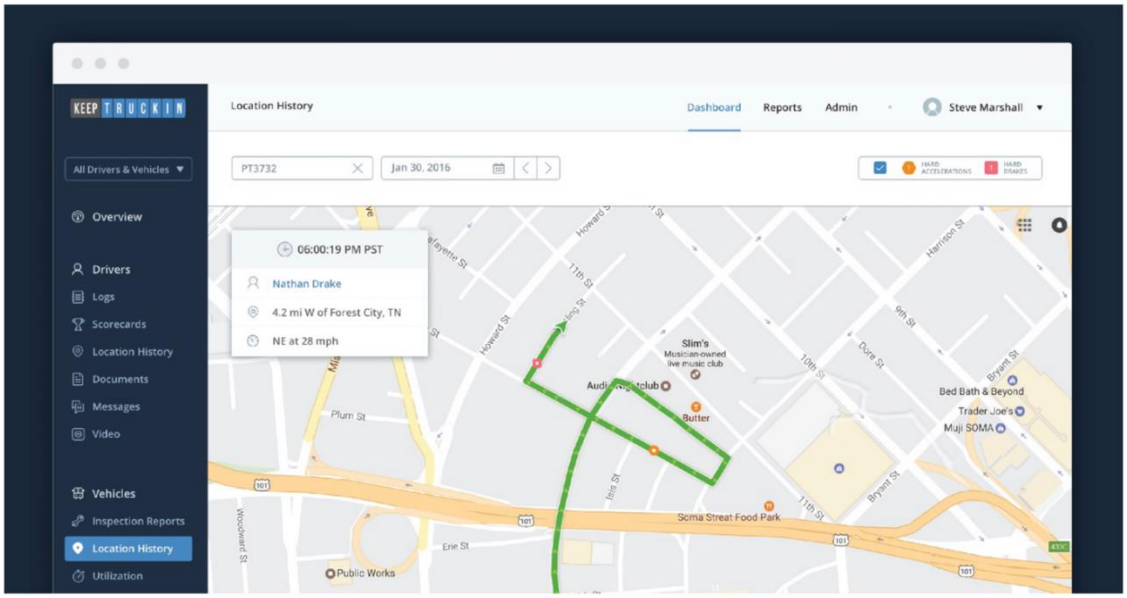
They offer the following graphic on how they improved the data[3]:



KeepTruckin also boasts that they made it easier for their clients to find the location history of their vehicles by adding new features to the software:[4]

- An accessible time slider at the bottom of the screen
- Clearly identifiable driving events with a bold outline in green
- More easily discoverable critical events
- Direction arrows for the vehicles course at each driving event

[3] https://keeptruckin.com/blog/keeptruckin-redefines-gps-tracking
[4] https://keeptruckin.com/blog/keeptruckin-redefines-gps-tracking



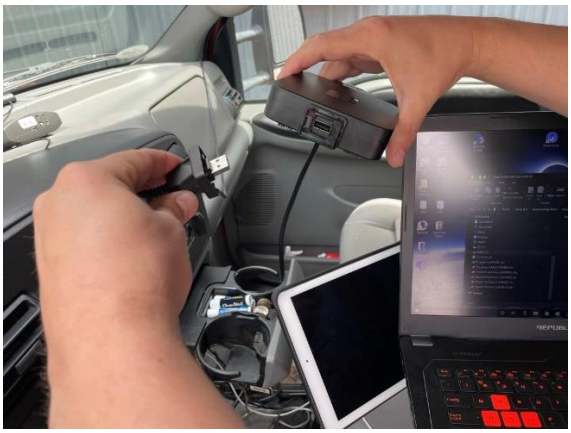
The fleet software allows managers, dispatchers, or fleet safety managers to log in and see in real time the current and historical locations of their vehicles. The drive camera can also be accessed from the console to watch in live time what the truck is doing as well as to review and download video from critical events. The ELD comes with its own data access point reinstalled which uses a GSM based cellular system.[5]

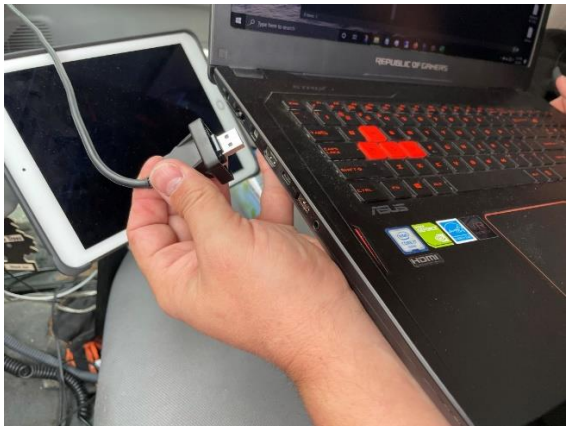
KEEPTRUCKIN DRIVE CAM

SRI identified that the drive cam for this system stores approximately 113 GB of video. This video is readily accessible to the investigator. SRI has identified the following steps to obtain the video and download onto any windows-based computer.[6]

First, unplug the USB cord connecting the Drive Camera to the ELD[7]:

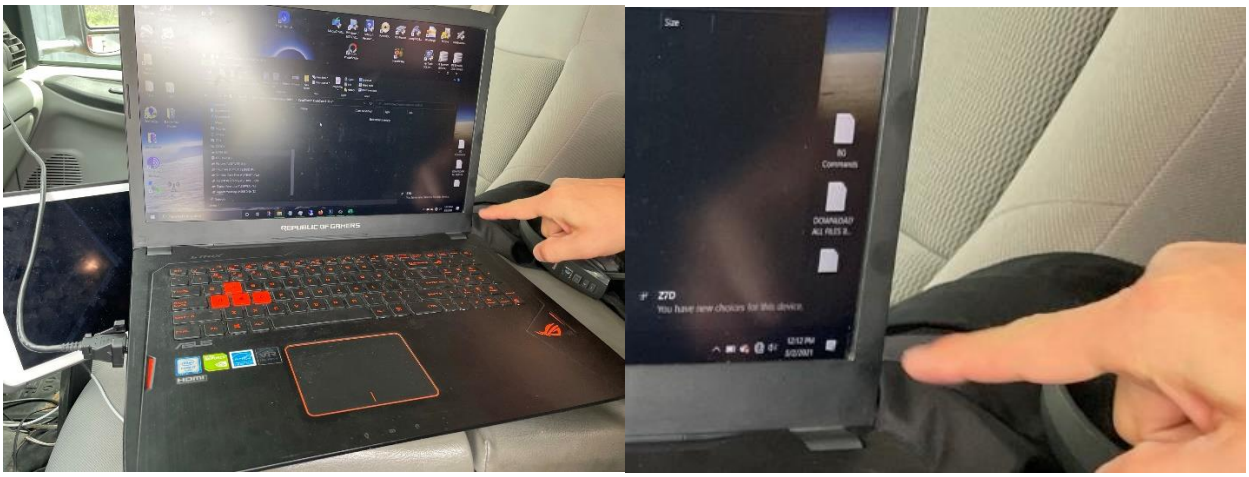
[5] https://keeptruckin.com/blog/keeptruckin-redefines-gps-tracking
[6] Note obtaining the video in this matter will not include the GPS location or speed data.
[7] Note this plug is difficult to unplug gently work it back and forth when pulling on it.



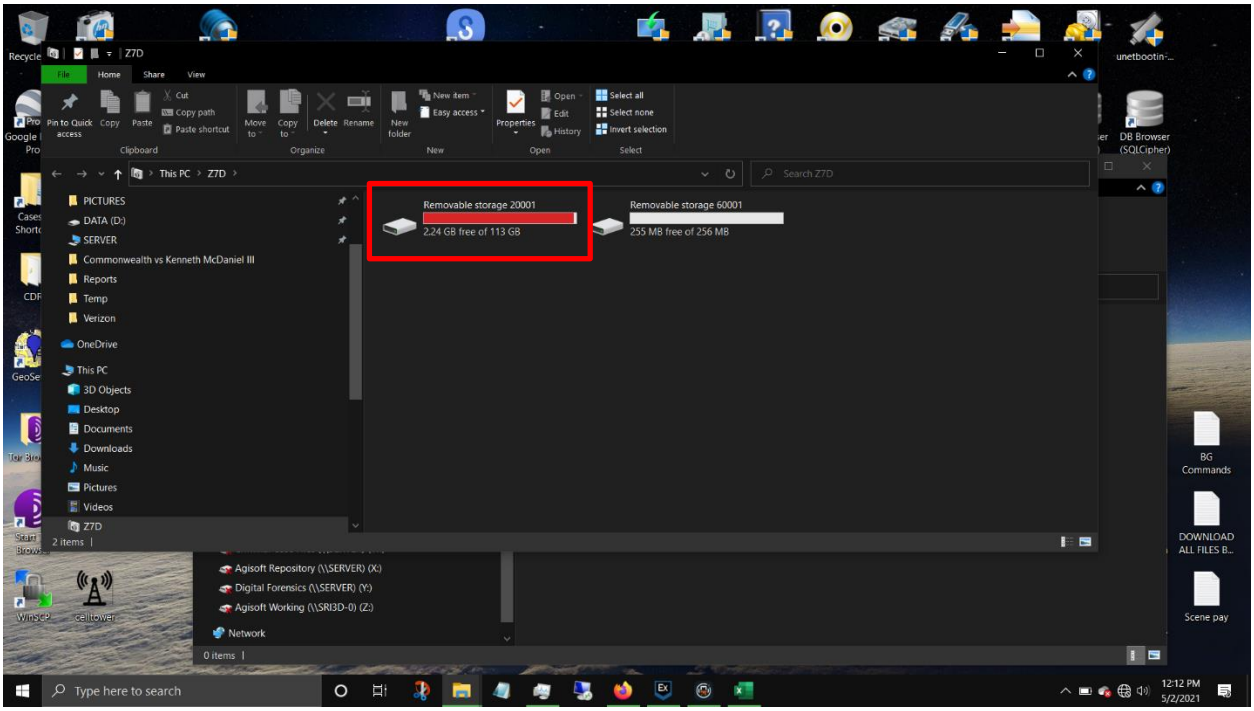


Unplug the USB cable for the drive camera and plug it into a laptop. It will take a minute for the laptop to detect this drive.

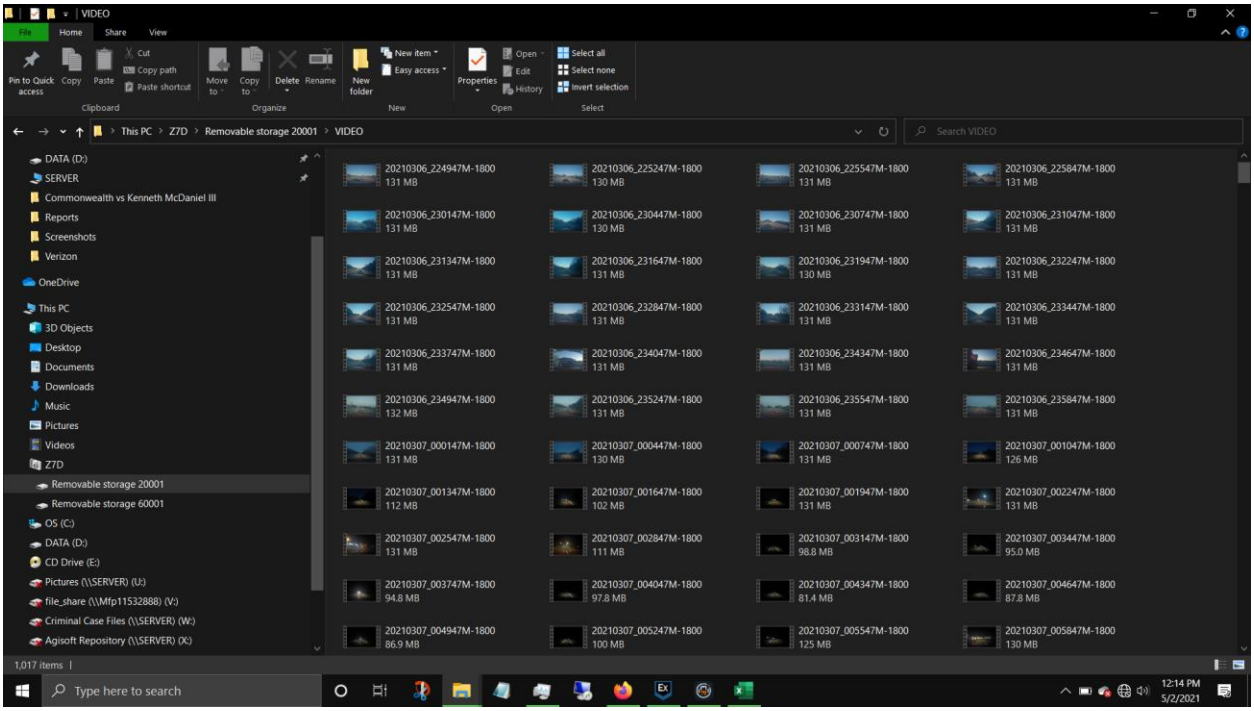
The laptop will recognize the drive camera as an additional drive on its own with a windows PC:



The computer will then open a window to access the drive:



Double click on the correct drive, and the videos from the drive cam will populate the window:

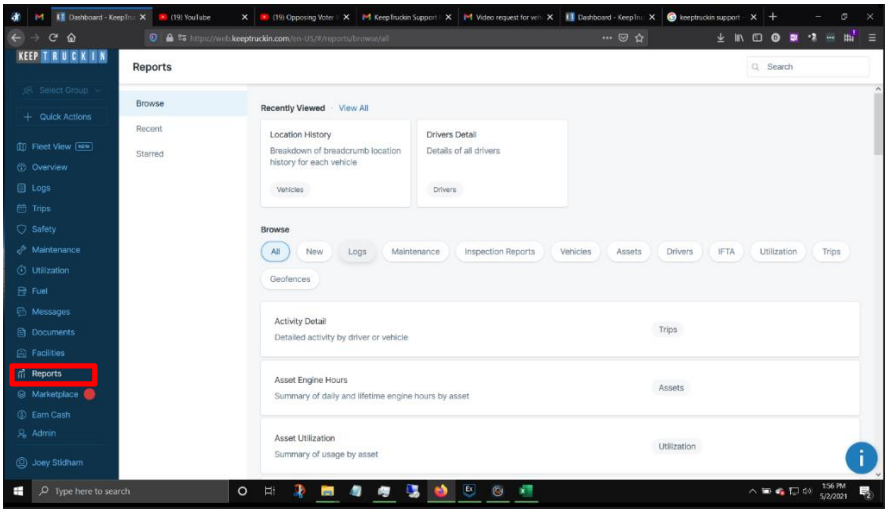


The videos can then be copied to your PC.

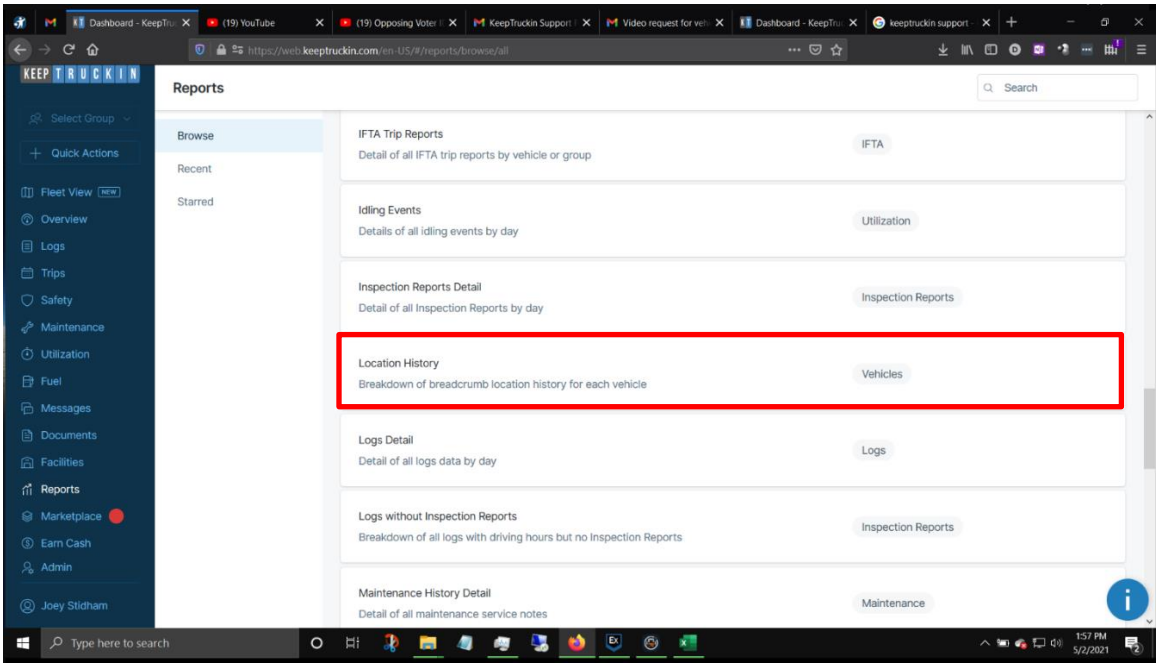
KEEPTRUCKIN GPS LOCATION HISTORY

KeepTruckin has made it easy for fleet safety managers to obtain the GPS Tracking History of trucks from the KeepTruckin Console. The following are the steps to obtain this data.

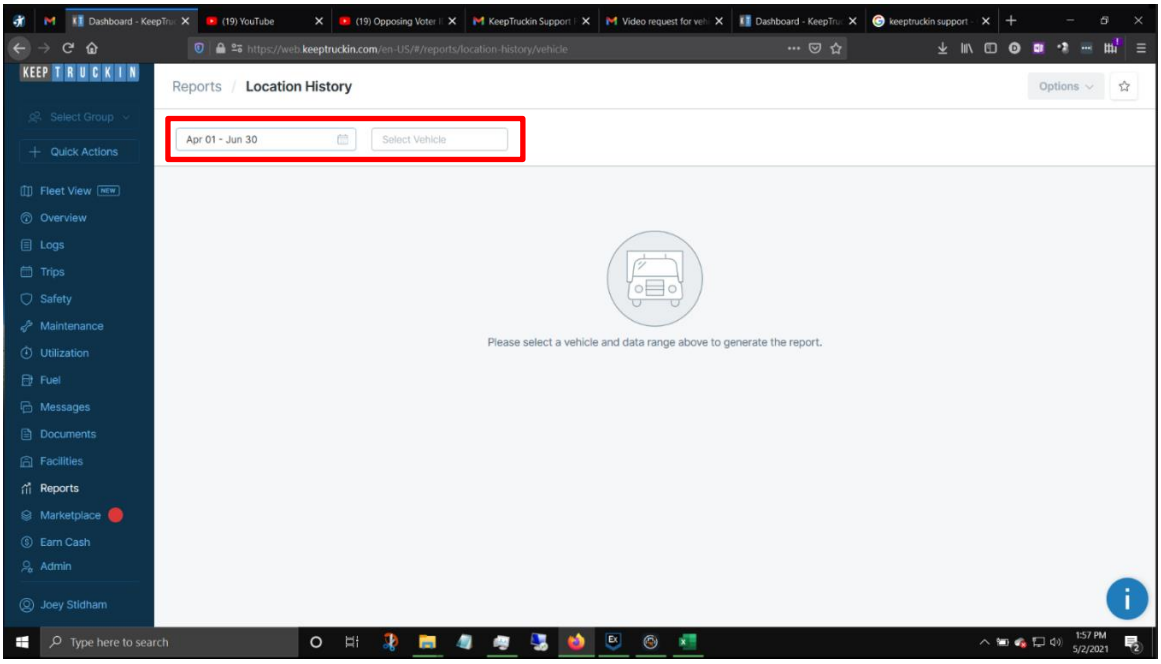
First, Access the login portal. Then click on the reports tab. The following is a screenshot of SRI's login page:



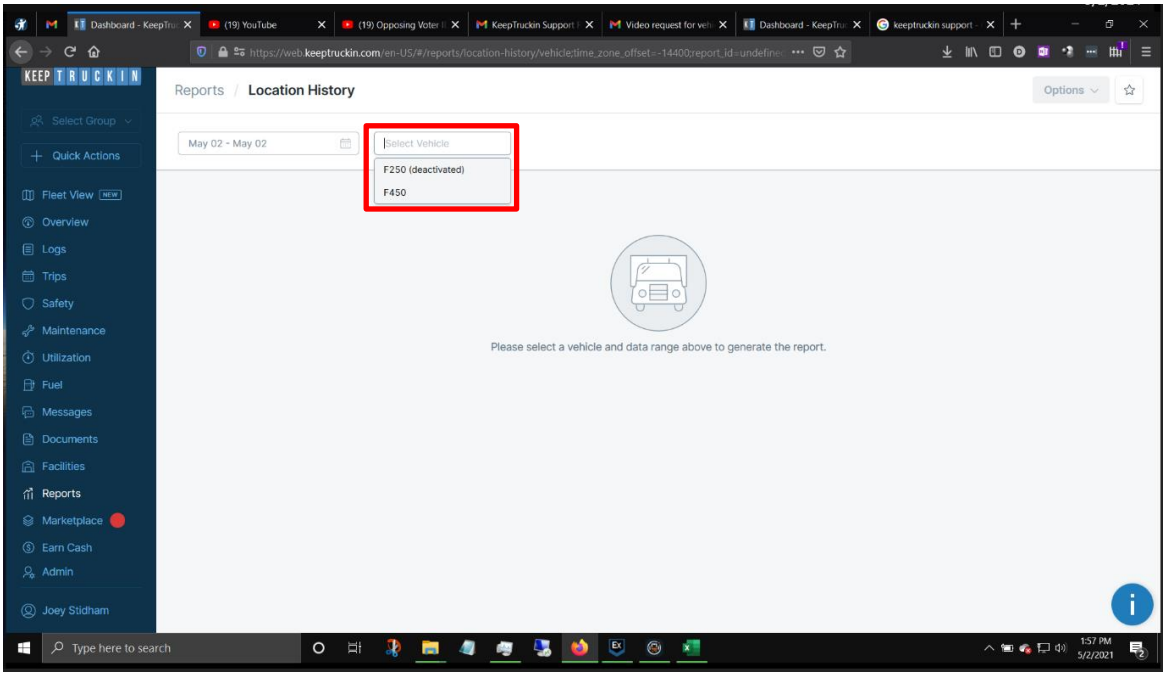
Second, choose the location history out of the various reports that populate the screen.

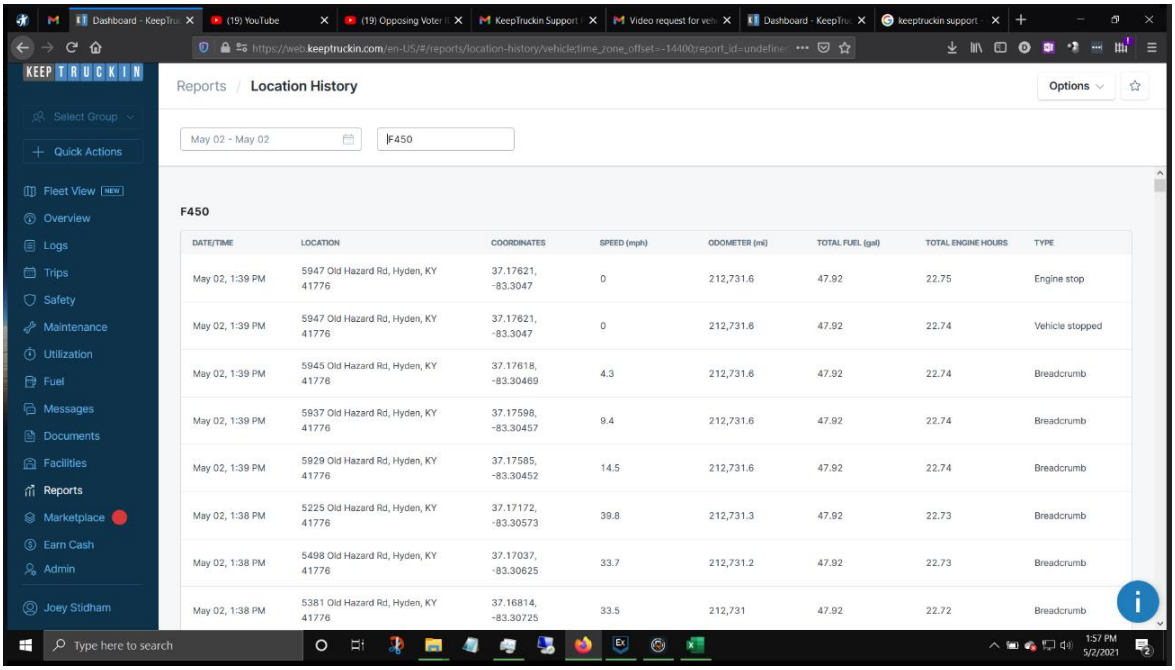


Third, select the time range and the vehicle that you are interested in. SRI only has one ELD device that is in the system.

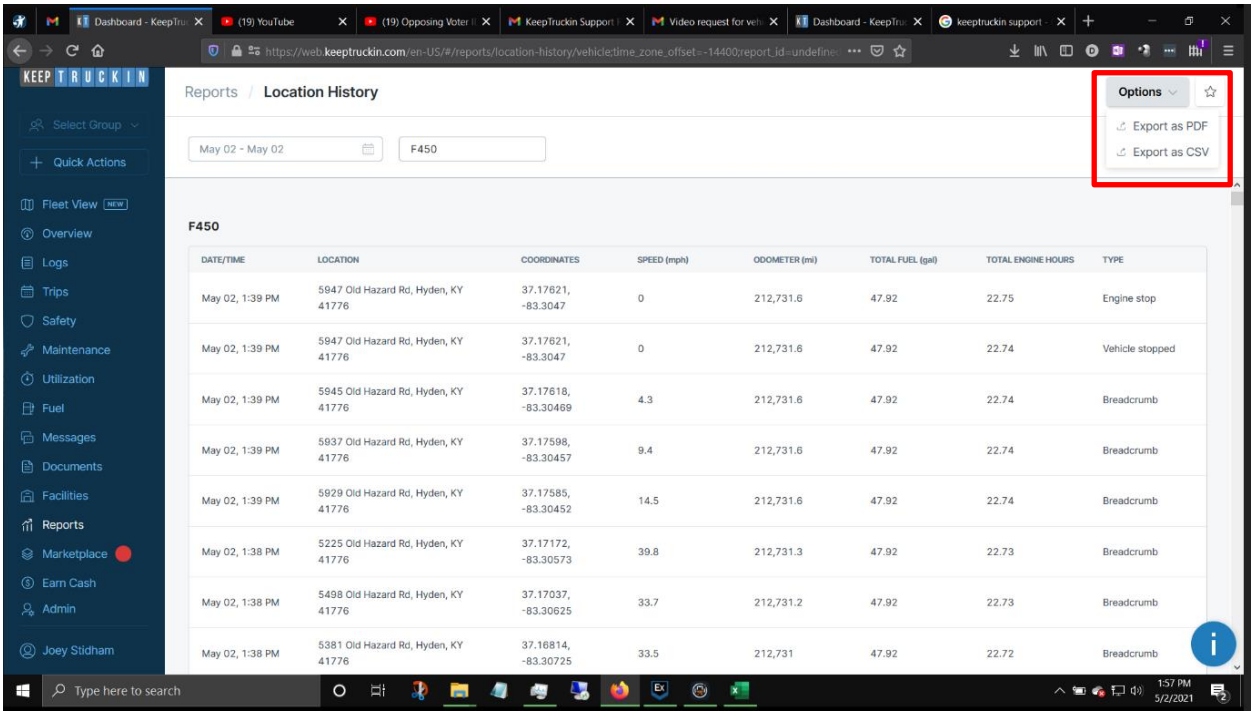


In 2017 SRI had a Ford F-250 that had the ELD system. That vehicle is still listed under the vehicle tab but is deactivated.


Reports / Location History
Options
May 02 - May 02
Select Vehicle
F250 (deactivated)
F450
Please select a vehicle and data range above to generate the report.
Fleet View
Overview
Logs
Trips
Safety
Maintenance
Utilization
Fuel
Messages
Documents
Facilities
Reports
Marketplace
Earn Cash
Admin
Joey Stidham


Reports / Location History
Options
May 02 - May 02
F450
F450
DATE/TIME | LOCATION | COORDINATES | SPEED (mph) | ODOMETER (mi) | TOTAL FUEL (gal) | TOTAL ENGINE HOURS | TYPE
May 02, 1:39 PM | 5947 Old Hazard Rd, Hyden, KY 41776 | 37.17621, -83.3047 | 0 | 212,731.6 | 47.92 | 22.75 | Engine stop
May 02, 1:39 PM | 5947 Old Hazard Rd, Hyden, KY 41776 | 37.17621, -83.3047 | 0 | 212,731.6 | 47.92 | 22.74 | Vehicle stopped
May 02, 1:39 PM | 5945 Old Hazard Rd, Hyden, KY 41776 | 37.17618, -83.30469 | 4.3 | 212,731.6 | 47.92 | 22.74 | Breadcrumb
May 02, 1:39 PM | 5937 Old Hazard Rd, Hyden, KY 41776 | 37.17598, -83.30457 | 9.4 | 212,731.6 | 47.92 | 22.74 | Breadcrumb
May 02, 1:39 PM | 5929 Old Hazard Rd, Hyden, KY 41776 | 37.17585, -83.30452 | 14.5 | 212,731.6 | 47.92 | 22.74 | Breadcrumb
May 02, 1:38 PM | 5225 Old Hazard Rd, Hyden, KY 41776 | 37.17172, -83.30573 | 39.8 | 212,731.3 | 47.92 | 22.73 | Breadcrumb
May 02, 1:38 PM | 5498 Old Hazard Rd, Hyden, KY 41776 | 37.17037, -83.30625 | 33.7 | 212,731.2 | 47.92 | 22.73 | Breadcrumb
May 02, 1:38 PM | 5381 Old Hazard Rd, Hyden, KY 41776 | 37.16814, -83.30725 | 33.5 | 212,731 | 47.92 | 22.72 | Breadcrumb

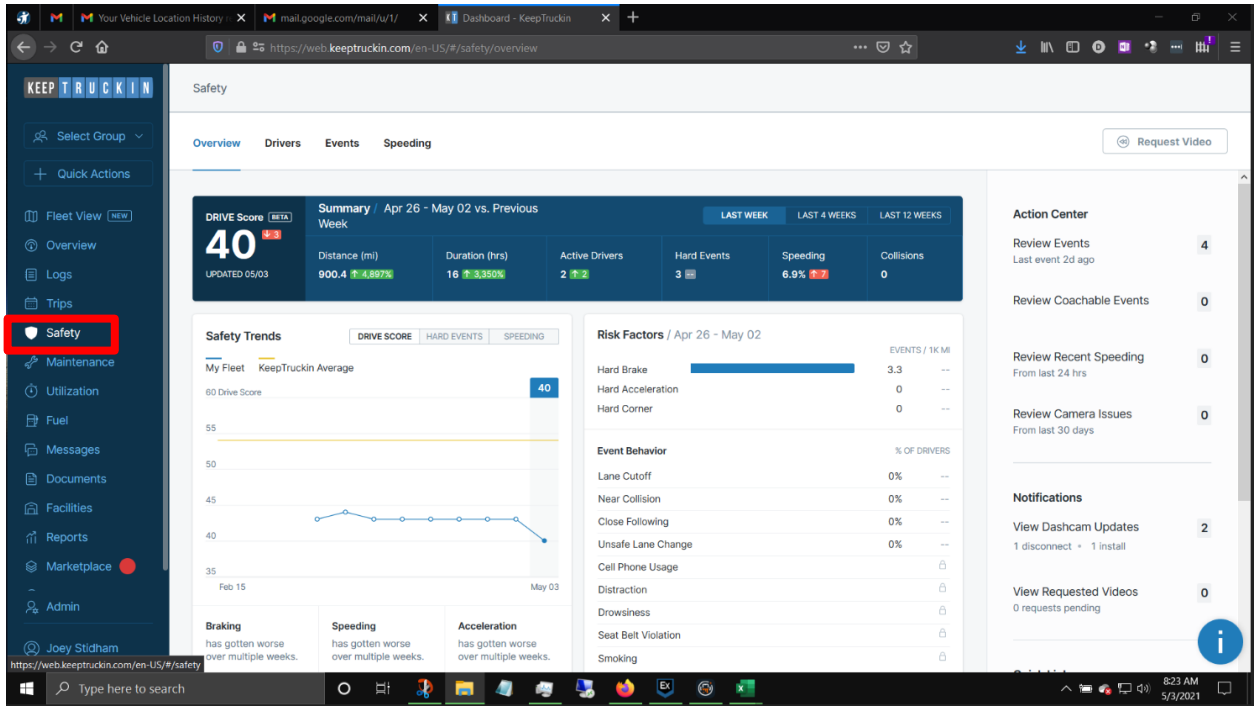
The data can be exported as a PDF or CSV file.



HARD BRAKE EVENT DATA

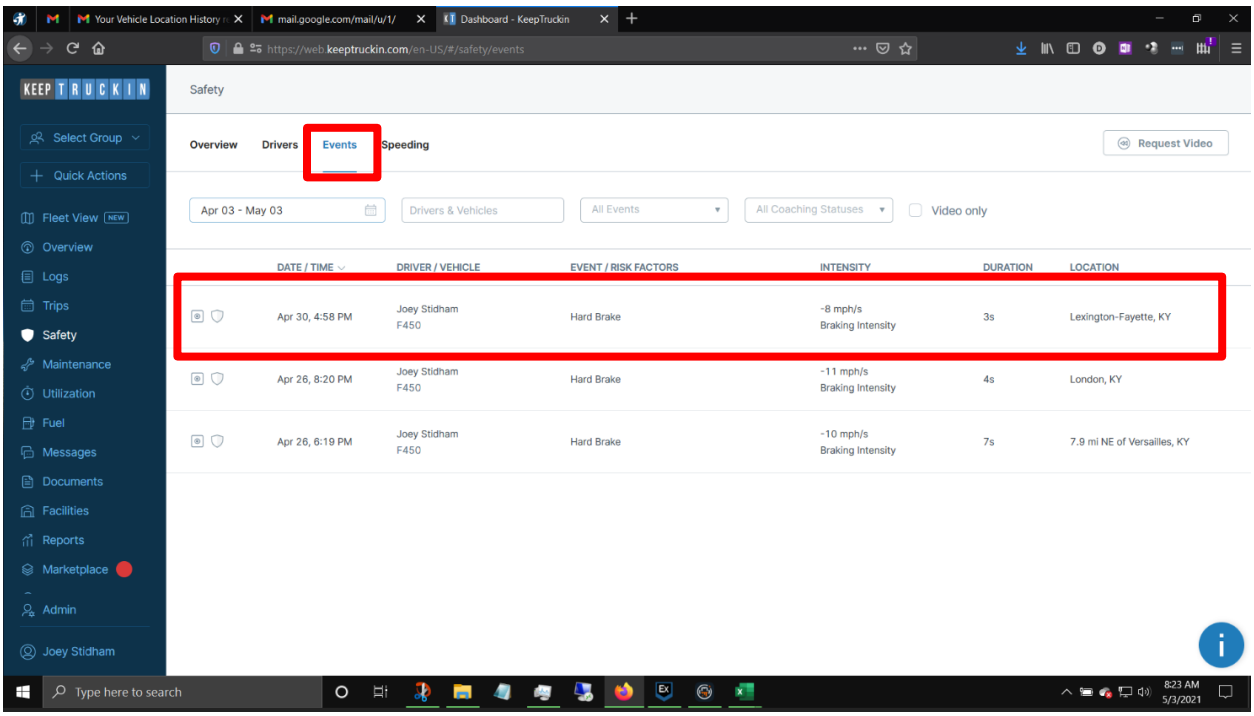
Keep Truckin captures and stores hard brake events. Our system is equipped with the Keep Truckin video camera. When a hard brake event occurs, the video, GPS data, speed, and time are automatically uploaded to the cloud and a warning is sent to the console. Keep Truckin makes it easy for the Motor Carrier and or Fleet Safety Manager to access this data in their console. The video from the event can be easily downloaded with the push of one button. The following are the steps to obtain this data from the console:

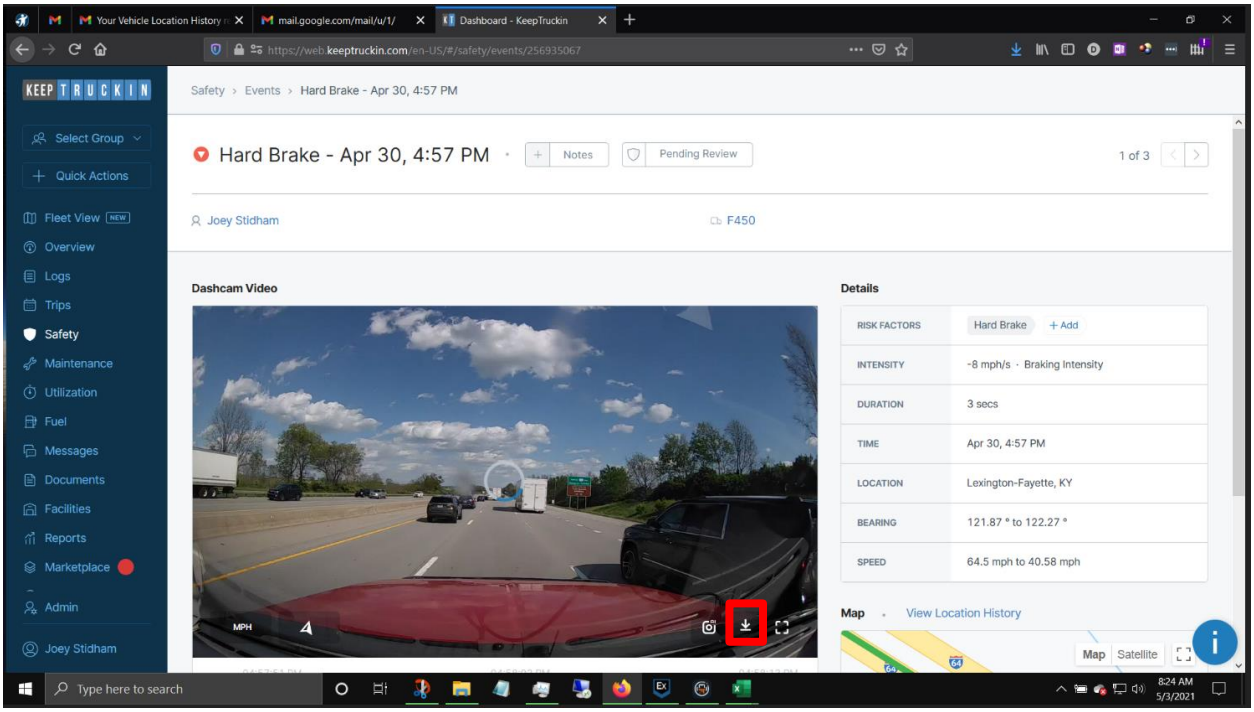
On the Keep Truckin portal home screen, in the left toolbar, click the Safety tab.



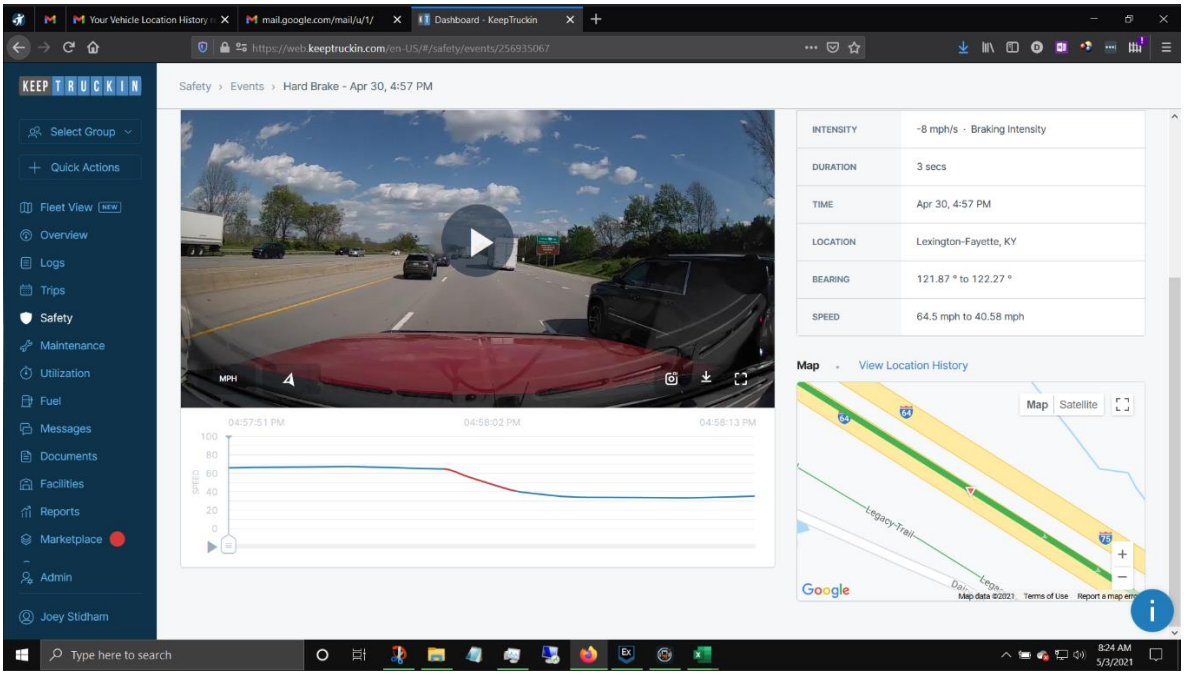
An overview screen will be shown. There are 4 options, Overview, Drivers, Events, Speeding.

Selecting 'Events' will show the events KeepTruckin deemed a safety risk. Below there are three (3) Hard Brake events shown. We selected event one, highlighted by the red box.

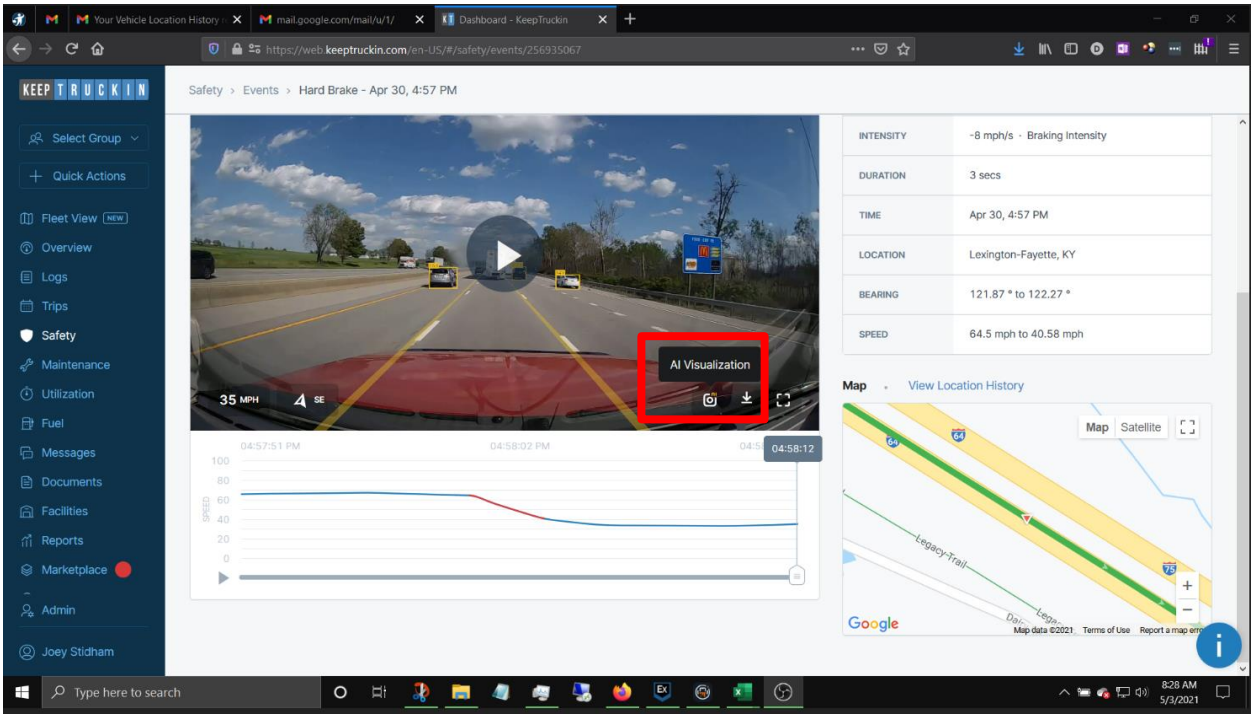




To download the video of this event, click on the download arrow highlighted by the red box.



This is the full screen of the event. The play button can be pushed on the video to watch the video. The time bar will follow the graph below the video.



By clicking the AI Visualization button, the time between your vehicle and the target vehicles will be displayed.

RESULTS

The testing performed by SRI on this system identified that the accuracy of the GPS is at or better than the 2.3 feet identified by the US Government Website for GPS accuracy. The time recorded by the GPS system is in real time and is obtained by the satellite systems and was consistent between the separate devices that were used. The KeepTruckin ELD obtains the speed of the truck from the ECM of the truck and embeds that speed in the bread crumb data. The mileage on the truck is also read by the ELD and is embedded in the bread crumb data. The capabilities of the KeepTruckin ELD are in compliance with FMCSR Appendix A to Subpart B of Part 395 – Functional Specifications for All Electronic Logging Devices (ELD's). In **4.2 ELD-Vehicle Interface** *(a) An ELD must be integrally synchronized with the engine of the CMV. Engine synchronization for purposes of ELD compliance means the monitoring of the vehicle's engine operation to automatically capture the engine's power status, vehicle's motion status, miles driven value, and engine hours value when the CMV's engine is powered.*[8]

The speeds that were documented by the ELD were compared to the Garmin drive cam that was obtaining speeds based solely from GPS data.

[8] FMCSR, Appendix A to Subpart B of Part 395, 4.2 ELD – Vehicle Interface

The KeepTruckin ELD would not let the operator make any changes to the system while the vehicle was in motion. This is also in compliance with Appendix A to Subpart B of Part 395 – Functional Specifications for All Electronic Logging Devices (ELD's). In **4.3.2. Driver's Manual Entries:**

(a) An ELD must prompt the driver to input information into the ELD only when the CMV is stationary and driver's duty status is not on-duty driving, except for the condition specified in section 4.4.1.2 of this appendix.

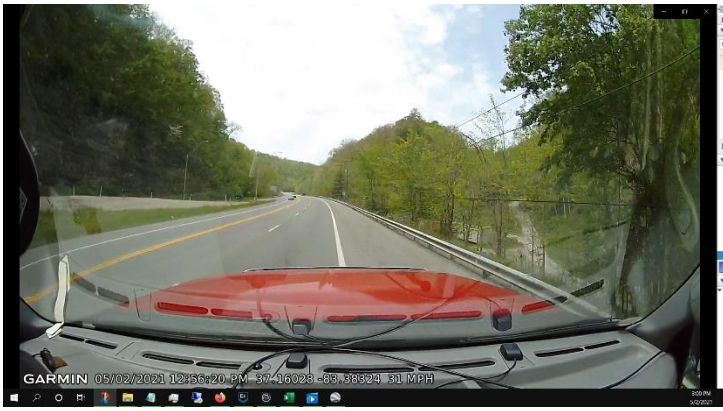
(b) If the driver's duty status is driving, an ELD must only allow the driver who is operating the CMV to change the driver's duty status to another duty status.

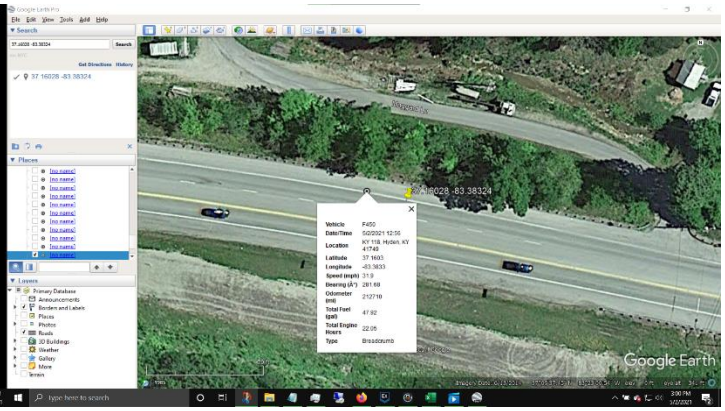
(c) A stopped vehicle must maintain zero (0) miles per hour speed to be considered stationary for purposes of information entry into an ELD[9].

DISCUSSION

To test the location accuracy of the GPS, SRI used a low volume section of roadway with excellent sight distance to perform testing. KY 118 is a roadway that has 10 feet wide paved shoulders that allowed us to perform this test safely. The truck was driven partially on the shoulder and partially on the road attempting to keep the ELD centered on the fog line. This test gave us a real-world landmark (the fog line) to determine the accuracy of the GPS in the left and right of the vehicle. Understanding that the GPS should ping approximately 30 seconds apart, with even more frequency as the bearing changed, we knew that we needed a sustained area to complete this test. The following are the GPS points plotted on a Google Earth map for this test as well as the corresponding frames of video from the Garmin 65W camera. The yellow pins on the following maps are the plotted GPS data for the Garmin drive camera, while the white circle with the black centers are the plotted data for the KeepTruckin ELD. The lat./long and speed is on the bottom of the Garmin screen capture while this data is in the white box for the KeepTruckin ELD.

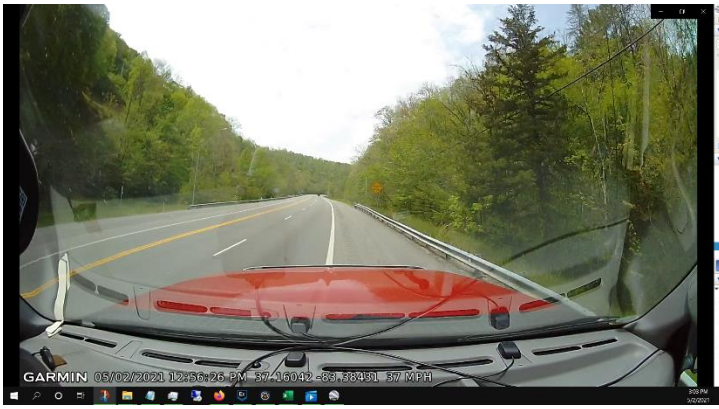
[9] FMCSR, Appendix A to Subpart B of Part 395, 4.3.2. Driver's Manual Entries

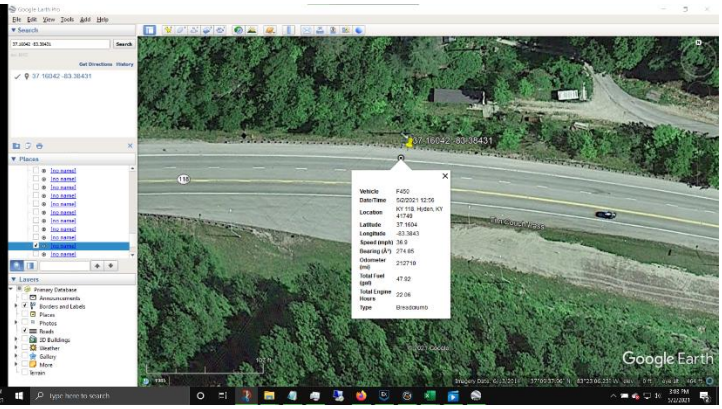




Garmin Dash Cam speed 31 mph

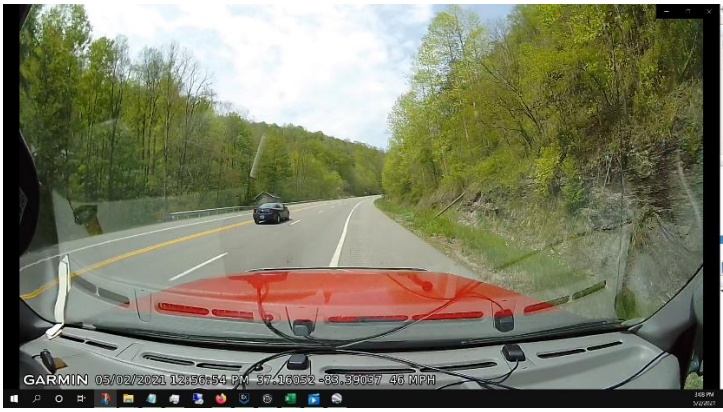
KeepTruckin speed 31.9 mph.

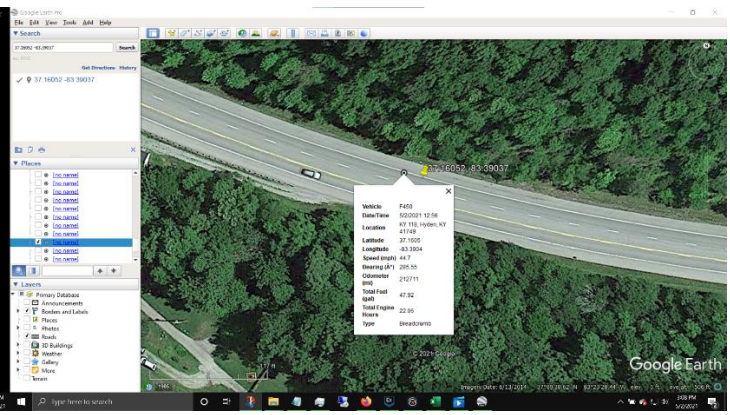




Garmin Dash Cam speed 37 mph

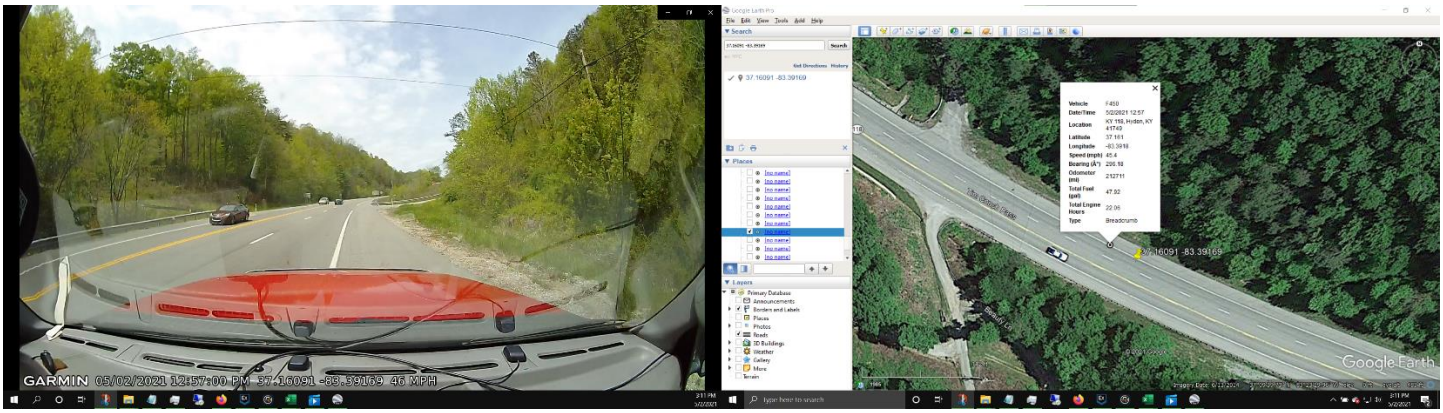
KeepTruckin speed 36.9 mph.



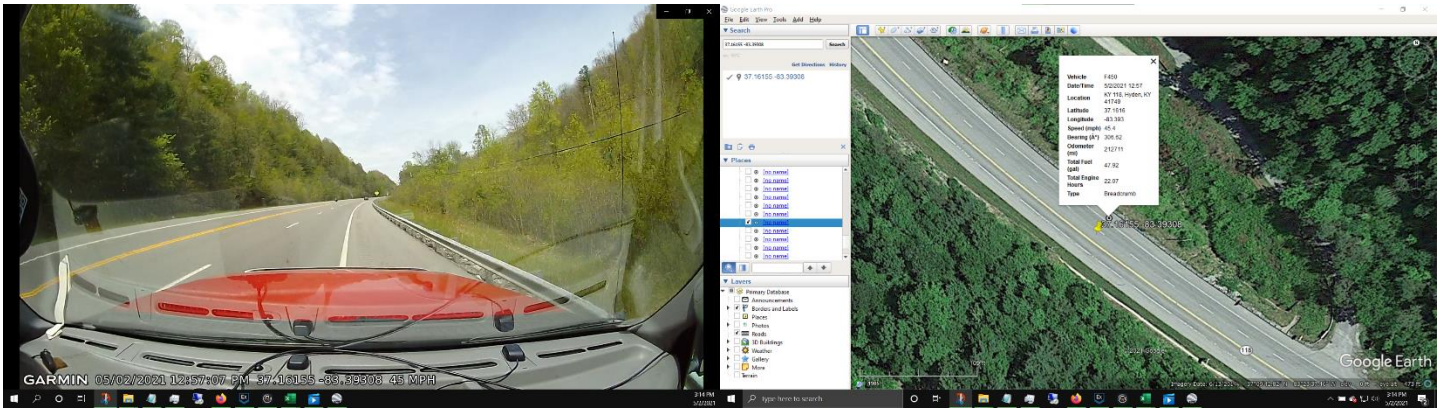


Garmin Dash Cam speed 46 mph

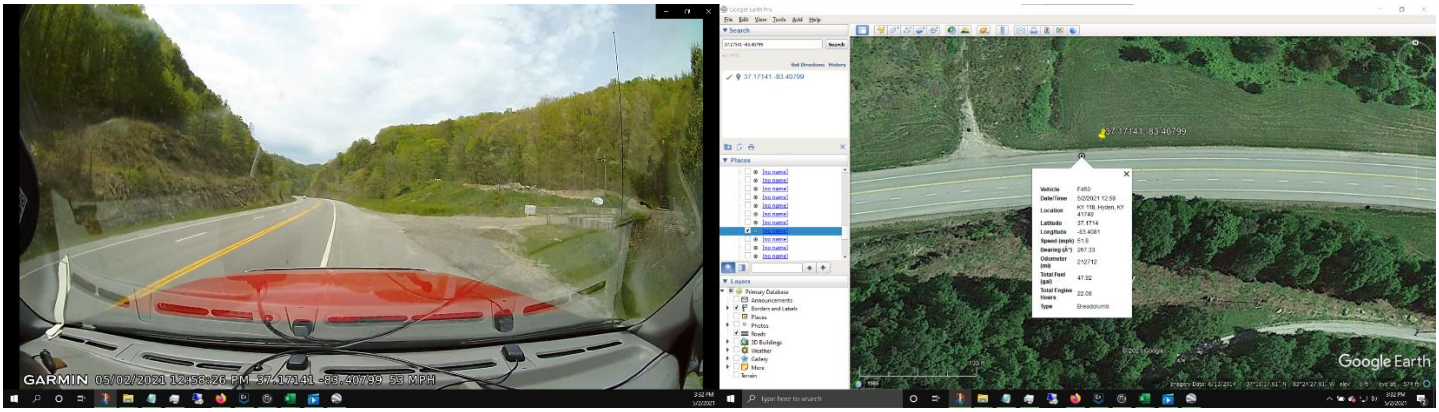
KeepTruckin speed 44.7 mph.



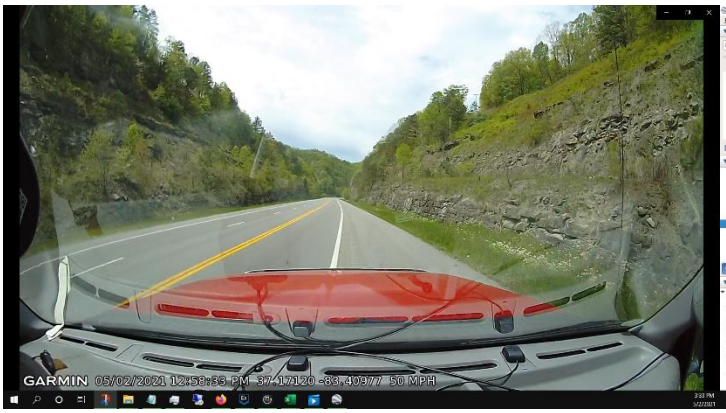
Garmin Dash Cam speed 46 mph KeepTruckin speed 45.4 mph.



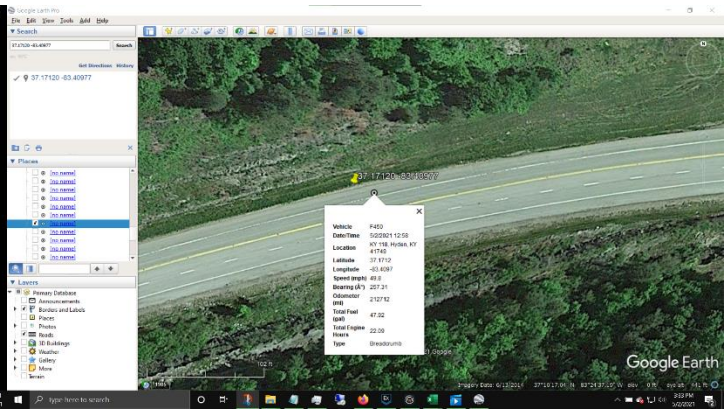
Garmin Dash Cam speed 45 mph KeepTruckin speed 45.4 mph.



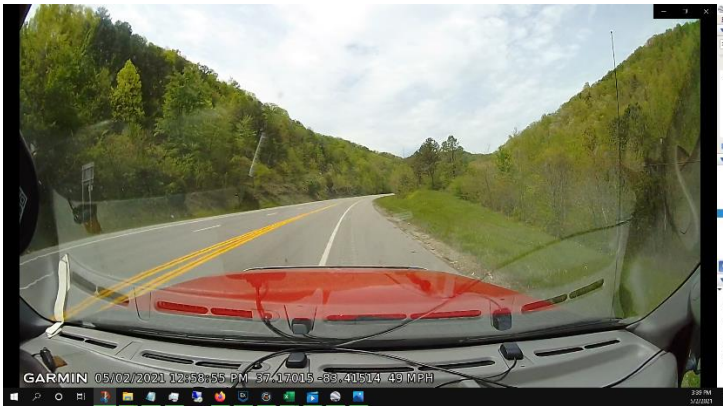
Garmin Dash Cam speed 53 mph KeepTruckin speed 51.8 mph.



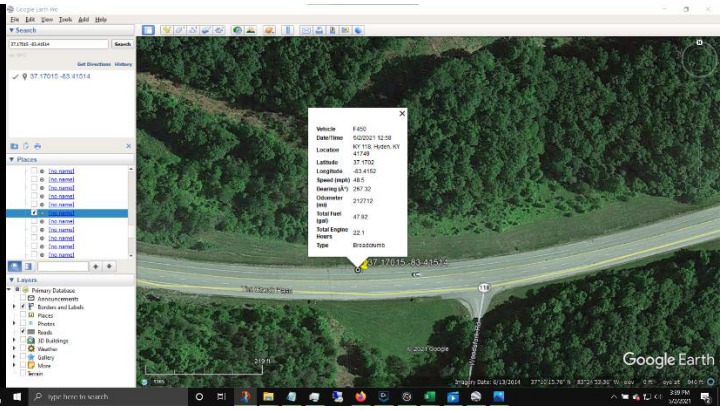
Garmin Dash Cam speed 50 mph



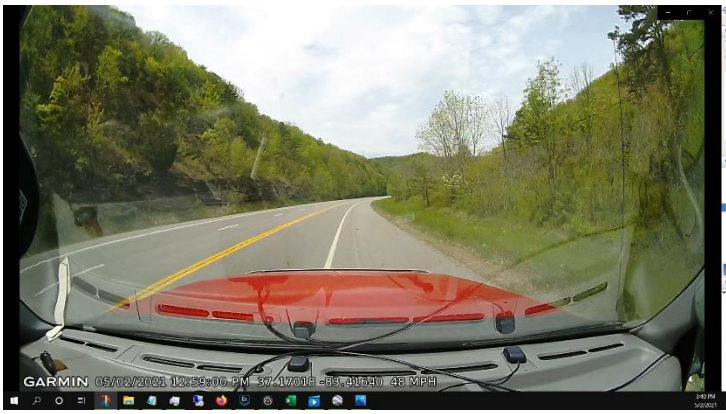
KeepTruckin speed 49.8 mph.



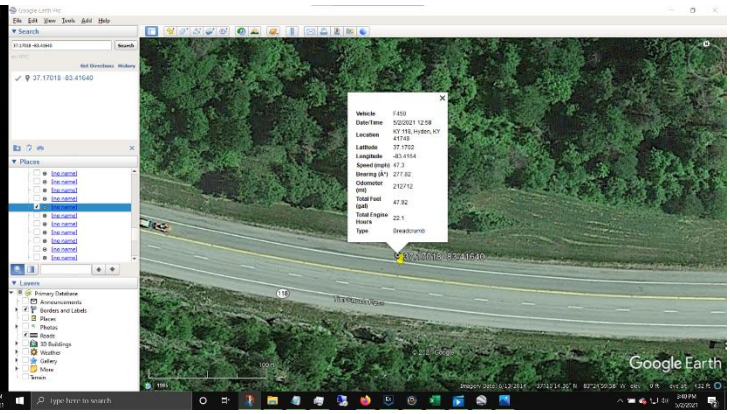
Garmin Dash Cam speed 49 mph



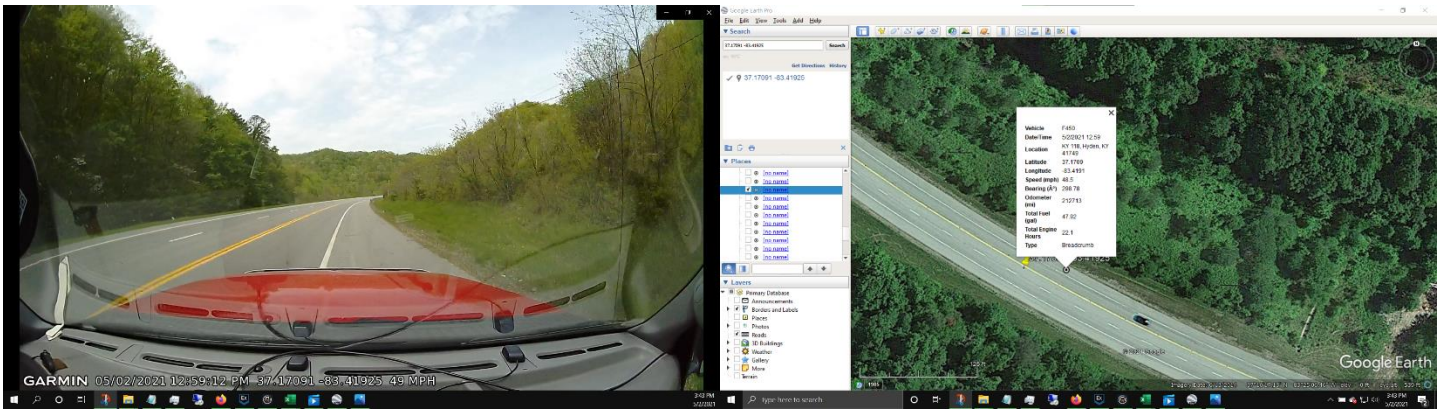
KeepTruckin speed 48.5 mph.



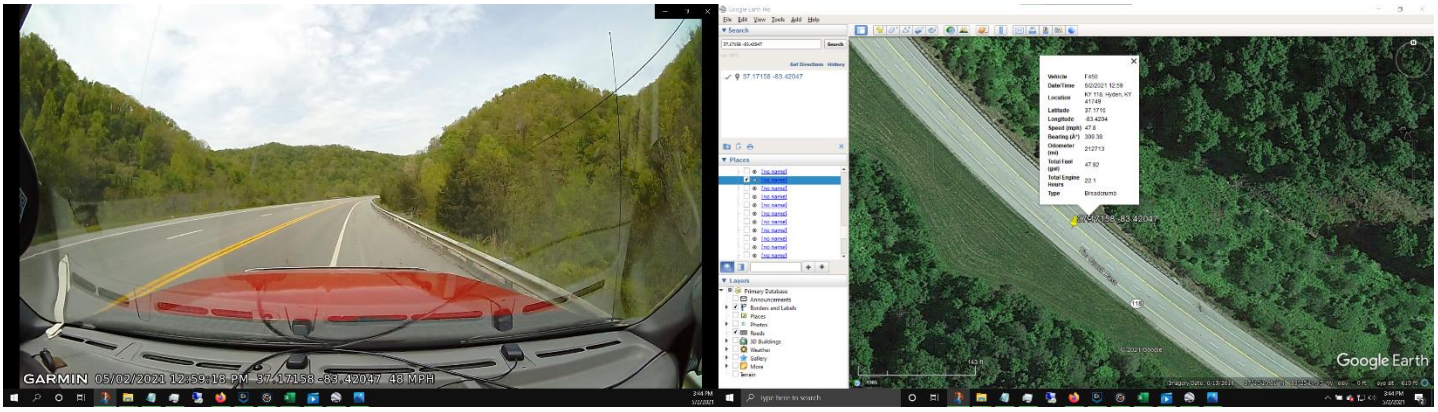
Garmin Dash Cam speed 48 mph



KeepTruckin speed 47.3 mph.

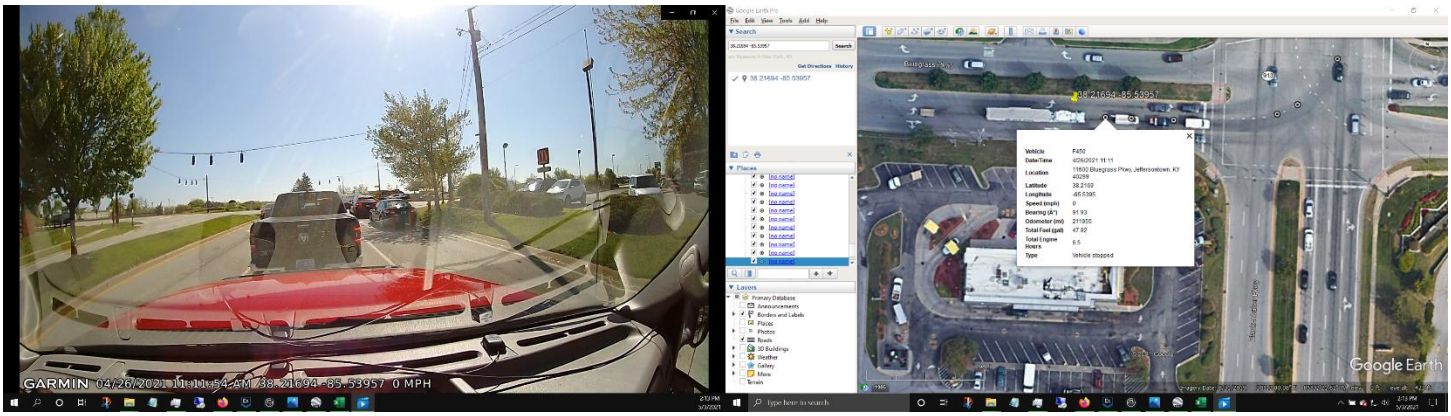


Garmin Dash Cam speed 49 mph KeepTruckin speed 48.5 mph.



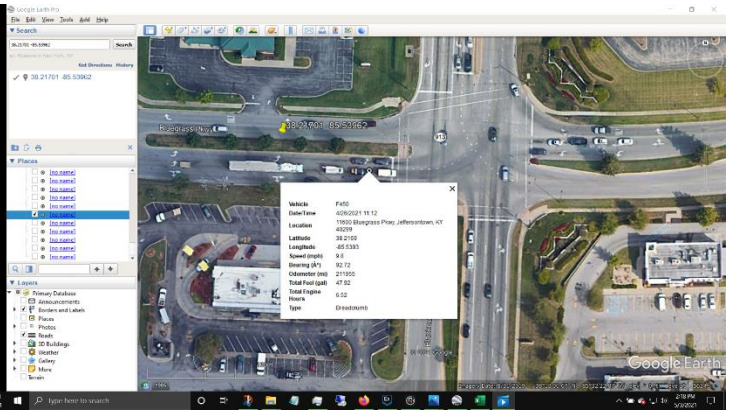
Garmin Dash Cam speed 48 mph KeepTruckin speed 47.8 mph.

SRI also analyzed data from driving. SRI wanted to identify if the data was accurate enough to determine lane usage.



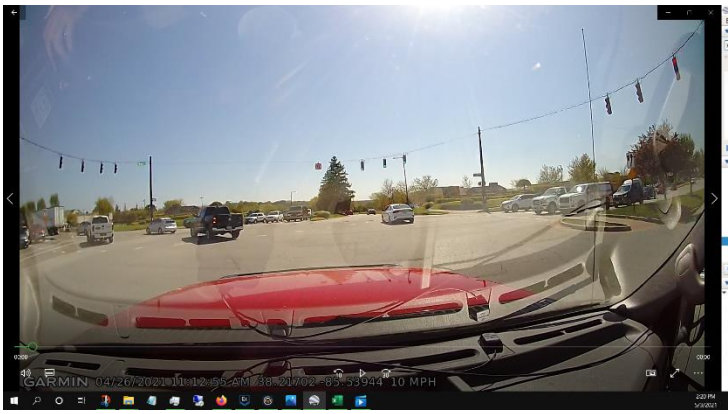
Garmin Dash Cam speed 0 mph

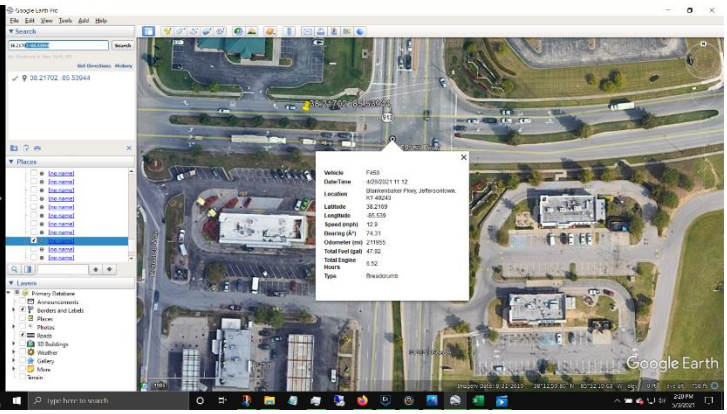
KeepTruckin speed 0 mph.



Garmin Dash Cam speed 7 mph

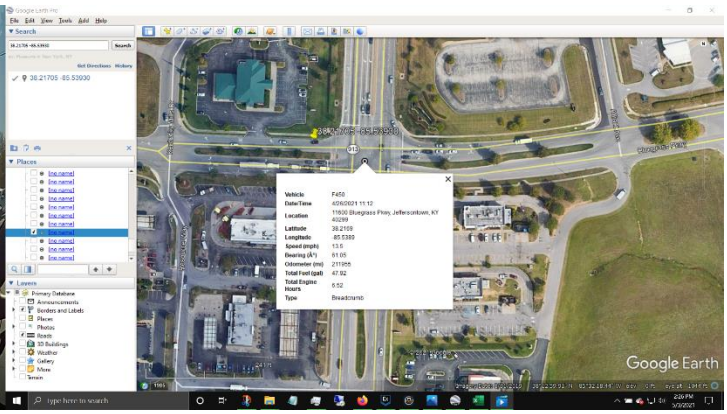
KeepTruckin speed 9.8 mph.





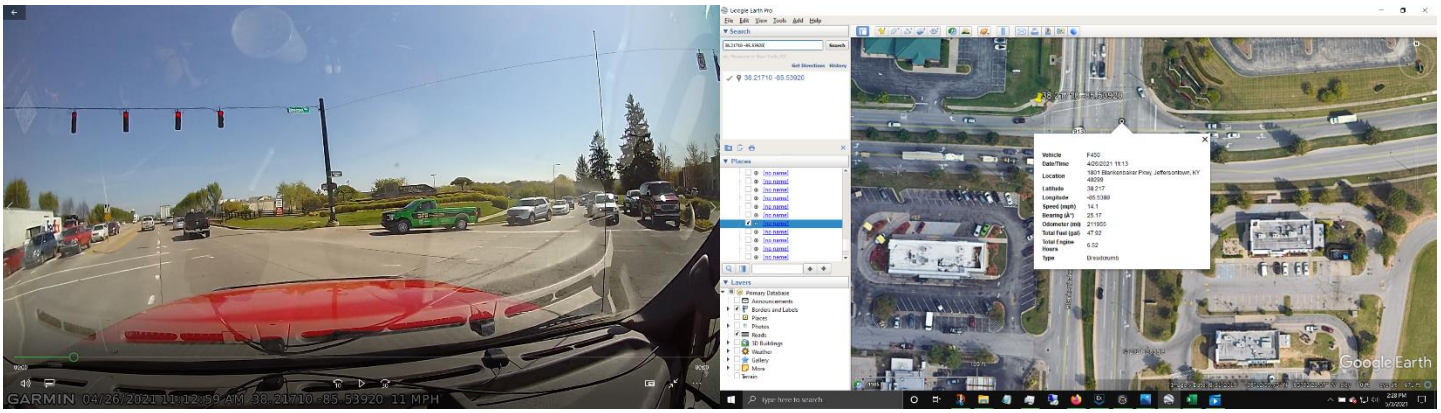
Garmin Dash Cam speed 10 mph

KeepTruckin speed 12.9 mph.

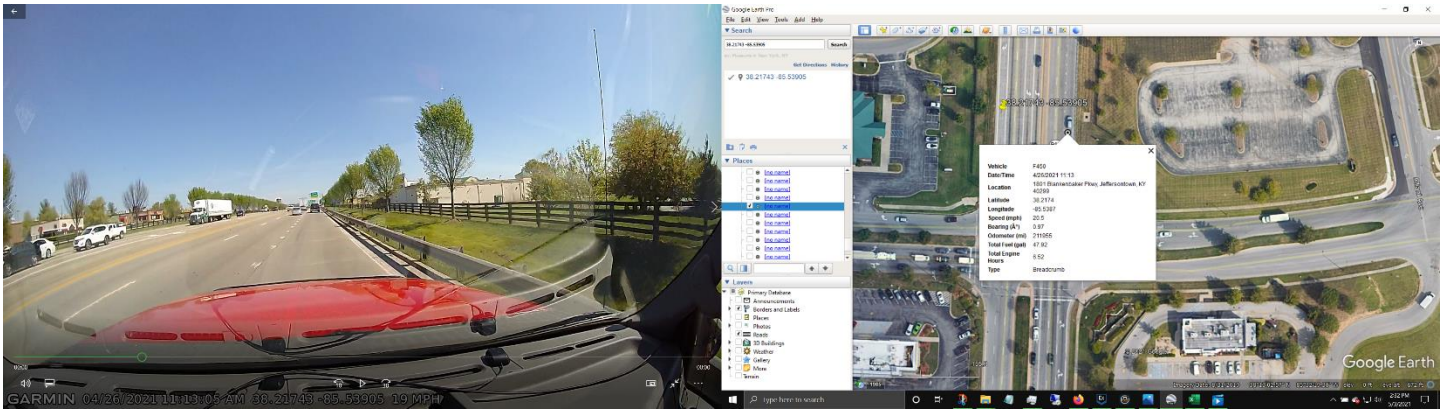


Garmin Dash Cam speed 11 mph

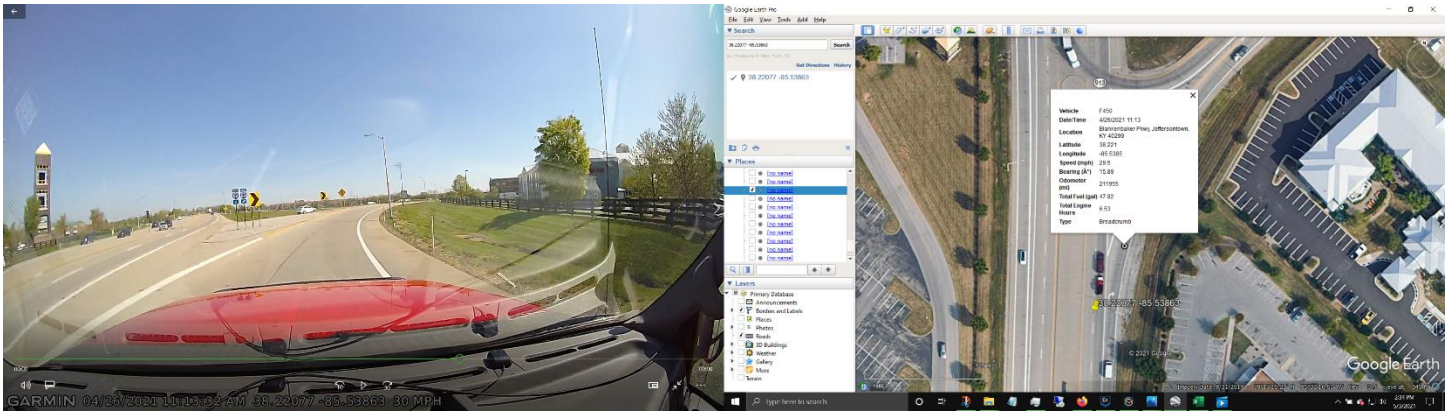
KeepTruckin speed 13.5 mph.



Garmin Dash Cam speed 11 mph KeepTruckin speed 14.1 mph.

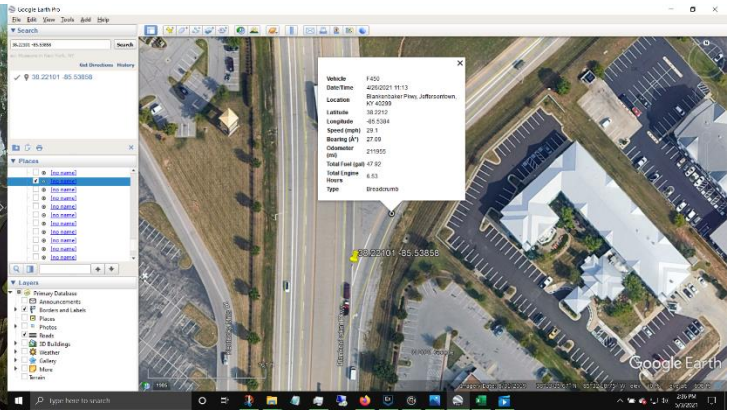


Garmin Dash Cam speed 19 mph KeepTruckin speed 20.5 mph.



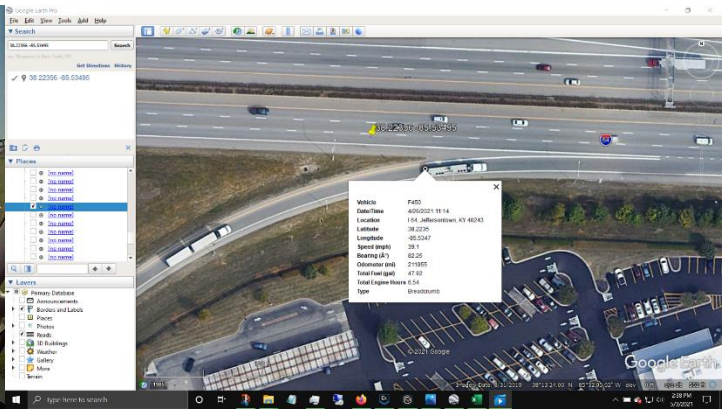
Garmin Dash Cam speed 30 mph KeepTruckin speed 29.5 mph.

Garmin Dash Cam speed 28 mph



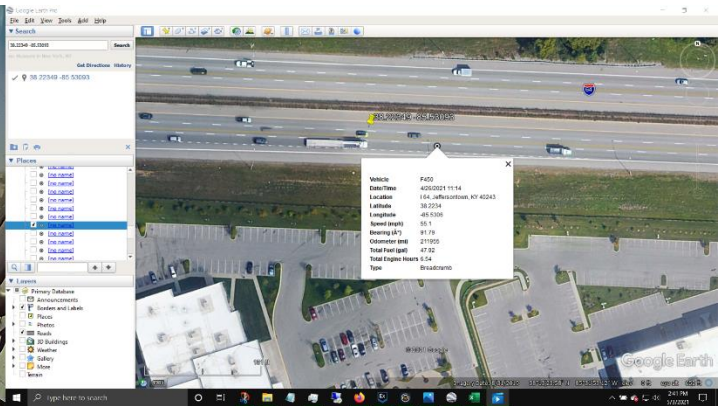
KeepTruckin speed 29.1 mph.

Garmin Dash Cam speed 40 mph

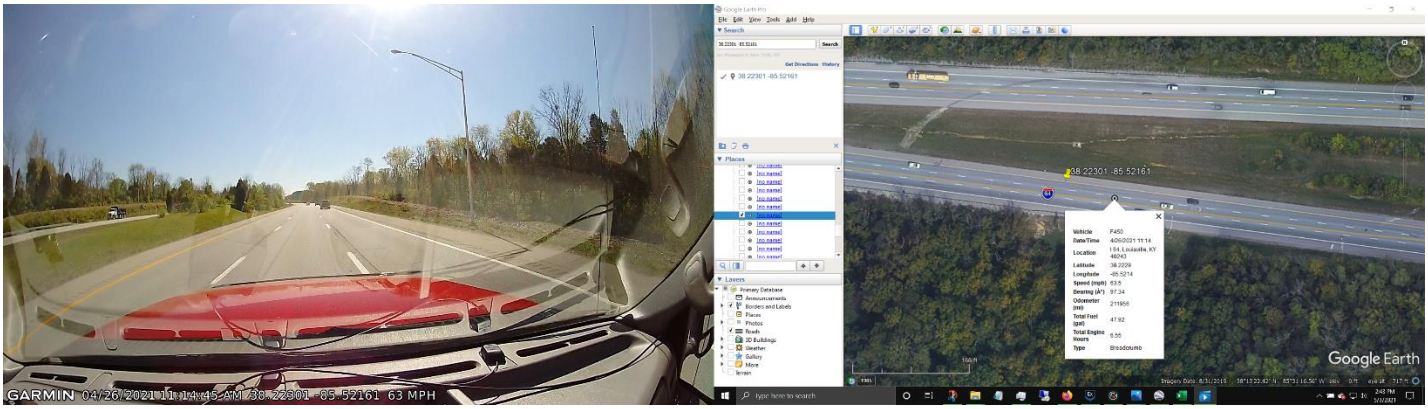


KeepTruckin speed 39.1 mph.

Garmin Dash Cam speed 55 mph



KeepTruckin speed 55.1 mph.



Garmin Dash Cam speed 63 mph KeepTruckin speed 63.5 mph.

The KeepTruckin ELD system was accurate at tracking the truck's location, lane position, and speed.

Further, SRI set up a test at the Clay County KY Industrial Park where traffic cones were set at 100 feet increments. The antenna of the ELD was aligned with cone one and pulled to cone two aligning the ELD antenna as close as possible to the cone before stopping. SRI wanted to see just how precisely the GPS would measure a known distance. Eight tests were performed, and the GPS points were plotted on Google Earth. The distances were measured from each 0-mph point. The following chart identifies the results of each individual test:

Test #	Measured Distance
1.	101.57
2.	98.9
3.	103.67
4.	98.42
5.	107.62
6.	101.35
7.	98.6
8.	98.31

Average distance traveled during testing = 101.05 feet This is 1.05 feet over the measured intervals of 100 feet.

Note: All documented data is attached in appendix C.

Technical Issues

SRI did identify a system error with KeepTruckin ELD. During the first tests at times the ELD system apparently disconnected from the truck ECM while driving and recorded 0 mph in the speed readings in the bread crumb data and showed that the truck was stationary on the ELD screen. However, at the data points where a 0-mph reading was found in the bread crumb data, the GPS lat./long data kept tracking the truck accurately as were the time stamps for the GPS data. After several discussions with Keep Truckin's technical support, it was determined that the cable they had provided was causing the issues. KeepTruckin sent a new cable to connect the ELD to the OBDII port and that fixed the issue.

Conclusions

As can be seen, during good weather conditions the GPS data as documented by the KeepTruckin ELD in this test, was at or better than the user range error (URE) of 2.3 feet as stated by the US Government in their study in 2016.[10]

The speed data received from the ECM of the test vehicle was also found to be exceptionally reliable as compared to the independent speed data from the Garmin GPS.

SRI identified the GPS data, speed, time, and mileage as documented on the bread crumb data is exceptionally reliable for the placement of the vehicle during good weather conditions.

Consideration should be given to situations where a weather event is occurring when using the GPS data to place a vehicle. However, the speed, mileage and time readings in the bread crumb data do not appear to be affected by weather as these datapoints are received from the vehicle's ECM and ELD.

As discussed, Motor Carriers and Fleet Safety Managers can easily access the vehicle history and hard brake data for any of their vehicles through the KeepTruckin Portal.

This completed 30-day study of the KeepTruckin ELD system by SRI has confirmed what was already believed. The system not only is in compliance with the regulations of the Federal Motor Carrier Safety Administration but in many aspects far exceeds the minimum specifications required.

[10] https://www.gps.gov/systems/gps/performance/accuracy/

Appendix A:

FMCSR Rules for data

The ELD systems are required by the Federal Motor Carrier Safety Regulations. The following are the rules on how and where ELD's are required to obtain their data.

§395.15 Automatic on-board recording devices.

(i) *Performance of recorders.* Motor carriers that use automatic on-board recording devices for recording their drivers' records of duty status shall ensure that:

(2) The automatic on-board recording device permits duty status to be updated only when the commercial motor vehicle is at rest, except when registering the time, a commercial motor vehicle crosses a State boundary;

§395.26 ELD data automatically recorded.

(a) *In general.* An ELD provides the following functions and automatically records the data elements listed in this section in accordance with the requirements contained in appendix A to subpart B of this part.

(b) *Data automatically recorded.* The ELD automatically records the following data elements:

(1) Date;

(2) Time;

(3) CMV geographic location information;

(4) Engine hours;

(5) Vehicle miles;

(6) Driver or authenticated user identification data;

(7) Vehicle identification data; and

(8) Motor carrier identification data.

4.2. ELD-Vehicle Interface

(a) An ELD must be integrally synchronized with the engine of the CMV. Engine synchronization for purposes of ELD compliance means the monitoring of the vehicle's engine operation to automatically capture the engine's power status, vehicle's motion status, miles driven value, and engine hours value when the CMV's engine is powered.

(b) An ELD used while operating a CMV that is a model year 2000 or later model year, as indicated by the vehicle identification number (VIN), that has an engine electronic control module (ECM) must establish a link to the engine ECM when the CMV's engine is powered and receive automatically the engine's power status, vehicle's motion status, miles driven value, and engine hours value through the serial or Control Area Network communication protocols supported by the engine ECM or the vehicle's databus. If the vehicle does not have an ECM, an ELD may use alternative sources to obtain or estimate these vehicle parameters with the listed accuracy requirements under section 4.3.1 of this appendix.

4.3.1.1. Engine Power Status

An ELD must be powered and become fully functional within 1 minute of the vehicle's engine receiving power and must remain powered for as long as the vehicle's engine stays powered.

4.3.1.2. Vehicle Motion Status

(a) An ELD must automatically determine whether a CMV is in motion or stopped by comparing the vehicle speed information with respect to a set speed threshold as follows:

(1) Once the vehicle speed exceeds the set speed threshold, it must be considered in motion.

(2) Once in motion, the vehicle must be considered in motion until its speed falls to 0 miles per hour and stays at 0 miles per hour for 3 consecutive seconds. Then, the vehicle will be considered stopped.

(3) An ELD's set speed threshold for determination of the in-motion state for the purpose of this section must not be configurable to greater than 5 miles per hour.

(b) If an ELD is required to have a link to the vehicle's engine ECM, vehicle speed information must be acquired from the engine ECM or the vehicle's databus. Otherwise, vehicle speed information must be acquired using an independent source apart from the positioning services described under section 4.3.1.6 of this appendix and must be accurate within ±3 miles per hour of the CMV's true ground speed for purposes of determining the in-motion state for the CMV.

4.3.1.3. Vehicle Miles

(a) An ELD must monitor vehicle miles as accumulated by a CMV over the course of an ignition power on cycle (accumulated vehicle miles) and over the course of CMV's operation (total vehicle miles). Vehicle miles information must use or must be converted to units of whole miles.

(b) If the ELD is required to have a link to the vehicle's engine ECM as specified in section 4.2 of this appendix:

(1) The ELD must monitor the odometer message broadcast on the engine ECM or the vehicle's databus and use it to log total vehicle miles information; and

(2) The ELD must use the odometer message to determine accumulated vehicle miles since engine's last power on instance.

(c) If the ELD is not required to have a link to the vehicle's engine ECM as specified in section 4.2 of this appendix, the accumulated vehicle miles indication must be obtained or estimated from a source that is accurate to within ±10% of miles accumulated by the CMV over a 24-hour period as indicated on the vehicle's odometer display.

4.3.1.4. Engine Hours

(a) An ELD must monitor engine hours of the CMV over the course of an ignition power on cycle (elapsed engine hours) and over the course of the total engine hours of the CMV's operation. Engine hours must use or must be converted to hours in intervals of a tenth of an hour.

(b) If an ELD is required to have a link to the vehicle's engine ECM, the ELD must monitor the total engine hours message broadcast on the engine ECM or the vehicle's databus and use it to log total engine hours information. Otherwise, engine hours must be obtained or estimated from a source that monitors the ignition power of the CMV and must be accurate within ±0.1 hour of the engine's total operation within a given ignition power on cycle.

4.3.1.5. Date and Time

(a) The ELD must obtain and record the date and time information automatically without allowing any external input or interference from a motor carrier, driver, or any other person.

(b) The ELD time must be synchronized to Coordinated Universal Time (UCT) and the absolute deviation from UCT must not exceed 10 minutes at any point in time.

4.3.1.6. CMV Position

(a) An ELD must determine automatically the position of the CMV in standard latitude/longitude coordinates with the accuracy and availability requirements of this section.

(b) The ELD must obtain and record this information without allowing any external input or interference from a motor carrier, driver, or any other person.

(c) CMV position measurement must be accurate to ±0.5 mile of absolute position of the CMV when an ELD measures a valid latitude/longitude coordinate value.

(d) Position information must be obtained in or converted to standard signed latitude and longitude values and must be expressed as decimal degrees to hundreds of a degree precision (*i.e.*, a decimal point and two decimal places).

(e) Measurement accuracy combined with the reporting precision requirement implies that position reporting accuracy will be on the order of ±1mile of absolute position of the CMV during the course of a CMV's commercial operation.

(f) During periods of a driver's indication of personal use of the CMV, the measurement reporting precision requirement is reduced to tenths of a degree (*i.e.*, a decimal point and single decimal place) as further specified in section 4.7.3 of this appendix.

(g) An ELD must be able to acquire a valid position measurement at least once every 5 miles of driving; however, the ELD records CMV location information only during ELD events as specified in section 4.5.1 of this appendix.

4.3.2. Driver's Manual Entries

(a) An ELD must prompt the driver to input information into the ELD only when the CMV is stationary and driver's duty status is not on-duty driving, except for the condition specified in section 4.4.1.2 of this appendix.

(b) If the driver's duty status is driving, an ELD must only allow the driver who is operating the CMV to change the driver's duty status to another duty status.

(c) A stopped vehicle must maintain zero (0) miles per hour speed to be considered stationary for purposes of information entry into an ELD.

(d) An ELD must allow an authenticated co-driver who is not driving, but who has logged into the ELD prior to the vehicle being in motion, to make entries over his or her own records when the vehicle is in motion. The ELD must not allow co-drivers to switch driving roles when the vehicle is in motion.

4.4.1.1. Automatic Setting of Duty Status to Driving

An ELD must automatically record driving time when the vehicle is in motion by setting duty status to driving for the driver unless, before the vehicle is in motion, the driver:

(a) Sets the duty status to off-duty and indicates personal use of CMV, in which case duty status must remain off-duty until driver's indication of the driving condition ends; or

(b) Sets the duty status to on-duty not driving and indicates yard moves, in which case duty status must remain on-duty not driving until driver's indication of the driving condition ends.

4.4.3. Date and Time Conversions

(a) An ELD must have the capability to convert and track date and time captured in UTC standard to the time standard in effect at driver's home terminal, taking the daylight savings time changes into account by using the parameter “Time Zone Offset from UTC” as specified in section 7.41 of this appendix.

(b) An ELD must record the driver's record of duty status using the time standard in effect at the driver's home terminal for a 24-hour period beginning with the time specified by the motor carrier for that driver's home terminal.

(c) The data element “Time Zone Offset from UTC” must be included in the “Driver's Certification of Own Records” events as specified in section 4.5.1.4 of this appendix.

We identified that the KeepTruckin Drive camera stores approximately 64 GB of video and can be easily accessible using the following steps:

4.6.1.2. Engine Synchronization Compliance Monitoring

(a) An ELD must monitor the data it receives from the engine ECM or alternative sources as allowed in sections 4.3.1.1-4.3.1.4 of this appendix, its onboard sensors, and data record history to identify instances and durations of its non-compliance with the ELD engine synchronization requirement specified in section 4.2.

(b) An ELD required to establish a link to the engine ECM as described in section 4.2 must monitor its connectivity to the engine ECM and its ability to retrieve the vehicle parameters described under section 4.3.1 of this appendix and must record an engine-synchronization data diagnostics event when it no longer can acquire updated values for the ELD parameters required for records within 5 seconds of the need.

(c) An ELD must set an engine synchronization compliance malfunction if connectivity to any of the required data sources specified in section 4.3.1 of this appendix is lost for more than 30 minutes during a 24-hour period aggregated across all driver profiles, including the unidentified driver profile.

4.6.1.3. Timing Compliance Monitoring

The ELD must periodically cross-check its compliance with the requirement specified in section 4.3.1.5 of this appendix with respect to an accurate external UTC source and must record a timing compliance malfunction when it can no longer meet the underlying compliance requirement.

4.6.1.4. Positioning Compliance Monitoring

(a) An ELD must continually monitor the availability of valid position measurements meeting the listed accuracy requirements in section 4.3.1.6 of this appendix and must track the distance and elapsed time from the last valid measurement point.

(b) ELD records requiring location information must use the last valid position measurement and include the latitude/longitude coordinates and distance traveled, in miles, since the last valid position measurement.

(c) An ELD must monitor elapsed time during periods when the ELD fails to acquire a valid position measurement within 5 miles of the CMV's movement. When such elapsed time exceeds a cumulative 60 minutes over a 24-hour period, the ELD must set and record a positioning compliance malfunction.

(d) If a new ELD event must be recorded at an instance when the ELD had failed to acquire a valid position measurement within the most recent elapsed 5 miles of driving, but the ELD has not yet set a positioning compliance malfunction, the ELD must record the character “X” in both the latitude and longitude fields, unless location is entered manually by the driver, in which case it must log the character “M” instead. Under the circumstances listed in this paragraph, if the ELD event is due to a change in duty status for the driver, the ELD must prompt the driver to enter location manually in accordance with section 4.3.2.7 of this appendix. If the driver does not enter the location information and the vehicle is in motion, the ELD must record a missing required data element data diagnostic event for the driver.

(e) If a new ELD event must be recorded at an instance when the ELD has set a positioning compliance malfunction, the ELD must record the character “E” in both the latitude and longitude fields regardless of whether the driver is prompted and manually enters location information.

Appendix B:

FHWA vehicle classification definitions

Class Group	Class Definition	Class Includes	Number of Axles
1	Motorcycles	Motorcycles	2
2	Passenger Cars	All cars Cars with one-axle trailers Cars with two-axle trailers	2, 3, or 4
3	Other Two-Axle Four-Tire Single-Unit Vehicles	Pick-ups and vans Pick-ups and vans with one- and two- axle trailers	2, 3
4	Buses	Two- and three-axle buses	2 or 3
5	Two-Axle, Six-Tire, Single-Unit Trucks	Two-axle trucks	2
6	Three-Axle Single-Unit Trucks	Three-axle trucks Three-axle tractors without trailers	3
7	Four or More Axle Single-Unit Trucks	Four-, five-, six- and seven-axle single-unit trucks	4 or more
8	Four or Fewer Axle Single-Trailer Trucks	Two-axle trucks pulling one- and two-axle trailers Two-axle tractors pulling one- and two-axle trailers Three-axle tractors pulling one-axle trailers	3 or 4
9	Five-Axle Single-Trailer Trucks	Two-axle tractors pulling three-axle trailers Three-axle tractors pulling two-axle trailers Three-axle trucks pulling two-axle trailers	5
10	Six or More Axle Single-Trailer Trucks	Multiple configurations	6 or more
11	Five or Fewer Axle Multi-Trailer Trucks	Multiple configurations	4 or 5
12	Six-Axle Multi-Trailer Trucks	Multiple configurations	6
13	Seven or More Axle Multi-Trailer Trucks	Multiple configurations	7 or more
14	Unused	----	----
15	Unclassified Vehicle	Multiple configurations	2 or more

Appendix C:

Distance Test 1

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel (gal)	Total Engine Hours	Type
F450	5/3/2021 16:42	Clay-Leslie	37.14718	-83.6561	0	211.73	212906.19	47.92	28.4	Vehicle stopped
F450	5/3/2021 16:42	Clay-Leslie	37.14718	-83.6561	0.1	211.77	212906.19	47.92	28.4	Breadcrumb
F450	5/3/2021 16:42	Clay-Leslie	37.14718	-83.6561	1.6	211.65	212906.19	47.92	28.4	Breadcrumb
F450	5/3/2021 16:42	Clay-Leslie	37.14724	-83.6561	15.7	211.92	212906.18	47.92	28.4	Breadcrumb
F450	5/3/2021 16:42	Clay-Leslie	37.14729	-83.6561	8.2	212.23	212906.17	47.92	28.4	Vehicle moving
F450	5/3/2021 16:41	Clay-Leslie	37.14741	-83.6559	0	211.99	212906.17	47.92	28.38	Vehicle stopped

Distance Test 2

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel	Total Engine Hours	Type
F450	5/3/2021 16:44	Clay-Leslie	37.14695	-83.6563	0	212.55	212906.2	47.92	28.43	Vehicle stopped
F450	5/3/2021 16:44	Clay-Leslie	37.14695	-83.6563	0.3	212.52	212906.2	47.92	28.43	Breadcrumb
F450	5/3/2021 16:44	Clay-Leslie	37.14695	-83.6563	4.2	212.51	212906.2	47.92	28.43	Breadcrumb
F450	5/3/2021 16:44	Clay-Leslie	37.14703	-83.6562	15.3	212.69	212906.2	47.92	28.43	Breadcrumb
F450	5/3/2021 16:44	Clay-Leslie	37.14709	-83.6562	6.4	212.47	212906.19	47.92	28.43	Vehicle moving
F450	5/3/2021 16:42	Clay-Leslie	37.14718	-83.6561	0	211.73	212906.19	47.92	28.4	Vehicle stopped

Distance Test 3

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel (gal)	Total Engine Hours	Type
F450	5/3/2021 16:45	Clay-Leslie	37.14671	-83.6565	0	211.33	212906.22	47.92	28.46	Vehicle stopped
F450	5/3/2021 16:45	Clay-Leslie	37.14671	-83.6565	5	211.41	212906.22	47.92	28.46	Breadcrumb
F450	5/3/2021 16:45	Clay-Leslie	37.14674	-83.6565	16.3	212.66	212906.21	47.92	28.46	Breadcrumb
F450	5/3/2021 16:45	Clay-Leslie	37.14687	-83.6564	5.2	211.87	212906.21	47.92	28.46	Vehicle moving
F450	5/3/2021 16:44	Clay-Leslie	37.14695	-83.6563	0	212.55	212906.2	47.92	28.43	Vehicle stopped

Distance Test 4

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel (gal)	Total Engine Hours	Type
F450	5/3/2021 16:51	Clay-Leslie	37.14743	-83.6559	0	212.47	212906.48	47.92	28.55	Vehicle stopped
F450	5/3/2021 16:51	Clay-Leslie	37.14743	-83.6559	1.2	212.46	212906.48	47.92	28.55	Breadcrumb
F450	5/3/2021 16:51	Clay-Leslie	37.14744	-83.6559	4.8	212.13	212906.48	47.92	28.55	Breadcrumb
F450	5/3/2021 16:51	Clay-Leslie	37.14753	-83.6559	15.7	211.68	212906.47	47.92	28.55	Breadcrumb
F450	5/3/2021 16:51	Clay-Leslie	37.14759	-83.6558	5.7	210.63	212906.47	47.92	28.55	Vehicle moving
F450	5/3/2021 16:48	Clay-Leslie	37.14766	-83.6558	0	211.02	212906.47	47.92	28.51	Vehicle stopped

Distance Test 5

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel (gal)	Total Engine Hours	Type
F450	5/3/2021 16:53	Clay-Leslie	37.14718	-83.6561	0	211.69	212906.5	47.92	28.59	Vehicle stopped
F450	5/3/2021 16:53	Clay-Leslie	37.14718	-83.6561	4.5	211.66	212906.5	47.92	28.59	Breadcrumb
F450	5/3/2021 16:53	Clay-Leslie	37.14722	-83.6561	14.2	211.93	212906.49	47.92	28.59	Breadcrumb
F450	5/3/2021 16:53	Clay-Leslie	37.14735	-83.656	6.9	211.73	212906.48	47.92	28.58	Vehicle moving
F450	5/3/2021 16:51	Clay-Leslie	37.14743	-83.6559	0	212.47	212906.48	47.92	28.55	Vehicle stopped

Distance Test 6

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel (gal)	Total Engine Hours	Type
F450	5/3/2021 16:55	Clay-Leslie	37.14695	-83.6563	0	211.5	212906.52	47.92	28.62	Vehicle stopped
F450	5/3/2021 16:55	Clay-Leslie	37.14695	-83.6563	4	211.42	212906.52	47.92	28.62	Breadcrumb
F450	5/3/2021 16:55	Clay-Leslie	37.14697	-83.6563	13.3	211.43	212906.51	47.92	28.62	Breadcrumb
F450	5/3/2021 16:55	Clay-Leslie	37.14708	-83.6562	7.2	212.91	212906.5	47.92	28.62	Vehicle moving
F450	5/3/2021 16:53	Clay-Leslie	37.14718	-83.6561	0	211.69	212906.5	47.92	28.59	Vehicle stopped

Distance Test 7

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel (gal)	Total Engine Hours	Type
F450	5/3/2021 16:58	Clay-Leslie	37.14671	-83.6565	0	211.99	212906.53	47.92	28.66	Vehicle stopped
F450	5/3/2021 16:58	Clay-Leslie	37.14672	-83.6565	4	211.89	212906.53	47.92	28.66	Breadcrumb
F450	5/3/2021 16:58	Clay-Leslie	37.14675	-83.6565	13.3	211.93	212906.53	47.92	28.66	Breadcrumb
F450	5/3/2021 16:58	Clay-Leslie	37.14687	-83.6564	7	212.94	212906.52	47.92	28.66	Vehicle moving
F450	5/3/2021 16:55	Clay-Leslie	37.14695	-83.6563	0	211.5	212906.52	47.92	28.62	Vehicle stopped

Distance Test 8

Vehicle	Date/Time	Location	Latitude	Longitude	Speed (mph)	Bearing (Â°)	Odometer (mi)	Total Fuel (gal)	Total Engine Hours	Type
F450	5/3/2021 16:39	Clay-Leslie	37.14743	-83.6559	0	212.27	212906.14	47.92	28.35	Vehicle stopped
F450	5/3/2021 16:39	Clay-Leslie	37.14743	-83.6559	1.1	212.27	212906.14	47.92	28.35	Breadcrumb
F450	5/3/2021 16:39	Clay-Leslie	37.14743	-83.6559	10	212.18	212906.14	47.92	28.35	Breadcrumb
F450	5/3/2021 16:39	Clay-Leslie	37.14747	-83.6559	13.2	212.02	212906.13	47.92	28.35	Breadcrumb
F450	5/3/2021 16:39	Clay-Leslie	37.14758	-83.6558	6.5	210.34	212906.12	47.92	28.35	Vehicle moving
F450	5/3/2021 16:37	Clay-Leslie	37.14766	-83.6558	0	210.82	212906.12	47.92	28.32	Breadcrumb

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Definitions

AOBRD- Automatic On-Board Recording Device
BCD- Bread crumb data- vehicle track log
CMV- Commercial Motor Vehicle
ECM- Electronic Control Module
ELD- Electronic Logging Devices
EOBR- Electronic On-Board Recorder
eRODs- Electronic Records of Duty Status
ECU- Engine Control Unit
FMS- Fleet Management System
GPS- Global Positioning System
GSM- Global System for Mobile Communications
HOS- Hours of Service
URE- User Range Error

FOLLOW UP TESTING

SRI plans on testing additional ELD systems in various vehicles to gain a broader understanding of how they work and their accuracy.

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