Telematics Discussion

Day in the life of a hard braking incident

Electronics of Usage Based Insurance

10 04 2011

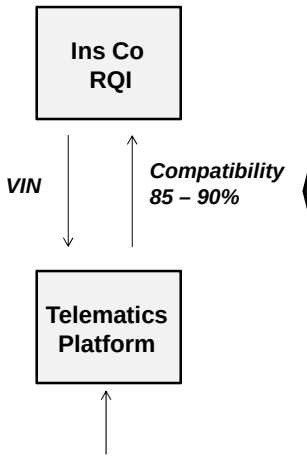
Bob Mathe
President and COO, Evogi

Telematics Discussion

Day in the life of a hard braking incident

Quoting – Getting Devices in Cars

Topography



- **1996 or newer**
- **Special issues, i.e., hybrids**
- **9 different OBDII protocols**
  - **data element support, e.g., VIN verify**
- **Device compatibility with product**
  - **real-time support, e.g., teen tracking**
  - **swerving and cornering , e.g., BBI**

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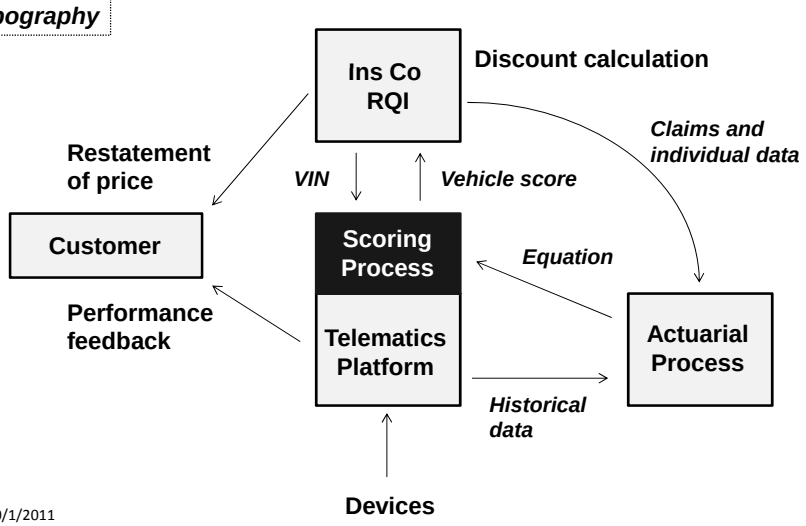
Risk Evaluation and Discount – Using the Results

Topography



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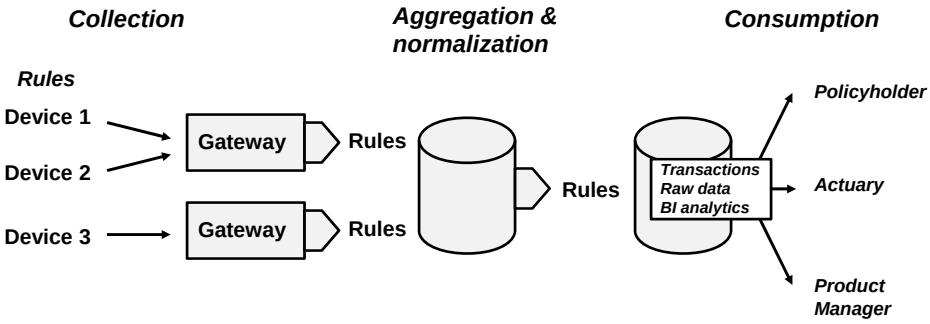
Telematics Platform



Business Objectives
- Operational reports: QOS, functioning, etc.
- Product segment and pricing analysis
- DOI filing support
- Policyholder alerts and reports

Process Objectives
- Stable: without frequent failure
- Reliable: same result with same event
- Flexible
- Useful: right data
- Right cost: affordable

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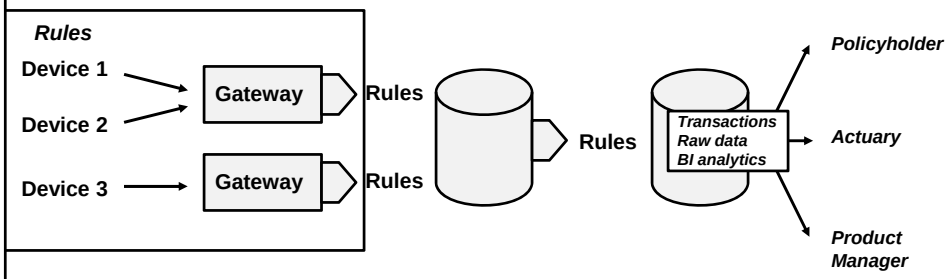
Telematics Platform – Area for Discussion

Collection



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Day in the life of a hard braking incident

How do you recognize a hard brake?

Device 1	a. Source: GPS speed sampled at 10 Hz b. Source: OBDII speed sampled at 1 Hz	***One or more event triggers on device***
Device 2	Accelerometer sampled at 200 Hz (equation running on the device; velocity vector needs to be normalized)	
Device 3	Raw data transferred from GPS /OBD/Accelerometer to gateway and rules engine decides	***Granular braking data***

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What is a hard brake?

Calculated change in speed	Measured force	Probable event
- 88 mph per second	4g	likely accident
- 11 mph per second	.5g	very hard brake
- 7 mph per second	.32g	hard brake

70 – 63 mph in 1 second is a hard brake

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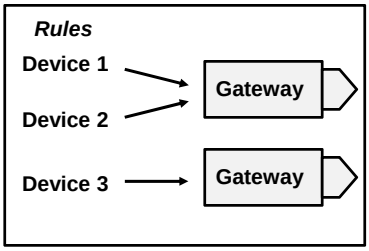
Day in the life of a hard braking incident

Summary - Key Issues



Description of Activity

Inputs and outputs
- Device differences
- Install orientation
- Acceleration equation (X, Y, Z axis)
  - Braking example

Key Concepts
- Acceleration and force
- Sampling versus transmission
- Accelerometer
- Threshold (events under threshold not recorded)
- Car protocols
- Device Car matchup
- TCP/IP v UDP transmission and timing

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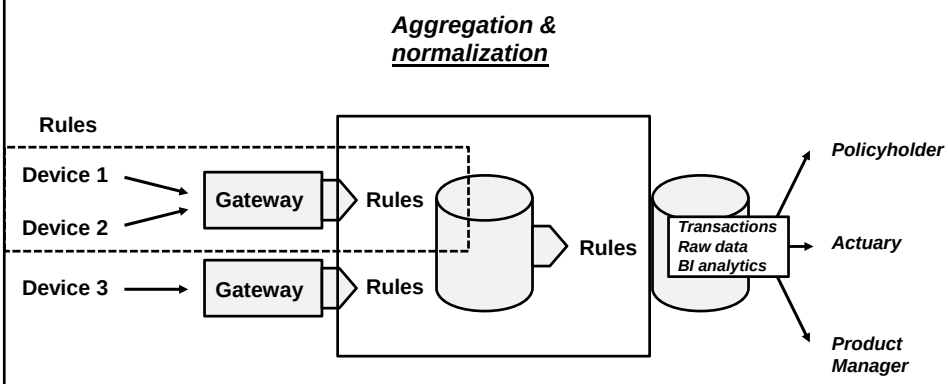
Day in the life of a hard braking incident

Telematics Platform – Area for Discussion



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Day in the life of a hard braking incident

Does the quality of my braking data vary?

Device 1	a. Source: GPS b. Source: OBDII	HDOP .7 excellent 8 flag as suspect 20 discard
Device 2	Accelerometer	Velocity vector accuracy: ± 5% for 90% of vehicles ± 20% for remaining
Device 3	Raw data transfer	Both above

Also for all…device self check

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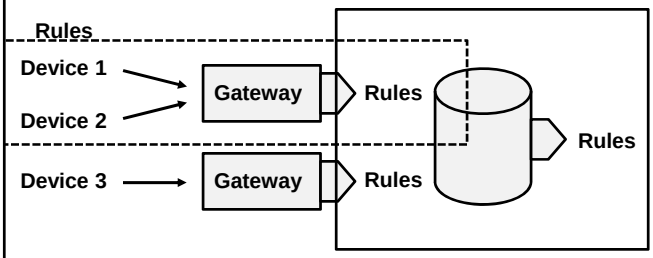
What are typical process quality measures?

- HDOP – horizontal dilution of precision
- Signal strength - number of satellites fixed
  - o Higher the number the greater the quality
  - o Minimal 3
  - o No upper limit
- Device self-check – issues during sampling
  - o High temp, humidity, vibration

Telematics Discussion

Day in the life of a hard braking incident

Summary - Key Issues



Description of Activity

Inputs and outputs

QOS

Compensation/normalization among devices

Braking example

Key Concepts

Real-time requirement of data transmission

HDOP

Rules - aggregation

Rules - normalization

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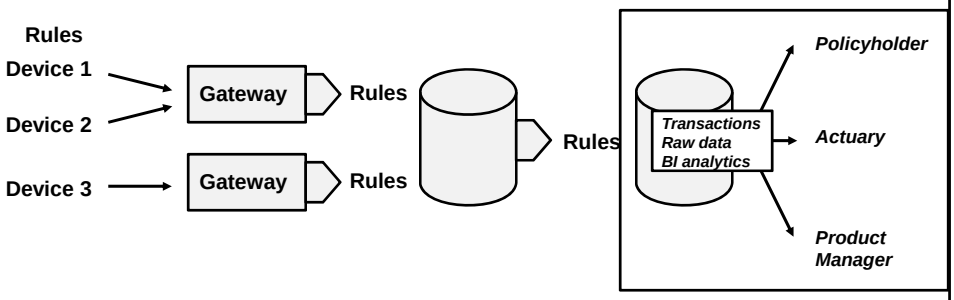
Telematics Platform – Area for Discussion

Consumption



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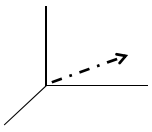
What problem are we trying to solve?	***Customer Alert***
Device 1: GPS or OBDII	Simple calculation - threshold exceeded Stored on device Event may or may not be real-time • Real-time versus memory page transactions
Device 2: Accelerometer 	Complex calculation - threshold exceeded Stored on device Device variances create differences in results • Accelerometer vendor • Complex calculation to normalize velocity vector • Complex calculation to measure event Event may or may not be real-time • Real-time versus memory page transactions
Device 3: Raw Data	Three options: GPS, OBDII or Accelerometer data Stream of data stored, not real-time Calculation on host

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Who needs the data and for what? And, what are the business rules?

BBI product element	Number of hard brakes per trip (incidents relative to thresholds) *Example* - 5 hard brakes, 2 very hard brakes, 0 possible accidents
Claims FNOL feature	Extreme hard brake event with time stamp and latitude & longitude
Actuarial analysis	Second-by-second data with hard brake with time stamp and latitude longitude AND added road type, weather, school zone, posted speed limit, actual speed limit for every brake event

Device design and rules dictates the type and amount of data collected. A brake event support different needs depending upon set-up.

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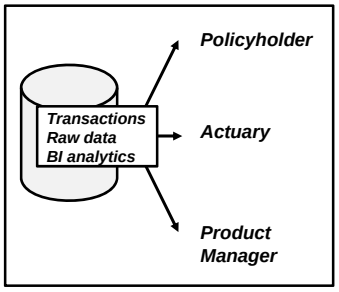
Summary of Key Issues

Description of Activity
- Policyholder: real time alerts, driving reports
- Actuary: accumulated data
- Product Manager: business performance, QOS

Inputs and outputs
- Device differences
  - Braking example

Key Concepts
- Data structure
- Sampling versus transmitting
- Real-time versus analytical



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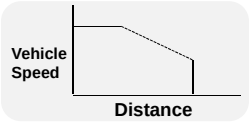
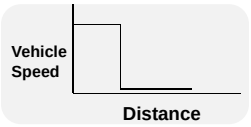
A simple case…

Facts: a vehicle approaches an intersection at 55 mph. on a rainy day. The driver sees crossing vehicle and locks brakes. Car slides 40 feet and hits obstructing car.

Is the data used for calculating hard brake correct?

GPS	Braking event identified	
OBDII	Wheels locked, speed zero	
Accelerometer	Braking event identified	

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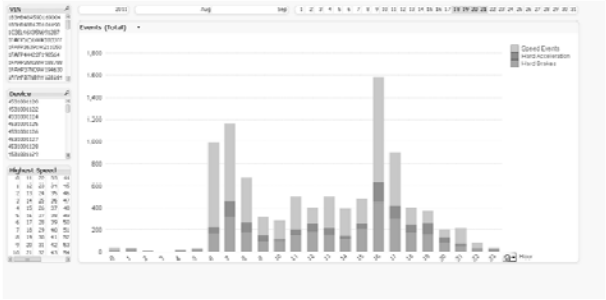
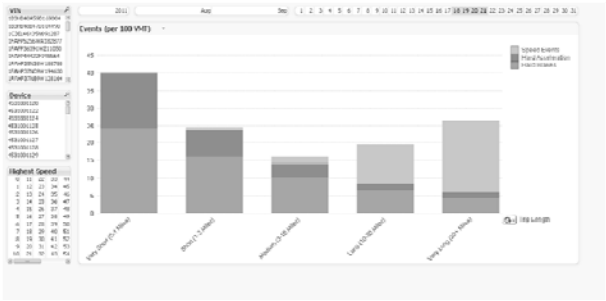
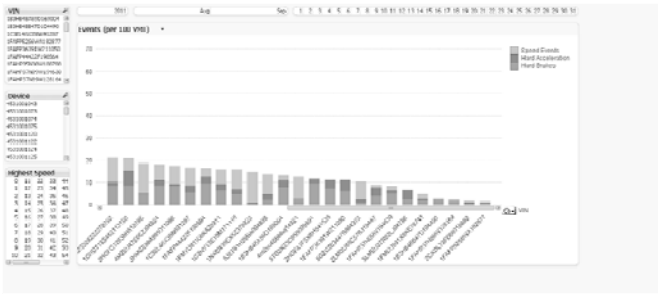
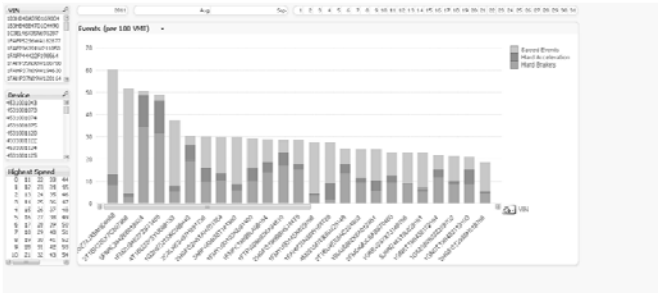
Appendices

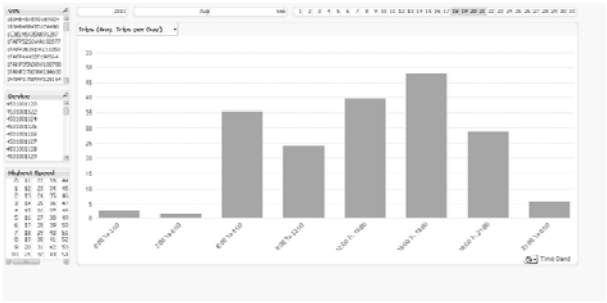
Appendix I
Example Reports

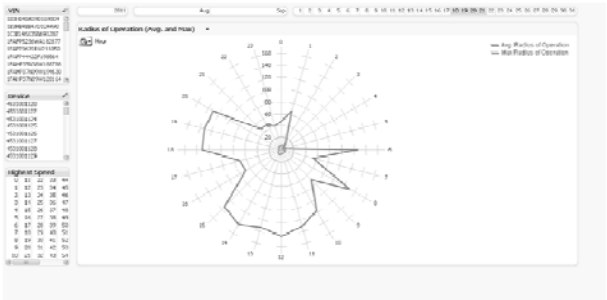






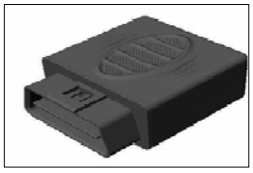






Appendix II
Telematics Device Considerations

Evogi EVG3000
OBD II Dongle Device
Specifications and Features



Key Functionality

Available sources of OBD data*
Vehicle ID (VIN)
Current odometer reading
Current speed
Engine RPMs
Battery voltage
Engine coolant temperature
Accelerator pedal position
Brake pedal position
Various Diagnostic Trouble Codes (DTCs) with filtering capability
Malfunction Indicator Lamp (MIL) codes

Possible Future (optional) sources of OBDII Data*
Integration with vehicle's OEM security system
Integration with vehicle's OEM keyless entry and remote start functions
Tire pressure
Oil life
Airbag status
Seatbelt indication
Fuel level
Subject to vehicle and device compatibility
Vehicle must support OBDII and supported protocols, and provide specified data from the vehicles CANbus when polled by the device.

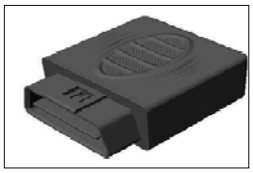
Accelerometer
The device may be configured to generate inertial wake-up/free-fall interrupt signals when a programmable acceleration threshold is crossed at least in one of the three axis. Thresholds are programmable Over-The-Air and may be set between 2g and 8g.

Programmable Event Triggers based on Accelerometer
Acceleration / Deceleration based on MEMS data
Cornering
Impact detection based on MEMS data (not to be used as true 'crash detection')
Pre and Post "impact detection" log of all available vehicle and device data based on MEMS Data (configurable time pre and post impact sense)

Standard Firmware Functions
Programmable event processing
Remote device management
Over the Air firmware and configuration update support for both Application and OBD processors
UDP and SMS communication support
Internal logging of up to 10,000 events
Automatic detection and configuration of OBD-II port
Ignition Sense

OBDII Event reporting capabilities*
Vehicle ID (VIN)
Current odometer reading
Current speed
Engine RPMs
Battery voltage
Engine coolant temperature
Accelerator pedal position
Brake pedal position
Various Diagnostic Trouble Codes (DTCs) with filtering capability

Evogi EVG3000
OBD II Dongle Device
Specifications and Features



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Current odometer reading
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Battery voltage
Engine coolant temperature
Accelerator pedal position
Brake pedal position
Various Diagnostic Trouble Codes (DTCs) with filtering capability

Evogi EVG3000 OBD II Dongle Device

Functinality cont'd
Programmable Event Triggers, based on GPS data
Location, Speed, Heading, Time of day
Acceleration / Deceleration based on GPS data
Virtual Odometer
Trip Information:
Engine IDLE, Distance, Duration
Trip Duration between multiple speed settings
Trip Distance traveled at selected speed settings
Tow mode
Direction Change
High Speed

Programmable Event Triggers, based on OBD data.*
High/Low limit threshold
Engine running status
Acceleration / Deceleration based on Speed from vehicle sensor
Trip Information:
Engine IDLE, Distance, based on vehicle sensors
Trip Duration above multiple speed and RPM thresholds
Trip Distance above selected speed and RPM thresholds
High Speed from vehicle sensor

Possible Future (optional) reporting capabilities, based on OBD data*
Integration with vehicle's OEM security system
Integration with vehicle's OEM keyless entry and remote start functions
Tire pressure
Oil life
Airbag status
Seatbelt indication
Fuel level
Average MPG
Acceleration / Deceleration based on OBD data from in-vehicle sensors
Additional custom codes
Simplified route trace logging – up to 100,000 points

Standard Hardware Features

General Specifications
Communications Modes GPRS packet data and SMS
Location Technology 50 Channel GPS
Internal antennas for Cellular and GPS antennas
Operating Temperature -30°C to +75°C
Mounting: J1962 OBDII port connector

Electrical Specifications
Operating Voltage
9 ~ 18 startup range
7 ~ 20V running range
Source: 12V battery line on OBDII connector
Power Consumption
3mA deep sleep, GPS off, OBD dormant (with wake up OBD activity)
10mA in idle standby with SMS messaging available, GPS off, OBD dormant
20mA in idle standby with GPRS messaging available, GPS off, OBD dormant
150mA active tracking, GSM on, GPS on, OBD active

Location Specifications
Internal GPS receiver module (uBlox NEO-6x)
50 Channel GPS (with SBAS, DGPS)
Accuracy 2.0 meters CEP (with SBAS)
Tracking Sensitivity -160dBm

GSM Specifications
Data Support: SMS, GPRS (UDP)
Cellular: FCC-Parts22,24, PTCRB
GPRS: up to Class 10
Quad Band (850/900/1800/1900 MHz
Output Power:
850 (class 4) 2 W
900 (Class 4) 2W
1800 (Class 1) 1W
1900 (Class 1) 1W

Evogi EVG3000 OBD II Dongle Device

Hardware Features, cont'd

I/O
1 Serial Interface (5 Pin)
4MB serial FLASH memory for storage of event log data
Store up to 10,000 events
Simplified route trace logging up to 100,000 points
Processors
Separate STM32 processor for application processing
Separate ARM-class processor for OBD-II interface control
Accelerometer
MEMS motion sensor and 3 Axis Accelerometer
± 2g/± 8g dynamically selectable full-scale
Capable of measuring accelerations with an output data rate of 100 Hz or 400 Hz
Extended Operating temperature range from -40°C to +85°C
+10000g high shock survivability

Status LED's
COMM = Orange
GPS = Green
OBD = Red

OBD-II Protocol Support
J1850 PWM
J1850 VPW
ISO-9141-2
ISO-14230 KPW2000
ISO-15765 CAN

Mechanicals
Dimensions: 1.8in x 1.5in x 1.0in
Weight: 90 Grams

Certifications:
Fully certified (FCC/IC/CE, PTCRB, AT&T and T-Mobile)

Evogi EVG3000 OBD II Dongle Device
Data Sampling Rates

Data Sampling Rates

Data type	Firmware Conditions	Vehicle Data Port	GPS Chipset	Accelerometer	Message Storage capacity	Utica National Requirement	Meets Specification	Exceeds Specification
GPS Data	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Timestamp	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Latitude	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Longitude	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Heading	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Speed (from GPS)	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Acceleration (from GPS Speed)	50 ms	N/A	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
Braking (from GPS Speed)	50 ms	N/A	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
GPS Positional Quality (HDOP)	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
GPS Quality (number of Satellites used to obtain fix)	50 ms	N/A	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Virtual Odometer (Calculated from GPS)	50 ms	N/A	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
IDLE (Calculated from GPS Speed)	50 ms	N/A	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
Vehicle Data Port: OBDII Data	50 ms	50 ms	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
Speed from Vehicle Speed Sensor (VSS)	50 ms	50 ms	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
Acceleration (Calculated from VSS)	50 ms	50 ms	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Braking (Calculated from VSS)	50 ms	50 ms	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Cornering (Calculated from VSS)	50 ms	50 ms	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Swerving (Speed from VSS)	50 ms	50 ms	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Impact (Speed from VSS)	50 ms	50 ms	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
Vehicle RPM	50 ms	50 ms	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
VIN	50 ms	50 ms	200 ms	50 ms	10,000	GPS data gathered per second	Yes	√
MIL	50 ms	50 ms	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
Fuel	50 ms	50 ms	200 ms	N/A	10,000	GPS data gathered per second	Yes	√
Odometer (vehicle)	50 ms	50 ms	200 ms	N/A	10,000	GPS data gathered per second	Yes	√

Evogi EVG3000 OBD II Dongle Device
Data Transfer Rates

Device Data Transfer Rate								
Device	**Modem Class**	**Uplink Speed**	**Downlink Speed**	**Timeout**	**Wireless Network Latency range**	**Utica National Requirement**	**Meets Specification**	**Exceeds Specification**
EVG3000 Dongle 32Bit	GPRS Class 10	43kbs	56kbs	15 Seconds	>1 Second, ≥8 Seconds	Not Specified	Yes	√
EVG3000 Dongle with OBDII support 32Bit	GPRS Class 10	43kbs	56kbs	15 Seconds	>1 Second, ≥8 Seconds	Not Specified	Yes	√
EVG500 Dongle 8Bit	GPRS Class 10	43kbs	18kbs	15 Seconds	>1 Second, ≥8 Seconds	Not Specified	Yes	√
EVG2600 Blackbox 32Bit	GPRS Class 10	43kbs	18kbs	15 Seconds	>1 Second, ≥8 Seconds	Not Specified	Yes	√
EVG4200 Blackbox 32Bit with Jbus interface	GPRS Class 12	43kbs	18kbs	15 Seconds	>1 Second, ≥8 Seconds	Not Specified	Yes	√

- **Device Certifications**
  Fully certified (FCC/IC/CE, PTCRB, AT&T and T-Mobile)
- **Data transmission components (GPRS, GSM, SMS, USB, etc.)**
  The EVG3000 supports GSM/GPRS & SMS data transmission, and is compliant with parts 22 and 24 of the FCC Rules.
  The EVG3000 offers quad-band (850/900/1800/1900 MHz) capabilities to support networks worldwide.
- **Certification of device by wireless carriers**
  The Evogi devices and system supports GSM/GPRS & SMS data transmission, and is compliant with part 15 of the FCC Rules.
  Certified for use on AT&T and T-Mobile networks.

Evogi EVG3000 OBD II Dongle Device
Application Reporting

Application Reporting								
Driver Feedback	**Map View**	**Historical View**	**Alert Notification**	**Geofence**	**Administration**	**Utica National Requirement**	**Meets Specification**	**Exceeds Specification**
Trip Data	Locations	√	E-Mail	Range	Behavior	Not Specified	Yes	√
Fuel Consumption	N/A	√	E-Mail	N/A	Behavior	Not Specified	Yes	√
Trip Start Timestamp	Local Time Zone 12hr	√	N/A	N/A	Behavior	Not Specified	Yes	√
Trip End Timestamp	Local Time Zone 12hr	√	N/A	N/A	Behavior	Not Specified	Yes	√
VIN	Popup	√	E-Mail	N/A	Exception	Not Specified	Yes	√
Malfunction Indicator Lamp (MIL) Status	Popup	√	E-Mail	N/A	Behavior & Exception	Not Specified	Yes	√
Distance traveled during trip	Popup	√	E-Mail	Range	Behavior	Not Specified	Yes	√
Average Speed	Popup	√	N/A	N/A	Behavior	Not Specified	Yes	√
Maximum Speed	Popup	√	E-Mail	Speed Zone	Behavior	Not Specified	Yes	√
Trip Positional Quality	Exception	√	N/A	N/A	Exception	Not Specified	Yes	√

Evogi EVG3000 OBD II Dongle Device
Conditional Reporting

Conditional Reporting								
Event	Message type	CANbus	Data	Calculation Speed	Message Frequency	Utica National Requirement	Meets Specification	Exceeds Specification
Trip Data	Event	Polled	Reported	50 ms	on condition	Not Specified	Yes	√
Fuel Consumption	Event	Polled	Accumulated	50 ms	on condition	Not Specified	Yes	√
Trip Start Timestamp	Event	N/A	Reported	50 ms	on condition	Not Specified	Yes	√
Trip End Timestamp	Event	N/A	Reported	50 ms	on condition	Not Specified	Yes	√
VIN	Event	Polled	Reported	50 ms	on condition	Not Specified	Yes	√
Malfunction Indicator Lamp (MIL) Status	Event	Polled	Reported	50 ms	on condition	Not Specified	Yes	√
Distance traveled during trip	Event	Polled	Accumulated	50 ms	on condition	Not Specified	Yes	√
Average Speed	Event	Polled	Accumulated	50 ms	on condition	Not Specified	Yes	√
Maximum Speed	Event	Polled	Accumulated	50 ms	on condition	Not Specified	Yes	√
Trip Positional Quality	Event	N/A	Reported	50 ms	on condition	Not Specified	Yes	√

Evogi EVG3000 OBD II Dongle Device
Wireless Reporting

Wireless Network Connectivity (device message types)									
Device Message	Preferred Message Type	Configurable	1 Second	30 Seconds	60 Seconds	Once per Trip	Utica National Requirement	Meets Specification	Exceeds Specification
GPS Data accumulated per second	Long	√	Long	Long	Long	N/A	GPS Data gathered per second	Yes	√
Trip Data (Calculated)	Long	√	Long	Long	Long	Long	Evogi Proposed, Not Specified	Yes	√
Trip Data (Accumulated) basic	Short	√	Short	Short	N/A	N/A	Trip Data Gathered Per Second	Yes	√
Trip Data (Accumulated) advanced	Long	√	Long	Long	Long	Long	Trip Data Gathered Per Second	Yes	√
Conditional Event Data reported per occurrence	Short	√	Short	Short	Short	Short	Evogi Proposed, Not Specified	Yes	√
Electronic Data Recording	Long	√	Long	Long	Long	N/A	Evogi Proposed, Not Specified	Yes	√

Message Types
Evogi supports 2 standard message types which vary in length, and are annotated by "Long" and "Short".
The minimum message size is 55bytes, and the maximum message size is 865 bytes.
The short message type supports a min of 55 bytes up to a maximum 108bytes.
The long message type supports a minimum of 108 bytes up to a maximum of 865 bytes.
The Short message contains basic, yet substantial, information related to GPS positional quality while the long message type contains additional information related to GPS positional quality.
The two message types may be configured simultaneously on a device to report different data sets at variable frequencies.

Firmware remotely updatable
The Evogi Group has standardized on firmware transmission upgrades over potentially expensive hardware replacements. The firmware upgrades and modifications can be transmitted on an as-needed basis for firmware updates. Additionally, reporting parameter settings may also be updated remotely "over the air". This is achieved via the device maintenance portal.

How does the device handle variable GPS data quality?
The Evogi devices measures GPS signal quality and reports the HDOP and number of satellite fixes with each event message. The device uses this capability in a variety of ways based upon a sophisticated firmware platform. Special event types may be triggered and reported to record GPS signal quality changes over time. These event types are monitored in our device management platform to ensure quality of service. The Evogi devices does not collect or calibrate OBD port speeds.

The device generally transmits data on a two-minute time interval. When trigger events occur, the device will transmit at shorter interval time periods. The device can be programmed to transmit at any time interval programmed.

Evogi EVG3000 OBD II Dongle Device
Device Messaging

Wireless Network Connectivity (device message types)									
Device Message	Message type	Configurable	1 Second	30 Seconds	60 Seconds	Once per Trip	Utica National Requirement	Meets Specification	Exceeds Specification
GPS Data accumulated per second	Long	√	108 bytes	450 bytes	865 bytes max	N/A	GPS Data gathered per second	Yes	√
Trip Data (Calculated)	Long	√	865 bytes max	865 bytes max	865 bytes max	865 bytes max	Evogi Proposed, Not Specified	Yes	√
Trip Data (Accumulated)	Short	√	108 bytes	108 bytes	N/A	N/A	Trip Data Gathered Per Second	Yes	√
Trip Data (Accumulated)	Long	√	865 bytes max	865 bytes max	865 bytes max	865 bytes max	Trip Data Gathered Per Second	Yes	√
Conditional Event Data per occurrence	Short	√	108 bytes	108 bytes	108 bytes	108 bytes	Evogi Proposed, Not Specified	Yes	√
Electronic Data Recording	Long	√	865 bytes max	865 bytes max	865 bytes max	N/A	Evogi Proposed, Not Specified	Yes	√

Device Messaging
Managing data transmission and associated cellular data plans is quite complex; Evogi has extensive expertise and knowledge in this area and has developed a number of proprietary algorithms to manage this process. If GPRS/GSM signal is not present the device will store the event message in a log file in non-volatile memory, which has a capacity of 10,000 events. The device will automatically report log files upon presence of GPRS/GSM signal coverage.

The size of a data packet per event report is:

1. Proprietary
2. Configurable.
   - This varies by the number of parameter settings and the time at which data is delivered. For example, when configured to report in real time as events are triggered, the message size (data packet) will be smaller than if the device collects event data over time and transmits all the information at the ignition off event.
   - Data transmission volumes can be tabulated as event triggers are added or removed from the reporting structure (data packet sizes increment in very amounts, as "bits & bytes", depending on the trigger configuration.)
   - Average message size is generally configured at 100bytes.

Evogi handles server balancing based on customer needs, transmission rates and data demand. The devices support reporting to up to three additional IP addresses and ports.