2018 November 22 Sofia

Event Data Recorder reading.....

BOSCH

CDR CRASH DATA RETRIEVAL

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	YV1LFBABDG1******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	VOLVO CDRX.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.3
Imaged with Software Licensed to (Company Name)	Company Name information was removed when this file was saved without VIN sequence number
Reported with CDR version	Crash Data Retrieval Tool 17.7.2
Reported with Software Licensed to (Company Name)	TrDarts
EDR Device Type	Airbag Control Module
Event(s) recovered	Event Record 1 Event Record 2

Event Data Recorder reading.....

BOSCH

CDR CRASH DATA RETRIEVAL

System Status at Event (Event Record 1)

Data Area Status, Event Record 1	Locked, Data Stored
Data Area Read Status, Event Record 1	Data Not Read
Complete File Recorded (Yes/No)	Yes
Multi-Event, Number of Events (1,2)	Event Number 1
Time from Preceding Event (sec)	Written but No Data Available
Maximum Delta-V, Longitudinal (MPH [km/h])	< -62 [-100]
Time, Maximum Delta-V, Longitudinal (msec)	100
Maximum Delta-V, Lateral (MPH [km/h])	-19.9 [-32.0]
Time, Maximum Delta-V, Lateral (msec)	>300

Deployment Command Data (Event Record 1)

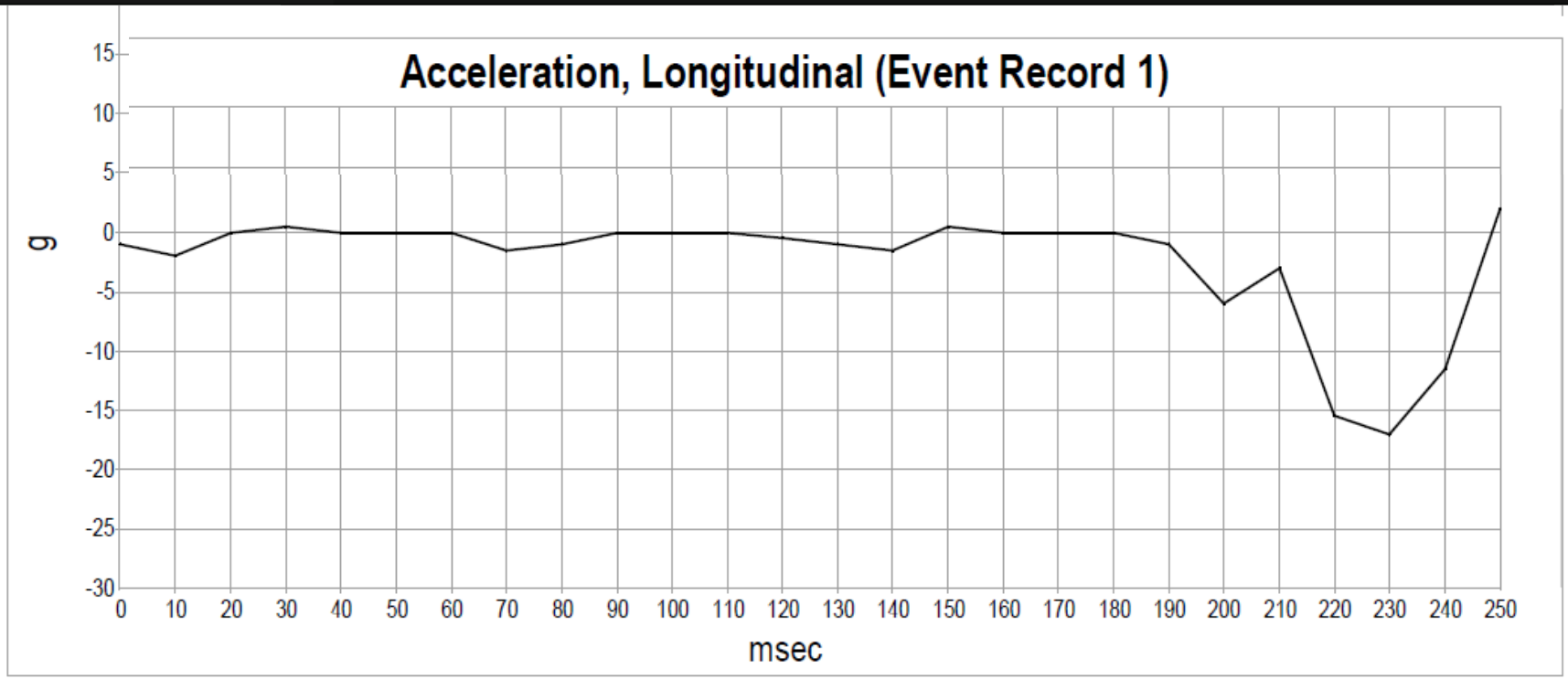
Frontal Airbag Deployment, Time to Deploy, First Stage, Driver (msec)	491
Frontal Airbag Deployment, Time to Deploy, First Stage, Front Passenger (msec)	491
Frontal Airbag Deployment, Time to Deploy, Second Stage, Passenger (msec)	Not Equipped

Event Data Recorder reading.....

Pre-Crash -5 to 0 sec (Event Record 1)

Time (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % Full (%)	Service Brake (On, Off)	Steering input (%)	ABS Activity	Stability Control Status
-5.0	43.5 [70.0]	100.0	Off	0.0	Off	On
-4.5	47.8 [77.0]	100.0	Off	0.0	Off	On
-4.0	52.2 [84.0]	100.0	Off	2.0	Off	On
-3.5	55.9 [90.0]	100.0	Off	3.0	Off	On
-3.0	58.4 [94.0]	100.0	Off	3.0	Off	On
-2.5	61.5 [99.0]	100.0	Off	11.0	Off	Engaged
-2.0	62.8 [101.0]	100.0	Off	6.0	Off	Engaged
-1.5	65.2 [105.0]	100.0	Off	-9.0	Off	Engaged
-1.0	67.1 [108.0]	100.0	Off	-8.0	Off	Engaged
-0.5	69.6 [112.0]	100.0	Off	-9.0	Off	Engaged
0.0	70.2 [113.0]	100.0	Off	-13.0	Off	Engaged

Event Data Recorder reading.....



DARTS

This presentation is not about….

but…..

DARTS

After some previous projects on using car electronics for crash analyses, interest remained high and development in new automotive technologies continued.

A number of officers from the Netherlands Police founded in March 2014:

D A R T S

***D**ATA **A**NALYSIS **R**ESEARCH **T**RAINING **S**ERVICES*

ASDARTS & TRDARTS

Starting with two partners:

***ASDARTS**: Automotive Support in Germany*

- Hard & software -

***TRDARTS**: Training & Research in the Netherlands*

-European Training-.

EUDARTS GROUP

From the start, police, public and private scientists were very interested and they requested the establishment of a partner group.

That's was setup the

EUDARTS GROUP

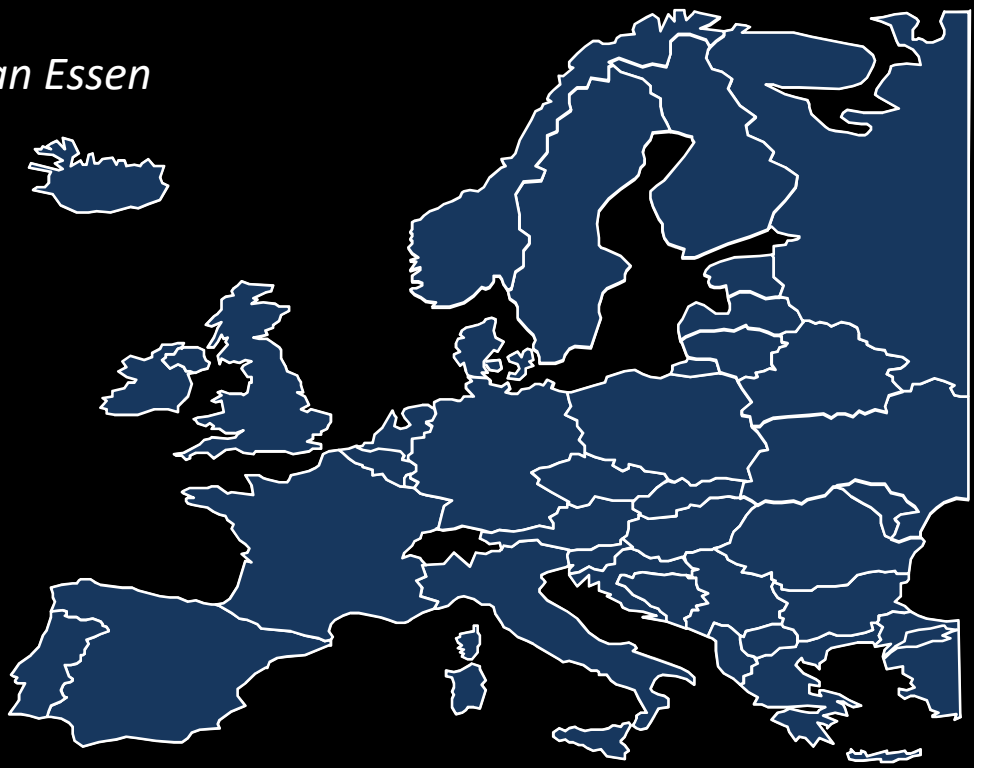
a European Network of trainers-members-followers-students

January 2018: 1.583 members and still growing.

EUDARTS GROUP in EUROPE

Netherlands Hans Bot

NLDARTS – Netherlands & Belgium: Jeroen van Essen
SPDARTS – Spain: David Cami
ITDARTS – Italy: Mattia Sillo
UKDARTS – UK: AITS Ric Ward
IRDARTS – Ireland: AITS Ric Ward
SLDARTS – Balkan: Jože Škrilec
GRDARTS – Greece: Dimitri Mageritas
NODARTS – Norway, Sweden: Simen Huse
GEDARTS – Germany: Juergen Kneifel
PLDARTS – Poland: Michal Krzeminsky
FRDARTS – France: Joseph Marra
AUDARTS – Austria: Michael Plank
BGDARTS – Bulgaria: Joseph Marra



2018.11.22 – Sofia - JP. Peters

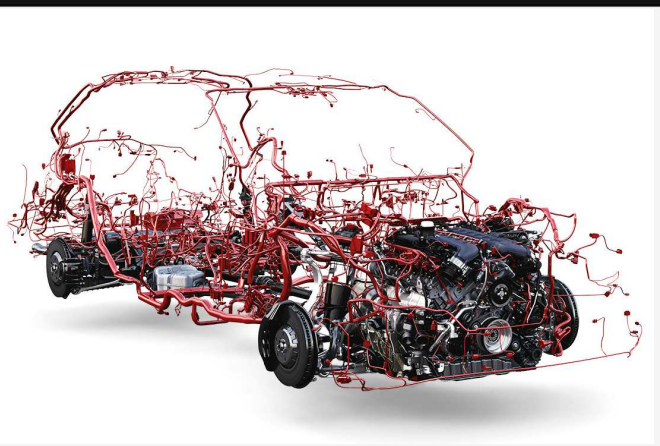
Event Data Recorder

- A Black box ?
- Event Data recorder ≠ Black box
- Flight recorder (Black box) registers permanently
- Event Data Recorder registers only **after a predefined event** ; (≈5 s.)
- **From now on: never use the word black box !**

The history of EDR

- Like in airplanes, the first EDR's were a separate box <u>added</u> to the vehicle
- Unfalldatenspeicher (UDS) Mannesmann-VDO
- Installed by many fleet owners

Modern cars have CAN and sensors



In the past: No sensors, No CAN No data

Modern cars have CAN with sensors and modules (AB, ABS, EMS)

Sensors send data over the CAN to the EDR

CAN and sensors made it easy to install an EDR

The history of EDR

- Development of the CAN (1983-86) allowed to link critical systems (ABS, Airbags, Engine management) and read-out for eventual defects, for warranty and R&D;
- GM started to make CAN data useable for Accident Reconstruction;
- 1991: NHTSA started research using EDR data
- 1997: NTSB recommended to fit cars with EDR;

The history of EDR - USA

- 2000: Delphi equipped an Indy 500 card with EDR as a demo;
- 2004 NHTSA draft regulation:
  - **EDR is voluntary , but if data is recorded, it has to be has according to the regulation**;
  - Debate: road-safety, privacy, extra costs etc.
  - All cars record data for maintenance and repair: EDR is de-facto mandatory
- 2010 model year 91,6% equipped with EDR.
- 2014 September 1st Regulation in force (49 CFR Part 563) .

The history of EDR - EU

- 2011: European Parliament request EC to daft a proposal on EDR
- 2014: EC DG Move published a report by TRL on EDR
- 2018 May 17th EC published proposal (COM(2018) 286 final):
  - Mandatory fitment for M1 and N1 vehicles
  - Mandatory for automated vehicles of all categories
  - Entry into force **36 months** after publication (for new models).
  - Existing models **24 months** later
- End 2018: EP and Council of Ministers expected to decide
- 2019 publication expected


EUROPEAN COMMISSION

Brussels, 17.5.2018
COM(2018) 286 final

2018/0145 (COD)

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users, amending Regulation (EU) 2018/... and repealing Regulations (EC) No 78/2009, (EC) No 79/2009 and (EC) No 661/2009

US Regulation (49 CFR Part 563) 1/4

- Each vehicle equipped with an EDR must meet the requirements… for **data elements**, ..for **data format**, …for **data capture**, …for crash test **performance and survivability**, and …for **information** in owner's Manual.
- **Data elements**
  - **a) required**
  - **b) required if recorded / fitted**
- **Data format**: for each element: range, accuracy, resolution and eventual filter class.

US Regulation (49 CFR Part 563) 2/4

- Definitions:
  - **Time zero** means for systems
    - with **"wake-up" air bag control systems**, the time occupant restraint control algorithm is activated;
    - for continuously running algorithms, the first point in the interval where a **longitudinal**, **cumulative delta-V of over 0.8 km/h** (0.5 mph) is reached within a **20 ms** time period;
    - or for vehicles that record "delta-V, lateral," the first point in the interval where a **lateral, cumulative delta-V of over 0.8 km/h** (0.5 mph) is reached within **a 5 ms** time period.
  - **Trigger threshold** means
    - a change in vehicle velocity, in the **longitudinal direction**, that **≥ 8 km/h within a 150 ms** interval.
    - For vehicles that record "delta-V, lateral", a change in vehicle velocity, in **either** the **longitudinal or lateral** direction that ≥ 8 km/h within a 150 ms interval.

US Regulation (49 CFR Part 563) 3/4

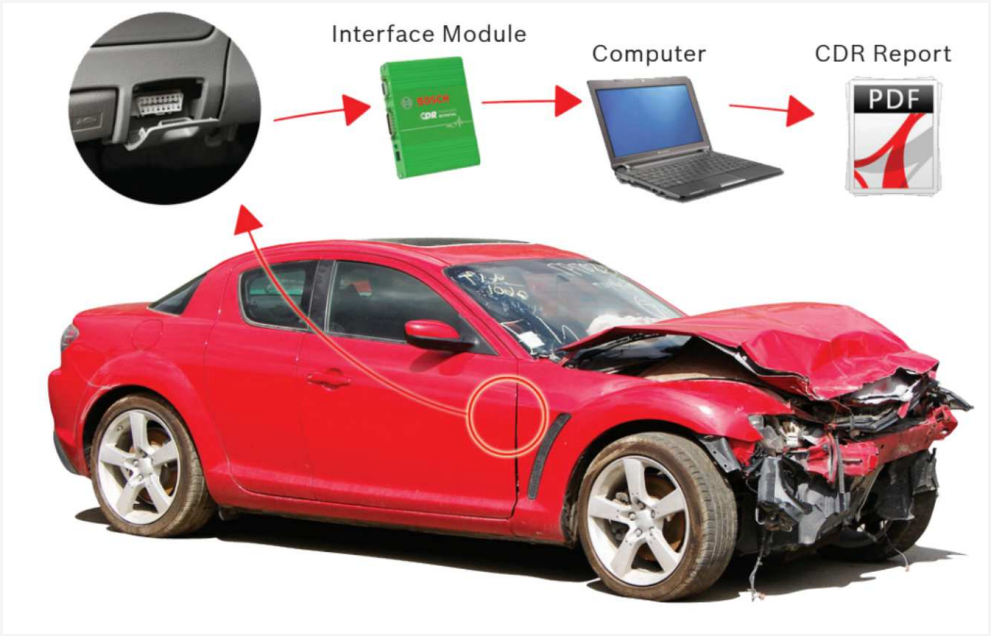
- Data Capture:
  - The EDR must capture and record the data elements for events in accordance with the following conditions and circumstances:
    a) **In an air bag deployment crash, the data recorded from any previous crash must be deleted** (both events). The data related to the deployment must be captured and recorded. The memory must **be locked to prevent any future overwriting** of these data.

    b) **In an air bag non-deployment crash** that meets the trigger threshold, **delete all previously recorded data** in the EDR's memory. Capture and record the current data, **up to two events**. In the case of two events, detection of the second event starts after the End of Event Time for event 1.
- Crash test performance and survivability (front, side)
  - The required data elements **must be recorded** in the specified format, exist at the completion of the crash test, and **be retrievable** …… for not less than **10 days** …., and the complete data recorded element must read **"yes"** after the test.

US Regulation (49 CFR Part 563) 4/4

- Information in owner's manual: text is given.
- Data retrieval tools:
  - Each manufacturer …shall ensure… **that a tool(s) is commercially available** that is capable of accessing and retrieving the data stored in the EDR
  - Practically all manufacturers use the **BOSCH CDR tool** (some Korean manufacturers have their own)
  - EDR data obtained by CDR can not:
    - altered
    - erased
    - manipulated

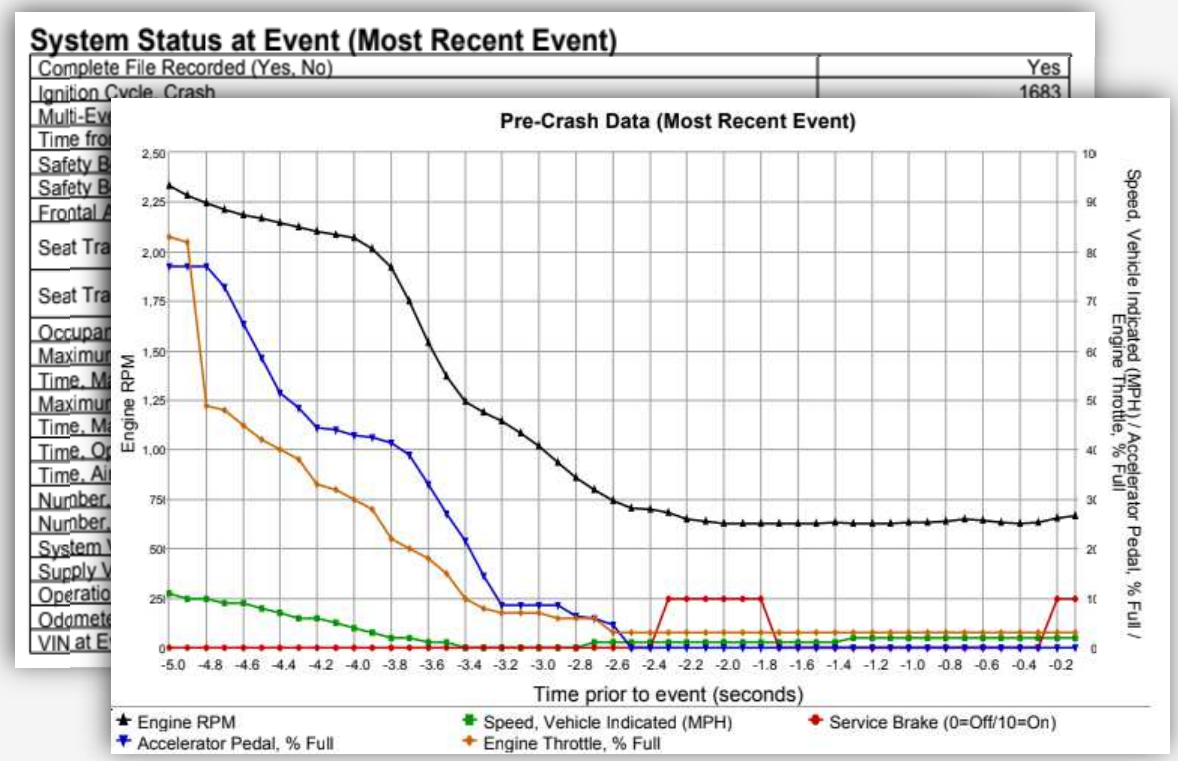
CDR (Crash Data Retrieval)



4 possibilities

1. Connect to OBD
2. If OBD is damaged : connect directly to Airbag Control Module (ACM)
3. Disassemble the ACM and connect
4. If ACM is damaged: send to ACM manufacturer to read the EPROM directly

CDR (Crash Data Retrieval) report



EDR report

- **In PDF and CSV**
- **30-50 pages !!**
  - Vehicle speed
  - Brake status
  - Steering wheel angle
  - Crash severity (delta-V)
  - Seat belt status
  - Accelerator pedal position
  - Transmission gear position
  - Airbag deployment data
  - Occupant detection information
  - Ignition cycle
  - Etc. (see complete list)

What you need to read the EDR

Bosch CDR Tool

- The **CDR System Starter Kit** includes all cables and hardware needed to retrieve crash data from vehicles in Europe through the vehicle's DLC or OBD connector.
- It does not include CDR direct connect cables and adapters required for connecting directly to an ACM or PCM.
- The **CDR System Starter Kit** was developed specifically as a **low-cost entry** to allow for the growing need for police departments, private-practice re-constructionist and insurance agencies to collect the crash data when inspecting vehicles.

Bosch CDR Tool

TRAINING EUDARTS

What do you need

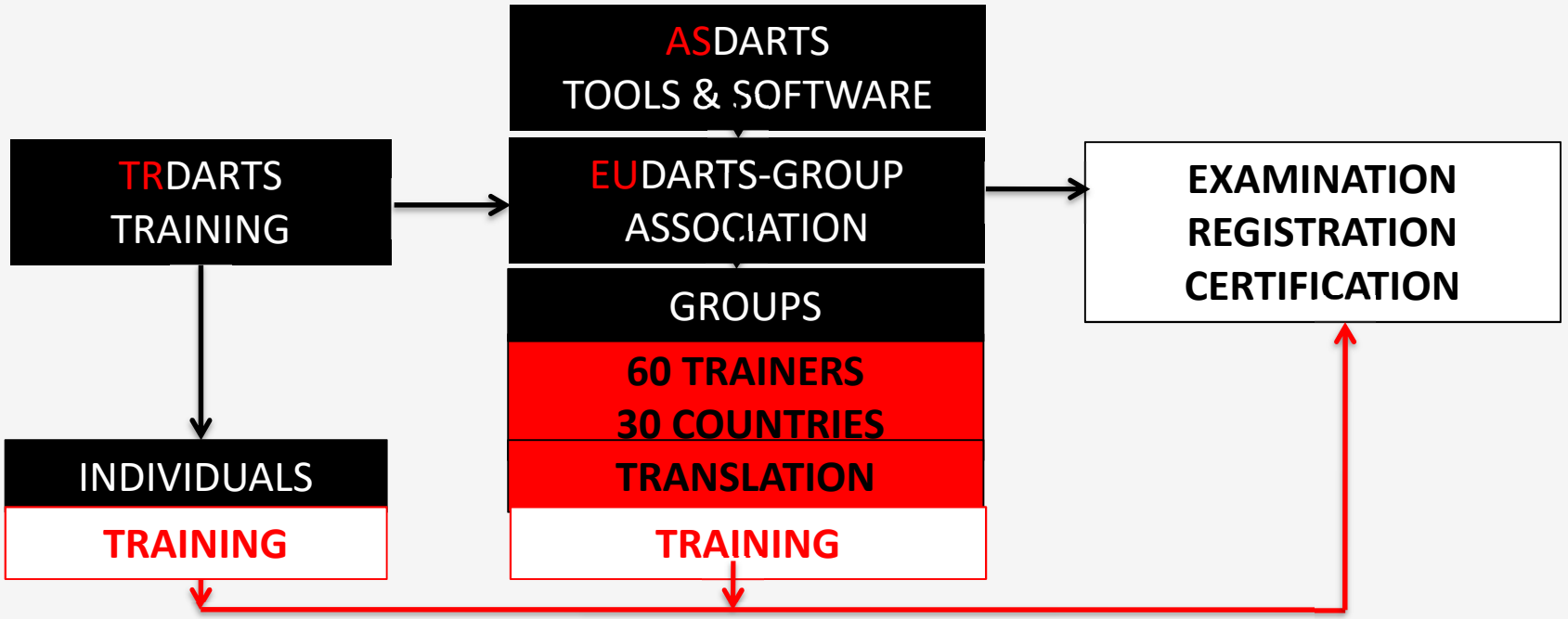
Knowledge, skills and expertise *are required.*

Training is needed: To image the data is easy, but to analyze the data isn't a simple "trick".

Users need to understand anomalies & faults to explain the data

They need shared validations or pre-validations by NCAP.

EDUCATION STRUCTURE



TRAINING EUDARTS

*The European CDR training is written **specifically with an European application**, European validations and European legislation and contains mostly **European** and some US **example**s.*

*A part of the course will give the students the **necessary information; to describe the EDR system to European laymen (i.e. client, court, public);** to explain the CDR report and collected data in the context of the case or study; to identify any case-critical information and to judge/assess the reliability and accuracy of this information.*

ADAS EDR : Be prepared !

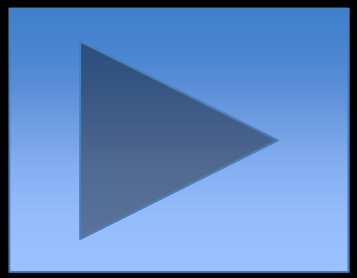
- *Adaptive cruise control (ACC)*
- *Adaptive high beam*
- *Alcohol ignition interlock*
- *Glare-free high beam and pixel light*
- *Adaptive light control: swiveling curve lights*
- *Automatic parking*
- *Automotive navigation system*
- *Automotive night vision*
- *Blind spot monitor*
- *Collision avoidance system (Pre-crash system) Crosswind stabilization*
- *Cruise control*
- *Driver drowsiness detection*
- *Driver Monitoring System*
- *Electric vehicle warning sounds used in*
- *hybrids and plug-in electric vehicles*
- *Emergency driver assistant*
- *Forward Collision Warning*
- *Intersection assistant*
- *Hill descent control*
- *Intelligent speed adaptation or intelligent speed advice (ISA)*
- *Lane departure warning system*
- *Lane change assistance*
- *Parking sensor*
- *Pedestrian protection system*
- *Rain sensor*
- *Surround View system*
- *Traffic sign recognition*
- *Turning assistant*
- *Vehicular communication systems*
- *Wrong-way driving warning*

VALIDATION EUDARTS

With crash test in Slovenia we validate the latest obtained data in Europe.

In the past we organized crash-tests to validate the data from Bosch CDR in cooperation with TNO / CARS / the OEM's / module-suppliers,

VALIDATION PROGRAM



VALIDATION PROGRAM

Bosch CDR

You can purchase:

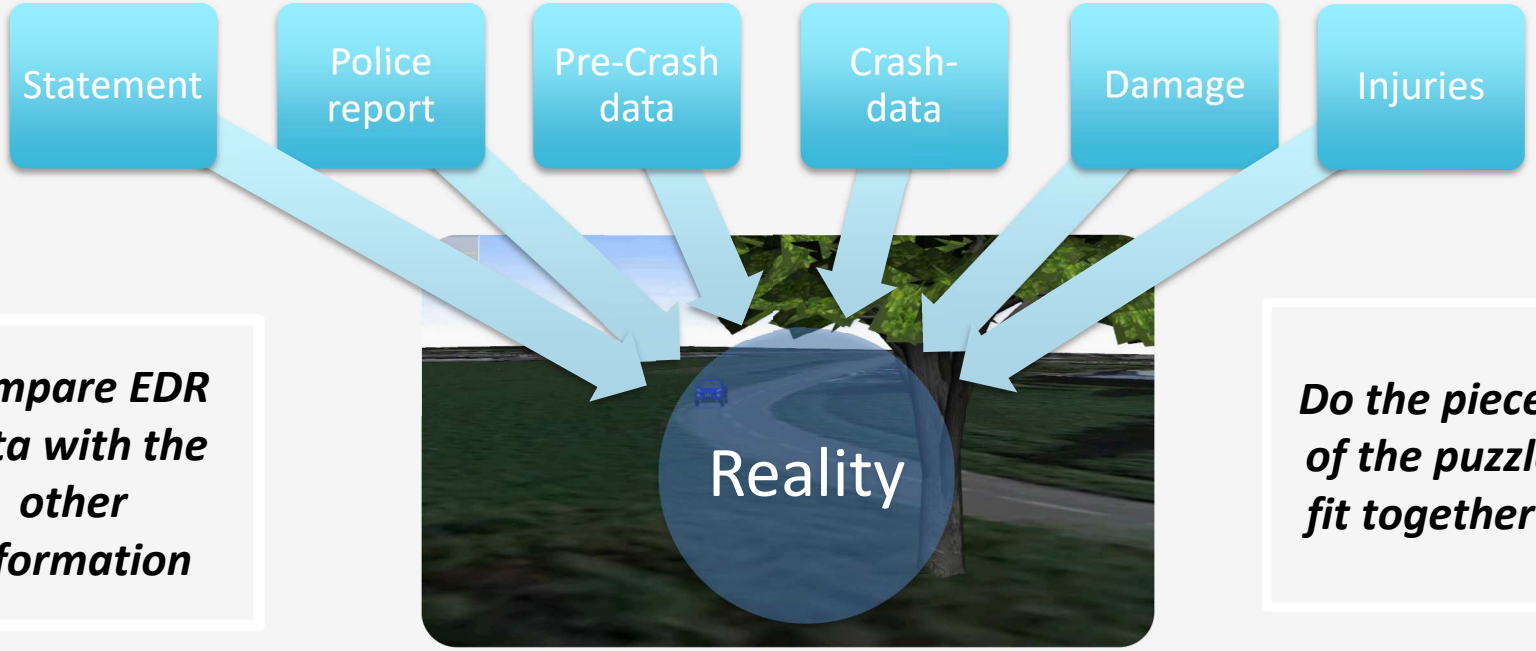
BOSCH hard & software
ASDARTS Germany.

Bosch Training & Support
TRDARTS Netherlands

Both you can find on
www.eudarts-group.com

Fraud examples

Use of CDR data for fraud detection



Compare EDR data with the other information

Do the pieces of the puzzle fit together?

Fraud investigation example 1

- An US import BMW 5-Series 2014 .
- Driver stated that a moose suddenly appeared in front of him (forested area) and he swerved the car to avoid and subsequently lost control and impacted a tree.

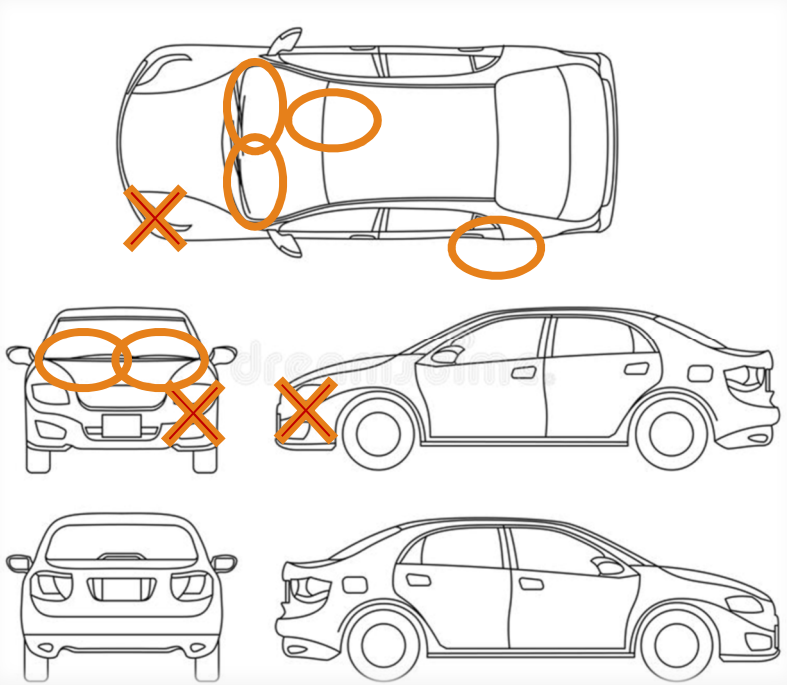
Fraud investigation example 1

Driver declaration:

A moose suddenly appeared in front of him and he swerved the car to avoid and subsequently lost control and impacted a tree.

Reported damages:

- frontal light X
- full front airbags deployed O
- left curtain airbag deployed O



Fraud investigation example 1

REAL CASE
OR
FRAUD??

USE OF THE CDR TO CONFIRM THE DRIVER DECLERATION

Fraud investigation example 1

- **PRE-CRASH data obtained from the CDR:**

zero initial velocity

(T=0) impact moment

Time (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % Full (%)	Engine RPM	Steering Input (deg)	Service Brake, On/Off	ABS Activity (Engaged, Non-engaged)	Stability Control (On Engaged, Non-engaged)
-5.0	0 [0]	0	800	0	Off	No ABS Activity	Unknown
-4.5	0 [0]	0	800	0	On	No ABS Activity	Unknown
-4.0	0 [0]	0	800	0	On	No ABS Activity	Unknown
-3.5	0 [0]	99	800	5	Off	No ABS Activity	Unknown
-3.0	1 [1]	99	1100	45	Off	No ABS Activity	Unknown
-2.5	3 [5]	100	1700	45	Off	No ABS Activity	Unknown
-2.0	6 [9]	99	1900	90	Off	No ABS Activity	Unknown
-1.5	7 [11]	100	2300	45	Off	No ABS Activity	Unknown
-1.0	7 [12]	100	2600	30	Off	No ABS Activity	Unknown
-0.5	7 [11]	100	1600	65	Off	No ABS Activity	Unknown
0.0	6 [10]	100	1800	195	Off	No ABS Activity	Unknown

full acceleration

no braking

Fraud investigation example 1

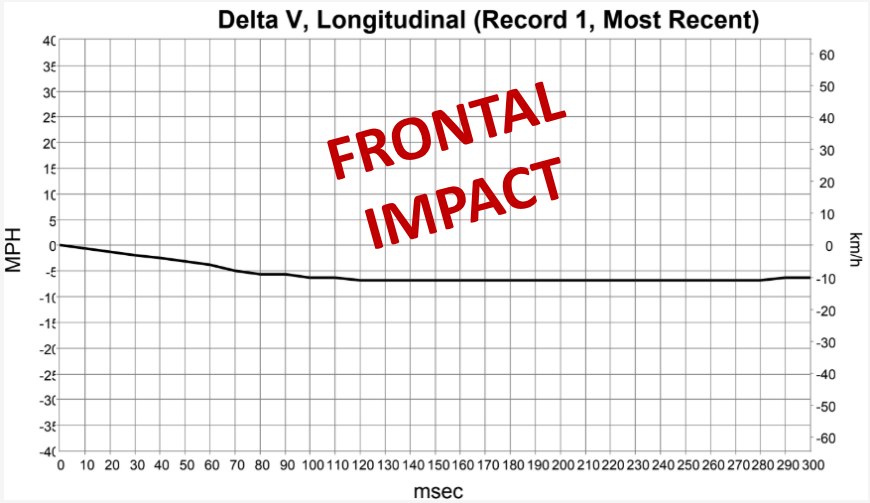
System Status at Event (Record 1, Most Recent)

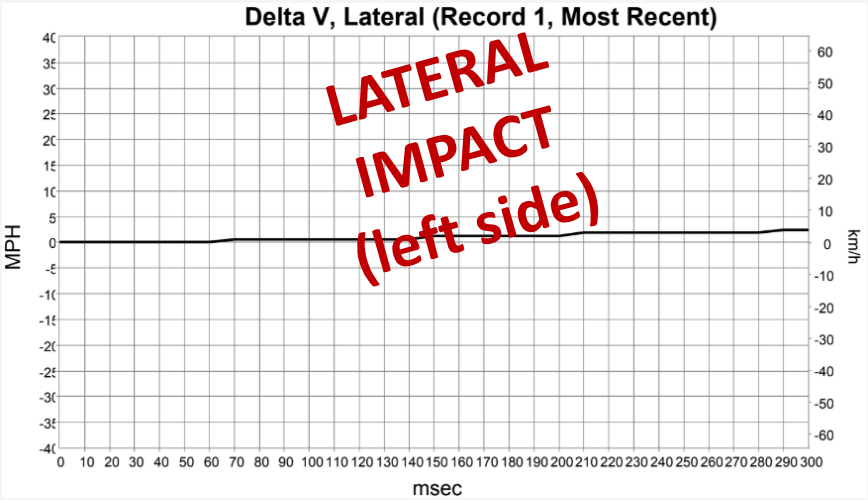
Event Type	Frontal
Ignition ON Timer, at Event (msec)	1,810,979,911
Time From Time Zero to Frontal Threshold (Beginning of Impact) (msec)	Not Recorded
Time From Time Zero to Side Threshold (Beginning of Impact) (msec)	Not Recorded
Time From Time Zero to Algorithm Wake-Up Start (Front) (msec)	0
Time From Time Zero to Algorithm Wake-Up Start (Side) (msec)	7
Time From Time Zero to Algorithm Wake-Up Start (Rear) (msec)	Not Recorded
Time From Time Zero to Deployment (Rollover) (msec)	Not Recorded
Time From Time Zero to Deployment (Pitchover) (msec)	Not Recorded
Time From Time Zero to Algorithm Wake-Up Start (Pedestrian Protection) (msec)	Not Recorded
Event Counter (counts)	2
Complete File Recorded (Yes, No)	Yes
Multi-Event, Number of Events	1
Time From Previous Event to Current Event (msec)	0
Maximum Delta-V, Longitudinal (MPH [km/h])	-6.8 [-11.0]
Maximum Delta-V, Lateral (MPH [km/h])	2.5 [4.0]
Time, Maximum Delta-V, Longitudinal (msec)	174
Time, Maximum Delta-V, Lateral (msec)	300
Time, Maximum Delta-V, Resultant (msec)	184

Two events recorded on the EDR

Fraud investigation example 1

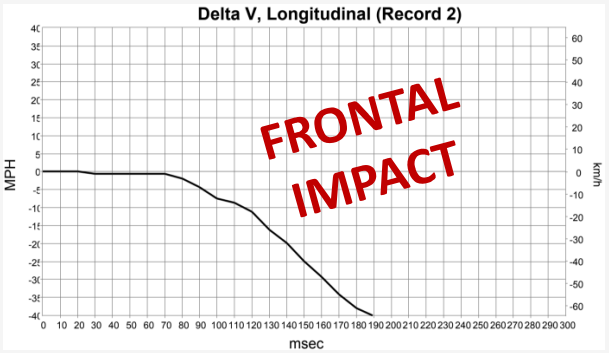
- AFTER CRASH data obtained from the CDR

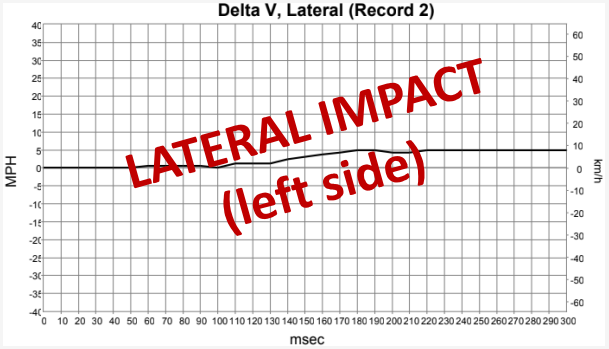




Compare these graphs with the next slide !

Fraud investigation example 1





- Crash data of the **previous memorized event**:

Same airbags deployed !

Deployment Command Data (Record 2)

Frontal Air Bag, Time to First Stage Deployment, Driver (msec)	82
Frontal Air Bag, Time to Second Stage Deployment, Driver (msec)	87
Frontal Air Bag, Time to Third Stage Deployment (Vent), Driver (msec)	144
Frontal Air Bag, Second Stage Disposal, Driver	No Disposal
Frontal Air Bag, Third Stage Disposal (Vent), Driver	No Disposal
Frontal Air Bag, Time to First Stage Deployment, Front Passenger (msec)	Unknown
Frontal Air Bag, Time to Second Stage Deployment, Front Passenger (msec)	Unknown
Frontal Air Bag, Time to Third Stage Deployment (Vent), Front Passenger (msec)	Unknown
Frontal Air Bag, Second Stage Disposal, Front Passenger	No Disposal
Frontal Air Bag, Third Stage Disposal (Vent), Front Passenger	No Disposal
Side Air Bag, Time to Deployment First Stage, Driver (msec)	Unknown
Side Curtain/Tube Air Bag,Time to Deployment, Driver Side (msec)	106
Pretensioner, Time to Deploy, Driver (msec)	82
Knee Bag, Time to Deploy, Driver (msec)	82
Side Air Bag, Time to Deployment First Stage, Front Passenger (msec)	Unknown
Side Curtain/Tube Air Bag, Time to Deployment, Passenger Side (msec)	Unknown
Pretensioner, Time to Deploy, Front Passenger (msec)	Unknown
Knee Bag, Time to Deploy, Front Passenger (msec)	Unknown

Fraud investigation example 1

Most relevant data:

- Pre-crash data: vehicle was stationary for 2 seconds, full gas and steered to the right;
- No braking;
- Visual inspection: full front AB deployment and left curtain, light front damage;
- Reported damages match with the previous reported crash event.

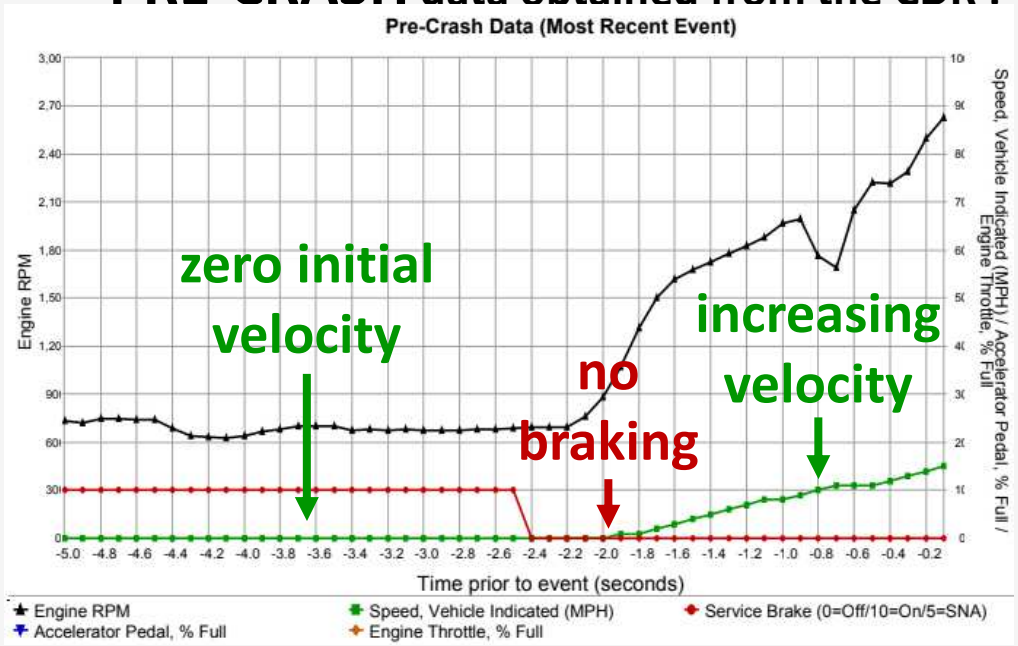
The car most likely was never fully repaired after the first crash event and the car owner tried to get twice the money to fix the car from the insurance company

Fraud investigation example 2

- Maserati Ghibli 2015.
- Driver statement: a wild animal suddenly appeared and I tried to maneuver to avoid it, hit a tree.

CDR for fraud investigation example 2

- **PRE-CRASH** data obtained from the CDR :



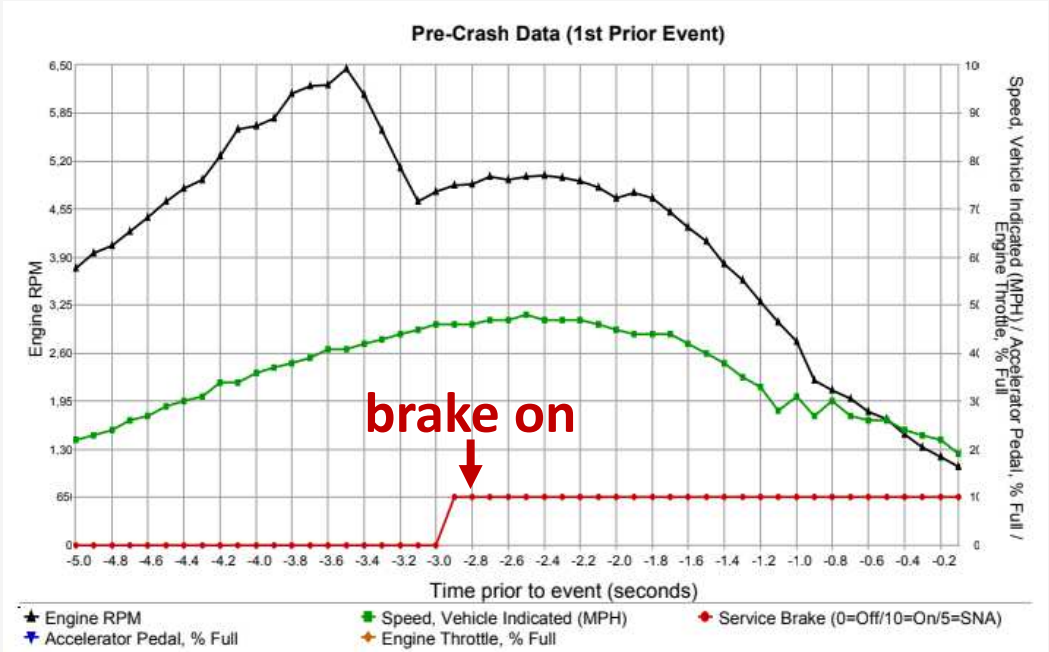
no steering

Time Stamp (sec)	Yaw Rate (deg/sec)
-5.0	0
-4.9	0
-4.8	0
-4.7	0
-4.6	0
-4.5	0
-4.4	0
-4.3	0
-4.2	0
-4.1	0
-4.0	0
-3.9	0
-3.8	0
-3.7	0
-3.6	0
-3.5	0
-3.4	0
-3.3	0
-3.2	0
-3.1	0
-3.0	0
-2.9	0
-2.8	0
-2.7	0
-2.6	0
-2.5	0
-2.4	0
-2.3	0
-2.2	0
-2.1	0
-2.0	0
-1.9	0
-1.8	0
-1.7	0
-1.6	0
-1.5	0
-1.4	0
-1.3	0
-1.2	0
-1.1	0
-1.0	0
-0.9	0
-0.8	0
-0.7	1
-0.6	2
-0.5	3
-0.4	1
-0.3	1
-0.2	1
-0.1	1

Driver declaration: frontal crash while avoiding an obstacle

CDR for fraud investigation example 2

- Pre-crash data of the **PREVIOUS MEMORIZED EVENT:**



significant steering

Time Stamp (sec)	Yaw Rate (deg/sec)	Steering Input (deg)
-5.0	0	0
-4.9	0	-1
-4.8	0	-3
-4.7	0	-3
-4.6	0	-4
-4.5	0	-5
-4.4	0	-5
-4.3	0	-4
-4.2	0	-3
-4.1	0	-3
-4.0	0	-3
-3.9	0	-3
-3.8	0	-3
-3.7	0	-3
-3.6	0	-3
-3.5	0	-2
-3.4	0	-2
-3.3	0	-2
-3.2	0	-3
-3.1	0	-4
-3.0	0	-4
-2.9	0	-5
-2.8	0	-5
-2.7	0	-5
-2.6	0	-4
-2.5	0	-4
-2.4	0	-1
-2.3	0	7
-2.2	1	18
-2.1	3	38
-2.0	9	71
-1.9	11	109
-1.8	10	134
-1.7	11	146
-1.6	14	170
-1.5	21	185
-1.4	26	183
-1.3	33	172
-1.2	32	149
-1.1	16	138
-1.0	17	118
-0.9	6	126
-0.8	12	134
-0.7	21	136
-0.6	20	142
-0.5	16	141
-0.4	16	140
-0.3	23	139
-0.2	25	146
-0.1	21	135

CDR for fraud investigation example 2

Crash data general information:

System Status at Event (Most Recent Event)

Complete File Recorded	Yes
Safety Belt Status, Driver	Not Buckled
Safety Belt Status, Outboard Front Passenger	Not Buckled
Airbag Warning Lamp, On/Off	Off
Seat Track Position Switch, Foremost, Status, Driver	No
Seat Track Position Switch, Foremost, Status, Outboard Front Passenger	No
Maximum Delta-V Longitudinal (MPH [km/h])	-17.4 [-28]
Time, Maximum Delta-V, Longitudinal (msec)	228
Maximum Delta-V Lateral (MPH [km/h])	0.6 [1]
Time, Maximum Delta-V, Lateral (msec)	86
Time, Operation System Time (sec)	1567243
Time, Airbag Warning Lamp On (min)	0
Event Number	2
Total Number of Events Recorded	2
Multi-Event, Number of Events (1,2)	1
Time from Event 1 to 2 (sec)	> 5
Operation Via Energy Reserve Only (Yes, No)	No
Supply Voltage at Event, ECU (V)	14.7
Temperature, Outside (deg C)	[illegible]
Odometer at Event (km)	15874.8
Ignition Cycle, Crash	[illegible]

System Status at Event (1st Prior Event)

Complete File Recorded	Yes
Safety Belt Status, Driver	Not Buckled
Safety Belt Status, Outboard Front Passenger	Not Buckled
Airbag Warning Lamp, On/Off	Off
Seat Track Position Switch, Foremost, Status, Driver	No
Seat Track Position Switch, Foremost, Status, Outboard Front Passenger	No
Maximum Delta-V Longitudinal (MPH [km/h])	-15.5 [-25]
Time, Maximum Delta-V, Longitudinal (msec)	288
Maximum Delta-V Lateral (MPH [km/h])	-2.5 [-4]
Time, Maximum Delta-V, Lateral (msec)	102
Time, Operation System Time (sec)	1459886
Time, Airbag Warning Lamp On (min)	0
Event Number	1
Total Number of Events Recorded	2
Multi-Event, Number of Events (1,2)	1
Time from Event 1 to 2 (sec)	> 5
Operation Via Energy Reserve Only (Yes, No)	No
Supply Voltage at Event, ECU (V)	14.2
Temperature, Outside (deg C)	[illegible]
Odometer at Event (km)	15208.3
Ignition Cycle, Crash	[illegible]

second crash event only after around 666 km

CDR for fraud investigation example 2

most relevant data last event:

- Zero speed for 2,5 s followed by an acceleration
- no braking, no tyre defects
- no steering,
- distance between last and previous event: 666,5 km

Case is similar to example 1.

The car was never fully repaired after the first crash event and the owner tries to get twice the money from the insurance company faking a second accident.

The car most likely was never fully repaired but only "dressed up" as we call the process.

Fraud investigation example 3

- Mazda CX-5 2014
- Statement driver: I lost control and car hit a tree, accident happened at a remote spot no emergency services at scene, had to take care for himself;
- No witness;
- No injuries.

Fraud investigation example 3

CDR File Information

User Entered VIN	JM3KE4CY7E0******
User	
Case Number	
EDR Data Imaging Date	01/21/2016
Crash Date	11/11/2111
Filename	MAZDA_CX5.CDRX
Saved on	Thursday, January 21 2016 at 11:05:50
Collected with CDR version	Crash Data Retrieval Tool 16.4
Reported with CDR version	Crash Data Retrieval Tool 16.4
EDR Device Type	Airbag Control Module
Event(s) recovered	Event Record 1, Event Record 2

Fraud investigation example 3

System Status at Event (Event Record 1)

Safety Belt Status, Driver	Belted
Safety Belt Status, Right Front Passenger	Unbelted
Occupant Size Classification, Front Passenger	Not Adult
Frontal Air Bag Warning Lamp (On, Off)	Off
Ignition Cycle, Crash	2419
Multi-Event, Number of Events (1, 2)	No. 1
Complete File Recorded (Yes/No)	Yes
Ignition Cycle, Download	4066
Maximum Delta-V, Longitudinal (MPH [km/h])	0.0 [0]
Time, Maximum Delta-V, Longitudinal (msec)	30.0
Maximum Delta-V, Lateral (MPH [km/h])	0.0 [0]
Time, Maximum Delta-V, Lateral (msec)	32.5
Time, Maximum Delta-V, Resultant (msec)	30.0
Time from Event 1 to 2 (sec)	SNA

System Status at Event (Event Record 2)

Safety Belt Status, Driver	Belted
Safety Belt Status, Right Front Passenger	Belted
Occupant Size Classification, Front Passenger	Not Adult
Frontal Air Bag Warning Lamp (On, Off)	Off
Ignition Cycle, Crash	4057
Multi-Event, Number of Events (1, 2)	No. 1
Complete File Recorded (Yes/No)	Yes
Ignition Cycle, Download	4066
Maximum Delta-V, Longitudinal (MPH [km/h])	-37.3 [-60]
Time, Maximum Delta-V, Longitudinal (msec)	100.0
Maximum Delta-V, Lateral (MPH [km/h])	3.1 [5]
Time, Maximum Delta-V, Lateral (msec)	57.5
Time, Maximum Delta-V, Resultant (msec)	100.0
Time from Event 1 to 2 (sec)	SNA

CDR for fraud investigation example 3

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1)
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	Engine Throttle, % full	Service Brake (On, Off)
-5.0	11 [18]	0	Off
-4.5	10 [16]	0	Off
-4.0	9 [15]	0	Off
-3.5	9 [14]	0	Off
-3.0	9 [14]	0	Off
-2.5	8 [13]	0	Off
-2.0	7 [12]	0	Off
-1.5	7 [12]	0	Off
-1.0	7 [11]	0	Off
-0.5	7 [11]	0	Off
0.0	6 [10]	0	Off

The drivers was standing next to his car in his suit without any wrinkles or any other signs that he was in that car during the accident. He told that he was at the time of accident alone in car and no emergency service has been on the scene.
Fraud ???????

Deployment Command Data (Event Record 2)

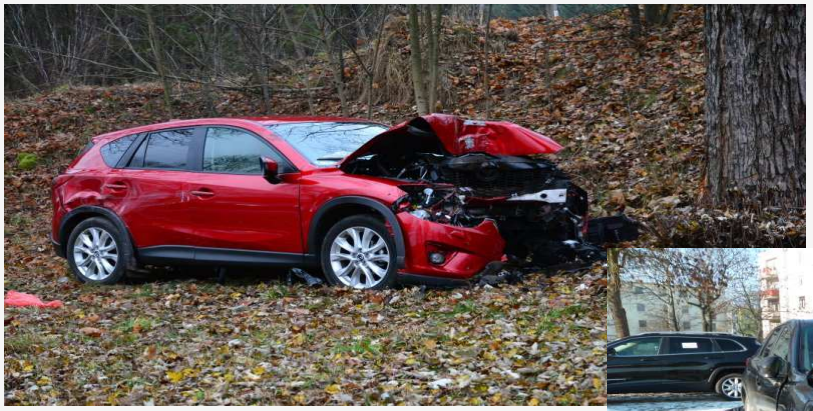
Pretensioner Deployment, Time to Fire, Driver (msec)	8
Pretensioner Deployment, Time to Fire, Right Front Passenger (msec)	SNA
Frontal Air Bag Deployment, Time to Deploy/First Stage, Driver (msec)	12
Frontal Air Bag Deployment, Time to Deploy/First Stage, Right Front Passenger (msec)	SNA
Side Air Bag Deployment, Time to Deploy, Driver (msec)	44
Side Air Bag Deployment, Time to Deploy, Right Front Passenger (msec)	SNA
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Driver Side (msec)	44
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Right Side (msec)	SNA
Frontal Air Bag Deployment, 2nd Stage Disposal, Driver (Yes/No)	No
Frontal Air Bag Deployment, 2nd Stage Disposal, Right Front Passenger (Yes/No)	No
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (msec)	17
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (msec)	SNA

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 2)
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	Engine Throttle, % full	Service Brake (On, Off)
-5.0	42 [68]	31	Off
-4.5	42 [68]	0	Off
-4.0	42 [68]	8	Off
-3.5	42 [68]	9	Off
-3.0	42 [67]	6	Off
-2.5	42 [67]	0	Off
-2.0	41 [66]	0	Off
-1.5	40 [65]	0	Off
-1.0	40 [65]	0	Off
-0.5	39 [63]	0	Off
0.0	37 [60]	0	On

Fraud investigation example 3

Damage comparising with same type of car. In this red car where 2 heavenly injured passengers. Look for any differences!



Accident examples

Example 1 – Accident Case

Example 1 – Accident Case

Information retrieved from Crime scene

- *4 deceased*
- *1 injured*
- *Maximum speed: 30 km/h*

Information retrieved from the CDR in the Dodge Ram

- *Speed 5 seconds before impact*
- *147 km/h*
- *Impact speed: 86 km/h*

Example 1 – EDR Data

BOSCH

CDR CRASH DATA RETRIEVAL SYSTEM

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CDR File Information

User Entered VIN	1D3HV13T69J506012
User	jeroen van Essen / hans Bot
Case Number	2009 438468-13
EDR Data Imaging Date	woensdag, januari 27 2010
Crash Date	zaterdag, december 26 2009
Filename	DODGE 4-VBH-27 1D3HV13T69J506012 ACM.CDR
Saved on	woensdag, januari 27 2010 at 10:43:05
Collected with CDR version	Crash Data Retrieval Tool 3.4
Reported with CDR version	Crash Data Retrieval Tool 3.4
EDR Device Type	airbag control module
Event(s) recovered	Most Recent Event

Comments

nieuwe uitlezing ivm softwareupdate 3.4

bandenmaat 275 / 60 R20

Data Limitations

AIRBAG CONTROL MODULE (ACM) DATA LIMITATIONS:

Pre-Crash Data (Most Recent Event - table 1 of 5)

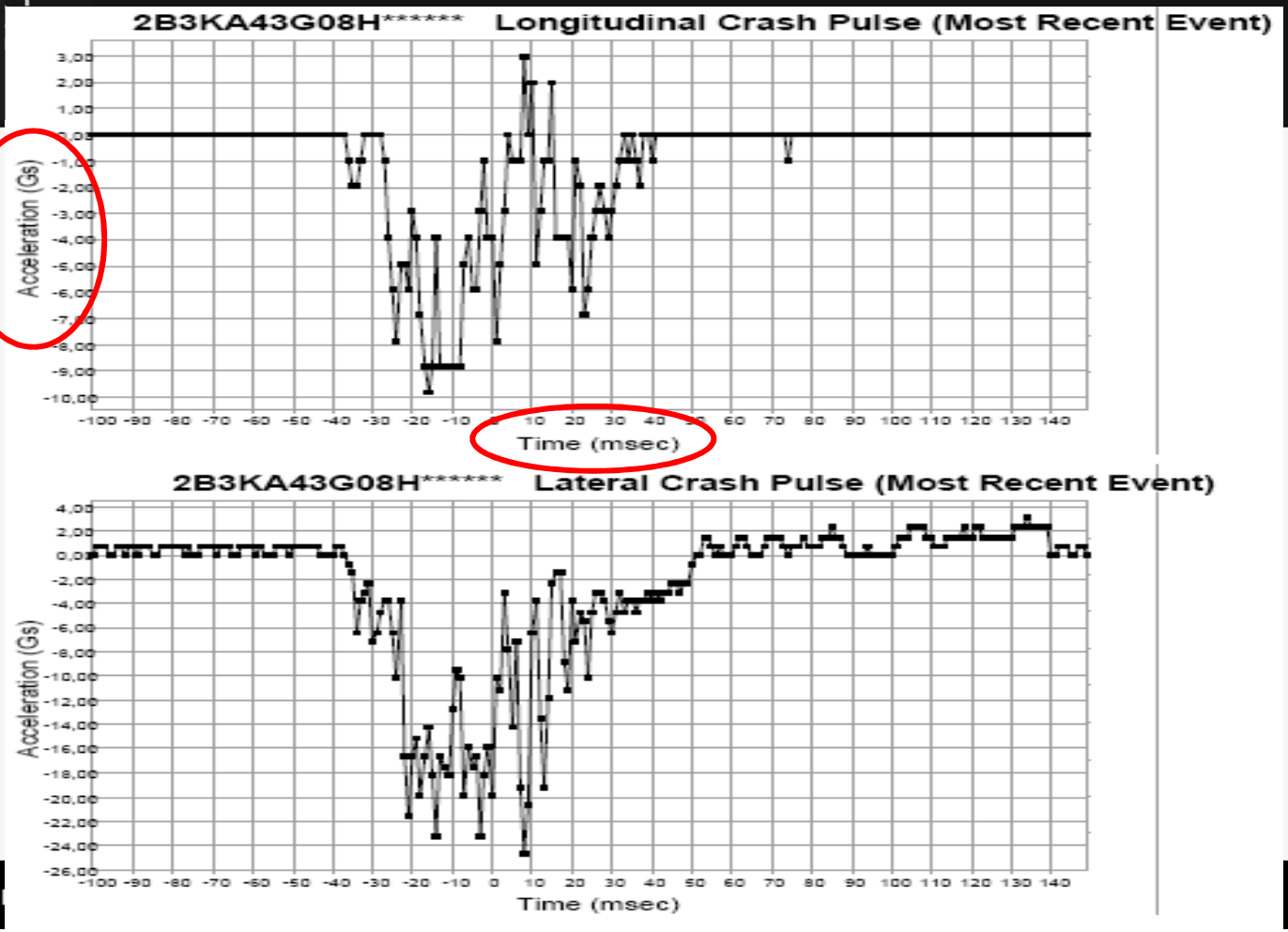
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	R	Speed, Vehicle Indicated (MPH [km/h])		Engine Throttle, % Full	Accelerator Pedal, % Full	Raw Manifold Pressure (kPa)	Service Brake	Brake Switch #2 Status	Brake Lamps On
-5,0	C			9,8	0,0	54	Off	Open	No
-4,9	C			8,7	0,0	30	Off	Open	No
-4,8	C	91 [147]		8,3	0,0	22	Off	Open	No
-4,7	C			7,9	0,0	19	Off	Open	No
-4,6	C	91 [147]		7,5	0,0	18	On	Closed	Yes
-4,5	Complete	3.648	90 [145]	7,1	0,0	16	On	Closed	Yes
-4,4	Complete	3.552	89 [144]	6,7	0,0	15	On	Closed	Yes
-4,3	Complete	3.328	89 [143]	6,3	0,0	14	On	Closed	Yes
-4,2	Complete	3.072	88 [142]	5,5	0,0	14	On	Closed	Yes
-4,1	Complete	2.816	88 [141]	5,1	0,0	14	On	Closed	Yes
-4,0	Complete	2.560	86 [139]	4,3	0,0	14	On	Closed	Yes
-3,9	Complete	2.528	86 [138]	3,9	0,0	15	On	Closed	Yes
-3,8	Complete	2.496	85 [137]	3,9	0,0	15	On	Closed	Yes
-3,7	Complete	2.496	84 [135]	3,9	0,0	16	On	Closed	Yes
-3,6	Complete	2.496	83 [134]	3,9	0,0	16	On	Closed	Yes
-3,5	Complete	2.464	82 [132]	3,9	0,0	16	On	Closed	Yes
-3,4	Complete	2.400	81 [131]	3,9	0,0	16	On	Closed	Yes
-3,3	Complete	2.272	81 [130]	3,9	0,0	16	On	Closed	Yes
-3,2	Complete	2.176	80 [128]	3,5	0,0	17	On	Closed	Yes
-3,1	Complete	2.080	80 [128]	3,5	0,0	17	On	Closed	Yes
-3,0	Complete	2.016	80 [128]	3,5	0,0	18	On	Closed	Yes
-2,9	Complete	1.984	79 [127]	3,5	0,0	18	On	Open	Yes
-2,8	Complete	1.952	79 [127]	3,1	0,0	18	Off	Open	No
-2,7	Complete	1.952	79 [127]	3,1	0,0	18	Off	Open	No
-2,6	Complete	1.952	78 [126]	3,1	0,0	17	Off	Open	No
-2,5	Complete	1.920	78 [126]	5,9	4,7	18	Off	Open	No
-2,4	Complete	2.112	78 [126]	9,1	11,4	25	Off	Open	No
-2,3	Complete	2.240	78 [126]	10,2	12,6	34	Off	Open	No
-2,2	Complete	2.240	78 [126]	10,6	12,6	42	Off	Open	No
-2,1	Complete	2.208	78 [125]	10,6	12,6	46	Off	Open	No
-2,0	Complete	2.208	78 [125]	10,2	12,6	49	Off	Open	No
-1,9	Complete	2.144	78 [125]	10,2	12,6	43	Off	Open	No
-1,8	Complete	2.112	78 [125]	8,7	9,8	35	Off	Open	No
-1,7	Complete	2.112	78 [125]	4,3	0,0	30	On	Closed	Yes
-1,6	Complete	2.112	77 [124]	4,3	0,0	26	On	Closed	Yes
-1,5	Complete	2.080	76 [123]	3,9	0,0	22	On	Closed	Yes
-1,4	Complete	2.080	76 [122]	3,5	0,0				
-1,3	Complete	2.016	74 [119]	3,1	0,0				
-1,2	Complete	1.952	72 [116]	3,1	0,0				
-1,1	Complete	1.888	69 [111]	3,1	0,0	19	On	Closed	Yes
-1,0	Complete	1.824	66 [106]	2,8	0,0	18	On	Closed	Yes
-0,9	Complete	1.760	67 [108]	2,8	0,0	18	On	Closed	Yes
-0,8				2,8	0,0	18	On	Closed	Yes
-0,7		58 [93]		2,8	0,0	18	On	Closed	Yes
-0,6				2,4	0,0	18	On	Closed	Yes
-0,5		56 [90]		2,4	0,0	18	On	Closed	Yes
-0,4				2,4	0,0	18	On	Closed	Yes
-0,3		53 [86]		2,4	0,0	18	On	Closed	Yes
-0,2				2,4	0,0	18	On	Closed	Yes
-0,1				2,4	0,0	19	On	Closed	Yes

Pre-Crash Data (Most Recent Event - table 2 of 5)

(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Panic Brake Assist Active (If equip.)			ESP Lamp (If equip.)	ESP Lamp Flashing Requested (If equip.)	ESP Disabled (If equip.)	Traction Control Button (If equip.)	ESP Active (If equip.)
-5,0				No	No	No	Off	Yes
-4,9				No	No	No	Off	Yes
-4,8				No	No	No	Off	Yes
-4,7				No	No	No	Off	Yes
-4,6				No	No	No	Off	Yes
-4,5				No	No	No	Off	Yes
-4,4				No	No	No	Off	Yes
-4,3				No	No	No	Off	Yes
-4,2				No	No	No	Off	Yes
-4,1				No	No	No	Off	Yes
-4,0	No	Off	Off	No	No	No	Off	Yes
-3,9	No	Off	Off	No	No	No	Off	Yes
-3,8	No	Off	Off	No	No	No	Off	Yes
-3,7	No	Off	Off	No	No	No	Off	Yes
-3,6	No	Off	Off	No	No	No	Off	Yes
-3,5	No	Off	Off	No	No	No	Off	Yes
-3,4	No	Off	Off	No	No	No	Off	Yes
-3,3	No	Off	Off	No	No	No	Off	Yes
-3,2	No	Off	Off	No	No	No	Off	Yes
-3,1	No	Off	Off	No	No	No	Off	Yes
-3,0	No	Off	Off	No	No	No	Off	Yes
-2,9	No	Off	Off	No	No	No	Off	Yes
-2,8	No	Off	Off	No	No	No	Off	Yes
-2,7	No	Off	Off	No	No	No	Off	Yes
-2,6	No	Off	Off	No	No	No	Off	Yes
-2,5	No	Off	Off	No	No	No	Off	Yes
-2,4	No	Off	Off	No	No	No	Off	Yes
-2,3	No	Off	Off	No	No	No	Off	Yes
-2,2	No	Off	Off	No	No	No	Off	Yes
-2,1	No	Off	Off	No	No	No	Off	Yes
-2,0	No	Off	Off	No	No	No	Off	Yes
-1,9	No	Off	Off	No	No	No	Off	Yes
-1,8	No	Off	Off	No	No	No	Off	Yes
-1,7	No	Off	Off	No	No	No	Off	Yes
-1,6	No	Off	Off	No	No	No	Off	Yes
-1,5	No	Off	Off	No	No	No	Off	Yes
-1,4	No	Off	Off	No	No	No	Off	Yes
-1,3	No	Off	Off	No	No	No	Off	Yes
-1,2	-1,1	No		No	No	No	Off	Yes
-1,1	-1,0	No		No	No	No	Off	Yes
-1,0	-0,9	No		No	No	No	Off	Yes
-0,9	-0,8	Yes		No	No	No	Off	Yes
-0,8	-0,7	Yes		No	No	No	Off	Yes
-0,7	-0,6	Yes		No	No	No	Off	Yes
-0,6	-0,5	Yes		No	No	No	Off	Yes
-0,5	-0,4	Yes		No	No	No	Off	Yes
-0,4	-0,3	Yes		No	No	No	Off	Yes
-0,3	Yes	Off	Off	No	No	No	Off	Yes
-0,2	Yes	Off	Off	No	No	No	Off	Yes
-0,1	No	Off	Off	No	No	No	Off	Yes

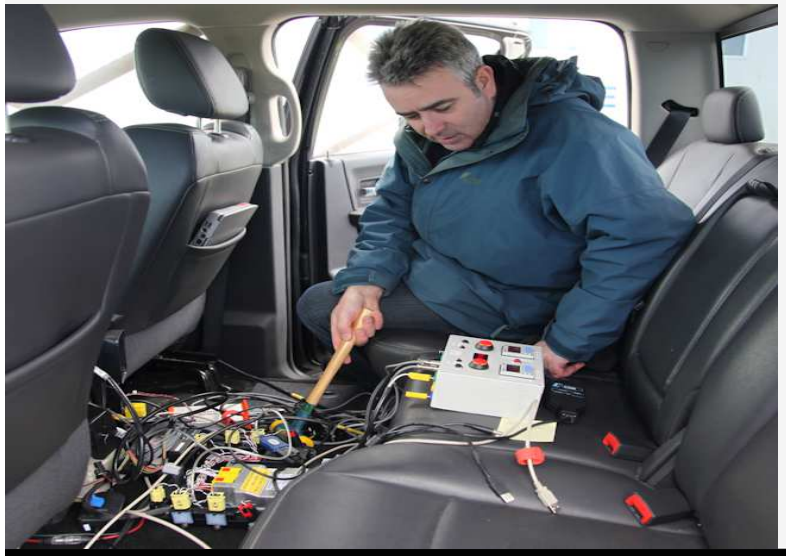


Example 1 - Data Validation

- *To validate the data from the EDR, a full scale reconstruction of the vehicle movements have been performed;*
- *Location: the runway of an old military airfield;*
- *In corporation with NFI, TRW (ECU supplier of Dodge);*
- *The investigating judge, the prosecutor and the lawyer of the accused were*

Example 1 - Data Validation

- *The exact data frames at 147 km/h were reproduced.*
- *Vehicle computers run at 500kps and transmit 16bit data frames*



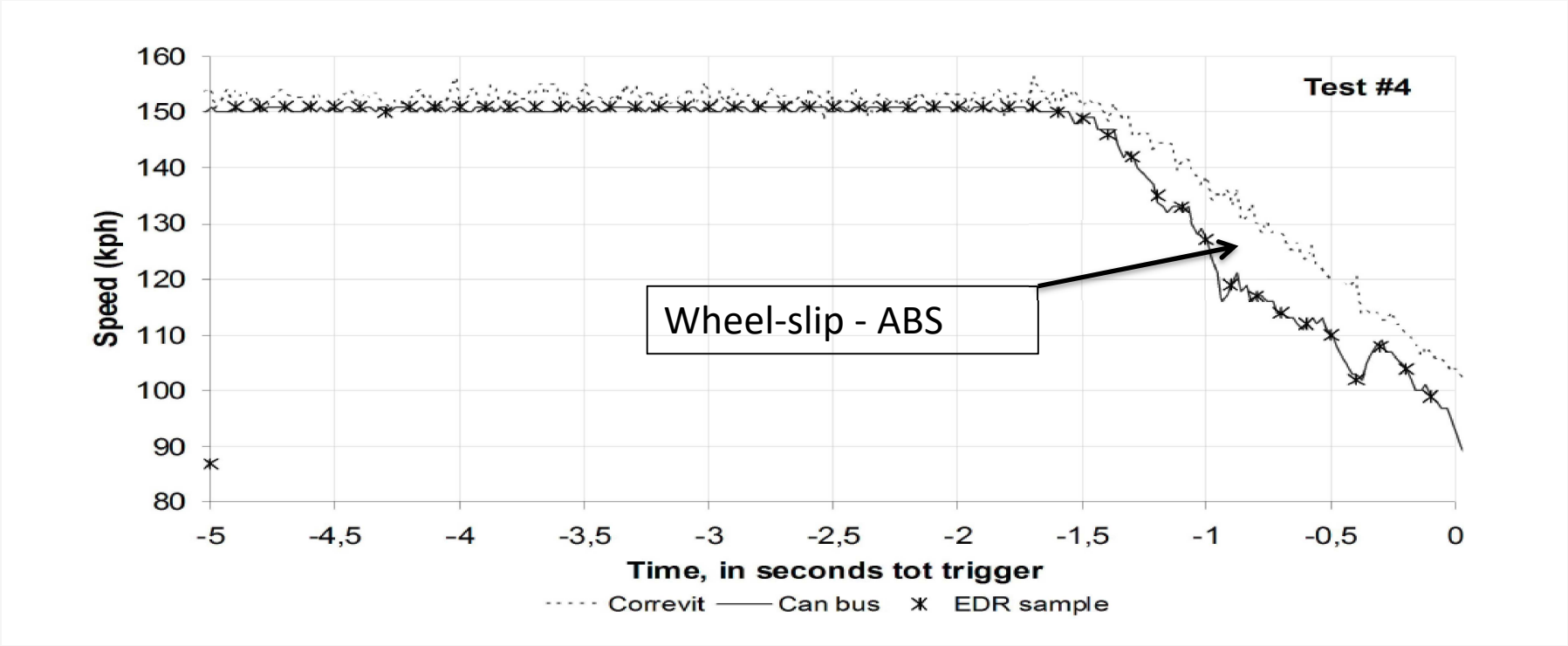
Example 1 - Data Validation

Data transfer of real-time speed within external CAN BUS network

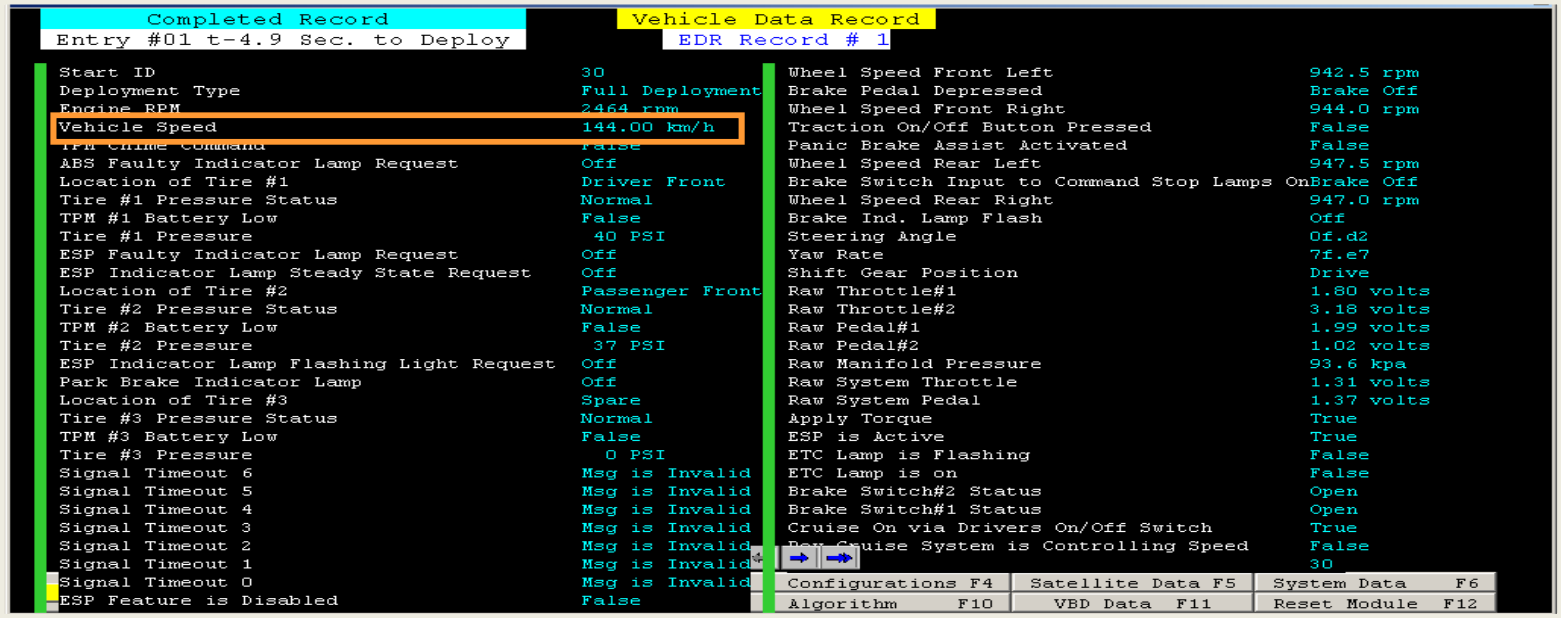
500KPS Optical speed Measuring

Example 1 - Data Validation

Data transfer of real-time speed within external CAN-BUS network



TRW SOFTWARE



The above screen shot is an abstract of a TRW EDR from a detected crash with full deployment. The screen shot is from the TRW PTM Tool. In orange highlighted is the velocity of 144.0 km/h freeze at 4.9 ms prior crash discrimination.

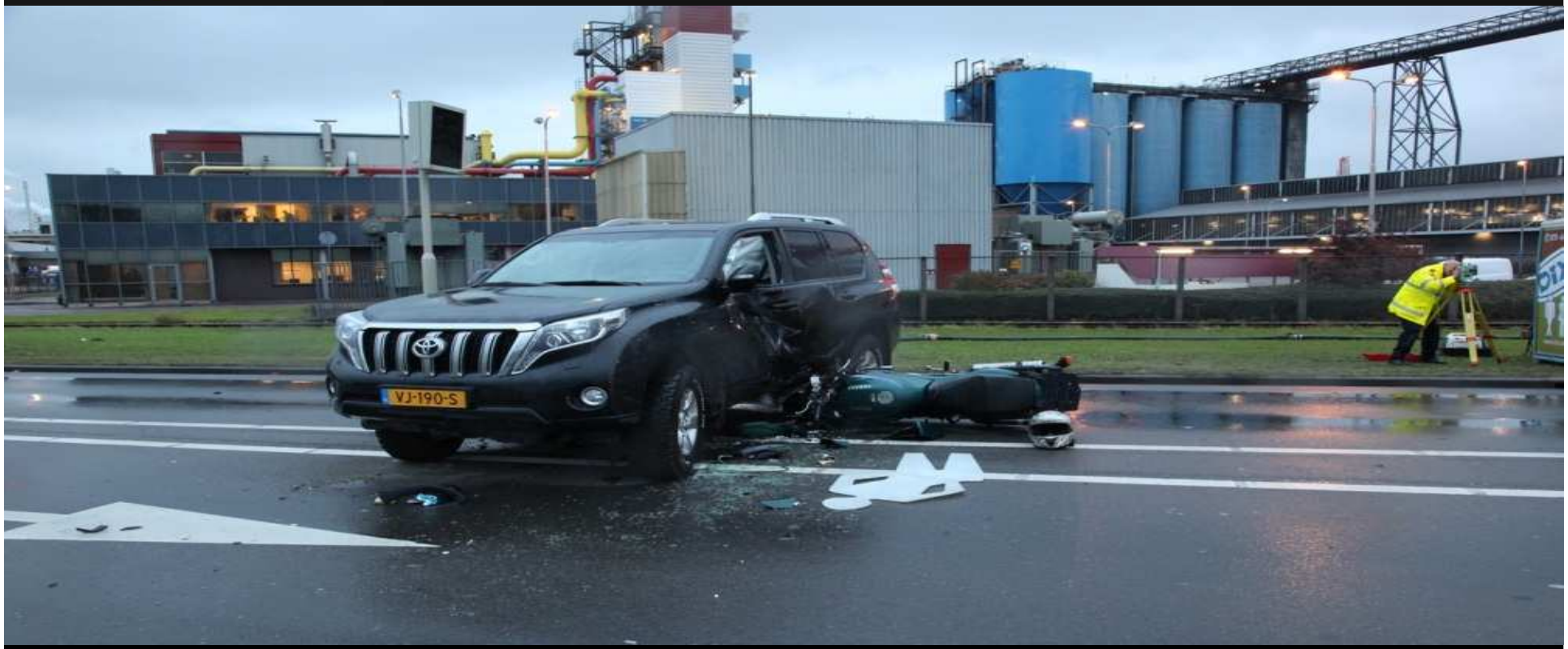
Example 1 - Court Judgement

- *Data Accepted in Court as evidence*
  - *Speed of the Dodge: 147 km/h*
  - *Speed Limit: 30 km/h*
- *Verdict*
  - *The driver of the Dodge Ram is guilty*
  - *Sentence*
    - *9 Years Prison (8 year after appeal)*
    - *10 Years suspension of driving license*

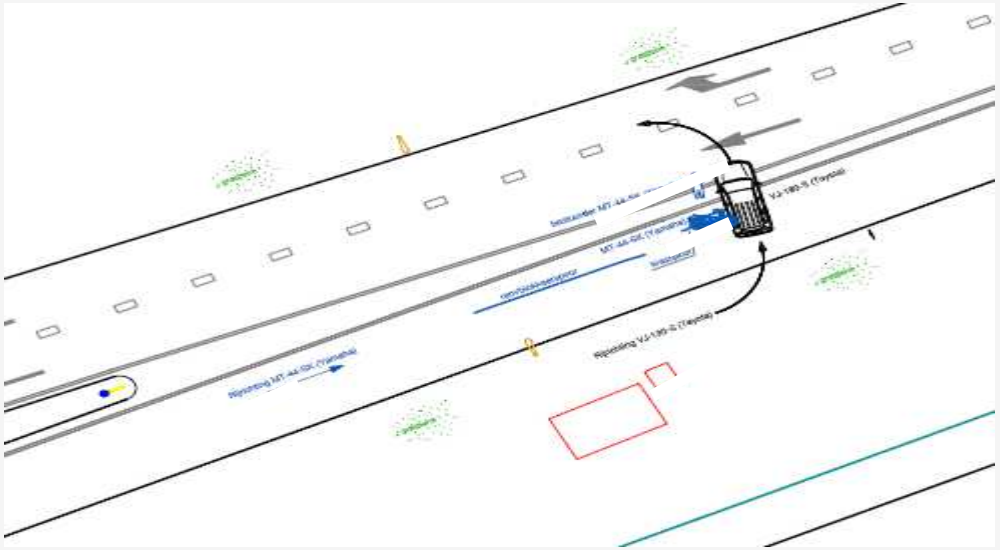
Example 2- EDR CASE 2

- *The Toyota is exiting the right shoulder of the road and want to turn his car in opposite direction.*
- *Motorbike is driving on the road and is confronted with the turning car in front of him.*
- *Driver motorbike is braking full with blocked wheels , falls on to the left side and slides into the left side of the turning car.*
- *Motorbike driver is seriously injured.*
- *Reconstruction Issues: How fast was the motorbike going at the time of the impact?*

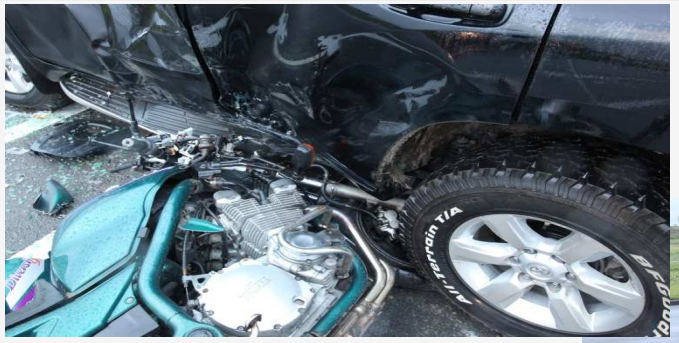
Example 2 - Case Study Using Toyota Data

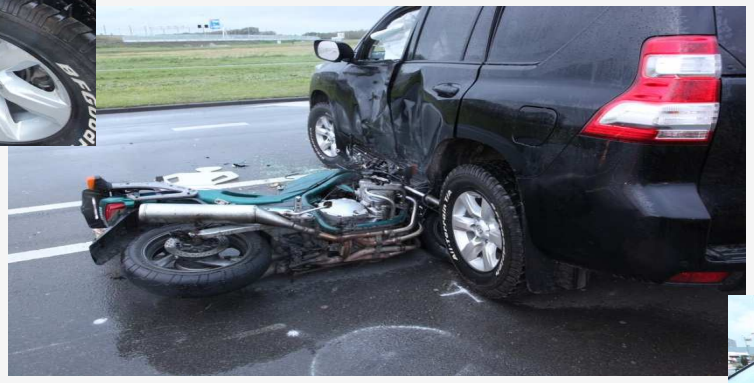


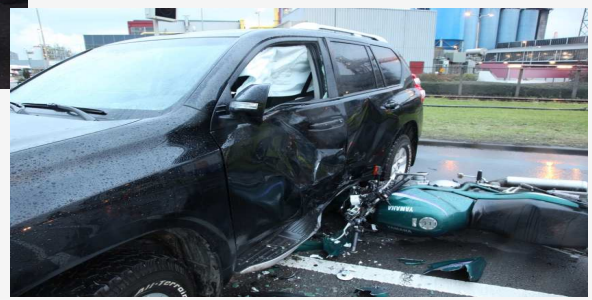
Example 2 - Accident scene



Example 2 - Impacts







Example 2 – Damaged vehicles

Example 2 – EDR report

BOSCH

CDR CRASH DATA RETRIEVAL

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CDR File Information

User Entered VIN	JTEBH3FJ00K117435
User	M. Huijsmans, J. van Essen, H. Bot
Case Number	2014 425988-3
EDR Data Imaging Date	10-21-2014
Crash Date	10-21-2014
Filename	JTEBH3FJ00K117435_ACM.CDRX
Saved on	dinsdag, oktober 21 2014 at 10:33:55
Collected with CDR version	Crash Data Retrieval Tool 14.1
Reported with CDR version	Crash Data Retrieval Tool 14.1
EDR Device Type	Airbag Control Module
Event(s) recovered	Side (1)

Comments

bandenmaat: 265/70r17 bf Goodrich

Example 2 – EDR report

BOSCH

CDR CRASH DATA RETRIEVAL

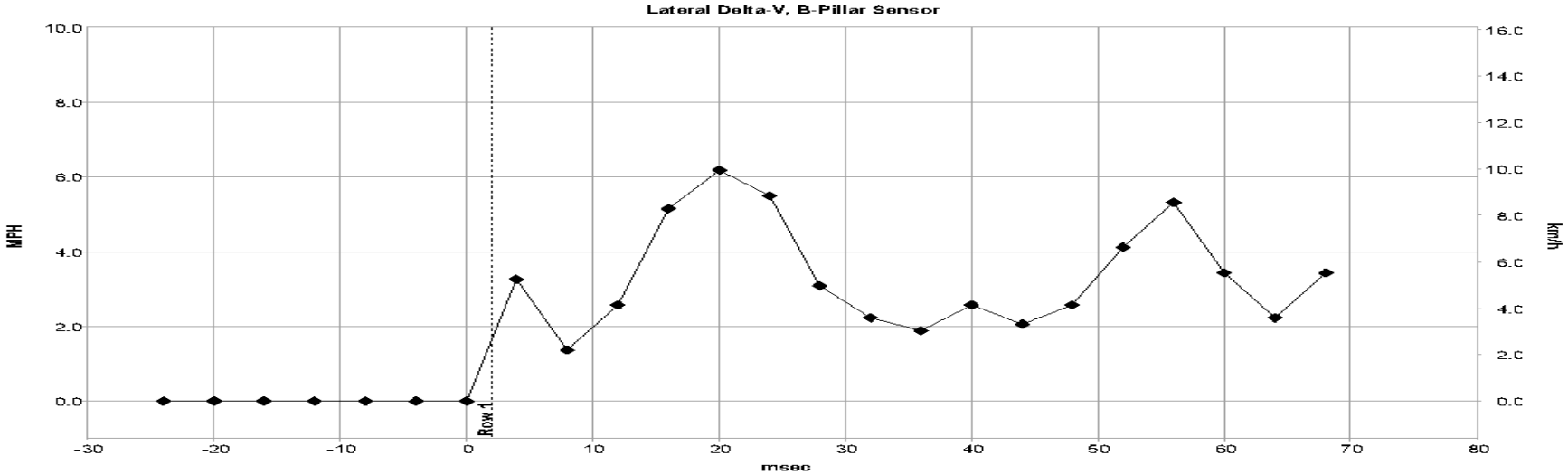
System Status at Time of Retrieval

ECU Part Number	89170-60451
ECU Generation	06EDR
Recording Status, All Pages	Complete
Freeze Signal	ON
Freeze Signal Factor	None
Diagnostic Trouble Codes Exist	No
Time from Previous Pre Crash TRG (msec)	16381 or greater
Latest Pre-Crash Page	0
Contains Unlinked Pre-Crash Data	No

Event Record Summary at Retrieval

Events Recorded	TRG Count	Crash Type	Time (msec)	Pre-Crash & DTC Data Recording Status	Event & Crash Pulse Data Recording Status
Most Recent Event	1	Side Crash	0	Complete (Page 0)	Complete (Side Page 0)

Example 2 – EDR report



Lateral Crash Pulse (Most Recent Event, TRG 1 - table 1 of 2)

Recording Status, Time Series Data	Complete
Time from TRG to Next Sample (msec)	0
Max Lateral Delta-V, B-Pillar Sensor (MPH [km/h])	6.2 [9.9]
Max Lateral Delta-V, C-Pillar Sensor (MPH [km/h])	5.0 [8.0]

Example 2 – EDR report

Lateral Crash Pulse (Most Recent Event, TRG 1 - table 2 of 2)

Time (msec)	Lateral Delta-V, Airbag ECU Sensor (MPH [km/h])	Lateral Delta-V, B-Pillar Sensor (MPH [km/h])	Lateral Delta-V, C-Pillar Sensor (MPH [km/h])
-24	0.0 [0.0]	0.0 [0.0]	0.0 [0.0]
-20	0.0 [0.0]	0.0 [0.0]	0.0 [0.0]
-16	0.0 [0.0]	0.0 [0.0]	0.0 [0.0]
-12	0.0 [0.0]	0.0 [0.0]	0.0 [0.0]
-8	0.0 [0.1]	0.0 [0.0]	0.0 [0.0]
-4	0.1 [0.1]	0.0 [0.0]	-0.1 [-0.1]
0	0.2 [0.4]	0.0 [0.0]	-0.1 [-0.1]
4	0.6 [1.0]	3.3 [5.2]	0.0 [0.0]
8	0.7 [1.1]	1.4 [2.2]	0.3 [0.6]
12	1.5 [2.5]	2.6 [4.1]	0.9 [1.5]
16	2.2 [3.5]	5.1 [8.3]	1.3 [2.1]
20	2.7 [4.4]	6.2 [9.9]	1.7 [2.8]
24	3.5 [5.6]	5.5 [8.8]	2.7 [4.4]
28	3.5 [5.7]	3.1 [5.0]	3.0 [4.8]
32	3.2 [5.1]	2.2 [3.6]	3.8 [6.1]
36	2.6 [4.1]	1.9 [3.0]	3.3 [5.2]
40	2.6 [4.1]	2.6 [4.1]	3.8 [6.1]
44	2.7 [4.4]	2.1 [3.3]	4.1 [6.6]
48	3.2 [5.1]	2.6 [4.1]	4.8 [7.7]
52	3.2 [5.1]	4.1 [6.6]	4.9 [7.9]
56	3.6 [5.8]	5.3 [8.6]	5.0 [8.0]
60	4.0 [6.5]	3.4 [5.5]	5.0 [8.0]
64	3.9 [6.2]	2.2 [3.6]	4.8 [7.7]
68	3.9 [6.2]	3.4 [5.5]	4.7 [7.6]

Example 2 – How much data?

- *The EDR had 6 data points of speed, brake, accel pedal and RPM – 5@1 sec intervals and the 6th data point at first event AE.*
- *Lateral Delta V Airbag ECU sensor 3,9 mph (6,2 kph) for side impact and graph and data table for 110ms at 10ms intervals.*
- *Lateral Delta V B and C pillar. We will not use these.*
- *No DTC's present at time of event.*
- *Driver safety belt was buckled.*

Example 2 – EDR analysis

Was the Recording from My Crash?

- *The motorbike a Yamaha XJ 900 did not have any accessible data recorder.*
- *The Toyota Landcruiser has EDR and is supported by the Bosch Crash Data Retrieval System.*
- *Vehicle electrical appeared intact post crash.*
- *One (side) airbag driver side was recorded and freeze signal is on.*
- *Conclude data **is** from the event of interest based on Delta V matching up with facts.*

Example 2- Needed data for this Case

- *On the scene we found brake marks from the motorbike with a length of approximately 9 meters and slide marks of 4 meter.*
- *Weight of the Toyota is 2.340 kg and the Yamaha 270 kg*
- *EDR data Toyota*
- *Deceleration data motorbike 6m/s2 for braking and 2,5 m/s2 for sliding (wet road)*
- *For an side crash, Lateral Delta V and vehicle weights can give you closing speed.*

Example 2- Solution?

- *Toyota is hit perpendicularly by the Yamaha.*
- *Point of impact laterally of centre of mass.*
- *Toyota lateral speed before impact is assumed 0.*
- *Thus: lateral speed directly after impact = ΔV.*
- *Yamaha + driver keep pushing against the Toyota.*
- *Problem:*
  - *How much Yamaha-speed is needed for Toyota-ΔV?*
- *Answer:*
  - *Depends on weight ratio. How? -> see formula next page.*

Example 2- Formula

$$V_{Yamaha} = \left(1 + \frac{Mass_{Toyota}}{Mass_{Yamaha} + Mass_{MC\ driver}}\right) \Delta V_{Toyota}$$

So Yamaha speed is 5 to 6 times Toyota-delta-V

Example2 - What Can I do with it?

- *What we can do now is to use the speed calculation from the Delta V (closing speed) and the speed calculated from the brake and slide marks to get the actual driven speed of the motorbike.*
- *Closing speed was around 52 km/h*
- *Driven speed around 66 km/h*

Summary

- De facto all models sold in the US are equipped with EDR;
- Other models are equipped but manufacturers haven't yet given the key.
- EDR from **Volvo, Audi, Toyota** worldwide can be read;
- Others manufacturers will follow soon;
- **Technical freedom**: differences in how to retrieve data per model and model year; each model / model year has its own **data limitations and terminology** ;
- Specific knowledge is needed to retrieve and understand EDR data;
- Experts from the Dutch police initiated an European wide **training** scheme: **www.eudarts-group.com**
- European legislation under preparation;
- ADAS systems will be included;

Thank you for your attention

And don't forget to have a look at:

www.eudarts-group.com