EDR-DSSAD-01-04

Event Data Recorder (EDR)
&
Data Storage System for Automated Driving (DSSAD)

EDR & DSSAD : the origins

"Governments should consider he **causal factors** involved in road traffic safety incidents, such as **collisions**, or **traffic rule violations** with highly and fully automated vehicles to resolve legal issues."

(ECE/TRANS/WP.1/2018/4/Rev.3: WP.1 Resolution on the deployment of highly and fully automated vehicles in road traffic)

⇨ EDR :

" records, in a readily usable manner, data valuable for **effective crash investigations** and for analysis of safety equipment performance (e.g., advanced restraint systems). These data will help provide a better **understanding of the circumstances** in which crashes and injuries occur and will lead to safer vehicle designs."

(49 CFR 563 – USA)

NB : the concept and benefits of EDR function are similar for AD and « conventionnal » vehicles :

"For crash reconstruction purposes (including during testing), it is recommended that ADS data be stored, maintained, and readily available for retrieval **as is current practice**, including applicable privacy protections, for crash **event data recorders**. Vehicles should record, at a minimum, all available information relevant to the crash, so that the circumstances of the crash can be reconstructed."

(Automated Driving Systems 2.0 – A vision for safety – NHTSA)

⇨ DSSAD :

"These data should also contain **the status of the ADS and whether the ADS or the human driver was in control of the vehicle** leading up to, during, and immediately following a crash."

(Automated Driving Systems 2.0 – A vision for safety – NHTSA)

"It might be important to collect data in retrieval format about **who was in control and of what** throughout the operation in case of an unexpected event that could impact road traffic safety."

(WP1 – IGEAD – 07-04 – Guidance for AVs)

International background on EDR (simplified)

2006 : 49 CFR Part 563 established requirements for **Event Data Recorders** for Light Duty Vehicles

2008 : **EDR** is introduced in JAPAN for Light Duty Vehicles on voluntary basis

Table 1	Table 2
Mandatory data	Data mandatory only if available

Concept and requirements for EDR from CHINA are quite similar to those of the EDR from USA

2012 : NHTSA proposed **EDR** to be covered by a FMVSS.
NPRM was withdrawn in 2019.
EDR is considered as « State of the Art » in USA

2015 : **EDR** is introduced in SOUTH KOREA for Light Duty Vehicles (if fitted)

2016 : CHINA starts to work on a **new standard** for **EDR** for M1 & N1 vehicles

2018 : EUROPE incorporated **EDR** for M & N vehicles in GSR ph2

mandatory for M1 & N1 vehicles :
2022 NewTypes
2024 All Registered

mandatory for M2, N2, M3, N3 :
2025 NewTypes
2028 All Registered

2021 : mandatory application of STEP1

Basically incorporates data of « Table 1 »

2023 : mandatory application of STEP 2

Basically mandates data of « Table 2 »

2010 2015 2020 2025

Clear Differentiation DSSAD – DER

as presented in GRSG-116

Function (GRXX)	AD vehicles	Non-AD vehicles
Who is driving (GRVA)	**DSSAD regulation** • Continuous storage of specific AD data set • Wide time-window **OICA position :** ➢ sufficient for **ALKS** ➢ All categories	Non Applicable
Accident reconstruction (GRSG)	**EDR regulation** • Independant triggering system • Event-based storage • Narrow time window **OICA position :** ➢ M1 N1 → based on US CFR ➢ HCV → to be defined	

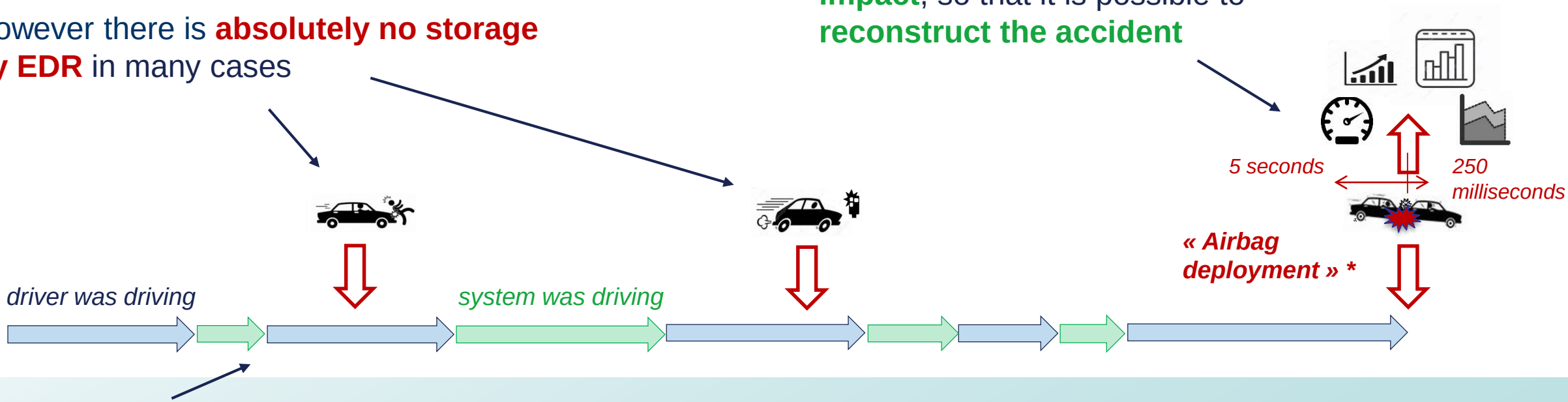
Key:
- **ALKS**: Automated Lane Keep System
- **HCV**: Heavy Commercial Vehicles
- **DSSAD**: Data Storage System for Automated Driving

EDR & DSSAD : different but however complementary :

BUT it is important to know if « driver or system was driving » **not only in the case of « crashes with airbag deployment ».**

However there is **absolutely no storage by EDR** in many cases

EDR stores the trace of **many valuable parameters, some of them continuous (= sampled)** a few seconds before a **significative impact**, so that it is possible to **reconstruct the accident**



DSSAD stores the trace of **« significative interaction between the AD system and the human driver »** so that it is possible to determine **whether the driver or the system was driving**, at any time within the last X months.

** The trigger of EDR is « variation of speed > 8 km/h within 150 ms », which is close to 1,5 G, and it is very similar to « airbag deployment condition »*

Why is EDR storage conditioned by a trigger ?

EDR storage is focused on a certain type of events *(basically « crashes with airbag deployment »)* because :

Accident analysis requires a large number of parameters,
some of them being **continuously variable.**

The limitation hides in the **storage capacity**.

The **privacy aspect** also needs to be considered.

***Sampling continuous parameters**, like EDR does, would mean **astronomical storage capacity** :*

*A « conventional » Event Data Recorder stores a **dozen** of parameters such as :*

*Vehicle speed (indicated by odometer) sampled @ 2 Hz during or 5 seconds = **10 values***

*Vehicle speed variation, sampled @ 100 Hz during 250 milliseconds = **25 values***

3 months** storage of **one parameter sampled @ 1 Hz** = **8.000.000 values

***Continuous** FR / RR / cockpit **video storage** covering a X month period would be **out of reach**, and...*

*…**continuous recording and storage** of video, location, speed, and/or surroundings of a vehicle seems to be contradictory with the regulations adressing **privacy protection**.*

*(a DSSAD that would **need consummer's approval** for recording and/or access to data and right to delete them would be **meaningless**)*

Why DSSAD storage can't be conditioned by a trigger ?

There are **many circumpstances** where the **need to know** if « **driver or system was (requested to be) in control of the driving task** » is **real**…

…**but** it is **impossible** to use the trigger of EDR *(« 1,5 G for 150 ms »)*, to cover **all the situations** :

A vehicle hits another vehicle.
***Big impact**, airbags are deployed.*
***EDR data** are **stored** and **retrievable** for analysis.*

*A **larger** vehicle hits a smaller vehicle, or a Passenger Car hits a **Vulnerable Road User**.*
*It may be a **small impact** for the larger vehicle, no airbag is deployed.*

***Absolutely no data** remains about the event.*

*A vehicle is blamed for **traffic offense**.*
No impact, no airbag is deployed.

***Absolutely no data** remains about the event.*

*A vehicle is blamed for an **unsafe manoeuver**.*
No impact, no airbag is deployed.

***Absolutely no data** remains about the event.*

A vehicle hits another vehicle.

*If it is a **small impact**, no airbag is deployed.*

***Absolutely no data** remains about the event.*

Why DSSAD storage can’t be conditioned by a trigger ?

What about « **another trigger** » **?**

It seems **difficult** to find triggers that would cover big impacts, small impacts, and manoeuvers that could be perceived as « unsafe » by other road users…

…and a **traffic offense cannot be detected**.

*Define a trigger @ **lower level of acceleration** ?*

***Success** when the system system detects the obstacle and engages an emergency manoeuver*

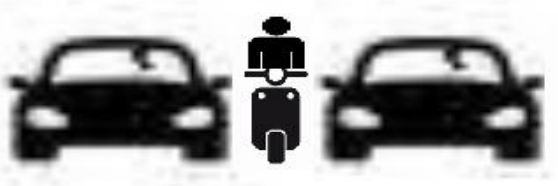
***Failure** when the system does not detect the obstacle and engages no preventive action*

*A **Traffic offense cannot be detected** by the system **itself** :*

« It would have known something is forbidden, it would not do it ! »

*Define a trigger that works for **Heavy Duty Vehicles** will be a **challenge***
(EDR is fitted on Light Duty Vehicles)

*Define a trigger based on **detection of targets near** the ego-vehicle ?*



*Would generate a lot of **false positive** and a lot of storage for nothing*

For DSSAD, a continuous storage makes more sense

DSSAD can operate a **continuous storage of a specific AD data set** so that it will **always** be able to **deliver the information** that will enable to know if **driver or system was (requested to be) in control of the driving task whenever** a specific event occured in the memorized time window, **whatever this event is.**

With or without detection by the system, with or without action by the system, with or without impact, with or without witness or involved tier…

The DSSAD must store a limited amount of useful data for a long period and must be able to deliver them when requested by an authorized entity.

Definition of the DSSAD as proposed by OICA in 2018 :

Definition :

The **D**ata **S**torage **S**ystem for **A**utomated **D**riving is a device or a function that :

records and stores a set of data (“timestamped flags”)

of any vehicle equipped with Level 3 / Level 4 / Level 5 Automated Driving Systems (ADS),

in order that **whenever a significant safety related event occurs,** it can provide

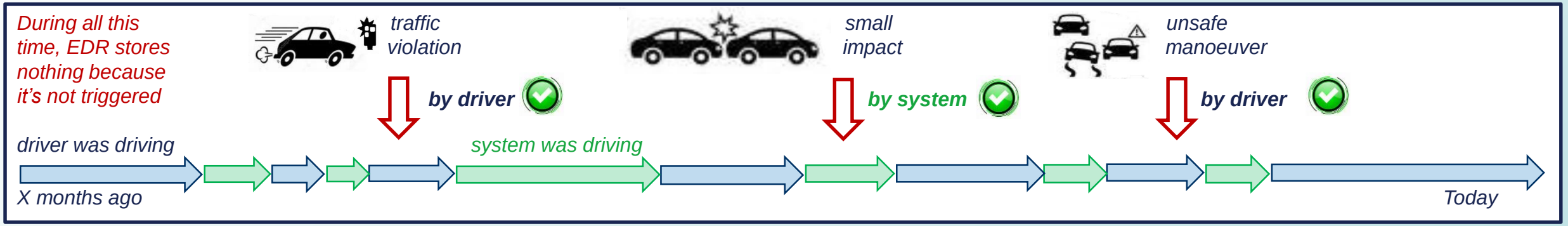
a clear picture of the **interactions between the driver and the system**,
before and after (*whenever possible*) the event, in order to **establish :**

- **who from the driver or the system was requested to be in control of the driving task,** and

- **who from the driver or the system was actually performing the driving task.**

What kind of data are needed for the DSSAD ?

The DSSAD stores some significative events that can be described as « **significant interaction between the AD system and the human driver** ».
These events are **timestamped**, so that this data will enable the determination of whether the driver or the system was driving, at any instant in the last X months.



The recording and retrievability of **System Status changes, Transition Demands, Take-Over by driver** and **Minimum Risk Manoeuvers engaged by the system,** are **sufficient** to determine **"who was requested to be in control"** and **"who was in control"** at any time.

(see simplified example next slide)

What can be seen after access to the data recorded by a DSSAD ?

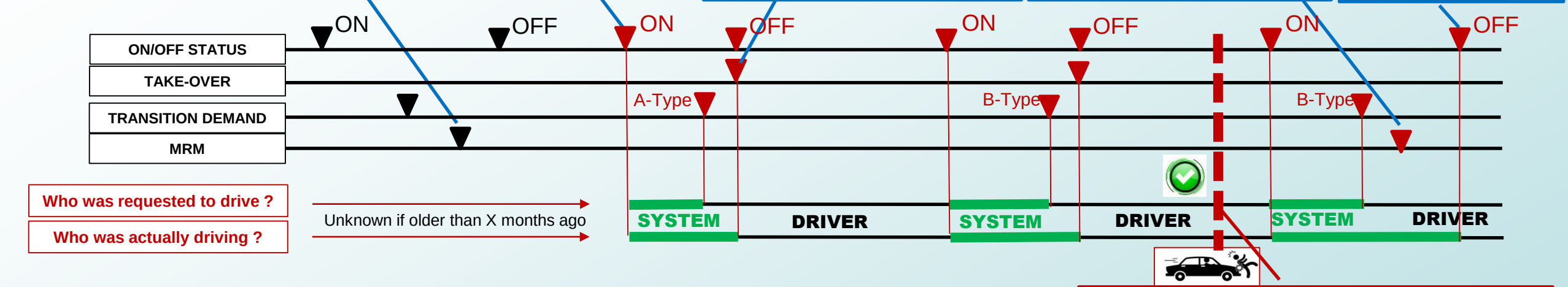
These data are **not available any longer** because they were stored **but** storage is now **too old**

From [3 months] ago, all information is **always available**, with time stamp

When the driver **Takes Over** after being requested, the system turns **OFF**

When the driver does not respond to **TD**, the system proceeds to a **MRM**

When the **MRM** is finished, the system turns **OFF**

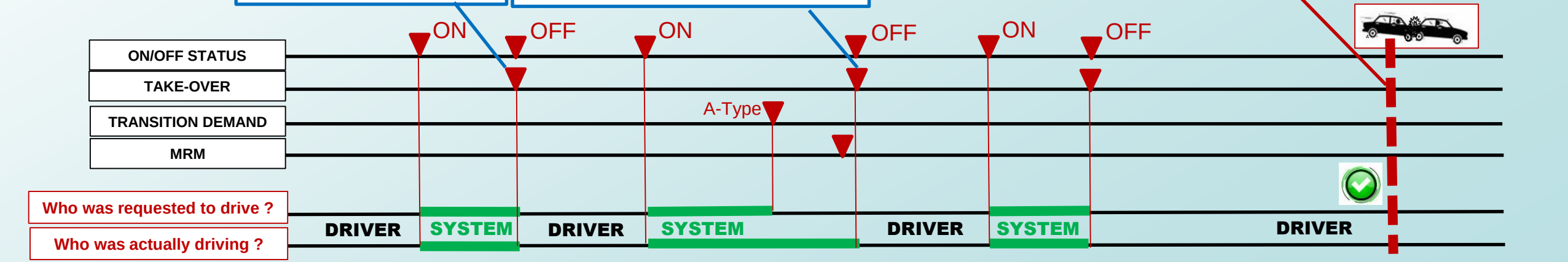


…even if the event occured 2 or 3 months ago…

When there is a safety related event, it is possible to determine who was driving at that time…

When the driver decides to Take Over it, the system turns **OFF**

When the **MRM** is engaged, the system turns **OFF** as soon as the driver **Takes Over.**



Conclusion : EDR & DSSAD = 2 different functions

	EDR (M1/N1)	DSSAD (All vehicles with ADS)
Purpose	Supporting crash analysis and reconstruction	Support legal information needs on vehicle control (Driver/System)
How	Record data when triggered (momentaneous)	Store data over a longer period
What data	Data relevant to crash analysis - Vehicle speed - Vehicle Speed reduction - Engine throttle - Service brake - Ignition - Airbag deployment - ..	Data relevant to vehicle control: - AD system ON/OFF - Transition Demand - Take Over - Minimum Risk Manoeuver - Repective data timestamps
Reference	FMVSS **49 CFR Part 563**	**Concept as proposed by OICA**
Application		
“conventional vehicle”	Applicable	No need
“vehicle with Automated Driving function” (LEV3, 4 & 5)	Applicable	Applicable

OICA position for EDR :

- EDR/DSSAD informal group to produce both a draft **UN regulation** and a draft **GTR**:
  1. Delivery of a draft **UN regulation** at 117th GRSG session (Oct. 2019), for light vehicles, limited to the currently required set of data *(i.e. based on existing US/Korea/Japan EDR)*
  2. Delivery of harmonized provisions per a draft **GTR** as a next step
- This approach would:
  1. Capture the legal roadmap in some regions *(e.g. EU GSR-2)*
  2. Pursue global harmonization
  3. Follow the development of technology per amendments to the regulations *(e.g. heavy vehicles, set of data, etc.)*

OICA position for DSSAD :

- EDR/DSSAD informal group to produce UN regulation.
  1. Delivery of a proposal for a **UN regulation** at GRVA session of Feb. 2020, based on OICA concept.