



European Association of Automotive Suppliers

# Airbag ECU Technology Limitations

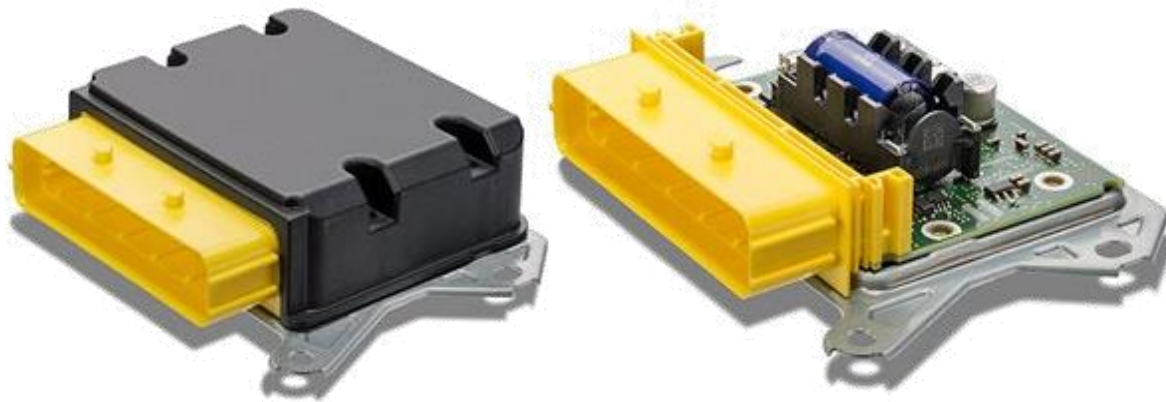
*5<sup>th</sup> Session EDR/DSSAD IWG*

*Washington DC (U.S.A), 18-19/03/2020.*

- + Airbag control units are safe in case of a crash
  - + Electronics are providing functional safety -> ASIL D
  - + Mandatory data has to be stored even when the battery is cut off (autarky)
- 
- Airbag ECUs have technology limits on how much EDR data can be recorded
  - Limits vary between OEM, supplier and product generation
  - Three categories can be identified:
    1. Amount of non-volatile memory (NVM), to permanently store the EDR record
    2. Amount of volatile memory (RAM), to buffer data before recording to NVM
    3. Backup power supply, to ensure one EDR record will be written in case battery is cut off during a crash

## Examples of Airbag ECUs with different autarky time


Typical:

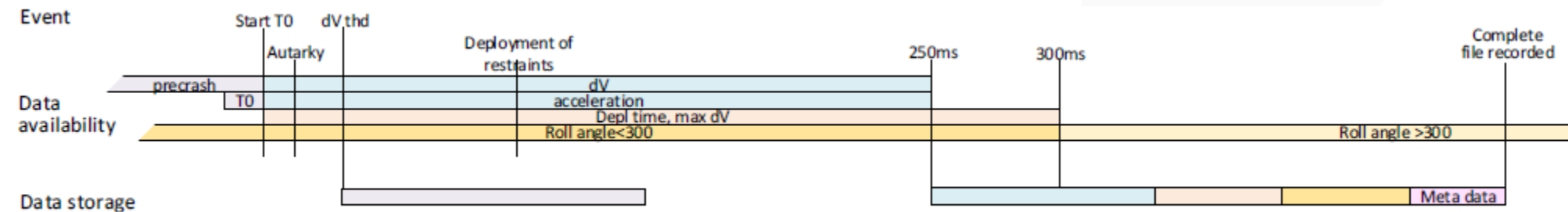


Technology Limit:



## Limitations on Storage Time & Availability

- Physical Limitations: Storage time is limited due to ECU internal architecture  

  
 Typical range: 50-500 Kbit/s (estimation to date)
- Data Availability: Storage is not continuous but in discrete sections which increases storage time. The sections can only be recorded sequentially (see below)\*

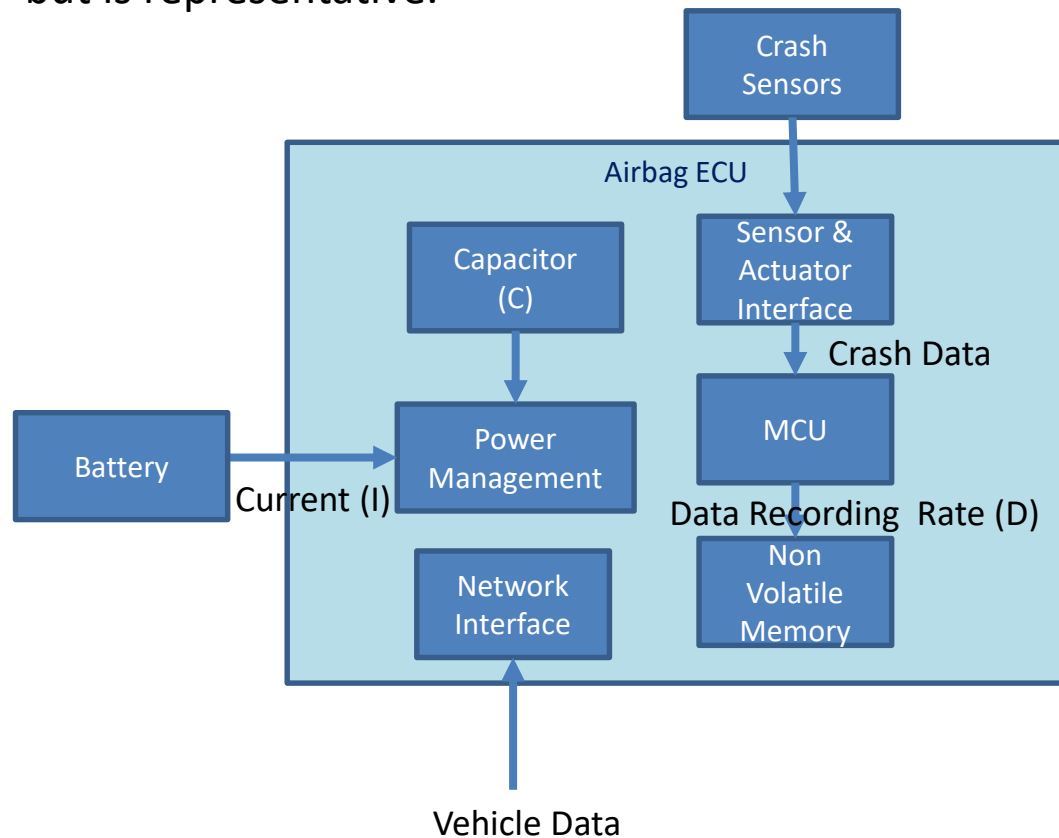


Chassis Systems Control | 2020-02-27

\*Diagram not to scale. This is an implementation example, not a rule.

# Limitations on Back-up Power Supply

- A simple model of technology attributes is provided to provide guidance -> It does not describe all EDR implementations, but is representative.



- When battery is lost, the Airbag ECU draws current ( $I$ ) from the capacitor ( $C$ ).
- The EDR record is written to NVM at a data-rate  $D$
- When the voltage across the capacitor falls below a threshold, writing of EDR stops.

Observations (For more information, see *Annex A*):

- NHTSA size EDR (~1kB) should be feasible for most airbag ECUs
- The technology limit is in the range 8kB to 12kB for one EDR record
  - Many OEMs use this 8-12kB capacity to store non-standardized crash-related data

# CLEPA Recommendations

1. CLEPA recommends limiting the amount of additional data to <20% of what is recorded today.
2. Fail-safe electronics need more chip-space for controllers and memories
3. Assuming a phased implementation of EDR, this corresponds to:
  - Step 0: few extra bytes (use designs compatible with NHTSA EDR)
  - Step 1: < 200 bytes (optimization of existing designs)
  - Step 2: To be discussed, based on maximum technology capacity.Other technologies exist to overcome the limits. These can be phased in at a later date.

# Annex A: Simple Model Specifications

	Parameter	Symbol	Units	Min	Max	Comment
Inputs	Capacitor	C	mF	2	6	From benchmarking.
	DeltaV	V		6	6	Allocated voltage drop, centered on 12V. In reality, each supplier will have a budget to allocate energy reserve to different functions, and the functions can run in parallel.
	Quiescent Current	I	mA	100	200	From benchmarking measurements at nominal battery voltage (13.5V)
	Data recording rate	D	kbit/s	50	500	
Outputs	Time for writing	T	ms	120	180	Simple model: $CV=IT$ . In reality, need to account for deployment, power conversion, etc
	Data	R	kB	1	11	Simple model: $R=TD$ . In reality, need to account for different types of EDR data, and when they can be written

- Assumptions:
  - NVM is either:
    - EEPROM device, external to microcontroller
    - Data flash, included in microcontroller
  - RAM is integrated in microcontroller
  - Power Supply
    - Typical quiescent current from battery in range 100mA to 200mA
  - Backup power supply
    - Electrolytic capacitor, initially charged to ~25V or ~35V
    - Typical value in range 2mF and 6mF
    - Constrained by ECU size  
e.g. one large capacitor (<16mm diameter, <50mm length)

These values are derived from observable attributes of production airbag ECUs. Each airbag ECU will be different, and some ECUs may be outside these ranges.