2017 CARSP Conference:

A State-of-the-Art Review of Event Data Recorder Technologies in Passenger and Commercial Vehicles

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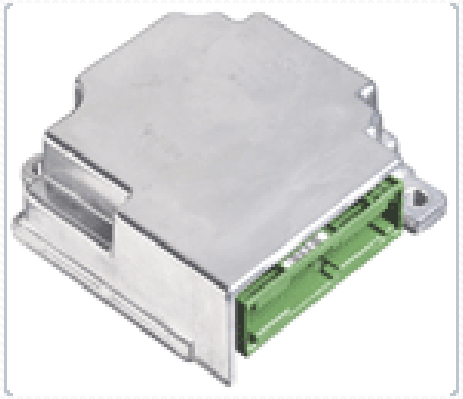
EDR – Event Data Recorders

- With the advances of technology in modern vehicles, more and more information is now available from electronic devices to assist in understanding what took place prior to, during and after a collision
- EDR is the term used to define event data from these electronic devices
- EDR varies greatly between vehicles



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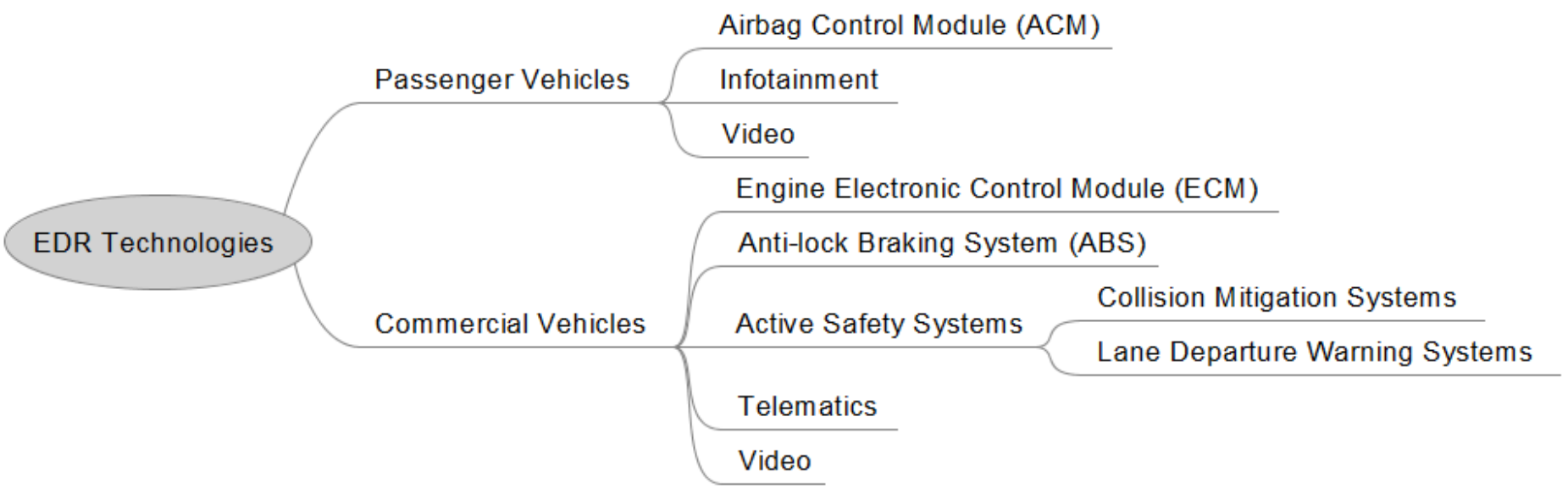
Introduction

- Coach:
  - Engine: Caterpillar
  - Thales Navigation Unit
  - Init Fare Collection
  - Fire Alarm Unit
  - Luminator Mark IV Unit
  - Proheat
  - Motorola radio
  - icom
  - Safety Vision dome cameras
  - Anti-lock Brakes (ABS): Bendix

- Which systems are recording Event Data?

Overview: State-of-the-Art Review



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Passenger Cars

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Airbag Control Module (ACM)

- Primary purpose: SAVE LIVES
- Secondary: record data surrounding an airbag deployment or near deployment
- EDR capability varies widely by manufacturer and vehicle model year. (More and better data with newer vehicles)
- NHTSA EDR Part 563: As of Sept 2012, minimum EDR data in new vehicles was standardized in US
- No law or regulation in Canada

ACM Data

Ignition Cycle, Crash	2191
Safety Belt Status, Driver	Not Buckled
Safety Belt Status, Passenger	Not Buckled
Airbag Warning Lamp, On/Off	Off
Seat Track Position Switch, Foremost, Status, Driver	No
Seat Track Position Switch, Foremost, Status, Passenger	No
Maximum Delta-V Longitudinal (MPH [km/h])	7.9 [13]
Time, Maximum Delta-V, Longitudinal (msec)	124
Maximum Delta-V Lateral (MPH [km/h])	15.8 [25]

... plus more

ACM Data

Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)
- 5.0	60 [97]	31.8	Off	2,000	non-engaged
- 4.5	61 [98]	41.3	Off	2,166	non-engaged
- 4.0	62 [100]	41.9	Off	2,644	non-engaged
- 3.5	63 [102]	38.1	Off	2,604	non-engaged
- 3.0	64 [103]	35.6	Off	2,584	non-engaged
- 2.5	65 [105]	31.3	Off	2,530	non-engaged
- 2.0	65 [105]	17.5	Off	2,386	non-engaged
- 1.5	66 [106]	16.5	Off	2,318	non-engaged
- 1.0	66 [106]	0.0	Off	1,858	non-engaged
- 0.5	55 [88]	0.0	On	1,554	non-engaged
0.0	49 [79]	0.0	On	1,364	engaged

ACM Data

- Newer vehicle models (e.g. Ford EDR13 type ACM
  - Higher resolution data – 0.1 second intervals
  - Additional (very useful) data points:
    - Steering wheel angle (degrees)
    - Lateral Acceleration (g)
    - Yaw Rate (deg/sec)
    - Roll Rate (deg/sec)

Infotainment

- In-vehicle actions
  - Phone use - some vehicles record every text message including the message content that is sent through the hands free device
  - Adjusting the radio, how loud was the radio
- GPS location history
  - Where was the vehicle prior to the collision?
  - How long had the vehicle been in use prior to collision?
- Lighting and door use history
  - Headlights on/off?
  - Amount of passengers based on door usage
- This is emerging - not commonplace data yet in accident reconstruction.

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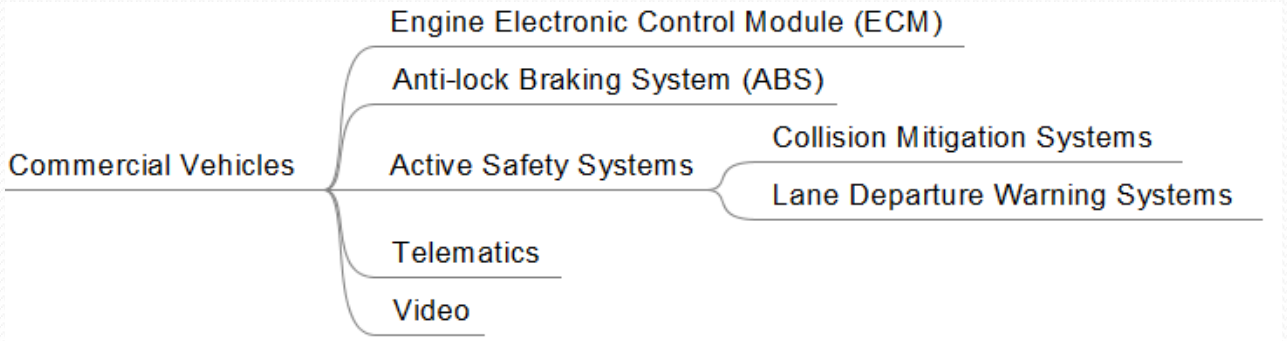
Commercial Vehicles

- Where does EDR data come from?
  - Depends on the fleet and individual vehicle



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Engine-Based Event Data Recorders

Engine-Based EDR

Engine	Hard Brake	Last Stop	Fault Codes	Daily Engine Usage	Engine History	Trip History	Governed Speeds
CAT	2		X		X		X
Cummins	3		X	X	X	X	X
Detroit Diesel/ Mercedes	2	1	X	X	X	X	X
MaxxForce	2	2	X		X	X	X
PACCAR	3		X		X	X	X
Volvo/Mack	1	1	X		X	X	X

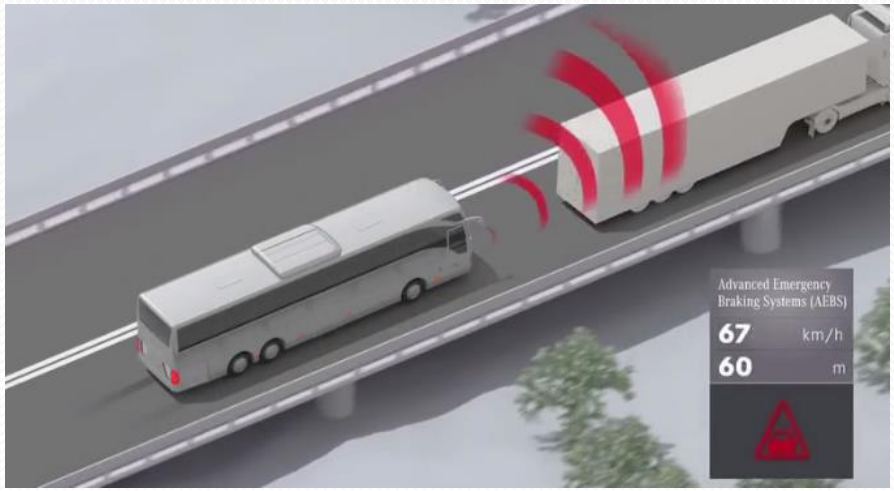
Engine-Based EDR: Hard Brake Event

Incident Time: 1/6/2017 8:46:43 AM (EST) Incident Odometer: 235170.8 mi

Time	Vehicle Speed (mph)	Engine Speed (rpm)	Brake	Clutch	Engine Load (%)	Throttle (%)
-0:04	53.0	1470	No	No	0.00	0.00
-0:03	52.5	1479	No	No	0.00	0.80
-0:02	49.0	1085	Yes	No	0.00	0.00
-0:01	44.5	1167	Yes	No	0.00	0.00
0:00	37.0	888	Yes	No	0.00	0.00
+0:01	30.5	676	Yes	No	0.00	0.00
+0:02	24.0	527	Yes	No	54.00	0.00
+0:03	21.0	500	Yes	No	80.00	0.00
+0:04	15.0	294	Yes	No	74.00	0.00
+0:05	7.0	62	Yes	No	74.00	0.40

Active Safety Systems – Collision Mitigation

- Collision Mitigation Systems (e.g. Meritor On-Guard) are typically tied to adaptive cruise control systems, and use a forward facing radar sensor
- If the system determines there is a potential for a rear end collision mitigating actions begin:
  - Audible and visual warnings
  - De-throttle of engine
  - Application of engine or foundation brakes
  - For Meritor On-Guard, EDR is contained within the radar unit at the front of the vehicle



Active Safety Systems

- Lane Departure Warning Systems
  - Uses a forward facing camera system
  - Warns against unintended lane changes
  - Encourages use of turn signals
  - Warns against erratic driving
    - Data available is generally forward facing video

Telematics – The Fleet's way of communicating

- Trucking companies now generally using telematics systems which are used for tracking vehicles and electronic driver log inputs
- These units have the ability to store a lot of data as they are constantly communicating the location of the vehicle to the company and service provider

Video Coaching Systems

DriveCam POWERED BY Lytx

PEOPLENET

SMARTDRIVE

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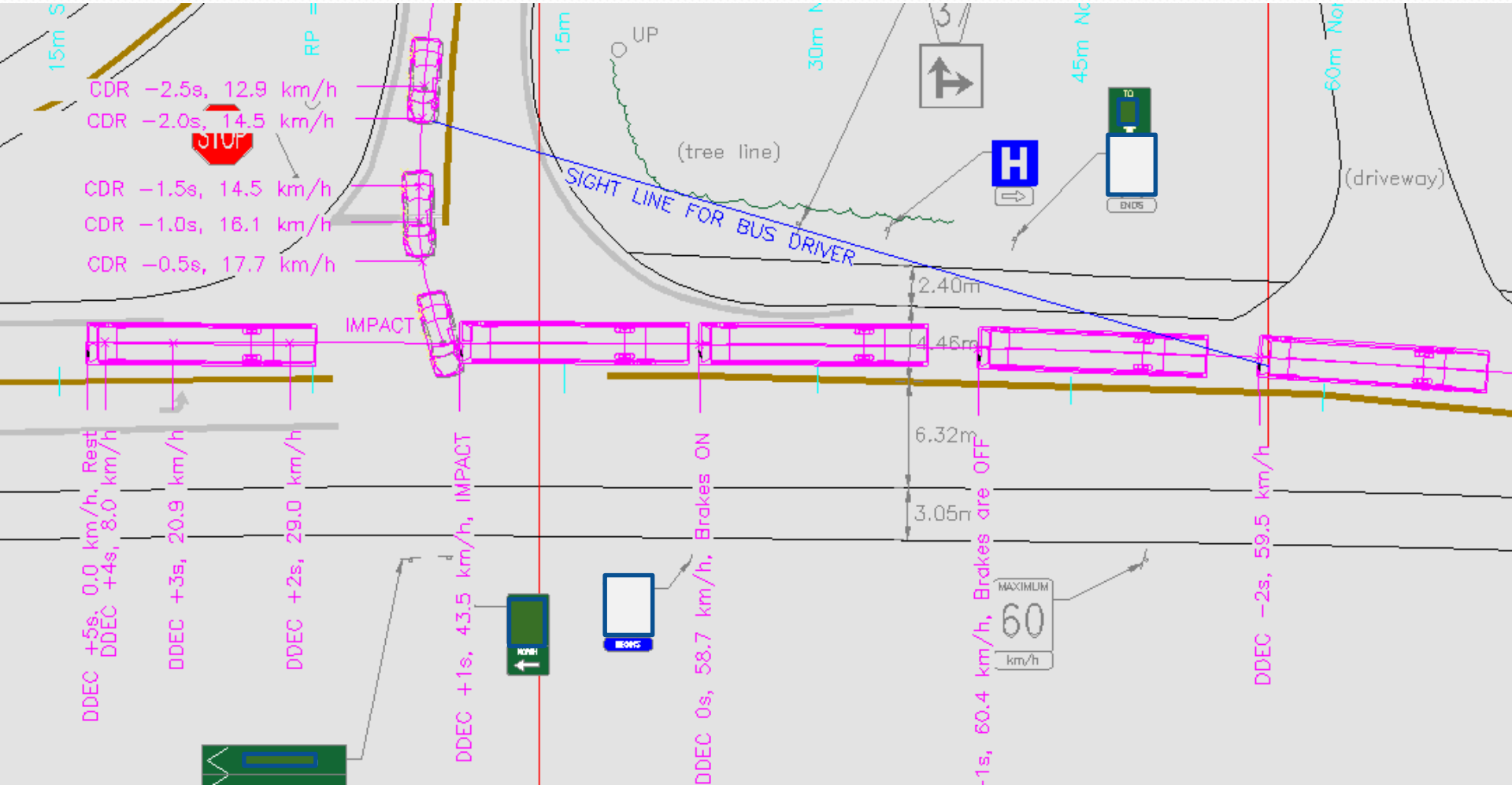
Using the Data

- Each piece of electronic data adds a new dimension to the analysis and reconstruction of a collision
- EDR can be used effectively to layer data on accident site diagrams or in simulations to assess:
  - Pre-collision vehicle dynamics
  - Pre-collision driver controls
  - Driver vision, driver perception-reaction
  - Impact severity
  - Diagnostic Trouble Codes – pre-collision or resulting from collision?

  … and more

Example: Using EDR for Position-Time History and Vehicle Speeds



Thank-you for Your Attention

- Questions?

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