

Uncovering the Driver Actions That Caused a Crash

Neal Carter
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- B.S. Engineering, Colorado School of Mines
- M.S. Mechanical Engineering, University of Utah
- Professional Engineer
- Accident Reconstructionist since 2007
- ACTAR Accredited
- Testified 30 times on cases in 8 states
- Published 30 Technical Papers and Articles
- Forthcoming Book: Pedestrian Accident Reconstruction (2026)



- ✓ Accident Reconstruction
- ✓ Biomechanics
- ✓ Human Factors
- ✓ Video Analysis
- ✓ Visualization

Jacquelyn Booker

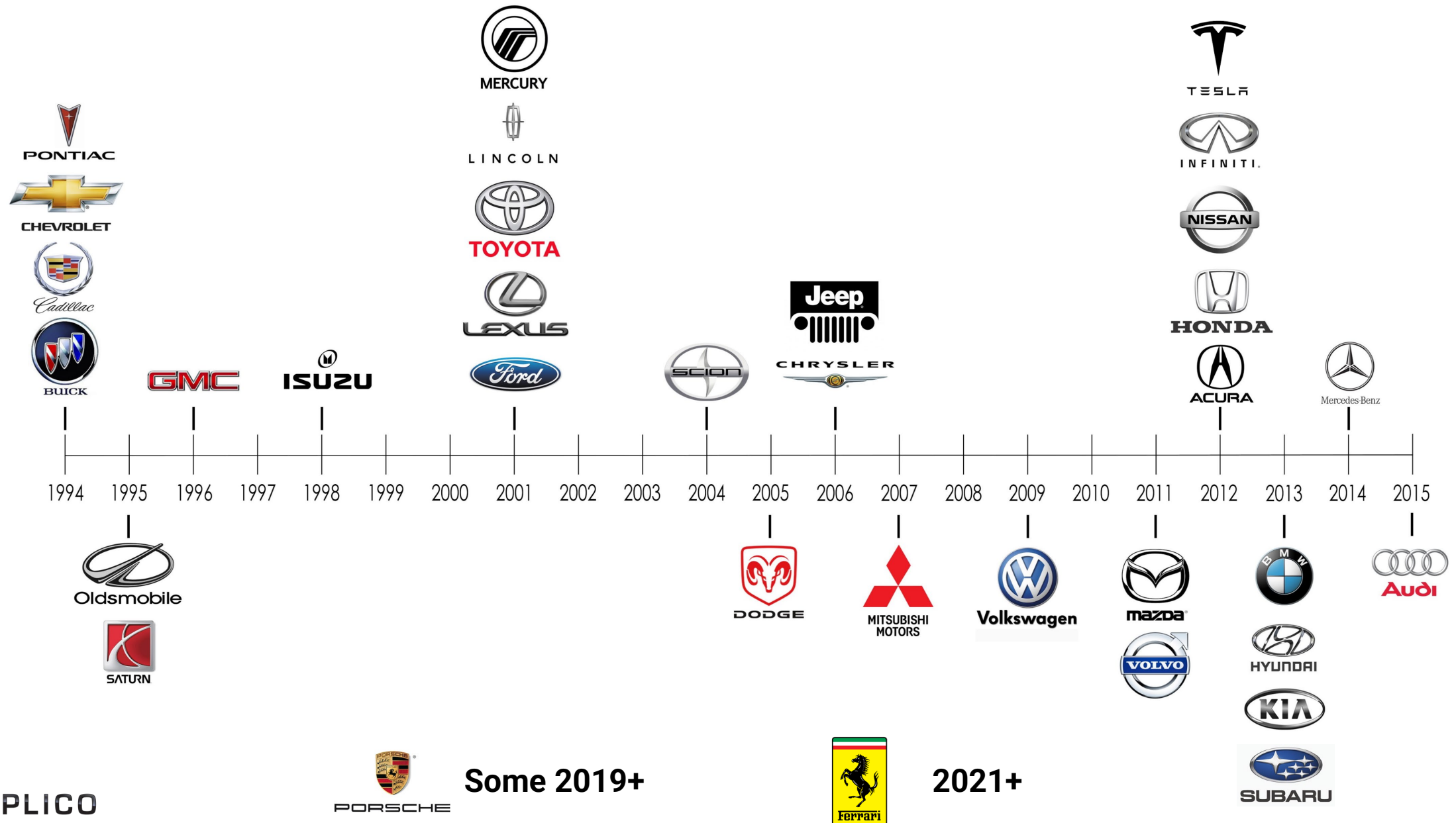


Jackie Booker is the managing shareholder at Sutton | Booker | PC. She has tried over 30 jury trials to verdict and has tried cases in federal and state district courts across Colorado. Jackie has also appeared and argued before the Colorado Court of Appeals and Colorado Supreme Court. She enjoys contributing her time to amicus curiae briefing when those opportunities arise.

Outline

- Before CFR Part 563 Event Data Recorder (EDR) data (1994-2013)
- After CFR Part 563 EDR Data (2013 to present)
- Beyond Part 563 – ADAS Data
- “Next Gen” EDR Image Data (2013 to present)

When did each manufacturer make EDR data available?



Pre-2013

- ✓ Longitudinal ΔV during crash
- ? Lateral ΔV during crash
- ? Pre-Crash Data

Pre-2013

Longitudinal and Lateral ΔV during crash

Recording duration?

Records positive Longitudinal ΔV (rear-end)?

2002 Toyota Prius

System Status at Event (Most Recent Frontal/Rear Event, TRG 2)

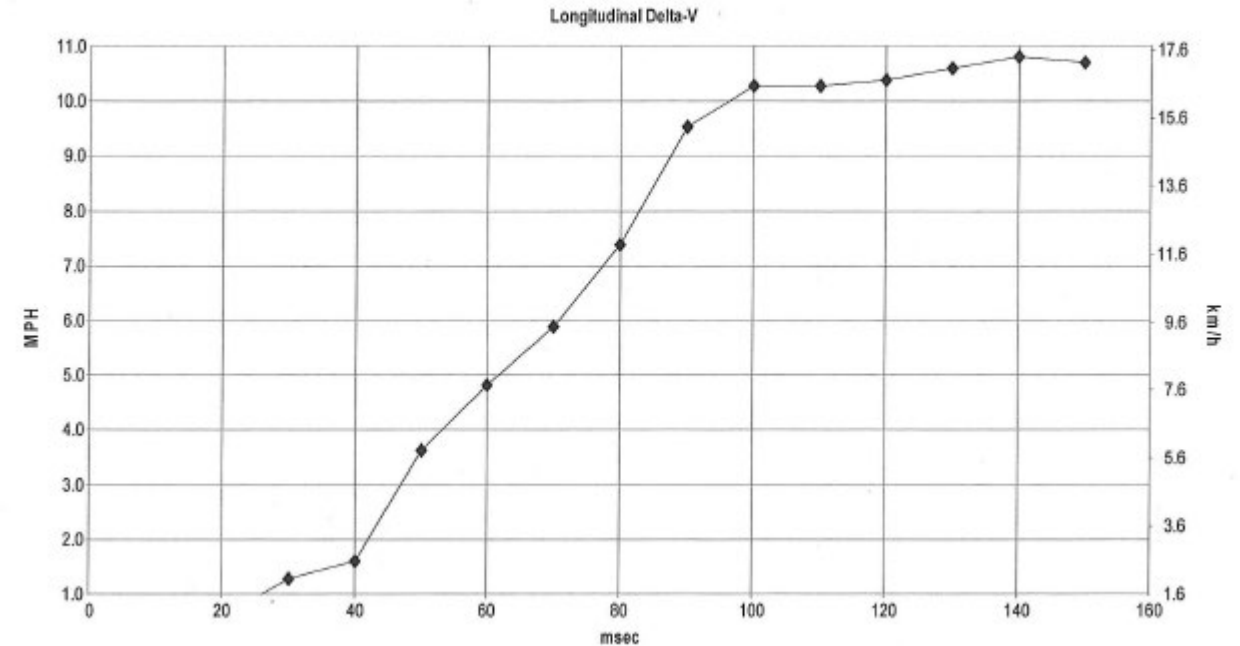
Recording Status, Front/Rear Crash Info.	Complete
TRG Count	2
Time From Previous TRG (msec)	5000 or greater
Buckle Switch, Driver	Buckled
Buckle Switch, Passenger	Unbuckled
Occupancy Status, Passenger	Not Occupied
Seat Position, Driver	Rearward

Longitudinal Crash Pulse (Most Recent Frontal/Rear Event, TRG 2 - table 2 of 2)

Time (msec)	Longitudinal Delta-V (MPH [km/h])
10	0.5 [0.9]
20	0.5 [0.9]
30	1.3 [2.1]
40	1.6 [2.6]
50	3.6 [5.9]
60	4.8 [7.8]
70	5.9 [9.5]
80	7.4 [11.9]
90	9.5 [15.3]
100	10.3 [16.5]
110	10.3 [16.5]
120	10.4 [16.7]
130	10.6 [17.1]
140	10.8 [17.4]
150	10.7 [17.2]

Longitudinal Crash Pulse (Most Recent Frontal/Rear Event, TRG 2 - table 1 of 2)

Max Longitudinal Delta-V (MPH [km/h])	10.8 [17.4]
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Pre-2013

Pre-Crash Data

May Include:

- Vehicle Indicated Speed
- Brake On/Off
- Accelerator Pedal %
- Engine RPM
- Steering Angle
- Engine Throttle
- ABS Active
- Traction Control Active
- Yaw Rate
- Brake Line Pressure
- Acceleration
- Seat Belt Status

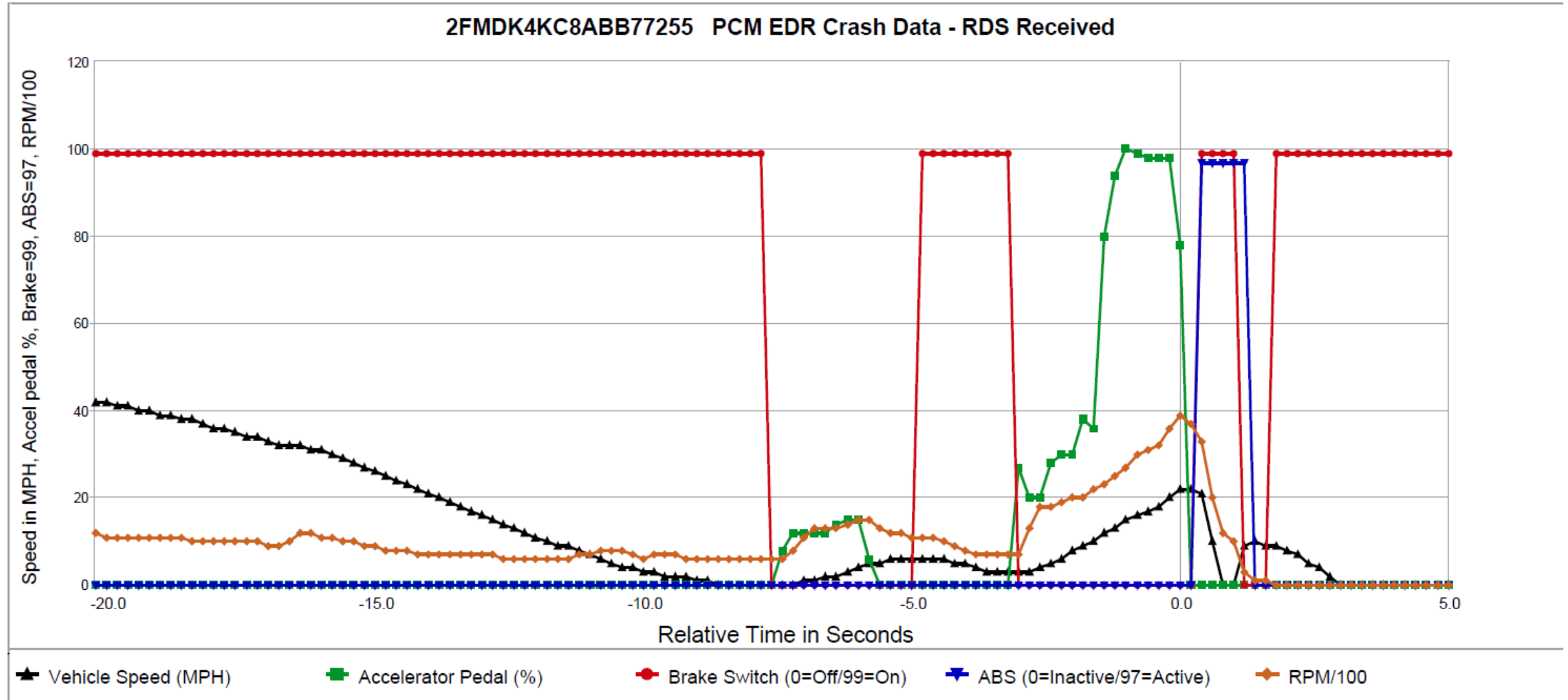
2010 Ford Edge



Pre-Crash Data (First Record)

Time (sec)	-4	-3	-2	-1	0
Accelerator Pedal Position (%)	0	0	22	40	99
Vehicle Speed (MPH [km/h])	6.0 [9.7]	3.2 [5.1]	4.1 [6.6]	10.8 [17.4]	17.3 [27.9]
ABS Event in Progress	No	No	No	No	No
ESP Event in Progress	No	No	No	No	No
TCS Event in Progress	No	No	No	No	No
Brake Lamp Switch Depressed (from PCM)	Yes	Yes	No	No	No
RCM Serial Number Received by OCS	No	No	No	No	No
OCS Sensor Status	Empty	Empty	Empty	Empty	Empty

2010 Ford Edge



49 CFR 563 - Application

- Vehicles Manufactured on or after September 1, 2012
- GVWR of 8,500 lb or less and unloaded weight of 5,500 lb or less
- Contain a device that records dynamic time-series data during a crash

After Part 563

Pre-Crash Data, ~ 5 Seconds

Includes:

- Vehicle Indicated Speed
- Throttle %
- Brake Application
- Driver Seat Belt Status

After Part 563

Pre-Crash Data, ~ 5 Seconds

May Include :

- Engine RPM
- Accelerations
- Roll Angle
- Yaw Angle
- Steering Input
- ABS Activity
- Passenger Seat Belt Status
- Occupant Size Classification

After Part 563

Crash Data

Includes :

- Longitudinal ΔV
- Maximum Longitudinal ΔV
- Time of Maximum Longitudinal ΔV

After Part 563

Crash Data

May Include (if recorded) :

- Longitudinal Acceleration
- Lateral Acceleration
- Lateral ΔV
- Maximum Lateral ΔV
- Time of Maximum Lateral ΔV

After Part 563

Recording Criteria

Must Record Data:

- Frontal airbag deployment (locked)
- Side airbag deployment (locked)
- Longitudinal ΔV greater than **5 mph** (unlocked)
- Lateral ΔV greater than **5 mph**, when recorded (unlocked)
- Must record up to two events
- Unlocked events can be overwritten

Case Study: Evaluating Driver Statements

Vehicle Tracking

Event Data Recorder Download

Event Data Recorder Analysis



This vehicle was “Not Available”



Driver stated she was traveling ~25 mph when entering smoke



ACM Download

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)	Brake Powertrain Torque Request	Driver Gear Selection
- 5.0	58 [93]	31.7	Off	2,562	non-engaged	No	Drive
- 4.5	58 [93]	27.8	Off	2,550	non-engaged	No	Drive
- 4.0	58 [93]	26.7	Off	2,546	non-engaged	No	Drive
- 3.5	57 [92]	0.0	Off	2,524	non-engaged	No	Drive
- 3.0	57 [91]	0.0	Off	2,490	non-engaged	No	Drive
- 2.5	56 [90]	0.0	Off	2,450	non-engaged	No	Drive
- 2.0	55 [89]	0.0	Off	2,424	non-engaged	No	Drive
- 1.5	54 [87]	0.0	Off	2,390	non-engaged	No	Drive
- 1.0	53 [85]	0.0	On	2,318	non-engaged	No	Drive
- 0.5	51 [82]	0.0	On	2,234	non-engaged	No	Drive
0.0	47 [75]	0.0	On	2,594	non-engaged	No	Drive

Next Gen EDR Modules / Active Safety Systems

- ✓ OEM Airbag Control Modules (Part 563)
- ❑ “Extra” info associated with Advanced Driver Assistance Systems (ADAS)
- ❑ Diagnostic Data from Other Vehicle Systems
- ❑ On-board Dash Cam Images or Video

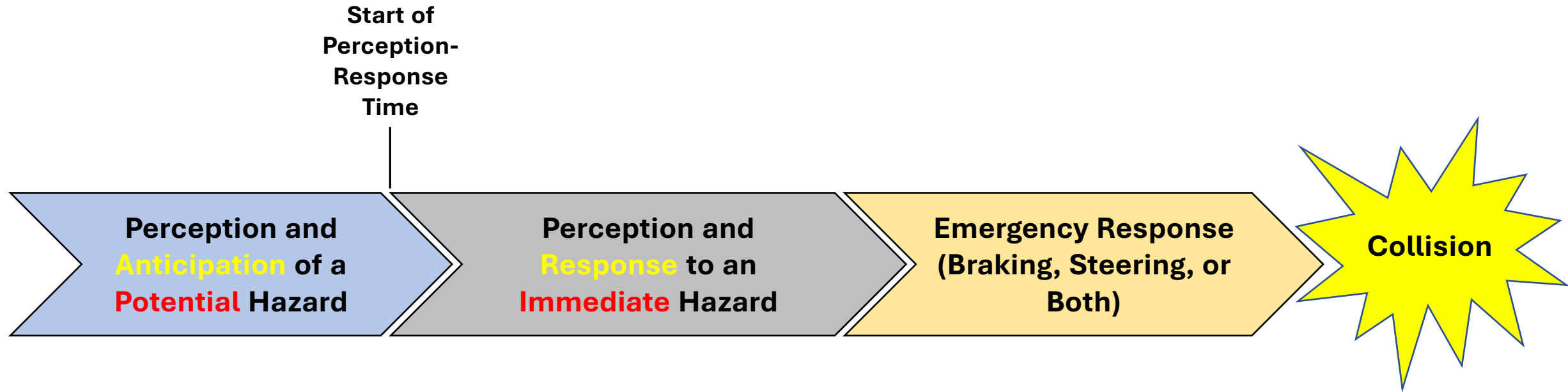
2021 Toyota Camry – 25 mph



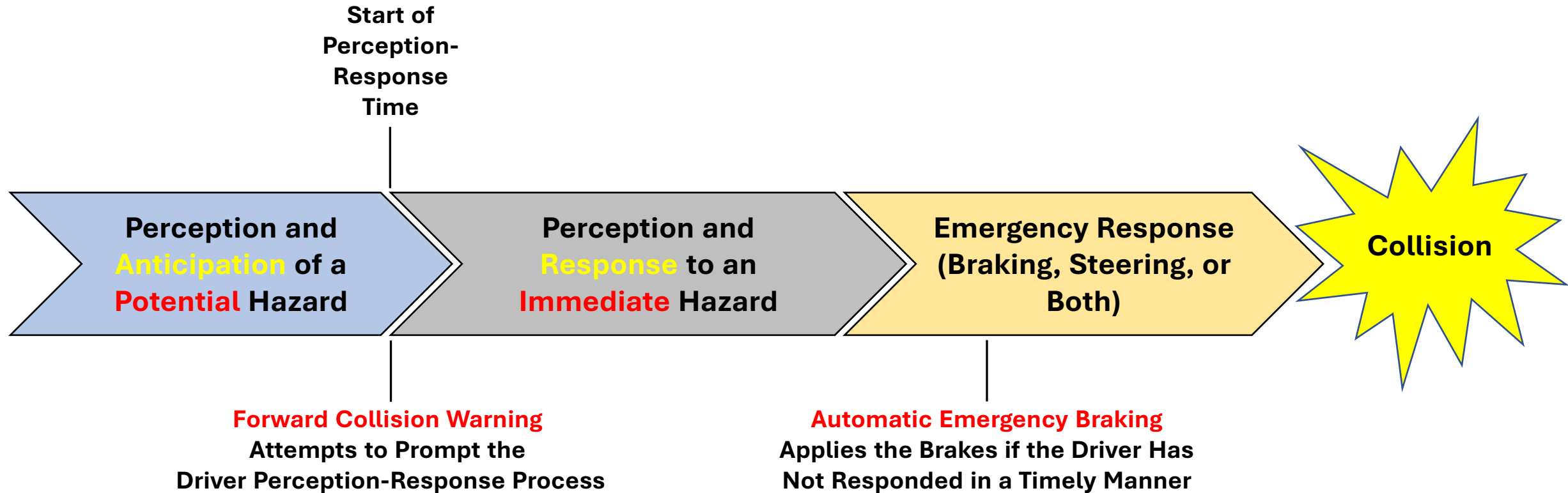
2022 Toyota Camry – 37 mph



Pre-Collision Crash Avoidance Process for Human Driver



Pre-Collision Crash Avoidance Process for Human Driver With FCW and AEB

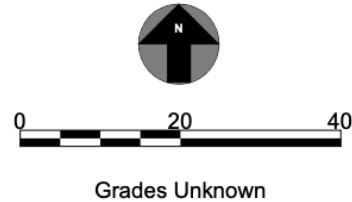


Case Study: “Next Gen” Event Data Recorder

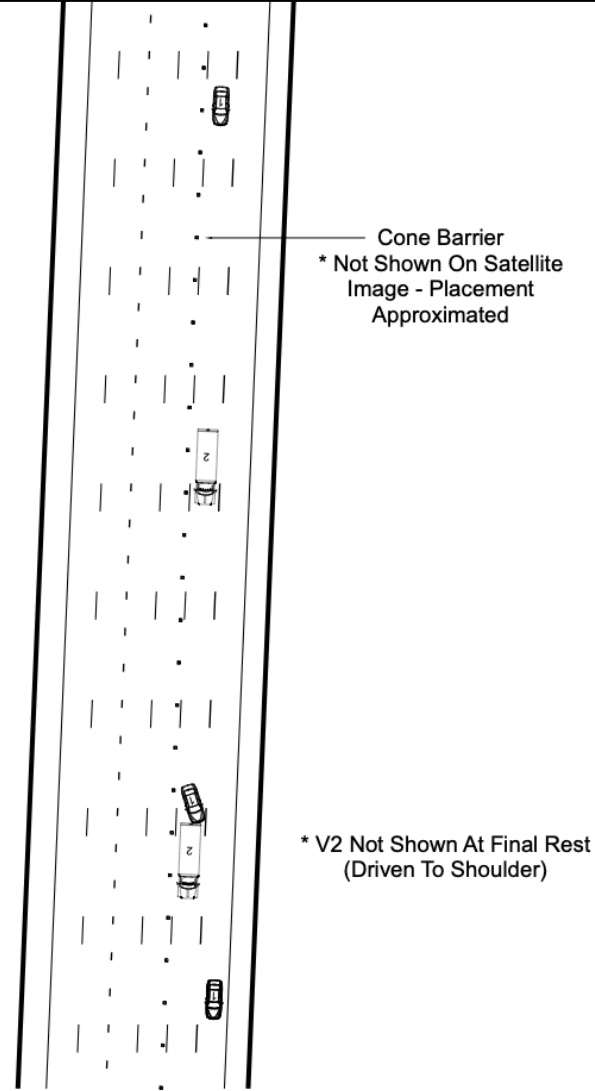
Advanced Driver Assistance System (ADAS)
Event Data Recorder Analysis

CISS Case #1-21-2020-013-04

Scaled Diagram
From Satellite Image



This crash occurred on a Friday
at 2:20 a.m. The vehicle was
driven by a 25-year-old male
who was the sole occupant.
He was uninjured.



Case Number:

1-21-2020-013-04

2018 Honda Accord

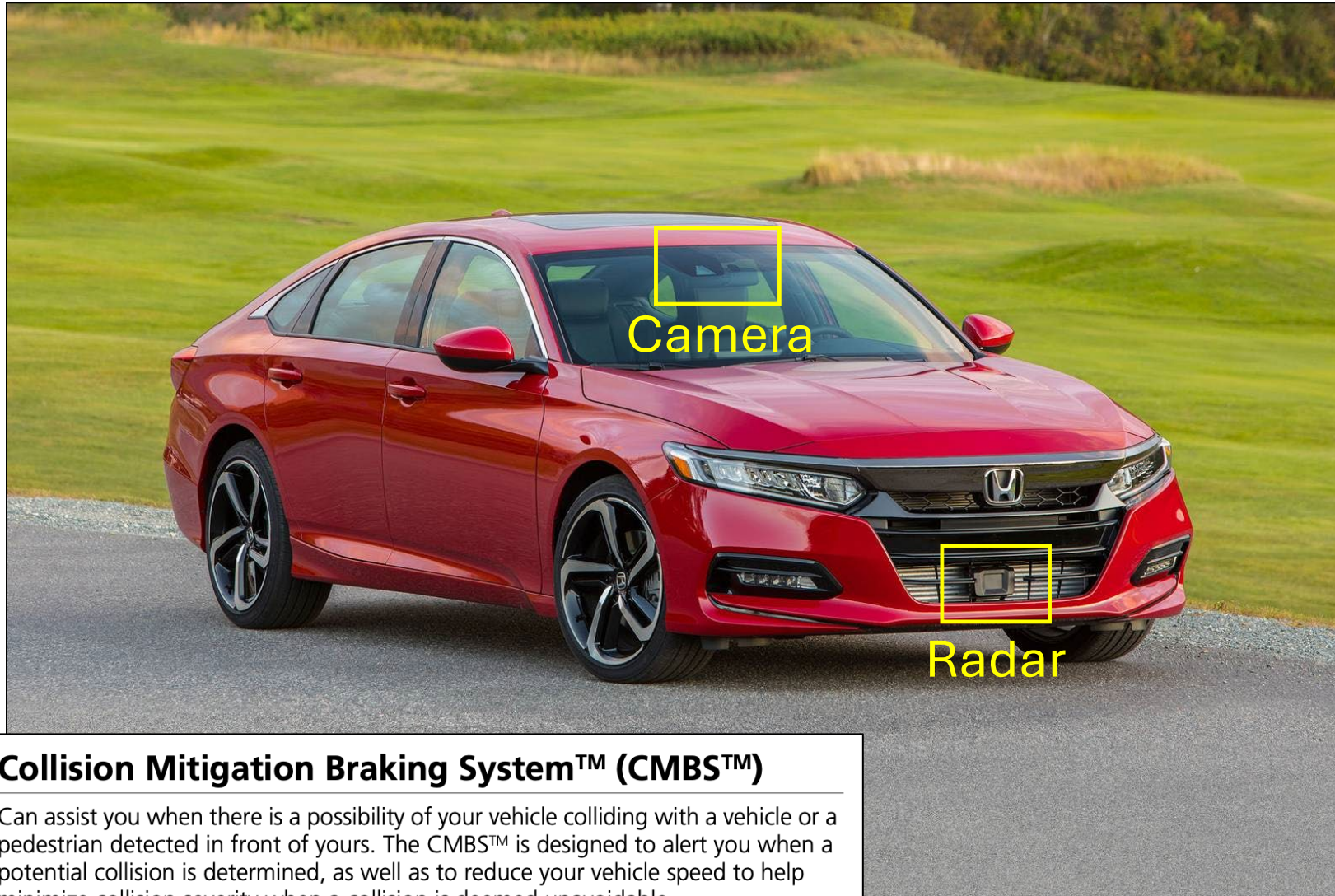


2018 Honda Accord



2018 Honda Accord

Forward Collision Warning and Collision Mitigation Braking



Collision Mitigation Braking System™ (CMBS™)

Can assist you when there is a possibility of your vehicle colliding with a vehicle or a pedestrian detected in front of yours. The CMBS™ is designed to alert you when a potential collision is determined, as well as to reduce your vehicle speed to help minimize collision severity when a collision is deemed unavoidable.

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1) - Table 1 of 3

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal Position, % full	Service Brake (On, Off)	ABS Activity (On, Off)	Stability Control (On, Off, Engaged)	Steering Input (deg)	Engine RPM
-5.0	95 [153]	45	Off	Off	On Non-Engaged	0	3,200
-4.5	95 [153]	46	Off	Off	On Non-Engaged	-5	3,200
-4.0	96 [154]	42	Off	Off	On Non-Engaged	-5	3,200
-3.5	96 [155]	48	Off	Off	On Non-Engaged	-5	3,200
-3.0	96 [155]	48	Off	Off	On Non-Engaged	-5	3,300
-2.5	97 [156]	48	Off	Off	On Non-Engaged	-5	3,300
-2.0	98 [157]	48	Off	Off	On Non-Engaged	-5	3,300
-1.5	98 [157]	64	Off	Off	On Non-Engaged	-5	3,300
-1.0	97 [156]	0	Off	Off	On Non-Engaged	0	3,400
-0.5	84 [135]	0	On	On	On Non-Engaged	100	2,800
0.0	84 [135]	0	On	On	On Non-Engaged	85	2,600

Driver Begins Braking

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1) - Table 2 of 3

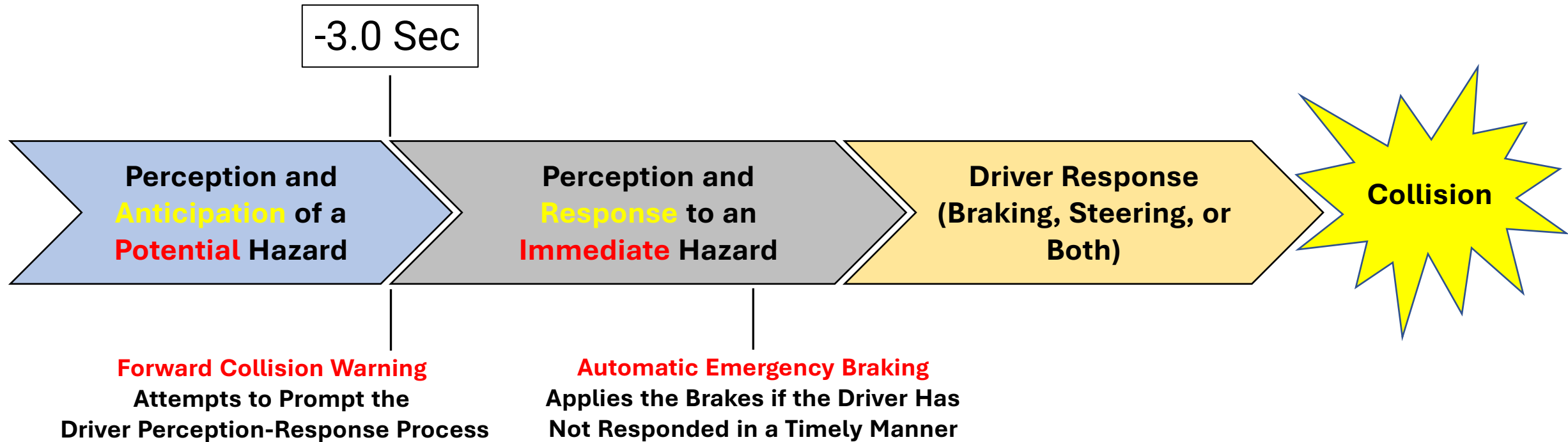
Time Stamp (sec)	PCM Derived Accelerator Pedal Position, % full	Forward Collision Warning (Not Warning/ Warning)	Collision Mitigation Braking System (Not Engaged/ Engaged)	Collision Mitigation Braking System, Forward Collision Warning (On/Off)	Lane Departure Warning (Not Warning/ Warning)	Road Departure Mitigation (Not Engaged/ Engaged)	Road Departure Mitigation, Lane Departure Warning (On/Off)
-5.0	45	Not warning	Not engaged	On	Not warning	Not engaged	Off
-4.5	46	Not warning	Not engaged	On	Not warning	Not engaged	Off
-4.0	42	Not warning	Not engaged	On	Not warning	Not engaged	Off
-3.5	48	Not warning	Not engaged	On	Not warning	Not engaged	Off
-3.0	48	Warning	Not engaged	On	Not warning	Not engaged	Off
-2.5	48	Warning	Not engaged	On	Not warning	Not engaged	Off
-2.0	48	Warning	Not engaged	On	Not warning	Not engaged	Off
-1.5	64	Warning	Engaged	On	Not warning	Not engaged	Off
-1.0	0	Warning	Engaged	On	Not warning	Not engaged	Off
-0.5	0	Not warning	Not engaged	On	Not warning	Not engaged	Off
0.0	0	Not warning	Not engaged	On	Not warning	Not engaged	Off

FCW

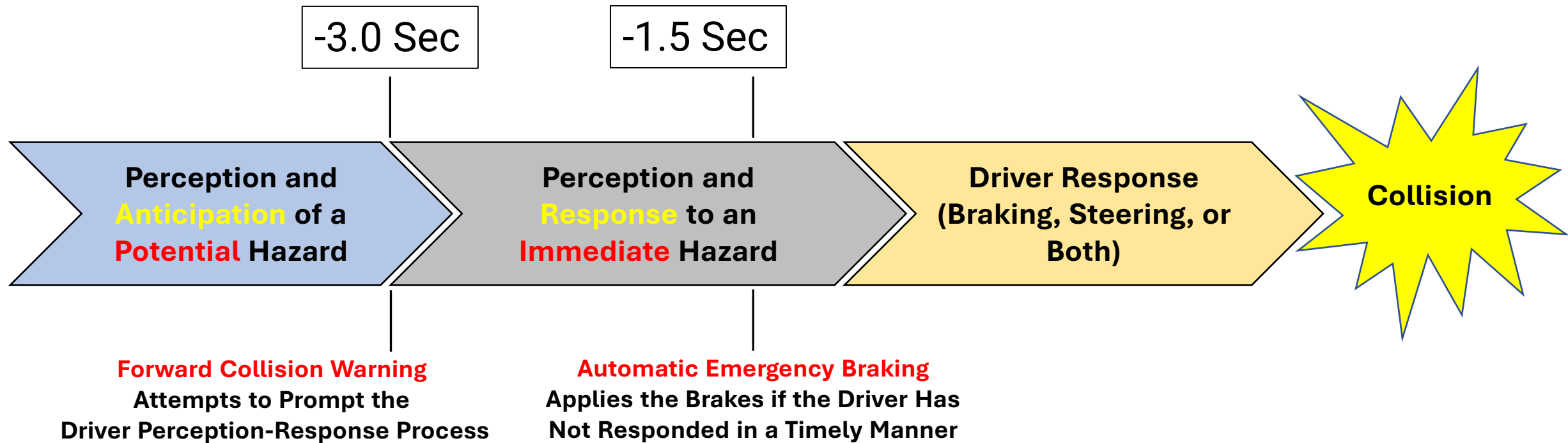
AEB

Driver Braking

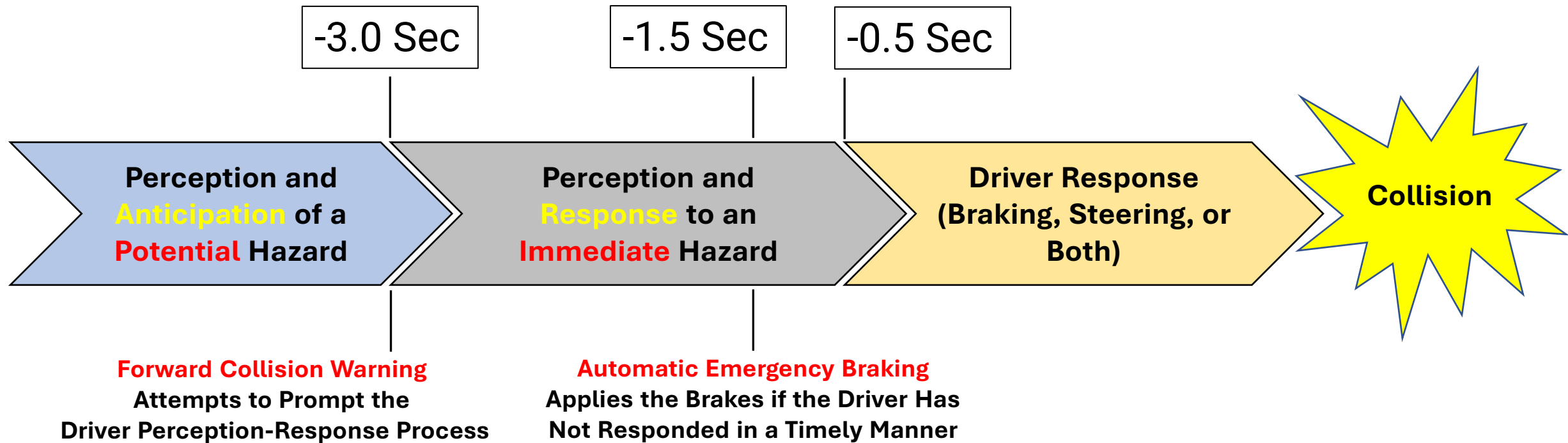
Pre-Collision Crash Avoidance Process for Human Driver With FCW and AEB



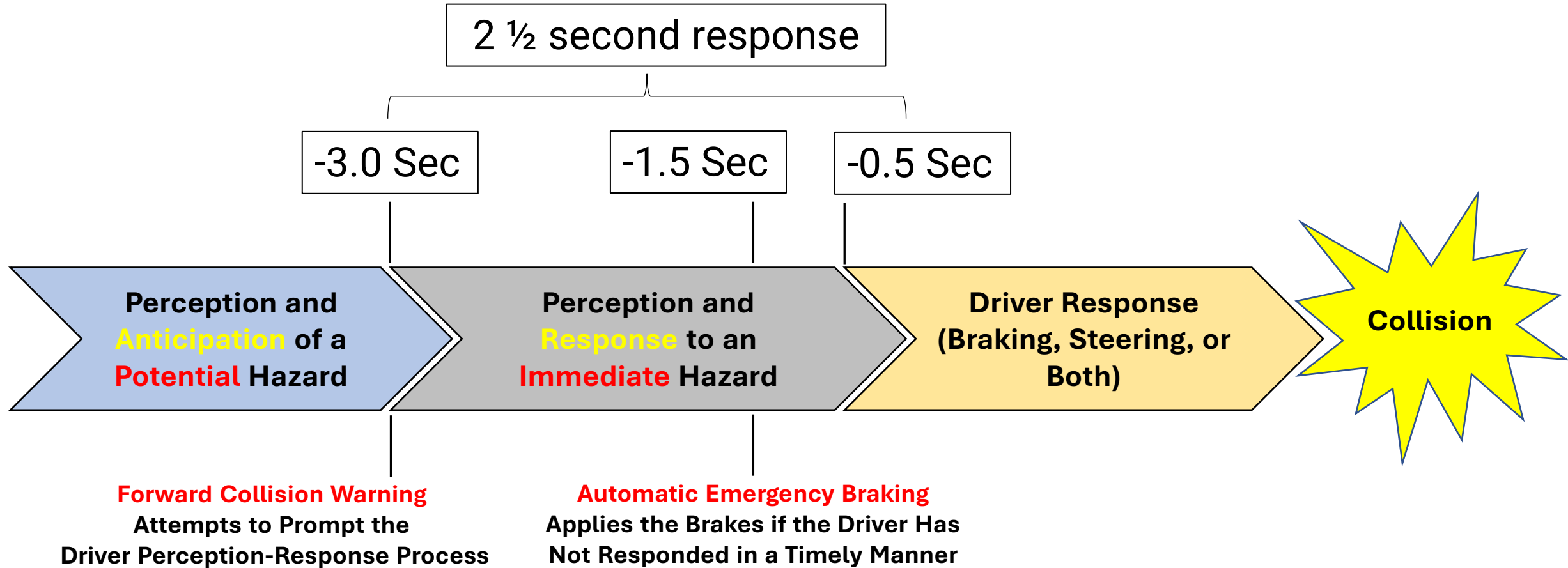
Pre-Collision Crash Avoidance Process for Human Driver With FCW and AEB



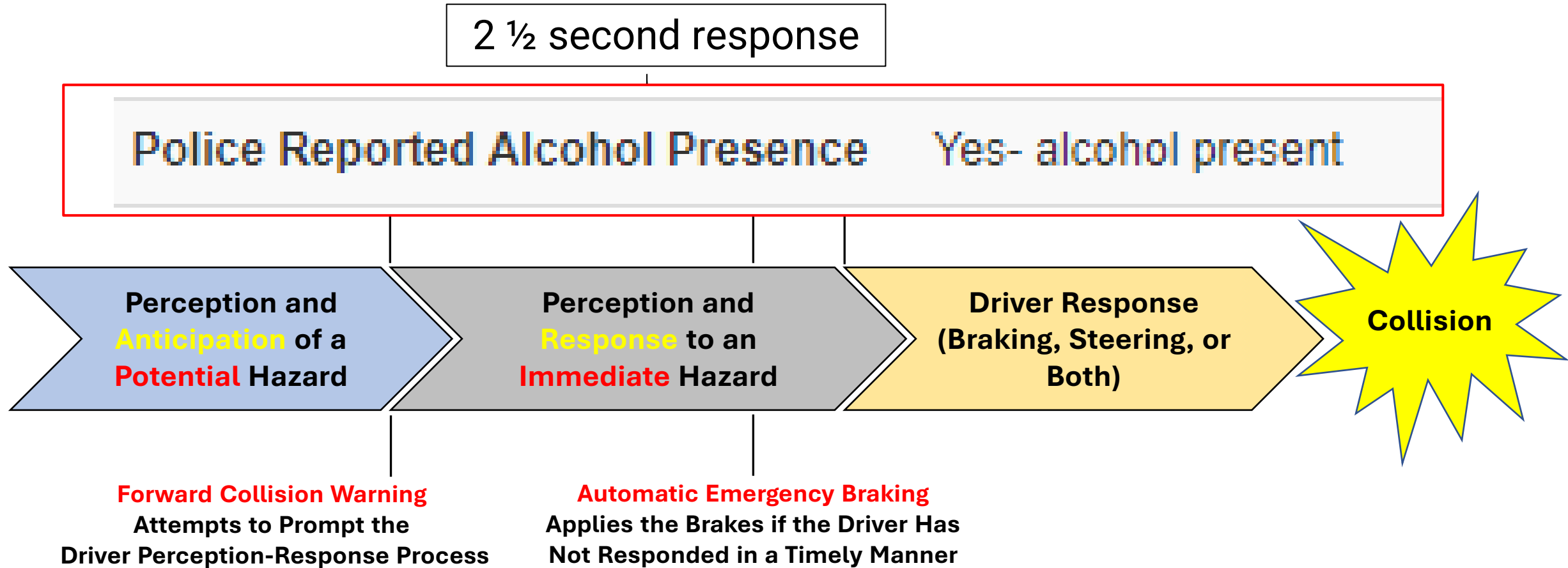
Pre-Collision Crash Avoidance Process for Human Driver With FCW and AEB



Pre-Collision Crash Avoidance Process for Human Driver With FCW and AEB



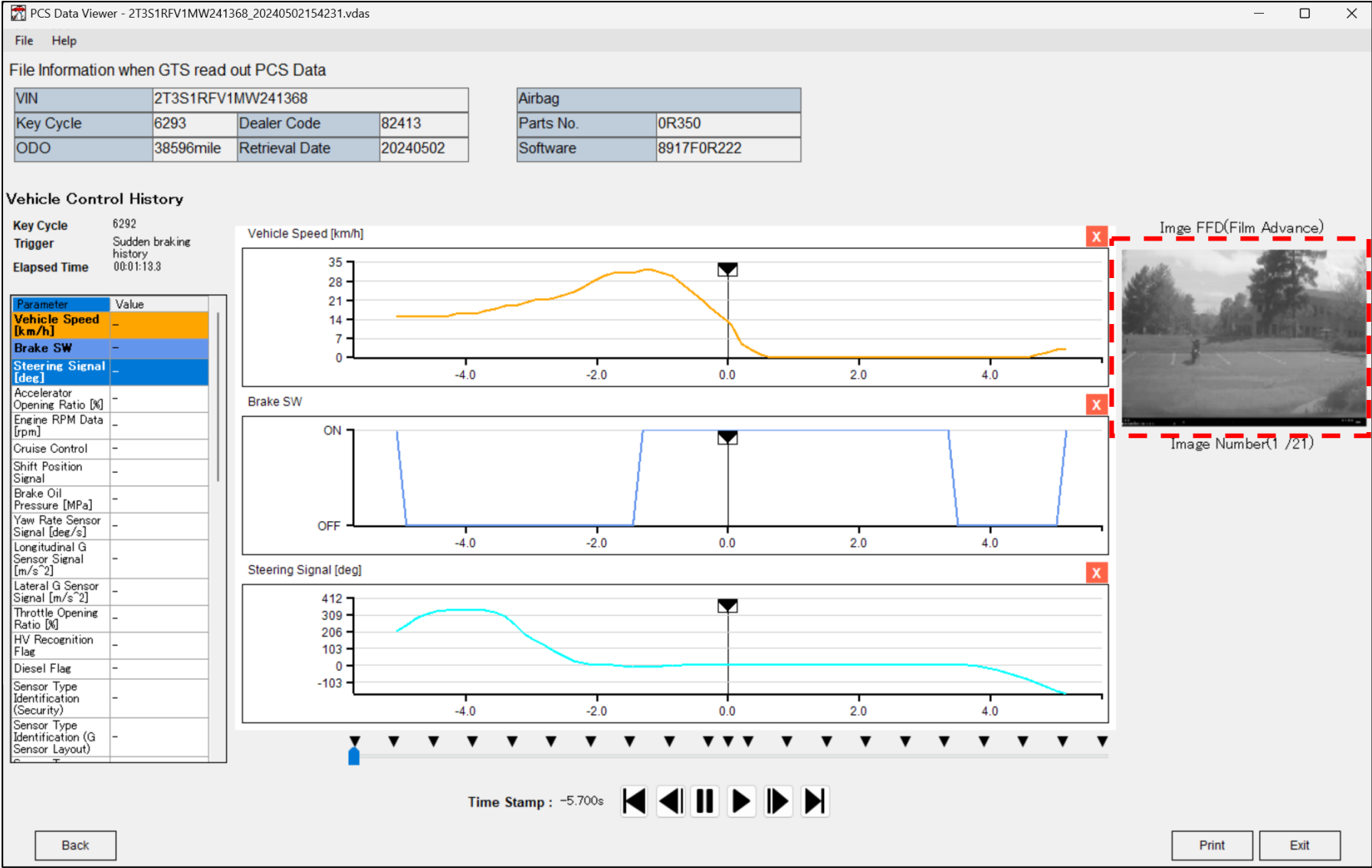
Pre-Collision Crash Avoidance Process for Human Driver With FCW and AEB



Case Study: “Next Gen” Event Data Recorder

Advanced Driver Assistance System (ADAS)
Event Data Recorder Analysis
Recorded Images

On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



On-board Images - Toyota



External Camera



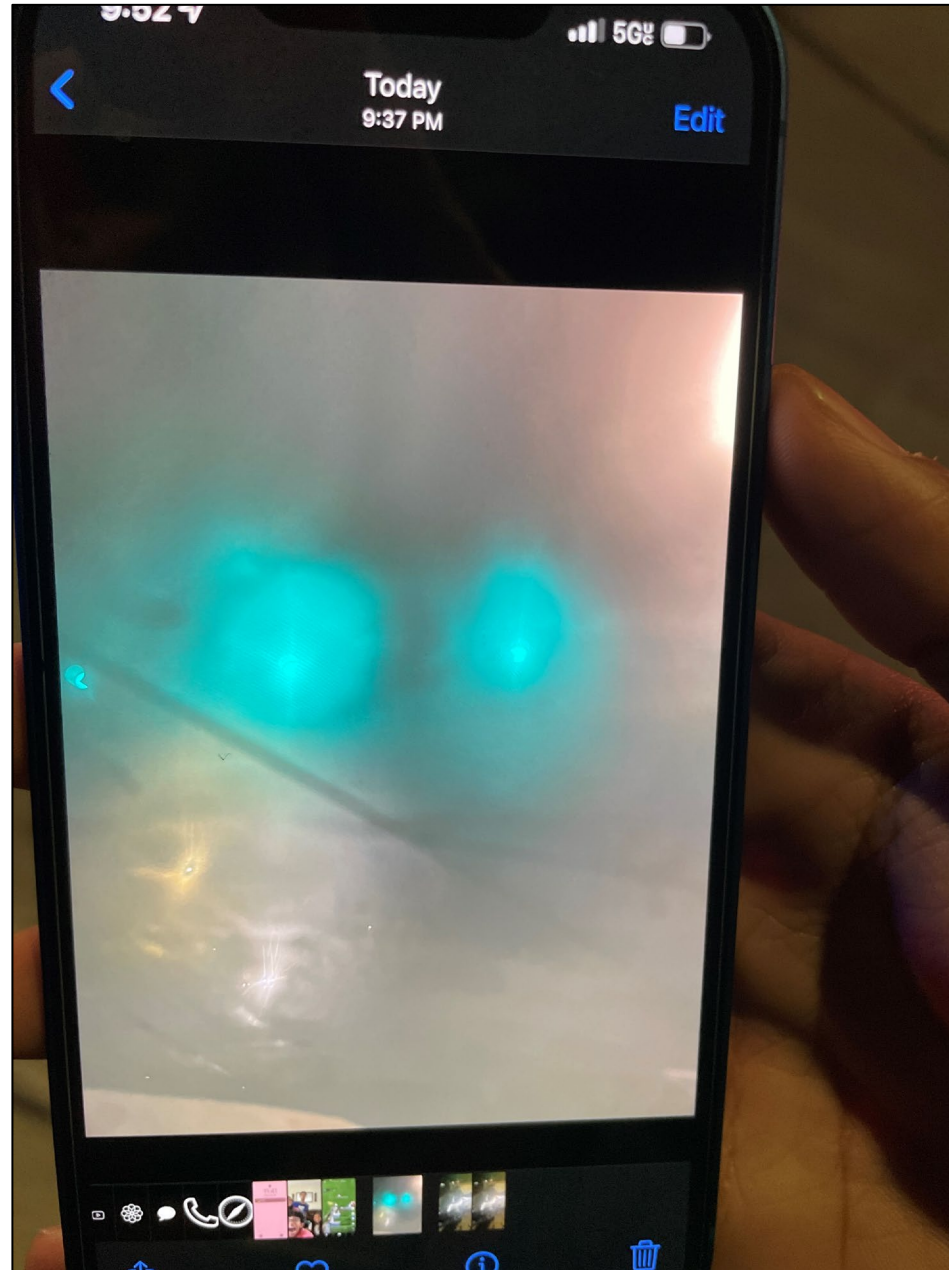
Case Study: “Next Gen” Event Data Recorder

Advanced Driver Assistance System (ADAS)
Event Data Recorder Analysis
Recorded Images

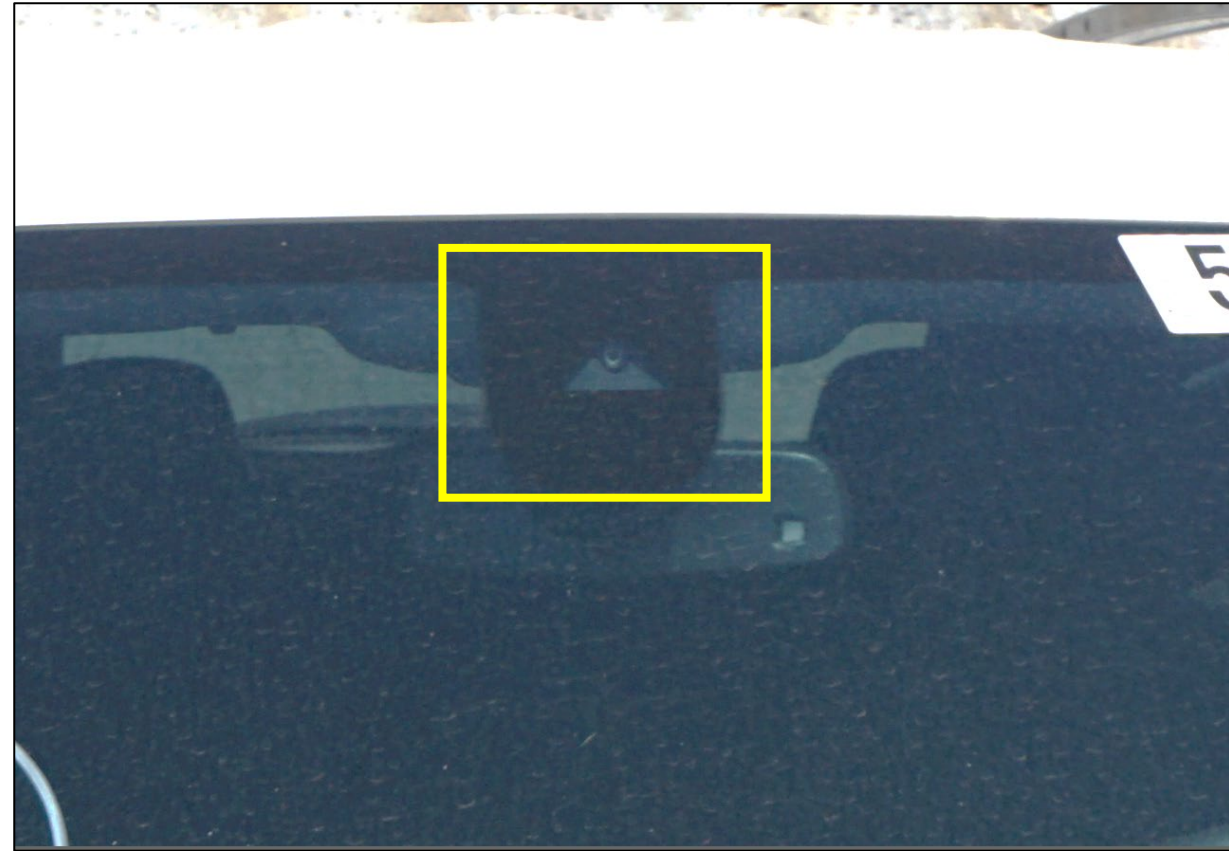
Case Study – On Board Camera Data



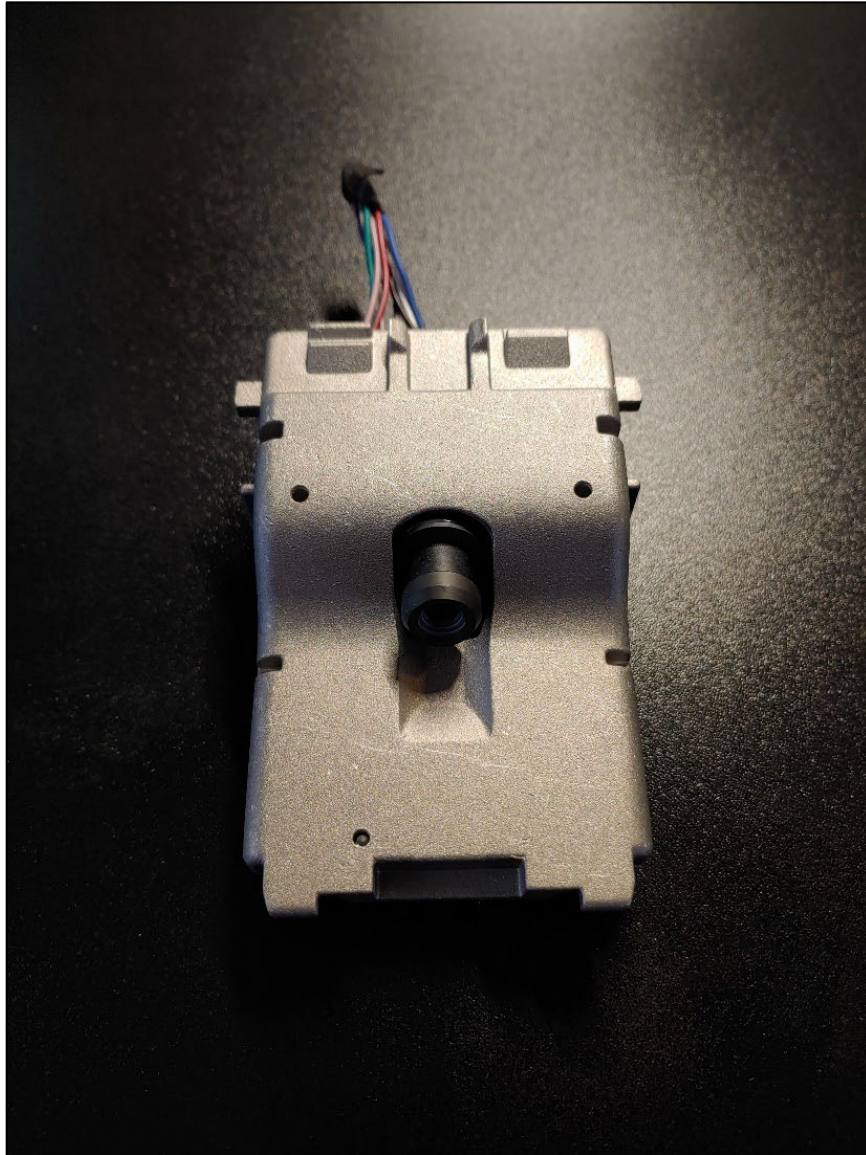
Green Light “Evidence” From Lexus Passenger



Removal of Front Camera Module



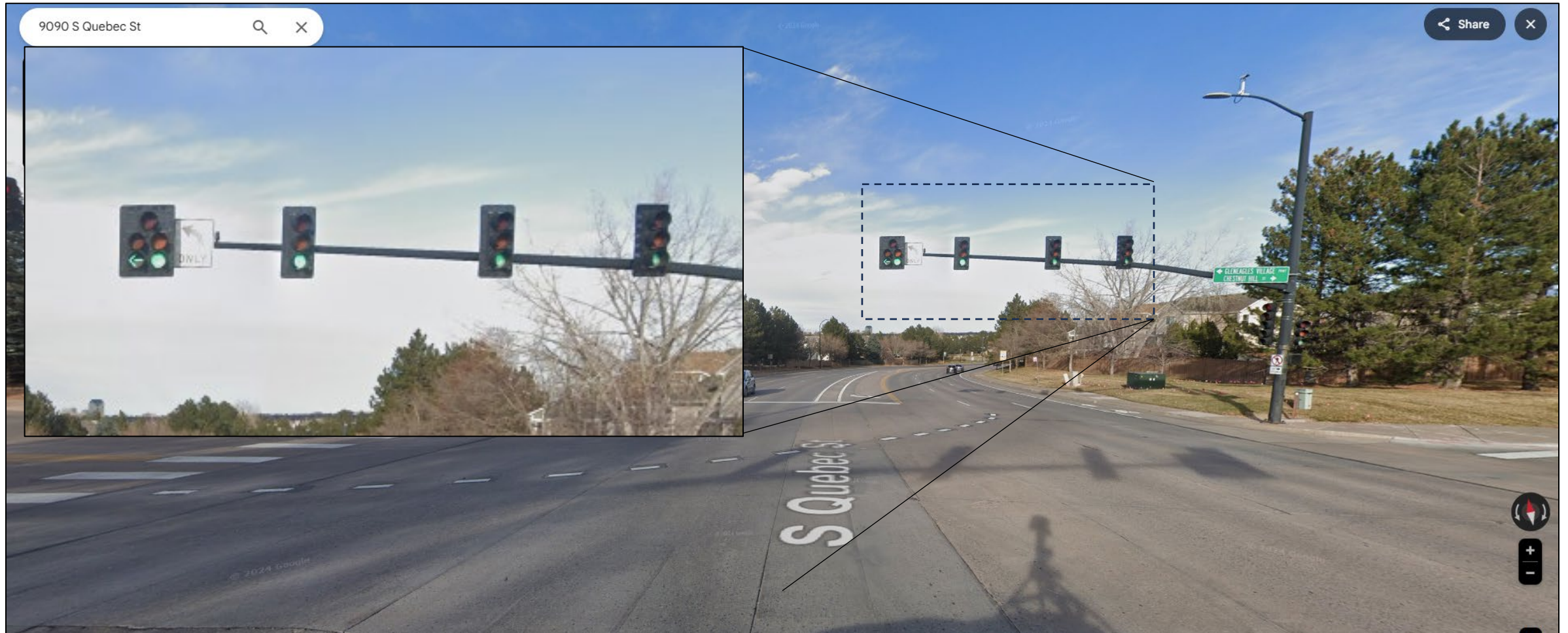
Removal of Front Camera Module



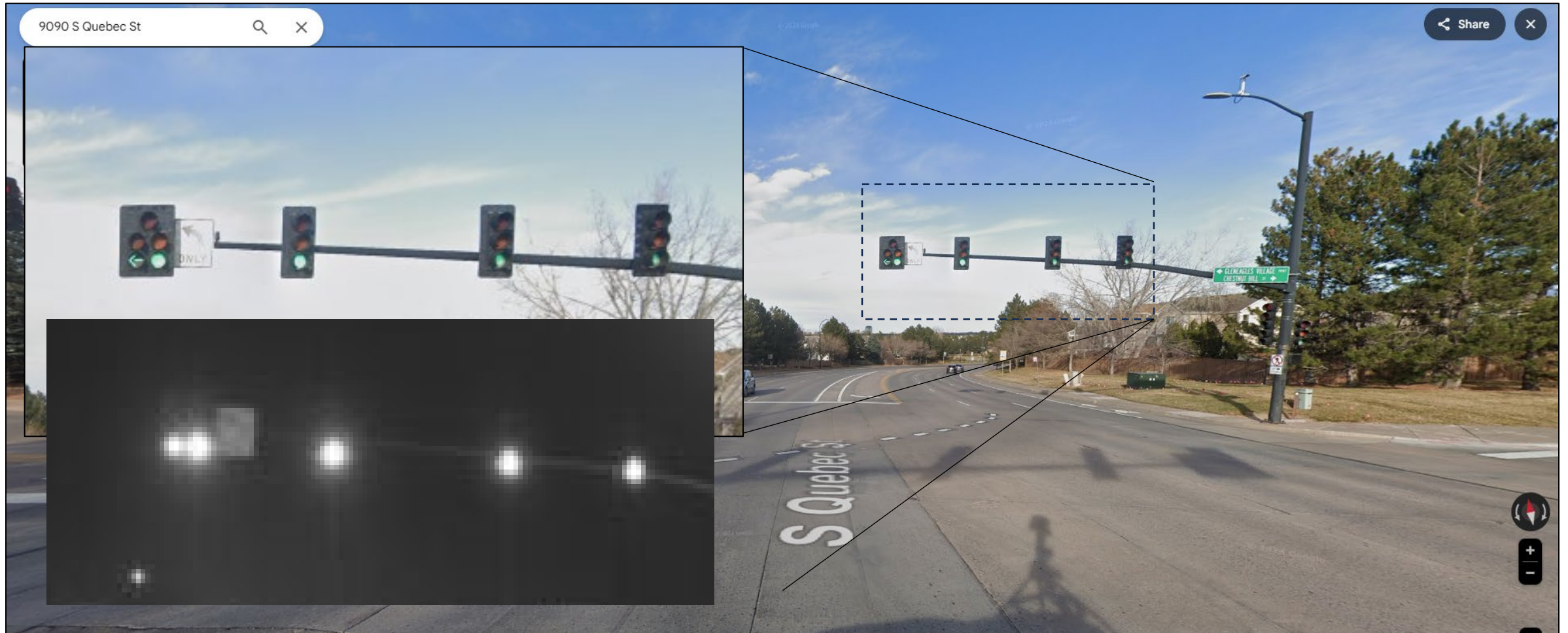
Front Camera Module Image – 4 Seconds Before Crash



Subject Intersection – Looking North



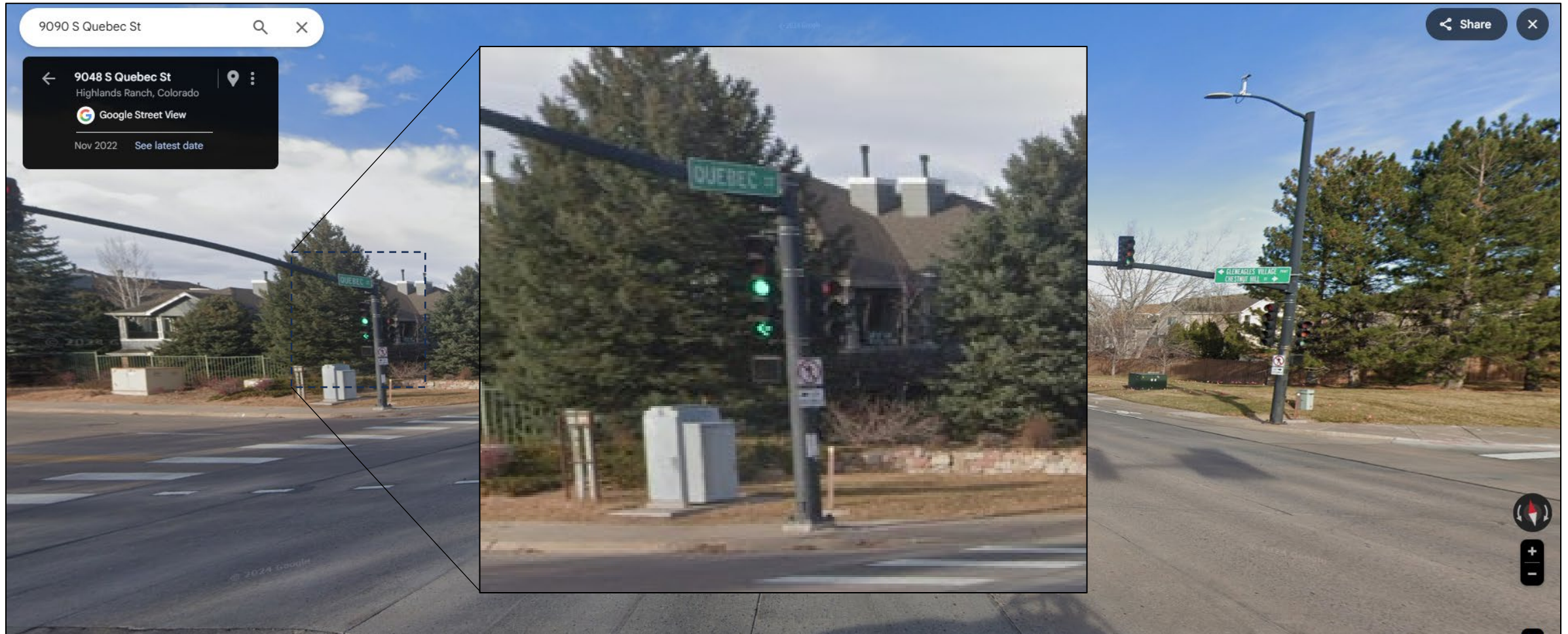
Subject Intersection – Looking North



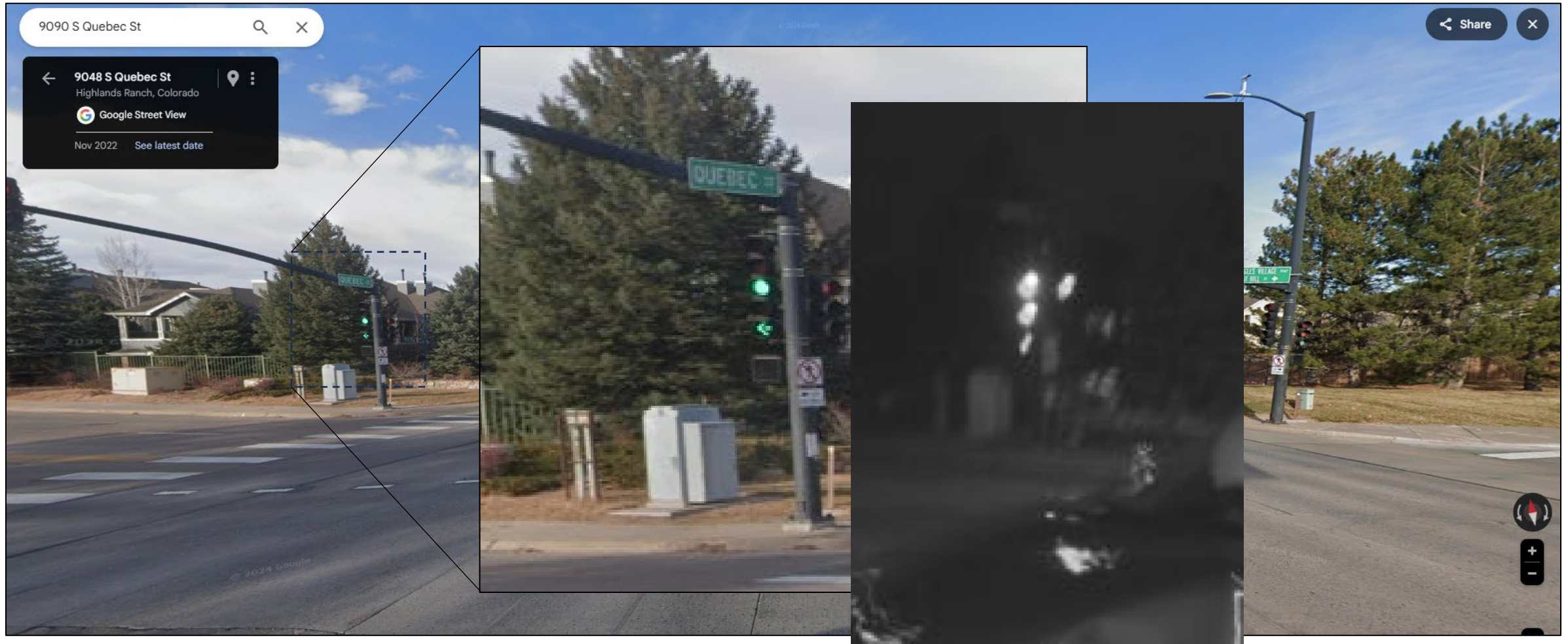
Front Camera Module Image – At Impact



Subject Intersection – Looking North



Subject Intersection – Looking North



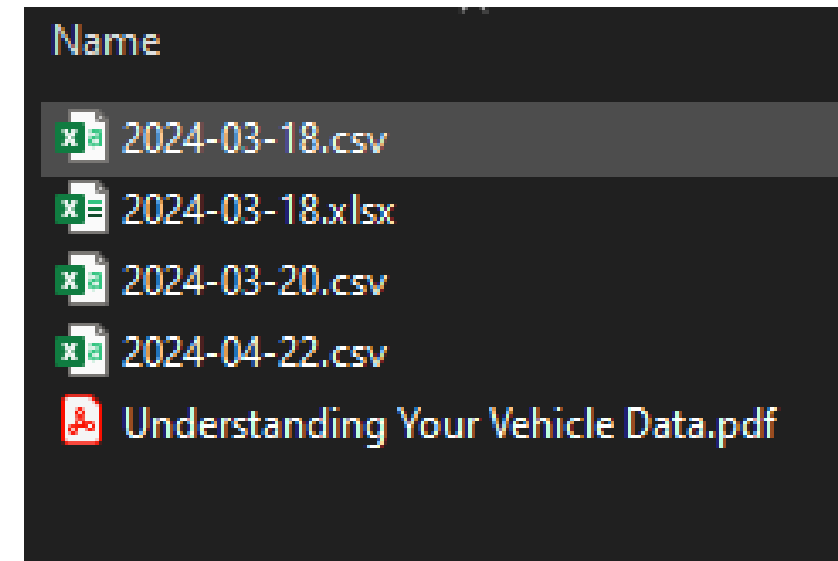
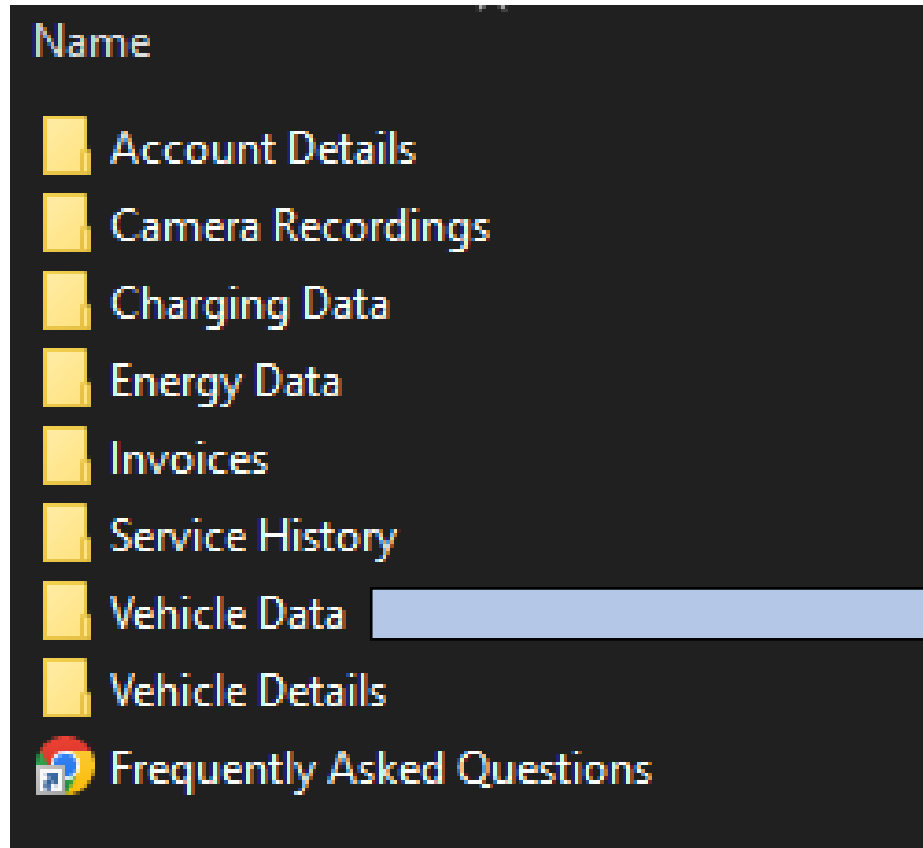
Vehicle Diagnostic Data - Tesla

The Data Associated With Your Tesla Account

You can request a copy of the data associated with your Tesla Account. This information may include:

- Order details
- Account information
- Customer support activity
- Service history from your ownership period
- Vehicle usage information
- Safety event camera recordings (if applicable)
- Infotainment system settings information
- Mobile app usage information
- Supercharging history

Vehicle Diagnostic Data - Tesla



<https://www.tesla.com/support/privacy>

Vehicle Diagnostic Data - Tesla



Vehicle Diagnostic Data - Tesla

Example Data (varies by year and model):

- One day of Data
- 18,186 Rows of Data
- 263 Parameters Measured, including:
 - Vehicle Speed
 - Steering Angle
 - Vehicle Yaw Rate
 - Braking
 - ABS Brake Event
 - Automatic Emergency Braking
 - Accelerator Pedal Position
 - Headlight and Turn Signal Data
 - Brake Lights
 - Seatbelt Status for All Seats
 - Longitudinal and Lateral Acceleration

On-board Video - Tesla



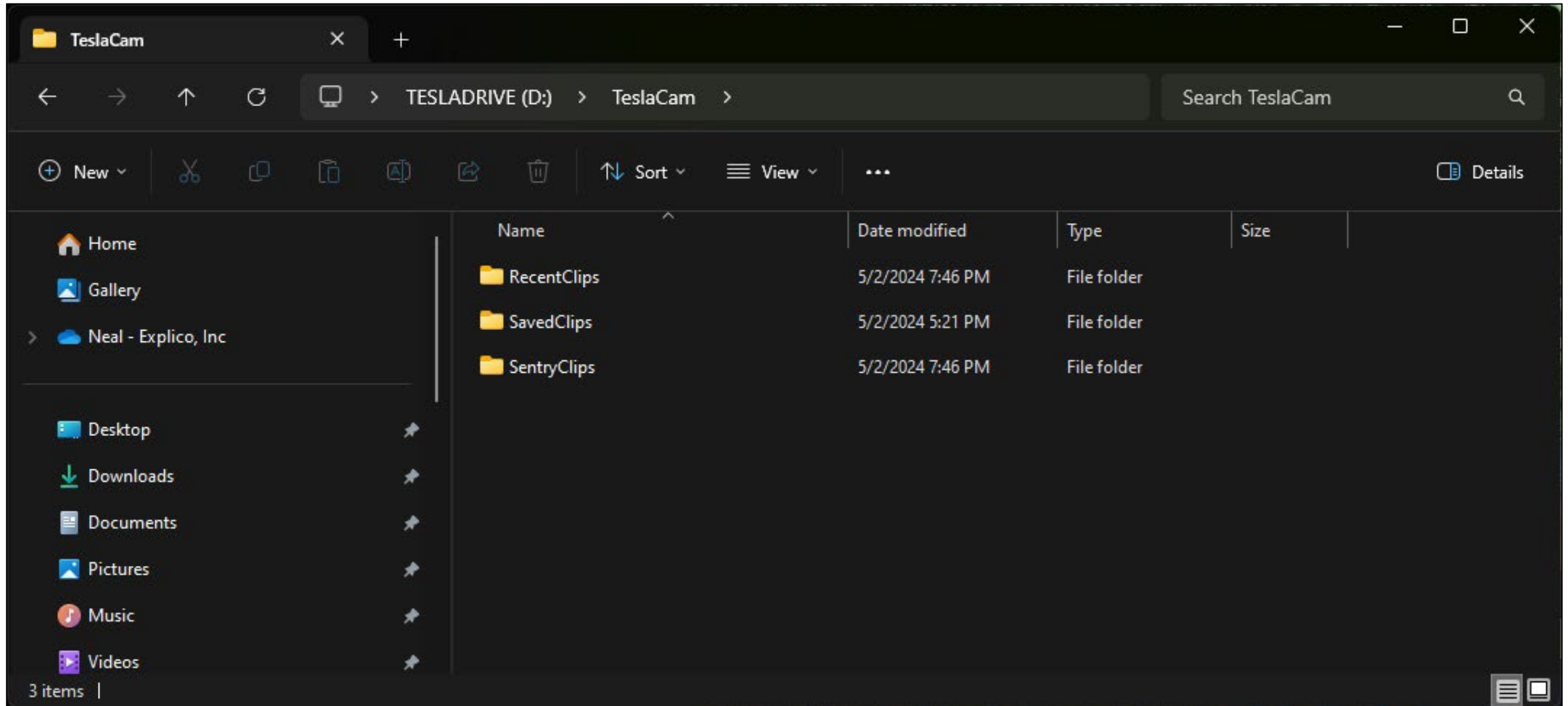
On-board Video - Tesla



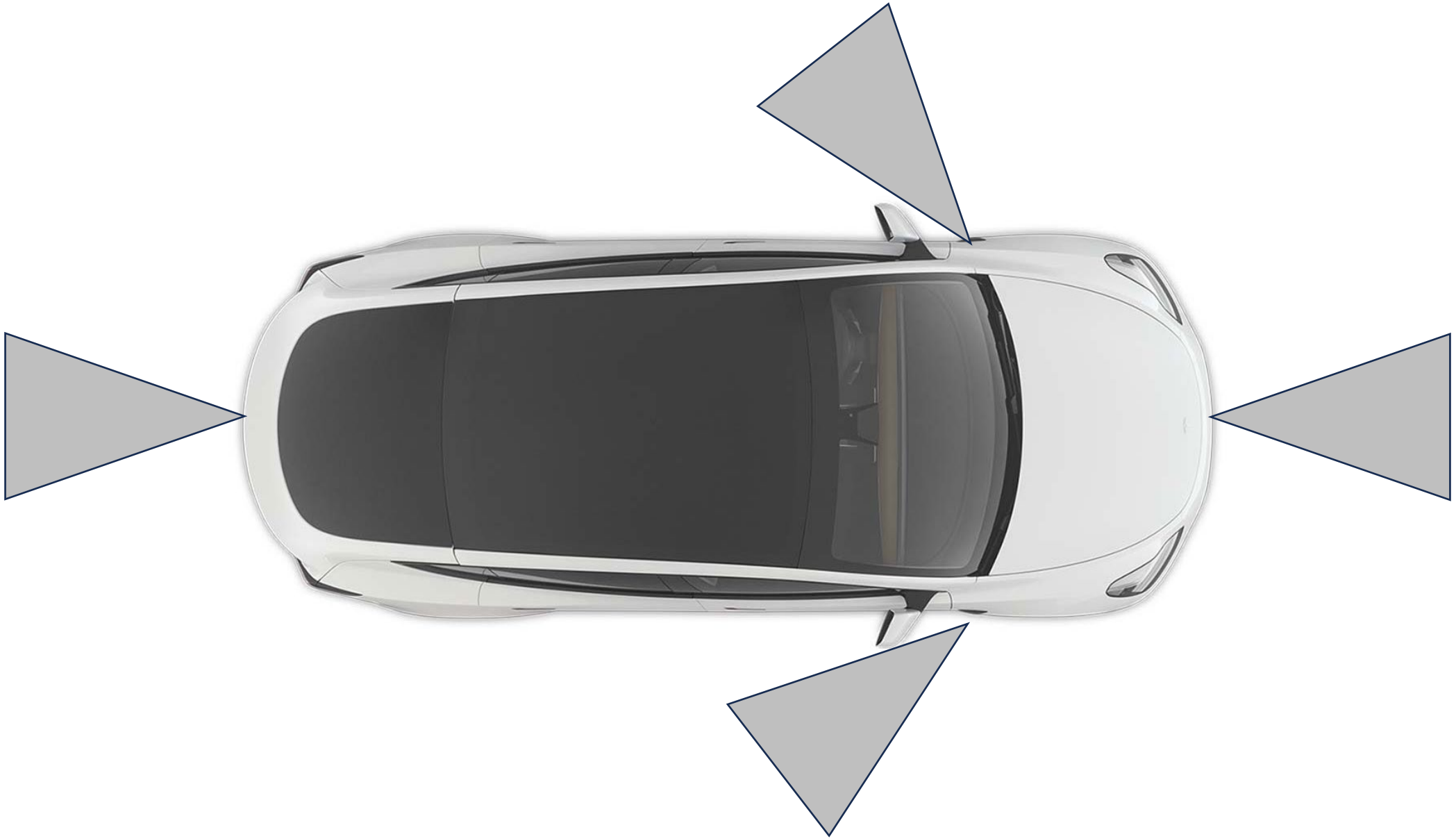
On-board Video - Tesla



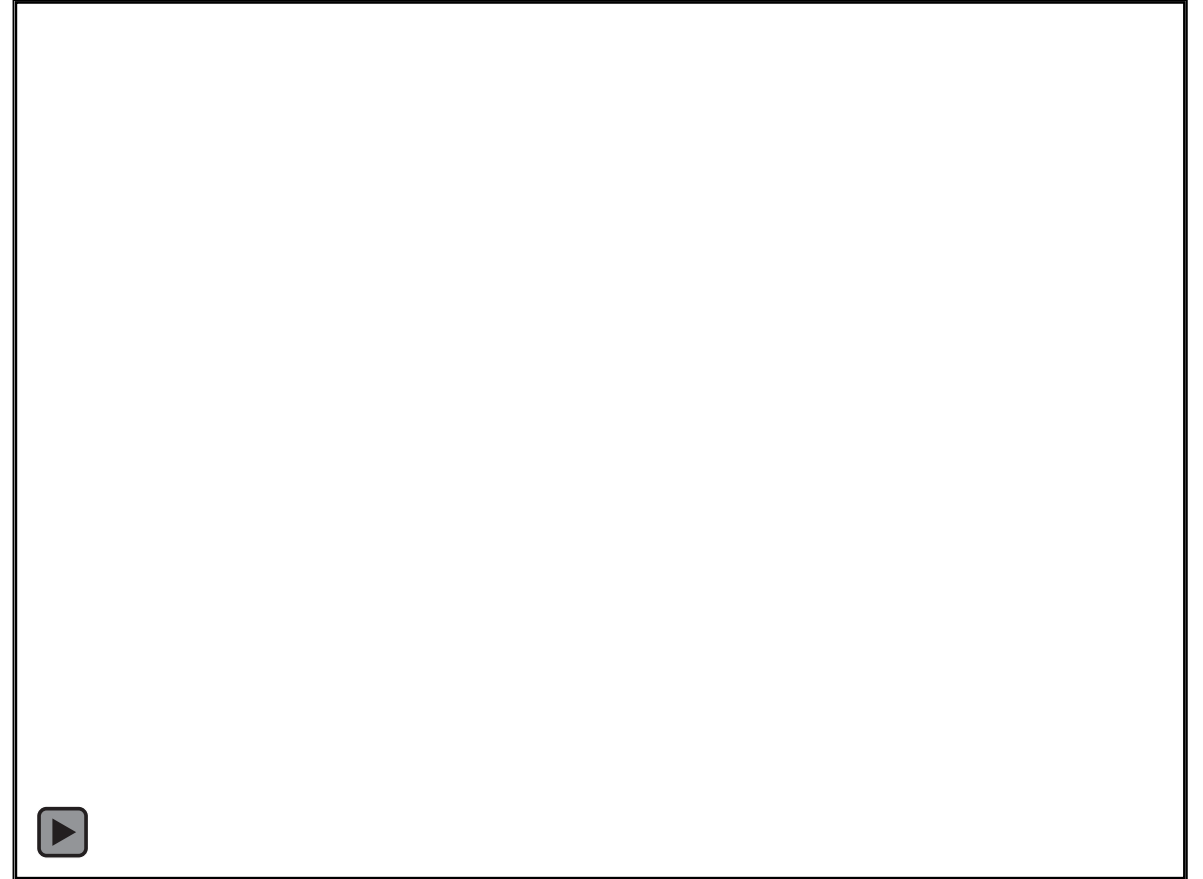
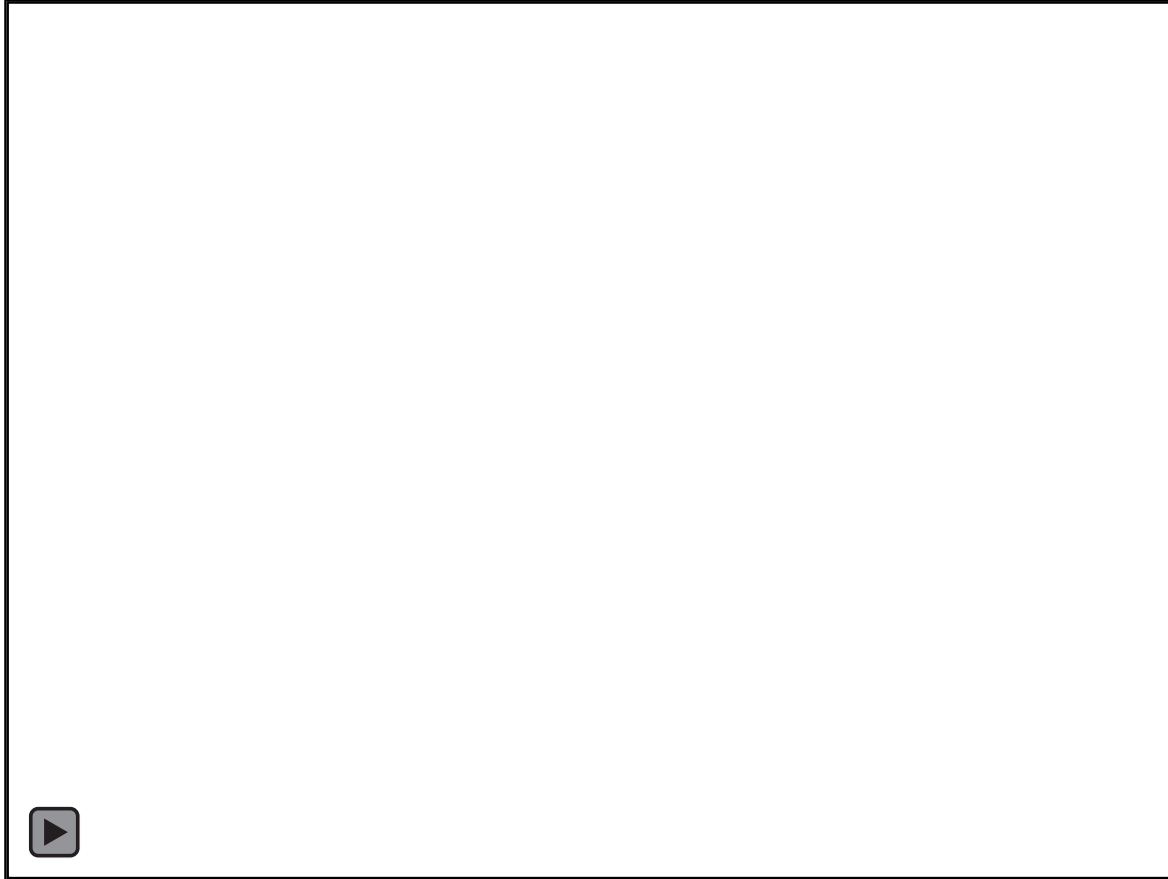
On-board Video - Tesla



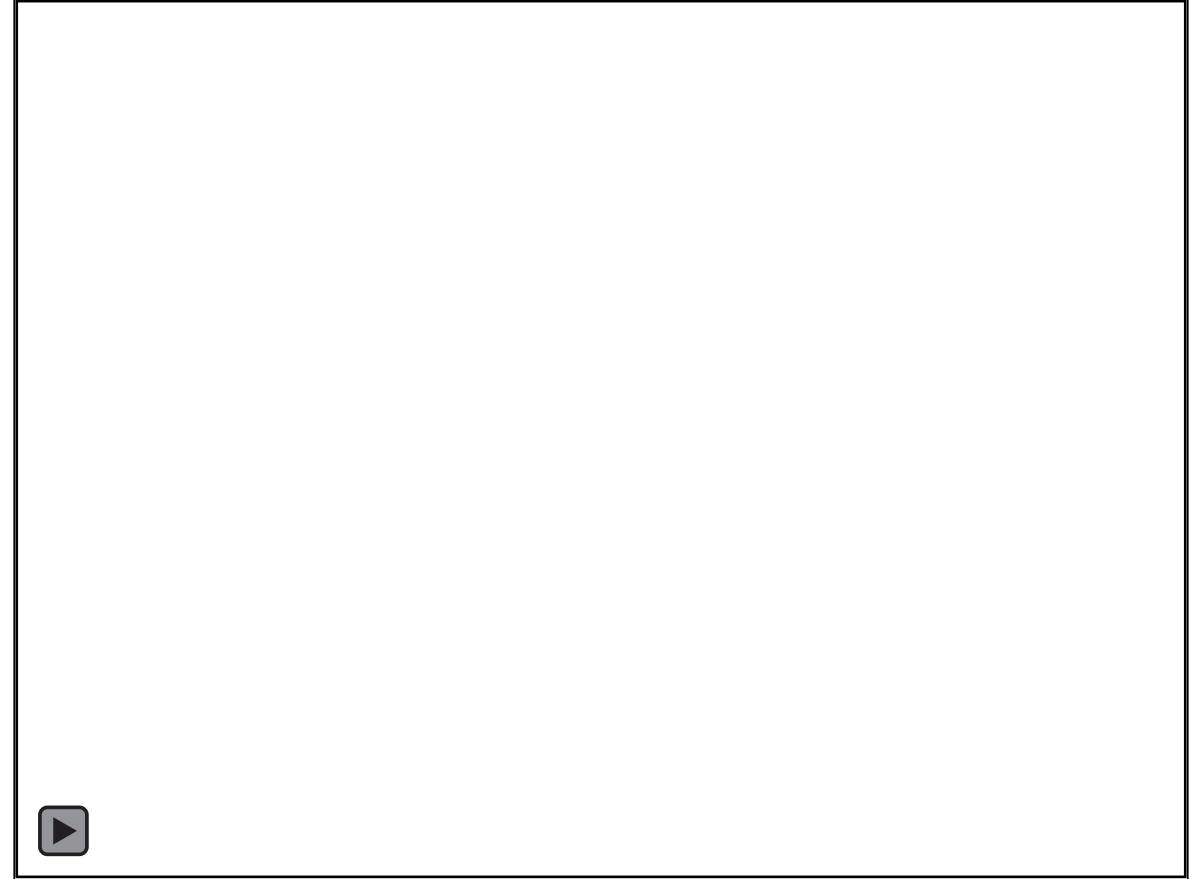
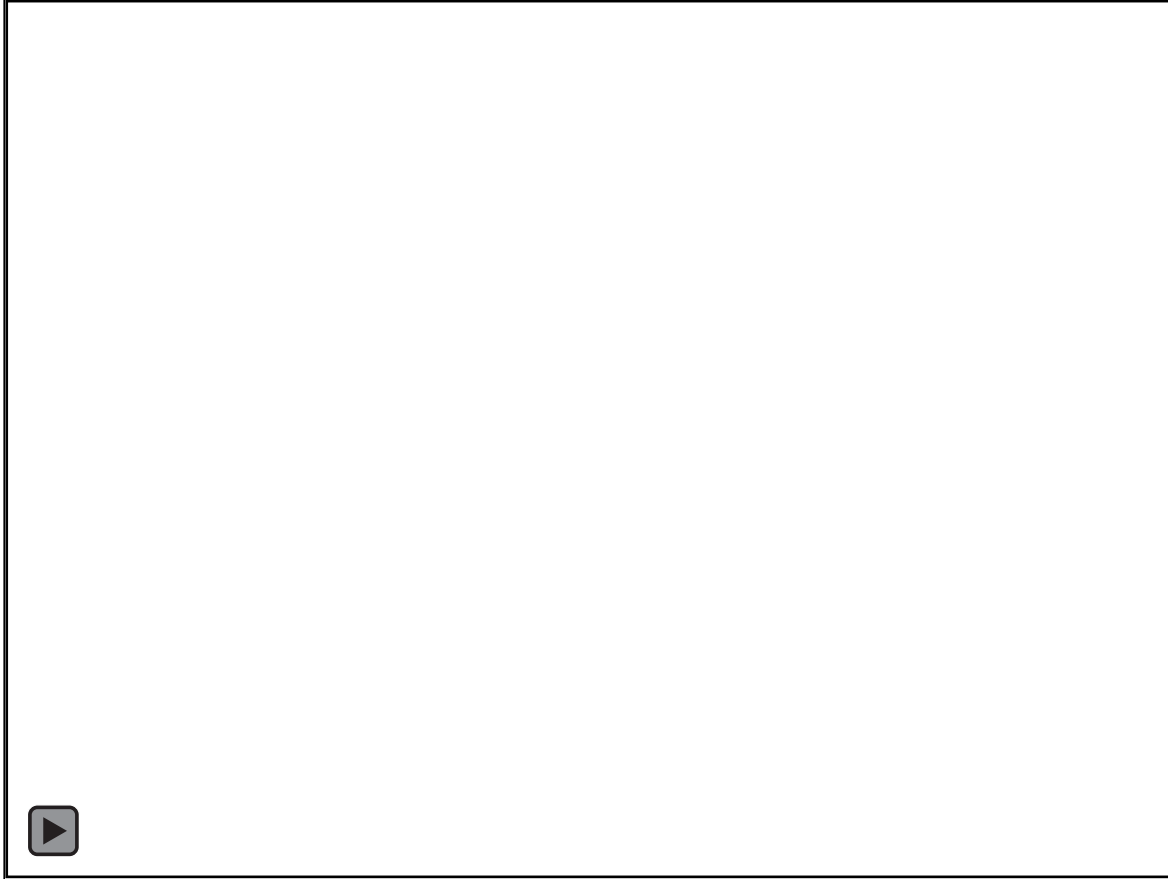
On-board Video - Tesla



On-board Video - Tesla



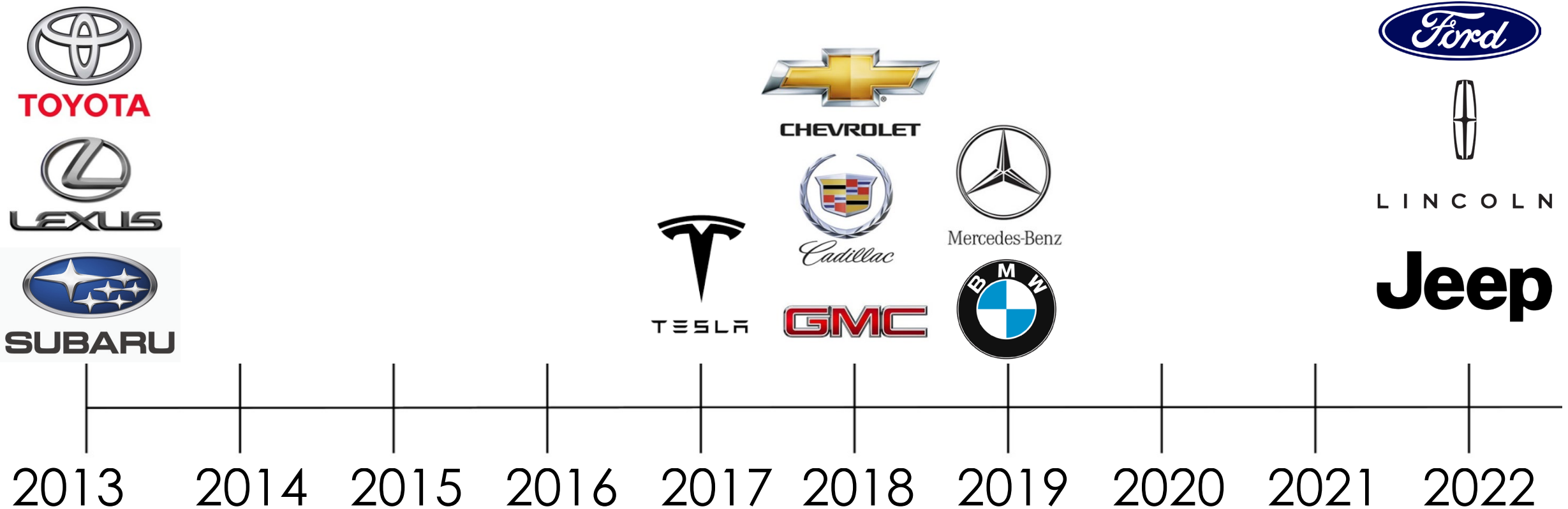
On-board Video - Tesla





<https://www.youtube.com/watch?v=5gFR3sMWSO0>

Vehicles that May Record Images or Video

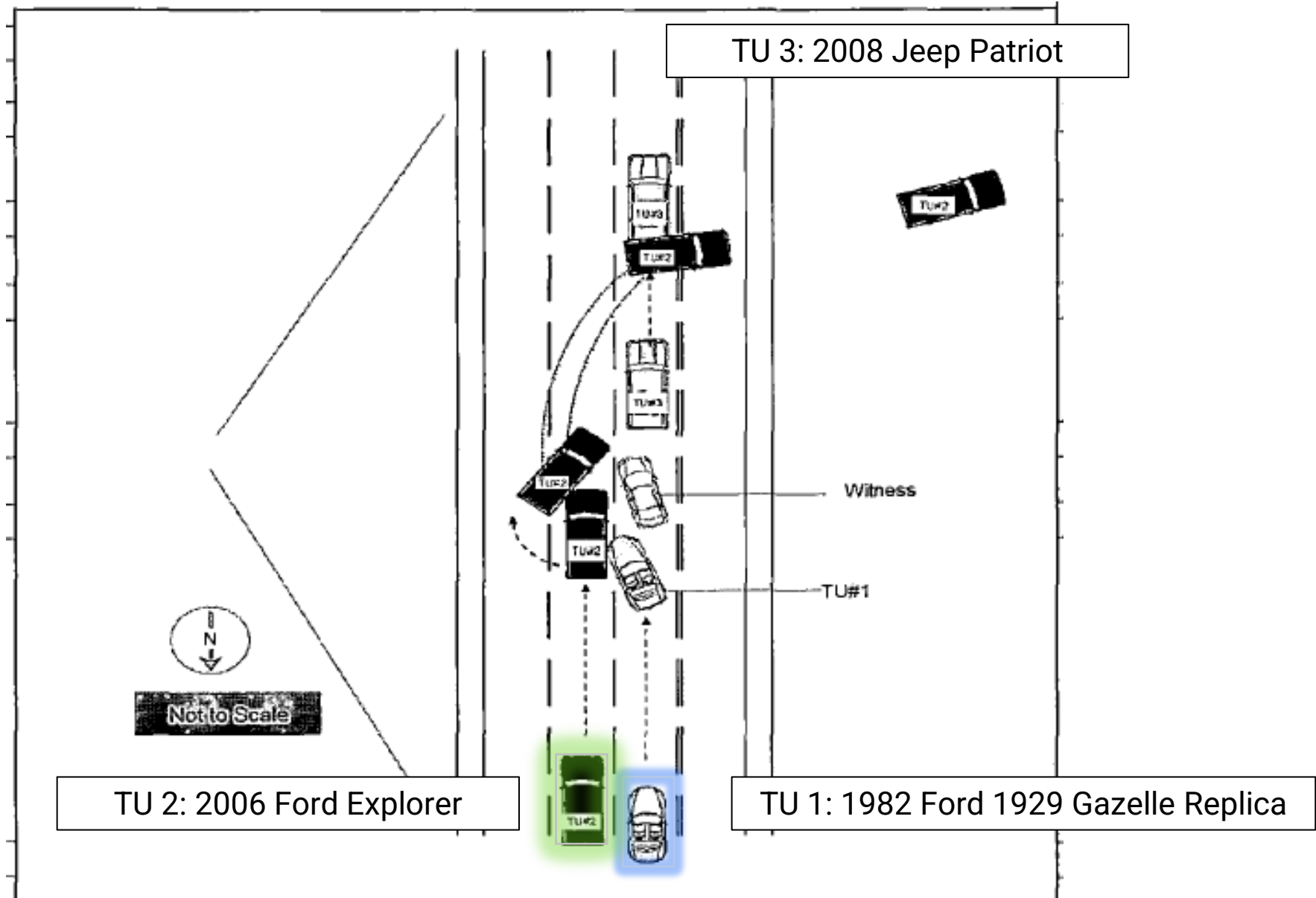


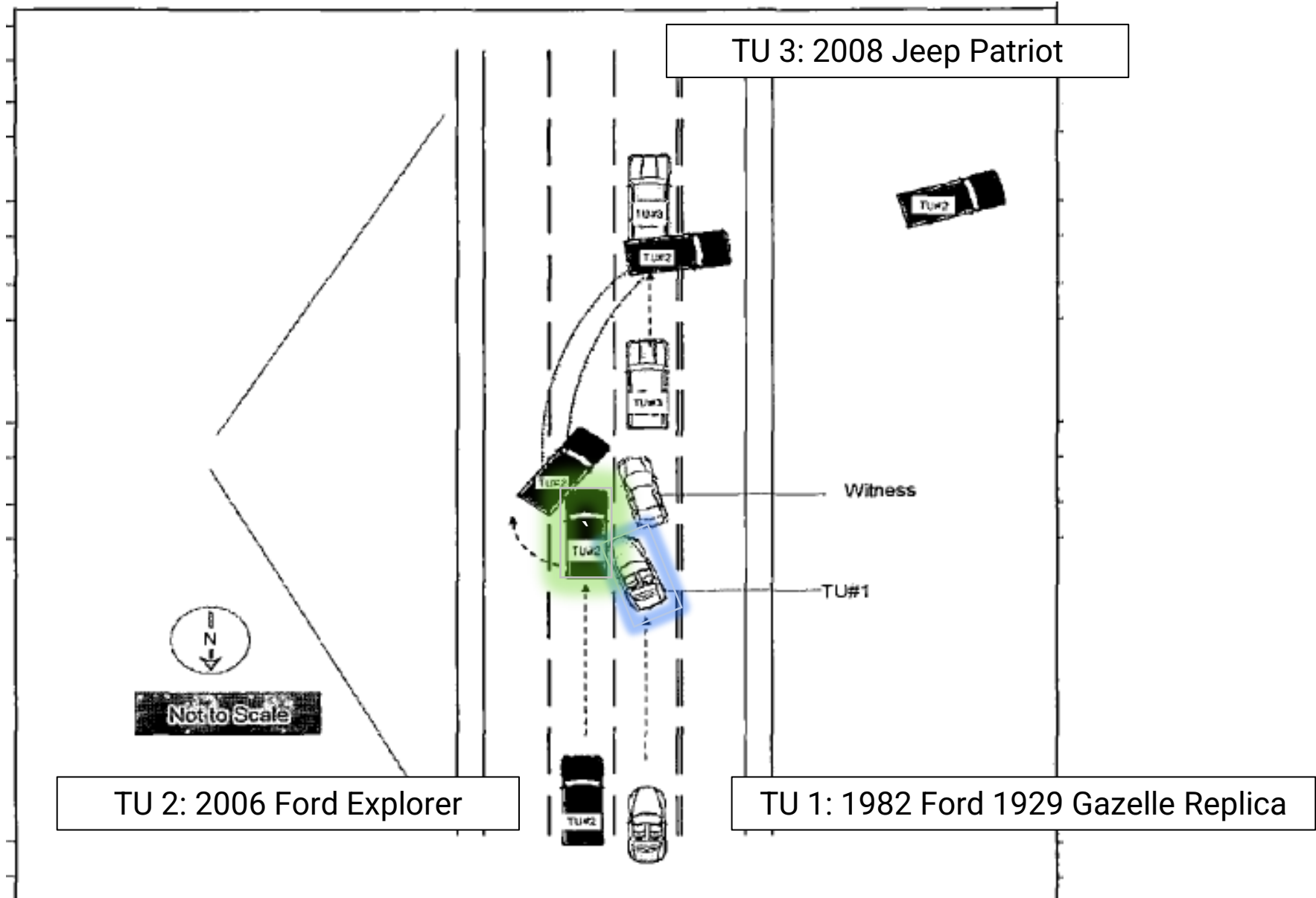
Case Study: Vehicle Availability

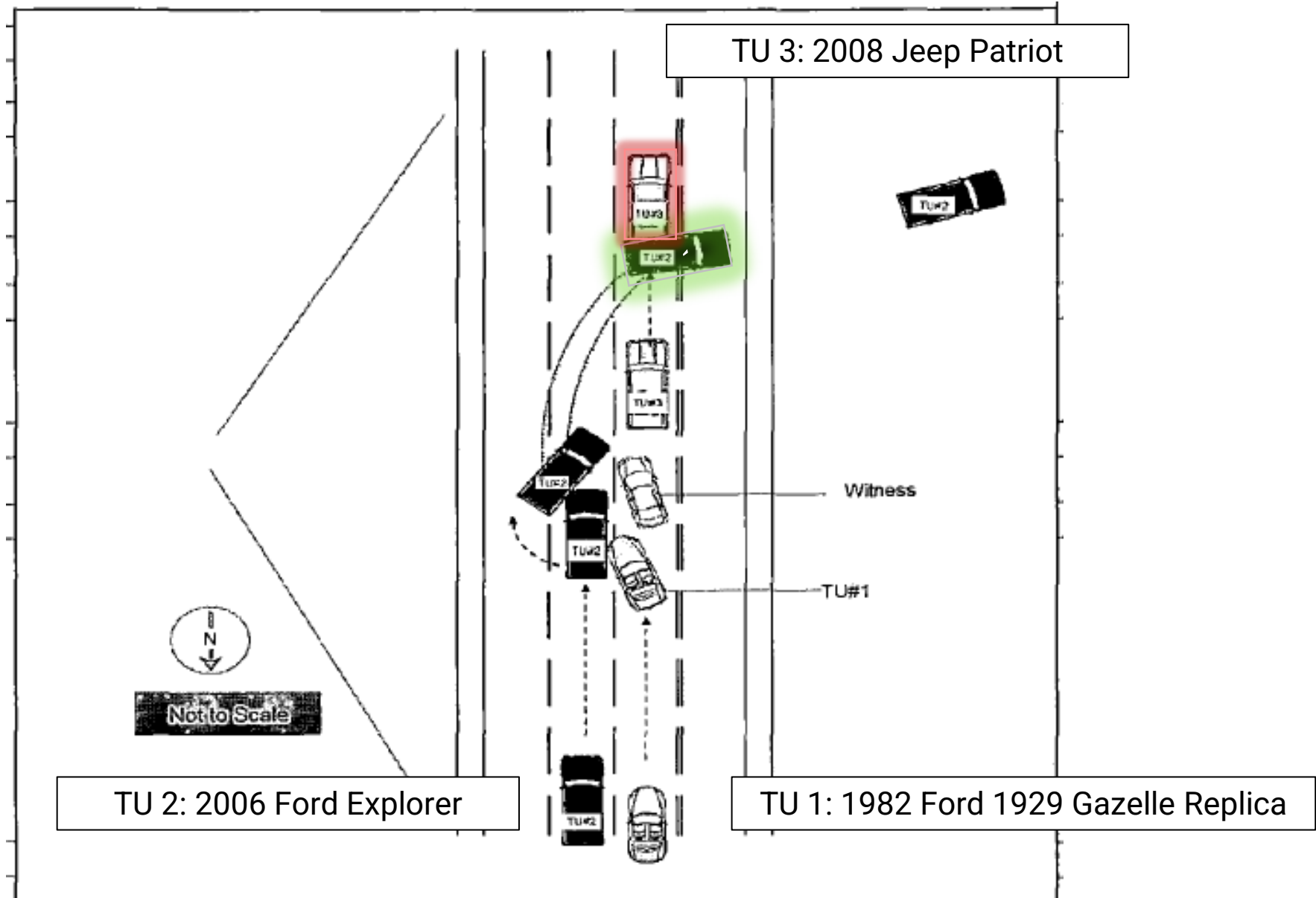
Vehicle Tracking

Event Data Recorder Download

Event Data Recorder Analysis







The Ford is “Not Available” per opposing attorney...

Carfax: No change in registration

DMV: Registered to same owner, after accident

Google Streetview, 2½ years after accident



Ford Explorer Inspection: More than 4 years after accident



ACM Download



ACM Data

Pre-Crash Data (First Record)

Time (sec)	-5	-4	-3	-2	-1
Accelerator Pedal (%)	59	42	29	0	0
Vehicle speed (MPH [km/h])	49.4 [79.6]	51.1 [82.2]	52.0 [83.7]	51.6 [83.0]	51.1 [82.3]
ABS event in progress	No	No	No	No	No
TCS engine event in progress	No	No	No	No	No
TCS brake event in progress	No	No	No	No	No
Brake depressed	No	No	No	No	Yes
IVD Event in Progress	No	No	No	No	No
OCS classification	Empty	Empty	Empty	Empty	Empty

Conclusions

- Vehicle EDRs possess a wealth of insightful digital data
- EDR Data can help uncover driver actions that caused a crash
- EDR Data can also eliminate the need for a traditional accident reconstruction
- Vehicle preservation is key

Preservation



SuttonBooker

Applicable Categories of Documents for Litigation Hold

Specific to this litigation-hold letter, you are made aware that a party has a duty to preserve evidence when it is placed on notice that the evidence is relevant to litigation or when the parties should have known that the evidence may be relevant to future litigation. See *Rockley v. Echo Star Communications Corp.*, 229 F.R.D. 506, 510 (D. Md. 2005). This duty encompasses any documents or tangible items authored, recorded or made by individuals likely to have discoverable information that the disclosing party may use to support its claims or defenses. *Id.* [citing *Zubulake v. UBS Warburg LLC*, 200 F.R.D. 212, 217-18 (S.D.N.Y. 2003)]. Any information relevant to the claims or defenses of any party, or which is relevant to the subject matter involved in the litigation is covered by the duty to preserve. *Id.*

To comply with your legal obligations and the obligations of your insured, it is essential that you and your policyholder and others preserve any documents and/or records, whether in paper or electronic form, concerning the following categories related to the events giving rise to this communication:

1. Video;
2. Digital images;
3. Audio;
4. Photographs;
5. Vehicles;
6. Cell and/or Smart Phone data;
7. Communications of any kind including, but not limited to emails, texts, instant messaging, social medial postings; and
8. Vehicle black-box data, also known as, a crash data recorder. Unless, the vehicle involved in the incident is a late model vehicle, it is likely that there is identifiable “black-box” data. This evidence may include, but is not limited to, the vehicle's speed, Delta V, brake on/off, percent throttle, seatbelt use, engine speed, etc. at the time of the collision. You shall take measures to identify the existence of this information and shall prevent the destruction of and preserve the contents of this information immediately.

Spoliation of Evidence



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State

- Duty to preserve evidence is ordinarily triggered by the filing of a lawsuit, but obligation to preserve evidence may arise even earlier if a party has notice that future litigation is likely.
- Conduct that falls somewhere between negligence and intentional conduct is sufficient to impose an adverse inference instruction.
- An adverse inference instruction is warranted, when the spoliator's conduct is "either intentional or so reckless that it must be held accountable."
- If the spoiling party is merely negligent, an adverse inference nevertheless may be imposed to remediate harm when the inference is "reasonably likely to have been contained in the destroyed evidence."
- Penalties range from a monetary sanction, to an adverse inference jury instruction, to a default judgment.

Federal

- To obtain sanctions for spoliation of evidence, a party must first show that
 - (1) a party had a duty to preserve evidence because it knew, or should have known, that litigation was imminent and
 - (2) the adverse party was prejudiced by the destruction of the evidence.
(*Burlington N. & Santa Fe Ry. Co. v. Grant*, 505 F.3d 1013, 1032 (10th Cir. 2007))
- The obligation to preserve evidence does not apply when information or evidence is lost before a duty to preserve attaches.
(See F.R.C.P. 37(e))
- A party is only entitled to an adverse inference if he can show it was the result of bad faith of the party destroying the records. (*Rife v. Okla. Dep't of Pub. Safety*, 846 F.3d 1119, 1135 (10th Cir. 2017))
- Evidence of intentional destruction or bad faith is required to be entitled to a spoliation instruction.

Thank you

NEAL CARTER

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