Utilizing Vehicle Data in Law Enforcement Investigations

In the past decade vehicles have changed drastically, and due to rapidly changing technologies they continue to evolve. This can be advantageous for police investigating all types of crimes. According to Berla Corporation, an automotive cybersecurity company, more than 80% of crimes involve a vehicle, and almost every crime involves a digital element.[1]

Vehicles can provide a wealth of information, including: vehicle speed; when doors are opened and closed; when lights are turned on and off; navigation history; gear shift changes; and much more.[2] In addition to the data gleaned from the vehicle itself, data can be extracted from devices, such as smartphones that are connected to the vehicle via Wi-Fi, Bluetooth, and/or USB. This information may include call logs, contact lists, texts messages, pictures, videos, and social media.[3] As a result, vehicle data has become an invaluable source of digital evidence and can help law enforcement investigators piece together the key "who, what, where, and when" of their investigations.

Basics of Vehicle Data

A typical vehicle has 75 or more computer systems, 150 million lines of code, and generates 25 gigabytes of data per hour.[4] Knowing how to access this valuable data is essential for successful investigations.

Electronic Control Units

Large amounts of vehicle data can be extracted from the multiple **Electronic Control Units (ECUs)** – small devices in a vehicle's body that are responsible for controlling a specific function. One modern vehicle may contain upwards of 100 different ECUs that control a variety of functions including: engine and power steering control; power windows; seats; heating, ventilation, and air conditioning (HVAC); door locks; keyless entry; airbags; automatic
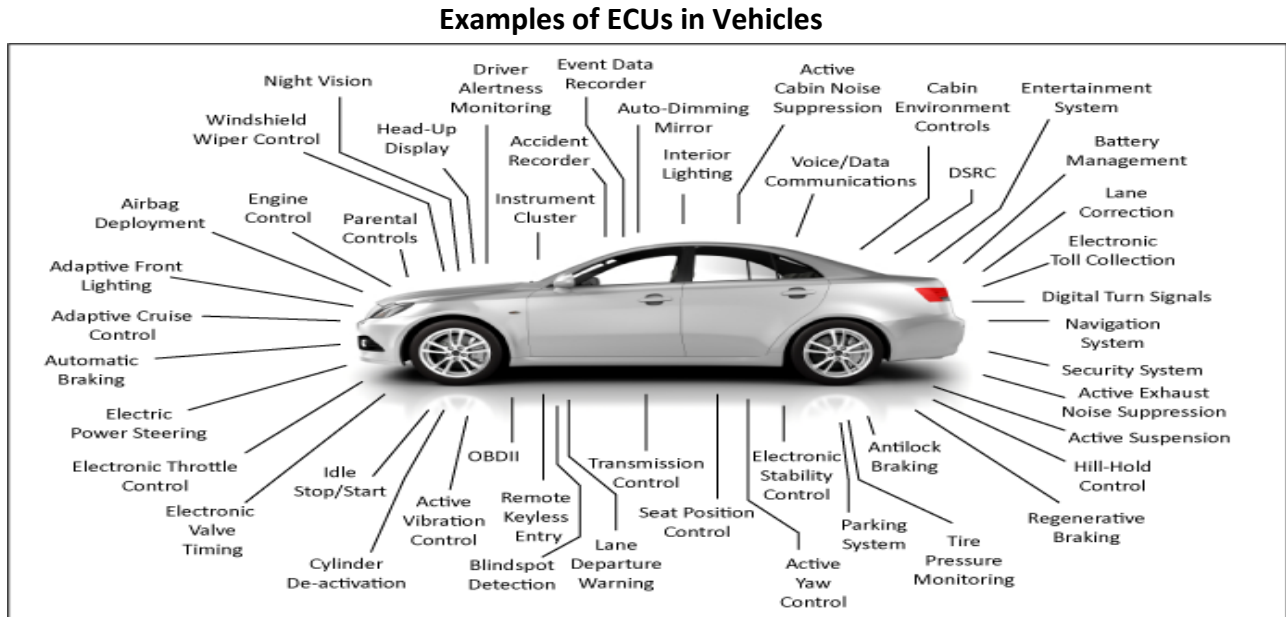
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[1] https://berla.co/12-days-of-vehicle-forensics/
[2] https://www.msab.com/download/case_studies/MSAB-BERLA-Article.pdf
[3] Ibid.
[4] https://berla.co/discover/

emergency braking; etc.[5] Such data can reveal if a car was in an accident, when someone was operating the vehicle, or even if seats were adjusted – indicating that a new or different driver was behind the wheel.

Examples of ECUs in Vehicles

Source: https://www.chipsetc.com/computer-chips-inside-the-car.html

Infotainment and Telematic Systems

Another source of digital data comes from the vehicle's **infotainment and telematic systems**, which have the capability to send, receive, and store data such as GPS navigation, vehicle location, and texting. The term "Infotainment" is a combination of the words "information" and "entertainment," so the vehicle's **infotainment system** "relates to the delivery of information and entertainment via the dashboard touchscreen, steering wheel controls, voice controls, Bluetooth™, Wi-Fi, USB devices, SD cards, or other means that an occupant uses to connect with their digital environment."[6]

The term "telematic" is a combination of the words "telecommunications" and "informatics." The **telematic system** involves "the transmission of information physically (for example, electrical wiring) or wirelessly (for example, using radio waves in Wi-Fi or Bluetooth™ devices)."[7]

The main difference between the telematic and the infotainment systems are that a vehicle's telematics system has two-way communication that sends, receives and stores information, but

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[5] https://www.aptiv.com/newsroom/article/what-is-an-electronic-control-unit
[6] https://abforensics.com/wp-content/uploads/2019/02/INTERPOL-4N6-PULSE-IssueIV-BATES.pdf
[7] Ibid.

generally does not include entertainment features like the infotainment system does. The focus of the telematics system is on monitoring the vehicle, the driver's performance, and safety, and not on entertaining drivers and passengers. [8]

Digital evidence from the infotainment and telematic systems have a large impact on vehicle related investigations, and their usefulness will likely continue to increase over the years as all motor vehicle manufacturers now incorporate some level of embedded telematics and infotainment systems into their new vehicle designs.[9]

Infotainment System Features:	Telematic System Features:
• GPS navigation	• Turn-by-turn navigation
• Video players	• Remote access
• Music streaming	• Notification of vehicle collision
• SMS texting	• Vehicle location by GPS
• Hands-free calling	• Control of vehicle speed
• USB and Bluetooth connectivity	• Emergency calling
• In-car internet	• Vehicle diagnostics and
• Wi-Fi	maintenance notifications

Source: https://vin.dataonesoftware.com/vin_basics_blog/vehicle-infotainment-vs-telematics-systems-what-is-the-difference

Key Fobs

Key Fobs are increasingly becoming a useful source of digital evidence. Remote keyless entry systems and smart key systems can store a range of useful investigative data such as the vehicle identification number (VIN), time and date stamps as to when the key was last used, odometer reading of when the key was last used[10], mileage of the car, and the fuel level. Newer versions also have the capability to store GPS Data.[11]

Transitioning Vehicle Data into Useful Evidence for Investigators

It is vital that investigators have an awareness of all available vehicle data and how it can be translated into evidence for their investigations. Useful vehicle data for investigators falls into three main categories:

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[8] https://vin.dataonesoftware.com/vin_basics_blog/vehicle-infotainment-vs-telematics-systems-what-is-the-difference

[9] https://abforensics.com/wp-content/uploads/2019/02/INTERPOL-4N6-PULSE-IssueIV-BATES.pdf

[10] Ibid.

[11] https://silent-pocket.com/blogs/news/how-much-information-does-your-key-fob-actually-store

(1) **Event Data** (speed, acceleration, braking, shifting, doors opening/closing, etc.);

(2) **Location Data** (destinations, routes, and tracklogs); and

(3) data from **Connected Devices**, such as mobile phones, that have been physically or wirelessly connected to a vehicle (calls, texts, contact lists, apps, images, etc.).[12]

Investigators can use evidence from vehicle data to piece together a timeline of the "who, what, and where" associated with their investigations.

WHO WAS INVOLVED

- Provide unique identifiers that tie individuals to a specific vehicle
- Identify known associates and establish communication patterns between them
- Determine who may have been present or aware of key information during an incident

WHAT HAPPENED

- Provide insight on the sequence of events that took place leading up to an incident
- Identify patterns of life and unusual events that happened around an incident
- Determine timelines of activity and establish a chain of significant events

WHERE IT OCCURED

- Provide historical data to show where a vehicle was at specific times
- Identify areas frequently visited, new locations traveled, and future plan
- Determine how long particular locations were visited

Source: https://berla.co/discover/

Utilizing Vehicle Evidence: Example Scenario

A *Digital Forensics Magazine* issue from 2017 provided a scenario to demonstrate how vehicle data can be useful in an investigation. [13] The scenario describes a hit-and-run that occurred on a dark back road with no witnesses. The victims, a mother and son, informed the investigators that the perpetrator drove a dark SUV with its headlights off. Based on the physical crash scene evidence and victim statements, the investigators were able to learn the name of the likely vehicle owner by questioning locals. They then obtained proof of the crime by requesting access to the suspect's SUV and downloading the infotainment and telematic systems data. The tracklog history revealed the SUV was traveling down the same road at approximately the same time the accident had occurred, while the infotainment system's event log showed that the SUV was driving on that road from the location of a bar and that the headlights were not turned

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[12] http://www.evidencemagazine.com/index.php?option=com_content&task=view&id=2790&Itemid=49
[13] https://www.msab.com/download/case_studies/MSAB-BERLA-Article.pdf

on. In addition, the event log showed the vehicle was placed into drive and reverse several times at the scene of the accident, and eventually the vehicle navigated to a location saved as "home" in the infotainment system.

This example demonstrates the power of vehicle data to further investigations and provide proof for successful prosecution. Infotainment and telematic systems can provide data related to user activities, navigation information, and event data. Being able to place the vehicle at the scene of the incident is important, and showing where the vehicle is prior to the incident can be equally as important in developing a timeline of events for before, during, and after the crime.[14]

Conclusion

Vehicle forensics is quickly becoming a growing field for law enforcement. Vehicles hold vast amounts of data and can provide key pieces of evidence for investigations. To utilize this evidence, investigators must understand the various types of available vehicle data, where to access the data, and how to translate the data into useful pieces evidence to help solve their investigations.

Appendix: Vehicle Data Forensic Tools and Trainings for Law Enforcement

The National Computer Forensics Institute offers a vehicle forensics training course.[15] It is a five-day course for experienced digital forensics examiners in both computers and mobile devices. Through classroom instruction and hands-on experience, students learn to extract and analyze data from a vehicle's telematics and infotainment system. Graduates return home with issued equipment necessary to perform forensic examinations.

Additionally, vendors such as Tonex[16] and Berla[17][18] offer trainings, software, and hardware that will assist agencies with extracting and analyzing vehicle data.

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[14] Ibid.

[15] https://www.ncfi.usss.gov/ncfi/pages/courses.xhtml;jsessionid=x7v-6aCor-9mXBuqpiVNCxKT?dswid=-2503

[16] Tonex offers a three-day vehicle forensics training called the Car Digital Forensic Training Bootcamp, Automotive Digital Forensic Training. https://www.tonex.com/training-courses/car-digital-forensic-training-bootcamp-automotive-digital-forensic-training/

[17] Berla offers the iVe Ecosystem, which is a collection of tools that supports investigators throughout the entire vehicle forensics process with a mobile application for identifying vehicles, a hardware kit for acquiring systems, and forensic software for analyzing data. https://berla.co/ecosystem/

[18] Berla offers a five-day Vehicle System Forensics Course, https://berla.co/training-courses/, a Certification Program for investigators who wish to earn documentation for advanced proficiency in vehicle system forensics, https://berla.co/training-certifications/, and a Continuing Education Program with ongoing learning opportunities to maintain proficiency and expertise in vehicle system forensics, https://berla.co/training-continuing-education/