With rapid technological advancement in the connected vehicle realm, it is incredibly likely that investigators are missing out on digital evidence that could potentially make or break their cases. Vehicles have gone from simply a mode of transportation to essentially a computer on wheels. Stored within a vehicle’s infotainment and telematics systems is a substantial amount of user data (generally from a paired smartphone), navigation data and recorded vehicle events. A newer vehicle can potentially reveal far more than a few seconds of crash data. Depending on the system, days, weeks, or even months of data could be sitting, waiting to tell the story of what really happened. Because the concept of vehicle system forensics is quite new, many are still unsure of what exactly that new data is and how to find and extract it. Although infotainment and telematics systems have been supplied in many passenger vehicles since about 2008, little attention has been given to them in the accident investigation community until now. Why the sudden attention? Word is getting out about the enormous amount of data that infotainment/telematics systems are capable of storing. It is a common misconception that investigators can get the full range of data off a system simply by calling a dealer or manufacturer and using their proprietary tool. Certainly, some data might be retrieved, but the most effective route is to perform a forensic “deep-dive” of the system when possible. Before we review specific recoverable data types, let’s answer a few questions.

**WHAT IS AN INFOTAINMENT SYSTEM?**

The word “infotainment” is a combination of the words “information” and “entertainment.” In short, the infotainment system is what connects the operator to their digital world and is the central hub within the vehicle. Through the infotainment system, the user can do things such as: sync their phone to take advantage of hands-free calling and texting, listen to the music stored on their phone, possibly access weather information, satellite radio, or even social media apps directly. Examples of infotainment systems include Ford SYNC, Toyota Entune, Chrysler UConnect, BMW ConnectedDrive, etc.

**WHAT IS A TELMATICS SYSTEM?**

Telematics is the integration of telecommunication and information, and it is embedded into the vehicle. The system facilitates requests to and from the infotainment system; the user does not directly interface with the telematics system. Telematics is used for vehicle to infrastructure (V2I) communication, and vehicle to vehicle (V2V) communication. For example, in V2I communication, if the infotainment system receives an input to turn the seat heater on, that request is then passed on to the telematics system. For vehicles that incorporate V2V communication, sensors detect when a vehicle comes within a certain distance of another. The system will then respond with an alert that gets the driver’s attention; the alert could be in the form of a sound, a flashing light, a vibration of the steering wheel, etc.

What data is stored on these systems? The data set is both system- and phone-de-
pended, but here is a general list of information that can potentially be found:

**User Data:**
- Connected devices
- Bluetooth connections
- Wi-Fi connections
- Call logs
- Contact lists
- SMS Messages
- Emails
- Pictures
- Social media feeds

**Navigation Data:**
- Recent destinations
- Saved locations
- Tracklogs
- Trackpoints
- Waypoints

**Vehicle Event Data:**
- Headlights on/off
- Door Open/Close
- Gear changes
- Connections to/disconnections from Bluetooth and Wi-Fi
- Connections and disconnections of mobile devices and other media (USB drive, SD card, etc.).

If the system includes a navigation unit, many of these artifacts will include a timestamp and geolocation data. Such data can be especially helpful to investigators as they are trying to assemble a detailed timeline of events.

In order to retrieve this valuable data, specialized hardware and software is required. Berla Corporation has developed a forensic tool kit solution called iVe that currently supports 4,300 vehicles, and that list is growing quickly. Currently supported manufacturers include BMW, Buick, Cadillac, Chevrolet, Chrysler, Dodge, Fiat, Ford, GMC, Hummer, Jeep, Lincoln, Maserati, Mercury, Pontiac, Ram, SRT, Saturn, Toyota and Volkswagen.

The method by which information is extracted varies by make. Some systems require partial disassembly, some systems require very little disassembly and some systems require no disassembly at all. The software includes a detailed guide to identifying, removing, and acquiring data from specific modules. Regardless of the method needed, the solution is completely non-destructive. The vehicle can be put back together easily and it will start and run exactly like it did prior to the procedure. The software allows a computer to connect to the vehicle system and retrieve data using forensically sound methods and best practices. Essentially, the tool creates a copy of the data (called a forensic image) and the examiner works off of that copy. This way, there is no risk of alteration or damage to the original data. The forensic image is automatically parsed by the software and stored on a computer so it can be easily viewed, searched, bookmarked, graphed, reported, etc. It is also important to note that many vehicles can record data for days, weeks, or even months depending on frequency of use and the amount of memory within the system. This is in comparison to the mere seconds of data recorded on most EDR tools.

There is obvious value in having this type of data as part of an accident investigation. Since the software is only about two years old, most of the cases in which it has been used are still in progress and specific examples are not available. However, there are several success stories from investigators in the field who have agreed to share under the condition that any identifying details are omitted.

GPS data from vehicle navigation systems have been used on numerous occasions to determine a vehicle’s pre-impact speeds and positions. User data from the infotainment system was used by investigators to show that a driver sent a text message just before a vehicle collision, consistent with distracted driving. Another case involved the wife of a prominent person in the community claiming that she accidentally ran over her husband, but event logs were able to show that her automatic transmission vehicle shifted into reverse and then into drive again. Combined with a biomechanical analysis of the injuries, the data showed the possibility that she ran him over twice, deliberately. A home invasion suspect claimed that he was alone during the commission of a crime, but inspection of the infotainment system showed the passenger side door opened at the house’s GPS coordinates. Historically, headlights incorporated incandescent light filaments, which can deform upon impact if in use. This allowed for post-accident analysis to determine whether headlights were in use at the time of impact. Today, most new vehicles incorporate light emitting diodes (LED), which do not sustain the same type of deformation. However, data from a vehicle’s telematics system can be used to determine the position of a vehicle’s headlight switch at the time of the accident.

These are just a few scenarios in which data from the infotainment system could make or break a case. Often, this invaluable data goes to waste because investigators are not aware that it exists, or they suspect it exists but are unsure of how to retrieve it. Consumers demand more and more connectivity and capabilities within their vehicles, to the tune of an estimated 220 million connected cars on the road by the year 2020. Vehicle system forensics is the way of the future, but is very relevant and very possible right now for those who want to stay ahead of the curve.

Berla also offers hands-on training sessions in Vehicle System Forensics to fully understand the capabilities of the systems, hardware and software necessary to obtain vehicle data. Several members of S-E-A’s engineering staff have attended Berla’s training and have been certified in Vehicle System Forensics. If you have any questions regarding infotainment/telematics systems and/or vehicle system forensics, please contact Mr. Cornetto at 410-766-2390 or Ms. McGee at cmcgee@berla.co / 443-333-9301.

Anthony D. Cornetto, III, P.E. is a licensed, mechanical engineer at S-E-A, Ltd. where he is responsible for managing and conducting the investigation and analysis of accidents involving vehicles, pedestrians, industrial equipment, and mechanical systems and equipment failures. He received his Master of Science and his Bachelor of Science in Engineering Science and Mechanics from Virginia Tech.

Ben LeMere is the CEO and co-founder of Berla Corporation. He is a widely recognized subject matter expert in digital forensics, GPS forensics and vehicle cybersecurity, with more than 15 years of military and federal government service. Under Ben’s leadership, Berla supports the DoD, Homeland Security and Law Enforcement communities while also beginning to establish roots in the commercial realm.

Carly McGee is a digital forensic analyst and marketing coordinator at Berla Corporation. She is an instructor of iVe and Blackthorn, Berla’s vehicle system forensics and GPS tools. She has been in the digital forensics field for about four years and is also a life-long car enthusiast. She contributes to and edits blog content, technical reports and literature.