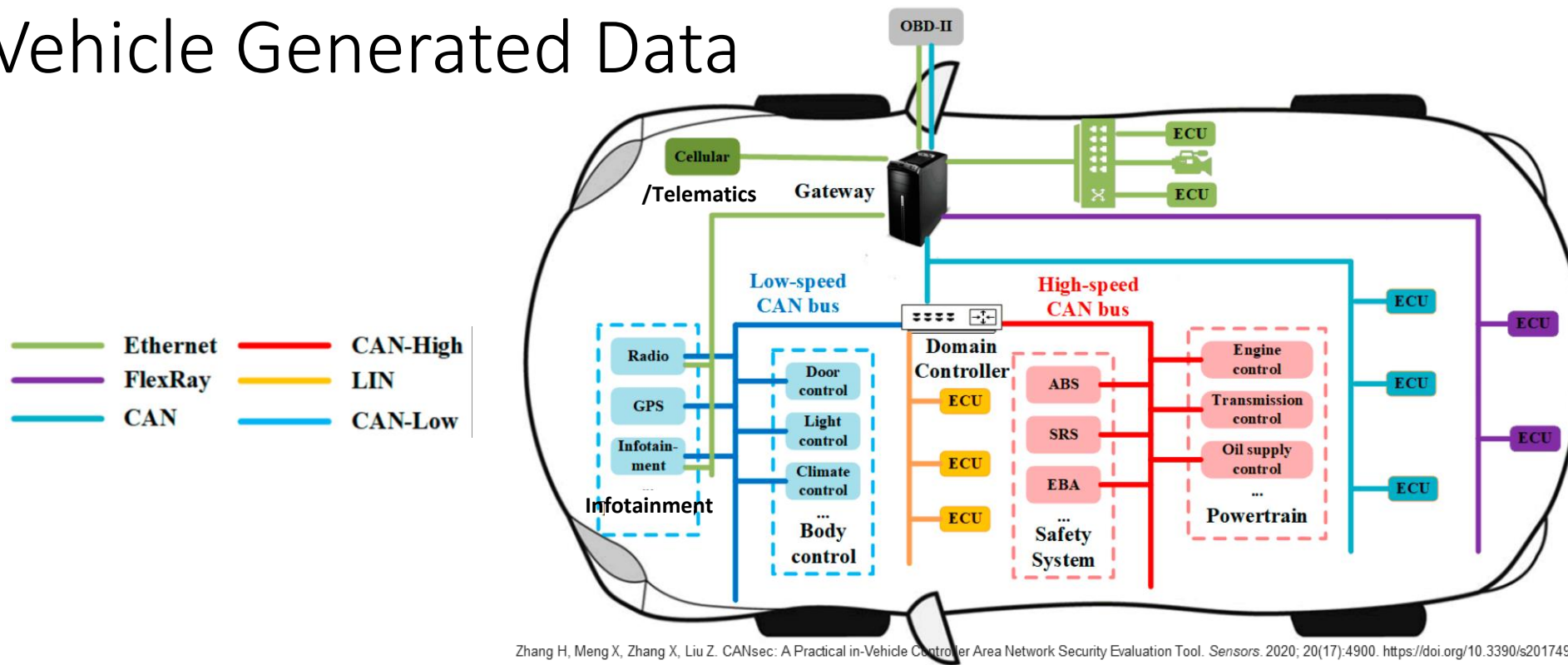


Vehicle Telematics Overview

Agenda

- Introduction to vehicle generated data
- Methods to access the data
 - Local Interactions (via tethered connection)
 - How
 - What type of data
 - For what purposes
 - Remote Interactions (via Telemetry)
 - How
 - What type of data
 - For what purposes
 - Connected Vehicle Privacy Notices

Vehicle Generated Data



- **Electronic Control Units:** ECUs are specialized microcontrollers embedded within various parts of the vehicle, each responsible for specific functions such as engine control, transmission, braking, and infotainment.
- **Data Generation:** Each ECU generates data related to its function. For example, the engine control unit monitors parameters like fuel injection, air intake, and engine temperature in real-time.
- **Data Traffic:** some of this data is consumed within an ECU, some is transmitted back and forth to other vehicle controllers. Data is transmitted between ECUs and sensors using protocols like CAN (Controller Area Network), LIN (Local Interconnect Network), FlexRay, Ethernet, etc.
- **Data Storage:** some ECUs may store data in their own flash memory. Other data may be stored, derived, or aggregated by a centralized controller.

Vehicle Generated Data: Concepts and Terminology

Real-Time Data: information that is delivered immediately after generation/collection. This data represents the current events or conditions.

Historic Data: Information that was generated/collected in the past or has been collected over a period of time. This data is not current but provides a record of past events and conditions.

Local: methods for accessing vehicle data that require the user to be physically present at the vehicle.

Remote: methods for accessing vehicle data from virtually anywhere, without the need to be physically present at the vehicle.

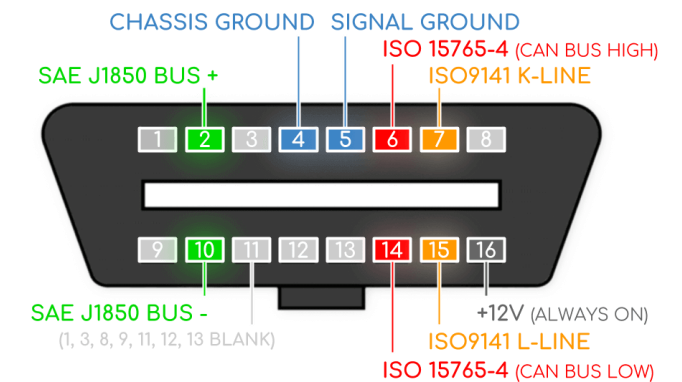
Data: information collected from various sensors and systems within the vehicle.

Command: an instruction sent to a vehicle's electronic control unit (ECU) or other control modules to perform a specific action

Local Interactions (via tethered connection)

The primary means of interacting with onboard diagnostics is via a diagnostic port, generally called an "OBDII" port. The physical shape of this connector, its electrical characteristics, and the communication protocols contained within it are described in various standards:

- Form factor: SAE J1962/ISO15031-3
- Communication protocols, e.g.
 - ISO15765-4: CAN
 - ISO13400: Diagnostics over IP, aka "ethernet"



How to get permission to access the diagnostic port?

Implied owner consent derived from:

1. Physical access to the vehicle
2. Physical access to vehicle's interior (unlock car to access diagnostic port in cabin)
3. Permission to change vehicle power states (vehicle key to change ignition to Start, Accessory, etc.)

Physical access to the vehicle and possession of physical car key is the method used by a vehicle owner to bestow repair privileges upon the automotive repairer.

*A subset of commands available on the port may have additional pre-requisites under the secure data release model. (i.e., to work on the vehicle's security system)

What type of devices plug into these ports?



Tethered harness connections to scan tools, laptops, mobile devices, other equipment.



Devices supporting local wireless connections (Bluetooth, WiFi, etc.) to near proximity scan tools, laptops, mobile devices, other equipment.



Hybrid devices supporting both tethered connections or local wireless connections.



Devices with embedded cellular or satellite connections to transmit information to a remote location.



What type of data is available?

Data Type	Description	Examples
Vehicle Identity	Meta data about the identity, type, or construction of the vehicle.	VIN, certification information, model type, contained hardware
Real-time data	Some are streamed continuously, some are requested for by the external device then transmitted	Vehicle speed, accelerator position, valve positions, time elapsed since the start of the trip, engine RPM, oxygen sensor, camera images
Lifetime data parameters	Usage based information, aggregated driving metrics, emissions related information	Odometer, engine run time, ignition cycles, city versus highway driving, number of propulsion system active trips since last refueling,
Diagnostic Error Codes	Used to represent presence of a malfunction or fault and may included associated snapshot data at the time the code was triggered	DTCs (Diagnostic Trouble Codes) and other malfunction indicators
Historic Data	Real-time signals, lifetime parameter, or diagnostic error codes recorded over time or upon specific events.	Vehicle speed over time, accel pedal position over time, timestamps of DTCs, EDR Event Data Recorder for snapshot of data at the time a collision occurred

What type of commands are available?

Command Type	Description	Examples
Electronically interact with the vehicle	Used to execute commands that otherwise would require manual user action	Honk horn, enable hazards, flash lights, roll down window, move seat, etc.
Exercise components	Used to control components or devices that might lack user interfaces	Command actuator to position X, open valve #2, run pump #3
Run diagnostic tests	Used to execute a routine or sequence of commands or test on demand	Run thermal system test, Run Evaporative Emission Control System Test, etc.
Initialize or calibrate components	Used in the process of fitting a replacement component to a vehicle	Run actuator calibration routine to learn end stops, reset/reboot controller
Reprogram electronic devices and controllers in the vehicle	Sending new application code or parameters to embedded controllers or software devices that change the way the component behaves or functions	Install software or calibration values on a replacement component to match that of the rest of the vehicle
Retrieve Data	Commands related to the retrieval of data described previously	

Some example data

- **Engine and Powertrain:**
 - Engine torque
 - Engine power
 - Cylinder misfire counts
 - Knock sensor readings
 - Camshaft position
 - Crankshaft position
 - Variable valve timing (VVT) status
- **Transmission and Drivetrain:**
 - Transmission gear ratio
 - Clutch engagement status
 - Transfer case status (for 4WD/AWD vehicles)
 - Differential temperature
- **Braking System:**
 - ABS (Anti-lock Braking System) status
 - Brake fluid level
 - Brake pad wear indicators
 - Brake booster pressure
- **Suspension and Steering:**
 - Suspension height (for vehicles with adjustable suspension)
 - Shock absorber status
 - Steering wheel angle
 - Power steering pressure
- **Comfort and Convenience:**
 - HVAC (Heating, Ventilation, and Air Conditioning) system status
 - Seat position sensors
 - Door lock status
 - Window position
 - Ambient Air temperature
- **Safety Systems:**
 - Airbag status
 - Seatbelt status
 - Seat occupant status
 - Tire pressure monitoring system (TPMS) readings
 - Collision avoidance system status
- **Vehicle Identity**
 - VIN
 - Calibration IDs
 - ECU Serial Numbers
- **Other**
 - Event Data Recorder Files (EDR)
 - Camera images

How do technicians know how to interact with the port?

For vehicle manufacturers, all repair and maintenance information, available offerings on diagnostic software, information on available data, etc. is made available on their repair information portals. Aggregated at Oem1stop.com

Using the above information and other sources, vehicle manufacturers and aftermarket part and tool providers design and put on the market a variety of products utilizing the diagnostic port.

The screenshot shows the Oem1stop.com website interface. At the top, there is a blue navigation bar with three white buttons: 'Home' (with a house icon), 'Position Statements', and 'Statement on Repair Procedures'. Below the navigation bar, the main content area has a dark background. On the left, there is a section titled 'What is OEM1Stop?' in large white text. Below this title, there is a paragraph explaining that OEM1Stop provides access to up-to-date repair information from participating automakers. A second paragraph states that no registration is required for the site itself, but each manufacturer's page has its own registration/login process and may require subscriptions. On the right side of the main content area, there is a blue box titled 'Recently Added' containing a list of links to various repair guides and diagnostic scan information for Ford, Acura, and Honda. At the bottom of the page, there is a grid of 40 white buttons, each containing a different car manufacturer's logo, including Alfa Romeo, Audi, BMW, Buick, Chevrolet, Ford, GMC, Honda, Hyundai, Infiniti, Isuzu, Jeep, Kia, Land Rover, Lexus, Mazda, Mercedes-Benz, Mitsubishi, Nissan, Opel, Peugeot, Rivian, Subaru, Suzuki, Tesla, Toyota, and Volkswagen.

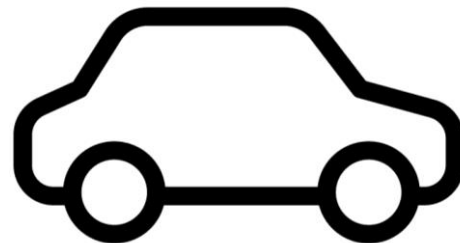
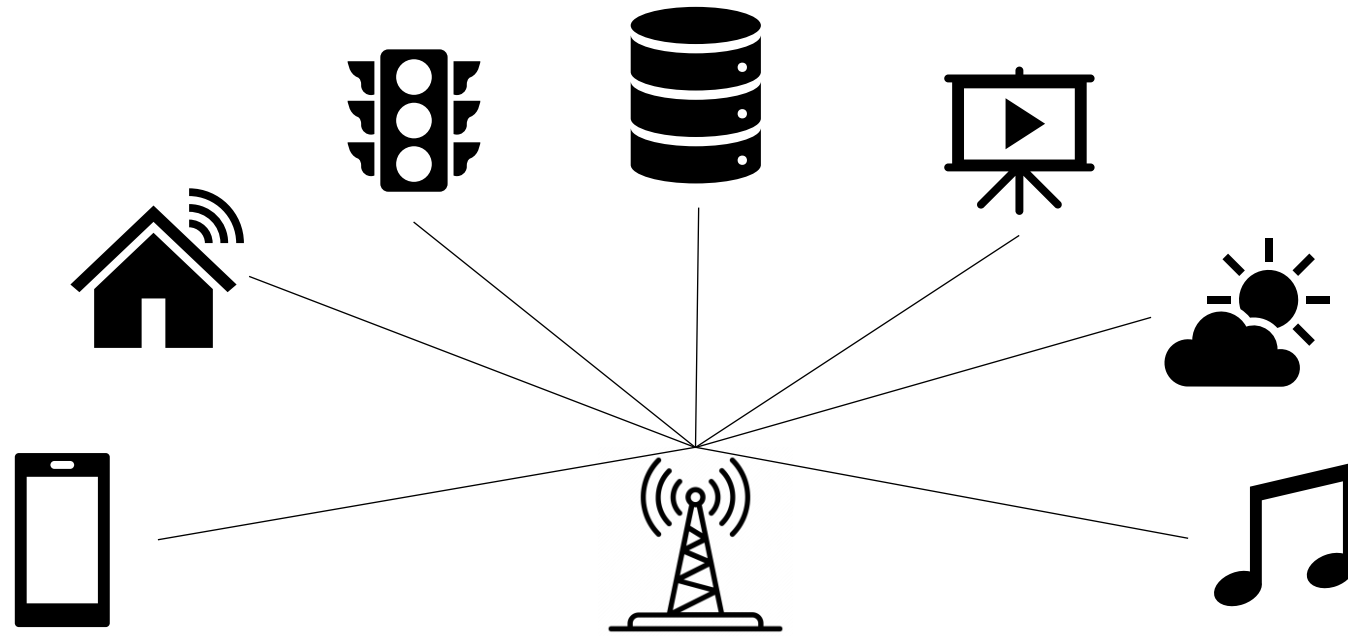
What is the diagnostic port used for?

Example Users	Description	Examples
Automotive Repairers	Repair and Maintenance	Diagnostic error codes, live signals, lifetime data parameters, commands
Regulatory Inspectors	Emissions testing, road worthiness testing	Emissions related data, diagnostic error codes, lifetime data parameters
Customs Officers	Vehicle identification, import fees and taxes	VIN, type approval, powertrain type, installed hardware
Taxi Companies, Ride-hailing services	To monitor vehicle usage, i.e. speed or distance to bill rider	Vehicle speed, odometer, # of occupants, location
Insurance Providers and adjustors	To monitor driving style and habits for usage-based insurance programs, accident reconstruction, assessment of claims	Speed, accelerator position, odometer, airbag near deploy events, EDR history
Fleet operators (logistics companies, businesses, rental car companies)	To monitor asset usage, driving style and habits of drivers, vehicle location	Speed, accelerator position, odometer, airbag near deploy events, vehicle location
Law Enforcement	Accident reconstruction, digital evidence collection	Navigation history, usage history, distances travelled, EDR history
Vehicle manufacturers	Within factory for original component commissioning	Assignment of VIN, initial configuration assignment

Local Interactions (via tethered connection)

Questions on physical interactions through diagnostic port?

Remote Interactions (via wireless telemetry)



What is wireless telemetry used for?

Data Type	Example
Convenience and Entertainment Features	Streaming music/video, gaming, digital voice assistants, generate local hotspot
Providing the vehicle information about its surrounding environment and other services	Routing and navigation, weather, real-time traffic, charging or refueling infrastructure, maps
Providing software updates to the vehicle	Introduce new features, cybersecurity updates, enhance vehicle functions, execute recalls
General telephony	Ability to make phone calls, send and receive text messages
Emergency Response	Call for help, send emergency services, transmission of vehicle data (location, airbag deployment, change in velocity, number of fastened seatbelts)
Onboard applications (Apple CarPlay, Android Auto, etc.)	Real-time vehicle data, driving data, vehicle location, destination, driving habits, infotainment features
Offboard applications (mobile apps)	Mobile apps providing features like remote start, set cabin temperature, monitor charging, location services, vehicle assets
Maintenance reminders, remote diagnostics	Miles since last oil change, Low tire pressure alert, etc.

What type of data/capabilities are available remotely?

Data Type	Description	Examples
Vehicle Identity	Meta data about the identity, type, or construction of the vehicle.	VIN, vehicle image asset, color, powertrain type
Vehicle Data	Information about how the vehicle is operated and used	Speed, accelerator, gear, brakes, steering, seat belts, lights, tire pressure
Infotainment/Media Data	Real time data from the infotainment system and analytics regarding infotainment usage	Currently playing song (title, artist, song, assets), radio presets, volume, media sources
Audio/Visual Data	Images from exterior or interior-facing cameras	Dashcam recordings, security camera recordings, voice commands and other utterances while vehicle's connected voice recognition system is in "active listen" state.
Autonomous Driving Data	Images and or sensor data from the vehicle's exterior or interior to improve automated driving operations and safety features	Images from exterior or interior-facing cameras, LIDAR, ultrasonic, radar, mapping and navigation, etc.
Commands	Commands used to digitally, and remotely, interact with a vehicle	Lock/unlock, remote start, honk horn, turn on hazard lights, open trunk, set the cabin temperature, interact with the infotainment system, send a destination

What is wireless telemetry used for?

Example User	Example
Vehicle owner to view vehicle data remotely via OEM/3 rd party mobile app	Odometer, speed, location, gear, cabin temperature, currently playing song, tire pressure, maintenance info
Vehicle owner to interact with their vehicle remotely via OEM/3 rd party mobile app	Lock/unlock, remote start, honk horn, turn on hazard lights, open trunk, set the cabin temperature, interact with the infotainment system, send a destination
Insurance Companies	Monitor driving style and habits to offer usage-based insurance programs
Vehicle Manufacturers	To conduct troubleshooting, research and development, cybersecurity, and other obligations inherent to being the provider of the connectivity infrastructure and vehicle operating system. (typically sent in a de-identified or anonymous form)
Research Institutions	To conduct research and development on automotive safety, transportation infrastructure, etc.
Law enforcement agencies, courts, regulatory agencies	To fulfill subpoena court orders, to fulfill NHTSA SGO 24 hour response ADAS crash reporting, emissions compliance monitoring, etc.
Vehicle listing sites, auction houses, insurers, lenders, used car sellers	Vehicle identity and usage data for vehicle representation and valuation (drivetrain, color, transmission, odometer, etc.)

Distinction in Nature of Data

- **VIN-Associated Data**

- **Vehicle Identification Number (VIN):** This is a unique code assigned to every motor vehicle when it's manufactured. It acts like a fingerprint for the vehicle.
- **Personal Identifiability:** Data linked to the VIN can be traced back to the specific vehicle and, potentially, its owner.
- **Use Cases:** VIN-associated data is often used for purposes like connectivity features through a mobile app, executing vehicle recalls, insurance, and personalized services.

- **De-Identified Data/Anonymous Data**

- **Anonymization:** De-identified data has had personal identifiers removed or masked, making it not possible or against policy to trace back to an individual vehicle or owner.
- **Privacy:** This type of data is used to protect the privacy of individuals while still allowing for analysis and insights. It includes aggregated data on traffic patterns, vehicle performance, and usage trends.
- **Use Cases:** De-identified data is typically used for product improvement, research & development, and improving infrastructure without compromising individual privacy.

Connected Vehicle Privacy Notices

As the original installers and sellers of the product and operators of the vehicle operating systems and network, vehicle manufacturers have unique obligation to notify potential and current customers of:

- Existence of installed equipment
- Type of data transmitted
- Who are the recipients of the data
- For what purpose is it used
- For how long is it retained
- Under what conditions it is further disclosed
- How to activate, deactivate, or customize data preferences

Connected Vehicle Privacy Notices

Connected vehicle privacy notices also describe how when a vehicle owner directly discloses or instructs the vehicle manufacturer to disclose vehicle data to a third party, it is the third party's terms and conditions and privacy policies (and not the vehicle manufacturer's Connected Vehicle Privacy Notice) that apply.

You can disclose Connected Vehicle Information to third parties, or you can direct Ford to disclose Connected Vehicle Information to third parties, when you choose to use their applications or services that:

- Are made available to you through the vehicle information and entertainment ("infotainment") system;
- Are made available to you through the third party's app on your mobile device when you connect your mobile device to the vehicle via Bluetooth or tether; or
- Require or permit the account you have with the third party to be linked to a Ford or Lincoln vehicle or mobile app.

If you choose to disclose Connected Vehicle Information with third parties, the third party's terms and conditions and privacy policies (and not this Connected Vehicle Privacy Notice) apply to the information you disclose, or that you direct Ford to disclose, to them.