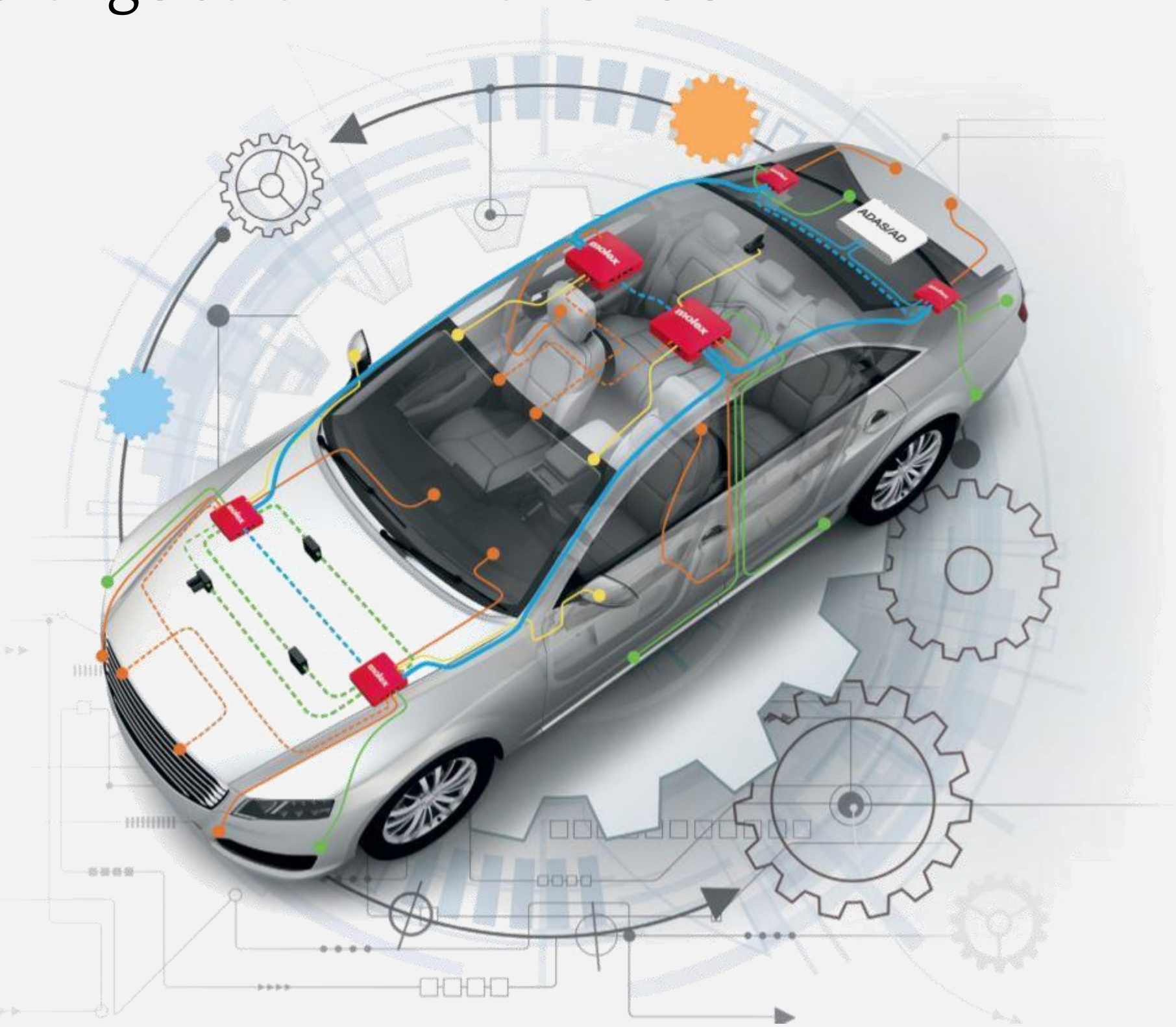
In-Vehicle LAN Communication Protocols

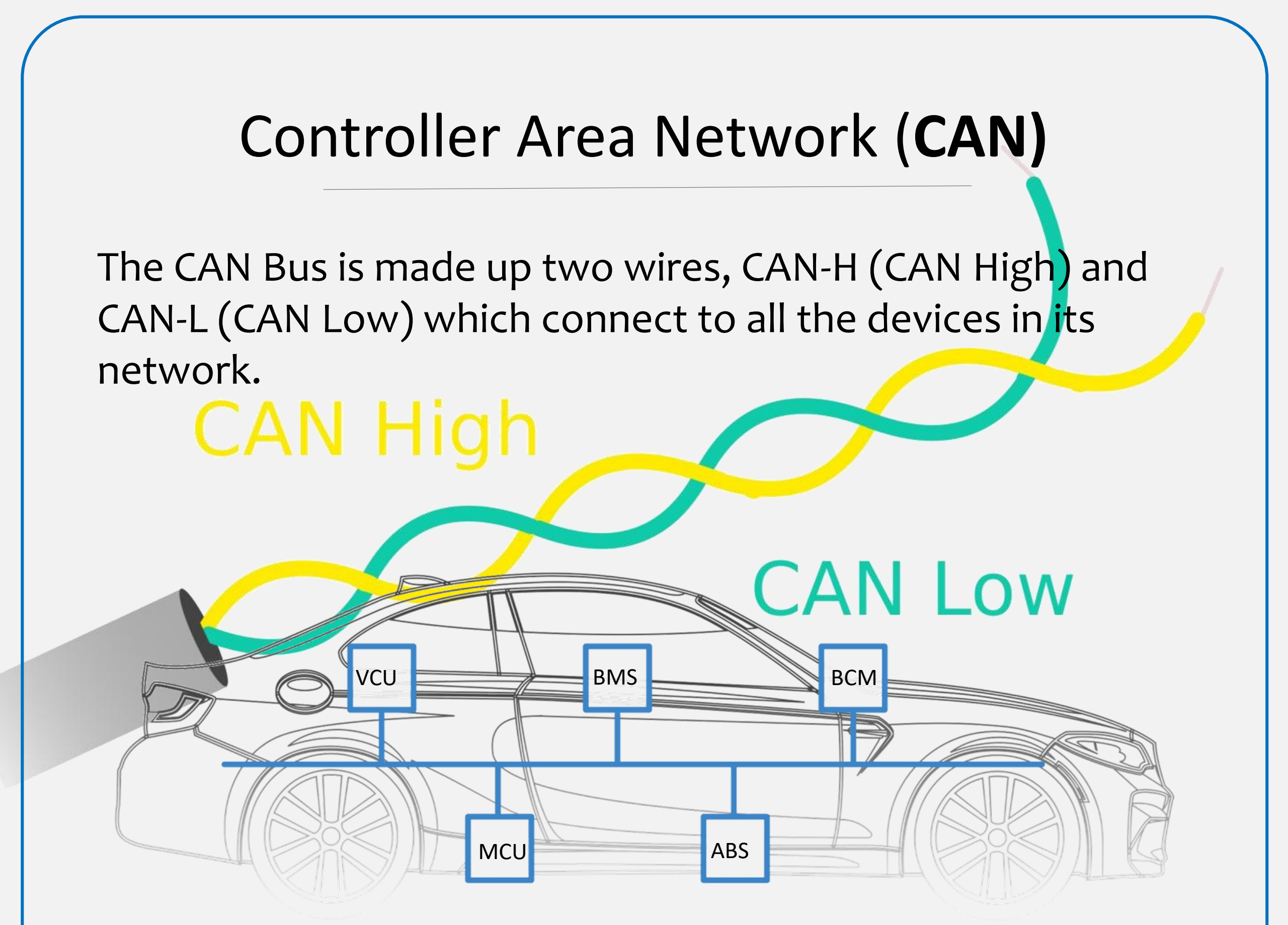
How different electronic components and systems exchange data within a vehicle .



Communication protocols in automotive systems are the backbone of data transfer and coordination between different components, enabling modern vehicles to be smarter, safer, and more efficient.

Controller Area Network (**CAN**)

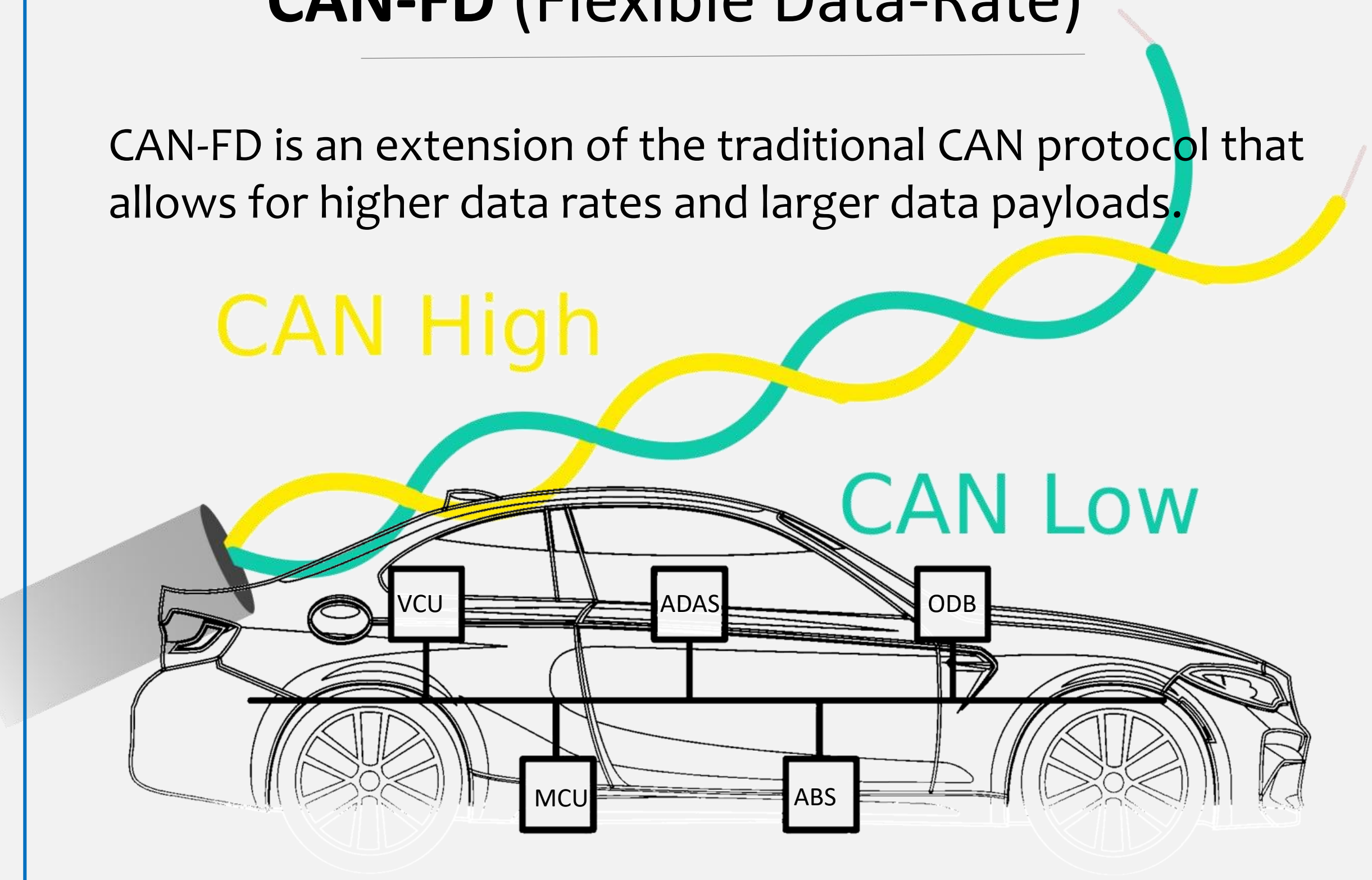
The CAN Bus is made up two wires, CAN-H (CAN High) and CAN-L (CAN Low) which connect to all the devices in its network.



CAN was first created for automotive use, so its most common application is in-vehicle electronic networking. However, as other industries have realized the dependability and advantages of CAN over the past 20 years, they have adopted the bus for a wide variety of applications such as railways, aircraft & medical.

CAN-FD (Flexible Data-Rate)

CAN-FD is an extension of the traditional CAN protocol that allows for higher data rates and larger data payloads.



A standard CAN network is limited bandwidth to **1 MBit/s**, with a maximum payload of **8 bytes** per frame.
CAN FD increases the both bandwidth **5 Mbit/s or above,** allowing longer data fields – **up to 64 byte**s per frame – without changing the CAN physical layer.

Application **ECU flashing** **Advanced driver assistance systems (ADAS)**

CAN-XL (Extended Length)

CAN XL (Controller Area Network with Extended Length) provides a superior solution for data rates of up to **20Mbit/s** by maintaining the advantages of the CAN protocol. It expands the number of data bytes per CAN frame up to **2048 bytes**.

The CAN XL protocol officially introduced at the 17th international CAN Conference (iCC) in 2021 was also an important conference topic at the following 18th iCC in 2024.

CAN XL is still in the early stages of adoption, and it will take time for automakers and suppliers to fully implement it into production vehicles.

Application

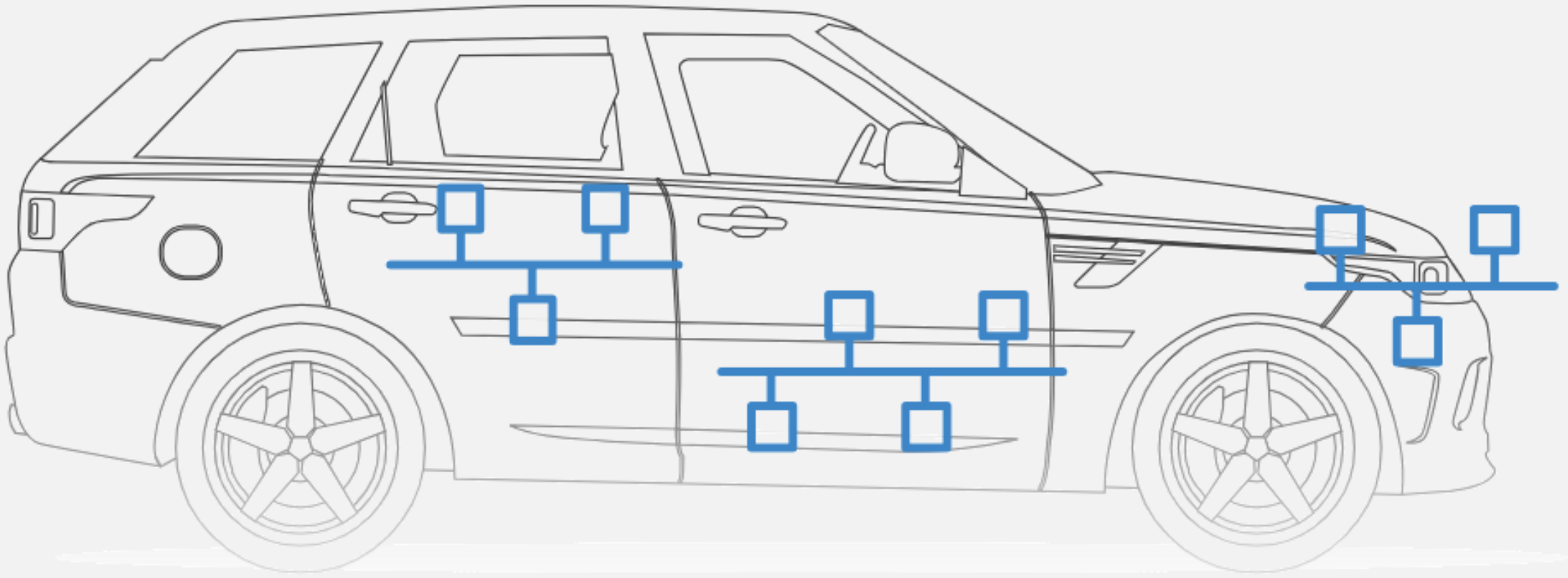
Over-the-Air (OTA) Updates

Cameras, lidar, radar, etc

Autonomous driving

Local Interconnect Network **(LIN)**

LIN bus is a supplement to CAN Bus with low-cost, single-wire communication protocol that supports communications up to 19.2 Kbit/s with a maximum bus length of 40 meters in master-slave architecture (1 master and up to 16 slave nodes).

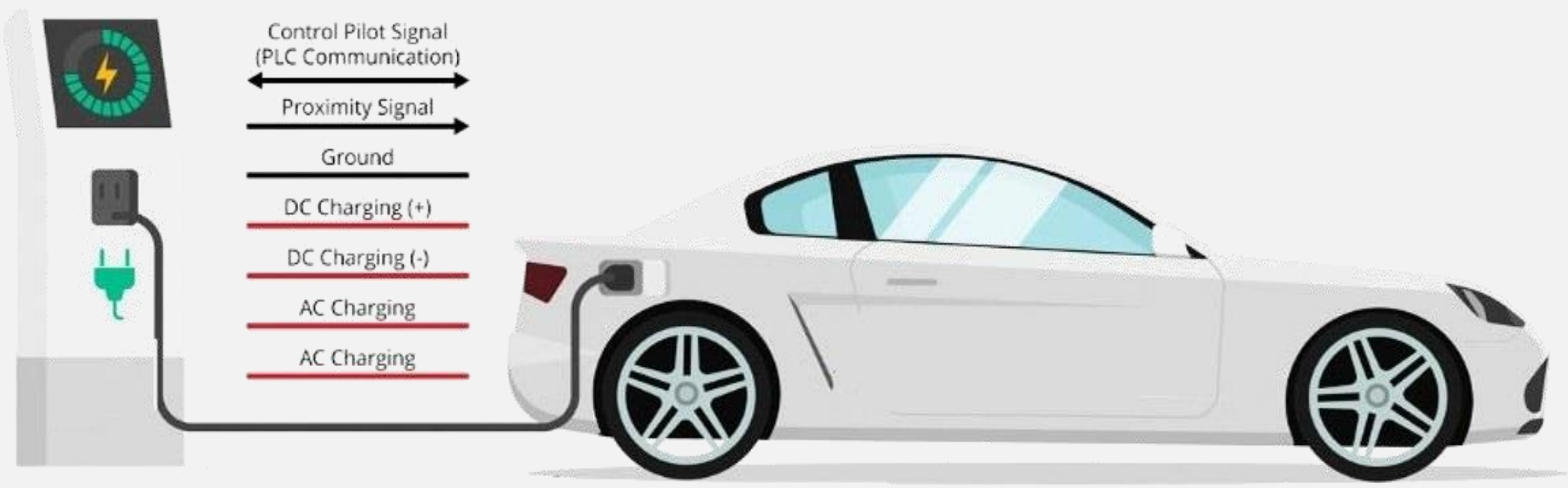


AUTOMOTIVE USE CASES

Steering wheel: wiper, climate control, radio
Comfort: Sensors for temperature, sun roof, light, humidity
Powertrain: Sensors for position, speed, pressure
Engine: Small motors, cooling fan motors
Air condition: Motors, control panel
Door: Side mirrors, windows, seat control, locks
Seats: Position motors, pressure sensors
Other: Window wipers, rain sensors, headlights, airflow

Power Line Communication **(PLC)**

PLC is used to communicate between the EV and the EV Supply Equipment (EVSE). PLC allows the charging station and the EV to negotiate charging sessions, allowing various charging profiles and potentially to negotiate payment.

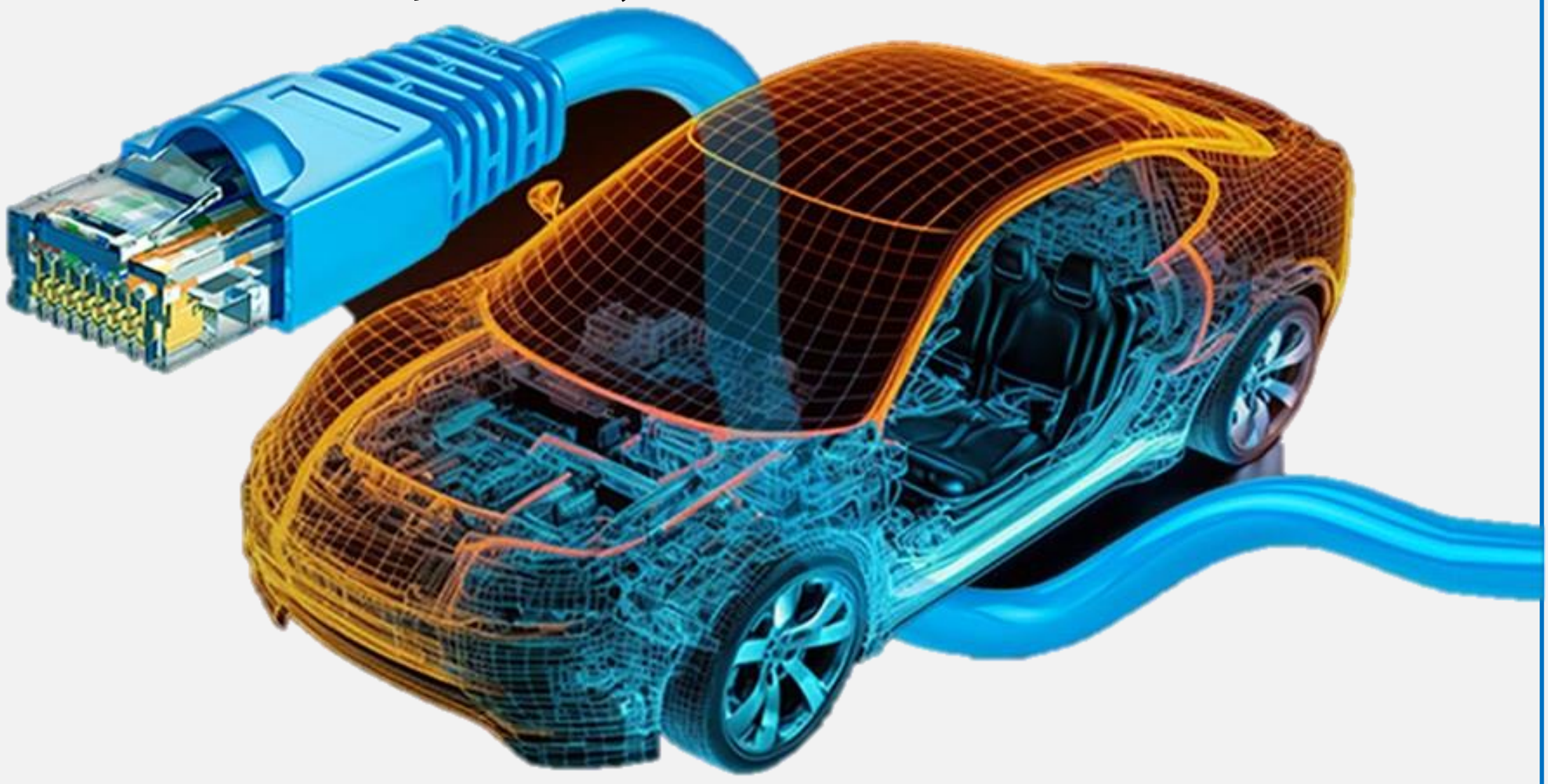


The **ISO 15118** standard defines the use of PLC for communication between the EV and the charging station.

Plug and Charge: The EV automatically communicates with the charging station to authenticate and start charging without any additional input from the driver.
Dynamic Charging Control: PLC enables the charging station to adjust the charging speed based on grid demand or user preferences.

Ethernet **(Automotive Ethernet)**

Automotive Ethernet is use Ethernet technologies for automotive use for applications that need lots of bandwidth (i.e. push high volumes of data every second).



Automotive 360 Vision System | V2X connectivity | Autonomous driving

By 2030, the amount of data to be processed from automotive applications will equal the amount in today's user networks. However, traditional communication buses such as CAN, CAN-FD and LIN will **not be able** to meet these growing demands for fast and reliable data transmission. This is where the automotive Ethernet standard comes in, supporting high speeds from **100 Mbit/s to 2 Gbit/s**.

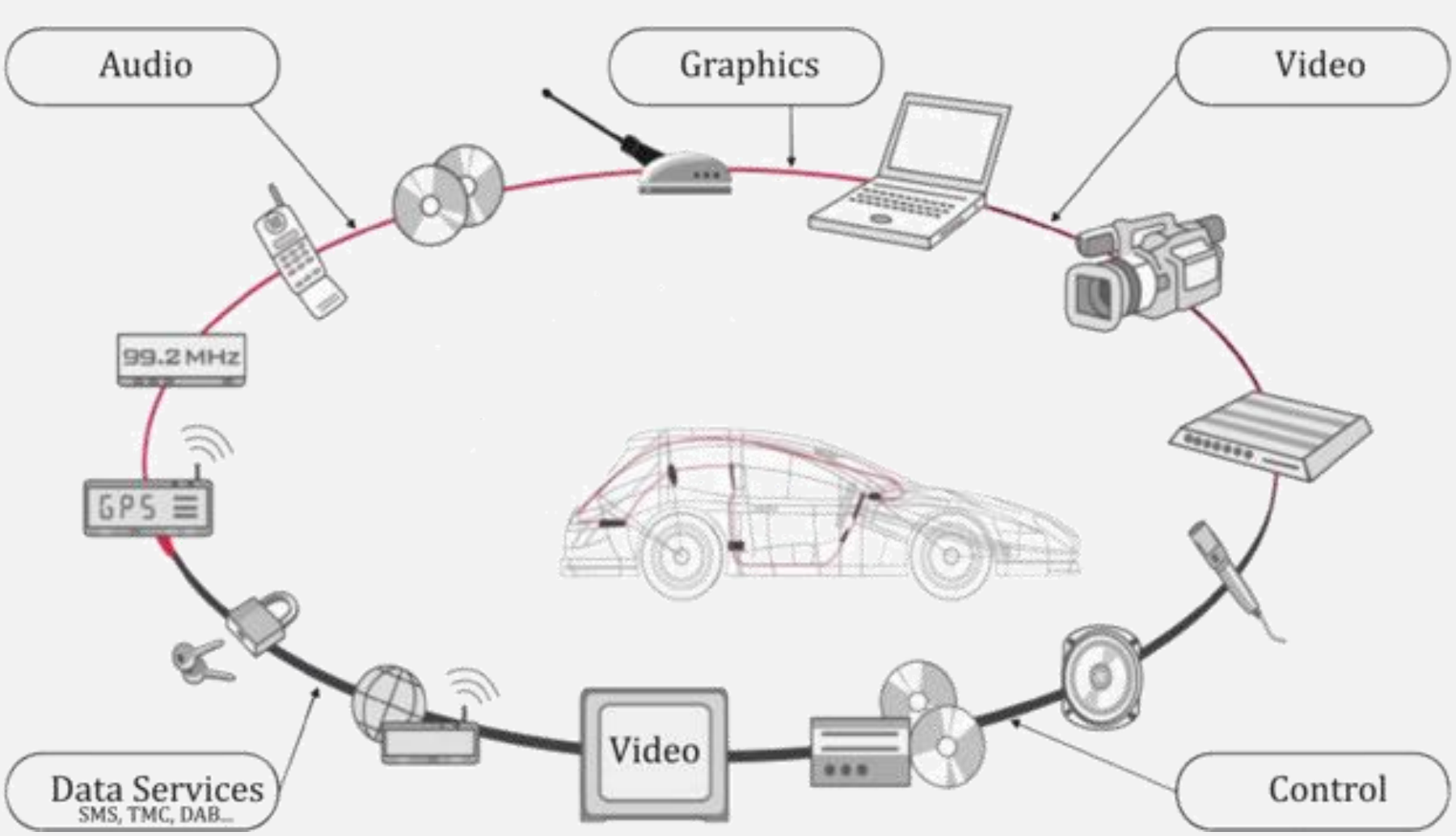
FlexRay

A faster and more reliable communication protocol than CAN, designed for real-time control systems and safety-critical applications, with a maximum data rate of 10 Mbps.

FlexRay has extensive usage in **steer-by-wire, brake-by-wire, adaptive cruise control, and active suspension systems**. While the FlexRay protocol has its advantages, such as high bandwidth and precise timing, it also has its limitations, including higher cost and complexity.

MOST (Media Oriented Systems Transport)

MOST is a high-speed multimedia communication protocol used in the automotive for transmitting audio, video, and data signals between various multimedia devices within a vehicle.

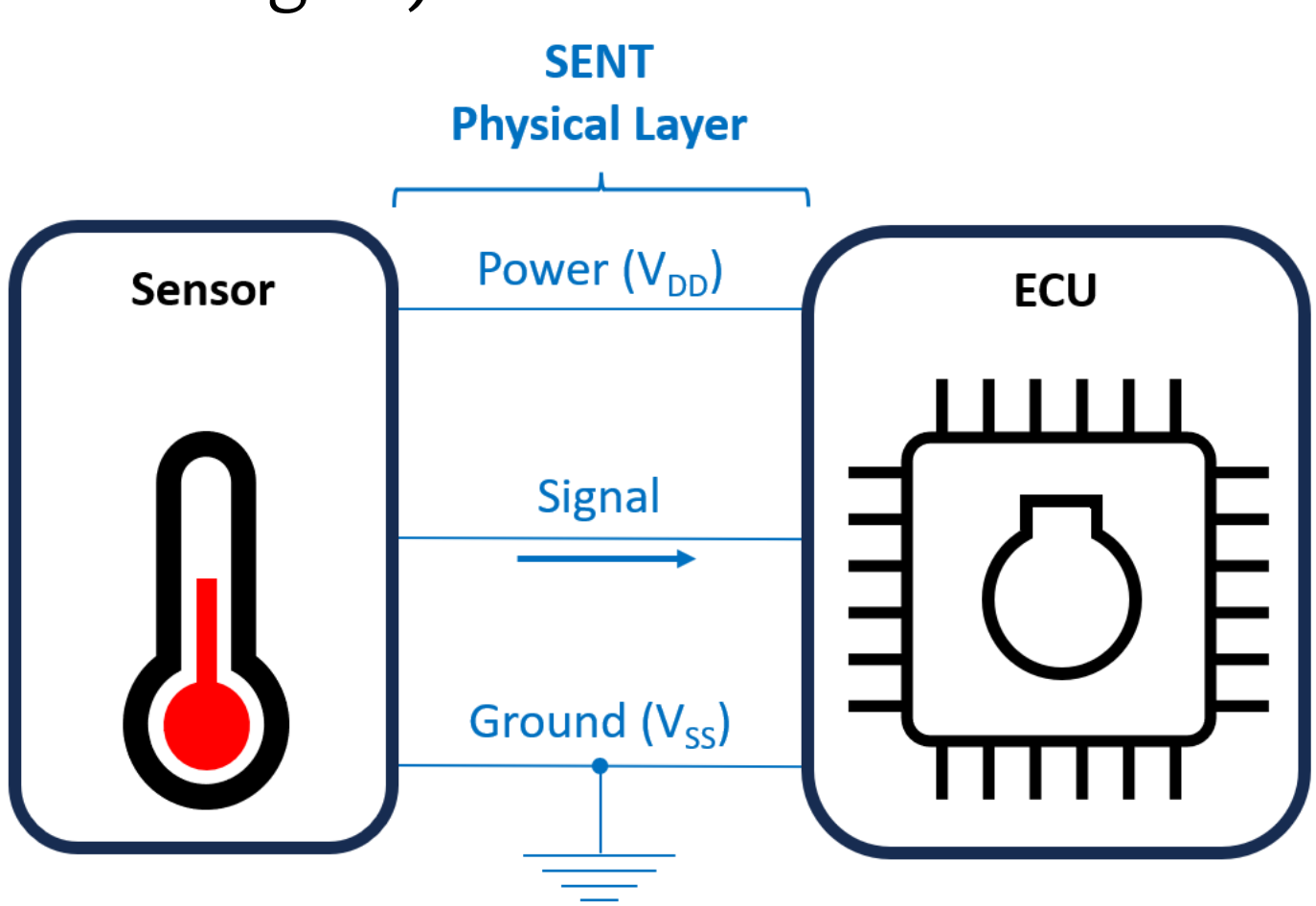


The MOST protocol operates on a ring topology, where devices are connected in a circular fashion. This topology ensures reliable data transmission and easy scalability.

The MOST bus comes in three main variants are MOST25, MOST50, and MOST150, each offering different data transfer rates and physical layer options.

SENT **(Single Edge Nibble Transmission)**

SENT protocol defined by SAE J2716 was created as a digital replacement for analog signals. Data is transmitted unidirectional over a single line. Three wires lead to the sensor (ground, 5V power line and signal).



SENT using the time trigger architecture in which the data are transmitted in the form of series pulses each 4-bit long (Nibble) where the data are measured from falling to falling edges time by the receiver device.

The SENT protocol is most commonly used for MAP pressure sensors, MAF flow meters, throttle position sensors or variable geometry sensors.