

Vehicle Data is the Lifeblood of Commercial Vehicle Operations

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**SECURE CONNECTIONS
FOR A SMARTER WORLD**

PUBLIC

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AGENDA

- Commercial Vehicles Market
- Commercial Vehicles Data Drivers and Use Cases
- Expanding the Use of Commercial Vehicle Data
- Future Vehicle Data-driven Use Cases

COMMERCIAL VEHICLE MARKET

Vehicles for transportation of goods or paying passengers

Vehicle Classifications: Light Commercial Vehicles (LCV), Heavy Trucks, Buses and Coaches

Broad Applications: Logistics, Mining and Construction, Industrial, Passenger Transportation

Market Size: ~\$1.5 trillion in 2020 to \$2.5 trillion in 2028 in range of 7-9% CAGR (Verified Market Research-May'21, Precedence Research-Nov'20)

Commercial Vehicle Sales (2019 - Pre-COVID)

- 20.2M LCV and 4.1M Heavy Trucks and 0.27M Buses and Coaches sold ([International Organization of Motor Vehicle Manufactures](#))





COMMERCIAL VEHICLE DATA DRIVERS

Operate fleet more productively and efficiently with lower cost

FLEET MANAGEMENT

Help prevent accidents (90% are driver related) and save lives

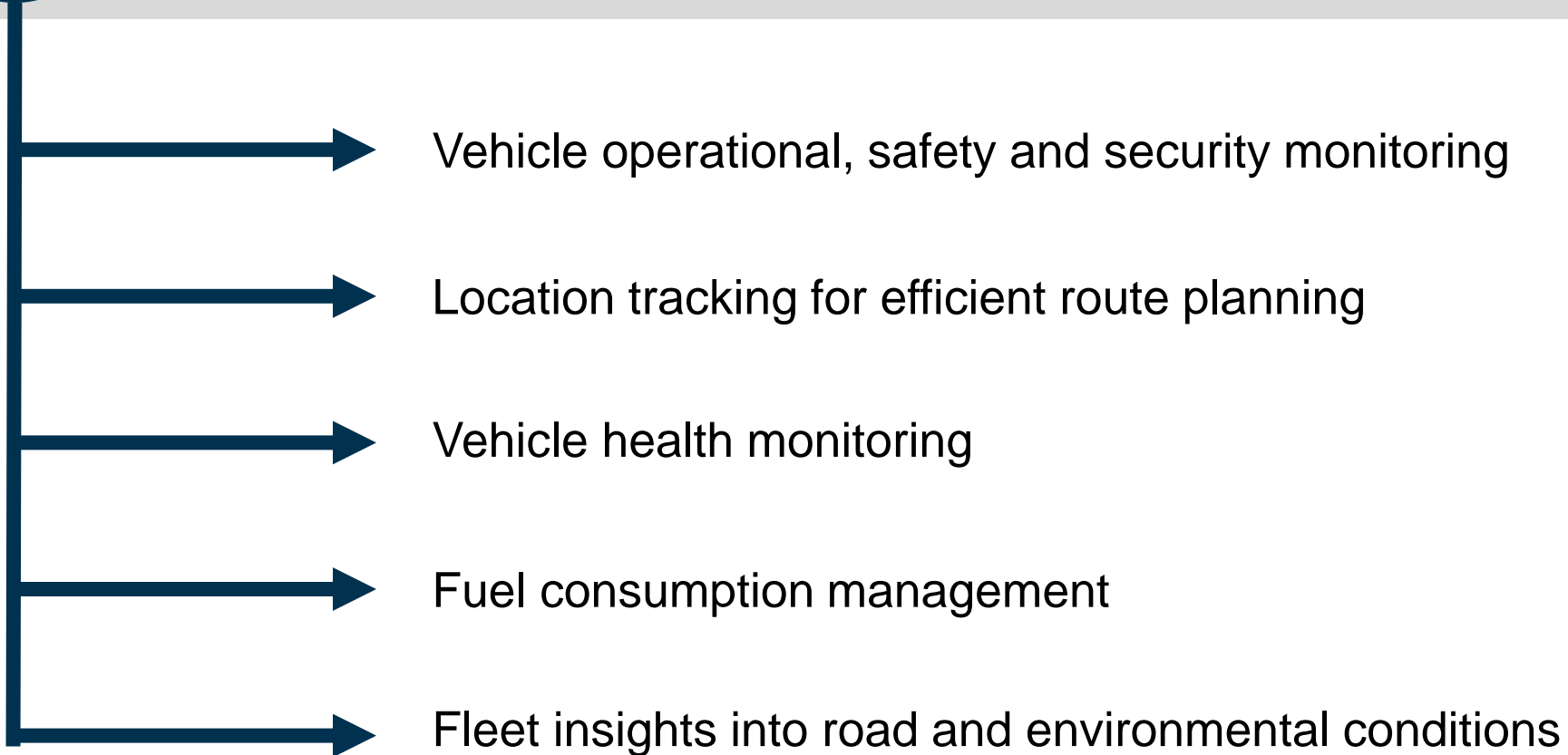
DRIVER SAFETY

Lower insurance cost, capture accident insights, comply with regulations

DATA LOGGING



FLEET MANAGEMENT





DRIVER SAFETY

- Driver monitoring (distracted driver, fatigue)
- Active driver alerts (tailgating, tires, rollover potential, imminent crash)
- Driving behavior (risky maneuvers, hard braking, speeding, turn signals)
- Driver feedback and coaching (areas for improvement, safe driver award)
- Cabin monitoring (unauthorized passengers) and geofencing alerts



DATA LOGGING



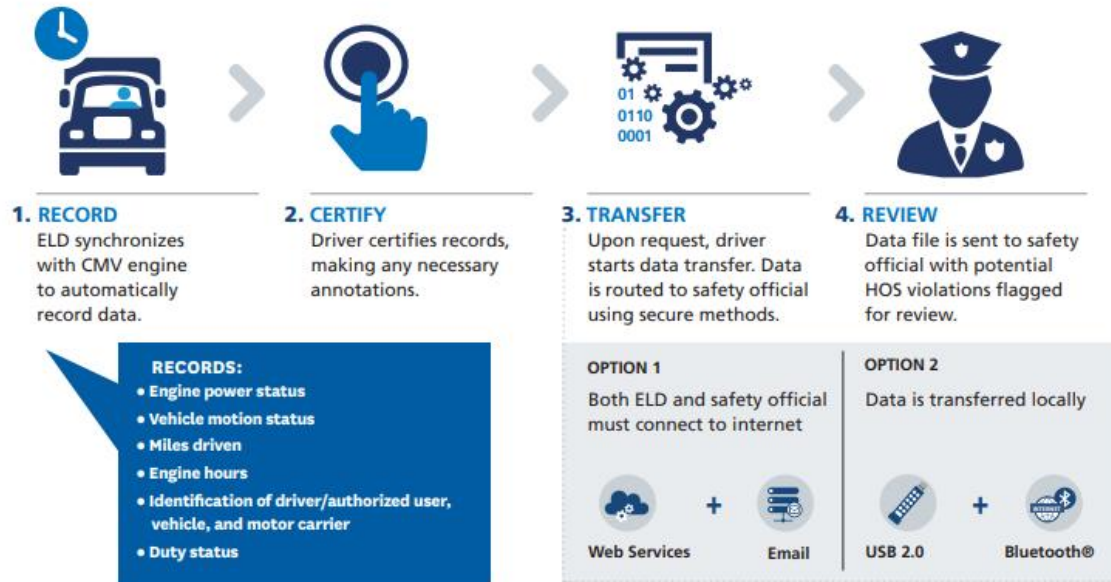
- Usage-Based Insurance (UBI) based on location and driving behavior
- Event Data Recorder (EDR) to capture vehicle and occupant information before, during and after of accident
- Electronic Logging Device (ELD) record vehicle and driving activity for government compliance
- Safety and security anomaly detection logging for fleet-wide monitoring
- Real-time performance monitoring

COMMERCIAL VEHICLE DATA LOGGING

• Electronic Logging Device (ELD)

HOW DOES AN ELD WORK?

An ELD synchronizes with a vehicle's engine to automatically record a driver's off-duty and on-duty time and securely transfer HOS data to a safety official.



FMCSA | Office of Communications | 202-366-9999 | FMCSA.publicaffairs@dot.gov | www.fmcsa.dot.gov/hours-service/elds/electronic-logging-devices
More information on the statistics listed here can be found in the Executive Summary of the ELD Final Rule.

HOS = Hours Of Service

• Electronic Data Recorder (EDR)

- Captures data in the event there is a crash
 - Pre-crash vehicle dynamics
 - Pre-crash vehicle system status
 - Driver inputs
 - Vehicle crash signature
 - Restraint usage and deployment status
 - Post-crash data (e.g., automatic collision detection)

An "event data recorder" has been defined by the National Highway Traffic Safety Administration as "a device installed in a motor vehicle to record technical vehicle and occupant information for a brief period of time (seconds, not minutes) before, during and after a crash."

KEY COMMERCIAL VEHICLE DATA SOURCES*

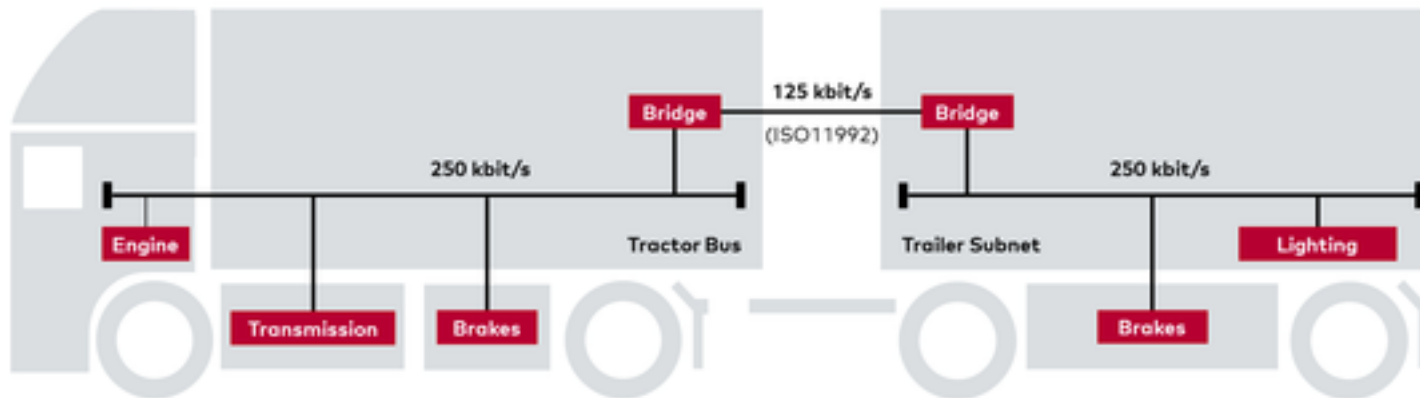


- ◆ GPS (location)
- ◆ Inertial Motion Unit
- ◆ Engine Performance
- ◆ Tire Pressure (TPMS)
- ◆ Temperatures
- ◆ Speed, Brake, Turn Signals
- ◆ ECU Status and Data
- ◆ Driver/Cabin Video
- ◆ Fault Codes
- ◆ Vehicle Usage (Idle, HOS)

* Deeper vehicle data access available in future vehicles

DATA COMMUNICATION IN HEAVY-DUTY COMMERCIAL VEHICLES

- Electronic Control Units (ECUs) share data by talking the same language using [SAE J1939](#) higher-layer protocol on CAN 2.0B bus data and physical layers running @ 250 (black connector) or 500 kbps (green connector)
 - Standardization is important across heavy-duty vehicles (as opposed to passenger vehicles that use unique standards per manufacturer)
 - ECUs can be swapped across manufacturers and diagnostic test equipment, data loggers, etc. can be easily attached
- J1939 typically broadcasts data without a specific destination (but destination addresses can be used)
 - 29-bit extended CAN identifier; 8 bytes of data per packet; up to 1785 bytes can be sent with multi-packet messages
 - J1939/71 defines parameter database (> 5000 parameters) and J1939/73 defines diagnostic trouble codes (DTCs)
 - Security concern since any ECU can inject messages that can tamper with other critical ECUs like powertrain and engine control



Source: Vector Informatik GmbH



J1939 Type 2 Connect – 500 kbps

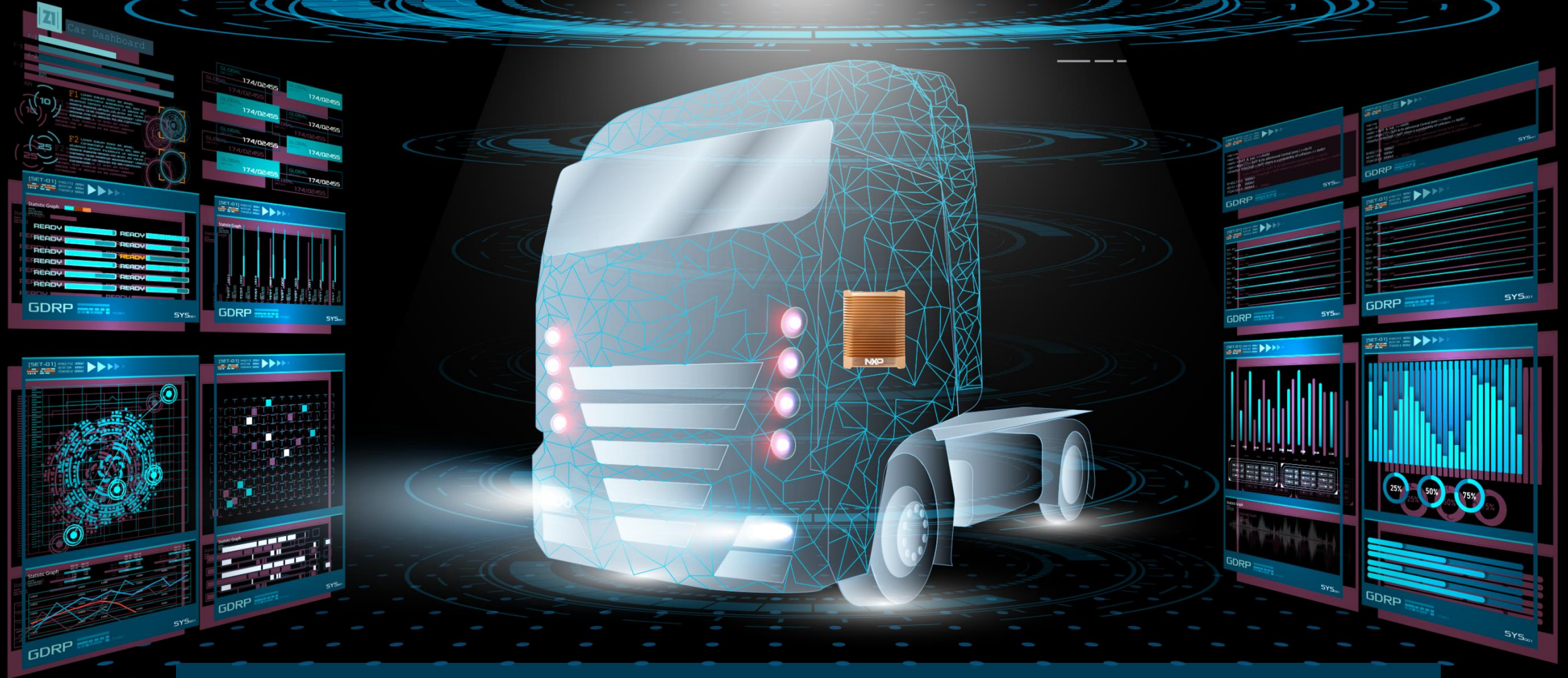


"We see connectivity as the supporting technology to help our customers with their business," said Roger Nielsen, President and CEO of Daimler Trucks North America, noting that connectivity is also a foundational system for automated and autonomous driving systems. – SAE WCX 2021

CONNECTED COMMERCIAL VEHICLE BENEFITS

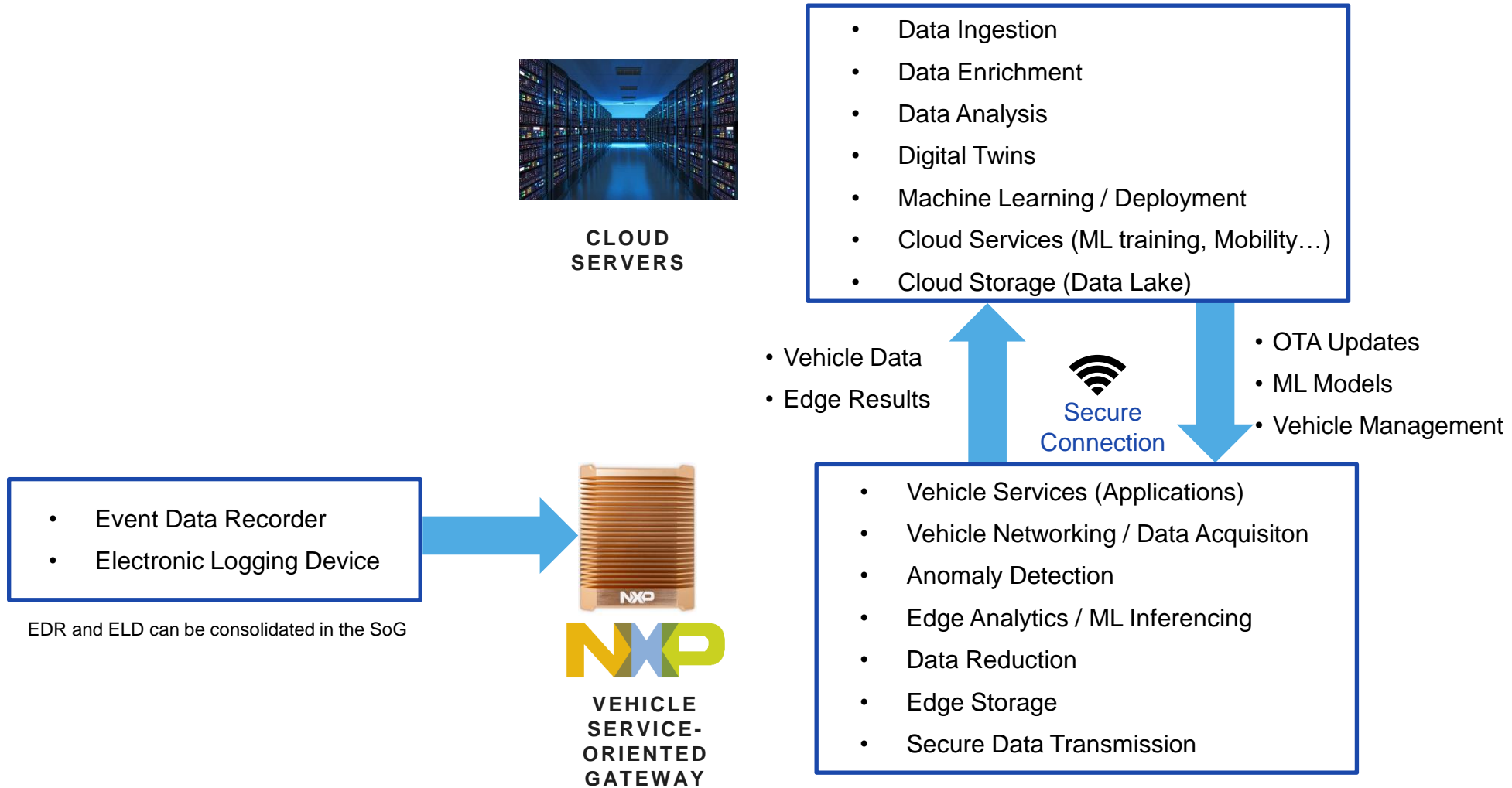
- Extend vehicle data to the cloud for fleet aggregation, tracking and services enablement
- 24/7 monitoring of vehicle fleet for latest status and identification of any issues
- Remote vehicle performance monitoring with prognostics to minimize maintenance costs and maximize fleet uptime
- Location tracking for safety and route planning
- Over-the-air updates for new services and vehicle enhancements over vehicle lifetime

NEW SERVICE-ORIENTED GATEWAY – ENABLES DEEPER VEHICLE DATA ACCESS TO DRIVE VEHICLE IMPROVEMENTS



Service-oriented Gateway provides vehicle services and centralized access to vehicle data

VEHICLE EDGE-TO-CLOUD PROCESSING FOR NEW DATA-DRIVEN OPPORTUNITIES



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DEEPER VEHICLE DATA ENABLES CONTINUAL COMMERCIAL VEHICLE IMPROVEMENTS



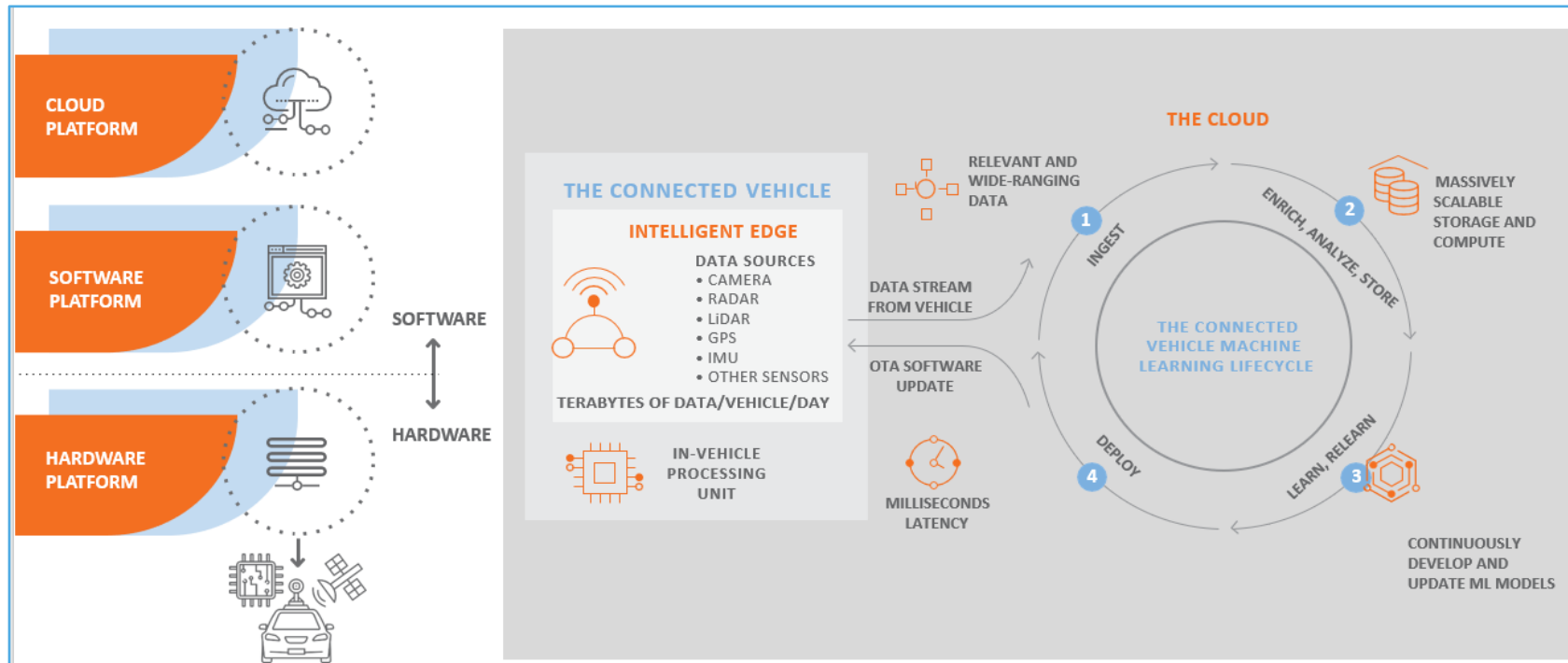
AUTONOMY



CONNECTED



ELECTRIC



- Vehicle data insights can drive digital twins and machine learning in the cloud
- Data management life streamlines
 - Data capture
 - In-vehicle processing
 - Cloud ingestion
 - Cloud processing
 - Cloud storage
 - Digital twin in cloud
 - ML training and optimization
 - ML deployment to the vehicle
- Drive improved safety, autonomy and extended vehicle range

FUTURE COMMERCIAL VEHICLE USE CASES – INTELLIGENT CONNECTED VEHICLE

Upgradable



Over-the-Air (OTA) updates for new vehicle services and enhanced features

Design Optimization



Deep vehicle data drives digital twin optimization and machine learning training in the cloud to test new features on real-world data and improve vehicle performance and efficiency

Predictive Maintenance



AI-based vehicle health management using advanced prognostics to predict component failures before they happen and maximize vehicle uptime

Advanced Insurance Services



Advanced insurance algorithms run in-vehicle for vehicle-specific risk assessments that are not possible or feasible outside the vehicle

The Evolution of Fleet Management Leverages Big Data, Artificial Intelligence and Connectivity

VEHICLE DATA IS THE LIFEBLOOD OF COMMERCIAL VEHICLE OPERATIONS

- Commercial vehicles present tremendous opportunities based on their abundant data
- Vehicle data is key for operational efficiency, cost reduction, safety and regulation compliance
- Deeper vehicle data access and edge intelligence can be enabled with service-oriented gateways
- New vehicle data-driven opportunities for continual vehicle improvements and operational value propositions





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