VOTARYTECH
Mobility. Solutions. Services

POC - Diagnostic Trouble Code System

Industry Standard – DTC (Diagnostic Trouble Code) System

Purpose

Ensure safe and reliable vehicle operation by detecting, validating, and reporting sensor or system faults in a standardized manner.

DTC Operation in Vehicles

- ❏ **Continuous Monitoring:** Sensors continuously measure critical parameters such as temperature, voltage, pressure, and speed.
- ❏ **Fault Identification:** The ECU evaluates sensor values against **defined diagnostic thresholds** to identify abnormalities.
- ❏ **Fault Validation:** Detected faults are confirmed over multiple driving cycles to prevent false alerts.
- ❏ **Code Generation:** A **standardized Diagnostic Trouble Code (ISO/SAE format, e.g., P0A1A)** is assigned once the fault is verified.
- ❏ **Logging & Snapshot:** The ECU records fault details including timestamp, occurrence count, and freeze-frame data.
- ❏ **Communication:** Fault information is transmitted over **standard automotive networks (CAN/LIN)** to the cluster, telematics, or diagnostic tools.
- ❏ **Driver Notification:** Warning lamps or messages inform the driver when attention or service is required.
- ❏ **Reset & Maintenance:** Faults are cleared manually using diagnostic tools or automatically after successful validation cycles.
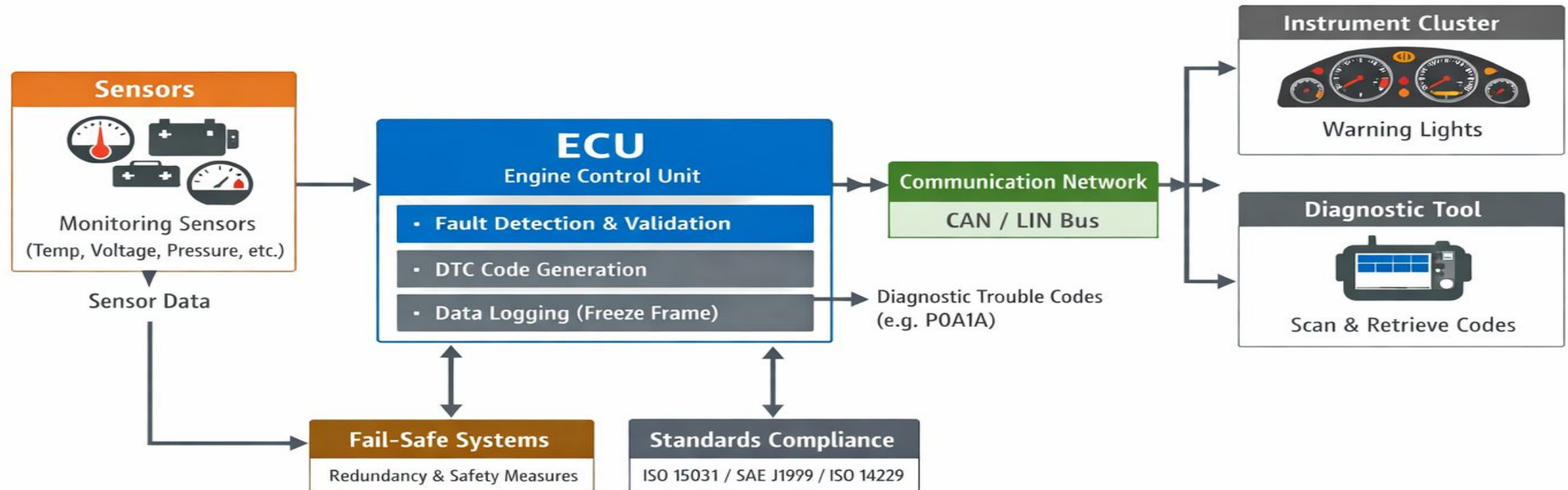
Built-in Safety

- ❏ **Redundancy & Fail-Safe Behavior:** Redundant sensing and controlled fallback modes maintain safe operation during faults.
- ❏ **Secure Communication:** Diagnostic communication is protected to ensure only valid fault information is processed.

Standards Alignment: Diagnostic codes, communication, and services follow **ISO 15031, SAE J1979, and ISO 14229 (UDS)**, ensuring consistency across automotive platforms.

Industry-Standard Diagnostic Trouble Code (DTC) System

Battery Temperature DTC Implementation

Signal Source: DS18B20 battery temperature sensor connected to **ESP32**

Monitoring: Temperature value sampled continuously

Fault Detection

➢ No valid sensor response (sensor disconnected)
➢ Temperature outside allowed range:

Below **−40 °C**

Above **125 °C**

Fault Confirmation: Fault condition persists for **3 seconds** before confirmation

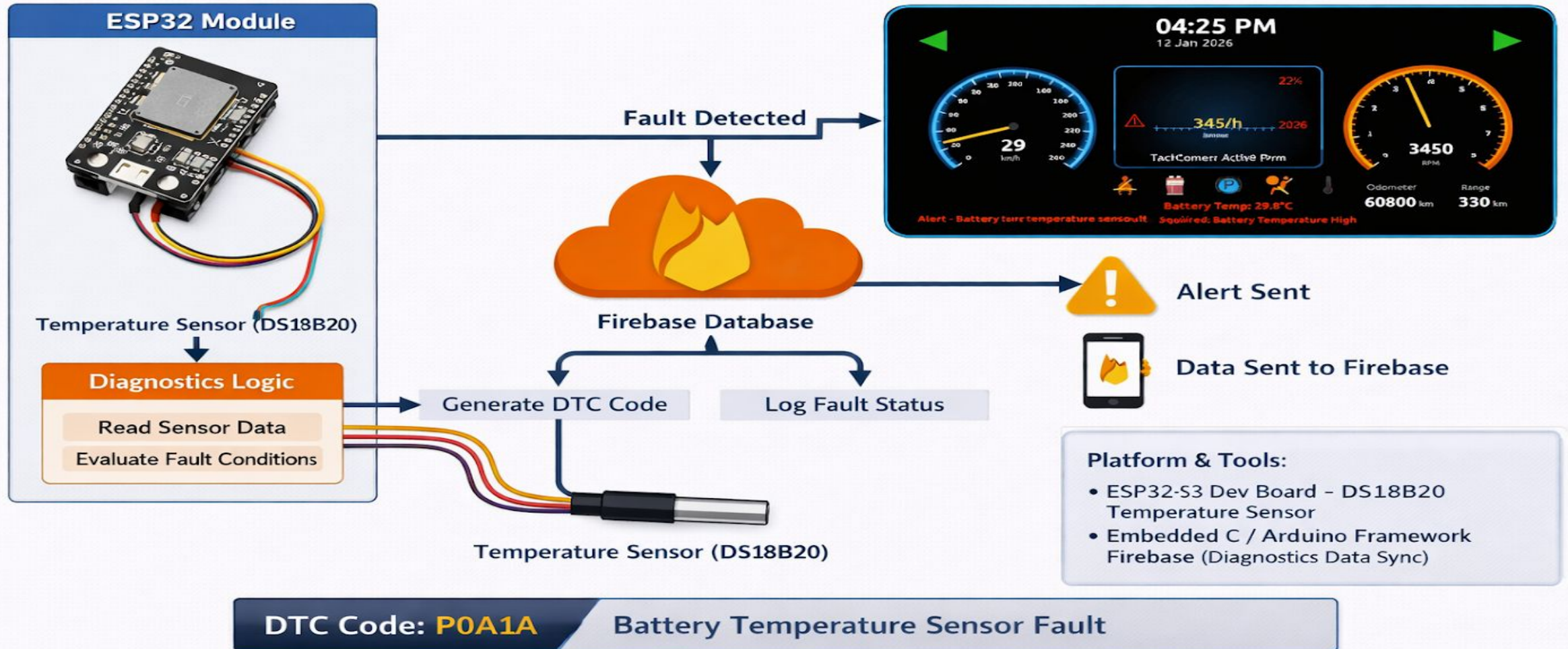**DTC Generation: P0A1A – Battery Temperature Sensor Fault**

Fault Reporting:

➢ DTC status sent to **Firebase**
➢ Used for system monitoring / display

Industry Reference: Detection, confirmation, and reporting behavior aligned with automotive DTC standards

Battery Temperature Sensor Fault (DTC)

Industry Reference vs Implemented DTC Behavior

Aspect	Industry-Standard Automotive DTC	Implemented Diagnostic Solution
Primary Objective	Vehicle-wide safety and reliability	Demonstrate DTC behavior for battery temperature
Monitored Signals	Multiple sensors (temp, voltage, pressure, speed, etc.)	Single battery temperature signal
Controller	Automotive ECU	ESP32
Fault Detection	Threshold-based checks per diagnostic specifications	Range check (< −40 °C / > 125 °C) and sensor disconnection
Fault Confirmation	Multi-cycle / time-based validation	Time-based validation (3 seconds)
DTC Assignment	ISO/SAE standardized codes	P0A1A – Battery Temperature Sensor Fault
Fault Logging	Timestamp, occurrence counter, freeze-frame data	DTC active state only
Communication Medium	CAN / LIN automotive networks	Cloud telemetry (Firebase)
Driver Indication	Cluster warning lamps / messages	Dashboard / application display
Fault Clearing	Diagnostic tool or automatic recovery	Telemetry-based update
Safety & Redundancy	Redundant sensors, fail-safe modes	Not implemented
Security	Secured in-vehicle diagnostic communication	Relies on cloud platform security
Standards Compliance	ISO 15031, SAE J1979, ISO 14229 (UDS)	Behavior aligned, not fully compliant

THANK YOU