Integrating InstantX with Automotive Grade Linux for Real-Time Vehicle Data Exchange

InstantX

AUTOMOTIVE GRADE LINUX

INTRODUCTION

This use case explores how two open source initiatives hosted by the Linux Foundation can be integrated to support emerging connected-vehicle scenarios:

- **InstantX**: An LF Edge project designed for real-time data exchange across industries including transportation, healthcare, finance, and manufacturing. A key focus of InstantX is **Vehicle-to-Everything (V2X)** communication, which enhances safety and efficiency by enabling data exchange between vehicles, infrastructure, and other road users.
- **Automotive Grade Linux (AGL)**: A Linux Foundation project developing a shared open source software platform for in-vehicle systems such as infotainment, telematics, and instrument clusters.

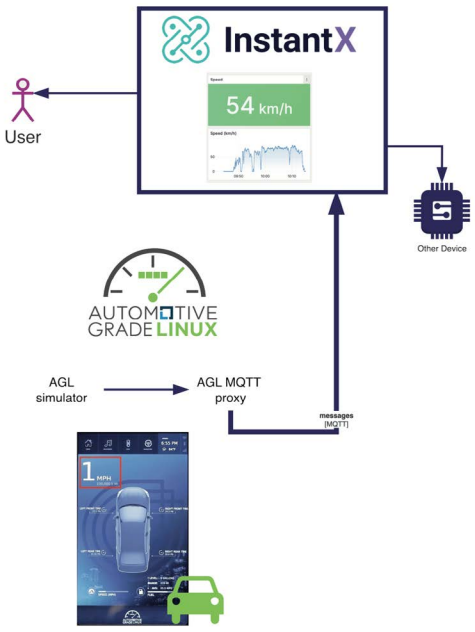
This document presents an **initial exploratory Proof of Concept (PoC)** demonstrating how InstantX and AGL can be integrated to enable **Vehicle-to-Cloud (V2C)** communication using open source technologies.

CHALLENGE

Connected vehicles generate large volumes of data from sensors, control units, and infotainment systems. However, securely and efficiently transmitting this data to cloud platforms for analytics, diagnostics, and updates presents several challenges:

- Lack of standardized orchestration frameworks for edge computing in vehicles.
- Limited interoperability between in-vehicle software and cloud services.
- Resource constraints on embedded automotive hardware.

This PoC explores how InstantX and AGL can address these challenges through a modular, open source integration approach.



SOLUTION

This PoC uses the **Automotive Grade Linux (AGL) simulator**, running on a standard computer, to emulate in-vehicle systems. The simulator provides a realistic environment for testing integration without requiring physical automotive hardware.

- **AGL Simulator** runs on a computer to emulate vehicle software components such as infotainment and telemetry services.
- **InstantX** orchestrates containerized services including data collectors, MQTT brokers, and cloud connectors.
- Simulated vehicle data (e.g., Speed.Data) is collected via AGL and transmitted to cloud endpoints using open protocols and lightweight messaging.
- A visualization dashboard displays the streamed data, demonstrating the potential for real-time monitoring and analytics.

BENEFITS

- **Open and vendor-neutral** architecture using Linux Foundation projects.
- **Modular deployment** enables flexibility across different vehicle platforms and use cases.
- **Secure communication** using MQTT and container isolation.
- **Scalable design** for future expansion to support additional V2X scenarios.

LESSONS LEARNED

- InstantX's modular design simplifies integration with AGL, but aligning AGL services with edge orchestration components requires careful planning.
- MQTT is effective for lightweight, real-time data transmission in simulated environments.
- Opportunities were identified to optimize the visualization dashboard and improve simulator timing for better performance.

FUTURE PLANS

- Extend the PoC to support **bi-directional communication** (e.g., over-the-air updates and remote commands).
- Continue collaboration in the context of **Software-Defined Vehicle (SDV)** initiatives to support dynamic, cloud-connected vehicle architectures and diagnostics.
- **Run the same PoC on real automotive-grade hardware** with the full AGL stack to validate performance, robustness, and deployment feasibility in production-like environments.