Ensuring Regulatory Compliance and Security in Electric Vehicles: Implementing UNECE R156 Supporting an Advanced Software Release Process

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Executive Summary

The transition towards electric and connected vehicles demands robust solutions for software integrity, cybersecurity, and regulatory compliance. This paper presents a comprehensive approach for managing software updates in vehicle fleets aligned with UNECE Regulation No. 156, which mandates secure, systematic software update processes for newly registered vehicles. Key features of the proposed system include automated compliance tracking, parameter management, and centralized documentation, enabling Original Equipment Manufacturers (OEMs) to efficiently manage software distribution while meeting stringent regulatory requirements. Through process automation and a shared platform for software and calibration engineers, the duration of release cycles can typically be reduced from months to days.

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1 Introduction

UNECE Regulation No. 156 establishes a framework for managing software updates in vehicles, enhancing security, traceability, and systematic update management. Since July 2024, compliance has been mandatory for newly registered vehicles. OEMs face significant challenges in adapting to secure, verifiable, and documented update processes. This paper proposes a structured solution to support UNECE R156 compliance, significantly shortening software release cycles through automated collaboration between software development and test and calibration teams.

2 Challenges with Software Management and UNECE R156 Requirements

UNECE Regulation No. 156 applies to various vehicle categories (e.g., M, N, O, R, S, T) and mandates a systematic approach to secure and traceable software updates. Key requirements include maintaining an auditable record of updates, ensuring update safety and compatibility, and providing accessible compliance documentation for regulatory authorities, involving numerous stakeholders as illustrated in Figure 1.
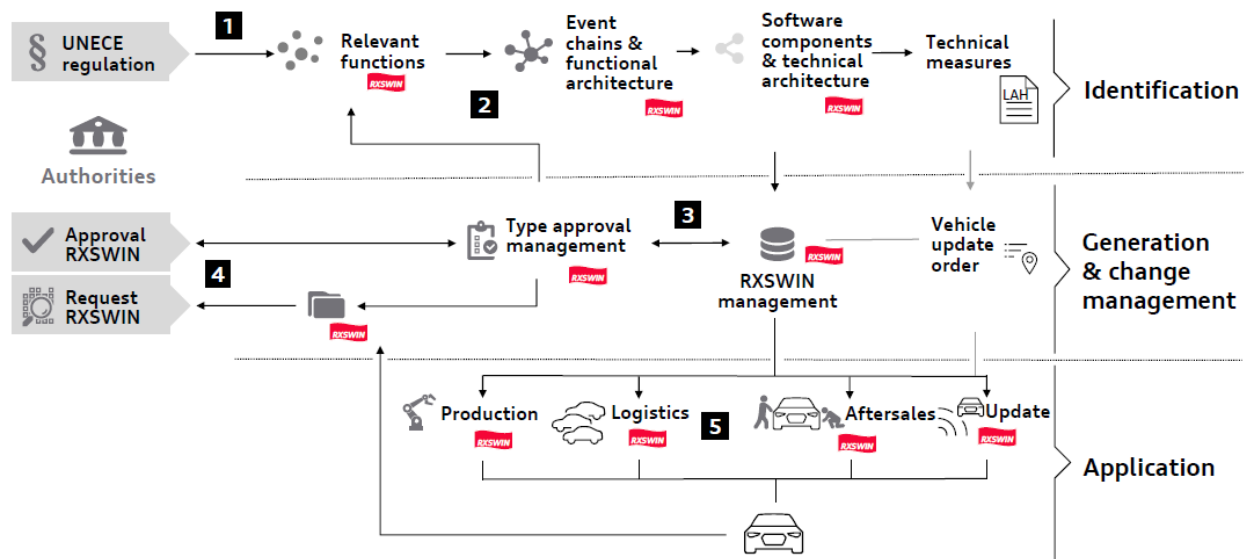
Figure 1 - UNECE R156 Stakeholder Involvement [1]

Challenges for OEMs include adapting to stringent requirements for Over-the-Air (OTA) updates, now critical for electric and connected vehicles. OTA updates demand strict control over timing, safety, and security to avoid compromising operational integrity during driving [2][3]. An automated process that ensures the integration of software versions with test and calibration environments is essential for efficient release cycles (Figure 2).
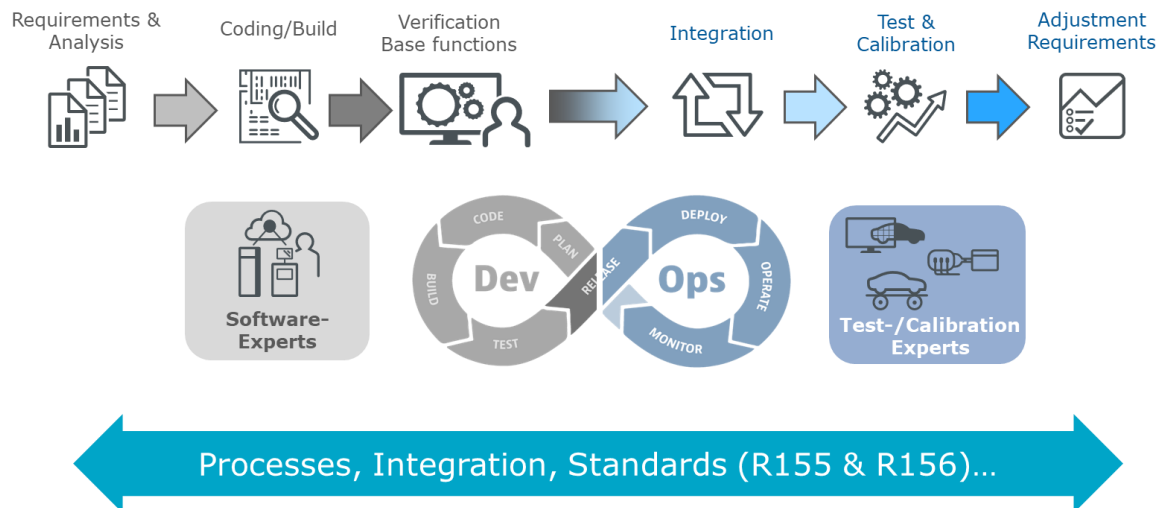

Figure 2 - Software release process

Typically, software and test/calibration teams operate in separate organizational units with distinct management systems, resulting in non-automated, inefficient processes.
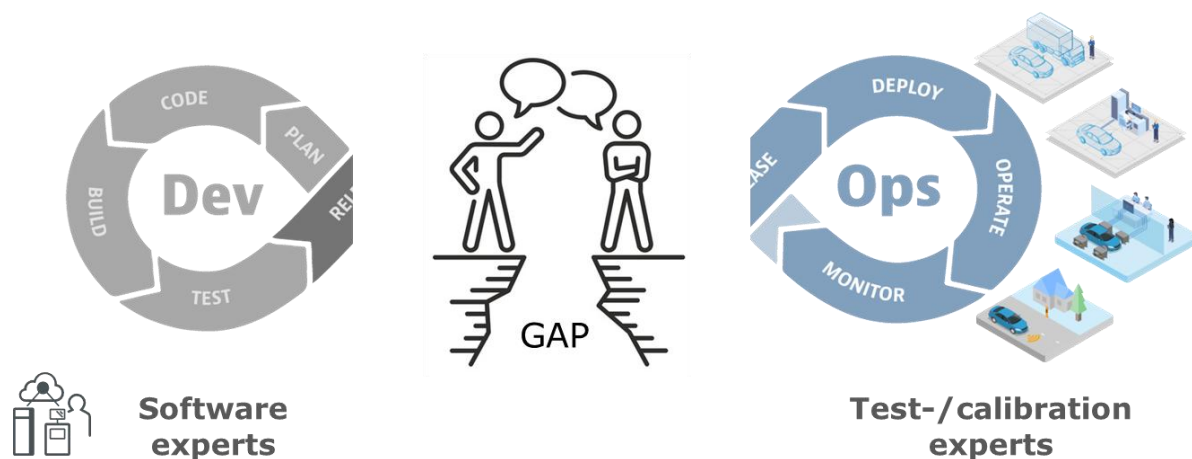
Figure 3 - Gap between software and test/calibration teams

This organizational gap slows release processes, conflicting with market demands for rapid updates in software-defined vehicles, where full traceability remains critical (Figure 3).

3 In the SDV Era, Fast Is Not Fast Enough

Vehicle development has shifted fundamentally with BEVs, ADAS, and SDVs. Software is now the core of vehicle functionality, with updates occurring continuously and frequently.

3.1 Software Is The Backbone

Hardware provides structure, but software delivers the user experience. A vehicle's hardware must support multiple generations of software through OTA updates, real-time calibration adjustments, and continuous feature delivery. Teams require workflows that support scalable iteration across development, calibration, testing, validation, and compliance, mitigating risks associated with rapid release cycles.

3.2 No Future Without Compliance

As release frequency increases, traditional workflows become bottlenecks. Automation, integrated DevOps workflows, and real-time synchronization between development and calibration teams are essential to maintain compliance with ISO 26262 and UNECE R156.

3.3 It's Not About Updates – It's About Innovation

High-frequency releases require automation, traceability, and compliance by design. Best practices include REST API and Python-based automation, virtual validation through SiL (Software-in-the-Loop) testing, audit-ready versioning, and role-based workflows to support global collaboration.

3.4 Software Is the New Benchmark

The software delivery pipeline has become a business-critical asset. Rapid, reliable releases strengthen market positioning. Organizations must assess their readiness for continuous delivery and scalability.
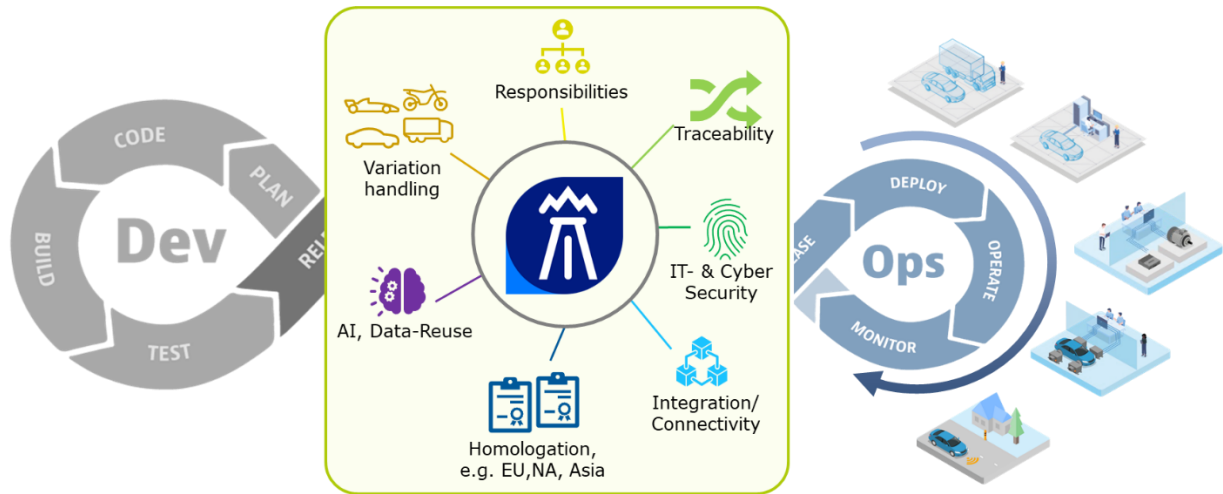
4 Solution: Key Features and Compliance Benefits

Figure 4 - Solution Overview

4.1 Parameter Management and Traceability

The solution offers detailed tracking of regulatory-relevant software parameters using unique identifiers, such as the Rx Software Identification Number (RxSWIN) [3]. Customizable labeling and color-coding simplify regulatory compliance management and auditing.

4.2 Automated Compliance Alerts and Approval Workflow

An automated alert system notifies project managers and regulatory authorities about modifications to critical parameters and triggers an approval workflow. Immediate notifications and streamlined processes enhance compliance efficiency and mitigate the risk of unauthorized updates [2][3].

4.3 Centralized Documentation and Regulatory Certification Storage:

The system includes a secure, centralized repository for all compliance certificates and regulatory records, ensuring accessibility for inspections. It supports detailed documentation of each update's purpose, impacted functions, and type approval relevance [3].

4.4 Secure Update Delivery and Tracking:

Software updates are delivered securely and efficiently, following protocols that comply with UNECE R156 guidelines. Mechanisms for rollback and comprehensive tracking logs ensure vehicle safety and functionality during update deployment [2].

4.5 Flexibility and Scalability for Large EV Fleets

The modular, scalable architecture supports large and diverse EV fleets across regions and vehicle types. It enables OEMs to tailor configurations while ensuring continued compliance with R156 requirements [2][3].

5 Conclusion:

The implementation of a software release process aligned with UNECE R156 significantly advances secure, systematic software update management across electric vehicle fleets. The proposed solution empowers OEMs to meet regulatory demands by providing features such as compliance tracking, secure update delivery, centralized documentation, and scalable management. By adopting this approach, OEMs can achieve heightened security, reliability, and regulatory adherence in an increasingly dynamic automotive landscape.

References

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Presenter Biography

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