RTI CUSTOMER SNAPSHOT

FlexCAR

A VEHICLE PLATFORM FOR THE MOBILITY OF THE FUTURE

HIGHLIGHTS

Connects an autonomous chassis to an autonomous transport system for indoor logistics applications

Establishes the ability to design a vehicle that can be updated and upgraded throughout its entire life cycle based on Service-Oriented Architecture

Enables a mixed-reality-based visualization of future software-defined vehicle concepts, illustrating the potential for future product development

> The FlexCAR vehicle platform is highly modular in terms of drive systems, body variants and flexible software components. We chose Connext because it gives us enormous flexibility, adaptability and good control over QoS in terms of hardware and software, which accelerates data communication and supports cutting-edge mobility concepts for future vehicles"
>
> — **Dr. Lukas Block** —
> Fraunhofer IAO

ABOUT FlexCAR

FlexCAR is a cyber-physical vehicle platform with open hardware and software interfaces collaboratively developed within the ARENA2036 project FlexCAR. The Fraunhofer Institute for Industrial Engineering IAO and the Institute of Human Factors and Technology Management IAT at the University of Stuttgart were responsible for the software architecture. The project team developed a standardized autonomous vehicle platform that allows new technological features to be implemented according to the plug-and-play principle. Following its launch in January 2021, the FlexCAR joint project has successfully applied this development model to future mobility concepts, offering the opportunity to test new innovations quickly and efficiently.

The FlexCAR project is funded by the German Federal Ministry of Research and Education (BMBF), and partners include Mercedes-Benz (project lead), Trumpf, Robert Bosch, Siemens, DXC, DLR, University of Stuttgart and Hochschule der Medien Stuttgart, as well as Fraunhofer IAO and Nokia (supporting partner).

CHALLENGE

The requirements for future vehicles are increasingly shifting from pure hardware to flexible software instances. This makes it possible to react quickly and efficiently to changing demands on computing resources due to functional adaptations, updates or even hardware failures. One of the key criteria is the ability to maintain an open development process, enabling teams to develop and implement open and stable interfaces for hardware and software.

Flexibility in development plays just as important a role as the ability to make adjustments via updates after the vehicle has been rolled out. Keeping pace with this evolution requires a highly flexible, next-level platform that allows teams to meet the demand for the continuous improvement of existing algorithms and improve data exchange with internal sensors, as well as integrate external sensors beyond the system's own limits.

SOLUTION

To meet these challenges, the Fraunhofer Institute for Industrial Engineering (IAO) and the Institute of Human Factors and Technology Management IAT at the University of Stuttgart researched the design of open, long-term interfaces and suitable network communication using the FlexCAR "Rolling Chassis" vehicle research platform. The communication architecture of the Rolling Chassis comprises both internal communication (onboard) and external communication (offboard).

These efforts helped guide the FlexCAR joint project, which established integrated yet flexible onboard and offboard communication via 5G. The onboard network provides fast and secure communication for all network participants over standardized, service-oriented message protocols via Ethernet, while offboard connectivity is handled using the air interface to provide communication. This allows over-the-air updates without the need for a visit to the mechanic. Remote maintenance not only enables control functions to be carried out, but also allows all onboard data to be flexibly transferred to the cloud, where it can be shared for visualizations or capacity calculations.

Communication with external devices is a fundamental requirement for Vehicle-2-everything connectivity (V2X). This can be accomplished by using Service-Oriented Architecture (SOA), so that the software is no longer tied to specific hardware and can be executed flexibly in the system. An easy SOA configuration was achieved by using RTI Connext®, which is based on the popular Data Distribution Service (DDS™) standard. Any mismatched network can be immediately detected by Connext's debugging tool, so that onboard communication can now be interoperable across software instances, programming languages and various operating systems. This ensures adaptive compatibility with ROS 2, as well as the AUTOSAR Classic/Adaptive Platform.

RESULTS

As part of the FlexCAR joint project, the team was able to develop a purely electrically powered — and fully X-by-Wire controlled — research vehicle, the Rolling Chassis.

To establish the reliable, real-time-capable and customizable flow of information between all control units and communication participants in the internal Ethernet network of the Rolling Chassis, data within the FlexCAR vehicle platform is exchanged via DDS with Connext. The standardized interfaces make it easy to exchange software and hardware modules, while the 5G interface makes it easy to carry out over-the-air updates and also integrate external sensors.

Because of the SOA foundation used, zone-based domains can be operated, and intelligent computing load distribution can be implemented, while it is also possible to upgrade the system at a later date without major customization costs. The use of Connext and the SOA model offers a flexible assignment of programs to the FlexCAR hardware, enhancing and thus raising the modularity of the FlexCAR concept. Together with broadband communication, this architecture enables complete data exchange for the use of edge and cloud computing.

These innovative approaches and methods can be used to design future forms of mobility in a targeted, fast and efficient manner with regard to automated or autonomous driving using the FlexCAR research and experimentation platform, which has been created with removable storage and production concepts and embedded VR/AR technology to give developers new levels of flexibility and adaptability in vehicle design. Moving forward, the FlexCAR platform offers an ideal space for further research and development work in one of the world's most competitive industries.

With its intelligent approach to provisioning computing resources, the FlexCAR project funded by BMBF represents a pioneering step forward in vehicle development, which has the potential to shape the mobility of the future. Controlling data flow with Connext gives the platform a flexible basis for the development of new mobility concepts that can be updated and upgraded to meet the evolving needs of both people and the environment.

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ABOUT RTI

Real-Time Innovations (RTI) is the infrastructure software company for smart-world systems. Across industries, RTI Connext® is the leading software framework for intelligent distributed systems. RTI runs a smarter world.

RTI is the market leader in products compliant with the Data Distribution Service (DDS™) standard. RTI is privately held and headquartered in Silicon Valley with regional offices in Colorado, Spain, and Singapore.

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CORPORATE HEADQUARTERS

232 E. Java Drive, Sunnyvale, CA 94089
Telephone: +1 (408) 990-7400
info@rti.com

rti.com
rti_software
rtisoftware
company/rti
rti.com/blog
rti.com/podcast