TECHNOLOGY BRIEF

DECEMBER 2018

Category: Generic Communication Protocols Evaluation

Franca / ARA::COM Interoperability

Summary

The objective of this project is to build a demonstrator for the interoperability of GENIVI (and Linux) based IVI systems and Adaptive AUTOSAR systems.

The interoperability should be demonstrated on a model level (via model integration and transformation) as well as on a target level (allowing an Adaptive AUTOSAR-ECU and a GENIVI IVI system to perform joint functionality).

In order to demonstrate the interoperability on both levels, it was necessary to:

- Work out a conceptual mapping between both technologies
- Develop new tools (e.g., model transformations)
- Test code generation on the GENIVI and AUTOSAR sides and establish a working communication connection with a SOME/IP stack on both sides
- Define interesting demo use-cases
- Implement these demo use-cases on model level and on the actual target demonstrators

This brief describes how the above goals were achieved by presenting both the tool and the demonstrator implemented.

Key Characteristics

- Interoperability of Adaptive AUTOSAR stack and GENIVI IVI stack at model-level and target-level
- Automated generation of the glue code on both sides, i.e., CommonAPI / SOME/IP bindings on GENIVI side and ARA::COM / SOME/IP bindings on Adaptive AUTOSAR side
- Qt-based UI on GENIVI stack

Introduction

When designing the current generation of connected vehicles, the automotive industry has to cope with too many choices, too much diversity, too much boiler-plate code, adaption layers, and incompatibility. There are a lot of communication protocols available, each one with different focus.

During the last months, the Generic Protocol Evaluation Project Team identified SOME/IP and Franca IDL (often used together with CommonAPI C++ bindings) as two of the preferred industry options. On the other side, AUTOSAR and its ARA::COM communication middleware are very important in the automotive

environment. When it comes to inter-domain communication between ECUs, messages have to be translated between CommonAPI and ARA::COM. This is not only tedious, but prone to human errors.

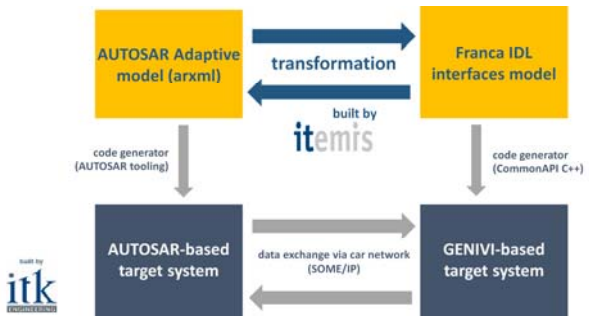
However, both communication technologies are based on model definitions (.arxml and .fidl/.fdepl files). This opens the possibility to translate using model-to-model transformation methods that can improve software quality and reduce development time and engineering costs.

In this document we present a tool that uses model-to-model transformation to achieve a compatible code generation on both sides of ARA::COM and Franca IDL. When combined with CommonAPI bindings and ARA::COM runtime, this achieves a runtime translation between the systems. Using such a tool makes it possible to have a specification in a single format (we propose Franca IDL for this), and yet to use the full advantage of both technologies on both sides of the communication.

The Tool

The Franca project offers not only an interface definition language (Franca IDL), but also a framework for building model-to-model transformations. This framework is being used here to implement transformations from Adaptive AUTOSAR models to Franca IDL and vice versa. These transformations can be used as part of any current Eclipse IDE. For build automation and Continuous Integration (CI) it also useful to deploy the transformations as a command-line tool. The goal of the automatic transformations is to apply code generation by AUTOSAR-compatible code generators as well as Franca-compatible generators (e.g., CommonAPI C++) in a way that leads to transparent communication between both systems at runtime. Therefore, the tooling is based on a proper mapping between Adaptive AUTOSAR concepts and Franca IDL concepts. For example, each operation on an AUTOSAR service interface is mapped to a method in Franca IDL.

The following diagram shows how the transformation tooling interacts with the code generators. The generated code on the AUTOSAR and GENIVI subsystems is using the SOME/IP protocol for communication. As the subsystems are integrated on model level, the communication is automatically compatible.

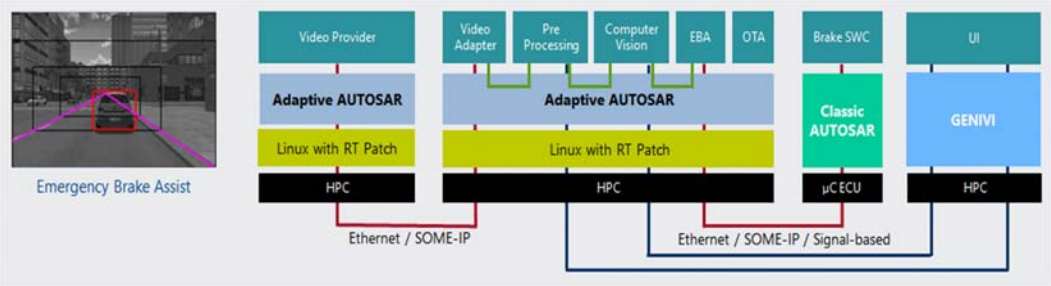


The ARA-to-Franca tool is implemented using the Xtend language, which is an extension of Java providing language features which ease the implementation of model-to-model transformations. It uses Artop (release 4.10) as an implementation of Adaptive AUTOSAR and Franca 0.13.0. Both are using the Eclipse Modeling Framework, which provides a common way of working with models.

The Demonstrator

The Franca ARA Demonstrator was built to provide proof of interoperability for a wide range of Franca IDL artifacts like message and data types and its mapping to Adaptive AUTOSAR.

The setup consists of four Ethernet connected ECUs running the GENIVI, the Adaptive AUTOSAR and the Classic AUTOSAR platforms. Together, those ECUs form an Emergency Brake Assistant with visualizations on the GENIVI IVI system.



The common basis for communication between the ECUs is established using SOME/IP. However, on top of the protocol stack, different middleware such as CommonAPI and ARA::COM is used as binding to the applications.

The following steps were executed to establish the communication between the applications:

- Interface definition using Franca IDL
- Transformation of the Franca IDL interface definition to an equivalent ARXML definition using the Franca model-to-model transformations
- Creation of the corresponding SOME/IP deployments for CommonAPI and ARA::COM
- Generation of the proxies and skeletons for both platforms
- Integration of the generated code into the demo applications.

A clear advantage of following this approach is that there is no need to define the same interface twice in Franca IDL and AUTOSAR ARXML. This reduces errors coming from manual maintaining the service interfaces by having only one source of origin.

Conclusion

The results of this project consolidate the use of Franca-based descriptions of interfaces when designing complex systems by enabling a seamless integration of GENIVI APIs and components into the automotive software engineering processes used for autonomous vehicle functions (a.k.a. Adaptive AUTOSAR).

The current implementation of the model transformations from Adaptive AUTOSAR to Franca IDL and vice versa is prototypical in several aspects. It is sufficient to support the requirements of the Franca ARA Demonstrator, but has to be enhanced significantly in order to be used for production development in actual automotive projects.

The project demonstrates the value and relevance of the GENIVI vehicle domain interaction strategy through the delivery of tangible and useful technology (e.g. code generators) to implement the interfaces of automotive complex systems.

Overall, the next step is to develop a (near) production-ready tool, which has the goal of reducing the cognitive load of developers as much as possible. This will lead to less errors and a more reliable communication between AUTOSAR and IVI systems.

References

- https://github.com/GENIVI/franca_ara_integration
- https://github.com/GENIVI/franca_ara_tools
- Generic Communication Protocols Evaluation Whitepaper (in development)

Authors

- Giovanni Vergine (Visteon), gvergine@visteon.com
- Christopher Schwager (ITK), Christopher.Schwager@itk-engineering.de
- Klaus Birken (Itemis), kbirken@itemis.de
- Participants of the Generic Communication Protocols Evaluation working group