Next Generation IMA Configuration Engineering – from Architecture to Application

Recent aircraft programmes introduced Integrated Modular Avionics (IMA) widely and it has become a common and growing standard. More and more systems implement their functions on IMA causing new demands on IMA hard- and software. Still, there are yet challenges in industrial use, one of it being the tool chains used to design, configure and integrate systems on IMA. Aircraft manufactures work hard to harmonise their processes and tools (the European SCARLETT and ASHLEY project being examples).

IMA provides a generic hardware platform comprising a standardised hardware/software interface and generic module management functionalities. Configurations define the binding of application software to IMA hardware modules. The configuration of IMA modules is split into a global and a local part. The global part describes the partition envelope and the local part describes the details of the binding between the Operation System and the application.

The process of integration can fail in case of certain integrity rules are not fulfilled. As there are different actors involved which create different parts of configurations and applications, it is difficult to manage. To address this integrity problem, a software framework is proposed which shall support the actors in the configuration process for their different tasks.

Within the first part of this publication, a detailed analysis of the process from architecture definition through module definition, system design and application development up to integration is being presented. This covers especially the challenges identified from the first generations of IMA in practice towards future processes and tools. When introducing new generations of IMA modules, one task is to cope with the parallel development of hard- and software, where system needs drive hardware design and hardware design affects system applications. Therefore, special care is taken to highlight the challenges that arise due to different IMA generations, new IMA module technologies and with respect to the strong heterogenic development and integration process.

While for IMA architecture design approaches exist that are very powerful and can cope with the many variants of hard- and software, the software frameworks available towards implementing system applications on IMA still have deficits. For example, there is no seamless tool chain that makes use of existing design data to retrieve initial templates for dedicated system design and application development throughout aircraft programmes. Existing standards like ARINC 653 are helpful but do not cover the complete configuration parameter domain like I/O definitions that are usually a huge part in the IMA equipment configuration. As a result, inconsistencies can occur that cause unnecessary development and integration cycles.

In the second part of this publication, the requirements on tools are addressed in particular. Integrated framework approaches struggle in real-life applications as they do not cover all configuration parameters and usually cannot fulfil required interfaces to other tools as these affect the intellectual property of module- and/or system suppliers. The results are fragmented tool chains each being powerful for a specific tasks (design, evaluation, integration) but hard to be connected with each other. It is therefore difficult to re-use already existing information. With the introduction of new modules these tool chains increase and it becomes a vital task to harmonise the overall configuration management.

The approach presented in this paper tries to bridge the gap between airframer in-house and supplier tool chains and introduces technologies that can cope with variants of IMA modules and respective changes in the configuration parameter domain. Over the years a configuration software framework for IMA concurrent configuration engineering has been developed that integrates into an existing process and provides a platform with an open and flexible architecture. The underlying data model covers existing IMA modules, its variants and I/O. It is based on linked meta-models that can be easily extended and allow to automatically generate required software interfaces, including those to 3rd party software.

Functionalities required by dedicated versions of the software are realised through plugins. Special care is taken to address data consistency. An extensible and configurable rule checker is presented that allows validating configuration data against integration rules that originate in the IMA usage domain or IMA design rules. This includes cross-module checks at aircraft level. Interfaces to common data formats and standards (including ARINC 653 configuration tables) allow exchanging configuration data with other tool chains.

Author: Martin Halle (Martin.Halle@tuhh.de)