The Architectural Platform of a System Family in Evolution

Position paper

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1 Introduction

This position paper is based on a longitudinal study of the development of a system family of integrated, distributed embedded systems using product-line engineering.

The system family has served as a basis for more than 40 ship-based system products and has now reach the maturity level where experiences should be possible to collect, analyse and document. It has also served as a base for applications in adjacent domains, for example a land-based air defence system (StriC) and a simulator (Strics) related to StriC.

The development approach, built on product-line engineering and systematic reuse, has shown to be very cost-effective and shorten time to market for products developed from the assets of the system family.

2 The Philosophy of the System Family

The overall objective at the start of the program was to define a system family as a long-ranged concept and establish a platform with a high degree of flexibility in configuration to meet different customer requirements in the future.

Previously, the functionality of many combat systems was covered by of a number of autonomous systems. The approach taken here was to integrate all the functionality into one system to achieve operational as well as maintenance advantages.

This involved several challenges. As the system family was expected to live over a long period of time and so were the system products, structural stability issues became very vital since the architecture would be exposed to technology changes as well as to functionality changes. It was therefore of vital interest to establish a system structure that would allow commercial off-the-shelf (COTS) components to be included in the systems.

Furthermore, products to be built from the system family were expected to vary in size and functionality, i.e. it was necessary to develop a scaleable architecture.

In order to meet these challenges, a high degree of modularity was needed so that new functions could be added without affecting old ones. New versions of existing functions/subsystems should also be possible to put into the system family without having to modify the function/subsystem concept.

The decision made to develop integrated systems had the consequence that more fault tolerance facilities also had to be part of the new system products compared to the old ones. Another challenge for the company was to increase the productivity over the software development stages.

3 The Establishment of the Architecture

A software architecture constitutes the level of abstraction where we demonstrate that the architectural elements and their constraints define a system that satisfy the stakeholders' current and future needs. It contributes to enlarge the comprehension of what the future system will offer its users. The architecture acts as a bridge between the users and their requirements, and the software engineers. It is the framework or the skeleton where the knowledge and understanding achieved about the application domain is put in place.

The architecture is the carrier of the views and concepts of the evolving system or system family, i.e. the means for communication between the people involved in the development of the systems.

A*ny strategy to establish an architecture must ensure that the process of building that knowledge and experience is as efficient as possible*. The main concern is to make the developers understand what they are going to develop and the most valuable information resource asset in this early phase is the knowledge accumulated by the designers. During the efforts to establish the architecture, the knowledge and understanding of the requirements is increased and the users as well as the system developers get a more thorough and comprehensive view of the future system.

4 Research Topics

The development of an architectural platform also contributes to fulfilment of quality objectives like portability, modifiability and variability. One main purpose of the research project is to analyse the stability of the architectural platform over time regarding changes in functionality, insertion of new building blocks, modifications of interfaces, exchange of technology, substitution of existing components for commercial-off-the-shelf products and so forth.

An adjacent goal is to identify architectural patterns related to the architectural qualities and principles established in system family. We believe that there is a need to identify and describe architectural patterns to understand mentally how complex, large-scale systems are constructed thus facilitating system developers to reuse prior practical experience.

Another research topic is to analyse experiences from other large industrial software projects (at Whirlpool, Ericsson, …), in specific related to the early phases of a software development paradigm. The vision we have is to build a software development model for product-line engineering upon evolution and communication of a common understanding of the future system between the designers, trying to avoid the loss of ”silent knowledge”. We will also analyse how modelling, simulation, visualisation and animation tools may support the process of giving a concrete form to the system architecture.