Model driven development and software architecture in embedded systems

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Supervised by Prof. Brian Fitzgerald
Research Area GSD
Project Title Automatic enforcement of architectural design rules

Industry-Based PhD Candidate from Sweden Who Chose Lero to do his PhD
- 19 years of experience in real-time embedded system development.
- Specialized in architecture and model driven development.

Research Objective
- Improve MDD development practices by automatic enforcement of software architecture design rules.
- Motivation:
  - Today, architectural enforcement is a laborious and error prone task relying on manual reviews. It could be automated if architectural design rules could be formally modelled.
  - Automatic architectural enforcement would be especially beneficial in distributed development, such as GSD.

Strong Cross Area Linkages
- Software Product Lines (SPL):
  - Formalization by means of Meta-Modelling
  - Software Architecture modelling

Results to Date
- The approach has been formalised into 11 mappings between meta-model constructs and system model constraints that can be implemented in a tool (Fig. 2).
- Modelling of the architectural design rules of an old relatively large (350 000 C++ eLOC) embedded system gave:
  - Only 12% of the rules were left for manual enforcement, thus relieving the architects from a major part of the enforcement effort.
  - These were all rules based on judgement of the developers, thus inherently impossible to model
  - Other benefits are that modelling eliminates ambiguities and redundancy in the rules which should make them easier to understand and give less room for erroneous interpretations.

Produced Papers
- Published
- To appear
  - A. Mattsson, B. Lundell, B. Lings, ‘Modelling architectural design rules in UML’ accepted to EMMSAD’08
- Submitted

Next Step
The next step will be to study the application of the approach in a running project. In order to do that the approach has to be transferred to the development organisation of the project. The issue of transferring the approach is in itself a complex one requiring additional work. A necessary pre-requisite for such successful transfer is the provision of effective tool support for the approach and our current work is now focused on developing such support.

Rule of old system
- All concrete arcComponent references are fetched from an arcComponentRegistry. They may not be instantiated outside the component registry.
- arcComponent references may only be fetched by an arcComponentUser

Representation in architecture model
- arcComponentRegistry
- arcComponentUser
- Component

Fig. 3 Example from the modelling of architectural rules from an old system