Abstract

The EC-funded project *Instant Mobility* is defining a comprehensive architecture for transport and mobility applications that aim to innovate by introducing future Internet technologies to this domain. A set of core enabling technologies are being developed by other projects in the Future Internet PPP such as FI-WARE, while the transport-domain Instant Mobility project will use these generic enablers where available, and will develop its own enablers where necessary. This paper outlines the decomposition and synthesis approach for defining a rational, non-intuitive architecture that embraces conventional and Future Internet technologies, reflects the insights that have been gained from applying this methodology in the Instant Mobility project and discusses the disadvantages and benefits of the outlined concept.
1 Introduction

*Instant Mobility* (IM) is a specific targeted research project that aims at creating benefit for travellers, drivers and goods delivery by introducing future Internet technologies into the transport and mobility domain. The project is co-funded by the European Commission within the work program of the Future Internet Public Private Partnership (FI-PPP) in the European Union’s Seventh Framework Programme of research. One of the project’s main objectives is to prepare for the implementation of future Internet enabled transport and mobility services. The technical realisation requires a comprehensive architecture that allows combining conventional technologies with innovative future Internet concepts, such as cloud computing, social networks and big data processing. The scope of the architecture is determined by a number of scenarios and use-cases that are built around applications and services that will be specified and developed in the project. These cover multi-modal travel assistance, sustainable urban traffic management (e.g. green driving) and efficient goods handling. This text outlines the approach taken to define such an architecture and reflect the insights gained from the project so far.

2 Paper Outline

The project follows a conventional three phase approach: An initial requirements definition phase, followed by the specification of the system and a concluding development phase. This makes the architecture definition a core activity of the specification phase that also influences the requirements definition in order to make the results of this process usable for the specification work. The architecture definition process relies on two main steps. A functional decomposition phase in which the consolidated requirements are analysed to an increasingly finer level and a synthesis phase that translates requirements to atomic functions and combines them in larger sets gaining in abstraction. The decomposition and synthesis is structured by the 4+1 architectural view concept ([Kru95]) to refine five key views of the architecture.

The 4+1 concept assumes that an architecture is described sufficiently if the views as depicted in figure 1 are diligently evolved. The IM architecture definition process adopts this concept and targets five viewpoints accordingly:

**Scenarios** The scenarios are the subject of a detailed requirements analysis
in the project and therefore the description of the use cases and scenarios serves as a main input for architecture definition.

**Logical View** The main objective of the functional decomposition process is the identification of the smallest functional units (services) and processes that are used to orchestrate them. The decomposition adopts a methodology proposed by [Sch08]. It is the identification of basic user roles and their interactions with the required system. Figure 2 illustrates the decomposition described in [Sch08].

**Process View** The decomposition identifies the smallest functional units and also identifies the corresponding orchestrating processes.
Development View  This view considers all necessary functionality that is not directly required from a user’s point of view but is needed to commission and operate the system. The most relevant subjects are software management, administration and maintenance.

Physical View  Each atomic function can be assigned to a physical instance that will provide it as a service in an operational stage. This clusters the physical components of the target system as well as the function sets that are provided by them.

In IM the Logical and Process Views are driven by the functional decomposition process that embraces the requirement analysis and specification work in the project. The Development and Physical view are deduced from a synthesis based on the outcome of functional decomposition.

The main challenges of fully specifying the architecture by using the outlined methodology are to consider and represent non-functional requirements. IM is embedded into the FI-PPP program and as a result is closely related to the FI-WARE project that provides a comprehensive technical suite to deliver a core platform based on future Internet technologies for IM (and the other usage area projects) to use. This dependency impacts the architecture definition process as it dictates some common paradigms and challenges IM to contribute to the definition of common requirements that should be satisfied by FI-WARE. Those non-functional requirements are particularly important for the synthesis of the Development and Physical View and will be addressed by defining clear interfaces.

3 Conclusions

The result of the described process is the architecture of the project which will form the foundation of the developments in the project. The main benefit of the illustrated approach is that rational design steps lead to a non-intuitive architecture which is well described through different perspectives. Another main advantage of this approach is that the architecture definition process can be distributed over loosely coupled but well-aligned teams that bring in their specific expertise. Only a few working steps are needed by a central instance to govern the process, e.g. to align the work teams, enforce quality aspects and consolidate results.
References
