IST Amigo Project

Deliverable D3.1

Detailed Design of the Amigo Middleware Core

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Abstract

This is a common introduction to all three deliverables constituting Deliverable D3.1: D3.1a, D3.1b, and D3.1c.

Keyword list

Keywords of D3.1a-b-c

Detailed Design of the Amigo Middleware Core

The Amigo project envisages an open networked home environment integrating any device and related application coming from any one of the Personal Computing, Mobile, Consumer Electronics and Home Automation domains, which are partially and independently present in today's home.

Key features of the Amigo home networked system, as originally identified in the Description of Work and further refined in the course of the project so far, are: (i) service-orientation, as the Service-Oriented Architecture paradigm has been identified as most appropriate for modeling heterogeneous devices and their hosted applications; and (ii) interoperability between diverse service-oriented architectures, as a common agreement on a single service architecture is not feasible in the open home environment.

In Deliverable D2.1, we elaborated an abstract middleware architecture for the Amigo home networked system, particularly targeting the above identified features. We structured this architecture identifying two essential levels. The lower level comprises the Interoperable Middleware Core, which provides essential middleware functionalities, such as service discovery, service interaction and quality of service support. Rather than being yet another middleware infrastructure, the principal objective of the Interoperable Middleware Core is to realize interoperability between existing middleware infrastructures in terms of its three essential functionalities. The upper level, on top of and complementing the Interoperable Middleware Core, comprises a set of higher-level middleware services, namely: Amigo-aware Service Discovery; Service Interoperability & Composition; Content Interoperability, Storage & Distribution; Security & Privacy; Accounting & Billing; and Mobility Management.

The present Deliverable D3.1 refines this abstract middleware architecture, as the first from subsequent steps towards the design and concrete implementation of the Amigo system. We address the Interoperable Middleware Core, elaborating design and first prototype implementation of its essential functionalities. We further elaborate on service modeling and specification, which are constitutional elements of Amigo-aware Service Discovery and Service Interoperability & Composition. Finally, we address Security & Privacy, Content Distribution and associated Data Storage. Deliverable D3.1 is organized in three sub-deliverables, which are linked to each other and are highly complementary.

Deliverable D3.1a: Service Modelling for Composability aims to initiate analysis on vocabularies required in various Amigo domains (domotic, PC, mobile, CE), and also to model non-functional properties of the service to cope with the heterogeneity of services descriptions and requirements specifications. The vocabulary ontologies for the semantic modeling of Amigo services are aimed to complement the language for service specification discussed in Deliverable D3.1b. The objective is not to deliver a set of new ontologies and classifications, but, rather, to integrate and extend the existing ones, and provide some recommendation for service developers how to use them.

Work on developing of a set of ontologies, modeling concepts and specific domains, which can be used as a general-use vocabulary for describing Amigo services, is in progress. This document presents the initial analysis on vocabularies and classifications for the domain specific services (i.e. domotic, CE, PC, mobile) and semantic modeling of non-functional properties of the Amigo services such as QoS and context information. Moreover, the methodology for semantic modeling of services, the existing methods and tools, including their shortcomings and benefits are overviewed.

Semantic modeling of functional and non-functional properties of Amigo services will enable dynamic 'ad hoc' service composition, adaptive to information related to user and services. Some approaches for adaptive service composition are outlined in the document. However, as the research in this direction is in its early stage, the candidate solutions will be further studied in our future work.

Deliverable D3.1b: Service Specification, Interoperable Middleware Core provides a considerable advance in the elaboration of the Amigo Interoperable Middleware Core, introducing: (i) design and first prototype implementation of service discovery interoperability and service interaction interoperability; (ii) design for a programming and deployment framework for Amigo services; (iii) early design and implementation of domotic interoperability mechanisms; and (iv) refined architecture for CE QoS interoperability. These advances in the middleware core have been linked together in an integrated prototype.

D3.1b further presents work on Amigo-aware service specification and matching, comprising: (i) definition of a declarative language for semantic service specification covering both service functional properties and non-functional ones, which is complemented and in accordance to the vocabulary elicited in D3.1a; (ii) a comprehensive conformance relation between services that enables service matching; and (iii) a survey of existing tools for semantic reasoning.

Finally, bridging these two efforts on middleware core and Amigo-aware services, D3.1b presents a study of service discovery and access in the Amigo networked home environment, identifying classes of networked services and related interoperability levels.

Deliverable D3.1c: Security & Privacy, Content Distribution, Data Storage describes the detailed design for Security & Privacy, content distribution and data storage. The design for Security & Privacy is a refinement of the security & privacy architecture as it was devised in WP2. The refinement concentrates on service discovery for concrete protocols, the interoperability with legacy devices, and authentication and authorization processes. It also describes an early version of the biometrics security infrastructure that will be further developed in our future work.

The content delivery design uses the architectural pieces described in WP2 to present a solution for the interoperability between different kinds and formats of content and the diversity of media rendering equipment found in an automated home like Amigo. Legacy content as well as legacy devices and processes how they can be integrated into the proposed design are described. Interoperability is realized by an adaptive system that prepares content off-line for the different classes of devices.

Data storage solves the responsibility of an automated home with respect to the secure and reliable storage of all kinds of data. Inhabitants of an Amigo home will only trust the system if they can rely on the system keeping their data secure in relation to access and persistence. Secure storage differs from the general Security & Privacy concepts because the security attributes are related, and have to be stored, with the data. General Security & Privacy on the other hand deals mainly with dynamic aspects like communication access and authorization requests.