Norms, Organisations and Semantic Web Services: The ALIVE approach

Sergio Alvarez-Napagao*, Owen Cliffe†, Javier Vazquez-Salceda* and Julian Padget†
*Departament de Llenguatges i Sistemes Informàtics, Universitat Politècnica de Catalunya, Barcelona, ES
†Department of Computer Science, University of Bath, BATH BA2 7AY, UK

***Abstract*—ALIVE is an EU FP7 STREP whose goal is the convergence of organisational and normative modelling with and service-oriented architectures (SOAs) using model-driven software engineering. The project provides a framework for designing and implementing systems, taking into account organisational, coordination and service perspectives. A key project aspect is the integration of normative systems with live SOAs, through the distributed monitoring of normative state. Here we give a brief overview of the project, explore of the domain from a service context, outline the architecture under construction and sketch the use-cases that illustrate and inform the project.**

I. Introduction

Recent developments in service-oriented architectures, including the proliferation of web services (both in a conventional context and in the context of the semantic web) have opened up the possibility for a new class of loosely coupled, open system. The software engineering methodology employed however constrains the resulting system and approaches such as UML lack the means both to capture high-level, abstract whole-system properties and to maintain them at run time of systems without explicit (user) specification.

In the context of socially-situated systems organisational models provide a way to model the relationships between users and system components as roles. In addition norms allow designers to specify succinctly the regulations that govern actors playing given roles and the expectations on their behaviour. These relationships may be maintained as the normative state of a system either explicitly or implicitly at run time, allowing designers to identify quickly where given system behaviours (specified as norms) are being upheld or violated. The ALIVE project aims to link existing work in modelling organisational structures and norms with the state of the art in service-oriented computing, allowing designers to build service oriented architectures that enact organisational interactions in a natural way. The process of engineering the systems themselves remains very complex, so the project takes advantage of model-driven development methodology to assist in the development of tools and software by offering the potential for verifiable automation of key translation processes.

II. The ALIVE Context

The ALIVE architecture combines *model driven development* (MDD) [6] with coordination and organisational mechanisms, providing support for *live* and *open* systems of services. ALIVE's approach extends current trends in engineering by

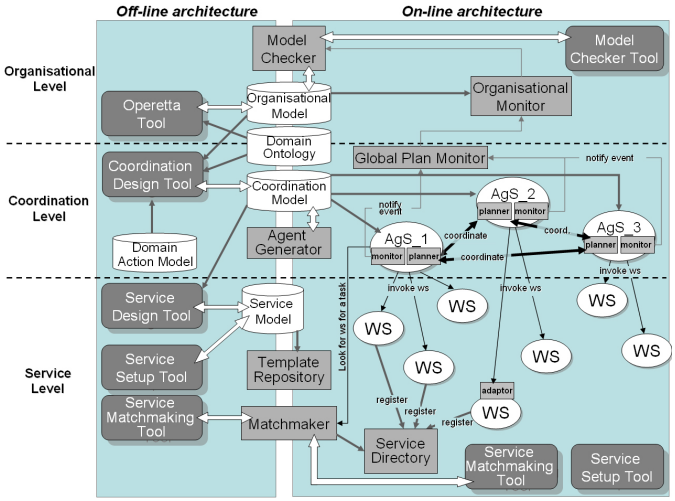

Fig. 1. ALIVE Multi-Level Architecture

defining three levels in the design and management of distributed systems: the Service, Coordination and Organisation Levels, illustrated in Fig. 1, and explained below.

The *Service Level* extends existing service models, to make components aware of their social context and of the rules of engagement with other components and services, by means of semantic Web technologies. This "semantification" is particularly useful when highly dynamic and frequently changing services (the WSs in Fig. 1) are present, as the meta-information in each service description (stored in a *service directory*) aids tasks such as finding substitute services (either via a matchmaker or manually) when the original fails.

The *Coordination Level* provides the means to specify, at a high level, the patterns of interaction among services, using a variety of powerful coordination techniques from recent agent research [2], [5]. These are represented by *agentified services*, that are organisationally-aware, meaning they are aware of system objectives and manage task allocation and workflow generation and agreement. Also, at the coordination level agreed workflows can be adapted *while* the system is running—essential when the system has to react to failures or exceptions (e.g., failing payment or booking systems).

The *Organisational Level* provides a social context for the Coordination and Service levels, specifying the organisational rules that govern interaction and using recent developments in organisational dynamics [7] to allow the structural adaptation

of systems over time. This is important when frequent changes of rules and restrictions are expected.

The ALIVE architecture can be seen as a service-oriented middleware supporting the combination, reorganisation and adaptation of services at both design- and run-time. These activities follow organisational patterns and adopt coordination techniques. Furthermore, the MDD paradigm offers significant developer assistance, through semi-automated transformations between models of the three levels, as well as the capacity for multiple target platforms and representation languages. More details of the theoretical and methodological aspects are available as public deliverables on the ALIVE website (http:www.ist-alive.eu).

III. Project use-cases

We now outline the three use cases on which we draw to demonstrate and evaluate the effectiveness of the approach.

Intelligent tourism: The first use case (from TMT Factory (http://tmtfactory.com), a company selling smart displays for urban tourist environments) focuses on providing assistance and advice to tourists through a variety of devices (including static displays). At the organisational level the use case applies models of city, regional and national laws to tune the types of services which are offered to customers (for instance night clubs not being recommended to under 18s), at the coordination it negotiates connected services (such as transport and activities) and at the service level it interacts with existing providers (such as cinema booking services and transport planning services).

Disaster Management: The second use case (from Thales D-CIS laboratory (http://www.decis.nl/)) extends existing work on the modelling and simulation of urban disasters (here the flooding of the Rotterdam harbour area). At an organisational level we model the structure and roles of the services (e.g. city councils, local and national disaster centres and emergency services) involved in handling a disaster at various scales (from simple localised flooding to a city-wide flood) and the regulations relating to how those parties interact. At the coordination level we model interactions between parties, instructions to particular agents (e.g. dispatching fire trucks to a particular area) and at the service level we link to an existing simulation environment which models the physical conditions of a flood as it happens.

Communication in Virtual Environments: The final use case (from Calico Jack Ltd. (http://www.calicojack.co.uk/), a networking research and services provider) deals with modelling human norms and conventions relating to conversation in virtual and on-line environments. The use case assumes that users are active in a number of contexts (such as FaceBook, Second life, Bebo, via SMS and over email) and handles the intelligent redirection of communication between users within these contexts, preserving modelled norms relating to those communications, such as a user's desire not to receive unsolicited communication from unknown parties while in Second Life. At the coordination level models relationships between users and their presence in particular contexts, while at the service level the focus is on low-level interaction with the underlying services (e.g. via game APIs, or SMS gateways) and composing services to interchange information contained within communications, such as transcribing voice-mail messages to text for delivery within a text-only environment.

IV. Current Status

The key to the success of the project is integrating state-of-the art approaches and tools from each of the areas of interest (organisations, coordination and services). To date, the project has focused on developing an end-to-end methodology and meta-model which unifies and relates concepts as follows: (i) Using the OPERA [1] organisational model and corresponding Operetta tool organisational concepts (Roles, Interactions, and Norms) can be specified. (ii) These concepts are reified as coordination actions and agents, which in turn may be used to build coordination plans (using the GPGP/TÆMS coordination framework [3]) for groups of agents enacting roles within the organisation. (iii) Actions in coordination plans link to the provision or consumption of semantic web services, by matchmaking tasks to existing semantic service descriptions and services using a hybrid matchmaker derived from OWL-S MX [4]. We are developing tools to assist in the process of semantic annotation of services. (iv) Agents enact their roles within the (either autonomously or via human controllers) organisation, by direct communication or by invoking the selected services, maintaining relevant state. (v) Monitors observe agent interactions, normative and organisational state (e.g. the status of agents' obligations, permissions, powers and the roles currently being assumed), and the agents interact with these monitors allowing them reason about the normative effects of their actions and re-plan after service failures.

Planned project deliverables include a comprehensive development methodology and a suite of Eclipse-based development tools (design and run time user assistance tools and programming libraries for system development).

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References

[1] Dignum, V.: A Model for Organizational Interaction Based on Agents, Founded in Logic. PhD thesis, University of Utrecht. 2004.

[2] Ghijsen, M., Jansweijer, W., Wielinga, B.B.: Towards a Framework for Agent Coordination and Reorganization, AgentCoRe. In: Coordination, Organizations, Institutions, and Norms in Agent Systems III. LNCS, vol. 4870, pp. 1–14. Springer, Heidelberg (2008).

[3] Lesser, V: Evolution of the GPGP/TAEMS domain-independent coordination framework. In AAMAS '02: Proceedings of the First International Joint Conference on Autonomous Agents and Multiagent Systems, pages 1-2, New York, NY, USA, 2002. ACM.

[4] Klusch, M., Fries, B., Sycara, K., Automated Semantic Web Service Discovery with OWLS-MX, Proc. 5th Intl Conf. on Autonomous Agents and Multi-Agent Systems (AAMAS), Hakodate, Japan, 2006.

[5] Matskin, M. et al.: Enabling Web Services Composition with Software Agents. In: Proc. of the Conference on Internet and Multimedia Systems, and Applications. Honolulu (2005)

[6] OMG: Model Driven Architecture. http://www.omg.org/mda/. Retrieved 20090527.

[7] van der Vecht, B., Dignum, F., Jules, J., Meyer, Ch., Dignum, V.: Organizations and Autonomous Agents: Bottom-up Dynamics of Coordination Mechanisms. In: 5th Workshop on Coordination, Organizations, Institutions, and Norms in Agent Systems. Estoril (2008).