Adapting Agent Organisations with Agreement Technologies[1]

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Abstract. The fact that software systems are ever more complex nowadays leads the designers to rethink the strategy to handle and manage them. Hence, their development and maintenance strategies must be redesigned. Adaptability (and also self-adaptation) can be considered one of the most important of their features at the architecture level. This position paper outlines an architectural solution to tackle that dynamism, providing adaptive organisations within multi-agent systems.

Keywords: Self-Adaptation, Adaptive Architecture, Multi-Agent Systems, Agreement Technologies, Service Ecosystem, Adaptation Pattern.

1   Introduction

The high level of complexity of present software systems is leading designers to rethink the strategy to handle and manage it. Many routine tasks, previously deferred to human users, are now being handled by systems themselves; including many actions related to their own functions. Consequently, this approach has a global influence on the system, at many levels, leading us to consider self-adaptation as a basic architectural concern [2]. Concurrently, Multi-Agent Systems (MAS) have been developed as a generic approach in Artificial Intelligence (AI) to solve complex problems. Some advanced approaches use the concept of organisations to provide further structuring, taking the shape of complex agent architectures. However, existing structures still have limitations in order to achieve actual self-adaptivity, e.g. change their settings and even their own composition and types.

The proposed approach intends to go beyond more "classic" MAS technologies and propose a solution based in the definition of service ecosystems with Agreement Technologies (AT) [4] to deal with the dynamism. The objective is to provide adaptive organisations, and the emphasis here is in the coordination mechanism, which is also adaptive.

The research[2] as referred to in this position paper takes into account, first, the definition of a general platform to describe the underlying agent-based, service-oriented and organization-centric architecture; second, the introduction of further structure, to make it adaptive; and lastly, the identification of the generic adaptive structure for organisations, in the form of the agreement construct, and its evolution. The main purpose is to define a generic problem-solving intelligent technology, capable of being used in an open context, and able to adapt to

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future evolution, supported by a self-organised architecture. Subsequent research has helped to refine and achieve these goals.

2 The Proposed Approach

Two scenarios were presented as motivating example in our research. The situation is a crisis caused by a fire. In scenario 1, the agents (firemen, policemen, etc.) come to the area and they must organise to face the emergency. In scenario 2, the organisation is already working in the zone, but some essential service is no longer provided. It becomes clear that an adaptive architecture is needed, and the organisations are dynamic in both cases. Therefore, it is necessary to modify their structures, configurations and coordination. The system must carry out a series of evolutionary steps until it finds an optimal point. This can perfectly be a continuous process, as the situation itself evolves. This example justifies why this behaviour could not be completely pre-designed; it should be emergent and the coordination should be achieved inside the architecture, which is essentially a service ecosystem, i.e. a set of services which were separately created and must interact and coordinate within a certain context.

In order to solve this kind of emergency a sum up of concepts are proposed: *controls* and *protocols*, so that a global structure can emerge in order to obtain agreement-based organisations; the *initiative*, an elemental group that emerges as a preliminary organisation; the *agreement*, the act by which the initiative became into a "stable" organisation; and *adaptation patterns*, i.e. architectural patterns that are pre-designed adaptive schemes unfolded by required services in an initiative; there are others. The original platform was Thomas [1], which provides services and facilities to carry out system reconfigurations. Its evolution is reflected in the Ovamah project [3], in order to facilitate dynamic answers for changing situations by means of the adaptation and/or evolution of the organizations.

Subsequent research has developed and implemented variants of this approach, in order to refine it. The concepts are still evolving and the process of defining their limits still continues but the existing fragments of the approach have already proven its utility and expressive power. Current results suggest that the adaptive architecture is indeed feasible because the infrastructure developed can grow just adding new adaptive patterns. The results could fulfil the promise of generalizing the usefulness and extension of the service ecosystem approach, adapting it to new and more flexible technologies.

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